

**LYNCHBURG CITY COUNCIL  
PHYSICAL DEVELOPMENT COMMITTEE**

**Tuesday, September 11, 2018  
8:00 a.m.**

**Information Items**

**Recent/Pending Contract Awards:** n/a

**Update on priority projects:** -See attached report.

**General Business**

- |                                                                  |             |
|------------------------------------------------------------------|-------------|
| 1. Blanket License Agreement- Install Aerial Fiber Optic Cable   | Lee Newland |
| 2. 501-221 National Environmental Policy Act (NEPA) alternatives | Don Deberry |
| 3. Update on WWTP Construction                                   | Jim Talian  |
| 4. College Lake funding assistance                               | Jim Talian  |
| 5. Roll Call                                                     |             |

Pc: Bonnie Svrcek, City Manager  
Reid Wodicka, Deputy City Manager  
John Hughes, Assistant City Manager  
Council Members  
Gaynelle Hart, Director of Public Works  
News & Advance

**Next Meeting: October 9, 2018**

## Lynchburg Capital Projects Greater Than \$1 Million (General Fund)

**September 11, 2018**

| Projects of Interest                           | Phase          | Phase Completion | Sch | Bud | Notes                                                        |
|------------------------------------------------|----------------|------------------|-----|-----|--------------------------------------------------------------|
| Timberlake / Logan's Lane Intersection         | Construction   | October 2018     |     |     | Construction Underway -                                      |
| Wards Ferry Road Improvements @ Heritage       | Construction   | October 2018     |     |     | Construction Underway                                        |
| Main Street Bridge                             | * Construction | November 2018    |     |     | Construction Underway - Deck Poured - Proceeding on Schedule |
| Fifth Street Phase 3                           | Construction   | June 2019        |     |     | Construction Underway                                        |
| Liberty Mountain Drive - Phase 3               | Construction   | August 2019      |     |     | Construction Underway                                        |
| Odd Fellows Road - Sections A and B1           | * Construction | August 2018      | V   | V   | Punchlist Items Being Completed                              |
| Odd Fellows Road - Section B2                  | * Construction | May 2019         | V   | V   | Construction Underway - Bridge to Close on October 9         |
| VDOT Median Barrier Replacement 29 North       | Construction   | December 2018    | V   | V   | Construction Underway                                        |
| Downtown Watermain Replacement & Streetscape 2 | Design         | May 2019         |     |     | Survey and Design Underway                                   |
| Main Street Renewal Project                    | Design         | April 2019       |     |     | Survey and Design Underway and working with AEP              |
| Indian Hill Road Bridge                        | Design         | August 2018      |     |     | In Design                                                    |
| College Lake Dam                               | Preliminary    | June 2019        | **  |     | Environmental Permitting Underway -                          |
| One Way Pairs @ 501/221                        | * Preliminary  | June 2019        |     |     | NEPA Document Underway - Public Meeting October              |
| Police Department Headquarters                 | Preliminary    | December 2018    |     |     | Environmental and Demolition RFP's Being Prepared -          |
|                                                |                |                  |     |     |                                                              |
|                                                |                |                  |     |     |                                                              |
|                                                |                |                  |     |     |                                                              |

### LEGEND

Schedule -

|        |                                                                                     |              |
|--------|-------------------------------------------------------------------------------------|--------------|
| Green  |  | 0-5% Behind  |
| Yellow |  | 5-10% Behind |
| Red    |  | > 10% Behind |
| V      | V                                                                                   | VDOT Managed |

Budget -

|        |                                                                                       |              |
|--------|---------------------------------------------------------------------------------------|--------------|
| Green  |  | 0-10% Over   |
| Yellow |  | 10-20% Over  |
| Red    |  | > 20% Over   |
| V      | V                                                                                     | VDOT Managed |



# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018, Physical Development Committee**

AGENDA ITEM #:

CONSENT:  
ACTION: X

REGULAR: X  
INFORMATION:

WORK SESSION:

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: Blanket License Agreement to Install Aerial Fiber Optic Cable on City Streets and maintain current lines.**

KEY ELEMENTS:

\_\_\_ Economic Development ☒ Excellent Government ☒ Natural and Built Environment \_\_\_ Safe Community ☒ Vibrant Community

RECOMMENDATION: Forward to Council to adopt a resolution granting Level 3 Communications, LLC a blanket License Agreement to install new fiber optic cable and conduit in city owned rights-of-way and property and maintain and operate existing lines under License Agreements previously approved by City Council.

SUMMARY: Level 3 Communications, LLC has submitted multiple requests to install aerial fiber optic cable and underground conduit in city owned rights-of-way and property throughout the City of Lynchburg. Level 3 has installed and/or purchased installations throughout the City, but did not have agreements for all of their facilities. In an attempt to get them into compliance, staff has been working with Level 3 to get up to date mapping of the facilities. With the blanket agreement, Level 3 will have to submit a new map and go through the Technical Review Committee for review and follow all requirements of the City Code before any new facilities can be installed. The immediate need/project is to provide improved internet service to Centra Health.

PRIOR ACTION(S): Technical Review Committee (TRC)-February, 2018

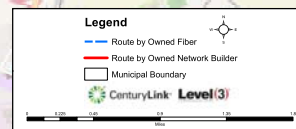
FISCAL IMPACT: None

CONTACT(S): Lee Newland, City Engineer-455-3947  
Gaynelle Hart, Director of Public Works-455-4406

ATTACHMENT(S): Resolution  
Citywide Route Map

REVIEWED BY:

Level3 Network  
Lynchburg, VA



CenturyLink Trade Name  
CONFIDENTIAL USE ONLY - Disclosure and distribution only to CenturyLink and (customer name) employees and authorized persons  
working on behalf of CenturyLink and Customer name/ having a legitimate business need to know. Disclosure and distribution is prohibited without authorization.  
The telephony engineer depicts a proposed route configuration and while reasonably believed to be first may be subject  
to modifications before construction. The final route will be determined based on fiber availability and construction  
conditions affecting but not limited to permitting and other requirements. CenturyLink disclaims representation or warranty  
the accuracy of the fiber route and has not made physical verification. This map depicts the vicinity of the route  
based on the inventory records.  
Copyright 2018 CenturyLink. All rights reserved. Not to be distributed or reproduced by anyone other than CenturyLink  
entities.

Resolution

BE IT RESOLVED That the City Manager is hereby authorized to execute a nonexclusive license agreement with Level 3 Communications, LLC for the installation, maintenance, and operation of aerial fiber optic cable and underground conduit in the City right-of-way and City property and to include previously installations under license agreements approved by City Council. Level 3 Communications, LLC's authority to install maintain, and operate fiber optic cable in the City's public right-of-way and property is subject to applicable law.

Adopted: \_\_\_\_\_

Certified: \_\_\_\_\_  
Clerk of Council

# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018 Physical Development Committee**

AGENDA ITEM #:

CONSENT:  
ACTION:

REGULAR: **X**  
INFORMATION: **X**

WORK SESSION:

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: 501-221 National Environmental Policy Act (NEPA) alternatives**

KEY ELEMENTS:

\_\_\_ Economic Development **X** Excellent Government \_\_\_ Natural and Built Environment **X** Safe Community \_\_\_ Vibrant Community

**RECOMMENDATION:** Review remaining alternatives being evaluated under the NEPA study. Staff Plans to present these alternatives to Council in the work session September 25<sup>th</sup> and will present them to the public at a meeting to be held October 4<sup>th</sup> at Fire Station 7 from 4:30 – 6PM where the project team will solicit comments and answer questions.

**SUMMARY:** As part of the NEPA process we are required to develop and evaluate feasible alternatives. We have narrowed the feasible alternatives down to those attached. Staff will provide updated status as the alternatives depicted in the attachments are currently being evaluated in detail.

**PRIOR ACTION(S):** None on the NEPA study.

**FISCAL IMPACT:** None.

**CONTACT(S):** Don DeBerry, City Transportation Engineer – 455-3935  
Lee Newland, City Engineer – 455-3947  
Gaynelle Hart, Director Public Works – 455-4406

**ATTACHMENT(S):** Alternative sketches

**REVIEWED BY:**



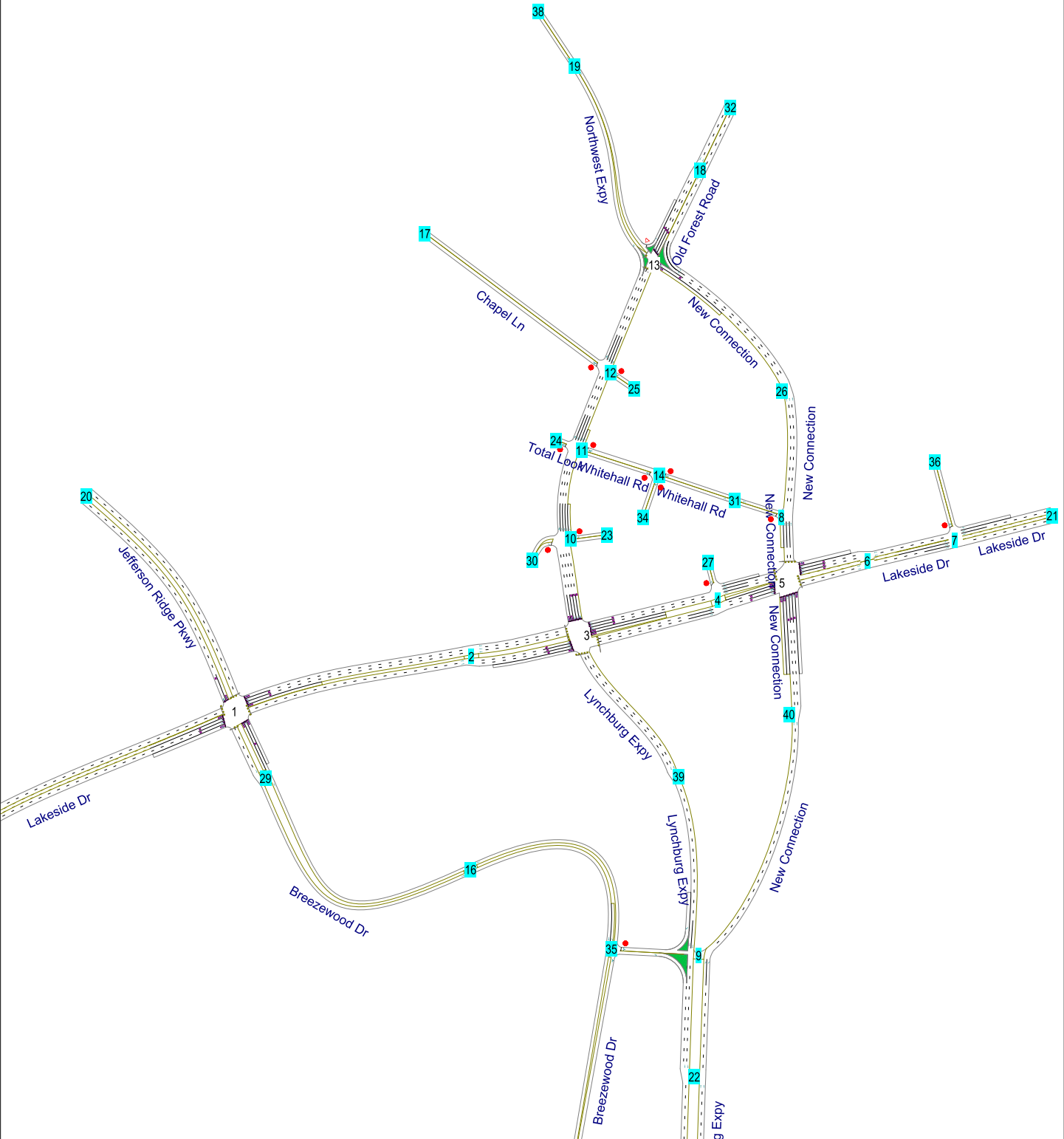
















## **COUNCIL MEMBER PERROW WILL GIVE THE INVOCATION**

### A G E N D A

City Council Meeting of September 11, 2018

**4:00 P.M.**

1. Recognitions:
  - City of Lynchburg Disaster Recovery Group
  - Police Department Recognition Award
  - Templeton Senior Center
2. Code Compliance Programs Update
3. Downtown 2040 Master Plan
4. Roll Call

**7:30 P.M.**

### **City Council Agenda Items**

#### **GENERAL POLICY REGARDING PUBLIC PARTICIPATION AT CITY COUNCIL MEETINGS**

Each speaker shall clearly state his or her name and locality of residence.

The City Council agenda is divided into three sections.

CONSENT AGENDA: This section includes routine items. All items may be approved by one vote.

PUBLIC HEARINGS: This section includes all public hearings as required by law or as Council may direct.

Procedure:

- Staff will make a presentation.
- For Zoning petitions, the applicant or his or her representative shall have ten (10) minutes to make a presentation.
- Comments will then be solicited from those in favor.
- Comments will then be solicited from those in opposition.

During the public hearing there shall be a time limit of three (3) minutes for each individual speaker. If the speaker represents a group, there shall be a time limit of five (5) minutes. A speaker representing a group shall identify that group at the beginning of his or her remarks. A group may have only one spokesperson.

After public comments have been received, for zoning petitions the applicant or the representative of the applicant, at his or her discretion, may respond with a rebuttal. There shall be a five (5) minute time limit for rebuttal.

Upon the conclusion of public comments or the applicant's rebuttal the public hearing will be closed and the matter referred to Council for deliberation.

PUBLIC PRESENTATIONS: Public presentations shall be for the purpose of allowing members of the public to present any matter, which, in their opinion, deserves the attention of the Council. They shall not serve as a forum for debate with the Council. Individuals may speak up to 3 minutes; or group spokesperson up to 5 minutes. Once Council has heard a presentation from a citizen or organization on a particular subject, the citizen or organization may not make another presentation on the same subject within three (3) months of the first presentation, except by a majority vote of the members of Council present and voting.

GENERAL BUSINESS: This section includes items of a general nature to be considered by Council.

City Council may make exceptions to these rules at its discretion.

Prior to a meeting, any questions which citizens may have regarding any item on the agenda may be addressed to City Council or the City Administration. The following numbers are provided for the convenience of the citizens:

CITY COUNCIL 455-3995      MAYOR 455-3995      CITY MANAGER 455-3990

A reasonable charge may be made for copying and other activities related to responding to long and involved inquiries.

CITIZENS OFTEN EXPRESS CONFLICTING AND DIVERSE POSITIONS REGARDING SPECIFIC ISSUES UNDER CONSIDERATION. TO ENCOURAGE CITIZEN PARTICIPATION AND TO AVOID INTIMIDATION TO PERSONS WHO MAY EXPRESS SOMETIMES UNPOPULAR OPINIONS, APPLAUSE, CHEERS, OR JEERS FROM THE AUDIENCE ARE NOT PERMITTED. WHEN APPEARING BEFORE CITY COUNCIL CITIZENS MAY NOT ENGAGE IN BEHAVIOR THAT INTIMIDATES OR INSULTS OTHERS, ENGAGE IN DISRUPTIVE BEHAVIOR, USE PROFANITY OR VULGAR LANGUAGE, PROMOTE PRIVATE BUSINESS VENTURES OR CAMPAIGN FOR PUBLIC OFFICE.

\* **PREVIOUSLY DISCUSSED AND/OR CONSIDERED BY CITY COUNCIL**



## CONSENT AGENDA

- #5. Consideration of approving the minutes of the August 14, 2018 meeting.
  - #6. Consideration of approving the minutes of the August 28, 2018 meeting
  - \*#7. Consideration of adopting Resolution #R-18-065 to amend the FY 2019 City/Federal/State Aid Fund budget and appropriate \$41,936 with resources from the 2017 Edward Byrne Memorial Justice Assistance Grant (JAG) to purchase law enforcement equipment for the Lynchburg Police Department, Lynchburg Sheriff's Office and the Office of the Commonwealth's Attorney.
  - \*#8. Consideration of adopting a Resolution #R-18-066 to amend the FY 2019 General Fund budget and appropriate \$196,031 with resources of \$178,531 from the State Department of Social Services and \$17,500 from Horizon Behavioral Health Services to the Division of Social Services for staff and operations in preparation for the expansion of Medicaid benefits and to approve the addition of three full-time positions for the Lynchburg Division of Social Services.
  - \*#9. Consideration of adopting Resolution #R-18-068 to amend the FY 2019 General Fund budget and appropriate \$40,500 from the Assigned Fund Balance Reserve for Parking to purchase four (4) parking payment stations.
  - \*#10. Consideration of adopting a Resolution #R-18-069 to amend the FY 2019 General Fund budget and appropriate \$15,000 to the Parks and Recreation Fees budget to provide a benefit match that incentivizes the purchase of fruits and vegetables for Supplemental Nutrition Assistance Program (SNAP) participants.
- 

## PUBLIC HEARING

- #11. Public hearing regarding the petition of the City of Lynchburg to adopt the Graves Mill Corridor Improvement Study as part of the City's Comprehensive Plan 2013-2030.  
(File: Community Development) #R-18-\_\_\_\_\_
- 

## PUBLIC COMMENT

- #12. Hear from a citizen regarding a concern (Thomas Shahady).
  - #13. Hear from a citizen regarding a concern (Melinda Tennis).
- 

## GENERAL BUSINESS

- #14. Consideration to review and reaffirm the City's Finance Committee Guidelines.
- #15. Consideration to review and reaffirm the City's Physical Development Committee Guidelines.
- #16. Consideration of adopting a Resolution to approve the renaming of the Region 2000 Local Government Council to the Central Virginia Planning District Commission; the Region 2000 Workforce Development Area Council to the Central Virginia Workforce Development Area Council; the Region 2000 Workforce Development Board to the Central Virginia Workforce Development Board; and the Region 2000 Radio Communications Board to the Central Virginia Radio Communications Board and approves the changes or amendment to the documents that govern each of these organizations.  
(File: Region 2000) #R-18-\_\_\_\_\_
- #17. Consideration of adopting an Ordinance to amend and reenact Section 25-188.3 of the Code of the City of Lynchburg relating to the operation of Golf Carts and Utility Vehicles on the Public Streets.  
(File: Public Works) #O-18-\_\_\_\_\_
- #18. a: Consideration of introducing a Resolution to amend the FY 2018 Adopted Budget to reflect the Fourth Quarter Adjustments in the General, City/Federal/State Aid and Detention Operating Budgets. #R-18-\_\_\_\_\_  
b: Consideration of introducing a Resolution to amend the FY 2019 Operating and Capital Budgets and appropriate or rescinding funds to reflect the FY 2019 First Quarter Adjustments.  
(File: Budget) #R-18-\_\_\_\_\_
- #19. Consideration of a closed meeting for consultation with legal counsel and briefings by staff concerning a specific legal matter requiring the provision of legal advice, specifically the discussion of the August 28, 2018, decision of the Lynchburg Board of Zoning Appeals involving the lighting of the Liberty University Monogram, pursuant to Section 2.2-3711(A)(7) of the Code of Virginia.



The winners of the 2018 Virginia Law Enforcement Challenge are as follows:

| <b>MUNICIPAL POLICE</b>                  |              |
|------------------------------------------|--------------|
| <b>Municipal 1: 1-25 Officers</b>        | <b>Place</b> |
| Ashland Police Department                | 1            |
| Bedford Police Department                | 2            |
| <b>Municipal 2: 26-60 Officers</b>       | <b>Place</b> |
| Herndon Police Department                | 1            |
| Culpeper Police Department               | 2            |
| Colonial Heights Police Department       | 3            |
| <b>Municipal 3: 61-125 Officers</b>      | <b>Place</b> |
| Harrisonburg Police Department           | 1            |
| Salem Police Department                  | 2            |
| <b>Municipal 4: 126-225 Officers</b>     | <b>Place</b> |
| Roanoke County Police Department         | 1            |
| Albemarle County Police Department       | 2            |
| Lynchburg Police Department              | 3            |
| <b>Municipal 5: 226-375 Officers</b>     | <b>Place</b> |
| Alexandria Police Department             | 1            |
| Roanoke Police Department                | 2            |
| Suffolk Police Department                | 3            |
| <b>Municipal 6: 376-700 Officers</b>     | <b>Place</b> |
| Henrico County Police Division           | 1            |
| Chesapeake Police Department             | 2            |
| <b>Municipal 7: 701 or More Officers</b> | <b>Place</b> |
| Virginia Beach Police Department         | 1 (tie)      |
| Fairfax County Police Department         | 1 (tie)      |
| Richmond Police Department               | 2            |
|                                          |              |

# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018**

AGENDA ITEM #: **2**

CONSENT:  
ACTION:

REGULAR:  
INFORMATION: **X**

WORK SESSION: **X**

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: Code Compliance Programs Update**

KEY ELEMENTS:

\_\_\_ Economic Development \_\_\_ Excellent Government \_\_\_ Natural and Built Environment \_X\_ Safe Community \_X\_ Vibrant Community

**RECOMMENDATION:** Provide an update on Code Compliance activities in the Inspections Division of the Community Development department.

**SUMMARY:** At the June 5<sup>th</sup>, Physical Development Committee (PDC) meeting, Council members inquired about neighborhood concerns, blighted properties and what the City does to address the associated issues. Staff will provide an overview to Council on the following:

- **Property Maintenance Program:** Provides for the inspection of residential and commercial structures throughout the City to insure compliance with minimum standards of the building code. Inspections are conducted in response to complaints or as a follow up to an emergency event.
- **Vacant Property Registration Program:** Property owners annually register their derelict buildings, which are vacant for at least twelve (12) months, boarded (or required to be secured) and not connected to public utilities. The program provides resources to help proactively monitor and address exterior issues on the vacant properties, freeing staff to focus on occupied housing issues.
- **Residential Rental Property Inspection Program:** Provides for the systematic inspection of rental units located within the City's six (6) rental inspections districts to insure they meet basic building code requirements. The rental inspection program area includes the highest ratio of rentals in some of oldest housing units in the City.
- **Neighborhood Services Program:** Includes the inspection and enforcement of nuisance issues such as overgrown yards, illegal dumping and abandoned vehicles.

**PRIOR ACTION:** N/A

**FISCAL IMPACT:** None

**CONTACT(S):** Keith Wright, Neighborhood Services Manager/Property Maintenance Official  
Kent White, Director of Community Development

**ATTACHMENT(S):** Presentation Slides

**REVIEWED BY:** raw

088K

# **Code Compliance Program Update**

Presentation to City Council  
September 11, 2018



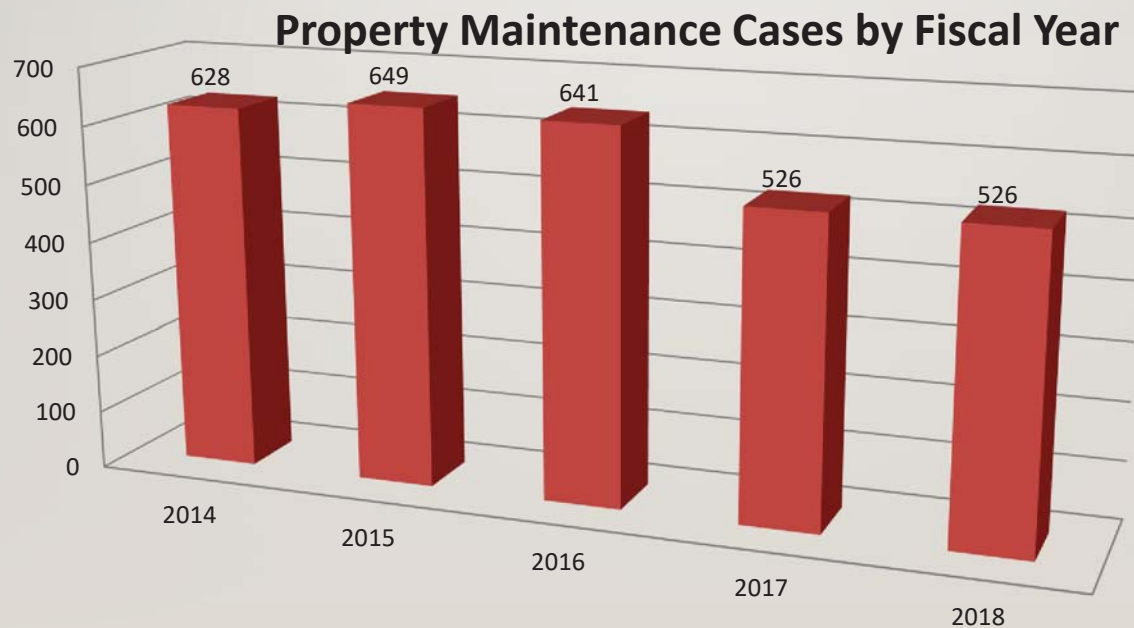
# PRESENTATION PURPOSE

---

As requested during the June 5<sup>th</sup>, Physical Development Committee (PDC) meeting, staff will provide an update on City programs to address concerns about safe housing and blighted properties.

# Property Maintenance

- City Code provides for the inspection of residential and commercial structures throughout the City to insure compliance with minimum standards of the building code.
- Inspections are conducted in response to complaints.
- Cases often take significant time to address through the court process.



# Property Maintenance - Exterior



- Objective is to work with owners to reach exterior compliance with City Code to prevent further deterioration from outside elements.





# Property Maintenance - Interior

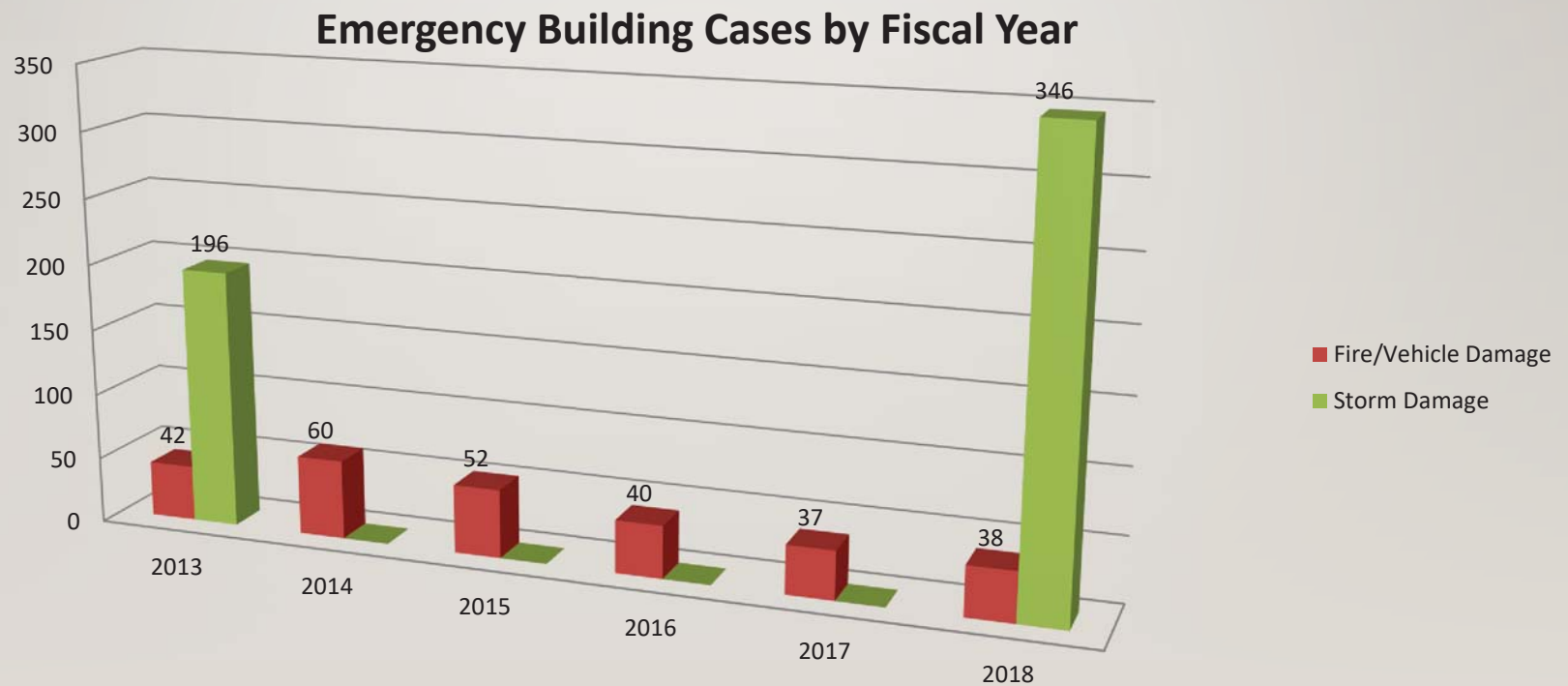


- Includes plumbing, electrical, mechanical and other interior conditions.



# Emergency Response

- Staff respond to Emergency Services calls that impact buildings. These typically include vehicle and fire damage.
- In addition, staff assess damage and monitor recovery efforts following disaster events.
- Structures are monitored during the repair process to insure resident safety.



# Response to Fire and Police Calls



- Provide damage assessments for structures impacted by emergencies



# Tracking Damage Assessments



- Staff tracking progress on over 350 damaged structures from recent emergency events.

# Vacant Building Registration

- There are limited regulatory provisions available to local government to address vacant buildings.
- The properties have traditionally been a source of numerous complaints from residents. Prior to registration program, staff responded on a complaint basis.
- The City invests over \$50,000 annually in resources to address issues with vacant and foreclosed buildings.
- In 2017, City Code was reauthorized to require owners to annually register buildings which have been vacant for 12 months and not connected to utilities. The cost of the registration is \$100.
- Staff monitors the properties every quarter to insure the structures are secured and the weeds are maintained. This regular monitoring has reduced resident complaints to our office.
- The program shifts a portion of the City's costs from the taxpayer to the property owner.



# Vacant Property Registration By the Numbers

2018 Totals: 392 Vacant Structures billed

\$18,300 collected (to date)

2017 Totals: 209 Vacant Structures billed

\$21,000 collected

---



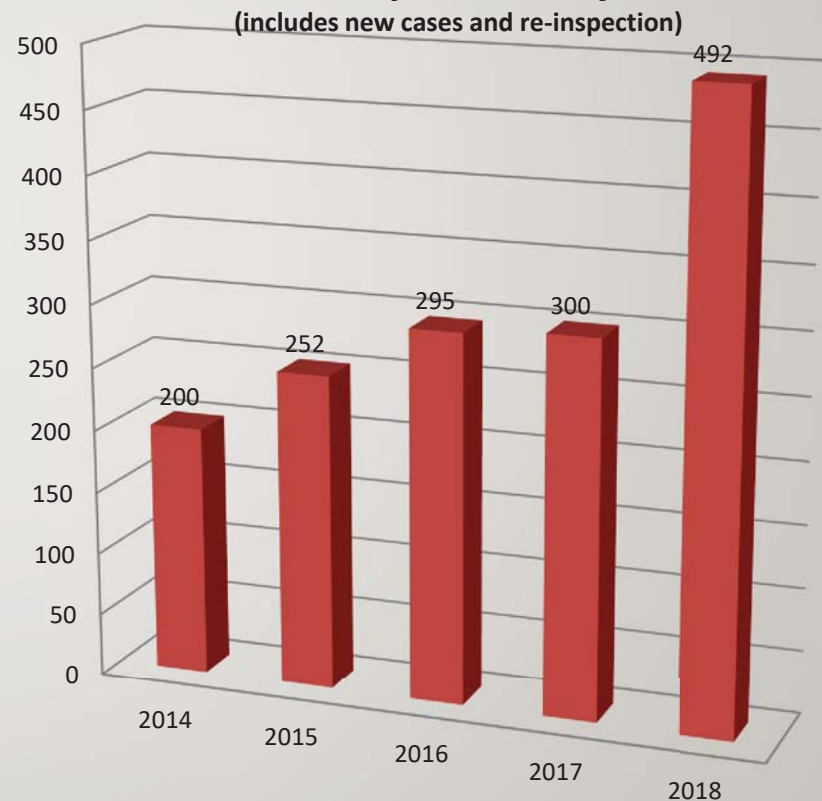
- Additional revenue used to support part time staff to monitor the properties.
- ~ 2% of existing owners have repaired or are currently repairing their properties.
- 40% of the properties that were registered as vacant or being monitored have changed ownership within the last year.



# Rental Inspection Program

- Residential rental properties in 6 rental inspection districts are inspected periodically to determine if they are being maintained with the City's minimum building code standards.
- The inspection districts include the highest ratios of renters, the oldest housing units and residences and the highest concentrations of converted in single-family homes in the City.
- The rental inspection program is our only proactive code compliance effort. Inspections are scheduled randomly from a list of registered rental properties. There is a \$50 charge for the initial rental inspection. The first follow-up inspection is no charge; subsequent inspections are \$50.
- If no violations are cited or minor violations abated within a reasonable time, a 4-year waiver and a Certificate of Compliance are issued. If violations are not abated within a reasonable period of time or if the repairs performed are likely not to withstand a minimum performance duration, a 1-year Certificate of Compliance is issued.

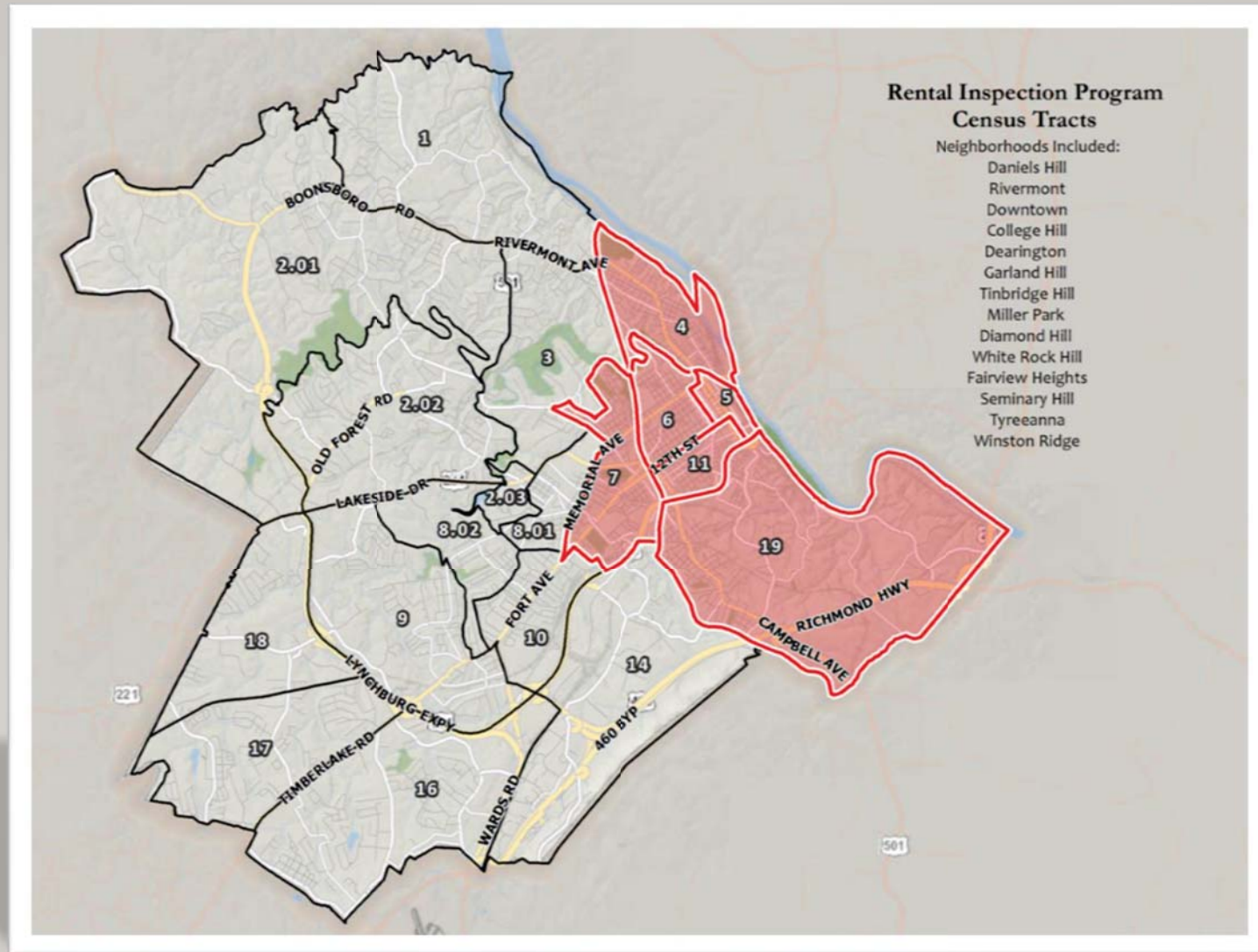
**Total Rental Inspections by Fiscal Year**



# Rental Inspection Program - Why It's Important

- Certified housing inspectors serve as resources to both the landlord and tenant.
- Inspections frequently identify safety issues that often go unnoticed.
- Many of the rental units in this area are often conversions of the oldest and most blighted homes that are repaired enough to meet basic codes and move tenants into the unit.
- Tenants may not complain because:
  - They may not be aware of their rights;
  - Language barriers or disabilities;
  - Fear of landlord retaliation; or
  - They have limited income to relocate.



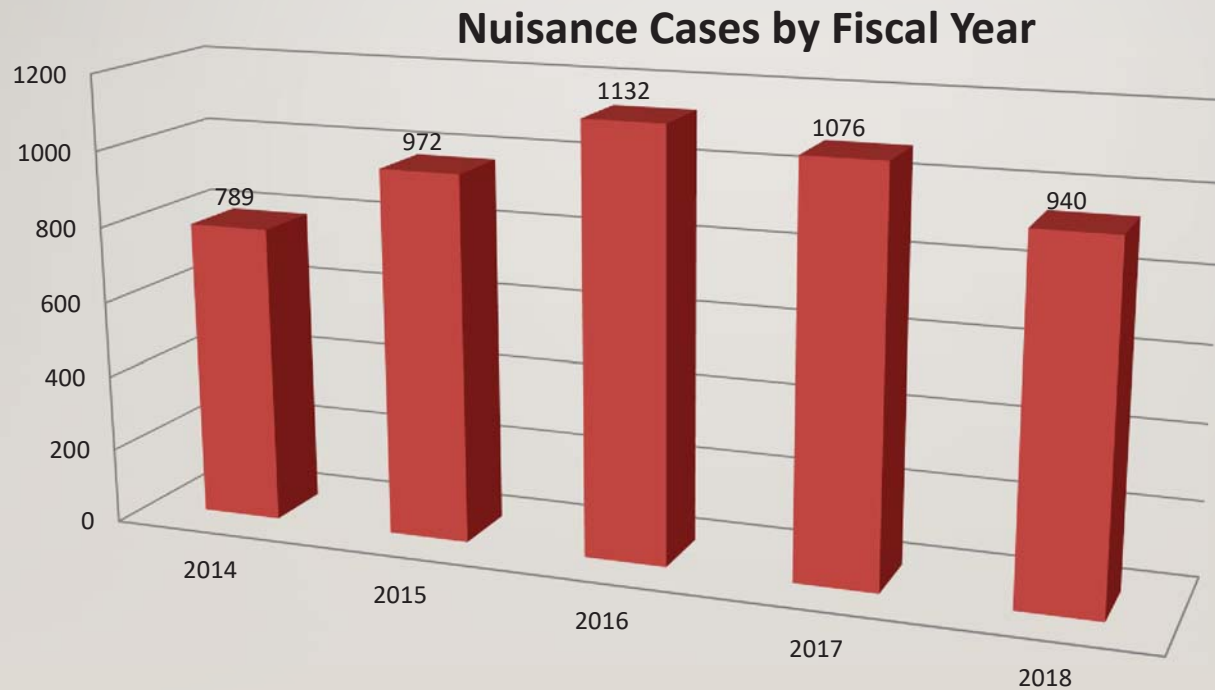


- There are an estimated 3,800 rental units in the rental inspection districts.
- In FY 2018 staff inspected 408 new apartment units, the most in a decade.
- However, even if all units received a 4-year waiver, staff would need to inspect 950 units per year to keep up with the current demand!



# Public Nuisances

- Includes tall weeds, inoperable vehicles and trash concerns on private property.
- Inspections are conducted in response to complaints.
- If violations are not addressed within allotted time, the City will abate the issue and bill the owner accordingly.



# Overgrown Lots

**FY 2018 Cases - 710**



- "Weeds" over 12 inches in height, excluding trees, ornamental shrubbery, vegetable and flower gardens purposefully planted and maintained.
- Complaints often coordinated with Public Works for hedges that extend into right-of-way



# Abandoned/Inoperative Vehicles

**FY18 Cases - 96**



Before



After

- Vehicles must be in running order, and have valid/current state tags/inspection.
- The Police Department addresses improperly tagged vehicles on City streets.



# Illegal Dumping

**FY 2018 Cases - 134**



- Includes household trash and abandoned material. Does not include items of a personal nature such as children's toys, bikes, and other similar items.
- Public Works manages illegal dumping issues in City right-of-way and on public property.

# Challenges to Achieving Compliance



- Out-of-state or deceased property owners
- “One man’s junk is another’s treasure”
- Violations vs. Aesthetics
- Private trees and private hedges
- Private disputes
- Limited Resources
- Weather



# Successes

- Code Compliance education/relationship building via neighborhood walk-throughs.
- Last year's vacant building inventory exercise allowed us to also practice for emergency damage assessments.
- Reorganized and cross-trained inspectors to assist with all Code Compliance programs as well as some zoning issues (i.e. occupancy and illegal business) that arise in neighborhoods.

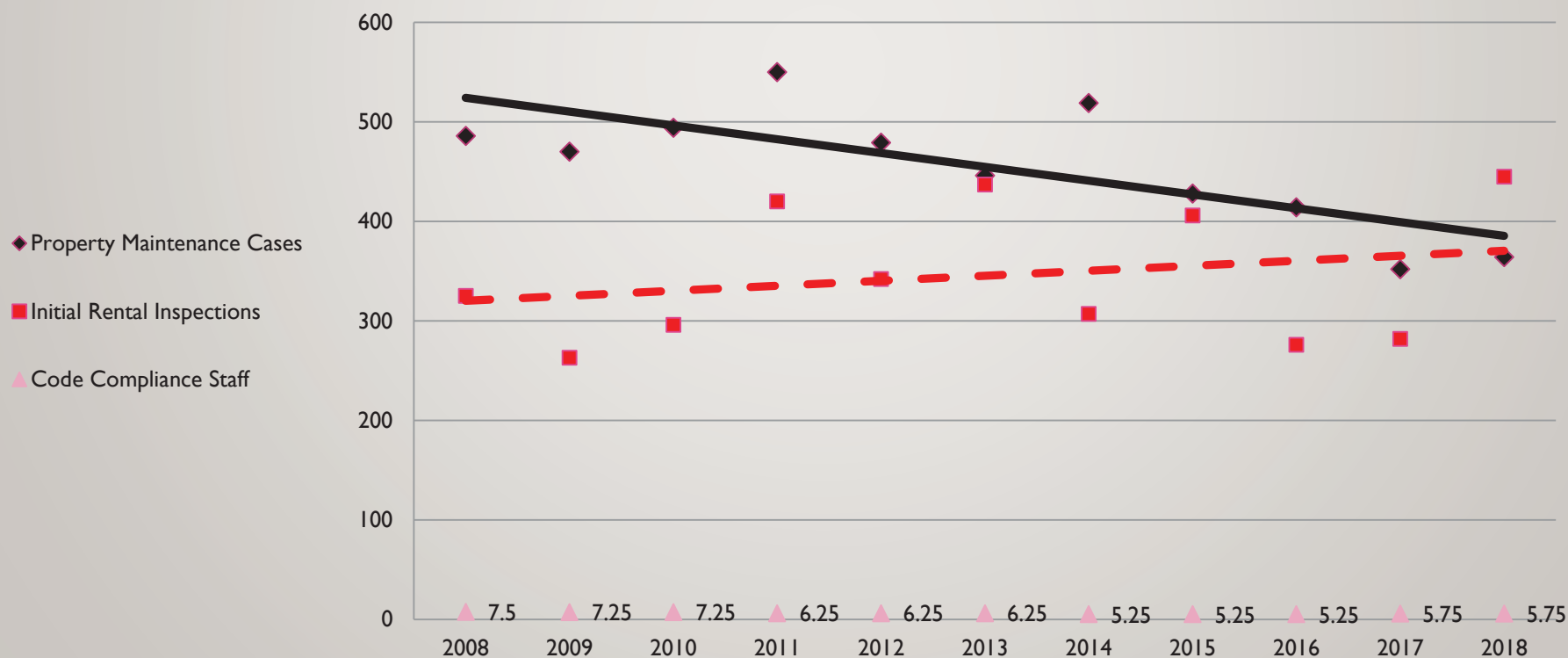




# Successes

- The addition of part time staff paid for by vacant building registration fees is helping to reduce some vacant building complaints and increase Rental Inspection Program cases.
- The number of new Property Maintenance cases is trending downward as the number of new Rental Inspection Program cases increase.

**10-Year Trend: Rental Inspections to New Property Maintenance Cases**



# QUESTIONS, COMMENTS, OBSERVATIONS

---

CODE COMPLIANCE PROGRAM UPDATE

# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018**

AGENDA ITEM #: **3**

CONSENT:  
ACTION:

REGULAR:  
INFORMATION:

WORK SESSION: **X**

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: Downtown 2040 Master Plan**

**KEY ELEMENTS:**

☒ Economic Development ☐ Excellent Government ☒ Natural and Built Environment ☐ Safe Community ☒ Vibrant Community

**RECOMMENDATION:** Conduct work session on Downtown 2040 Master Plan.

**SUMMARY:** On April 26, 2017, the Planning Commission initiated revisions to the Downtown & Riverfront Master Plan 2000. The Downtown 2040 Master Plan builds upon the successes of the Downtown & Riverfront Master Plan 2000 and provides a blueprint and direction forward for the next twenty years.

After significant community outreach and participation, the Planning Commission conducted a public hearing on August 22, 2018 and recommended adoption of the Downtown 2040 Master Plan. The following edits were recommended by the Planning Commission with adoption; however, they are not yet included in the Master Plan:

- Temporary road closures to create pedestrian only streets at certain times of the week / year as a tool to create additional public space in Downtown streets. (p. 95)
- Narrowing of Rivermont Avenue on the northwest side of the bridge to match the bridge road diet, particularly on the inbound route. (p. 175)
- Amending City Code to require deliveries to be made in loading zones, not travel lanes, regardless of street direction. (pp. 135 & 149)

At the September 11, 2018 work session, staff will give an overview of the Downtown 2040 Master Plan with more focused discussion on the recommendation of converting traffic patterns to "2-Way". The City's consultants, Mr. David Hill, Hill Studio and Mr. Wade Walker, Alta Planning & Design, will be in attendance at the work session to address questions from City Council.

**PRIOR ACTION(S):**

August 8, 2018: Planning Commission Work Session

August 22, 2018: The Planning Division recommended approval of the Downtown 2040 Master Plan.  
The Planning Commission recommended approval (4-0 with three absent, Bowden, Light and Johnson) of the Downtown 2040 Master Plan following a public hearing.

**FISCAL IMPACT:** To be determined.

**CONTACT(S):** Tom Martin, City Planner – 455-3900  
Kent White, Community Development Director – 455-3900

**ATTACHMENT(S):**

- Downtown 2040 Master Plan (as a separate file due to size)
- Downtown 2040 Master Plan Appendices (as a separate file due to size)

**REVIEWED BY:** raw

090K





# Downtown 2040

DOWNTOWN LYNCHBURG MASTER PLAN  
LYNCHBURG, VIRGINIA



JULY 26, 2018

DRAFT

CITY OF LYNCHBURG | HILL STUDIO | ARNETT MULDROW | ALTA PLANNING | HURT & PROFFITT

PAGE LEFT INTENTIONALLY BLANK

# TABLE OF CONTENTS

|                                                                 |           |                                                        |            |
|-----------------------------------------------------------------|-----------|--------------------------------------------------------|------------|
| <b>A VISION FOR DOWNTOWN 2040.....</b>                          | <b>7</b>  | <b>CHAPTER 4: PUBLIC SPACE AND RECREATION.....</b>     | <b>61</b>  |
| GOALS FOR DOWNTOWN 2040.....                                    | 9         | 4.1 PARKS AND GATHERING AREAS .....                    | 64         |
| <b>CHAPTER 1: BACKGROUND.....</b>                               | <b>13</b> | 4.2 TRAILS AND PEDESTRIAN CONNECTIONS .....            | 84         |
| 1.1 STUDY AREA BOUNDARIES .....                                 | 15        | 4.3 STREETS AS PUBLIC SPACE .....                      | 94         |
| 1.2 DOWNTOWN DEVELOPMENT CHARACTER AREAS .....                  | 16        | 4.4 PUBLIC SPACE AND RECREATION: GOALS.....            | 98         |
| 1.3 INTEGRATION OF PREVIOUS DOWNTOWN PLANNING .....             | 18        | 4.5 PUBLIC SPACE AND RECREATION: RECOMMENDATIONS ..... | 98         |
| 1.4 OPPORTUNITIES FOR CONTINUED DEVELOPMENT .....               | 24        | <b>CHAPTER 5: PARKING.....</b>                         | <b>101</b> |
| 1.5 COMMUNITY INVOLVEMENT AND DIRECTION .....                   | 26        | 5.1 FINDINGS .....                                     | 103        |
| 1.6 PUBLIC REVIEW AND ADOPTION OF MASTER PLAN .....             | 30        | 5.2 PARKING MANAGEMENT RECOMMENDATIONS .....           | 106        |
| <b>CHAPTER 2: LAND USE AND URBAN DESIGN.....</b>                | <b>31</b> | 5.3 MIXED-USE PARKING DEVELOPMENT .....                | 110        |
| 2.1 EXISTING CONDITIONS .....                                   | 33        | 5.4 PARKING IN 2040 .....                              | 116        |
| 2.2 FUTURE LAND USE AND DEVELOPMENT .....                       | 34        | 5.5 PARKING: GOALS.....                                | 118        |
| 2.3 FUTURE URBAN DESIGN .....                                   | 35        | 5.6 PARKING: RECOMMENDATIONS .....                     | 118        |
| 2.4 LAND USE AND URBAN DESIGN: GOALS.....                       | 37        | <b>CHAPTER 6: MOBILITY AND ACCESSIBILITY .....</b>     | <b>121</b> |
| 2.5 LAND USE AND URBAN DESIGN: RECOMMENDATIONS .....            | 37        | 6.1 BEST PRACTICES IN DOWNTOWNS.....                   | 124        |
| <b>CHAPTER 3: HISTORIC AND ARCHITECTURAL RESOURCES .....</b>    | <b>41</b> | 6.2 FINDINGS .....                                     | 125        |
| 3.1 HISTORIC CHARACTER .....                                    | 44        | 6.3 WALKABILITY .....                                  | 126        |
| 3.2 ADAPTIVE REUSE OF VACANT HISTORIC BUILDINGS .....           | 46        | 6.4 VEHICULAR CIRCULATION AND MANAGEMENT .....         | 132        |
| 3.3 PRESERVING LYNCHBURG'S ARCHITECTURAL CHARACTER .....        | 55        | 6.5 TRANSIT FACILITIES.....                            | 140        |
| 3.4 HISTORIC AND ARCHITECTURAL RESOURCES: GOALS.....            | 57        | 6.6 BIKEABILITY .....                                  | 144        |
| 3.5 HISTORIC AND ARCHITECTURAL RESOURCES: RECOMMENDATIONS ..... | 57        | 6.7 MOBILITY AND ACCESSIBILITY: GOALS .....            | 148        |
|                                                                 |           | 6.8 MOBILITY AND ACCESSIBILITY: RECOMMENDATIONS.....   | 148        |



## **CHAPTER 7: UTILITIES, STREETScape, REFUSE & SAFETY .. 151**

|     |                                                              |     |
|-----|--------------------------------------------------------------|-----|
| 7.1 | ONGOING PROJECTS .....                                       | 153 |
| 7.2 | FUTURE DOWNTOWN UTILITY AND STREETScape PROJECT PHASES ..    | 155 |
| 7.3 | STREETScape PALETTE.....                                     | 158 |
| 7.4 | REFUSE COLLECTION .....                                      | 162 |
| 7.5 | SAFETY.....                                                  | 165 |
| 7.6 | UTILITIES, STREETScape, REFUSE AND SAFETY: GOALS .....       | 166 |
| 7.7 | UTILITIES, STREETScape, REFUSE AND SAFETY: RECOMMENDATIONS . | 166 |

## **CHAPTER 8: CONNECTING COMMUNITIES..... 169**

|     |                                               |     |
|-----|-----------------------------------------------|-----|
| 8.1 | GATEWAY ENTRANCES .....                       | 172 |
| 8.2 | NEIGHBORHOODS.....                            | 180 |
| 8.3 | COLLEGES AND REGIONAL TRANSPORTATION .....    | 185 |
| 8.4 | CONNECTING COMMUNITIES: GOALS.....            | 188 |
| 8.5 | CONNECTING COMMUNITIES: RECOMMENDATIONS ..... | 188 |

## **CHAPTER 9: ECONOMIC AND MARKET ASSESSMENT ..... 191**

|     |                                              |     |
|-----|----------------------------------------------|-----|
| 9.1 | METHODOLOGY AND DATA COLLECTION SUMMARY..... | 193 |
| 9.2 | MARKET TRADE AREAS .....                     | 195 |
| 9.3 | SUMMARY OF FINDINGS.....                     | 196 |
| 9.4 | MARKET OPPORTUNITIES FOR THE FUTURE.....     | 198 |

## **CHAPTER 10: BUSINESS DEVELOPMENT AND MARKETING ..... 199**

|      |                                                           |     |
|------|-----------------------------------------------------------|-----|
| 10.1 | ECONOMIC CLIMATE .....                                    | 201 |
| 10.2 | ONGOING BUSINESS DEVELOPMENT AND MARKETING EFFORTS.....   | 203 |
| 10.3 | BUSINESS DEVELOPMENT RECOMMENDATIONS .....                | 204 |
| 10.4 | MARKETING RECOMMENDATIONS .....                           | 213 |
| 10.5 | BUSINESS DEVELOPMENT AND MARKETING: GOALS.....            | 224 |
| 10.6 | BUSINESS DEVELOPMENT AND MARKETING: RECOMMENDATIONS ..... | 224 |

## **CHAPTER 11: WAYFINDING..... 229**

|      |                                                               |     |
|------|---------------------------------------------------------------|-----|
| 11.1 | EXISTING CONDITIONS .....                                     | 231 |
| 11.2 | WAYFINDING PROGRAM.....                                       | 234 |
| 11.3 | KEY WAYFINDING ROUTES, DECISION POINTS AND DESTINATIONS ..... | 236 |
| 11.4 | WAYFINDING: DESIGN RECOMMENDATIONS .....                      | 240 |
| 11.5 | WAYFINDING: GOALS .....                                       | 260 |
| 11.6 | WAYFINDING: RECOMMENDATIONS .....                             | 260 |

## **CHAPTER 12: IMPLEMENTATION & NEXT STEPS ..... 263**

|      |                                     |     |
|------|-------------------------------------|-----|
| 12.1 | SUMMARY IMPLEMENTATION MATRIX ..... | 265 |
|------|-------------------------------------|-----|

PAGE LEFT INTENTIONALLY BLANK

PAGE LEFT INTENTIONALLY BLANK



# A VISION FOR DOWNTOWN 2040

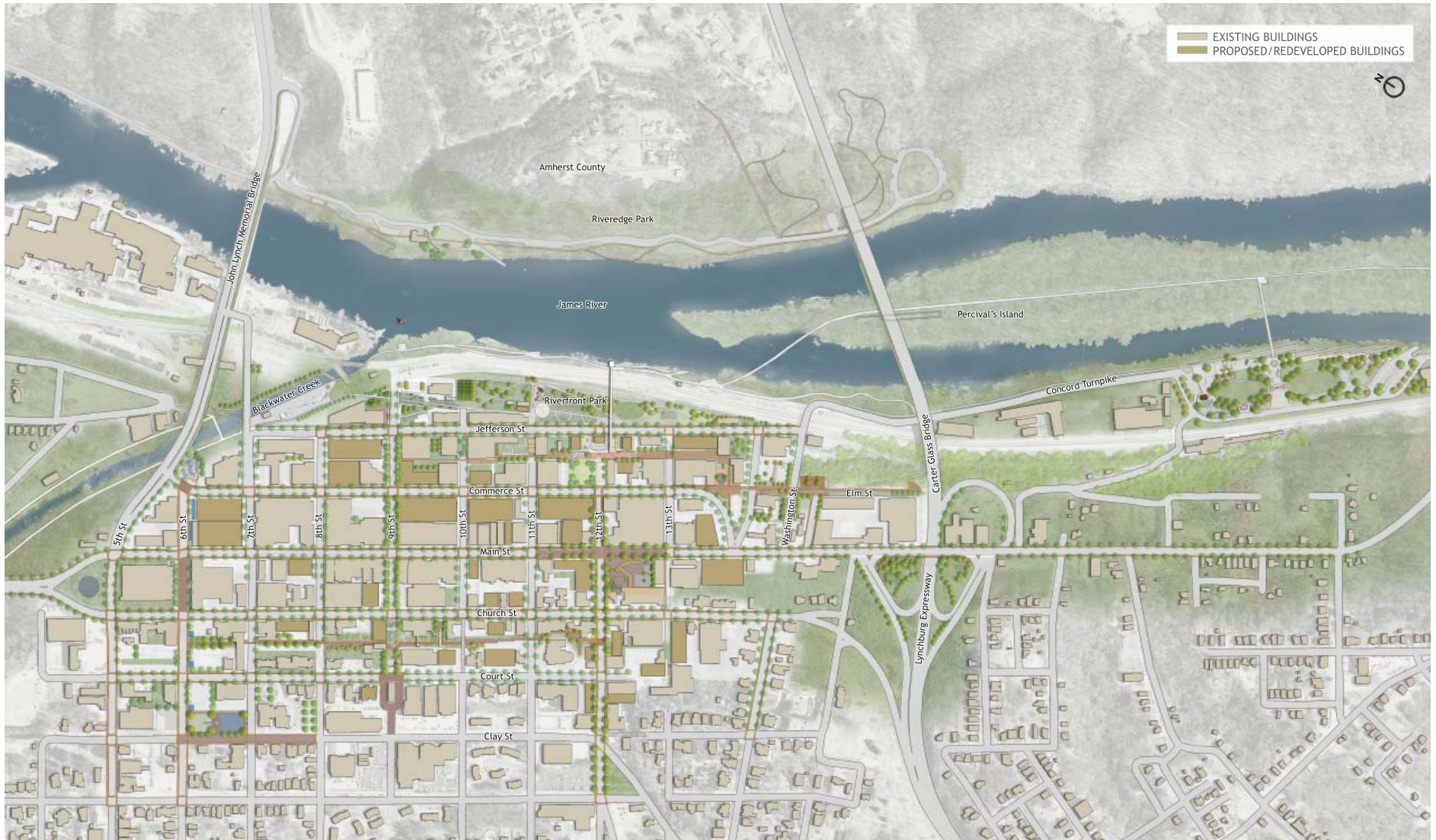
*In 2040, Downtown Lynchburg will be a bustling and thriving urban core; the economic, social, and cultural hub of Central Virginia – a destination for visitors and a livable neighborhood for residents. Both locals and tourists alike will enjoy a diverse offering of retail, restaurants, and recreational activities set in a downtown rich with historic architecture, unique topography, and vibrant public spaces. This is the exciting atmosphere that makes Downtown Lynchburg the heart of the region.*

In 2000, the vision developed for Downtown Lynchburg set a high bar for revitalizing the historic central business district. Since then, much has been accomplished and invested by both the public and the private sectors. Over \$50 Million has been invested in Downtown public park and infrastructure projects since 2002. This public investment has more than doubled real estate values in the Central Business District (\$115 Million in 2000 to \$267 Million in 2017).

As of 2017, Downtown hosts over 430 businesses and has added more than 900 residential units. The City has seen substantial growth in tax revenues in the last five years; over \$12.7 Million was generated from 2012-2017 by business license, meals, lodging, amusement, and utility taxes. Indeed, it is again a commercial hub for the region with unique offerings sited within an authentic historic and architectural core. A majority of this revitalization success has occurred as a result of capital improvements to the Riverfront and Lower Bluffwalk areas of Downtown.

Building on that success, this plan sets higher goals and integrates public engagement and previous planning efforts to chart growth and prosperity for the next 20 years.

# A VISION FOR DOWNTOWN 2040



Illustrative Master Plan

## GOALS FOR DOWNTOWN 2040

The following goals provide direction for achieving the future vision for development and investment in Downtown:

### ■ LAND USE AND URBAN DESIGN

- > Encourage investment and development up the terraces of Downtown towards Main Street, Church Street, and Court Street.
- > Ensure that new development and public improvements complement the historic and architectural character of Downtown streets while also providing opportunities for modern architecture that embraces the continued growth of Downtown Lynchburg as an urban commercial center.
- > Foster a balance of land uses (commercial, residential, institutional, and public spaces) that will sustain Downtown as a lively, attractive, and economically vibrant central business district.

### ■ HISTORIC AND ARCHITECTURAL RESOURCES

- > Preserve and enhance the architectural and historic integrity of Downtown.
- > Increase awareness of Lynchburg's historic and architectural assets as a tool for economic development.
- > Encourage the adaptive reuse of vacant historic buildings.



## ■ PUBLIC SPACE AND RECREATION

- > Provide a network of parks and open spaces that celebrates the James River and the unique scenery of Lynchburg.
- > Enhance Downtown as a destination that provides citizens with exceptional opportunities for social interaction and recreational experiences.
- > Boost economic growth and tourism by developing a signature venue in Downtown that can support large-scale outdoor events.
- > Weave high-quality public spaces into the fabric of Downtown to create a more livable neighborhood.
- > Provide access and strengthen connections to the James River.

## ■ CONNECTING COMMUNITIES

- > Enhance gateway entrances into Downtown.
- > Improve connectivity between Downtown and its surrounding neighborhoods through parks, public spaces, transportation, and streetscape improvements.
- > Attract students and staff from Lynchburg's universities and colleges to Downtown by providing amenities and transportation options.
- > Connect to regional transportation hubs to better attract Lynchburg visitors to Downtown.

## ■ MOBILITY AND ACCESSIBILITY

- > Create great Complete Streets in and to Downtown that result in effective transportation circulation and accommodate all modes of travel: vehicular, transit, bicycle, and pedestrian.
- > Prioritize the movement of pedestrians Downtown to fully capture the health, safety and economic benefits of pedestrian activity.
- > Remove or mitigate barriers to walking and biking such as high vehicle speeds, network gaps, and steep grades.
- > Foster a downtown that allows residents to live car-free.

## ■ PARKING

- > Share parking resources with other Downtown interests by fostering public / private partnerships.
- > Improve parking resources in Downtown using solutions that are attractive, convenient, manageable, and financially feasible.
- > Connect parking areas to destinations through street, transit, pedestrian, bike, and wayfinding networks.
- > Communicate clear and concise information about parking.
- > Capitalize on premium on-street spaces, creating turnover, while providing lower cost, long-term options nearby.
- > Create a Downtown where visitors only need to park once.

## ■ WAYFINDING

- > Improve wayfinding into and within Downtown using a consistent, functional, and easily maintained signage system.
- > Monitor wayfinding signs to ensure accuracy.
- > Develop temporary wayfinding solutions that effectively communicate detours and foster a positive perception during construction.

## ■ BUSINESS DEVELOPMENT AND MARKETING

- > Identify and recruit new retail investment and grow small businesses in Downtown by strengthening anchors, capitalizing on the James River and outdoor amenities, and enhancing restaurant and cultural attractions.
- > Pursue office and employment growth that continues to establish Downtown as a destination for national firms.
- > Attract additional residential development to Downtown, including renovated loft apartments, as well as owner-occupied housing products.
- > Market Downtown using an integrated branding system and coordinated marketing messages.

## ■ UTILITIES AND INFRASTRUCTURE

- > Manage, prioritize, and look for opportunities to accelerate the Downtown Utility and Streetscape Project.
- > Minimize disruption to businesses and continuously inform the public of construction schedule and programs.
- > Ensure clean public parks, streets and facilities.
- > Improve public perception of Downtown safety.

PAGE LEFT INTENTIONALLY BLANK



# 1. BACKGROUND

- 1.1 STUDY AREA BOUNDARIES
- 1.2 DOWNTOWN DEVELOPMENT CHARACTER AREAS
- 1.3 INTEGRATION OF PREVIOUS DOWNTOWN PLANNING
- 1.4 OPPORTUNITIES FOR CONTINUED DEVELOPMENT
- 1.5 COMMUNITY INVOLVEMENT AND DIRECTION
- 1.6 PUBLIC REVIEW AND ADOPTION OF MASTER PLAN

PAGE LEFT INTENTIONALLY BLANK

## 1.1 STUDY AREA BOUNDARIES

Boundaries for the Downtown Study Area were the James River to the northeast, Fifth Street to the northwest, Court Street to the southwest, and the Lynchburg Expressway to the southeast. The project team also looked beyond this specific area as Downtown both impacts and is impacted by the surrounding area.

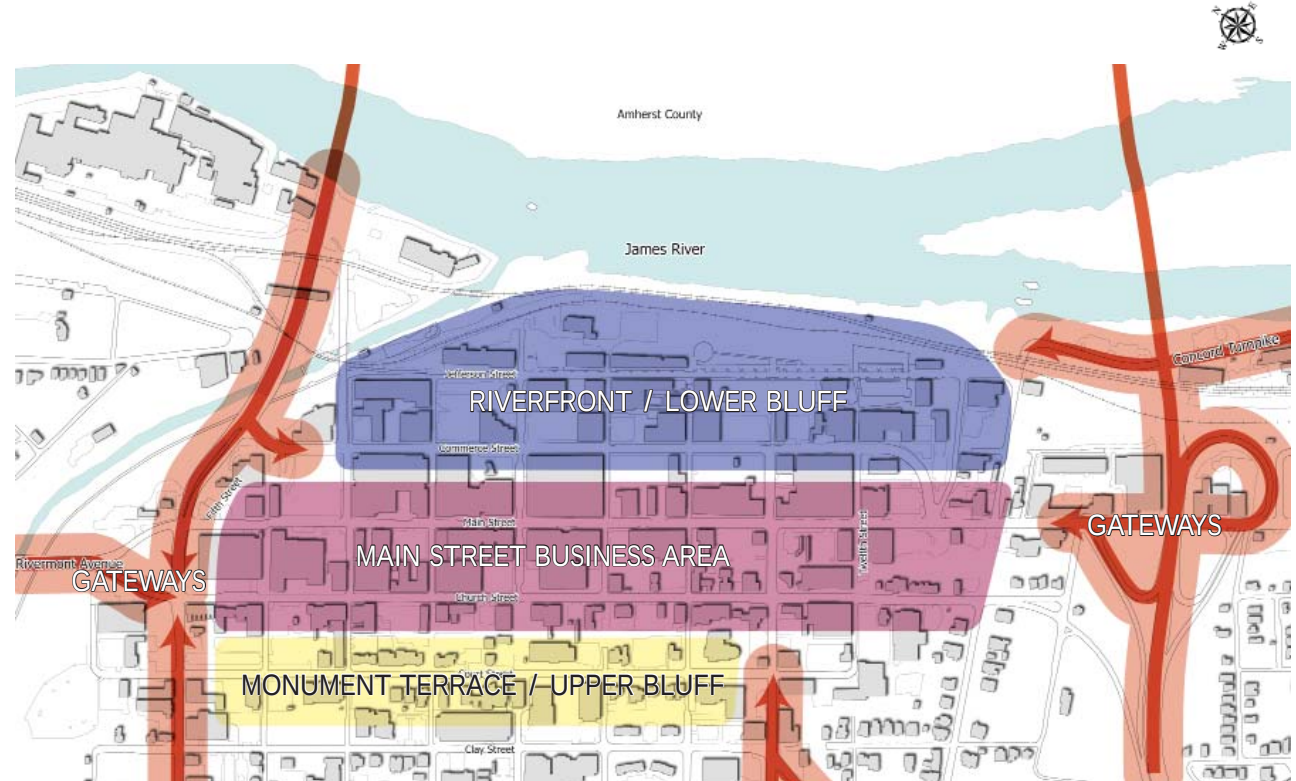




## 1.2 DOWNTOWN DEVELOPMENT CHARACTER AREAS

As the historic center of commerce since the mid-1700s, Downtown Lynchburg has evolved over time. Its growth and transition reflect the community's history in trade and manufacturing along the James River. Over the past twenty years, planning and investment in Downtown has been successful in stabilizing historic buildings, revitalizing public infrastructure, and encouraging business investment.

As of 2018, Downtown retains a special sense of place that celebrates significant architectural buildings sited on prominent terraces that overlook the James River. In general, the revitalization and growth of Downtown has occurred in four specific areas that share common development characteristics, and architectural and environmental features. Each area is discussed here and depicted on the map to the right:



*Downtown Character Areas*

**Riverfront / Lower Bluff** – Area between the James River and Commerce Street. It includes Riverfront Park, Jefferson Street, the Lower Bluffwalk, and both sides of Commerce Street. This area exhibits public and private investments that feature Riverfront Park, large historic warehouses, industrial design elements (iron, brick, and stone), cobblestone streets, green infrastructure (flood zone), and enhanced pedestrian access with river views along the Lower Bluffwalk. The buildings on Commerce Street include smaller, one and two-story commercial buildings.

**Main Street Business** – Area that includes both sides of Main and Church Streets. Development in this area has been facilitated by supporting development in the Riverfront/Lower Bluff District, streetscape improvements to 9th and 12th Streets, enhancements to the Lynchburg Community Market, and growing business investment. This area exhibits primarily multi-story, masonry commercial buildings (both large and small), many with elaborate architectural detailing.

**Monument Terrace / Upper Bluff**– Area above Church Street, mainly Court Street. Traditionally, this area served as the center for government, institutions (e.g., churches, museums, schools), and other small businesses and services in Downtown. Monument Terrace is a distinctive landscape and historic feature. This area hosts a steep, climbing topography and includes the planned Upper Bluffwalk. Many of the buildings in this section of Downtown are large, multi-story masonry commercial, institutional, or civic buildings with distinctive architectural and character-defining features (elaborate entrances, massive columns, patterned windows, and decorative building masonry). Established, historic neighborhoods surround the outer edges of this district (College Hill, Diamond Hill, Garland Hill).

**Gateways** – Areas that serve as entrances into Downtown. These gateways include the Lynchburg Expressway Exit to Main Street, Concord Turnpike, 12th Street, and 5th Street. These important portals contain key businesses that signal a visitor's arrival Downtown. Improvements should help emphasize this arrival for pedestrians or motorists Downtown and/or the connecting neighborhoods. They are good locations for directional or welcome signage that is in context with the specific area.



*Riverfront / Lower Bluff*



*Monument Terrace / Upper Bluff*



*Main Street Business*

## 1.3 INTEGRATION OF PREVIOUS DOWNTOWN PLANNING

The Downtown 2040 Master Plan design team reviewed and considered over twenty relevant studies and capital improvement projects for Downtown, including the following:

- > Downtown & Riverfront Master Plan (Sasaki, 2000)
- > Downtown Implementation Plan (Nelson Byrd Woltz, 2007)
- > 2030 Comprehensive Plan (2013)
- > Lynchburg Historic District, Commercial Design Review Guidelines (Thomason, 2007)
- > Central Business District Water Main Replacement Program, Preliminary Engineering Report (Whitman Requardt, 2011)
- > Downtown Parking Deck Feasibility Study (Desman Associates, 2012)
- > Strategic Parking Plan (Carl Walker, 2007)
- > Region 2000 Blueways and Greenways Plan (2012)
- > Region 2000 Bike/Pedestrian Plan (2012)
- > Region 2000 Wayfinding Study 2012
- > Main Street Gateway Preliminary Bridge Design (2014)
- > Clay Street Reservoir Reports (1997, 2002)
- > TIGER Grant Application / Transportation and Infrastructure Improvements (2016)
- > Canal Park Plan (Kennon Williams, 2014)
- > Community Market Studies and Updated Master Plan (2004, 2006, Wendel 2016)
- > “The Hopper” Downtown Circulator (2016)
- > Downtown Speed Study (EPR, 2016)
- > Fifth Street Corridor Master Plan (Sympoetica, 2006)
- > Tyreeanna/Pleasant Valley Neighborhood Plan (Sympoetica, 2003)
- > Tyreeanna Sewer Study (2005)
- > Solids Management Handling and Capital Improvement Plan (Brown & Caldwell, 2010)
- > Growing Tinbridge Hill (Clarion Associates, 2014)

The Downtown 2040 Master Plan builds on these past studies and identifies additional projects and strategies to foster continued prosperity and development. For reference, the following paragraphs summarize some of the most important studies that influenced the transformation and revitalization of Downtown and directed the public and private investment to date.



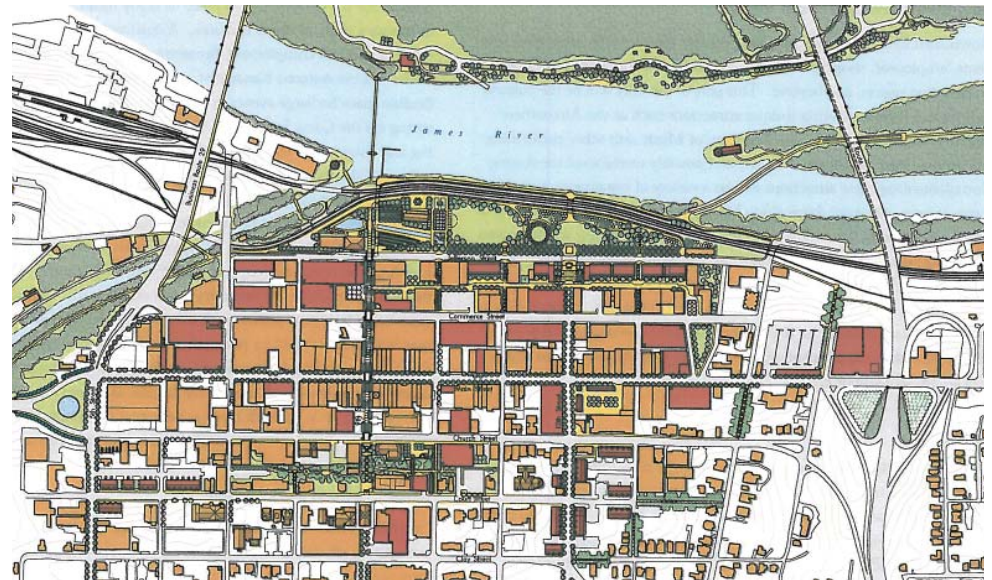
## LYNCHBURG DOWNTOWN & RIVERFRONT MASTER PLAN 2000 (SASAKI ASSOCIATES)

This initial plan for Downtown was adopted by City Council on May 22, 2001. It focused on successfully establishing a downtown core to serve the City and the region by offering unique uses in culture, entertainment, housing, retail, and services. Key recommended initiatives include:

- > **Create Downtown Walking Loop** – Improve the streetscape on 9th Street, Main Street, 12th Street, Jefferson Street.
- > **Celebrate the Stairs** - Establish a system of stairs and bluff walks.
- > **Connect Neighborhoods with Downtown** – Strengthen pedestrian connections and extend the residential fabric into the heart of Downtown.
- > **Reinvent the River as a Place** – Interpret the City, develop water-related activities, and link the trail system.
- > **Acknowledge Gateways** – Define gateways and create a sequence of arrival experiences into Downtown and at key destinations.
- > **Intertwine Programmed Activities, Park Design, and Economic Development** – Balance these elements and focus on programmed activities and capital investment.

### Downtown and Riverfront Vision (2000 Plan)

*Downtown Lynchburg will be a vital district enlivened by additional resident, employees, shoppers, tourists, and other visitors from the City, the surrounding region, and beyond. This part of the City will be the cultural hub for the region, offering unique attractions such as the Amazeement Square children's museum, the Academy of Music and other performing arts venues, the Community Market, and possibly recreational ice-skating. Complementing these attractions will be a variety of restaurants, a possible movie theater and retail shops along Main Street, with other destinations in key locations along the riverfront. The history of Lynchburg will be woven into all aspects of downtown, embracing the Old Courthouse Museum, the historic hill neighborhoods, notable architecture, interpretive markers and signage along the riverfront, and gateways into downtown. New residences on the bluff overlooking the river and throughout downtown will provide critical mass that complements the historic hill neighborhoods and engenders an 18- to 24-hour city.*



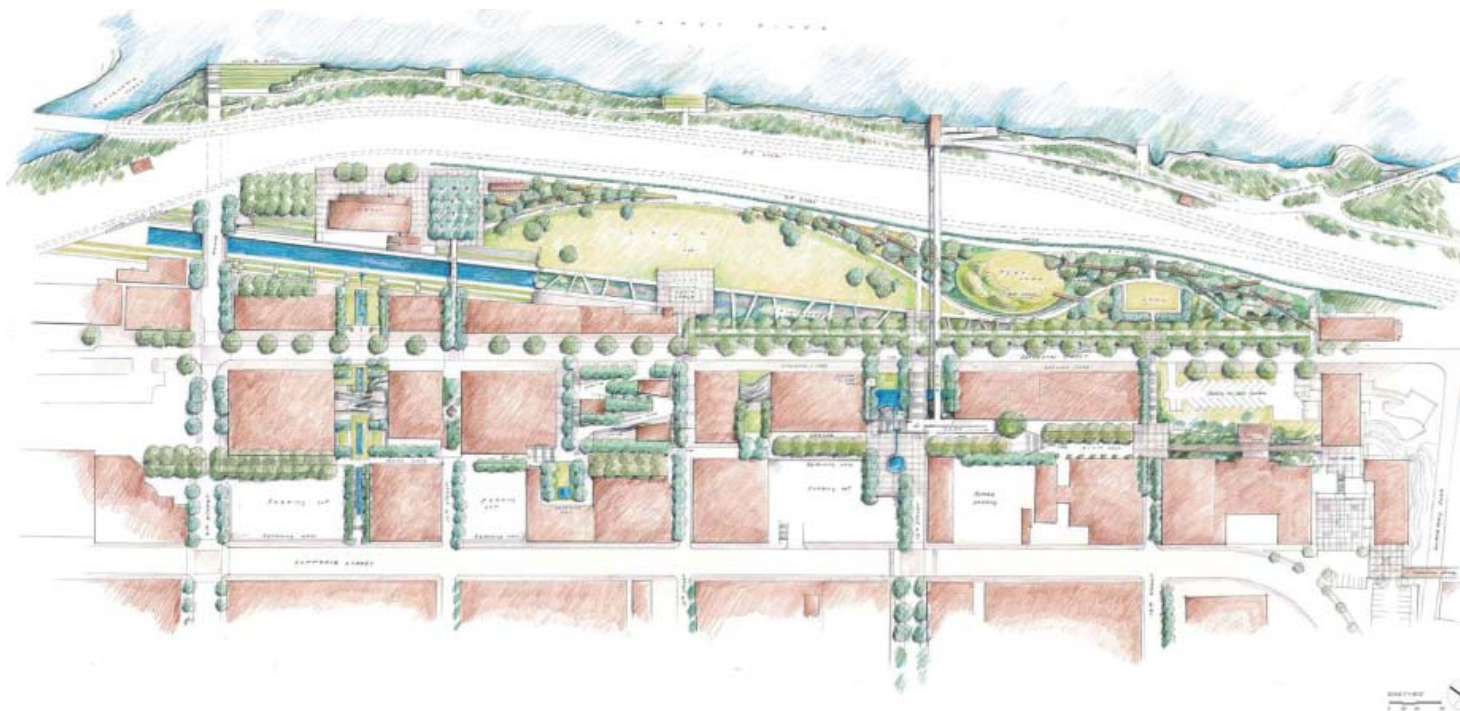
*Illustrative Master Plan, 2000 Downtown & Riverfront Master Plan, Sasaki Associates*

## RIVERFRONT IMPLEMENTATION PLAN 2006 (NELSON BYRD WOLTZ)

In 2006, the City worked with downtown stakeholders to refine direction for downtown projects recommended by the 2000 Sasaki Plan for Downtown. The Riverfront Implementation Plan recommended the following changes to the Lower Bluffwalk and to Riverfront Park:

- > **Bluffwalk** – Add service and vehicle access to the pedestrian walk and move the pedestrian bridge (and tower terminus) from 12th Street to 13th Street.

- > **Riverfront Park and Jefferson Street** – Make the “great lawn” the centerpiece of Riverfront Park and add a portable stage oriented to the river. In addition, extend the canal feature into the park and provide a wide, raised walk on the south side of Jefferson Street.
- > **Riverwalk** – Add pedestrian connections at 9th and 12th Streets, as well as more overlooks for interest and activities.

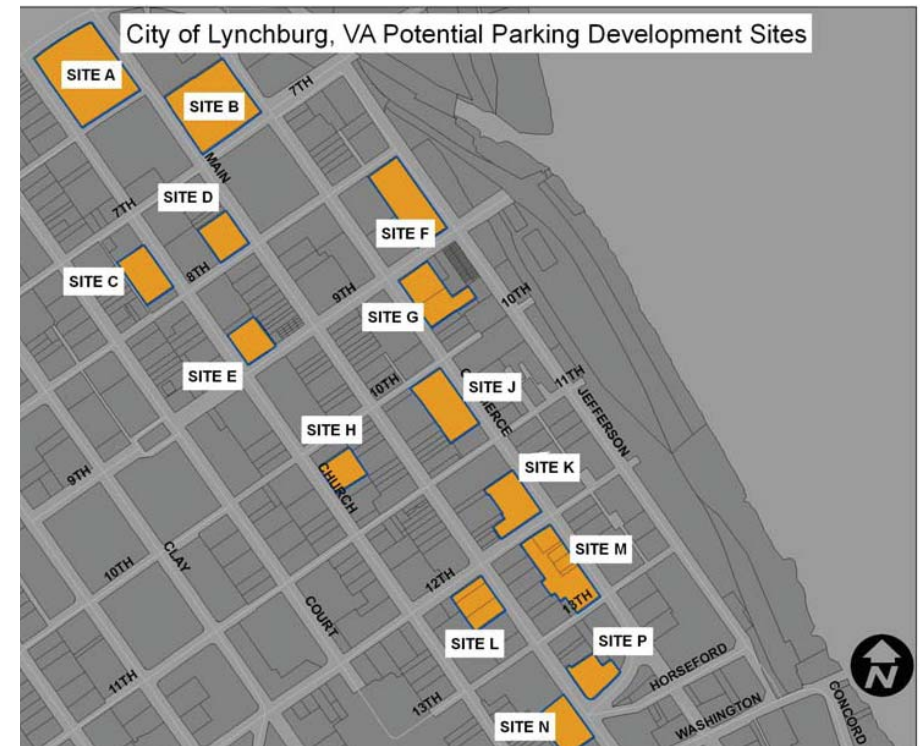


Updated Riverfront Implementation Plan, 2006, Nelson Byrd Woltz. (Not formally adopted by City Council)

## DOWNTOWN PARKING STUDIES

Since 2007, the City has completed two Downtown parking studies. Brief summaries of these studies are shared below and additional details are discussed in Chapter 5, Parking.

- > **Strategic Parking Plan (Carl Walker 2007)** - The plan concluded that there was not a parking capacity issue in Downtown. The plan recommended various strategies to improve parking including paid parking options, parking management changes, requiring parking for new residential development, and a new parking garage.
- > **Downtown Parking Deck Feasibility Study (Desman Associates 2012)** - This study investigated twelve development sites for a public parking garage and identified a preferred site at 12th and Commerce Streets, which is Site K on the adjacent map. A parking inventory identified approximately 7,000 available parking spaces in Downtown under public and private ownership. The study concluded that on-street parking was misused for long-term use by employees and residents.



*Suggested Sites for Public Parking Garages from Downtown Parking Deck Feasibility Report (Desman Associates 2012)*



## STREETSCAPE AND UTILITY IMPROVEMENTS

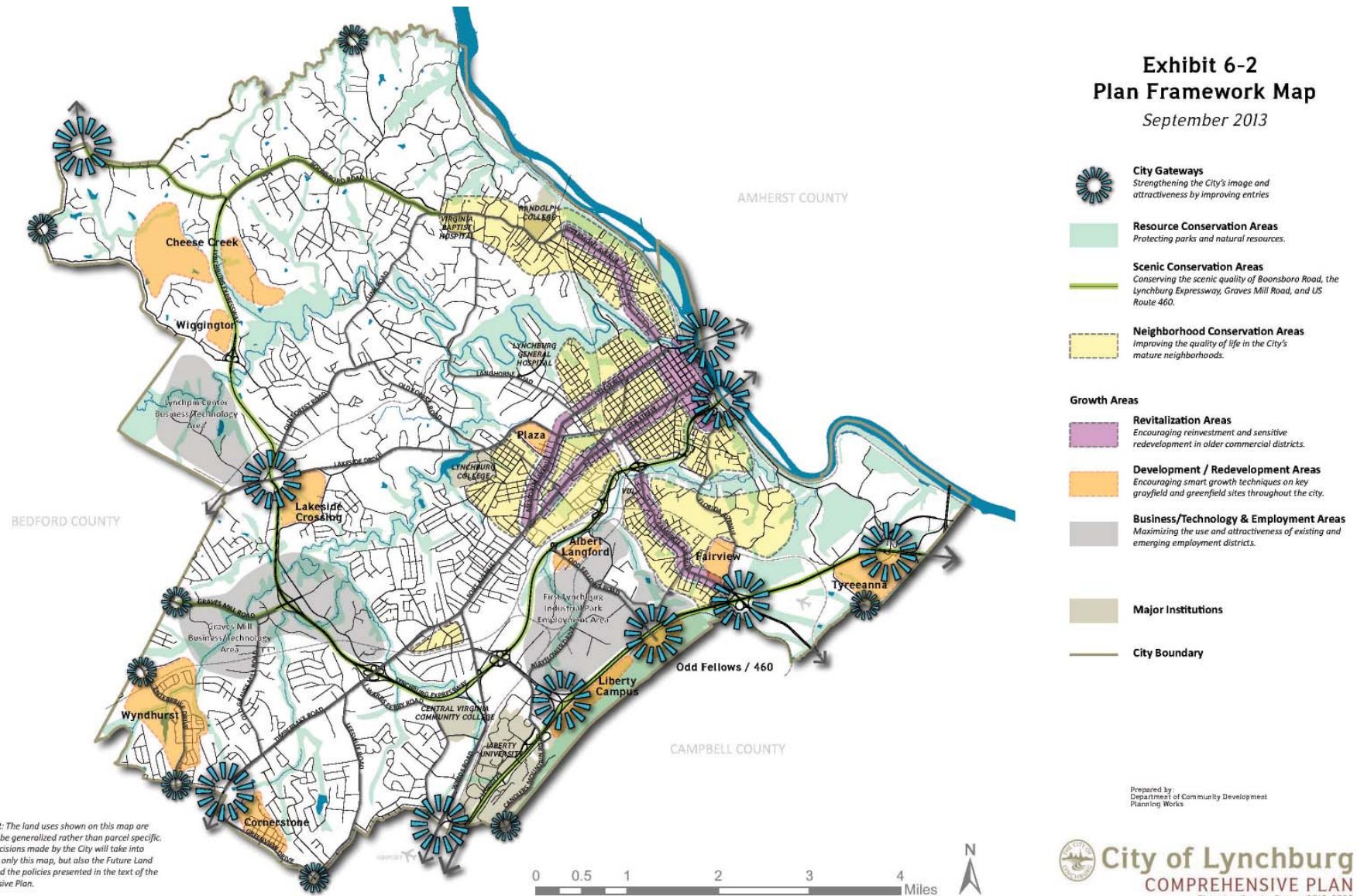
In addition to completion of public improvements to the Downtown streetscape, Bluffwalk, and Riverfront Park, the City has embarked on the complete replacement of aging water and sewer lines in the Central Business District. This replacement was necessary to protect businesses and residents against main line breaks and to provide sufficient water and fire flow to Downtown. As of 2017, main lines have been replaced on Main and Church Streets between 5th and 8th Streets, as well as lines at in-between side streets (7th Street and 8th Street). This construction has been accompanied by continued streetscape improvements (i.e., new sidewalks, crosswalks, parking, and landscaping). The next phase of utility construction will be coordinated with the recommendations of this updated Downtown Plan.

## 2030 COMPREHENSIVE PLAN

In the Council-adopted 2030 *Comprehensive Plan for Lynchburg, Virginia*, Downtown is a designated revitalization area and city gateway (James River). In general, the Comprehensive Plan recommends restoring historic centers; eliminating vacancy and blight; providing retail and employment opportunities in close proximity to city neighborhoods; reusing and adapting existing buildings; promoting sensitive design to development in historic areas; and encouraging public investment and incentives to spur revitalization. The plan establishes the following development goal and future land use provisions for Downtown:

- > **Development Goal:** Maintain a strong, mixed-use downtown that is a focus for civic, business, residential, entertainment, art, culture, and recreational activities. Celebrate and strengthen connections to the James River.
- > **Future Land Use:** Downtown is the central commercial core of the city and appropriately contains a mix of retail, entertainment, restaurant, office, employment, residential, public, park, and institutional uses. The area should retain its urban character; demolition of historic buildings and replacement with suburban style, low-density development is inappropriate.

## Exhibit 6-2 Plan Framework Map September 2013



DISCLAIMER: The land uses shown on this map are intended to be generalized rather than parcel specific. Land use decisions made by the City will take into account not only this map, but also the Future Land Use Map and the policies presented in the text of the Comprehensive Plan.

The 2030 Comprehensive Plan Framework Map illustrates recommended connections and development strategies.

## 1.4 OPPORTUNITIES FOR CONTINUED DEVELOPMENT

### PROGRESS TO DATE

Since 2000, there has been substantial capital investment in Downtown. Over \$50 Million has been invested by the City in public park and infrastructure projects since 2002. This has generated substantial private investment in Downtown and City tax revenue from 2012-2017 amounted to over \$12.7 Million. As of 2017, there are over 430 businesses in Downtown that employ approximately 5,600 persons, and there are over 900 residential units.

Public projects that have been completed in Downtown include:

- > Streetscape improvements to Jefferson Street (8th Street to Washington Street);
- > Streetscape improvements to 9th Street (Monument Terrace to Jefferson Street);
- > Streetscape improvements to 12th Street (Main Street to Bluffwalk);
- > Utility line replacement and upgrades (water, sewer, stormwater, etc.) and streetscape improvements to Main Street and Church Street and side streets (from 8th Street to 5th Street);
- > Construction of the Lower Bluffwalk between 10th Street to Craddock Terry Hotel near Horseford Road;
- > Riverfront Park improvements (open lawn, spray fountain, Riverwalk Trail (James River Heritage Trail), public parking areas, landscaping and green solutions for stormwater management);
- > Gateway directional signage in Downtown, as well as a wayfinding study (2012);
- > 5th Street improvements (roundabout gateway and streetscape improvements to the neighborhood business district);
- > Downtown Expressway bridge improvements (construction in 2018);
- > Community Market improvements (former parking deck infrastructure shoring and additional communal space);
- > Regularly scheduled events in Riverfront Park including concerts, movies, holiday activities, summer events, and festivals (Downtown Lynchburg Association and other event partners);





5th Street



12th Street



Lower Bluffwalk



Riverfront Park



Jefferson Street



9th Street

Examples of Completed Public Projects

## 1.5 COMMUNITY INVOLVEMENT AND DIRECTION

Community outreach and participation was a fundamental component in developing the new Downtown 2040 Plan. The Downtown Lynchburg Association was very involved in assisting the project design team and coordinating public engagement events and outreach tools. Engagement included the following outreach efforts:

- > Project webpage;
- > Kick-off event with guest speaker;
- > On-line survey of conditions and development opportunities (over 900 responses);
- > Public listening sessions (5);
- > Pop-up events (9); and
- > Design workshop (3 days).

Some of the common themes revealed through the various public outreach efforts included:

**James River** - The James River is a great asset for Downtown and the City of Lynchburg. Access to the river is important, as are public views to the river. Citizens desired additional park improvements and trails connections, as well as protected views, more attractive green spaces and gathering areas, and enhanced public facilities and amenities for events and activities (restrooms, better event space, and children's playground).

**Riverfront, Jefferson Street and Lower Bluffwalk** - The development and improvements along the Riverfront, Jefferson Street and the Lower Bluffwalk have been very successful in terms of private investment and increased Downtown activity. All three of these investments were identified as the most successful Downtown improvements. Citizens are attracted to the eclectic mix of businesses (especially the restaurants), the Lower Bluffwalk and the pleasant pedestrian atmosphere, the historic character and architecture, trails and the river, culture and events, and appealing residential loft housing.

**Businesses** - Citizens desired additional shopping choices and more retail businesses in Downtown. They specifically noted a need for a grocery store, drug store, and more places for entertainment. The Community Market was frequently mentioned as a destination.

**Parking** - Parking was identified most frequently as the issue needing change and improvement. Citizens expressed a need for improved and expanded parking options, as well as better information and directional signage to public parking. Many liked having free parking; however, they felt that parking was challenged by the increasing residential population in Downtown and employees who used the free parking spaces.

**Transportation and Mobility** – Citizens wanted improved accessibility in Downtown and safe, attractive pedestrian connections. They specifically mentioned improved sidewalks, expanded trails, increased directional signs, and better bicycle and bus/shuttle options (hours and loop times). Traffic flow was identified as one of the top issues facing Downtown in the future. There was considerable discussion of one and two-way traffic patterns. Citizens wanted easy access to businesses and parking; businesses wanted accessible service delivery; and developers wanted the best circulation for traffic and pedestrians to further successful business investment.

**Buildings, Architecture and Art** – Citizens responded that the retention and rehabilitation of the historic buildings are important to the future of Downtown. The historic buildings celebrate the unique identity of Downtown Lynchburg. Many citizens would welcome more art to public spaces.

**Physical Maintenance of Public and Private Properties** – Citizens noted that additional maintenance was needed for public infrastructure and vacant buildings in Downtown. They cited increasing problems with trash, overgrown landscaping, damaged sidewalks and fixtures, and deteriorating buildings. The much needed utility upgrades to the 100+ year old waterlines on Main and Church Streets have been a challenge for businesses, residents, and citizens maneuvering in and through Downtown; yet, there is recognition that those same projects also serve as a catalyst for the future upgrades that further plan goals.

**Special Places in Downtown** – Citizens highlighted many destinations in Downtown of special cultural value. These included Monument Terrace, Community Market, Academy Center of the Arts, City Hall, the Courthouse, historic homes and neighborhoods surrounding Downtown, Riverfront Park, Blackwater Creek, Percival's Island, and several individual historic buildings (e.g., Armory, Old City Auditorium, Allied Arts Building, Krise Building, YMCA, Craddock Terry Hotel, and various buildings on Main Street).



## PROJECT WEBPAGE

A project webpage provided detailed information on the project, the planning process and opportunities for public input and review of preliminary design initiatives.

## PROJECT KICK-OFF EVENT

A special project kick-off event on August 9, 2017 provided interested citizens an opportunity to meet the project team; learn about previous plans for Downtown; share their thoughts on downtown assets, challenges, and improvement needs; and hear a special guest speaker and author, Melody Warnick, talk about why place matters and “loving the place where you live.” The event was attended by approximately 300 people.

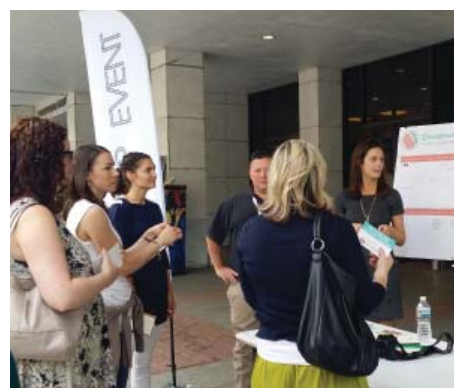
## DOWNTOWN SURVEY

The project team developed a survey to engage citizens in their vision for Downtown. Using Survey Monkey, an on-line tool, the survey asked approximately ten questions regarding downtown assets, special places, improvement needs, future issues facing Downtown, thoughts about public investments, and opportunities for future development and growth. The survey received over 900 responses. Some common response themes are illustrated in the word clouds shown here.

### Pop-Up Events at Locations Across Lynchburg



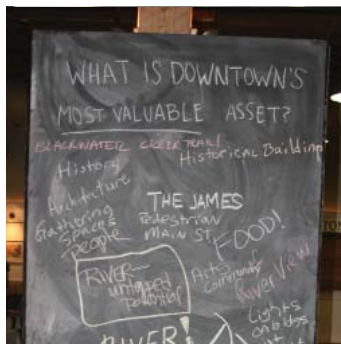
### Kick-off Event



## PUBLIC LISTENING SESSIONS

The project team hosted a full day of “public listening sessions” to allow citizens the opportunity to share more specific insight and concerns about various downtown topics, such as Doing Business in Downtown, Transportation and Parking, Quality of Life, and Doing Development in Downtown. In addition, an Open Topic session was held in the evening.

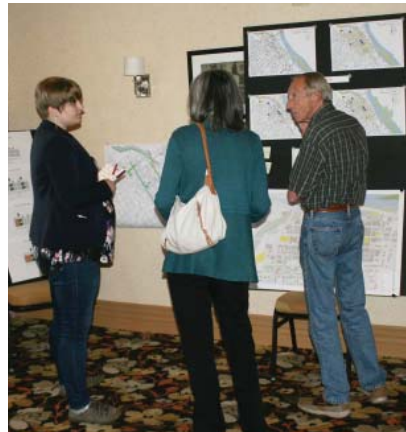
*Listening Sessions*



## POP-UP EVENTS

Nine impromptu information and listening sessions were held in August at various locations around Lynchburg. Event sites included several retail centers, area colleges, the library, the Community Market, and Riverfront Park. These pop-up gatherings allowed citizens outside the central business district to engage in the future plan for Downtown.

*Design Workshop*



## DESIGN WORKSHOP

After review of relevant Downtown planning documents, projects and consideration of the information gathered from the public outreach tools, the project team hosted a three-day design workshop to develop potential design initiatives that would encourage further growth and development in Downtown. Two evening sessions provided opportunities for public review and comment on proposed initiatives for Downtown 2040. Using the feedback received, the project team refined the initiatives and developed the recommended strategies and projects discussed in Chapters 3-8 of this updated Master Plan.

*Project Logo*



**Downtown 2040**

Downtown Lynchburg  
Master Plan

**#DT40**

## 1.6 PUBLIC REVIEW AND ADOPTION OF MASTER PLAN

*(to be updated with PC recommendation and CC adoption)*



## 2. LAND USE AND URBAN DESIGN

- 2.1 EXISTING CONDITIONS
- 2.2 FUTURE LAND USE AND DEVELOPMENT
- 2.3 FUTURE URBAN DESIGN
- 2.4 LAND USE AND URBAN DESIGN: GOALS
- 2.5 LAND USE AND URBAN DESIGN:  
RECOMMENDATIONS

PAGE LEFT INTENTIONALLY BLANK

## 2.1 EXISTING CONDITIONS

The 2030 Comprehensive Plan adopted by City Council includes recommendations for future land use and community design. Downtown is identified as a “revitalization area” that is the central commercial core of the City. Consequently, the plan recommends that Downtown retain its urban character, density, and historic qualities in any future development. The following sections provide additional direction and guidance for future land development and urban design features in Downtown.

### LAND USE

Downtown consists of a mix of defined future land uses including retail, entertainment, restaurant, office, employment, residential, public, park, and institutional. This mixture of uses is important to the vibrancy and continued success of Downtown as a central commercial core. Future development initiatives should foster the appropriate balance of all of these mixed uses, as each is fundamental to sustaining a central business district that is a destination and an exceptional place to work, live, and play.

### URBAN DESIGN

Much investment has been made in Downtown that complements the unique historic features, encourages safe pedestrian movement, and enhances the appearance of natural and physical assets. Future development projects in Downtown must maintain this attention to quality design and pedestrian scale.



*The Bluffwalk provides a great public space and connection between the Craddock Terry Hotel and 10th Street*



*Ninth Street*



## 2.2 FUTURE LAND USE AND DEVELOPMENT

Future land use and development in Downtown must achieve an appropriate balance of mixed uses (commercial, residential, institutional, recreational, public, etc.). Careful consideration must be given to new projects and investment to ensure that they strengthen the land use dynamics and prosperity of Downtown as a whole.

### DENSITY

Downtown must continue to develop with substantial density, mass, and scale to maintain the built commercial core and development context that distinguishes Lynchburg.

### FIRST FLOOR USE

Because Downtown is the Central Business District, the floors located at street level should be actively used by businesses. This maintains the integrity of Downtown and furthers its sustainability as a commercial core. Many cities address uses for the first floor in their downtown through their zoning code and restrict permitted uses to retail, office, or commercial; residential uses are permitted above the ground floor. Lynchburg should amend the zoning code to limit first floor land uses to business; the code could include a provision for first floor residential as a special exception/conditional use.

### MIXED LAND USES

Downtown must continue to develop with a balanced diversity of uses that encourage activity and economic vitality. Large buildings should consider a mixture of uses, where possible. For example, a parking garage should not just be for parking, but should include other uses such as retail, office, and/or residential. Since the Zoning Code does not regulate the mixture of uses, it is critical that board and administrative review of new development projects encourage mixed-uses.



*Active street level use with outdoor cafe seating along Jefferson Street*

## 2.3 FUTURE URBAN DESIGN

The following design guidelines for public spaces and streets, site development, and buildings should apply to new development in Downtown. These guidelines should be considered when discussing potential public and private projects. Ideally, they can be expanded to be more specific and used in conjunction with development and building approvals by City administrators and decision-making boards. In addition, certain design parameters could be established as development standards in the zoning code or as part of an adopted design review platform.



*Quality public spaces, such as the Lower Bluffwalk, provide accessible and pleasant areas in Downtown Lynchburg for residents, workers, and visitors.*

### PUBLIC SPACE AND STREETS

- > Public spaces and streets in Downtown should provide pleasant, safe, and reasonably accessible experiences for pedestrians and cyclists who shop, work, live, and visit there.
- > Street crossings should be prominently marked for safety and intersections constructed to enable safe, convenient, and attractive pedestrian access.
- > Streetscape improvements should retain, restore and preserve the authentic architectural and historic features of Downtown. If authentic materials are not available, then compatible materials with similar architectural features and detailing may be used. (See additional recommended palette details for the streetscape in Chapter 6, Mobility and Accessibility.)
- > Urban spaces and sidewalks should be sufficiently landscaped (using native shade and ornamental trees, decorative planters, green spaces, etc.) and include pedestrian-scale lighting, benches, bike racks, and interesting elements, such as interpretive markers or public art.
- > Public art and interpretive signage should be included in strategic locations in Downtown to enliven the streetscape and encourage additional pedestrian traffic. In particular, public art should be added to neighborhood entrances and gateways to better link adjacent neighborhoods to Downtown.

## SITE DEVELOPMENT

- > Buildings should be constructed close to the street, adjacent to the pedestrian sidewalk, to create consistent street views and setbacks.
- > Where possible, development should consider provisions for wide sidewalks, pedestrian gathering areas, and landscaping to enliven the space between the building and the street. (Examples of enlivened streetscape spaces include outdoor dining areas and parklets.)
- > Parking should be located on the street, behind the building, or preferably located in a shared parking garage or facility that contains a mixture of structured parking and business and/or residential uses.
- > New surface parking lots should not be located on the main streets in Downtown (i.e. Court Street, Main Street, Church Street, Commerce Street, and Jefferson Street). Existing surface parking lots should have minimal, coordinated entrance/exit points and be landscaped with shade trees at the street edges and within the interior.
- > Lighting should be of a pedestrian scale, 12-15' maximum, and shielded to prevent light overflow.
- > Important views of the James River should not be substantially obstructed by new infill development. These landscape views are considered a community asset that is significant to the ambience and architectural character of Downtown. Dense infill can be designed to preserve portions of views.

## BUILDINGS

- > Historic buildings should be preserved and renovated appropriately to maintain their distinguishing architectural features.
- > Demolition of historic buildings should be considered only as a last resort because of structural conditions that cannot be alleviated.
- > The first floor of buildings in Downtown should be used for commerce or public space.
- > New infill buildings should complement the historic and architectural character of Downtown (i.e., building materials and exterior architectural detailing) and include articulated entries, storefront display windows, pedestrian-scaled lighting and signage. New infill buildings should be compatible in mass and scale with surrounding buildings. Consistent density and site development (i.e., floor area ratio) is essential to the continued growth of Downtown.



## 2.4 LAND USE AND URBAN DESIGN: GOALS

- > Encourage investment and development up the terraces of Downtown towards Main Street, Church Street, and Court Street.
- > Ensure that new development and public improvements complement the historic and architectural character of Downtown streets while also providing opportunities for modern architecture that embraces the continued growth of Downtown Lynchburg as an urban commercial center.
- > Foster a balance of land uses (commercial, residential, institutional, and public spaces) that will sustain Downtown as a lively, attractive, and economically vibrant central business district.



51 11th Street Lofts on the Lower Bluffwalk.

## 2.5 LAND USE AND URBAN DESIGN: RECOMMENDATIONS

**Corridor Overlay Districts** – Entrance corridors into Downtown and scenic corridors that overlook the James River are very important to sustaining the revitalization that Lynchburg has experienced. In Virginia, local regulation of these corridors is permitted only in conjunction with designated historic districts (Downtown is a National Register Historic District - see Chapter 3 for discussion on establishing a Local Historic District).

- > **Gateway Entrance Corridors** - Provisions for protecting gateway entrance corridors should be adopted to provide design controls on development along key entrances into the historic Downtown (e.g., Main Street, 12th Street, 5th Street, and Concord Turnpike). The City Zoning Code could include an “overlay district” that contains specific design standards that address mass, scale, and architectural features for modifications and new development (from a sign to a new building).
- > **Lower and Upper Bluffwalk Corridors** – During development of this Plan, protection of views to the James River along the Bluffwalk were identified as very important to citizens. These corridors should be included in any adopted regulatory provisions.

**Public Activity Spaces** – Increased public activity on the sidewalk and in public spaces (i.e. outdoor plazas, seating, sidewalk cafe dining, outdoor performance spaces, etc.) can enliven Downtown, making it a desirable destination for people and events. Using public property for gatherings, vendors, and dining requires local ordinances with carefully thought out policies and procedures for operation. Typically, a permit is required and a fee established for use of the public space. Many cities in Virginia have example ordinances including Roanoke, Charlottesville, and Richmond.

To accommodate additional streetscape elements within limited sidewalk space, Section 19.1 (c) of the Streets and Sidewalks Ordinance should be revised to allow items placed within 4 feet of curb edges. As long as 4 foot clear zones are maintained from travel lanes, there is no reason to limit this space as it is the ideal location for many streetscape elements to create a vibrant sidewalk environment.

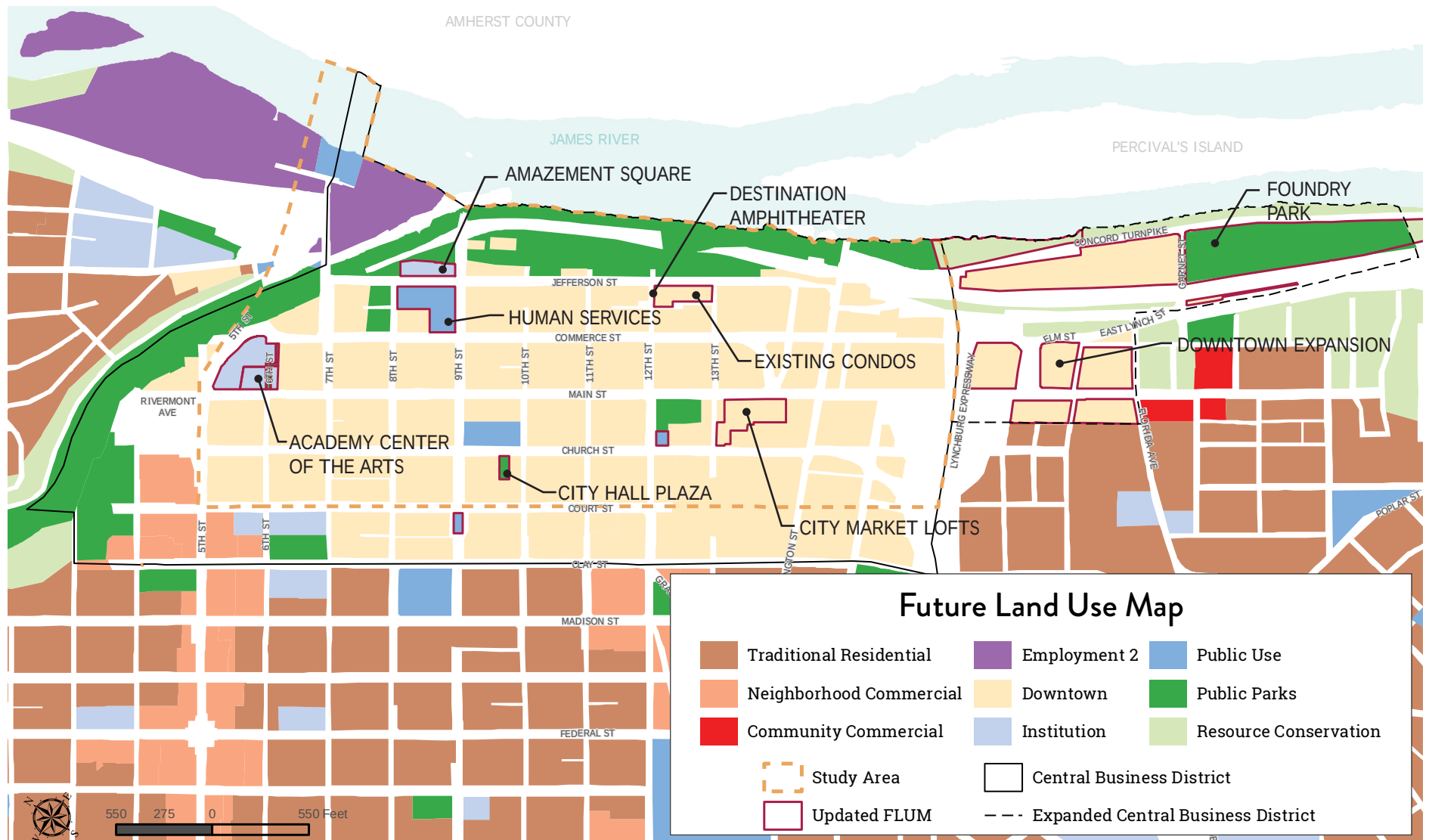
**Future Land Use Map** – To appropriately plan for the long-term development of Downtown, the Future Land Use Map should be updated to reflect the future public land uses and facilities recommended in this Master Plan. Recommendations for map amendments are listed below and shown on the accompanying Downtown Future Land Use Map.

- > *City Hall Plaza* – this area, which contains the elevator, connects City Hall to the Upper Bluffwalk. It is shown as a Public Park.
- > *Downtown Amphitheater* – this recommended location for a central amphitheater near Riverfront Park is shown as a Public Park. However, its success greatly depends on a collaborative private and public development effort.



*Urbavore's sidewalk seating is a good example of how adjacent businesses can increase public activity on sidewalks.*

- > *Expanded Downtown Central Business District (CBD)*– there are areas adjacent to Downtown that should be included in the CBD to ensure consistency in land development and use goals. The expanded CBD includes a portion of Main Street (to Florida Avenue) and a portion of Concord Turnpike. These properties should be designated Downtown, rather than Community Commercial and Employment 2.
- > *Foundry Park* – the James River is an outdoor and natural destination asset for Downtown. This Master Plan recommends active connection to the River via a connected river trail and park system. A new park discussed in this Master Plan will provide access to the river. Foundry Park on Concord Turnpike is shown as a Public Park.



Proposed Future Land Use Map



## LAND USE AND URBAN DESIGN

| SHORT-TERM STRATEGIES                                                                                                                                                                                                                           | MID-TERM STRATEGIES                                                                                                                                                                                                                                                    | LONG-TERM STRATEGIES |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <ul style="list-style-type: none"> <li>• <b>Land Use Map</b> - Update and revise the adopted Future Land Use Map to identify and plan for future public spaces and facilities. Specifically those recommended in this master plan.</li> </ul>   |                                                                                                                                                                                                                                                                        |                      |
| <ul style="list-style-type: none"> <li>• Change Section 19.1 (c) of the <b>Streets and Sidewalks Ordinance</b> to allow items placed within 4 feet of curb edges. Review all of Streets and Sidewalks for other necessary revisions.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Outdoor Dining and Retail</b> - Develop administrative policies and permit procedures for using suitable right-of-way spaces (i.e. wide sidewalks, street parking spaces, etc.) for outdoor vendors and dining.</li> </ul> |                      |
| <ul style="list-style-type: none"> <li>• Review Zoning Ordinance and create a comprehensive list of potential B-4 district changes to further Downtown style development.</li> </ul>                                                            | <ul style="list-style-type: none"> <li>• <b>First Floor Use</b> - Amend the zoning code to restrict first floor uses of Downtown buildings to commercial businesses and public spaces.</li> </ul>                                                                      |                      |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

## 3. HISTORIC AND ARCHITECTURAL RESOURCES

- 3.1 HISTORIC CHARACTER
- 3.2 ADAPTIVE REUSE OF VACANT HISTORIC BUILDINGS
- 3.3 PRESERVING LYNCHBURG'S ARCHITECTURAL CHARACTER
- 3.4 HISTORIC AND ARCHITECTURAL RESOURCES: GOALS
- 3.5 HISTORIC AND ARCHITECTURAL RESOURCES: RECOMMENDATIONS

PAGE LEFT INTENTIONALLY BLANK



The historic architecture of Lynchburg's Downtown embodies the City's rich history and gives it a unique sense of place. Lynchburg developed as a tobacco, manufacturing, and transportation center on the south bank of the James River from its founding in the late 18th century through the mid-20th century. With the James River, and later the railroads, providing a direct link to Richmond and the ports of the Chesapeake Bay, Lynchburg served as a primary transportation center for tobacco products as well as manufactured goods and supplies from the surrounding region. The present grid system of streets and lots dates to 1786. The town was incorporated in 1805 followed by the establishment in 1813 of the courthouse on Court Street to create the primary axis along Ninth Street. Since its founding, the Downtown area has continuously served as the governmental, financial, commercial, industrial, religious and cultural center of the growing city.



*View of Main Street in 1903*

*Source: Lynchburg Historic District Commercial Design Review Guidelines*

### 3.1 HISTORIC CHARACTER

The architecture of Downtown Lynchburg consists of relatively-intact blocks of buildings ranging in functions and styles from the 18th through the 20th centuries. These buildings, including a number of notable high-style examples by well-known architects, stand as a tangible reminder of the city's rich history and reflect its continued development and prosperity throughout this period. It is important to preserve these historic Downtown buildings as they reflect the people, places and events that, through time, have given the city its unique history and architectural character.

In order to preserve buildings, it is critical that they continue to serve a purpose. As governmental, commercial, industrial, religious and residential activities change over time, the use of buildings may need to change as well. The adaptive reuse of historic buildings, combined with the retention of their character-defining features and historic materials, is the best approach to preserving the architecture and history of the past while also providing for the future needs of a city and its citizens.



*Unique Architectural Character in Downtown Lynchburg*





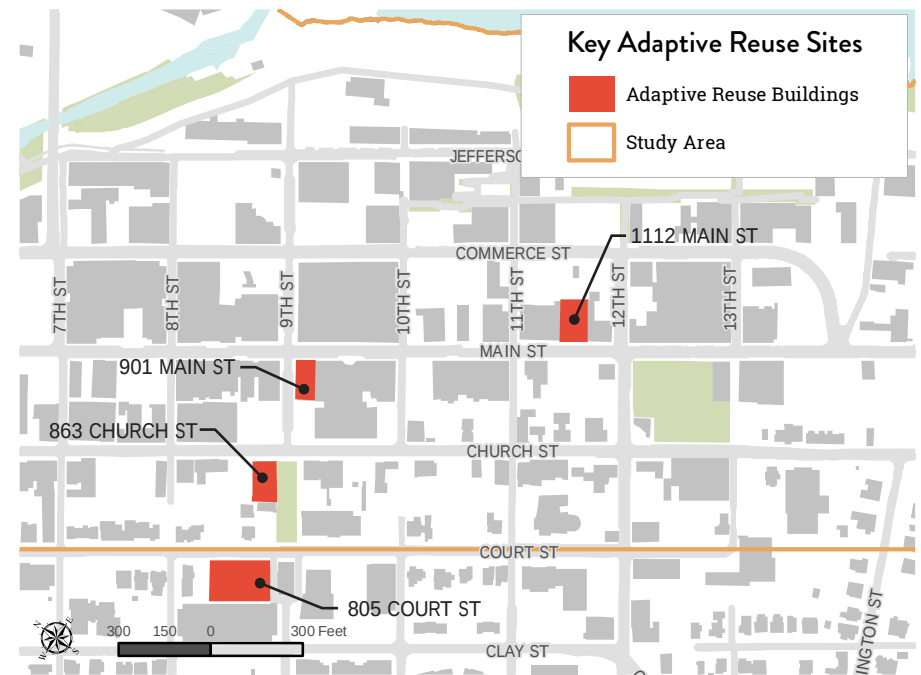


## 3.2 ADAPTIVE REUSE OF VACANT HISTORIC BUILDINGS

Vacant historic buildings that can no longer serve their original functions provide challenges as well as opportunities for Downtown Lynchburg. Four large buildings in particular, three of which were vacant at the time of this study, greatly contribute to the architectural character of Downtown with their significant historic functions, high-style designs and prominent locations. The adaptive reuse of these buildings is critical to preserving the City's rich architectural heritage and the vitality of Downtown. The historic configuration and size of these structures require a creative approach to identifying an appropriate new function. A strategic approach to their adaptive use also presents opportunities for targeted residential and commercial development geared towards emerging market segments in Downtown Lynchburg. These key market segments are identified in Chapter 9, Economic and Market Assessment and further described in the market analysis report section of the Appendix.

The concepts described in this section present potential strategies to put four of Downtown's architectural assets back to good use. Uses other than those proposed here may also be viable and should be encouraged as long as the buildings receive a sensitive rehabilitation and become actively used. The vacant properties listed below are contributing resources in the Courthouse Hill/ Downtown Historic District and eligible to utilize state and federal historic rehabilitation tax credits to assist in their redevelopment.

- > City Auditorium and Market Building – 1112 Main Street
- > First National Bank – 901 Main Street
- > Carter Glass Building – 863 Church Street
- > First Presbyterian Church – 805 Court Street





*Vacant and/or Underutilized Historic Buildings Present Challenges and Opportunities for Downtown Lynchburg*

## CITY AUDITORIUM AND MARKET, 1112 MAIN STREET

Located at 1112 Main Street, the 1910 City Auditorium and Market Building occupies the site of the original 1874 Market Building. This large, three-story, seven-bay public building housed the city market on the ground level and a 2,000-seat auditorium on the second level in addition to a bowling alley and offices. Designed by Frye and Chesterman in the Beaux-Arts tradition, the building features many elements from the Italian Palazzo Revival style, including an arcaded ground floor surmounted by a piano nobile, bands of arched windows, decorative insets of tile and marble, and a terra-cotta tiled roof. The building served its public function until 1932 when the new Armory and Market Building was constructed nearby.

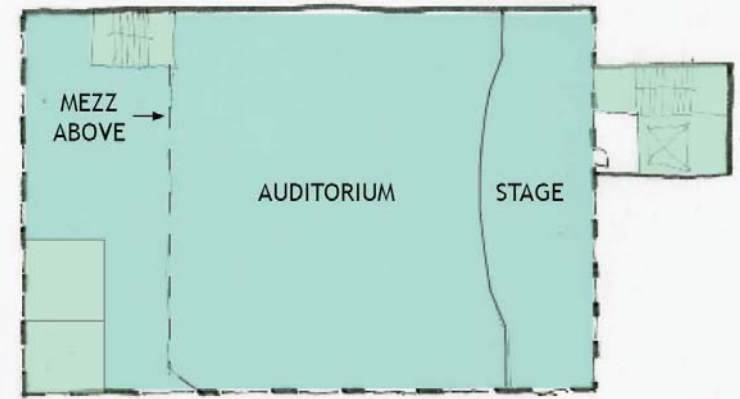
This building, which occupies a prime Downtown location, is already prepared for adaptive reuse. The interior demolition of non-historic additions to the building by a previous owner will expedite the construction of the interior build-out. The building is ready for the sensitive addition of walls, finishes, systems and components to revitalize the facility. As local colleges and universities have expressed a strong interest in having a Downtown presence, this plan recommends the adaptive reuse of the former City Auditorium and Market Building as a multi-institutional conference center. The upper level, which originally functioned as an auditorium with a mezzanine and rich architectural detailing, retains its large, open space to accommodate large meetings, conferences or lectures. The original market area on the ground level provides flexible space that can be subdivided into break out rooms, meeting rooms or classrooms. This proposed new use takes advantage of the building's original design as a public facility and rich architecture to create a strong Downtown presence for local colleges and universities.



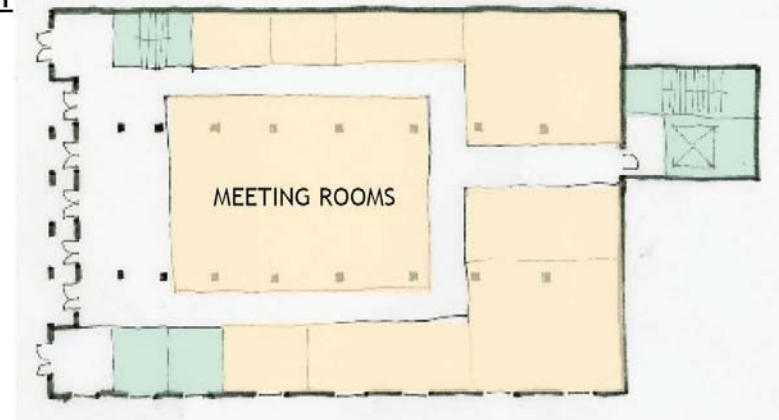


Exterior view of the City Auditorium and Market Building at 1112 Main Street

## LEVEL 2



## LEVEL 1



City Auditorium and Market Building Adaptive Reuse Concept for Multi-Institutional Conference Center

## FIRST NATIONAL BANK, 901 MAIN STREET

Constructed in 1916 at the prominent corner of Main and Ninth Streets, the First National Bank stands as a testament to the power of banking in the early 20th century. This Neoclassical building was designed by the British architect Alfred S. Bossom during his years of practice in New York. Bossom's design, with its two primary elevations and classical detailing, exemplifies the Beaux Arts tradition by taking advantage of its prominent corner location on axis with Monument Terrace. The original plan, focused on the grand banking lobby, failed to provide sufficient office space for the growing administrative needs of the banking industry. By 1948, the bank constructed a small office wing with the later addition of a second floor to the main banking lobby in the 1960s. By the 1970s, the bank moved to a new building and 901 Main Street ceased to function as a bank.

The Neoclassical design of the building's exterior remains intact and continues to have a strong presence at the center of Downtown. However, interior alterations currently obscure the grand banking lobby with its glazed ceiling dome and classical detailing. The removal of two non-historic office floors and modifications will restore the grand open space and architectural detailing that characterize this significant building. In this restored condition, the building will not only be one of the most notable buildings in Lynchburg, but in all of Virginia. While spaces of this size are sometimes difficult to adaptively reuse, other cities have renovated similar bank structures and used them in creative ways. Below are two recommended adaptive reuse functions:

- > **Cooperative Work Space** - The building can be a location for a membership-based, open workspace. Entrepreneurs, small business employees and telecommuters can rent a small space within a large shared workplace. Therefore, a new business can benefit from a prestigious address without much of a financial investment while also benefiting from the synergy created by other entrepreneurs.
- > **Culinary Palace** – This space could serve as a place for people to visit and experience various tiers of the culinary and beverage world. The building can host a variety of restaurants, chefs and bars at a range of types and styles.

Any combination of these uses is feasible. The main space is quite flexible as to what it can accommodate while retaining its architectural character.



901 Main Street - Exterior View

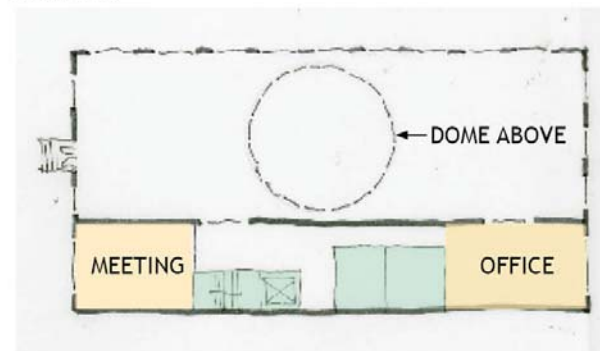


*First National Bank - Architectural Detail*

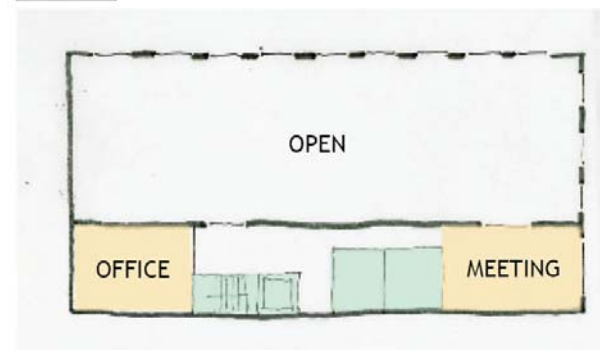


*First National Bank - sketch*

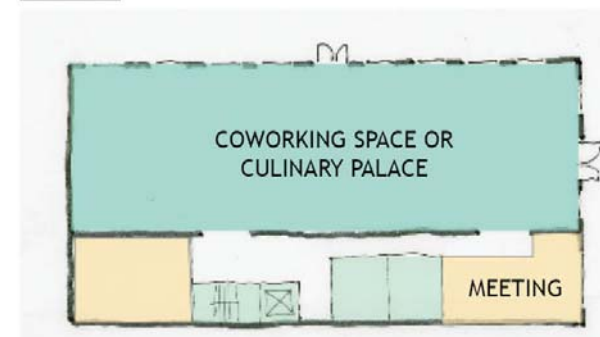
### LEVEL 3



### LEVEL 2



### LEVEL 1



*First National Bank - Proposed Concepts*



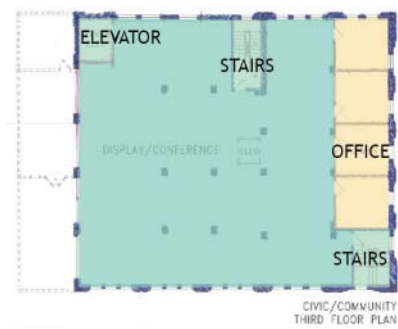
## CARTER GLASS BUILDING, 863 CHURCH STREET

The Carter Glass family, publishers of the *Lynchburg News and Daily Advance*, constructed the office building at 863 Church Street in 1931 to serve as headquarters for the two daily newspapers. Situated at the base of Monument Terrace and near the U.S. Post Office and City Hall, this building stands at the civic core of Downtown. Designed by Roanoke architect Robert M. Allen in the Art Deco style, the four-story building emphasizes its verticality through the use of incised and fluted pilasters and recessed window bays with connecting cast-iron grillwork. Projecting pilasters, capped by panels with a bas-relief allegorical figure holding the lamp of learning, frame the central entrance bay with its clock. After the newspaper moved out of the building in the 1970s, the building stood vacant for a number of years before the ground floor became a post office and the upper floors provided additional office space for the nearby municipal building.

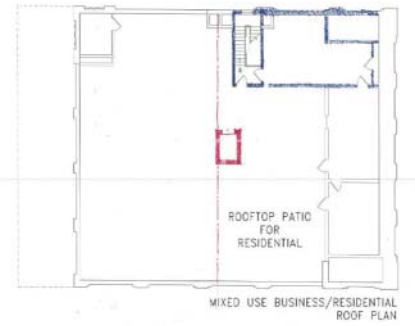
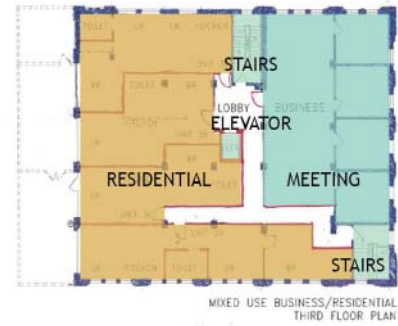
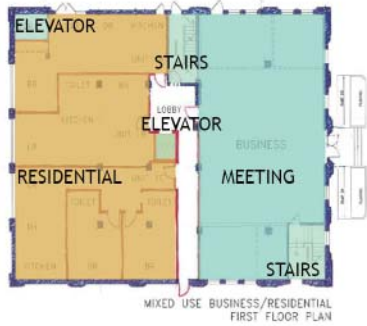
CJMW Architecture completed a feasibility study for this building in 2012 at the request of The City of Lynchburg. The study thoroughly reviews the building in terms of its historic significance and interior layout. The study proposes three options for adaptive reuse: civic/community, business/restaurant and business/residential. All three options restore the historic lobby to its original design. Also, this building could serve as the multi-college Conference Center. The information from the CJMW study with the primary functions highlighted is included.



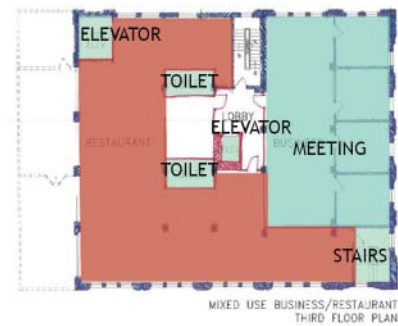
863 Church Street - Exterior View



Carter Glass Redevelopment Option 1 - Civic / Community Space



Carter Glass Redevelopment Option 2 - Mixed-Use: Business & Residential



Carter Glass Redevelopment Option 3 - Mixed-Use: Business & Restaurant  
Source: CJMW Feasibility Study

## FIRST PRESBYTERIAN CHURCH, 805 COURT STREET

Edward Frye's design for First Presbyterian Church is typical of his ecclesiastical work of the late 19th century and is considered one of his most impressive church designs. Completed in 1900 on Court Street at the top of Monument Terrace, the Romanesque-Revival style church features a richly-articulated corner tower that rises twice the height of the sanctuary to dominate the facade. A shorter, round, crenellated tower on the opposite corner frames the three-bay portico with Romanesque arches and the gable front with a large, central, rose window. After 1952, the First United Methodist Church occupied the building followed by Higher Heights Church. Most recently, the Lynchburg City Police Department used the building for a training facility. The structure itself appears to be very solid. While at times it can be difficult to find uses for a former church, ideas for adaptive reuse include a museum, an art gallery, a center for cultural and other non-profit organizations, a learning center or a conference center. Furthermore, other developers have creatively converted historic churches into restaurants or performance venues.



*First Presbyterian Church*



### 3.3 PRESERVING LYNCHBURG'S ARCHITECTURAL CHARACTER

With the Virginia Historic Rehabilitation Tax Credit worth 25% of eligible expenditures and the Federal Historic Rehabilitation Tax Credit worth 20%, the programs have been responsible for much of the revitalization of Downtown Lynchburg. To date, more than ninety buildings in Lynchburg have been rehabilitated using the state and federal historic tax credits. These rehabilitation projects, which require review by the Virginia Department of Historic Resources and the National Park Service for adherence to the *Secretary of the Interior's Standards for the Rehabilitation of Historic Buildings*, represent more than \$200 million in investment. Participation in the state and federal historic tax credit programs, however, is voluntary and building owners are not required to follow *the Secretary of the Interior's Standards* if they are not pursuing the tax credits. Furthermore, once a tax-credit project is completed and the five-year recapture period has expired, there is no long-term protection of the historic building as no further review of subsequent work is required.

No local protection currently exists to regulate the treatment of historic buildings in Downtown Lynchburg. While the City has adopted a local historic district ordinance as part of its Zoning Code that regulates exterior alterations and demolition (Lynchburg Code Section 35.1-44.1), Downtown is not included in the overlay zoning district. In comparison, other surrounding historic neighborhoods listed on the National Register of Historic Places are included in the local historic zoning district. In 2007, City Council adopted the Lynchburg Commercial Historic Districts Design Review Guidelines to provide non-binding, minimal standards for external work in commercial historic areas. Until recently, proposed work in the Downtown district was reviewed during the building permit process by a Design Review Board which applied the Guidelines to development work. However, due to the inability of enforcing the guidelines, City Council recently discontinued this advisory review process. As a result, there is now no review mechanism for exterior alterations, demolition or new construction within the Downtown unless a project pursues historic tax credits. In addition, once the credit oversight period ends after five years, additional improvements to a historic building have no architectural review.

During public engagement, City residents acknowledged that the historic architectural character of Lynchburg was a unique asset and they expressed a desire to preserve the historic buildings in Downtown. To ensure the long-term protection and preservation of the historic architectural character, there must be enforceable, regulatory review of the treatment of historic buildings, sites and structures. Thus, this plan recommends the Downtown area, including the Lower Basin National Register Historic District and the Courthouse Hill/Downtown National Register Historic District, be included in the local historic overlay zoning district. The application of this local historic district zone will require review and approval of future exterior alterations and demolition in the district by requiring a Certificate of Appropriateness issued by the City's Historic Preservation Commission in compliance with the district regulations and adopted design review guidelines.



*Examples of Historic Tax Credit Projects in Downtown Lynchburg*



### 3.4 HISTORIC AND ARCHITECTURAL RESOURCES: GOALS

- > Preserve and enhance the architectural and historic integrity of Downtown.
- > Increase awareness of Lynchburg's historic and architectural assets as a tool for economic development.
- > Encourage the adaptive reuse of vacant historic buildings.

### 3.5 HISTORIC AND ARCHITECTURAL RESOURCES: RECOMMENDATIONS

Citizens responding to the Downtown 2040 survey identified the architectural and historic character of Downtown Lynchburg as one of the most important character defining features of Downtown. Regulatory review of the treatment of historic buildings, sites and structures is essential for the long-term protection and preservation of the historic architectural character of Downtown Lynchburg. Protecting the historic architecture and Downtown environs are fundamental to the character and success of the Central Business District.

**Formal, local architectural review should be required for development located in the Downtown National Register Historic Districts** (Lower Basin Historic District and the Courthouse Hill / Downtown District, and Court House Hill Expansion District) as authorized by the Commonwealth of Virginia (Code of Virginia - Title 15.2, Chapter 22: Section 15.2-2306). The districts deserve binding, official review of alterations, new development, and demolitions using an established board, a regulated review process, a Certificate of Appropriateness, and adopted design review standards.



## HISTORIC AND ARCHITECTURAL RESOURCES

| SHORT-TERM STRATEGIES                                                                                                                                                                                                                                                                             | MID-TERM STRATEGIES                                                                                                                                                                                               | LONG-TERM STRATEGIES                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ADAPTIVE REUSE</b>                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                   |                                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>• <b>City Auditorium and Market Building</b><br/>Meet with representatives from local colleges and universities to confirm interest on a potential adaptive reuse project to transform the building into a Multi-Institution Conference Center.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>City Auditorium and Market Building</b><br/>Conduct a feasibility study for the adaptive reuse of the building into a Multi-Institution Conference Center.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>City Auditorium and Market Building</b><br/>Encourage and support renovations for the Multi-Institution Conference Center.</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>First National Bank-</b> Work with private developer to remove inappropriate, non-historic modifications to promote the buildings potential for reuse.</li> </ul>                                                                                     |                                                                                                                                                                                                                   |                                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>• <b>Carter Glass Building -</b> Actively market a rehabilitation plan for the designs prepared by CJMW to targeted use groups and/or developers.</li> </ul>                                                                                               |                                                                                                                                                                                                                   |                                                                                                                                                                                   |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

## HISTORIC AND ARCHITECTURAL RESOURCES

| SHORT-TERM STRATEGIES                                                                                                                                                                                                           | MID-TERM STRATEGIES                                                                                                                                                                                                                     | LONG-TERM STRATEGIES                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>HISTORIC PRESERVATION</b>                                                                                                                                                                                                    |                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                         |
| <ul style="list-style-type: none"> <li>Conduct public meeting or workshop with property owners and tenants in Downtown Commercial Districts to explore the designation of these districts as historic overlay zones.</li> </ul> | <ul style="list-style-type: none"> <li><b>Historic District</b> - Amend the zoning code to include Downtown as a designated Historic District.</li> </ul>                                                                               | <ul style="list-style-type: none"> <li><b>Corridor Overlay District</b> - Amend the zoning code to provide for a Corridor Overlay District that regulates the architectural aesthetic qualities of new development along gateway entrance corridors into Downtown. Apply district to major Downtown portals, such as portions of 12th Street, Concord Turnpike, Main Street, and 5th Street.</li> </ul> |
| <ul style="list-style-type: none"> <li>Publish case studies of exemplary revitalization projects in Downtown.</li> </ul>                                                                                                        | <ul style="list-style-type: none"> <li><b>Historic District Design Guidelines</b>- Update and amend the Downtown Commercial District Design Review Guidelines to provide more flexibility for infill buildings.</li> </ul>              | <ul style="list-style-type: none"> <li><b>Corridor Overlay District Design Guidelines</b> - Develop and adopt design guidelines for the Corridor Overlay District that define site development and architectural standards for building alterations, new buildings, and demolition.</li> </ul>                                                                                                          |
| <ul style="list-style-type: none"> <li>Encourage development of a network of trained craftsmen with traditional building materials and practices through a local certification and referral process.</li> </ul>                 | <ul style="list-style-type: none"> <li>Provide grants to local building tradesmen for training in the proper treatment of historic building materials.</li> </ul>                                                                       | <ul style="list-style-type: none"> <li>Work with local institutions to develop low-interest loans and other financial tools to encourage investment in Downtown.</li> </ul>                                                                                                                                                                                                                             |
| <ul style="list-style-type: none"> <li>Expand tours of renovated Downtown office and residential spaces.</li> </ul>                                                                                                             | <ul style="list-style-type: none"> <li>Encourage partnerships to develop a historic plaque program that identifies historic buildings, including information on the original design, construction date, owner, and function.</li> </ul> | <ul style="list-style-type: none"> <li>Develop a maintenance manual for historic buildings.</li> </ul>                                                                                                                                                                                                                                                                                                  |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

PAGE LEFT INTENTIONALLY BLANK



# 4. PUBLIC SPACE AND RECREATION

- 4.1 PARKS AND GATHERING AREAS
- 4.2 TRAILS AND PEDESTRIAN CONNECTIONS
- 4.3 STREETS AS PUBLIC SPACE
- 4.4 PUBLIC SPACE AND RECREATION: GOALS
- 4.5 PUBLIC SPACE AND RECREATION: RECOMMENDATIONS

PAGE LEFT INTENTIONALLY BLANK



Riverfront Park System

Until the 2000 Downtown and Riverfront Plan, parks and recreation facilities in Lynchburg tended to be concentrated in residential neighborhoods, away from the business-oriented Downtown. Riverfront Park, the largest park in Lynchburg's central business district, brought a natural greenspace into the foreground of the City's landscape.

Feedback from multiple community outreach events suggest the desire to continue momentum from Riverfront Park to develop better connections to new and existing parks and other destinations. Results from public surveys also highlighted important factors to consider in this plan, such as the city's unique topographical features; scenic quality of the James River, and the outdoor opportunities available in and near Downtown.

Public investment in high quality public spaces should continue Downtown and focus on:

- > Building high quality major gathering areas as they are significant drivers of growth Downtown;
- > Using trails and pathways to build connections within and out of Downtown; and
- > Dispersing smaller scale parks and park-like amenities throughout the area, creating a complete network of public space, and an exciting, livable Downtown.



## 4.1 PARKS AND GATHERING AREAS

As progress continues on improvements introduced in the *2000 Downtown and Riverfront Plan*, and Downtown residential life flourishes, additional specific and purposeful open spaces are needed. The Lower Bluffwalk, for example, is a series of walkways, overlooks, and staircases that connect Jefferson Street up to Commerce Street and provide gathering spaces with views to the James River.

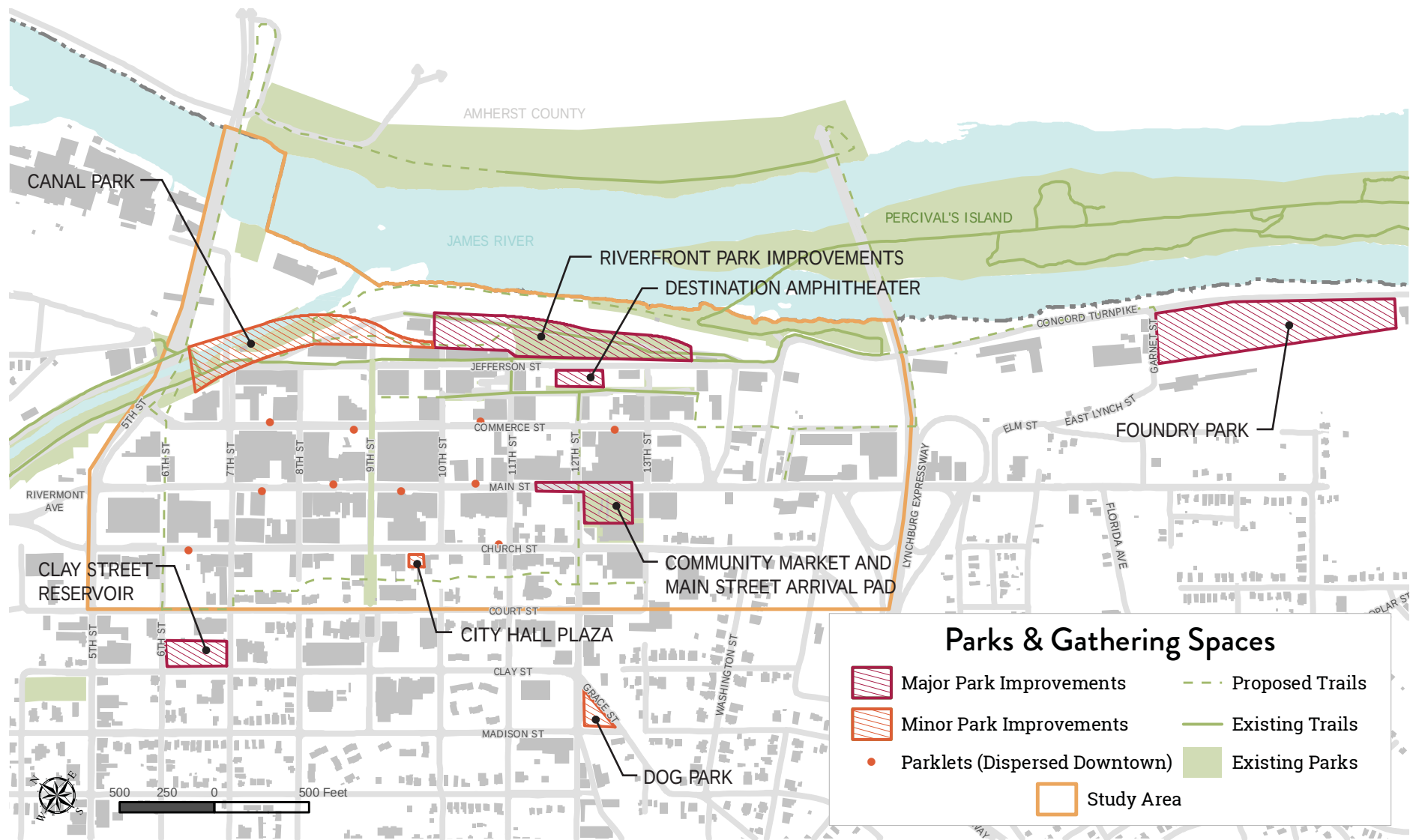


*Lower Bluffwalk*

Several vacant and underutilized lots have great potential to become active public spaces as Downtown continues to prosper. This section proposes a number of major initiatives to create key public spaces that will drive growth as well as minor park improvements aimed at dispersing green space throughout Downtown.



*Vacant Lot on Jefferson Street*



Parks and Gathering Areas Proposed Projects

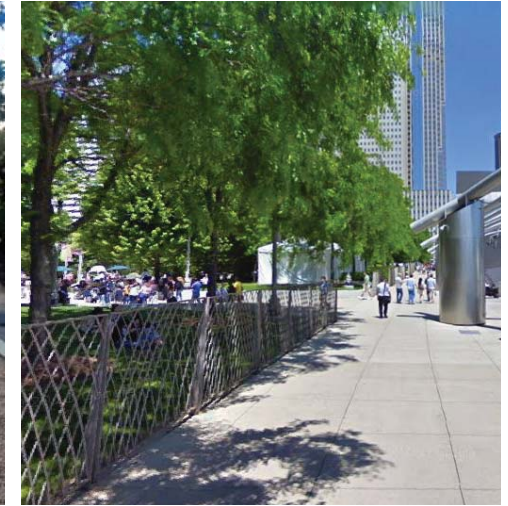
## RIVERFRONT PARK

The creation of Riverfront Park was one of the key components of the *Downtown and Riverfront Master Plan 2000*. The twenty-acre linear park presently serves as the hub for green space and recreational activities in the Downtown area. This key outdoor civic site attracts new development and serves a multitude of recreational, cultural, and environmental needs. However, the benefits of this popular destination have come with unforeseen challenges, as areas of the park show signs of soil compaction and worn natural turf. In addition, citizens have raised concerns regarding conflicts with scheduling park activities and requested additional amenities in the park like restrooms and play areas. Creating program-specific spaces will allow the park to recover from overuse and serve its intended “open green space” purpose. To address these issues and enhance the park further are the following recommendations:

- > Partner to build the Destination Amphitheater discussed later this section to provide a designated, program-specific space for outdoor concerts. The preferred location is on the southwest side of Jefferson Street, where Twelfth Street meets the Lower Bluffwalk. This option provides a key opportunity to develop the adjacent parcels in conjunction with the amphitheater. An alternative would be to include the amphitheater in the park itself as shown on this plan.
- > Install a decorative fence and gate system into the park to designate event areas but open up lawns between events.
- > Build public restrooms into the park.
- > Include a playground for both Downtown residents with children and visitors.



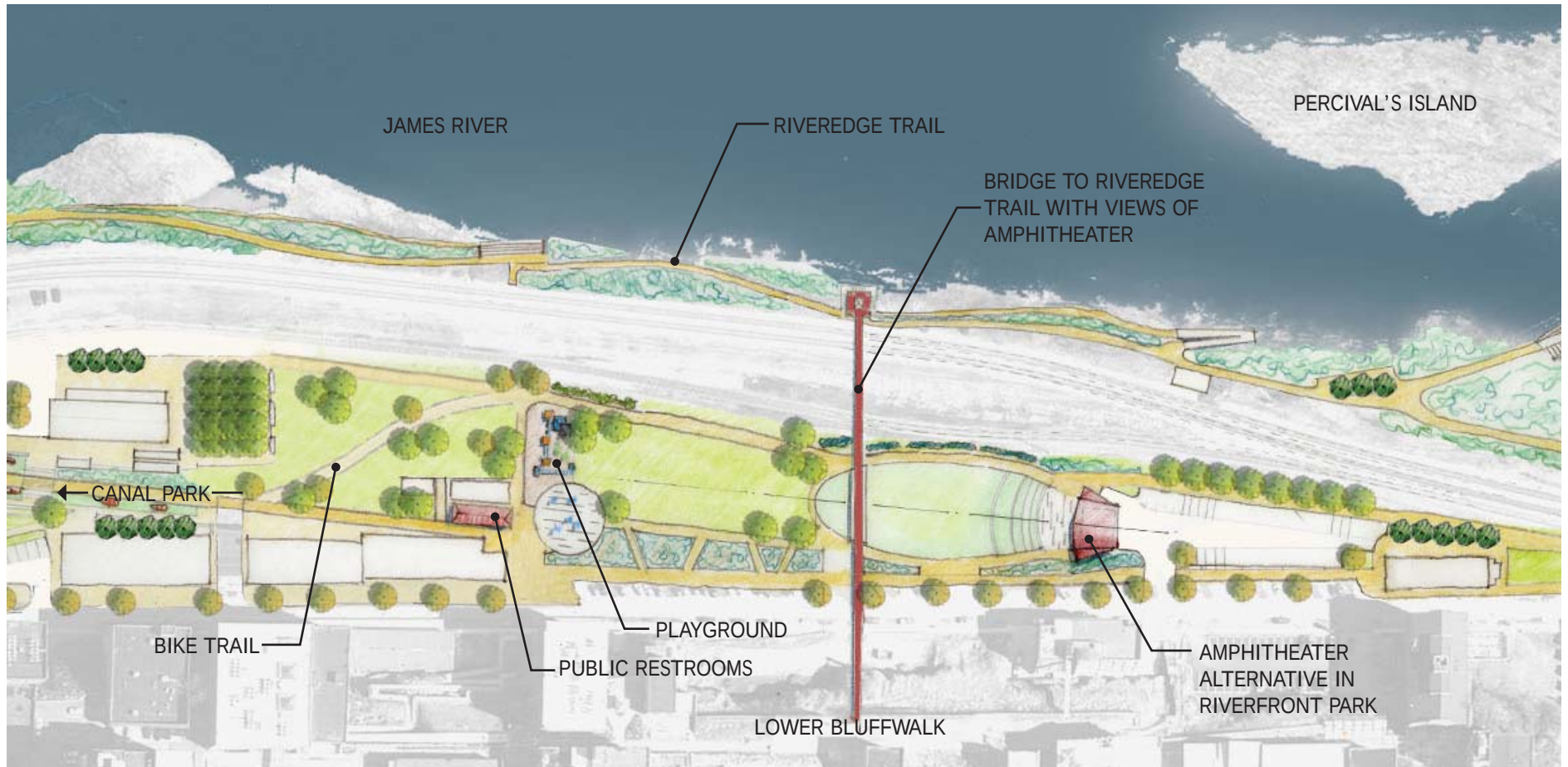
*Current Event Fencing in Riverfront Park*



*Decorative fencing in Millenial Park bandstand in Chicago.*

- > Include additional shade canopy and park space to the southeast of the Depot Grille once an alternative for concerts is found and new parking accommodations established.
- > Establish Foundry Park (see later this chapter) down river for additional event space.
- > Continue the park westward with Canal Park (discussed later this section) and use the parks to connect the Percival's Island Trail with the Blackwater Creek and Point of Honor Trails, removing bicycle traffic from the Jefferson Street sidewalks.
- > Continue to pursue the Riveredge Trail proposed by the 2000 Plan to gain visual (or physical) access to the James River.





*Riverfront Park Proposed Improvements*



*Riverfront Park  
Active and  
Passive Uses*



## DESTINATION AMPHITHEATER

During the summer of 2017, the Academy Center of the Arts sponsored a summer concert series at Riverfront Park. The five concerts were well-attended, with George Clinton and Parliament drawing thousands of spectators. The response was so overwhelming that police were forced to turn away latecomers. The popularity of these series reaffirms the desire for live music venues in Downtown. However, many factors make it exceedingly difficult for Riverfront Park to host top-tier artists and provide an exceptional concert experience.

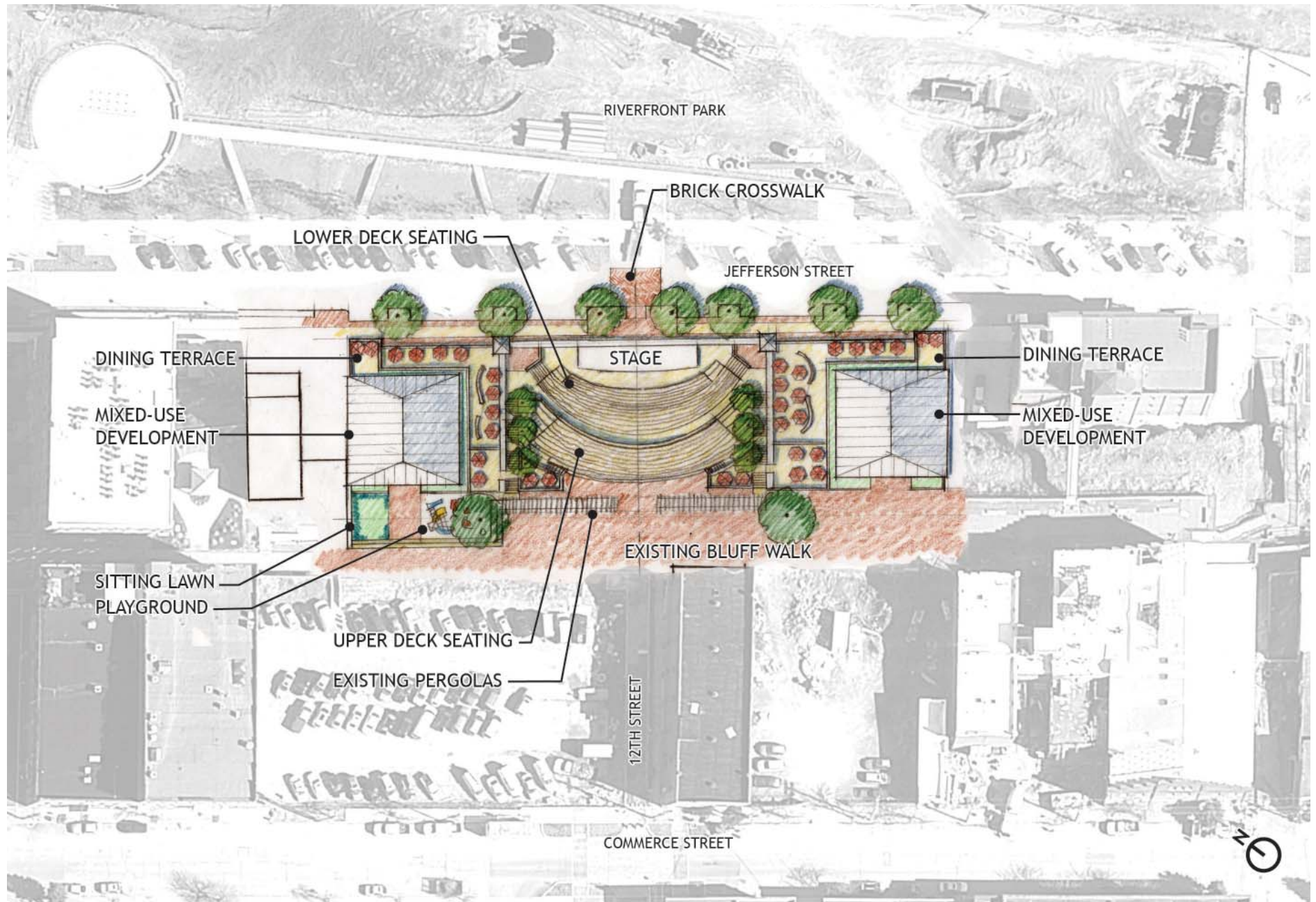
The Destination Amphitheater is a priority improvement project for Downtown. This plan proposes that the amphitheater be implemented as part of a public/private partnership to promote Downtown Lynchburg, as well as nearby businesses. This initiative will allow Downtown restaurants and retailers to benefit from the concert traffic. By partnering with surrounding restaurants and nightclubs, premium seating can be incorporated into the amphitheater. The project could also induce significant private development around the site, such as residential or office units with balconies for tenants to benefit from the concert venue.

This plan proposes the site for the terraced Destination Amphitheater to be along the Bluffwalk, at the bottom of 12th Street. The proposed location takes advantage of the steep slopes for theater rake and balconies to give audience members views of the river and scenery. The current design provides seating for 4,500 – 5,000 people as this is a reasonable threshold for high-quality artists to play at an outdoor venue. The construction of a playground nearby would allow parents to supervise their children while enjoying the shows. Public amenities can be integrated into the design including a street-to-street elevator, and public restrooms. Back-of-house facilities, such as a green room and truck/ bus docks, can be located in adjacent parking structures.

The illustration below depicts a mix-use facility in a lot currently vacant between Jefferson Street and the Bluffwalk. However, this concept can be adapted to other sites in the Downtown or within Riverfront Park.



*Proposed Destination Amphitheater and Mixed-Use Development Concept*



*Destination Amphitheater - Proposed Concept*



### DOWNTOWN RIVEREDGE TRAIL

Previous Downtown plans identify the narrow sliver of riverbank between the CSX tracks and the James River (outbound of Riverfront Park) as an opportunity to develop a connection between the Riverwalk Trail on Percival's Island and the Blackwater Creek Trail. See Proposed Trail Systems Map on page 87.

The 2006 *Riverfront Implementation Plan* proposed an elevated connection over the train tracks aligned with 13th Street. This alignment takes advantage of fewer railroad tracks and land available where the bridge reaches the river. In addition, this location is closer to the existing Riverwalk Trail, and creates an opportunity to incorporate the vacant switching tower as part of the design. It also serves as a gateway to the proposed 13th Street Hill Climb project.

Previous plans recommended connecting a river trail to 9th Street where spectacular views to the James River are available; however, the construction of a pedestrian crossing over the train tracks can be avoided at this location by extending the trail upstream to the existing boat launch steps at the proposed Canal Park.



Riverwalk Trail proposed in Downtown & Riverfront Master Plan 2000



Schuylkill Banks Boardwalk, Philadelphia. Photo Source: [http://www.philly.com/philly/home/20140928\\_Changing\\_Skyline\\_A\\_Stroll\\_on\\_the\\_Schuylkill.html](http://www.philly.com/philly/home/20140928_Changing_Skyline_A_Stroll_on_the_Schuylkill.html)



## CANAL PARK

Downtown Lynchburg was once an active industrial center and the riverfront was the center of transportation for the region. The Kanawha Canal ran directly through what is now Riverfront Park in 1840, but it quickly became obsolete in the age of the railroad and its towpaths were used to lay additional track in the later part of that century. Some of the few remnants of the canal and aqueduct as it ran through Downtown can still be seen at the bottom of 9<sup>th</sup> Street and should be repurposed as a continuation of Riverfront Park.



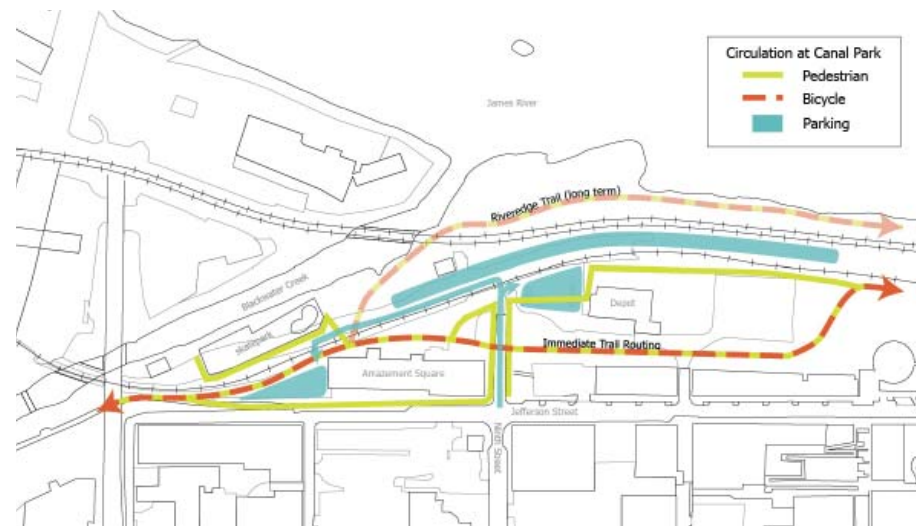
*Canal Park - Existing Conditions, 9th Street Bridge*



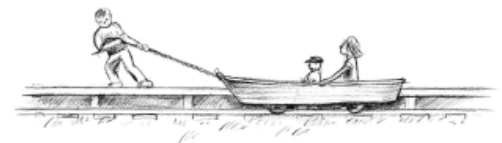
*Lynchburg's Industrial Riverfront with Kanawa Canal*

Both the previous plans from 2000 and 2006 called for the canal to be recreated as a water feature in the new park, however the installation of a major sewer line through the path of the canal in 2016 precludes these previous plans. A study in 2014 proposed multiple new concepts for the canal, and this plan recommends implementing the proposal that creates a direct connection between the Blackwater Creek Bike Trail and the Percival's Island Trail. As the Riveredge Trail will take some time to fund and complete, this is an important interim solution that will decrease conflicts between bikers, vehicles and pedestrians on Jefferson and 9th Street, while also creating an exciting, unique section of trail that runs through the heart of Downtown.

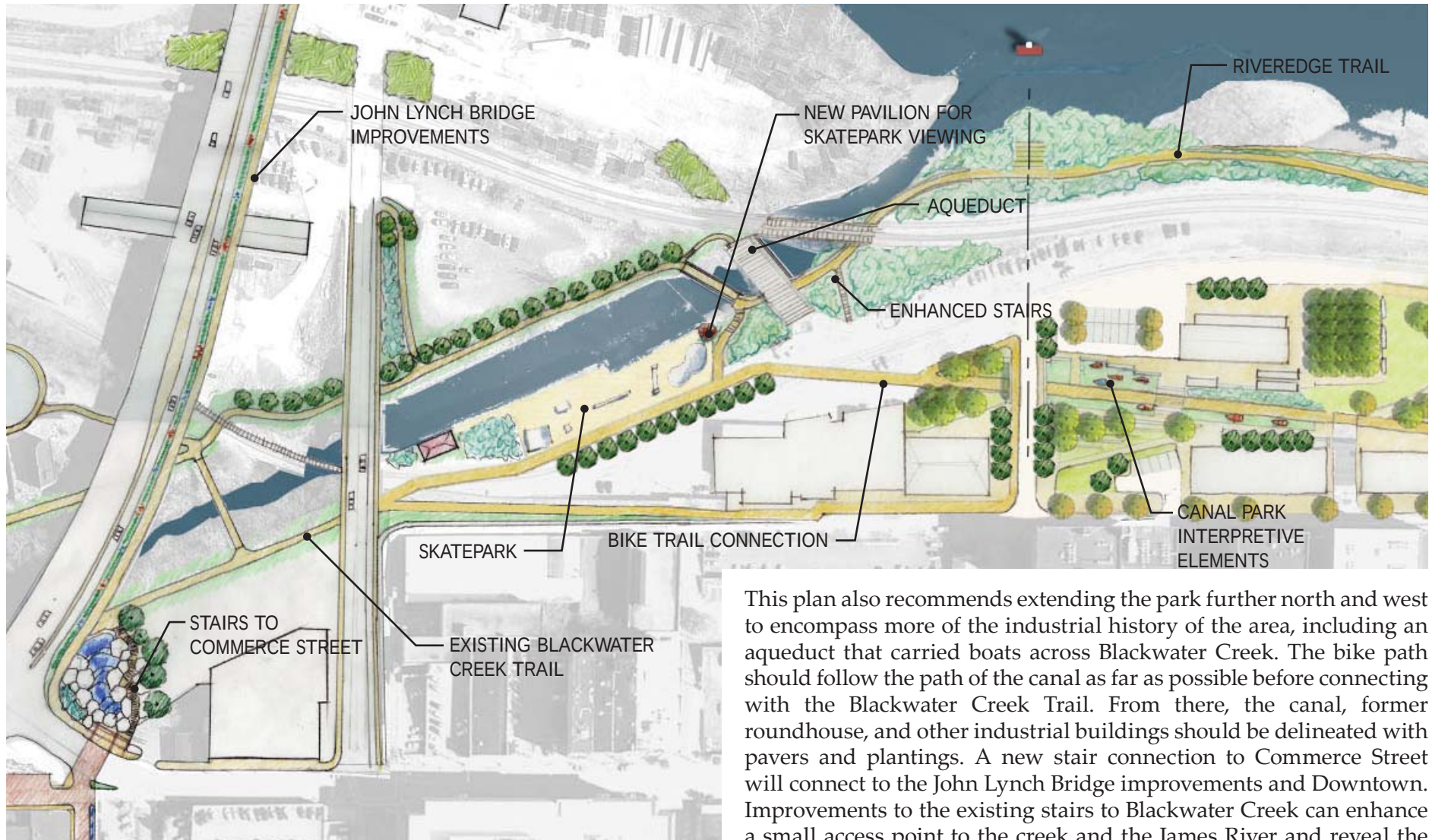
Additional concepts from the 2014 plan included park amenities to 1) interpret the industrial history of this narrow sliver of land, 2) activate this somewhat hidden space, and 3) provide additional outdoor play area for visitors of Amazement Square, the children's museum directly adjacent to the park.



Canal Park Section and sketches of play features (Kennon Williams Landscape Studio 2014)







This plan also recommends extending the park further north and west to encompass more of the industrial history of the area, including an aqueduct that carried boats across Blackwater Creek. The bike path should follow the path of the canal as far as possible before connecting with the Blackwater Creek Trail. From there, the canal, former roundhouse, and other industrial buildings should be delineated with pavers and plantings. A new stair connection to Commerce Street will connect to the John Lynch Bridge improvements and Downtown. Improvements to the existing stairs to Blackwater Creek can enhance a small access point to the creek and the James River and reveal the remnants of the aqueduct.

Rotary Centennial Riverfront Skatepark, constructed in the 2000s, helps activate what will be Canal Park today but should be enhanced to be a centerpiece. Skateparks are not just for skaters, but for spectators too, and seating to allow the public enjoy the space and watch the skaters.



## FOUNDRY PARK

Foundry Park is proposed on a currently vacant, flat seven-acre post-industrial site at the former location of the Internet Foundry. Federal and State Brownfield Programs may be used to assist with any assessment, planning, or redevelopment work at the site.

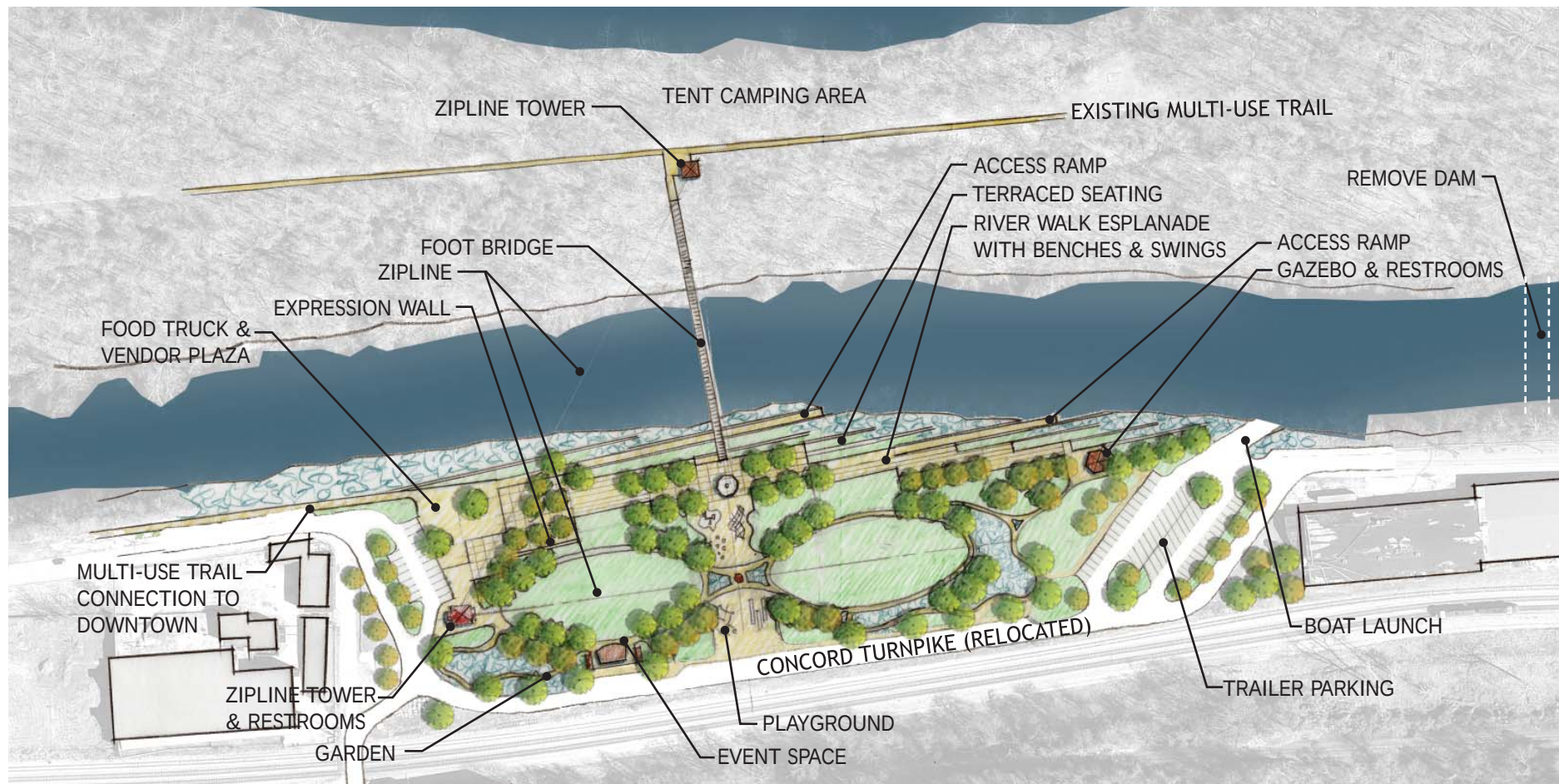
Located downstream from the Carter Glass Bridge, the proposed park provides vehicular access from Concord Turnpike with parking areas on both ends. Foundry Park complements Riverfront Park by providing a significant stretch of direct river access without the need to cross the railroad tracks. With the removal of an obsolete dam at the down river end of the park, the site can serve as a launching point for urban boaters and tubers, allowing adventurers to depart as well as arrive at Foundry Park. This extends the launch point system on the James River which includes Canal Park and Amherst Riveredge Park. With larger open spaces similar to Riverfront Park, the Parks

and Recreation Department can program appealing spaces to boaters, fishermen, and families with children. An in-stream kayak and canoe course could even be developed.

Proposed park amenities include: a river-side esplanade with terraced seating and sloped-ramps to access the James River, boat trailer parking near the boat launch area, multi-use open lawns, a concession/storage area and restroom facilities. The park is designed as a child-friendly space with a large playground and interactive fountain. Additional lawn areas surrounded by shading gardens provide an opportunity to host small events. A proposed system of utility connection bollards allows access for food trucks during events. An interactive wall separating the food truck area and lawn provides the public with a creative way to interact with the site. Lastly, a zip line and swing bridge crossing the river to Percival's Island offers an adventure experience for both adults and children.



*Foundry Park Proposed Location at the Former Internet Foundry*



Foundry Park Concept



## CLAY STREET RESERVOIR PARK

Redeveloping the previous Clay Street Reservoir into a park as recommended by the Fifth Street Master Plan creates an opportunity to draw development up the hill. The site location provides an opportunity to display dramatic panoramas, while its history and architectural detailing draw special interest to this facility. By removing the recent cap, this forgotten space can be restored in a sympathetic manner to its early 20th Century form.

The proposed plan for Clay Street Reservoir Park generally maintains the historic walls and railings in place while allowing access into the park. The new design features a grassy section to the north and a standing pool to the south. The previous bridge and gazebo are replaced by a new sidewalk and a gazebo. The water bearer statue, currently located at the Lower Bluffwalk is proposed to be located back to the reservoir at its original location.

A small interactive fountain is designed to run from the park down to the proposed 6th Street Climb project, enlivening all the fountains in the sequence. The water would shut off after approximately a minute, requiring more interaction. On the south side, standing water, a few inches deep, makes for a highly interactive space ideal for photographers. During the winter time, the reservoir can be turned into an ice rink. Partnerships with local businesses and media channels could help fund operations, such as temporary rental booths and online ticketing system, in coordination with the Downtown Lynchburg Association and the Department of Parks and Recreation.



*Illustration of Historic Clay Street Reservoir*

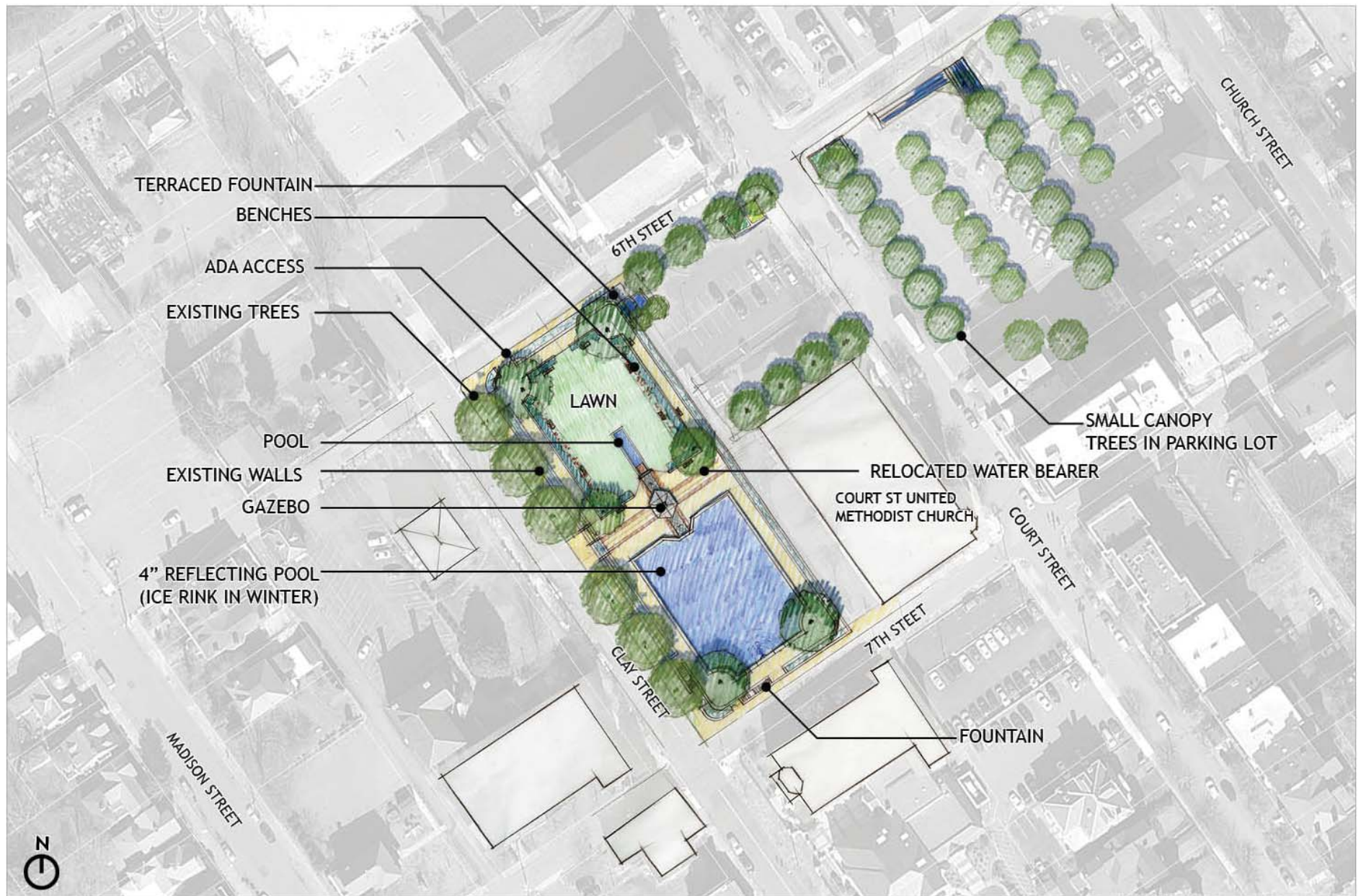


*Clay Street Reservoir Existing Conditions*



*Rendering from Fifth Street  
Master Plan*





Clay Street Reservoir Park Proposed Concept

## DOWNTOWN DOG PARK

As the Downtown pet-friendly population continues to grow, a dog park in the heart of the Central Business District can provide an additional outdoor amenity similar to the dog park at the Blackwater Creek Athletic Area (BCAA). A triangular 0.75-acre space at the intersection of 12th Street and Grace Street is proposed for a pilot Dog Park project to serve pets and their owners Downtown and adjacent neighborhoods. The park should provide a double fence to protect dogs from traffic and separate spaces for small and large dogs. Additional design amenities could include a sand trap digging area, wash stations, biodegradable waste bag dispensers and a large porch with swings for people to enjoy. A dog biscuit dispenser could also be installed to help fund park maintenance.



SOURCE: Lynchburg Dog Park. <https://www.facebook.com/LynchburgDogPark/>

## BEST PRACTICES

- > One acre or more of land surrounded by a four- to six-foot high chain-link fence. Preferably, the fence should be equipped with a double-gated entry to keep dogs from escaping and to facilitate wheelchair access.
- > Cleaning supplies, including covered garbage cans, waste bags, and pooper-scooper stations.
- > Shade and water for both dogs and owners, along with benches and tables.
- > A safe, accessible location with adequate drainage and a grassy area that is mowed routinely.
- > If space allows, it is preferable to provide separate areas for small and large dogs. This will enable large dog owners to allow their pets to run more freely, while protecting smaller dogs who may not be suited to the enthusiastic play of larger breeds.
- > Signs that specify park hours and rules.
- > Parking close to the site

### Examples of successful projects:

Monmouth County, New Jersey  
Sarasota County, Florida  
Sausalito, California  
Tallahassee, Florida

SOURCE: American Kennel Club. <http://images.akc.org/pdf/GLEG01>

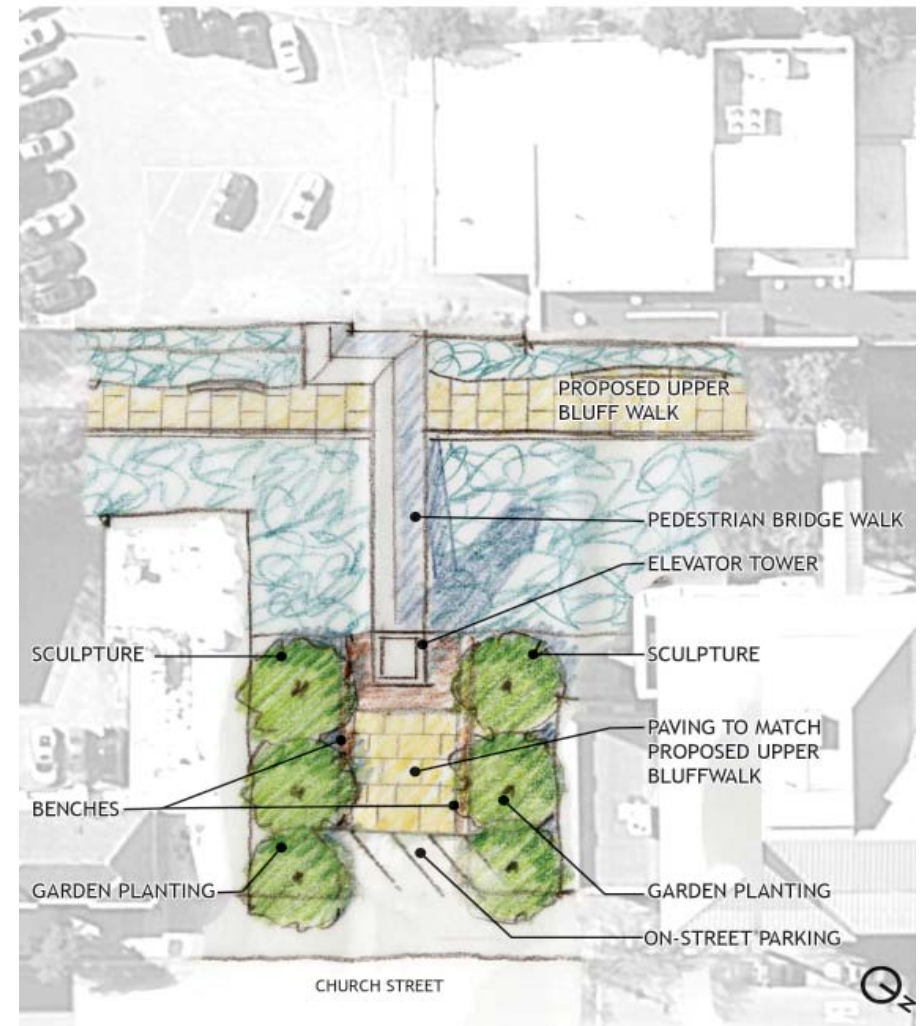


## CITY HALL PLAZA

Located across Church Street from City Hall and at the base of the Monument Terrace Elevator, this small, restricted parking lot should be repurposed as an active public space. With space for less than fifteen vehicles, it is the perfect opportunity to imbue more public space on the upper part of Downtown. Similar to the Main Street Arrival Pad, this plaza could provide a gathering area for residents and workers in the Downtown area, as well as a venue for small scale events. The proposed design includes pavers and landscaping sensitive to the elevator location and compatible with the proposed Upper Bluffwalk described later in this section. The illustrated concept also recommends potential locations for public art and plantings, as well as diagonal on-street parking.



Existing Parking Lot at City Hall Plaza



City Hall Plaza - Proposed Concept



## COMMUNITY MARKET IMPROVEMENTS

Initial improvements to the Community Market have been completed per recommendations from the 2006 *Community Market Redevelopment Plan – Phase 1* (Market Ventures Inc.) and the 2016 *Community Market Concept Design Report* (Wendel). Additional recommendations remain in planning and design stages that have yet to be finalized; including:

- > Provide a centralized seating area inside the Market Building.
- > Improve flow and maximize vendor area usage inside the Market Building by eliminating existing rows (currently located parallel to Main Street). Implement large standalone kiosks that are self-sufficient and border the perimeter of a centralized seating area.
- > Create a retail-friendly façade by extending the lower level forward to align with the second story.
- > Create a central entry to maximize space, visual appeal, and radial retail experience.
- > Update Market Plaza to meet recreation space needs.
- > Increase number and function of farmer / exterior stall space.
- > Create year-round vending space to maximize user experience and return on investment.
- > Create multi-use space to include common areas, small amphitheater, and water feature.
- > Create more user-friendly area to better serve patrons, improve circulation, and increase street presence.



Community Market Master Plan

Source: Lynchburg Community Market Conceptual Design Report (Wendel, 2016)

These interior and exterior improvements are critical to the efficient operation of Community Market activities as well as the preservation of one of Lynchburg's iconic community assets. Their effective implementation will be key in improving pedestrian activity along Main Street as well as fostering economic vitality in Downtown.





*Illustration of Community Market Improvements and Extended Street / Pedestrian Treatments on Main Street*



## MAIN STREET ARRIVAL PAD

To complement future upgrades to the Community Market Plaza, this plan recommends extending a unique paver pattern from the plaza across and along Main Street. These improvements would start at the intersection of 13th Street and extend past the previous City Auditorium and Market Building, where a multi-college Conference Center is proposed (See Chapter 3).

The Main Street Arrival Pad is intended to serve as a departure point and drop-off area for the multi-college express bus, as well as calm vehicular traffic in one of the busiest pedestrian areas Downtown. On Market Saturdays, pedestrians often “play Frogger” to cross Main Street and rarely walk out of their way to use the crosswalk at 12<sup>th</sup> Street. Extending the pavers into the street gives priority to pedestrians over vehicles, gives the Market significant street presence, and creates an iconic area of Downtown.

As evidenced by Westlake Plaza in Seattle, the Main Street Arrival Pad can help reduce traffic speeds and create a more inviting urban environment, while accommodating all modes of travel. By introducing site furnishings and providing outdoor Wi-Fi, the plaza could also become a hub and outdoor hangout for college students and residents all days of the week. Based on public input during the development of this plan, such spaces are lacking and much desired in the Downtown area.

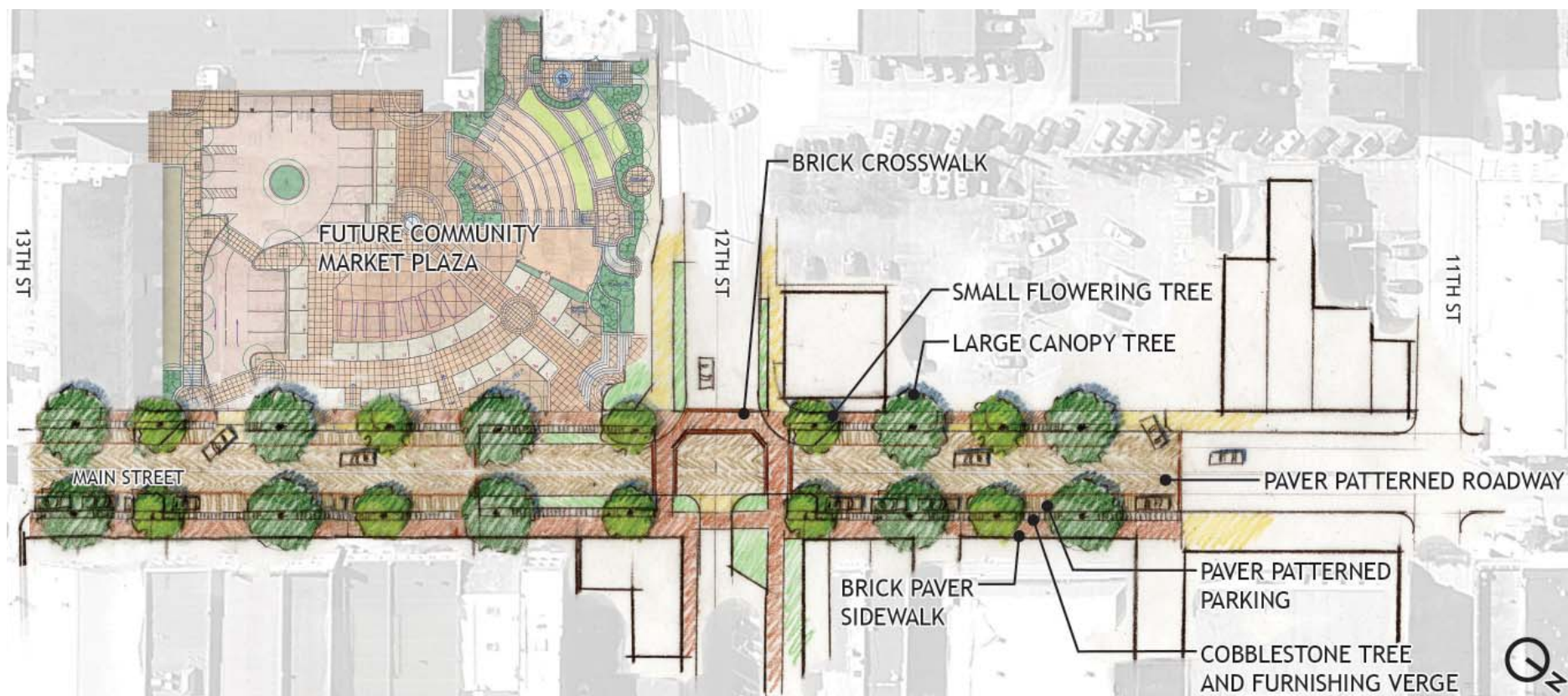


*Westlake Plaza, Seattle*



*Paving Pattern Extending into Street from Westlake Plaza in Seattle*





*Main Street Arrival Pad as an Extension of the Community Market Plaza*

## 4.2 TRAILS AND PEDESTRIAN CONNECTIONS

A coherent, accessible, and stimulating system of pathways connecting Downtown destinations creates an inviting atmosphere for residents, workers, business owners, and visitors. The ongoing Downtown Utility and Streetscape Project, implemented over the next several decades, presents an opportunity to implement a cohesive system of streets and sidewalks with a consistent streetscape palette. The intent of the following initiatives is to improve connectivity between destinations and surrounding residential neighborhoods by extending existing pathways, building new ones, and applying special features to key routes. Through the implementation of urban design elements and interactive features, the pathways themselves become destinations. These improvements promise to draw pedestrians to less-visited sections of Downtown, stimulating business activity, driving residential development, and extending visitor stays.

The map on the next page creates two key pedestrian loops. The first is within Downtown, drawing pedestrians up Downtown's hill via 6th Street or 12th Street and the Bluffwalk. The second is larger, and connects Downtown Lynchburg with Amherst County via improvements to the John Lynch Bridge and a separate pedestrian bridge attached to the Carter Glass Bridge. Connecting to Riveredge Park in Amherst County provides river access and dramatic views back to the City. This is an especially valuable recreational amenity to offer Downtown.

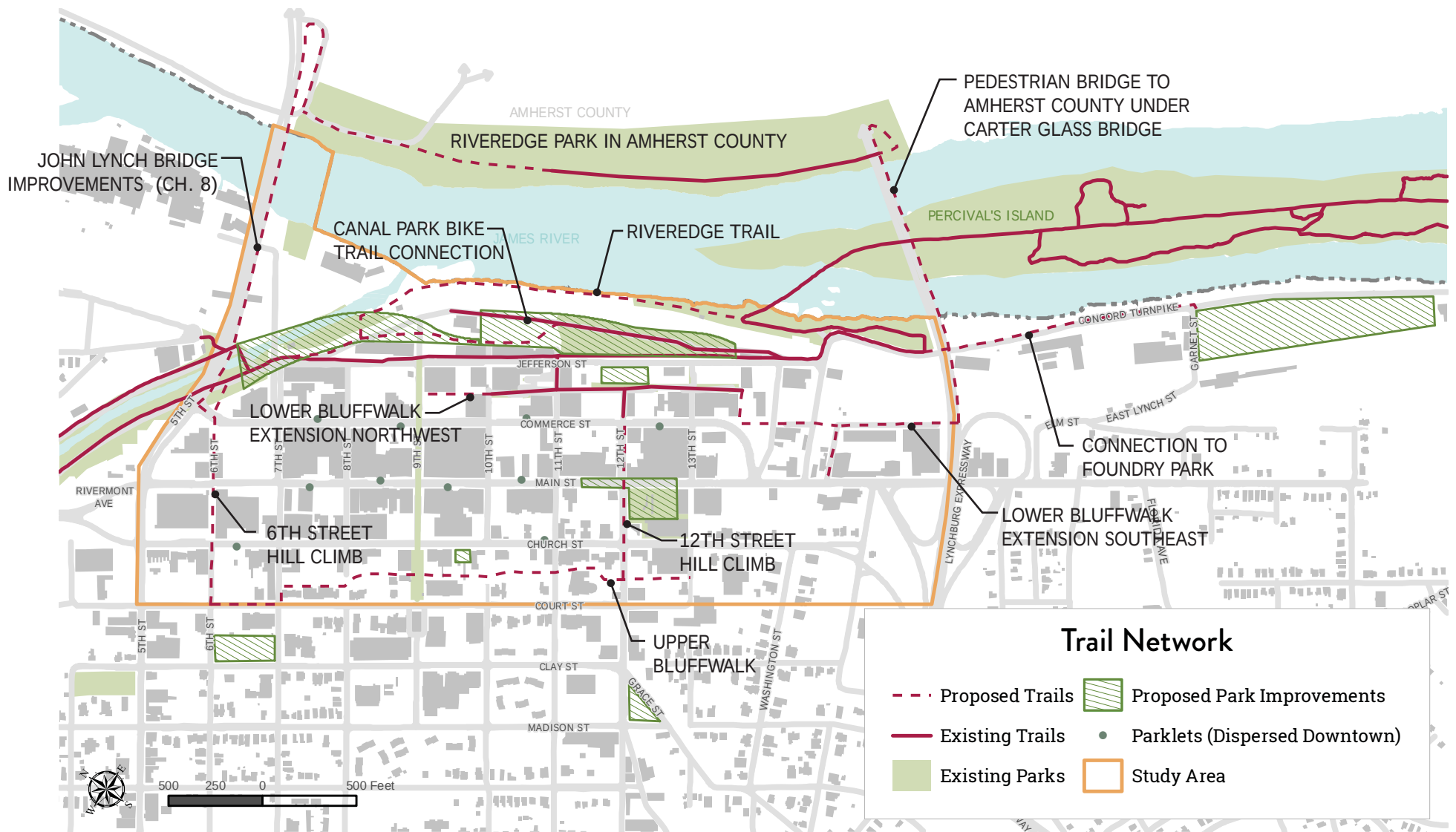


*Existing Trail in Downtown*



*Harry Flood Byrd Memorial Bridge where the Blue Ridge Parkway crosses the James River holds a pedestrian bridge under a vehicular bridge, similar to what could be implemented under the Carter Glass Bridge.*







## LOWER BLUFFWALK IMPROVEMENTS AND EXTENSIONS

The *Lynchburg Downtown & Riverfront Master Plan 2000* envisioned the Lower Bluffwalk to celebrate the City's unique topography through a series of stairs, walkways, trails, and overlooks that connect the riverfront to other areas of Downtown. The City has completed a portion of the Lower Bluffwalk that runs between the Craddock Terry Hotel and 10th Street; this portion creates an exciting new pedestrian atmosphere along the rear alleys of historic brick warehouses built into the bluff. Building on the current success of the Lower Bluffwalk, this plan recommends improving sections of the existing path and extending it on each end.

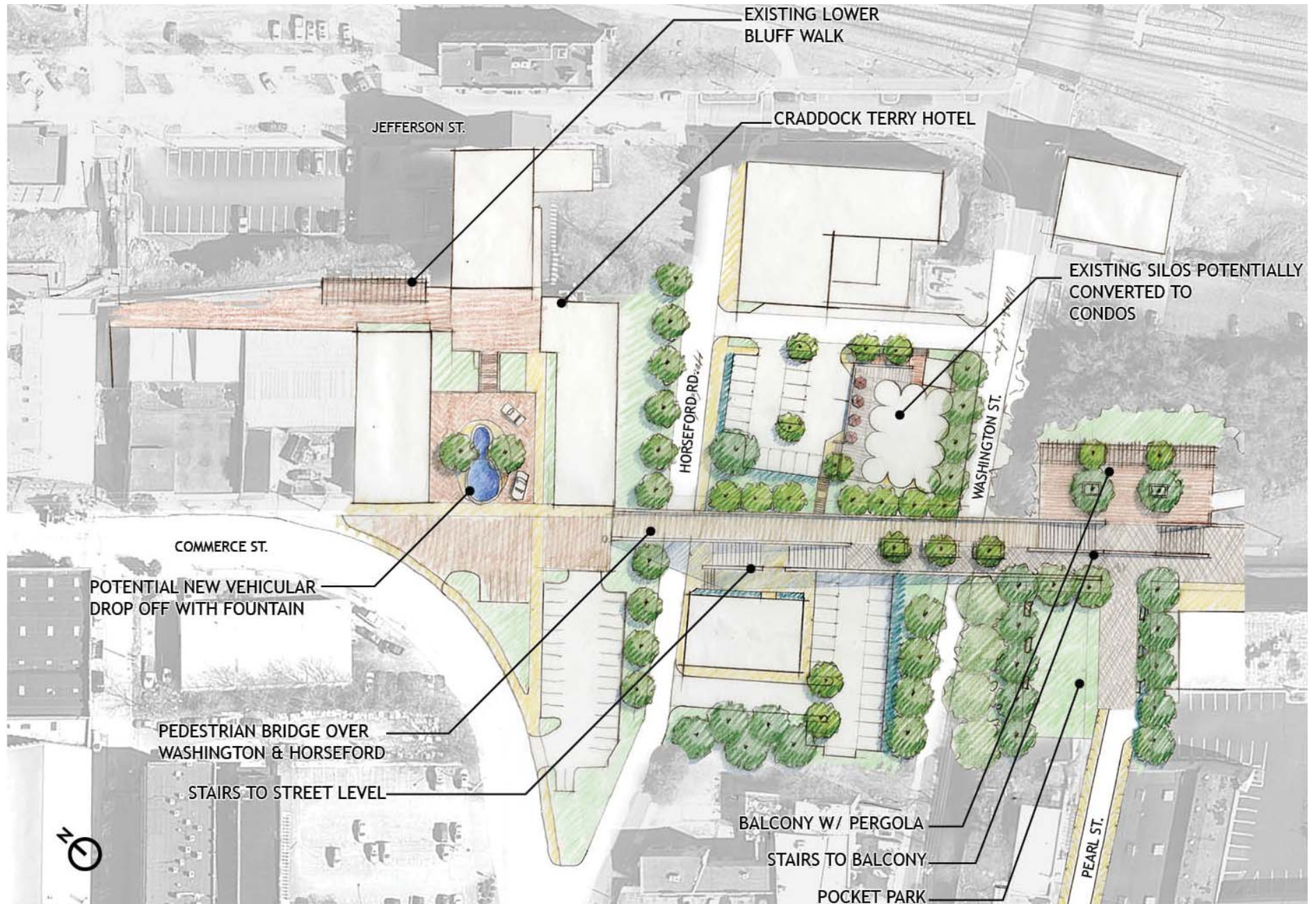
Simple improvements to the existing Lower Bluffwalk can increase pedestrian activity and safety. Better directional signage from Commerce and Jefferson Streets will help people reach the Lower Bluffwalk and additional seating and shade will invite people to not just walk along it, but to sit and stay, enjoying the views and atmosphere it provides. Public art can help add additional interest (see discussion later this chapter). Consistent lighting and the increase in pedestrian volume will improve the perception of safety along the Bluffwalk as well.

The intent of the Lower Bluffwalk extension is to foster additional mixed-use development and connectivity. The southeast extension, illustrated in this section, is proposed to cross Horseford Road and connect to an overlook at the Carter Glass Bridge, opening up more land for redevelopment and providing a direct connection to the trail system via a pedestrian bridge to Percival's Island (see *Connecting Communities* Chapter). As proposed in the *Lynchburg Downtown & Riverfront Master Plan 2000*, the northwest section will continue the Lower Bluffwalk route to 9th Street.



Bluffwalk Existing Conditions



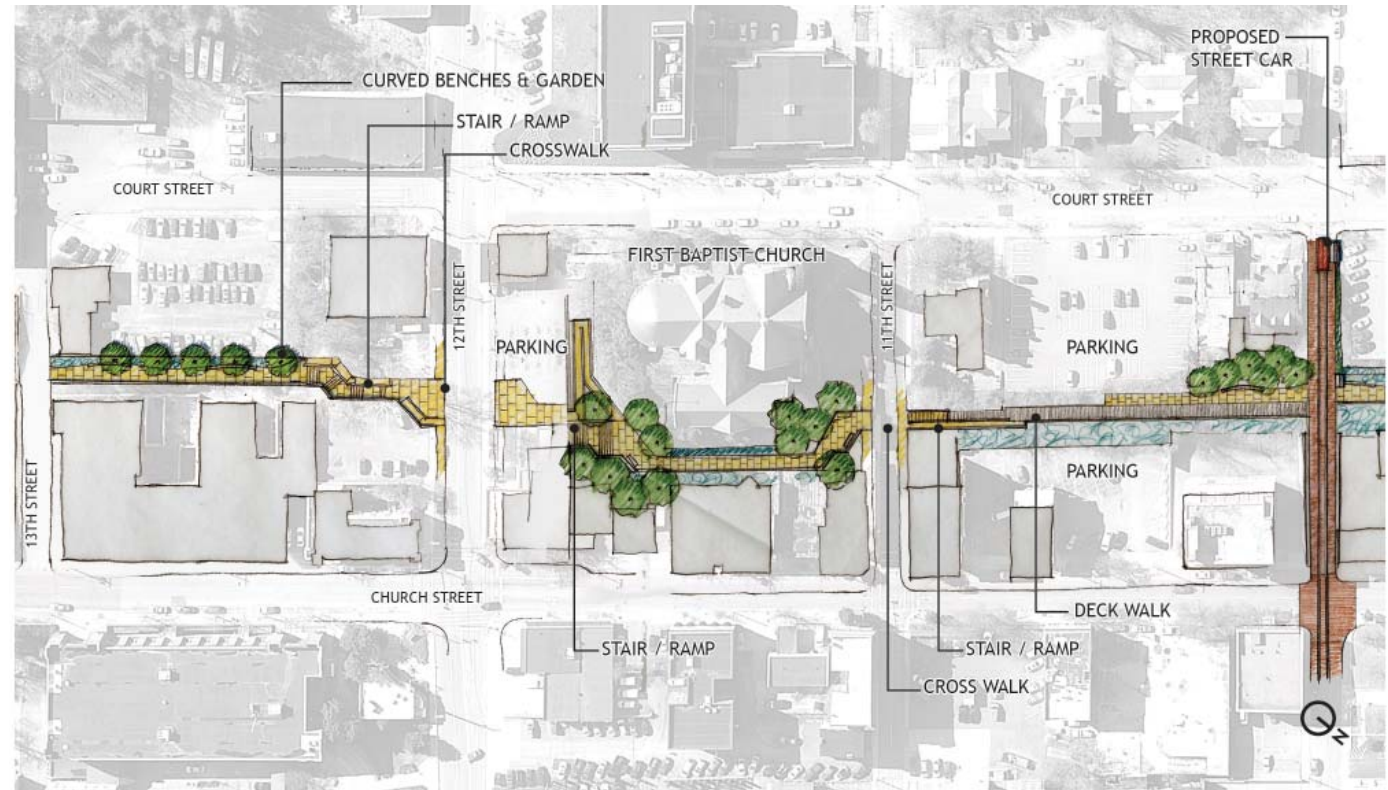


*Bluffwalk Concept for Proposed Southeast Extension*

## NEW UPPER BLUFFWALK

The Upper Bluffwalk, also recommended in *Lynchburg Downtown & Riverfront Master Plan 2000*, is proposed to extend parallel to the existing Lower Bluffwalk, between Court and Church Streets. The Upper Bluffwalk would wind through underutilized areas between buildings, creating a pedestrian promenade with sweeping panoramic views of the Downtown skyline. This space contrasts with the Lower Bluffwalk by being a quieter, more passive recreation space.

A future phase could include extending the pathway to Washington Street, strengthening the connection to the Diamond Hill neighborhood. The Upper Bluffwalk project can enliven and activate the south and west areas of Downtown, encourage new development opportunities, and increase connectivity.



*New Upper Bluffwalk Proposed Concept*



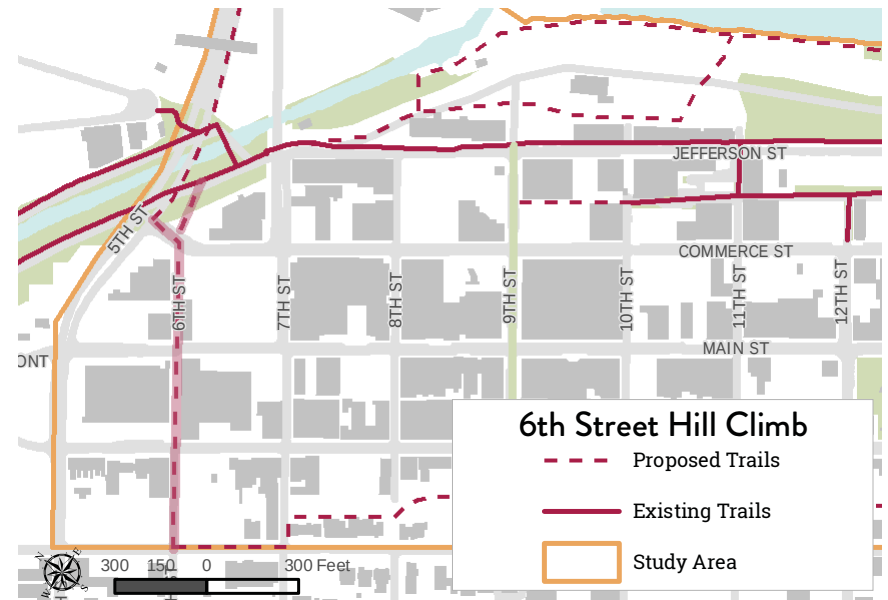


*New Upper Bluffwalk Proposed Concept*

## 6TH STREET HILL CLIMB

To continue the pedestrian walking loop recommended in the *Downtown & Riverfront Master Plan 2000*, and to help draw pedestrians up Downtown's steep grades, this plan proposes two "hill climb" projects at each end of Downtown. Hill climbs provide interesting and exciting routes connecting destinations that require uphill travel. They encourage walking by engaging pedestrians with public art and interactive features. The 6th Street Hill Climb is located at the northwest end of Downtown. Although steep, this quiet street with low traffic volume provides a calmer alternative to Fifth Street. The proposed climb connects the Blackwater Creek Trail, the Academy Center of the Arts and the Virginian Hotel to amenities at the top of the hill, including the future Clay Street Reservoir Park and Upper Bluffwalk.

The hill climb has water at both ends, connecting the historic reservoir with the Blackwater Creek Trail. With naturally steep grades, 6<sup>th</sup> Street could also be designed to expose the flow of water in an urban environment from one end to the other. This can be done through a gravity-driven fountain with a series of stations stemming from Clay Street Reservoir Park, or through the integration of artful stormwater features that capture the stormwater runoff from the street and adjacent development and filters it before it reaches Blackwater Creek. This water theme can be understood through sculpture and historical panels interpreting Lynchburg's historic public works achievements with water, as well as new concerns regarding stormwater runoff and the health of our streams and rivers, where 6<sup>th</sup> Street ultimately flows.



6th Street Hill Climb Existing Conditions

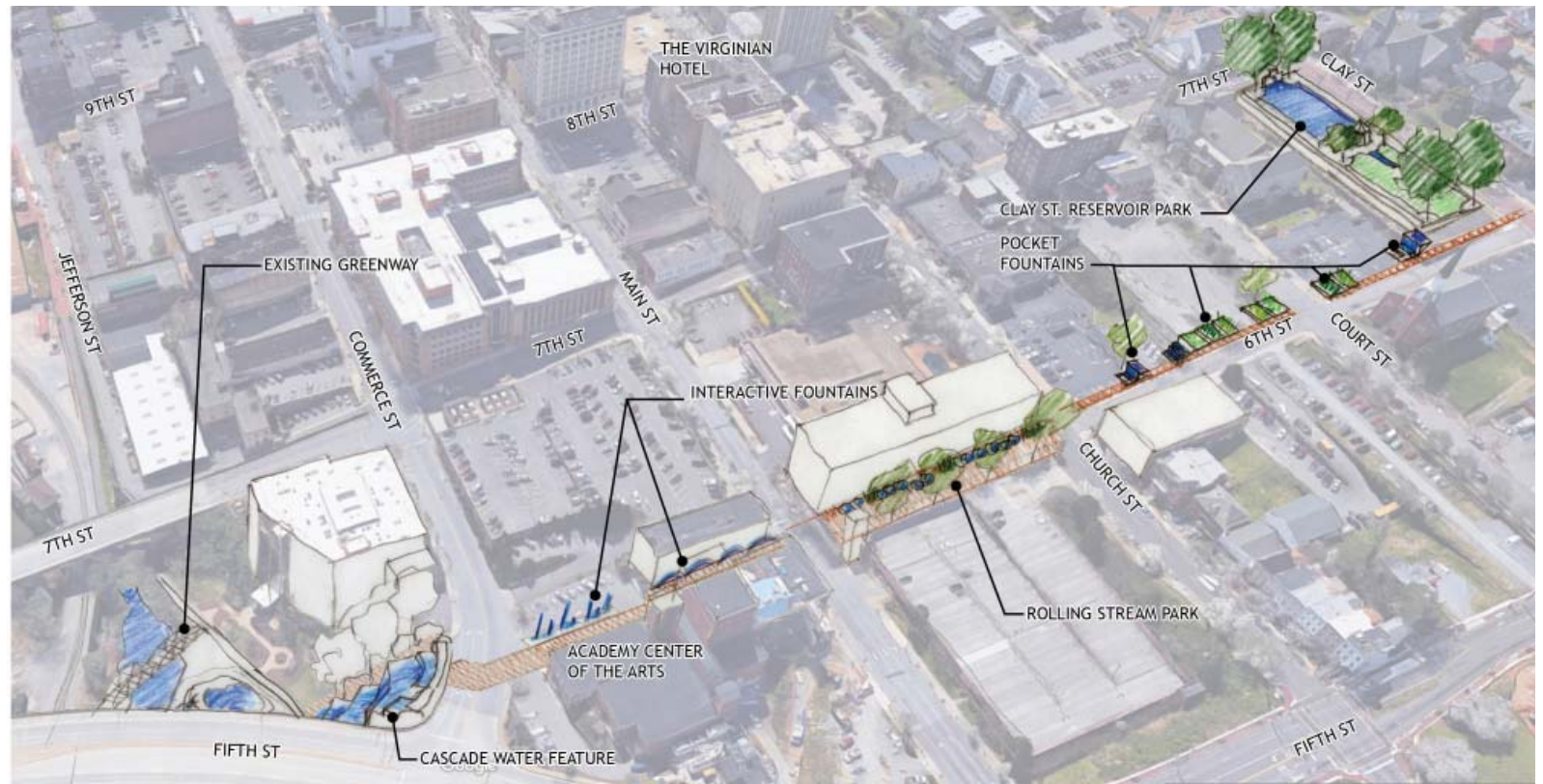




Vine Street Stormwater Features, Seattle. Photo Source: Google Streetview



Artful Stormwater Drainage



6th Street Hill Climb  
Proposed Concept



## CASE STUDY: MONUMENT TERRACE

The Monument Terrace stairs combined with streetscape improvements along 9th Street make the “9th Street Hill Climb” a most pleasant Downtown route. The 9th Street corridor is the spine of Downtown, extending from the original ferry landing on the James River to Monument Terrace. The stretch features sophisticated streetscape elements, some active ground floor retail, and a spectacular view at the top of Court House Hill. A strong civic theme further enhances the experience along the corridor, established by the memorials on Monument Terrace. Similar themed experiences would benefit cross streets at each end of Downtown.



## 12TH STREET HILL CLIMB

The 12th Street Hill Climb project complements the 6th Street Hill Climb by connecting Jefferson Street and the southeast end of the Lower Bluffwalk with the Community Market and the Upper Bluffwalk. Many improvements have already been implemented along this corridor’s northeast end, but additional focus as pedestrians continue southwest will help complete the walking loop recommended in the *Lynchburg Downtown & Riverfront Master Plan 2000*, tie important areas together, and improve the atmosphere on a significant street. 12th Street is a major entryway into Downtown and pedestrian improvements should even continue up 12th Street beyond Downtown to help draw pedestrians from the surrounding neighborhoods.

The area just beyond 12th Street would benefit from a smaller scale connectivity project as well. 13th Street should be connected between Main and Church Streets via a set of steps. This will better tie the southeast end of Church Street and the Diamond Hill Neighborhood to the southeast end of the Lower Bluffwalk.



Before  
12th and Main Street Intersection

Unlike 6<sup>th</sup> Street, 12<sup>th</sup> Street has high traffic volumes southwest of Main Street. To improve this connection, this plan proposes the following:

- > widening sidewalks
- > reducing the number of lanes and/or adding a pedestrian refuge at crossings
- > providing leading pedestrian signal phases
- > consolidating driveway entrances to reduce curb cuts
- > including street trees in the right-of-way



*After*  
Intersection of 12th and Main where the Hill Climb intersects with the Main Street Arrival Pad. Main Street should have unique paving pattern extending from Community Market. 12th Street should focus on having public art incorporated into buildings and streetscape elements like bus shelters.

Like 6<sup>th</sup> Street builds on a the theme of water in the city, 12<sup>th</sup> Street should become a major hub for public art, drawing on local artisans from the adjacent Community Market and Art on 12<sup>th</sup> Studios, as well as the plethora of arts organizations Downtown. The streetscape should incorporate traditional artwork like sculpture and combine it with functional street art like creative crosswalks, painted utility cabinets, sidewalk art (see section on Public Art later this chapter) etc. Willing property owners could also work together to create an “art alley,” like the one that is seen in Rapid City, South Dakota. Together, these efforts will turn 12<sup>th</sup> Street into an outdoor gallery.



*Plaza pavers incorporate art by local children in Seattle, WA*



*Art Alley in Rapid City, SD*



*13th Street Alley where stairs should connect to Church Street*



*Existing mural on 12th Street*



## 4.3 STREETS AS PUBLIC SPACE

While the specific pathway connections discussed in the previous section are key improvements with unique opportunities, all streets Downtown should be treated as important public spaces. Small-scale tools are available to make streets enjoyable spaces people want to be in and to help disperse public space throughout Downtown.

### PARKLETS

A parklet is a sidewalk extension that provides more space and amenities for people using the street. Usually parklets are installed on parking lanes and use one or several parking spaces to create more pedestrian space. Parklets typically extend out at the level of the sidewalk to the width of the adjacent parking space. This calms traffic on the street and for adjacent businesses or restaurants, can provide outdoor cafe seating for patio dining.

Parklets can be permanent or temporary installations. Park(ing) Day began in 2005 and is a one day event in Cities around the globe where parking spaces are converted to parks to reimagine what a 200 square foot patch of real estate in a downtown could be. Space that is normally dedicated to holding one car can be transformed into valuable public space.



Parklet on Park(ing) Day 2012. Photo Source: [https://metroduo.wordpress.com/2012/09/28/parking-day-2012-los-angeles/parkingday2012-swadsc\\_0077/](https://metroduo.wordpress.com/2012/09/28/parking-day-2012-los-angeles/parkingday2012-swadsc_0077/)



Example of How a Parklet Could Be Installed on Main Street



## PAVEMENT TO PARKS

Taking the idea of a parklet a step further, there may be underutilized street space in and around Downtown that can be converted to public space. In the example below, an unnecessary right turn spur was transformed into a plaza with low-cost materials.



*Underutilized Street Space Converted to Public Space*



*Federal and Hollins Street Unnecessary Pavement Was Repurposed*

## POCKET PARKS

A pocket park is a small-scale green space, typically created on an underutilized vacant lot or irregular shaped piece of land. They can be on public or private land, but are open to the public as passive recreation space. Pocket parks should be incorporated as needed and as opportunities arise. Both City Hall Plaza and the Grace Street Dog Park are pocket park projects, but others both larger and smaller may be possible around Downtown and will be an important way to spread park space throughout Downtown. Having public space available on-site or directly nearby increases property values and livability. Private developers should be encouraged or even incentivized to incorporate this kind of public space into their developments.

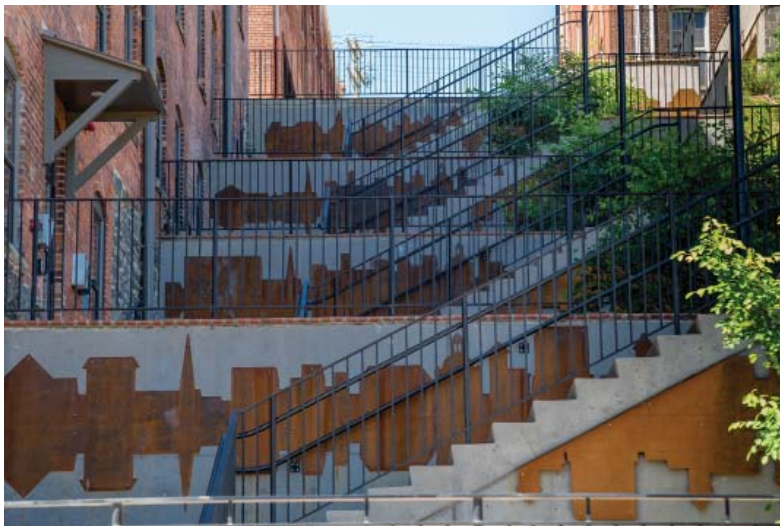


*Private Land That Could Be Improved and Officially Made a Pocket Park*

## PUBLIC ART

Public art enlivens the urban environment by adding visual interest to the streetscape and is a community amenity that enhances identity, civic pride, economic development, and livability. It also provides citizens with outlets for interpretation and inspiration while contributing to the city's aesthetics. The Citizen Survey included a number of responses requesting that public art Downtown be enhanced. Some excellent examples of public art already exist in Downtown Lynchburg, predominantly in the form of sculptures, murals, and elements of street design.

In 2010, the City adopted the James River Arts & Cultural District that incorporates Downtown and offers financial incentives for art and culture programming in the form of grants (up to \$5,000) and certain tax exemptions for qualifying entities. The intent of the James River Arts and Culture District is to foster new artistic and cultural events, activities, capital investments, promotions, and improvements.



*Lynchburg Public Art at 11th Street Stair*

While this program has been successful in supporting cultural organizations and programming in Downtown, a more strategic public art program can proactively work to imbue Downtown with public art. New initiatives to consider include:

- > A Public Art Plan to identify key locations, funding opportunities, and implementation strategies for permanent installations as part of future streetscape, park, building, wayfinding, and connectivity initiatives. The adoption of a Public Art Plan is critical in establishing guidelines for how public art is collected, managed, marketed, and delivered to the community.
- > Temporary installations can also be planned along with streetscape and infrastructure projects in order to minimize visual nuisance. Feedback from various public outreach events indicated the negative impacts of Downtown construction activities on street life and the overall pedestrian experience. Incorporating public art into detours, construction site fences, monolithic walls of Downtown parking decks can improve curb appeal, leading to increased foot traffic and real estate development interest.



*Construction Fence at the Henry Street in Roanoke, Virginia*



- > A Public Art Agency or Commission should be established to implement the Public Art Plan with the help of the Department of Community Development who currently facilitates the installation of public art with the City's Public Art Policy and Guidelines. Members of this type of agency should be local residents who support the arts in some fashion, usually serving or working for local arts organizations, supporting local art, or are artists themselves. The Arts Commission will implement the Public Art Plan and expand the current Public Art Policy to include policies for obtaining or acquiring art, managing and maintaining art, funding art, and implementing art projects.
- > A Percent for Art Program is the most successful and direct way a locality can work towards including more public art in the urban landscape. In this program, 1% (or a fraction of a %) of the construction costs of public projects are set aside for public art. Art can either be incorporated into the project itself or be set aside for implementation elsewhere. The City Administration with guidance from the Arts Commission would be responsible for deciding what projects received funding. While the requirement only applies to public projects, it could be coupled with benefit to private developers for incorporating art into their projects as well.
- > Expanding "art" to nontraditional forms. Art can be incorporated into the urban landscape in unexpected ways that will make being in Downtown exciting. Crosswalks, sidewalks, streetlights, and building facades can all become venues for public art and can add to the vibrancy Downtown. The 12<sup>th</sup> Street Hill Climb should be a focus for this kind of public art, though it should spread throughout Downtown.



Parking Garage Mural in San Diego, CA  
Source: <https://coolsandiegosights.com/2015/09/28/cool-new-parking-garage-mural-in-downtown-san-diego/>



Streetlight in Paris



Existing Public Art Downtown



Manhole Cover paid for by a Percent for Art Program



## 4.4 PUBLIC SPACE AND RECREATION: GOALS

- > Provide a network of parks and open spaces that celebrates the James River and the unique scenery of Lynchburg.
- > Enhance Downtown as a destination that provides citizens with exceptional opportunities for social interaction and recreational experiences.
- > Boost economic growth and tourism by developing a signature venue in Downtown that can support large-scale outdoor events.
- > Weave high-quality public spaces into the fabric of Downtown to create a more livable neighborhood.
- > Provide access and strengthen connections to the James River.

## 4.5 PUBLIC SPACE AND RECREATION: RECOMMENDATIONS

Successful downtowns have signature public facilities that are well maintained and operated. Public investment in improvements deserves maintenance and excellence in operations and community coordination. With respect to Downtown Lynchburg, maintenance of public plazas, parks, sidewalks, landscaping, trash collection, etc. is critical to the growth and visual appeal of Downtown. The following should be considered to address maintenance and operation of the public improvements advocated in this Master Plan:

**Adequate Funding** - Public Works and Parks & Recreation should be given adequate funding to cover streets and sidewalk maintenance, including monitoring trash in these areas, and landscape maintenance.

**Events** – Public events need to be a coordinated effort through partnerships. A shared calendar is an effective tool that facilitates collaboration between partners as well as the effective management of Downtown events. All events in public areas should be undertaken in compliance with an adopted City “memorandum of agreement” that specifically outlines responsibilities and any collaborative initiatives.

In order to achieve the goals and recommendations identified in this section, the *Downtown Lynchburg 2040 Plan* proposes a series of short, mid and long-term strategies that build upon the successes of previous efforts while meeting the public space and recreation needs of Downtown.

## PUBLIC SPACE AND RECREATION

| SHORT-TERM STRATEGIES                                                                                                                                                                          | MID-TERM STRATEGIES                                                                                                                                                                     | LONG-TERM STRATEGIES                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PARKS AND GATHERING AREAS</b>                                                                                                                                                               |                                                                                                                                                                                         |                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li><b>Riverfront Park</b> - Restroom improvements, decorative fencing and gating system.</li> </ul>                                                        | <ul style="list-style-type: none"> <li><b>Destination Amphitheater</b> - Complete.</li> </ul>                                                                                           | <ul style="list-style-type: none"> <li><b>Riverfront Park</b> - Restore after proposed amphitheater is constructed and complete implementation from 2000 Plan.</li> </ul>                                  |
| <ul style="list-style-type: none"> <li><b>Destination Amphitheater</b> - Secure a site and development collaborative for the project. Prepare designs.</li> </ul>                              | <ul style="list-style-type: none"> <li><b>Canal Park</b> - Install play amenities, landscaping, historic interpretation</li> </ul>                                                      | <ul style="list-style-type: none"> <li><b>Riveredge Trail</b> - Negotiate with CSX, Pursue Easements, Design Overpass, Implement Project</li> </ul>                                                        |
| <ul style="list-style-type: none"> <li><b>Canal Park</b> - Establish trail route through canal, connecting Blackwater Creek and Percival's Island Trails. Add seating to skatepark.</li> </ul> | <ul style="list-style-type: none"> <li><b>Foundry Park</b> - Design and Implement</li> </ul>                                                                                            |                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li><b>Dog Park</b> - Design, build, and establish partnerships with organizations, such as Friends of Lynchburg Dog Park, to help raise funds.</li> </ul>  | <ul style="list-style-type: none"> <li><b>Clay Street Reservoir Park</b> - Design and Implement project in conjunction with 6th Street Improvements</li> </ul>                          | <ul style="list-style-type: none"> <li><b>Clay Street Reservoir Park</b> - Establish partnerships to assist with operations and management of special events such as the Reservoir Park on Ice.</li> </ul> |
| <ul style="list-style-type: none"> <li><b>Community Market</b> - Implement indoor recommendations.</li> </ul>                                                                                  | <ul style="list-style-type: none"> <li><b>Community Market</b> - Complete plaza design and coordinate with Arrival Pad and Downtown Streetscape Project.</li> </ul>                     |                                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li><b>City Hall Plaza</b> - Relocate parking and implement.</li> </ul>                                                                                     | <ul style="list-style-type: none"> <li><b>Main Street Arrival Pad</b> - Coordinate design and construction with the Community Market Plaza and Downtown Streetscape Project.</li> </ul> |                                                                                                                                                                                                            |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

## PUBLIC SPACE AND RECREATION

| SHORT-TERM STRATEGIES                                                                                                                                                            | MID-TERM STRATEGIES                                                                                                                                                        | LONG-TERM STRATEGIES                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TRAILS AND PEDESTRIAN CONNECTIONS</b>                                                                                                                                         |                                                                                                                                                                            |                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>• <b>Lower Bluffwalk Improvements</b> - Install flexible seating, shade structures, and lighting as needed.</li> </ul>                    | <ul style="list-style-type: none"> <li>• <b>Lower Bluffwalk Extensions</b> - Identify and pursue easements on private properties and implement projects.</li> </ul>        |                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>• <b>New Upper Bluffwalk</b> - Identify and pursue easements on private properties for implementation.</li> </ul>                         | <ul style="list-style-type: none"> <li>• <b>New Upper Bluffwalk</b> - Complete Master Plan.</li> </ul>                                                                     | <ul style="list-style-type: none"> <li>• <b>New Upper Bluffwalk</b> - Implement in coordination with potential adjacent development.</li> </ul> |
|                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>• Implement <b>Hill Climb</b> projects in coordination with Downtown Utilities Project and Clay Street Reservoir Project</li> </ul> |                                                                                                                                                 |
| <b>STREETS AS PUBLIC SPACE</b>                                                                                                                                                   |                                                                                                                                                                            |                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>• Support the installation of <b>parklets, plazas, and pocket parks</b> as feasible and requested by adjacent property owners.</li> </ul> |                                                                                                                                                                            |                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>• Implement <b>temporary art installations</b> with construction projects.</li> </ul>                                                     | <ul style="list-style-type: none"> <li>• Establish an Arts Commission</li> </ul>                                                                                           |                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>• Develop a <b>Public Art Plan</b>.</li> </ul>                                                                                            | <ul style="list-style-type: none"> <li>• Enact a <b>Percent for Art</b> Ordinance</li> </ul>                                                                               |                                                                                                                                                 |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*



# 5. PARKING

- 5.1 FINDINGS
- 5.2 PARKING MANAGEMENT
- 5.3 MIXED-USE PARKING DEVELOPMENT
- 5.4 PARKING IN 2040
- 5.5 PARKING: GOALS
- 5.6 PARKING: RECOMMENDATIONS

PAGE LEFT INTENTIONALLY BLANK

## 5.1 FINDINGS

### EXISTING PARKING STUDIES

Two parking studies for Downtown Lynchburg were completed after the initial 2000 Master Plan was adopted (Strategic Parking Study by Carl Walker in 2007 and Downtown Parking Deck Feasibility Study by Desman Associates in 2012). Each study concluded that as a whole, Downtown actually had a surplus of parking supply. Other important findings of the studies were:

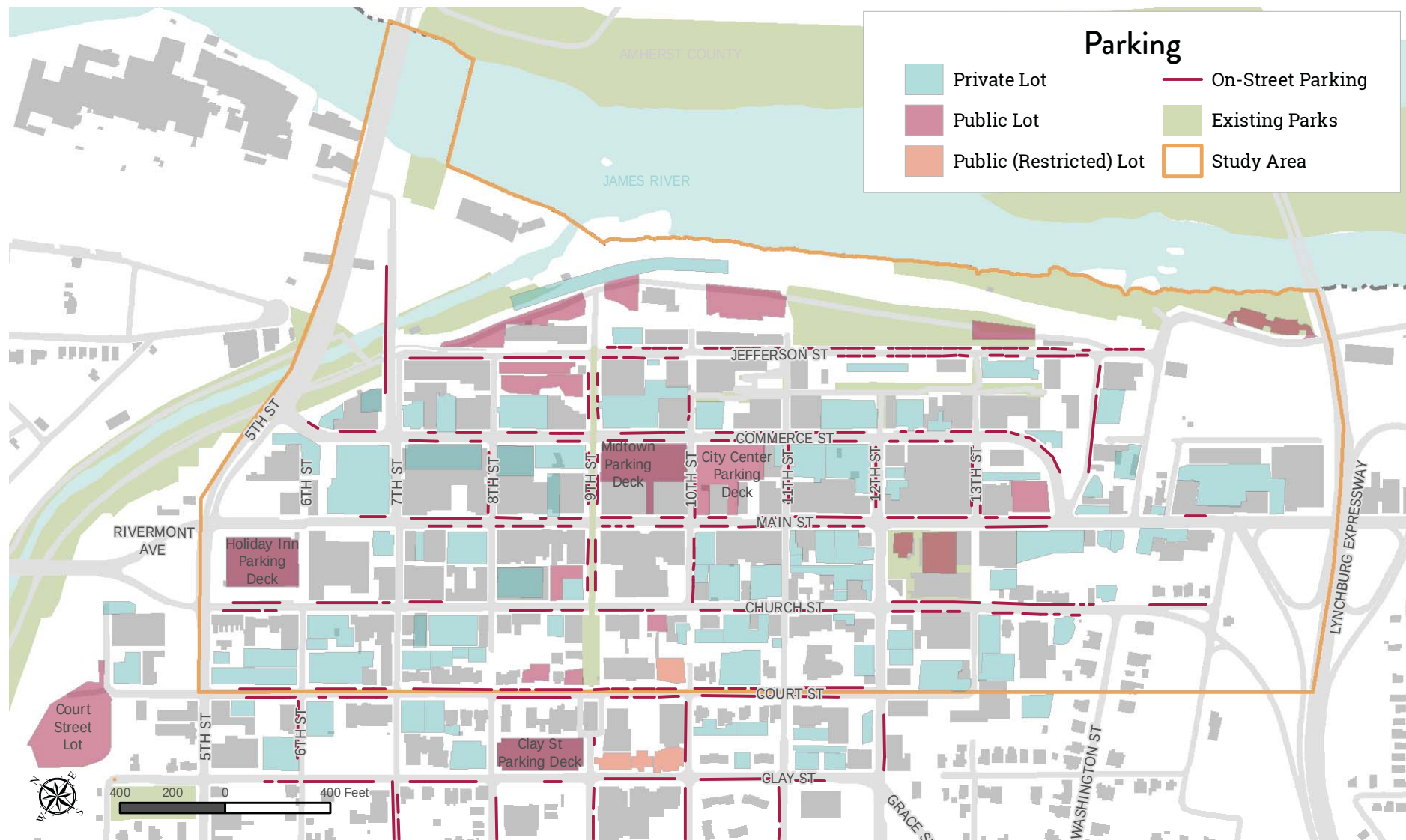
- > Certain areas of Downtown experienced parking pressures due to inconsistent utilization of the parking supply.
  - > Connectivity of some of the parking supply to Downtown created underutilization of some facilities.
  - > There were little to no options for long-term visitor parking for longer than 2 hours because public parking garages catered to contracted monthly parking. Of note is that since those studies were completed, four locations Downtown have opened for hourly paid parking to accommodate long-term visitors.
  - > Observations indicated that existing hourly parking is underutilized.
- > There is a need for a better wayfinding system to indicate where off-street public parking is located.
  - > Both studies recommended establishing a pay structure for on-street parking spaces in order to manage parking and provide revenue for needed improvements. In 2016, the City conducted its first paid on-street pilot project study to gather input from stakeholders regarding the re-introduction of paid on-street parking. The pilot project included twelve parking spaces in the 1300 block of Main St. only. At the completion of the pilot project study, community stakeholders and visitors had mixed reactions on the effects it had on parking in general. According to the City's Parking Management Department, the pilot project was successful in providing convenient parking spaces that were previously unavailable due to lack of vehicle turn-over. On the other hand, some of the issues that arose resulted from having available close-by free parking, the introduction of new pay stations being too technical, and confusion about the overall purpose of the project. Any future on-street paid parking implementation efforts should include a more encompassing area, as well as a comprehensive communications outreach campaign.



## FURTHER OBSERVATIONS

The project team found the following additional observations that together formed the basis of this chapter's recommendations:

- > The existing parking supply in Downtown is ample and distributed through the Central Business District. This is evident from the Parking Map (on the next page) which illustrates all public and private parking resources, both on and off-street. Of note is that many of the lots are private in nature, with most of them being used only when offices are occupied or when church is in session. Attempts by the City to negotiate leases for shared parking on private lots have had limited success.
- > Much of the available free public parking is being used by residents and employees of Downtown. Since 2000, there have been over 900 residential units added in Downtown and there are currently over 430 businesses.
- > Like many cities who have focused on revitalizing their downtowns, there are no minimum parking requirements in the Downtown B-4, Urban Commercial Zoning District. Consequently, new development in Downtown (residential and commercial) is not required to provide parking.
- > As recommended in Donald Shoup's acclaimed book, *The High Cost of Free Parking*, and as is the state of the practice in downtown revitalization today, parking needs are market driven. Therefore, parking minimums are typically not required for redevelopment projects. As a result, developers and businesses provide only what they believe will be necessary for operation and tend to share parking resources; such as on-street spaces, surface lots, and garages. The hesitation of requiring developers to build new parking in a historic and dense urban environment is that it will deter redevelopment and could result in the removal of historic buildings, detracting from the Downtown environment.
- > Downtown should be a "park once" area of the City. Drivers should leave their car once they find parking and walk or take other means of transportation between their Downtown destinations. Because blocks Downtown are short, it has the right "bones" for being a walkable community. Additional street life and efforts to reduce the burden of Lynchburg's hills can help this. Strategies throughout this document should be implemented to ensure this "park once" environment.
- > Downtown's geographic area measures slightly over 150 acres. Of that area, 40 acres is occupied by surface parking lots, which means roughly 25% of Downtown is consumed by surface parking. This is a significant amount of land that could be eventually repurposed for a higher and better use than simply car storage. Many downtowns have used surface parking lots as opportunity sites for new infill development. In Greenville, SC, and many other revitalizing cities, mixed use buildings are constructed on surface lots; integrating structured parking into the redevelopment of the lot. In this way, many needs are met on an existing site while creating a downtown where people can live, work, and play without having to drive to each and every destination.



Much of Downtown Lynchburg is dedicated to parking, split between private and public lots, public parking structures, and on-street parking.

## 5.2 PARKING MANAGEMENT RECOMMENDATIONS

As identified in the previous section, Downtown Lynchburg suffers more from parking management issues than supply issues. During the stakeholder engagement and charrette sessions, parking often took the front seat as the challenge that residents felt was most pressing. Ironically, this perception of a parking issue often goes hand in hand with success in a downtown. While the past studies show that Downtown Lynchburg does not yet have a parking space shortfall, the perception is quite different. Often this is due to topographical challenges between available parking and destinations. This is addressed in a Chapter 6 section titled ‘Solutions to Lynchburg’s Topography.’

The previous studies gave a direction on how to address the management of parking resources. This plan identifies overall strategies to effectively manage the public and private supply of parking Downtown and looks ahead to 2040 and the changing landscape of parking in downtowns.

### PUBLIC PARKING

Public parking Downtown consists of all City-owned spaces, which include on-street spaces, off-street surface lots, and off-street decks. There are approximately 1,035 on-street spaces and 2,189 off-street spaces within the Central Business District. However, there are approximately 3,276 privately owned spaces. While limited, it is important for the City to manage the parking resources it has to boost economic impact, effectively use public land, and pay for the maintenance, upkeep, and expansion of such parking.

### ON-STREET PAID PARKING

As Downtown has become more successful, on-street parking should be converted to paid parking as recommended by both the 2007 and the 2012 parking studies. Most successful downtowns charge for on-street parking and Lynchburg has reached this point. These spaces are the most valuable to a vibrant downtown, as they are the most conveniently situated next to downtown destinations. This convenience should come with a premium. The following are key components to successfully implementing a paid on-street parking system:

- > Implementation must encompass a large area. Phasing the implementation would be more cost-effective on the capital side; however, each phase should be large enough to produce effective results. A reasonable first stage could be the Main Street and Church Street pairs, including cross streets for one block in each direction.
- > Less convenient off-street parking should be made free for short term users (1 or 2 hours maximum). The initial implementation of paid on-street parking should be coupled with the removal of fees for short term parking in off-street spaces. People parked for longer than two hours would need to pay. This alternative free parking for short-term uses should remain in place until a significant capital cost (i.e. new garage) comes into play.
- > Pay stations with “pay by space” or “pay by plate” technology should be implemented to make it easy for the users. Various parking vendors are available to test their systems to determine which is right for Lynchburg.
- > One City entity should manage both the on and off-street parking supply. Currently, different city departments manage the on and off-street parking, which creates some disconnect in the management of the overall parking supply and makes it difficult to set up a market based system. Most cities with successful parking management systems have all parking resources under one department or authority. The City should consider placing

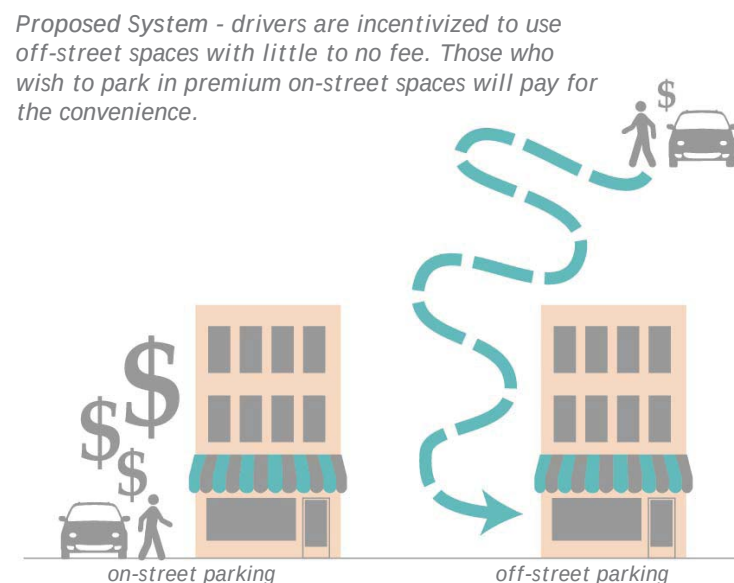
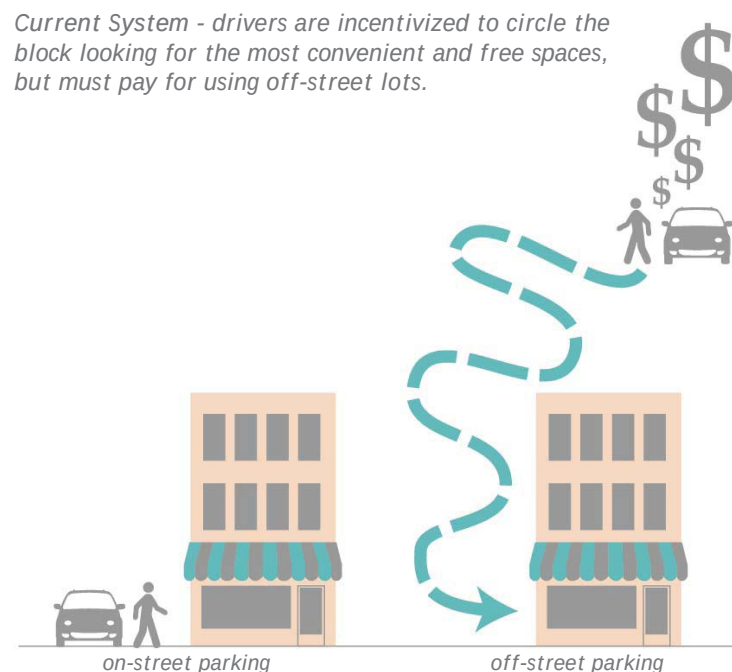


all Downtown parking resources (including on-street parking) under one entity for management, enforcement, and potential expansions; this action should occur only simultaneously with the implementation of paid on-street parking. A responsibility of this entity would also be to monitor utilization of surface lots and to continue to pursue lease agreements for shared use of private lots, and to monitor the physical conditions of the lot and to bring attention to maintenance issues that may arise.

There are a number of benefits to on-street paid parking:

- > Creates space turnover in the most convenient spaces near businesses and facilitates quick stops by drivers who otherwise would keep moving through Downtown.
- > Prevents the incentive to circle the block looking for free on-street spaces, reducing traffic.
- > Paid on street parking eliminates abuse of convenient free spaces by long term parkers (residents and employees) who move their vehicles from space to space to avoid tickets.
- > As the most valuable spaces, on-street parking can provide a significant source of revenue to fund future investments in the parking system, including maintenance and renovation of current facilities, construction of new facilities, leases of shared facilities, and funding of management of the parking resources.

Additional parking should be added as the need and opportunity arises; the following are a few ways that the City can be proactive in providing new parking supply as Downtown continues its success.



## PARKING GARAGES

While progress has been made in providing longer term off-street parking for Downtown visitors, the Midtown garage is still underutilized for that purpose. Also underutilized is the Holiday Inn garage, which most people don't realize is public. Finally, the Clay Street garage, while fully utilized today, will be an available resource once the police department moves to a new headquarters.

Part of the issue is a lack of clear wayfinding to direct visitors to longer term (>2 hours) parking garages and lots. A comprehensive wayfinding program should highlight visitor long-term parking (See Wayfinding Chapter). In addition, web-based resources showing visitors the location of available parking should be enhanced and made more accessible. Many cities are doing this effectively so that visitors know where to park before ever beginning their journey to a downtown, minimizing the frustration of hunting for parking upon arrival.

## NEW PARKING GARAGES

Previous studies recommended siting the next public parking garage at the western corner of 12th and Commerce. This plan recommends this location also but coupled with design guidance and requirements for all new and renovated garages. Garages should contribute to the fabric of Downtown and must have active ground floor storefronts. Additionally, garages can include active office or residential uses in a multi-story format. See section on mixed-use garages later this chapter for more information on design.

This format provides for an opportunity for public/private partnerships to construct new garages concurrent with development. While the City should be open to potential public/private partnerships to add to the parking supply, a new public deck should not be pursued until existing parking supply regularly operates at 85% capacity and can be financially supported through parking revenues.



*My Dog Duke's Diner is a local Lynchburg example of a restaurant use within a parking deck, helping activate the street.*

## LEASES FOR PRIVATE PARKING

The City has been relatively unsuccessful in securing lease arrangements to use private parking lots or garages in off peak times, although a new agreement with the Criminal Justice Academy now allows public parking in the 12th/Commerce lot on nights and weekends. The City should continue efforts to pursue such lease agreements and consider innovative approaches such as evening and weekend valet service for Downtown patrons. Controlled access of private parking lots would address vandalism and cleanup concerns of property owners. Communities like Columbus, Georgia have used this approach successfully. Vendors make their money through the valet fees, which in Columbus, are paid by the Downtown Merchants Association.

## PRIVATE PARKING

There are significant amounts of private parking in Downtown. With more than both on and off-street public parking combined, private parking plays a major role in the parking supply. While many citizens spoke out saying it was time for developers to be required to provide parking in Downtown Lynchburg, it has been the experience of this team that market forces should be the driving force behind whether or not developers provide parking. Requiring parking encourages car travel by Downtown visitors and ownership among residents, adding traffic and consuming real estate for car storage. Thus, we do not recommend instituting parking requirements for new development.

### MARKET-DRIVEN PARKING REQUIREMENTS

Many cities do not require parking in urban downtowns. The elimination of minimum parking requirements is frequently used to encourage downtown investment and revitalization, since by not requiring developers to construct new parking typically removes a significant barrier to development from both logistical and cost perspectives. In this scenario, the entire downtown parking supply is considered as a “parking pool” for downtown, with the understanding that people may have to walk a block or even a few to reach their destination after parking their car. Careful design of the streetscapes and active streets/storefronts make those blocks conducive to strolling. That short walk becomes less of a burden and actually enjoyable as visitors experience an exciting downtown along their walk. By creating this “park once” environment people use their car only to access the downtown; once there, they walk among destinations. This is similar to what suburban mall developers do, in that a person parks their car and then strolls along active storefronts where interesting things are going on in the mall corridors. However, downtowns are typically even better at creating and maintaining a real and always-changing environment.

Lynchburg removed its Downtown parking requirements several years ago and afterward saw the beginning of Downtown’s revitalization. To continue this upward trend, the private market should continue to dictate the amount of parking it needs. In addition, downtowns sometimes establish parking maximums in certain areas to prevent dedicated surface parking lots where the land may be better utilized with development.

While it has only been five years since the last parking study, the City should evaluate the amount and utilization of parking in Downtown to reset a baseline for future decisions. These utilization counts should be updated at least every two years to stay current with land use changes in Downtown. Other mechanisms that can be used to provide parking for redevelopment include the following:

- > The unbundled parking where a developer sells parking a la carte in addition to the price of a residential unit;
- > Public-Private Partnerships (PPP) in joint use garages;
- > Creation of a “parking pool” for Downtown where developers can purchase spaces. This scenario requires a baseline study to understand how much public parking supply is available and offer the spaces to developers for cost through lease purchase.
- > Facilitated lease agreements for shared parking between complementary uses.
- > Set parking triggers based on utilization studies to be updated regularly. An 85% utilization is a typical metric for an indicator that a mitigation measure in the form of additional parking or pricing adjustment is needed.

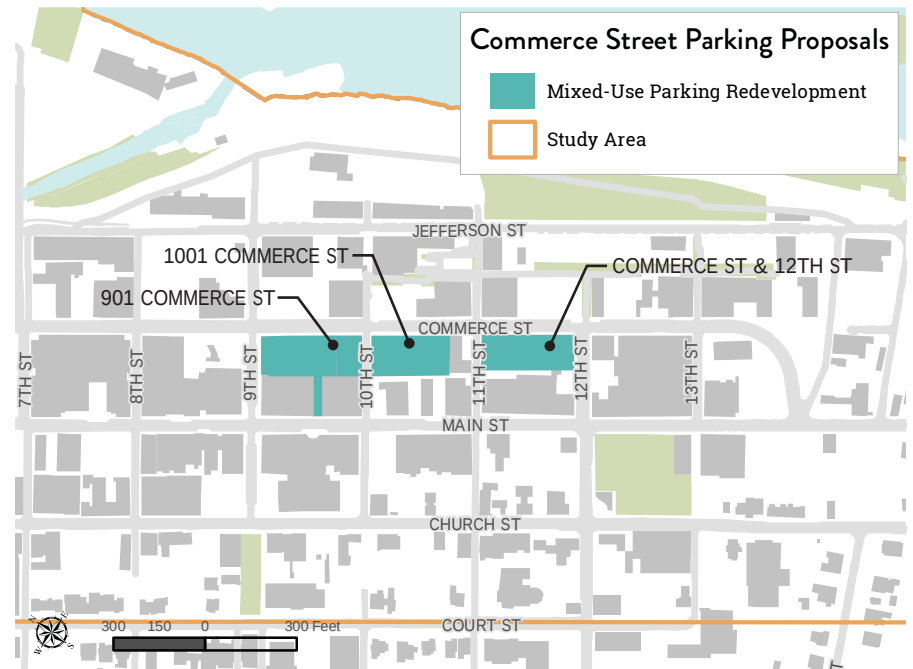


## 5.3 MIXED-USE PARKING DEVELOPMENT

This plan proposes three concepts for mixed-use structures with potential to increase parking and boost economic development in Downtown Lynchburg. The sites described in this section were selected based on their central location along Commerce Street; current use as parking facilities; size and configuration; and opportunities for historic tax credits. One site is a surface parking lot; the other two are existing aging garages.

The first concept proposes the construction of a new structure at an existing surface parking lot at the corner of 12th and Commerce Streets. described in the *Downtown Parking Deck Feasibility Report (2013)* by Desman Associates. The second approach recommends repurposing sections of a historic parking structure for commercial infill. A third concept suggests the replacement of an existing garage, nearing the end of its lifespan, for the development of a new hotel, parking deck, and retail shops.

All three concepts integrate a mix of uses in order to increase parking and commercial activity between Jefferson and Court Street. Retail and public uses, rather than parking, will primarily occupy the ground levels of these structures to encourage street life along Commerce Street. With this approach, parking garages can serve multiple functions (including delivery and loading for businesses) while contributing to Downtown's public realm and the City's economic growth.



Proposed Locations for Mixed-Use Parking Development



## CASE STUDY: CHARLESTON, SC

Charleston, South Carolina has been very successful in accomplishing public-private partnerships for a mixed use parking structure. The garage above replaced an outdated facility in the historic district of Charleston. This project was a 3-party public-private partnership between the City, College of Charleston, and a private developer. The garage contains over 600 spaces with student housing on the top three floors. The main College dining facility is located on the ground floor along with a CVS pharmacy. By creating this mixture of uses, the partners were able to both provide needed parking and activate the streetscape.



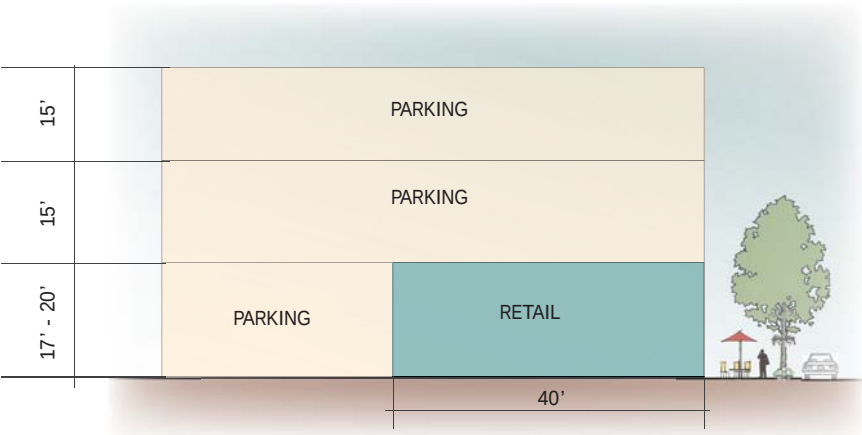
*A new parking structure is a long-term strategy to provide parking. This structure should include street-level retail, mixed-uses, and streetscape enhancements. The addition of shuttles and/or street car service could better connect parking lots to Downtown destinations.*

COMMERCE STREET AND 12TH STREET

A new mixed-use parking structure is proposed at the corner of Commerce Street and 12th Street. The property is currently occupied by three surface parking lots: two that serve the property at 1100 Main Street, and one that is owned by the Central Virginia Criminal Justice Academy. The *Downtown Parking Deck Feasibility Report* (2013) by Desman Associates, classifies this lot (referred to as Site K) as a preferred location for a new parking deck; ranking high in two categories: ease of property development and potential to double the amount of parking currently provided. Furthermore, the report recommends introducing a mix of commercial and retail spaces at street level to induce more pedestrian activity.

The proximity of the site to the Bluffwalk, as well as the anticipated hotel development nearby, suggests the need for more commercial activity along Commerce Street. Public space and recreation initiatives proposed in Chapter 4 further support the viability of a mixed-use structure that provides central parking while providing services that attract residents and visitors to Lynchburg’s Central Business District.

In order to meet Downtown’s fluctuating market needs, the proposed concept for this underutilized lot recommends a flexible design that will allow the transformation of the structure later on. One approach is to provide a floor-to-floor height of 15 feet between each parking level, rather than the standard 10 feet. Although a more-costly tactic, the increased height provides an opportunity for the structure to be adapted to accommodate retail, office or apartment spaces without major structural upgrades.



*Parking garage design should encourage non-parking activities on the first floor, such as retail at the ground level. Stairs and elevators should be designed to fit within the boundaries of the garage, rather than on the exterior as an attached stair and/or elevator tower.*



*Building materials should be similar in color and texture to those of nearby structures. Retail storefronts should incorporate clear glass to provide visual interaction with the pedestrian/vehicular traffic.*



## 1001 COMMERCE STREET

The parking deck at 1001 Commerce Street represents a significant mid-century trend in downtown commercial development. As the use of automobiles increased, parking garages proliferated across the nation as historic downtown business districts tried to compete with suburban shopping malls and office parks. Designed ca. 1949 by David Wickline Jr. and built by Fred B. Fuqua for Parking Center, Inc., this parking deck is one of the earliest examples of this building type constructed in Lynchburg. The parking deck and its associated attendant's booth and retail space represented the desire to provide full-service and convenient parking in Downtown.

The historic parking garage contributes to the Historic District and should continue to be used as a garage. Older steel parking garages tend to have a limited lifespan compared to concrete structures. The structure should be repaired and reinforced in order to keep the stability of this building as it functions as a parking garage. The impact of vehicular use compared to pedestrian activity is much greater on the existing structure and reinforcement may be required. However, if the use changes, there may be fewer requirements for structural capacity.

The existing garage structure originally included a small retail space and features tall floor-to-floor heights. Two enclosed spaces, one on the ground level and one on the second level, have functioned as businesses since its original construction. Currently, a newly opened diner utilizes the enclosed space on the ground level.

The existing structure is well suited to be partially repurposed into another function such as retail, office, residential or hospitality. Given its contributing status, it may be possible to utilize historic rehabilitation tax credits in the adaptive reuse of this historic parking garage.



*1001 Commerce Street - Historic Parking Structure*

## 901 COMMERCE STREET

This Master Plan recommends the replacement of the existing parking garage with a new mixed-use parking development. The limited life span of the steel structure creates an opportunity to replace it with a more efficient parking layout and variety of uses. Site topography allows for the provision of access points to the top level of the new facility from an alley on Main Street, and the lower level from Commerce Street.

The concept for this site proposes a mix of retail storefronts on the ground floor along Commerce Street, parking on the middle levels, and another use at the top Main Street level. The sketch on the following page illustrates an option for a three-story hotel above the parking area. Other potential uses include office space or residential units. Access for vehicles would take place from Main Street at the top parking level. Delivery access could also be provided at this level to the back of businesses facing Main Street. A public elevator proposed at the northeast corner of the new structure would provide access to interior spaces, as well as an ADA connection from Commerce Street to Main Street. See Chapter 6, Mobility and Accessibility, for proposed vertical circulation systems.

In terms of architectural character, a variety of exterior materials could be introduced into these concepts to articulate different uses and create a less monolithic façade. As proposed in Chapter 4, public art could also be incorporated as part of the design for a more interesting and engaging building aesthetic.

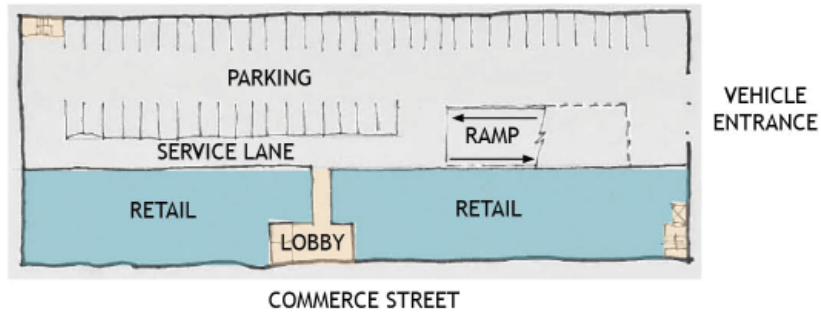


901 Commerce Street - Existing Parking Structure

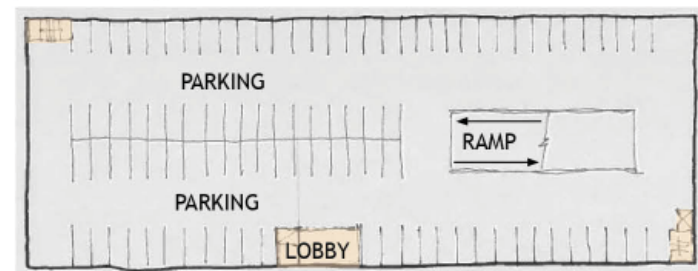


901 Commerce Street - Proposed Concept Sketch

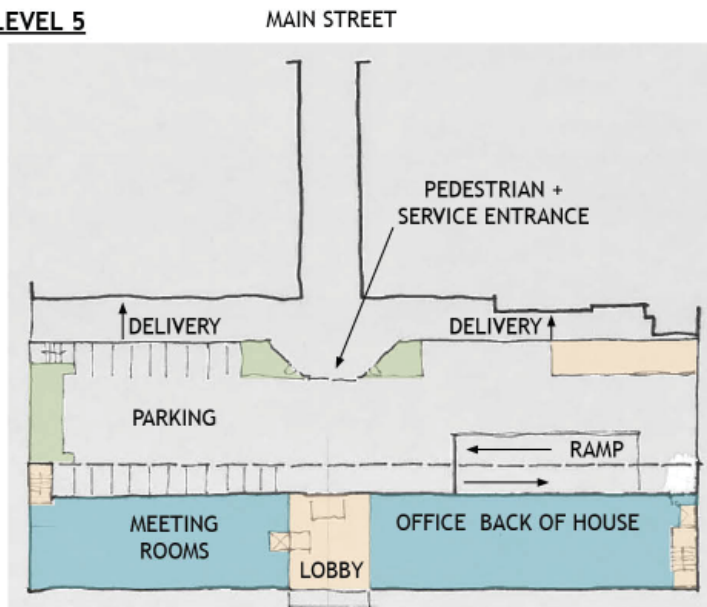
### LEVEL 1 + 2



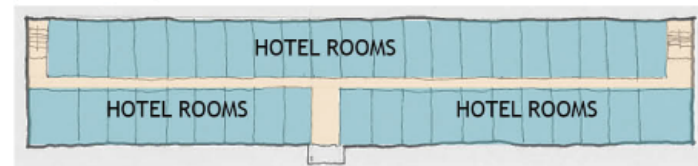
### LEVEL 3 + 4



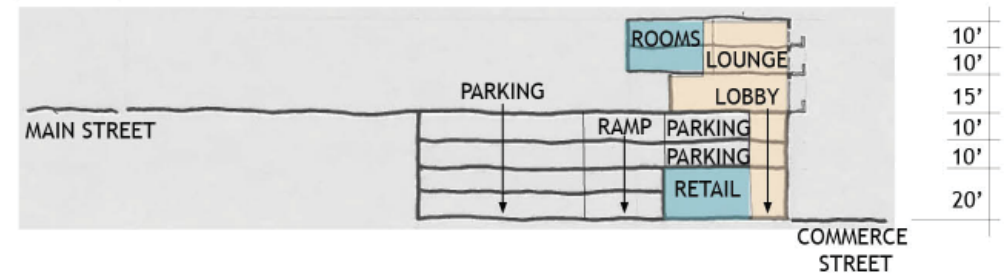
### LEVEL 5



### LEVEL 6 + 7



### SECTION



901 Commerce Street - Proposed Concept



## 5.4 PARKING IN 2040

In 2017, the majority of people coming to Downtown traveled there by personal vehicle. This causes a focus on and demand for both more and free parking. However, as it continues to grow, Downtown will struggle to accommodate a parking space for everyone and planning to will limit its growth. Surface parking is an inefficient use of land in an urban area and structured parking is expensive to build and maintain. Supporting and encouraging the use of other modes of transportation are critical components to seeing continued growth Downtown. Additionally, Lynchburg will need to be flexible moving forward to accommodate changing transit technologies and maximize growth.

### TRANSIT & PARKING

Transit should be improved both to and within Downtown to minimize demand for parking in the future. Reduced headways from nearby neighborhoods and improved transit stops can help this. Within Downtown, if feasible, routes should connect parking areas with destinations, and should be focused on primary routes up and down the hill, the main barrier to walking Downtown. See Mobility Chapter for more information on transit recommendations.



Comparison of the space it takes for 60 people to travel by bus, bike, and car.  
Photo Source: <http://humantransit.org/2012/09/the-photo-that-explains-almost-everything.html>

## MOBILITY HUB

A mobility hub or hubs should be established Downtown. Mobility hubs are places where bus transfers can take place, shuttles can stop, vehicles can “park and ride,” and services such as bikeshare and carshare are available. Bus routes from colleges and other destinations outside of Downtown would interface at this location to provide multi-modal access. New residential housing in a transit-oriented format could be established near this mobility hub. An available location for a mobility hub would be on the existing Court Street Lot (Lot R) near the Lynchburg Regional Business Alliance. A second should be established in a key location in the center of Downtown. See Mobility Chapter for more information on how the hubs should tie into the transit network.



An Example of a Shared Mobility Hub. | Image by Sophia Von Berg via Shared-use Mobility.

## AUTONOMOUS VEHICLES

By 2040, autonomous vehicles will likely be a reality on Downtown streets. While how they will be integrated into the urban landscape is still unknown, the City should remain flexible and adaptive to this new technology. *Shared* autonomous vehicles provide an enormous opening to reduce parking demand and should be encouraged; however, individually owned autonomous vehicles will likely increase the demand for parking or increase emissions and traffic while vehicles circle the block waiting for their owners. Buses/other modes of transit and delivery trucks will also likely become autonomous. Loading/unloading zones or even designated lots may become more prominent features Downtown and begin to replace parking. Sensors may need to be incorporated into the streetscape to communicate surrounding conditions to these vehicles.

As the time approaches to build a new public parking deck, due consideration should be given to the true utility of such an expensive structure in the future. In addition to ensuring it has ground floor retail, the City should question whether it is truly necessary or what accommodations should be incorporated to make it most functional in an autonomous vehicle future. See Mobility Chapter for more discussion on shared autonomous vehicles.

## 5.5 PARKING: GOALS

- > Share parking resources with other Downtown interests by fostering public / private partnerships.
- > Improve parking resources in Downtown using solutions that are attractive, convenient, manageable, and financially feasible.
- > Connect parking areas to destinations through street, transit, pedestrian, bike, and wayfinding networks.
- > Communicate clear and concise information about parking.
- > Capitalize on premium on-street spaces through the implementation of a paid parking program to create vehicular turnover, while also providing lower cost, long-term options nearby.
- > Create a Downtown where visitors only need to park once.
- > Reduce parking demand by encouraging the use of other modes of travel.

## 5.6 PARKING: RECOMMENDATIONS

Parking was identified by the public as one of the major challenges for Downtown Lynchburg in the future. In order to further the recommendations set forth in this 2040 Master Plan, public direction and action is needed for the following:

**Parking Management** – The City should adopt a market-based approach to parking and charge for premium on-street spaces and reduce fees for off-street spaces. All parking resources should be placed under one entity for management in order to make the system work.

**Parking Fund** – A parking fund was established along with the Parking Department to facilitate future parking improvements and facilities. A clear, strategic parking plan should help support other Downtown improvement and beautification projects such as hanging baskets, parklets, bike share programs, etc.

**Parking Aesthetics** – Surface parking should be discouraged as an inefficient use of a limited resource Downtown (land), and new parking should be incorporated into mixed-use decks.

**Large Capital Projects** – Should be carefully considered in regards to occupancy rates of current decks and in the context of changing technologies with shared autonomous vehicles.

**Private Parking** – Minimum parking should not be dictated as it will stymie development and detracts from streetscapes. Tools should be used to prevent building demolition for surface parking.



## PARKING

| SHORT-TERM STRATEGIES                                                                                                                                                                                                                                                   | MID-TERM STRATEGIES                                                                                                                                                                                                                                       | LONG-TERM STRATEGIES                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• <b>Implement Parking Pay Structure</b> for on-street parking and evaluate. Allow first two hours free in public garage or lot in conjunction, and nights/weekends similar to current practice in 12th/Commerce lot.</li> </ul> | <ul style="list-style-type: none"> <li>• Create “<b>parking pool</b>” for Downtown to allow developers to purchase spaces (long term rental).</li> <li>• Conduct comprehensive parking demand and utilization study based on 2040 Master Plan.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Evaluate parking requirements</b> for development and monitor for potential changes to current practice of not requiring or limiting parking for new or redevelopment.</li> </ul> |
| <ul style="list-style-type: none"> <li>• <b>Evaluate and secure public/private partnerships</b> for parking (shared use, leases, etc.).</li> </ul>                                                                                                                      | <ul style="list-style-type: none"> <li>• Adopt <b>design requirements</b> for new parking Downtown into the Zoning Ordinance.</li> </ul>                                                                                                                  | <ul style="list-style-type: none"> <li>• <b>Develop a new mixed-use Parking Garage</b> (public/private partnership with development)</li> </ul>                                                                               |
| <ul style="list-style-type: none"> <li>• <b>Implement Wayfinding</b> for Downtown Parking.</li> </ul>                                                                                                                                                                   | <ul style="list-style-type: none"> <li>• <b>Complete feasibility study for a mixed-use parking garage</b> project in light of changing technology with shared autonomous vehicles and identify best opportunity.</li> </ul>                               |                                                                                                                                                                                                                               |
| <ul style="list-style-type: none"> <li>• <b>Revise parking management structure</b> so that the same entity manages both on and off-street parking.</li> </ul>                                                                                                          | <ul style="list-style-type: none"> <li>• <b>Evaluate and reconfigure transit connections</b> to parking.</li> </ul>                                                                                                                                       |                                                                                                                                                                                                                               |
| <ul style="list-style-type: none"> <li>• <b>Undertake biennial parking utilization studies</b> and set triggers for mitigation measures.</li> </ul>                                                                                                                     | <ul style="list-style-type: none"> <li>• Establish a <b>mobility hub</b> in Downtown.</li> </ul>                                                                                                                                                          |                                                                                                                                                                                                                               |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

PAGE LEFT INTENTIONALLY BLANK

## 6. MOBILITY AND ACCESSIBILITY

- 6.1 BEST PRACTICES IN DOWNTOWNS
- 6.2 FINDINGS
- 6.3 WALKABILITY
- 6.4 TRAFFIC CIRCULATION AND MANAGEMENT
- 6.5 TRANSIT
- 6.6 BIKEABILITY
- 6.7 MOBILITY AND ACCESSIBILITY: GOALS
- 6.8 MOBILITY AND ACCESSIBILITY: RECOMMENDATIONS

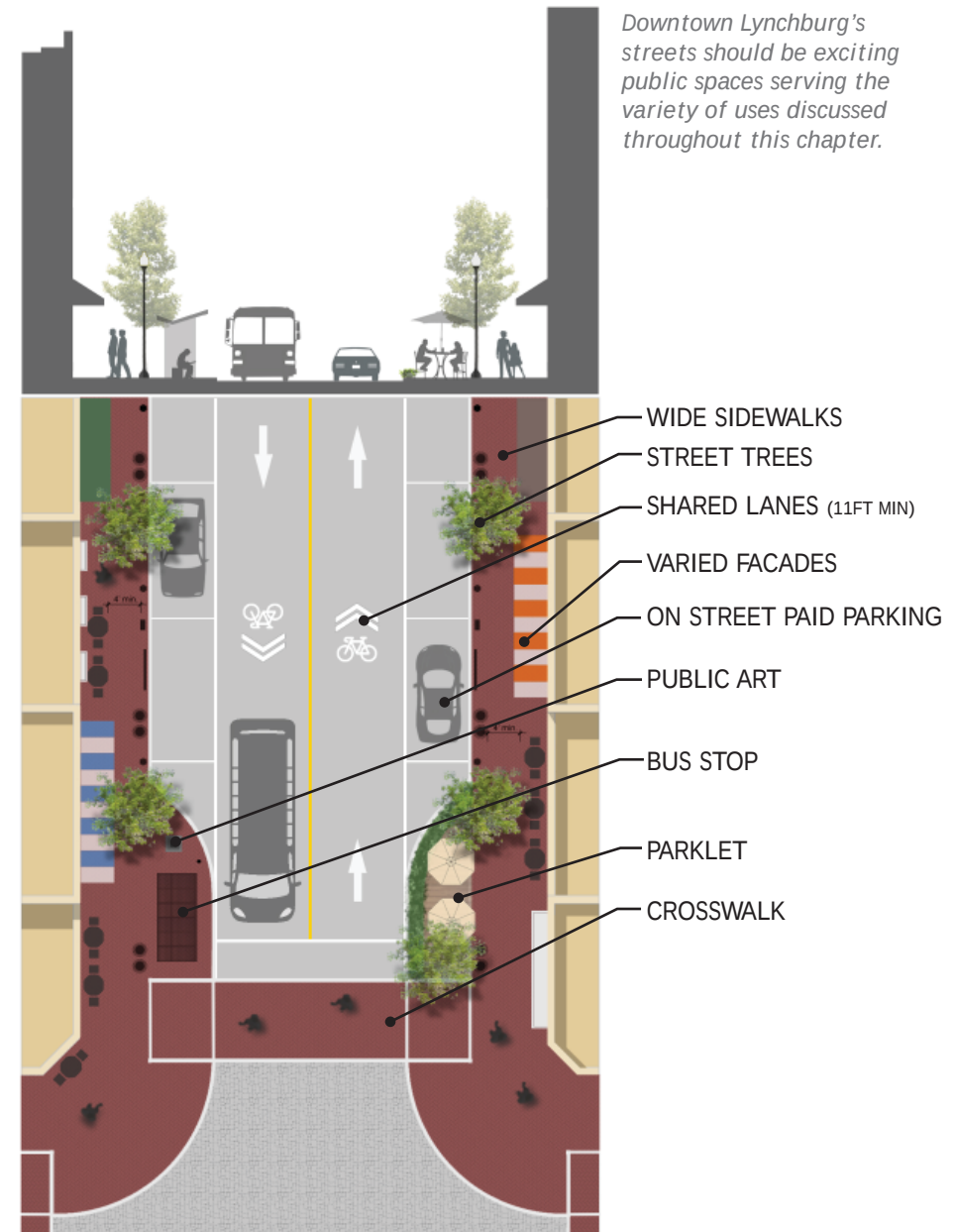


PAGE LEFT INTENTIONALLY BLANK

This section focuses on the mobility of all types of transportation to, from and within Downtown. In the past, transportation projects have focused primarily on moving the most automobiles as quickly as possible with little regard for the surrounding context or other modes of travel – foot, bike, or transit. Transformative projects from the Downtown & Riverfront Master Plan 2000 that began to rectify this trend kicked off the revitalization seen Downtown today and are beginning to create a bustling, successful urban center that has life at all hours of the day. This section makes recommendations that focus on the benefit of the Downtown environment and how to continue the growth in Downtown Lynchburg.

Because Downtown has seen so much transformation since its previous master plan, the recommendations in this section include two major categories. Some are recommendations from the 2000 plan that have not yet been implemented, such as the conversion of one-way streets to two-way, which must be accomplished now. This plan includes more detail on why, how, and when this should be completed. There are also new recommendations geared toward addressing mobility issues and challenges due to changes in Downtown and the way people in America move. Emerging modes of travel, such as shared autonomous vehicles and bike-share, are enabled with this planning effort.

All recommendations contained herein, new and legacy, increase mobility and accessibility for Downtown residents, workers, students, and visitors. How people move to, from, and within Downtown will be paramount to the success of this next wave of a reimagined Lynchburg.



## 6.1 BEST PRACTICES IN DOWNTOWNS

For too long streets have been designed for one function – to move cars quickly and without delay. The reality is that streets can do more than just move cars. They can move people on foot, on bikes, and on transit, often without impacting vehicular throughput. They can also be more than just a way to get somewhere else. Good streets can be good places, too. They are public places where people meet, sit, eat, socialize, conduct business, wander about, play, and more. Downtowns need to create this atmosphere in order to succeed in the 21<sup>st</sup> Century. Over time best practices on designing downtown streets have evolved from being focused on simply moving cars to serving this variety of purposes. Creating these kinds of streets requires the combination of a walkable, mixed-use land use pattern and a transportation network that supports it.

*“The best transportation plan is a good land use plan”*  
– Former Vancouver planning director Brent Toderian.

Cities determine their desired land use and tailor their transportation network to it. If a dense, bustling, urban core is preferred, then the transportation planning efforts should focus on:

1. Walkable streets
2. People and space efficient transportation options

The key is to make sure that growth is not limited by the transportation network. If it is expected that everyone will travel by car to, from, and within a downtown, then the city will quickly run out of space to contain the automobiles and deter further growth. If the transportation network focuses on moving the most people, the amount of growth a downtown can accommodate becomes limitless.



*Streets can serve many uses and become good public spaces that foster Downtown life and activity.*



## 6.2 FINDINGS

Walkable, mixed-use downtowns are also good for business. According to a study completed by the EPA (Smart Growth and Economic Success: The Business Case: U.S. Environmental Protection Agency's Office of Sustainable Communities; 2013), many companies are moving to walkable downtowns because they recognize that locations with housing and transportation options, coupled with a mix of land uses and cultural amenities can benefit potential employees as well as surrounding business through:

- > **Increased productivity and innovation.** Dense downtowns provide easier access to labor and suppliers, which improves productivity. Downtowns also promote and encourage social interaction both within and among firms, creating an atmosphere of collaboration. Increased walkability also makes it easier for employees to participate in physical activity, which can improve health and potentially decrease health care costs.
- > **Improved ability to compete for labor.** Trends indicate that many professionals and recent college graduates prefer to have the opportunity to walk to work, as well as to walk to shops, restaurants, and entertainment. Additionally, low-wage workers need access to affordable housing near jobs and transportation options. In order to meet the needs of both groups, many businesses seek walkable central business districts, with access to transit.
- > **Stronger retail sales.** If customers can reach stores in multiple ways, stores find it easier to attract customers.

The planning team found the following while looking at transportation in Downtown Lynchburg:

- > The success in revitalizing Downtown Lynchburg since the adoption of the Downtown & Riverfront Master Plan 2000 is a direct result of methodically implementing the recommendations included in that planning effort. Many items have been “checked off the list” since adoption of the plan and the results are extremely visible in new residential units, new restaurants and stores, recreational facilities (i.e. the Bluffwalk), and cultural facilities (i.e. the Academy Theater).
- > The **behavior of traffic**, on one-way streets – Main and Church Streets, and on the four lane segments of Fifth Street and the John Lynch Memorial Bridge creates vehicle speeds, weaving behavior and has other effects that are detrimental to the walkable environment. See more in the Vehicular Circulation and Management section later this chapter.
- > **Significant grades** between the “levels” of Downtown as people move up and away from the riverfront make Downtown seem more disconnected than the actual distance would indicate.
- > **Transit is underutilized.** Ridership of the Hopper and GLTC Routes could and should be increased. There are direct routes into Downtown that should make transit the easiest way to reach Downtown.
- > Downtown Lynchburg streets already have components that are conducive to walking. Blocks are short and of a walkable scale, most have on-street parking and street trees, and there is a well-established grid of streets with wide sidewalks that connect to each other and important destinations in Downtown. This is the perfect foundation to build a very walkable downtown.

## 6.3 WALKABILITY

As some point everybody becomes a pedestrian. Whether they drive, bike or take transit, eventually they leave their vehicle, become a pedestrian, and walk. The model for a successful Downtown, where visitors park once, maybe a few blocks away, and walk to their destinations, relies on having an appealing pedestrian environment. If the distance the pedestrian must walk uninviting, they will be deterred from making the walk, viewing it as too much of a burden. Because walking is transportation's lowest common denominator, walkability is possibly the most critical component to continuing Downtown's growth and should be reinforced with every project.

### PRINCIPLES OF WALKABILITY

Prioritizing walkability requires some significant changes that dramatically change the streetscape (i.e. the conversion to two-direction traffic). Primarily though, creating a walkable environment requires small but pervasive changes throughout a streetscape that subtly affect the pedestrian's experience. The following principles identified by The San Francisco Bay Area Planning and Urban Research Association (SPUR) 2013 report *Getting to Great Places* are keys to determining the walkability needed Downtown.

**Create fine-grained pedestrian circulation.** Frequent and densely interconnected pedestrian routes are the basis to walkability, as they shorten both actual and perceived distances. Lynchburg's Downtown blocks are already of a walkable scale, but could be enhanced through additional pathways through blocks, especially where streets have been closed or disconnected due to topography, creating larger than normal blocks.

**Orient buildings to street and open spaces.** Buildings should not be set back behind parking lots or large landscaped areas. This provides easy pedestrian access to buildings, frames the street environment, and emphasizes walking as the primary mode of transportation.



*A building on Church Street is set back from the sidewalk with a more suburban style of development. The entire sidewalk acts as a driveway, degrading the walkability in front of the business.*

**Organize uses to support public activity.** The most public/active uses, such as restaurants, lobbies, and stores, should be placed on the ground level along pedestrian routes and designed to be visible and build interest from the street. Uses that are more private and less active should be designed to be internal to blocks and on upper floors. Place parking behind or below buildings. Surface parking requires large amounts of space and detracts from creating a walkable, urban environment. Parking in Downtown should be in mixed use garages as discussed in the Parking Chapter. Pedestrian exits from these garages should be located to help activate the street.

**Address the human scale with building and landscape details.** Façade elements such as lighting, signage, awnings, and window openings can break up large masses and help humanize buildings. Sidewalks should include features like benches, street trees, and public art to humanize street spaces.

**Provide clear, continuous pedestrian access.** Sidewalks should be continuous throughout Downtown and not be broken by driveway entrances. Where sidewalks cross streets, high visibility crosswalks should be provided. These critical intersection points should also be minimized by curb extensions, reduced curb radii, median refuges and pedestrian signals. See the Vehicular Circulation and Management section for more discussion on intersection design.



*Curb extensions help to shorten the crossing distance for pedestrians. Coupled with high visibility crosswalks, the crossing of major roadways such as Commerce Street can become more comfortable for all users. Additionally, landscape and streetscape enhancements improve the aesthetics of the street, benefiting both the pedestrians and local businesses.*



**Build complete streets.** Ensure streets accommodate all modes of travel and all abilities. The City of Lynchburg has already made it a priority to rebalance its transportation system to better accommodate all modes of travel. In 2013, the City adopted a “Better Streets Policy” which combines the principles of Complete Streets, which maintains streets are not just for cars, and Green Streets, which encourages streets to serve environmental purposes too. The next step is to develop more specific design guidelines that articulate the needs of each corridor type (e.g. sidewalk width, curb height, amenities, etc). Downtown, only the street space that is necessary to maintain functionality should be allocated to private vehicles, as Downtown should contain the most balanced use between all modes.



*Only the space really necessary to maintain functionality is dedicated to vehicles in revitalizing urban areas. Extra space in this photo is used for a wide pedestrian path, bike paths, and public space.*



## SOLUTIONS TO LYNCHBURG'S TOPOGRAPHY

Downtown Lynchburg's unique geographic features provide its characteristic vistas of the James River. To account for the grade change, historic development occurred in terraces, creating a segmented Downtown, separated by steep roadways. While vehicular circulation is unhindered by topography, pedestrian, particularly that of people in wheelchairs, and bicycle accessibility suffer from the steep topography (nearly 20% slope) of the roadways which are perpendicular to the River. Main Street and Jefferson Street are very close physically, but separated by extreme grades, creating a barrier for moving from one street to the other.

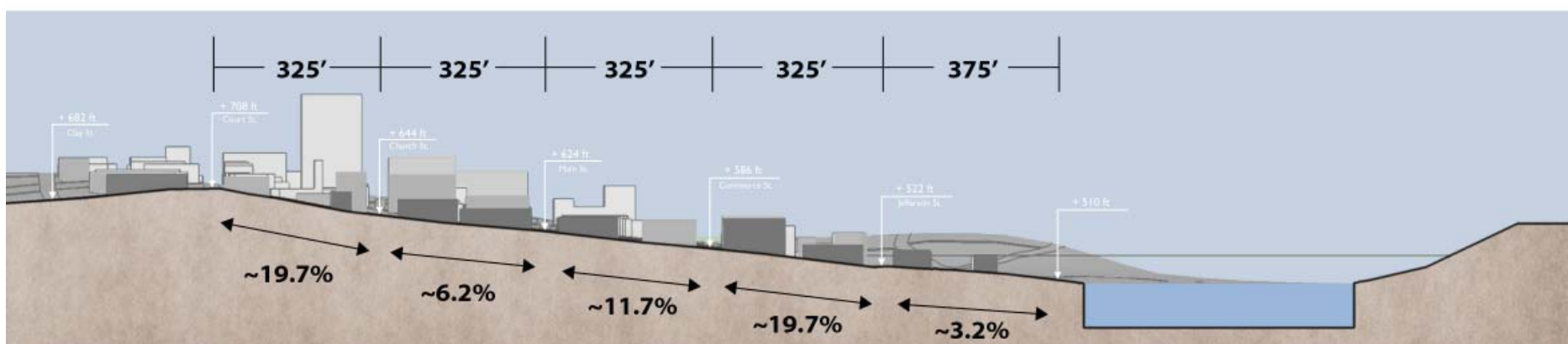
### AMERICANS WITH DISABILITIES ACT (ADA)

Ideally, a sidewalk grade should not exceed 5%. Where the sidewalk grade approaches or exceeds that of the maximum permitted for a ramp, it is good practice to provide a level rest area. The slope of the level landing should not exceed 2 percent in any direction. The dimensions of the level landing should be at least 5 feet x 5 feet to

allow wheelchair users to stop and rest without blocking the flow of pedestrians. This area can be greater to become parklets and able to include other amenities such as benches, hand rails, and drinking fountains. While not specifically addressing the Americans with Disabilities Act (ADA), amenities make being a pedestrian more attractive even if it takes longer to reach a destination.

Since sidewalks typically follow the street grade, it is often difficult to maintain comfortable slopes in Lynchburg, especially for wheelchairs. In areas with steep slopes, such as Downtown cross streets, accommodations for alternate modes of travel are needed. At a minimum, sidewalks need to be wide to permit the wheelchair user to travel in a zig-zag motion.

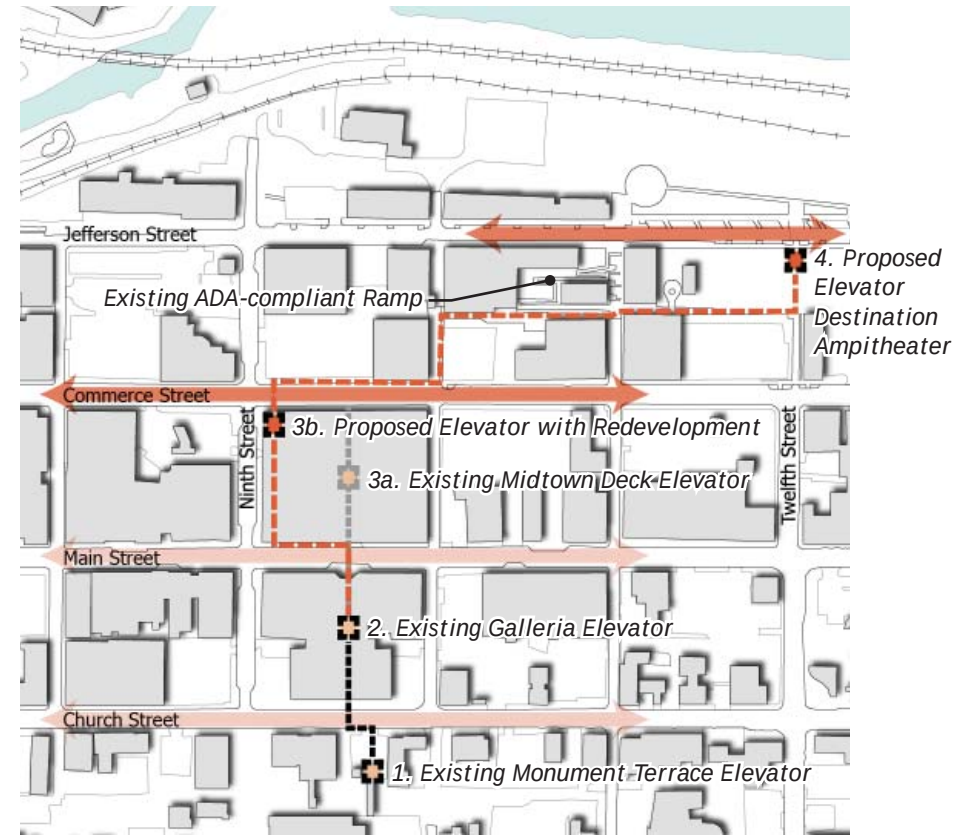
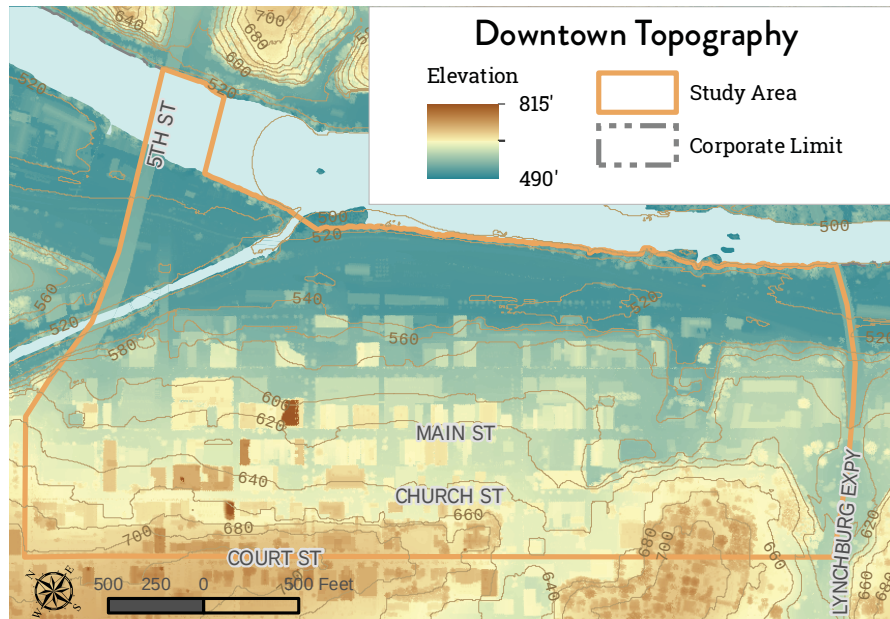
While walking Downtown Lynchburg's steep grades is certainly good exercise and more attractive with an improved walking environment and paid on-street parking, other available tools include elevators, escalators and transit.



Analysis of existing street/sidewalk grades between Court Street and the James River.

## ELEVATORS

Elevators integrated into new development Downtown can help ease travel up and down the hill both for people with physical disabilities and for everyone in extreme weather. Existing public and semi-public elevators already help travel between Court Street, Church Street, Main Street and Commerce Street, though the connection to Commerce Street is less known. Through these public and semi-public elevators, Monument Terrace is accessible to everyone from the lower side of Commerce Street. This plan recommends two new elevators to improve ADA access down to Jefferson Street, currently accommodated by an existing ramp.



*Public and Semi-Public Elevators Help Improve Accessibility on Downtown's Multiple "Levels"*

As the Midtown Parking deck is replaced, a public elevator is recommended to access Commerce Street along a public street, rather than internal to the garage. The other opportunity for a public elevator is the design and construction of the Destination Amphitheater proposed in Chapter 4. The addition of these two elevators will improve the accessible connection between the riverfront and Monument Terrace. Others should be encouraged and incentivized with private development as needed to improve accessibility Downtown. As they are implemented, their locations should be along public streets as much as possible to clearly illustrate to potential users where they go and their ease of use. If users are unsure where they go and where they'll end up, they will be less likely to use them and more likely to drive or not make the trip to a nearby business at all.



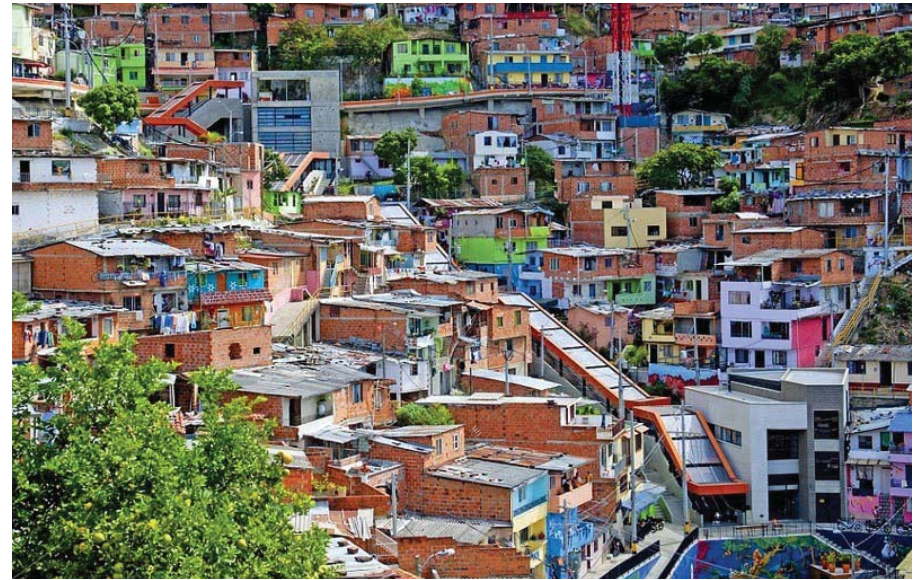
## ESCALATORS

The installation of outdoor escalators (as well as ski gondolas) in steep, informal settlements of South American cities have successfully eased pedestrian travel up the extreme slopes of these neighborhoods and should be considered as a tool for tackling the grades of Downtown Lynchburg. These escalators can provide a unique street feature that would dramatically transform one (or more) of Downtown's steep streets and make Lynchburg feel much flatter than it is.

Typically, a permanent transportation investment along a street spurs redevelopment of adjacent sites. Careful design to ensure the structures contribute to the Downtown environment could do the same in Lynchburg. Tenth Street may be a good central location for a series of escalators reaching from Jefferson to Court Street and would benefit from attracting infill development to adjacent sites. New technologies may even allow a facility such as this to be ADA accessible with wider platforms available to move people in wheelchairs (or strollers and shopping carts) up the hill.



*10th Street has the potential to accommodate a series of escalators to help move people uphill and attract adjacent redevelopment.*



*Escalators were installed to move people up the steep slopes of Medellín, Colombia, better connecting the community on the hill. Photo Source: <http://www.amusingplanet.com/2015/03/massive-outdoor-escalator-in-comuna-13.html>*



## TRANSIT ON THE HILLS

Transit should also be used to tackle Downtown's hills. Buses are extremely flexible because their routes can be easily be changed; however, more permanent transportation is more likely to see use and promote adjacent development. Once a successful route is determined, bus routes should be made to look as permanent as possible with stops that have a significant presence on the streetscape and clear routing. See the section on transit later this chapter for a comprehensive discussion on how to improve transit to promote Downtown growth.



*Permanent transportation infrastructure like trolleys are more attractive to users because there is a degree of certainty in their routing. Adjacent land also often redevelops because of the permanence of this major investment. However, Buses are less costly and have more flexible routing. Lynchburg should continue to use buses but consider more permanent infrastructure in the future.*

## 6.4 VEHICULAR CIRCULATION AND MANAGEMENT

### TRAVEL DIRECTION

One of the primary goals of this plan is to reinforce that Downtown is a place that people go *to*, and do not simply drive *through*. To that end, it is critical to have a mobility system that adequately balances the needs of motorists with other modes of transportation, primarily walking, but also biking and transit. After all, a successful mobility system focuses on moving people, and not just cars. As indicated previously, walkability is a basic tenet of a successful Downtown.

One of the main barriers to improving walkability Downtown is the behavior of traffic on one-way streets. One-way streets are counter to the best practices in downtowns discussed earlier in this chapter as they are primarily designed to move the most vehicles as quickly as possible out of downtowns, to the detriment of the pedestrian environment.

The following are the specific reasons to convert Downtown's travel direction from one-way to two-way:

- > One-way streets increase out of direction travel and unnecessary turning movements, increasing Downtown traffic volumes.
- > One-way streets require extra travel routes for first time visitors trying to reach a specific destination. To ensure continued Downtown growth, it is vital that visitors have good first experiences, so that they come back.
- > Two-way streets promote transit use. Transit routes are able to operate in both directions on the same street, which eliminates confusion for visitors and non-frequent users of transit Downtown, encouraging them to become regular users and thus freeing up parking spaces.

#### LYNCHBURG, 1954

Main Street and Church Street were converted to one direction travel in June of 1954. City Council had decided in February of that year, in a 4-3 vote, to conduct a 90-day trial of one-way streets. It was one of three proposals to combat automobile congestion on Downtown streets, but not the one narrowly favored (316-302 votes) by the public according to a survey conducted by the Lynchburg News just before City Council's vote. This decision was one of many that followed the nationwide trend of the era to facilitate automobile use and suburban retail shopping experiences. The construction of the Lynchburg Expressway and the John Lynch Bridge, the removal of parking on 5th Street, the routine widening of streets like Memorial Avenue and Langhorne Road, the replacement of time actuated signals with vehicle actuated ones, the increase of curb radii to facilitate quicker turning movements and the conversion of previously two-way streets to one direction all helped decentralize the city and unforgivingly eroded the pedestrian environment in Downtown.



Main Street - Late 1940s

- > One-way streets with multiple lanes and coordinated signals enable aggressive motorists to speed and “slalom” in passing slower traffic. This situation is exacerbated when the street has excess capacity like Main and Church Streets. This atmosphere weakens a walkable downtown environment.
- > Pedestrians walking with traffic at their backs feel less comfortable.
- > Two-lane, one-way streets with stop-signs (as was implemented with Phase I of the Utility and Streetscape Project) create undesirable crossing environments where adjacent cars shield pedestrians and vehicles from view. In a walkable Downtown, the slower speeds and the elimination of the possibility of the “dual threat pedestrian collision” illustrated in the diagram to the right contribute to a pedestrian’s sense of safety and comfort in walking along and across the street.
- > The speeding encouraged on one-way streets creates driver “tunnel vision,” where they see little around them and are unlikely to stop at adjacent businesses.
- > From an economic standpoint on two-way streets each and every business has equal ability of its frontage to be seen by passing traffic; on a one-way street, businesses can be located on “eclipsed” frontage as shown in the diagram to the right, putting them at a disadvantage from a potential customer standpoint.
- > During construction, detours are more difficult to route and provide the same business accessibility as there are fewer options for traffic traveling each direction. This will be important to consider as Lynchburg continues its fifty-block waterline and streetscape project Downtown.



*The “Multiple Threat” Pedestrian Conflict*

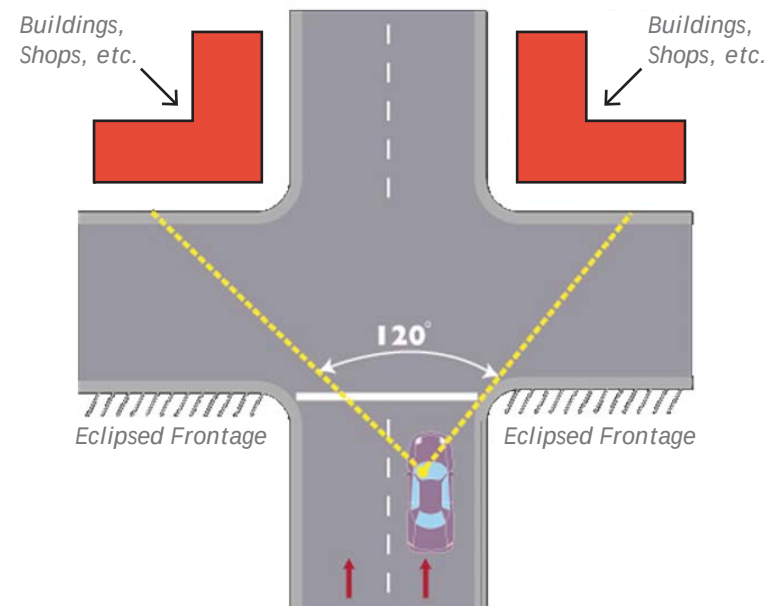


Image Courtesy Walter Kulash

*Retail Eclipsing on one-way streets*



## CASE STUDY: CHATTANOOGA

A time lapse of aerial photography from a few blocks of the converted pair of ML King/McCallie and Bailey Avenues in Chattanooga reveals the extent of redevelopment that occurred on the corridors as a result of the conversion to two-way traffic. The first photo is from 1997, while the streets were still one-way. The University of Tennessee-Chattanooga is on the north side of McCallie Avenue. The second aerial is from 2002, about four months after the conversion was accomplished. While the conversion was being debated, parcel owners were preparing to move on redevelopment, which is evident in locations along the corridors. The final image is 2016 aerial, showing the extent of new development along the corridors. While success was certainly not guaranteed on these corridors in Chattanooga, it is evident from the time lapse that the majority of the development that took place happened after the conversion was completed. That success did not extend along the one-way pair of ML King/McCallie and Bailey Avenues. In addition, Chattanooga is in the process of converting the remainder of their Downtown one-way streets to two-way operation. The “orphan” one-way streets have consistently underperformed in economic vitality in comparison to two-way streets in Downtown.



*ML King/McCallie and Bailey Avenues:  
Chattanooga, 1997: Pre-Conversion*

*ML King/McCallie and Bailey Avenues:  
Chattanooga, April 2002 (conversion opened  
in January of that year). Note all the  
construction*

*ML King/McCallie and Bailey Avenues:  
Chattanooga, 2016  
Conversion opened in January of 2002*

## DELIVERIES

While there are certainly advantages to two-way traffic, it was evident from discussions with a few business owners that there is push-back on converting one-way streets to two-way. The biggest issue raised by these owners was the ability of businesses on Main Street to receive deliveries. Currently, delivery trucks stop and block one of the two travel lanes to make deliveries to businesses, even though loading and delivery zones are clearly marked in the on-street parking areas of the street. Other cities that have successfully made conversions or have always had two-direction travel always enact the following measures to facilitate deliveries and support businesses:

1. adequate provisions for loading zones
2. time restrictions on those zones as needed so the zones can revert to parking at off-delivery hours
3. enforcement of loading zone requirements so that travel lanes are not blocked and loading zones are available as needed

These provisions were developed through joint conversations with businesses, delivery companies, and cities to develop solutions that best addresses the needs of all parties. While there have been discussions on loading and deliveries with the merchants on the subject segment of Main Street, there are concerns still among some business owners. All cities that have successfully converted one-way streets in similar contexts (restaurant uses, no alleys) have successfully navigated these design issues related to deliveries.

As the graphic illustrates, deliveries on Main Street can be accommodated without blocking a travel lane. This scheme was developed collaboratively between the city and business stakeholders. Delivery schemes such as this will need to be developed for business owners along all of the converted sections. The success of the 2040 Downtown Plan will depend on an acceptable solution and should continue the dialogue to ensure that businesses and delivery providers can maintain timely and convenient service.



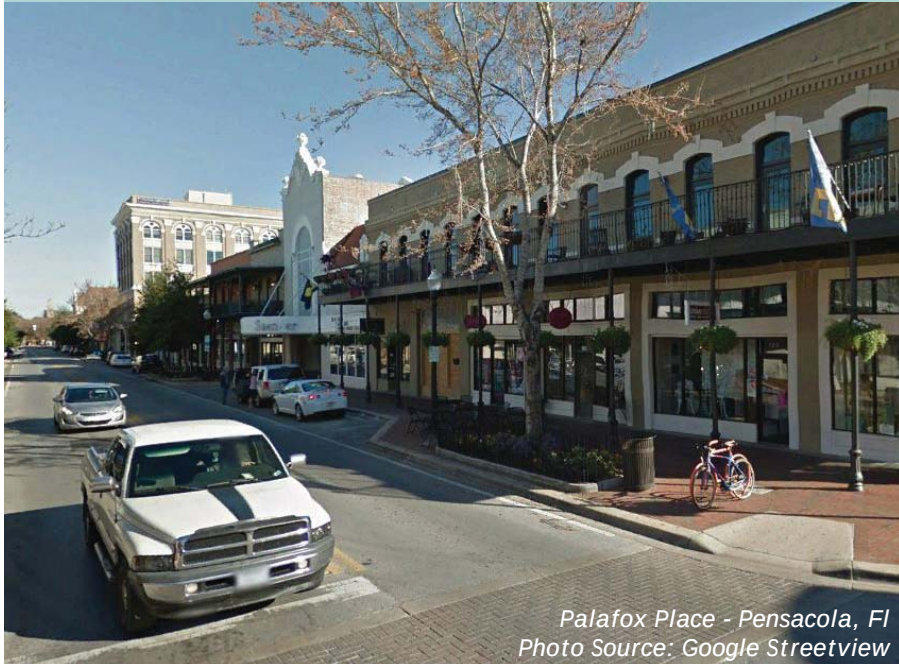
*The city has been working with business owners to develop delivery schemes under a two-way conversion, as illustrated here for the 1100 blocks of Main and Church. This plan recommends that collaboration with individual businesses continue to ensure that businesses can adequately receive deliveries along the converted two-way streets.*

**PLANNED  
LOADING ZONES**



## CASE STUDY: PENSACOLA

An example of successfully working with businesses and delivery companies is Downtown Pensacola, Florida, which converted Palafox Place (their Downtown Main Street) in 2009. Prior to the conversion, deliveries were made on Palafox the same way that Main Street Lynchburg deliveries are made today; a delivery truck would simply stop in one of the two travel lanes. The City worked to open a dialogue among the business owners and the delivery companies that served them to develop a plan for deliveries that would facilitate two-way traffic, including time limited loading zones with all parties agreeing to modify their schedules. As a result, Palafox was named one of the 10 Great Main Streets in 2014 by the American Planning Association (<https://www.planning.org/greatplaces/streets/2013/palafoxstreet.htm>).



*Palafox Place - Pensacola, FL  
Photo Source: Google Streetview*

## MAIN STREET/CHURCH STREET

There was much discussion and debate during the Master Plan public input sessions about returning Main Street and Church Street traffic to two-way operation. As first recommended in the Downtown Master Plan of 2000, and reiterated by other technical studies since (including a detailed engineering and traffic analysis study), the streets do not need to remain as a single direction, two lane cross section to maintain adequate traffic movement to and through Downtown Lynchburg. As other parts of Downtown have become revitalized, they have a very different feel than these two corridors; they have slower traffic, and are more conducive to walking. Also, the blocks with one-way traffic have not seen the amount of redevelopment that other streets have experienced. In other downtowns where one-way streets are mixed with two-way streets, the experience has been that revitalization and redevelopment on the one-way segments lag behind the two-way streets.

Many downtowns have embarked on converting one-way streets to two-way travel, often as part of a downtown revitalization process much like Lynchburg's. In many cities after World War 2, streets were converted to one-way to move workers into and out of downtown as quickly as possible. Renewed interest in living downtown has minimized that desire to get out of the city as quickly as possible. Case studies in downtowns such as Chattanooga and Pensacola, among others, have shown that conversion of one-way streets to two-way have resulted in significant economic development when coupled with an actionable master plan such as this.

Because of the numerous benefits of two-direction travel, that there are implementable solutions to the main downside (ease of deliveries), and that the City recently completed a detailed traffic study that shows negligible traffic operations and delay differences, Main Street and Church Street should be converted to two-direction travel as soon as possible, before the next phase of waterline replacements (see Chapter on Utility and Streetscape).



It was clear from the work sessions and analyses that Main Street and Church Street have more vehicular capacity than they need and that this condition is resulting in vehicular speeds and behavior that are out of context with a walkable Downtown. Three options were explored to ease this condition:

- > **Max Circulation** - the recommended conversion of one-way traffic to two-way to maximize walkability;
- > **Max Parking** - an option that removed a travel lane and converted one side to back-in angled parking; and
- > **Max Mode Choice** - a concept that eliminated one travel lane and provided a dedicated/separated bicycle facility.

Each of these potential conditions is illustrated in the cross sections to the right. The concept that converts the lane to angled parking would have the benefit of additional on-street parking; however, with only one lane, the city does not reap the benefits of two-way travel, and using street space simply as car-storage runs counter to major themes of this plan aimed at activating Downtown streets. The separated bike lanes option would have the benefit of providing dedicated space for cyclists protected from motor vehicles; however, again the city loses the benefits of two-way travel. All three options would eliminate the excess capacity on Main Street and Church Street, and “rightsize” the street for the amount of traffic they carry while controlling motor vehicle speeds and behavior. The “max circulation” concept allows movement of motor vehicles in the most direct access and all types of vehicles; it increases accessibility for visitors, deliveries, and emergency services; it simplifies bus routes; provides a similar amount of on-street parking as exists currently; and slows traffic to make the streets more walkable and bikeable.



*Three concepts were developed to retrofit Main and Church Streets: Max Circulation provides two bi-directional streets to enhance circulation; Max Parking provides the most potential parking spaces; while Max Mode provides dedicated bike lanes for maximum mode choice.*

## SIDE STREETS

While Main and Church streets are the primary thoroughfares that operate in one-direction, many side streets between 5th and 12th Street are one-direction as well. These should be considered for two-way traffic on a case by case basis, depending on street width, the needs

of adjacent businesses, and area connectivity. In general, as many of these streets should convert as soon as possible to improve vehicular circulation and walkability.



Existing



Proposed

## INTERSECTIONS

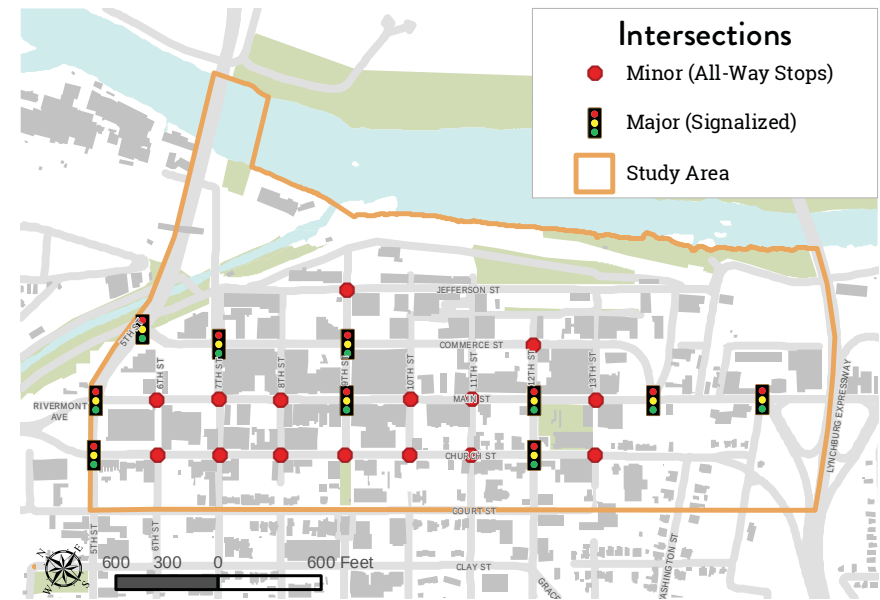
Downtown intersections are key locations where vehicles and pedestrians interact and priority is either granted to vehicles or people. Creating the walkable Downtown this plan calls for will require improvements to make sure pedestrians feel and are safe while crossing streets Downtown.

### MAJOR INTERSECTIONS

Major intersections – Main Street with 5th, 9th, and 12th Street and Church Street with 5th and 12th – should continue to be signalized where they are today, but incorporate a leading pedestrian interval, where pedestrians walking parallel to traffic, are allowed to walk before the vehicular traffic light changes, forcing turning traffic to wait until pedestrians have finished crossing. This increases safety and comfort for pedestrians. If pedestrian traffic increases significantly, the City should explore an all-pedestrian signal phase to further enhance walkability.

### MINOR INTERSECTIONS

The current plan to remove signals and install all way stops at minor intersections is an appropriate recommendation under current traffic volumes, as long as neither vehicle nor pedestrian volumes grow significantly. In the event that any of these intersections require future signalization, leading pedestrian signals or all-pedestrian phases should be installed. Additionally, because the streets are still one-way, the current configuration at minor intersections between 5<sup>th</sup> and 9<sup>th</sup> Streets, creates an unsafe situation where one car blocks the view from another car of pedestrians trying to cross the street. See discussion of the “dual threat pedestrian collision” earlier this chapter. Signals will need to return if traffic is to remain one-direction.



Additionally, the following tools will improve intersections Downtown:

- > Crosswalks should be highly visible.
- > Long crossings should be reduced through
  - Installing pedestrian refuges where pedestrians only have to cross one or two lanes of travel at a time; and
  - Implementing “Neckdowns” or curb extensions – a reallocation of street space away from automobile. After snowstorms is a good time to see what street space is not really necessary for automobile travel as it will be used for snow storage. See “pavement to parks” section in the Public Space and Recreation Chapter.
- > Curb radii should be reduced to minimum possible. These were often enlarged in downtowns to allow for quicker vehicle turns or to facilitate larger truck movements.
- > Ramps should be oriented perpendicular to the street, not angled into the intersection.
- > Midblock crossings should be explored where high levels of pedestrians are crossing without protection.



## 6.5 TRANSIT FACILITIES

Transit will play a significant role in the success of Downtown, not just in overcoming the topographical challenges Downtown faces as discussed earlier, but because it has the potential to transport the most people as efficiently as possible. Transit supports walkability as it helps pedestrians travel longer distances, up steep hills, or in unpleasant or unexpected weather.

In Downtown Lynchburg, transit should be used to:

- > Overcome Downtown topography
- > Better connect available parking areas to Downtown destinations
- > Spur redevelopment along transit corridors
- > Connect nearby neighborhoods via an attractive alternative to driving
- > Link Downtown to regional transportation such as Amtrak and the airport
- > Tie Lynchburg's numerous colleges with its urban center.

### ROUTES

#### NEIGHBORHOODS

Neighborhoods surrounding Downtown provide a great opportunity to increase transit use. If taking transit is cheaper, more convenient, and faster than driving and parking, riders will be likely to switch. See Connecting Communities Chapter for a more comprehensive discussion of neighborhood connectivity.

#### COLLEGES AND REGIONAL TRANSPORTATION

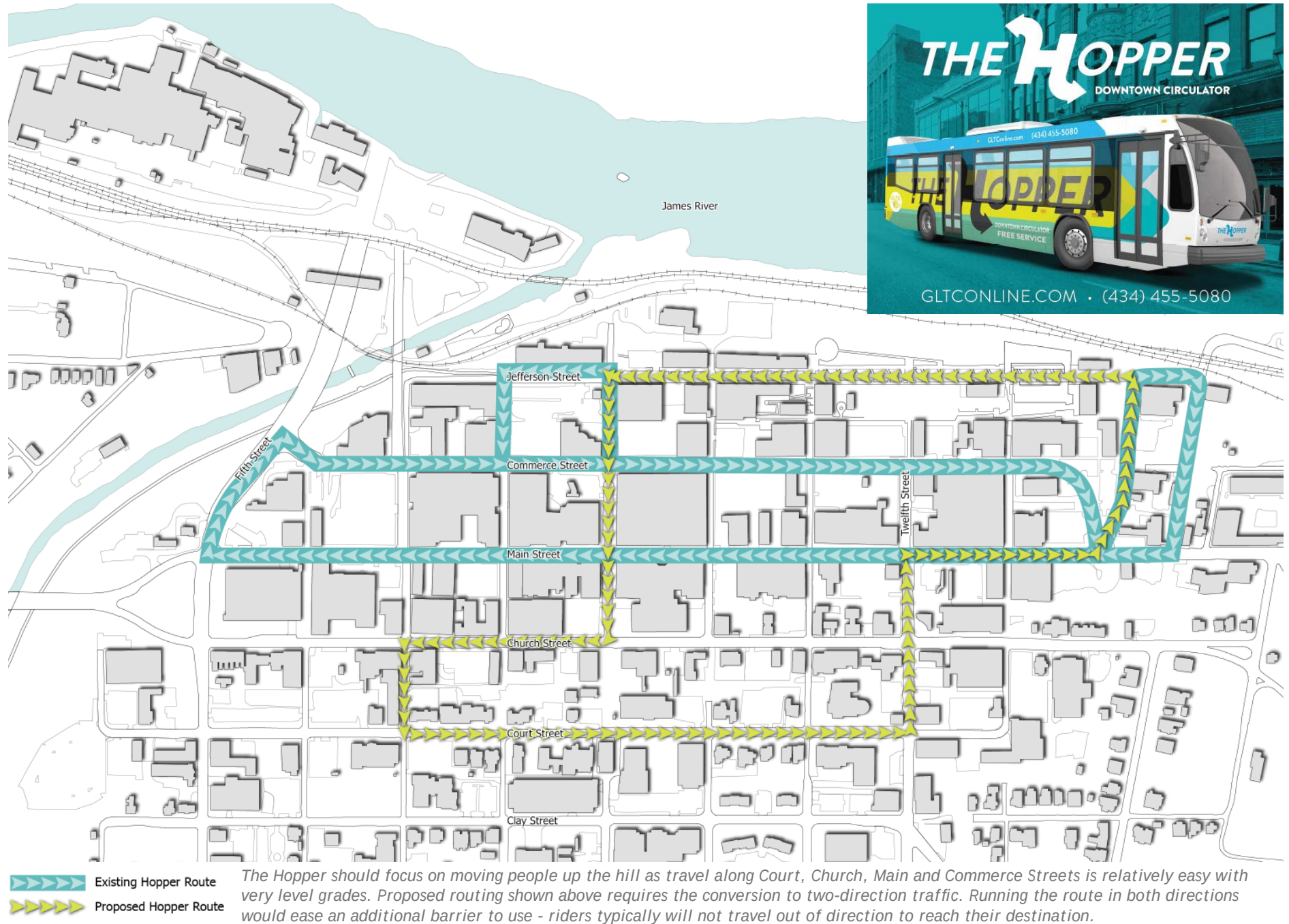
There are four colleges within Lynchburg's city limits, an enormous resource for creative and cultural activity, but none of them have a presence Downtown. Increasing the accessibility of Downtown to students and faculty can help bring some of this activity Downtown, as well as encourage students to remain in Lynchburg after graduation as they learn to love the City outside of their campus. A route to Lynchburg College can also connect to the Amtrak and Greyhound Bus Station in its direct route. Liberty University's route could also connect to the Lynchburg Airport. See Connecting Communities Chapter for a more comprehensive discussion on college connectivity.

#### THE HOPPER

The Hopper is a local circulator bus, aimed at easing travel up the hills, that began running in 2017 but has had limited success due long headways, limited hours of operation and confusing routing. It should continue use into the future as it is the most flexible tool to move pedestrians uphill.

The following would help improve Hopper service:

1. Smaller, more agile buses, that focus on the vertical routes through Downtown would better help serve the purpose of moving people up the hill. Riders typically do not want to and will not use routes that require out of direction travel.
2. Buses that can travel along the cobblestones of Jefferson Street would negate the need for confusing turnarounds.
3. Buses should run in both directions along a route to emphasize its routing and ease of use for round trips. Two-direction traffic on streets will be important to implementing this.
4. Once a successful route is determined, it should be made to look more permanent with branding and significant stopping points along the streetscape.



## RIDERSHIP

Greater Lynchburg Transit Company (GLTC) is underutilized by Lynchburg residents. This may be for a number of reasons, including the ease of travel by personal vehicle in Lynchburg and the dispersal of destinations throughout the community. While the ease of travel by car is a good problem to have, this means that those who take transit typically do so because they do not have another choice – the young, old, low-income, and those with physical or mental disabilities. A dispersal of destinations as seen in Lynchburg makes it difficult for a transit company to adequately serve a city. Because of these issues, GLTC embarked on a Transit Development Plan in 2017 focusing on increasing utility and ridership. Because Transit ridership is a critical component to continuing Downtown growth, as discussed in the Parking chapter, the following initiatives should be used to increase transit use to Downtown.

## FREQUENCY

One of the primary complaints about existing bus service in Lynchburg is that the buses do not run with enough frequency. If someone misses a bus, there may not be another for another hour. This uncertainty deters people from riding. The City should partner with GLTC to focus on increasing frequency on key routes into Downtown with a goal of having buses travel at least every 15 minutes during peak travel times.

## MULTIMODALITY

Transit riders become pedestrians or cyclists at either end of their trip. Having sidewalks to stops around the City is an important safety feature and helps support transit usage. Additionally, GLTC buses should continue to provide bike racks so that cyclists can make use of the bus system to travel longer distances, in weather events, or if they are just tired.

The mobility hubs discussed in the Parking chapter should be integrally tied into the transit network. They should be established at key locations Downtown where they are accessible to residents without cars and easily accessed by drivers switching modes of travel. Significant bus stops on streets could be coupled with the development of a new parking garage that provide the amenities of a mobility hub.



## BUS STOPS

Many stops in Lynchburg are simply comprised of a sign on the side of a road. More significant stops that

1. make the stops seem more permanent,
2. protect riders from the elements while they wait,
3. legitimize transit usage for choice users, and
4. provide amenities like a bus minute countdown, cell phone charging stations, or even free wifi, are more likely to see use.



*Bus stop in front of Riverside Park, a destination just a few miles from Downtown on Rivermont Avenue.*

## SHARED AUTONOMOUS VEHICLES (SAVS)

SAVs will likely change the face of transit by 2040. Public buses will likely become autonomous and traditional transit routes may be supplemented or supplanted by on demand routes in smaller vehicles. This could be a complete evolution of transportation systems and spur a major shift in the way Americans travel for the better. Streetscape designs should remain flexible and adaptive to accommodate these technologies and promote the use of transit systems.



*Bus stop with countdown to arrival and clear branding sees significant usage. Photo Source: [https://commons.wikimedia.org/wiki/File:Movia\\_bus\\_line\\_6A\\_at\\_Gammeltorv.JPG](https://commons.wikimedia.org/wiki/File:Movia_bus_line_6A_at_Gammeltorv.JPG)*

## 6.6 BIKEABILITY

Biking is becoming a more and more popular form of transportation in American cities and has been popular in Europe for many years. Lynchburg has a significant trail system for recreational biking that has some commuter use. Bike facilities for recreation are an important amenity that increase the livability of Downtown; however, reinforcing that bike facilities can be used for transportation will encourage Downtown's transformation over the next twenty years.

### STREETSCAPE

While Downtown's vertical streets may be extremely difficult for biking, corridors such as Main, Church, and Commerce Streets are relatively flat as they exist on Downtown's different terraces and should include accommodations to keep cyclists safe. Dedicated bicycle facilities (separate paths or lanes, ideally protected from adjacent traffic by a buffer) are the preferred model for promoting bicycling in an urban area. However, with limited space on Downtown's narrow streets, and the recommendation to prioritize pedestrian walkability within Downtown, making these accommodations becomes difficult.



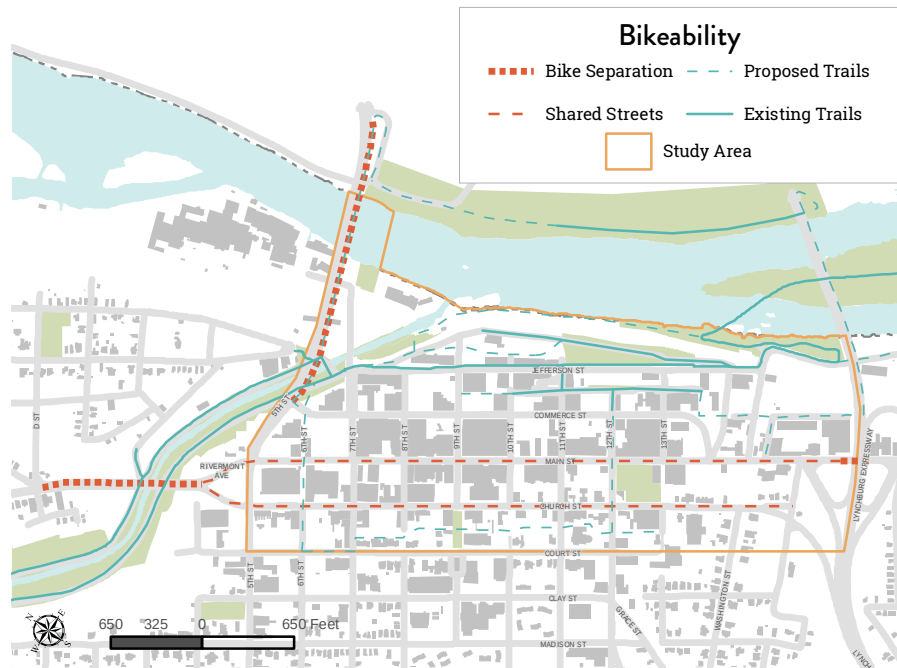
*Sharrow symbol in road and sign encouraging cyclists to travel with vehicular traffic and use full lane as it help avoid being hit by opening doors. Photo Source: [https://farm8.static.flickr.com/7184/6939409441\\_3a4dede392\\_b.jpg](https://farm8.static.flickr.com/7184/6939409441_3a4dede392_b.jpg)*

### ACCOMMODATIONS

If Downtown streets convert to two-direction travel as recommended by this plan, and minor intersections convert to all-way stops as was done with the Phase I Utility and Streetscape project, vehicular traffic may be slowed enough to accommodate cyclists within the travel lanes. Twelve to fifteen miles per hour is the recommended design speed for use of sharrows according the National Association of City Transportation Officials (NACTO). Sharrow symbols should be placed in the roadway to signal the dual use to drivers and encourage cyclists to safely travel in the center of the travel lane. This is not the ideal accommodation as it is asking cyclists to stop and start pedaling at every intersection, but strikes a balance between the needs of all users of Downtown streets.

If Downtown streets remain one-way, and especially if traffic signals return to intersections, separate bicycle facilities become extremely important as vehicles will speed, develop "tunnel vision," and create an unsafe shared environment for cyclists. With one-direction travel, lanes may be able to be narrowed to create a bike lane.

Major thoroughfares that bring cyclists Downtown should be priorities for separated bicycle facilities. These can help encourage people to bike Downtown rather than drive and take up limited parking. See Connecting Communities chapter for more information on bicycle accommodations into Downtown.



## BICYCLE PARKING

Downtown should be the most bikeable destination in the City and with the recommended improvements, it will be. To both support Downtown's bikeability and prevent damage and misuse of the streetscape, bicycle racks should be dispersed throughout Downtown. The City's Zoning Ordinance requires bicycle parking with new development, and allows racks to be placed within the City's right-of-way in situations like Downtown. These racks should be located in the buffer area of sidewalks, between pedestrians and the street, and parallel to traffic to prevent bikes from blocking sidewalks. There are already artistic bike racks on Downtown Streets and these should be encouraged as long as they meet the standards of the Zoning Ordinance.



The "Sir Speedy" bike rack on Main Street was built through a design competition organized by Region 2000. This rack helps buffer the sidewalk and is located parallel to the street so that parked bikes do not block sidewalks.



## BIKE-SHARE

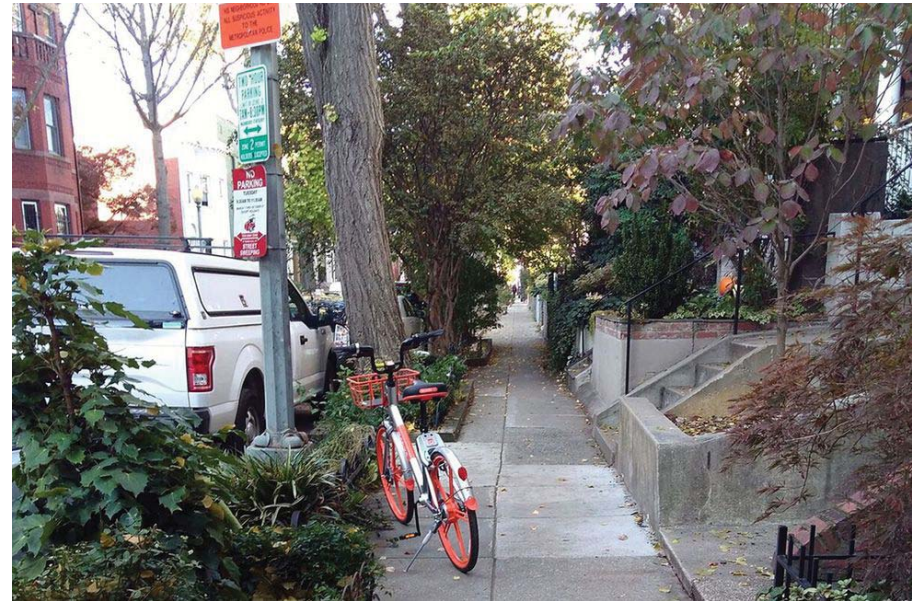
Bike-share systems, which are essentially easy single-trip bike rentals, promote bicycle use for visitors or one-direction trips without requiring bicycle ownership. The City should partner with one of the many available vendors for a bike-share system, particularly a dockless system, that does not limit users to fixed stations. These bikes can be dispersed within designated areas and simply be parked at bike racks around Downtown and approved areas. If possible, the system should not be limited to credit card holders as this prevents use by all. Both the design of the bikes and including incentives for positive use while discouraging negative use are vital to a successful system. A feasibility study should be completed to evaluate the potential of bike share in Lynchburg.

## BIKE ASSISTS

Because Downtown's vertical streets are so steep, average cyclists cannot be expected to travel up them. To promote cycling and ease uphill travel, bikes should be allowed on any pedestrian escalators installed Downtown and "wheeling ramps" should be installed on all staircases. Additionally, Trondheim, Norway has the world's first bicycle escalator, called a 'cyclocable.' If a primary vertical bike route is determined and the technology is adaptable to the United States, a cyclocable should be considered to aid uphill travel.



*Stairs Downtown should be built or retrofitted with "wheeling ramps."*  
Photo Source: <https://www.straitstimes.com/singapore/Ita-ramps-up-effort-to-get-people-to-take-up-cycling>



*Dockless bike-share provides flexibility precluded by previously installed standard docking systems. Docking stations are expensive to construct, consume valuable street space, and can be inconvenient to users when destinations are dispersed in an urban area.* Photo Source: <https://www.bicycling.com/news/g20037384/dockless-bike-share-washington-dc/>



*Cyclocable in Trondheim, Norway helps move cyclists up steep hills.*  
Photo Source: <https://www.citylab.com/transportation/2014/04/bike-elevator-take-you-steep-hills/8774/>

## TRAILS

One of the great amenities to living Downtown is that residents get the best of both worlds. They enjoy being in an urban environment and are not very far from recreational activities. With relatively short drives they can reach world-class hiking in the Blue Ridge Mountains, or just out their front door are miles of City biking, hiking, and walking trails in lush urban forests. These trails are incredibly valuable and unique and should continue to be celebrated and enhanced in the coming years.

This extensive trail network typically follows creek beds that conveniently lead to Downtown where Blackwater Creek meets the James River. They extend to different neighborhoods to the north and west, providing safe and direct bicycle access to Downtown, making them ideal commuter routes. The following can reinforce their use for daily commuting and promote Downtown growth:

- > Pedestrian scale lighting, potentially solar powered, to encourage their use as transportation facilities, not just for daytime recreation. These lights should be dark-sky sensitive to not allow spill-over lights into adjacent neighborhoods.
- > Call boxes for emergencies should be installed concurrently with the expanded hours of trail use.
- > Extensions to additional neighborhoods wherever possible. The current trail reaches neighborhoods but do not have connection points where the public can enter. This leads existing trailheads to have parking issues. If the trails reach more neighborhoods, users can bike directly on without having to drive and park.

See Connecting Communities Chapter for more discussion on connecting to neighborhoods.



*The Van Gogh Path by Studio Roosegaarde is located in the Netherlands and runs from the town Nuenen to the city of Eindhoven. New technologies in bike path paving or paint can extend a path's usable hours and make a memorable place. Source: Studio Roosegaarde*



*Lights on a commuter trail in Copenhagen focus downward to prevent spillover to adjacent neighborhoods. Photo Source: <http://www.copenhagenize.com/2009/05/bicycle-lanes.html>*



## 6.7 MOBILITY AND ACCESSIBILITY: GOALS

- > Create great Complete Streets in and to Downtown that result in effective transportation circulation and accommodate all modes of travel: vehicular, transit, bike, and pedestrian.
- > Prioritize the movement of pedestrians Downtown to fully capture the health, safety, and economic benefits of pedestrian activity.
- > Remove or mitigate barriers to walking and biking such as high vehicle speeds, network gaps, and steep grades.
- > Foster a Downtown that allows residents to live car-free.

## 6.8 MOBILITY AND ACCESSIBILITY: RECOMMENDATIONS

Transportation improvements to, from, and within Downtown will be major drivers shaping and spurring growth over the next twenty years. The City of Lynchburg must continue to prioritize rebalancing its transportation system to better accommodate all modes of travel and should foster Downtown walkability in every decision. The following policies will help achieve the walkable, accessible Downtown envisioned for 2040:

**Walking as the primary mode of transportation** – Walking should be prioritized Downtown. Only the minimum space necessary to maintain functionality should be dedicated to vehicular travel. During construction, pedestrian routes need to be maintained.

**Embrace transit** – Existing and emerging modes of transportation can play valuable roles moving people to and within Downtown. Parking is limited in downtowns. Due consideration should be given to promoting transit as the most people and space efficient way to move people into Downtown.

**Complete Streets** – The following design guides for transportation should be used by the City as part of its Complete Streets Policy: Designing Walkable Urban Thoroughfares: A Context Sensitive Approach (ITE/CNU, 2010); Urban Street Design Guide (NACTO, 2013); and Urban Bikeway Design Guide (NACTO, 2012).

All new roads and retrofitted roads should include bicycle and pedestrian facilities using sidewalks, bike lanes, protected lanes, or off-road shared use paths, trails and greenways, as feasible. Sharrows should be used when other accommodations are not possible.



## MOBILITY AND ACCESSIBILITY

| SHORT-TERM STRATEGIES                                                                                                                                                                                                                                                                                                                                                                                                                        | MID-TERM STRATEGIES                                                                                                                                                                                                                                                                                                                                                       | LONG-TERM STRATEGIES                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>POLICIES/STUDIES</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                      |
| <ul style="list-style-type: none"> <li>Adopt <b>design guides</b> and implementation procedures for transportation design to foster implementation of the recommended Complete Streets Policy.</li> <li><b>Complete a feasibility study</b> and a plan for a bike share system for Downtown.</li> </ul>                                                                                                                                      | <ul style="list-style-type: none"> <li>Develop <b>Streetscape Design Guidelines</b> for specific corridors to supplant the interim guidance for Complete Streets.</li> </ul>                                                                                                                                                                                              |                                                                                                                      |
| <b>PROJECTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                      |
| <ul style="list-style-type: none"> <li><b>Redesign + Expand Downtown Shuttle Service</b> (Hopper) - may require acquisition of different bus vehicles.</li> <li><b>Convert Main and Church Street from One-way to Two-way</b> (Max Circulation Cross Section).</li> <li>Partner with GLTC to improve bus service Downtown.</li> <li><b>Install dark-sky friendly lighting</b> and emergency call boxes on Blackwater Creek trail.</li> </ul> | <ul style="list-style-type: none"> <li>Partner with private vendor for dockless bike share system if feasible.</li> <li><b>Retrofit entryways into Downtown</b> for Bicycle and Pedestrians. (See Connecting Communities Chapter)</li> <li><b>Retrofit Rivermont Avenue Bridge</b> for Bicycle and Pedestrians.</li> <li><b>Extend trails</b> to neighborhoods</li> </ul> | <ul style="list-style-type: none"> <li>Implement permanent <b>vertical transportation infrastructure.</b></li> </ul> |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

PAGE LEFT INTENTIONALLY BLANK

# 7 UTILITIES, STREETSCAPE, REFUSE & SAFETY

- 7.1 ONGOING PROJECTS
- 7.2 FUTURE DOWNTOWN UTILITY AND STREETSCAPE PROJECT PHASES
- 7.3 STREETSCAPE PALETTE
- 7.4 REFUSE COLLECTION
- 7.5 SAFETY
- 7.6 UTILITIES, STREETSCAPE, REFUSE & SAFETY: GOALS
- 7.7 UTILITIES, STREETSCAPE, REFUSE & SAFETY: RECOMMENDATIONS



PAGE LEFT INTENTIONALLY BLANK

## 7.1 ONGOING PROJECTS

In 2015, the City of Lynchburg began the extensive fifty block Downtown Utility and Streetscape Project. Lynchburg is home to one of the oldest water systems in the nation, with some active waterlines dating back to 1829. Given that most of the waterlines in the Downtown area have outlived their 100-year lifespan and realizing the serious impact that continued waterline breaks cause for Downtown businesses and residents, the City has prioritized the replacement of the Downtown waterlines to avoid catastrophic failures and promote continued growth in Downtown.

Since replacing the utility infrastructure causes major disruption to pedestrian and street traffic, additional streetscape work like traffic calming, the updating of sidewalks, and the planting of new trees is also being completed.

In order to upgrade the streetscaping and also maintain Downtown's historic character, the City is using historically compatible materials like clay-fired dark red brick sidewalk pavers and streetlights that correspond with Lynchburg's early 20th Century electric Downtown lights.



*Improved streetscape at 8th and Main Streets*

## PHASE I

The first phase of construction, an eight-block area of Church Street and Main Street between Fifth Street and Eighth Street, was completed in Fall 2017. It cost \$8.5 million and took 17 months to complete. During this phase, construction significantly impacted Downtown residents and businesses. During data collection and workshop sessions, the community shared its concerns regarding the effects of current and future construction activities in Downtown. While most everyone acknowledges the need to replace and update infrastructure, the community would like the City to develop (and adhere to) an improvement schedule for their own planning purposes. It was also noted that the City should be sensitive to any construction fatigue felt by businesses and residents within the project area.

One of the unique challenges to replacement of the infrastructure is the sheer number of stakeholders affected by construction. In planning and executing each phase, the City needs to communicate with various departments within its own structure (including Water Resources, Public Works, Parking Management, Economic Development, etc.), multiple contractors and subcontractors, numerous utility companies, the Downtown Lynchburg Business Association, event planners, over 1200 Downtown business stakeholders and residents, and the general public.



*Disruption of Street Life by Ongoing Construction in Downtown Lynchburg*



*Pedestrian bridge to maintain access to Church Street businesses during construction.*

Success was seen in Phase I by utilizing a public relations initiative developed by the City. The program included:

- > Creation of a project logo
- > Website development and maintenance
- > Public meetings and outreach
- > Media relations
- > Print and e-blast newsletters
- > Press releases
- > Information cards and fliers for businesses

Most importantly, the program featured direct outreach to property and business owners, residents, City staff, emergency services, business associations, and events coordinators. This relationship-based public outreach continually interfaced with businesses and residents located within or adjacent to the construction zone, City officials, construction managers, and the public at-large to minimize construction impact and develop creative solutions for pedestrian access and parking.

Additionally, a series of public meetings were held during construction by the City and its consultants and contractors to establish project expectations, explain project goals and timelines, reveal detailed plans, and establish main points of contact for project queries.



## 7.2 FUTURE DOWNTOWN UTILITY AND STREETScape PROJECT PHASES

The City recognizes the need to carefully select and communicate each phase of the Utility and Streetscape Project. After hearing the public's concerns over phasing, the project team and many City department staff members met to discuss future phases further and compiled a list of replacement parameters and street segment factors that should guide the selection of each phase.

### REPLACEMENT PARAMETERS

- > The future projects should have a construction budget of approximately \$4 Million for a year's construction. The projects should be approximately 4-5 street segments for each year of construction.
- > The next phase of the water main replacement is estimated to begin in summer of 2019, as two other major projects are completed and funds for construction become available. The design for the next phase of Downtown water main replacement and streetscape will occur in 2018.
- > Planning phases far into the future is especially difficult due to changing conditions over time and outside factors beyond City control. However, all stakeholders should be given at least one year's notice prior to construction.

### STREET SEGMENT FACTORS

**Worst Place and Best Place to Transform:** Are there segments that need to be enhanced and others that are adequate now?

**Adjacent Properties Under Construction:** Are there other ongoing or future projects that would influence the infrastructure project in a positive or negative way?

**Neighbors Weary from Recent Construction:** Are there indications from residents or businesses that a break is justified before starting another project?

**Most Efficiently Continues Utilities Progress:** Does it make sense to connect a recent project with an ensuing project?

**Reasonable Cost:** Is one block more expensive than another to do?

**Citizens Have Requested Construction:** Has anyone expressed interest in having a utility upgrade now?

**Encourages New Development:** Would new streetscape enhancements encourage new development?

**Maximizes Visitor Experience:** Would new streetscape enhancements improve the appeal of the segment for visitors?

**More Attractive to Grants:** Could other funding sources be used to rebuild the segment?

**Impacts or Effects on Business:** Does construction within the street segment impact business?

**Works Well with Other Improvements:** Can an improvement be delayed to tie in with another project?

## MAIN STREET RENEWAL PROJECT

Following the end of construction on both rebuilding the Main Street Bridge over the Lynchburg Expressway and the utility and streetscaping on Fifth Street Phase 3, the City will begin work on the next part of Main Street. This phase runs along Main Street from Eighth Street to Twelfth Street and includes one block of Tenth Street, between Main and Church Streets. This phase will begin in the Summer of 2019 and was chosen due to:

- > the need of Appalachian Electric Power (AEP) to upgrade their infrastructure in this area, some of which may date to 1914;
- > the availability of their specialized crews to work in this unique system;
- > the opportunity to cost-share survey and streetscape costs with AEP;
- > the need to coordinate in-ground utility installation in limited street widths;
- > the potentially limited service available to accommodate new electric loads on Main Street; and
- > the desire of the City not to close street segments multiple times as the water infrastructure in the area still needs replacement.



*10th Street will be included in the next phase because of the need to replace the vaults in the left turn lane.*

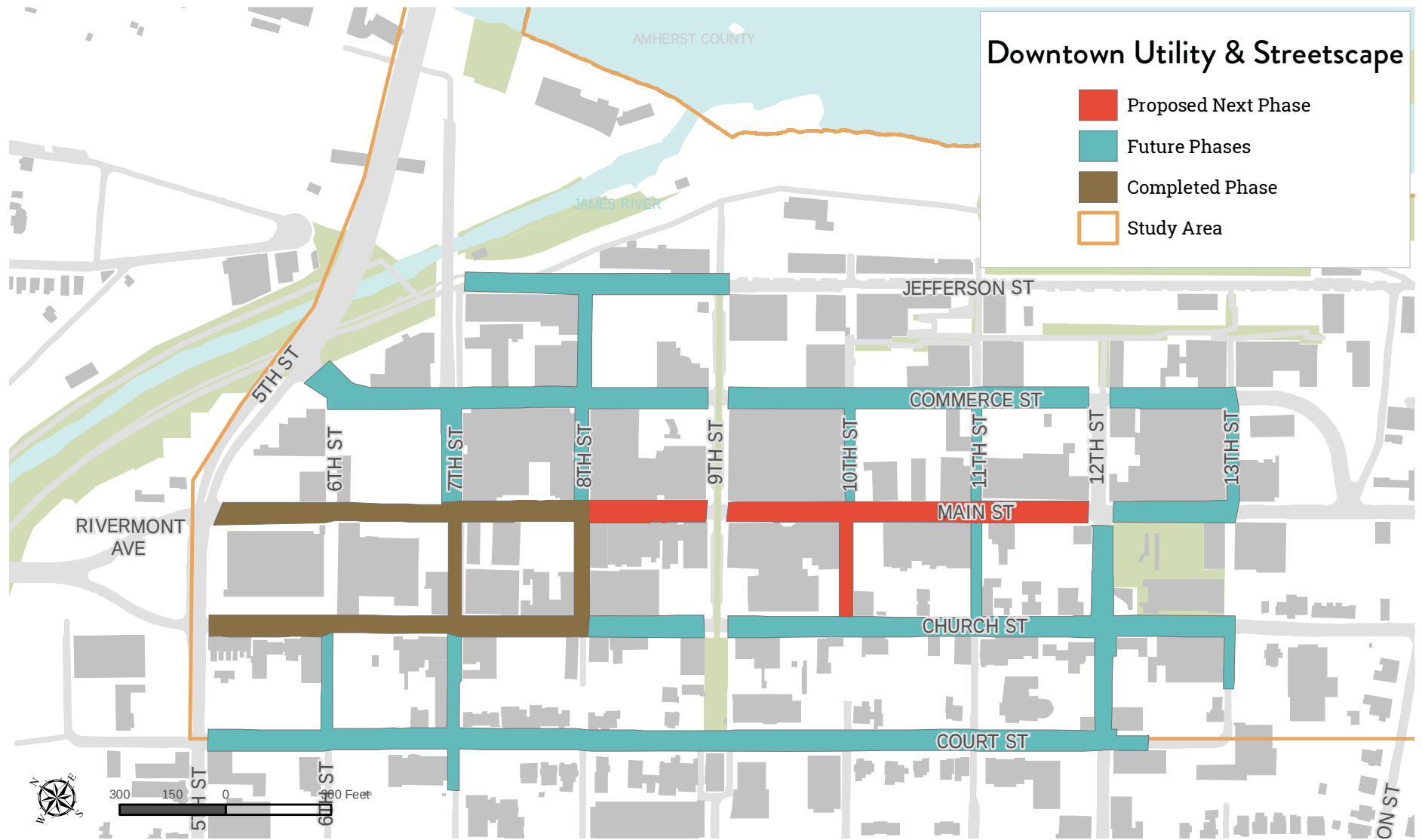


*Main Street between 10th and 11th Streets*

## BEYOND MAIN STREET

The City and the Department of Water Resources should investigate whether other revenue sources can be found to expedite the replacement projects to prevent the potential effects of decades of ongoing construction Downtown.

For the long term, the City should hold a public workshop after the completion of each phase to allow further discussion on how street closures and detours affect the Downtown community and effects can be mitigated. This feedback would likely influence future utility project schedules. In addition, the City should review and update the “Lessons Learned” memorandum from the initial project on Main and Church Street (August 28, 2017) and apply to ensuing projects.



Next Project Location for Downtown Utility and Streetscape Improvements



## 7.3 STREETSCAPE PALETTE

Visitors and residents can appreciate the history of Downtown Lynchburg through the character of the streetscape and its historic buildings. Layers of Lynchburg's history are revealed in the historic streetscape materials. Lynchburg's heritage as a manufacturing hub in the James River watershed, and its importance as a crossroads from the Piedmont into the Blue Ridge, is a story told through the use of heritage materials that relate to the both the landscape and the transportation and public works history of the City.

Authentic materials related to Lynchburg's heritage characterize Downtown's historic streetscapes and shape an attractive urban fabric. Going forward, the City should choose the authentic options.

For future streetscape construction, the following priority guidelines are recommended:

### RESTORE AND PRESERVE MATERIALS

Several surviving examples of Lynchburg's historic streets serve as models for future design. Generally, if heritage materials are found in place, and other criteria (such as safety or universal access) are not in conflict, they should remain as part of future construction. Examples of heritage materials that may be salvaged and restored-in-place include:

- > Brick paving block, as seen in Daniels Hill, Diamond Hill, 10th Street, and potentially, under asphalt on sections of Court Street.
- > Brick sidewalks and stone curbs as seen on Court Street.

#### ORIGIN STORY:

10th Street displays many of Lynchburg's heritage building materials: In the foreground, cobblestones which were ballast in the packet boats, bounded by local slate stone curbs, stone slabs with carved grooves for horseshoe traction, and beyond local fieldstone stacked rubble wall, enclosed with a granite cap, possibly "borrowed" from canal lock construction.



## USE COMPATIBLE MATERIALS

If authentic materials cannot be found in their original location, consider using a compatible palette to heritage materials used in traditional streets. A compatible palette may include:

### STREET PAVING AND CURBING

- > Recycled or new asphalt on **main arteries, and principal streets** used for heavy traffic.
- > Brick pavers (min. 4x4x10") on **residential streets, or low-volume streets** where traffic calming is important.
- > Cut granite curbs that generally matches the detailing of 9th Street: sawn top, split face, 6" high above roadway surface; Georgia Gray or Robin Blue color; from the quarries around Elberton, Georgia.

### SIDEWALKS

- > A mix of clay-fired dark red or chocolate walkway paving brick with butt-tight joints on **residential streets, or low-volume streets** where traffic calming is important. Provide reinforced concrete slab and 1" sand leveling course under and surrounding the sidewalk to prevent horizontal movement. Adjust concrete slabs for loading requirements to provide a solid base with easy adjustment through the sand leveling course, should the brick pavers become unlevelled.
- > Additional local materials for accents in special seating or outdoor cafe areas. These may include other brick colors, bluestone flagstone, Buckingham slate, or cobblestones.
- > Sidewalk material should continue across driveway entrances.



*Brick paving block street and brick sidewalk, in Daniels Hill*



*New sidewalk showing red-to-brown color field along 12th Street*



## CROSSWALKS

- > Brick, dry set on concrete sub-base with concrete edging bands bordering the crosswalk and
- > High visibility, thermoplastic 2' bars where appropriate for cost-savings and visibility.
- > Truncated dome bricks on ADA ramps OR Weathering steel bump strips for low-visibility contrast.

## METAL APPURTENANCES (I.E. TRASH CANS, BOLLARDS, ETC)

- > Black cast iron or steel, painted gloss black.

## STREET LIGHTING

- > Cast iron or steel street lights with black gloss paint. Light type should be of pedestrian scale with poles of approximately 12' high to base of luminaire, so as to match the height of transom glass on first floor businesses.
- > Along 9th Street: match existing offset fixture, which also provides for banner poles.
- > Along other streets: match fixture to correspond with Lynchburg's early 20th Century electric Downtown lights.
- > In Warehouse Alleyway areas: Shepherd's Crook Warehouse light.



Granite curbs and brick crosswalk along Commerce Street



9th Street Fixture



Warehouse Alley Fixture



## STREET TREES

- > Trees with native heritage to the Lynchburg region where a healthy amount of space can be provided.
- > Provide shade trees where appropriate.
- > All tree types to be approved by urban forester.



*Street Trees along 9th Street*

## VIBRANT DOWNTOWN STREETSCAPES

As discussed in the Mobility Chapter streets should serve a variety of uses and a hallmark of a successful downtown is vibrant street life. Recommendations throughout this document are aimed at fostering this vibrancy. As the utility and streetscape project extends through Downtown, the public project should incorporate elements that directly enliven streets as public spaces. Café seating, parklets and public art, discussed in the Public Space and Recreation Chapter are important elements to design for. Additionally, interesting lighting and uplighting on buildings can help transform street spaces.

As part of the Phase I project, pedestals for public art and a drinking fountain were incorporated into the streetscape. Including drinking fountains in the streetscape is a perfect way to commemorate the significant public investment of replacing 100 year old water lines throughout all of Downtown. The fountains can help reduce reliance on bottled water (and the associated litter), reinforce Lynchburg as the “runner friendly community” it has been designated as, and increase the livability of Downtown’s streets. The opportunity to convert them to public art can establish them as a truly unique streetscape feature that will set Lynchburg apart.



*Artful drinking fountain in Minneapolis, MN.  
Photo Source: <http://secondward.blogspot.com/2009/11/first-water-fountain-installed.html>*

## 7.4 REFUSE COLLECTION

### FINDINGS

With the revitalization of Downtown, waste collection has become an issue among residents and businesses. The increasing number of restaurants has put a strain on existing waste collection systems. There is no single organized program for handling the waste or recycling, aside from City curbside trash pickup and numerous private vendors that service dumpsters at varying times. Nuisance concerns include the timing of collection on nearby residents, the timing of collection during business hours, placement of curbside bins, and the foul smells associated with waste sitting too long. In addition, citizens attending the workshops indicated that litter is an increasing problem in Downtown.



*Curbside bins blocking crosswalk on Main Street in Lynchburg.*

### CASE STUDY: ROANOKE, VA

The City of Roanoke, Virginia has experienced revitalization similar to that being seen in Lynchburg today. The restaurants in Downtown Roanoke once had the same issues that Lynchburg is now experiencing. There was no centralized collection program and individual cans for collection would sit for days on the sidewalk waiting for different City or private collection companies. This case study summarizes the team's discussion with Bob Bengtson, the Director of Roanoke's Public Works Department.

#### Issues

The previous waste collection system was strained with the growth of the downtown area. Timing for collection was very difficult to manage as some businesses would set their container on the sidewalk when they closed for business at 5:00 PM, but the empty container would stay there after pickup in the evening until 8:00 AM the next morning. Increased foot traffic made waste management difficult on business owners because residents and others would use their containers. Another challenge occurred when restaurants started growing and needed multiple daily collections. Some restaurants required up to three collections per day. The cost of collection for businesses was nearly \$70-\$120/month.

Residents and local businesses were experiencing dirty sidewalks with many containers leaking restaurant grease. New residents who moved into Downtown were disturbed by the various collection times from the City and private companies. Collection during the day also proved to be more difficult as traffic began to increase.

case study continues...

### Establishing Centralized Compactors

Downtown Roanoke, Incorporated, a non-profit organization, provided the recommendation for the waste management solution that is in operation today as a public private partnership. Steps involved to alleviate refuse collection issues included:

- > The City created an ordinance that does not allow any containers to sit on the sidewalk.
- > The City found five strategic locations for trash compactors that they lease from private entities.
- > The compactor is also leased so if something needs to be fixed, the private company will fix it.
- > The compactors are enclosed in a metal enclosure that has a doorway requiring a small security key for entry.
- > Each user (business or resident) must register and pay a fee with Downtown Roanoke Incorporated.
- > The registration allows each user to have two free dumps per week. Every dump thereafter costs \$1 each.
- > The compactor enclosure also has recyclable containers that are free (to encourage recycling). This also reduces the number of dumps in the compactor and saves the user the dumping fee.
- > The user activates the compactor prior to leaving.
- > The City has an employee that constantly checks the five compactors daily for cleanliness, operation and the recyclables.
- > Private companies, apartments and condominiums primarily use this same system; however, they are allowed to create their own collection system.



### Impact of New Collection Management System

Changing the collection management system was difficult at first. Opposition came mainly from the users that now had to adjust to the new locations. However, the opposition didn't last long, as people adapted and recognized the benefits. Improvements from the new management system included:

- > It quickly cleaned up the sidewalks by no longer having containers and bags on the streets.
- > It became cheaper to the businesses that were paying for multiple pickups from small sidewalk containers. Some businesses' bills were cut in half.
- > The City also experienced a significant cost savings since that they no longer required 3 crews collecting trash multiple times, day and night, and on weekends.



## REFUSE RECOMMENDATIONS

While there may have been growing pains as Roanoke adapted to their new system, rethinking how waste is collected Downtown can help accommodate continued growth and activity and minimize nuisance concerns. The following are recommended to improve waste collection Downtown:

- > Establish a system with centralized compactors similar to Roanoke's for private residents and businesses.
- > Continue to incorporate attractive public trash cans into the streetscape, especially where litter is an issue.
- > Include recycling bins with new trash cans, reducing speed at which trash cans fill up, encouraging recycling, and branding Lynchburg as an environmentally-friendly city.



*Public trash and recycling containers in downtown Milwaukee, WI also incorporate public art into the design.*



*Current Refuse Collection in Downtown Lynchburg*

## 7.5 SAFETY

The study team met with the police, fire and rescue, and emergency services staff to discuss public safety in Downtown. In addition, the team received citizen comments during other outreach and engagement discussions with the public.

### FINDINGS

The police department has seen an overall improvement in the safety of Downtown. Violent crime has been reduced. Service calls in Downtown today deal mostly with traffic, graffiti, vandalism or theft. The City recognizes that although the actual safety has improved, many citizens still perceive Downtown as having safety issues. More outreach is needed to inform citizens of the improved safety of Downtown.

- > Because there are more people and many special events Downtown now, there has been a strain on public safety staffing and emergency communications.
- > The notification system for emergencies needs improvement; the current phone and email system does not effectively reach residents and businesses in Downtown.
- > Often, there is confusion of the location of an emergency when a call is received. Block markings have helped and call boxes are recommended.
- > The Bluffwalk has limited vehicular emergency access. The police department believes that safety can be improved at the Bluffwalk and the Trail System with the use of a small “gator” emergency vehicle. This type of vehicle will allow quick, easy transport for equipment or emergency personnel.

- > Pedestrian crossings could use improved markings. Certain streets and intersections could benefit from improved lighting.
- > Although there are many calls regarding cars going the wrong direction on one-way streets, there have not been many accidents.
- > Hydrant locations and flow has been good for fire response.
- > The City’s existing ladder truck can reach the 8th story of a building. The ladder truck requires 22’ of street width for access and operations.
- > Homelessness has not been a big issue in Downtown. Non-profits in the community have been effective.
- > The Police Department is considering a move to consolidate its department from the four buildings they are in now to a single location, possibly at the old Greater Lynchburg Transit Company (GLTC) Building near Kemper Street.

### SAFETY RECOMMENDATIONS

- > Since it has been recognized that while safety has improved, perception from many citizens is that it has not. More outreach is necessary to show that Downtown has improved in overall safety. The City should implement a public announcement initiative to promote the improvements.
- > The City should also continue working on effective means to improve response times, including: staffing, call boxes, signage/ location markers, lighting, security cameras.
- > Review special events procedures to ensure adequate staffing and effective communication methods.

## 7.6 UTILITIES, STREETSCAPE, REFUSE AND SAFETY: GOALS

- > Manage, prioritize and provide opportunities to accelerate the Downtown Waterline and Streetscape Replacement project to complete in a timely manner.
- > Minimize disruptions to businesses and inform the public of the replacement priorities.
- > Ensure clean and safe public parks, streets and facilities.
- > Improve public perception of the safety of Downtown.

## 7.7 UTILITIES, STREETSCAPE, REFUSE AND SAFETY: RECOMMENDATIONS

Public improvements in Downtown as recommended in this plan will facilitate new business investment and further the vision for Downtown as a vibrant and safe urban destination for Central Virginia. Continued collaboration of the City with residents and businesses is essential for success, particularly with respect to the following public initiatives:

**Utilities** – Future infrastructure projects should employ effective public outreach methods to communicate and inform citizens and businesses about construction, schedules, and outcomes.

**Safety** – City departments should discuss and implement methods to continue improving public safety in Downtown, particularly with respect to managing large events and emergencies. Better communicating actual crime levels and locations can help decrease the perception of danger Downtown.

**Refuse Collection** – With the growth of Downtown, there is need for a coordinated refuse collection system that works for Downtown Lynchburg. As a start, the initiative should engage residents and businesses in discussing issues and potential solutions.



## UTILITIES, STREETScape, REFUSE AND SAFETY

| SHORT-TERM STRATEGIES                                                                                                                                                                                                                                                                          | MID-TERM STRATEGIES                                                                                                                                                                                                                                                              | LONG-TERM STRATEGIES                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>UTILITY INFRASTRUCTURE</b>                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                  |                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>Address issues of “Lessons Learned” memorandum from the initial project on Main and Church Street.</li> </ul>                                                                                                                                           | <ul style="list-style-type: none"> <li>Create a 1-year notice program to inform public about next project.</li> </ul>                                                                                                                                                            | <ul style="list-style-type: none"> <li>Expedite utility replacement and streetscape improvements to complete as quickly as possible.</li> </ul> |
| <ul style="list-style-type: none"> <li>Host a public workshop after the completion of each phase of water main replacement project to allow further discussion on how street closures and detours affect the Downtown community and can be mitigated.</li> </ul>                               | <ul style="list-style-type: none"> <li>Evaluate selection of each phase based on outlined factors.</li> </ul>                                                                                                                                                                    |                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>Replace utility infrastructure and improve streetscape on Main Street.</li> </ul>                                                                                                                                                                       |                                                                                                                                                                                                                                                                                  |                                                                                                                                                 |
| <b>REFUSE COLLECTION</b>                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                  |                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>Develop a strategic map to locate refuse stations and include recycling.</li> </ul>                                                                                                                                                                     | <ul style="list-style-type: none"> <li>Create a partnership with a Downtown entity that can manage the waste collection registrations</li> </ul>                                                                                                                                 | <ul style="list-style-type: none"> <li>Implement collection of compactors and monitor the systems created for successful operation.</li> </ul>  |
| <ul style="list-style-type: none"> <li>Involve the public in waste collection discussions. Host workshops and invite residents, businesses, building owners, property associations, etc. to help navigate through the issues for good locations, pickup times, operations and cost.</li> </ul> | <ul style="list-style-type: none"> <li>Revise the current City Code Section 21.2 that allows for curbside collection and enact an ordinance that prohibits the use of private collection bins on sidewalks and requires the use of designated compactors in Downtown.</li> </ul> |                                                                                                                                                 |
|                                                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>Arrange leasing agreements with private entities for the compactor location, installation, aesthetics, and operation.</li> </ul>                                                                                                          |                                                                                                                                                 |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

## UTILITY INFRASTRUCTURE, REFUSE AND SAFETY

| SHORT-TERM STRATEGIES                                                                                                                                                                         | MID-TERM STRATEGIES                                                                                                                                                   | LONG-TERM STRATEGIES                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SAFETY IMPROVEMENTS</b>                                                                                                                                                                    |                                                                                                                                                                       |                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Study more effective emergency response methods for use in Downtown.</li> </ul>                                                                        | <ul style="list-style-type: none"> <li>Increase lighting mid-block of Downtown streets, especially along Commerce Street between parking lots and garages.</li> </ul> | <ul style="list-style-type: none"> <li>Provide call boxes or improved location signage at mid-blocks for easier identification in an emergency.</li> </ul> |
| <ul style="list-style-type: none"> <li>Investigate the use of prominent markers or call boxes on the Bluff Walk and Trails to allow callers to easily identify their location.</li> </ul>     | <ul style="list-style-type: none"> <li>Increase the mileage/marker signs along the trails to identify location.</li> </ul>                                            |                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Review and discuss public safety staffing, especially as it relates to increased events and residents in Downtown.</li> </ul>                          |                                                                                                                                                                       |                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Work with local news outlets to improve reporting on crime in Downtown versus nearby neighborhoods to better align perception with reality.</li> </ul> |                                                                                                                                                                       |                                                                                                                                                            |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

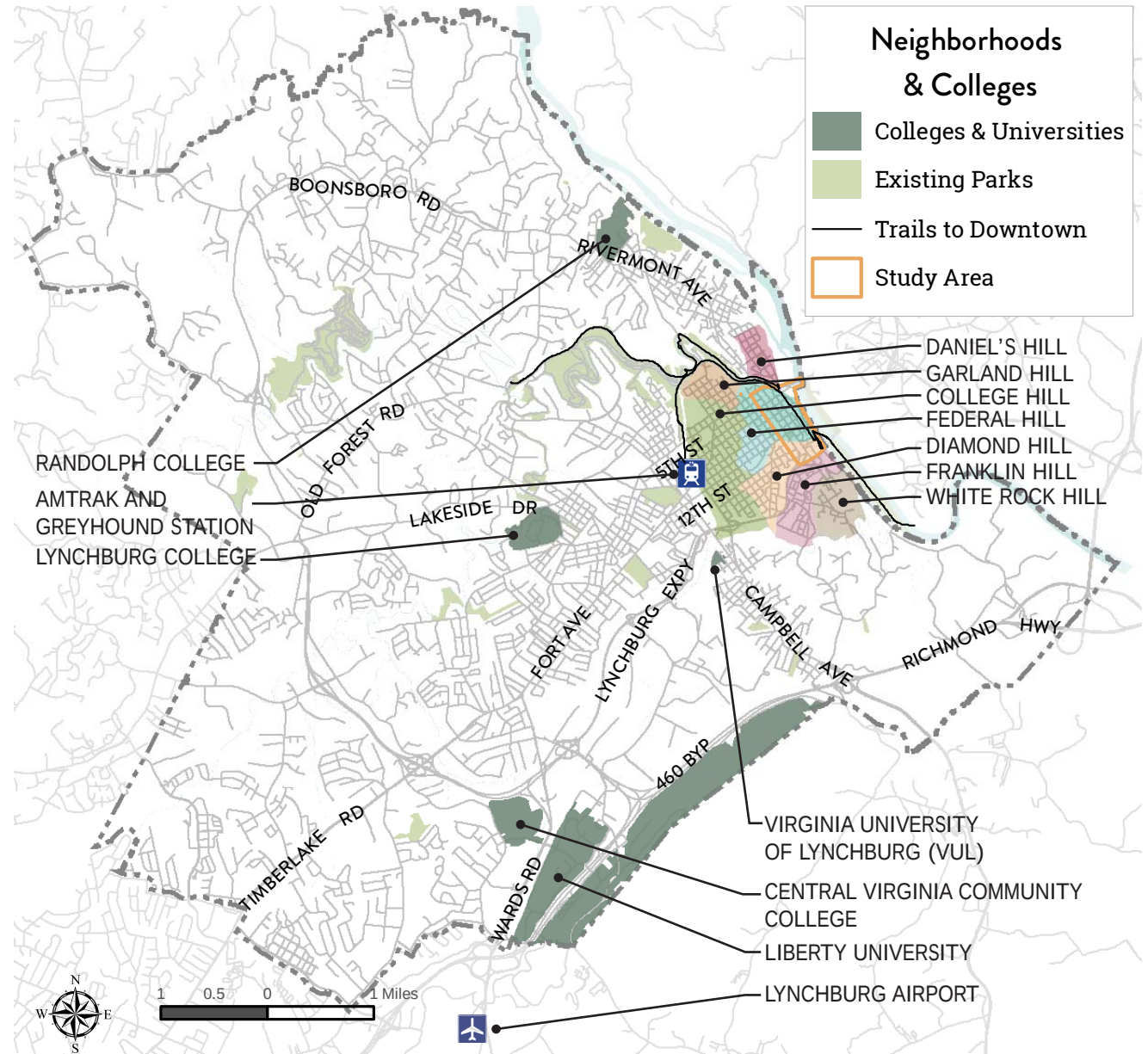
## 8. CONNECTING COMMUNITIES

- 8.1 GATEWAY ENTRANCES
- 8.2 NEIGHBORHOODS
- 8.3 COLLEGES AND REGIONAL TRANSPORTATION
- 8.4 CONNECTING COMMUNITIES: GOALS
- 8.5 CONNECTING COMMUNITIES: RECOMMENDATIONS



PAGE LEFT INTENTIONALLY BLANK

Connections to and within Downtown increase opportunities to boost economic activity while promoting social interaction between residents, businesses, and organizations. The following section outlines strategic physical improvements to gateway corridors, bridges, and entrances to Downtown; recommendations for improving connectivity to Lynchburg's neighborhoods, both those nearby and farther from Downtown; and improvements to better tie Lynchburg's colleges and regional transit hubs and invite student populations to experience Downtown more.



Lynchburg Colleges / Universities & Downtown Neighborhoods

## 8.1 GATEWAY ENTRANCES

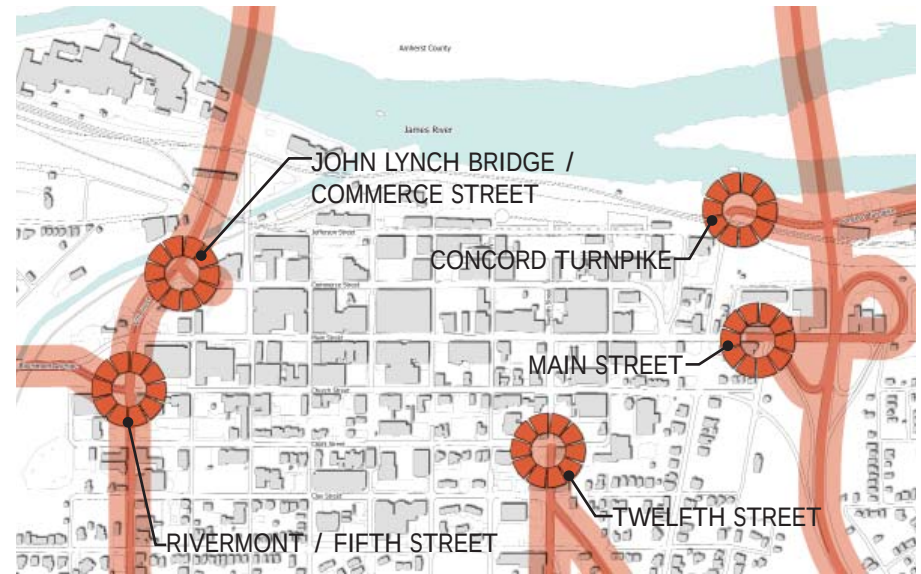
First impressions of Downtown take shape along major access corridors and at key entrances. Successful gateways clearly signal the transition into Downtown and create a sense of anticipation. Also, a coordinated system of gateways provides a cohesive identity and reinforces the Downtown image. Primary gateways into Downtown Lynchburg include:

- > Lynchburg Expressway interchange at Main Street Bridge
- > John Lynch Bridge / Commerce Street
- > Rivermont Bridge and intersections with Fifth Street
- > Concord Turnpike

Other important, though smaller, gateways include:

- > Twelfth Street and Grace Street
- > Fifth Street
- > Neighborhood Streets leading into Downtown

Along with signage recommendations described in the Wayfinding Chapter, this section proposes gateway improvements to better connect surrounding areas to Downtown and enhance the sense of arrival as people enter Downtown. In addition to gateway improvements, this plan also recommends a new gateway at U.S. 460 to connect the Tyreeanna neighborhood to Downtown via a scenic parkway along the James River.

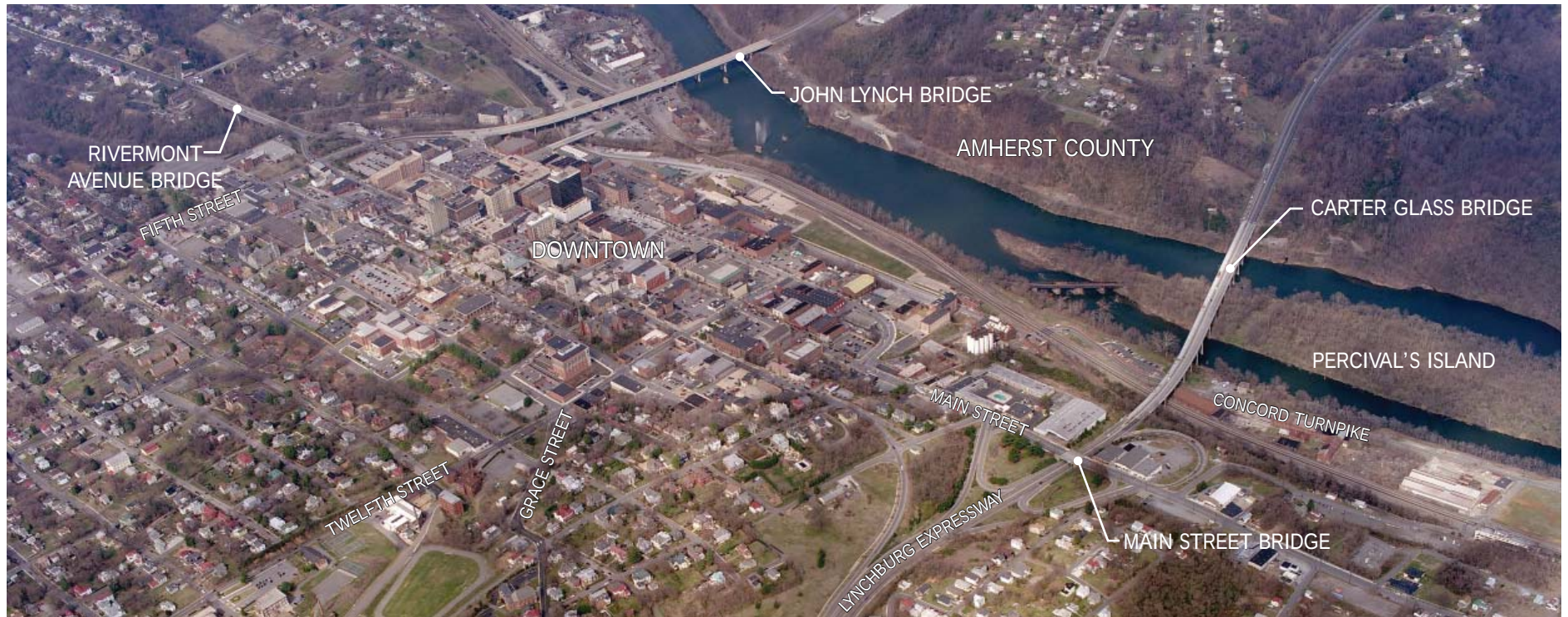


Key Gateways Downtown

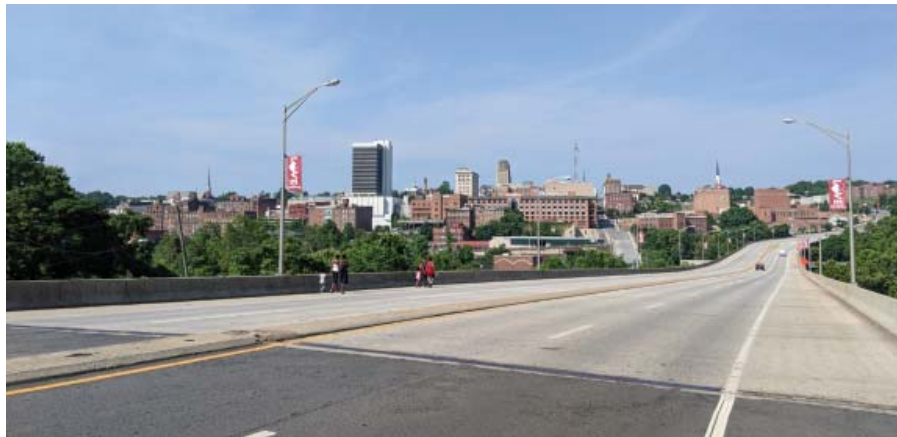
### SMALL GATEWAYS

Streets that tie into Downtown from adjoining commercial areas and residential neighborhoods should both draw people in and signalize the transition into the center of city. These streets should be evaluated for streetscape and intersection improvements that make these routes especially walkable with crosswalks, short crossing distances, and sidewalks with buffers from traffic and street trees.





*Downtown Gateways*



*The John Lynch Bridge provides a striking gateway entrance visually for cars but could use enhancements to accomodate other modes of travel.*



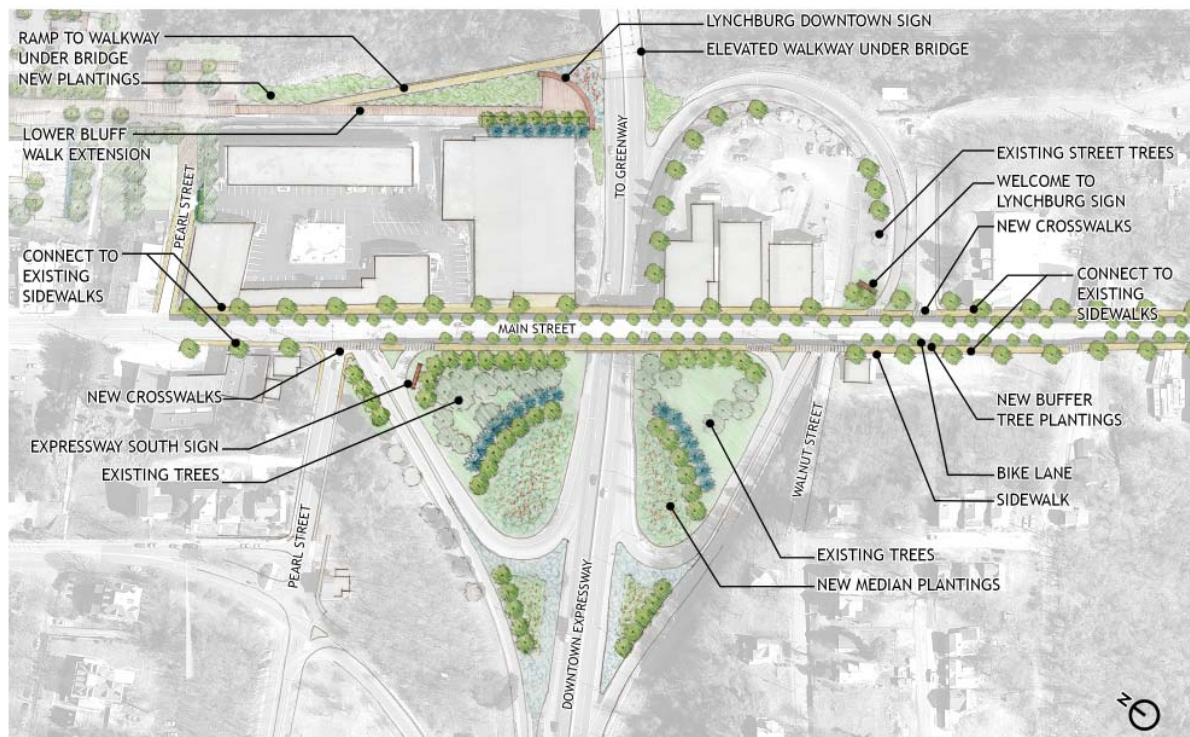
*6th and Madison Streets, looking northeast towards Downtown should be enhanced to better tie the neighborhood to the commercial area.*



## MAIN STREET BRIDGE GATEWAY

The Lynchburg Expressway - Main Street interchange is currently undergoing improvements for the construction of a new bridge (2017-2018). The temporary closure of the interchange provides an opportunity to transform this primary Downtown gateway into a welcoming entrance for motorists and pedestrians. Streetscape improvements, such as plantings, lighting, and directional signage can strengthen visual and physical connections between the interchange and Downtown.

Additionally, improvements on the bridge will help better connect commercial areas and neighborhoods southeast of Downtown. The bridge is planned to be rebuilt with the same lane configuration (4 travel lanes), but after construction the number of lanes should be reconsidered and space used by excess lanes should be redistributed to improve pedestrian and bicycle connections across the bridge. From there, streetscaping can tie this route into the Lower Bluffwalk extension. This section of Main Street could also be further emphasized as a gateway by incorporating banners into the streetscape improvements plan.



Main Street / Lynchburg Expressway Gateway - Proposed Concept



Concept for Main Street / Lynchburg Expressway Bridge Replacement in 2018 (Kennon Williams)

## RIVERMONT AVENUE BRIDGE

Rivermont Avenue and its adjoining neighborhoods access Downtown via the Rivermont Bridge. Just northwest of Downtown, Church Street and Main Street merge into Rivermont Avenue, and cross a bridge that spans over Blackwater Creek and the James River Heritage Trail. Both the approach segments and the bridge deck itself are four travel lanes, as shown in the existing conditions diagram for the bridge. The bridge deck contains narrow sidewalks directly adjacent to the vehicular travel lanes and some shared lane markings for bicyclists. Traffic counts on the bridge suggest that traffic could be accommodated by two travel lanes.

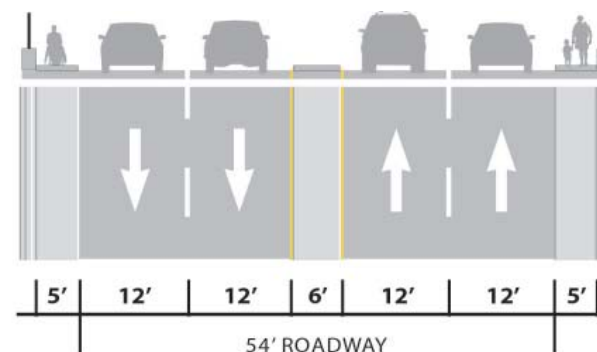
The following are recommended for the Rivermont Avenue Bridge gateway:

- > Repurpose the bridge deck to include separated bike lanes, safety railing, and buffer space from traffic to better connect Downtown to Rivermont Avenue neighborhoods and create a formal gateway.
- > Provide pedestrian-friendly crossings on either side of the bridge and use the center median as a pedestrian refuge.
- > Incorporate public art or a fountain (per 2000 Plan) into the Morrison Garden to activate the space and enhance the sense of arrival from the Rivermont Bridge, John Lynch Bridge, and Fifth Street.

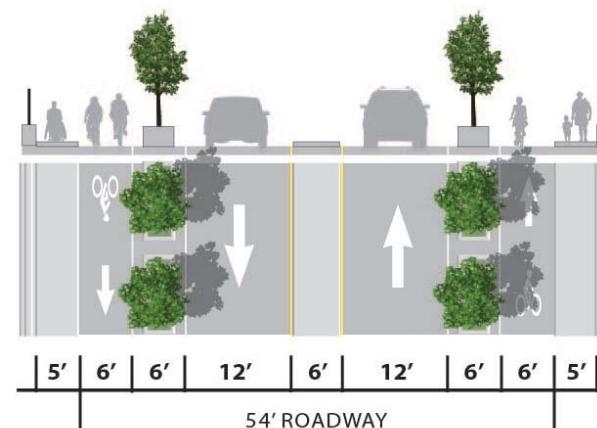
The proposed cross section would have minimal impact on traffic while providing a much-improved multimodal connection to residents, at a much lower cost than reconstructing the bridge deck. Rebalancing the cross section would also better control traffic speeds and behavior, improving the surrounding areas and making it easier to cross Rivermont Avenue.



Rivermont Bridge in 2018



EXISTING



PROPOSED

*Repurposing the existing Rivermont Avenue bridge deck for separated bicycle lanes and landscaping can better serve all modes of travel, while improving the aesthetics of a major Downtown gateway. Stand alone planters are available that are self-watering in the required dimensions.*



## JOHN LYNCH MEMORIAL BRIDGE

Fifth Street forms the northwest boundary of Downtown proper and is connected to Amherst County and Madison Heights across the James River by the John Lynch Memorial Bridge. While both Fifth Street and Amherst Highway are two lanes as they move further from the bridge and river, the approach segments and the bridge deck itself are four travel lanes, (see the existing conditions diagram for the bridge). Once a major route between the City of Lynchburg and Amherst County, the four-lane bridge has become underutilized following improvements to U.S. 29 and U.S. 460.

Lynchburg's Riverfront Park lies on the southwest side of the James River and Amherst's Riveredge Park is on the northeast side - offering spectacular views of Downtown Lynchburg back across the James River. The bridge deck does not include any provisions for pedestrian or bicycle traffic to move between Downtown and the Amherst County side of the river. Similar to the Rivermont Bridge, this bridge deck can accommodate a dedicated bicycle and pedestrian facility by reallocating the excess space currently underutilized by vehicular traffic. Additionally, as the structure is a significant part of the view from Downtown, this plan also recommends introducing public art into the bridge design, potentially using a series of lights, to transform the appearance of this otherwise utilitarian bridge.



*Reallocating some of the existing pavement of the John Lynch Memorial Bridge can better connect the pedestrian and bicycle network, while provide a new amenity for Lynchburg visitors and residents to interact with the James River.*

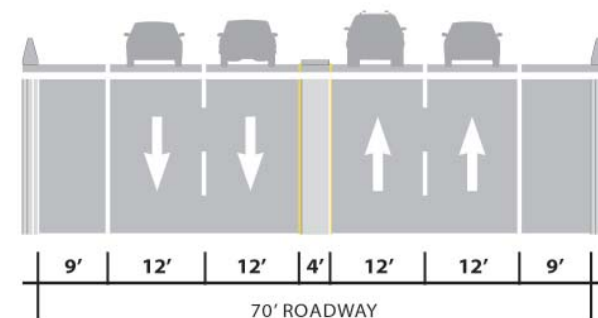
This Plan recommends the conversion of the outbound lane on the southeast side into a multi-use pedestrian and bike lane. With minimal impact to traffic flow, completing this conversion will:

- > Provide a multi-modal connection between Downtown and Amherst County at a relatively low cost
- > Complete a segment of a trail loop that runs between Riverfront Park and Amherst's Riveredge Park (see Public Space and Recreation Chapter)
- > Help control traffic speeds by having a consistent cross section for the entire length of Fifth Street and Amherst Highway
- > Offer pedestrians and cyclists with an overlook to the riverfront and Downtown without interfering with traffic
- > Connect Downtown to Amherst Riveredge Park, providing much-desired riverfront access in the near term
- > Enhance the experience of crossing this highly visible gateway

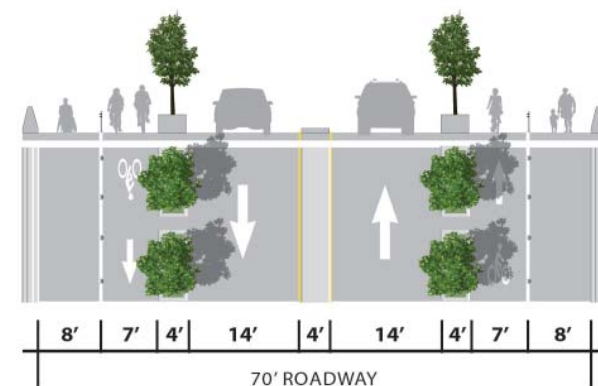


*Safety railing like shown here should be incorporated into these designs to safely separate traffic from pedestrians, planters, and other bridge amenities.*

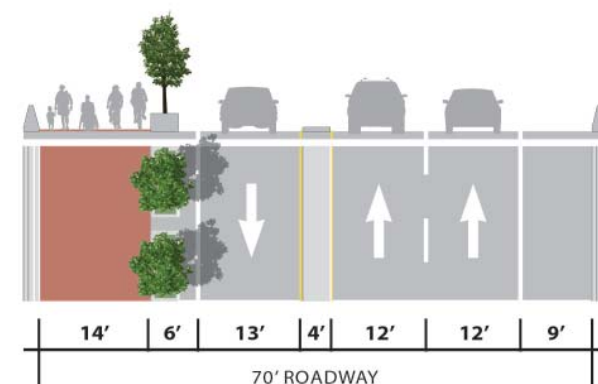
*There are multiple options for accommodating pedestrian and bicycle facilities on John Lynch Memorial Bridge. Each should provide vertical separation (bollards or planters) from the roadway, aesthetic improvements, and adequate width to accommodate passing of people who may stop to overlook the River.*



EXISTING



PROPOSED A



PROPOSED B

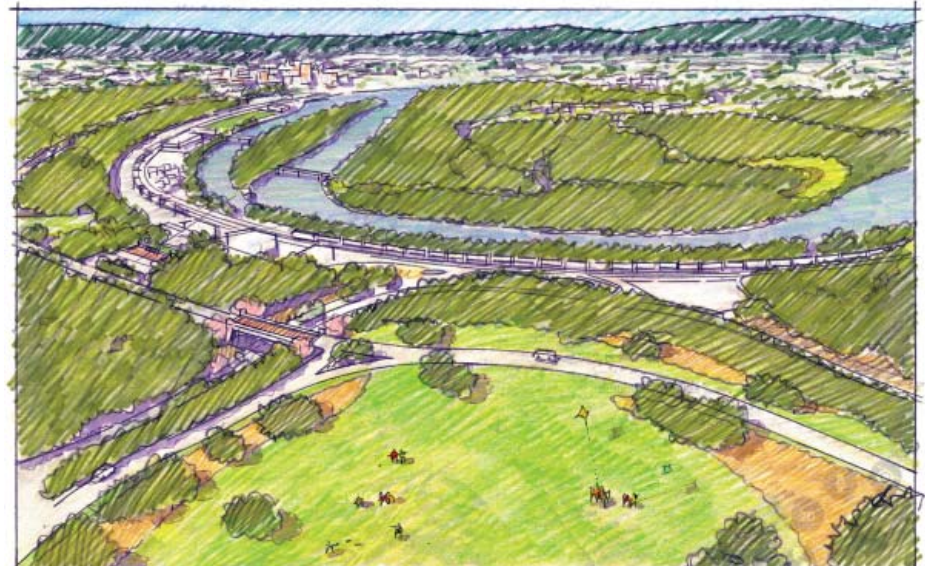


## JAMES RIVER SCENIC PARKWAY

Recent improvements to U.S. 29 and U.S. 460 allow travelers to quickly bypass much of the City. Many visitors destined for Downtown use this route and then travel along Concord Turnpike to reach Downtown. Concord Turnpike travels through an industrial zone, passing the former landfill and the wastewater treatment plant. The James River Scenic Parkway proposed here can create a significant new gateway to Downtown. A two-lane parkway connecting Route 460, Tyreeanna, and White Rock Hill to Downtown would provide a scenic drive with spectacular views of the bluffs and the James River—a dramatic entrance to Downtown. The landfill closure and anticipated expansion of the wastewater treatment plant, presents an opportunity to begin planning for this as its development will take many years. The proposed route follows mainly undeveloped lands through a series of greenfields and would reduce traffic on dangerous at-grade railroad crossings. The Concord Turnpike corridor would remain open to reduced industrial traffic.



*Proposed James River Parkway Alignment (Scenery Approaching Downtown)*  
Source: GoogleEarth

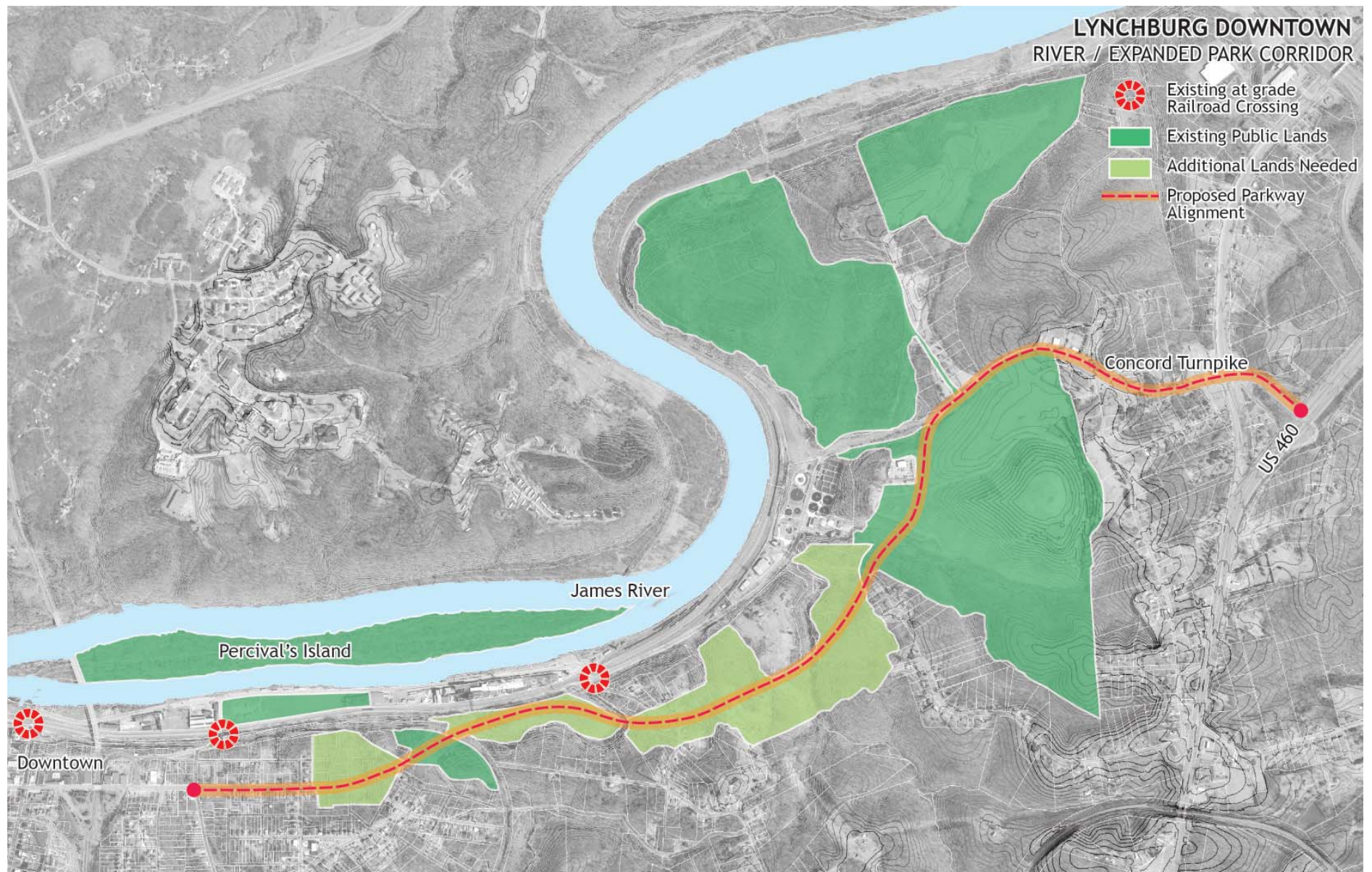


*James River Parkway Proposed Concept*

The James River Scenic Parkway project provides a significant opportunity to improve the first impressions of the large number of visitors entering Downtown from the southeast. Additionally, the project includes the following benefits:

1. Provides the only direct route to the heart of Downtown from U.S. 460, uninterrupted by traffic signals, railroad crossings, and turning conflicts.
2. Provides panorama views over the James River and Downtown.
3. Improves access for the Tyreeanna and White Rock Hill Neighborhoods to services and amenities Downtown.
4. Connects Downtown, and its surrounding neighborhoods, to potentially the largest cluster of outdoor spaces and parklands in the City (if the landfill is repurposed).
5. Removes travelers and traffic from the wastewater treatment plant and industrial zone that currently share the Concord Turnpike.
6. Reduces traffic from three hazardous railroad crossings, which can qualify the project for special transportation funding.
7. Connects to the southeast end of Main Street, positioning adjacent neighborhoods for increased development activity.





Routing and land availability for the James River Scenic Parkway

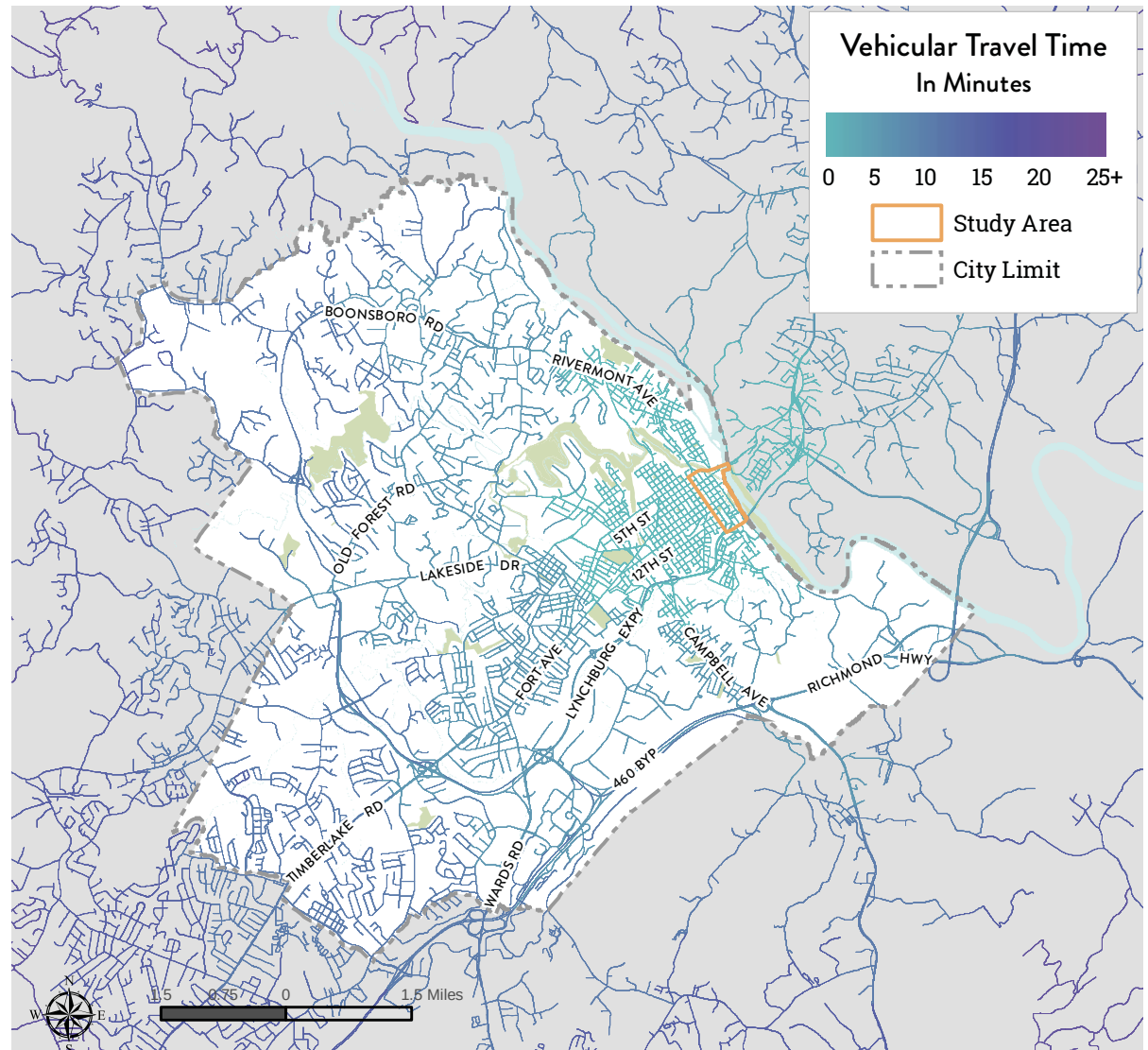


## 8.2 NEIGHBORHOODS

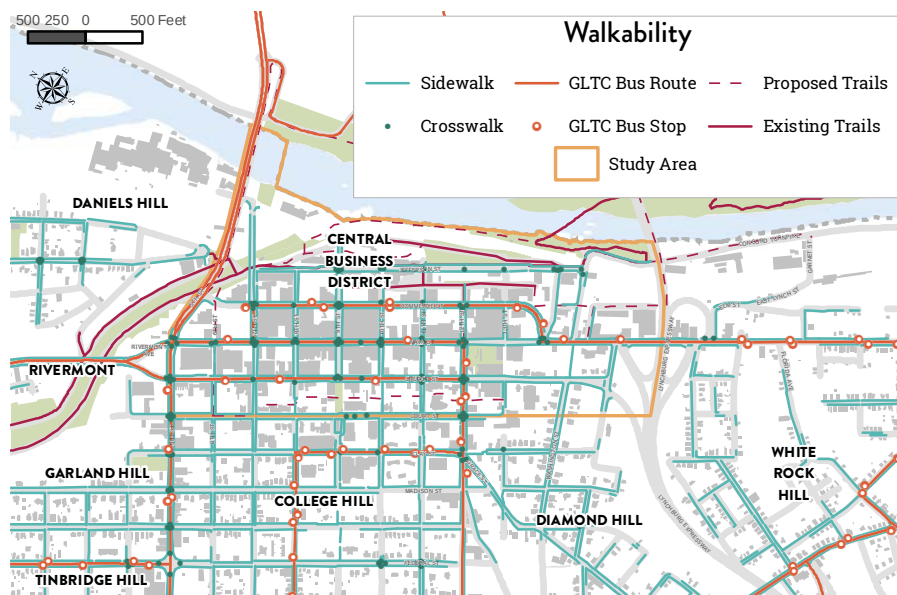
The neighborhoods of Lynchburg will play a vital role in continuing Downtown's revitalization. Both the neighborhoods immediately surrounding Downtown, the walkable ones, and outer neighborhoods should be well connected to Downtown, reinforcing Downtown as the center of the region. Driving to reach Downtown is relatively easy from anywhere in the City as most of the City is accessible within fifteen minutes. However, if Downtown is successful, parking and travel within Downtown will become more difficult over time. Increasing connectivity for pedestrians, cyclists, and transit riders will help ease the effects of this success and support further growth.



Garland Hill Neighborhood



While the map does not take into account traffic, vehicular travel to Downtown is very easy. Drivers can reach Downtown from most of the City within fifteen minutes.



*Crossing Madison Street could be enhanced to encourage pedestrians from the nearby College Hill Neighborhood.*

## WALKABLE NEIGHBORHOODS

The neighborhoods immediately bordering Downtown contain unique historic homes and buildings in attractive neighborhoods. As Downtown continues to revitalize, the housing in these neighborhoods will see increased demand. Likewise, Downtown's success is also reliant on these neighborhoods. Downtown should be easily accessible and facilitate walking from these nearby areas rather than encouraging residents to drive short distances, find and pay for parking. However, Lynchburg's distinctive natural topography, with its dramatic bluffs and slopes, can make linkages to Downtown challenging. Wide roads and disjointed sidewalk systems also deter pedestrian and bicycle use. Improvements to Downtown's gateways discussed in the previous section will help, but implementing the "principles of walkability" discussed in the Mobility Chapter will be a key to enhancing the connectivity to these neighborhoods.

Routes from the surrounding neighborhoods should be assessed and upgraded for:

- > Sidewalk/crosswalk connectivity
- > Pedestrian environment
- > Potential cut-throughs to ease travel (i.e. Diamond Hill Stairs)
- > Street trees/adequate shade
- > Bus connectivity in the case of inclement weather

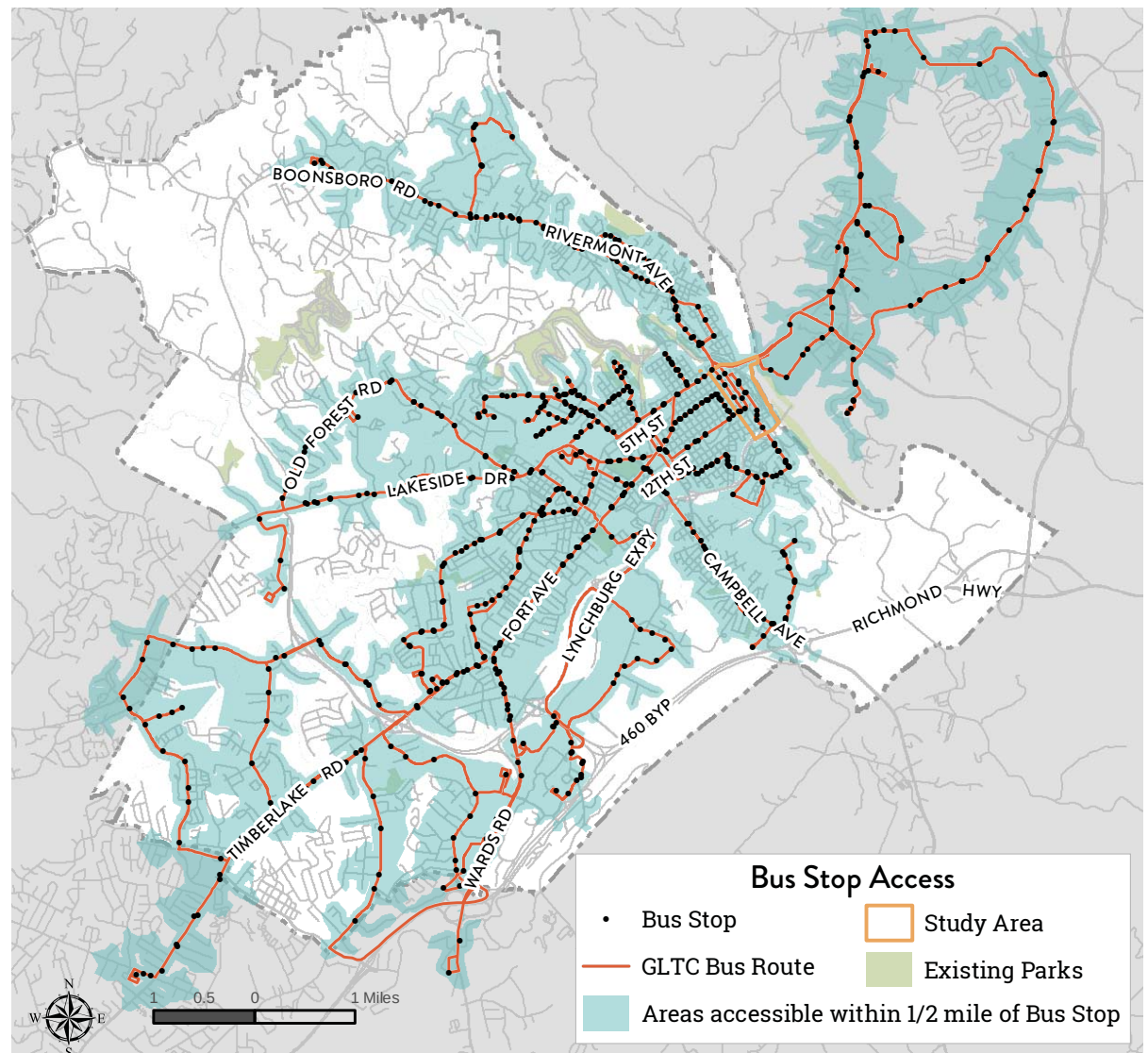


## PERIPHERAL NEIGHBORHOODS

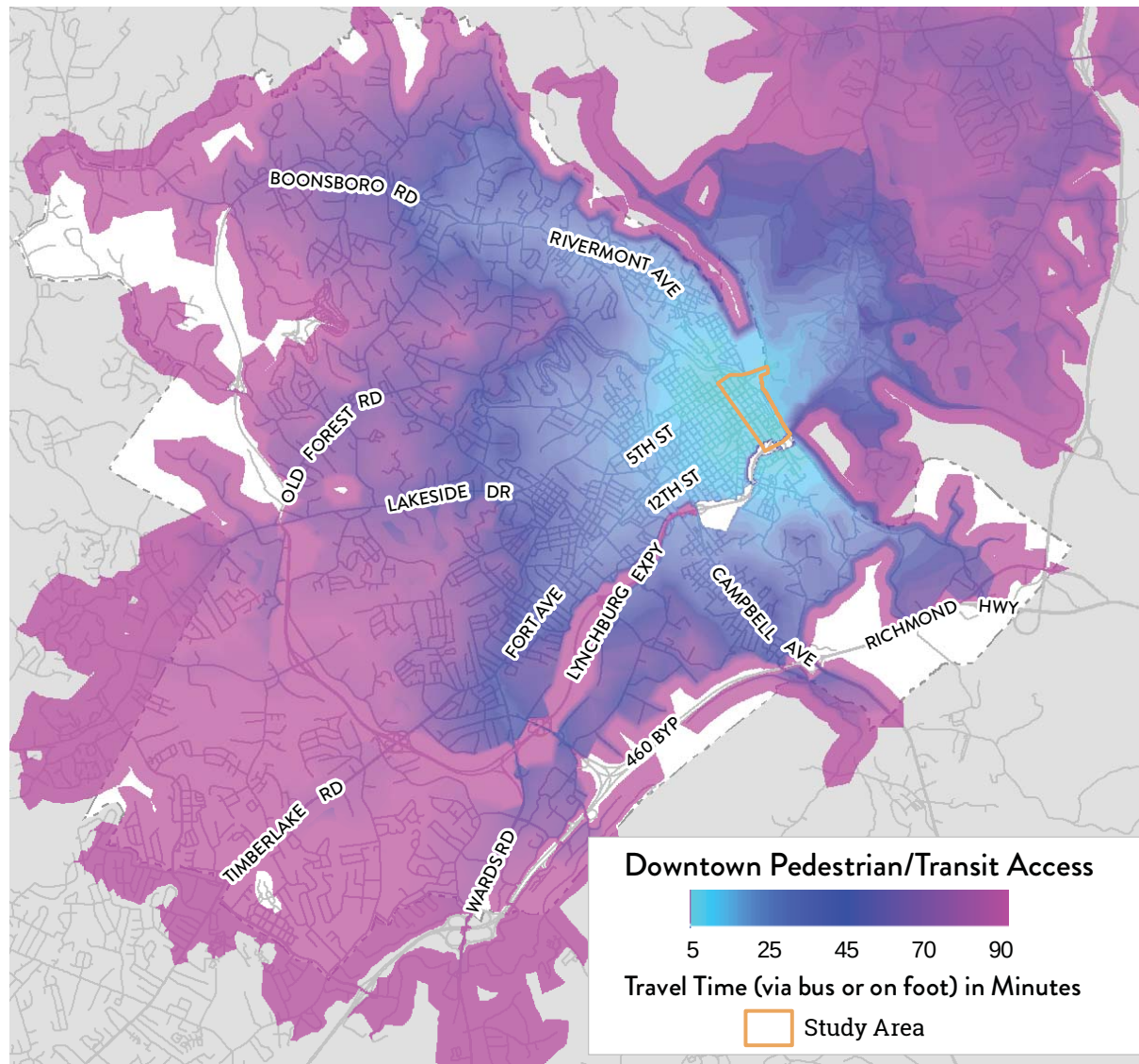
Many of Lynchburg's neighborhoods are only a few miles from Downtown via direct thoroughfares like Rivermont Avenue, Fifth Street and Memorial Avenue, Fort Avenue, and Florida Avenue. These neighborhoods could also be easily accessible via short bike or transit rides with enhancements to the system.

### BUS ACCESS

Many of these peripheral neighborhoods can easily access a bus stop on major thoroughfares. The map to the right illustrates areas within a half mile of a bus stop. However, the time it takes to get Downtown via bus because of the infrequent service deters potential riders.



Many neighborhoods within Lynchburg are within walking distance to a bus stop.



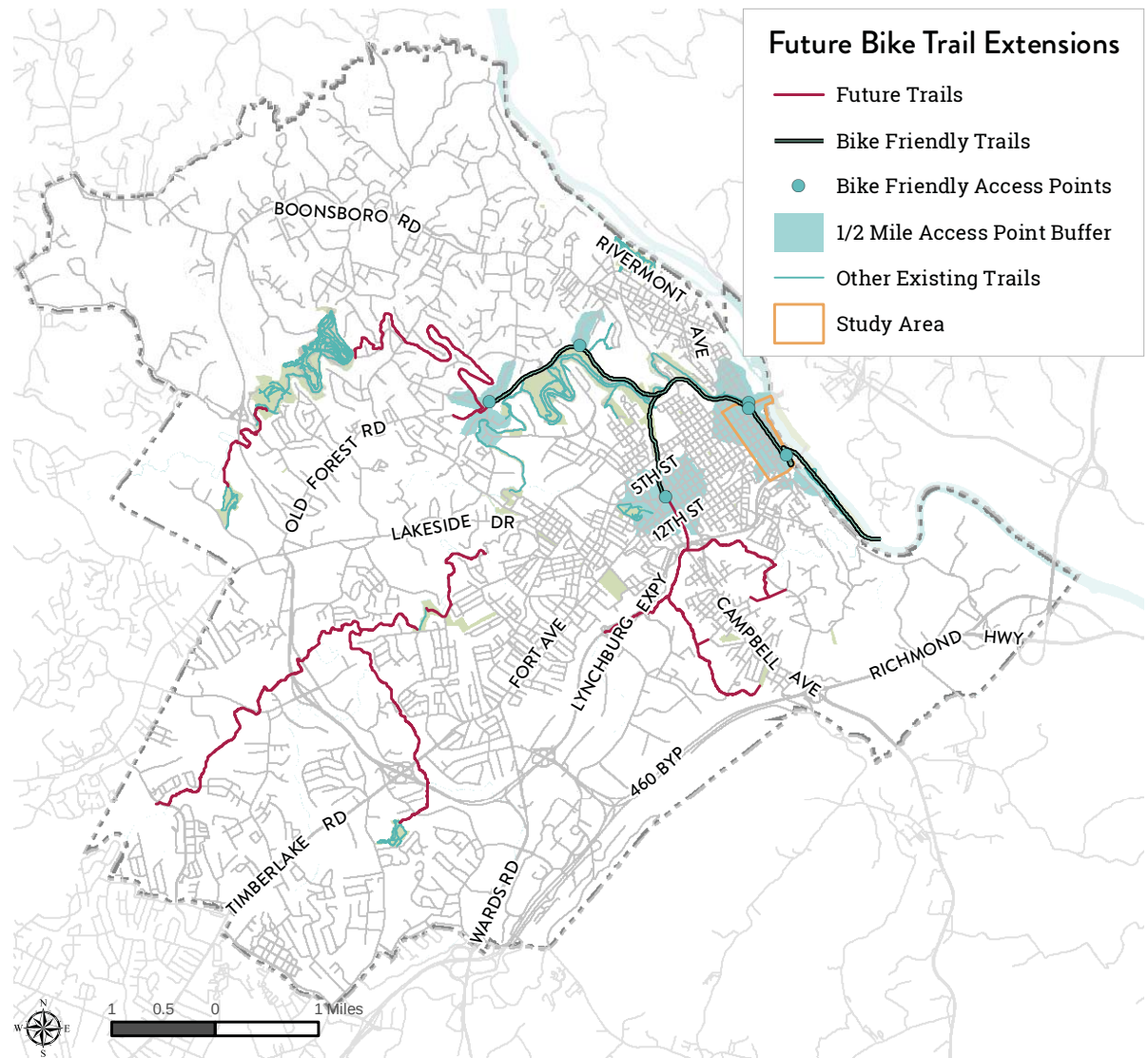
For example, Rivermont Avenue provides a direct route from many neighborhoods, however drivers can be Downtown within 10 minutes. Paying nothing for on-street parking, it would be difficult for anyone to choose riding the bus as it is both slower and more expensive. This map shows the average travel time to reach Downtown between 5 and 7pm from other areas of the City.

Increasing this accessibility can help reduce demand for parking Downtown, encourage more frequent travel Downtown by those without access to vehicles, and accommodate denser development around the City. See Mobility Chapter for more discussion on increasing bus route ridership.

## BIKE ACCESS

As discussed in the Mobility Chapter, Lynchburg has an extensive trail system. These trails weave along creek beds behind many neighborhoods but actually have limited connection points to the paved trails (routes commuters could potentially take to reach Downtown). Extensions of the paved trails and small spurs that connect neighborhoods to the existing trails would help neighborhood residents better access Downtown via bicycle, encouraging up another mode of travel.

See Mobility Chapter for more discussion on trail improvements to encourage Downtown travel by bicycle.



*Relatively few areas of the City are currently directly connected to the trail network, requiring people to drive and park before using the trails. However, the potential to tie neighborhoods in and encourage people to bike from their front door to reach Downtown is an enormous opportunity. Trail extensions as well as small spur trails connecting to the existing network will encourage this.*



## 8.3 COLLEGES AND REGIONAL TRANSPORTATION

Lynchburg benefits from several institutions of higher learning within a short drive of Downtown. With its fashionable new apartments and mixed-use buildings, Downtown is becoming a residential destination for faculty and students. However, the Central Business District has yet to really capture the college energy and vibrancy. While the potential for Downtown to benefit from area colleges is enormous, the colleges should also benefit by marketing close Downtown ties to their prospective students and employees.

### TRANSIT CONNECTIVITY

Analyzing the current levels of transit connectivity between Downtown and the Colleges reveals the difficulty for students and faculty to reach Downtown unless they own a personal vehicle. Despite relatively short drives (all the Colleges are accessible in less than 15 minute via car), the accessibility of Downtown via transit in less than 30 minutes was very low.

On weekdays between 7am and 7pm, area colleges were accessible within 30 minutes the following percent of the time throughout the course of the day:

Randolph College- 50%  
Virginia University of Lynchburg (VUL)- 50%  
University of Lynchburg (Lynchburg College)- <10%  
Central Virginia Community College (CVCC)- 0%  
Liberty University (LU)- 0%

Partnering with the colleges and Greater Lynchburg Transit Company (GLTC) can improve this connectivity immensely. If both a cheaper and just as (or more) convenient alternative is available, students and staff from the colleges will be enticed to take transit to reach Downtown. Better connectivity to Downtown will be an exciting amenity the colleges can offer students, while also helping Downtown harness and benefit from the energy on Lynchburg's college campuses.

## FOCUS GROUP RECOMMENDATIONS

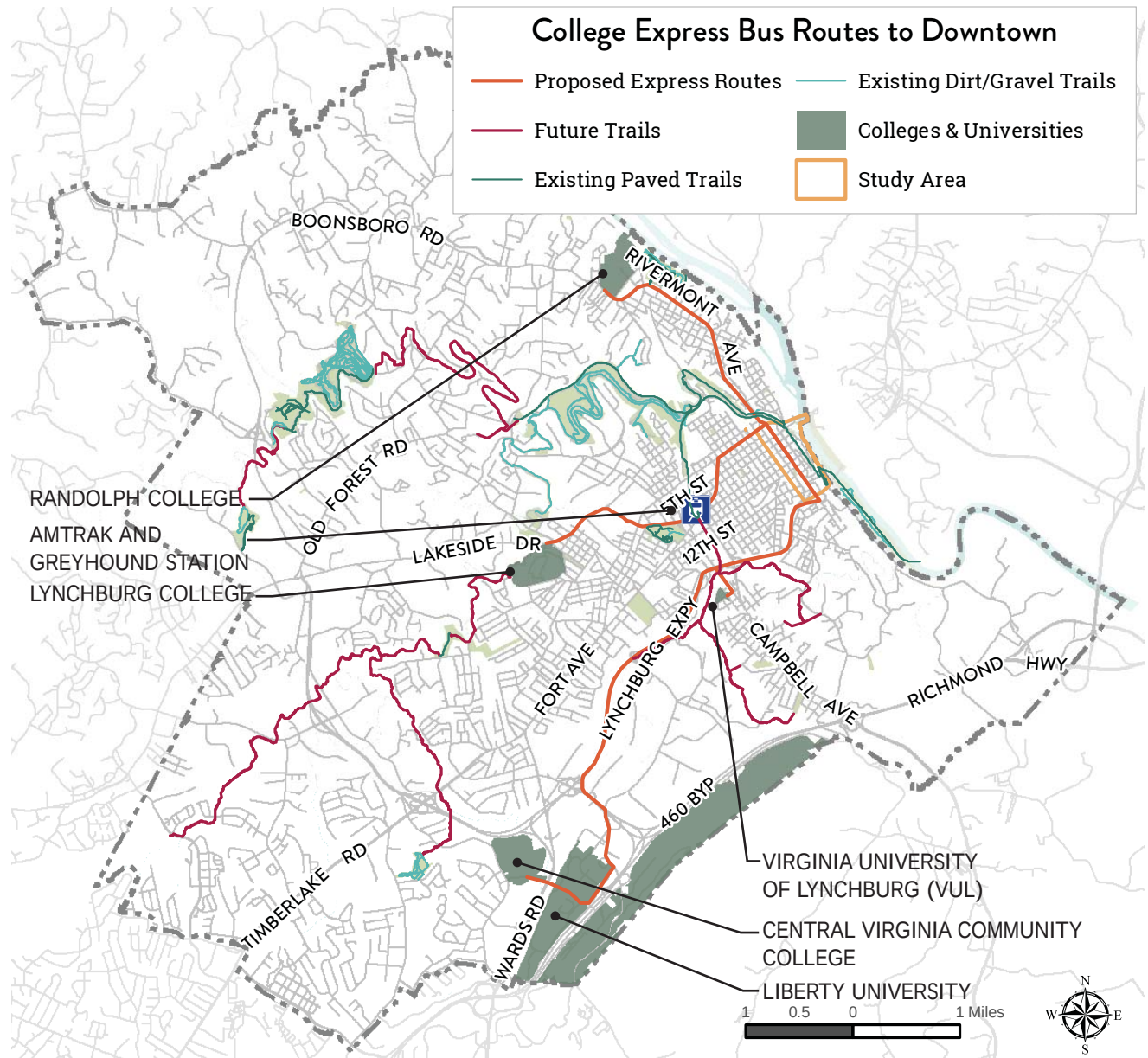
Focus groups, including college representatives, brainstormed several ways to potentially connect Downtown to local institutions and foster student life activities. The opening of the historic theater at the Academy Center of the Arts will be a first step toward bringing this vital demographic Downtown. Other recommended methods include:

- > A partnership with the Downtown Lynchburg Association and higher education institutions to create a program that allows students to make purchases at Downtown restaurants and businesses with a swipe card system.
- > Free or discounted bus service to Downtown (or all routes) for enrolled students financed by student fees.
- > Express buses running directly from a central location in Downtown to each of the colleges. See Express Bus Routes Map on the following page.
- > Amenities oriented to the student demographic such as the proposed **Main Street Arrival Pad and Destination Amphitheater** in Section 4.1 Parks and Gathering Areas. See Amenities Map in following pages.
- > A facility dedicated to student events such as the proposed **Multi-College Conference Center** in Chapter 3: Historic and Architectural Resources
- > Continued improvement of multi-modal networks that link local colleges and universities to Downtown. This includes prioritizing bicycle routes to these institutions, as illustrated in the bike trail extension map in the previous section.

## REGIONAL TRANSPORTATION

Many visitors to Lynchburg opt to stay in hotels outside of Downtown that are closer to the airport or the destination they are visiting, often Lynchburg's colleges. If Downtown were more easily accessed from regional transportation hubs like the Amtrak/Greyhound station and the Lynchburg Airport, and large destinations are easily accessed from Downtown via Express Bus routes, visitors will be more likely to choose to stay Downtown where they can experience the destination restaurants, concentration of amenities, and culture of Lynchburg. Two key recommendations will help better tie Downtown to regional transportation and make it more attractive to Lynchburg visitors:

- > The Express route to Lynchburg College could easily stop at Kemper Street Station to and from its route Downtown. This will make train and Greyhound bus travel accessible, as well as provide a direct route to the Greater Lynchburg Transit Company (GLTC) transfer center.
- > Shuttles to and from the Airport at key departure and arrival times can facilitate Downtown visits as they also allow visitors not to rely on rental vehicles.



Express Bus Routes to Lynchburg Colleges and Universities



## 8.4 CONNECTING COMMUNITIES: GOALS

- > Enhance gateway entrances into Downtown.
- > Improve connectivity between Downtown and its surrounding neighborhoods through parks, public spaces, transportation, and streetscape improvements.
- > Attract students and staff from Lynchburg's universities and colleges to Downtown by providing amenities and transportation options.
- > Connect to regional transportation hubs to better attract Lynchburg visitors to Downtown.

## 8.5 CONNECTING COMMUNITIES: RECOMMENDATIONS

Strategic recommendations are proposed to improve access and connectivity between Downtown and its surrounding neighborhoods, as well as to promote social interaction among Lynchburg's diverse population groups. The short, mid, and long-term strategies on the following page summarize policy and design actions Lynchburg can take as part in. Additionally, many other initiatives related to Mobility and Accessibility, Public Space and Recreation, and Utility Infrastructure will also help better connect these communities.

## CONNECTING COMMUNITIES

| SHORT-TERM STRATEGIES                                                                                                                                                                                  | MID-TERM STRATEGIES                                                                                                                                                                                                                                                                                    | LONG-TERM STRATEGIES                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>GATEWAYS</b>                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                        |                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Convert a portion of the underutilized John Lynch Bridge into a multi-use trail connecting Amherst Riveredge Park to Downtown.</li> </ul>                       | <ul style="list-style-type: none"> <li>Reduce lanes on Main Street Bridge and add bike lanes with buffers. Improve Gateway streetscape on either side of bridge.</li> </ul>                                                                                                                            |                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Develop a master plan for the construction of the <b>James River Parkway</b>. Acquire land as needed.</li> </ul>                                                |                                                                                                                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Design and build the <b>James River Scenic Parkway</b>.</li> </ul>                                                  |
| <ul style="list-style-type: none"> <li>Convert underutilized lanes of Rivermont Avenue Bridge into bike lanes with buffers.</li> </ul>                                                                 |                                                                                                                                                                                                                                                                                                        |                                                                                                                                                            |
| <b>CONNECTIVITY</b>                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                        |                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Identify intersections and streets to improve walkability from adjacent neighborhoods.</li> </ul>                                                               | <ul style="list-style-type: none"> <li>Implement pedestrian and bicycle improvements on neighborhoods streets.</li> </ul>                                                                                                                                                                              |                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Work with neighborhoods to identify and build potential spur trails.</li> </ul>                                                                                 | <ul style="list-style-type: none"> <li>Increase bus frequency and enhance bus stops along key corridors.</li> </ul>                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Extend paved trail network to reach additional neighborhoods and promote commuting via bicycle Downtown.</li> </ul> |
| <ul style="list-style-type: none"> <li>Establish a merchant program in partnership with Downtown Lynchburg Association (DLA) that accepts pre-paid college cards for payment and discounts.</li> </ul> | <ul style="list-style-type: none"> <li>Establish a bus pass program for students as part of college fees. Partner with the Greater Lynchburg Transit Company (GLTC) and higher education institutions to create express routes and shuttles from colleges and regional transportation hubs.</li> </ul> |                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>Ensure all buses have bicycle hardware in partnership with the Greater Lynchburg Transit Company (GLTC).</li> </ul>                                             | <ul style="list-style-type: none"> <li>Identify priority greenway improvements that better link Downtown to colleges.</li> </ul>                                                                                                                                                                       |                                                                                                                                                            |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

PAGE LEFT INTENTIONALLY BLANK



# 9. ECONOMIC AND MARKET ASSESSMENT

- 9.1 METHODOLOGY AND DATA  
COLLECTION SUMMARY
- 9.2 MARKET TRADE AREAS
- 9.3 SUMMARY OF FINDINGS
- 9.4 MARKET OPPORTUNITIES FOR THE FUTURE

PAGE LEFT INTENTIONALLY BLANK

A market analysis was conducted for Downtown Lynchburg to define the geographic market area, assess the current user base, and identify specific opportunities for business support and economic development. The market analysis consisted of five components:

- > **Zip Code Survey** - Used to define the trade areas relevant to Downtown Lynchburg.
- > **Retail Leakage Analysis** - Identified the supply and demand in the trade area and opportunities for growth in Downtown Lynchburg.
- > **Demographic Snapshot** - Examined trends in population and income in Lynchburg and the surrounding region.
- > **Market Segmentation study** - Analyzed the makeup of Lynchburg's primary trade area in order to determine consumer needs and target markets.
- > **Residential and Commercial Development Analysis** - Looked at trends and potential for residential and commercial development in Downtown Lynchburg.

The findings of the market analysis were used as a basis for business development and recruitment strategies in Chapter 10.

A summary of the market analysis is provided on the following pages. Additional detail can be found in the market analysis report located in the Appendix.

## 9.1 METHODOLOGY AND DATA COLLECTION SUMMARY

The market analysis establishes the retail trade area for Downtown Lynchburg. This information is critical to the remainder of the market study and provides the baseline data for the subsequent leakage and shares analyses. Our process began with a zip code survey of customers to determine the market base relevant to Lynchburg.

During a one-week period in July 2017, thirty-seven businesses in Downtown Lynchburg tallied the resident zip codes of their customers using the provided form shown below.

**Zip Code Survey of Customers – Downtown Lynchburg**

Business Name: \_\_\_\_\_ Dates: ٢٠١٧ - ٢٣<sup>rd</sup> July

**Instructions**

1. Simply ask customers, "We're conducting research for downtown, can I have your zip code?"
2. Please write in the **residence** zip code for each customer who enters your business.
3. Ask if the customer is a **CURRENT STUDENT** of a **LOCAL COLLEGE** (Liberty, Lynchburg, Randolph) and check the box accordingly.
4. Someone from DLA will collect at end of survey period.



For more information, contact Aaron Arnett at [aaron@arnettmuldrow.com](mailto:aaron@arnettmuldrow.com) or 864.233.0950

| Zip Code                 |                          | Student                  |                          | Zip Code                 |                          | Student                  |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sample - 24501           |                          |                          |                          | 29609                    |                          |                          |                          |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |                          |                          |                          |

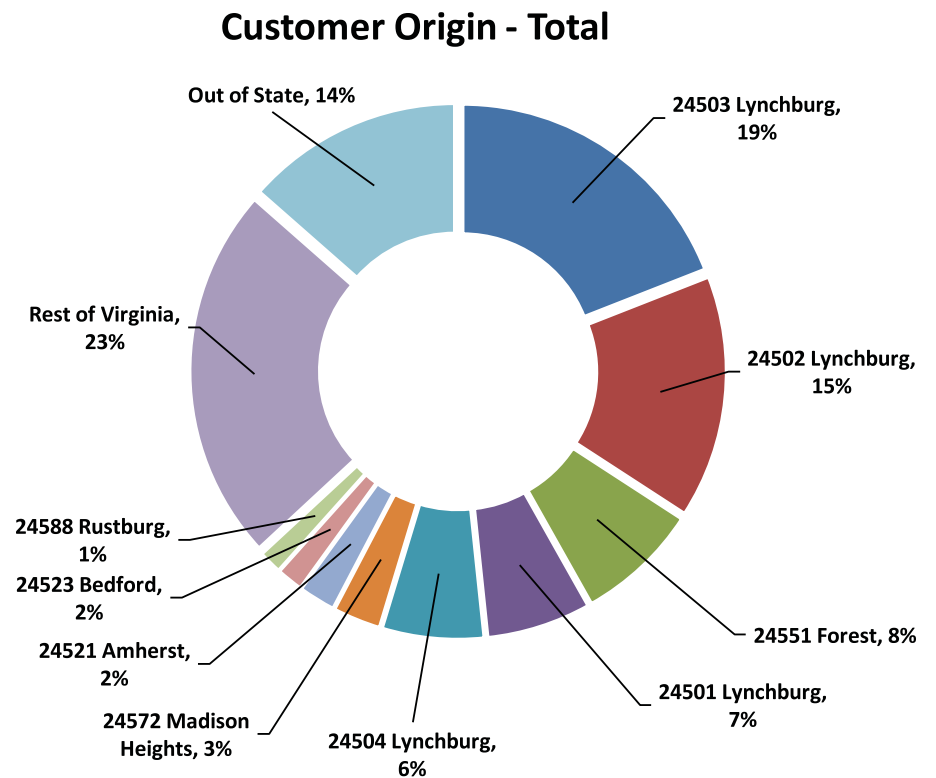


Participating businesses included a variety of retail, restaurant, cultural institutions, and visitor destinations located in Downtown. Businesses recorded the zip code of each customer and also asked if the customer was a current student of a local college. The survey recorded 3,077 visits from 413 unique Zip Codes, 38 states, and 3 foreign countries. Approximately 86.5% of customers were from Virginia, with 47.9% from Lynchburg.



Location of Businesses Participating in Zip Code Survey  
Source: Arnett Muldrow & Associates

For the businesses that asked whether their customers went to local colleges, approximately 13% identified that they were students. While this is a significant portion of the market, it should be noted that the survey was done while colleges were not in regular session, and it can be assumed that the percentage would be higher during the school year.



Zip Code Survey Customer Origin  
Source: Arnett Muldrow & Associates

## 9.2 MARKET TRADE AREAS

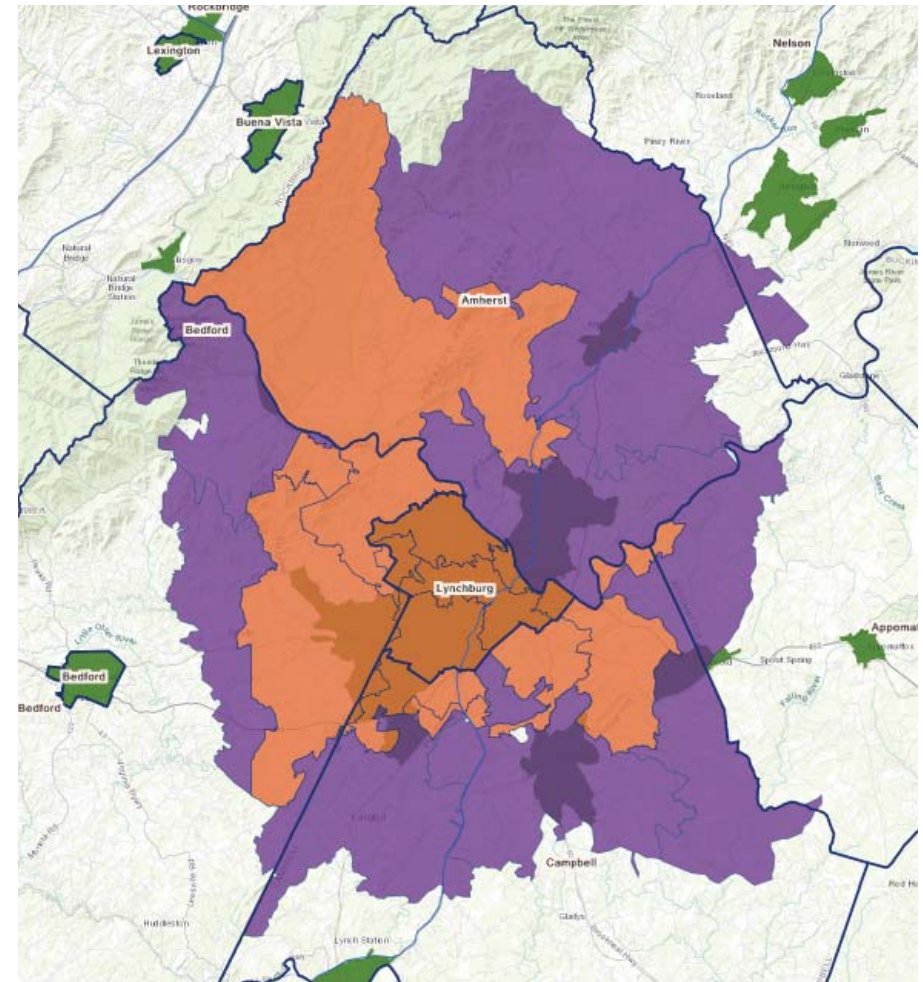
The results of the zip code survey were analyzed against the total population of each individual zip code to determine the market saturation. From this analysis, primary and secondary trade areas were identified for Downtown Lynchburg.

The primary trade area (PTA), with approximately 55% of the total visits, consists of the following zip codes:

|                     |                 |
|---------------------|-----------------|
| 24503 Lynchburg     | 24502 Lynchburg |
| 24504 Lynchburg     | 24574 Monroe    |
| 24536 Coleman Falls | 24501 Lynchburg |
| 24551 Forest        |                 |

The secondary trade area (STA), with approximately 10% of the total visits, consists of the following zip codes:

|                       |                  |
|-----------------------|------------------|
| 24556 Goode           | 24526 Big Island |
| 24521 Amherst         | 24538 Concord    |
| 24572 Madison Heights | 24550 Evington   |
| 24588 Rustburg        |                  |



■ Primary Trade Area  
■ Secondary Trade Area

Map of Lynchburg Primary Trade Area and Secondary Trade Area  
Source: ESRI, Arnett Muldrow & Associates

## 9.3 SUMMARY OF FINDINGS

### DEMOGRAPHICS

According to Nielsen Claritas, a national marketing service used by planners, consultants, and private businesses for their market research, the estimated 2017 population of the City of Lynchburg is 80,585. With 132,980 people in the PTA and 52,387 in the STA, Lynchburg's combined trade area has a population of over 185,000. Population in the City of Lynchburg and the PTA have grown faster than the metropolitan region. The U.S. Census Bureau shows that from 2000 to 2010, Lynchburg grew by 15.8% and the primary trade area grew by 16.7%. During the same time period, the Lynchburg Metropolitan Statistical Area (MSA or "metro") grew by 10.5%. Claritas projects Lynchburg and the PTA to grow by 4.7% from 2017 to 2022.

With a median age of 28.7, Lynchburg has the youngest population in the region. The median age in the PTA is 34.2 and the median age in the metro is 40.1 (Source: Claritas).

The median household income in Lynchburg (\$40,163) is on the lower end in the region and the median household income in the PTA (\$49,575) is in the mid-range of incomes in the region. The percent of families living below poverty in Lynchburg (18.9%) is significantly higher than that of the PTA (12.9%) and region (11.4%) (Source: Claritas).

### EMPLOYMENT

Downtown Lynchburg is a regional center of both employment and commerce, with national and global reach. As Downtown has become more desirable, it has attracted growing business and destination retail anchors. As of March 2018, the unemployment rate in Lynchburg was 3.8% (Source: Bureau of Labor Statistics). The largest employment sectors in Downtown Lynchburg are education (29%), finance and

insurance (23%), public administration (14%), healthcare and social assistance (6%), and professional, scientific and tech (6%) (Source: US Census On the Map).

### RESIDENTIAL AND COMMERCIAL DEVELOPMENT

The median value of all owner-occupied housing units in Lynchburg is \$148,856, compared to \$170,507 in the Lynchburg MSA and \$178,822 in the PTA (Source: Claritas). Overall, Lynchburg's housing market is strong, with rising values and decreasing days on market. Single-family residential permits in the Lynchburg MSA declined following the recession but have held steady since 2013. A small sample of building permit data from Downtown Lynchburg shows that the number of single-family building permits in Downtown has been increasing since 2012 (Source: City of Lynchburg).

Over 900 rental residential units have been developed as loft apartments in historic Downtown Lynchburg since 2007 (Source: City of Lynchburg). According to advertised rents on various Downtown loft websites, the current market sees a range of rents from \$550/month to greater than \$1,250/month, with units ranging from 595 square feet to 2,500 square feet.



*Historic Residential Loft on Jefferson Street*



In general, commercial investment in Downtown Lynchburg has been stable over the past decade, as evidenced by business licenses and commercial permits. Business licenses for new businesses in the Central Business District peaked in 2004, but annual revenues for all businesses in Downtown have been steadily increasing. In the past ten years, Downtown business license and meals-lodging-amusement tax revenues have increased each year, with an average annual growth of 12% during that time. \$1.75 million in revenue was generated in 2016 in Downtown (Source: City of Lynchburg). According to the City's data, commercial permits have been a mix of renovation to existing structures and new construction, with permits generally increasing over the past decade. A high of 43 commercial building permits in downtown was recorded in 2015.

## RETAIL LEAKAGE ANALYSIS

A retail leakage analysis was performed on Lynchburg's primary and secondary trade areas in order to examine retail trade patterns in the community and identify potential opportunities for retail growth based on demand in the market.

"Retail Leakage" refers to the difference between the retail expenditures by residents living in an area and the retail sales produced by the stores located in the same area. If consumer expenditures in an area are higher than retail sales in the same area, then the area is said to be "leaking." Conversely, if retail sales in an area are higher than consumer expenditures, the area is said to be "gaining." All the following data comes from Nielsen Claritas.

The retail leakage analysis revealed:

- > Stores in Lynchburg's primary trade area sold \$3.1 billion in merchandise in the previous year. Consumers living in Lynchburg's primary trade area spent \$2.4 billion in merchandise during the same time period. Therefore, Lynchburg's primary trade area gained \$659.3 million in sales last year.
- > Lynchburg's secondary trade area had \$523 million in sales and \$941.6 million in consumer expenditures, resulting in a \$418.6 million leakage.
- > The combined trade area gained \$240.7 million.
- > The City of Lynchburg had \$2.38 billion in retail sales and \$1.43 billion in consumer expenditures, resulting in a gain of \$943.6 million.

The retail leakage analysis indicates that Downtown Lynchburg and its trade areas are a retail center, pulling a significant amount of sales from the outside. Lynchburg is an urban market that pulls in consumers from a large, rural geographic area. It also has a robust visitor market that drives sales in destination businesses leading directly to retail gain. While the trade areas are experiencing gain overall, there are a number of categories that show opportunity for growth based on demand.

## 9.4 MARKET OPPORTUNITIES FOR THE FUTURE

### NEW MARKET POTENTIAL FOR RETAIL

While Lynchburg is generally serving the needs of the residents living in Downtown's trade areas, opportunities exist to both grow clusters to capture more of the regional market and to target growth in key retail categories that currently experience leakage.

Retail leakage in certain categories translates to an immediate opportunity to target new business. For this analysis, a capture scenario was used whereby a reasonable portion of the primary and secondary trade area leakage could be accommodated Downtown. The conservative scenario estimate a capture of 20% of primary trade area leakage, and 10% of secondary trade area leakage, then translates leakage dollars to supportable square footage. This analysis suggests a potential capture in Downtown Lynchburg of a range of up to 150,000 to 228,000 square feet of new retail. The lower figure removes certain categories (such as general merchandising or building materials) that may not be feasible in a downtown environment. Key opportunities in select retail categories are shown in the following chart.

|                                          | Calculated Capture<br>(Square Footage) |
|------------------------------------------|----------------------------------------|
| <b>Selected Retail Categories Below</b>  | <b>228,396</b>                         |
| Furniture Stores                         | 15,061                                 |
| Home Furnishing Stores                   | 5,156                                  |
| Household Appliances Stores              | 3,677                                  |
| Building Material and Supply Dealers     | 9,465                                  |
| Hardware Stores                          | 727                                    |
| Grocery Stores                           | 11,751                                 |
| Health and Personal Care Stores          | 10,381                                 |
| Clothing and Clothing Accessories Stores | 19,717                                 |
| Women's Accessory & Specialty            | 3,531                                  |
| Shoe Stores                              | 2,711                                  |
| Jewelry Stores                           | 1,197                                  |
| Luggage and Leather Goods Stores         | 1,380                                  |
| Sporting Goods Stores                    | 3,084                                  |
| Hobby, Toys and Games Stores             | 2,258                                  |
| Sew/Needlework/Piece Goods Stores        | 1,246                                  |
| Book Stores                              | 11,024                                 |
| General Merchandise Stores               | 66,486                                 |
| Florists                                 | 204                                    |
| Gift, Novelty and Souvenir Stores        | 1,304                                  |
| Foodservice and Drinking Places          | 33,729                                 |
| Drinking Places -Alcoholic Beverages     | 24,306                                 |

*Capture Scenario for New Retail Space in Downtown Lynchburg.*

*Source: Arnett Muldrow, Claritas, ULI Dollars and Cents of Shopping Centers*

# 10. BUSINESS DEVELOPMENT AND MARKETING

- 10.1 ECONOMIC CLIMATE
- 10.2 ONGOING BUSINESS DEVELOPMENT & MARKETING EFFORTS
- 10.3 BUSINESS DEVELOPMENT RECOMMENDATIONS
- 10.4 MARKETING RECOMMENDATIONS
- 10.5 BUSINESS DEVELOPMENT AND MARKETING: GOALS
- 10.6 BUSINESS DEVELOPMENT AND MARKETING: RECOMMENDATIONS



PAGE LEFT INTENTIONALLY BLANK

Business development strategies for Downtown Lynchburg are based on the opportunities outlined in the economic assessment as well as the overall economic climate of the Downtown market. The actions identified in this section are intended to help the City and its partners recruit new investment while sustaining a healthy environment for Downtown business.

## 10.1 ECONOMIC CLIMATE

The economic outlook in Downtown Lynchburg is positive, particularly given the successful implementation of the 2000 Master Plan. The challenges faced sixteen years ago have evolved, and new hurdles exist today. Overall, Downtown Lynchburg remains a desirable place to live, invest, and open a business.

### DOWNTOWN SUCCESS

- > Greater than \$12.7 million in tax revenue has been generated from private investment in Downtown since 2012. Much of this development has occurred along Jefferson Street and Riverfront Park, as well as Commerce Street and Lower Bluffwalk.
  - > Residential growth is a huge economic driver as over 900 new units have been developed over the past decade. Most have been market-rate, loft apartments constructed by private developers utilizing local property tax incentives and state and federal historic tax credits.
  - > New residential continues to show potential in Downtown. Rents are increasing and leasing is active, and there is continued interest from the private sector in market-rate lofts and for-sale units.
- > Downtown continues to be the center of government and employment, with key employer expansions including Pacific Life, Innovative Wireless Technologies, AntWorks, and others.
  - > Similarly, Downtown has seen increased small business activity since the previous plan, particularly with restaurants and specialty retailers.
  - > Downtown activity is driven by key destinations such as Amazement Square, Academy Center of the Arts, Lynchburg Community Market, Downtown events and others.



*Amazement Square*

## CURRENT BUSINESS CLIMATE

- > Many small retail owners in Downtown sense that overall business is “down” for the first time in years because of recent construction, a changing market, or both. These business owners, as well as some developers, are concerned about the future and the effect of planned infrastructure projects.
  - > Liberty University and other local colleges are considered a good market draw for residents and consumers. This was confirmed by the market research.
  - > Downtown has seen a growing younger market driven by college students and young professionals who live Downtown, dine in local restaurants, or enjoy Downtown events. Some businesses see this as very positive, while others wonder if it means Downtown is losing its traditional market.
  - > Within the near future, Downtown will have additional active anchors such as the Academy of Music Theatre and Grassroots Local Market.
  - > Internet retailing has become the biggest competitor to Downtown shops. Some businesses have successfully addressed this by supplementing their trade with sales on Facebook, Etsy, and dedicated websites.
  - > Additional owner-occupied housing is needed in Downtown. Lynchburg’s Real Estate Rehabilitation and Renovation Program has been incredibly successful in providing incentives for developing loft residential units. Most residential development in Downtown, however, has been with renter occupied housing.
- The Real Estate Rehabilitation and Renovation program was amended in early 2018, and provides tax exemptions for residential, commercial, and industrial.
- > Overall, Downtown has a robust geographic market pull that creates demand for new business. The market analysis presented earlier in this report shows the potential for between 150,000 - 228,000 square feet of new retail space that could be directed to Downtown.



## 10.2 ONGOING BUSINESS DEVELOPMENT AND MARKETING EFFORTS

The City of Lynchburg has excellent business development and marketing tools focused on economic development, civic communication, tourism, and Downtown promotion.

### BUSINESS DEVELOPMENT

The City of Lynchburg's Office of Economic Development and Tourism (OEDT) cultivates a healthy business environment and positions the city and Downtown for new development.

- > The Opportunity Lynchburg website is a clearinghouse of information related to investing in Lynchburg. It includes an economic profile, database of available properties, incentives, and information on why Lynchburg is a sound investment.
- > The City facilitates various economic incentives such as Enterprise Zone investment and jobs grants, as well as the highly successful Real Estate Rehabilitation and Renovation Program, among others.
- > The Office of Economic Development and Tourism offer numerous programs that support small business. This includes Launched in Lynchburg and CO.STARTERS. These programs may evolve over time, but OEDT and the City are committed to continued support of small business.

### CIVIC COMMUNICATION

The City of Lynchburg operates an expansive website that provides important information for its citizenry such as departmental information, services, and press releases. This includes information on Lynchburg Regional Airport, Lynchburg TV, and City schools, among others. It also provides the ability to pay tax, utility, and business licensing payments online.

### DOWNTOWN ACTIVITY

An expanded customer base for local businesses is generated through the programming of events, active marketing of Downtown shops and restaurants, and the activity created by Downtown destinations.

- > The Downtown Lynchburg Association programs events such as Get Downtown and Deck the Hills.
- > The organization also facilitates targeted marketing campaigns highlighting creative businesses, such as "Where the Makers Are," deployed through digital media in 2017.
- > The Lynchburg Community Market creates daily commerce and event activity in Downtown. It drives resident and visitor traffic to local growers and artisans, and actively promotes the "Lynchburg is for Locavores" marketing campaign.

### ACTIVE SOCIAL MEDIA

Most of the initiatives above are fully integrated into digital and social media on the City and Downtown Lynchburg Association websites, Facebook, Instagram, and Twitter.

## 10.3 BUSINESS DEVELOPMENT RECOMMENDATIONS

True economic development focused on downtowns is often an afterthought in many mid-sized cities like Lynchburg. More often than not, these activities are the responsibility of regional economic agencies whose focus is on recruiting investment to industrial sites and business parks. Similarly, small business development efforts are often limited in our downtowns, with locally owned shops and employers left to fend for themselves.

Neither of these is the case in Lynchburg. The City's Economic Development Office as well as the Downtown Lynchburg Association have been implementing exceptional business development initiatives from which many of its peer communities could learn.

The following business development strategies recommended are based on capturing the opportunity identified in the market research, while also growing the foundation of small business and development already in Lynchburg.

### TARGETED RECRUITMENT

#### Tailor Recruitment Efforts Based on Opportunities Identified in Market Research.

The market analysis showed a growing employment market, continued residential development opportunity, and significant retail potential for Downtown. While any prospect should be considered, active recruitment strategies should focus on those opportunities that show potential for success.

#### Retail Recruitment

The market analysis showed potential for up to 150,000 to 228,000 square feet of retail that could be accommodated in Downtown. Targeted recruitment efforts should begin with identifying potential vacant or underutilized space that could house key opportunities. Certain businesses may need a particular location, have specific parking/loading needs, upfit requirements, etc. Use this information to direct potential prospects to favorable locations.

#### Develop Retail Anchors

Create "anchors" and cluster retailers in locations where they can benefit from similar businesses. Downtown has an abundance of high-quality retailers, but it is difficult to see the depth of retail due to the relative distance or topographic changes between locations and streets. Clustering could solidify key retail destinations in Downtown, and could include:

- > ***Specialty Retail Anchor*** in the block surrounding the Main Street and 12th Street intersection - This area currently has some specialty retail, but also has non-retail occupying key street-level commercial space, infill sites, and the vacant City Auditorium.
- > ***Specialty Retail Cluster*** in the enhanced Main Street corridor - This cluster would complement the signature public/private destination amphitheater and capitalize on activity generated by the Lower Bluffwalk, Community Market, and amphitheater. The market research identifies upwards of 46,000 square feet of demand for key specialty retailers.

- > ***Creative Business Anchor District*** - Amazement Square and Riverviews Artspace have emerged to establish a creative anchor district at the intersection of 9th and Jefferson Streets. This area could grow with additional gallery space and creative retailers.

For example, the market analysis detailed opportunity for home furnishing stores (5,000 sf) and furniture stores (15,000 sf). Targeted recruitment for this anchor district could include creative-type businesses such as interior designers that sell home furnishing products, or design-focused furniture stores such as Galaxie Modern.

- > ***Visitor and Entertainment Businesses*** - Specialty foods, restaurants, and gift shops could locate near lodging clusters (Craddock Terry, Holiday Inn, Virginian) or near primary destinations (Jefferson Street between Amazement Square and Riverfront Park).

### Continue Restaurant Recruitment

Downtown Lynchburg currently has 32 restaurants and specialty food businesses. Market research indicates that the district brings in dining customers from across the region and beyond. More importantly, it shows potential for up to 30,000 square feet of additional restaurant space, and 24,000 square feet of drinking, or entertainment-type establishments. Restaurants are critical to continued Downtown development as they generate both local and visitor activity.

Lynchburg should continue to grow Downtown's current dining cluster. Restaurants are challenging to operate, and it is important that any new establishments have sound business plans, sufficient operating capital, and a track record of successful operation. In addition, recruitment strategies should also include an effort to diversify the current offerings. Downtown has a great mix of restaurants, yet many

of the newer establishments cater to a similar market, price point, and diner. These products still have potential in Downtown, but diversification should always be a consideration.

### Target Asset-Based Businesses

The James River, Percival's Island, Blackwater Creek Trail and other trails generate a tremendous amount of activity in Downtown Lynchburg. However, there are only two local businesses that cater to this captive market. Other active communities in Virginia have had success recruiting outfitters, kayak or fishing guide businesses, bike rentals and shuttles, among others. The market analysis showed local demand for sporting goods for up 3,000 square feet, but with the outdoor recreation visitor market, the potential is much greater.



*Outfitters and Bike Rental businesses would complement the James River and local trails that intersect within Downtown.*



### Recruit Signature Retail Tenant

Downtown Lynchburg has great destinations such as the Academy Center of the Arts, Amazement Square, Riverfront Park, and others. While each impacts nearby businesses, only the Community Market has a significant retail component. A signature retail tenant would not be a national chain, but rather a unique shopping destination that generates both retail and visitor activity. Examples include Mast General Store (nine locations in NC, TN, and SC) or Floyd Country Store in Floyd, VA. The City could target regional prospects like Mast, or identify more locally connected investors who may share a similar vision for Downtown Lynchburg.



*Destination Retail such as the Floyd Country Store in Floyd, Virginia would generate visitor activity and commerce.*

### Promote Residential Recruitment

Much of Downtown's success is due to residential development, and market indicators and private interests suggest a growing potential for new housing in Downtown.

- > Continue to recruit developers for Downtown rental lofts. Lynchburg has over 900 residential units in Downtown. Most of these are market-rate rental properties with a wide range of sizes and price points. Lynchburg should continue to work with developers to find appropriate product (buildings) and provide incentives through the City's Real Estate Rehabilitation and Renovation Program.
- > Actively recruit developers of for-sale condominium and townhome-type residential. Local developers felt like there is market demand for owner-occupied housing, but due to available product and lack of incentives, development in Downtown is a challenge. In order to have more success in bringing this type of residential product, Lynchburg should:
  - Host an investment round-table for residential developers to understand challenges the development community has with building new residential and owner-occupied housing. Peer communities like Greenville, SC and Asheville, NC routinely engage the private sector to understand needs and work towards common goals.
  - Continue annual **review of incentive packages** such as the Real Estate Rehabilitation and Renovation program to encourage more owner-occupied housing, or even establish criteria for mixed use such as ground-floor retail.

### Promote Office Recruitment

Downtown Lynchburg will continue to be the primary employment center for the City and region. The City has been successful in bringing employers and investment into Downtown despite challenges of parking, building product, and rentable space. The City's Economic Development Office already does the most important thing in maintaining a database of available properties and local incentives. It also promotes "best city" rankings and the general quality of life. Other tasks can include:

- > **Host a quarterly employers' round-table.** During the planning process, employers offered critical input related to parking, available space, and even the need for Downtown living. Numerous stakeholders recognized the City's efforts to create a great and well-rounded quality of life, and felt the livability in Downtown impacts their ability to recruit qualified employees. Ongoing input will be important to refining and implementing strategies for office recruitment.
- > **Target national firms to invest in Downtown** including finance, tech, professional businesses, and headquarter operations. One way to facilitate this is by coordinating recruitment trips to other cities and regions. This would be done in cooperation with partners like Lynchburg Regional Business Alliance, Downtown Lynchburg Association, and Region 2000.
- > **Target creative employers** including tech firms, marketing and graphic designers, architecture firms, etc. Local employers felt that the future of Downtown may lie not simply in larger employers with national markets, but also in smaller professional firms with a creative focus. Downtown has established an urban feel that is desirable for these small businesses with 10 employees or less. Like retail, the City can identify smaller spaces in Downtown (2,000-5,000 square feet) that could accommodate these firms, and create targeted marketing materials to attract creative industry to Downtown.
- > Continue annual **review of incentive packages** such as the Real Estate Rehabilitation and Renovation program, and encourage their use for the renovation of loft space for office and live-work opportunities in Downtown. This incentive has been a successful tool in Lynchburg, and was most recently updated in 2017.

## CONDUCT ECONOMIC DEVELOPMENT ACTIVITIES

### Plan for Economic Development Visits to Other Communities

Take a contingent of elected leaders, department heads, economic development staff, and private developers to peer communities to learn about projects and initiatives. Successful communities are accustomed to receiving representatives from other places and enjoy sharing their success. They also could learn from Lynchburg about its achievements. These visits could be tailored to specific projects or the overall vision of Downtown Lynchburg, such as:

- > **Greenville, SC** – successful public-private partnerships.
- > **Asheville, NC** – development of the River Arts District as an economic focus area with artist, studios, and creative industries.
- > **Mount Airy, NC** – development of Renfro Lofts and other mills in Downtown that have utilized state and federal pass-through tax credits for owner-occupied residential.

### Cultivate Relationships with Investors/Developers

Building relationships with real estate developers is critical to bringing in new investment to Downtown. The brokerage community often has the best contacts, and communication and sharing of information often results in bringing prospects to the table. Other communities have facilitated meetings where the City shares planning efforts, the private sector highlights new projects with their peers, and guest speakers are brought in to discuss economic development.

### Expand Opportunity Lynchburg with Dedicated Downtown Page

The Opportunity Lynchburg website is an extremely well-designed tool to promote citywide economic opportunities. The City's Economic Development Office should consider creating a dedicated page on the Opportunity site that focuses on investment specifically in Downtown, including properties, incentives, quality of life, etc. This page would not need to be expansive like the full Opportunity site, but rather a simple overview of why investing in Downtown makes sense.



### Consider Public-Private Partnerships

Public-Private Partnership is a broadly-used and somewhat loosely defined mechanism to incentivize private investment through public infrastructure, grant programs, land swaps, tax abatement, etc. The resulting public commitment is often an amenity to be used for the common good (parking facility, public park), and is needed to help make the private capital investment feasible.

All communities, including the City of Lynchburg, participate in public-private partnerships in some form or another. For example, the Rehabilitation and Renovation Program sponsored by the City provides tax exemptions for qualified renovation and rehabilitation projects. Similarly, the Economic Development Authority through the EDA Capital Investment Program provides cash or infrastructure improvements for qualifying capital investments that generate positive tax base return on the public investment.

Greenville, SC has long used public-private partnerships to drive economic development, from large public parking decks in conjunction with anchor developments, to small public pocket-parks that may be needed to bring in a key investment. The City has formalized these partnerships creating an application and development criteria for each effort, and tying each of its potential public funding strategies to potential developments. This allows for maximum flexibility and negotiation, as well as identifying multi-year public investments over time. Greenville has used public-private partnerships to fund parking structures, acquire land for development, streetscape enhancements,

and renovation to public spaces. For example, The Project ONE development in Downtown Greenville was the result of a \$130 million public-private deal including \$118 million in investment from the private sector. The City's portion included not only a 474-space public parking garage, but a signature Downtown public plaza that serves as a primary destination for Greenville. These types of projects require agreements and investment from both the private sector as well as the public.

The City of Lynchburg and the Economic Development Authority have Economic Development Principles that guide decision making on public support from local government for private-sector investment. The program is similar to Greenville's in that it provides a framework for public investment in projects that will increase tax base and jobs growth, while addressing local market needs. The City should identify which projects within this Master Plan are most suitable for public-private-partnerships, and solicit private investment on a case-by case basis. In addition, utilizing a formal public-private-partnership form, like Greenville's "application", may help ensure private developers are meeting the development principles, and have all required documentation in place during preliminary due diligence. In Greenville, the process creates an organized efficiency for maximum impact, one that also provides a consistent expectation from the private sector.



*Project ONE Public-Private Partnership in Greenville SC.*



## Consider Expanded Public Funding Tools

Large projects always require creative funding, and the City and the Economic Development Authority (EDA) should continue to consider certain tools that may enhance its ability to develop key projects, or participate in public-private deals. The right tool will depend on the specific project, and certain projects may need to use multiple tools. Each of the funding mechanisms below have been used by other cities in Virginia and would be permitted by state statutes. Case studies for many of these mechanisms are presented in an appendix that accompanies the Master Plan.

- > **Tax increment financing, or TIF.** TIF financing is widely used across Virginia to leverage increased tax base from development to fund key public infrastructure in a district. In TIFs, a district is designated and an initial baseline tax value is identified. Each taxing entity (city, schools, county) continues to receive property taxes based on the initial baseline. As investment occurs and tax base increases in the district, the increase (increment) in taxes is used to fund public projects. TIFs are often used to fund projects like parking structures, and have been utilized successfully in Virginia Beach, Chesapeake, Henrico County, Hampton, Arlington, & others. VA Code §§ 58.1-3245 to -3245.5 - Tax Increment Financing.
- > **TIF by Agreement.** TIF has also been used in Virginia outside of TIF statute. Referred to as “synthetic TIF” in other states, it’s called “TIF by Agreement” in Virginia. The methodology is the same as statutory TIF in that public projects are funded through increases in tax base. TIF by Agreement can be more flexible than statutory TIF, in that the City could determine what tax revenues and what percentages would be used for the public

project, as well as establishing certain development criteria. It would enter into agreement with a Community Development Authority (defined below) or the EDA, whereby the designated revenues would be paid to the CDA/EDA to support bonds issued by that authority. Since the tax revenues are not created through an “increment”, the revenues would come from the general fund.

- > **Community Development Authority, or CDA.** CDAs are special taxing districts and statutory development agencies used to finance infrastructure improvements in a defined area through the issue of bonds and collection of an additional real estate tax. The bonds are paid via an additional real estate tax, special taxes, TIF, or combination. CDAs can be initiated by the private sector, and require the approval of at least 51% of property owners within the designated district. They have been used throughout cities in Virginia including Richmond, Williamsburg, Hampton, Fredericksburg, and others. VA Code §§ 15.2-5152 to -5159 – Community Development Authorities.
- > **Business Improvement Districts, or BID.** In BIDs, business property owners agree to pay an additional tax to fund improvements such as streetscape, parking, beautification and marketing. BIDs are private-sector initiatives functioning as independent non-profit entities. They have not been as widely used in Virginia as the tools above, but the Cities of Arlington and Hampton have multiple BIDs.



### Consider Enhancing And Expanding Current Incentives

Additional incentives to recruit small businesses are identified below. These efforts can be funded in a number of ways including allocation of general funds, grants, and private sector participation. New incentives should be tied to businesses identified through market research and support the vision for Downtown Lynchburg. The City may consider adopting requirements for incentives, such as participation in CO.STARTERS or Launched in Lynchburg programming, to be eligible.

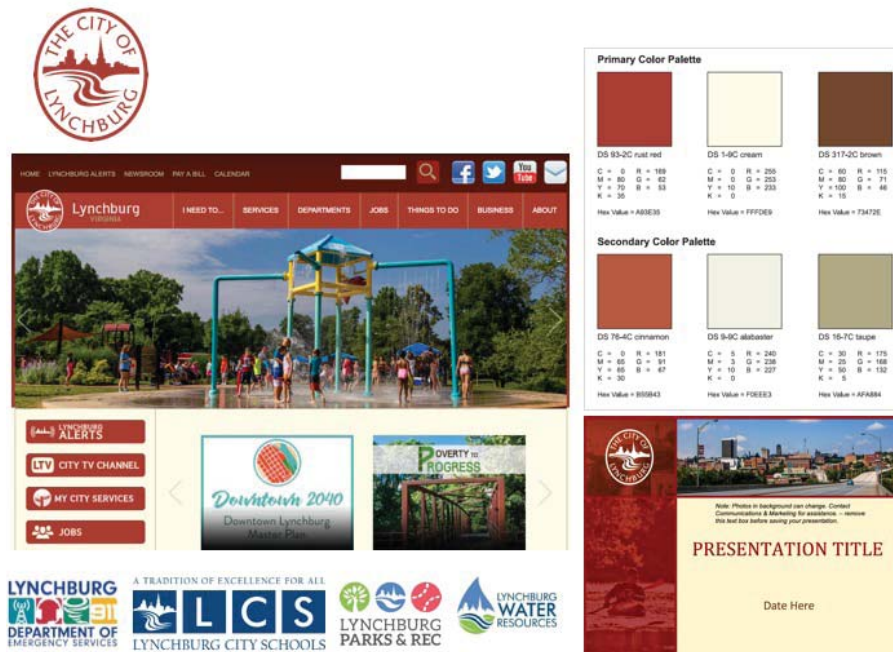
- > **Entrepreneurial challenges.** Other communities and business development organizations have created small, locally focused entrepreneurial challenges funded through both public and private seed monies. Opportunity SWVA facilitates the competitive My Southwest Virginia Cup funded by a Collaborative Communities Grant from the Virginia Department of Housing And Community Development. A similar program called Pop Up Marion Small Business Boot Camp is done in Marion, Virginia. The City of Lynchburg has successfully implemented the similar INOV8 and Community Business Launch Programs, in addition to other small business support such as CO.STARTERS and Launched in Lynchburg.
- > **Marketing grants.** Lynchburg has great creative resources and firms who can educate and help local small businesses build marketing collateral. Other communities have appropriated funds to provide marketing grants for as little as \$500-\$1000 to help local businesses. In Lynchburg, a key focus could be social media marketing, particularly as businesses try to connect with local colleges. Norfolk offers a wide-ranging and flexible grant program called “Vibrancy Grants” - facilitated through the Downtown Norfolk Council.

- > **Small office grants.** Grant awards tied to small offices (ten employees or less) could be given to targeted small businesses and start-ups. Similar programs have applied grants to small rent subsidies, utilities, etc.
- > **Business License Incentive.** Similarly, business license incentives can be a significant tool in bringing in small businesses and offices to Downtown. This could be tied to Lynchburg’s existing Enterprise Zone program or a new program. The City of Virginia Beach offers an initiative whereby qualifying businesses pay only \$50 per year for the first two-years’ business license as a partial tax exemption. Criteria could be applied to business type, number of jobs, gross receipts, etc. Norfolk and Arlington offer similar programs.
- > **Live Work Subsidies.** This is a private-sector initiative that could be encouraged by the city. As part of recruitment, local employers could provide rent subsidies or down payment assistance to employees who look to live in Downtown.

## 10.4 MARKETING RECOMMENDATIONS

The City of Lynchburg has marketing resources and expertise that allows it to communicate better than most other communities of similar size. The marketing messages focus on city government, economic development, Downtown as a destination, and tourism, each with a distinct marketing identity.

- > **City of Lynchburg Brand** – This is represented by the City seal showing the river and Downtown skyline. The City has a style guide for implementation that details colors, typeface and use.



City of Lynchburg Government Brand System

- > **Opportunity Lynchburg Brand** – Opportunity Lynchburg represents the Economic Development identity for the City and is the most recent of the City's brands. The design (name, imagery, colors) presents an "economic development" identity, and is connected through digital tools such as website, social media, and video production.



Opportunity Lynchburg Economic Development Brand System

- > **Downtown Lynchburg Brand** – This brand represents both the destination and organization of Downtown. Like Opportunity Lynchburg, the brand is fully integrated into digital, social media, and video tools. Downtown Lynchburg Association has developed a marketing plan to fully implement the Downtown brand.

- > **Lynchburg Tourism Brand** – The brand is for the Lynchburg Regional Convention & Visitors Bureau (CVB), which now exists within the City’s Office of Economic Development & Tourism.

Each of the City’s brands have all been implemented independently and therefore lack a cohesion and connected brand message. Also, there is no separation between the destinations (Lynchburg or Downtown) and the organization (City or Downtown Lynchburg Association).



*Downtown Lynchburg Brand*



## INTEGRATION AND EXTENDING DOWNTOWN BRAND

### A Unified Brand System For The Community

Create a uniform, destination-based brand identity for the Lynchburg community. This would include unique, yet connected logos for the different identities (government, economic development, tourism and Downtown). This task would require an extensive public engagement process on character and design. Opportunity Lynchburg and Downtown Lynchburg have achieved very effective outcomes with working with local design firms to create brands and marketing strategies, and the development of a community-wide brand could come from the same processes. An example of a connected system is shown below:



*Unified Destination Brand System for Grayling Michigan.*

## Create A More User-Friendly Parking Map

The existing digital parking map is well designed and simple, with the only shortcoming being the complex naming convention of the public parking facilities. A more user-friendly naming strategy should be used for the parking resources, and be incorporated into the parking map.



Example of Downtown Parking Map showing key public parking resources

## Integrate Into Downtown Pedestrian Kiosks

Also, the parking map shown here could be incorporated into a Downtown pedestrian kiosk, with concise information on parking, destinations, dining and shopping. Kiosks typically are located in primary parking resources, as well as strategic locations within Downtown.



Map for Pedestrian Kiosk

### Create Communication Tools To Use During Downtown Infrastructure Construction

In Lynchburg, streetscape construction, replacing bridges, and redirecting traffic will cause a temporary, but real inconvenience to Downtown users and businesses. Effective communication tools during construction can turn a negative experience into a positive message. Communities have used billboards, temporary signage, social media marketing, and even kids' events to market these improvements. More importantly, they remind users and businesses that the projects are part of realizing the vision for a revitalized Downtown.



*Billboard to be located outside of Downtown promoting progress.*



*Temporary spring sign located in Downtown at point of construction or diversion.*



### Deploy Print Material In Lynchburg Hotels And Key Destinations

Downtown Lynchburg Association (DLA) should develop a rack card-type brochure or destination/parking map and distribute to lodging establishments, both inside and out of Downtown. Currently, there is either no information in local hotels, or the products created by private, ad-based advertising companies. A branded tool created by DLA would reinforce the Downtown brand, while also delivering the most useful information about the Downtown experience.

### Create A Downtown Passport

The Downtown Passport would be a print and/or app-based tool that would encourage users to go to the different districts (Main Street, Jefferson Street, Commerce Street, etc.) in Downtown. It would help provide awareness of different businesses that are separated by the challenging topography of Downtown.

The Atchafalaya Passport is shown as an example. In Lynchburg, the passport program could be implemented to foster more student activity in Downtown, similar to the swipe card system or discounted bus service recommendations suggested in Section 8.2 of this report.



*Branded "Passport" for Atchafalaya National Heritage Area*

## Create A Branded Business Recruitment Package

The City of Lynchburg Economic Development Office and the Downtown Lynchburg Association should cooperate to create branded marketing material specifically to promote investment in Downtown. This would include inserts for available properties, incentives, demographics, and market opportunity, etc.



Branded Business Recruitment Package and inserts from Lovettsville, Virginia.

## Create A Master Plan Poster

Create a branded Downtown Master Plan marketing brochure or poster to market the plan, its vision and implementation strategies to potential investors, employers, state leaders, and representatives of potential funding agencies. The poster could be formatted as a graphic, intensive executive summary of the plan and can be distributed whenever meeting with prospects or partner agencies.



Branded Master Plan Poster for Columbus, Mississippi

## MARKET POSITION FOR DOWNTOWN LYNCHBURG

Lynchburg Office of Economic Development and Tourism and the Downtown Lynchburg Association are doing exceptional jobs of marketing Downtown, with well thought-out marketing messages that promote Downtown for economic development, event programming, and an expanded customer base.

It is recommended that the City and Downtown Lynchburg establish a concise market position based on these messages, market data gathered during this process, as well as the overall vision of the 2040 Downtown Master Plan. It should be noted that a market position is intended to be very succinct and specific as described below. In addition, a market position should change as the Downtown evolves, and as such, should be evaluated as needed.

The following presents the framework of market positions, key targets relevant to Downtown Lynchburg, and key themes and value propositions for Downtown.

It is important to note that positioning a community is different than promoting a consumer product such as a shoe company or a soft drink company. A community identity or place-based brand is much more broad and multi-faceted. A Downtown district is relevant to numerous target markets, and the values important to that user will vary depending on how he or she interacts with the place. Therefore, a community should not ask itself whether it needs to be either a “historic town” or a “college town,” a “retiree destination” or an “employment center.” In reality, it has to be relevant to all potential markets, and the market position must be flexible as it addresses the various targets. While different from a consumer product, creating a market position for a community begins with the same questions.

- > Who are the target markets and what values do they hold?
- > What unique assets does it have that it can use to connect and be relevant to those markets?

### Geographic Market

Downtown is an urban market that pulls in customers not only from the City of Lynchburg, but also a large rural geographic area including portions of Amherst, Bedford Campbell, Appomattox, and Nelson Counties. The Lynchburg Metropolitan Statistical Area (MSA) alone has a population of 258,062 according to the 2016 Census ACS Data. Downtown also serves a substantial visitor market, with key destinations drawing tourists from at least 38 states and multiple countries, according to the zip-code survey conducted during this process.



## MARKET SEGMENTATION

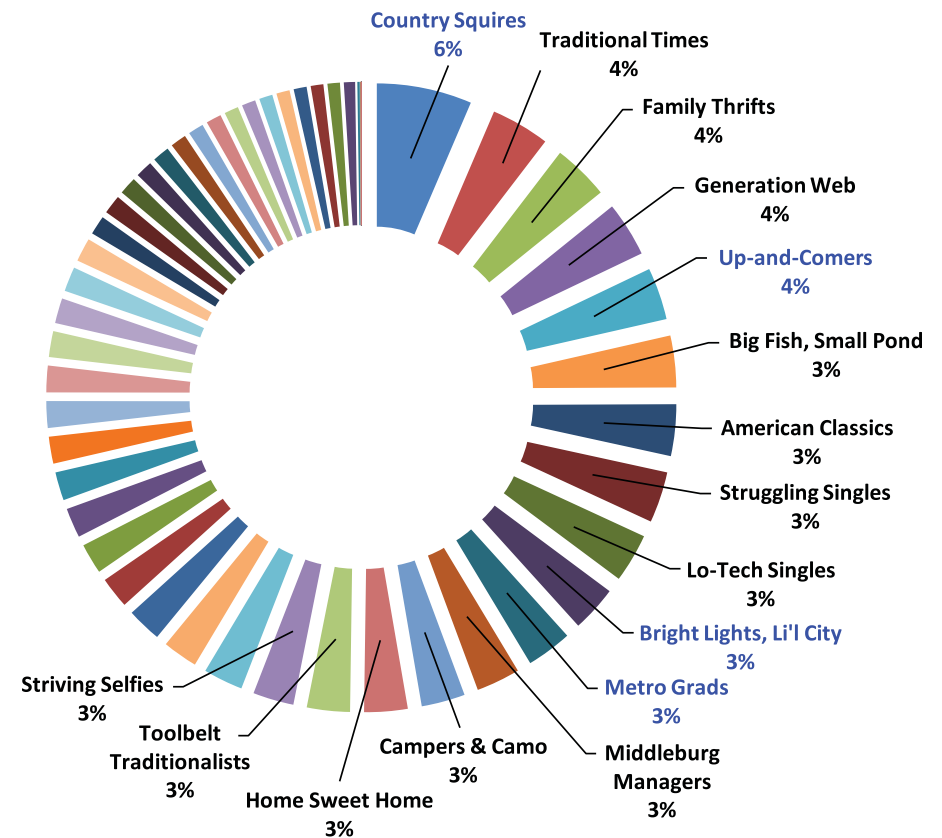
A segmentation analysis was performed to better understand the makeup of Lynchburg's market by describing the behavioral traits and consumer patterns based on various "segments" including factors such as age, income, education and family structure.

Of the 68 segments identified by Claritas, 49 segments are used to describe households in the Lynchburg PTA. The segmentation analysis indicates that while households in the Lynchburg PTA trend older, there is a healthy portion of younger families and singles. The chart below shows the various household segments represented in Lynchburg's PTA. Opportunities exist to target select segments for residential development Downtown, focusing on young professionals and empty-nesters that prefer an urban lifestyle. Select segments include those identified in the segmentation analysis such as Up-and-Comers, Metro Grads, Empty-Nesters, and Young and Influentials. Opportunities also exist to cater towards academics, including both professors and students.

**Detail about key segments is provided in the market analysis report located in the appendix.**

This data can help define the potential target markets for new residents, workers, and visitors to recruit to Downtown Lynchburg.

### Market Segmentation



Market Segmentation for Downtown Lynchburg PTA.  
Source: Nielsen Claritas Premier Segmentation

## Target Market Segments

The demographics of Downtown's market vary significantly, and an understanding of Downtown's user base helps to describe the most relevant market segments for Downtown. Key user bases include:

- > **Professional** workforce that come Downtown to work on a daily basis. These employees work in local government, finance, technology, hospitality, and retail.
- > **Visitors** who come Downtown to enjoy the various historic sites, outdoor recreation, cultural assets, dining, and shopping.
- > **Residents** who live in the loft and condo units in Downtown. These people range from college students and young professionals, to wealthy retirees.
- > **Local citizens** who live in Lynchburg and come Downtown for civic business, culture & heritage, recreation, and entertainment.
- > **College students and faculty** of local institutions who live in Downtown, come for entertainment, or open businesses in the district.
- > **Business owners and developers** looking to invest in Downtown as a source of income, but also contribute to Downtown's quality of life.

The market research included a Market Segmentation Study (referenced previously) that analyzed the local trade areas based on a number of socio-economic, consumer, and lifestyle characteristics. While Downtown is and should be relevant to all segments in its market, the ones below are key target segments to cultivate in Downtown:

- > **Country Squires:** Wealthy residents and families 55 years and older with graduate degrees or higher education. They are executives and professionals who live in large properties outside of the community core.
- > **Up-and-Comers:** Younger families aged 25-44 who are college graduates with professional jobs. They enjoy athletic activities, technology, and nightlife.
- > **Bright Lights, Li'l City:** Younger, college educated families with upper-middle incomes who live in the suburbs but frequent downtowns for dining and entertainment.
- > **Metro Grads:** Middle aged couples and singles without children who are focused on their careers. They live in suburban areas but enjoy everything from professional sports to opera.
- > **Young and Influential:** These midscale singles and couples without kids are becoming influential in their community through active engagement and social networking.

## Target Market Value Proposition

Key themes and value propositions of Downtown that connect to the target markets are shown below. These are the basis for the overall market position for Downtown.

- > **Shopping** – Downtown Lynchburg provides an exceptional shopping experience, with a variety of high-quality goods and hand-made products in our many unique specialty shops and businesses.
- > **Dining and entertainment** – Downtown Lynchburg has a full slate of signature events and festivals to entertain locals and visitors alike. This includes a vast array of restaurants and eateries, from cafés and lunch counters, to fine dining and creative local cuisine.
- > **Recreation** – Downtown Lynchburg offers active outdoor experiences for the novice to the adventurer, including biking our nationally recognized nature trails, kayaking our historic river, or simply strolling along our terraced streets.
- > **Culture** – Downtown Lynchburg is the center of creative culture for much of Central Virginia, with our award-winning children’s museum, exceptional performing arts, unique makerspace, and fine art galleries.

- > **Downtown Living** – Downtown Lynchburg offers all the modern comforts of home in a historic downtown, with affordable amenity-rich living in our numerous lofts, historic homes and condos, all within walking distance to work, the great outdoors, unique shops and restaurants.
- > **Employment** – Downtown Lynchburg is a regional center of employment and commerce, from large employers with a national and global reach, to smaller, creative businesses who take inspiration from Downtown’s unique setting.
- > **Investment Opportunity** – Creative thinking and collaboration between the public and private sector has made Downtown Lynchburg a profitable return on investment. Businesses have thrived and investments have bloomed under a common understanding that historic preservation is economic development.

The information above related to target markets and value propositions should form the basis for a concise and consolidated market position for Downtown Lynchburg.



## 10.5 BUSINESS DEVELOPMENT AND MARKETING: GOALS

- > Identify and recruit new retail investment and grow small businesses in Downtown by strengthening anchors, capitalizing on the James River and outdoor amenities, and enhancing restaurant and cultural attractions.
- > Pursue office and employment growth that continues to establish Downtown as a destination for national firms.
- > Attract additional residential development to Downtown, including renovated loft apartments, as well as owner-occupied housing products.
- > Market Downtown using an integrated branding system and coordinated marketing messages.

## 10.6 BUSINESS DEVELOPMENT AND MARKETING: RECOMMENDATIONS

Economic Development involves three key elements: understanding market potential for business growth (market research); creating an environment for business growth and investment (physical infrastructure, business support tools); and promoting the opportunities that exist (marketing and communication). These fundamentals apply to a community targeting a new industry, as well as attracting small business and investment in a Downtown environment, such as Lynchburg.

The business development and marketing recommendations in this plan apply the opportunities identified in the market research to strategies that create a healthy business environment, target new investment, and communicate the market potential to future businesses, employers, and residents.

## BUSINESS DEVELOPMENT AND MARKETING

| SHORT-TERM STRATEGIES                                                                                                                                               | MID-TERM STRATEGIES                                                                                                                                                                                                                                           | LONG-TERM STRATEGIES                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>RETAIL RECRUITMENT</b>                                                                                                                                           |                                                                                                                                                                                                                                                               |                                                                                                                                          |
| <ul style="list-style-type: none"> <li>Tailor recruitment efforts based on opportunities identified in market research.</li> </ul>                                  | <ul style="list-style-type: none"> <li>Develop retail anchors in strategic locations (specialty retail, creative retail, entertainment).</li> </ul>                                                                                                           | <ul style="list-style-type: none"> <li>Continue to evaluate and revise short and mid-term retail recruitment strategies.</li> </ul>      |
| <ul style="list-style-type: none"> <li>Pair available space to suitable prospects.</li> </ul>                                                                       | <ul style="list-style-type: none"> <li>Recruit signature destination retail tenant.</li> </ul>                                                                                                                                                                |                                                                                                                                          |
| <ul style="list-style-type: none"> <li>Target asset-based businesses (outdoor recreation, creative retail, etc).</li> </ul>                                         |                                                                                                                                                                                                                                                               |                                                                                                                                          |
| <b>RESIDENTIAL RECRUITMENT</b>                                                                                                                                      |                                                                                                                                                                                                                                                               |                                                                                                                                          |
| <ul style="list-style-type: none"> <li>Continue to recruit developers of Downtown rental lofts.</li> </ul>                                                          | <ul style="list-style-type: none"> <li>Expand and enhance Downtown recreational uses to support residents and visitors.</li> </ul>                                                                                                                            | <ul style="list-style-type: none"> <li>Continue to evaluate and revise short and mid-term residential recruitment strategies.</li> </ul> |
| <ul style="list-style-type: none"> <li>Actively recruit developers of for-sale housing units.</li> </ul>                                                            | <ul style="list-style-type: none"> <li>Continue to evaluate Real Estate Rehabilitation &amp; Renovation Program to encourage more owner-occupied housing.</li> </ul>                                                                                          |                                                                                                                                          |
| <ul style="list-style-type: none"> <li>Host investment round-table with residential developers.</li> </ul>                                                          |                                                                                                                                                                                                                                                               |                                                                                                                                          |
| <ul style="list-style-type: none"> <li>Target businesses that support residential (for example: dry cleaners, grocery, health &amp; personal care, etc.)</li> </ul> |                                                                                                                                                                                                                                                               |                                                                                                                                          |
| <b>OFFICE RECRUITMENT</b>                                                                                                                                           |                                                                                                                                                                                                                                                               |                                                                                                                                          |
| <ul style="list-style-type: none"> <li>Host regular employers' round-tables.</li> </ul>                                                                             | <ul style="list-style-type: none"> <li>Coordinate recruitment trips to target National firms to invest in Downtown.</li> </ul>                                                                                                                                | <ul style="list-style-type: none"> <li>Continue to evaluate and revise short and mid-term office recruitment strategies.</li> </ul>      |
| <ul style="list-style-type: none"> <li>Target and recruit creative employers (technology firms, marketing and graphic design, architecture, etc.).</li> </ul>       | <ul style="list-style-type: none"> <li>Encourage private-sector use of live-work subsidies.</li> </ul>                                                                                                                                                        |                                                                                                                                          |
|                                                                                                                                                                     | <ul style="list-style-type: none"> <li>Continue to evaluate and revise, if needed, the Real Estate Rehabilitation and Renovation Program to encourage renovation of loft space for live-work, and ground floor retail, in addition to residential.</li> </ul> |                                                                                                                                          |

## BUSINESS DEVELOPMENT AND MARKETING

| SHORT-TERM STRATEGIES                                                                                                                 | MID-TERM STRATEGIES                                                                                                                                                                                           | LONG-TERM STRATEGIES                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ECONOMIC DEVELOPMENT</b>                                                                                                           |                                                                                                                                                                                                               |                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>Plan economic development visits to learn from other successful communities.</li> </ul>        | <ul style="list-style-type: none"> <li>Coordinate recruitment trips to other cities and regions.</li> </ul>                                                                                                   | <ul style="list-style-type: none"> <li>Conduct update to market analysis for retail, residential, and office demand every 5 years, and update strategies accordingly.</li> </ul> |
| <ul style="list-style-type: none"> <li>Host regular real estate/investor meetings.</li> </ul>                                         | <ul style="list-style-type: none"> <li>Identify key projects in this plan for Public-Private Partnerships, and pursue private sector partners.</li> </ul>                                                     |                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>Create economic development presence for Downtown Lynchburg on Opportunity website.</li> </ul> |                                                                                                                                                                                                               |                                                                                                                                                                                  |
| <b>FUNDING AND INCENTIVES</b>                                                                                                         |                                                                                                                                                                                                               |                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>Create small incentives for marketing, office recruitment, etc.</li> </ul>                     | <ul style="list-style-type: none"> <li>Expand public funding tools to use in Public-private partnerships fund for public projects identified in this plan (TIF, CDA, BID, etc.).</li> </ul>                   |                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>Consider business license incentives targeting small business and employers.</li> </ul>        | <ul style="list-style-type: none"> <li>Continue to provide programs to promote and support small business in Downtown (such as CO.STARTERS, Community Business Launch, and Launched in Lynchburg).</li> </ul> |                                                                                                                                                                                  |



## BUSINESS DEVELOPMENT AND MARKETING

| SHORT-TERM STRATEGIES                                                                                                                                                          | MID-TERM STRATEGIES                                                                                                                                                                        | LONG-TERM STRATEGIES                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <b>MARKETING</b>                                                                                                                                                               |                                                                                                                                                                                            |                                                                                                                                |
| <ul style="list-style-type: none"> <li>Consolidate color palettes and typography of existing brands (City, Opportunity, Downtown) to connect marketing/messaging.</li> </ul>   | <ul style="list-style-type: none"> <li>Create communication tools to use during upcoming infrastructure projects (billboard, temporary signage, social media strategy, events).</li> </ul> | <ul style="list-style-type: none"> <li>Create a unified destination-based brand system for the Lynchburg community.</li> </ul> |
| <ul style="list-style-type: none"> <li>Integrate consistent branding into Downtown parking maps and pedestrian kiosks.</li> </ul>                                              | <ul style="list-style-type: none"> <li>Create branded business recruitment package for Downtown investment.</li> </ul>                                                                     |                                                                                                                                |
| <ul style="list-style-type: none"> <li>Create branded print brochure/parking &amp; destination map promoting Downtown. Deploy in Lynchburg area hotels.</li> </ul>             |                                                                                                                                                                                            |                                                                                                                                |
| <ul style="list-style-type: none"> <li>Create a Downtown passport or app-based tool.</li> </ul>                                                                                |                                                                                                                                                                                            |                                                                                                                                |
| <ul style="list-style-type: none"> <li>Create a Downtown 2040 Master Plan poster to communicate vision to investors, funding partners.</li> </ul>                              |                                                                                                                                                                                            |                                                                                                                                |
| <ul style="list-style-type: none"> <li>Adopt a unified and concise market position for Downtown Lynchburg focusing on urban character and "cool" factor of downtown</li> </ul> |                                                                                                                                                                                            |                                                                                                                                |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

PAGE LEFT INTENTIONALLY BLANK

# 11. WAYFINDING

11.1 EXISTING CONDITIONS

11.2 WAYFINDING PROGRAM

11.3 KEY WAYFINDING ROUTES, DECISION  
POINTS AND DESTINATIONS

11.4 WAYFINDING: DESIGN  
RECOMMENDATIONS

11.5 WAYFINDING: GOALS

11.6 WAYFINDING: RECOMMENDATIONS

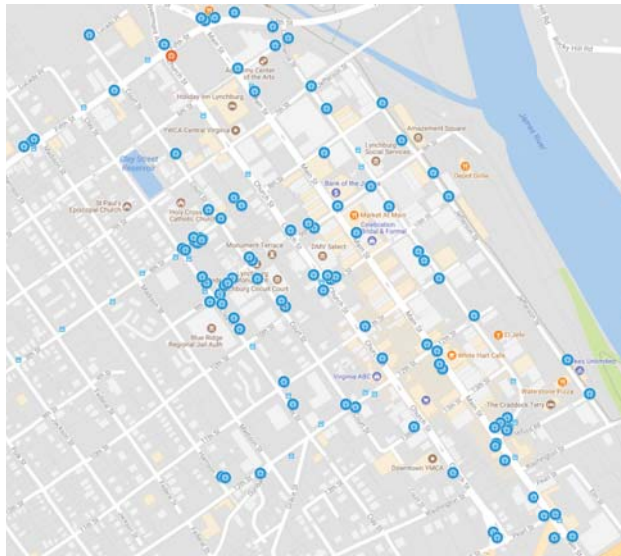


PAGE LEFT INTENTIONALLY BLANK

The wayfinding assessment began with a study of the current state of existing signage in Downtown Lynchburg. This started with a review of an initial wayfinding plan created in 2003 by Bizzell Design, and a subsequent wayfinding assessment completed in 2012 by Region 2000. It also addressed current signage graphics as well as Downtown and City branding. The wayfinding recommendations below provide both short and long-term actions for the City and Downtown Lynchburg to follow to implement new wayfinding in Downtown.

## 11.1 EXISTING CONDITIONS

The existing wayfinding for Downtown was planned and implemented beginning in 2003. Since then, the system has evolved with the change in destinations, but also the ability of the City's sign shop to produce its own signage and change existing signage. The system as it has progressed is assessed briefly below.



City of Lynchburg  
Wayfinding Inventory.  
Source: City of  
Lynchburg

## STRENGTHS

- > The City of Lynchburg maintains a thorough and well-managed inventory of all of its signage in Downtown including parking, directional trailblazers, and specialty signage.
- > Region 2000, operating as the Central Virginia Metropolitan Planning Organization (MPO), published a wayfinding study in 2012 for the entire Greater Lynchburg Region. The signage assessment looked region wide, not just at the City of Lynchburg or Downtown. It included an analysis of the existing conditions, most of which is still relevant today.
- > The City's sign shop in the Department of Public Works has the ability to produce its own signage, greatly reducing costs for fabrication and maintenance of the existing system.
- > The existing system is professionally designed, and includes highly attractive, creative wayfinding.



Directional Trailblazer  
in Existing System

## WEAKNESSES

- > The current wayfinding system does not meet MUTCD (Manual of Uniform Traffic Control Device) standards for size, content, retro-reflectivity, breakaway standards, etc. The existing signage was designed in 2003, and the current MUTCD standards were established in 2009.
- > There have been significant changes over time including new signage, destinations, and materials, with the result being the current disjointed and disconnected system.
- > The original signage system is overly designed and expensive. They tend to be ineffective in their complexity, and are extremely costly to reproduce. The existing cabinet type trailblazers with multi-pieces can cost over \$10,000 per sign.
- > The signs and materials have not aged well. Many are discolored, edits to the signs over the years have resulted in a change from relief letters to flat letters, and ghost images exist where old lettering once was.
- > There is currently no connection between Downtown's wayfinding and citywide signage, either in design or function.
- > Existing gateways to Downtown are attractive, but are too small or improperly placed (Main Street gateway) to be effective.
- > There is significant signage clutter throughout Downtown, creating inconsistencies that lead to driver confusion.
- > Some of this clutter is due to the overabundance of parking signage and poorly marked parking facilities. In some portions of Downtown, there are individual parking signs on every single parking space and in some cases, two signs per space.
- > Similarly, the current lot naming for parking resources is not driver or visitor friendly.
- > There is too much content on individual signage, particularly those that are intended for motorists. There should be no more than three (and in limited cases four) destinations per individual vehicular trailblazer. Some downtown vehicular signage has as many as eight total destinations.
- > Similarly, there is too much variation between typography (point size, italics) on individual signs making them virtually unreadable.
- > A few signs are in locations that are after the designated turn.
- > There is inconsistency in destination names on the signage (Riverfront, Riverfront Park, Riverfront Parks, Historic Riverfront).
- > There are destinations and districts that no longer exist included in the signage.





High-end multi-part sign panel with separate topper, attached arrow



Fading colors, ghost imaging on current signage



Inconsistent type (relief and flat) on current signage



Vinyl peeling from sign



Directional Arrow that had fallen and reattached.



Kiosk Panel with dated information

## 11.2 WAYFINDING PROGRAM

### POLICY AND MANAGEMENT

A key project goal is to establish a wayfinding policy and management program that will ensure the sustainability of the wayfinding recommendations and provide a roadmap for physical maintenance and system expansion over time.

#### WAYFINDING POLICY

A useful wayfinding policy will address two key issues: one, the inclusion and exclusion of potential destinations into the wayfinding recommendations; and two, an assessment of the relative significance of qualifying destinations.

It should be noted that not all destinations will be included in a directional wayfinding signage. Some will be identified by building markers (such as police department), district gateways or street sign toppers (historic neighborhoods) or on kiosks or maps (trails and greenways).

#### TYPES OF QUALIFYING DESTINATIONS

To be considered for inclusion into the community wayfinding recommendations for Downtown Lynchburg, a destination or attraction must clearly conform to one of the categories below. There are other destinations that exist in the City (airports, industrial parks, etc.) that would be part of a city-wide system. The destinations below exist in or near Downtown Lynchburg, or may be a future destination in Downtown.

- > **Architectural & Historical:** Historic Sites, Historic Districts
- > **Commercial:** Farmers Markets, Shopping Districts
- > **Community:** Neighborhoods
- > **Cultural & Institutional:** Colleges and Universities, Convention Centers, Courthouses, Government Buildings, Health Care Centers, Libraries, Museums, Schools, Theaters
- > **Recreational:** Boating Access, Campgrounds, Hiking/Biking Trails and Routes, National/State/Regional Parks, Parks and Recreational Facilities, Sports Facilities
- > **Transportation:** Historic Routes, Parking Resources, and Transit Centers
- > **Visitor Services:** Hospitals, Visitor Information Centers.

SCORING CRITERIA FOR QUALIFYING DESTINATIONS

By establishing scoring criteria, destinations can be ranked to determine what destinations would be included on directional signage, as well as which ones take priority on the individual signs. The criteria below were established for the Downtown Lynchburg system. They have been used in this plan to determine qualifying destinations and sign content, but also are a tool for the City to use whenever new destinations are developed in Downtown that may or may not be included in the system.

**Size of Attraction:** Score based on number of full-time employees.

|             |   |
|-------------|---|
| 10 or fewer | 1 |
| 11-49       | 2 |
| 50 or more  | 3 |

**Access to Attraction:** Score based on ease of access via roads and entrances.

|                                                       |   |
|-------------------------------------------------------|---|
| Unmarked and unpaved/no entrance                      | 0 |
| Entrance poorly marked and/or unpaved entrance/access | 1 |
| Clearly marked entrance with paved entrance/access    | 2 |

**Parking Resources:** Score based on number of parking spaces or nearby on-street parking.

|                                               |   |
|-----------------------------------------------|---|
| No on-site or nearby on-street parking        | 0 |
| Nearby on-street parking only                 | 1 |
| Dedicated parking lot with 10 or fewer spaces | 2 |
| Dedicated parking lot with 11 or more spaces  | 3 |

**Seasonality:** Score based on annual availability or access to destination on an annual basis.

|                  |   |
|------------------|---|
| 6 months or less | 1 |
| 6-9 months       | 2 |
| 9-12 months      | 3 |

**Hours of Operation:** Score based on weekly availability or access.

|                       |   |
|-----------------------|---|
| 0-20 hours/week       | 1 |
| 20-40 hours/week      | 2 |
| 40 or more hours/week | 3 |

**Significance of Attraction:** score based on local, regional, or national importance.

|                       |   |
|-----------------------|---|
| Local significance    | 1 |
| Regional significance | 2 |
| National significance | 3 |



## 11.3 KEY WAYFINDING ROUTES, DECISION POINTS AND DESTINATIONS

### RECOMMENDED DESTINATIONS

The consultants worked with the City to edit and rank the destinations to be included in the wayfinding recommendations. Destinations are divided into two categories based on their overall significance as a visitor destination. Rankings are done to determine what destinations may be included in the system. Tiering is done to identify which destinations have the highest priority within the system. In other words, a destination may have a higher score, while a lower scoring destination may actually have higher priority in the signage system.

**Tier One Destinations** are regarded as more significant than Tier Two Destinations, and will typically require a directional trailblazer sign to direct visitors to the destination. **Tier Two Destinations** will require a directional trailblazer when a turn is necessary and may be included in a directional trailblazer when a directional trailblazer is required because of a Tier One Destination. **Tier Three Destinations** do not meet the minimum scoring criteria to be eligible for directional wayfinding signage. However, they can be included on pedestrian-scaled signage, kiosks, maps, and monument signage.

Naming for sign panel text has been formatted appropriately for directional trailblazer signage. All abbreviations are necessary only for this type of sign. Pedestrian signs may not require abbreviations.



*Downtown Destinations*

To determine the appropriate locations for wayfinding signage, the consultants identified key wayfinding routes to, through, and within Downtown Lynchburg. These key wayfinding routes will serve as the basic infrastructure of the wayfinding recommendations. The intersections of key wayfinding routes represent important decision locations for the user. These key decision locations should be signed adequately to optimize the visitor experience in Downtown.



- Primary Routes for Wayfinding
- Secondary Routes for Wayfinding

*Key Routes and Decision Points*

## SYSTEM MANAGEMENT

The wayfinding recommendations will be managed with a cooperative effort by the Office of Economic Development and Tourism (OEDT), the Department of Public Works, Downtown Lynchburg Association, and Parking Management. These partners will play different, yet complementary roles in managing the physical and administrative elements of this wayfinding program.

### DAY-TO-DAY SYSTEM MANAGEMENT

The City of Lynchburg and its Department of Public Works have been managing the updates to the existing wayfinding system including changes to existing signs, new sign fabrication and installation. This plan should be incorporated into the Downtown Wayfinding Policy adopted in October 2009. Overall management should be the responsibility of one entity, possibly OEDT, while the Department of Public Works would be responsible for scheduled system maintenance, including cleaning and repair to minor damage of system components, and fabrication and installation of new signage.

The partners should convene as often as necessary to review the system status, address maintenance or repair issues, and discuss and recommend (if needed) action to alter, modify, or expand the existing system. Future design services can be managed by the Department of Public Works or through an as-needed services contract with a qualified firm.

### LONG-TERM SYSTEM MANAGEMENT

Project partners will be required to manage, and allocate additional funds to, an ongoing wayfinding management program. It is recommended that at least fifteen percent of the funding for project implementation be earmarked for long-term system repair, replacement, and expansion. City Council may be required, on occasion, to contribute additional funds to ensure the system is adequately maintained.

### IMPLEMENTATION

Based on these wayfinding recommendations, the OEDT and the Department of Public Works should coordinate to determine internal fabrication and installation capabilities, where certain recommendations will require outside fabricators, and total cost of fabrication, installation, and on-going maintenance.

Once total cost has been estimated, then potential funding streams can be identified. In other communities, wayfinding has been funded through appropriation of general funds, grants, and allowable local taxing streams such as lodging and meals taxes.

After budget has been established, project priorities and potential phasing can be determined.



### CONCEPTUAL MODEL

A conceptual model explores how visitors should engage with wayfinding recommendations. The visitor experience of Downtown Lynchburg should be curated starting with the roadways that lead motorists into the community. Upon arrival, the visitor should be welcomed to Downtown Lynchburg and should be directed to key destinations within the district. A network of gateway signs, directional trailblazers, and parking directional signage should guide the visitor to the desired destination, or parking facility. In some cases, parking facility signage, as well as pedestrian-scale maps, and directional signage, may be appropriate to guide visitors in the district.



*Wayfinding Conceptual Model*

## 11.4 WAYFINDING: DESIGN RECOMMENDATIONS

The consultants worked with the City and its partners to edit and refine artwork for the wayfinding recommendations. Important considerations included color palette, form, materials, and other design elements.

Using the Downtown Lynchburg brand identity package as well as the Manual of Uniform Traffic Control Devices (MUTCD) as guides, the consultants prepared the wayfinding design concepts, as broken down on the following pages. The downtown brand, developed by the Downtown Lynchburg Association, includes a style guide for its usage. MUTCD standards are used by Federal and State agencies as requirements for roadway signage including wayfinding. While the majority of downtown roadways in Lynchburg may not require VDOT approval of signage, MUTCD standards are best practices for effective and attractive directional signage, and should be used for any downtown wayfinding.

### TYPEFACES

The wayfinding recommendations for Downtown Lynchburg features two typefaces which are described and illustrated below.

The first typeface is **Highway Gothic**. This typeface should be utilized for vehicular signage, which is intended for viewing by people in motorized vehicles along public roadways. The cap height for sign copy must be six inches for signs in speed zones thirty miles-per-hour and above and four inches for speed zones less than thirty miles-per-hour.

The second approved typeface is **Brandon Grotesque**, which should be utilized for pedestrian signage. This typeface is intended for viewing by people on foot or non-motorized vehicles outside the public right-of-way. Brandon Grotesque should also be utilized for destination markers, which are on-site signs that identify specific destinations included in the wayfinding recommendations.

Highway Gothic

abcdefghijklmnopqrstuvwxyz  
ABCDEFGHIJKLMNOPQRSTUVWXYZ

Brandon Grotesque

abcdefghijklmnopqrstuvwxyz  
ABCDEFGHIJKLMNOPQRSTUVWXYZ

*Recommended Typefaces*

## COLOR PALETTE

The recommended color palette for the wayfinding system draws directly from the brand palette for the Downtown Lynchburg Association. It is important to note that shades of red, orange, and yellow may not be used as sign backgrounds, as these colors may resemble regulatory signage and confuse and endanger motorists.



*Approved Colors*

## ARROWS AND SYMBOLS

It is recommended that MUTCD (Type D) arrows should be used in all motorist-oriented signage in the Lynchburg wayfinding recommendations. For pedestrian-oriented trailblazers, an alternate set of arrows should be used.



*Vehicular Arrows*



*Approved Pedestrian Arrows*



## MATERIALS

Based on MUTCD standards, the below materials are recommended when fabricating and assembling the wayfinding signs.

### POLE-MOUNTED SIGNAGE

- > 3M High Intensity Prismatic Reflective Sheeting 3930 with 3M approved UV/Graffiti Vinyl Over-laminate over .25 gauge aluminum.
- > Breakaway posts and decorative post features should be constructed with of powder-coated metal with triangular slip base per MUTCD standards.
- > All installed signs should meet federal and state requirements for minimum height and breakaway features. Minimum height for trailblazers and full-width parking signs is eight feet above grade.
- > Single pole-mounted directional signs may feature a secondary panel on the opposite side of the pole that indicates what street the observer is on.

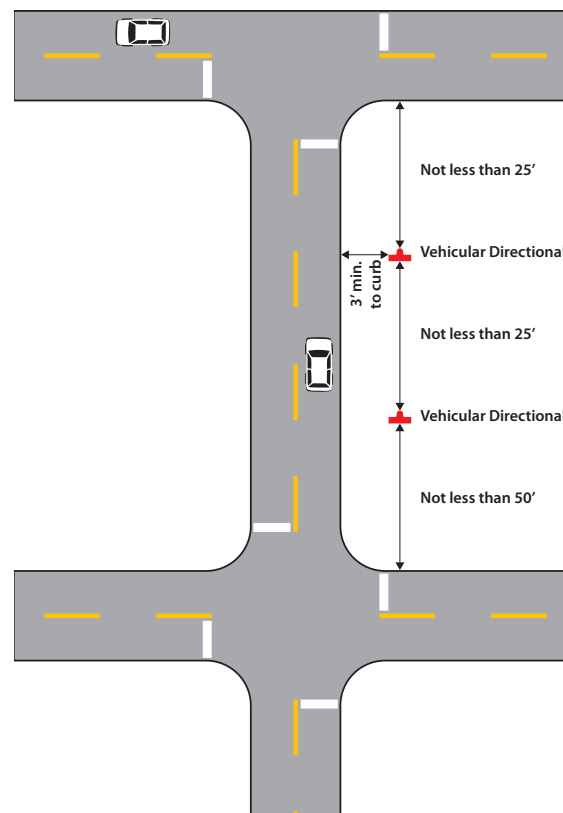
### MONUMENT-STYLE DISTRICT GATEWAY SIGNAGE

- > Monument signage should be constructed of brick or stone masonry with concrete footers and adhere to all relevant state and federal regulations related to sight lines, rights of way, clear zones, etc.
- > These signs should be illuminated.

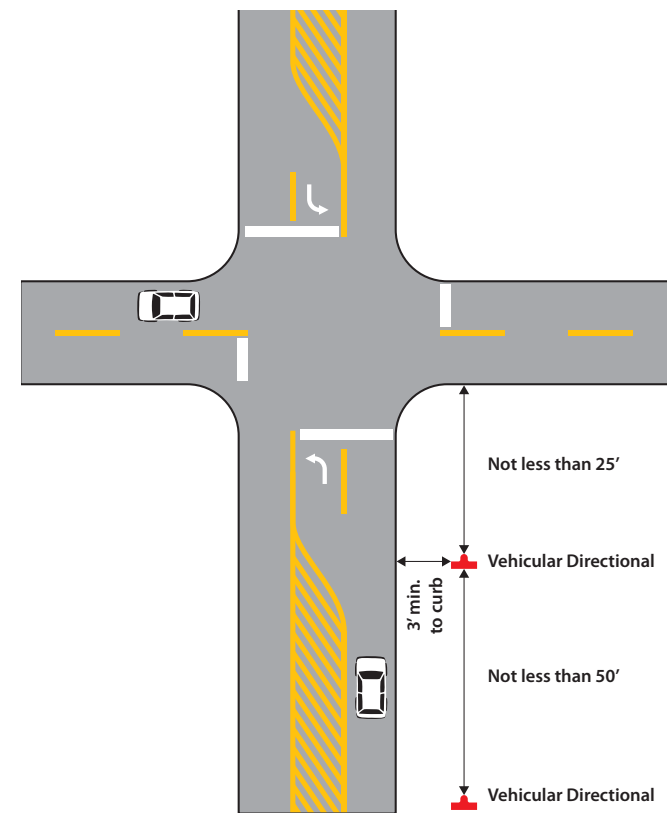
## SIGN PLACEMENT

Wayfinding signage should be installed in locations per MUTCD guidance. Sign location diagrams for “typical” intersections displayed.

Locations that have been identified on the accompanying maps and sign schedule for Downtown Lynchburg are based on this guidance, as well as the conditions of existing infrastructure, traffic direction, driveways, etc.



*Typical Intersection*



*Typical Intersection with Turning Lane*

## SHORT-TERM STRATEGIES

### PARKING SIGNAGE

A key element to any successful downtown wayfinding plan is to clearly mark and direct visitors to the available municipal parking facilities. By implementing bold, clean directional signs, drivers are consistently shown where they can park and what restrictions may apply to the various parking facilities. Many communities, including Downtown Lynchburg, suffer from a perceived parking shortage, when the reality is they suffer from a parking awareness issue. The signs illustrated in the following pages use the design elements established for the Downtown Wayfinding Recommendations and should adhere to MUTCD standards in regard to construction materials and sign placement.

### Parking Facility Naming

In order to reinforce a sense of place and assist drivers in remembering where they parked, the following recommendation focuses on renaming the public parking facilities in Downtown Lynchburg. The current system of lettering parking decks and parking lots can still be utilized internally for departmental management purposes, but a more informative nomenclature should be used for user facing signage and other collateral.

Each public parking facility identified by the Downtown Lynchburg Association on its parking identification map should be renamed based primarily on its street, or a nearby public landmark. For example, the main parking resource on Jefferson Street is recommended to be renamed (in its signage and mapping) as as “Riverfront Lot,” while the smaller lot on Jefferson is to be identified as “Jefferson Street Parking Lot.” Most importantly, it is recommended that the existing Midtown Parking Deck be renamed “Main Street Parking Deck.” This is primarily to avoid confusion with the Midtown area in Lynchburg, commonly referred to yet located outside of Downtown.





Revised Parking Map

### On-Street Marker (Stencil)

The purpose of on-street markers is to reinforce directional vehicular traffic signage to parking garage entrances. Painted on-street markers can be used in conjunction with pole-mounted or building mounted signs and also when street-side obstructions may impede the use of additional signs.



*Street Marker/Stencil*



*Street Marker/Stencil Conceptual Rendering*

### Vehicular Directional Parking Signage

The purpose of these pole-mounted signs is to direct vehicular traffic to parking facility entrances. Much like Directional Trailblazers, these signs should be placed well before parking facility entrances to ensure drivers have enough time to react accordingly. There is no set distance before the lot that would be required, so actual distance will vary depending on speed of street and existing infrastructure. There are two different design options that can be used depending on size and location restrictions.



*Small Parking Directional Sign*



*Large Parking Directional Sign*

## Vehicular Regulatory Signage

The purpose of vehicular regulatory signage is to convey relevant rules, regulations, and policies to motorists inside of city parking facilities. These signs should be placed conspicuously at the entrance to parking facilities. Most importantly, these signs should be consistent in their design, color and typography to the wayfinding system.



Large Regulatory Sign



Medium Regulatory Sign



Small Regulatory Sign

## Event Parking

These portable signs are easy to deploy during special events where parking facilities may be accessible for public use that are normally private or reserved for permit-only parking. By incorporating the colors and designs of the rest of the Parking Wayfinding recommendations, these signs maintain consistency and reinforce visitor awareness.



Event Parking Sign Examples



### SHORT-TERM TEMPORARY DIRECTIONAL SIGNAGE

Short-term recommendations for directional signage in Downtown Lynchburg are to allow the City and the Downtown Lynchburg Association to install interim signage where necessary, prior to the installation of new permanent wayfinding signage. The goal is to create a set of environmental graphics to be deployed in a temporary fashion, where needed. These signs could be cover-ups to the existing downtown trailblazers, temporary road signage for use during construction projects or detouring, or new signage applied to existing infrastructure (utility and streetscape) where possible.

### Temporary Roadside Signs

These mounting options allow for the new design recommendations to be rolled out in areas that are either under construction or do not currently have their permanent hardware. There are a variety of different mounting hardware available from numerous vendors.

Mounting options come in various forms, including but not limited to weighted bases that use water, sand, or heavy metal plates, spring stands (typical of many road construction signs that reduce the chances of toppling over due to passing traffic and weather events), or simple metal framed stands (that suspend the sign from chains that allow it to sway, reducing the chances of toppling).



*Examples of Temporary Sign Mounting Options*

## Cover-Ups

By utilizing sign manufacturing and mounting resources available from the Department of Public Works, new MUTCD-compliant panels can be made and attached to the existing cabinet-style signs already in place around Downtown Lynchburg. The Department of Public Works can request guidance from outside sign vendors to determine the appropriate material and mounting application to maximize sustainability while adhering to MUTCD standards. Where required, the City should follow all relevant federal and state guidelines for wayfinding signage.



*Before and After Rendering*



*Before and After Example*  
(Photo credit: <http://studerer.org/2015/05/leap-class-unveils-new-downtown-signage/>)

## Temporary Construction Awareness Signs

These sign concepts demonstrate how temporary signs can be used to remind passers-by that current construction conditions are only temporary and that services and amenities are still available and accessible while improvements are being made to downtown infrastructure. The purpose of these signs is to convey a positive message using the Downtown Lynchburg brand identity to reassure the viewer during a period of inconvenience.



*Temporary Construction Sign Concept*



*Temporary Construction Sign Example*

## LONG-TERM STRATEGIES

The recommended short-term solutions are only a temporary fix. In the long-term, the City of Lynchburg should remove all existing directional wayfinding and install new MUTCD compliant wayfinding signage as prescribed herein.

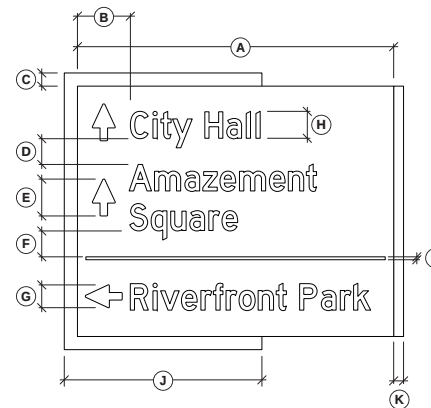
The wayfinding recommendations are composed of several unique sign types which serve different functions. All dimensions should be considered “typical” for each sign type, as detailed below.

### DIRECTIONAL TRAILBLAZERS

Directional Trailblazers are designed to be as visible as possible without creating unnecessary distraction for motorists. These signs include an optional color-coded panel on the reverse side to identify the corridor the observer is on. Another option is a Downtown Lynchburg panel near the top of the pole. Decorative posts for trailblazers are shown for illustration purposes only.

- > Trailblazers must meet federal and state requirements for breakaway features.
- > Text must have a minimum of 4” cap height.
- > No more than 3 destinations per sign.
- > Destinations are ranked in the following directional order with destinations in the same direction being ordered from nearest to farthest:
  - Straight
  - Left
  - Right
- > A separator is to be used when directional arrows change on each panel.

### Dimensions



|   |      |
|---|------|
| A | 48"  |
| B | 8"   |
| C | 2"   |
| D | 4"   |
| E | 5.5" |
| F | 4"   |
| G | 3.5" |
| H | 4"   |
| I | 0.5" |
| J | 30"  |
| K | 1.5" |

*Directional Trailblazer Dimensions*



*Directional Trailblazers*



### POLE-MOUNTED GATEWAY

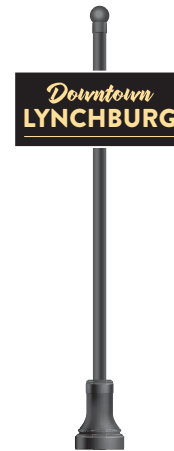
Pole-mounted Gateways are constructed similar to Directional Trailblazers and are to be placed at the edges of the Downtown District where a Monument Gateway is not feasible.

### MONUMENTAL GATEWAY

Monumental Gateways are located at the primary ingress points to the Downtown District. They establish the identity for the district and create a sense of arrival for visitors. These gateway signs are designed to reflect the historic character of the Downtown architecture while incorporating the current brand system. Appropriate illumination should be used to ensure visibility at all times of day. Gateway entrances are discussed in more detail in Section 8.3: Gateway Entrances.

#### Positioning

Monumental gateways should be positioned so that each ingress route it faces has as close to a direct line-of-sight as possible and adhere to all federal and state guidelines as they pertain to rights-of-way, clear zones, breakaway, etc. For example, the current gateway sign on Main Street coming into Downtown, off the expressway, is directed *only* at the traffic coming off of the southbound exit from Madison Heights. When coming from the northbound exit, the gateway sign is not placed in the direction of traffic, which is not ideal. This unique situation may require a multi-faced gateway construction that includes two separate gateway panels.

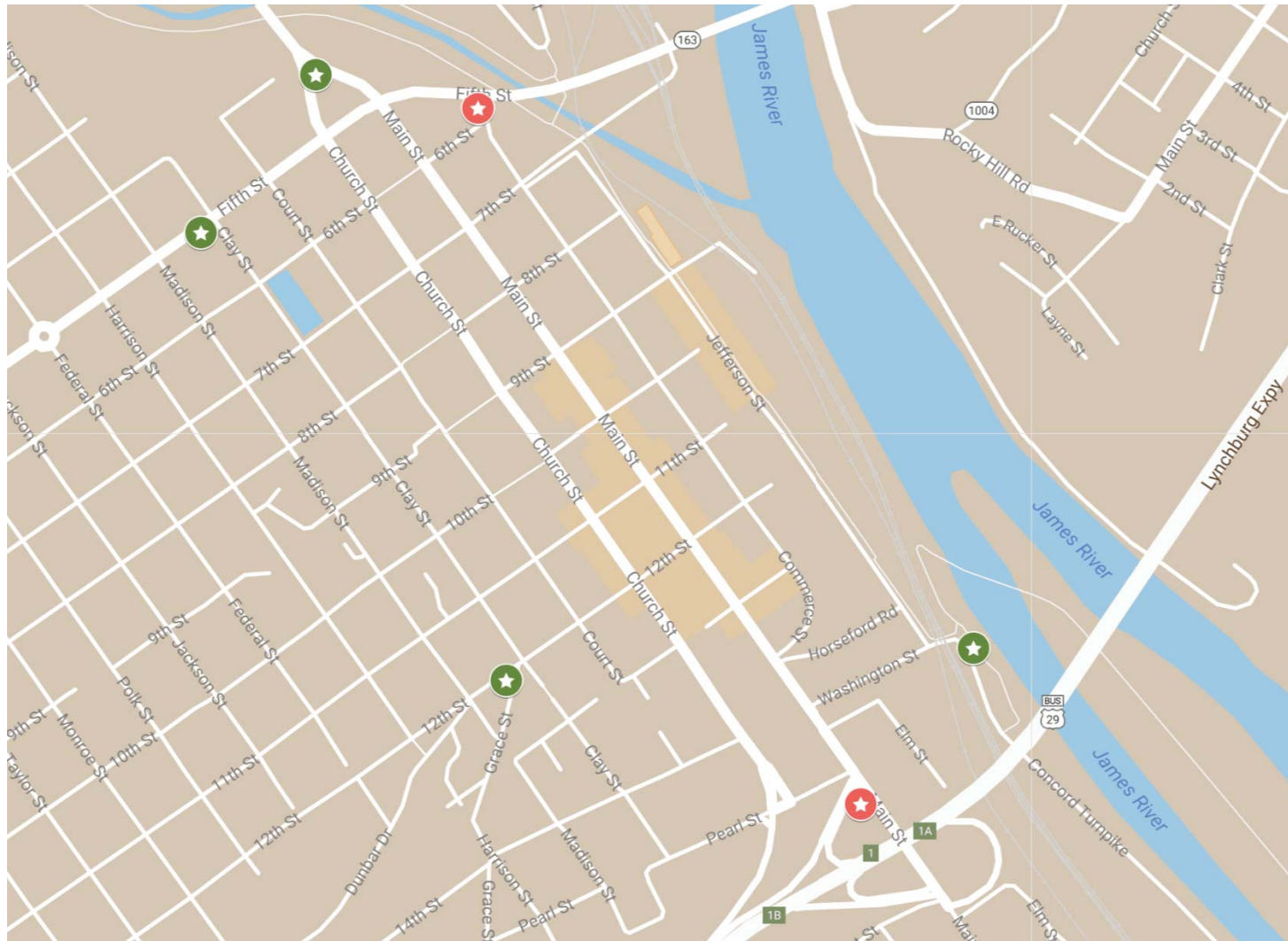


*Pole-Mounted Gateway*



*Monumental Gateway*

## GATEWAY SIGN LOCATIONS



- Pole-Mounted Gateway
- Monumental Gateway

Recommended Gateway Sign Locations

## VEHICULAR SIGN SCHEDULE

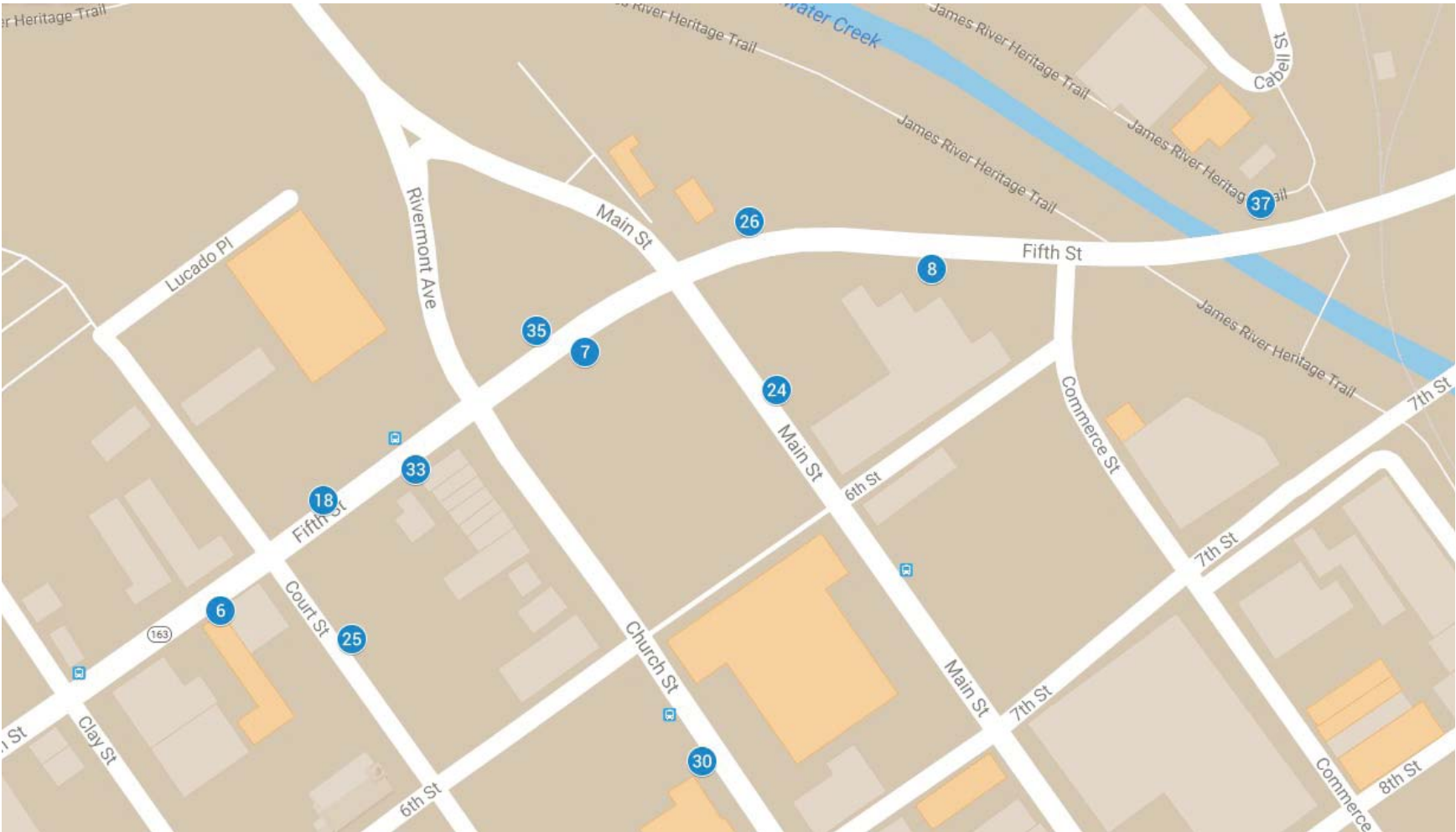
This chart below lists the content of each of the recommended signs. This sign schedule is also included in the companion wayfinding spreadsheet that shows location, destination content for each sign, and direction of arrows. The coding corresponds to the maps included here as well as the online mapping tool developed for this project. The sign schedule and map should be seen as a working tool as Lynchburg implements and updates the wayfinding program for Downtown. For example, all recommended sign locations are based on the existing infrastructure within Downtown including the one-way streets. As streets are returned to two-way as recommended in Chapter 5, Mobility and Accessibility, these wayfinding guidelines and sign schedule can be used to identify locations and content for new signage.

| CODE      | SIGN TYPE                | DESTINATION A              | DIR A | DESTINATION B              | DIR B | DESTINATION C              | DIR C |
|-----------|--------------------------|----------------------------|-------|----------------------------|-------|----------------------------|-------|
| DT-LS -1  | Vehicular Trailblazer-Lo | Academy Center of the Arts | ↑     | Renaissance Theatre        | ←     | Bluffwalk                  | ←     |
| DT-LS -2  | Vehicular Trailblazer-Lo | Academy Center of the Arts | ←     | Amazement Square           | ←     | Riverfront Park            | ←     |
| DT-LS -3  | Vehicular Trailblazer-Lo | Amazement Square           | ←     | Riverfront Park            | ←     | Percival's Island          | ←     |
| DT-LS -4  | Vehicular Trailblazer-Lo | Amazement Square           | ←     | Riverfront Park            | ←     | Riverviews Artspace        | ←     |
| DT-LS -5  | Vehicular Trailblazer-Lo | Amazement Square           | ↑     | Academy Center of the Arts | ↑     | Riverfront Park            | ↑     |
| DT-LS -6  | Vehicular Trailblazer-Lo | Amazement Square           | ↑     | Lynchburg Museum           | →     | Court Complex              | →     |
| DT-LS -7  | Vehicular Trailblazer-Lo | Amazement Square           | ↑     | Riverfront Park            | ↑     | Point of Honor             | ←     |
| DT-LS -8  | Vehicular Trailblazer-Lo | Amazement Square           | →     | Academy Center of the Arts | →     | Riverfront Park            | →     |
| DT-LS -9  | Vehicular Trailblazer-Lo | Amazement Square           | →     | Riverfront Park            | →     | Riverviews Artspace        | →     |
| DT-LS -10 | Vehicular Trailblazer-Lo | Bluffwalk                  | ←     | Community Market           | ←     |                            |       |
| DT-LS -11 | Vehicular Trailblazer-Lo | City Hall                  | →     | Monument Terrace           | →     |                            |       |
| DT-LS -12 | Vehicular Trailblazer-Lo | Bluffwalk                  | ↑     | City Hall                  | ←     | Monument Terrace           | ←     |
| DT-LS -13 | Vehicular Trailblazer-Lo | City Hall                  | ←     | Monument Terrace           | ←     | Court Complex              | ←     |
| DT-LS -14 | Vehicular Trailblazer-Lo | Community Market           | ↑     | Renaissance Theatre        | →     | Riverfront Park            | ↘     |
| DT-LS -15 | Vehicular Trailblazer-Lo | Court Complex              | →     | Lynchburg Museum           | →     |                            |       |
| DT-LS -16 | Vehicular Trailblazer-Lo | Court Complex              | →     | Lynchburg Museum           | →     |                            |       |
| DT-LS -17 | Vehicular Trailblazer-Lo | Downtown                   | ←     | Riverfront Park            | ←     | Visitors Center            | ←     |
| DT-LS -18 | Vehicular Trailblazer-Lo | Legacy Museum              | ↑     | Lynchburg Museum           | ←     | Court Complex              | ←     |
| DT-LS -19 | Vehicular Trailblazer-Lo | Lynchburg Museum           | →     | Court Complex              | →     |                            |       |
| DT-LS -20 | Vehicular Trailblazer-Lo | Monument Terrace           | ↑     | City Hall                  | ↑     | Academy Center of the Arts | →     |
| DT-LS -21 | Vehicular Trailblazer-Lo | Monument Terrace           | ←     | Academy Center of the Arts | ←     | City Hall                  | ←     |
| DT-LS -22 | Vehicular Trailblazer-Lo | Percival's Island          | ←     | Visitors Center            | →     | Community Market           | →     |
| DT-LS -23 | Vehicular Trailblazer-Lo | Percival's Island          | ↑     | Bluffwalk                  | →     | Renaissance Theatre        | →     |
| DT-LS -24 | Vehicular Trailblazer-Lo | Point of Honor             | ↑     | Legacy Museum              | ←     | Old City Cemetery          | ←     |
| DT-LS -25 | Vehicular Trailblazer-Lo | Legacy Museum              | ←     | Old City Cemetery          | ←     | Point of Honor             | →     |
| DT-LS -26 | Vehicular Trailblazer-Lo | Visitors Center            | ↑     | Community Market           | ↑     | Point of Honor             | →     |
| DT-LS -27 | Vehicular Trailblazer-Lo | Renaissance Theatre        | ↖     | Riverfront Park            | ↗     | Percival's Island          | ↗     |
| DT-LS -28 | Vehicular Trailblazer-Lo | Riverfront Skate Park      | ←     | Riverfront Park            | →     | Percival's Island          | →     |
| DT-LS -29 | Vehicular Trailblazer-Lo | Visitors Center            | ←     | Lynchburg Museum           | ←     | Bluffwalk                  | →     |
| DT-LS -30 | Vehicular Trailblazer-Lo | Visitors Center            | ↑     | Community Market           | ↑     | City Hall                  | ↑     |
| DT-LS -31 | Vehicular Trailblazer-Lo | Visitors Center            | ↑     | Riverfront Park            | →     | Amazement Square           | →     |
| DT-LS -32 | Vehicular Trailblazer-Lo | Visitors Center            | →     | Community Market           | →     | Academy Center of the Arts | →     |
| DT-LS -33 | Vehicular Trailblazer-Lo | Visitors Center            | →     | Monument Terrace           | →     | Community Market           | →     |
| DT-LS -34 | Vehicular Trailblazer-Lo | Visitors Center            | ←     | City Hall                  | ←     | City Market                | ←     |
| DT-LS -35 | Vehicular Trailblazer-Lo | Visitors Center            | ←     | Monument Terrace           | ←     | Community Market           | ←     |
| DT-LS -36 | Vehicular Trailblazer-Lo | Monument Terrace           | ←     | Amazement Square           | →     | Riverfront Park            | →     |
| DT-LS -37 | Vehicular Trailblazer-Lo | Amazement Square           | ←     | Riverfront Park            | ←     | Academy Center of the Arts | ←     |
| DT-LS -38 | Vehicular Trailblazer-Lo | Downtown                   | →     | Riverfront Park            | →     | Visitors Center            | →     |

Sign Schedule

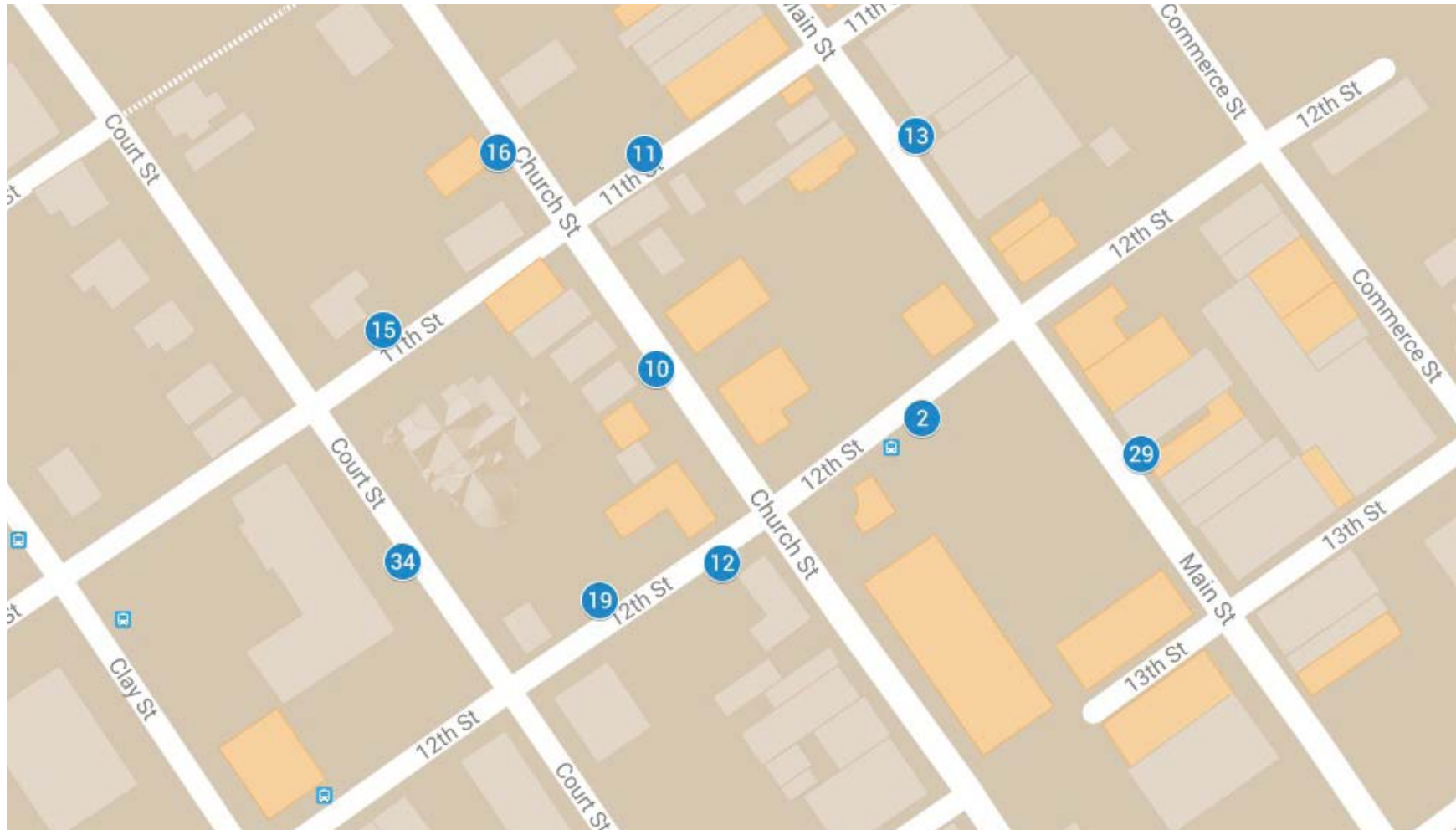


DIRECTIONAL TRAILBLAZER SIGN LOCATIONS



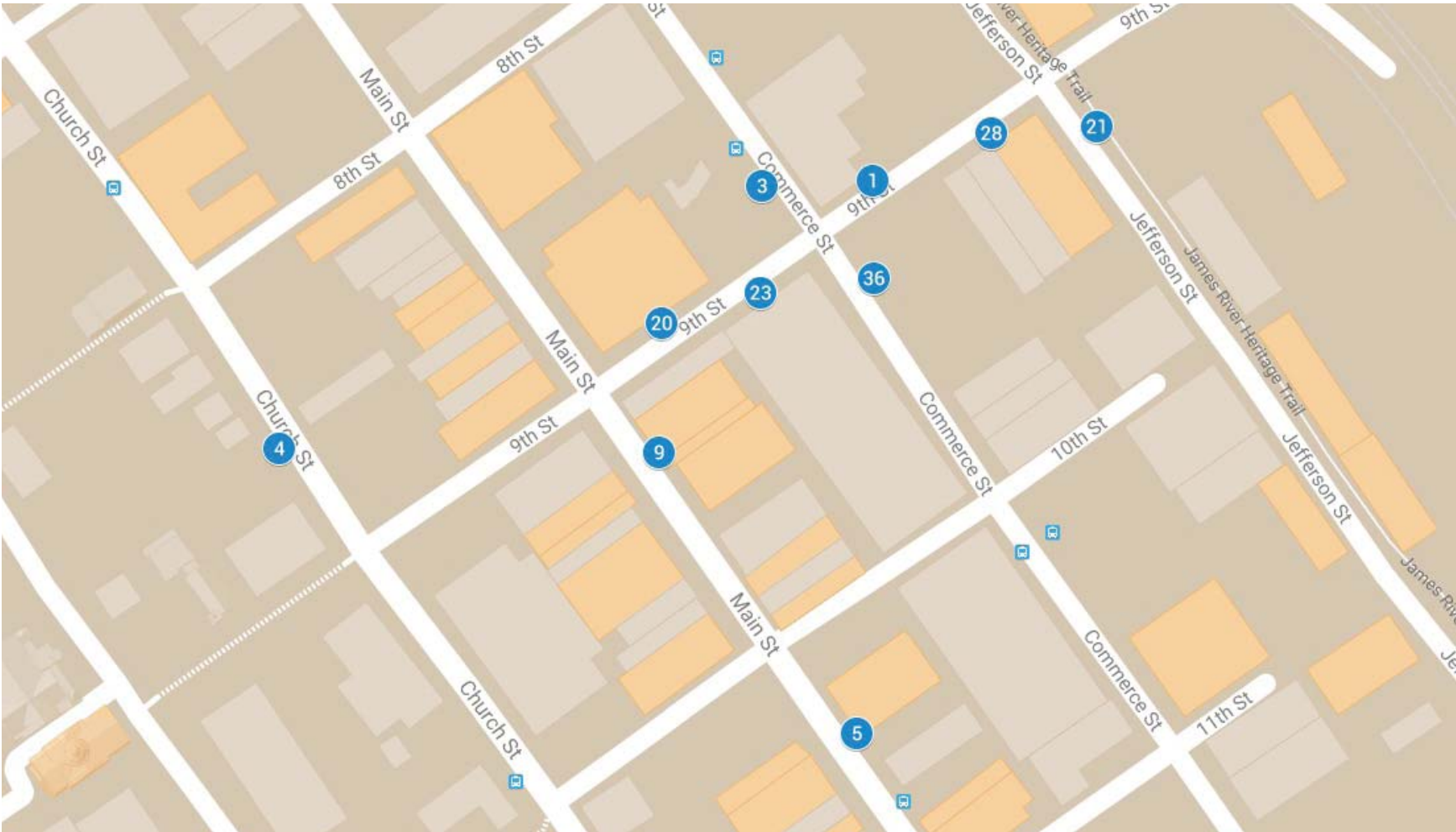
Recommended Sign Locations

## DIRECTIONAL TRAILBLAZER SIGN LOCATIONS



*Recommended Sign Locations*

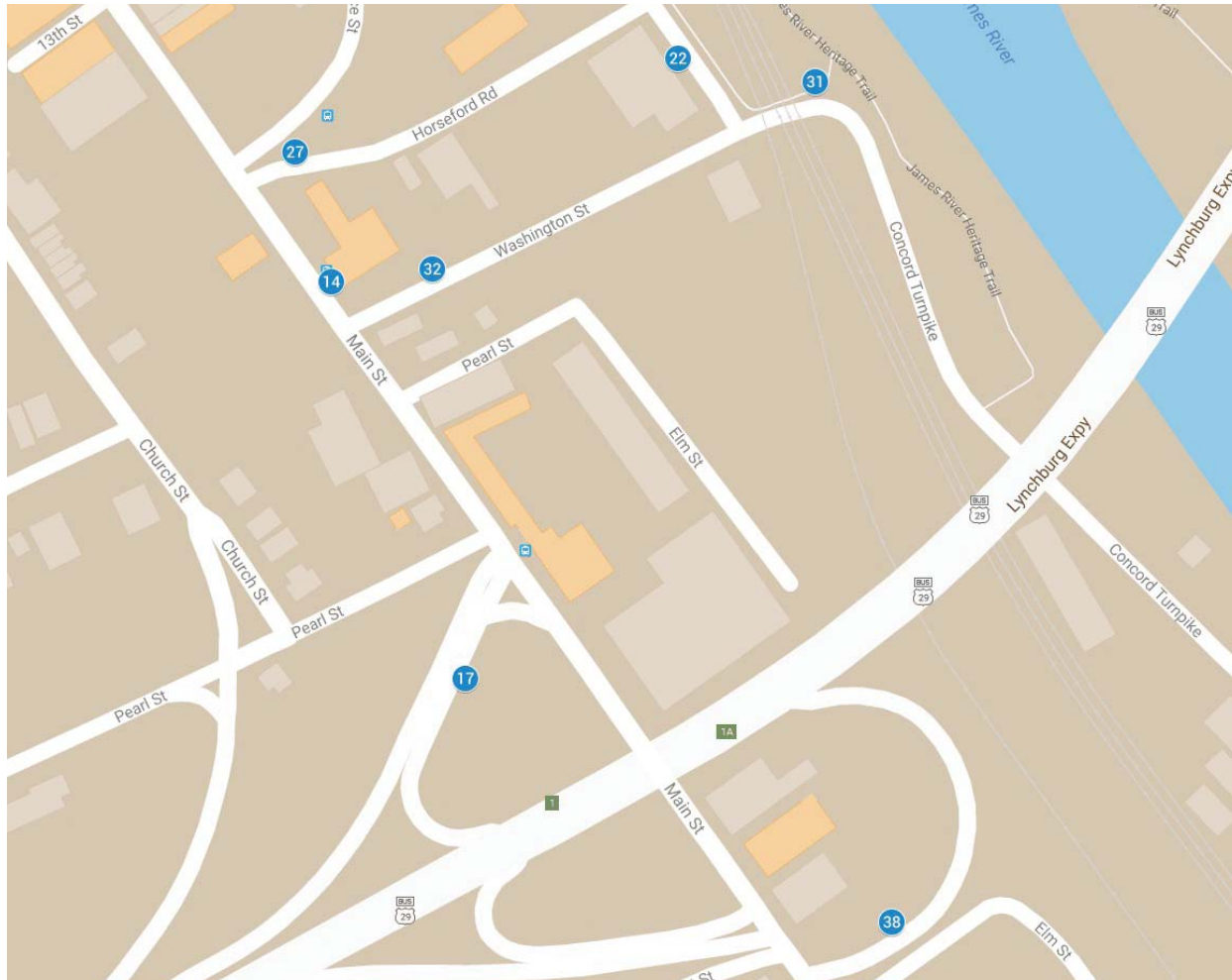
DIRECTIONAL TRAILBLAZER SIGN LOCATIONS



Recommended Sign Locations



## DIRECTIONAL TRAILBLAZER SIGN LOCATIONS



*Recommended Sign Locations*

## PEDESTRIAN WAYFINDING

Pedestrian Wayfinding provides a greater level of detail than vehicular wayfinding. Pedestrian signs are not regulated by the MUTCD, but they are restricted from being retro-reflective. These signs should be placed at or near intersections as well as parking lot or garage exits which are considered key decision points for pedestrians. Unlike vehicular trailblazers, pedestrian signs can include more than three locations as well as private businesses. The following examples demonstrate how flexible a pedestrian wayfinding system can be.

### Pole-Mounted Pedestrian Sign

Typefaces on the destinations should be no smaller than 1" cap height to ensure legibility. The example shown is the same width as the corridor identification panel seen on the reverse side of the vehicular trailblazers. This design helps maintain a visual consistency with the overall system. These panels should also be fabricated with separate panels for each destination that can be added or removed as new places of interest open, relocate, change names, or close down. Pedestrian Trailblazers will not be mounted on the same poles as vehicular trailblazers. Depending on location, these signs can be mounted to existing infrastructure such as light poles or they may require a new stand-alone pole.



*Pedestrian Directional Trailblazer*

## Pedestrian Map

The Pedestrian Map can be implemented in a similar way to the pole-mounted signs. This map provides a greater context for the viewer. This type of map is often printed on more durable, coated material and housed in a simple cabinet style enclosure behind Plexiglas since the information may change throughout the life of the sign.



Pedestrian Map Concept

## Pedestrian Kiosk

Kiosks can range from small, single sided enclosures to large, covered structures. Other kiosks are designed to reflect the architectural character of their surroundings or as an homage to the historical significance of their location. Locating these structures near parking facilities enables a great deal of information to be presented to a visitor at a key transition from being a vehicular traveler to a pedestrian.

Kiosks provide ample space to convey important local information such as:

- Maps
- Calendar of events
- Key destinations
- Contact information
- Regional brochures
- Sponsorship opportunities



Pedestrian Kiosk Examples





## 11.5 WAYFINDING: GOALS

- > Improve wayfinding into and within Downtown using a consistent, functional, and easily maintained signage system.
- > Monitor wayfinding signs to ensure accuracy.
- > Develop temporary wayfinding solutions that effectively communicate detours and foster a positive perception during construction.

## 11.6 WAYFINDING: RECOMMENDATIONS

The recommendations below are intended to improve wayfinding within Downtown using a creative, attractive, consistent, and functional signage system. The system should incorporate the Downtown Lynchburg brand identity, as well as comply with recommended uniform traffic control device standards which provide information for motorists to easily navigate preferred routes to key destinations, public amenities, and parking facilities. Wayfinding is an effective traffic control mechanism that encourages vehicles to use the optimal routes to limit congestion and increase community awareness.

Since very little of the existing Downtown wayfinding infrastructure adheres to MUTCD compliant best-practices, design recommendations in this plan incorporate standards that can be used by Downtown Lynchburg, the Department of Public Works, and other associated parties, to fabricate and implement a safe and effective wayfinding system.

Public policy can set the foundation for the implementation of an effective wayfinding signage system by adopting the following recommendations:

**Wayfinding Signage System**– Wayfinding signage, design, destination listing, and placement should be in accordance with the standards and placement defined in the Wayfinding Plan in Chapter 7.

**Wayfinding Management** – Wayfinding should be managed by the City’s Office of Economic Development and Tourism, with maintenance and installation provided by the Department of Public Works.

WAYFINDING

| SHORT-TERM STRATEGIES                                                                                                                | LONG-TERM STRATEGIES                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Update parking facility naming convention to increase user awareness.</li></ul>              | <ul style="list-style-type: none"><li>• Install new MUTCD-compliant footers, sign poles, and directional trailblazers.</li></ul> |
| <ul style="list-style-type: none"><li>• Apply on-street stencils for parking facilities.</li></ul>                                   | <ul style="list-style-type: none"><li>• Install updated monumental gateway signs.</li></ul>                                      |
| <ul style="list-style-type: none"><li>• Install updated parking directional signs before facility entrances.</li></ul>               | <ul style="list-style-type: none"><li>• Implement pedestrian wayfinding signs.</li></ul>                                         |
| <ul style="list-style-type: none"><li>• Install new parking facility regulation signage at parking facility entrances.</li></ul>     | <ul style="list-style-type: none"><li>• Install pedestrian kiosks.</li></ul>                                                     |
| <ul style="list-style-type: none"><li>• Purchase portable event parking signs.</li></ul>                                             |                                                                                                                                  |
| <ul style="list-style-type: none"><li>• Distribute temporary roadside directional signs for construction zones or detours.</li></ul> |                                                                                                                                  |
| <ul style="list-style-type: none"><li>• Distribute temporary construction awareness signs.</li></ul>                                 |                                                                                                                                  |
| <ul style="list-style-type: none"><li>• Update printed maps.</li></ul>                                                               |                                                                                                                                  |

*Timing of these strategies will vary. Implementation depends on the availability staff and funding as well as the changing environment Downtown.*

PAGE LEFT INTENTIONALLY BLANK



# 12. IMPLEMENTATION & NEXT STEPS

## 12.1 SUMMARY IMPLEMENTATION MATRIX

PAGE LEFT INTENTIONALLY BLANK

Successful implementation of the recommended strategies discussed in this Master Plan will require careful coordination and communication among diverse stakeholder groups. Many of the significant projects and strategies need both public and private support to further investment and achieve the vision and goals for Downtown Lynchburg in 2040.

## 12.1 SUMMARY IMPLEMENTATION MATRIX

The recommended strategies and public policies are discussed in detail in the respective chapters for land use, architecture, public space and recreation, mobility, utility infrastructure, business development and marketing, and wayfinding. For quick reference, a table at the end of each topic chapter provides recommended strategies for short-term to long-term implementation.

A comprehensive Summary Implementation Matrix is included in the Appendix which lists in one table all the recommended strategies for short, mid, and long-term implementation, as well as preliminary costs, potential funding sources, and implementation partners. This matrix can serve as a tool for monitoring progress and planning for future Downtown improvements.



PAGE LEFT INTENTIONALLY BLANK

# APPENDICES

**APPENDIX A:** DOWNTOWN  
LYNCHBURG MARKET ANALYSIS

**APPENDIX B:** CASE STUDIES  
FOR CREATIVE FINANCING &  
DOWNTOWN DEVELOPMENT

**APPENDIX C:**  
IMPLEMENTATION MATRIX

PAGE LEFT INTENTIONALLY BLANK



## APPENDIX A: Downtown Lynchburg Market Analysis

|            |                                         |           |
|------------|-----------------------------------------|-----------|
| <b>1.0</b> | <b>INTRODUCTION.....</b>                | <b>2</b>  |
| <b>2.0</b> | <b>ZIP CODE SURVEY .....</b>            | <b>3</b>  |
| <b>2.1</b> | <b>CUSTOMER BREAKDOWN</b>               | <b>5</b>  |
| <b>2.2</b> | <b>TRADE AREA DEFINITIONS</b>           | <b>8</b>  |
| <b>3.0</b> | <b>RETAIL ANALYSIS.....</b>             | <b>10</b> |
| <b>3.1</b> | <b>RETAIL LEAKAGE</b>                   | <b>10</b> |
| <b>3.2</b> | <b>KEY DEMAND OPPORTUNITIES</b>         | <b>14</b> |
| <b>3.2</b> | <b>RETAIL SHARES</b>                    | <b>16</b> |
| <b>4.0</b> | <b>RESIDENTIAL AND EMPLOYMENT .....</b> | <b>18</b> |
| <b>4.1</b> | <b>RESIDENTIAL MARKET</b>               | <b>18</b> |
| <b>4.2</b> | <b>COMMERCIAL MARKET</b>                | <b>22</b> |
| <b>4.3</b> | <b>EMPLOYMENT</b>                       | <b>23</b> |
| <b>5.0</b> | <b>DEMOGRAPHICS .....</b>               | <b>25</b> |
| <b>5.1</b> | <b>POPULATION</b>                       | <b>25</b> |
| <b>5.2</b> | <b>INCOME</b>                           | <b>27</b> |
| <b>6.0</b> | <b>MARKET SEGMENTATION .....</b>        | <b>28</b> |

## 1.0 INTRODUCTION

This report is a companion to the market assessment in the Downtown Lynchburg Master Plan. It presents the findings of the full market analysis for Downtown Lynchburg including a market definition exercise, assessment of the current market, and identification of opportunities for business growth. The report includes five sections:

- A zip code survey that is used to define the local trade areas relevant to Downtown Lynchburg, as well as a snapshot of the visitor market.
- A retail analysis to examine retail leakage and gains in the trade area and identify opportunities for growth in Downtown Lynchburg.
- An analysis of residential and commercial development in Downtown Lynchburg.
- A demographic snapshot that examines trends in population and income in Downtown Lynchburg's trade areas and the surrounding region.
- A market segmentation study that analyzes the makeup of Lynchburg's primary trade area in order to determine consumer needs and target markets.

The market analysis was used as the basis for the business support and development strategies included in the Master Plan.



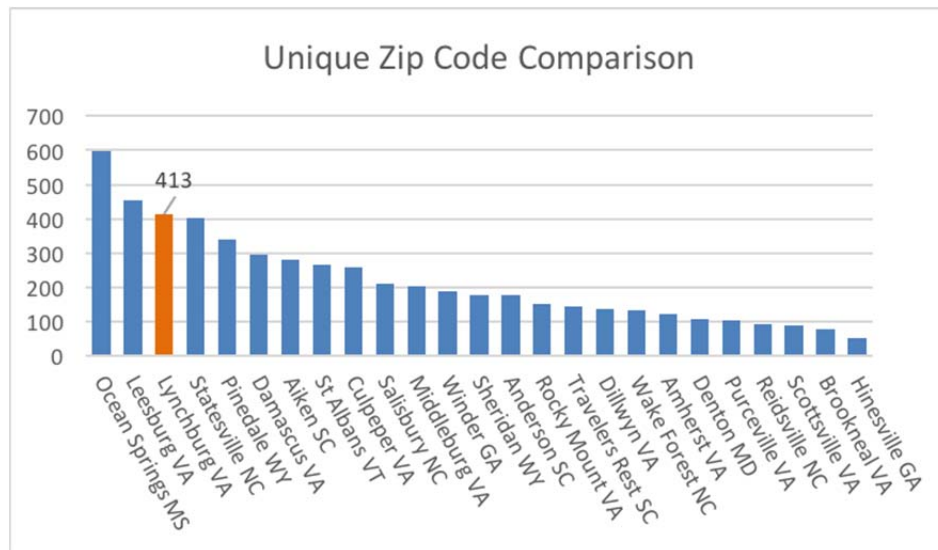


Figure 2: Unique Zip Code Comparison

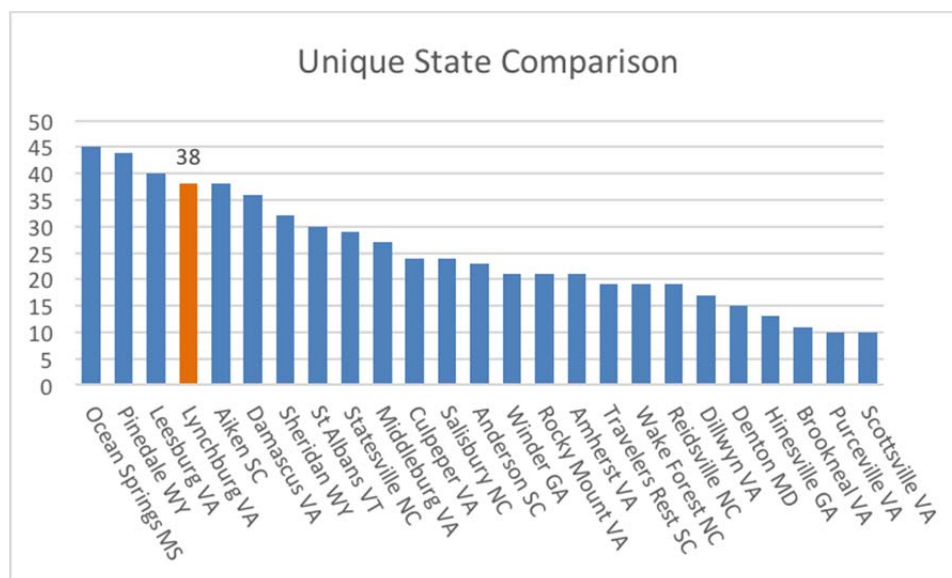


Figure 3: Unique State Comparison



## 2.1 CUSTOMER BREAKDOWN

The chart below shows Lynchburg's market base broken down by customers' place of residence.

- Approximately 34% of customers came from either the 24503 or 24502 Lynchburg zip codes
- Forest (24551) represents 8% of Downtown's market
- Nearly half of customers (47.9%) came from all of Lynchburg zip codes.
- 10.7 % of all customers live in Bedford County, followed by Amherst (6%) and Campbell (4%)
- 86.5% of customers were from Virginia
- 14% live out of state.

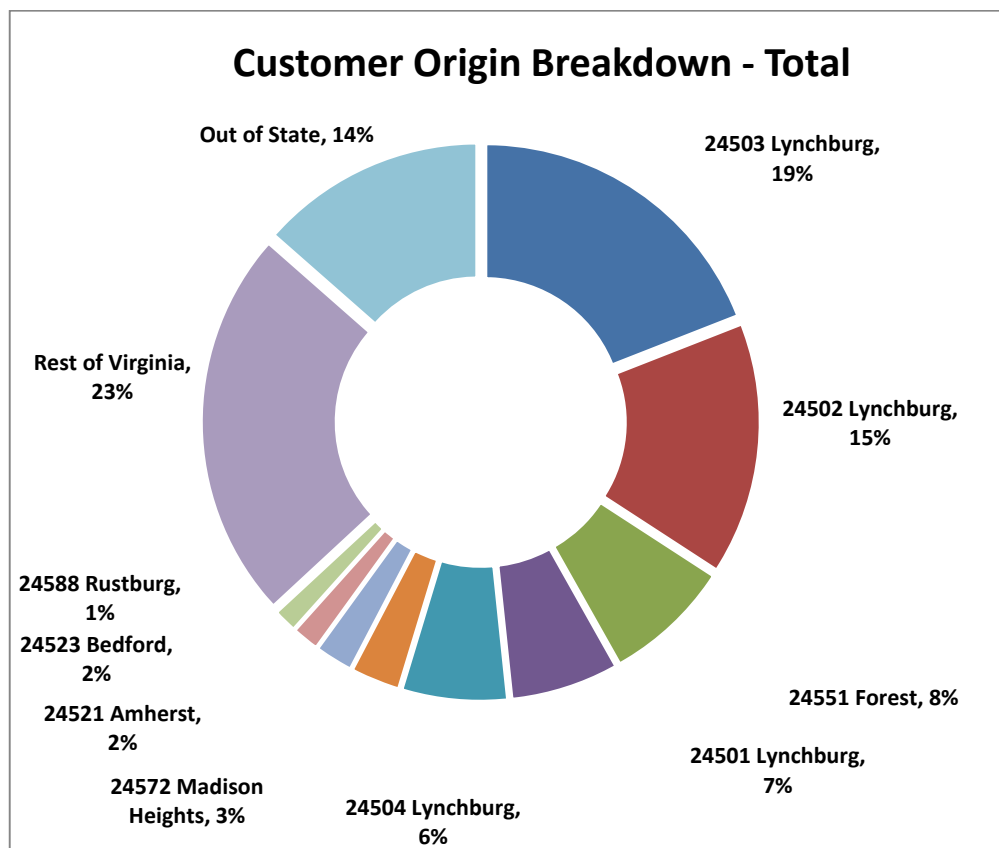


Figure 4: Zip Code Survey Customer Origin

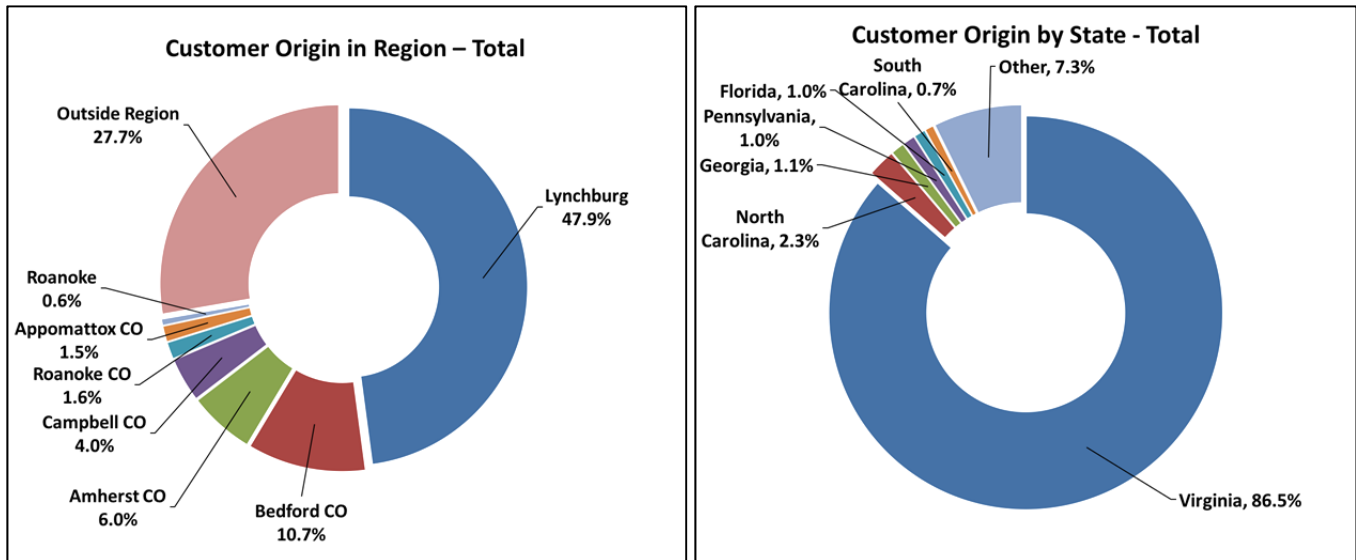


Figure 5: Customer Origin In the Region (left) and Customer Origin by State (right).

Customers were also asked if they were a current student of one of the local colleges (Liberty, Randolph, Lynchburg, etc). Approximately 13% of visits were college students. While this is a significant portion of the customer base overall, it should be noted that the survey was conducted in the summer when the colleges were not in regular session. It is likely therefore that the student population represents a larger portion of the downtown market.

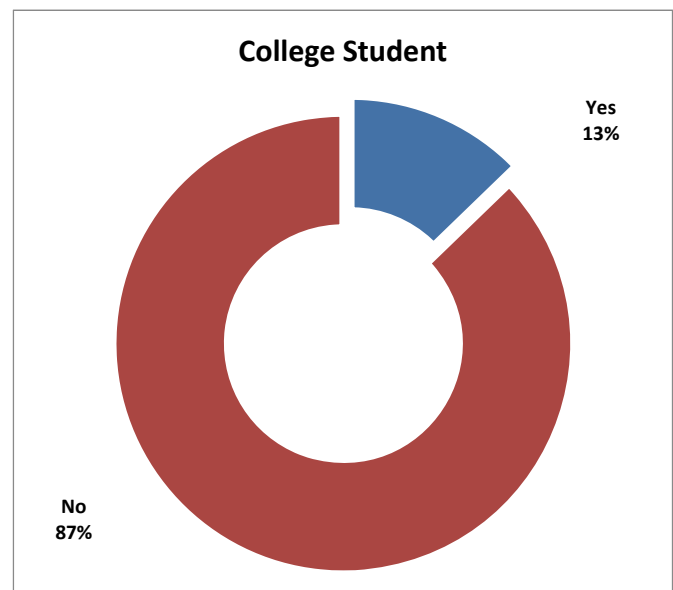


Figure 6: Customers who were current students of local colleges.

There was enough of a cluster of businesses to examine customer origin data by District (Main Street, Jefferson Street, Commerce/Church/Other) as well as type (retail, restaurant, destination), in order to determine if the market varies by location.

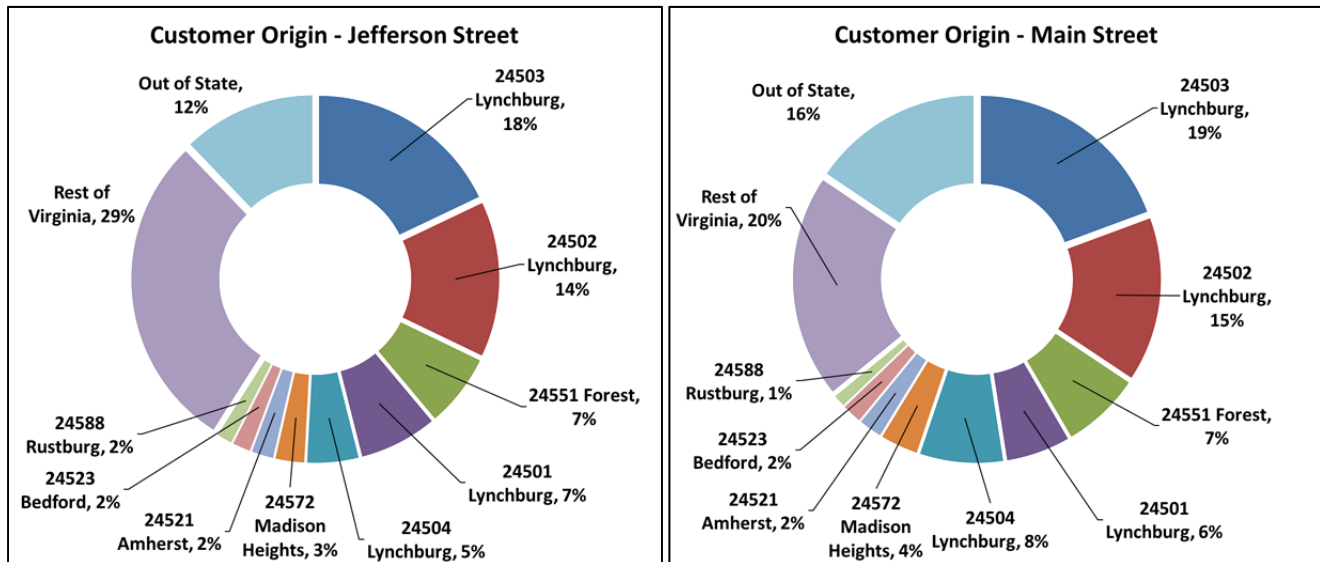


Figure 7: Customer Origin for Businesses on Jefferson Street (left) and Main Street (right)

Jefferson and Main Street businesses generally showed similar data. However, while Jefferson Street had a larger overall visitor base, Main Street business had a larger portion of its customers coming from out of state. With business type, destination businesses had the largest overall visitor base (47% of customers from outside the region or state). Retail businesses had a visitor base of around 27%, while restaurants were 26%. All told, Downtown Lynchburg has an extremely robust visitors market.

## 2.2 TRADE AREA DEFINITIONS

The customer origin data provided in the previous section presents the results of the zip code survey as simple totals from each individual zip code. However, because zip codes vary by geographic area and total population, the results cannot be analyzed by total visits alone. Rather, trade areas are defined by examining the number of visits in relation to the total population of the areas of interest. The table below shows customer visits per 1,000 residents for each of the highest representative zip codes.

| Zip Code | Area            | 2015<br>Population | Visits | Visits/1000<br>Pop |
|----------|-----------------|--------------------|--------|--------------------|
| 24503    | Lynchburg       | 18,901             | 379    | 20.05              |
| 24504    | Lynchburg       | 10,222             | 144    | 14.09              |
| 24536    | Coleman Falls   | 244                | 3      | 12.30              |
| 24551    | Forest          | 22,966             | 150    | 6.53               |
| 24502    | Lynchburg       | 46,545             | 287    | 6.17               |
| 24574    | Monroe          | 4,475              | 19     | 4.25               |
| 24501    | Lynchburg       | 26,074             | 109    | 4.18               |
| 24556    | Goode           | 3,543              | 14     | 3.95               |
| 24521    | Amherst         | 10,779             | 42     | 3.90               |
| 24572    | Madison Heights | 15,461             | 58     | 3.75               |
| 24588    | Rustburg        | 8,575              | 24     | 2.80               |
| 24526    | Big Island      | 1,092              | 3      | 2.75               |
| 24538    | Concord         | 4,536              | 11     | 2.43               |
| 24550    | Evington        | 8,208              | 18     | 2.19               |
| 24522    | Appomattox      | 9,558              | 17     | 1.78               |
| 24523    | Bedford         | 19,281             | 27     | 1.40               |
| 24517    | Altavista       | 5,581              | 7      | 1.25               |
| 24579    | Natural Bridge  | 1,613              | 2      | 1.24               |
| 22922    | Arrington       | 1,851              | 2      | 1.08               |
| 24571    | Lynch Station   | 1,889              | 2      | 1.06               |
| 24569    | Long Island     | 949                | 1      | 1.05               |
| 24593    | Spout Spring    | 2,044              | 2      | 0.98               |
| 24528    | Brookneal       | 3,072              | 3      | 0.98               |
| 23959    | Phenix          | 1,308              | 1      | 0.76               |
| 24554    | Gladys          | 4,126              | 3      | 0.73               |
| 24563    | Hurt            | 5,645              | 4      | 0.71               |

Figure 8: Primary and Secondary Trade Areas. Visits per 1000 population.



Lynchburg's primary and secondary trade areas were determined based on the zip code survey results as analyzed relative to total population. By this measure, the primary trade area consists of the following zip codes:

- 24503 Lynchburg
- 24504 Lynchburg
- 24536 Coleman Falls
- 24551 Forest
- 24502 Lynchburg
- 24526 Monroe
- 24501 Lynchburg

The PTA had a 2015 population of 129,000 people and represents 61% of Downtown Lynchburg's customer base.

The secondary trade area (with approximately 10% of the total visits) consists of the following zip codes:

- 24556 Goode
- 24521 Amherst
- 24572 Madison Heights
- 24588 Rustburg
- 24526 Big Island
- 24538 Concord
- 24550 Evington

The STA had a population of 52,000 and represents 10% of the customer base.

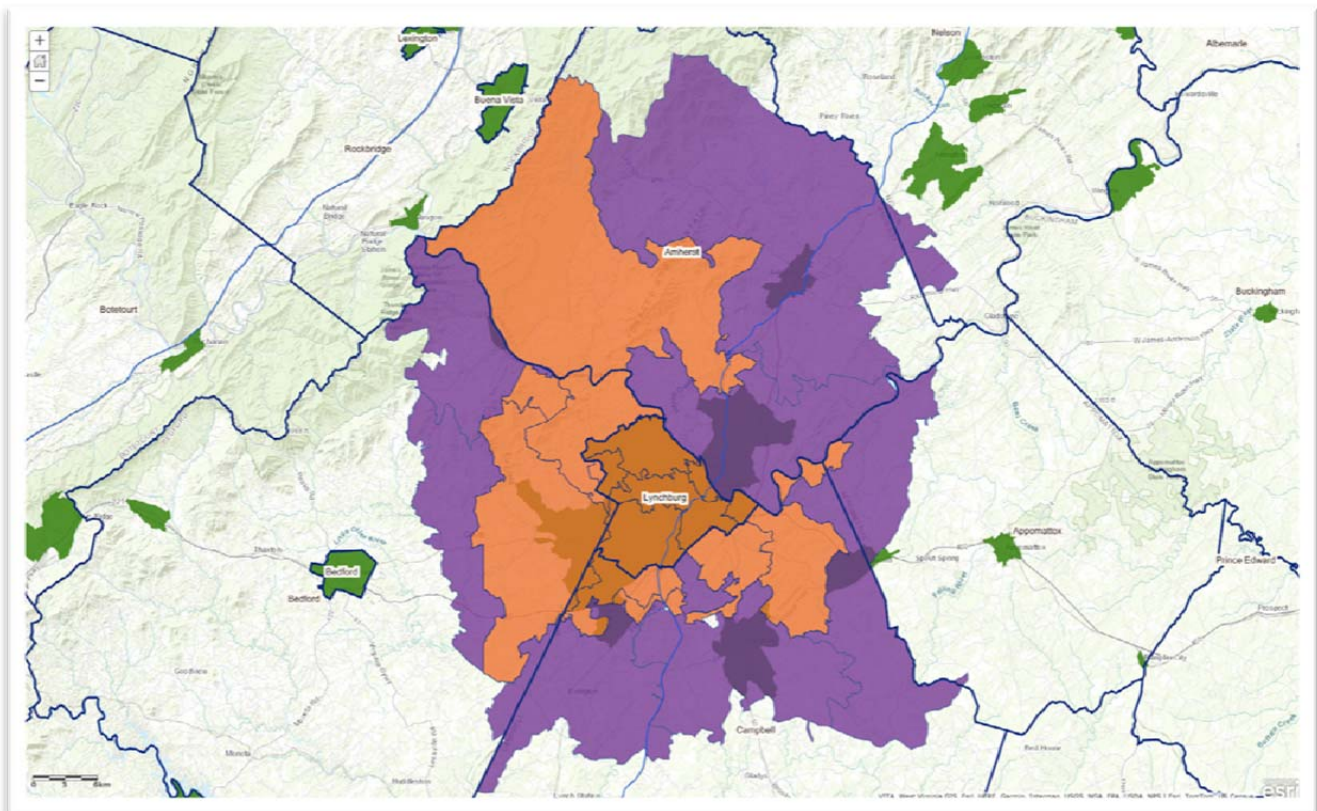


Figure 9: Lynchburg Primary Trade Area (in orange) and Secondary Trade Area (in purple)

### 3.0 RETAIL ANALYSIS

This section presents the findings of the retail analysis for Lynchburg's primary and secondary trade areas in order to identify potential opportunities for retail growth based on demand in the market. It includes:

- A retail leakage analysis that will look at the primary and secondary trade areas to see how much money is "leaking" from the area to stores in other areas.
- From this, a space demand analysis will be developed to illustrate how much retail space could potentially be brought into Downtown Lynchburg based on the demand in the market.
- A retail shares analysis that examines performance of retail stores in Lynchburg's primary trade area as a benchmark of the greater region. This study will seek to determine if there are any retail-clustering opportunities.

#### 3.1 RETAIL LEAKAGE

"Retail Leakage" refers to the difference between the retail expenditures by residents living in an area and the retail sales produced by the stores located in the same area. If desired products are not available within that area, consumers will travel to other places or use different methods to obtain those products. Consequently, the dollars spent outside of the area are said to be "leaking." Even large communities may see leakage in certain retail categories while some small communities may be attractors in categories.

The data presented below comes from Claritas, Inc., a national retail marketing service used by town planners, retail & restaurant site planners, and national chains for their market research. Claritas gets its data from a number of sources including: Census of Retail Trade; Annual Survey of Retail Trade; Claritas Business Facts; Census of Employment and Wages; Sales Tax Reports; and various Trade Associations.

#### Retail Leakage Analysis in the Primary and Secondary Trade Areas

The retail leakage analysis revealed the following:

- Stores in Downtown's primary trade area sold \$3.1 billion in merchandise. Consumers living in the primary trade area spent \$2.4 billion on merchandise. Therefore, Downtown's primary trade area **gained \$659.3 million** in sales last year.
- The secondary trade area had \$523 million in sales and \$941.6 million in consumer expenditures, resulting in a **\$418.6 million leakage**.
- The combined trade area **gained \$240.7 million**.

The table on the following two pages details the consumer expenditures, retail sales, and inflow/outflow of dollars by individual retail category and begins to outline the opportunity for retail Downtown Lynchburg.

| Opportunity Gap - Retail Stores                           | PTA                     |                      |                      | STA                     |                    |                     |
|-----------------------------------------------------------|-------------------------|----------------------|----------------------|-------------------------|--------------------|---------------------|
|                                                           | (Consumer Expenditures) | (Retail Sales)       | Leakage (Inflow)     | (Consumer Expenditures) | (Retail Sales)     | Leakage (Inflow)    |
| <b>Total Retail Sales Incl Eating and Drinking Places</b> | <b>2,444,324,512</b>    | <b>3,103,620,594</b> | <b>(659,296,082)</b> | <b>941,649,019</b>      | <b>523,020,397</b> | <b>418,628,622</b>  |
| <b>Motor Vehicle and Parts Dealers-441</b>                | <b>504,932,998</b>      | <b>680,502,235</b>   | <b>(175,569,237)</b> | <b>203,398,116</b>      | <b>71,726,253</b>  | <b>131,671,863</b>  |
| Automotive Dealers-4411                                   | 433,364,876             | 541,579,813          | (108,214,937)        | 173,509,583             | 51,339,258         | 122,170,325         |
| Other Motor Vehicle Dealers-4412                          | 32,200,395              | 49,054,220           | (16,853,825)         | 14,674,608              | 7,725,239          | 6,949,369           |
| Automotive Parts/Accsrs, Tire Stores-4413                 | 39,367,727              | 89,868,202           | (50,500,475)         | 15,213,925              | 12,661,756         | 2,552,169           |
| <b>Furniture and Home Furnishings Stores-442</b>          | <b>46,147,692</b>       | <b>38,351,594</b>    | <b>7,796,098</b>     | <b>17,491,811</b>       | <b>3,073,131</b>   | <b>14,418,680</b>   |
| Furniture Stores-4421                                     | 24,539,607              | 17,556,370           | 6,983,237            | 9,236,431               | 1,840,517          | 7,395,914           |
| Home Furnishing Stores-4422                               | 21,608,085              | 20,795,224           | 812,861              | 8,255,380               | 1,232,614          | 7,022,766           |
| <b>Electronics and Appliance Stores-443</b>               | <b>43,410,702</b>       | <b>46,236,767</b>    | <b>(2,826,065)</b>   | <b>14,550,366</b>       | <b>33,122,675</b>  | <b>(18,572,309)</b> |
| Household Appliances Stores-443141                        | 5,887,408               | 1,374,651            | 4,512,757            | 2,344,167               | 4,137,171          | (1,793,004)         |
| Electronics Stores-443142                                 | 37,523,294              | 44,862,116           | (7,338,822)          | 12,206,199              | 28,985,504         | (16,779,305)        |
| <b>Building Material, Garden Equip Stores -444</b>        | <b>246,519,009</b>      | <b>382,355,910</b>   | <b>(135,836,901)</b> | <b>101,951,579</b>      | <b>88,522,996</b>  | <b>13,428,583</b>   |
| Building Material and Supply Dealers-4441                 | 225,978,468             | 345,491,497          | (119,513,029)        | 93,676,515              | 80,200,953         | 13,475,562          |
| Home Centers-44411                                        | 91,484,865              | 104,030,852          | (12,545,987)         | 37,708,914              | 33,364,808         | 4,344,106           |
| Paint and Wallpaper Stores-44412                          | 4,317,205               | 6,630,815            | (2,313,610)          | 1,891,486               | 0                  | 1,891,486           |
| Hardware Stores-44413                                     | 23,547,559              | 28,072,168           | (4,524,609)          | 9,442,940               | 8,563,263          | 879,677             |
| Other Building Materials Dealers-44419                    | 106,628,839             | 206,757,662          | (100,128,823)        | 44,633,175              | 38,272,882         | 6,360,293           |
| Building Materials, Lumberyards-444191                    | 39,918,763              | —                    | (37,222,998)         | 16,335,981              | —                  | 2,056,279           |
| Lawn, Garden Equipment, Supplies Stores-4442              | 20,540,541              | 36,864,413           | (16,323,872)         | 8,275,064               | 8,322,043          | (46,979)            |
| Outdoor Power Equipment Stores-44421                      | 3,734,252               | 5,683,895            | (1,949,643)          | 1,628,788               | 1,223,090          | 405,698             |
| Nursery and Garden Centers-44422                          | 16,806,289              | 31,180,518           | (14,374,229)         | 6,646,276               | 7,098,953          | (452,677)           |
| <b>Food and Beverage Stores-445</b>                       | <b>301,801,618</b>      | <b>327,904,388</b>   | <b>(26,102,770)</b>  | <b>116,458,460</b>      | <b>76,639,317</b>  | <b>39,819,143</b>   |
| Grocery Stores-4451                                       | 272,273,872             | 306,565,471          | (34,291,599)         | 105,746,985             | 62,056,112         | 43,690,873          |
| Supermarkets, Grocery (Ex Conv) Stores-44511              | 253,567,230             | 272,772,808          | (19,205,578)         | 98,476,485              | 52,268,411         | 46,208,074          |
| Convenience Stores-44512                                  | 18,706,642              | 33,792,663           | (15,086,021)         | 7,270,500               | 9,787,701          | (2,517,201)         |
| Specialty Food Stores-4452                                | 9,883,505               | 11,218,115           | (1,334,610)          | 3,802,024               | 11,074,500         | (7,272,476)         |
| Beer, Wine and Liquor Stores-4453                         | 19,644,241              | 10,120,802           | 9,523,439            | 6,909,451               | 3,508,705          | 3,400,746           |



| Opportunity Gap - Retail Stores                      | PTA                     |                    |                     | STA                     |                    |                     |
|------------------------------------------------------|-------------------------|--------------------|---------------------|-------------------------|--------------------|---------------------|
|                                                      | (Consumer Expenditures) | (Retail Sales)     | Leakage (Inflow)    | (Consumer Expenditures) | (Retail Sales)     | Leakage (Inflow)    |
| <b>Health and Personal Care Stores-446</b>           | <b>145,540,233</b>      | <b>187,493,332</b> | <b>(41,953,099)</b> | <b>60,685,430</b>       | <b>35,014,754</b>  | <b>25,670,676</b>   |
| Pharmacies and Drug Stores-44611                     | 120,240,210             | 165,289,551        | (45,049,341)        | 50,203,718              | 28,372,232         | 21,831,486          |
| Cosmetics, Beauty Supplies, Perfume Stores           | 12,177,090              | 14,409,378         | (2,232,288)         | 5,112,477               | 4,547,264          | 565,213             |
| Optical Goods Stores-44613                           | 4,201,501               | 2,926,132          | 1,275,369           | 1,657,431               | 716,971            | 940,460             |
| Other Health and Personal Care Stores-44619          | 8,921,432               | 4,868,271          | 4,053,161           | 3,711,804               | 1,378,287          | 2,333,517           |
| <b>Gasoline Stations-447</b>                         | <b>149,787,812</b>      | <b>195,125,970</b> | <b>(45,338,158)</b> | <b>57,946,542</b>       | <b>141,485,968</b> | <b>(83,539,426)</b> |
| Gasoline Stations With Conv Stores-44711             | 75,193,971              | 70,427,721         | 4,766,250           | 29,101,485              | 0                  | 29,101,485          |
| Other Gasoline Stations-44719                        | 74,593,841              | 124,698,249        | (50,104,408)        | 28,845,057              | 141,485,968        | (112,640,911)       |
| <b>Clothing and Clothing Accessories Stores-448</b>  | <b>107,214,781</b>      | <b>138,841,750</b> | <b>(31,626,969)</b> | <b>36,688,055</b>       | <b>4,233,071</b>   | <b>32,454,984</b>   |
| Clothing Stores-4481                                 | 80,529,893              | 90,495,054         | (9,965,161)         | 27,763,336              | 3,192,674          | 24,570,662          |
| Men's Clothing Stores-44811                          | 3,775,307               | 6,695,741          | (2,920,434)         | 1,205,158               | 151,681            | 1,053,477           |
| Women's Clothing Stores-44812                        | 17,950,064              | 33,139,822         | (15,189,758)        | 6,226,282               | 414,319            | 5,811,963           |
| Childrens, Infants Clothing Stores-44813             | 3,904,911               | 9,099,095          | (5,194,184)         | 1,461,135               | 0                  | 1,461,135           |
| Family Clothing Stores-44814                         | 43,888,836              | 20,837,541         | 23,051,295          | 14,961,131              | 2,075,359          | 12,885,772          |
| Clothing Accessories Stores-44815                    | 4,157,433               | 7,138,789          | (2,981,356)         | 1,398,293               | 173,104            | 1,225,189           |
| Other Clothing Stores-44819                          | 6,853,342               | 13,584,066         | (6,730,724)         | 2,511,337               | 378,211            | 2,133,126           |
| Shoe Stores-4482                                     | 14,565,308              | 29,423,325         | (14,858,017)        | 5,149,361               | 844,551            | 4,304,810           |
| Jewelry, Luggage, Leather Goods Stores-4483          | 12,119,580              | 18,923,371         | (6,803,791)         | 3,775,358               | 195,846            | 3,579,512           |
| Jewelry Stores-44831                                 | 10,957,064              | 18,923,371         | (7,966,307)         | 3,356,245               | 195,846            | 3,160,399           |
| Luggage and Leather Goods Stores-44832               | 1,162,516               | 0                  | 1,162,516           | 419,113                 | 0                  | 419,113             |
| <b>Sporting Goods, Hobby, Book, Music Stores-451</b> | <b>50,135,954</b>       | <b>54,744,984</b>  | <b>(4,609,030)</b>  | <b>15,923,508</b>       | <b>5,592,726</b>   | <b>10,330,782</b>   |
| Sporting Goods, Hobby, Musical Inst Stores-4511      | 40,778,675              | 54,595,562         | (13,816,887)        | 13,691,956              | 4,994,244          | 8,697,712           |
| Sporting Goods Stores-45111                          | 26,658,531              | 39,472,706         | (12,814,175)        | 9,297,248               | 4,564,210          | 4,733,038           |
| Hobby, Toys and Games Stores-45112                   | 10,049,368              | 9,910,663          | 138,705             | 3,025,022               | 0                  | 3,025,022           |
| Sew/Needlework/Piece Goods Stores-45113              | 1,708,380               | 1,483,975          | 224,405             | 645,108                 | 160,765            | 484,343             |
| Musical Instrument and Supplies Stores-45114         | 2,362,396               | 3,728,218          | (1,365,822)         | 724,578                 | 269,269            | 455,309             |
| Book, Periodical and Music Stores-4512               | 9,357,279               | 149,422            | 9,207,857           | 2,231,552               | 598,482            | 1,633,070           |
| Book Stores and News Dealers-45121                   | 9,357,279               | 149,422            | 9,207,857           | 2,231,552               | 598,482            | 1,633,070           |



| Opportunity Gap - Retail Stores               | PTA                     |                    |                      | STA                     |                   |                   |
|-----------------------------------------------|-------------------------|--------------------|----------------------|-------------------------|-------------------|-------------------|
|                                               | (Consumer Expenditures) | (Retail Sales)     | Leakage (Inflow)     | (Consumer Expenditures) | (Retail Sales)    | Leakage (Inflow)  |
| <b>General Merchandise Stores-452</b>         | <b>268,361,713</b>      | <b>557,278,144</b> | <b>(288,916,431)</b> | <b>104,346,490</b>      | <b>15,321,381</b> | <b>89,025,109</b> |
| Department Stores Excl Leased Depts-4521      | 142,281,337             | 451,180,516        | (308,899,179)        | 55,156,323              | 10,954,604        | 44,201,719        |
| Other General Merchandise Stores-4529         | 126,080,376             | 106,097,628        | 19,982,748           | 49,190,167              | 4,366,777         | 44,823,390        |
| <b>Miscellaneous Store Retailers-453</b>      | <b>69,873,865</b>       | <b>97,641,731</b>  | <b>(27,767,866)</b>  | <b>27,121,064</b>       | <b>11,292,791</b> | <b>15,828,273</b> |
| Florists-4531                                 | 2,921,411               | 4,527,487          | (1,606,076)          | 1,192,599               | 886,245           | 306,354           |
| Office Supplies, Stationery, Gift Stores-4532 | 22,890,206              | 26,316,997         | (3,426,791)          | 8,402,038               | 1,481,102         | 6,920,936         |
| Office Supplies and Stationery Stores-45321   | 12,949,826              | 16,149,427         | (3,199,601)          | 4,723,204               | 0                 | 4,723,204         |
| Gift, Novelty and Souvenir Stores-45322       | 9,940,380               | 10,167,570         | (227,190)            | 3,678,834               | 1,481,102         | 2,197,732         |
| Used Merchandise Stores-4533                  | 9,338,451               | 9,078,943          | 259,508              | 2,909,383               | 1,173,172         | 1,736,211         |
| Other Miscellaneous Store Retailers-4539      | 34,723,797              | 57,718,304         | (22,994,507)         | 14,617,044              | 7,752,272         | 6,864,772         |
| <b>Non-Store Retailers-454</b>                | <b>222,702,786</b>      | <b>32,915,576</b>  | <b>189,787,210</b>   | <b>86,931,374</b>       | <b>6,847,526</b>  | <b>80,083,848</b> |
| <b>Foodservice and Drinking Places-722</b>    | <b>287,895,349</b>      | <b>364,228,213</b> | <b>(76,332,864)</b>  | <b>98,156,224</b>       | <b>30,147,808</b> | <b>68,008,416</b> |
| Special Foodservices-7223                     | 21,225,371              | 2,725,175          | 18,500,196           | 7,351,337               | 44,152            | 7,307,185         |
| Drinking Places -Alcoholic Beverages-7224     | 10,165,918              | 1,073,142          | 9,092,776            | 3,221,122               | 0                 | 3,221,122         |
| Full-Service Restaurants-722511               | 143,333,387             | 189,632,545        | (46,299,158)         | 48,340,199              | 17,851,958        | 30,488,241        |
| Limited-Service Eating Places-722513          | 97,121,047              | 163,685,629        | (66,564,582)         | 33,678,124              | 11,476,027        | 22,202,097        |
| Cafeterias, Grill Buffets, and Buffets-722514 | 2,558,755               | 18,863             | 2,539,892            | 887,294                 | 0                 | 887,294           |
| Snack and Nonalcoholic Beverage Bars-722515   | 13,490,871              | 7,092,859          | 6,398,012            | 4,678,148               | 775,671           | 3,902,477         |

Figure 10: Retail leakage in the Primary and Secondary Trade Area (Source: Claritas Inc)

### 3.2 KEY DEMAND OPPORTUNITIES

The results of the retail leakage analysis indicate that Downtown Lynchburg and its trade areas are a retail center pulling a significant amount of sales from the outside. Lynchburg is an urban market that pulls in consumers from a large, rural geographic area. It also has a robust visitor market that drives sales in destination businesses leading directly to retail gain.

Lynchburg businesses are generally serving the needs of the residents living in downtown's trade areas. However, even with the gain in total sales, there are a number of categories that experience leakage. This leakage translates to an immediate opportunity to target new business. Similarly, as a commercial magnet, there is a possibility to grow clusters to capture more of the regional market.

Demand exist for the following retail categories:

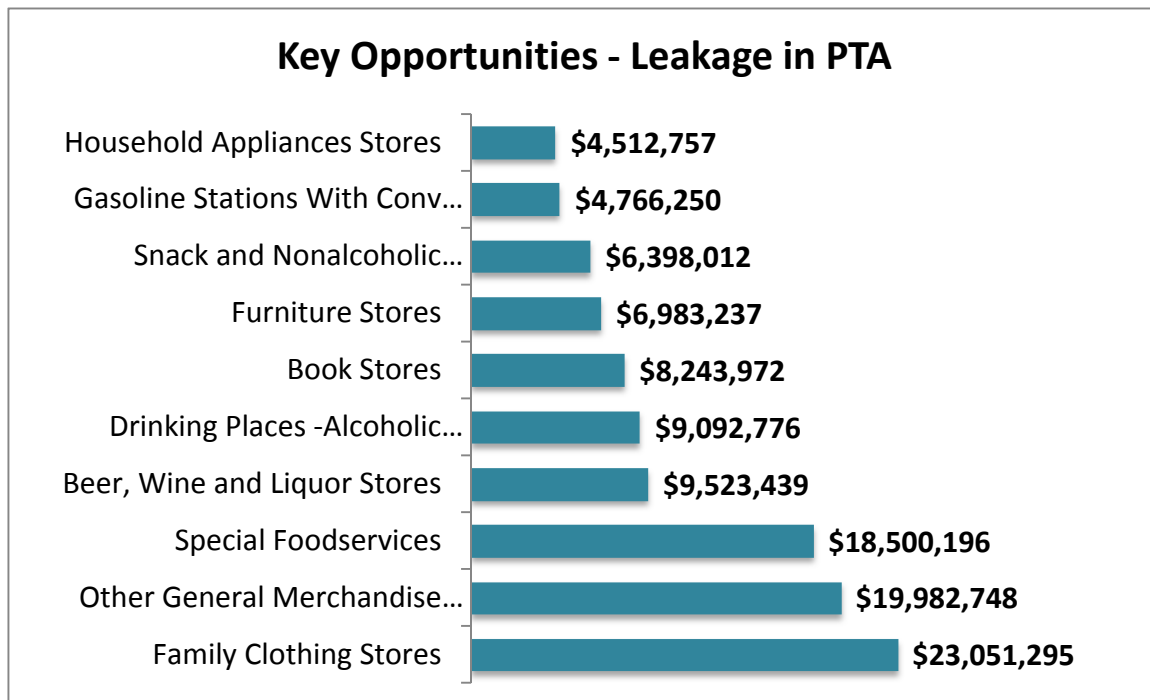


Figure 11: Retail leakage for Key Categories in the Primary Trade Area (Source: Claritas Inc)

Leakage in certain retail categories introduces an opportunity to target new business based on existing demand. Of course, Downtown Lynchburg cannot reasonably expect to recapture 100% of the sales leaking from its trade areas. However, through strategic recruitment, economic development and marketing, a district could reasonably expect to recapture a certain amount of sales leaking out of its trade areas. A typical capture scenario is 20% of leakage from the primary trade area and 10% of the leakage from the secondary trade area.

The table below illustrates the new or expanded retail space that could be supported in Lynchburg by capturing some of the leaking sales. Based on this analysis, demand exists for up to 228,000 square feet of additional retail in Downtown Lynchburg.

|                                          | 20% of PTA<br>Outflow | 10% Of STA<br>Outflow | Potential<br>Capture | Sales per<br>Square<br>Foot | Calculated<br>Capture |
|------------------------------------------|-----------------------|-----------------------|----------------------|-----------------------------|-----------------------|
| Selected Retail Categories Below         | 6,234,246             | 31,656,584            |                      |                             | 228,396               |
| Furniture Stores                         | 1,396,647             | 739,591               | 2,136,239            | 141.84                      | 15,061                |
| Home Furnishing Stores                   | 162,572               | 702,277               | 864,849              | 167.75                      | 5,156                 |
| Household Appliances Stores              | 902,551               |                       | 902,551              | 245.44                      | 3,677                 |
| Building Material and Supply Dealers     |                       | 1,347,556             | 1,347,556            | 142.38                      | 9,465                 |
| Hardware Stores                          |                       | 87,968                | 87,968               | 121.08                      | 727                   |
| Grocery Stores                           |                       | 4,369,087             | 4,369,087            | 371.79                      | 11,751                |
| Health and Personal Care Stores          |                       | 2,567,068             | 2,567,068            | 247.29                      | 10,381                |
| Clothing and Clothing Accessories Stores |                       | 3,245,498             | 3,245,498            | 164.60                      | 19,717                |
| Women's Accessory & Specialty            |                       | 581,196               | 581,196              | 164.60                      | 3,531                 |
| Shoe Stores                              |                       | 430,481               | 430,481              | 158.81                      | 2,711                 |
| Jewelry Stores                           |                       | 316,040               | 316,040              | 263.92                      | 1,197                 |
| Luggage and Leather Goods Stores         | 232,503               | 41,911                | 274,415              | 198.82                      | 1,380                 |
| Sporting Goods Stores                    |                       | 473,304               | 473,304              | 153.46                      | 3,084                 |
| Hobby, Toys and Games Stores             | 27,741                | 302,502               | 330,243              | 146.28                      | 2,258                 |
| Sew/Needlework/Piece Goods Stores        | 44,881                | 48,434                | 93,315               | 74.91                       | 1,246                 |
| Book Stores                              | 1,648,794             | 127,797               | 1,776,591            | 161.16                      | 11,024                |
| General Merchandise Stores               |                       | 8,902,511             | 8,902,511            | 133.90                      | 66,486                |
| Florists                                 |                       | 30,635                | 30,635               | 149.82                      | 204                   |
| Gift, Novelty and Souvenir Stores        |                       | 219,773               | 219,773              | 168.55                      | 1,304                 |
| Foodservice and Drinking Places          |                       | 6,800,842             | 6,800,842            | 201.63                      | 33,729                |
| Drinking Places -Alcoholic Beverages     | 1,818,555             | 322,112               | 2,140,667            | 88.07                       | 24,306                |

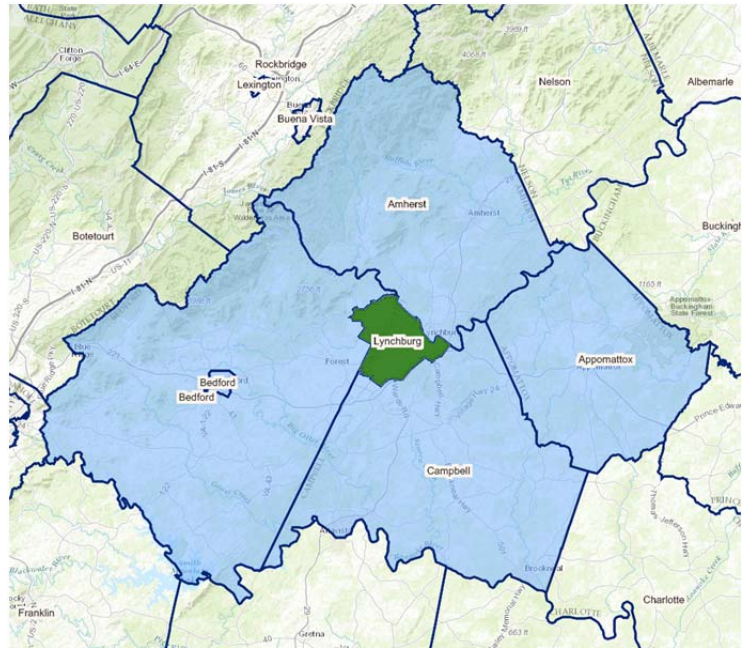
Figure 12: Capture Scenario Based on Existing Retail Sales and Demand

Certain categories above may not be the preferred use for downtown space. For example, “general merchandising stores” include Wal-Mart and Dollar General-type stores. While dollar stores are often found in downtowns, they are not the destination retail businesses that fits in the existing mix in Downtown Lynchburg. Similarly, building materials and supply dealers are not a great fit for downtowns. If we remove these two opportunities, it indicates that Downtown Lynchburg can accommodated up to **between 150,000 and 228,000 square feet of new retail.**

### 3.2 RETAIL SHARES

A retail shares analysis is a supply-side study that compares sales in the City of Lynchburg as a share of the larger metropolitan region. This type of analysis identifies potential to develop a cluster in select retail categories that are performing exceptionally well, drawing consumers in from a larger geographic region.

The total retail sales in Lynchburg is approximately 51% of all sales in the MSA. A share value significantly above the benchmark of 51% would indicate a potential to develop a cluster. Typically, clusters emerge for destination-based businesses. The table below presents the retail shares analysis performed for Lynchburg. The categories with the highest share percentage are drinking places, women's clothing stores, shoe stores, gift and novelty stores, and used merchandise stores.



| Retail Shares Analysis                                    | Retail Shares - Metro Region |                        |              |                     |             |
|-----------------------------------------------------------|------------------------------|------------------------|--------------|---------------------|-------------|
|                                                           | Sales                        |                        | Share        | Sales               | Share       |
|                                                           | CITY                         | Lynchburg MSA          | %            | 24504               | %           |
| <b>Total Retail Sales Incl Eating and Drinking Places</b> | <b>\$2,376,840,776</b>       | <b>\$4,650,813,447</b> | <b>51.1%</b> | <b>\$46,575,337</b> | <b>1.0%</b> |
| Furniture Stores-4421                                     | \$16,308,898                 | \$25,481,331           | 64.0%        | \$905,389           | 3.6%        |
| Clothing Stores-4481                                      | \$97,592,941                 | \$133,487,702          | 73.1%        | \$7,496,608         | 5.6%        |
| Women's Clothing Stores-44812                             | \$29,222,519                 | \$35,579,091           | 82.1%        | <b>\$6,669,778</b>  | 18.7%       |
| Childrens, Infants Clothing Stores-44813                  | \$6,954,452                  | \$9,099,095            | 76.4%        | <b>\$634,916</b>    | 7.0%        |
| Clothing Accessories Stores-44815                         | \$5,108,056                  | \$7,770,402            | 65.7%        | \$116,118           | 1.5%        |
| Shoe Stores-4482                                          | \$22,340,633                 | \$30,341,269           | 73.6%        | \$0                 | 0.0%        |
| Sporting Goods Stores-45111                               | \$31,220,760                 | \$49,491,479           | 63.1%        | \$5,137,652         | 10.4%       |
| Florists-4531                                             | \$4,219,286                  | \$6,355,969            | 66.4%        | <b>\$256,379</b>    | 4.0%        |
| Gift, Novelty and Souvenir Stores-45322                   | \$9,578,511                  | \$13,083,848           | 73.2%        | \$233,226           | 1.8%        |
| Used Merchandise Stores-4533                              | \$8,115,450                  | \$11,085,556           | 73.2%        | <b>\$666,067</b>    | 6.0%        |
| Drinking Places -Alcoholic Beverages-7224                 | \$1,073,141                  | \$1,073,141            | 100.0%       | \$144,627           | 13.5%       |
| Full-Service Restaurants-722511                           | \$163,910,414                | \$249,419,191          | 65.7%        | <b>\$6,398,946</b>  | 2.6%        |

Figure 13: Retail Shares for Lynchburg Primary Trade Area (Source: Arnett Muldrow, Claritas Inc)



## Findings of the Retail Market Analysis

The retail market analysis for Downtown Lynchburg and its trade areas indicates:

- Downtown and Lynchburg represent a major retail center in the regional market.
    - o Lynchburg accounts for 51% of metro market's sales.
    - o Downtown has a high share of destination business (restaurant, specialty, entertainment, furniture)
    - o Existing businesses are meeting the needs of the local market, but there are opportunities for growth based on demand.
  - Trade areas experienced retail gain, but demand exists in key categories
    - o General Merchandise (68k square feet). This type of business may not be suitable for a downtown environment, however there are certain independent stores similar to Floyd Old Country Store in Floyd, VA and Mast General Stores found throughout North and South Carolina.
    - o Restaurant (33k square feet of demand). Downtown Lynchburg has about 32 restaurants presently. While the downtown is pulling in dining customers from outside of the city, the trade areas (particularly STA) show demand. It is important that Lynchburg be strategic in its recruitment of restaurants, ensuring that new operations have sound business plans, but also complement existing downtown offerings.
    - o Clothing (19k square feet). Most of this demand is in Family Clothing Stores, as well as demand for Women's Clothing, primarily from the STA.
    - o Grocery (12k square feet). A conventional grocery store begins at about 45,000 square feet, so this seems like a limited opportunity. However, the Grassroots co-op grocery store is currently being planned for Downtown Lynchburg. This type of specialty grocer is a great fit in a downtown environment, and the market data suggest opportunity based on demand.
    - o Furniture/ Home Furnishings (20k square feet). There currently is a high-end furniture designer and store (Galaxie Modern) which is one of downtown's anchor businesses. Both the shares and leakage studies show opportunity here.
    - o A number of specialty retail categories also show opportunity based on demand including shoes, sporting goods, hobby, books, etc.
  - Demand is based on local needs, so it doesn't reflect the potential should Downtown continue to grow visitor market.
-

## 4.0 RESIDENTIAL AND EMPLOYMENT

A snapshot of both the residential and employment market in Lynchburg and downtown is shown in this section.

### 4.1 RESIDENTIAL MARKET

According to Claritas, the median value of all owner-occupied housing units in Lynchburg is \$148,856, compared to \$170,507 in the metro and \$178,822 in the PTA. These figures are for all units, regardless of whether or not they are on the market. For homes that are currently for sale, the median list price in the MSA is about \$219,900, and \$159,900 in the City. For-sale products currently are averaging about 80 days on market prior to sale. Approximately 53% of housing units are owner-occupied and 47% are renter-occupied.

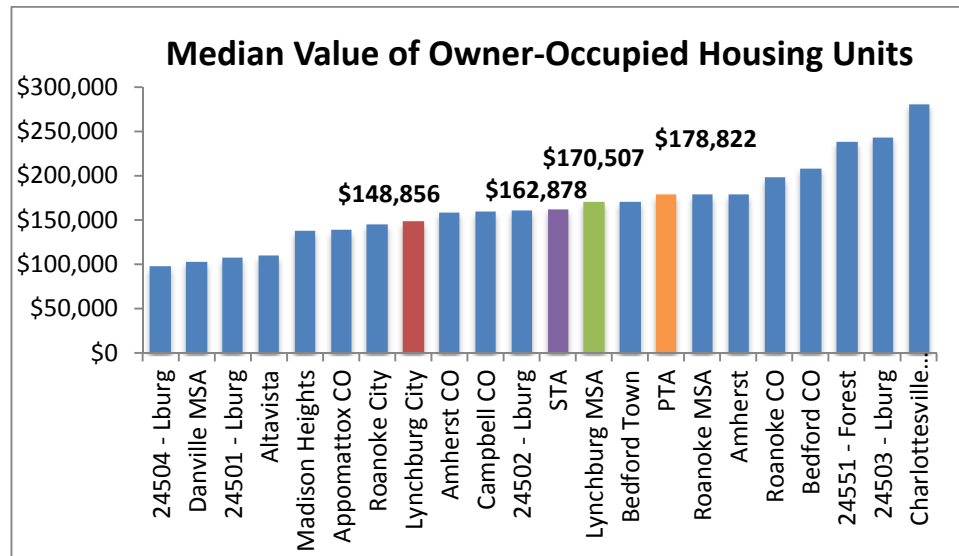


Figure 14: Regional Median Value of Owner-Occupied Housing Units (Source: Claritas Inc.)

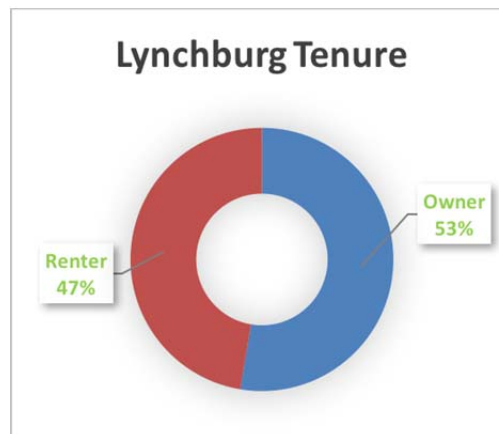


Figure 15: Housing Tenure in Lynchburg (Source: Claritas Inc.)

Zillow is an online real estate database that provides real time market reports for communities in larger metro areas. The resource estimates the median market value of housing in Lynchburg to be \$140,700, which is a 6% year-over-year increase. Values are expected to rise 2.2% in the next year. Median rent is estimated to be \$950, a 1.4% increase over the past year. Overall, the housing market is strong with values increasing and days on market decreasing.

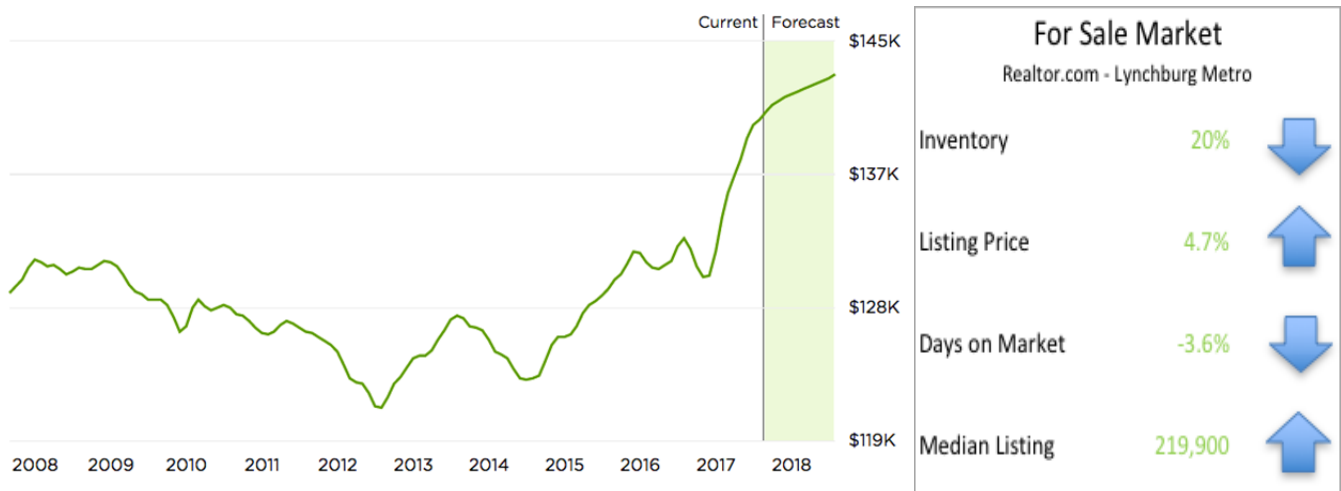


Figure 16: Median Value of Housing in Lynchburg 2008-2018 (Source: Zillow)

Another measure of the residential market is new housing starts. Single-family residential building permits in the Lynchburg MSA declined following the recession and have held relatively steady since 2013. However, it is important to note that this is a large area, representing Lynchburg and the four surrounding counties. Building permit data from downtown Lynchburg, though a small sample, shows building permits increasing since 2012. Multi-family building permits spiked in 2007 and then again in 2012-2014, but have been declining since.

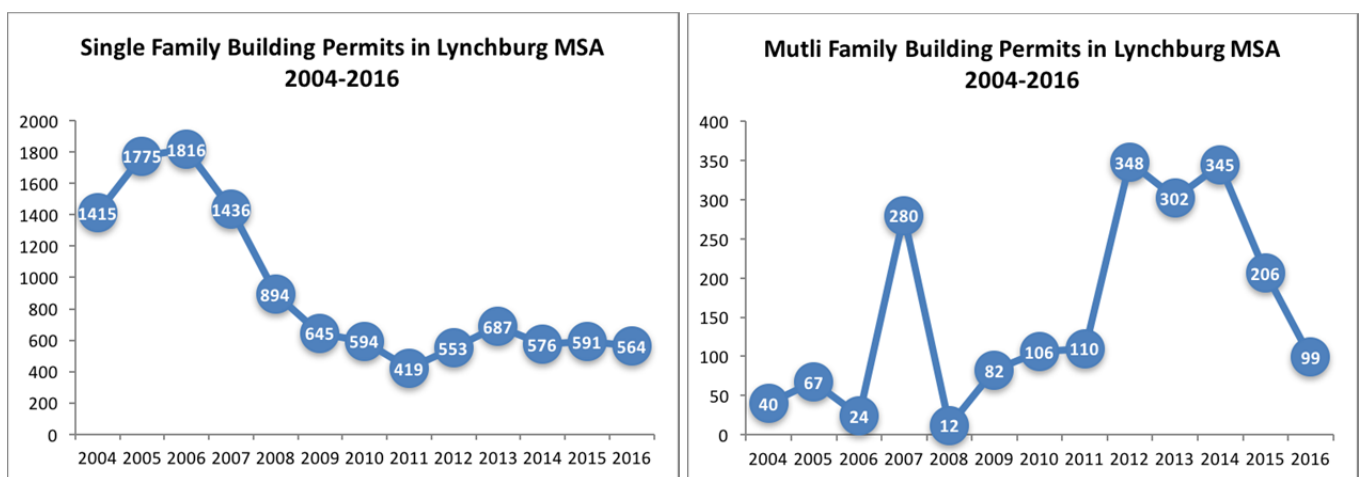


Figure 17: Single-Family (left) and Multi-Family (right) Building Permits in the Lynchburg MSA (Source: US Census)

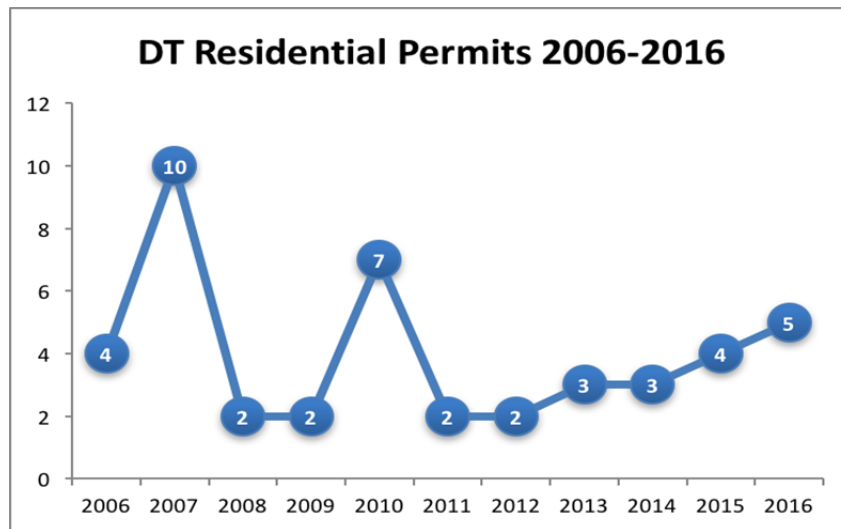


Figure 18: Residential Building Permits in Downtown Lynchburg, 2006-2016 (Source: City of Lynchburg)

Downtown Lynchburg has a robust market for apartments and lofts, as the City has partnered with private developers with its Rehabilitation and Renovation Tax Credit. This program, along with market demand for downtown residential, has resulted in 1,000 multi-family residential units added in Lynchburg since 2007. This translates to between 1,500 and 2,000 people. The current product in downtown includes units with 595-2,500 square feet in size with monthly rents between \$550 and \$1,250.

Each loft development is amenity-rich, with features such as bike storage, fitness centers, community rooms, high-speed internet and cable, access to trails and the riverfront, designated parking, high ceilings, and upscale finishes.





Demand for this type of residential housing continues to exist, as indicated by increasing rents, current lease rates, and population growth. More importantly, private developers continue to express interest in finding opportunities to develop loft apartments in downtown.

There also is interest in developing for-sale products such as townhomes and condos. James River Place and 51 11<sup>th</sup> Street Lofts are proof that there is demand, but owner-occupied residential has certain constraints to development. Financing in general is more difficult as lenders are more flexible with rental products, and there are no historic tax credit incentives for revitalization like there are for rental lofts. Owner-occupied housing would likely occur in downtown through new construction as opposed to rehabilitation, which also increases the complexity of the project. Another challenge for any type of residential in downtown includes parking availability. Many of Lynchburg's peer communities have utilized public-private partnerships and creative financing to mitigate these constraints, particularly parking. Recommendations on how the City can partner with the private sector to incent private residential development are presented in the Master Plan.

## 4.2 COMMERCIAL MARKET

Commercial investment in Downtown Lynchburg has been generally stable over the past decade as evidenced by business licenses and commercial permits. Business licenses in the Central Business District peaked in 2004, but have been relatively stable. Commercial permits have been a mix of renovation to existing structures and new construction.

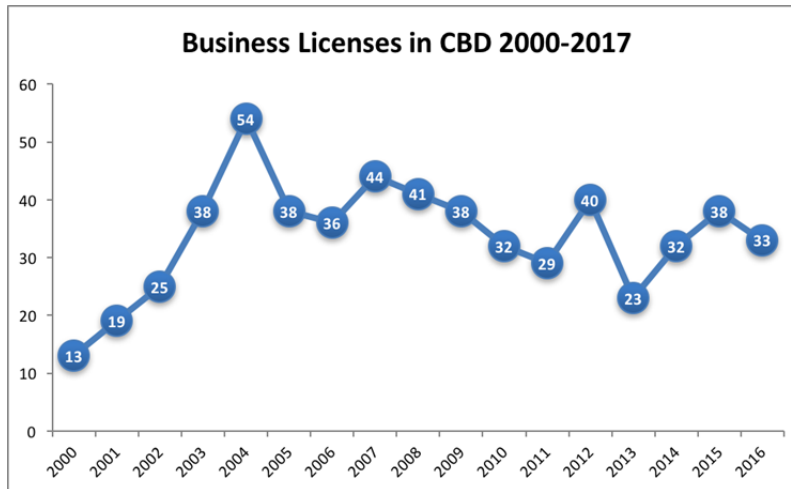


Figure 19: Business Licenses in the Lynchburg CBD (Source: City of Lynchburg)

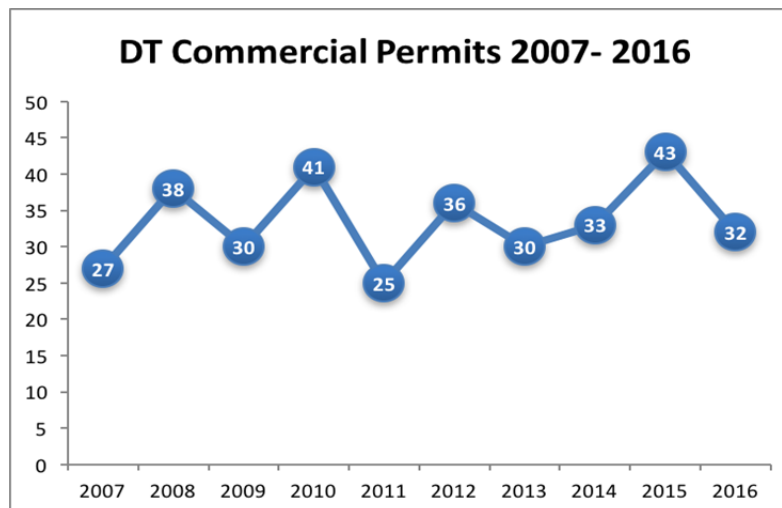


Figure 20: Commercial Permits in Downtown Lynchburg (Source: City of Lynchburg)

### 4.3 EMPLOYMENT

Downtown Lynchburg is a regional center of both employment and commerce with national and global reach. As downtown has become more desirable, it has attracted growing business and employer expansion. In addition, the urban fabric of downtown has seen a number of creative businesses locating downtown. These small businesses often have 10 or fewer employees, and include architects, graphic designers, advertising agencies, etc. With its residential lofts, restaurants, specialty retail and recreation, Downtown Lynchburg has become a desirable place to invest for this type of business, particularly those that chose to locate in downtown in order to attract employees.

The largest employment sectors in Downtown Lynchburg are education (29%), finance and insurance (23%), public administration (14%), healthcare and social assistance (6%), and professional, scientific and tech (6%).

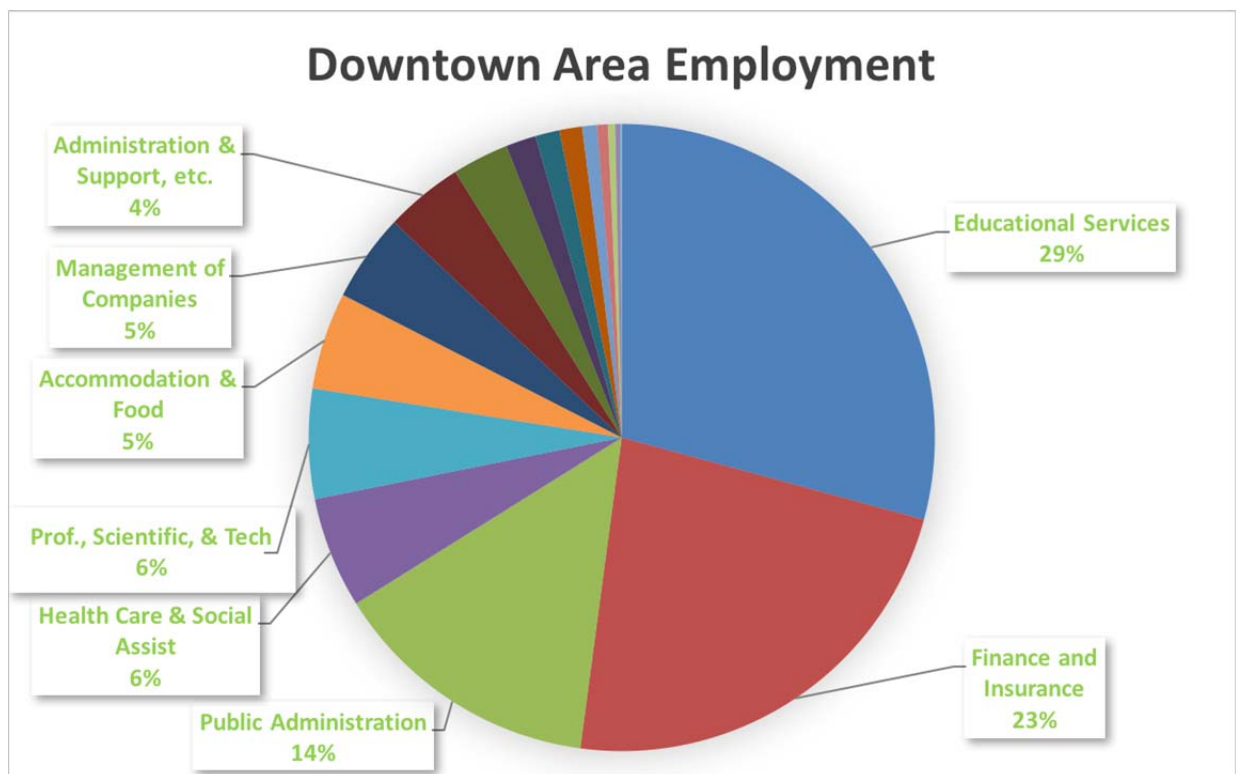


Figure 21: Downtown Area Employment (Source: US Census On the Map)

The maps below show commuting patterns for the city of Lynchburg (left) and Downtown (right). 72% of workers employed in Lynchburg commute into the city for work. In Downtown, 99% of workers commute in from outside of Downtown.

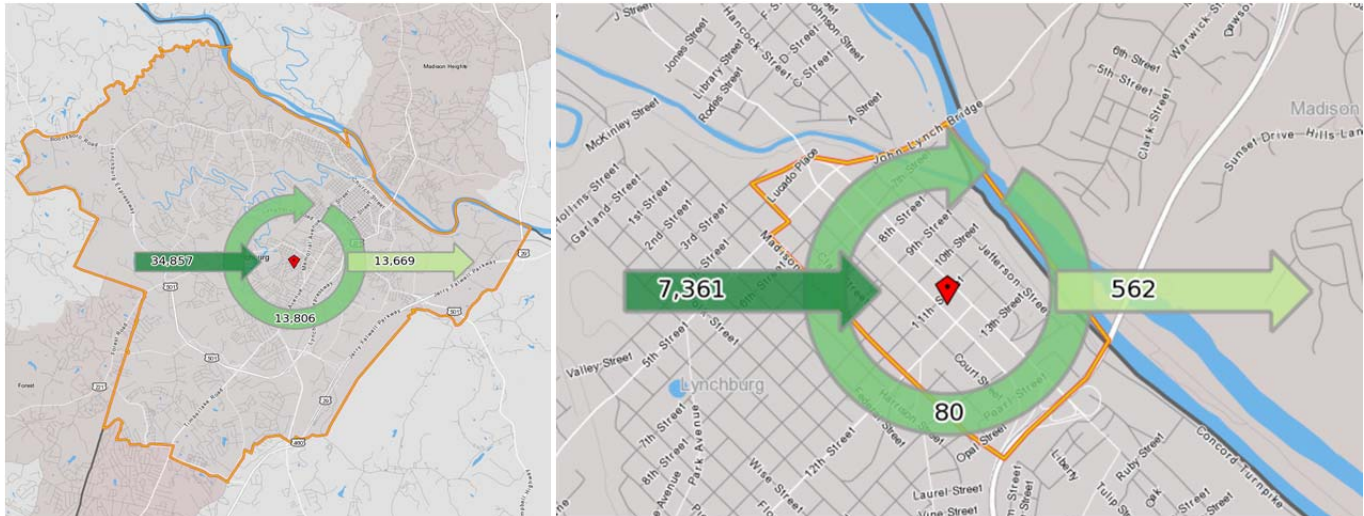


Figure 22: Commute patterns for Lynchburg (left) and Downtown Lynchburg (right) (Source: US Census On the Map)

As of June 2017, the unemployment rate in Lynchburg was 5.8%. While this is higher than nearby counties, it should be noted that the unemployment rate has been decreasing in Lynchburg since the end of the 2009 Recession. The average wage in the city is \$21.55 per hour or \$45,000.

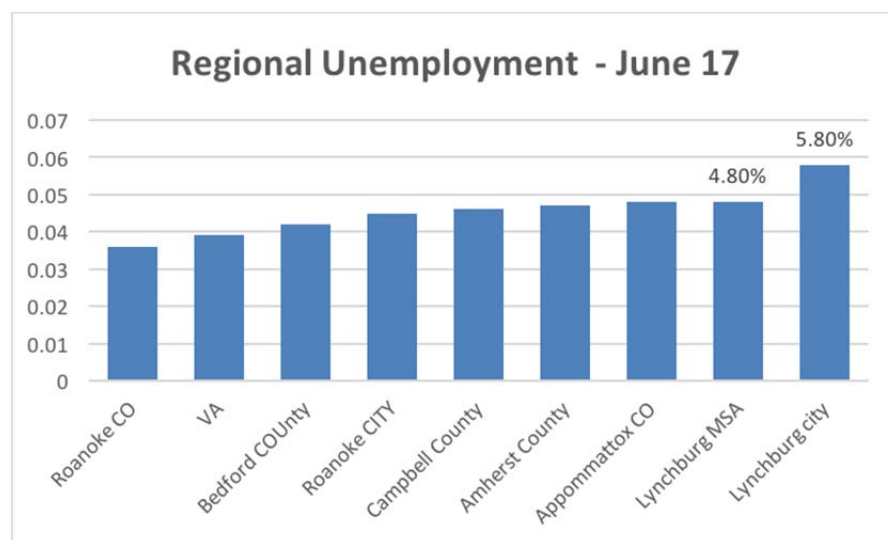


Figure 23: Regional Unemployment, June 2017 (Source: State of Virginia)

Region 2000 provides occupation growth projections through the year 2024. Seven out of the top ten growth occupations in the region are in the health care industry including home health, practitioners, outpatient care, medical labs, physicians and dentists.



## 5.0 DEMOGRAPHICS

This section provides a snapshot of the region, but particularly how the Downtown Lynchburg trade areas compare to the larger area.

### 5.1 POPULATION

The City of Lynchburg and the PTA have grown faster than the metropolitan region. From 2000 to 2010, Lynchburg grew by 15.8% and the primary trade area grew by 16.7%. The Lynchburg MSA grew by 10.5% during this same period. Similarly, the City (6.6%) and PTA (6.3%) have grown at a faster rate than the metro (3.8%) from 2010 to 2017.

The estimated 2017 population of Lynchburg is 80,585. With 132,980 people in the PTA and 52,387 in the STA, Lynchburg's combined trade area has a population of approximately 185,000. Both Lynchburg and the PTA are projected to grow by 4.7% from 2017 to 2022.

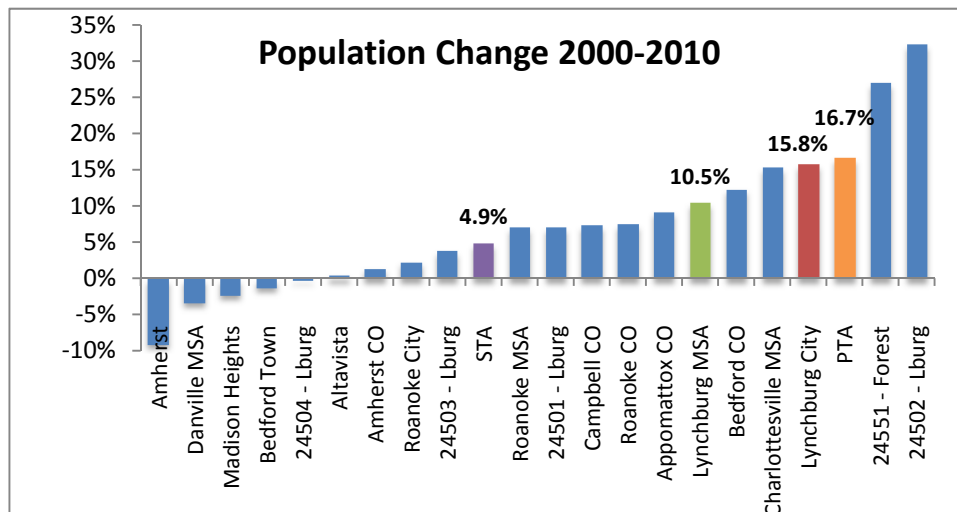


Figure 24: Regional Population Change 2000-2010 (Source: Claritas)

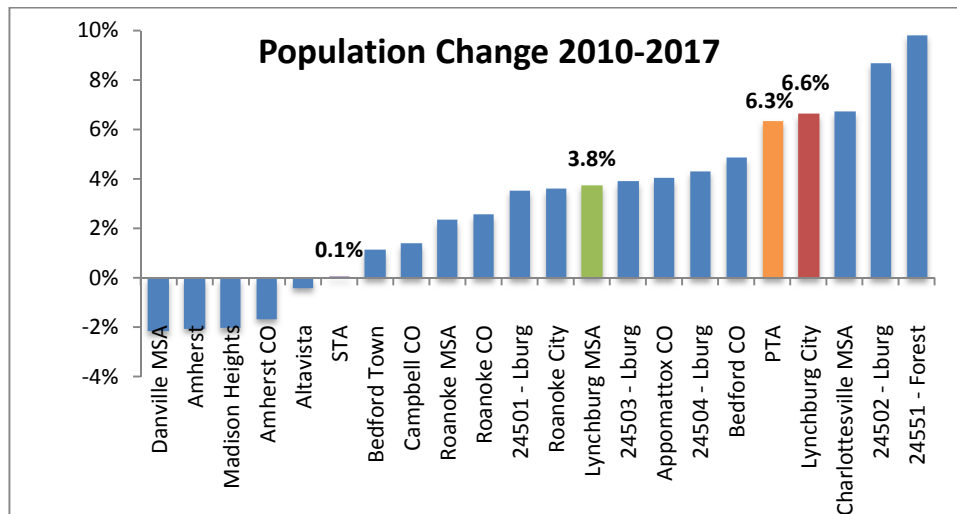


Figure 25: Regional Population Change 2010-2017 (Source: Claritas)

With a median age of 28.7, Lynchburg has the youngest population in the region. The median age in the PTA is 34.2 and the median age in the metro is 40.1. The average household size in Lynchburg is 2.29, compared to 2.38 in the PTA and 2.39 in the metro.

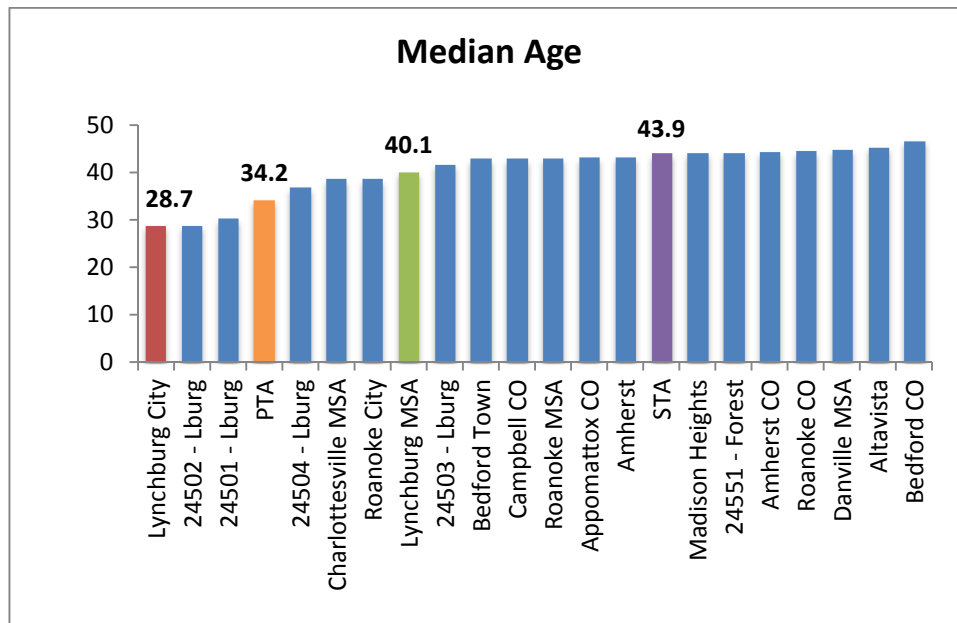


Figure 26: Median Age in the Region (Source: Claritas)

## 5.2 INCOME

The median household income in Lynchburg is \$40,163. At \$49,575, the median household income in the PTA is in the mid-range of incomes in the region. The 24551 Forest zip code area has the highest median household income at \$72,405. The percent of families living below poverty in Lynchburg (18.9%) is significantly higher than that of the PTA (12.9%) and region (11.4%).

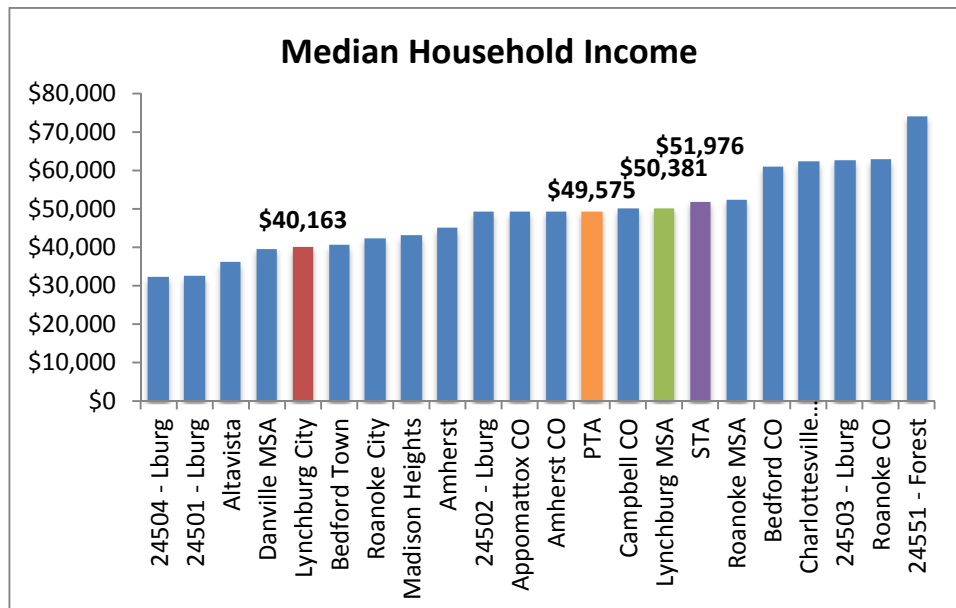


Figure 27: Regional Median Household Income (Source: Claritas)

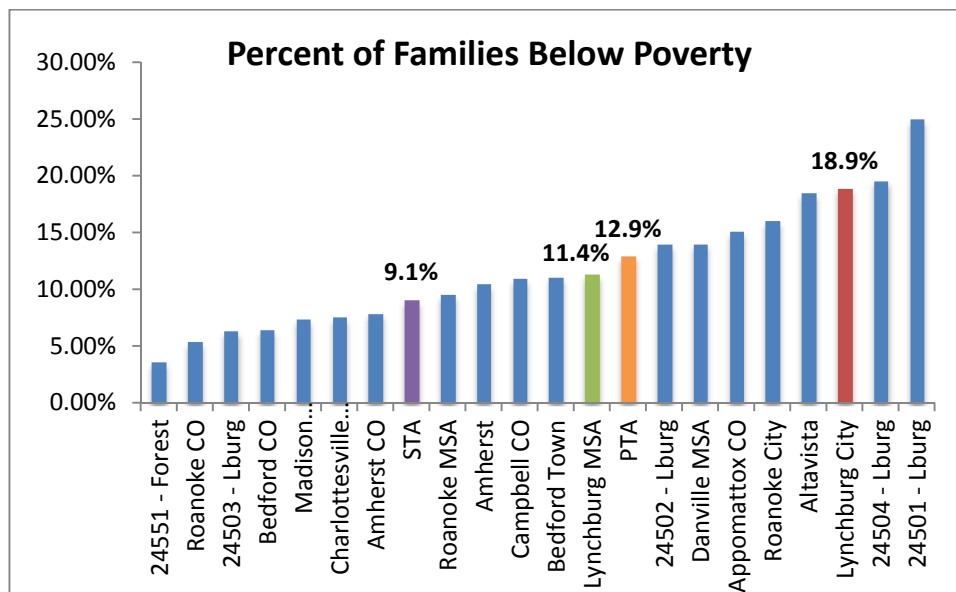


Figure 28: Poverty Rates in the Region (Source: Claritas)

## 6.0 MARKET SEGMENTATION

A better understanding of the makeup of Lynchburg's market can be made by performing a market segmentation study. The segmentation analysis describes behavioral traits and consumer patterns based on various "segments" that make up the market. Segments are demographic groupings based on things such as age, income, education and family structure. All data comes from PRIZM NE cluster groups as calculated by Claritas, Inc.

The segmentation data provided in this section are for the Downtown Lynchburg primary trade area. Grouping is based on Life Stage (age and presence of children) and Social Characteristics (urbanization and socioeconomics).

The Life Stage analysis shows that residents in the Lynchburg PTA trend older, with many empty nesters and retirees. However, there is a healthy portion of younger population with no children. Many of these residents likely live in some of the renovated lofts in Downtown Lynchburg. Residents in the Mature Year make up 40% of the population, with Younger Life and Family life each accounting for 30% of the population.

Social Groups are categorized by urbanization (urban, suburban, second city or town & rural) and affluence. Approximately 47% of households in the Lynchburg PTA are Town and Rural, 21% are Suburban, and 32% are classified as Second Cities.

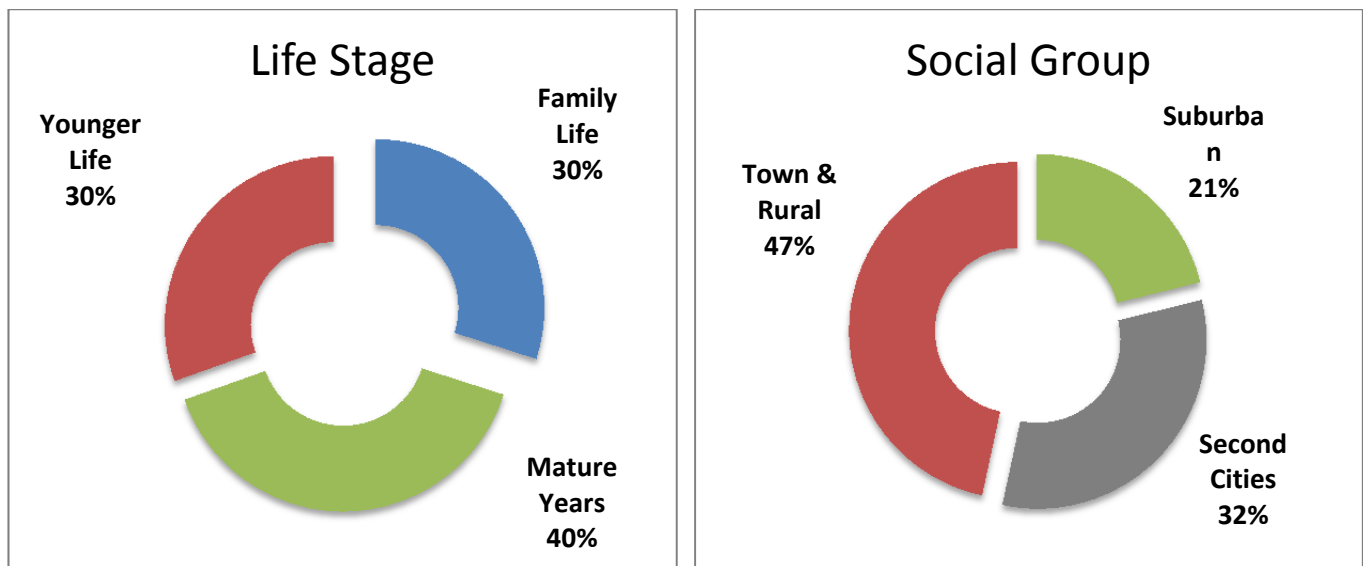


Figure 29: Life Stage (left) and Social Group (right) Segmentation for Downtown Lynchburg PTA



Of the 68 PRIZM segments identified by Claritas, 49 segments are used to describe households in the Lynchburg PTA. The largest segment in the PTA is Country Squires representing 6% of households. The market for Downtown Lynchburg is very broad in terms of consumers and their traits. While this is often the case in a more urban area, the segmentation study can point to key market segments that downtown may want to target with its retail mix, housing opportunity, and even employment base.

Key segments shown below include younger, active households with more disposable income such as Up-and-Comers (4%), Bright Lights, Li'l City (3%), Metro Grads (3%), and Young and Influential (1%). Each of these segments is described in further detail on the following pages.

## Market Segmentation

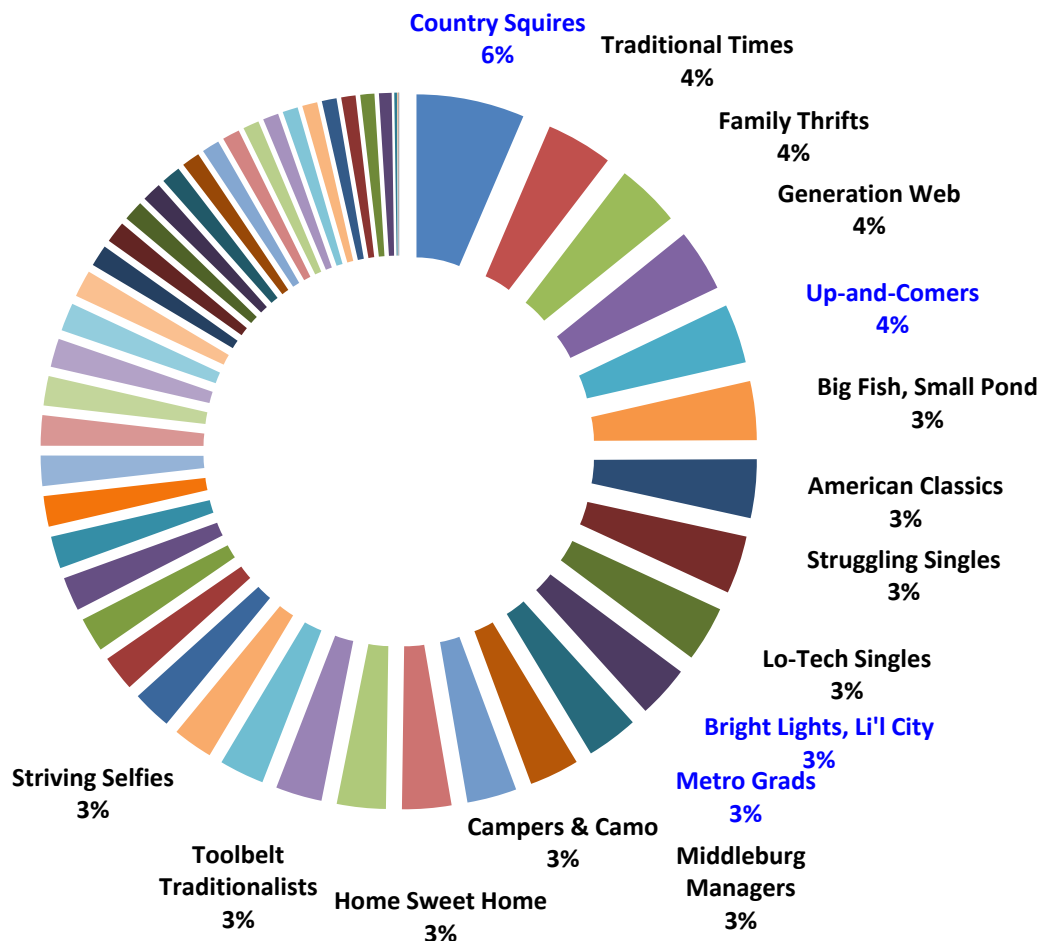


Figure 30: Market Segmentation for Downtown Lynchburg PTA (Source: Claritas)

## 05 - Country Squires

### Wealthy Middle Age Family Mix

The wealthiest residents in exurban America live in Country Squires, an oasis for affluent Baby Boomers who've fled the city for the charms of small-town living. In their bucolic communities noted for their recently built homes on sprawling properties, the families of executives live in six-figure comfort.



**Social Group:** 11 - T1 Landed Gentry

**Lifestage Group:** 04 - F1 Accumulated Wealth

#### Demographics Traits

- Urbanicity: Town
- Income: Wealthy
- Income Producing Assets: Elite
- Household Technology: Above Average
- Age Ranges: Age <55
- Presence of Kids: Family Mix
- Homeownership: Mostly Owners
- Employment Levels: Management and Professional
- Education Levels: Graduate Plus

#### Lifestyle & Media Traits

- Owns a Volkswagen
- Eats at Dunkin Donuts
- Shops at Pottery Barn
- Plays golf
- Stays at Spring Hill Suites
- Uses Living Social
- Listens to Album Rock

## 25 - Up-and-Comers

### Upper Mid(Scale) Younger Family Mix

Up-and-Comers is a stopover for younger, midscale singles before they marry, have families, and establish more deskbound lifestyles. Found in suburban areas and second cities, these mobile adults, mostly age 25 to 44, include many recent college graduates who are into athletic activities, the latest technology, and nightlife.



**Social Group:** 06 - S3 Middleburbs

**Lifestage Group:** 01 - Y1 Midlife Success

#### Demographics Traits

- Urbanicity: Metro Mix
- Income: Upper Mid(Scale)
- Income Producing Assets: Low
- Household Technology: Above Average
- Age Ranges: Age 25-44
- Presence of Kids: Family Mix
- Homeownership: Mostly Renters
- Employment Levels: Management and Professional
- Education Levels: College Graduate

#### Lifestyle & Media Traits

- Owns a Volkswagen
- Eats at Panera
- Shops at Gap Kids
- Follows college hockey
- Flies Southwest
- Watches ESPN Classic
- Listens to Inspirational

## 37 - Bright Lights, Li'l City

### Upper Mid(Scale) Younger Family Mix

Not all of America's chic sophisticates live in major metros. Brite Lights, Li'l City is a group of well-off, college educated, middle-aged couples settled in the nation's satellite cities and suburbs. Despite living further out from the urban downtowns, they still like to go out on the town with frequent meals out and karaoke evenings.



**Social Group:** 08 - C1 Second City Society

**Lifestage Group:** 06 - F3 Mainstream Families

#### Demographics Traits

- Urbanicity: Metro Mix
- Income: Upper Mid(Scale)
- Income Producing Assets: Low
- Household Technology: Average
- Age Ranges: Age 25-44
- Presence of Kids: Family Mix
- Homeownership: Mix
- Employment Levels: Management and Professional
- Education Levels: College Graduate

#### Lifestyle & Media Traits

- Owns a Cadillac
- Eats at Taco Bell
- Shops at Express
- Follows motocross
- Cruises on Carnival
- Watches Adult Swim
- Listens to Rock

## 50 - Metro Grads

### Lower Mid(Scale) Middle Age Mostly w/o Kids

Metro Grads are middle age singles and couples still establishing themselves in their careers and their lives. They are settled in suburban areas and second cities but are often out and about, attending everything from soccer and hockey games to operas.



**Social Group:** 07 - S4 Inner Suburbs

**Lifestage Group:** 02 - Y2 Young Achievers

#### Demographics Traits

- Urbanicity: Metro Mix
- Income: Lower Mid(Scale)
- Income Producing Assets: Moderate
- Household Technology: Average
- Age Ranges: Age <55
- Presence of Kids: Mostly w/o Kids
- Homeownership: Homeowners
- Employment Levels: Mix
- Education Levels: College Graduate

#### Lifestyle & Media Traits

- Owns a GMC
- Eats at Jack in the Box
- Shops at Books-a-Million
- Plays soccer
- Stays at La Quinta
- Watches Univision
- Listens to Adult Contemporary

### 34 - Young & Influential

#### Midscale Younger Mostly w/o Kids

Young & Influential is a segment of younger, lower middle class households that might not have high incomes but are nonetheless influential in their communities and social networks and are very tech savvy. The segment is a common address for middle-class singles and couples who are more preoccupied with balancing work and leisure pursuits and who live in apartment complexes surrounded by ball fields, health clubs, and casual-dining restaurants.



**Social Group:** 07 - S4 Inner Suburbs

**Lifestage Group:** 01 - Y1 Midlife Success

#### Demographics Traits

- **Urbanicity:** Metro Mix
- **Income:** Midscale
- **Income Producing Assets:** Low
- **Household Technology:** Highest
- **Age Ranges:** Age 25-44
- **Presence of Kids:** Mostly w/o Kids
- **Homeownership:** Renters
- **Employment Levels:** Management and Professional

#### Lifestyle & Media Traits

- Owns a Mercury
- Eats at Chick-fil-A
- Shops at Express
- Follows college baseball
- Stays at Doubletree
- Watches MTV2
- Listens to Inspirational

Figure 31: Market Segmentation Categories for Downtown Lynchburg PTA (Source: Claritas)

All market segments for the PTA are shown on the following page. Additional detail on each category can be found at [www.mybestsegments.com](http://www.mybestsegments.com). The Master Plan details recommendations on target markets, and how downtown can attract and become more relevant to these consumers and residents.



### LYNCHBURG PTA SEGMENTATION

| Code | Name                     | Households | Pct. Index | Income | Inc. Producing Assets | Age       | Pred HH Comp. | Pred. Tenure/Type | Pred. Education | Pred. Employment | HH Technology       | Urbanicity |             |
|------|--------------------------|------------|------------|--------|-----------------------|-----------|---------------|-------------------|-----------------|------------------|---------------------|------------|-------------|
| 5    | Country Squires          | 3,302      | 6.44       | 278    | Wealthy               | Elite     | <55           | Family Mix        | Mostly Owners   | College Grad +   | Mgmt/ Professional  | Above Avg  | Town        |
| 32   | Traditional Times        | 2,032      | 3.96       | 286    | Upper Mid             | Elite     | 65+           | HH w/o Kids       | Homeowners      | College Grad +   | Mostly Retired      | Below Avg  | Town        |
| 64   | Family Thrifts           | 1,946      | 3.79       | 415    | Low Inc               | Low       | <55           | Mostly w/o Kids   | Mostly Renters  | High School      | Mix                 | Average    | Second City |
| 48   | Generation Web           | 1,902      | 3.71       | 221    | Low Inc               | Low       | <55           | Family Mix        | Renters         | High School      | Service Mix         | Above Avg  | Metro Mix   |
| 25   | Up-and-Comers            | 1,811      | 3.53       | 237    | Upper Mid             | Low       | 25-44         | Family Mix        | Mostly Renters  | College Graduate | Mgmt/ Professional  | Above Avg  | Metro Mix   |
| 9    | Big Fish, Small Pond     | 1,793      | 3.5        | 215    | Upscale               | Elite     | 65+           | Mostly w/o Kids   | Homeowners      | College Grad +   | Mostly Retired, mix | Average    | Town        |
| 49   | American Classics        | 1,790      | 3.49       | 209    | Lower Mid             | Moderate  | 55+           | HH w/o Kids       | Mix             | Some College     | Mostly Retired      | Below Avg  | Metro Mix   |
| 54   | Struggling Singles       | 1,773      | 3.46       | 262    | Low Inc               | Low       | <55           | Mostly w/o Kids   | Mix             | High School      | Mix                 | Average    | Second City |
| 53   | Lo-Tech Singles          | 1,694      | 3.3        | 234    | Downscale             | Low       | 65+           | HH w/o Kids       | Homeowners      | High School      | Mostly Retired      | Below Avg  | Metro Mix   |
| 37   | Bright Lights, Li'l City | 1,596      | 3.11       | 224    | Upper Mid             | Low       | 25-44         | Family Mix        | Mix             | College Graduate | Mgmt/ Professional  | Average    | Metro Mix   |
| 50   | Metro Grads              | 1,577      | 3.08       | 215    | Lower Mid             | Moderate  | <55           | Mostly w/o Kids   | Homeowners      | Some College     | Mix                 | Average    | Metro Mix   |
| 22   | Middleburg Managers      | 1,520      | 2.96       | 121    | Upscale               | Elite     | <55           | Family Mix        | Mostly Owners   | College Graduate | Mgmt/ Professional  | Average    | Metro Mix   |
| 51   | Campers & Camo           | 1,514      | 2.95       | 163    | Downscale             | Below Avg | 35-54         | Family Mix        | Homeowners      | High School      | Service Mix         | Below Avg  | Town        |
| 26   | Home Sweet Home          | 1,505      | 2.94       | 228    | Upper Mid             | Low       | <55           | HH w/o Kids       | Mostly Owners   | College Graduate | Mix                 | Above Avg  | Metro Mix   |
| 36   | Toolbelt Traditionalists | 1,492      | 2.91       | 119    | Upper Mid             | Low       | 55+           | Mostly w/o Kids   | Mostly Owners   | Some College     | Mix                 | Average    | Metro Mix   |
| 47   | Striving Selfies         | 1,418      | 2.77       | 194    | Low Inc               | Low       | <55           | Mostly w/o Kids   | Renters         | Some College     | Service Mix         | Highest    | Metro Mix   |
| 29   | White Picket Fences      | 1,373      | 2.68       | 174    | Midscale              | Low       | 25-44         | Family Mix        | Mostly Renters  | College Graduate | Mix                 | Above Avg  | Town        |
| 20   | Empty Nests              | 1,216      | 2.37       | 149    | Upper Mid             | Elite     | 65+           | HH w/o Kids       | Mostly Owners   | College Graduate | Mostly Retired      | Below Avg  | Suburban    |
| 60   | Small-Town Collegiates   | 1,201      | 2.34       | 243    | Downscale             | Low       | <55           | Family Mix        | Renters         | High School      | Service Mix         | Average    | Town        |
| 67   | Park Bench Seniors       | 1,084      | 2.11       | 231    | Low Inc               | Low       | 55+           | Mostly w/o Kids   | Renters         | High School      | Mostly Retired      | Below Avg  | Second City |
| 24   | Pickup Patriarchs        | 1,052      | 2.05       | 203    | Upscale               | High      | 45-64         | Mostly w/o Kids   | Mostly Owners   | College Graduate | Mgmt/ Professional  | Average    | Town        |
| 58   | Golden Ponds             | 1,032      | 2.01       | 107    | Downscale             | Below Avg | 55+           | Mostly w/o Kids   | Mix             | High School      | Mostly Retired      | Below Avg  | Town        |
| 18   | Mayberry-ville           | 986        | 1.92       | 117    | Upscale               | Elite     | 55+           | Mostly w/o Kids   | Mostly Owners   | College Grad +   | Mix                 | Below Avg  | Rural       |
| 11   | Fast-Track Families      | 935        | 1.82       | 97     | Upscale               | High      | 35-54         | Mostly w/Kids     | Mostly Owners   | College Graduate | Mgmt/ Professional  | Average    | Rural       |
| 44   | Country Strong           | 926        | 1.81       | 55     | Lower Mid             | Below Avg | <55           | Family Mix        | Mostly Owners   | High School      | Blue Collar Mix     | Below Avg  | Rural       |
| 59   | New Melting Pot          | 923        | 1.8        | 128    | Downscale             | Low       | <55           | Family Mix        | Mostly Renters  | High School      | Service Mix         | Average    | Second City |
| 62   | Crossroad Villagers      | 899        | 1.75       | 169    | Downscale             | Below Avg | 65+           | HH w/o Kids       | Mostly Owners   | High School      | Mostly Retired      | Lowest     | Town        |
| 66   | New Beginnings           | 872        | 1.7        | 173    | Low inc               | Low       | <55           | Mostly w/o Kids   | Renters         | High School      | Service Mix         | Average    | Metro Mix   |
| 38   | Hometown Retired         | 854        | 1.67       | 122    | Midscale              | Low       | 55+           | Mostly w/o Kids   | Mostly Owners   | Some College     | Mix                 | Below Avg  | Town        |

| LYNCHBURG PTA SEGMENTATION |                        |            |            |        |                       |           |               |                   |                 |                  |                    |            |
|----------------------------|------------------------|------------|------------|--------|-----------------------|-----------|---------------|-------------------|-----------------|------------------|--------------------|------------|
| Code                       | Name                   | Households | Pct. Index | Income | Inc. Producing Assets | Age       | Pred HH Comp. | Pred. Tenure/Type | Pred. Education | Pred. Employment | HH Technology      | Urbanicity |
| 15                         | New Homesteaders       | 819        | 1.6        | 156    | Upscale               | High      | 25-44         | Mostly w/Kids     | Mostly Owners   | College Graduate | Mgmt/ Professional | Above Avg  |
| 55                         | Red, White & Blue      | 659        | 1.28       | 92     | Low Inc               | Low       | <55           | Family Mix        | Mix             | High School      | Mix                | Below Avg  |
| 23                         | Township Travelers     | 656        | 1.28       | 117    | Upper Mid             | Low       | <55           | Family Mix        | Homeowners      | College Graduate | Mgmt/ Professional | Average    |
| 39                         | Kid Country, USA       | 614        | 1.2        | 107    | Midscale              | Low       | 25-44         | Mostly w/Kids     | Mix             | College Graduate | Service Mix        | Average    |
| 30                         | Pools & Patios         | 589        | 1.15       | 79     | Upper Mid             | Low       | 25-44         | Mostly w/Kids     | Mostly Owners   | College Graduate | Mgmt/ Professional | Above Avg  |
| 34                         | Young & Influential    | 587        | 1.15       | 124    | Midscale              | Low       | 25-44         | Mostly w/o Kids   | Renters         | College Graduate | Mgmt/ Professional | Highest    |
| 13                         | Upward Bound           | 553        | 1.08       | 101    | Upscale               | High      | 25-44         | Family Mix        | Mix             | College Graduate | Mgmt/ Professional | Above Avg  |
| 27                         | Big Sky Families       | 536        | 1.04       | 42     | Upper Mid             | Above Avg | 35-54         | Mostly w/Kids     | Mostly Owners   | College Graduate | Mgmt/ Professional | Average    |
| 12                         | Cruisin' to Retirement | 528        | 1.03       | 42     | Upscale               | Elite     | 55+           | Mostly w/o Kids   | Mostly Owners   | College Grad +   | Mgmt/ Professional | Average    |
| 46                         | Heartlanders           | 491        | 0.96       | 77     | Lower Mid             | Above Avg | 45-64         | Mostly w/o Kids   | Mostly Owners   | Some College     | Mix                | Lowest     |
| 52                         | Simple Pleasures       | 479        | 0.93       | 72     | Lower Mid             | Above Avg | 65+           | HH w/o Kids       | Mostly Owners   | High School      | Mostly Retired     | Lowest     |
| 57                         | Back Country Folks     | 465        | 0.91       | 35     | Downscale             | Low       | 55+           | Mostly w/o Kids   | Mostly Owners   | High School      | Mostly Retired     | Lowest     |
| 28                         | Country Casuals        | 460        | 0.9        | 49     | Upper Mid             | High      | 55+           | Mostly w/o Kids   | Mostly Owners   | Some College     | Mix                | Below Avg  |
| 41                         | Domestic Duos          | 450        | 0.88       | 90     | Lower Mid             | Moderate  | 65+           | HH w/o Kids       | Mostly Owners   | Some College     | Mostly Retired     | Lowest     |
| 68                         | Bedrock America        | 438        | 0.85       | 89     | Low Inc               | Low       | <55           | Mostly w/o Kids   | Mostly Renters  | High School      | Mix                | Below Avg  |
| 10                         | Executive Suites       | 431        | 0.84       | 64     | Upscale               | High      | 35-54         | Mostly w/Kids     | Homeowners      | College Graduate | Mgmt/ Professional | Above Avg  |
| 65                         | Young & Rustic         | 389        | 0.76       | 37     | Low inc               | Low       | <55           | Family Mix        | Mix             | High School      | Mix                | Below Avg  |
| 16                         | Beltway Boomers        | 82         | 0.16       | 14     | Upper Mid             | Low       | <55           | Family Mix        | Mostly Owners   | College Graduate | Mgmt/ Professional | Above Avg  |
| 14                         | Kids & Cul-de-Sacs     | 32         | 0.06       | 5      | Upscale               | Below Avg | 25-44         | Family Mix        | Mostly Owners   | College Graduate | Mgmt/ Professional | Above Avg  |
| 33                         | Second City Startups   | 3          | 0.01       | 1      | Upper Mid             | Low       | 25-44         | Mostly w/Kids     | Mix             | College Graduate | Mgmt/ Professional | Average    |

Figure 32: All market segments for Downtown Lynchburg's PTA. Source: Claritas PRIZM NE Segmentation.

B.

## CASE STUDIES FOR CREATIVE FINANCING & DOWNTOWN DEVELOPMENT

PAGE LEFT INTENTIONALLY BLANK



## **TAX INCREMENT FINANCING**

Tax Increment Financing (TIF) is a tool for stimulating investment and providing funding for public improvements such as infrastructure, parking, streetscape improvements, and community facilities within a designated district. TIF uses marginal real estate taxes generated by development to fund improvements in a specified area over a specified amount of time.

### **Case Study: Virginia Beach, Virginia**

Virginia Beach has successfully employed TIFs in multiple districts over the past two decades. Two of the TIF districts are the Lynnhaven Mall TIF and the Pembroke TIF.

The Lynnhaven Mall TIF was created in 1998 to stimulate investment and support the expansion of one of the largest malls in Virginia. The TIF generated \$11.5 million in funds and stimulated \$100 million in investment, a nearly 9-1 return on investment. TIF funds were used for a new parking garage, improved drainage, roads, and public transit. The term of the TIF expired in 2012, and the \$1.65 million in additional real estate taxes now go to the City's general fund.

TIF is being used in the Pembroke Strategic Growth Area to encourage development in the CBD. The Pembroke SGA is a 1,200 acre area that was designated as a growth area that could support higher density and mixed-use developments. At the core of the district is Town Center, a 25-acre urban mixed-use development that includes office space, retail, luxury residential units, entertainment and cultural facilities. TIF is specifically being used to fund parking garages for high-rise office, hotel, retail and residential facilities.



## Case Study: Chesapeake, Virginia

Chesapeake, Virginia has two TIF districts, one in Greenbrier and another in South Norfolk. The Greenbrier TIF was adopted in 2004 and supports improvements to pedestrian access, parking decks, streetscapes and transit. The 3.7 square-mile Greenbrier TIF is one of the largest mixed-use districts in Hampton Roads. The South Norfolk TIF was adopted a year later in 2005 and supports public infrastructure improvements, streetscape improvements, transit improvements, parks and open areas.



*Lynnhaven Mall (below) and Pembroke SGA (above), TIF districts in Virginia Beach, Virginia. Photo Source: [www.virginiabeach.guide/lynnhaven-mall-in-virginia-beach](http://www.virginiabeach.guide/lynnhaven-mall-in-virginia-beach) and [www.cbda.net/about/pembroke-sga](http://www.cbda.net/about/pembroke-sga)*

## BUSINESS IMPROVEMENT DISTRICTS & COMMUNITY IMPROVEMENT DISTRICTS

In Business Improvement Districts (BIDs) business property owners pay an additional tax to fund improvements such as streetscape and beautification projects, parking, signage, and marketing. Community Improvement Districts (CID) operate similarly to BIDs but in CIDs, residential property owners are assessed the additional tax rather than commercial property owners.

### Case Study: Arlington, Virginia

Arlington, Virginia has BIDs in Crystal City, Rosslyn, and Ballston that support community branding, transportation enhancements and physical improvements.

The Ballston BID covers a 25-block area that contains 8.3 million square feet of office space, 1 million square feet of retail space and 8,000 residential units. The Ballston BID aims to strengthen the economic vitality of Ballston and to create an amenity-rich destination. The Ballston BID assesses an additional tax of 0.045 cents per \$100 of assessed value. Funded projects include transportation enhancements, management, and marketing and branding.



*Ballston Business Improvement District, Arlington, Virginia.*

*Photo Source: [www.thecrossingatballston.com](http://www.thecrossingatballston.com) and [wtop.com/section/sponsored-content/creating-a-thriving-community/](http://wtop.com/section/sponsored-content/creating-a-thriving-community/)*

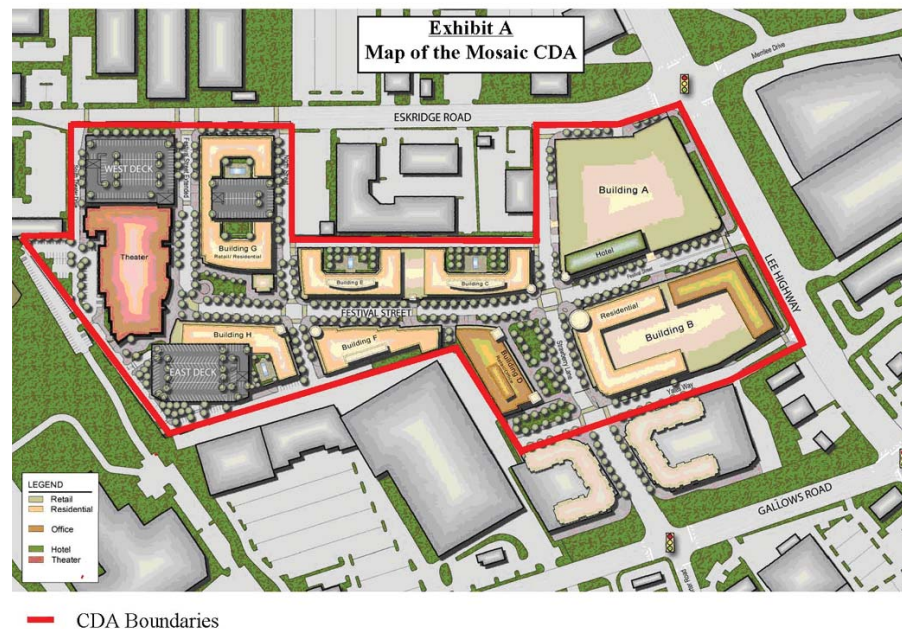


## COMMUNITY DEVELOPMENT AUTHORITY

Community Development Authorities (CDA) are used to finance and fund infrastructure improvements in a defined area through the issue of bonds and collection of an additional real estate tax. Infrastructure improvements typically funded through CDAs include roads, sidewalks, bridges, parking, utilities, and stormwater management.

### Case Study: Mosaic CDA in Fairfax County, Virginia

Fairfax County established the Mosaic District CDA in 2009 to support improvements in the 31-acre mixed-use Merrifield Town Center development. The development included 1,000 residential units, a movie theatre, a hotel, 125,000 square feet of office, and 500,000 square feet of other non-residential uses. The CDA was established to issue bonds to assist in financing of public improvements including infrastructure, landscaping, parking facilities, pedestrian improvements, stormwater improvements, lighting, signage, roads, public parks and plazas, and land acquisition. In 2011, the CDA issued nearly \$66 million worth of bonds to finance public improvements, using both TIF and special assessments.



Map of Mosaic District CDA, Fairfax County, Virginia.  
Source: [www.fairfaxcounty.gov](http://www.fairfaxcounty.gov).



## PUBLIC PRIVATE PARTNERSHIPS

One of the best ways for Lynchburg to take the development of downtown to the next level is to participate in public private partnerships. These partnerships use a number of the tools mentioned in this report, applied in creative ways for public realm projects that are necessary to bring in significant private development.

### Case Study: Greenville, South Carolina

Greenville is not only a National leader in downtown revitalization, but the City is also adept at working creatively with the private sector to bring in significant development and investment. Beginning in 1982 with the Hyatt Regency and continuing to today, most substantial private developments have included a public portion that often includes public parking structures, streetscape, signature parks, public art and pocket parks, among others. As financing models have evolved, Greenville has formalized its public-private partnership program in order to maximize flexibility and approach each potential investment on a case-by-case basis.

### Hyatt Commons and NOMA Square

After Greenville's initial downtown plan in 1979, the first realization of its vision of a vibrant downtown was the Hyatt Regency at the north end of Main Street. The City used \$10 million in funding from a number of sources (HUD, UDAG, EDA Grant, City funds) to incent \$24 million in private investment.

The \$34 million project included a 350-room hotel, 43,000 square feet of meeting space, restaurant, and 92,000 square feet of leasable office space. The main public investment was an 832-space public parking structure attached to the development. In addition, the Atrium lobby was creatively financed as an official public park for use by the hotel and the citizens of Greenville. The Atrium, which connects with the public NOMA square, still exists as a public park and a functional event space.



NOMA Square and Hyatt Commons. Source: [www.jhmhotels.com](http://www.jhmhotels.com)

## Project ONE

The latest public-private partnership to be developed in Greenville is Project ONE. The mixed-use development sits on an anchor site in downtown Greenville formally occupied by a defunct Woolworths store, dated public plaza, and underutilized parking resource. The City had looked to develop this site at the 100 percent corner of downtown for a number of years. It ultimately worked with local developers to create a signature public-private development that will prove to be the future standard for Downtown Greenville.

The project fully opened in 2015 and included \$118 million in private investment to just \$11.5 million in public funding. Today, the site has a world-class public plaza anchored by a 9-story (175,000 square foot) office tower, an 11-story (200,000 square foot tower), 50,000 square feet of retail, dedicated meeting space, and a 144-room Aloft Hotel. The signature public elements include a 474-space parking garage and ONE City Plaza. Key tenants include Clemson University, Tupelo Honey Restaurant, Orvis, and Brooks Brothers, among others. The City used a number of public funding resources for this project.



*ONE City Plaza and Project ONE*

## Poinsett Corners

Poinsett Corners is a public-private development that opened in 2005. The concept is a creative mixed-use development whereby a parking structure is completely wrapped in private development. The City of Greenville paid for the 300-space public parking garage with \$.94 million in TIF funds and an additional \$3.62 million in TIF bonding. This \$4.56 million investment incented \$11 million in private sector funding.

The project includes 81 residential units, 17,000 square feet of commercial and office space. In addition to the parking garage, the public portion included the sale of the property and various streetscape improvements.



*Poinsett Corners Mixed-use Development.*



## The Bookends

The Bookends is a phased public-private partnership that began with the construction of a 905-space public parking garage, including space on either “bookend” dedicated for private development. The first phase (2005) included 30 condominium units and 6,200 square feet of retail space on the street level. The second phase (2012) included 48 apartment units and an additional 6,000 square feet of retail. In the interim between phase one and two, the location of the second phase was used as a temporary public pocket park.

The public portion of the project included \$1.1 million in TIF bonding and a \$13.1 million bond paid by parking revenues. The private sector investment totaled \$7 million. Only a small portion of the garage is used by the private residents with the bulk of the project serving as the largest and most centrally located parking resource in the downtown.



*he Bookends Mixed-use Development.*

Funding for Greenville’s public-private partnerships varies on a case-by-case basis and have included:

- > TIF revenue
- > TIF Bonds
- > Synthetic TIF
- > Accommodations Tax (lodging)
- > Hospitality Tax (restaurant receipts)
- > Sunday alcohol permits
- > Special property tax assessment
- > Facilities revenue
- > Parking Fund revenue and bonds

- > Land purchase and sale
- > Dedicated Economic Development Fund
- > HUD, UDAG, EDA Grants
- > County and State participation
- > General Fund
- > Dedicated Infrastructure funds

Each potential public-private partnership project must go through an application process that establishes development details, cost, requested public assistance, estimate of community impact, etc. Many start in a more “entrepreneurial” process whereby the city sits down with developers to talk about concept and where the public could benefit, as well as what are the public spaces or resources.

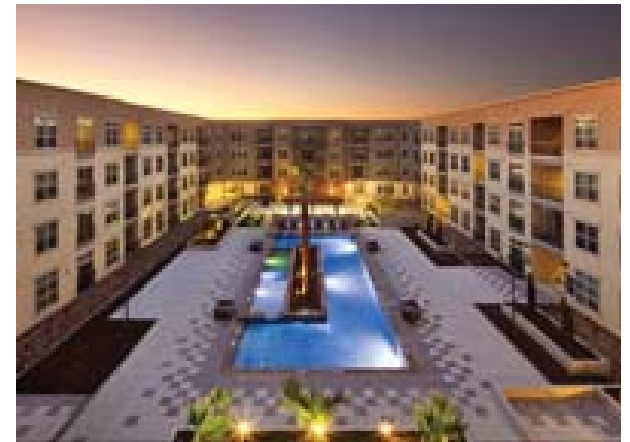
## TOOLS TO INCENTIVIZE DOWNTOWN HOUSING

In recent decades, cities across the nation have started to provide incentives to attract housing in their downtowns. Incentives often come in the form of grants or tax abatements.

### Case Study: San Antonio, Texas

As part of its effort to activate downtown, the City of San Antonio sought to incentivize downtown residential development. In 2012, the City created two programs, the Inner City Reinvestment Policy (ICRP) and the Center City Housing Incentive Policy (CCHIP), to help achieve this goal. CCHIP provides financial incentives for multi-family housing projects in a designated area of downtown. Potential incentives include fee waivers, property tax rebates, and low-interest loans. Over \$53 million in tax incentives have stimulated \$708 million in development since the CCHIP program was established in 2012. Among the projects given incentives through the CCHIP program are:

- > Casa Blanca Lofts – 17-unit condo project that represented a \$3.3 million investment. \$274,088 in public incentives were given.
- > Cevallos Lofts – a \$39 million development with 252 mixed-income apartments, given \$3.6 million in public incentives.
- > Peal Parkway North and South - \$35 million mixed-use development with 82 market-rate housing units



Examples of Projects Awarded Incentives Through San Antonio's CCHIP Program.  
 Photo Source: <http://www.sanantonio.gov/CCDO/Downtown-Projects/PastProjects>



100

// A regular meeting of the Council of the City of Lynchburg was held on the 14<sup>th</sup> day of August, 2018, at 4:00 P.M. in the Council Chamber, City Hall, Treney Tweedy, President, presiding. The following

Members were present:

Present: MaryJane Dolan, Jeff S. Helgeson, J. Randy Nelson, E. J. Turner Perrow,

Sterling A. Wilder, Beau Wright, Treney Tweedy

7

Absent:

0

// City Manager Bonnie Svrcek presented for consideration a Resolution Declaring and Rescinding a State of Emergency for the College Lake Flood and Dam event that occurred on August 2, 2018. Council adopted the resolution Declaring and Rescinding a State of Emergency for the College Lake Flood and Dam Event. On motion of Council Member Helgeson, seconded by Council Member Wilder, Council by the following recorded vote adopted Resolution #R-18-063, as presented, Declaring and Rescinding a State of Emergency for the College Lake Flood and Dam Event:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy

7

Noes:

0

A brief video was shown of the flooding on August 2<sup>nd</sup> at the College Lake Dam. Director of Water Resources Tim Mitchell gave an update on where we are but most importantly where we are going. Mr. Mitchell provided a comprehensive timeline explaining the flood on August 2<sup>nd</sup> and background information of the College Lake Dam. He stated that the water from the lake overtopped Lakeside Drive. Emergency personnel began evacuating residents downstream around 12:30 a.m., on August 3<sup>rd</sup> the overtopping ended. City staff met with external engineers the next day to inspect the dam and determine the best path forward. The Immediate concern was water pressure on a compromised dam and significantly higher risk of failure associated with other overtopping events. When meeting with external advisors and state regulators, it was decided to open a sluice gate and drain the lake. Mr. Mitchell said they made this decision to prioritize public safety in the event of another rain event. The continued conversation to immediately remove debris blocking the low level outlet (the debris could result in outfall becoming pressurized) and then open the sluice gate on the low level outlet.

- Relieve any water pressure being exerted on the dam
- Provide additional upstream storage for future rain events
- Monitor downstream for changes and weeps

101

The next step would be to evaluate emergency repair versus temporary repair on the dam. A decision was made to proceed with temporary repairs to the dam in lieu of emergency repairs to restore two lanes of traffic on Lakeside Drive. Mr. Mitchell mentioned the following Focus Areas:

- Develop plans for temporary dam repairs
- Environmental recovery
- Regulatory involvement
- Collaboration with University of Lynchburg
- State and Federal assistance
- Short and long term planning

Mr. Mitchell went on to say that a meeting will be held with University of Lynchburg President Dr. Garren and Board of Trustees to discuss and ask for approval of the following:

1. Authorize the university to work with the City to develop short and long term options for the lake bed
2. Permit the City to perform the work necessary on the lake bed for short and long term stabilization
3. Agree to collaboratively work with the City and others to develop options and phasing scenarios for wetlands restoration
4. Agreement to ultimately remove the dam and build a bridge over the Lake
5. Collaboratively explore various sources of funding including grants, creation of wetland mitigation banks, etc.
6. Permit the City to spread a wetland seed mixture to begin stabilization possibly as early as next week including the use of the athletic fields at Faculty Drive for staging
7. Assist the City with long term monitoring of the Lake (also great opportunities for staff and students to be involved in the design, regulatory process, construction, various other hands-on opportunities)
8. Agree to a vision of transitioning the Lake to a Wetlands Learning Laboratory and destination for environmental exploration by citizens, students, and tourists; as well as become a model for best practices in the development of Wetlands Stream Restoration

In looking ahead to begin stabilization of existing lake bed with wetland seed mix, continue work and modifications to temporary riser structure, develop a longer term plan for low level outfall – current situation is very temporary, focus projects on upper lake bed first and control erosion through lake bed likely by a combination of stream bed stabilization and grade control structures, look at options to control float debris entering the lake, seek state, federal and private funding assistance and move forward as quickly as possible with long term solution and the long term solution must be submitted to Department of Conservation and Recreation (DCR) by March 31, 2020. Mr. Mitchell mentioned the challenges and decisions.

102

1. Very complex situation with multiple stakeholders
2. Construction in the lake bed is extremely difficult and costly
3. Managing the flow through the lake and particularly the low level outlet
4. Extremely maintenance intensive
5. Look at options to control float debris entering the lake
6. Move forward as quickly as possible with long term solution – hard deadline with DCR
7. Be prepared for a long process
8. Immediate decisions will need to be made regarding level of lake bed restoration, where funding will come from, and long term plans

Mr. Mitchell further stated the City is ultimately moving toward removing the dam and building a bridge over the remaining waterway to accommodate traffic on Lakeside Drive. He did not provide a timeline for any changes. We really want to make the best use of the money we invest in this process and a better way to keep the water levels low. City Manager Bonnie Svrcek echoed Mr. Mitchell's statements, advising Council that the City is in the early stages of these conversations and is pursuing every opportunity for funding.

After the presentation, Council Members asked several questions. Council Member Helgeson commended City staff for their response on August 2<sup>nd</sup>. Council Member Helgeson asked about financing the lake bed restoration, indicating University of Lynchburg (UL) should fund most of it because the lake is its property. Mr. Mitchell said he discussed the situation with City Attorney Walter Erwin, who advised him the City can provide assistance for the restoration, even though it is private property, because it is for the greater public good. However, he said a lot of discussions need to take place regarding the funding. Council Member Nelson asked about the estimated cost to repair the dam and bridge again to two way traffic. Mr. Mitchell responded the cost of the dam and the bridge repair is around two hundred thousand dollars. What is the probability of the dam overtopping in the case of a storm similar to the one that hit the City on August 2<sup>nd</sup>. Mr. Mitchell responded in that exact scenario, the dam would overtop again. For a smaller storm event, which is much more likely, we are in a much safer situation than we were before. Council Member Nelson also mentioned the water quality in the tributaries feeding into College Lake, saying the amount of sedimentation in them would suggest that development regulations aren't sufficient or well-enforced. According to Mr. Mitchell, Lynchburg's erosion control regulations for development are stricter than State requirements; this is very typical of an urban area as it is very hard to control sediment runoff in an urban environment. Council Member Wilder stated he wanted to commend Mr. Mitchell and his staff on the hard work everyone has done. He asked about the cost for repairing the lake. Mr. Mitchell responded that it's too early in the process to know the cost. Council Member Wilder mentioned in reference to the flood, is there any State or Federal funds to help with the assistance. Mr. Mitchell responded that all our options to possibly help with this situation are

being explored. Council Member Wright asked, what is the environmental effect downstream? Mr. Mitchell responded, they have set up a stream monitoring system. Council Member Perrow and Mayor Tweedy praised Mr. Mitchell and his team's efforts in prioritizing public safety on August 2<sup>nd</sup> and in the following days. Mayor Tweedy said she was grateful that citizens' needs were met that rainy night and is optimistic funds will come to replace and repair what we need to fix.

// Chief of Police Diaz presented information on issues in the department related to retention of current officers, recruitment of new officers and right-sizing of staffing levels. During the presentation, Chief Diaz briefed Council on the difficulties facing the department, such as its staffing levels. When considering right-sizing, he said the City must incorporate a number of factors, including calls for service, technology and best practices for 21<sup>st</sup> century policing. The time Lynchburg Police Department (LPD) officers spend on calls for service has risen from 56 percent in 2015 to more than 75 percent this year. Chief Diaz said the International City/County Management Association recommends this number should not exceed 60 percent of an officer's workload "because then we become reactive, not proactive." Additionally, the average time of a call for service is up from 21 minutes in 2001 to 43 minutes in 2015. All of these factors place a strain on the current force, which is asked by the City to do more in the community. Officers participate in more than two dozen community organizations and programs and they sit on the board of several local civic organizations. When discussing right-sizing the force, the police chief cited data showing the city lags behind its neighboring cities in the number of sworn officers per capita. Currently, Lynchburg has 2.15 officers per 1,000 people. Danville has 3.29 sworn officers per 1,000 people. Another challenge of the department is retention, which is directly related to staffing. If people stay and don't leave, I don't have to recruit that many people. He said the most recent statistics from the U.S. Department of Justice show an average 7 percent annual turnover. Lynchburg's average over the last five years was almost 14 percent. The department is constantly training officers who then leave in a few years for other opportunities. Over 80 percent of our road patrol officers have less than five years of experience. Chief Diaz went on to say it costs \$17,000 to hire a new officer. New officers on the force must work with a more experienced officer for nine to 10 months before they can go out on their own. It takes another three to five years before the officers really settle into the job. There is an art to it and it takes time to develop the ability to do it right. To address these challenges several proposals to consider; increase staffing, implementing a pay scale with wage progression and reinstating retirement health benefits for officers with 25 years of service. Chief Diaz asked staff to incorporate and prioritize the recommendations for the fiscal year 2020 budget, but said he hopes the City can implement sooner than next year's budget cycle.

Overall, Council Members were receptive to Chief Diaz requests but took no action at the meeting. Council Members said they prioritized public safety in the community and praised the



104

department's efforts to reduce crime and participate in community organizations. Council Member Helgeson asked City staff to look at adding a placeholder for 25 new officers for Council review in an upcoming meeting. Vice Mayor Dolan mentioned, certainly the report was very powerful and comprehensive. Vice Mayor Dolan went on to say "as a governing body, if we are unable to see how serious this is and we do not find the resources to meet those needs, we are failing." Mayor Tweedy cautioned that while she understands the public safety needs, we would love to fund everything but the City has many challenges. Chief Diaz stated this presentation required no action at this time.

// Due to time constraints the Code Compliance Programs Overview was postponed until the September 11, 2018 work session.

// During roll call Council Member Nelson mentioned calls that he received from citizens regarding the speed limits on Rivermont Avenue and would it be appropriate to evaluate and make any adjustments. Each Council Member mentioned they had received calls regarding speeding on Rivermont Avenue.

// Council Member Perrow mentioned the speeding on Rivermont Avenue and the pedestrian cross walks. He thanked the City staff for removing the restriction at the Landfill for citizens to take their items after the flood.

// Council Member Helgeson mentioned the City gave a special exempt status to the Krise building in June 2016 and nothing has been done on that building. Council Member Helgeson asked Donna Witt, Director of Financial Services to speak to this item. Ms. Witt stated that the penalty was waived and the accrued interest was recalculated at 3% from a rate of 10% for delinquent real estate taxes on the Krise building. Ms. Witt went on to say that she heard from the attorney and they will close on August 22 or 23, 2018. The City should collect about \$94,000 which will pay all the back taxes on the Krise building and the interest that has accrued on the building. Council Member Helgeson further stated if the Krise building does not close on the stated date then Council on what action to take.

// Council Member Wright mentioned he also received calls regarding the speeding on Rivermont Avenue.

// Council Member Wilder mentioned the National Night Out held at the Riverfront which was a great success and thanked City staff for their support. He mentioned the Lynchburg City Schools Convocation at E. C. Glass that was held on Monday, August 13, 2018 and thanked Vice Mayor Dolan for speaking at the National Night Out and the Convocation in the absence of Mayor Tweedy. School starts on Wednesday, August 15, 2018, again this year with the "Men to School". Any man who wants to greet students, wishing them well, encouraging them, and conveying how much we appreciate them and to have a great school year is encouraged to participate. The Men to School will begin at the high schools at 7:05 a.m.; middle schools at 7:25 a.m. and elementary schools at 8:10 a.m.

105

// Vice Mayor Dolan gave a shout out to the Lynchburg City Schools staff and teachers and wished them a great year.

// Mayor Tweedy made the following announcements:

- City Council Retreat will be held on Tuesday, August 28, 2018 from 8:30 a.m. to 4:00 p.m. at the Dolan Conference Room at Lynchburg General Hospital.
- Lynchburg City Schools start on Wednesday, August 15, 2018 and she encouraged citizens to slow down and watch out for our students.

// On motion of Council Member Wilder, seconded by Council Member Dolan, Council by the following recorded vote elected to hold a closed meeting to consider appointments to Council-appointed Boards and Commissions, i.e. Martin Luther King, Jr./Lynchburg Community Council, Historic Preservation Commission, Virginia Alcohol Safety Action Program (VASAP), Region 2000 Local Government Council and Region 2000 Workforce Investment Council; pursuant to Section 2.2-3711(A)(1), Code of Virginia (1950), as amended:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy

7

Noes:

0

// The meeting was re-opened to the public.

// Council Member Helgeson made the following motion:

WHEREAS, the Council of the City of Lynchburg has convened a closed meeting on this date, pursuant to an affirmative recorded vote and in accordance with the provisions of The Virginia Freedom of Information Act; and

WHEREAS, Section 2.2-3712 of the Code of Virginia requires a certification by City Council that such closed meeting was conducted in conformity with Virginia law;

NOW, THEREFORE, BE IT RESOLVED that the Council of the City of Lynchburg certifies that, to the best of each member's knowledge, (i) only public business matters lawfully exempted from open meeting requirements by Virginia law were discussed in the closed meeting to which this certification

106

resolution applies, and (ii) only such public business matters as were identified in the motion convening the closed meeting were heard, discussed or considered by Council. The Motion was seconded by Vice Mayor Dolan, and Council by the following recorded vote adopted the motion:

|                                                                       |   |
|-----------------------------------------------------------------------|---|
| Ayes: Dolan, Helgeson, Nelson, Perrow, Tweedy, Wilder, Wright, Tweedy | 7 |
| Noes:                                                                 | 0 |

// In the matter of Appointments, and on nomination of Council Member Helgeson, seconded by Council Member Wilder, Council by the following recorded vote appointed Vivian C. Miller, to serve on the Dr. Martin Luther King, Jr./Lynchburg Community Council with a term expiring June 30, 2021:

|                                                               |   |
|---------------------------------------------------------------|---|
| Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy | 7 |
| Noes:                                                         | 0 |

On nomination of Council Member Helgeson, seconded by Council Member Wilder, Council by the following recorded vote appointed Michael J. Erquiaga to serve on the Historic Preservation Commission, with a term to expire June 30, 2021:

|                                                               |   |
|---------------------------------------------------------------|---|
| Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy | 7 |
| Noes:                                                         | 0 |

On nomination of Council Member Helgeson, seconded by Council Member Wilder, Council by the following recorded vote reappointed Brenda Finch to serve on the Virginia Alcohol Safety Action Program (VASAP) Board for a term to expire August 31, 2021:

|                                                               |   |
|---------------------------------------------------------------|---|
| Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy | 7 |
| Noes:                                                         | 0 |

On nomination of Council Member Helgeson, seconded by Council Member Wilder, Council by the following recorded vote appointed Mayor Treney Tweedy to serve on the Region 2000 Local Government Council for a term to expire June 30, 2022:

107

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy 7

Noes: 0

On nomination of Council Member Helgeson, seconded by Council Member Wilder, Council by the following recorded vote appointed Mayor Treney Tweedy to serve on the Region 2000 Workforce Investment Council:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy 7

Noes: 0

// City Council recessed the meeting at 6:12 p.m.

// City Council reconvened the meeting at 7:30 p.m.

The following Members were present:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy 7

Noes: 0

// Vice Mayor Dolan gave the Invocation, followed by the Pledge of Allegiance.

// Copies of the minutes of the May 22, 2018 meeting, having been previously furnished Council, reading was dispensed with, and on motion of Council Member Helgeson, seconded by Council Member Perrow, Council by the following recorded vote approved the minutes as amended:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Tweedy 6

Noes: 0

Abstain: Wright 1

// Copies of the minutes of the June 5, 2018 meeting, having been previously furnished Council, reading was dispensed with, and on motion of Council Member Perrow, seconded by Council Member Nelson, Council by the following recorded vote approved the minutes as presented:



108

Ayes: Dolan, Nelson, Perrow, Wilder, Tweedy 5

Noes: 0

Abstain: Helgeson, Wright 2

// Copies of the minutes of the June 12, 2018 meeting, having been previously furnished Council, reading was dispensed with, and on motion of Council Member Wilder, seconded by Council Member Helgeson, Council by the following recorded vote approved the minutes as presented:

Ayes: Dolan, Helgeson, Nelson, Wilder, Tweedy 5

Noes: 0

Abstain: Perrow, Wright 2

// Copies of the minutes of the June 19, 2018 meeting, having been previously furnished Council, reading was dispensed with, and on motion of Council Member Helgeson, seconded by Council Member Wilder, Council by the following recorded vote approved the minutes as presented:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Tweedy 6

Noes: 0

Abstain: Wright 1

// Copies of the minutes of the June 26, 2018 meeting, having been previously furnished Council, reading was dispensed with, and on motion of Council Member Wilder, seconded by Council Member Helgeson, Council by the following recorded vote approved the minutes as presented:

Ayes: Helgeson, Nelson, Perrow, Wilder, Tweedy 5

Noes: 0

Abstain: Dolan, Wright 2

// Copies of the minutes of the July 2, 2018 meeting, having been previously furnished Council, reading was dispensed with, and on motion of Vice Mayor Dolan, seconded by Council Member Wilder, Council by the following recorded vote approved the minutes as presented:

109

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy 7

Noes: 0

// Copies of the minutes of the July 10, 2018 meeting, having been previously furnished Council, reading was dispensed with, and on motion of Council Member Perrow, seconded by Council Member Wilder, Council by the following recorded vote approved the minutes as presented:

Ayes: Dolan, Nelson, Perrow, Wilder, Wright, Tweedy 6

Noes: 0

Abstain: Helgeson 1

// In the matter of Fire, Resolution #R-18-062, to amend the FY 2019 City/Federal/State Aid Fund budget and appropriate \$56,938 with resources of \$28,204 from the Virginia Office of Emergency Medical Services – Rescue Squad Assistance Fund, \$25,000 transferred from the FY 2019 General Fund Fire Department budget, and \$3,734 appropriated from the General Fund Fire Equipment Assigned Fund Balance to purchase CPR manikins, (1) LifePak cardiac monitor and (1) Power Pro stretcher for the Fire Department, laid over from the July 10, 2018 meeting, was again presented and read, and on motion of Vice Mayor Dolan, seconded by Council Member Wilder, Council by the following recorded vote adopted

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy 7

Noes: 0

// In the matter of Community Development - Rezoning, a public hearing was held regarding City Council Report #14 outlining the petition of Todd DeCourcy, Thomas Road Baptist Church to rezone approximately twenty three hundredths (.23) acres at 4259 White Street from R-2, Low-Medium Density Residential to R-3, Medium Density Residential to allow the use of an existing structure as a duplex. City Planner Tom Martin provided a summary of the request stating the petition is consistent with the Zoning Ordinance, which permits duplexes within an R-3 Medium Density Residential District. The Comprehensive Plan 2013 – 2030 Future Land Use Map (FLUM) recommends an Institutional use for the property. Mr. Martin went on to say that the Planning Commission recommended approval of the rezoning petition. Mr. Norm Walton of Perkins & Orrison was present to represent the petitioner.

110

Mr. Walton stated that Thomas Road Baptist Church owns the property and would like to use this property to house missionary families. He went on to say that there is adequate parking and there will be no exterior changes to the house. One individual spoke in favor of the petition and no one spoke in opposition. There was no one else present who wished to speak to this item, and the public hearing was closed. Council Member Nelson made the following statement. "In the past I have served as legal counsel for Liberty University on real estate matters. I felt it would not be a conflict of interest and needed to disclose that statement. I am able to participate in this matter fairly, objectively and in the public interest. Therefore, I will participate in the discussion of and vote on this item." On motion of Council Member Helgeson, seconded by Council Member Wilder, Council by the following recorded vote adopted Ordinance #0-18-064, as presented, granting the petition of Todd DeCourcy, Thomas Road Baptist Church to rezone approximately twenty three hundredths (.23) acres at 4259 White Street from R-2, Low-Medium Density Residential to R-3, Medium Density Residential to allow the use of an existing structure as a duplex:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy

7

Noes:

0

// In the matter of Police, City Council Report #15 was considered introducing a Resolution to amend the FY 2019 City/Federal/State Aid Fund budget and appropriate \$41,936 with resources from the 2017 Edward Byrne Memorial Justice Assistance Grant (JAG) to purchase law enforcement equipment for the Lynchburg Police Department, Lynchburg Sheriff's Office and the Office of the Commonwealth's Attorney. Police Chief Diaz provided an overview of the request. Council Member Helgeson, Chair of the Finance Committee (FC) stated that the request was considered by the FC and made a motion to approve the request. The motion did not require a second, and Council by the following recorded vote introduced and laid over to a later meeting for final action Resolution #R-18-065, as presented, to purchase law enforcement equipment for the Lynchburg Police Department, Lynchburg Sheriff's Office and the Office of the Commonwealth's Attorney:

111

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy 7

Noes: 0

// In the matter of Human Services, City Council Report #16 was considered, to amend the FY 2019 General Fund budget and appropriate \$196,031 with resources of \$178,531 from the State Department of Social Services and \$17,500 from Horizon Behavioral Health Services to the Division of Social Services for staff and operations in preparation for the expansion of Medicaid benefits and to approve the addition of three full-time positions for the Lynchburg Division of Social Services. Human Services Director Tamara Rosser provided a summary of the request. Council Member Helgeson, Chair of the Finance Committee (FC) stated that the request was considered by the FC and made a motion to approve the request. The motion did not require a second, and Council by the following recorded vote introduced and laid over to a later meeting for final action Resolution #R-18-066, as presented, to approve the addition of three full-time positions for the Lynchburg Division of Social Services:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy 7

Noes: 0

// In the matter of Water Resources, City Council Report #17 was considered, to amend the FY 2019 Water Fund Operating Budget to add one new full time engineering project manager. Water Resources Director Tim Mitchell provided a summary of the request. Council Member Helgeson, Chair of the Finance Committee (FC) stated that the request was considered by the FC and made a motion to approve the request. The motion did not require a second, and Council by the following recorded vote adopted Resolution #R-18-067, as presented, to amend the FY 2019 Water Fund Operating Budget to add one new full time engineering project manager:

Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy 7

Noes: 0

// In the matter of Parking, City Council Report #18 was considered, to amend the FY 2019 General Fund budget and appropriate \$40,500 from the Assigned Fund Balance Reserve for Parking to purchase four



112

(4) parking payment stations. Parking Manager David Malewitz provided a summary of the request. Council Member Helgeson, Chair of the Finance Committee (FC) stated that the request was considered by the FC and made a motion to approve the request. The motion did not require a second, and Council by the following recorded vote introduced and laid over to a later meeting for final action Resolution #R-18-068, as presented, to amend the FY 2019 General Fund budget and appropriate \$40,500 from the Assigned Fund Balance Reserve for Parking to purchase four (4) parking payment stations:

|                                                               |   |
|---------------------------------------------------------------|---|
| Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy | 7 |
| Noes:                                                         | 0 |

// In the matter of Parks and Recreation, City Council Report #19 was considered, to amend the FY 2019 General Fund budget and appropriate \$15,000 to the Parks and Recreation Fees budget to provide a benefit match that incentivizes the purchase of fruits and vegetables for Supplemental Nutrition Assistance Program (SNAP) participants. Community Market Manager Jennifer Kennedy provided a summary of the request. Council Member Helgeson, Chair of the Finance Committee (FC) stated that the request was considered by the FC and made a motion to approve the request. The motion did not require a second, and Council by the following recorded vote introduced and laid over to a later meeting for final action Resolution #R-18-069, as presented, to provide a benefit match that incentivizes the purchase of fruits and vegetables for Supplemental Nutrition Assistance Program (SNAP) participants:

|                                                               |   |
|---------------------------------------------------------------|---|
| Ayes: Dolan, Helgeson, Nelson, Perrow, Wilder, Wright, Tweedy | 7 |
| Noes:                                                         | 0 |

// The meeting was adjourned at 8:07 P.M.

100

// A special meeting of the Council of the City of Lynchburg was held on the 28<sup>th</sup> day of August, 2018, at 8:30 A.M. at the Dolan Conference Room at Lynchburg General Hospital. Treney Tweedy, President, presiding. The purpose of the meeting was for City Council Annual Retreat. The following Members were present:

Present: MaryJane Dolan, Jeff S. Helgeson, J. Randy Nelson, E. J. Turner Perrow,

Sterling A. Wilder, Beau Wright, Treney Tweedy

7

Absent:

0

// Mayor Tweedy gave an overview of the agenda and thanked Mr. Stripling for meeting with each Council Member earlier putting in the time to organize the council retreat.

// City Manager Bonnie Svrcek introduced the facilitator Mr. Robert (Bob) Stripling and presented the following information

- Retired City Manager
- Thirty-two Years' Experience in Local Government
- Five Different Local Governments
- Eight Years of Teaching
- Two Years in Private Sector
- MBA

// Mr. Stripling led City Council and City leaders through small group activities and discussion about the distinct roles of elected officials and city administration. Mr. Stripling began the Annual Retreat asking Council "Why are we here" and what tools are available to make the "Governing Process better?"

Governing - Conduct the policies, actions and affairs of a local government.

a. What it is?

b. Different Styles

Governing Styles

- Many Different Styles
- Effective styles take into account the environment within which one operates, and his or her Strengths, Experiences and Preferences

101

### How Governance Really Works

- Logic versus emotion
- Setting priorities versus trading votes
- Consensus versus factions
- Anecdotal versus statistic
- Common good versus interest groups
- Politics versus administration

### Governing includes Political and Management Leadership

- The City Council and the City Management Team
  - o Management “What do you Know”
  - o Politics “What do you hear”
  - o Politics “Everyone I Talk To”

### Governing is an Art (Council Constraints)

- Vague Task and Role Definition
- No Hierarchy
- No Specialization
- Little Formal Feedback or Evaluation of Performance
- Open Meeting Requirements

### How do we Overcome the Barriers to Good Governing

- Recognize the value of making progress on big issues
- Agree on norms of behavior
- Reduce uncertainty – set goals and rank priorities
- Practice group solving problem solving techniques
- Define how best to work with staff

### Personal Relationship

- Trust and Loyalty

### Political Leadership

- Under the City Charter, the City Council Can only “ACT” as a “BODY”
- But, in executing their plan of action in concert with Management, Council Members can contribute as individuals by providing “Political Leadership”
- Political leadership has many different styles and models

Throughout the day City Council meet in small groups for exercises and group participation to discuss the following:

- Governing
- Value Based Decision Making
- What does the Vision Statement Really Mean
- Building a Model for Success

102

// City Council took a break at 10:30 a.m. and reconvened the meeting at 10:40 a.m.

// Mr. Stripling asked council members to identify talents of fellow elected official, identify key drivers behind past successful projects and define practical aspects of Lynchburg's vision statement. He said having a list of these items will allow Council to better match interests and models of success so city government is functioning at its highest capacity.

// The Role of Values in Decision-Making

- How do we really make decisions, most difficult decisions are about values?

#### Value Based Decision-Making

- Representation
- Efficiency
- Social Equity
- Individual Rights

#### Balancing Public Values and Choices

- Problems always involve more than one value
- They can't be solved with just one value
- No one value is always better
- We don't choose the same value every time
- How will you will treat those values with which you disagree
- Disagreement to inevitable
- What we see as conflict the way the democratic process is designed to work
- It's okay to disagree because you prefer a different value
- It's not okay to reject that value simply because you disagree

#### Concepts versus Practice

- I have explained the concepts
- Now let's see what happens in actual practice

// City Council had a working lunch at 12:30 p.m. reconvened the meeting at 1:30 p.m. During Council working lunch the topic of discussion was "What Does the Vision Statement Really Mean". Council was



103

divided into three groups and each group had one component of the Vision Statement: Live, Work and Play.

What Makes Lynchburg a Great Place to Live, Work and Play

- What does the vision statement really mean?
- How does the City translate the vision into a practical game plan to keep it and improve it?
- What key assets are in place to support the vision?
- Is the vision for both residents (current and future) and visitors?
- If so, how does the vision differentiate Lynchburg other cities

// Building a Model for Success included:

- Setting realistic schedule
- Clearly defined project scope
- Selecting right people for project team
- List parts of the process or project implementation that make it especially successful

Mr. Stripling asked Council to identify talents of fellow elected officials, identify key drivers behind past successful projects and define practical aspects of Lynchburg vision statement. By have a list of these items it will allow Council to better match interests and models of success so City government is functioning at its highest capacity.

// Choosing Priorities for FY 2019 and FY 2020. After the discussion, City Council met in groups to determine the City's priorities for the coming fiscal year. The top priorities identified by Council:

1. Adoption and Implementation of 2019 - 2023 Economic Development Plan
2. Improve Public Schools K-12
3. Bridging Poverty and Progress Programs
4. Long Range Financial Planning
5. Police Recruitment, Retention, Right-Sizing all City Departments
6. Adoption and Implementation of the 2040 Downtown Master Plan

104

Most priorities overlapped between the groups with a deep discussion. Council was encouraged to look at different opinions as a positive and incorporate all perspectives when looking at various issues

// Mayor Tweedy closed out the meeting by emphasizing the importance of including all Lynchburg residents in conversations about the City's future. Mayor Tweedy stated "I just want us to be intentional and inclusive in our conversations going forward". If we don't have those deliberate conversations and that intentionality for some of those groups throughout our communities, it can stick with them for a long time.

// City Manager Bonnie Svrcek stated Staff will process the information gathered in the Council Retreat discussion and present it to the City Leadership Team very soon for them to talk about. Ms. Svrcek went on to say the goals of the Council Retreat included learning about each other and setting priorities.

// The City Council Retreat meeting was adjourned at 3:15 P.M.

# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018**

AGENDA ITEM #: **11**

CONSENT:  
ACTION: **X**

REGULAR: **X**  
INFORMATION:

WORK SESSION:

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: Graves Mill Road Corridor Improvement Study**

**KEY ELEMENTS:**

\_\_\_Economic Development \_\_\_Excellent Government **X** Natural and Built Environment \_\_\_Safe Community \_\_\_Vibrant Community

**RECOMMENDATION:** Approval of the Graves Mill Road Corridor Improvement Study as part of the *Comprehensive Plan 2013-2030*.

**SUMMARY:** The Graves Mill Road Corridor Improvement Study was prepared by EPR, PC, in partnership with the Central Virginia Metropolitan Planning Organization, Region 2000 Local Government Council, the Virginia Department of Transportation, the City of Lynchburg, and Bedford County. Recommendations of the plan include a variety of short term and priority projects designed to accommodate a wide array of users while enhancing traffic flow and providing for pedestrian safety.

A summary of projects is listed on pages 29-30 of the study, but this includes projects in both Bedford County and the City. Projects proposed within the City are as follows:

### Short Term Recommendations

- Convert the protected westbound left turn lane to a protected-permissive left using a flashing yellow arrow from Graves Mill Road to Old Graves Mill Road.
- Implement coordinated and adaptive control measures for all signals.
- Extend eastbound and westbound left turn lanes for the 501 ramp intersections by 75'.

### Priority 1 Projects

- Widen Graves Mill Road to accommodate a single westbound turn lane with protected-permissive left using a flashing yellow arrow.
- Improved 501 southbound ramps with lane widening, lane reconfiguration and study implementation of flashing yellow arrows to mitigate angle crashes.

### Priority II Projects

- Widen the connector at Creekside Drive to accommodate dual northbound right turn lanes and install pedestrian crossings.
- Install a single-lane roundabout with eastbound slip lane, sidewalks and pedestrian crossings at McConville Road.
- Provide eastbound right turn lane and modify access points at Millrace Drive.
- Provide landscaped median with left turn lanes at key intersections from Millrace Drive to City limits. Include multi-use path or sidewalk.

### Priority III Projects

- Provide an additional eastbound thru lane and sidewalks from Old Graves Mill Road to Creekside Drive.
- Widen Graves Mill Road at Graves Mill Road to accommodate dual westbound left turn lanes.
- Construct a "Diverging Diamond Interchange" (DDI) at Graves Mill Road and 501.

### Development Driven Projects

- Complete sidewalks along Graves Mill Road as part of the Rosedale mixed use development.
- As an alternative to sidewalks consider (with public input) a multi-use path that would extend to each end of Graves Mill Road.
- Improve roadway lighting from Millside Drive to McConville Road.
- Prioritize transit stops along Graves Mill Road.

- Rosedale site entrance should consist of dual eastbound left turn lanes and dual southbound left turn lanes, with single westbound and southbound right turn lanes. Install pedestrian crossings.
- Roundabout at McConville Road could be programmed as additional development occurs along Nationwide Drive.

PRIOR ACTION(S):

July 11, 2018:

The Planning Division recommended adoption of the Graves Mill Corridor Study.

The Planning Commission recommended adoption of the Graves Mill Corridor Study (6-0, with 1 member absent, Lowe)

FISCAL IMPACT:

N/A

CONTACT(S):

Scott Smith, Transportation Planning Director, Region 2000 – 434-845-3491

Tom Martin, City Planner – 434-455-3900

Kent White, Community Development Director – 434-455-3900

ATTACHMENT(S):

- Resolution
- Planning Commission Minutes – July 11, 2018
- Planning Commission Packet – July 11, 2018
  - o Planning Commission Report
  - o Speaker Signup Sheet
- Graves Mill Road Corridor Improvement Study (as a separate file due to size)

REVIEWED BY:

raw



RESOLUTION:

A RESOLUTION ADOPTING THE GRAVES MILL ROAD CORRIDOR IMPROVEMENT STUDY INTO AND AS A PART OF THE CITY'S COMPREHENSIVE PLAN 2013-2030.

BE IT RESOLVED BY THE COUNCIL OF THE CITY OF LYNCHBURG that the Graves Mill Road Corridor Improvement Study, be, and the same is hereby approved and adopted as part of the City's Comprehensive Plan 2013-2030.

Adopted:

Certified:

\_\_\_\_\_  
Clerk of Council

091K

**MINUTES OF THE JULY 11, 2018 PLANNING COMMISSION MEETING (MINUTES HAVE NOT BEEN APPROVED):**

**Petition of the City of Lynchburg to adopt the Graves Mill Corridor Improvement Study as part of the City's *Comprehensive Plan 2013-2030*. The study recommends improvements to traffic operations, safety, and multimodal elements, including measures such as additional turn lanes, adaptive and coordinated signal controls, and a multi-use path. The plan also recommends a roundabout at the intersection of McConville Road & Graves Mill Road and a diverging diamond interchange along the Graves Mill Road/US 501 Expressway Bridge.**

Mr. Bill Wuensch of EPR, PC was available to summarize the study. He stated that his firm has been working with Central Virginia Metropolitan Planning Organization (CVMPO), Region 2000 Local Government Council, the Virginia Department of Transportation (VDOT), the City of Lynchburg and the County of Bedford over the last several months. The study formally goes from Gristmill Drive to McConville Road along Graves Mill Road, including the expressway interchange.

The goals and expected outcomes of the plan are to evaluate current multimodal travel and safety conditions; to assess the impact of planned developments within the study area; to evaluate future multimodal opportunities; to recommend improvements and strategies to improve operations and safety and to line up improvements with potential funding sources.

Mr. Wuensch outlined the project process. The first step was to collect data. Next they projected travel demands (considering planned developments). There was an existing and future conditions analysis. They then developed some proposed preliminary improvements and strategies. Next they held two community meetings where they presented an existing conditions overview and obtained feedback on issues and opportunities. They also share preliminary recommendations at these meetings. Lastly, they developed a final project list and summary report.

Mr. Wuensch commented that the public meetings were well attended with extensive news coverage. The theme of the meetings was that the citizens were glad that everyone is "getting in front of development." The topic of congestion dominated the discussion but there was also a focus on bicycle and pedestrian mobility options. There were numerous recommendations to also study Old Graves Mill Road. Mr. Wuensch mentioned that summary memos of the meetings were available on the website.

They first looked at a "no build" scenario and received input from the first community meeting. They then developed and evaluated numerous preliminary concepts. They then developed and evaluated numerous preliminary concepts and vetted those at a second community meeting. They then finalized a project list.

One of the recommendations is to widen Graves Mill Road near Home Depot and extend that back to Creekside Drive. The models show that if there are two right turn lanes getting on to the expressway ramp, the traffic will be dispersed and reduce the queuing situation that is going on there now. Another recommendation is to provide a channelized southbound right turn lane off the ramp in the same area. This is being called an early action Priority I recommendation because it will start to unlock some of the congestion at the expressway.

Another Priority I recommendation is to provide a single westbound left turn lane at Gristmill Drive and to provide dual northbound right turn lanes. Pedestrian accommodations are also recommended. This recommendation works well with another recommendation in the 221 Corridor Study for an additional approach lane. That approach lane is already funded and under design. Commissioner Bowden asked why they are recommending two right turn lanes but only one left turn lane. Mr. Wuensch said it seems to fit in better. If we can require less green time for the traffic coming from Gristmill Drive, it provides more green time for the traffic turning left.

Mr. Wuensch discussed some Priority II recommendations: Provide dual northbound right turn lanes at Creekside Lane, install pedestrian crossing and countdowns, install a roundabout at McConville Road and maintain the eastbound right slip lane, provide an eastbound right turn lane at Millrace Drive and consider bringing north side driveway into signalization.

Some additional Priority II recommendations are to provide a landscaped median with turn lanes between Millrace Drive and Millside Drive. The median would connect with the westbound lane at Millrace Drive and support Millside Drive improvements. There is a recommendation to include a multiuse path or sidewalk along the south side of Graves Mill Road.

Mr. Wuensch discussed some Priority III recommendations: Provide an additional eastbound through lane beginning west of Old Graves Mill Road; provide dual westbound left turn lanes at Old Graves Mill Road and provide pedestrian accommodations at Old Graves Mill Road when sidewalks are installed.

Commissioner Bowden noted that there are problems at Old Graves Mill Road and the Old Graves Mill Road Extension. Mr. Wuensch indicated that they had to take conditions there into consideration in their models even though it was not part of the study area. They had to make some assumptions about improvements there in the future. If the grades allow, it could be a roundabout or a bigger intersection altogether. They noted that it will need more study in the future.

Some additional Priority III recommendations are to construct a diverging diamond interchange at 501, implement the replacement of the existing bridge and ensure the new bridge is wide enough to accommodate a multiuse path or sidewalks. The current recommendations do not preclude the diverging diamond interchange.

The commissioners were in consensus that the plan was well thought out and they liked how the recommendations make the plan more attractive to outside funding sources. Chair Perault asked if there was anyone who wished to speak in favor of the petition. No one came forward. He asked if there was anyone who wished to speak in opposition to the petition. No one came forward. He closed the public hearing portion of the petition.

Commissioner Marion made the following motion, which was seconded by Commissioner Bowden, and passed by the following vote:

**"That the Planning Commission recommends to City Council the adoption of the Graves Mill Road Corridor Improvement Study as part of the City's *Comprehensive Plan 2013-2030*."**

|              |                                                    |   |
|--------------|----------------------------------------------------|---|
| AYES:        | Bowden, Johnson, Light, Perault, Marion and Rogers | 6 |
| NOES:        |                                                    | 0 |
| ABSTENTIONS: |                                                    | 0 |
| ABSENT:      | Lowe                                               | 1 |

# **The Department of Community Development**

**City Hall, Lynchburg, VA 24504** **434-455-3900**

---

**To:** Planning Commission  
**From:** Planning Division  
**Date:** July 11, 2018  
**Re:** Graves Mill Road Corridor Improvement Study

---

## **I. PETITIONER**

Central Virginia Metropolitan Planning Organization

**Representative:** Scott Smith, Transportation Planning Director, Virginia's Region 2000 Local Government Council, 828 Main Street, 12<sup>th</sup> Floor, Lynchburg, Virginia 24504

## **II. LOCATION**

The study area extends along Graves Mill Road from Gristmill Drive in Bedford County to McConville Road in the City of Lynchburg.

## **III. PURPOSE**

The purpose of the petition is to adopt the study as part of the City's Comprehensive Plan 2013-2030.

## **IV. SUMMARY**

- The *Comprehensive Plan 2013-2030* lists Graves Mill Road as an Urban Arterial. The only major transportation project indicated with the adoption of the Plan was the non-funded project of connecting Lillian Lane and Stonemill Drive.
- The *Comprehensive Plan 2013-2030* indicates Graves Mill Road as part of the Graves Mill Road Business/Technology & Employment Area.
- Graves Mill Road should continue to accommodate a wide variety of users, while maintaining and enhancing traffic flow and balancing multi-modal accessibility.

**The Planning Division recommends adoption of the Graves Mill Road Corridor Improvement Study as part of the City's *Comprehensive Plan 2013-2030*.**

---

## **V. FINDINGS OF FACT**

1. **Comprehensive Plan.** The *Comprehensive Plan 2013-2030* includes Graves Mill Road within the Graves Mill Road Business/Technology & Employment Area. For these areas, the Plan encourages the efficient use of developable lands, the preservation of natural buffer zones between industrial and surrounding residential uses, the discouragement of large-scale retail uses in areas better suited to industrial development, and the gradual removal of isolated residential uses within the areas. By encouraging the clustering of similar uses in these designated areas, the City seeks to preserve and expand the City's employment base, concentrate infrastructure investment, and minimize potential use conflicts. While limited commercial use may be appropriate to serve the needs of employers and employees in these areas, permitting a broad mix of uses is not recommended. Given the size and location of the Graves Mill area, a mixed use core with higher density residential development and retail uses is appropriate for the area south and west of the interchange of Graves Mill Road and the Lynchburg Expressway.  
(pp.69-70)



2. **Zoning.** Properties fronting Graves Mill Road are primarily zoned for Industrial, Office or Commercial purposes. There is one portion land zoned for R-C, Conservation uses on the south side of Graves Mill Road, west of Old Graves Mill Road. There is also a tract of land zoned R-1, Low Density Residential east of and adjacent to Tomahawk Creek. Adoption of the study would not change the underlying zoning and would support existing and planned uses along the corridor.
3. **Board of Zoning Appeals (BZA).** N/A
4. **Surrounding Area.** There have been a several items requiring City Council approval in the immediate area:
  - On February 9, 1982, Council approved the petition of Robert Taylor to rezone 905 Graves Mill Road from I-1, Restricted Industrial District to I-2, Light Industrial District to allow the construction of a retail sales and millwork manufacturing facility.
  - On October 13, 1992, Council adopted the Graves Mill Road/US 221 Study. This study amended zoning for several parcels in the area.
  - On August 12, 1986, Council approved the petition of Dreaming Creek Properties to rezone 1301 Old Graves Mill Road from I-1, Restricted Industrial District to B-5C, General Business District (Conditional) and a Conditional Use Permit to allow the construction of offices, showrooms and warehouses.
  - On December 8, 1987 Council rezoned the property along the western intersection of the Lynchburg Expressway and Graves Mill Road from R-1, Low Density Residential to R-4, Multi-Family Residential and B-5C, General Business District (Conditional) to allow for speculative development of the area.
  - On December 11, 1990, Council approved the petition of Frank Davidson to rezone 1301 Old Graves Mill Road from B-5C, General Business District (Conditional) to B-5C, General Business District (Conditional) to amend previously approved proffers.
  - On January 12, 1999, Council approved the petition of Petrie, Dierman and Kughn to rezone the property located at 7902 Graves Mill Road and 2000 Creekside Drive from R-4, Multi-Family Residential and B-5C, General Business District (Conditional) and a Conditional Use Permit to allow fill in the 100 year floodplain to allow the construction of a shopping center and parking area.
  - On September 12, 2000, Council approved the Conditional Use Permit petition of First Assembly of God to allow the construction of a church at 1208 Graves Mill Road.
  - On December 12, 2000, Council approved the Conditional Use Permit petition of Lowe's Home Centers Inc. to allow fill within the 100 Year Floodplain at 7902 Graves Mill Road.
  - On August 13, 2002, Council approved the Conditional Use Permit petition of Miller-Mottee Technical College to allow a college for up to two hundred fifty (250) students at 1011 Creekside Drive.
  - On July 13, 2004, Council approved the Conditional Use Permit petition of Home Depot to allow fill within the 100 Year Flood Plain at 1200 Graves Mill Road.

- On January 11, 2005, Council approved the Conditional Use Permit petition of Millside Development, LLC to allow the construction of a Cluster Commercial Development at Graves Mill Road and Lillian Lane.
  - On February 14, 2006, Council approved the petition of Dry River Investments, LLC at for a Conditional Use Permit to allow the construction of a building across the City/County Boundary Line at 1740 Graves Mill Road.
  - On August 11, 2009, Council approved the Conditional Use Permit petition of JMU, LLC at 1700 Graves Mill Road to allow the construction of a fifty (50) unit townhome development.
  - On March 8, 2011, Council approved the petition of O’Keeffe & Spies for a third and final Conditional Use Permit Extension to allow the construction of a fifty (50) unit townhome development at 1700 Graves Mill Road.
  - On April 8, 2014, Council approved the petition of Rosedale Farms LLC and Bella Rose Plantation LLC to rezone 1600 and 1220 Graves Mill Road from R-1, Low Density Residential and B-5C, General Business District (Conditional) to B-3C, Community Business District (Conditional) and approved a Conditional Use Permit to allow a Cluster Commercial Development.
  - On March 10, 2015, Council approved the Conditional Use Permit petition of Rosedale Farm LLC, to add the addition of a 3<sup>rd</sup> & 4<sup>th</sup> Phase and roundabout to the previously approved Cluster Commercial Development.
  - On March 24, 2015, Council approved the petition of David Moore to rezone the property located at 1001 and 1005 Creekside Lane from B-5C, General Business District (Conditional) to B-5C, General Business District (Conditional) to amend previously approved proffers.
  - On April 11, 2017, Council approved the Conditional Use Permit petition of Bella Rose Plantation, LLC to allow the amendment of the previously approved Cluster Commercial Development to allow the construction of a three (3) story event center at 1220 and 1600 Graves Mill Road.
5. **Site Description.** The study area consists of Graves Mill Road from Gristmill Drive in Bedford County to McConville Road in the City of Lynchburg. The corridor contains a mix of industrial, office, and retail uses.
  6. **Proposed Use of Property.** N/A
  7. **Traffic, Parking and Public Transit.** Final recommendations of the study can be found on pages 29-30 of the plan. The recommendations include a variety of short term and priority projects. The recommendations are designed to accommodate a wide array of users while enhancing traffic flow and providing for pedestrian safety.
  8. **Stormwater Management.** N/A
  9. **Emergency Services:** N/A
  10. **Impact.** Adoption of the study would provide the City of Lynchburg and Bedford County with a guide for improving traffic safety and enhancing the future capacity of Graves Mill Road.
  11. **Technical Review Committee.** N/A
-

## **VI. PLANNING DIVISION RECOMMENDATION**

**Based on the preceding Findings of Fact, the Planning Commission recommends to City Council the adoption of the Graves Mill Road Corridor Improvement Study as part of the City's *Comprehensive Plan 2013-2030*.**

This matter is respectfully offered for your consideration.



William T. Martin, AICP  
City Planner

pc: Ms. Bonnie M. Svrcek, City Manager  
Mr. Reid Wodicka, Deputy City Manager  
Mr. Mike Goetz, Director of Information Technology  
Mr. Walter C. Erwin, City Attorney  
Mr. Kent L. White, Director of Community Development  
Mr. J. Lee Newland, City Engineer  
Ms. Cynthia Kozzerow, Lynchburg Police Department  
Battalion Chief Thomas Goode, Fire Marshal  
Mr. Don DeBerry, Transportation Engineer  
Mr. Doug Saunders, Building Official  
Mr. Kevin Henry, Zoning Administrator  
Mr. Scott Smith, Region 2000

## **VII. ATTACHMENTS**

### **1. Graves Mill Road Corridor Improvement Study – June 14, 2018**

**Graves Mill Corridor Study**  
**July 11, 2018**

**PLEASE PRINT**

[illegible]





# GRAVES MILL ROAD CORRIDOR IMPROVEMENT STUDY

City of Lynchburg and Bedford County, Virginia

June 14, 2018  
Revised August 30, 2018

**FINAL**

# Graves Mill Road Corridor Improvement Study

June 14, 2018  
Revised August 30, 2018

**Prepared for**

Central Virginia Metropolitan Planning Organization  
City of Lynchburg  
Bedford County

**Prepared by**

**EPRPC**

902 East Jefferson Street, Suite 101, Charlottesville, VA 22902

Table of Contents

**Introduction..... 1**

Corridor Study Area ..... 1

General Description of the Study Area ..... 1

**Methodology Overview ..... 3**

Relevant Plans and Studies ..... 3

Field Observations ..... 3

Crash Analysis ..... 5

*Summary of Corridor Crashes* ..... 5

*Corridor Crash Rates* ..... 5

Traffic Analysis ..... 14

*Traffic Model Development* ..... 14

*Performance Measures* ..... 14

**Existing Traffic Conditions ..... 15**

Delay and LOS ..... 15

Queuing ..... 15

Turn Warrants ..... 16

**Traffic Forecasting..... 19**

**Future No Build Traffic Conditions..... 19**

Delay and LOS ..... 19

Queuing ..... 19

Turn Warrants ..... 20

**Public Informational Meeting #1 ..... 23**

Specific Public Comments ..... 23

**Project Development, Screening and Analysis ..... 24**

Preliminary Concepts and Ideas ..... 24

**Public Information Meeting #2..... 28**

**Final Recommendations ..... 29**

Other Considerations ..... 30

**Cost Estimates ..... 31**

**Funding Opportunities ..... 31**

Figure 1 – Study Area..... 2

Figure 2 – Multimodal Conditions ..... 4

Figure 3 –Crash Locations..... 6

Figure 4 –Corridor Crash Rates..... 10

Figure 5 – Existing (2017) Traffic Volumes ..... 17

Figure 6 – Existing (2017) LOS and Delay ..... 18

Figure 7 – Future (2040) Traffic Volumes ..... 21

Figure 8 – Future (2040) LOS and Delay ..... 22

Figure 9 – Project Development Goals ..... 24

Table 1 – Corridor Crash Statistics..... 5

Table 2 – Corridor Crash Rates ..... 5

Table 3 – Intersection Crash Rates ..... 5

Table 4– Level of Service Criteria ..... 14

Table 5– Existing Queuing ..... 15

Table 6– Existing Turn Warrants..... 16

Table 7– Future (2040) No Build Queuing ..... 19

Table 8– Future No Build Turn Warrants..... 20

Table 9 – Comprehensive Project Screening Results..... 25

Table 10 – Draft Project Summary (Pre Final Public Meeting) ..... 27

Table 11 – Final Project List ..... 29

Table 12 – Gristmill Drive Cost Estimates..... 31

Table 13 – Eastbound Right Turn Lane Extension and US 501 SB Ramp Widening Cost Estimates ..... 31

Table 14 – Smart Scale Funding..... 31

Table 15 – Highway Safety Improvement Funding..... 31

Table 16 – Transportation Alternatives Funding ..... 31

Table 17 – Revenue Share Funding ..... 32

Table 18 – Maintenance Funding ..... 32

Table 19 – Proffer Funding ..... 32

Table 20 – BUILD Funding..... 32

List of Appendix Items..... 33



## Acronyms Used in this Document

---

|       |                                                      |
|-------|------------------------------------------------------|
| BUILD | Better Utilizing Investments to Leverage Development |
| CVMPO | Central Virginia Metropolitan Planning Organization  |
| FHWA  | Federal Highways Administration                      |
| HSIP  | Highway Safety Improvement Program                   |
| HCM   | Highway Capacity Manual                              |
| LOS   | Level of Service                                     |
| MVMT  | Million Vehicle Miles Traveled                       |
| MEV   | Million Entering Vehicles                            |
| NEMA  | National Electrical Manufacturers Association        |
| SPS   | Statewide Planning System                            |
| TAC   | Technical Advisory Committee                         |
| TAP   | Transportation Alternatives Program                  |
| TAZ   | Traffic Analysis Zone                                |
| TDM   | Travel Demand Model                                  |
| TMC   | Turning Movement Count                               |
| VDOT  | Virginia Department of Transportation                |
| VPD   | Vehicles Per Day                                     |

|     |                    |
|-----|--------------------|
|     | Directions         |
| NB  | Northbound         |
| NBL | Northbound Left    |
| NBT | Northbound Through |
| NBR | Northbound Right   |
| SB  | Southbound         |
| SBL | Southbound Left    |
| SBT | Southbound Through |
| SBR | Southbound Right   |
| WB  | Westbound          |
| WBL | Westbound Left     |
| WBT | Westbound Through  |
| WBR | Westbound Right    |
| EB  | Eastbound          |
| EBL | Eastbound Left     |
| EBT | Eastbound Through  |
| EBR | Eastbound Right    |



## Introduction

Graves Mill Road, located in the City of Lynchburg and Bedford County, is an important roadway that serves large volumes of commuter traffic, while also providing access to commercial interests. Given 1) heavy traffic demand, 2) proximity to future development potential 3) interchange expressway access, and 4) its status as a key commuter route, the City of Lynchburg, Bedford County, and the Central Virginia Metropolitan Planning Organization (CVMPO) have undertaken a study to develop a plan to address existing and expected future mobility challenges along this important corridor.

The purpose of this study is to investigate existing and future traffic conditions, traffic operations, multimodal features, and safety issues along Graves Mill Road. The results of the investigation will then lead to the development of recommendations that will help to minimize congestion and improve multimodal mobility within the Graves Mill Road corridor. The key steps in the process include:

- **Existing Conditions:** existing traffic conditions as of the date of this study.
- **Future No Build Conditions:** future 2040 traffic demand under existing geometric conditions, plus the addition of any planned transportation related improvements. Future no build establishes a baseline improvements can then be compared against.
- **Future Build Conditions:** recommended improvements, vetted through a public involvement process, that accommodate 2040 traffic demand and address safety issues.
- **Funding and Implementation:** prioritization, strategies and funding opportunities.

Each step in the study informs subsequent steps and allows for the creation of a comprehensive concept plan for the transportation system that may be implemented over time. The results have been shared with the public through an interactive and transparent public engagement process, which is integral to the success of the plan, resulting in recommendations for the benefit of the citizens and businesses in the surrounding study area.

A summary of the recommended projects is included. This information is intended to aid the City, County, and CVMPO with project prioritization and implementation when grant or other funding opportunities arise in the future. It will also help to inform current development and potential development of what future transportation related projects may affect them. Projects should continue to be updated in the future as a tool to track opportunities and needs within the corridor.

## Corridor Study Area

This corridor study area extends along Graves Mill Road, from McConville Road at the eastern terminus to Gristmill Drive at the western terminus, a distance of approximately 1.6 miles. **Figure 1** provides an illustration of the study area, as well as the intersections this study examined. The study area includes the following six (6) signalized intersections and two (2) unsignalized intersection:

- Gristmill Drive (signalized)
- Millrace Drive (signalized)
- Millside Drive (unsignalized)
- Old Graves Mill Road (signalized)
- Creekside Drive (signalized)
- US501 eastbound interchange ramps (signalized)
- US501 westbound interchange ramps (signalized)
- McConville Road (unsignalized)

## General Description of the Study Area

Graves Mill Road is a four-lane undivided roadway from Gristmill Road east to The US 501 Expressway (“501”), where it then becomes a divided four-lane roadway to McConville Road. Graves Mill Road is classified as a minor arterial and designed for “through” and local traffic. The posted speed limited ranges from 35 miles per hour (mph) near Gristmill Road in Bedford County, to 45 mph along the middle section west of Old Graves Mill Road, down to 35 mph east to McConville Road in the City of Lynchburg. The Virginia Department of Transportation (VDOT) reports that the 2016 average daily traffic (ADT) counts are approximately 26,000 vehicles per day (VPD) between 501 and Old Graves Mill Road, and 21,000 VPD west of Old Graves Mill Road. East of the interchange the ADT is 9,100 VPD.

Graves Mill Road is a unique, albeit important transportation facility as it serves many functions and users. It is geographically situated between the 501 to the east and US 221 (“221”) to the west. Collectively, these corridors are critical to the City’s economic health and quality of life. As such, Graves Mill Road serves many purposes including:

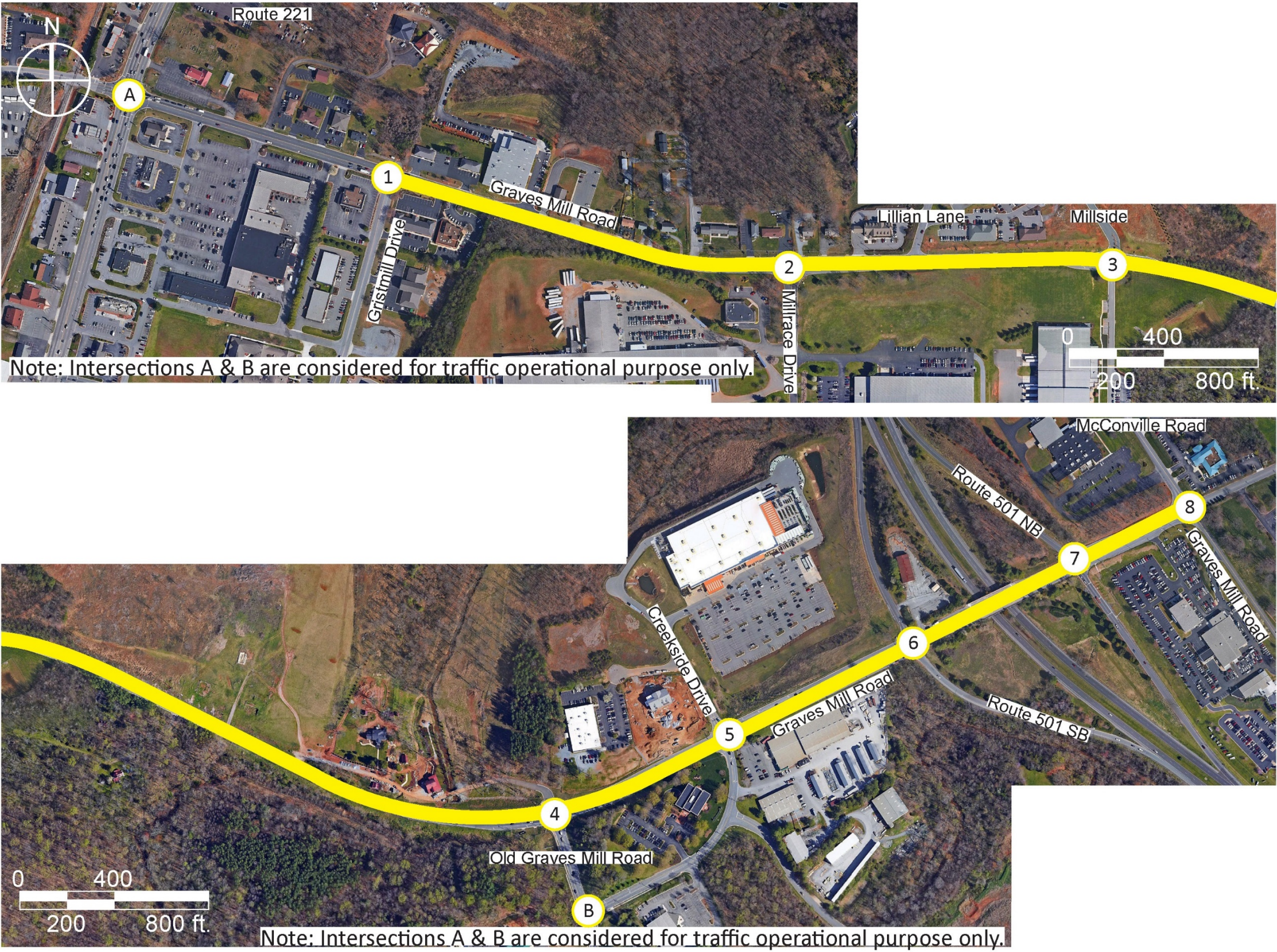
- Local residential and shopping access
- School related traffic
- Local and regional truck traffic
- Employment commuting
- Some pedestrian and transit activity
- Local business access
- Emergency and security response

Graves Mill Road must continue to accommodate a wide array of users with varying trip purposes. Maintaining and enhancing traffic flow within the corridor is of crucial importance, as well as balanced multi-modal accessibility. Access to future development should also be planned for and designed to ensure that it does not impede or further restrict traffic flow.





Figure 1 – Study Area





## Methodology Overview

This corridor planning study includes a multifaceted approach that consisted of assemblage of relevant plans and studies, detailed field review, crash analysis, development of a traffic model, and assessment of performance measures. Collectively, these elements may uncover existing deficiencies in the network, and provide a baseline on which future conditions can then be established upon.

### Relevant Plans and Studies

Relevant studies and plans that have been completed in the study area have been collected and reviewed. The following provides a summary of each:

City Comprehensive Plan – The City of Lynchburg completed a land use and population analysis as part of their Comprehensive Plan. The Graves Mill Road corridor is generally flanked by industrial, commercial and institutional uses, with residential beyond. One important note in the City is the shift in population growth. Over the first decade of the 21st century, the City began to capture a greater share of the region’s growth, increasing by a percentage that exceeded every county in the region and the state as a whole – with the highest growth areas in the southern portions of City served by Graves Mill Road.

The City has also developed a Plan Framework Map that highlights the City’s primary commercial and mixed use corridors. As important local and regional travel routes and commercial destinations, these areas strongly influence the City’s accessibility, attractiveness, and economic vitality. This map identifies the Graves Mill Road area as a business/technology and employment growth area.

Rosedale Farms Development – The proposed development is located just west of the existing Home Depot side off of Graves Mill Road in the City of Lynchburg. The proposed site includes three entrance locations on Graves Mill Road – one right in only, one right out only and one full entrance. The site is planned to be constructed in three phases with an ultimate build-out year of 2024. The proposed land uses include a mix of residential, office, retail, grocery, service and restaurant land uses with the potential to generate over 15,000 new daily trips.<sup>1</sup>

Elements at Old Graves Mill Road – The proposed development is located on Old Graves Mill Road, approximately 500’ south of Graves Mill Road in the City of Lynchburg. The site will have one entrance to Old Graves Mill Road. The site is currently moving forward with construction and will include a mix of residential and office land uses with the potential to generate over 2,000 new daily trips. While many trips are expected to head south along Old Graves Mill Road, some will travel north to Graves Mill Road to access either US501 or US221.<sup>2</sup>

### Field Observations

A detailed field review was conducted on Friday, August 18<sup>th</sup>. Subsequent field reviews were conducted thereafter as needed. These observations examined traffic patterns and queues for each approach, driver behavior and decision factors, pedestrian use, signage, signal operations and other relevant transportation characteristics. Key observations include:

- The intersection of Gristmill Drive experienced a relatively significant amount of westbound queuing (making the left off Graves Mill Road). No dedicated left turn lane is provided; therefore, vehicles are observed queuing back and drivers familiar with the intersection are typically in the right lane well before the approach. This ultimately creates a de facto turn lane and the westbound through movement functions as a single lane.
- Drivers use Gristmill Drive as a bypass for the 221/Graves Mill Road intersection. In fact, based off observations, the majority of drivers using Gristmill Drive did not access the adjacent commercial and business uses during the peak hours.
- Continuing east from Gristmill Drive, traffic demand appeared higher, compared to between Gristmill Drive and 221 (supports the bypass use).
- High speeds were observed (>50 miles per hour) between Millrace Drive and Old Graves Mill Road, even during more congested times of day. This section of Graves Mill Road has fewer driveways and the alignment allows for higher speeds.
- Approaching Old Graves Mill Road and Creekside Drive, lane utilization will need to be a consideration, particularly in the eastbound direction approaching the 501 ramps. Lane bias was observed as queues were substantially longer in the right lane. The eastbound queue in the right lane consistently did not clear the intersection at Creekside Drive. The beginning of this queue was the eastbound right at the 501 southbound ramp.
- Outside of the eastbound movement at the southbound ramp, the remaining approaches appeared to function reasonably well. There was moderate southbound right queuing observed at the 501 southbound ramp, and the eastbound left turn lane backed up to Graves Mill Road at the 501 northbound ramp. The northbound approach off 501 cleared for nearly every cycle though during a short duration, some vehicles appeared to not clear.
- From a signal operations perspective, the timings for the ramp intersections could be improved.
- The four-way stop at McConville Road processed traffic reasonably well, though right at 5:00 PM for the rush it backed up for about a 10-minute period (4 or 5 car queuing).
- The office park east of McConville Road is generally built out; however, there is one large parcel remaining that once developed, could generate more traffic.
- No bicyclists were observed, and only one pedestrian was observed waiting at a bus stop just east of Gristmill Drive. Sidewalks are only installed along Graves Mill Road along the south side east of Gristmill Drive, and along the north side east of Old Graves Mill Road.
- A cluster of bus stop were located along the south side of Graves Mill Road east of Millrace Road. No accommodations (benches, trash cans, pad, shelter) were provided at the stops, only a sign.

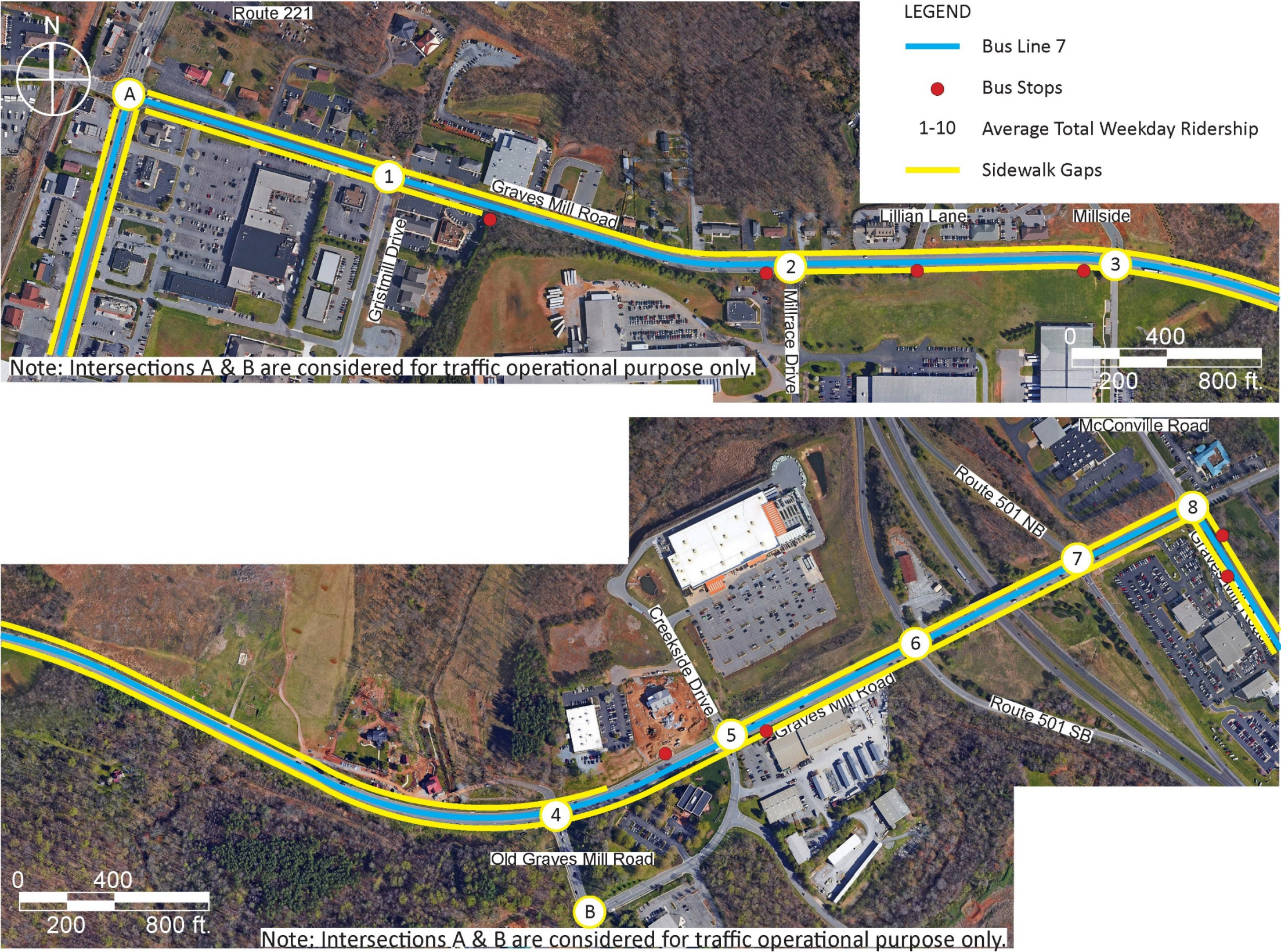
**Figure 2** illustrates the multimodal conditions along the corridor.

<sup>1</sup> Rosedale Farms Traffic Impact Analysis, November 2013 (revised January 2014).

<sup>2</sup> Elements at Old Graves Mill Road Traffic Impact Analysis, June 2016 (supplemental revision August 2016).



Figure 2 – Multimodal Conditions





Crash Analysis

A crash analysis was performed on the Graves Mill Road study corridor using crash data from the VDOT Roadway Network System (RNS). The crash data covered the period from January 1, 2012 to December 31, 2016 and was used to identify crash patterns based on crash severity, roadway characteristics, and environmental characteristics. The complete crash data is provided in the **Appendix**.

Summary of Corridor Crashes

142 total crashes were reported within the study area over the six-year crash analysis period. Of the reported crashes, 100 involved property damage only and 31 involved injuries. There was one fatality involving an angle collision at Gristmill Drive in 2013. A total summary of the crashes, by type, is shown in **Table 1**.

Table 1 – Corridor Crash Statistics

| Year  | Rear End | Angle | Fixed Object | Side-swipe | Head On | Other | Deer | Total |
|-------|----------|-------|--------------|------------|---------|-------|------|-------|
| 2011  | 11       | 7     | 3            | 1          | 1       | 1     | 1    | 25    |
| 2012  | 9        | 8     | 1            | 2          | 0       | 1     | 0    | 21    |
| 2013  | 9        | 6     | 0            | 0          | 1       | 1     | 1    | 18    |
| 2014  | 11       | 7     | 4            | 1          | 0       | 0     | 0    | 23    |
| 2015  | 14       | 8     | 2            | 1          | 1       | 0     | 0    | 26    |
| 2016  | 15       | 8     | 2            | 2          | 1       | 1     | 0    | 29    |
| Total | 69       | 44    | 12           | 7          | 4       | 4     | 2    | 142   |

The total number of crashes by year illustrate a concerning trend. From 2011, the number of crashes occurring along the corridor were steadily reducing, bottoming in 2013. From 2013, the number of crashes began to steadily increase, peaking in 2016 at a rate that significantly outpaces growth in traffic levels. In fact, the number of annual crashes have increased by approximately 60% between 2013 and 2016, while historical traffic indicates traffic levels increased by less than 10%. Unfortunately, this could reflect a national trend and is largely blamed on distracted drivers using cell phones. That, combined with increasing congestion, exacerbates safety conditions.

Corridor Crash Rates

Crash rates can be an effective tool to measure the relative safety at a particular location or segment along a corridor. They account for roadway characteristics such as segment length, number of crashes, and traffic demand; thereby, allowing for a “weighted” comparison of locations. Crash rates are expressed as "crashes per Million Entering Vehicles" (MEV) for intersection locations and as "crashes per Million Vehicle Miles Traveled" (MVMT) for roadway segments. VDOT maintains local (City of Lynchburg) and statewide roadway crash rates by facility type that can be used for comparison. **Table 2** illustrates how individual segments along Graves Mill Road compare to state and local average rates.

Table 2 – Corridor Crash Rates

| Segment                              | Segment Rate | VA Hwy Rate | Lynchburg Hwy Rate | VA Minor Arterial Rate |
|--------------------------------------|--------------|-------------|--------------------|------------------------|
| Gristmill Dr. to Millrace Dr.        | 324          | Higher      | Higher             | Higher                 |
| Millrace Dr. to Millside             | 259          | Higher      | Higher             | Higher                 |
| Millside to Old Graves Mill Rd.      | 68           | Lower       | Lower              | Lower                  |
| Old Graves Mill Rd. to Creekside Dr. | 176          | Higher      | Higher             | Higher                 |
| Creekside Dr. to 501 SB Ramps        | 327          | Higher      | Higher             | Higher                 |
| 501 SB Ramps to 501 NB Ramps         | 244          | Higher      | Higher             | Higher                 |
| 501 NB Ramps to McConville Rd.       | 274          | Higher      | Higher             | Higher                 |

With the exception of Graves Mill Road between Millside Drive and Old Graves Mill Road, the corridor exhibits crash rates that are higher than state and local average rates. The likely reason the one segment is lower is that there are few driveways limiting vehicle conflict points. **Table 3** summarizes the intersection crash rates along Graves Mill Road.

Table 3 – Intersection Crash Rates

| Intersection         | Intersection Rate | Rank |
|----------------------|-------------------|------|
| Gristmill Drive      | 0.23              | 3    |
| Millrace Drive       | 0.28              | 2    |
| Millside Drive       | 0.05              | 8    |
| Old Graves Mill Road | 0.10              | 6    |
| Creekside Drive      | 0.40              | 1    |
| 501 SB Ramps         | 0.09              | 7    |
| 501 NB Ramps         | 0.11              | 5    |
| McConville Road      | 0.11              | 4    |

Clearly, the intersections of Creekside Drive, Millrace Drive, and Gristmill Road stand out among the eight (8) intersections. Creekside Drive experiences heavy peak hour congestion and queues consistently extend from the 501 SB ramps, back through the intersection to Old Graves Mill Road. Gristmill Road also experiences heavy peak hour congestion due to the lack of a westbound dedicated left turn lane, plus heavy northbound right turning movements. Millrace Drive stands out because it doesn’t serve a high number of turning movements, but high speed is likely a contributing factor as most of the crashes are rear ends.

The locations of crashes and corridor crash rates are illustrated on **Figures 3** and **4**, respectively. To note, the number identified on Figure 3 for each location is a unique identifier, not the number of crashes.



Figure 3 –Crash Locations



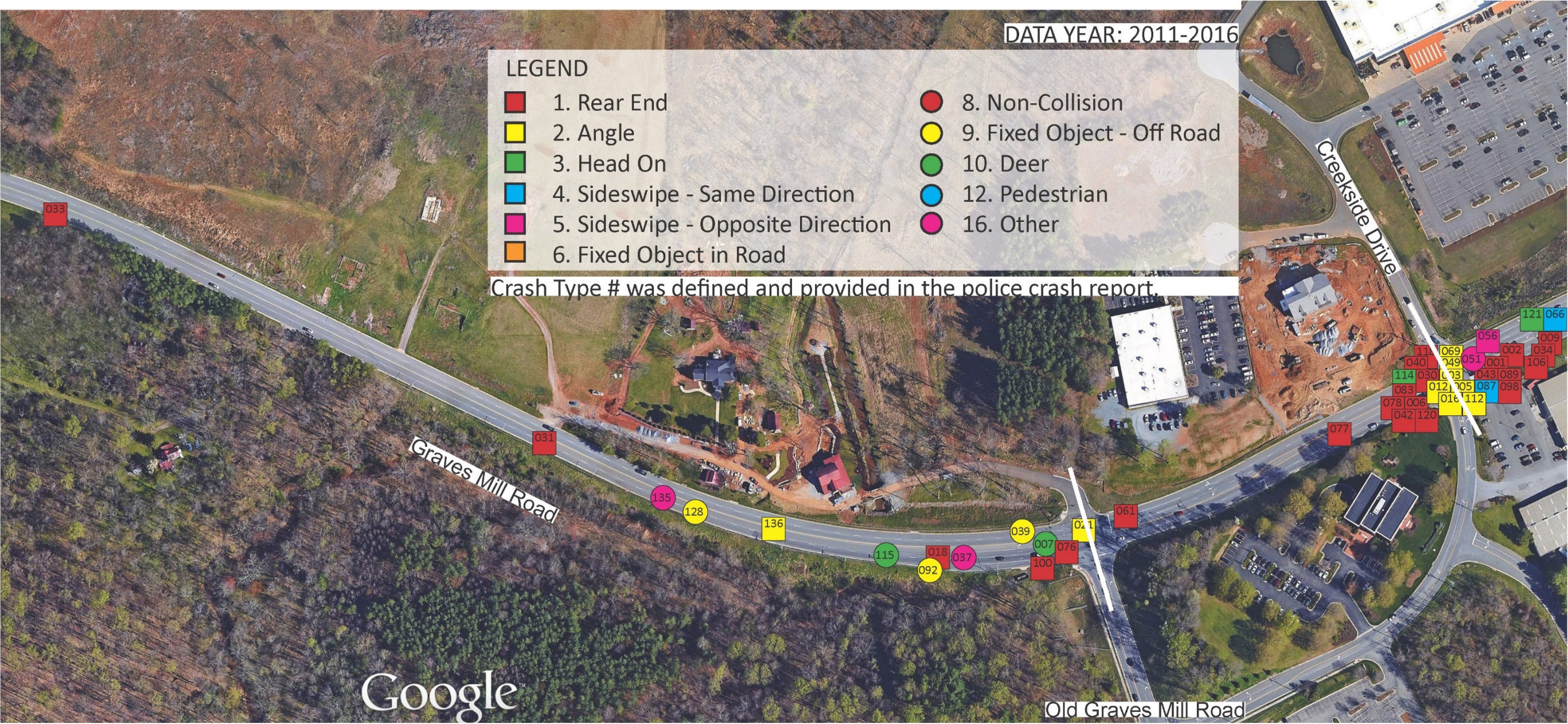


Crash Location Figure Continued





Crash Location Figure Continued





Crash Location Figure Continued

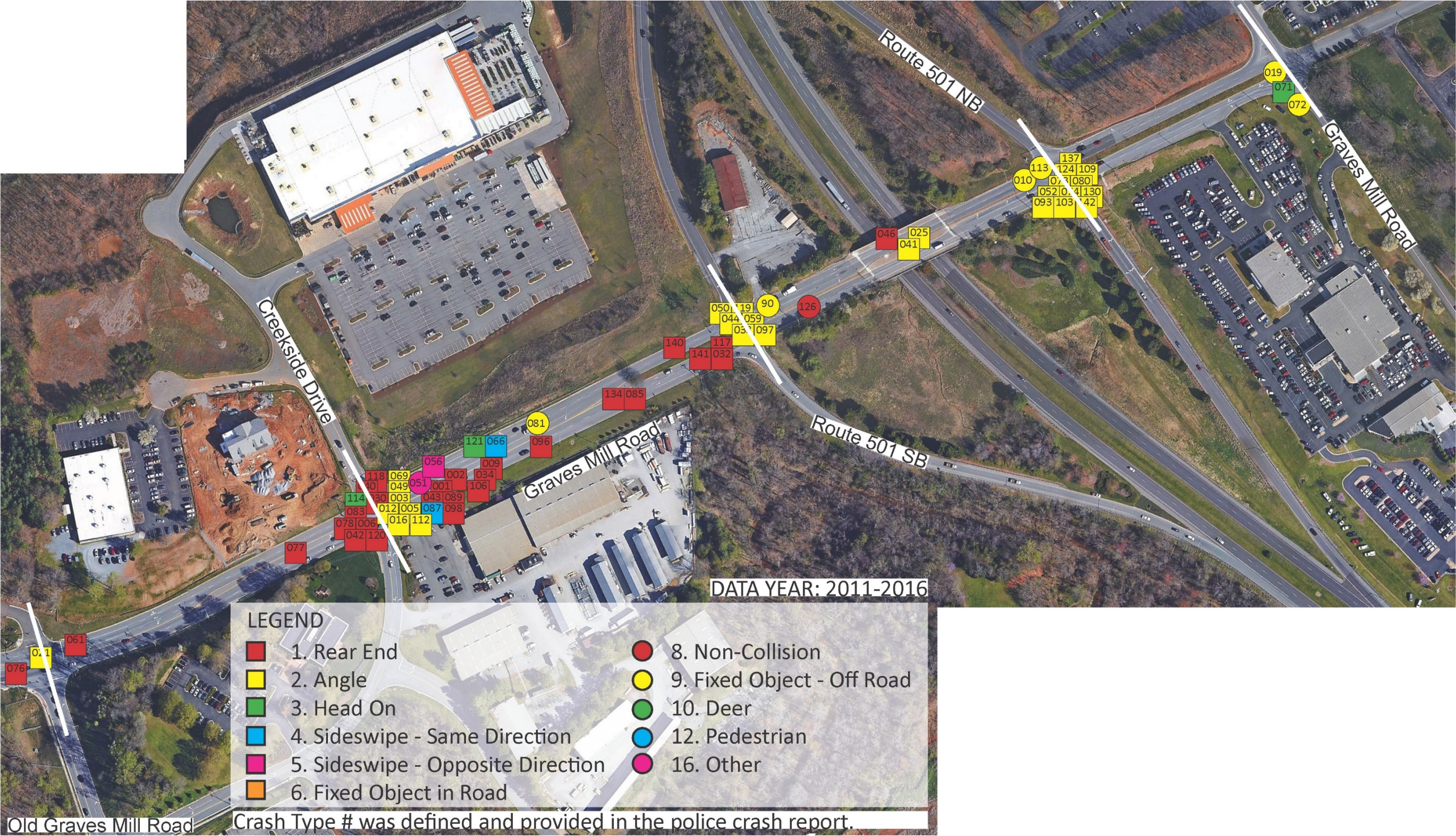
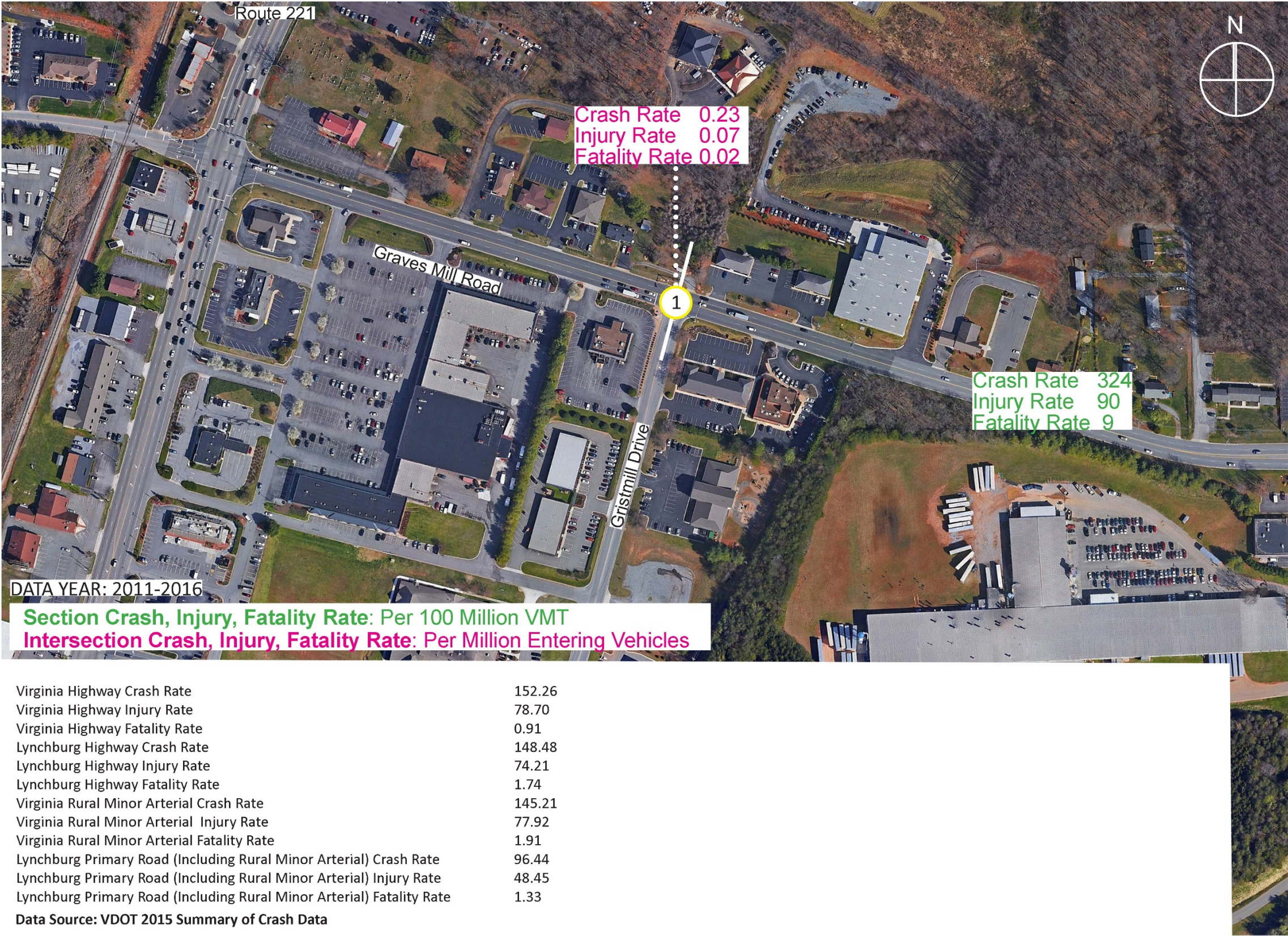


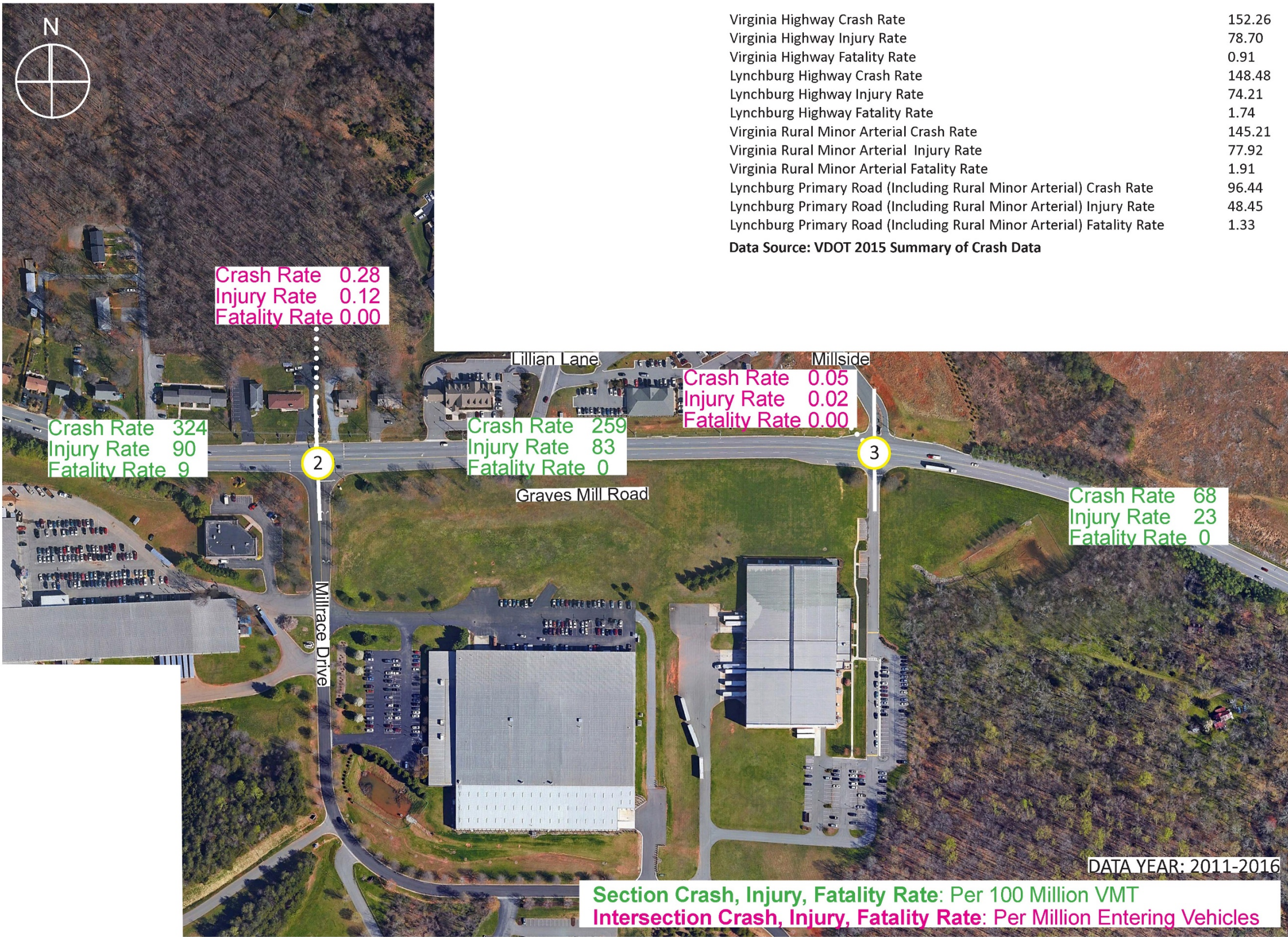


Figure 4 –Corridor Crash Rates





Corridor Crash Rates Figure Continued





Corridor Crash Rates Figure Continued

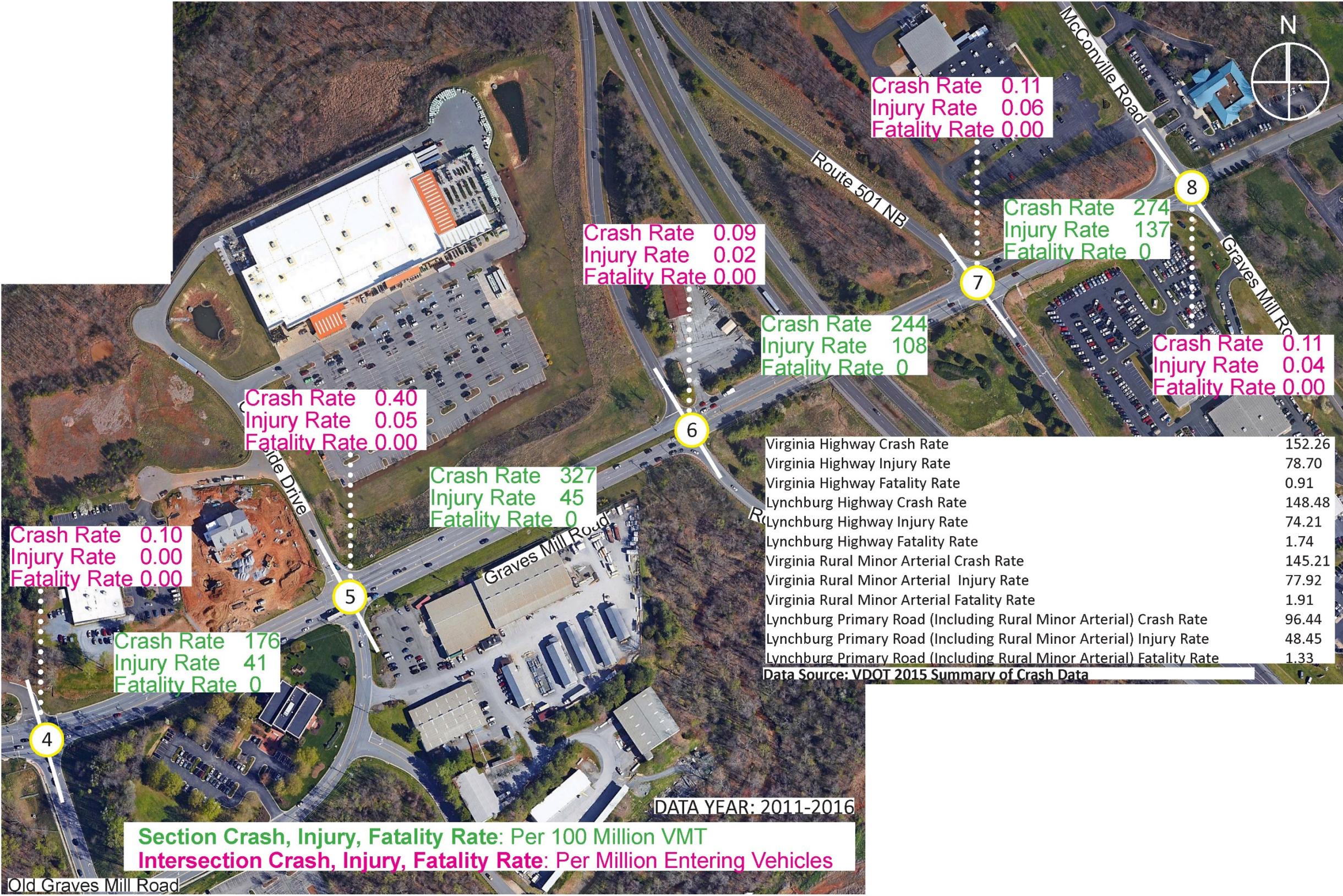
|                                                                       |        |
|-----------------------------------------------------------------------|--------|
| Virginia Highway Crash Rate                                           | 152.26 |
| Virginia Highway Injury Rate                                          | 78.70  |
| Virginia Highway Fatality Rate                                        | 0.91   |
| Lynchburg Highway Crash Rate                                          | 148.48 |
| Lynchburg Highway Injury Rate                                         | 74.21  |
| Lynchburg Highway Fatality Rate                                       | 1.74   |
| Virginia Rural Minor Arterial Crash Rate                              | 145.21 |
| Virginia Rural Minor Arterial Injury Rate                             | 77.92  |
| Virginia Rural Minor Arterial Fatality Rate                           | 1.91   |
| Lynchburg Primary Road (Including Rural Minor Arterial) Crash Rate    | 96.44  |
| Lynchburg Primary Road (Including Rural Minor Arterial) Injury Rate   | 48.45  |
| Lynchburg Primary Road (Including Rural Minor Arterial) Fatality Rate | 1.33   |

Data Source: VDOT 2015 Summary of Crash Data





Corridor Crash Rates Figure Continued





Traffic Analysis

Intersection turning movement counts (TMCs) at each study area intersection were collected on September 6 – 7, 2017 on clear days while local schools were in session. TMCs were collected during the AM peak period from 7:00 – 9:00 AM, and during the PM peak period from 4:00 – 6:00 PM. All traffic counts are provided in the **Appendix**.

All AM and PM TMCs were totaled by 15-minute and one-hour increments. To be more conservative and ensure operations unique to each intersection are captured, the individual intersection AM and PM peak hour was used for the purposes of this study. For most intersections, the peak hours fell between 7:30 – 8:30 AM, and 5:00 – 6:00 PM, with a few deviating by 15 minutes. Heavy vehicle counts were also collected at each study intersection as part of the data collection process. Heavy vehicle percentages were calculated for each movement at all study area intersections during the AM and PM peak hours. In general, truck percentages on Graves Mill Road ranged from one to two percent. However, individual turning movements experience higher truck percentages at several locations in the corridor due to lower total volume.

The Graves Mill Road corridor contains multiple access points and parking lots located between the study area intersections; therefore, some discontinuity in traffic volumes is expected. To avoid manual adjustments that could potentially over or under-inflate traffic levels, volumes were not balanced for the purposes of this analysis. To note, the peak hours were very consistent along the corridor with only minor fluctuations observed between intersections.

The existing TMCs for the AM and PM peak hours are illustrated on **Figure 5**.

Traffic Model Development

The traffic modeling network was developed using aerial mapping, roadway geometry, traffic, and signal operational information provided by the City. The operational analysis for the study area intersections was completed using Synchro 9.0, a computer-based intersection operations model that replicates procedures from the *Highway Capacity Manual* (HCM) (Transportation Research Board, 2000 and 2010). The program was used to assess existing and future operations of intersections in the study area. At present, the traffic signals are coordinated during the Mid-day peak hour; however, run free during the PM peak. Two measures of effectiveness were selected to measure the quantitative performance of the study area intersections:

- Average vehicle delay by movement, approach, and intersection – measured in seconds per vehicle
- 95<sup>th</sup> percentile queue length – measured in feet

The signal timing and phasing plans for all signalized intersections were provided by the City of Lynchburg and VDOT.

Performance Measures

To determine lane geometric needs, intersection level of service (LOS) standards have been applied. Intersection LOS is a qualitative measure of vehicular delay and takes into account a number of conditions related to intersection design and traffic volume, and the perception of those conditions by motorists. Ratings range from A to F, with LOS A indicating little or no average delay and LOS F indicating severe average delays. Typically, LOS A-C are considered acceptable ratings for an intersection, while LOS D-F indicate the potential need for improvements. To note, LOS D (and sometimes LOS E), with greater vehicle delay, are often considered acceptable for more urbanized areas because of the accessibility benefits and higher pedestrian interactions that result from increased density. **Table 4** summarizes the LOS criteria, as specified in HCM 2000 and 2010.

Table 4– Level of Service Criteria

| Level of Service (LOS) | Signalized Intersection            | Unsignalized Intersection          |
|------------------------|------------------------------------|------------------------------------|
|                        | Control Delay<br>(seconds/vehicle) | Control Delay<br>(seconds/vehicle) |
| A                      | 0-10                               | 0-10                               |
| B                      | >10-20                             | > 10-15                            |
| C                      | >20-35                             | >15-25                             |
| D                      | >35-55                             | >25-35                             |
| E                      | >55-80                             | >35-50                             |
| F                      | >80                                | >50                                |

Source: 2010 Highway Capacity Manual

In addition to LOS, the 95<sup>th</sup> percentile queue is the probable furthest distance from the stop bar to the back of the last vehicle waiting at an intersection. This queue represents the length of the line of cars that arrive at an intersection when the signal is red combined with vehicles that did not clear the intersection during the previous green light. Comparing the length of this line of vehicles to potential lane lengths available at each intersection provides another measure of how efficiently the intersection is processing traffic demand. **To note, maximum queues (essentially 100 percentile) were occasionally reviewed via traffic model simulation runs, as conditions dictated.**

Existing Traffic Conditions

Traffic operations analyses for existing conditions were conducted using Synchro to evaluate overall performance of the study intersections within the Graves Mill Road corridor.

Delay and LOS

Delay and LOS are reported from the HCM 2010 from *Synchro* for signalized intersections with standard (National Electrical Manufacturers Association (NEMA) phasing and all unsignalized intersections. HCM 2000 methodology results are still used to report signalized intersections with non-NEMA signal phasing. **Figure 6** illustrates the average AM and PM peak hour delay and LOS for each movement for the eight (8) study intersections along the Graves Mill Road corridor. The intersection HCM outputs from Synchro can be found in the **Appendix**.

The results in **Figure 6** indicate that all study area intersections operate at LOS D, or better during both AM and PM peak hours. However, there are individual movements that experience higher delays (LOS E and F) than the overall intersection. These locations include:

- The westbound left at Gristmill Drive experiences high delays and queueing (using simulations and confirmed with field review).
- The eastbound approaches to Old Graves Mill Road and Creekside experience high delays.
- The northbound left at US 501 northbound ramps operates at LOS F during the AM peak (field review supports this, thought duration was short at less than 15 minutes).
- While not formally a study area intersection, queuing at 221 extends nearly back to Gristmill Drive.
- The westbound movement at McConville operates at LOS E during the PM peak (field review supports this, thought duration was short at less than 10 minutes right at 5:00 PM).

Queueing

A queueing analysis was completed for the study intersections during the AM and PM peak hours. Synchro 95<sup>th</sup> percentile queue lengths in feet were reported for each lane. **Table 5** summarizes the 95<sup>th</sup> percentile queue lengths during the AM and PM peak hours under existing conditions, compared against the storage length capacity for that particular turning movement.

Table 5– Existing Queueing

| INTERSECTION             | APPROACH       | MOVEMENT | STORAGE LENGTH | AM Peak    | PM Peak    |
|--------------------------|----------------|----------|----------------|------------|------------|
|                          |                |          |                | 95TH QUEUE | 95TH QUEUE |
| 1. Graves Mill/Gristmill | Graves Mill EB | EBT/EBR  |                | 165        | 131        |
|                          | Graves Mill WB | WBL/WBT  |                | 93         | #225       |
|                          | Gristmill NB   | NBL      |                | 20         | 33         |
|                          | Gristmill NB   | NBR      | 130            | #367       | 60         |
| 2. Graves Mill/Millrace  | Graves Mill EB | EBT/EBR  |                | 240        | 162        |
|                          | Graves Mill WB | WBL      | 180            | 12         | 9          |
|                          | Graves Mill WB | WBT      |                | 50         | 106        |
|                          | Millrace NB    | NBL      |                | 18         | 62         |
|                          | Millrace NB    | NBR      | 190            | 12         | 47         |
| 3. Graves Mill/Millside  | Graves Mill EB | EBL/EBT  |                | 0          | 0          |
|                          | Graves Mill EB | EBR      | 110            | 0          | 0          |

| INTERSECTION                      | APPROACH            | MOVEMENT    | STORAGE LENGTH | AM Peak    | PM Peak    |
|-----------------------------------|---------------------|-------------|----------------|------------|------------|
|                                   |                     |             |                | 95TH QUEUE | 95TH QUEUE |
|                                   | Graves Mill WB      | WBL/WBT     |                | 0          | 0          |
|                                   | Graves Mill WB      | WBR         | 110            | 0          | 0          |
|                                   | Baush Lomb NB       | NBL/NBT/NBR |                | 3          | 5          |
|                                   | Millside SB         | SBL/SBT/SBR |                | 5          | 18         |
| 4. Graves Mill/Old Graves Mill    | Graves Mill EB      | EBL         | 200            | 0          | 6          |
|                                   | Graves Mill EB      | EBT         |                | 269        | 340        |
|                                   | Graves Mill EB      | EBR         | 210            | 22         | 43         |
|                                   | Graves Mill WB      | WBL         | 280            | 95         | #321       |
|                                   | Graves Mill WB      | WBT/WBR     |                | 92         | 216        |
|                                   | Old Graves Mill NB  | NBL/NBT     |                | 118        | 122        |
|                                   | Old Graves Mill NB  | NBR         |                | 0          | 0          |
|                                   | Private Entrance SB | SBL/SBT/SBR |                | 0          | 10         |
| 5. Graves Mill/Creekside          | Graves Mill EB      | EBL         | 200            | 17         | 23         |
|                                   | Graves Mill EB      | EBT/EBR     |                | 382        | #368       |
|                                   | Graves Mill WB      | WBL         | 320            | 156        | 99         |
|                                   | Graves Mill WB      | WBT         |                | 206        | 296        |
|                                   | Graves Mill WB      | WBR         | 200            | 11         | 20         |
|                                   | Connector NB        | NBL/NBT     |                | 36         | 72         |
|                                   | Connector NB        | NBR         | 130            | 219        | 164        |
|                                   | Creekside SB        | SBL         | 120            | 54         | 96         |
|                                   | Creekside SB        | SBT/SBR     |                | 31         | 40         |
|                                   | Graves Mill EB      | EBT         |                | 115        | 84         |
| 6. Graves Mill/Expressway Ramp SB | Graves Mill EB      | EBR         | 180            | 56         | #356       |
|                                   | Graves Mill WB      | WBL         | 200            | 27         | 55         |
|                                   | Graves Mill WB      | WBT         |                | 111        | 122        |
|                                   | Expressway Ramp SB  | SBL/SBT     |                | 104        | 47         |
|                                   | Expressway Ramp SB  | SBR         | 125            | 93         | #256       |
|                                   | Graves Mill EB      | EBL         | 130            | 85         | 78         |
| 7. Graves Mill/Expressway Ramp NB | Graves Mill EB      | EBT         |                | 54         | 32         |
|                                   | Graves Mill WB      | WBT         |                | 74         | 117        |
|                                   | Graves Mill WB      | WBR         | 120            | 7          | 32         |
|                                   | Expressway Ramp NB  | NBL         |                | #329       | #330       |
|                                   | Expressway Ramp NB  | NBL/NBT/NBR | 300            | #245       | #322       |
|                                   | Graves Mill EB      | EBL/EBT     |                | 198        | 45         |
| 8. Graves Mill/McConville         | Graves Mill EB      | EBR         |                | 55         | 48         |
|                                   | Nationwide WB       | WBL/WBT/WBR |                | 15         | 215        |
|                                   | Graves Mill NB      | NBL/NBT/NBR |                | 85         | 230        |
|                                   | McConville SB       | SBL/SBT     |                | 10         | 5          |
|                                   | McConville SB       | SBR         | 125            | 30         | 33         |
|                                   |                     |             |                |            |            |

“#” means volumes exceeds capacity and queueing may be longer.



From **Table 5** it can be observed that the turn-lane storages fall short of accommodating back of queues for several locations and thru movement queuing can be extensive. These locations include:

- The westbound left queuing at Gristmill Drive is ~350’ during the PM peak (when an isolated simulation was run). Queues for the northbound right extend over 350’ during the AM peak.
- Eastbound thru queuing at Millrace extends ~250’ during the AM peak.
- The westbound left at Old Graves Mill Road extends beyond the available storage during the PM peak. The eastbound thru queuing extends over 300’ during the PM peak.
- Eastbound thru queuing at Creekside Drive extends over 350’ during the AM and PM peak. There is lane bias occurring at the locations as most drivers merge into the outside lane; therefore, actual queuing is longer and spills back to Old Graves Mill Road. Northbound right queuing extends over 200’ during the AM peak.
- Eastbound right queuing at the 501 southbound ramps extends over 350’ during the PM peak. The southbound right queues extend over 250’ during the PM peak, as well.
- **Collective** eastbound queuing beginning at the 501 southbound ramps extends back over 1,000’ during the PM peak.
- The northbound left/shared queuing at the 501 northbound ramps extends over 325” during the AM and PM peak.

To note, the 95<sup>th</sup> percentile queue length is the queue length that has a 5% probability of being exceeded during the analysis peak hours. Therefore, there are times when a maximum queue may exceed the available storage length capacity. Field observations are generally consistent with the 95<sup>th</sup> percentile queueing as reported; however, there were intermittent queues observed that extended further than reported.

Turn Warrants

VDOT turn lane warrants were evaluated for several of the study intersections for existing conditions. The turn lane warrant forms per the VDOT Road Design Manual were examined in this study and provided in the **Appendix**. Based on VDOT criteria, a turn lane is warranted for the eastbound right to Millrace Drive under existing traffic conditions. **Table 6** summarizes the results.

Table 6– Existing Turn Warrants

| Intersection         | Turning Movement | Existing Turn Lane Warrant              |                                    |
|----------------------|------------------|-----------------------------------------|------------------------------------|
|                      |                  | AM                                      | PM                                 |
| Graves Mill/Millrace | Eastbound Right  | Full-width Turn Lane and Taper Required | Taper Required                     |
| Graves Mill/Millside | Eastbound Left   | No Left Turn Storage Lane Required      | No Left Turn Storage Lane Required |
| Graves Mill/Millside | Westbound Left   | No Left Turn Storage Lane Required      | No Left Turn Storage Lane Required |



Figure 5 – Existing (2017) Traffic Volumes

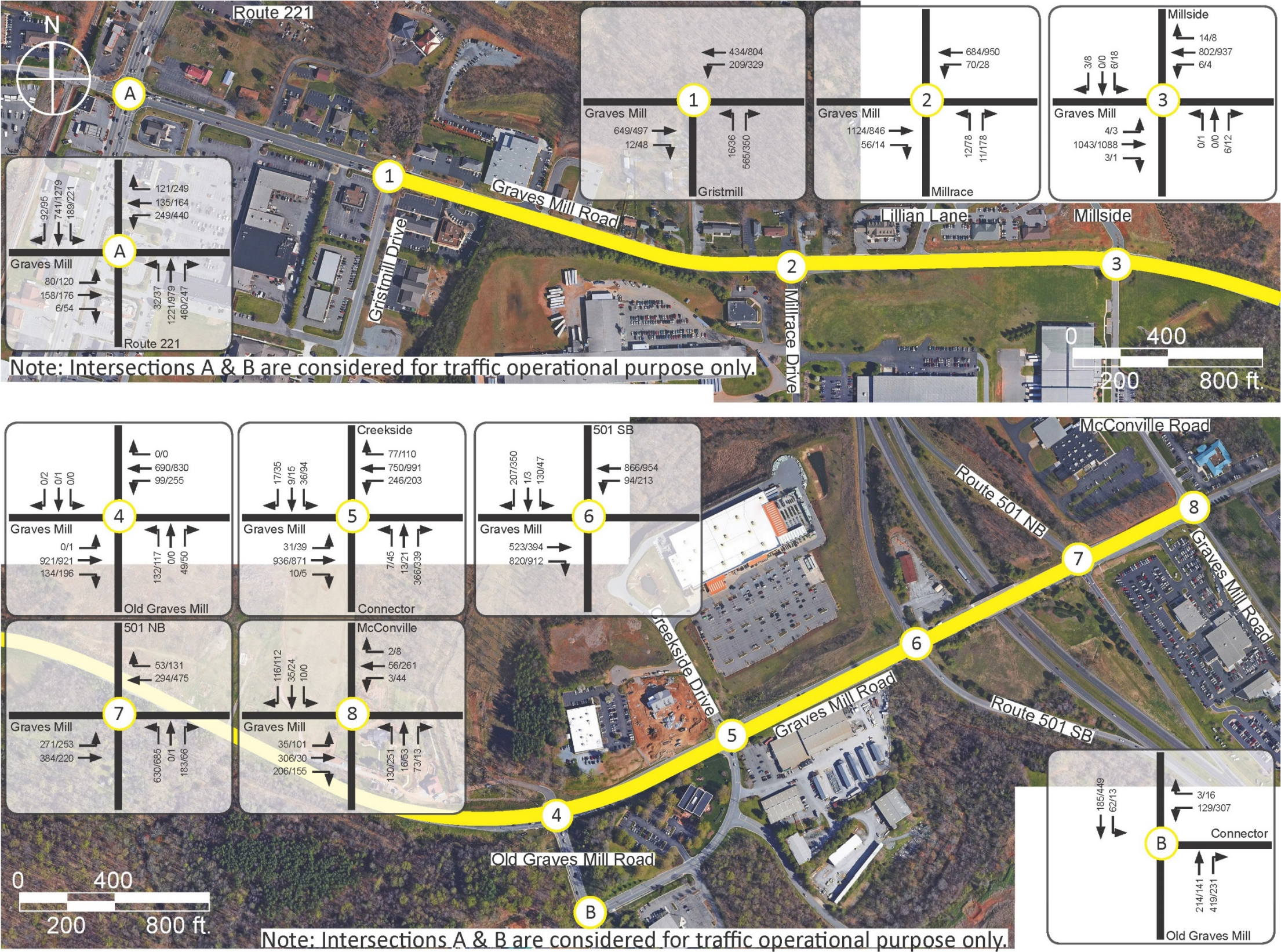
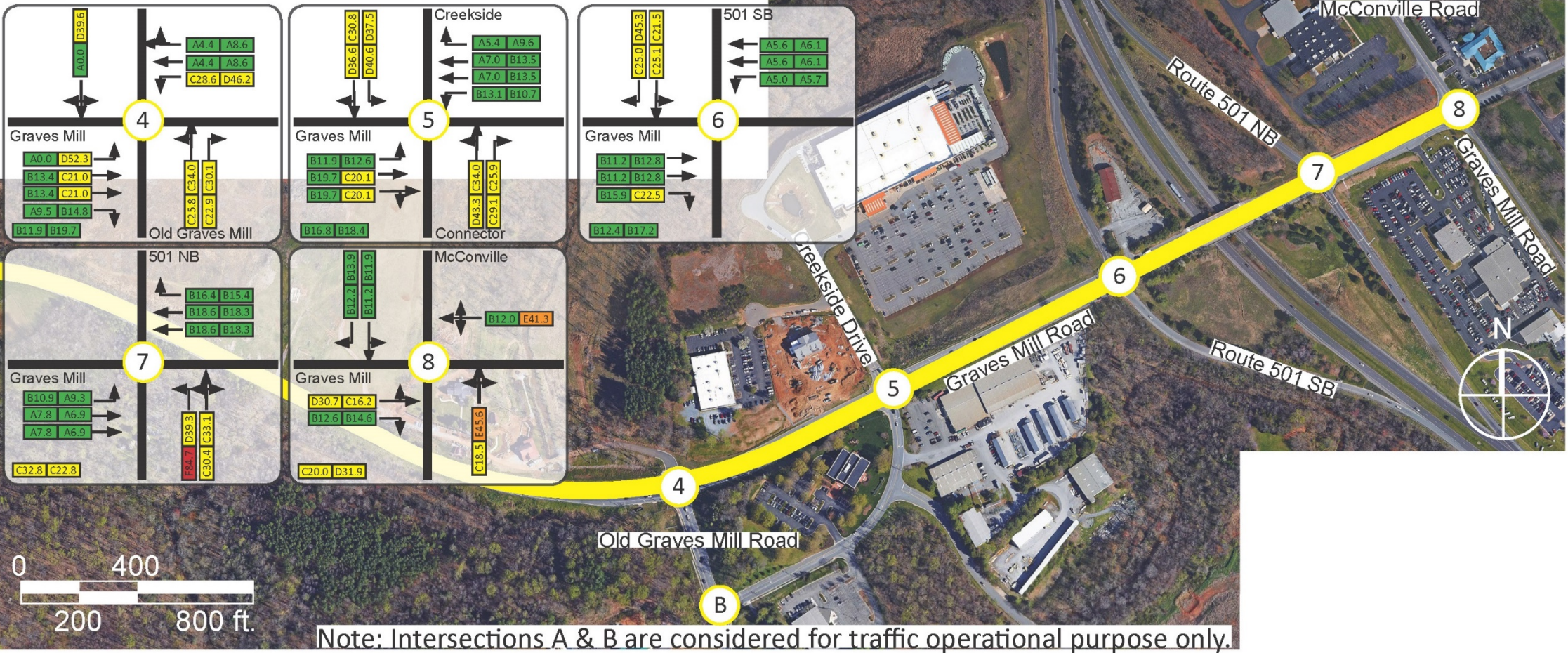




Figure 6 – Existing (2017) LOS and Delay





Traffic Forecasting

Project level traffic forecasting is an essential part of the corridor planning process. Transportation investments can be very large and will typically be in service for many years; therefore, future traffic projections will help to ensure these investments not only serve near-term traffic demand, but longer-term demand. Multiple sources were reviewed to determine an appropriate growth rate for a 23-year time horizon (2017 to 2040) including:

- Existing traffic demand
- Historical traffic demand
- Land use context using transportation analysis zones (TAZs)
- VDOT Statewide Planning System (SPS)
- Travel demand model (TDM) projections
- Planned development

The traffic projections methodology will be applied to existing traffic counts to develop traffic volumes for use in the analysis of future conditions for the study corridor. A technical memorandum detailing the methodology is provided in the **Appendix**. Based on:

- TAZ, SPS, and TDM linear growth rates that range from 0.5% to 2.0% annually (1.25% average rate),
- new traffic anticipated from Rosedale Farms and Elements at Old Graves Mill Road, and
- 1.25% annual historical growth likely to continue that is unrelated to planned developments,

a **1.25% annual background growth rate, plus the site generated traffic from the planned developments** will be used to forecast 2040 projections. The 1.25% linear rate has been applied to all existing – or “background” – traffic counts collected in the study area that is unrelated to traffic generated specifically by developments proposed along Graves Mill Road. Then, site generated trips from each of the two (2) developments has been applied. To note, trips from Rosedale Farms will be distributed west through the study area based on existing travel patterns. With the application of a 1.25% rate, plus the addition of the site generated trips, the effective annual growth rate along the corridor is approximately 2% in the morning peak, and 2.5% in the evening peak.

**Figure 7** illustrates the future TMCs for the eight (8) study intersections along the Graves Mill Road corridor.

Future No Build Traffic Conditions

No-build traffic conditions were analyzed to evaluate the results of future (2040) traffic demand on the existing roadway network. The intent of the no-build conditions analysis is to provide a general understanding of the baseline future traffic conditions that may then be used to evaluate the effectiveness of potential future improvement strategies.

The existing conditions Synchro models were used as a basis to develop the no-build models. Because this is a future scenario, planned and approved projects identified through previous efforts that are anticipated along the corridor would need consideration. Within the study area, a new signalized intersection has been included to serve the planned Rosedale mixed use development. Outside of the study area, improvements at 221 are also being planned to include dual westbound left turn lanes. These geometric modifications were included in the model. The same measures of effectiveness used to evaluate existing conditions were used to measure the quantitative performance under no-build conditions.

Delay and LOS

Delay and LOS are reported from the HCM 2010 from Synchro for signalized intersections with standard NEMA phasing and all unsignalized intersections. HCM 2000 methodology results are still used to report signalized intersections with non-NEMA signal phasing. **Figure 8** summarizes the average AM and PM peak hour delay and LOS for each movement for the eight (8) study intersections along the Graves Mill Road corridor. The intersection HCM outputs from Synchro can be found in the **Appendix**.

The results in **Figure 8** indicate that under future traffic conditions, six of the nine study area intersections will operate at LOS E and F during at least one peak hour. High delays experienced for individual movements are only exacerbated under no build. Notable locations include:

- Gristmill Drive will operate at LOS F for both peak hours.
- Because traffic demand has increased since the last study was completed for the Rosedale mixed use development, key inbound/outbound movements will operate at LOS F during both peak hours under the previous configuration (not illustrated on the figures but included in the modeling).
- The eastbound thru movements at Old Graves Mill Road and Creekside Drive will operate at LOS E and F for both peak hours.
- Key 501 off-ramp movements will operate at LOS E and F for both peak hours.
- The stop controlled intersection at McConville Road will operate at LOS F for both peak hours.
- While not formally a study area intersection, multiple movements at 221.

Queuing

A queuing analysis was completed for the study intersections during the AM and PM peak hours. Synchro 95<sup>th</sup> percentile queue lengths in feet were reported for each lane. **Table 7** summarizes the 95<sup>th</sup> percentile queue lengths during the AM and PM peak hours under no build conditions, compared against the storage length capacity for that particular turning movement.

Table 7– Future (2040) No Build Queuing

| INTERSECTION             | APPROACH       | MOVEMENT    | STORAGE LENGTH | AM Peak    | PM Peak    |
|--------------------------|----------------|-------------|----------------|------------|------------|
|                          |                |             |                | 95TH QUEUE | 95TH QUEUE |
| 1. Graves Mill/Gristmill | Graves Mill EB | EBT/EBR     |                | 384        | 397        |
|                          | Graves Mill WB | WBL/WBT     |                | #407       | #850       |
|                          | Gristmill NB   | NBL         |                | 27         | 82         |
|                          | Gristmill NB   | NBR         | 130            | #1007      | #902       |
| 2. Graves Mill/Millrace  | Graves Mill EB | EBT/EBR     |                | 342        | 575        |
|                          | Graves Mill WB | WBL         | 180            | 48         | 16         |
|                          | Graves Mill WB | WBT         |                | 3          | 430        |
|                          | Millrace NB    | NBL         |                | 35         | 88         |
|                          | Millrace NB    | NBR         | 190            | 23         | 134        |
| 3. Graves Mill/Millside  | Graves Mill EB | EBL/EBT     |                | 0          | 0          |
|                          | Graves Mill EB | EBR         | 110            | 0          | 0          |
|                          | Graves Mill WB | WBL/WBT     |                | 3          | 3          |
|                          | Graves Mill WB | WBR         | 110            | 0          | 0          |
|                          | Baush Lomb NB  | NBL/NBT/NBR |                | 0          | 23         |
|                          | Millside SB    | SBL/SBT/SBR |                | 0          | 98         |

|                                   |                     |             |     |      |       |
|-----------------------------------|---------------------|-------------|-----|------|-------|
| 4. Graves Mill/Old Graves Mill    | Graves Mill EB      | EBL         | 200 | 0    | 1     |
|                                   | Graves Mill EB      | EBT         |     | 389  | #974  |
|                                   | Graves Mill EB      | EBR         | 210 | 22   | 112   |
|                                   | Graves Mill WB      | WBL         | 280 | #269 | #705  |
|                                   | Graves Mill WB      | WBT/WBR     |     | 16   | 196   |
|                                   | Old Graves Mill NB  | NBL/NBT     |     | 228  | 290   |
|                                   | Old Graves Mill NB  | NBR         |     | 0    | 6     |
|                                   | Private Entrance SB | SBL/SBT/SBR |     | 0    | 14    |
| 5. Graves Mill/Creekside          | Graves Mill EB      | EBL         | 200 | 7    | 14    |
|                                   | Graves Mill EB      | EBT/EBR     |     | #750 | 164   |
|                                   | Graves Mill WB      | WBL         | 320 | 226  | 252   |
|                                   | Graves Mill WB      | WBT         |     | 88   | 210   |
|                                   | Graves Mill WB      | WBR         | 200 | 4    | 5     |
|                                   | Connector NB        | NBL/NBT     |     | 49   | #197  |
|                                   | Connector NB        | NBR         | 130 | #597 | #647  |
|                                   | Creekside SB        | SBL         | 120 | #102 | #248  |
|                                   | Creekside SB        | SBT/SBR     |     | 44   | 70    |
| 6. Graves Mill/Expressway Ramp SB | Graves Mill EB      | EBT         |     | 78   | 108   |
|                                   | Graves Mill EB      | EBR         | 180 | #340 | #1698 |
|                                   | Graves Mill WB      | WBL         | 200 | 31   | 77    |
|                                   | Graves Mill WB      | WBT         |     | 311  | 372   |
|                                   | Expressway Ramp SB  | SBL/SBT     |     | #238 | 96    |
|                                   | Expressway Ramp SB  | SBR         | 125 | #383 | #826  |
| 7. Graves Mill/Expressway Ramp NB | Graves Mill EB      | EBL         | 130 | #393 | #452  |
|                                   | Graves Mill EB      | EBT         |     | 94   | 56    |
|                                   | Graves Mill WB      | WBT         |     | #235 | 442   |
|                                   | Graves Mill WB      | WBR         | 120 | 40   | 117   |
|                                   | Expressway Ramp NB  | NBL         |     | #645 | #804  |
|                                   | Expressway Ramp NB  | NBL/NBT/NBR | 300 | 484  | #713  |
| 8. Graves Mill/McConville         | Graves Mill EB      | EBL/EBT     |     | 380  | 73    |
|                                   | Graves Mill EB      | EBR         |     | 85   | 80    |
|                                   | Nationwide WB       | WBL/WBT/WBR |     | 20   | 433   |
|                                   | Graves Mill NB      | NBL/NBT/NBR |     | 130  | 463   |
|                                   | McConville SB       | SBL/SBT     |     | 13   | 8     |
|                                   | McConville SB       | SBR         | 125 | 43   | 53    |

“#” means volumes exceeds capacity and queuing may be longer.

From **Table 7** it can be observed that the turn-lane storages fall short of accommodating back of queues for several locations and thru movement queuing can be extensive. These locations include:

- The westbound left queuing at Gristmill Drive is ~675’ during the PM peak (no storage provided). Queues for the northbound right extend ~625’ during the AM peak.

- Eastbound thru queuing at Millrace extends ~550’ during the AM peak.
- Westbound thru queuing at Rosedale extends ~550’ during the PM peak. The eastbound and southbound left queuing extends beyond the proposed storage.
- The westbound left at Old Graves Mill Road extends beyond the available storage during the PM peak. The eastbound thru queuing extends over 750’ during the PM peak.
- Eastbound thru queuing at Creekside Drive extends over 750’ during the AM and PM peak. There is lane bias occurring at the locations as most drivers merge into the outside lane; therefore, actual queuing is longer and spills back through Old Graves Mill Road (continuous queue). Northbound right queuing extends over 525’ during the AM peak.
- Eastbound right queuing at the 501 southbound ramps extends over 900’ during the PM peak. The southbound right queues extend over 425’ during the PM peak, as well.
- The northbound left/shared queuing at the 501 northbound ramps extends over 500” during the AM and PM peak.
- Queuing for the approach movements at McConville Road extend over 350’ during the AM and PM peak.

To note, the 95<sup>th</sup> percentile queue length is the queue length that has a 5% probability of being exceeded during the analysis peak hours. Therefore, there are times when a maximum queue may exceed the available storage length capacity. Field observations are generally consistent with the 95<sup>th</sup> percentile queueing as reported; however, there were intermittent queues observed that extended further than reported.

### Turn Warrants

VDOT turn lane warrants were evaluated for several of the study intersections for existing conditions. The turn lane warrant forms per the VDOT Road Design Manual were examined in this study and provided in the **Appendix**. Based on FHWA and VDOT criteria, a turn lane is warranted for each location under future no build traffic conditions. **Table 8** summarizes the results. Note that the storage length is in addition to the deceleration and transition distance requirements.

**Table 8– Future No Build Turn Warrants**

| Intersection         | Turning Movement | 2040 No Build Turn Lane Warrant         |                                      |
|----------------------|------------------|-----------------------------------------|--------------------------------------|
|                      |                  | AM                                      | PM                                   |
| Graves Mill/Millrace | Eastbound Right  | Full-width Turn Lane and Taper Required | Taper Required                       |
| Graves Mill/Millside | Eastbound Left   | No Left Turn Storage Lane Required      | 50’ Left Turn Storage Lane Required  |
| Graves Mill/Millside | Westbound Left   | 100’ Left Turn Storage Lane Required    | 125’ Left Turn Storage Lane Required |



### Figure 7 – Future (2040) Traffic Volumes

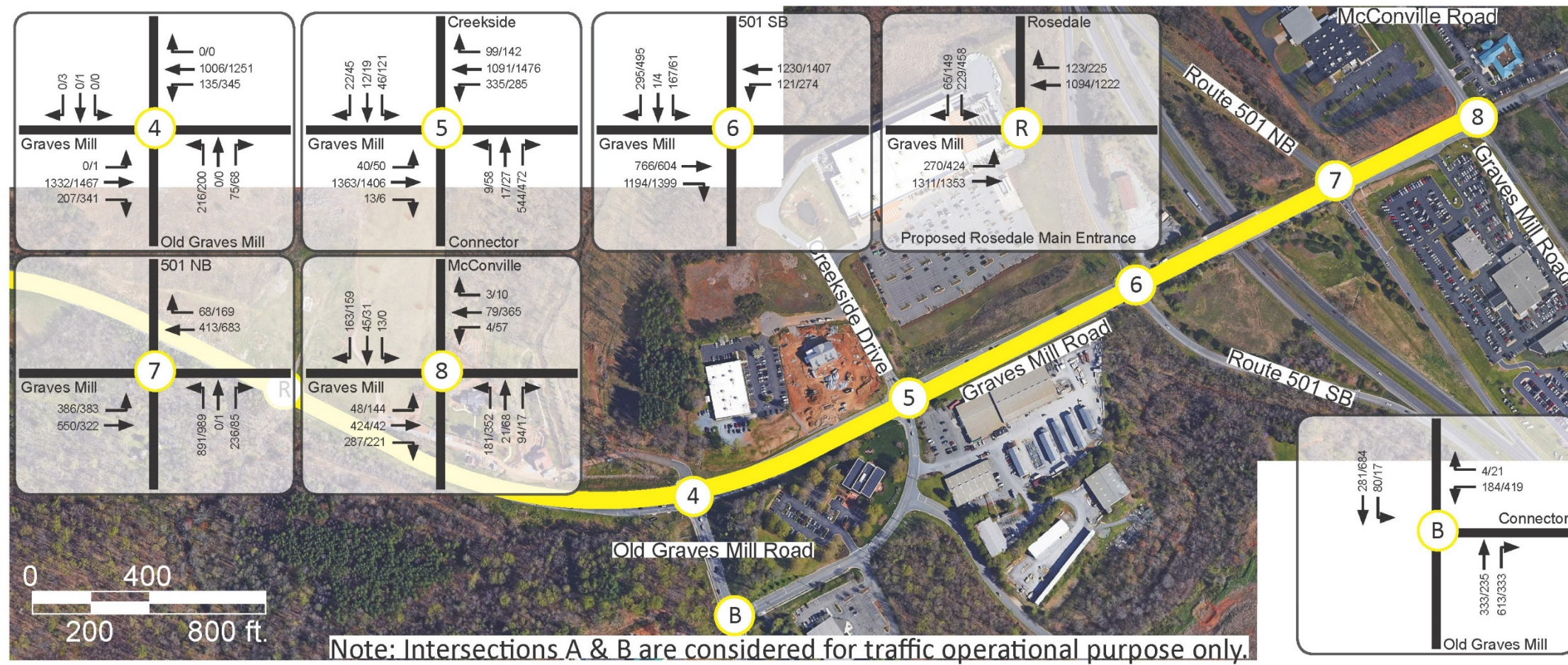
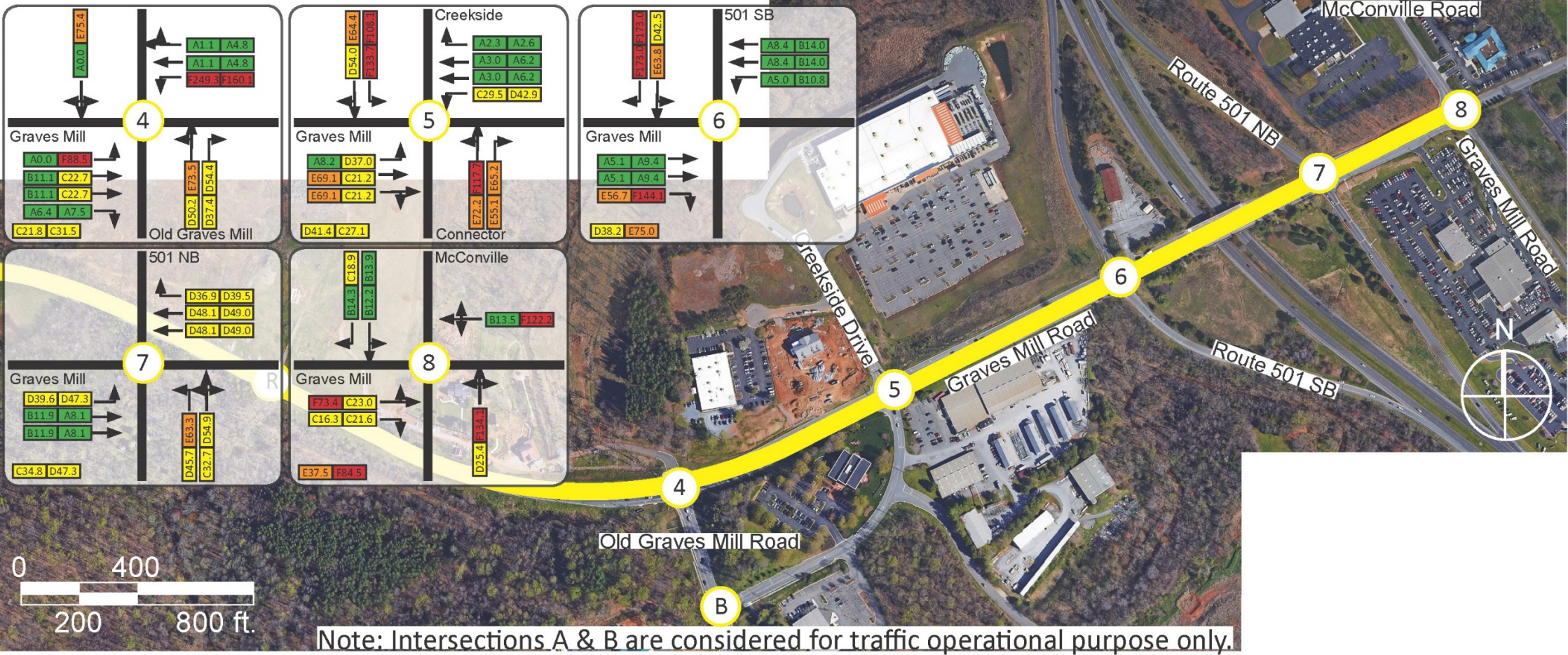
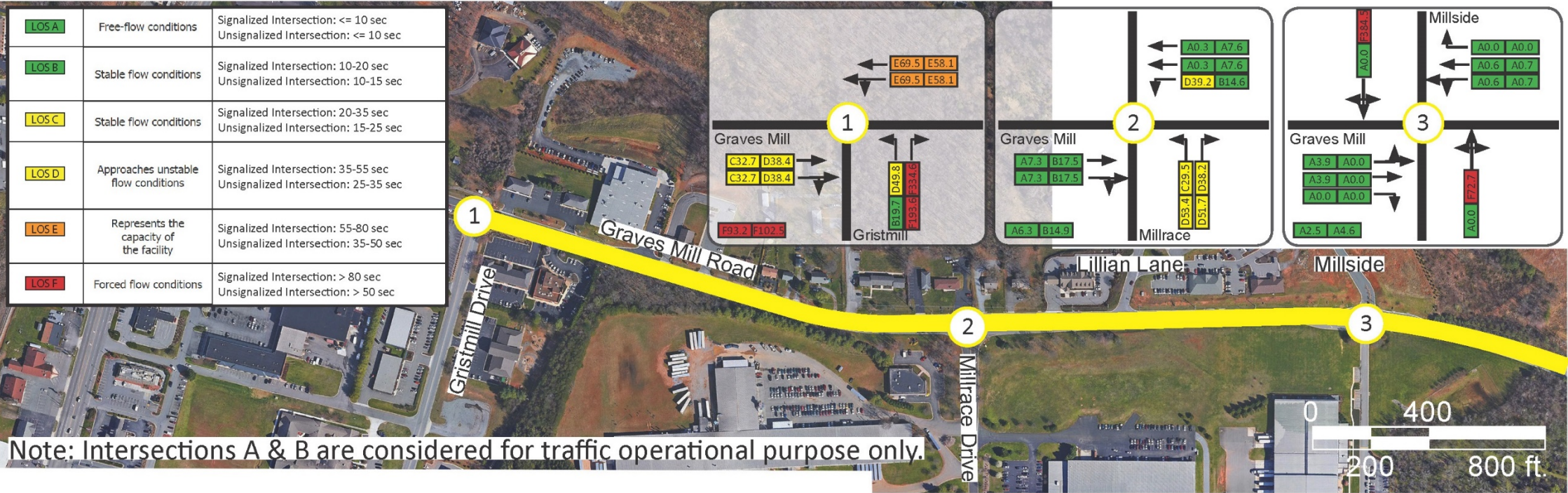




Figure 8 – Future (2040) LOS and Delay





## Public Informational Meeting #1

Improvement projects were developed to address safety, geometric, and operational deficiencies along the Graves Mill Road corridor identified in the existing and no-build analyses, as well as during the community meeting

A first public meeting for the Graves Mill Road Corridor Study was held on Tuesday, December 12, 2017 at the Lynchburg Humane Society in Lynchburg, Virginia. The meeting was organized as an open-house format and was open to the general public from 4:00 – 6:30 pm.

Advertisement for the meeting included:

- Mail-outs to residents and businesses near the study area approximately two weeks in advance of the meeting
- Deployment of variable message signs on Graves Mill Road approximately one week in advance of the meeting
- Press release
- Advertisement via social media
- Advertisement via local news agencies
- Notice included on the project website ([www.gravesmillplan.com](http://www.gravesmillplan.com))

The goal of this meeting was for the public to 1) learn about the study, 2) review information about the corridor, and 3) share comments regarding concerns, opportunities, and improvement ideas. Attendees were encouraged to provide feedback and offer suggestions that would help to inform the project development process. Representatives from the Virginia Department of Transportation (VDOT), City of Lynchburg, Bedford County, Virginia's Region 2000 Local Government Council, and project consultants were available to explain materials, answer questions, and record feedback. Information boards were set up in the meeting space that presented the following subjects:

- Welcome and purpose of the meeting
- Information about the study
- Summary of existing and future traffic conditions
- Crash data (six years)
- Summary of multimodal conditions (sidewalks, transit stops, etc.)
- General information on innovative intersection ideas applicable to the corridor

In addition to the information boards, large table-top maps of the corridor were available for attendees to gather around and mark-up. Comment sheets were also made available for participants. The meeting was attended by approximately 50 people (that signed in), including business owners/representatives along the corridor. There were also several local news organizations that covered the meeting (WDBJ7, NewsAdvance, WSLs, and WLNI).



A consistent flow of attendees began right at 4:00 PM and continued through approximately 6:00 PM. Representatives were provided sufficient time to walk attendees through the study and answer questions, as needed. Several news organization interviews were provided by the public and agency representatives. Overall, attendees were very pleased City officials were attempting to stay in front of potential growth that could exceed 50% over the next 20 years. In addition to managing traffic congestion, attendees were also pleased attention was being paid to transit, pedestrian and bicycle accommodations along the corridor. It was further suggested by multiple attendees the City (or other agencies) undergo a study along Old Graves Mill Road between Graves Mill Road and Timberlake Road.



### Specific Public Comments

The following public comments were written on comment sheets that were provided at the meeting, or emailed via the project website (specific identifying information has been removed, and at times, comments are paraphrased):

*I was not able to attend the meeting. One suggestion (and it might be a long shot) is to have Graves Mill Road 3 lanes each way. However, a more feasible suggestion would be signage. An issue with accidents in Lynchburg is the lack of signs. People from out of town that use Graves Mill to go to the expressway merge over at the very end and back end or swipe other cars. Every street that intersects with the expressway should have a sign like the one on Timberlake Rd. I have heard from transportation officials that "signs are expensive" but this is one of the key reasons for congestion from 3-6pm weekdays.*

*I have lived in this area since 1976. There used to be little traffic even though it was a cut thru. Now, I can hardly get out of my street. The traffic from Timberlake Road is awful. From McConville Rd to 221 there are too many lights & way too much traffic. Traffic isn't flowing, a light needs to be at Nationwide Dr., that "annex" is a nightmare, it's like crossing 3 lanes & you take your life in your hands using it. People block that light at Bella Rosa. Lots of times it turns green but you can't go because of cars blocking it. People fly from 221 to just get to the exit for the expressway. There are lots of things that can be done to help traffic.*

*I was not able to attend the meeting, and I don't know if a stop light at Lillian Ln or Millside Center is part of the discussion, but there are currently a lot of senior citizens that are trying to access this area of Graves Mill with no safe and/or easy way to do it. I'm not sure if a turn lane in this stretch or a stop light is a good solution, but if there is a master plan being developed, I think something like this would be quite helpful.*

*Has any thought been given to a roundabout at the intersection of Graves Mill Rd. and McConville Rd.? With Lynchburg's consideration of roundabouts throughout the City, this seems to me to be one place that one would work well. The four-way stop is confusing at best and dangerous at worst, especially during times of heavy traffic.*

*Sync lights so the thru traffic doesn't have to stop at every light.*

*Plan a stop light for the Bella Rose community development.*

*Do not add sidewalks directly beside the road. Needs separation by 3' – 5' from road. The same goes for bike lanes.*

*Road milling contributes to uneven lanes and vehicles crashing.*

*Add lights so they are on both sides of the road.*

Keep speed limit at 45 mph.

Access to highway is currently acceptable.

Roundabout absolutely needed at McConville Rd.

My concerns relate to Old Graves Mill Road. As the area has grown, there has been a tremendous increase in traffic on Old Graves Mill Road between Timberlake Road and Graves Mill Road. Old Graves Mill needs traffic control to better manage cars and commercial truck traffic. Sidewalks throughout the section should also be installed. Old Graves Mill Road is also too narrow and has not been updated since it was originally designed as a rural road.

I attended the recent public meeting at the Lynchburg Humane Society which presented the Graves Mill Road Plan. I was disappointed that the Plan did not include a study of Old Graves Mill Road between Timberlake Road and Graves Mill Road. As a homeowner off Old Graves Mill road, I have no choice but the travel this section of road daily and am increasingly concerned whether this section of road can safely handle traffic. Recent years have seen a marked increase in traffic along Old Graves Mill Road as more drivers use it as a short cut to and from the Graves Mill Road and Timberlake Road areas. Recent development of the Old Graves Mill Road and Graves Mill Road areas has also dramatically added to this traffic. The planned development of this corridor in the near future will surely further increase traffic on Old Graves Mill Road. As you know, the section of Old Graves Mill Road north of Timberlake Road still has a narrow section without shoulders or sidewalks that dates back to an earlier and rural age. In addition, there is considerable commercial truck traffic to and from the Tomahawk Industrial Park not to speak of the number of school buses that pick up children throughout this neighborhood. All this makes for periods of heavy, unregulated traffic that result in the neighbors having difficulty turning onto Old Graves Mill Road from side streets and driveways. Also, please note that the speed limit of 35 MPH is routinely and grossly exceeded. I personally have had cars pass me on Old Graves Mill Road while I am driving the speed limit! I hope that you, VDOT and Lynchburg engineers find my concerns warrant further interest. Specifically, I hope that consideration will be given to regulating traffic flow with a stoplight at the intersection of Tomahawk Industrial Park and Old Graves Mill Road. I believe that a traffic light at that intersection would greatly add to the safety along this stretch of road.

A technical memorandum summarizing comments written on table top maps that were provided at the meeting, or on blank note boards located between the informational boards, sign-in sheets, and a summary of news coverage is provided in the **Appendix**.

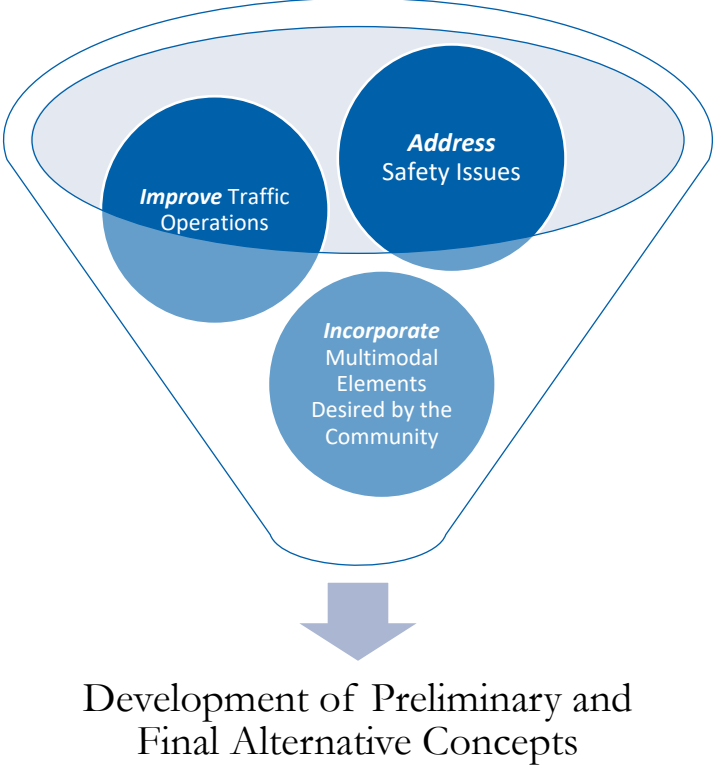
Project Development, Screening and Analysis

Now that a baseline of future conditions has been established to evaluate the effectiveness of potential future improvement strategies, the concept development phase can proceed. The following efforts, beginning with no build, were undertaken to ensure the most effective concepts and ideas were advanced as part of the final corridor plan:

- Completion of no build – determined operational and safety needs.
- Held community meeting #1 – uncovered additional needs and community desires, including multimodal elements.
- Developed numerous preliminary concepts and ideas to address those needs.
- Screened numerous concepts (linework for right-of-way assessment, planning level cost screening, operational analysis).

Figure 9 illustrates the project development goals.

Figure 9 – Project Development Goals



Preliminary Concepts and Ideas

A comprehensive list of preliminary concepts and ideas were developed based on analysis results, safety considerations, and input from public and agency partners. In fact, multiple ad hoc meetings were held with the City to coordinate project efforts and results shared during the January CVMPO Technical Advisory Committee meeting.

The no build traffic models were used as a basis for screening concepts and ideas. Each was analyzed independently, though the no build models do include signal coordination and projects were “optimized” and compared against conflicting movements to ensure indirect negative impacts did not occur.

The complete list of all concepts and ideas are shown in **Table 9**.



Table 9 – Comprehensive Project Screening Results

| Graves Mill Road Corridor Study - Preliminary Screening |                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                      |          |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------|
| Intersection                                            | Issues                                                                                                                                                                                                                                                                                                                                                                                  | Options Considered                                                                                                   | Advance? |
| Gristmill Drive                                         | Under future no build, heavy WB queuing (over 600' during the PM), and LOS F conditions for the intersection and WB and NB movements. Drivers utilize Gristmill as a 221 by-pass option.                                                                                                                                                                                                | Signal Optimization/Coordination.                                                                                    | Yes      |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Restripe NB approach to shared left/right and right.                                                                 | Yes      |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add WBL dedicated turn lane only.                                                                                    | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add WBL dedicated turn lane, plus reduce eastbound approach to single lane.                                          | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add WBL dedicated turn lane, plus reduce eastbound approach to single lane, plus add an eastbound right turn pocket. | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add WBL and remark NBL to shared left/right.                                                                         | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add WBL dedicated turn lane, plus additional NBR turn lane and implement overlap phasing                             | Yes      |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add an additional NBR turn lane so configuration is shared left/right and dedicated right.                           | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add WB left turn lane, modify NBR to free flow (maintain NBL), and remove an EBT lane (provide EBR turn pocket).     | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | WBL permitted only phase was tested.                                                                                 | N/A      |
| Millrace Drive                                          | Under future no build, all movements operate at LOS C, or better. However, eastbound queues extend over 400'. EBR right turn warrant under future conditions.                                                                                                                                                                                                                           | Signal Optimization/Coordination.                                                                                    | Yes      |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add EBR turn lane (warranted).                                                                                       | Yes      |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Remove WBL protected phase (it's currently protected/permitted).                                                     | No       |
| Millside Drive                                          | NBL and SBL operate at LOS F under future conditions due to free flow conditions on Graves Mill. Volume does not meet signal warrants (<100 for the left across). Crash frequency is relatively low (only two crashes over six years). Meets EBL and WBL turn warrants under future conditions.                                                                                         | Implement rcut. This would require widening out Graves Mill to accommodate the treatments (no existing median).      | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Install EB and WB left turn lanes.                                                                                   | Yes      |
| Rosedale Site Entrance                                  | The new intersection has been included under future no build in support of the Rosedale mixed use development. The background, no build configuration was based off the previous TIA. However, new data and growth factors suggest the recommended configuration is not adequate. The single EBL turn lane is LOS F and impacts the WBT (LOS E). The SBL from the site is also a LOS F. | Signal Optimization/Coordination.                                                                                    | Yes      |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Provide dual EBL turn lanes only.                                                                                    | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Provide dual SBL turn lanes only.                                                                                    | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Provide dual EBL and SBL turn lanes.                                                                                 | Yes      |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Implement a Green T intersection, maintaining a single EBL turn lane.                                                | No       |
| Old Graves Mill Road                                    | Under future conditions heavy EB queuing and WBL queue extends beyond available storage.                                                                                                                                                                                                                                                                                                | Signal Optimization/Coordination.                                                                                    | Yes      |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Extend WBL turn lane to the furthest extent feasible.                                                                | No       |
|                                                         |                                                                                                                                                                                                                                                                                                                                                                                         | Add another WBL turn lane. This would require widening Old Graves Mill Road to accommodate two southbound lanes.     | Yes      |

|                                                     |                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                          |     |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|                                                     |                                                                                                                                                                                                                                                                                                  | Implement protected/permitted phasing for the WBL, with flashing yellow arrow.                                                                                                                                                                                                                                           | Yes |
| <b>Creekside Drive</b>                              | The NB and SBL movements operate at LOS E/F due to priority given to Graves Mill Road. The NBR experiences ~325' of queuing under future conditions.                                                                                                                                             | Signal Optimization/Coordination.                                                                                                                                                                                                                                                                                        | Yes |
|                                                     |                                                                                                                                                                                                                                                                                                  | Add an additional NBR turn lane.                                                                                                                                                                                                                                                                                         | Yes |
| <b>US 501 SB Ramps</b>                              | With corridor improvement as noted above, the SBR movement is improved to LOS D with queuing ~275'. To note, without the additional thru lane that drops at the ramp, the EBR and SBR movements operate at LOS F with extensive queuing. The options reflect no implementation of the thru lane. | Signal Optimization/Coordination.                                                                                                                                                                                                                                                                                        | Yes |
|                                                     |                                                                                                                                                                                                                                                                                                  | Provide dual SBR turn lanes (controlled).                                                                                                                                                                                                                                                                                | No  |
|                                                     |                                                                                                                                                                                                                                                                                                  | Provide channelized SBR free flow.                                                                                                                                                                                                                                                                                       | Yes |
|                                                     |                                                                                                                                                                                                                                                                                                  | Add an additional EB right turn lane, providing dual controlled turning lanes. Maintain two thru lanes.                                                                                                                                                                                                                  | No  |
|                                                     |                                                                                                                                                                                                                                                                                                  | Restripe EB approach to a single thru, and dual rights.                                                                                                                                                                                                                                                                  | No  |
|                                                     |                                                                                                                                                                                                                                                                                                  | Reconfigure approach to a single through lane and dual eastbound, controlled rights. Convert the existing right turn lane to a travel lane by extending back to Creekside Drive. The US 501 southbound ramp will then be widened to accommodate two lanes that will merge to a single lane, before merging on to US 501. | Yes |
|                                                     |                                                                                                                                                                                                                                                                                                  | Provide EBR channelized free flow lane that would merge with other ramp traffic. This option would require widening out the ramp's entrance and still maintain two lanes to 501 SB. Two EBR free flow lanes would require a three-lane ramp; therefore, not considered.                                                  | No  |
| <b>Old Graves Mill, Creekside, and 501 SB Ramps</b> | Heavy future EB congestion pushes the LOS to E for the EBT movements. The WBL is LOS E/F for each intersection. EB queuing extends back ~800' from Old Graves Mill during the PM peak. This queue continues eastward to the SB ramp. WB progression appears to be managed reasonably well.       | Signal Optimization                                                                                                                                                                                                                                                                                                      | Yes |
|                                                     |                                                                                                                                                                                                                                                                                                  | Install an additional EB thru lane that begins just west of Old Graves Mill and continues east to the 501 SB ramps.                                                                                                                                                                                                      | Yes |
| <b>US 501 NB Ramps</b>                              | The NB off-ramp movement operates at LOS F under future conditions. EBL queue extends beyond available storage.                                                                                                                                                                                  | Signal Optimization                                                                                                                                                                                                                                                                                                      | Yes |
|                                                     |                                                                                                                                                                                                                                                                                                  | Implement a Diverging Diamond Interchange                                                                                                                                                                                                                                                                                | Yes |
|                                                     |                                                                                                                                                                                                                                                                                                  | Provide a dedicated NBR turn lane to help manage queuing.                                                                                                                                                                                                                                                                | No  |
|                                                     |                                                                                                                                                                                                                                                                                                  | Extend EBL turn lane to the furthest extent feasible.                                                                                                                                                                                                                                                                    | Yes |
| <b>McConville Road</b>                              | Multiple approaches operate at LOS F                                                                                                                                                                                                                                                             | Install a single lane roundabout with no slip lanes.                                                                                                                                                                                                                                                                     | Yes |
|                                                     |                                                                                                                                                                                                                                                                                                  | Signalization.                                                                                                                                                                                                                                                                                                           | N/A |

Through this iterative process, list of alternative concepts and ideas were screened down to a short list of potential improvements at each intersection based on safety, operations, ease of implementation, and feedback from the community. However, the number of projects needed to help improve operations and safety along the corridor is still more than could reasonably be funded, considering other local and regional project needs. Therefore, a phasing plan was developed that allocated projects by priority. The priorities include:

**Short-Term Recommendations:** These recommendations reflect short-term improvements uncovered through the study efforts that can be completed and funded directly by the City, or funded through a grant opportunity such as Highway Safety Improvement Program (HSIP) funds. These recommendations can be implemented in less than five (5) years and typically cost less than \$1 million.

**Priority I Projects:** These recommended projects are the primary improvements determined through this study’s efforts. They exhibit *existing* safety and operational challenges that are only exacerbated with future growth. These locations were also a focal point during the public meetings. The Priority I projects will be considered for the VDOT Six-Year Improvement Plan, and other regional and local transportation plans.

**Priority II Projects:** These recommendations are secondary improvements that were determined as part of the *future* conditions analysis and offer support to Priority 1 projects. Typically, existing conditions don’t warrant them – at least not on a consistent basis; however, as growth occurs and Priority I projects are implemented, Priority II projects should be revisited.

**Priority III Projects:** Building on Priority II Projects, these recommended improvements will be needed if a *maximum* buildout and growth scenario occurs along the corridor. Priority III projects should be monitored over time as conditions dictate.

Based on the screening results, a final set of projects was selected to share with the public at the second community meeting. More detailed design, cost estimates, and schedule estimates were then developed for these selected “final” improvement projects. **Table 10** summarizes the draft project list shared with the public during community meeting #2.

Table 10 – Draft Project Summary (Pre Final Public Meeting)

| Summary of Projects for Public Review                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Short-Term Recommendations                                                                                                                                                                                                                                                                |
| Restripe northbound approach on Gristmill Drive to shared left/right and right.                                                                                                                                                                                                           |
| Convert the protected westbound left from Graves Mill Road to Old Graves Mill Road to a protected-permissive left using a flashing yellow arrow (a critical gap analysis would need to be completed prior to implementation).                                                             |
| Implement coordinated and adaptive control measures at all signalized intersections from Gristmill Drive through the interchange (adaptive control HSIP grant application in progress per date of this report).                                                                           |
| Extend eastbound and westbound left turn lanes for the two 501 ramp intersections by approximately 75’ each.                                                                                                                                                                              |
| Priority I Projects                                                                                                                                                                                                                                                                       |
| Gristmill Drive                                                                                                                                                                                                                                                                           |
| Widen Graves Mill Road to accommodate a single westbound left turn lane (with protected-permissive left using a flashing yellow arrow).                                                                                                                                                   |
| Widen Gristmill Drive to accommodate dual northbound right turn lanes and implement overlap signal phasing.                                                                                                                                                                               |
| Provide a pedestrian crossing and countdown signal across Gristmill Drive. If sidewalks are implemented along the north side of Graves Mill Road (which would likely require additional right of way), then pedestrian crossings across Graves Mill Road could be installed at that time. |
| 501 Southbound Ramps                                                                                                                                                                                                                                                                      |

|                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reconfigure eastbound approach to a single thru lane and dual, controlled rights. Convert the existing right turn lane to a travel lane by extending back to Creekside Drive.                                                                                                    |
| Widen the southbound on-ramp to accommodate two lanes that will merge to a single lane, before merging on to US 501.                                                                                                                                                             |
| Provide a channelized southbound right, free flow lane. The lane will end as a dedicated right turn lane at Creekside Drive.                                                                                                                                                     |
| Priority II Projects                                                                                                                                                                                                                                                             |
| Multiple Intersections                                                                                                                                                                                                                                                           |
| Provide an additional eastbound thru lane beginning ~500’ west of Old Graves Mill Road and terminating at the new lane provided as part of the Priority I projects at US 501 southbound ramp intersection.                                                                       |
| Creekside Drive                                                                                                                                                                                                                                                                  |
| Widen the connector at Creekside Drive to accommodate dual northbound right turn lanes and maintain overlap phasing. Install pedestrian crossings and countdown pedestrian signal heads to improve multimodal conditions.                                                        |
| McConville Road                                                                                                                                                                                                                                                                  |
| Install a single lane roundabout to replace the four-way stop. Consider an eastbound right slip lane.                                                                                                                                                                            |
| Priority III Projects                                                                                                                                                                                                                                                            |
| 501 Interchange                                                                                                                                                                                                                                                                  |
| Construct a diverging diamond interchange to improve safety and better manage traffic flow for the northbound and southbound 501 ramps and Graves Mill Road. The new interchange will support – and expand upon priority I and II projects.                                      |
| Millrace Drive                                                                                                                                                                                                                                                                   |
| Provide an eastbound right turn lane (warranted via traffic existing and future demand).                                                                                                                                                                                         |
| Modify future access and bring two access points along the north side into the traffic signal.                                                                                                                                                                                   |
| Old Graves Mill Road                                                                                                                                                                                                                                                             |
| Widen Graves Mill Road to accommodate dual westbound left turn lanes. This will require an additional receiving lane on Old Graves Mill Road.                                                                                                                                    |
| Install pedestrian crossings and countdowns.                                                                                                                                                                                                                                     |
| Development Driven Projects                                                                                                                                                                                                                                                      |
| Complete sidewalks along Graves Mill Road as part of the Rosedale mixed use development.                                                                                                                                                                                         |
| As an alternative to sidewalks, consider a multiuse path that could be extended to each end of Graves Mill Road (decision between sidewalks and multiuse paths should be based on public input, and other plans that may have developed by the time implementation is imminent). |
| Improve roadway lighting between Millside Drive and McConville Road. An initial effort could be accomplished through incorporating these elements as part of the frontage improvements resulting from the Rosedale mixed use development.                                        |
| Prioritize transit stops for better accommodations as part of the next GLTC Transit Development Plan.                                                                                                                                                                            |
| Rosedale site entrance at Graves Mill Road should consist of dual eastbound left turn lanes and dual southbound left turn lanes, in addition to a single westbound right turn lane and single southbound right turn lane.                                                        |
| The potential roundabout at McConville Road could be programmed as additional development occurs along Nationwide Drive.                                                                                                                                                         |



## Public Information Meeting #2

A public meeting for the Graves Mill Road Corridor Study was held on Monday, April 23, 2018 at the Lynchburg Humane Society in Lynchburg, Virginia. The meeting was organized as an open-house format and was open to the general public from 4:00 – 6:00 pm. Advertisement for the meeting included:

- Mail-outs to residents and businesses near the study area approximately two weeks in advance of the meeting
- Deployment of variable message signs on Graves Mill Road approximately one week in advance of the meeting
- Press release
- Advertisement via social media
- Advertisement via local news agencies
- Notice included on the project website ([www.gravesmillplan.com](http://www.gravesmillplan.com))



The goal of this meeting was for the public to **1) learn more about the study and progress to date, 2) review draft short- and long-term roadway improvements, and 3) share comments and thoughts on bicycle and pedestrian needs.**

Attendees were encouraged to provide feedback and offer suggestions that would help to inform the project development process. Representatives from the Virginia Department of Transportation (VDOT), City of Lynchburg, Virginia's Region 2000 Local Government Council, and project consultants were available to explain materials, answer questions, and record feedback. Information boards were set up in the meeting space that presented the following subjects:



- Welcome and purpose of the meeting
- Information about the study
- Priority I recommendations
- Priority II recommendations
- Priority III recommendations
- Information on roundabout and diverging diamond interchanges
- Overview of existing multimodal conditions



In addition to the information boards, posters illustrating existing and future traffic conditions, and historical crash data shared at the first meeting was also available for review on surrounding tables. Large table-top maps of the corridor were available for attendees to gather around and mark-up regarding multimodal needs and desires. Comment sheets were also made available for participants. The meeting was attended by approximately 30 people (that signed in), including business owners/representatives along the corridor. Local news organizations covered the first meeting extensively, and gathered information via the project website and Virginia's Region 2000 Local Government Council for meeting #2.

A consistent flow of attendees began right at 4:00 PM and continued through approximately 5:30 PM. Representatives were provided sufficient time to walk attendees through the study recommendations and answer questions, as needed. Overall, attendees were very pleased of the recommendations presented and that transportation representatives were attempting to stay in front of potential growth that could exceed 50% over the next 20 years. One key topic that was discussed included project implementation and funding opportunities. While some focus was paid to transit, pedestrian

and bicycle accommodations along the corridor, the majority of attention was on the draft recommendations. To note, this was consistent with the first meeting, as many participants recognize this is a higher speed, cut-through road. However, multimodal recommendations included additional sidewalks, signalized pedestrian crossings, a multiuse path along one side off the road, and enhanced transit stop amenities.

It was further suggested, in this meeting and at the first, that the City (or other agencies) undergo a study along Old Graves Mill Road between Graves Mill Road and Timberlake Road.

### Specific Public Comments

The following public comments were **written on comment sheets** that were provided at the meeting, or **emailed via the project website** (specific identifying information has been removed, and at times, comments are paraphrased):

*Please address no turn lanes from Graves Mill Road to Lillian. There are many rear end accidents that occur.*

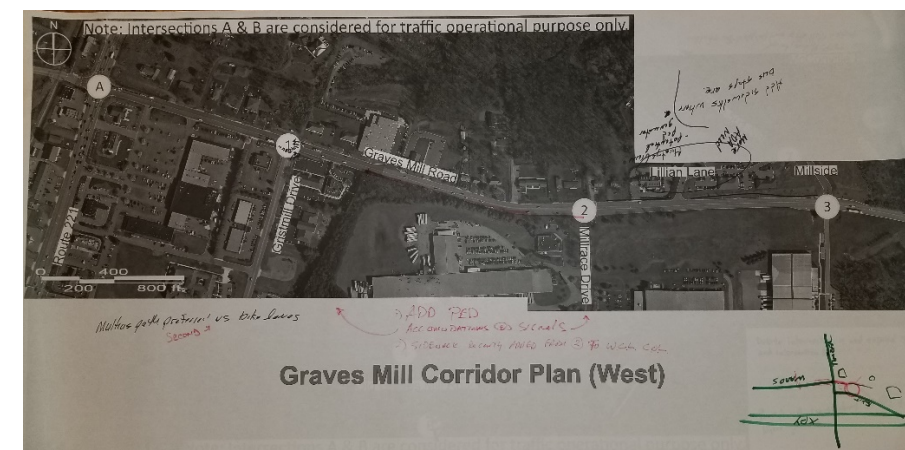
*Very difficult to make a left across Graves Mill Road from Lillian during rush hour.*

*The connector between Old Graves Mill Road and Graves Mill Road is a concern.*

*Need a center turn lane on the western side of the project (west of Millside Drive).*

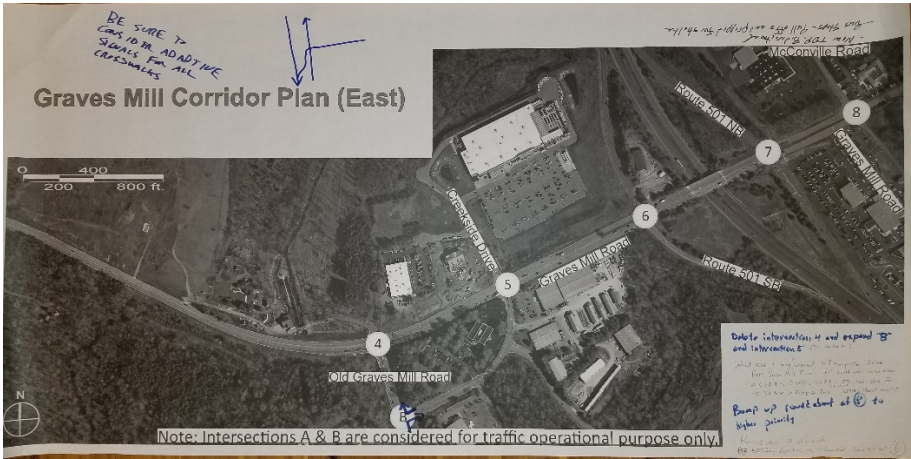
*Are there any current plans to connect all the sidewalks on Old Graves Mill Rd from humane society to Timberlake Road? A lot of pedestrians walk towards Kroger etc. and there are no sidewalks to accommodate.*

The following images depict public comments **provided on table top maps** located between the informational boards. A summary is provided under each.



The comments on this map indicate a greater desire for a multiuse path along portions of Graves Mill Road when compared to a sidewalk. This was a common theme heard from participants as residents feel it would be more utilized because it can also accommodate bikes. In addition to a multiuse path, enhanced pedestrian accommodations should be provided, including ADA. To note, intersection #1 includes a pedestrian crossing and signal as part of the study's Priority I recommendations.





The following comments were noted on the table top map above:

- Be sure to consider adaptive signals. To note, the City has applied for adaptive signal technology that covers the eastern intersections of Graves Mill Road.
- Consider connecting Enterprise Drive with Graves Mill Road. This would ease conditions from Old Graves Mill Road to 221. It would also add relief to Enterprise Drive.
- Bump up the roundabout priority.

Final Recommendations

Following the community meeting #2, the project list was updated to include the ideas/concerns raised by the public that address operational, safety, and multimodal needs along the corridor. A draft final project list and report was then shared with the CVMPO TAC for final comment and review. Once comments were included, a final project list was established and shared with the Planning Commission and City Council for approval. **Table 11** summarizes the final projects, aggregated by priority and mode, with consideration given to development driven projects. Illustrative project sheets and are provided in the **Appendix**.

Table 11 – Final Project List

| Summary of Projects                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Short-Term Recommendations                                                                                                                                                                                                    |
| Restripe northbound approach on Gristmill Drive to shared left/right and right.                                                                                                                                               |
| Convert the protected westbound left from Graves Mill Road to Old Graves Mill Road to a protected-permissive left using a flashing yellow arrow (a critical gap analysis would need to be completed prior to implementation). |
| Implement coordinated and adaptive control measures at all signalized intersections from Gristmill Drive through the interchange (adaptive control HSIP grant application in progress per date of this report).               |
| Extend eastbound and westbound left turn lanes for the two 501 ramp intersections by approximately 75’ each.                                                                                                                  |
| Priority I Projects                                                                                                                                                                                                           |
| Gristmill Drive                                                                                                                                                                                                               |
| Widen Graves Mill Road to accommodate a single westbound left turn lane (protected-permissive left using a flashing yellow arrow.                                                                                             |
| Widen Gristmill Drive to accommodate dual northbound right turn lanes and implement overlap phasing.                                                                                                                          |

Provide a pedestrian crossing and countdown signal across Gristmill Drive. If sidewalks are implemented along the north side of Graves Mill Road (which would likely require additional right of way), then pedestrian crossings across Graves Mill Road could be installed at that time.

501 Southbound Ramps

Reconfigure eastbound approach to a single thru lane and dual, controlled rights. Convert the existing right turn lane to a travel lane by extending back to Creekside Drive.

Widen the southbound on-ramp to accommodate two lanes that will merge to a single lane, before merging on to US 501.

Provide a channelized southbound right, free flow lane. The lane will end as a dedicated right turn lane at Creekside Drive.

Conduct a study to implement flashing yellow arrows to mitigate angle crashes occurring at the interchange ramp intersections.

Priority II Projects

Creekside Drive

Widen the connector at Creekside Drive to accommodate dual northbound right turn lanes and maintain overlap phasing. Install pedestrian crossings and countdowns to improve multimodal conditions.

McConville Road

Install a single lane roundabout to replace the four-way stop. Maintain the eastbound right slip lane. Install sidewalks and pedestrian crossings to better accommodate multimodal activity, particularly to/from the businesses along Nationwide Drive.

Millrace Drive

Provide an eastbound right turn lane. Modify future access and bring two access points along the north side into signalization.

Millrace Drive to Millside Drive

Provide a landscaped median with left turn lanes at key locations in general compliance with VDOT access management standards. These locations should include Lillian Lane and Millside Drive. This will require the widening of Graves Mill Road between the two intersections to accommodate the landscaped median. Include a multiuse path or sidewalk along the south side of Graves Mill Road as part of the widening that connects with the existing sidewalk to the west, and potential sidewalk included as part of the Rosedale development to the east. Consider extending the landscaped median through the proposed traffic signal serving the Rosedale development since Graves Mill Road would require widening as part of that traffic signal installation as well.

Priority III Projects

Old Graves Mill Road to Creekside Drive

Provide an additional eastbound thru lane beginning at least 500’ west of Old Graves Mill Road and terminating at the new lane provided as part of the Priority I projects at US 501 southbound ramp intersection. Install sidewalks where appropriate to better accommodate multimodal activity.

Old Graves Mill Road

Widen Graves Mill Road to accommodate dual westbound left turn lanes. This will require an additional receiving lane on Old Graves Mill Road southbound. Install pedestrian crossings and countdowns.

501 Interchange

Construct a diverging diamond interchange (DDI) to better manage traffic flow for the northbound and southbound 501 ramps and Graves Mill Road. The new interchange will support – and expand upon Priority I and II projects. The project would align with the existing bridge replacement; therefore, the new bridge should also be wide enough to accommodate a multiuse path or sidewalk. The DDI is slated as a Priority III project because it aligns with the bridge replacement. However, if it’s determined the bridge should be replaced sooner, or if a Smart Scale grant application opportunity arises, this concept could jump to a higher priority.

Development Driven Projects

Complete sidewalks along Graves Mill Road as part of the Rosedale mixed use development (development frontage along the north and south side of Graves Mill Road – crossing at the proposed traffic signal).



|                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| As an alternative to sidewalks, consider a multiuse path that could be extended to each end of Graves Mill Road (decision between sidewalks and multiuse paths should be based on public input, and other plans that may have developed by the time implementation is imminent).                                                                               |
| Improve roadway lighting between Millside Drive and McConville Road. An initial effort could be accomplished through incorporating these elements as part of the frontage improvements resulting from the Rosedale mixed use development.                                                                                                                      |
| Prioritize transit stops for better accommodations as part of the next GLTC Transit Development Plan.                                                                                                                                                                                                                                                          |
| Rosedale site entrance at Graves Mill Road should consist of dual eastbound left turn lanes and dual southbound left turn lanes, in addition to a single westbound right turn lane and single southbound right turn lane. Install pedestrian crossings and countdowns to improve multimodal conditions to connect potential sidewalks/multiuse paths as noted. |
| The potential roundabout at McConville Road could be programmed as additional development occurs along Nationwide Drive.                                                                                                                                                                                                                                       |

Other Considerations

Graves Mill Road must continue to accommodate a wide array of users with varying trip purposes. Maintaining and enhancing traffic flow within the corridor is of crucial importance, as well as balanced multi-modal accessibility. Access to future development should also be planned for and designed to ensure that it does not impede or further restrict traffic flow and is in general compliance with VDOT access management standards. As new development occurs, curb cuts should be minimized and cross parcel access shall be provided to avoid adding unnecessary short trips to Graves Mill Road. A design traffic study should accompany any widening project to ensure appropriate access management standards are adhered to, promoting safe and efficient multimodal activity.



Cost Estimates

Cost estimates for the Priority I concepts have been developed using the latest VDOT unit costs and summarized in **Table 12** and **13**. Cost estimates for the remaining priority projects will be developed as needed moving forward. While not indicated on the concept sheets, the cost estimates also include replacing/providing pedestrian signal heads with modern countdown pedestrian signal heads as needed. The cost allocations are also included in the **Appendix**.

Table 12 – Gristmill Drive Cost Estimates

| Description                | Total       |
|----------------------------|-------------|
| Preliminary Engineering    | \$430,568   |
| Construction               | \$2,289,807 |
| Right of Way and Utilities | \$132,632   |
|                            |             |
| Grand Total                | \$2,853,007 |

Source: EPR, PC, May 2018

Table 13 – Eastbound Right Turn Lane Extension and US 501 SB Ramp Widening Cost Estimates

| Description                | Total       |
|----------------------------|-------------|
| Preliminary Engineering    | \$697,821   |
| Construction               | \$4,993,528 |
| Right of Way and Utilities | \$473,149   |
|                            |             |
| Grand Total                | \$6,164,498 |

Source: EPR, PC, May 2018

Funding Opportunities

Table 14 – Smart Scale Funding

| Smart Scale         |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose             | SMART SCALE is a statewide program that intends to distribute funding based on a standard and objective evaluation of projects that will determine to how effectively they help the state achieve its transportation goals.                                                                                                                                                                                                     |
| Funding             | There are two main pathways to funding within the SMART SCALE process—the construction District Grant Program (DGP) and the High Priority Projects Program (HPPP). A project applying to funds from the DGP is prioritized with projects from the same construction district. A project applying for funds from the HPPP is prioritized with projects statewide. The CTB then makes a final decision on which projects to fund. |
| Eligible Projects   | Projects must address improvements to a Corridor of Statewide Significance, Regional Network, or Urban Development Area (UDA). Project types can include highway improvements such as widening, operational improvements, access management, and intelligent transportation systems, transit and rail capacity expansion, and transportation demand management including park and ride facilities.                              |
| Eligible Applicants | Projects may be submitted by regional entities including MPOS and PDCs, along with public transit agencies, counties, cities, and towns that maintain their own infrastructure. Projects pertaining to UDAs can only be submitted by localities.                                                                                                                                                                                |

|                     |                                                                                                                                                                                                                                                  |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Evaluation Criteria | There are five factors evaluated for all projects: Safety, Congestion Mitigation, Accessibility, Environmental Quality, and Economic Development. MPOs with a population greater than 200,000 are also evaluated by land use policy consistency. |
| Website             | <a href="http://www.vasmartyscale.org/">http://www.vasmartyscale.org/</a>                                                                                                                                                                        |

Table 15 – Highway Safety Improvement Funding

| Highway Safety Improvement Program (HSIP) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose                                   | Established by the federal transportation legislation MAP-21, this program is structured and funded to make significant progress in reducing highway fatalities and injuries on all public roads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Funding                                   | The Federal share for highway safety improvements is 90%, with certain types of projects (including, as relevant to this study, maintaining retro-reflectivity of pavement markings and the installation of traffic signs) eligible to be funded at 100%. If project cost is higher than what was originally submitted, the project manager and sponsor will be responsible for identifying sources for funding those estimates.                                                                                                                                                                                                                                                                             |
| Eligible Projects                         | Projects involve the identification of high-crash spots or corridor segments, an analysis of crash trends and existing conditions, and the prioritization and scheduling of improvement projects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Eligible Applicants                       | Local governments, VDOT District and Regional Staff.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Evaluation Criteria                       | <ul style="list-style-type: none"><li>• Evaluated on a statewide basis rather than on a local or district basis.</li><li>• Locations or corridors where a known “substantive safety” problem exists as indicated by location-specific data on severe crashes, and where it is determined that the specific project action can with confidence produce a measurable and significant reduction in the number and/or consequences of severe crashes.</li><li>• To achieve the maximum benefit, the focus of the program is on cost- effective use of funds allocated for safety improvements.</li><li>• Priority will be given to projects having higher total number of deaths and serious injuries.</li></ul> |
| Website                                   | <a href="http://www.viriniadot.org/business/ted_app_pro.asp">http://www.viriniadot.org/business/ted_app_pro.asp</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

Table 16 – Transportation Alternatives Funding

| Transportation Alternatives Program (TAP) |                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose                                   | This program is intended to help local sponsors fund community based projects that expand non-motorized travel choices and enhance the transportation experience by improving the cultural, historical, and environmental aspects of transportation infrastructure. It focuses on providing pedestrian and bicycle facilities and other community improvements.                                                               |
| Funding                                   | TAP is not a traditional grant program and funds are only available on a reimbursement basis. It is therefore important to have the necessary funding available to pay for services and materials until appropriate documentation can be submitted and processed for reimbursement. The program will allow a maximum federal reimbursement of 80% of the eligible project costs and requires a 20% local match.               |
| Eligible Projects                         | <ul style="list-style-type: none"><li>• Pedestrian and bicycle facilities such as sidewalks, bike lanes, and shared use paths</li><li>• Pedestrian and bicycle safety and educational activities such as classroom projects, safety handouts and directional signage for trails (Safe Routes to School)</li><li>• Preservation of abandoned railway corridors such as the development of a rails-to-trails facility</li></ul> |
| Eligible Applicants                       | Any local governments, regional transportation authorities, transit agencies, natural resource or public land agencies, school districts, local educational agencies, or school, tribal government, and any other local or regional government entity with responsibility for oversight of transportation or recreation trails.                                                                                               |

| Transportation Alternatives Program (TAP) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Evaluation Criteria                       | <ul style="list-style-type: none"> <li>• Number of federal enhancement categories</li> <li>• Inclusion in a state, regional, or local plan</li> <li>• Public/private venture-cooperation (multi-jurisdictional)</li> <li>• Total cost and matching funds in excess of minimum</li> <li>• Demonstrable need, community improvement</li> <li>• Community support and public accessibility</li> <li>• Compatibility with adjacent land use</li> <li>• Environmental and ecological benefits</li> <li>• Historic criteria met, significant aesthetic value to be achieved and visibility from a public right of way</li> <li>• Economic impact and effect on tourism</li> </ul> |
| Website                                   | <a href="http://www.virginiadot.org/business/prehancegrants.asp">http://www.virginiadot.org/business/prehancegrants.asp</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

Table 17 – Revenue Share Funding

| VDOT Revenue Share Program |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose                    | This program provides additional funding for use by a county, city, or town to construct, reconstruct, improve, or maintain the highway systems within such county, city, or town and for eligible rural additions in certain counties of the Commonwealth. Locality funds are matched, dollar for dollar, with state funds, with statutory limitations on the amount of state funds authorized per locality.                                                                                                                                                                                                                                             |
| Funding                    | Application for program funding must be made by resolution of the governing body of the jurisdiction requesting funds. Project funding is allocated by resolution of the CTB. Project costs are divided equally between the Revenue Share Fund and locality funding.                                                                                                                                                                                                                                                                                                                                                                                      |
| Eligible Projects          | <ul style="list-style-type: none"> <li>• Supplemental funding for projects listed in the adopted in the six-year plan</li> <li>• Construction, reconstruction, or improvement projects not including in the adopted six-year plan</li> <li>• Improvements necessary for the specific subdivision streets otherwise eligible for acceptance into the secondary system for maintenance (rural additions)</li> <li>• Maintenance projects consistent with the department's operating policies</li> <li>• New hardsurfacing (paving)</li> <li>• New roadway</li> <li>• Deficits on completed construction, reconstruction, or improvement projects</li> </ul> |
| Eligible Applicants        | Any county, city, or town in the Commonwealth                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Evaluation Criteria        | <ul style="list-style-type: none"> <li>• Priority 1: Construction projects that have previously received Revenue Sharing funding</li> <li>• Priority 2: Construction projects that meet a transportation need</li> <li>• Priority 3: Projects that address deficient pavement resurfacing and bridge rehabilitation</li> <li>• Priority 4: All other projects</li> </ul>                                                                                                                                                                                                                                                                                  |
| Website                    | <a href="http://www.virginiadot.org/business/local-assistance-access-programs.asp#Revenue_Sharing">http://www.virginiadot.org/business/local-assistance-access-programs.asp#Revenue_Sharing</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

Table 18 – Maintenance Funding

| VDOT Road Maintenance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The VDOT Road Maintenance category of funding covers a wide variety of maintenance and operations activities. Road maintenance funds comprise the majority of VDOT's scheduled funding (versus new construction). Road maintenance funding addresses needs having to do with pavement management, signals, pavement markings, signs, stripes, guardrails, and ITS (Intelligent Transportation Systems) assets that are considered to be of critical safety and operational importance. Maintenance funding also addresses operation services comprising ordinary and preventative maintenance work such as cleaning ditches, washing bridge decks, patching pot-holes, debris removal, snow and ice removal, emergency response, incident management, mowing, and equipment management. |

Table 19 – Proffer Funding

| Development Proffer |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose             | Developer contributions, known as proffers, provide one potential source of funding for capital facilities. Proffers are typically cash amounts, dedicated land, and/or in-kind services that are voluntarily granted to the locality to partially offset future capital facility costs associated with specific land developments. Recent legislation has limited the ability of local governments to receive proffers, but through the rezoning process developers may still consider proffering infrastructure improvements under the current legislation. |
| Funding             | The cost of the program can be partially financed with developer contributions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Eligible Projects   | <ul style="list-style-type: none"> <li>• Rezoning requests that permit residential and/or commercial uses in accordance with State enabling legislation</li> <li>• Limited to offsetting impacts that are directly attributable to new development</li> <li>• To "accept" a proffer, a locality should have completed an exhaustive study to document the real project costs</li> </ul>                                                                                                                                                                       |
| Eligible Applicants | Any property owners or developers seeking a rezoning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

Table 20 – BUILD Funding

| Better Utilizing Investments to Leverage Development (BUILD) Transportation Discretionary Grants (Previously TIGER) |                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose                                                                                                             | The BUILD Transportation grants replace the pre-existing Transportation Investment Generating Economic Recovery (TIGER) grant program. As the Administration looks to enhance America's infrastructure, FY 2018 BUILD Transportation grants are for investments in surface transportation infrastructure and are to be awarded on a competitive basis for projects that will have a significant local or regional impact. |
| Funding                                                                                                             | Since 2009, the Program has provided a combined \$5.6 billion to 463 projects in all 50 states, the District of Columbia, Puerto Rico, Guam, the Virgin Island. The Consolidated Appropriations Act of 2018 made available \$1.5 billion for National Infrastructure Investments, through September 30, 2020.                                                                                                             |
| Eligible Projects                                                                                                   | BUILD funding can support roads, bridges, transit, rail, ports or intermodal transportation.                                                                                                                                                                                                                                                                                                                              |
| Eligible Applicants                                                                                                 | BUILD can provide capital funding directly to any public entity, including municipalities, counties, port authorities, tribal governments, MPOs, or others in contrast to traditional Federal programs which provide funding to very specific groups of applicants (mostly State DOTs and transit agencies).                                                                                                              |
| Evaluation Criteria                                                                                                 | Projects for BUILD will be evaluated based on merit criteria that include safety, economic competitiveness, quality of life, environmental protection, state of good repair, innovation, partnership, and additional non-Federal revenue for future transportation infrastructure investments.                                                                                                                            |
| Website                                                                                                             | <a href="https://www.transportation.gov/BUILDgrants">https://www.transportation.gov/BUILDgrants</a>                                                                                                                                                                                                                                                                                                                       |

Appendix List

| Letter     | Description                    |
|------------|--------------------------------|
| Appendix A | Project Summary Sheets         |
| Appendix B | Detailed Crash Data            |
| Appendix C | Raw Traffic Counts             |
| Appendix D | Traffic Forecasting Memorandum |
| Appendix E | Public Meeting Summaries       |
| Appendix F | HCM and Queuing Reports        |
| Appendix G | Turn Lane Warrants             |
| Appendix H | Project Cost Estimates         |



# Appendix A

## Project Summary Sheets

# GRAVES MILL ROAD CORRIDOR STUDY

**Priority I Projects:** Key improvements for locations that exhibit existing safety and operational challenges that are intensified with future growth. These locations were also a focal point during the first public meeting. The Priority I projects will be considered for the VDOT Six-Year Improvement Plan, and other regional and local transportation plans.



## Location: US 501 Southbound Ramp Intersections

### Existing Conditions

- Queuing for the eastbound right extends back through Creekside Drive, primarily during the PM peak.
- Lane bias becomes an issue west of Creekside Drive. The eastbound queue in the right lane consistently does not clear the intersection at Creekside Drive.
- Moderate southbound right queuing for the off-ramp occurs during both peaks.

### 2040 No Build Conditions (Coordinated Network Implemented)

- Eastbound queuing and delays increase substantially, extending back well beyond Old Graves Mill Road.
- Unable to clear the intersection for multiple cycle lengths.
- Safety conditions likely to deteriorate due to congestion and “queue jumping” from lane bias.
- Southbound right will experience significant delays and queuing on the off-ramp.

### Project Description

- Reconfigure eastbound approach to a single thru lane and dual, controlled rights. Convert the existing right turn lane to a travel lane by extending back to Creekside Drive.
- Widen the southbound on-ramp to accommodate two lanes that will merge to a single lane, before merging on to US 501.
- Provide a channelized southbound right, free flow lane. The lane will end as a dedicated right turn lane at Creekside Drive.

### Planning Level Costs

| Phase                   | Six Year Improvement Program |
|-------------------------|------------------------------|
| Preliminary Engineering | \$ 697,821                   |
| ROW/Utility             | \$ 473,149                   |
| Construction            | \$ 4,993,528                 |
| <b>Total Costs</b>      | <b>\$ 6,164,498</b>          |



| Level of Service (Delay in Seconds) |               |           |            |          |
|-------------------------------------|---------------|-----------|------------|----------|
| Intersection                        | 2040 No Build |           | 2040 Build |          |
|                                     | AM            | PM        | AM         | PM       |
| Eastbound Right                     | E (56.7)      | F (144.1) | A (<5.0)   | A (<5.0) |
| Southbound Right                    | F (173.0)     | F (173.0) | A (<5.0)   | A (<5.0) |
| Overall*                            | D (38.2)      | E (75.0)  | A (9.3)    | A (<5.0) |

\* Represents the intersection's average delay.

| 95 <sup>th</sup> Percentile Queuing (in Feet) |               |        |            |           |
|-----------------------------------------------|---------------|--------|------------|-----------|
| Intersection                                  | 2040 No Build |        | 2040 Build |           |
|                                               | AM            | PM     | AM         | PM        |
| Eastbound Right                               | 340'          | 1,698' | <50'       | <50'      |
| Southbound Right                              | 383'          | 826'   | Free Flow  | Free Flow |
| Overall*                                      | 1,381'        | 3,177' | 981'       | 278'      |

\*Represents the sum of all approach queues.

### Project Benefits

- Substantial reduction in movement delay and overall delay.
- Overall queues are reduced by over 30 percent for the AM peak, and over 90 percent for the PM peak.
- Better lane management improves safety conditions and reduces lane bias; thereby reducing eastbound queuing at Creekside Drive and Old Graves Mill Road.



# GRAVES MILL ROAD CORRIDOR STUDY

**Priority I Projects:** Key improvements for locations that exhibit existing safety and operational challenges that are intensified with future growth. These locations were also a focal point during the first public meeting. The Priority I projects will be considered for the VDOT Six-Year Improvement Plan, and other regional and local transportation plans.



## Location: Gristmill Drive

### Existing Conditions

- Gristmill Drive functions as a cut-through to avoid US 221 at Graves Mill Road.
- At times, unable to clear westbound movement in a single cycle length.
- Lack of a dedicated westbound left turn lane (shared thru-left) creates heavy queuing during the PM peak.
- Northbound right is consistent and heavy due to cut-through traffic, generating lengthy queues during the AM peak.

### 2040 No Build Conditions (Coordinated Network Implemented)

- Queuing and delays increase substantially.
- Unable to clear the intersection for multiple cycle lengths.
- Safety conditions likely to deteriorate due to congestion and increased driver frustration.

### Project Description

- Widen Graves Mill Road to accommodate a single westbound left turn lane (protected-permissive phasing).
- Widen Gristmill Drive to accommodate dual northbound right turn lanes (overlap phasing).
- Provide a pedestrian crossing and countdown timer across Gristmill Drive. If sidewalks are eventually implemented along the north side of Graves Mill Road, then pedestrian crossings could be installed at that time.

| Intersection       | Level of Service (Delay in Seconds) |            |            |           |
|--------------------|-------------------------------------|------------|------------|-----------|
|                    | 2040 No Build                       |            | 2040 Build |           |
|                    | AM                                  | PM         | AM         | PM        |
| Westbound Approach | F (122.8)                           | F (195.0)  | D (41.8)*  | B (17.6)* |
| Northbound Right   | F (193.6)                           | F (>200.0) | D (45.2)   | D (45.1)  |
| Overall**          | F (107.8)                           | F (164.9)  | C (26.4)   | B (18.0)  |

\*New westbound left turn lane. Approach for AM is B (14.4) and for PM is A (7.0).

\*\*Represents the intersection's average delay.

| Intersection       | 95 <sup>th</sup> Percentile Queuing (in Feet) |        |            |       |
|--------------------|-----------------------------------------------|--------|------------|-------|
|                    | 2040 No Build                                 |        | 2040 Build |       |
|                    | AM                                            | PM     | AM         | PM    |
| Westbound Approach | 596'                                          | 1,397' | 230'*      | 206'* |
| Northbound Right   | 1,007'                                        | 902'   | 352'       | 269'  |
| Overall**          | 1,955'                                        | 2,467' | 991'       | 992'  |

\*New westbound left turn lane. Thru movement approach for AM is <50' and for PM is 51'.

\*\*Represents the sum of all approach queues.

### Project Benefits

- Substantial reduction in movement delay and overall delay.
- Overall queues are reduced by over 50 percent for both peak hours.
- Better lane management improves safety conditions.



### Planning Level Costs

| Phase                   | Six Year Improvement Program |
|-------------------------|------------------------------|
| Preliminary Engineering | \$ 430,568                   |
| ROW/Utility             | \$ 132,632                   |
| Construction            | \$ 2,289,807                 |
| Total Costs             | \$ 2,853,007                 |





# GRAVES MILL ROAD CORRIDOR STUDY

**Priority II Projects:** Secondary improvements that were determined as part of the future conditions analysis, and offer support to Priority 1 projects. These projects are more targeted and may eventually be considered for regional and local transportation plans.



Location

Issues

Project Description

Operations

Sketch Concept

## Creekside Drive

- Under future conditions, northbound right operates at LOS E (LOS F for shared thru/left movement)
  - Under future conditions, queuing for the northbound right exceeds 600'.
- Widen the connector at Creekside Drive to accommodate dual northbound right turn lanes.
  - Install pedestrian crossings and countdowns.

| Level of Service (Delay in Seconds) |                                    |           |                 |                               |          |
|-------------------------------------|------------------------------------|-----------|-----------------|-------------------------------|----------|
|                                     | 2040 with only Priority I Projects |           |                 | 2040 with Priority II Project |          |
|                                     | AM                                 | PM        |                 | AM                            | PM       |
| NB Left/Through                     | E (72.0)                           | F (117.8) | NB Left/Through | D (51.4)                      | E (78.1) |
| NB Right                            | E (55.2)                           | E (65.2)  | NB Right        | C (31.8)                      | D (44.2) |
| Overall                             | D (40.9)                           | C (27.2)  | Overall         | C (21.2)                      | C (21.3) |

| 95th Percentile Queuing in Feet |                                    |      |                 |                               |      |
|---------------------------------|------------------------------------|------|-----------------|-------------------------------|------|
|                                 | 2040 with only Priority I Projects |      |                 | 2040 with Priority II Project |      |
|                                 | AM                                 | PM   |                 | AM                            | PM   |
| NB Left/Through                 | 49                                 | 197  | NB Left/Through | 49                            | 197  |
| NB Right                        | 596                                | 647  | NB Right        | 234                           | 285  |
| Overall                         | 2031                               | 1904 | Overall         | 1677                          | 1434 |



## McConville Road

- Under future conditions, extensive queuing occurs, primarily with movements associated with Nationwide Drive.
  - Under future conditions, several movements will operate at LOS F, including the overall intersection during the PM peak.
- Install a full size roundabout with a raised island.
  - Maintain the eastbound right slip lane.

| Level of Service (Delay in Seconds) |                                    |           |                 |                               |          |
|-------------------------------------|------------------------------------|-----------|-----------------|-------------------------------|----------|
|                                     | 2040 with only Priority I Projects |           |                 | 2040 with Priority II Project |          |
|                                     | AM                                 | PM        |                 | AM                            | PM       |
| EB Left/Through                     | F (73.4)                           | C (23.0)  | EB Left/Through | A (9.5)                       | A (5.5)  |
| WB                                  | B (13.5)                           | F (122.2) | WB              | A (5.8)                       | D (33.8) |
| NB                                  | D (25.4)                           | F (134.1) | NB              | B (14.7)                      | B (11.5) |
| Overall                             | E (37.5)                           | F (84.5)  | Overall         | A (8.1)                       | C (16.2) |

| 95th Percentile Queuing in Feet |                                    |      |                 |                               |     |
|---------------------------------|------------------------------------|------|-----------------|-------------------------------|-----|
|                                 | 2040 with only Priority I Projects |      |                 | 2040 with Priority II Project |     |
|                                 | AM                                 | PM   |                 | AM                            | PM  |
| EB Left/Through                 | 380                                | 73   | EB Left/Through | 75                            | 25  |
| WB                              | 20                                 | 433  | WB              | 0                             | 225 |
| NB                              | 130                                | 463  | NB              | 75                            | 75  |
| Overall                         | 671                                | 1110 | Overall         | 200                           | 375 |



## Millrace Drive

- Under future conditions, the eastbound right meets turn lane warrants, per VDOT standards.
- Provide an eastbound right turn lane.
  - Maintain existing access, but consider bringing north side driveway into signalization.

| Level of Service (Delay in Seconds) |                               |          | 95th Percentile Queuing in Feet |                               |      |
|-------------------------------------|-------------------------------|----------|---------------------------------|-------------------------------|------|
|                                     | 2040 with Priority II Project |          |                                 | 2040 with Priority II Project |      |
|                                     | AM                            | PM       |                                 | AM                            | PM   |
| EB Through                          | A (5.2)                       | B (13.2) | EB Through                      | 362                           | 553  |
| EB Right                            | A (2.4)                       | A (8.9)  | EB Right                        | 2                             | 7    |
| Overall                             | A (4.9)                       | B (14.0) | Overall                         | 469                           | 1258 |



# GRAVES MILL ROAD CORRIDOR STUDY

**Priority II Projects:** Secondary improvements that were determined as part of the future conditions analysis, and offer support to Priority 1 projects. These projects are more targeted and may eventually be considered for regional and local transportation plans.

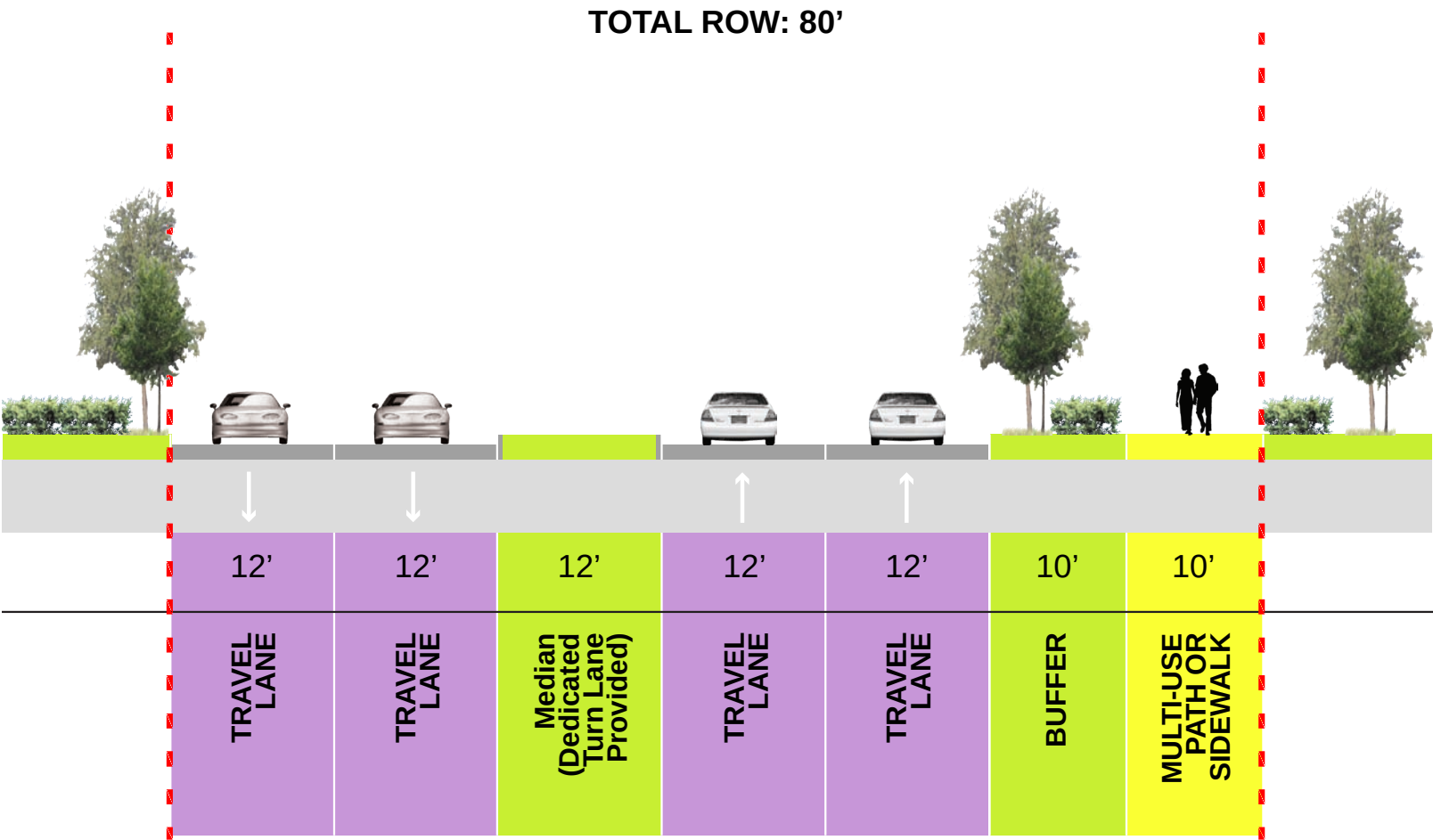


| Location | Issues | Project Description | Operations |
|----------|--------|---------------------|------------|
|----------|--------|---------------------|------------|

**Millrace Drive to  
Millside Drive**

- Numerous accidents clustered near the Lillian Lane intersection.
  - Difficulty making an eastbound left and southbound left.
  - High speeds and steeper grade along this portion of Graves Mill Road.
  - Under future conditions, the eastbound and westbound left movements at Millside Drive meet turn lane warrants, per VDOT standards.
- Provide a landscaped median with left turn lanes between Millrace Drive and Millside Drive.
  - The landscaped median would connect with the westbound left at Millrace Drive and support the potential Millside Drive improvements as dedicated left turn lanes.
  - The improvement would require widening Graves Mill Road to accommodate the additional lane.
  - The project would be enhanced by a multiuse path or sidewalk along the south side of Graves Mill Road (previous multimodal recommendation).

- The landscaped median should help to reduce the occurrence of rear-end crashes associated with eastbound and westbound lefts.
- if full access opening is not considered for the landscaped median, northbound and southbound lefts could make u-turns at the nearest signalized intersection.





# GRAVES MILL ROAD CORRIDOR STUDY

**Priority III Projects:** Building on Priority II Projects, these recommended improvements will be needed if a maximum buildout and growth scenario occurs along the corridor. Priority III projects should be monitored over time as conditions dictate.



## Location

**Old Graves Mill Road and Creekside Drive**

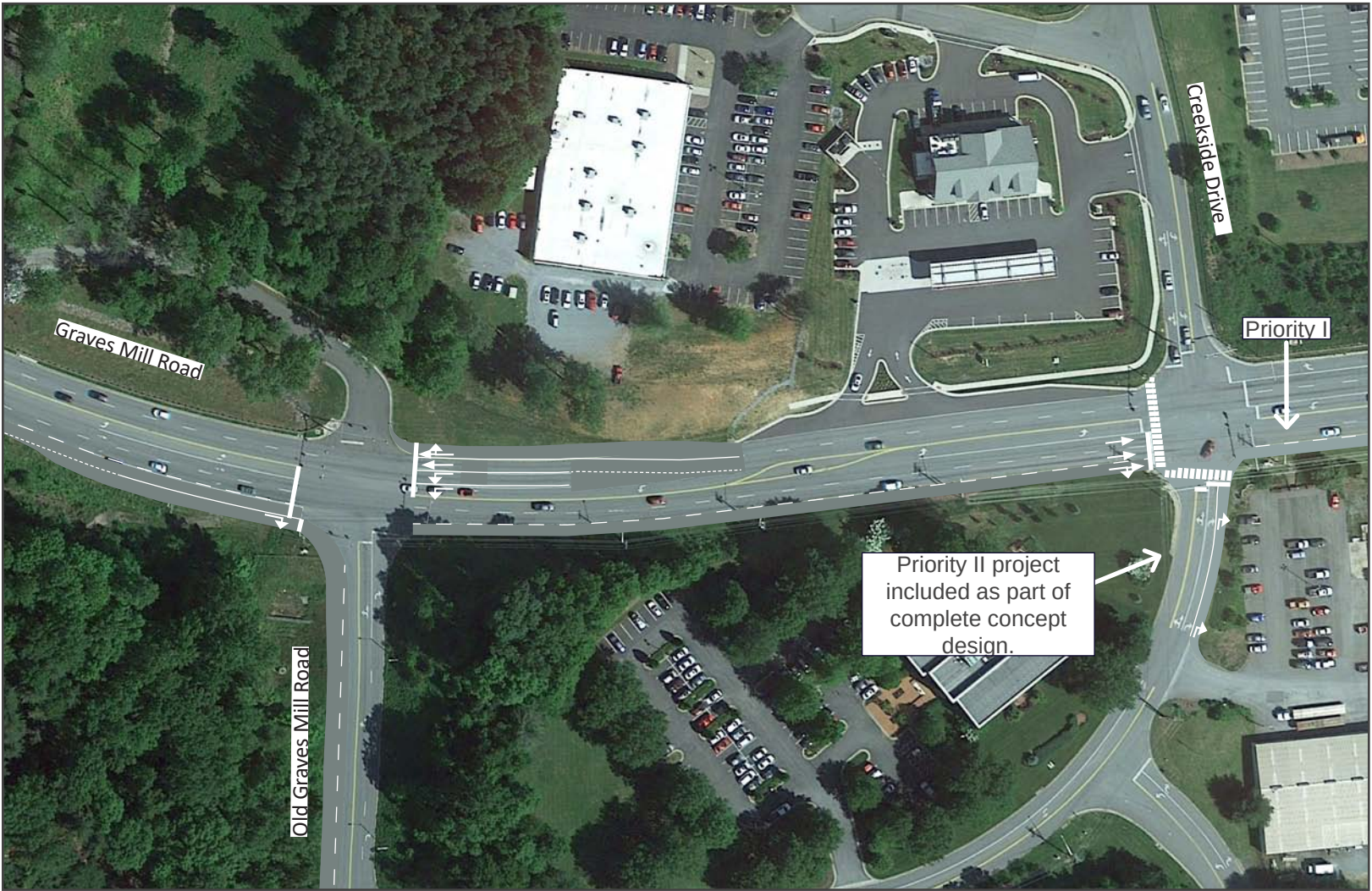
## Issues

- Under future conditions, heavy eastbound movement results in long delays, particularly for westbound left movements (priority given to Graves Mill Road).
- Lane bias may remain an issue with only two lanes.
- Eastbound queuing over 1,000' at Old Graves Mill Road.
- Queues extends beyond available storage for several left turn lanes.

## Project Description

- Provide an additional eastbound through lane, beginning west of Old Graves Mill Road and connecting with the Priority I lane addition at Creekside Drive.
- Provide dual westbound left turn lanes at Old Graves Mill Road. This will require two receiving lanes on Old Graves Mill Road.
- The additional northbound right at Creekside Drive included as part of complete concept.

## Sketch Concept



Note: Future study needed to identify appropriate intersection for Old Graves Mill Road and Connector Road.

## Operations

| Level of Service (Delay in Seconds) |                                    |           |             |                               |          |
|-------------------------------------|------------------------------------|-----------|-------------|-------------------------------|----------|
|                                     | 2040 with only Priority I Projects |           |             | 2040 with Priority II Project |          |
| Old Graves Mill Road                | AM                                 | PM        |             | AM                            | PM       |
| EB Approach                         | A (8.6)                            | C (23.5)  | EB Approach | A (6.7)                       | B (14.3) |
| WB Left                             | F (248.5)                          | F (164.9) | WB Left     | D (45.9)                      | D (51.5) |
| WB Approach                         | C (30.5)                           | D (40.3)  | WB Approach | A (6.7)                       | B (15.9) |
| Overall                             | C (20.8)                           | C (34.2)  | Overall     | B (10.6)                      | B (19.0) |
| 2040 with only Priority I Projects  |                                    |           |             |                               |          |
| Creekside Drive                     | AM                                 | PM        |             | AM                            | PM       |
| EB Approach                         | B (19.3)                           | B (15.6)  | EB Approach | B (12.2)                      | B (17.0) |
| Overall                             | C (21.2)                           | C (21.3)  | Overall     | B (18.1)                      | B (19.8) |

| 95th Percentile Queuing in Feet    |                                    |      |             |                               |      |
|------------------------------------|------------------------------------|------|-------------|-------------------------------|------|
|                                    | 2040 with only Priority I Projects |      |             | 2040 with Priority II Project |      |
| Old Graves Mill Road               | AM                                 | PM   |             | AM                            | PM   |
| EB Approach                        | 283                                | 1088 | EB Approach | 161                           | 441  |
| WB Left                            | 268                                | 706  | WB Left     | 96                            | 236  |
| WB Approach                        | 284                                | 956  | WB Approach | 112                           | 485  |
| Overall                            | 795                                | 2354 | Overall     | 501                           | 1236 |
| 2040 with only Priority I Projects |                                    |      |             |                               |      |
| Creekside Drive                    | AM                                 | PM   |             | AM                            | PM   |
| EB Approach                        | 754                                | 176  | EB Approach | 314                           | 154  |
| Overall                            | 1677                               | 1434 | Overall     | 1237                          | 1357 |



# GRAVES MILL ROAD CORRIDOR STUDY

**Priority III Projects: DDI at US 501** Building on Priority II Projects, these recommended improvements will be needed if a maximum buildout and growth scenario occurs along the corridor. Priority III projects should be monitored over time as conditions dictate.

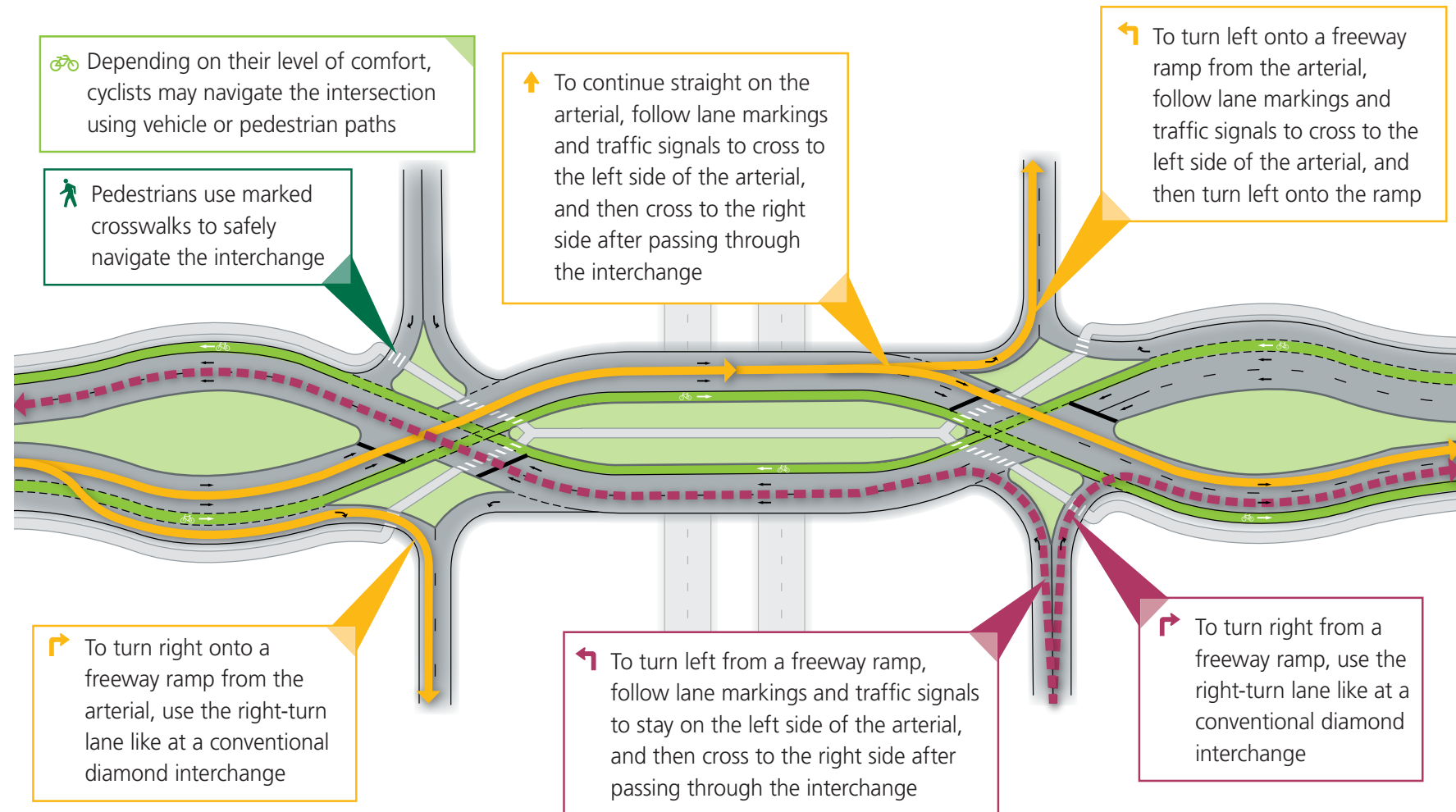


## Diverging Diamond Interchange (DDI)

### What are the benefits of a DDI?

- **Improved safety:** Reduces the number of points where vehicles may cross paths
- **Increased efficiency:** Crossovers can operate with only two traffic signal phases, which allows the interchange to handle a greater volume of traffic and operate with less delay
- **Easier access to freeway:** Design allows traffic to enter and exit the freeway without crossing opposing lanes of traffic
- **Cost effective:** Since there are no left-turn lanes on the arterial, a DDI can have a narrower cross section and may be more cost effective than a retrofit or new interchange construction

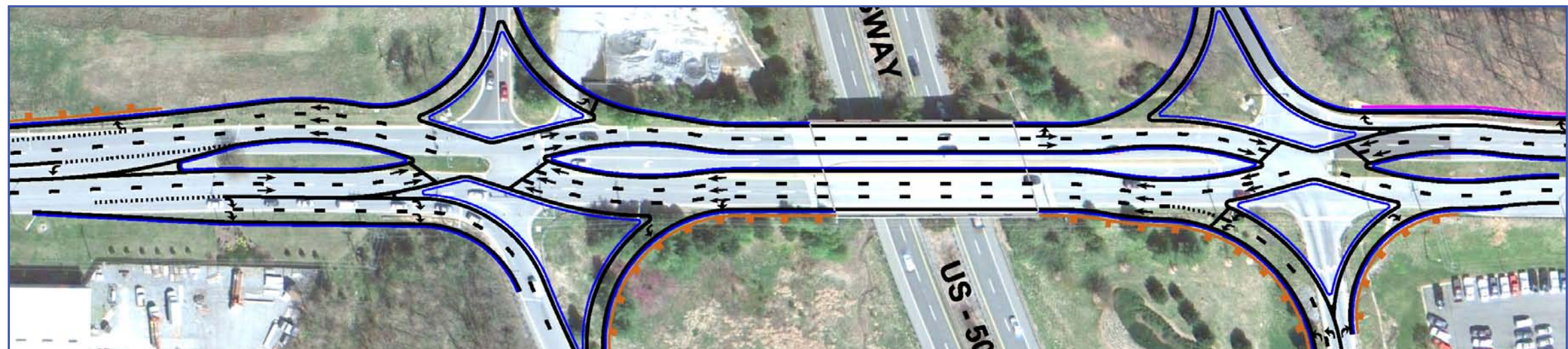
Visit [www.virginiadot.org/innovativeintersections](http://www.virginiadot.org/innovativeintersections) to learn more.



*Note: For simplicity, only two directions of traffic are shown. Opposing traffic follows similar routes. Diagram not to scale.*

### Concept at US 501 Interchange

- Preliminary results suggest the DDI offers the greatest reduction in delay and queuing, when compared to more conventional designs.
- Would likely be implemented when the Graves Mill Road / US 501 interchange bridge needs replacing.
- Because the bridge would be replaced, ensure the new one is also wide enough to accommodate a multiuse path or sidewalk.
- Need for additional analysis to advance the concept further.



# Appendix B

## Detailed Crash Data

| ID | DOCUMENT  | DATE       | DAY OF WEEK | Time        | TYPE                          | SEVERITY                 | LIGHT CONDITIO   | ROADWAY COND | Alcohol? | Unbelted? | Speeding? | Bike? | Ped? | Vehicle# |
|----|-----------|------------|-------------|-------------|-------------------------------|--------------------------|------------------|--------------|----------|-----------|-----------|-------|------|----------|
| 13 | 110910421 | 2/10/2011  | Thursday    | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | UNBELTED  | N         | N     | N    | 3        |
| 18 | 110875284 | 3/6/2011   | Sunday      | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 2. Wet       | N        | N         | SPEED     | N     | N    | 2        |
| 23 | 110905042 | 3/28/2011  | Monday      | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 31 | 111465069 | 5/20/2011  | Friday      | 3PM TO 6PM  | 1. Rear End                   | B.Visible Injury         | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 34 | 111665057 | 6/6/2011   | Monday      | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 35 | 111665064 | 6/9/2011   | Thursday    | 6AM TO 9AM  | 1. Rear End                   | B.Visible Injury         | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 40 | 111875090 | 6/23/2011  | Thursday    | 12PM TO 3PM | 1. Rear End                   | B.Visible Injury         | 2. Daylight      | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 64 | 112715136 | 9/23/2011  | Friday      | 6AM TO 9AM  | 1. Rear End                   | PDO.Property Damage Only | 1. Dawn          | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 77 | 113215143 | 11/4/2011  | Friday      | 12PM TO 3PM | 1. Rear End                   | C.Non-Visible Injury     | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 3        |
| 83 | 113405052 | 11/26/2011 | Saturday    | 6PM TO 9PM  | 1. Rear End                   | PDO.Property Damage Only | 4. Darkness - Ro | 1. Dry       | ALCOHOL  | N         | SPEED     | N     | N    | 2        |
| 88 | 120055214 | 12/30/2011 | Friday      | 3AM TO 6AM  | 1. Rear End                   | PDO.Property Damage Only | 4. Darkness - Ro | 1. Dry       | N        | N         | N         | N     | N    | 3        |
| 7  | 110875193 | 1/14/2011  | Friday      | 9PM TO 12AM | 10. Deer                      | PDO.Property Damage Only | 4. Darkness - Ro | 1. Dry       | N        | N         | N         | N     | N    | 1        |
| 51 | 112145181 | 7/29/2011  | Friday      | 12PM TO 3PM | 16. Other                     | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 1        |
| 3  | 110875164 | 1/3/2011   | Monday      | 12PM TO 3PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | N         | SPEED     | N     | N    | 3        |
| 12 | 110875249 | 2/7/2011   | Monday      | 12PM TO 3PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | UNBELTED  | N         | N     | N    | 2        |
| 14 | 110940575 | 2/16/2011  | Wednesday   | 3PM TO 6PM  | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 25 | 110975034 | 3/30/2011  | Wednesday   | 9AM TO 12PM | 2. Angle                      | C.Non-Visible Injury     | 2. Daylight      | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 41 | 111795195 | 6/23/2011  | Thursday    | 3PM TO 6PM  | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 59 | 112505259 | 8/30/2011  | Tuesday     | 9AM TO 12PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 69 | 112925085 | 10/11/2011 | Tuesday     | 12PM TO 3PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 71 | 113050147 | 10/19/2011 | Wednesday   | 6PM TO 9PM  | 3. Head On                    | PDO.Property Damage Only | 5. Darkness - Ro | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 87 | 120055183 | 12/21/2011 | Wednesday   | 3PM TO 6PM  | 4. Sideswipe - Same Direction | PDO.Property Damage Only | 4. Darkness - Ro | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 19 | 110875371 | 3/10/2011  | Thursday    | 6AM TO 9AM  | 9. Fixed Object - Off Road    | B.Visible Injury         | 1. Dawn          | 2. Wet       | N        | UNBELTED  | N         | N     | N    | 1        |
| 81 | 113275143 | 11/16/2011 | Wednesday   | 6PM TO 9PM  | 9. Fixed Object - Off Road    | PDO.Property Damage Only | 4. Darkness - Ro | 2. Wet       | N        | N         | N         | N     | N    | 1        |
| 86 | 120055181 | 12/18/2011 | Sunday      | 9PM TO 12AM | 9. Fixed Object - Off Road    | PDO.Property Damage Only | 4. Darkness - Ro | 1. Dry       | N        | N         | N         | N     | N    | 1        |



| ID  | DOCUMENT  | DATE       | DAY OF WEEK | Time        | TYPE                          | SEVERITY                 | LIGHT CONDITION    | ROADWAY COND | Alcohol? | Unbelted? | Speeding? | Bike? | Ped? | Vehicle# |
|-----|-----------|------------|-------------|-------------|-------------------------------|--------------------------|--------------------|--------------|----------|-----------|-----------|-------|------|----------|
| 116 | 121105138 | 4/14/2012  | Saturday    | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 118 | 121155121 | 4/19/2012  | Thursday    | 6AM TO 9AM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 133 | 121645385 | 6/12/2012  | Tuesday     | 3PM TO 6PM  | 1. Rear End                   | B.Visible Injury         | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 134 | 121725127 | 6/13/2012  | Wednesday   | 3PM TO 6PM  | 1. Rear End                   | C.Non-Visible Injury     | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 138 | 121945145 | 7/5/2012   | Thursday    | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 4        |
| 1   | 122295210 | 8/14/2012  | Tuesday     | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 2   | 122295211 | 8/14/2012  | Tuesday     | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 6   | 122505171 | 8/25/2012  | Saturday    | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight        | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 17  | 123065198 | 10/26/2012 | Friday      | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 135 | 121805064 | 6/15/2012  | Friday      | 6AM TO 9AM  | 16. Other                     | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 3        |
| 104 | 120685097 | 3/2/2012   | Friday      | 12PM TO 3PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight        | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 110 | 120875179 | 3/26/2012  | Monday      | 9PM TO 12AM | 2. Angle                      | PDO.Property Damage Only | 4. Darkness - Road | 2. Wet       | N        | N         | N         | N     | N    | 2        |
| 111 | 120965082 | 3/29/2012  | Thursday    | 6AM TO 9AM  | 2. Angle                      | B.Visible Injury         | 4. Darkness - Road | 1. Dry       | N        | N         | N         | N     | N    | 4        |
| 130 | 121655192 | 6/7/2012   | Thursday    | 6PM TO 9PM  | 2. Angle                      | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 137 | 121885072 | 6/30/2012  | Saturday    | 12PM TO 3PM | 2. Angle                      | B.Visible Injury         | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 5   | 122505099 | 8/20/2012  | Monday      | 9AM TO 12PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 15  | 130585199 | 10/17/2012 | Wednesday   | 6AM TO 9AM  | 2. Angle                      | B.Visible Injury         | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 28  | 123535189 | 12/3/2012  | Monday      | 3PM TO 6PM  | 2. Angle                      | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 20  | 123165176 | 11/9/2012  | Friday      | 3PM TO 6PM  | 4. Sideswipe - Same Direction | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 24  | 123325216 | 11/13/2012 | Tuesday     | 3PM TO 6PM  | 4. Sideswipe - Same Direction | PDO.Property Damage Only | 2. Daylight        | 1. Dry       | N        | N         | N         | N     | N    | 2        |
| 90  | 120265058 | 1/9/2012   | Monday      | 12PM TO 3PM | 9. Fixed Object - Off Road    | C.Non-Visible Injury     | 4. Darkness - Road | 1. Dry       | ALCOHOL  | N         | SPEED     | N     | N    | 1        |

| ID  | DOCUMENT  | DATE       | DAY OF WEEK | Time        | TYPE        | SEVERITY                 | LIGHT CONDITION      | ROADWAY CONDITION | Alcohol? | Unbelted? | Speeding? | Bike? | Ped? | Vehicle# |
|-----|-----------|------------|-------------|-------------|-------------|--------------------------|----------------------|-------------------|----------|-----------|-----------|-------|------|----------|
| 33  | 130245105 | 1/8/2013   | Tuesday     | 3PM TO 6PM  | 1. Rear End | B.Visible Injury         | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 2        |
| 46  | 130585244 | 2/18/2013  | Monday      | 6AM TO 9AM  | 1. Rear End | PDO.Property Damage Only | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 2        |
| 47  | 130515137 | 2/20/2013  | Wednesday   | 9AM TO 12PM | 1. Rear End | B.Visible Injury         | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 2        |
| 48  | 130575262 | 2/22/2013  | Friday      | 12PM TO 3PM | 1. Rear End | C.Non-Visible Injury     | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 2        |
| 78  | 131775237 | 6/17/2013  | Monday      | 12PM TO 3PM | 1. Rear End | PDO.Property Damage Only | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 3        |
| 79  | 131855193 | 6/25/2013  | Tuesday     | 6AM TO 9AM  | 1. Rear End | PDO.Property Damage Only | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 2        |
| 95  | 132615165 | 9/10/2013  | Tuesday     | 3PM TO 6PM  | 1. Rear End | PDO.Property Damage Only | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 2        |
| 98  | 132765054 | 9/27/2013  | Friday      | 12PM TO 3PM | 1. Rear End | PDO.Property Damage Only | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 4        |
| 117 | 133535100 | 11/26/2013 | Tuesday     | 12PM TO 3PM | 1. Rear End | PDO.Property Damage Only | 2. Daylight          | 2. Wet            | N        | N         | N         | N     | N    | 2        |
| 115 | 133535076 | 11/21/2013 | Thursday    | 12PM TO 3PM | 10. Deer    | C.Non-Visible Injury     | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 1        |
| 37  | 130245155 | 1/17/2013  | Thursday    | 3PM TO 6PM  | 16. Other   | B.Visible Injury         | 2. Daylight          | 2. Wet            | N        | N         | N         | N     | N    | 1        |
| 49  | 130585262 | 2/22/2013  | Friday      | 6AM TO 9AM  | 2. Angle    | PDO.Property Damage Only | 2. Daylight          | 2. Wet            | N        | N         | N         | N     | N    | 2        |
| 50  | 130595195 | 2/26/2013  | Tuesday     | 9AM TO 12PM | 2. Angle    | PDO.Property Damage Only | 2. Daylight          | 2. Wet            | N        | N         | N         | N     | N    | 2        |
| 97  | 132745173 | 9/25/2013  | Wednesday   | 12PM TO 3PM | 2. Angle    | PDO.Property Damage Only | 2. Daylight          | 1. Dry            | N        | N         | N         | N     | N    | 2        |
| 101 | 132845084 | 10/4/2013  | Friday      | 6PM TO 9PM  | 2. Angle    | PDO.Property Damage Only | 5. Darkness - Road N | 1. Dry            | N        | N         | N         | N     | N    | 2        |
| 103 | 132975178 | 10/7/2013  | Monday      | 9AM TO 12PM | 2. Angle    | PDO.Property Damage Only | 2. Daylight          | 2. Wet            | N        | N         | N         | N     | N    | 2        |
| 107 | 133065214 | 10/31/2013 | Thursday    | 3PM TO 6PM  | 2. Angle    | K.Fatal Injury           | 2. Daylight          | 1. Dry            | N        | N         | SPEED     | N     | N    | 3        |
| 121 | 133535218 | 12/10/2013 | Tuesday     | 6PM TO 9PM  | 3. Head On  | B.Visible Injury         | 4. Darkness - Road L | 1. Dry            | N        | N         | N         | N     | N    | 3        |

| ID  | DOCUMENT  | DATE       | DAY OF WEEK | Time        | TYPE                          | SEVERITY                 | LIGHT CONDITIO   | ROADWAY CONDI | Alcohol? | Unbelted? | Speeding? | Bike? | Ped? | Vehicle# |
|-----|-----------|------------|-------------|-------------|-------------------------------|--------------------------|------------------|---------------|----------|-----------|-----------|-------|------|----------|
| 140 | 140725243 | 3/6/2014   | Thursday    | 6AM TO 9AM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 9   | 141285181 | 4/23/2014  | Wednesday   | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 27  | 141745298 | 6/23/2014  | Monday      | 6PM TO 9PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | SPEED     | N     | N    | 2        |
| 30  | 142115193 | 7/17/2014  | Thursday    | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 3        |
| 32  | 142335147 | 8/12/2014  | Tuesday     | 6PM TO 9PM  | 1. Rear End                   | B.Visible Injury         | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 36  | 142415212 | 8/25/2014  | Monday      | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 4        |
| 55  | 142905298 | 10/11/2014 | Saturday    | 3PM TO 6PM  | 1. Rear End                   | A.Ambulatory Injury      | 2. Daylight      | 1. Dry        | N        | UNBELTED  | N         | N     | N    | 2        |
| 60  | 143185265 | 11/3/2014  | Monday      | 6AM TO 9AM  | 1. Rear End                   | C.Non-Visible Injury     | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 61  | 143185280 | 11/7/2014  | Friday      | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 4. Darkness - Ro | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 63  | 143255211 | 11/13/2014 | Thursday    | 6AM TO 9AM  | 1. Rear End                   | B.Visible Injury         | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 65  | 143295418 | 11/21/2014 | Friday      | 6AM TO 9AM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 127 | 140135308 | 1/5/2014   | Sunday      | 9AM TO 12PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 4. Icy        | N        | N         | N         | N     | N    | 1        |
| 136 | 140375186 | 1/26/2014  | Sunday      | 12PM TO 3PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 11  | 141285254 | 5/7/2014   | Wednesday   | 12PM TO 3PM | 2. Angle                      | C.Non-Visible Injury     | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 21  | 141635176 | 6/3/2014   | Tuesday     | 9AM TO 12PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 38  | 142475169 | 9/1/2014   | Monday      | 9AM TO 12PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 70  | 143495076 | 12/9/2014  | Tuesday     | 6AM TO 9AM  | 2. Angle                      | PDO.Property Damage Only | 1. Dawn          | 1. Dry        | N        | N         | N         | N     | N    | 2        |
| 74  | 143645116 | 12/29/2014 | Monday      | 6PM TO 9PM  | 2. Angle                      | PDO.Property Damage Only | 4. Darkness - Ro | 2. Wet        | N        | N         | N         | N     | N    | 2        |
| 66  | 143355413 | 11/26/2014 | Wednesday   | 12PM TO 3PM | 4. Sideswipe - Same Direction | PDO.Property Damage Only | 2. Daylight      | 2. Wet        | N        | N         | N         | N     | N    | 2        |
| 128 | 140135312 | 1/5/2014   | Sunday      | 6AM TO 9AM  | 9. Fixed Object - Off Road    | B.Visible Injury         | 4. Darkness - Ro | 4. Icy        | N        | N         | N         | N     | N    | 1        |
| 10  | 141285200 | 4/28/2014  | Monday      | 3PM TO 6PM  | 9. Fixed Object - Off Road    | PDO.Property Damage Only | 2. Daylight      | 2. Wet        | N        | N         | N         | N     | N    | 1        |
| 67  | 143395290 | 12/2/2014  | Tuesday     | 6PM TO 9PM  | 9. Fixed Object - Off Road    | PDO.Property Damage Only | 4. Darkness - Ro | 2. Wet        | N        | N         | N         | N     | N    | 1        |
| 75  | 150065254 | 12/31/2014 | Wednesday   | 6AM TO 9AM  | 9. Fixed Object - Off Road    | C.Non-Visible Injury     | 2. Daylight      | 1. Dry        | N        | N         | N         | N     | N    | 1        |



| ID  | DOCUMENT  | DATE       | DAY OF WEEK | Time        | TYPE                          | SEVERITY                 | LIGHT CONDITION      | ROADWAY CONDI      | Alcohol? | Unbelted? | Speeding? | Bike? | Ped? | Vehicle# |
|-----|-----------|------------|-------------|-------------|-------------------------------|--------------------------|----------------------|--------------------|----------|-----------|-----------|-------|------|----------|
| 76  | 150065257 | 1/2/2015   | Friday      | 12PM TO 3PM | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 82  | 150285219 | 1/26/2015  | Monday      | 6AM TO 9AM  | 1. Rear End                   | PDO.Property Damage Only | 1. Dawn              | 2. Wet             | N        | N         | N         | N     | N    | 2        |
| 85  | 150505126 | 2/13/2015  | Friday      | 6AM TO 9AM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 94  | 150775184 | 3/11/2015  | Wednesday   | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 2. Wet             | N        | N         | N         | N     | N    | 2        |
| 99  | 150925311 | 4/1/2015   | Wednesday   | 3PM TO 6PM  | 1. Rear End                   | B.Visible Injury         | 2. Daylight          | 1. Dry             | N        | N         | SPEED     | N     | N    | 2        |
| 106 | 151255229 | 4/28/2015  | Tuesday     | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 120 | 151735254 | 6/16/2015  | Tuesday     | 6AM TO 9AM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 131 | 152245135 | 8/10/2015  | Monday      | 9AM TO 12PM | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 132 | 152305118 | 8/11/2015  | Tuesday     | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 139 | 152665143 | 9/21/2015  | Monday      | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 2. Wet             | N        | N         | N         | N     | N    | 3        |
| 141 | 152795171 | 9/28/2015  | Monday      | 12PM TO 3PM | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 2. Wet             | N        | N         | N         | N     | N    | 2        |
| 8   | 153145153 | 11/7/2015  | Saturday    | 12PM TO 3PM | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 2. Wet             | N        | N         | N         | N     | N    | 2        |
| 22  | 153635248 | 12/18/2015 | Friday      | 12PM TO 3PM | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 4        |
| 26  | 160125116 | 12/30/2015 | Wednesday   | 3PM TO 6PM  | 1. Rear End                   | PDO.Property Damage Only | 2. Daylight          | 2. Wet             | N        | N         | N         | N     | N    | 2        |
| 80  | 150265257 | 1/21/2015  | Wednesday   | 12PM TO 3PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 108 | 151315220 | 5/4/2015   | Monday      | 3PM TO 6PM  | 2. Angle                      | B.Visible Injury         | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 112 | 151415087 | 5/19/2015  | Tuesday     | 9PM TO 12AM | 2. Angle                      | PDO.Property Damage Only | 4. Darkness - Road L | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 119 | 151695103 | 6/15/2015  | Monday      | 12PM TO 3PM | 2. Angle                      | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 124 | 151955195 | 7/13/2015  | Monday      | 3PM TO 6PM  | 2. Angle                      | B.Visible Injury         | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 129 | 152195206 | 8/7/2015   | Friday      | 12PM TO 3PM | 2. Angle                      | B.Visible Injury         | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 142 | 152875270 | 10/12/2015 | Monday      | 12PM TO 3PM | 2. Angle                      | B.Visible Injury         | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 16  | 153415184 | 12/2/2015  | Wednesday   | 6AM TO 9AM  | 2. Angle                      | PDO.Property Damage Only | 2. Daylight          | 2. Wet             | N        | N         | N         | N     | N    | 2        |
| 4   | 153015301 | 10/26/2015 | Monday      | 6AM TO 9AM  | 3. Head On                    | B.Visible Injury         | 1. Dawn              | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 105 | 151185181 | 4/21/2015  | Tuesday     | 12PM TO 3PM | 4. Sideswipe - Same Direction | PDO.Property Damage Only | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 2        |
| 92  | 150705082 | 3/4/2015   | Wednesday   | 9AM TO 12PM | 9. Fixed Object - Off Road    | PDO.Property Damage Only | 2. Daylight          | 9. Water (Standing | N        | N         | N         | N     | N    | 1        |
| 113 | 151465362 | 5/19/2015  | Tuesday     | 3PM TO 6PM  | 9. Fixed Object - Off Road    | B.Visible Injury         | 2. Daylight          | 1. Dry             | N        | N         | N         | N     | N    | 1        |

| ID  | DOCUMENT  | DATE       | DAY OF WEEK | Time        | TYPE                              | SEVERITY                 | LIGHT CONDITION    | ROADWAY CON | Alcohol? | Unbelted? | Speeding? | Bike? | Ped? | Vehicle# |
|-----|-----------|------------|-------------|-------------|-----------------------------------|--------------------------|--------------------|-------------|----------|-----------|-----------|-------|------|----------|
| 29  | 160145205 | 1/13/2016  | Wednesday   | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 3        |
| 42  | 160615260 | 2/25/2016  | Thursday    | 12PM TO 3PM | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 3        |
| 43  | 160685195 | 3/3/2016   | Thursday    | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 3. Dusk            | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 53  | 160975106 | 3/31/2016  | Thursday    | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 54  | 160975044 | 4/1/2016   | Friday      | 6AM TO 9AM  | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 58  | 161175116 | 4/20/2016  | Wednesday   | 12PM TO 3PM | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | ALCOHOL  | N         | N         | N     | N    | 3        |
| 62  | 161325103 | 5/5/2016   | Thursday    | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 2. Wet      | N        | N         | N         | N     | N    | 2        |
| 68  | 161535207 | 5/26/2016  | Thursday    | 3PM TO 6PM  | 1. Rear End                       | B.Visible Injury         | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 3        |
| 84  | 162095302 | 7/20/2016  | Wednesday   | 3PM TO 6PM  | 1. Rear End                       | B.Visible Injury         | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 3        |
| 89  | 162455137 | 8/26/2016  | Friday      | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 96  | 162725158 | 9/22/2016  | Thursday    | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 3        |
| 100 | 162795113 | 10/4/2016  | Tuesday     | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 102 | 162945276 | 10/14/2016 | Friday      | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 122 | 163435158 | 12/2/2016  | Friday      | 3PM TO 6PM  | 1. Rear End                       | PDO.Property Damage Only | 4. Darkness - Road | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 123 | 163435166 | 12/5/2016  | Monday      | 9AM TO 12PM | 1. Rear End                       | C.Non-Visible Injury     | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 3        |
| 44  | 160685193 | 3/3/2016   | Thursday    | 6AM TO 9AM  | 2. Angle                          | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 52  | 160905160 | 3/22/2016  | Tuesday     | 12PM TO 3PM | 2. Angle                          | B.Visible Injury         | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 3        |
| 57  | 161125532 | 4/20/2016  | Wednesday   | 9AM TO 12PM | 2. Angle                          | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 73  | 161955201 | 6/16/2016  | Thursday    | 9AM TO 12PM | 2. Angle                          | B.Visible Injury         | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 91  | 162435342 | 8/29/2016  | Monday      | 3PM TO 6PM  | 2. Angle                          | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 93  | 162525255 | 9/1/2016   | Thursday    | 6AM TO 9AM  | 2. Angle                          | B.Visible Injury         | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 109 | 163145126 | 11/2/2016  | Wednesday   | 9PM TO 12AM | 2. Angle                          | PDO.Property Damage Only | 4. Darkness - Road | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 125 | 170035373 | 12/14/2016 | Wednesday   | 3PM TO 6PM  | 2. Angle                          | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 114 | 163335387 | 11/12/2016 | Saturday    | 3PM TO 6PM  | 3. Head On                        | B.Visible Injury         | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 45  | 160705169 | 3/9/2016   | Wednesday   | 9AM TO 12PM | 4. Sideswipe - Same Direction     | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 56  | 161165228 | 4/17/2016  | Sunday      | 6PM TO 9PM  | 5. Sideswipe - Opposite Direction | B.Visible Injury         | 4. Darkness - Road | 1. Dry      | N        | N         | N         | N     | N    | 2        |
| 126 | 163575189 | 12/17/2016 | Saturday    | 9AM TO 12PM | 8. Non-Collision                  | B.Visible Injury         | 2. Daylight        | 4. Icy      | N        | N         | N         | N     | N    | 1        |
| 39  | 160605103 | 2/21/2016  | Sunday      | 3PM TO 6PM  | 9. Fixed Object - Off Road        | PDO.Property Damage Only | 2. Daylight        | 2. Wet      | N        | N         | N         | N     | N    | 1        |
| 72  | 161655348 | 6/8/2016   | Wednesday   | 6AM TO 9AM  | 9. Fixed Object - Off Road        | PDO.Property Damage Only | 2. Daylight        | 1. Dry      | N        | N         | N         | N     | N    | 1        |

# Appendix C

## Raw Traffic Counts



# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Gristmill  
 Site Code : 33333333  
 Start Date : 9/6/2017  
 Page No : 1

Groups Printed- Passenger Veh - Trucks

|                 | From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Gristmill<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|-----------------|------------|------|------|------|------------|--------------------------|------|------|------|------------|-------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time      | Right      | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                   | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| 07:00 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 82   | 27   | 0    | 109        | 94                      | 0    | 3    | 0    | 97         | 3                        | 147  | 0    | 0    | 150        | 356        |
| 07:15 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 90   | 36   | 0    | 126        | 120                     | 0    | 2    | 0    | 122        | 3                        | 153  | 0    | 0    | 156        | 404        |
| 07:30 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 122  | 50   | 0    | 172        | 174                     | 0    | 4    | 0    | 178        | 1                        | 208  | 0    | 0    | 209        | 559        |
| 07:45 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 121  | 70   | 0    | 191        | 156                     | 0    | 7    | 0    | 163        | 7                        | 159  | 0    | 0    | 166        | 520        |
| Total           | 0          | 0    | 0    | 0    | 0          | 0                        | 415  | 183  | 0    | 598        | 544                     | 0    | 16   | 0    | 560        | 14                       | 667  | 0    | 0    | 681        | 1839       |
| 08:00 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 101  | 53   | 0    | 154        | 115                     | 0    | 3    | 0    | 118        | 1                        | 129  | 0    | 0    | 130        | 402        |
| 08:15 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 132  | 53   | 0    | 185        | 96                      | 0    | 2    | 0    | 98         | 4                        | 113  | 0    | 0    | 117        | 400        |
| 08:30 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 127  | 39   | 0    | 166        | 102                     | 0    | 1    | 0    | 103        | 1                        | 149  | 0    | 0    | 150        | 419        |
| 08:45 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 121  | 21   | 0    | 142        | 83                      | 0    | 2    | 0    | 85         | 2                        | 147  | 0    | 0    | 149        | 376        |
| Total           | 0          | 0    | 0    | 0    | 0          | 0                        | 481  | 166  | 0    | 647        | 396                     | 0    | 8    | 0    | 404        | 8                        | 538  | 0    | 0    | 546        | 1597       |
| *** BREAK ***   |            |      |      |      |            |                          |      |      |      |            |                         |      |      |      |            |                          |      |      |      |            |            |
| 04:00 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 174  | 61   | 0    | 235        | 99                      | 0    | 3    | 0    | 102        | 2                        | 130  | 0    | 0    | 132        | 469        |
| 04:15 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 158  | 80   | 0    | 238        | 67                      | 0    | 3    | 0    | 70         | 3                        | 130  | 0    | 0    | 133        | 441        |
| 04:30 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 183  | 84   | 0    | 267        | 76                      | 0    | 8    | 0    | 84         | 5                        | 127  | 0    | 0    | 132        | 483        |
| 04:45 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 207  | 90   | 0    | 297        | 84                      | 0    | 11   | 0    | 95         | 7                        | 109  | 0    | 0    | 116        | 508        |
| Total           | 0          | 0    | 0    | 0    | 0          | 0                        | 722  | 315  | 0    | 1037       | 326                     | 0    | 25   | 0    | 351        | 17                       | 496  | 0    | 0    | 513        | 1901       |
| 05:00 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 212  | 90   | 0    | 302        | 109                     | 0    | 12   | 0    | 121        | 3                        | 158  | 0    | 0    | 161        | 584        |
| 05:15 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 202  | 65   | 0    | 267        | 81                      | 0    | 5    | 0    | 86         | 33                       | 103  | 0    | 0    | 136        | 489        |
| 05:30 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 187  | 66   | 0    | 253        | 77                      | 0    | 3    | 0    | 80         | 3                        | 111  | 0    | 0    | 114        | 447        |
| 05:45 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 139  | 71   | 0    | 210        | 62                      | 0    | 8    | 0    | 70         | 3                        | 102  | 0    | 0    | 105        | 385        |
| Total           | 0          | 0    | 0    | 0    | 0          | 0                        | 740  | 292  | 0    | 1032       | 329                     | 0    | 28   | 0    | 357        | 42                       | 474  | 0    | 0    | 516        | 1905       |
| Grand Total     | 0          | 0    | 0    | 0    | 0          | 0                        | 2358 | 956  | 0    | 3314       | 1595                    | 0    | 77   | 0    | 1672       | 81                       | 2175 | 0    | 0    | 2256       | 7242       |
| Apprch %        | 0          | 0    | 0    | 0    | 0          | 0                        | 71.2 | 28.8 | 0    |            | 95.4                    | 0    | 4.6  | 0    |            | 3.6                      | 96.4 | 0    | 0    |            |            |
| Total %         | 0          | 0    | 0    | 0    | 0          | 0                        | 32.6 | 13.2 | 0    | 45.8       | 22                      | 0    | 1.1  | 0    | 23.1       | 1.1                      | 30   | 0    | 0    | 31.2       |            |
| Passenger Veh   | 0          | 0    | 0    | 0    | 0          | 0                        | 2335 | 956  | 0    | 3291       | 1591                    | 0    | 74   | 0    | 1665       | 81                       | 2149 | 0    | 0    | 2230       | 7186       |
| % Passenger Veh | 0          | 0    | 0    | 0    | 0          | 0                        | 99   | 100  | 0    | 99.3       | 99.7                    | 0    | 96.1 | 0    | 99.6       | 100                      | 98.8 | 0    | 0    | 98.8       | 99.2       |
| Trucks          | 0          | 0    | 0    | 0    | 0          | 0                        | 23   | 0    | 0    | 23         | 4                       | 0    | 3    | 0    | 7          | 0                        | 26   | 0    | 0    | 26         | 56         |
| % Trucks        | 0          | 0    | 0    | 0    | 0          | 0                        | 1    | 0    | 0    | 0.7        | 0.3                     | 0    | 3.9  | 0    | 0.4        | 0                        | 1.2  | 0    | 0    | 1.2        | 0.8        |

# Data Collection Group

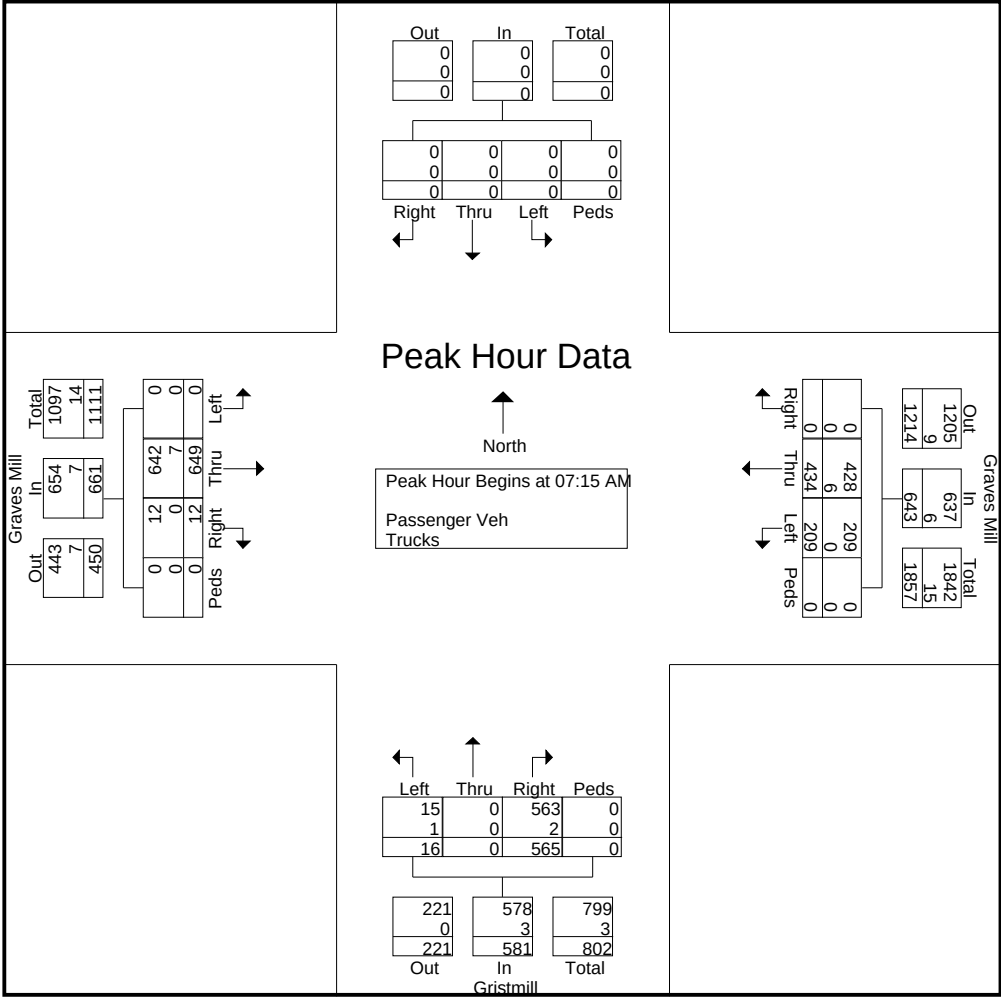
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Gristmill  
 Site Code : 33333333  
 Start Date : 9/6/2017  
 Page No : 2

|                                                            | From North |      |      |      |            | Graves Mill<br>From East |            |           |      |            | Gristmill<br>From South |      |          |      |            | Graves Mill<br>From West |            |      |      |            |            |
|------------------------------------------------------------|------------|------|------|------|------------|--------------------------|------------|-----------|------|------------|-------------------------|------|----------|------|------------|--------------------------|------------|------|------|------------|------------|
| Start Time                                                 | Right      | Thru | Left | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Right                   | Thru | Left     | Peds | App. Total | Right                    | Thru       | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1 |            |      |      |      |            |                          |            |           |      |            |                         |      |          |      |            |                          |            |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 07:15 AM       |            |      |      |      |            |                          |            |           |      |            |                         |      |          |      |            |                          |            |      |      |            |            |
| 07:15 AM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 90         | 36        | 0    | 126        | 120                     | 0    | 2        | 0    | 122        | 3                        | 153        | 0    | 0    | 156        | 404        |
| 07:30 AM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | <b>122</b> | 50        | 0    | 172        | <b>174</b>              | 0    | 4        | 0    | <b>178</b> | 1                        | <b>208</b> | 0    | 0    | <b>209</b> | <b>559</b> |
| 07:45 AM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 121        | <b>70</b> | 0    | <b>191</b> | 156                     | 0    | <b>7</b> | 0    | 163        | <b>7</b>                 | 159        | 0    | 0    | 166        | 520        |
| 08:00 AM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 101        | 53        | 0    | 154        | 115                     | 0    | 3        | 0    | 118        | 1                        | 129        | 0    | 0    | 130        | 402        |
| Total Volume                                               | 0          | 0    | 0    | 0    | 0          | 0                        | 434        | 209       | 0    | 643        | 565                     | 0    | 16       | 0    | 581        | 12                       | 649        | 0    | 0    | 661        | 1885       |
| % App. Total                                               | 0          | 0    | 0    | 0    | 0          | 0                        | 67.5       | 32.5      | 0    |            | 97.2                    | 0    | 2.8      | 0    |            | 1.8                      | 98.2       | 0    | 0    |            |            |
| PHF                                                        | .000       | .000 | .000 | .000 | .000       | .000                     | .889       | .746      | .000 | .842       | .812                    | .000 | .571     | .000 | .816       | .429                     | .780       | .000 | .000 | .791       | .843       |
| Passenger Veh                                              | 0          | 0    | 0    | 0    | 0          | 0                        | 428        | 209       | 0    | 637        | 563                     | 0    | 15       | 0    | 578        | 12                       | 642        | 0    | 0    | 654        | 1869       |
| % Passenger Veh                                            | 0          | 0    | 0    | 0    | 0          | 0                        | 98.6       | 100       | 0    | 99.1       | 99.6                    | 0    | 93.8     | 0    | 99.5       | 100                      | 98.9       | 0    | 0    | 98.9       | 99.2       |
| Trucks                                                     | 0          | 0    | 0    | 0    | 0          | 0                        | 6          | 0         | 0    | 6          | 2                       | 0    | 1        | 0    | 3          | 0                        | 7          | 0    | 0    | 7          | 16         |
| % Trucks                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 1.4        | 0         | 0    | 0.9        | 0.4                     | 0    | 6.3      | 0    | 0.5        | 0                        | 1.1        | 0    | 0    | 1.1        | 0.8        |

**Data Collection Group**  
**LSmith@DataCollectionGroup.net**

File Name : Graves Mill and Gristmill  
Site Code : 33333333  
Start Date : 9/6/2017  
Page No : 3





# Data Collection Group

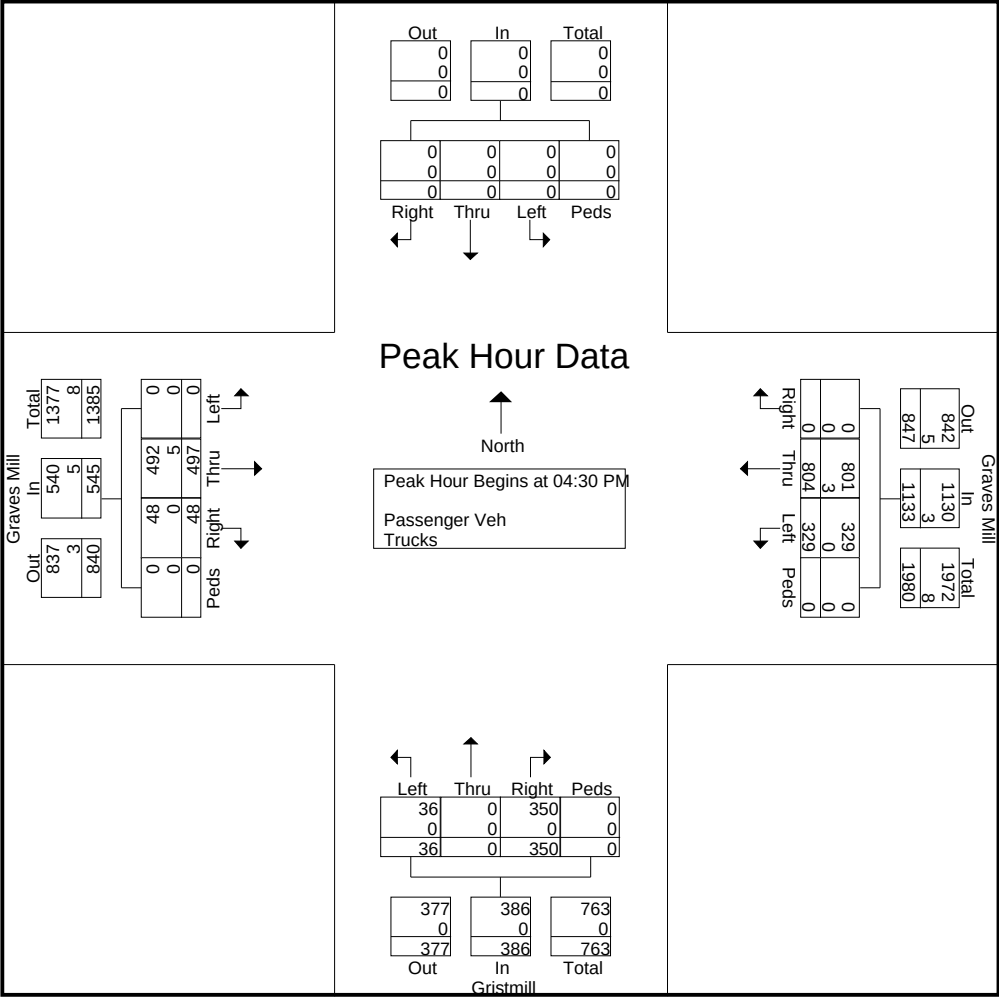
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Gristmill  
 Site Code : 33333333  
 Start Date : 9/6/2017  
 Page No : 4

|                                                            | From North |      |      |      |            | Graves Mill<br>From East |            |           |      |            | Gristmill<br>From South |      |           |      |            | Graves Mill<br>From West |            |      |      |            |            |
|------------------------------------------------------------|------------|------|------|------|------------|--------------------------|------------|-----------|------|------------|-------------------------|------|-----------|------|------------|--------------------------|------------|------|------|------------|------------|
| Start Time                                                 | Right      | Thru | Left | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Right                   | Thru | Left      | Peds | App. Total | Right                    | Thru       | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1 |            |      |      |      |            |                          |            |           |      |            |                         |      |           |      |            |                          |            |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 04:30 PM       |            |      |      |      |            |                          |            |           |      |            |                         |      |           |      |            |                          |            |      |      |            |            |
| 04:30 PM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 183        | 84        | 0    | 267        | 76                      | 0    | 8         | 0    | 84         | 5                        | 127        | 0    | 0    | 132        | 483        |
| 04:45 PM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 207        | <b>90</b> | 0    | 297        | 84                      | 0    | 11        | 0    | 95         | 7                        | 109        | 0    | 0    | 116        | 508        |
| 05:00 PM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | <b>212</b> | 90        | 0    | <b>302</b> | <b>109</b>              | 0    | <b>12</b> | 0    | <b>121</b> | 3                        | <b>158</b> | 0    | 0    | <b>161</b> | <b>584</b> |
| 05:15 PM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 202        | 65        | 0    | 267        | 81                      | 0    | 5         | 0    | 86         | <b>33</b>                | 103        | 0    | 0    | 136        | 489        |
| Total Volume                                               | 0          | 0    | 0    | 0    | 0          | 0                        | 804        | 329       | 0    | 1133       | 350                     | 0    | 36        | 0    | 386        | 48                       | 497        | 0    | 0    | 545        | 2064       |
| % App. Total                                               | 0          | 0    | 0    | 0    | 0          | 0                        | 71         | 29        | 0    |            | 90.7                    | 0    | 9.3       | 0    |            | 8.8                      | 91.2       | 0    | 0    |            |            |
| PHF                                                        | .000       | .000 | .000 | .000 | .000       | .000                     | .948       | .914      | .000 | .938       | .803                    | .000 | .750      | .000 | .798       | .364                     | .786       | .000 | .000 | .846       | .884       |
| Passenger Veh                                              | 0          | 0    | 0    | 0    | 0          | 0                        | 801        | 329       | 0    | 1130       | 350                     | 0    | 36        | 0    | 386        | 48                       | 492        | 0    | 0    | 540        | 2056       |
| % Passenger Veh                                            | 0          | 0    | 0    | 0    | 0          | 0                        | 99.6       | 100       | 0    | 99.7       | 100                     | 0    | 100       | 0    | 100        | 100                      | 99.0       | 0    | 0    | 99.1       | 99.6       |
| Trucks                                                     | 0          | 0    | 0    | 0    | 0          | 0                        | 3          | 0         | 0    | 3          | 0                       | 0    | 0         | 0    | 0          | 0                        | 5          | 0    | 0    | 5          | 8          |
| % Trucks                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 0.4        | 0         | 0    | 0.3        | 0                       | 0    | 0         | 0    | 0          | 0                        | 1.0        | 0    | 0    | 0.9        | 0.4        |

**Data Collection Group**  
**LSmith@DataCollectionGroup.net**

File Name : Graves Mill and Gristmill  
Site Code : 33333333  
Start Date : 9/6/2017  
Page No : 5



# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Millrace  
 Site Code : 34444444  
 Start Date : 9/6/2017  
 Page No : 1

Groups Printed- Passenger Veh - Trucks

|                 | From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Millrace<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|-----------------|------------|------|------|------|------------|--------------------------|------|------|------|------------|------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time      | Right      | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                  | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| 07:00 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 93   | 21   | 0    | 114        | 4                      | 0    | 2    | 0    | 6          | 16                       | 214  | 0    | 0    | 230        | 350        |
| 07:15 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 131  | 11   | 0    | 142        | 2                      | 0    | 1    | 0    | 3          | 9                        | 269  | 0    | 0    | 278        | 423        |
| 07:30 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 178  | 19   | 0    | 197        | 3                      | 0    | 5    | 0    | 8          | 13                       | 355  | 0    | 0    | 368        | 573        |
| 07:45 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 212  | 20   | 0    | 232        | 4                      | 0    | 3    | 0    | 7          | 20                       | 286  | 0    | 0    | 306        | 545        |
| Total           | 0          | 0    | 0    | 0    | 0          | 0                        | 614  | 71   | 0    | 685        | 13                     | 0    | 11   | 0    | 24         | 58                       | 1124 | 0    | 0    | 1182       | 1891       |
| 08:00 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 163  | 20   | 0    | 183        | 2                      | 0    | 3    | 0    | 5          | 14                       | 214  | 0    | 0    | 228        | 416        |
| 08:15 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 185  | 14   | 0    | 199        | 4                      | 0    | 1    | 0    | 5          | 10                       | 189  | 0    | 0    | 199        | 403        |
| 08:30 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 152  | 19   | 0    | 171        | 4                      | 0    | 10   | 0    | 14         | 12                       | 209  | 0    | 0    | 221        | 406        |
| 08:45 AM        | 0          | 0    | 0    | 0    | 0          | 0                        | 137  | 11   | 0    | 148        | 4                      | 0    | 2    | 0    | 6          | 9                        | 242  | 0    | 0    | 251        | 405        |
| Total           | 0          | 0    | 0    | 0    | 0          | 0                        | 637  | 64   | 0    | 701        | 14                     | 0    | 16   | 0    | 30         | 45                       | 854  | 0    | 0    | 899        | 1630       |
| *** BREAK ***   |            |      |      |      |            |                          |      |      |      |            |                        |      |      |      |            |                          |      |      |      |            |            |
| 04:00 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 200  | 1    | 0    | 201        | 48                     | 0    | 26   | 0    | 74         | 3                        | 223  | 0    | 0    | 226        | 501        |
| 04:15 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 213  | 4    | 0    | 217        | 10                     | 0    | 13   | 0    | 23         | 2                        | 204  | 0    | 0    | 206        | 446        |
| 04:30 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 234  | 3    | 0    | 237        | 23                     | 0    | 11   | 0    | 34         | 3                        | 191  | 0    | 0    | 194        | 465        |
| 04:45 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 245  | 4    | 0    | 249        | 17                     | 0    | 18   | 0    | 35         | 7                        | 208  | 0    | 0    | 215        | 499        |
| Total           | 0          | 0    | 0    | 0    | 0          | 0                        | 892  | 12   | 0    | 904        | 98                     | 0    | 68   | 0    | 166        | 15                       | 826  | 0    | 0    | 841        | 1911       |
| 05:00 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 254  | 8    | 0    | 262        | 44                     | 0    | 20   | 0    | 64         | 2                        | 239  | 0    | 0    | 241        | 567        |
| 05:15 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 241  | 9    | 0    | 250        | 40                     | 0    | 14   | 0    | 54         | 4                        | 217  | 0    | 0    | 221        | 525        |
| 05:30 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 210  | 7    | 0    | 217        | 77                     | 0    | 26   | 0    | 103        | 1                        | 182  | 0    | 0    | 183        | 503        |
| 05:45 PM        | 0          | 0    | 0    | 0    | 0          | 0                        | 197  | 1    | 0    | 198        | 17                     | 0    | 5    | 0    | 22         | 2                        | 164  | 0    | 0    | 166        | 386        |
| Total           | 0          | 0    | 0    | 0    | 0          | 0                        | 902  | 25   | 0    | 927        | 178                    | 0    | 65   | 0    | 243        | 9                        | 802  | 0    | 0    | 811        | 1981       |
| Grand Total     | 0          | 0    | 0    | 0    | 0          | 0                        | 3045 | 172  | 0    | 3217       | 303                    | 0    | 160  | 0    | 463        | 127                      | 3606 | 0    | 0    | 3733       | 7413       |
| Apprch %        | 0          | 0    | 0    | 0    | 0          | 0                        | 94.7 | 5.3  | 0    |            | 65.4                   | 0    | 34.6 | 0    |            | 3.4                      | 96.6 | 0    | 0    |            |            |
| Total %         | 0          | 0    | 0    | 0    | 0          | 0                        | 41.1 | 2.3  | 0    | 43.4       | 4.1                    | 0    | 2.2  | 0    | 6.2        | 1.7                      | 48.6 | 0    | 0    | 50.4       |            |
| Passenger Veh   | 0          | 0    | 0    | 0    | 0          | 0                        | 3027 | 167  | 0    | 3194       | 293                    | 0    | 157  | 0    | 450        | 126                      | 3575 | 0    | 0    | 3701       | 7345       |
| % Passenger Veh | 0          | 0    | 0    | 0    | 0          | 0                        | 99.4 | 97.1 | 0    | 99.3       | 96.7                   | 0    | 98.1 | 0    | 97.2       | 99.2                     | 99.1 | 0    | 0    | 99.1       | 99.1       |
| Trucks          | 0          | 0    | 0    | 0    | 0          | 0                        | 18   | 5    | 0    | 23         | 10                     | 0    | 3    | 0    | 13         | 1                        | 31   | 0    | 0    | 32         | 68         |
| % Trucks        | 0          | 0    | 0    | 0    | 0          | 0                        | 0.6  | 2.9  | 0    | 0.7        | 3.3                    | 0    | 1.9  | 0    | 2.8        | 0.8                      | 0.9  | 0    | 0    | 0.9        | 0.9        |



# Data Collection Group

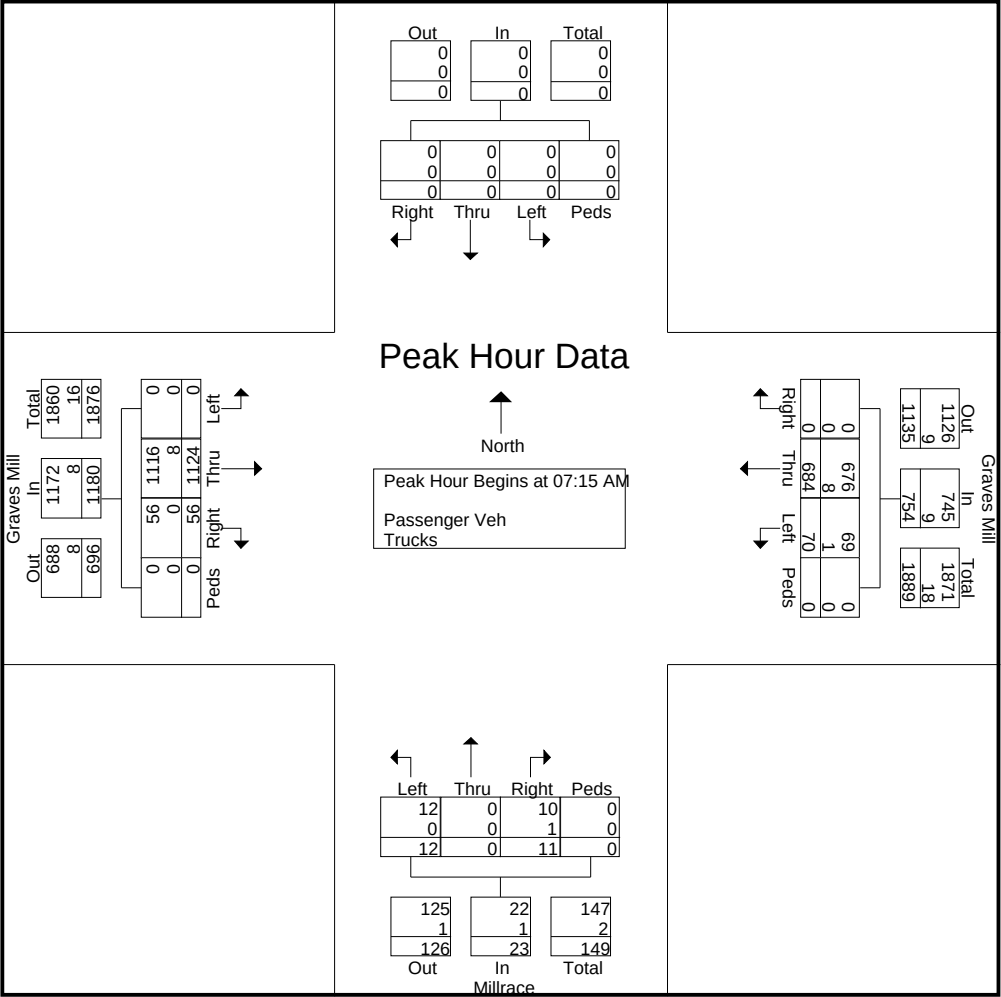
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Millrace  
 Site Code : 34444444  
 Start Date : 9/6/2017  
 Page No : 2

|                                                            | From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Millrace<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|------------------------------------------------------------|------------|------|------|------|------------|--------------------------|------|------|------|------------|------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time                                                 | Right      | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                  | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1 |            |      |      |      |            |                          |      |      |      |            |                        |      |      |      |            |                          |      |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 07:15 AM       |            |      |      |      |            |                          |      |      |      |            |                        |      |      |      |            |                          |      |      |      |            |            |
| 07:15 AM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 131  | 11   | 0    | 142        | 2                      | 0    | 1    | 0    | 3          | 9                        | 269  | 0    | 0    | 278        | 423        |
| 07:30 AM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 178  | 19   | 0    | 197        | 3                      | 0    | 5    | 0    | 8          | 13                       | 355  | 0    | 0    | 368        | 573        |
| 07:45 AM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 212  | 20   | 0    | 232        | 4                      | 0    | 3    | 0    | 7          | 20                       | 286  | 0    | 0    | 306        | 545        |
| 08:00 AM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 163  | 20   | 0    | 183        | 2                      | 0    | 3    | 0    | 5          | 14                       | 214  | 0    | 0    | 228        | 416        |
| Total Volume                                               | 0          | 0    | 0    | 0    | 0          | 0                        | 684  | 70   | 0    | 754        | 11                     | 0    | 12   | 0    | 23         | 56                       | 1124 | 0    | 0    | 1180       | 1957       |
| % App. Total                                               | 0          | 0    | 0    | 0    | 0          | 0                        | 90.7 | 9.3  | 0    |            | 47.8                   | 0    | 52.2 | 0    |            | 4.7                      | 95.3 | 0    | 0    |            |            |
| PHF                                                        | .000       | .000 | .000 | .000 | .000       | .000                     | .807 | .875 | .000 | .813       | .688                   | .000 | .600 | .000 | .719       | .700                     | .792 | .000 | .000 | .802       | .854       |
| Passenger Veh                                              | 0          | 0    | 0    | 0    | 0          | 0                        | 676  | 69   | 0    | 745        | 10                     | 0    | 12   | 0    | 22         | 56                       | 1116 | 0    | 0    | 1172       | 1939       |
| % Passenger Veh                                            | 0          | 0    | 0    | 0    | 0          | 0                        | 98.8 | 98.6 | 0    | 98.8       | 90.9                   | 0    | 100  | 0    | 95.7       | 100                      | 99.3 | 0    | 0    | 99.3       | 99.1       |
| Trucks                                                     | 0          | 0    | 0    | 0    | 0          | 0                        | 8    | 1    | 0    | 9          | 1                      | 0    | 0    | 0    | 1          | 0                        | 8    | 0    | 0    | 8          | 18         |
| % Trucks                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 1.2  | 1.4  | 0    | 1.2        | 9.1                    | 0    | 0    | 0    | 4.3        | 0                        | 0.7  | 0    | 0    | 0.7        | 0.9        |

**Data Collection Group**  
**LSmith@DataCollectionGroup.net**

File Name : Graves Mill and Millrace  
Site Code : 34444444  
Start Date : 9/6/2017  
Page No : 3



# Data Collection Group

## LSmith@DataCollectionGroup.net

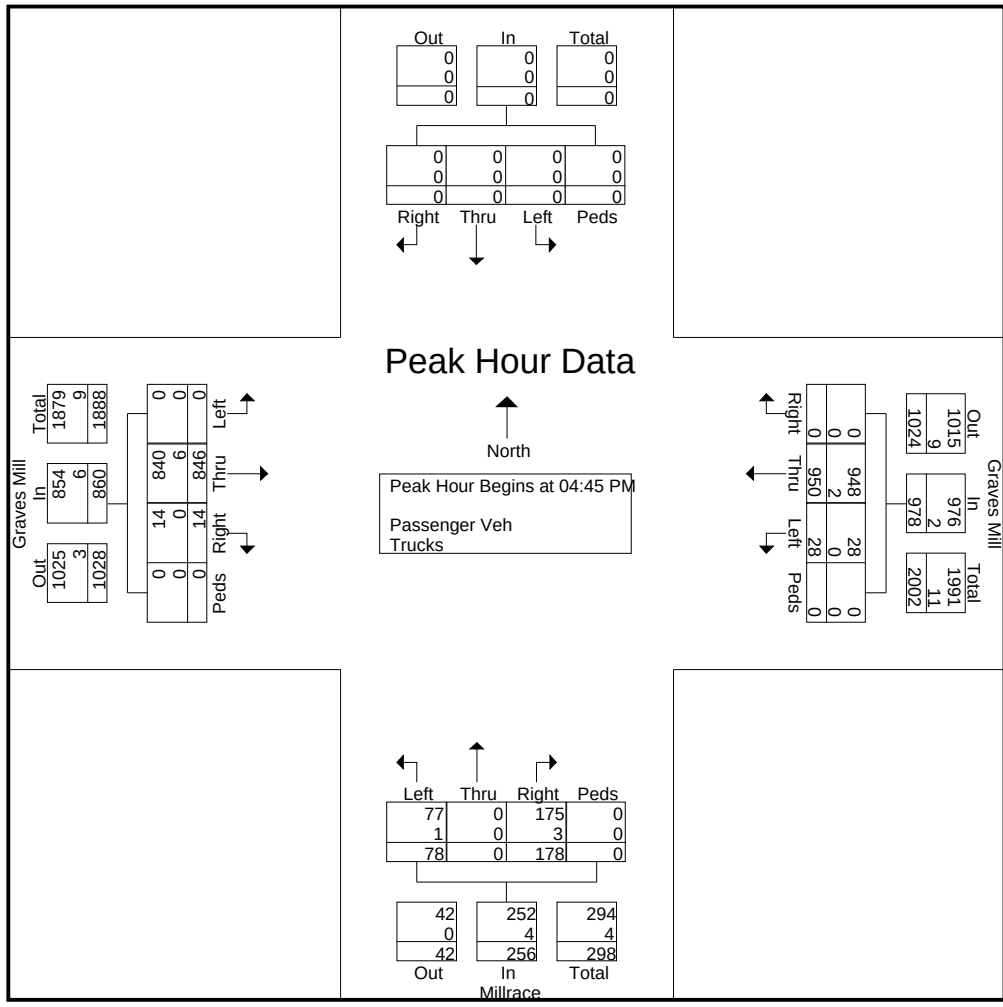
File Name : Graves Mill and Millrace  
 Site Code : 34444444  
 Start Date : 9/6/2017  
 Page No : 4

|                                                            | From North |      |      |      |            | Graves Mill<br>From East |            |          |      |            | Millrace<br>From South |      |           |      |            | Graves Mill<br>From West |            |      |      |            |            |
|------------------------------------------------------------|------------|------|------|------|------------|--------------------------|------------|----------|------|------------|------------------------|------|-----------|------|------------|--------------------------|------------|------|------|------------|------------|
| Start Time                                                 | Right      | Thru | Left | Peds | App. Total | Right                    | Thru       | Left     | Peds | App. Total | Right                  | Thru | Left      | Peds | App. Total | Right                    | Thru       | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1 |            |      |      |      |            |                          |            |          |      |            |                        |      |           |      |            |                          |            |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 04:45 PM       |            |      |      |      |            |                          |            |          |      |            |                        |      |           |      |            |                          |            |      |      |            |            |
| 04:45 PM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 245        | 4        | 0    | 249        | 17                     | 0    | 18        | 0    | 35         | 7                        | 208        | 0    | 0    | 215        | 499        |
| 05:00 PM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | <b>254</b> | 8        | 0    | <b>262</b> | 44                     | 0    | 20        | 0    | 64         | 2                        | <b>239</b> | 0    | 0    | <b>241</b> | <b>567</b> |
| 05:15 PM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 241        | <b>9</b> | 0    | 250        | 40                     | 0    | 14        | 0    | 54         | 4                        | 217        | 0    | 0    | 221        | 525        |
| 05:30 PM                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 210        | 7        | 0    | 217        | <b>77</b>              | 0    | <b>26</b> | 0    | <b>103</b> | 1                        | 182        | 0    | 0    | 183        | 503        |
| Total Volume                                               | 0          | 0    | 0    | 0    | 0          | 0                        | 950        | 28       | 0    | 978        | 178                    | 0    | 78        | 0    | 256        | 14                       | 846        | 0    | 0    | 860        | 2094       |
| % App. Total                                               | 0          | 0    | 0    | 0    | 0          | 0                        | 97.1       | 2.9      | 0    |            | 69.5                   | 0    | 30.5      | 0    |            | 1.6                      | 98.4       | 0    | 0    |            |            |
| PHF                                                        | .000       | .000 | .000 | .000 | .000       | .000                     | .935       | .778     | .000 | .933       | .578                   | .000 | .750      | .000 | .621       | .500                     | .885       | .000 | .000 | .892       | .923       |
| Passenger Veh                                              | 0          | 0    | 0    | 0    | 0          | 0                        | 948        | 28       | 0    | 976        | 175                    | 0    | 77        | 0    | 252        | 14                       | 840        | 0    | 0    | 854        | 2082       |
| % Passenger Veh                                            | 0          | 0    | 0    | 0    | 0          | 0                        | 99.8       | 100      | 0    | 99.8       | 98.3                   | 0    | 98.7      | 0    | 98.4       | 100                      | 99.3       | 0    | 0    | 99.3       | 99.4       |
| Trucks                                                     | 0          | 0    | 0    | 0    | 0          | 0                        | 2          | 0        | 0    | 2          | 3                      | 0    | 1         | 0    | 4          | 0                        | 6          | 0    | 0    | 6          | 12         |
| % Trucks                                                   | 0          | 0    | 0    | 0    | 0          | 0                        | 0.2        | 0        | 0    | 0.2        | 1.7                    | 0    | 1.3       | 0    | 1.6        | 0                        | 0.7        | 0    | 0    | 0.7        | 0.6        |



**Data Collection Group**  
**LSmith@DataCollectionGroup.net**

File Name : Graves Mill and Millrace  
Site Code : 34444444  
Start Date : 9/6/2017  
Page No : 5



# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Old Graves Mill

Site Code : 35555555

Start Date : 9/6/2017

Page No : 1

Groups Printed- Passenger Veh - Trucks

|                 | Driveway<br>From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Old Graves Mill<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|-----------------|------------------------|------|------|------|------------|--------------------------|------|------|------|------------|-------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time      | Right                  | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                         | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| 07:00 AM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 106  | 8    | 0    | 114        | 9                             | 0    | 25   | 0    | 34         | 14                       | 197  | 0    | 0    | 211        | 359        |
| 07:15 AM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 136  | 13   | 0    | 149        | 7                             | 0    | 24   | 0    | 31         | 31                       | 229  | 0    | 0    | 260        | 440        |
| 07:30 AM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 169  | 24   | 0    | 193        | 13                            | 0    | 34   | 0    | 47         | 25                       | 299  | 0    | 0    | 324        | 564        |
| 07:45 AM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 185  | 30   | 0    | 215        | 15                            | 0    | 37   | 0    | 52         | 45                       | 254  | 0    | 0    | 299        | 566        |
| Total           | 0                      | 0    | 0    | 0    | 0          | 0                        | 596  | 75   | 0    | 671        | 44                            | 0    | 120  | 0    | 164        | 115                      | 979  | 0    | 0    | 1094       | 1929       |
| 08:00 AM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 165  | 17   | 0    | 182        | 12                            | 0    | 18   | 0    | 30         | 37                       | 194  | 0    | 0    | 231        | 443        |
| 08:15 AM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 171  | 28   | 0    | 199        | 9                             | 0    | 43   | 0    | 52         | 27                       | 174  | 0    | 0    | 201        | 452        |
| 08:30 AM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 155  | 12   | 0    | 167        | 19                            | 0    | 23   | 0    | 42         | 25                       | 182  | 0    | 0    | 207        | 416        |
| 08:45 AM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 126  | 19   | 0    | 145        | 15                            | 0    | 29   | 0    | 44         | 30                       | 221  | 0    | 0    | 251        | 440        |
| Total           | 0                      | 0    | 0    | 0    | 0          | 0                        | 617  | 76   | 0    | 693        | 55                            | 0    | 113  | 0    | 168        | 119                      | 771  | 0    | 0    | 890        | 1751       |
| *** BREAK ***   |                        |      |      |      |            |                          |      |      |      |            |                               |      |      |      |            |                          |      |      |      |            |            |
| 04:00 PM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 160  | 28   | 0    | 188        | 6                             | 0    | 31   | 0    | 37         | 42                       | 205  | 0    | 0    | 247        | 472        |
| 04:15 PM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 189  | 38   | 0    | 227        | 8                             | 1    | 24   | 0    | 33         | 42                       | 171  | 0    | 0    | 213        | 473        |
| 04:30 PM        | 1                      | 0    | 1    | 0    | 2          | 0                        | 199  | 37   | 0    | 236        | 6                             | 0    | 25   | 0    | 31         | 41                       | 183  | 0    | 0    | 224        | 493        |
| 04:45 PM        | 2                      | 1    | 0    | 0    | 3          | 0                        | 215  | 48   | 0    | 263        | 15                            | 0    | 29   | 0    | 44         | 34                       | 203  | 0    | 0    | 237        | 547        |
| Total           | 3                      | 1    | 1    | 0    | 5          | 0                        | 763  | 151  | 0    | 914        | 35                            | 1    | 109  | 0    | 145        | 159                      | 762  | 0    | 0    | 921        | 1985       |
| 05:00 PM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 231  | 78   | 0    | 309        | 14                            | 0    | 26   | 0    | 40         | 57                       | 244  | 1    | 0    | 302        | 651        |
| 05:15 PM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 209  | 74   | 0    | 283        | 10                            | 0    | 39   | 0    | 49         | 54                       | 233  | 0    | 0    | 287        | 619        |
| 05:30 PM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 175  | 55   | 0    | 230        | 11                            | 0    | 23   | 0    | 34         | 51                       | 241  | 0    | 0    | 292        | 556        |
| 05:45 PM        | 0                      | 0    | 0    | 0    | 0          | 0                        | 167  | 29   | 0    | 196        | 6                             | 0    | 33   | 0    | 39         | 34                       | 158  | 0    | 0    | 192        | 427        |
| Total           | 0                      | 0    | 0    | 0    | 0          | 0                        | 782  | 236  | 0    | 1018       | 41                            | 0    | 121  | 0    | 162        | 196                      | 876  | 1    | 0    | 1073       | 2253       |
| Grand Total     | 3                      | 1    | 1    | 0    | 5          | 0                        | 2758 | 538  | 0    | 3296       | 175                           | 1    | 463  | 0    | 639        | 589                      | 3388 | 1    | 0    | 3978       | 7918       |
| Apprch %        | 60                     | 20   | 20   | 0    |            | 0                        | 83.7 | 16.3 | 0    |            | 27.4                          | 0.2  | 72.5 | 0    |            | 14.8                     | 85.2 | 0    | 0    |            |            |
| Total %         | 0                      | 0    | 0    | 0    | 0.1        | 0                        | 34.8 | 6.8  | 0    | 41.6       | 2.2                           | 0    | 5.8  | 0    | 8.1        | 7.4                      | 42.8 | 0    | 0    | 50.2       |            |
| Passenger Veh   | 3                      | 1    | 1    | 0    | 5          | 0                        | 2739 | 519  | 0    | 3258       | 168                           | 1    | 455  | 0    | 624        | 578                      | 3359 | 1    | 0    | 3938       | 7825       |
| % Passenger Veh | 100                    | 100  | 100  | 0    | 100        | 0                        | 99.3 | 96.5 | 0    | 98.8       | 96                            | 100  | 98.3 | 0    | 97.7       | 98.1                     | 99.1 | 100  | 0    | 99         | 98.8       |
| Trucks          | 0                      | 0    | 0    | 0    | 0          | 0                        | 19   | 19   | 0    | 38         | 7                             | 0    | 8    | 0    | 15         | 11                       | 29   | 0    | 0    | 40         | 93         |
| % Trucks        | 0                      | 0    | 0    | 0    | 0          | 0                        | 0.7  | 3.5  | 0    | 1.2        | 4                             | 0    | 1.7  | 0    | 2.3        | 1.9                      | 0.9  | 0    | 0    | 1          | 1.2        |

# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Old Graves Mill  
 Site Code : 35555555  
 Start Date : 9/6/2017  
 Page No : 2

|                                                            | Driveway<br>From North |      |      |      |            | Graves Mill<br>From East |            |           |      |            | Old Graves Mill<br>From South |      |           |      |            | Graves Mill<br>From West |            |      |      |            |            |
|------------------------------------------------------------|------------------------|------|------|------|------------|--------------------------|------------|-----------|------|------------|-------------------------------|------|-----------|------|------------|--------------------------|------------|------|------|------------|------------|
| Start Time                                                 | Right                  | Thru | Left | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Right                         | Thru | Left      | Peds | App. Total | Right                    | Thru       | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1 |                        |      |      |      |            |                          |            |           |      |            |                               |      |           |      |            |                          |            |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 07:30 AM       |                        |      |      |      |            |                          |            |           |      |            |                               |      |           |      |            |                          |            |      |      |            |            |
| 07:30 AM                                                   | 0                      | 0    | 0    | 0    | 0          | 0                        | 169        | 24        | 0    | 193        | 13                            | 0    | 34        | 0    | 47         | 25                       | <b>299</b> | 0    | 0    | <b>324</b> | 564        |
| 07:45 AM                                                   | 0                      | 0    | 0    | 0    | 0          | 0                        | <b>185</b> | <b>30</b> | 0    | <b>215</b> | <b>15</b>                     | 0    | 37        | 0    | <b>52</b>  | <b>45</b>                | 254        | 0    | 0    | 299        | <b>566</b> |
| 08:00 AM                                                   | 0                      | 0    | 0    | 0    | 0          | 0                        | 165        | 17        | 0    | 182        | 12                            | 0    | 18        | 0    | 30         | 37                       | 194        | 0    | 0    | 231        | 443        |
| 08:15 AM                                                   | 0                      | 0    | 0    | 0    | 0          | 0                        | 171        | 28        | 0    | 199        | 9                             | 0    | <b>43</b> | 0    | 52         | 27                       | 174        | 0    | 0    | 201        | 452        |
| Total Volume                                               | 0                      | 0    | 0    | 0    | 0          | 0                        | 690        | 99        | 0    | 789        | 49                            | 0    | 132       | 0    | 181        | 134                      | 921        | 0    | 0    | 1055       | 2025       |
| % App. Total                                               | 0                      | 0    | 0    | 0    | 0          | 0                        | 87.5       | 12.5      | 0    |            | 27.1                          | 0    | 72.9      | 0    |            | 12.7                     | 87.3       | 0    | 0    |            |            |
| PHF                                                        | .000                   | .000 | .000 | .000 | .000       | .000                     | .932       | .825      | .000 | .917       | .817                          | .000 | .767      | .000 | .870       | .744                     | .770       | .000 | .000 | .814       | .894       |
| Passenger Veh                                              | 0                      | 0    | 0    | 0    | 0          | 0                        | 682        | 96        | 0    | 778        | 46                            | 0    | 128       | 0    | 174        | 130                      | 916        | 0    | 0    | 1046       | 1998       |
| % Passenger Veh                                            | 0                      | 0    | 0    | 0    | 0          | 0                        | 98.8       | 97.0      | 0    | 98.6       | 93.9                          | 0    | 97.0      | 0    | 96.1       | 97.0                     | 99.5       | 0    | 0    | 99.1       | 98.7       |
| Trucks                                                     | 0                      | 0    | 0    | 0    | 0          | 0                        | 8          | 3         | 0    | 11         | 3                             | 0    | 4         | 0    | 7          | 4                        | 5          | 0    | 0    | 9          | 27         |
| % Trucks                                                   | 0                      | 0    | 0    | 0    | 0          | 0                        | 1.2        | 3.0       | 0    | 1.4        | 6.1                           | 0    | 3.0       | 0    | 3.9        | 3.0                      | 0.5        | 0    | 0    | 0.9        | 1.3        |



# Data Collection Group

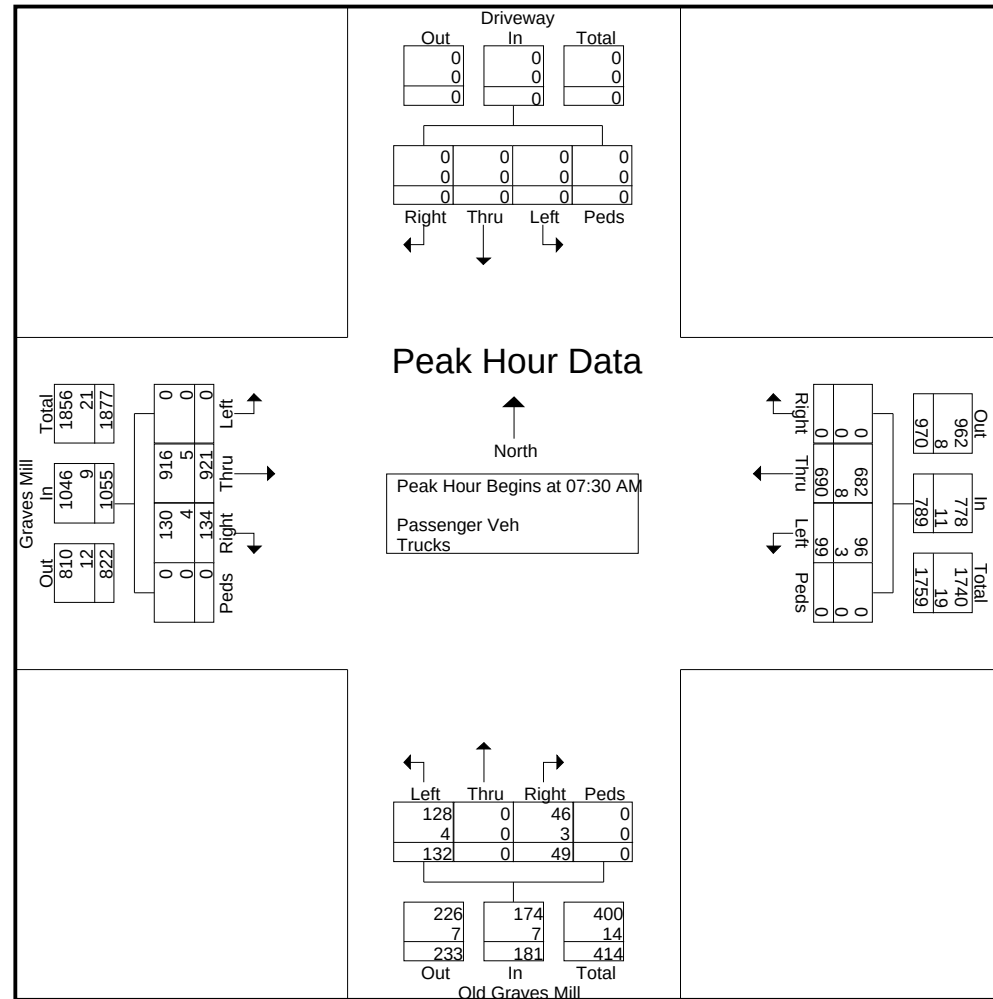
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Old Graves Mill

Site Code : 35555555

Start Date : 9/6/2017

Page No : 3



# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Old Graves Mill

Site Code : 35555555

Start Date : 9/6/2017

Page No : 4

|                                                            | Driveway<br>From North |          |      |      |            | Graves Mill<br>From East |            |           |      |            | Old Graves Mill<br>From South |      |           |      |            | Graves Mill<br>From West |            |          |      |            |            |
|------------------------------------------------------------|------------------------|----------|------|------|------------|--------------------------|------------|-----------|------|------------|-------------------------------|------|-----------|------|------------|--------------------------|------------|----------|------|------------|------------|
| Start Time                                                 | Right                  | Thru     | Left | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Right                         | Thru | Left      | Peds | App. Total | Right                    | Thru       | Left     | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1 |                        |          |      |      |            |                          |            |           |      |            |                               |      |           |      |            |                          |            |          |      |            |            |
| Peak Hour for Entire Intersection Begins at 04:45 PM       |                        |          |      |      |            |                          |            |           |      |            |                               |      |           |      |            |                          |            |          |      |            |            |
| 04:45 PM                                                   | <b>2</b>               | <b>1</b> | 0    | 0    | <b>3</b>   | 0                        | 215        | 48        | 0    | 263        | <b>15</b>                     | 0    | 29        | 0    | 44         | 34                       | 203        | 0        | 0    | 237        | 547        |
| 05:00 PM                                                   | 0                      | 0        | 0    | 0    | 0          | 0                        | <b>231</b> | <b>78</b> | 0    | <b>309</b> | 14                            | 0    | 26        | 0    | 40         | <b>57</b>                | <b>244</b> | <b>1</b> | 0    | <b>302</b> | <b>651</b> |
| 05:15 PM                                                   | 0                      | 0        | 0    | 0    | 0          | 0                        | 209        | 74        | 0    | 283        | 10                            | 0    | <b>39</b> | 0    | <b>49</b>  | 54                       | 233        | 0        | 0    | 287        | 619        |
| 05:30 PM                                                   | 0                      | 0        | 0    | 0    | 0          | 0                        | 175        | 55        | 0    | 230        | <b>11</b>                     | 0    | <b>23</b> | 0    | <b>34</b>  | <b>51</b>                | <b>241</b> | 0        | 0    | <b>292</b> | <b>556</b> |
| Total Volume                                               | 2                      | 1        | 0    | 0    | 3          | 0                        | 830        | 255       | 0    | 1085       | 50                            | 0    | 117       | 0    | 167        | 196                      | 921        | 1        | 0    | 1118       | 2373       |
| % App. Total                                               | 66.7                   | 33.3     | 0    | 0    |            | 0                        | 76.5       | 23.5      | 0    |            | 29.9                          | 0    | 70.1      | 0    |            | 17.5                     | 82.4       | 0.1      | 0    |            |            |
| PHF                                                        | .250                   | .250     | .000 | .000 | .250       | .000                     | .898       | .817      | .000 | .878       | .833                          | .000 | .750      | .000 | .852       | .860                     | .944       | .250     | .000 | .925       | .911       |
| Passenger Veh                                              | 2                      | 1        | 0    | 0    | 3          | 0                        | 828        | 250       | 0    | 1078       | 49                            | 0    | 115       | 0    | 164        | 195                      | 912        | 1        | 0    | 1108       | 2353       |
| % Passenger Veh                                            | 100                    | 100      | 0    | 0    | 100        | 0                        | 99.8       | 98.0      | 0    | 99.4       | 98.0                          | 0    | 98.3      | 0    | 98.2       | 99.5                     | 99.0       | 100      | 0    | 99.1       | 99.2       |
| Trucks                                                     | 0                      | 0        | 0    | 0    | 0          | 0                        | 2          | 5         | 0    | 7          | 1                             | 0    | 2         | 0    | 3          | 1                        | 9          | 0        | 0    | 10         | 20         |
| % Trucks                                                   | 0                      | 0        | 0    | 0    | 0          | 0                        | 0.2        | 2.0       | 0    | 0.6        | 2.0                           | 0    | 1.7       | 0    | 1.8        | 0.5                      | 1.0        | 0        | 0    | 0.9        | 0.8        |

# Data Collection Group

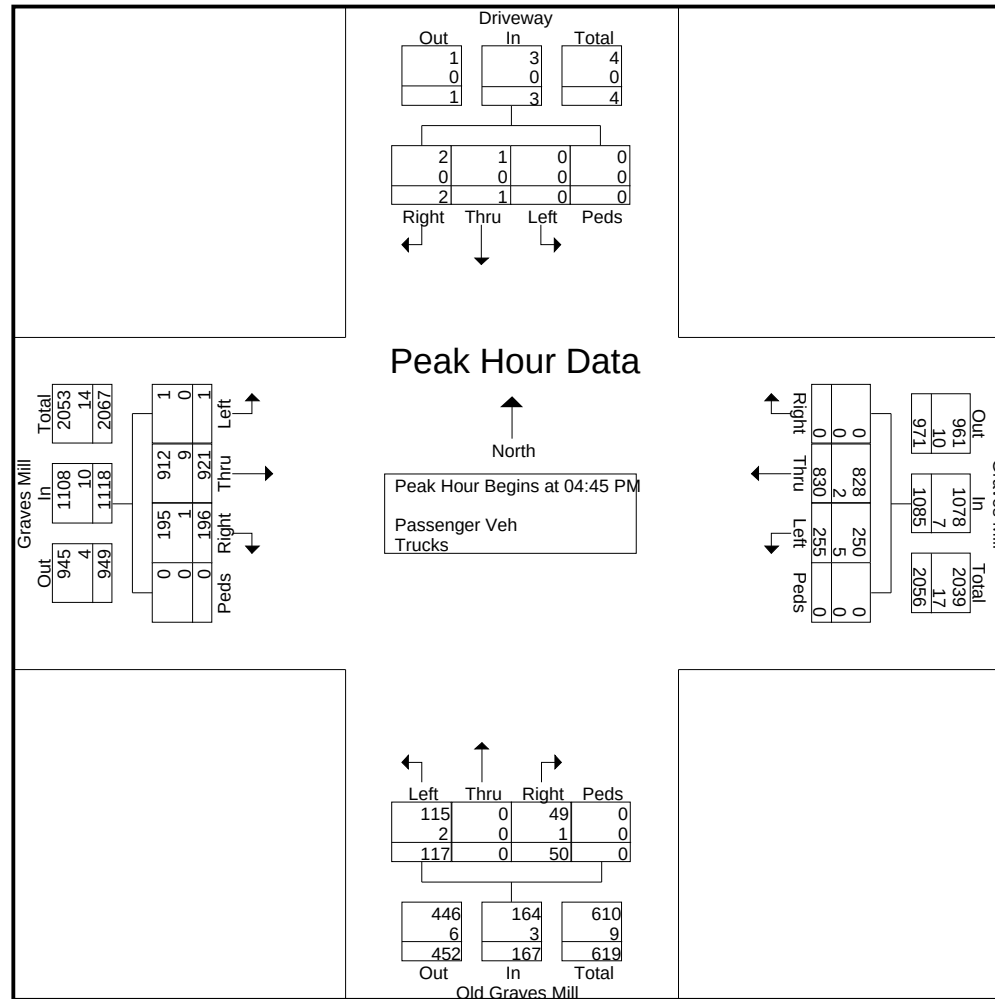
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Old Graves Mill

Site Code : 35555555

Start Date : 9/6/2017

Page No : 5





# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Creekside  
 Site Code : 00033396  
 Start Date : 9/6/2017  
 Page No : 1

Groups Printed- Passenger Veh - Trucks

|                 | Creekside<br>From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Old Graves Mill<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|-----------------|-------------------------|------|------|------|------------|--------------------------|------|------|------|------------|-------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time      | Right                   | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                         | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| 07:00 AM        | 0                       | 2    | 6    | 0    | 8          | 4                        | 113  | 40   | 0    | 157        | 45                            | 2    | 1    | 0    | 48         | 4                        | 201  | 1    | 0    | 206        | 419        |
| 07:15 AM        | 1                       | 1    | 6    | 0    | 8          | 9                        | 140  | 35   | 0    | 184        | 67                            | 3    | 5    | 0    | 75         | 2                        | 209  | 5    | 0    | 216        | 483        |
| 07:30 AM        | 4                       | 2    | 7    | 0    | 13         | 9                        | 199  | 55   | 0    | 263        | 92                            | 2    | 1    | 0    | 95         | 0                        | 301  | 4    | 0    | 305        | 676        |
| 07:45 AM        | 8                       | 2    | 6    | 0    | 16         | 30                       | 190  | 62   | 0    | 282        | 124                           | 3    | 1    | 0    | 128        | 3                        | 285  | 7    | 0    | 295        | 721        |
| Total           | 13                      | 7    | 25   | 0    | 45         | 52                       | 642  | 192  | 0    | 886        | 328                           | 10   | 8    | 0    | 346        | 9                        | 996  | 17   | 0    | 1022       | 2299       |
| 08:00 AM        | 2                       | 4    | 12   | 0    | 18         | 18                       | 175  | 64   | 0    | 257        | 72                            | 2    | 3    | 0    | 77         | 4                        | 185  | 9    | 0    | 198        | 550        |
| 08:15 AM        | 3                       | 1    | 11   | 0    | 15         | 20                       | 186  | 65   | 0    | 271        | 78                            | 6    | 2    | 0    | 86         | 3                        | 165  | 11   | 0    | 179        | 551        |
| 08:30 AM        | 6                       | 2    | 14   | 0    | 22         | 15                       | 156  | 50   | 0    | 221        | 64                            | 7    | 5    | 0    | 76         | 3                        | 185  | 3    | 0    | 191        | 510        |
| 08:45 AM        | 5                       | 0    | 20   | 0    | 25         | 26                       | 130  | 47   | 0    | 203        | 66                            | 4    | 7    | 0    | 77         | 6                        | 215  | 7    | 0    | 228        | 533        |
| Total           | 16                      | 7    | 57   | 0    | 80         | 79                       | 647  | 226  | 0    | 952        | 280                           | 19   | 17   | 0    | 316        | 16                       | 750  | 30   | 0    | 796        | 2144       |
| *** BREAK ***   |                         |      |      |      |            |                          |      |      |      |            |                               |      |      |      |            |                          |      |      |      |            |            |
| 04:00 PM        | 15                      | 5    | 26   | 0    | 46         | 23                       | 158  | 42   | 0    | 223        | 58                            | 4    | 12   | 0    | 74         | 2                        | 188  | 12   | 0    | 202        | 545        |
| 04:15 PM        | 10                      | 7    | 28   | 0    | 45         | 25                       | 219  | 56   | 0    | 300        | 64                            | 4    | 2    | 0    | 70         | 3                        | 164  | 12   | 0    | 179        | 594        |
| 04:30 PM        | 8                       | 6    | 19   | 0    | 33         | 25                       | 201  | 45   | 0    | 271        | 60                            | 4    | 15   | 0    | 79         | 1                        | 172  | 7    | 0    | 180        | 563        |
| 04:45 PM        | 11                      | 5    | 24   | 0    | 40         | 25                       | 258  | 48   | 0    | 331        | 90                            | 5    | 5    | 0    | 100        | 2                        | 204  | 11   | 0    | 217        | 688        |
| Total           | 44                      | 23   | 97   | 0    | 164        | 98                       | 836  | 191  | 0    | 1125       | 272                           | 17   | 34   | 0    | 323        | 8                        | 728  | 42   | 0    | 778        | 2390       |
| 05:00 PM        | 12                      | 0    | 34   | 0    | 46         | 24                       | 270  | 43   | 0    | 337        | 87                            | 8    | 19   | 0    | 114        | 1                        | 216  | 9    | 0    | 226        | 723        |
| 05:15 PM        | 5                       | 6    | 16   | 0    | 27         | 37                       | 258  | 65   | 0    | 360        | 88                            | 3    | 8    | 0    | 99         | 1                        | 237  | 8    | 0    | 246        | 732        |
| 05:30 PM        | 7                       | 4    | 20   | 0    | 31         | 24                       | 205  | 47   | 0    | 276        | 74                            | 5    | 13   | 0    | 92         | 1                        | 214  | 11   | 0    | 226        | 625        |
| 05:45 PM        | 8                       | 9    | 27   | 0    | 44         | 25                       | 185  | 48   | 0    | 258        | 57                            | 1    | 5    | 0    | 63         | 0                        | 162  | 9    | 0    | 171        | 536        |
| Total           | 32                      | 19   | 97   | 0    | 148        | 110                      | 918  | 203  | 0    | 1231       | 306                           | 17   | 45   | 0    | 368        | 3                        | 829  | 37   | 0    | 869        | 2616       |
| Grand Total     | 105                     | 56   | 276  | 0    | 437        | 339                      | 3043 | 812  | 0    | 4194       | 1186                          | 63   | 104  | 0    | 1353       | 36                       | 3303 | 126  | 0    | 3465       | 9449       |
| Apprch %        | 24                      | 12.8 | 63.2 | 0    |            | 8.1                      | 72.6 | 19.4 | 0    |            | 87.7                          | 4.7  | 7.7  | 0    |            | 1                        | 95.3 | 3.6  | 0    |            |            |
| Total %         | 1.1                     | 0.6  | 2.9  | 0    | 4.6        | 3.6                      | 32.2 | 8.6  | 0    | 44.4       | 12.6                          | 0.7  | 1.1  | 0    | 14.3       | 0.4                      | 35   | 1.3  | 0    | 36.7       |            |
| Passenger Veh   | 99                      | 54   | 272  | 0    | 425        | 330                      | 2994 | 783  | 0    | 4107       | 1150                          | 59   | 98   | 0    | 1307       | 29                       | 3244 | 124  | 0    | 3397       | 9236       |
| % Passenger Veh | 94.3                    | 96.4 | 98.6 | 0    | 97.3       | 97.3                     | 98.4 | 96.4 | 0    | 97.9       | 97                            | 93.7 | 94.2 | 0    | 96.6       | 80.6                     | 98.2 | 98.4 | 0    | 98         | 97.7       |
| Trucks          | 6                       | 2    | 4    | 0    | 12         | 9                        | 49   | 29   | 0    | 87         | 36                            | 4    | 6    | 0    | 46         | 7                        | 59   | 2    | 0    | 68         | 213        |
| % Trucks        | 5.7                     | 3.6  | 1.4  | 0    | 2.7        | 2.7                      | 1.6  | 3.6  | 0    | 2.1        | 3                             | 6.3  | 5.8  | 0    | 3.4        | 19.4                     | 1.8  | 1.6  | 0    | 2          | 2.3        |

# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Creekside  
 Site Code : 00033396  
 Start Date : 9/6/2017  
 Page No : 2

|                                                            | Creekside<br>From North |          |           |      |            | Graves Mill<br>From East |            |           |      |            | Old Graves Mill<br>From South |          |          |      |            | Graves Mill<br>From West |            |           |      |            |            |
|------------------------------------------------------------|-------------------------|----------|-----------|------|------------|--------------------------|------------|-----------|------|------------|-------------------------------|----------|----------|------|------------|--------------------------|------------|-----------|------|------------|------------|
| Start Time                                                 | Right                   | Thru     | Left      | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Right                         | Thru     | Left     | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1 |                         |          |           |      |            |                          |            |           |      |            |                               |          |          |      |            |                          |            |           |      |            |            |
| Peak Hour for Entire Intersection Begins at 07:30 AM       |                         |          |           |      |            |                          |            |           |      |            |                               |          |          |      |            |                          |            |           |      |            |            |
| 07:30 AM                                                   | 4                       | 2        | 7         | 0    | 13         | 9                        | <b>199</b> | 55        | 0    | 263        | 92                            | 2        | 1        | 0    | 95         | 0                        | <b>301</b> | 4         | 0    | <b>305</b> | 676        |
| 07:45 AM                                                   | <b>8</b>                | 2        | 6         | 0    | 16         | <b>30</b>                | 190        | 62        | 0    | <b>282</b> | <b>124</b>                    | 3        | 1        | 0    | <b>128</b> | 3                        | 285        | 7         | 0    | 295        | <b>721</b> |
| 08:00 AM                                                   | 2                       | <b>4</b> | <b>12</b> | 0    | <b>18</b>  | 18                       | 175        | 64        | 0    | 257        | 72                            | 2        | <b>3</b> | 0    | 77         | <b>4</b>                 | 185        | 9         | 0    | 198        | 550        |
| 08:15 AM                                                   | 3                       | 1        | 11        | 0    | 15         | 20                       | 186        | <b>65</b> | 0    | 271        | 78                            | <b>6</b> | 2        | 0    | 86         | 3                        | 165        | <b>11</b> | 0    | 179        | 551        |
| Total Volume                                               | 17                      | 9        | 36        | 0    | 62         | 77                       | 750        | 246       | 0    | 1073       | 366                           | 13       | 7        | 0    | 386        | 10                       | 936        | 31        | 0    | 977        | 2498       |
| % App. Total                                               | 27.4                    | 14.5     | 58.1      | 0    |            | 7.2                      | 69.9       | 22.9      | 0    |            | 94.8                          | 3.4      | 1.8      | 0    |            | 1                        | 95.8       | 3.2       | 0    |            |            |
| PHF                                                        | .531                    | .563     | .750      | .000 | .861       | .642                     | .942       | .946      | .000 | .951       | .738                          | .542     | .583     | .000 | .754       | .625                     | .777       | .705      | .000 | .801       | .866       |
| Passenger Veh                                              | 16                      | 9        | 34        | 0    | 59         | 73                       | 736        | 240       | 0    | 1049       | 351                           | 13       | 7        | 0    | 371        | 9                        | 923        | 29        | 0    | 961        | 2440       |
| % Passenger Veh                                            | 94.1                    | 100      | 94.4      | 0    | 95.2       | 94.8                     | 98.1       | 97.6      | 0    | 97.8       | 95.9                          | 100      | 100      | 0    | 96.1       | 90.0                     | 98.6       | 93.5      | 0    | 98.4       | 97.7       |
| Trucks                                                     | 1                       | 0        | 2         | 0    | 3          | 4                        | 14         | 6         | 0    | 24         | 15                            | 0        | 0        | 0    | 15         | 1                        | 13         | 2         | 0    | 16         | 58         |
| % Trucks                                                   | 5.9                     | 0        | 5.6       | 0    | 4.8        | 5.2                      | 1.9        | 2.4       | 0    | 2.2        | 4.1                           | 0        | 0        | 0    | 3.9        | 10.0                     | 1.4        | 6.5       | 0    | 1.6        | 2.3        |

**Data Collection Group**  
**LSmith@DataCollectionGroup.net**

File Name : Graves Mill and Creekside  
Site Code : 00033396  
Start Date : 9/6/2017  
Page No : 3



# Data Collection Group

## LSmith@DataCollectionGroup.net

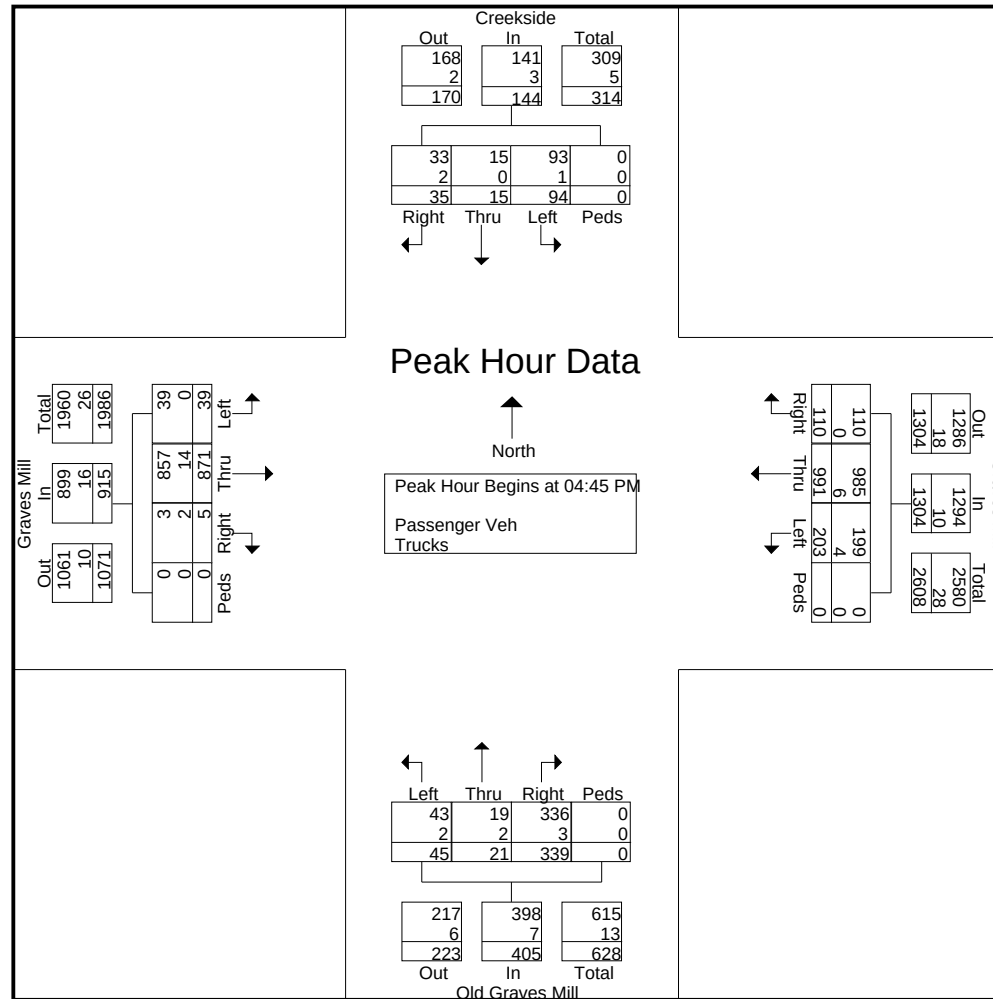
File Name : Graves Mill and Creekside  
 Site Code : 00033396  
 Start Date : 9/6/2017  
 Page No : 4

|                                                            | Creekside<br>From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Old Graves Mill<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|------------------------------------------------------------|-------------------------|------|------|------|------------|--------------------------|------|------|------|------------|-------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time                                                 | Right                   | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                         | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1 |                         |      |      |      |            |                          |      |      |      |            |                               |      |      |      |            |                          |      |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 04:45 PM       |                         |      |      |      |            |                          |      |      |      |            |                               |      |      |      |            |                          |      |      |      |            |            |
| 04:45 PM                                                   | 11                      | 5    | 24   | 0    | 40         | 25                       | 258  | 48   | 0    | 331        | 90                            | 5    | 5    | 0    | 100        | 2                        | 204  | 11   | 0    | 217        | 688        |
| 05:00 PM                                                   | 12                      | 0    | 34   | 0    | 46         | 24                       | 270  | 43   | 0    | 337        | 87                            | 8    | 19   | 0    | 114        | 1                        | 216  | 9    | 0    | 226        | 723        |
| 05:15 PM                                                   | 5                       | 6    | 16   | 0    | 27         | 37                       | 258  | 65   | 0    | 360        | 88                            | 3    | 8    | 0    | 99         | 1                        | 237  | 8    | 0    | 246        | 732        |
| 05:30 PM                                                   | 7                       | 4    | 20   | 0    | 31         | 24                       | 205  | 47   | 0    | 276        | 74                            | 5    | 13   | 0    | 92         | 1                        | 214  | 11   | 0    | 226        | 625        |
| Total Volume                                               | 35                      | 15   | 94   | 0    | 144        | 110                      | 991  | 203  | 0    | 1304       | 339                           | 21   | 45   | 0    | 405        | 5                        | 871  | 39   | 0    | 915        | 2768       |
| % App. Total                                               | 24.3                    | 10.4 | 65.3 | 0    |            | 8.4                      | 76   | 15.6 | 0    |            | 83.7                          | 5.2  | 11.1 | 0    |            | 0.5                      | 95.2 | 4.3  | 0    |            |            |
| PHF                                                        | .729                    | .625 | .691 | .000 | .783       | .743                     | .918 | .781 | .000 | .906       | .942                          | .656 | .592 | .000 | .888       | .625                     | .919 | .886 | .000 | .930       | .945       |
| Passenger Veh                                              | 33                      | 15   | 93   | 0    | 141        | 110                      | 985  | 199  | 0    | 1294       | 336                           | 19   | 43   | 0    | 398        | 3                        | 857  | 39   | 0    | 899        | 2732       |
| % Passenger Veh                                            | 94.3                    | 100  | 98.9 | 0    | 97.9       | 100                      | 99.4 | 98.0 | 0    | 99.2       | 99.1                          | 90.5 | 95.6 | 0    | 98.3       | 60.0                     | 98.4 | 100  | 0    | 98.3       | 98.7       |
| Trucks                                                     | 2                       | 0    | 1    | 0    | 3          | 0                        | 6    | 4    | 0    | 10         | 3                             | 2    | 2    | 0    | 7          | 2                        | 14   | 0    | 0    | 16         | 36         |
| % Trucks                                                   | 5.7                     | 0    | 1.1  | 0    | 2.1        | 0                        | 0.6  | 2.0  | 0    | 0.8        | 0.9                           | 9.5  | 4.4  | 0    | 1.7        | 40.0                     | 1.6  | 0    | 0    | 1.7        | 1.3        |

# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and Creekside  
 Site Code : 00033396  
 Start Date : 9/6/2017  
 Page No : 5



# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and W Side of Expressway Ramps

Site Code : 00000223

Start Date : 9/6/2017

Page No : 1

Groups Printed- Passenger Veh - Trucks

|                 | Expressway Off Ramp<br>From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Expressway On Ramp<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|-----------------|-----------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|----------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time      | Right                             | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                            | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| 07:00 AM        | 25                                | 0    | 13   | 0    | 38         | 0                        | 133  | 15   | 0    | 148        | 0                                | 0    | 0    | 0    | 0          | 200                      | 53   | 0    | 0    | 253        | 439        |
| 07:15 AM        | 40                                | 0    | 20   | 0    | 60         | 0                        | 144  | 22   | 0    | 166        | 0                                | 0    | 0    | 0    | 0          | 209                      | 73   | 0    | 0    | 282        | 508        |
| 07:30 AM        | 57                                | 0    | 25   | 0    | 82         | 0                        | 206  | 39   | 0    | 245        | 0                                | 0    | 0    | 0    | 0          | 281                      | 119  | 0    | 0    | 400        | 727        |
| 07:45 AM        | 49                                | 0    | 51   | 0    | 100        | 0                        | 233  | 29   | 0    | 262        | 0                                | 0    | 0    | 0    | 0          | 238                      | 179  | 0    | 0    | 417        | 779        |
| Total           | 171                               | 0    | 109  | 0    | 280        | 0                        | 716  | 105  | 0    | 821        | 0                                | 0    | 0    | 0    | 0          | 928                      | 424  | 0    | 0    | 1352       | 2453       |
| 08:00 AM        | 52                                | 1    | 31   | 0    | 84         | 0                        | 205  | 17   | 0    | 222        | 0                                | 0    | 0    | 0    | 0          | 149                      | 120  | 0    | 0    | 269        | 575        |
| 08:15 AM        | 49                                | 0    | 23   | 0    | 72         | 0                        | 222  | 9    | 0    | 231        | 0                                | 0    | 0    | 0    | 0          | 152                      | 105  | 0    | 0    | 257        | 560        |
| 08:30 AM        | 33                                | 0    | 25   | 0    | 58         | 0                        | 188  | 26   | 0    | 214        | 0                                | 0    | 0    | 0    | 0          | 147                      | 116  | 0    | 0    | 263        | 535        |
| 08:45 AM        | 47                                | 0    | 40   | 0    | 87         | 0                        | 156  | 31   | 0    | 187        | 0                                | 0    | 0    | 0    | 0          | 171                      | 137  | 0    | 0    | 308        | 582        |
| Total           | 181                               | 1    | 119  | 0    | 301        | 0                        | 771  | 83   | 0    | 854        | 0                                | 0    | 0    | 0    | 0          | 619                      | 478  | 0    | 0    | 1097       | 2252       |
| *** BREAK ***   |                                   |      |      |      |            |                          |      |      |      |            |                                  |      |      |      |            |                          |      |      |      |            |            |
| 04:00 PM        | 63                                | 0    | 12   | 0    | 75         | 0                        | 160  | 33   | 0    | 193        | 0                                | 0    | 0    | 0    | 0          | 197                      | 79   | 0    | 0    | 276        | 544        |
| 04:15 PM        | 63                                | 0    | 7    | 0    | 70         | 0                        | 237  | 29   | 0    | 266        | 0                                | 0    | 0    | 0    | 0          | 180                      | 78   | 0    | 0    | 258        | 594        |
| 04:30 PM        | 53                                | 0    | 9    | 0    | 62         | 0                        | 218  | 41   | 0    | 259        | 0                                | 0    | 0    | 0    | 0          | 192                      | 59   | 0    | 0    | 251        | 572        |
| 04:45 PM        | 72                                | 2    | 16   | 0    | 90         | 0                        | 259  | 43   | 0    | 302        | 0                                | 0    | 0    | 0    | 0          | 221                      | 98   | 0    | 0    | 319        | 711        |
| Total           | 251                               | 2    | 44   | 0    | 297        | 0                        | 874  | 146  | 0    | 1020       | 0                                | 0    | 0    | 0    | 0          | 790                      | 314  | 0    | 0    | 1104       | 2421       |
| 05:00 PM        | 94                                | 1    | 11   | 0    | 106        | 0                        | 243  | 79   | 0    | 322        | 0                                | 0    | 0    | 0    | 0          | 240                      | 97   | 0    | 0    | 337        | 765        |
| 05:15 PM        | 112                               | 0    | 12   | 0    | 124        | 0                        | 248  | 60   | 0    | 308        | 0                                | 0    | 0    | 0    | 0          | 248                      | 94   | 0    | 0    | 342        | 774        |
| 05:30 PM        | 72                                | 0    | 8    | 0    | 80         | 0                        | 204  | 31   | 0    | 235        | 0                                | 0    | 0    | 0    | 0          | 203                      | 105  | 0    | 0    | 308        | 623        |
| 05:45 PM        | 48                                | 0    | 6    | 0    | 54         | 0                        | 210  | 33   | 0    | 243        | 0                                | 0    | 0    | 0    | 0          | 177                      | 72   | 0    | 0    | 249        | 546        |
| Total           | 326                               | 1    | 37   | 0    | 364        | 0                        | 905  | 203  | 0    | 1108       | 0                                | 0    | 0    | 0    | 0          | 868                      | 368  | 0    | 0    | 1236       | 2708       |
| Grand Total     | 929                               | 4    | 309  | 0    | 1242       | 0                        | 3266 | 537  | 0    | 3803       | 0                                | 0    | 0    | 0    | 0          | 3205                     | 1584 | 0    | 0    | 4789       | 9834       |
| Apprch %        | 74.8                              | 0.3  | 24.9 | 0    |            | 0                        | 85.9 | 14.1 | 0    |            | 0                                | 0    | 0    | 0    |            | 66.9                     | 33.1 | 0    | 0    |            |            |
| Total %         | 9.4                               | 0    | 3.1  | 0    | 12.6       | 0                        | 33.2 | 5.5  | 0    | 38.7       | 0                                | 0    | 0    | 0    | 0          | 32.6                     | 16.1 | 0    | 0    | 48.7       |            |
| Passenger Veh   | 901                               | 4    | 296  | 0    | 1201       | 0                        | 3206 | 529  | 0    | 3735       | 0                                | 0    | 0    | 0    | 0          | 3087                     | 1579 | 0    | 0    | 4666       | 9602       |
| % Passenger Veh | 97                                | 100  | 95.8 | 0    | 96.7       | 0                        | 98.2 | 98.5 | 0    | 98.2       | 0                                | 0    | 0    | 0    | 0          | 96.3                     | 99.7 | 0    | 0    | 97.4       | 97.6       |
| Trucks          | 28                                | 0    | 13   | 0    | 41         | 0                        | 60   | 8    | 0    | 68         | 0                                | 0    | 0    | 0    | 0          | 118                      | 5    | 0    | 0    | 123        | 232        |
| % Trucks        | 3                                 | 0    | 4.2  | 0    | 3.3        | 0                        | 1.8  | 1.5  | 0    | 1.8        | 0                                | 0    | 0    | 0    | 0          | 3.7                      | 0.3  | 0    | 0    | 2.6        | 2.4        |



# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and W Side of Expressway Ramps  
 Site Code : 00000223  
 Start Date : 9/6/2017  
 Page No : 2

|                                                            | Expressway Off Ramp<br>From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Expressway On Ramp<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|------------------------------------------------------------|-----------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|----------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time                                                 | Right                             | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                            | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1 |                                   |      |      |      |            |                          |      |      |      |            |                                  |      |      |      |            |                          |      |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 07:30 AM       |                                   |      |      |      |            |                          |      |      |      |            |                                  |      |      |      |            |                          |      |      |      |            |            |
| 07:30 AM                                                   | 57                                | 0    | 25   | 0    | 82         | 0                        | 206  | 39   | 0    | 245        | 0                                | 0    | 0    | 0    | 0          | 281                      | 119  | 0    | 0    | 400        | 727        |
| 07:45 AM                                                   | 49                                | 0    | 51   | 0    | 100        | 0                        | 233  | 29   | 0    | 262        | 0                                | 0    | 0    | 0    | 0          | 238                      | 179  | 0    | 0    | 417        | 779        |
| 08:00 AM                                                   | 52                                | 1    | 31   | 0    | 84         | 0                        | 205  | 17   | 0    | 222        | 0                                | 0    | 0    | 0    | 0          | 149                      | 120  | 0    | 0    | 269        | 575        |
| 08:15 AM                                                   | 49                                | 0    | 23   | 0    | 72         | 0                        | 222  | 9    | 0    | 231        | 0                                | 0    | 0    | 0    | 0          | 152                      | 105  | 0    | 0    | 257        | 560        |
| Total Volume                                               | 207                               | 1    | 130  | 0    | 338        | 0                        | 866  | 94   | 0    | 960        | 0                                | 0    | 0    | 0    | 0          | 820                      | 523  | 0    | 0    | 1343       | 2641       |
| % App. Total                                               | 61.2                              | 0.3  | 38.5 | 0    |            | 0                        | 90.2 | 9.8  | 0    |            | 0                                | 0    | 0    | 0    |            | 61.1                     | 38.9 | 0    | 0    |            |            |
| PHF                                                        | .908                              | .250 | .637 | .000 | .845       | .000                     | .929 | .603 | .000 | .916       | .000                             | .000 | .000 | .000 | .000       | .730                     | .730 | .000 | .000 | .805       | .848       |
| Passenger Veh                                              | 195                               | 1    | 125  | 0    | 321        | 0                        | 854  | 93   | 0    | 947        | 0                                | 0    | 0    | 0    | 0          | 788                      | 520  | 0    | 0    | 1308       | 2576       |
| % Passenger Veh                                            | 94.2                              | 100  | 96.2 | 0    | 95.0       | 0                        | 98.6 | 98.9 | 0    | 98.6       | 0                                | 0    | 0    | 0    | 0          | 96.1                     | 99.4 | 0    | 0    | 97.4       | 97.5       |
| Trucks                                                     | 12                                | 0    | 5    | 0    | 17         | 0                        | 12   | 1    | 0    | 13         | 0                                | 0    | 0    | 0    | 0          | 32                       | 3    | 0    | 0    | 35         | 65         |
| % Trucks                                                   | 5.8                               | 0    | 3.8  | 0    | 5.0        | 0                        | 1.4  | 1.1  | 0    | 1.4        | 0                                | 0    | 0    | 0    | 0          | 3.9                      | 0.6  | 0    | 0    | 2.6        | 2.5        |

# Data Collection Group

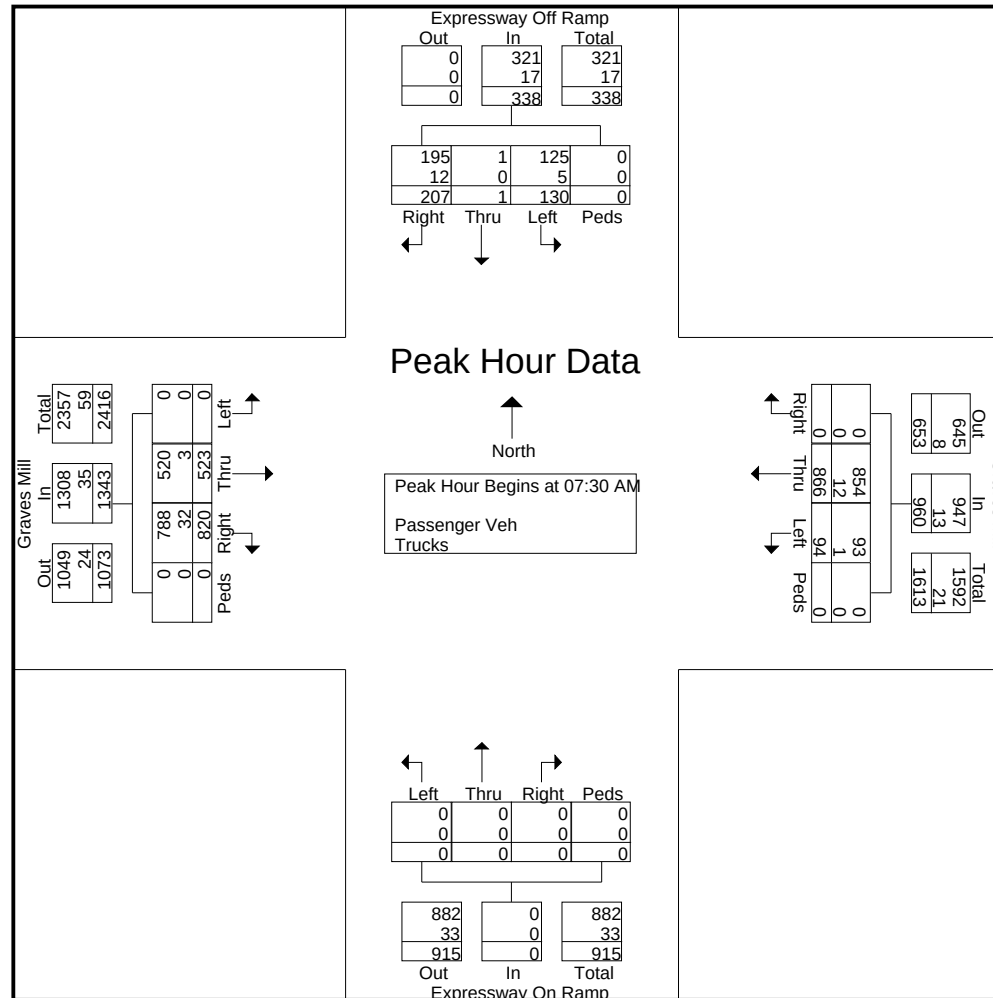
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and W Side of Expressway Ramps

Site Code : 00000223

Start Date : 9/6/2017

Page No : 3



# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and W Side of Expressway Ramps

Site Code : 00000223

Start Date : 9/6/2017

Page No : 4

|                                                            | Expressway Off Ramp<br>From North |          |           |      |            | Graves Mill<br>From East |            |           |      |            | Expressway On Ramp<br>From South |      |      |      |            | Graves Mill<br>From West |            |      |      |            |            |
|------------------------------------------------------------|-----------------------------------|----------|-----------|------|------------|--------------------------|------------|-----------|------|------------|----------------------------------|------|------|------|------------|--------------------------|------------|------|------|------------|------------|
| Start Time                                                 | Right                             | Thru     | Left      | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Right                            | Thru | Left | Peds | App. Total | Right                    | Thru       | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1 |                                   |          |           |      |            |                          |            |           |      |            |                                  |      |      |      |            |                          |            |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 04:45 PM       |                                   |          |           |      |            |                          |            |           |      |            |                                  |      |      |      |            |                          |            |      |      |            |            |
| 04:45 PM                                                   | 72                                | <b>2</b> | <b>16</b> | 0    | 90         | 0                        | <b>259</b> | 43        | 0    | 302        | 0                                | 0    | 0    | 0    | 0          | 221                      | 98         | 0    | 0    | 319        | 711        |
| 05:00 PM                                                   | 94                                | 1        | 11        | 0    | 106        | 0                        | 243        | <b>79</b> | 0    | <b>322</b> | 0                                | 0    | 0    | 0    | 0          | 240                      | 97         | 0    | 0    | 337        | 765        |
| 05:15 PM                                                   | <b>112</b>                        | 0        | 12        | 0    | <b>124</b> | 0                        | 248        | 60        | 0    | 308        | 0                                | 0    | 0    | 0    | 0          | <b>248</b>               | <b>94</b>  | 0    | 0    | <b>342</b> | <b>774</b> |
| 05:30 PM                                                   | 72                                | 0        | 8         | 0    | 80         | 0                        | 204        | 31        | 0    | 235        | 0                                | 0    | 0    | 0    | 0          | 203                      | <b>105</b> | 0    | 0    | 308        | 623        |
| Total Volume                                               | 350                               | 3        | 47        | 0    | 400        | 0                        | 954        | 213       | 0    | 1167       | 0                                | 0    | 0    | 0    | 0          | 912                      | 394        | 0    | 0    | 1306       | 2873       |
| % App. Total                                               | 87.5                              | 0.8      | 11.8      | 0    |            | 0                        | 81.7       | 18.3      | 0    |            | 0                                | 0    | 0    | 0    |            | 69.8                     | 30.2       | 0    | 0    |            |            |
| PHF                                                        | .781                              | .375     | .734      | .000 | .806       | .000                     | .921       | .674      | .000 | .906       | .000                             | .000 | .000 | .000 | .000       | .919                     | .938       | .000 | .000 | .955       | .928       |
| Passenger Veh                                              | 347                               | 3        | 45        | 0    | 395        | 0                        | 947        | 211       | 0    | 1158       | 0                                | 0    | 0    | 0    | 0          | 894                      | 392        | 0    | 0    | 1286       | 2839       |
| % Passenger Veh                                            | 99.1                              | 100      | 95.7      | 0    | 98.8       | 0                        | 99.3       | 99.1      | 0    | 99.2       | 0                                | 0    | 0    | 0    | 0          | 98.0                     | 99.5       | 0    | 0    | 98.5       | 98.8       |
| Trucks                                                     | 3                                 | 0        | 2         | 0    | 5          | 0                        | 7          | 2         | 0    | 9          | 0                                | 0    | 0    | 0    | 0          | 18                       | 2          | 0    | 0    | 20         | 34         |
| % Trucks                                                   | 0.9                               | 0        | 4.3       | 0    | 1.3        | 0                        | 0.7        | 0.9       | 0    | 0.8        | 0                                | 0    | 0    | 0    | 0          | 2.0                      | 0.5        | 0    | 0    | 1.5        | 1.2        |



**Data Collection Group**  
**LSmith@DataCollectionGroup.net**

File Name : Graves Mill and W Side of Expressway Ramps  
Site Code : 00000223  
Start Date : 9/6/2017  
Page No : 5

# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and E Side of Expressway Ramps

Site Code : 00006243

Start Date : 9/7/2017

Page No : 1

Groups Printed- Passenger Veh - Trucks

|                 | Lynchburg Expwy On Ramp<br>From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Lynchburg Expwy Off Ramp<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|-----------------|---------------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|----------------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time      | Right                                 | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                                  | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| 07:00 AM        | 0                                     | 0    | 0    | 0    | 0          | 5                        | 21   | 0    | 0    | 26         | 18                                     | 0    | 129  | 0    | 147        | 0                        | 41   | 48   | 0    | 89         | 262        |
| 07:15 AM        | 0                                     | 0    | 0    | 0    | 0          | 6                        | 29   | 0    | 0    | 35         | 28                                     | 0    | 153  | 0    | 181        | 0                        | 50   | 53   | 0    | 103        | 319        |
| 07:30 AM        | 0                                     | 0    | 0    | 0    | 0          | 10                       | 83   | 0    | 0    | 93         | 42                                     | 0    | 170  | 0    | 212        | 0                        | 86   | 70   | 0    | 156        | 461        |
| 07:45 AM        | 0                                     | 0    | 0    | 0    | 0          | 16                       | 77   | 0    | 0    | 93         | 74                                     | 0    | 185  | 0    | 259        | 0                        | 134  | 72   | 0    | 206        | 558        |
| Total           | 0                                     | 0    | 0    | 0    | 0          | 37                       | 210  | 0    | 0    | 247        | 162                                    | 0    | 637  | 0    | 799        | 0                        | 311  | 243  | 0    | 554        | 1600       |
| 08:00 AM        | 0                                     | 0    | 0    | 0    | 0          | 14                       | 65   | 0    | 0    | 79         | 38                                     | 0    | 135  | 0    | 173        | 0                        | 96   | 60   | 0    | 156        | 408        |
| 08:15 AM        | 0                                     | 0    | 0    | 0    | 0          | 13                       | 69   | 0    | 0    | 82         | 29                                     | 0    | 140  | 0    | 169        | 0                        | 68   | 69   | 0    | 137        | 388        |
| 08:30 AM        | 0                                     | 0    | 0    | 0    | 0          | 19                       | 66   | 0    | 0    | 85         | 42                                     | 0    | 143  | 0    | 185        | 0                        | 85   | 50   | 0    | 135        | 405        |
| 08:45 AM        | 0                                     | 0    | 0    | 0    | 0          | 25                       | 58   | 0    | 0    | 83         | 56                                     | 0    | 130  | 0    | 186        | 0                        | 97   | 51   | 0    | 148        | 417        |
| Total           | 0                                     | 0    | 0    | 0    | 0          | 71                       | 258  | 0    | 0    | 329        | 165                                    | 0    | 548  | 0    | 713        | 0                        | 346  | 230  | 0    | 576        | 1618       |
| *** BREAK ***   |                                       |      |      |      |            |                          |      |      |      |            |                                        |      |      |      |            |                          |      |      |      |            |            |
| 04:00 PM        | 0                                     | 0    | 0    | 0    | 0          | 29                       | 65   | 0    | 0    | 94         | 18                                     | 1    | 145  | 0    | 164        | 0                        | 44   | 43   | 0    | 87         | 345        |
| 04:15 PM        | 0                                     | 0    | 0    | 0    | 0          | 27                       | 91   | 0    | 0    | 118        | 20                                     | 0    | 171  | 0    | 191        | 0                        | 47   | 46   | 0    | 93         | 402        |
| 04:30 PM        | 0                                     | 0    | 0    | 0    | 0          | 28                       | 104  | 0    | 0    | 132        | 17                                     | 0    | 161  | 0    | 178        | 0                        | 37   | 38   | 0    | 75         | 385        |
| 04:45 PM        | 0                                     | 0    | 0    | 0    | 0          | 34                       | 134  | 0    | 0    | 168        | 20                                     | 0    | 158  | 0    | 178        | 0                        | 55   | 52   | 0    | 107        | 453        |
| Total           | 0                                     | 0    | 0    | 0    | 0          | 118                      | 394  | 0    | 0    | 512        | 75                                     | 1    | 635  | 0    | 711        | 0                        | 183  | 179  | 0    | 362        | 1585       |
| 05:00 PM        | 0                                     | 0    | 0    | 0    | 0          | 41                       | 158  | 0    | 0    | 199        | 14                                     | 0    | 170  | 0    | 184        | 0                        | 58   | 62   | 0    | 120        | 503        |
| 05:15 PM        | 0                                     | 0    | 0    | 0    | 0          | 27                       | 111  | 0    | 0    | 138        | 14                                     | 1    | 199  | 0    | 214        | 0                        | 43   | 77   | 0    | 120        | 472        |
| 05:30 PM        | 0                                     | 0    | 0    | 0    | 0          | 29                       | 72   | 0    | 0    | 101        | 18                                     | 0    | 158  | 0    | 176        | 0                        | 64   | 62   | 0    | 126        | 403        |
| 05:45 PM        | 0                                     | 0    | 0    | 0    | 0          | 26                       | 84   | 0    | 0    | 110        | 13                                     | 0    | 139  | 0    | 152        | 0                        | 34   | 46   | 0    | 80         | 342        |
| Total           | 0                                     | 0    | 0    | 0    | 0          | 123                      | 425  | 0    | 0    | 548        | 59                                     | 1    | 666  | 0    | 726        | 0                        | 199  | 247  | 0    | 446        | 1720       |
| Grand Total     | 0                                     | 0    | 0    | 0    | 0          | 349                      | 1287 | 0    | 0    | 1636       | 461                                    | 2    | 2486 | 0    | 2949       | 0                        | 1039 | 899  | 0    | 1938       | 6523       |
| Apprch %        | 0                                     | 0    | 0    | 0    |            | 21.3                     | 78.7 | 0    | 0    |            | 15.6                                   | 0.1  | 84.3 | 0    |            | 0                        | 53.6 | 46.4 | 0    |            |            |
| Total %         | 0                                     | 0    | 0    | 0    | 0          | 5.4                      | 19.7 | 0    | 0    | 25.1       | 7.1                                    | 0    | 38.1 | 0    | 45.2       | 0                        | 15.9 | 13.8 | 0    | 29.7       |            |
| Passenger Veh   | 0                                     | 0    | 0    | 0    | 0          | 341                      | 1234 | 0    | 0    | 1575       | 456                                    | 2    | 2415 | 0    | 2873       | 0                        | 1036 | 887  | 0    | 1923       | 6371       |
| % Passenger Veh | 0                                     | 0    | 0    | 0    | 0          | 97.7                     | 95.9 | 0    | 0    | 96.3       | 98.9                                   | 100  | 97.1 | 0    | 97.4       | 0                        | 99.7 | 98.7 | 0    | 99.2       | 97.7       |
| Trucks          | 0                                     | 0    | 0    | 0    | 0          | 8                        | 53   | 0    | 0    | 61         | 5                                      | 0    | 71   | 0    | 76         | 0                        | 3    | 12   | 0    | 15         | 152        |
| % Trucks        | 0                                     | 0    | 0    | 0    | 0          | 2.3                      | 4.1  | 0    | 0    | 3.7        | 1.1                                    | 0    | 2.9  | 0    | 2.6        | 0                        | 0.3  | 1.3  | 0    | 0.8        | 2.3        |

# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and E Side of Expressway Ramps  
 Site Code : 00006243  
 Start Date : 9/7/2017  
 Page No : 2

|                                                            | Lynchburg Expwy On Ramp<br>From North |      |      |      |            | Graves Mill<br>From East |           |      |      |            | Lynchburg Expwy Off Ramp<br>From South |      |            |      |            | Graves Mill<br>From West |            |           |      |            |            |
|------------------------------------------------------------|---------------------------------------|------|------|------|------------|--------------------------|-----------|------|------|------------|----------------------------------------|------|------------|------|------------|--------------------------|------------|-----------|------|------------|------------|
| Start Time                                                 | Right                                 | Thru | Left | Peds | App. Total | Right                    | Thru      | Left | Peds | App. Total | Right                                  | Thru | Left       | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1 |                                       |      |      |      |            |                          |           |      |      |            |                                        |      |            |      |            |                          |            |           |      |            |            |
| Peak Hour for Entire Intersection Begins at 07:30 AM       |                                       |      |      |      |            |                          |           |      |      |            |                                        |      |            |      |            |                          |            |           |      |            |            |
| 07:30 AM                                                   | 0                                     | 0    | 0    | 0    | 0          | 10                       | <b>83</b> | 0    | 0    | <b>93</b>  | 42                                     | 0    | 170        | 0    | 212        | 0                        | 86         | 70        | 0    | 156        | 461        |
| 07:45 AM                                                   | 0                                     | 0    | 0    | 0    | 0          | <b>16</b>                | 77        | 0    | 0    | 93         | <b>74</b>                              | 0    | <b>185</b> | 0    | <b>259</b> | 0                        | <b>134</b> | <b>72</b> | 0    | <b>206</b> | <b>558</b> |
| 08:00 AM                                                   | 0                                     | 0    | 0    | 0    | 0          | 14                       | 65        | 0    | 0    | 79         | 38                                     | 0    | 135        | 0    | 173        | 0                        | 96         | 60        | 0    | 156        | 408        |
| 08:15 AM                                                   | 0                                     | 0    | 0    | 0    | 0          | 13                       | 69        | 0    | 0    | 82         | 29                                     | 0    | 140        | 0    | 169        | 0                        | 68         | 69        | 0    | 137        | 388        |
| Total Volume                                               | 0                                     | 0    | 0    | 0    | 0          | 53                       | 294       | 0    | 0    | 347        | 183                                    | 0    | 630        | 0    | 813        | 0                        | 384        | 271       | 0    | 655        | 1815       |
| % App. Total                                               | 0                                     | 0    | 0    | 0    | 0          | 15.3                     | 84.7      | 0    | 0    |            | 22.5                                   | 0    | 77.5       | 0    |            | 0                        | 58.6       | 41.4      | 0    |            |            |
| PHF                                                        | .000                                  | .000 | .000 | .000 | .000       | .828                     | .886      | .000 | .000 | .933       | .618                                   | .000 | .851       | .000 | .785       | .000                     | .716       | .941      | .000 | .795       | .813       |
| Passenger Veh                                              | 0                                     | 0    | 0    | 0    | 0          | 50                       | 281       | 0    | 0    | 331        | 183                                    | 0    | 614        | 0    | 797        | 0                        | 382        | 266       | 0    | 648        | 1776       |
| % Passenger Veh                                            | 0                                     | 0    | 0    | 0    | 0          | 94.3                     | 95.6      | 0    | 0    | 95.4       | 100                                    | 0    | 97.5       | 0    | 98.0       | 0                        | 99.5       | 98.2      | 0    | 98.9       | 97.9       |
| Trucks                                                     | 0                                     | 0    | 0    | 0    | 0          | 3                        | 13        | 0    | 0    | 16         | 0                                      | 0    | 16         | 0    | 16         | 0                        | 2          | 5         | 0    | 7          | 39         |
| % Trucks                                                   | 0                                     | 0    | 0    | 0    | 0          | 5.7                      | 4.4       | 0    | 0    | 4.6        | 0                                      | 0    | 2.5        | 0    | 2.0        | 0                        | 0.5        | 1.8       | 0    | 1.1        | 2.1        |



# Data Collection Group

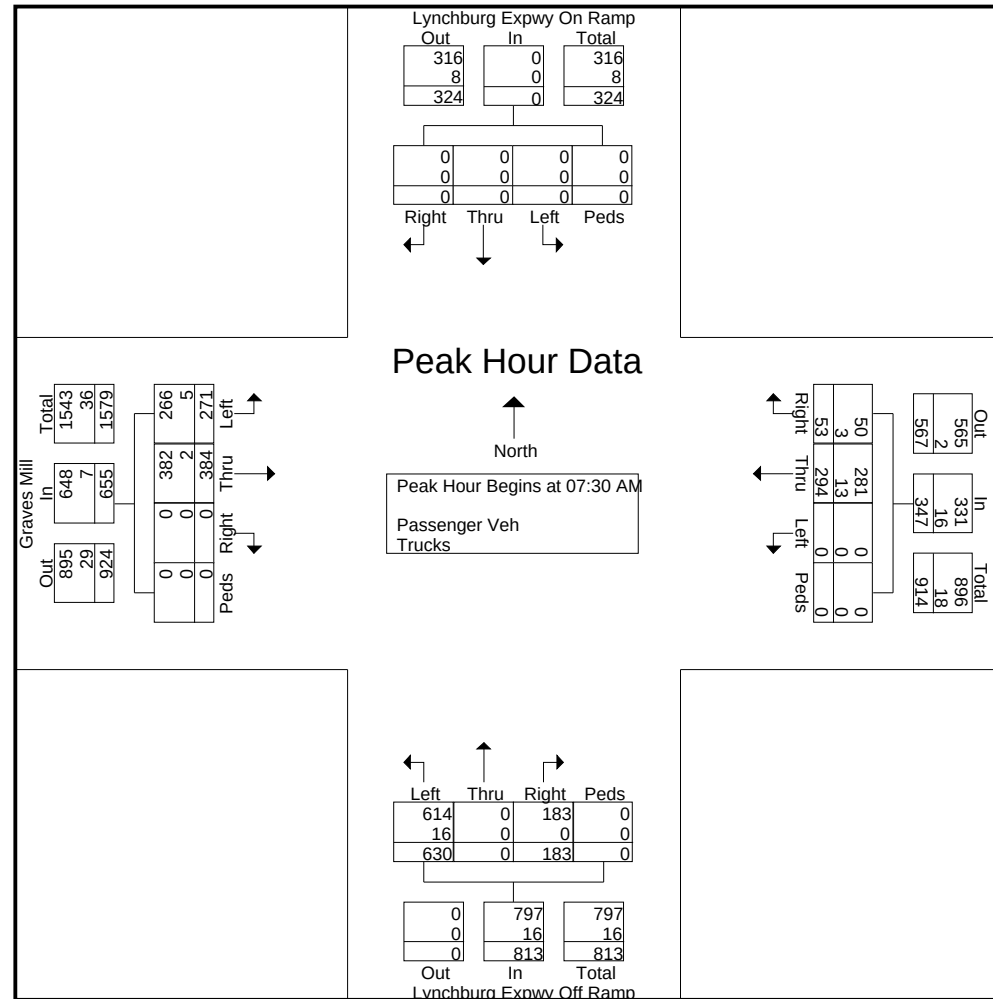
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and E Side of Expressway Ramps

Site Code : 00006243

Start Date : 9/7/2017

Page No : 3



# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and E Side of Expressway Ramps

Site Code : 00006243

Start Date : 9/7/2017

Page No : 4

|                                                            | Lynchburg Expwy On Ramp<br>From North |      |      |      |            | Graves Mill<br>From East |      |      |      |            | Lynchburg Expwy Off Ramp<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|------------------------------------------------------------|---------------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|----------------------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time                                                 | Right                                 | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Right                                  | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1 |                                       |      |      |      |            |                          |      |      |      |            |                                        |      |      |      |            |                          |      |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 04:45 PM       |                                       |      |      |      |            |                          |      |      |      |            |                                        |      |      |      |            |                          |      |      |      |            |            |
| 04:45 PM                                                   | 0                                     | 0    | 0    | 0    | 0          | 34                       | 134  | 0    | 0    | 168        | 20                                     | 0    | 158  | 0    | 178        | 0                        | 55   | 52   | 0    | 107        | 453        |
| 05:00 PM                                                   | 0                                     | 0    | 0    | 0    | 0          | 41                       | 158  | 0    | 0    | 199        | 14                                     | 0    | 170  | 0    | 184        | 0                        | 58   | 62   | 0    | 120        | 503        |
| 05:15 PM                                                   | 0                                     | 0    | 0    | 0    | 0          | 27                       | 111  | 0    | 0    | 138        | 14                                     | 1    | 199  | 0    | 214        | 0                        | 43   | 77   | 0    | 120        | 472        |
| 05:30 PM                                                   | 0                                     | 0    | 0    | 0    | 0          | 29                       | 72   | 0    | 0    | 101        | 18                                     | 0    | 158  | 0    | 176        | 0                        | 64   | 62   | 0    | 126        | 403        |
| Total Volume                                               | 0                                     | 0    | 0    | 0    | 0          | 131                      | 475  | 0    | 0    | 606        | 66                                     | 1    | 685  | 0    | 752        | 0                        | 220  | 253  | 0    | 473        | 1831       |
| % App. Total                                               | 0                                     | 0    | 0    | 0    | 0          | 21.6                     | 78.4 | 0    | 0    |            | 8.8                                    | 0.1  | 91.1 | 0    |            | 0                        | 46.5 | 53.5 | 0    |            |            |
| PHF                                                        | .000                                  | .000 | .000 | .000 | .000       | .799                     | .752 | .000 | .000 | .761       | .825                                   | .250 | .861 | .000 | .879       | .000                     | .859 | .821 | .000 | .938       | .910       |
| Passenger Veh                                              | 0                                     | 0    | 0    | 0    | 0          | 130                      | 470  | 0    | 0    | 600        | 66                                     | 1    | 677  | 0    | 744        | 0                        | 219  | 251  | 0    | 470        | 1814       |
| % Passenger Veh                                            | 0                                     | 0    | 0    | 0    | 0          | 99.2                     | 98.9 | 0    | 0    | 99.0       | 100                                    | 100  | 98.8 | 0    | 98.9       | 0                        | 99.5 | 99.2 | 0    | 99.4       | 99.1       |
| Trucks                                                     | 0                                     | 0    | 0    | 0    | 0          | 1                        | 5    | 0    | 0    | 6          | 0                                      | 0    | 8    | 0    | 8          | 0                        | 1    | 2    | 0    | 3          | 17         |
| % Trucks                                                   | 0                                     | 0    | 0    | 0    | 0          | 0.8                      | 1.1  | 0    | 0    | 1.0        | 0                                      | 0    | 1.2  | 0    | 1.1        | 0                        | 0.5  | 0.8  | 0    | 0.6        | 0.9        |

# Data Collection Group

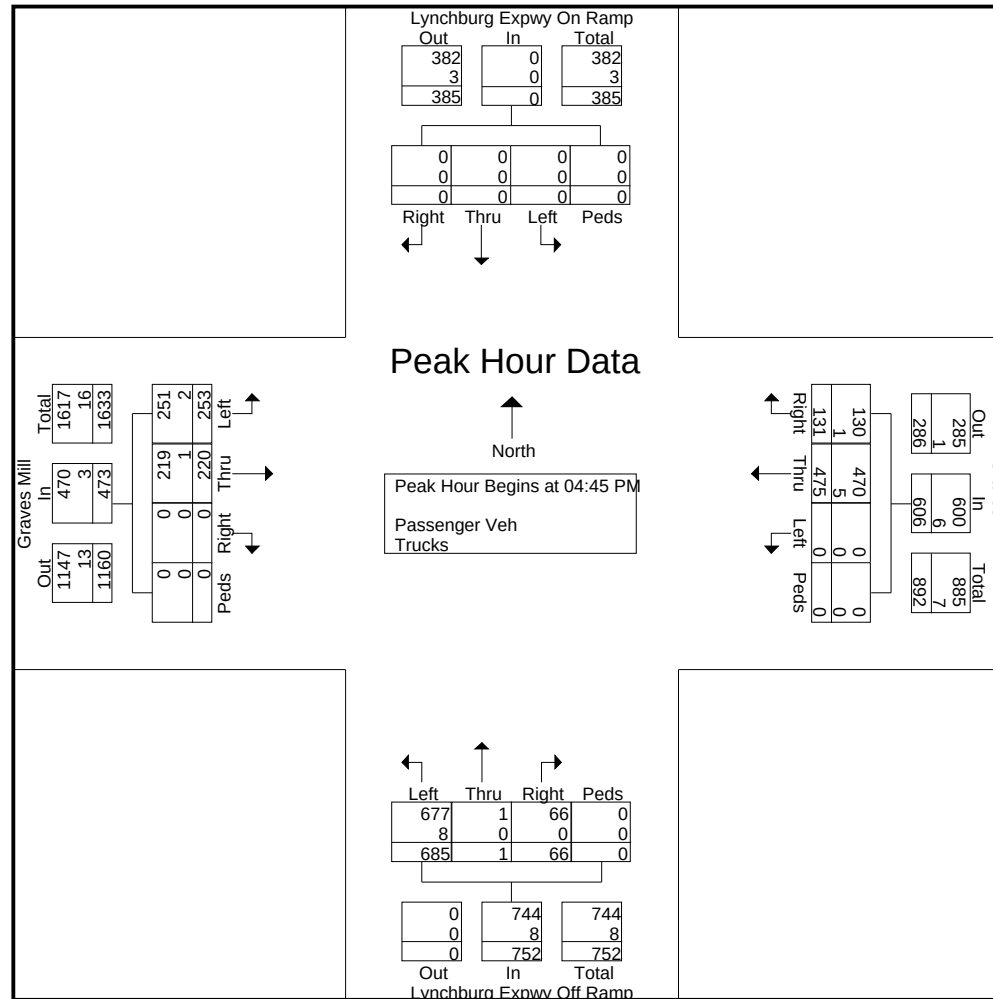
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and E Side of Expressway Ramps

Site Code : 00006243

Start Date : 9/7/2017

Page No : 5





# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and McConville

Site Code : 00101010

Start Date : 9/6/2017

Page No : 1

### Groups Printed- Passenger Veh - Trucks

|                 | McConville<br>From North |      |      |      |            | Nationwide<br>From East |      |      |      |            | Graves Mill<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|-----------------|--------------------------|------|------|------|------------|-------------------------|------|------|------|------------|---------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time      | Right                    | Thru | Left | Peds | App. Total | Right                   | Thru | Left | Peds | App. Total | Right                     | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| 07:00 AM        | 16                       | 6    | 0    | 0    | 22         | 0                       | 2    | 0    | 0    | 2          | 4                         | 2    | 8    | 0    | 14         | 32                       | 27   | 6    | 0    | 65         | 103        |
| 07:15 AM        | 31                       | 8    | 1    | 0    | 40         | 0                       | 0    | 0    | 0    | 0          | 13                        | 3    | 21   | 0    | 37         | 37                       | 52   | 7    | 0    | 96         | 173        |
| 07:30 AM        | 49                       | 13   | 5    | 0    | 67         | 0                       | 6    | 1    | 0    | 7          | 14                        | 6    | 36   | 0    | 56         | 51                       | 67   | 10   | 0    | 128        | 258        |
| 07:45 AM        | 30                       | 8    | 2    | 0    | 40         | 0                       | 18   | 1    | 0    | 19         | 30                        | 2    | 41   | 0    | 73         | 73                       | 114  | 12   | 0    | 199        | 331        |
| Total           | 126                      | 35   | 8    | 0    | 169        | 0                       | 26   | 2    | 0    | 28         | 61                        | 13   | 106  | 0    | 180        | 193                      | 260  | 35   | 0    | 488        | 865        |
| 08:00 AM        | 27                       | 7    | 1    | 0    | 35         | 1                       | 14   | 0    | 0    | 15         | 15                        | 5    | 24   | 0    | 44         | 44                       | 65   | 6    | 0    | 115        | 209        |
| 08:15 AM        | 10                       | 7    | 2    | 0    | 19         | 1                       | 18   | 1    | 0    | 20         | 14                        | 3    | 29   | 0    | 46         | 38                       | 60   | 7    | 0    | 105        | 190        |
| 08:30 AM        | 21                       | 6    | 1    | 0    | 28         | 0                       | 19   | 2    | 0    | 21         | 7                         | 5    | 32   | 0    | 44         | 46                       | 62   | 10   | 0    | 118        | 211        |
| 08:45 AM        | 30                       | 3    | 0    | 0    | 33         | 0                       | 27   | 1    | 0    | 28         | 6                         | 4    | 20   | 0    | 30         | 48                       | 61   | 16   | 0    | 125        | 216        |
| Total           | 88                       | 23   | 4    | 0    | 115        | 2                       | 78   | 4    | 0    | 84         | 42                        | 17   | 105  | 0    | 164        | 176                      | 248  | 39   | 0    | 463        | 826        |
| *** BREAK ***   |                          |      |      |      |            |                         |      |      |      |            |                           |      |      |      |            |                          |      |      |      |            |            |
| 04:00 PM        | 22                       | 5    | 0    | 0    | 27         | 0                       | 44   | 10   | 0    | 54         | 2                         | 16   | 34   | 0    | 52         | 27                       | 19   | 21   | 0    | 67         | 200        |
| 04:15 PM        | 26                       | 6    | 1    | 0    | 33         | 2                       | 57   | 8    | 0    | 67         | 3                         | 6    | 30   | 0    | 39         | 33                       | 10   | 26   | 0    | 69         | 208        |
| 04:30 PM        | 25                       | 5    | 0    | 0    | 30         | 2                       | 56   | 5    | 0    | 63         | 4                         | 11   | 50   | 0    | 65         | 31                       | 10   | 19   | 0    | 60         | 218        |
| 04:45 PM        | 32                       | 7    | 0    | 0    | 39         | 1                       | 67   | 13   | 0    | 81         | 4                         | 12   | 57   | 0    | 73         | 35                       | 15   | 28   | 0    | 78         | 271        |
| Total           | 105                      | 23   | 1    | 0    | 129        | 5                       | 224  | 36   | 0    | 265        | 13                        | 45   | 171  | 0    | 229        | 126                      | 54   | 94   | 0    | 274        | 897        |
| 05:00 PM        | 29                       | 9    | 0    | 0    | 38         | 3                       | 92   | 20   | 0    | 115        | 3                         | 16   | 82   | 0    | 101        | 53                       | 4    | 21   | 0    | 78         | 332        |
| 05:15 PM        | 26                       | 3    | 0    | 0    | 29         | 2                       | 46   | 6    | 0    | 54         | 2                         | 14   | 62   | 0    | 78         | 36                       | 1    | 33   | 0    | 70         | 231        |
| 05:30 PM        | 23                       | 4    | 1    | 0    | 28         | 2                       | 31   | 1    | 0    | 34         | 0                         | 10   | 50   | 0    | 60         | 42                       | 4    | 32   | 0    | 78         | 200        |
| 05:45 PM        | 17                       | 5    | 0    | 0    | 22         | 1                       | 26   | 3    | 0    | 30         | 2                         | 11   | 49   | 0    | 62         | 16                       | 5    | 19   | 0    | 40         | 154        |
| Total           | 95                       | 21   | 1    | 0    | 117        | 8                       | 195  | 30   | 0    | 233        | 7                         | 51   | 243  | 0    | 301        | 147                      | 14   | 105  | 0    | 266        | 917        |
| Grand Total     | 414                      | 102  | 14   | 0    | 530        | 15                      | 523  | 72   | 0    | 610        | 123                       | 126  | 625  | 0    | 874        | 642                      | 576  | 273  | 0    | 1491       | 3505       |
| Apprch %        | 78.1                     | 19.2 | 2.6  | 0    |            | 2.5                     | 85.7 | 11.8 | 0    |            | 14.1                      | 14.4 | 71.5 | 0    |            | 43.1                     | 38.6 | 18.3 | 0    |            |            |
| Total %         | 11.8                     | 2.9  | 0.4  | 0    | 15.1       | 0.4                     | 14.9 | 2.1  | 0    | 17.4       | 3.5                       | 3.6  | 17.8 | 0    | 24.9       | 18.3                     | 16.4 | 7.8  | 0    | 42.5       |            |
| Passenger Veh   | 413                      | 99   | 14   | 0    | 526        | 15                      | 515  | 72   | 0    | 602        | 117                       | 121  | 616  | 0    | 854        | 621                      | 575  | 270  | 0    | 1466       | 3448       |
| % Passenger Veh | 99.8                     | 97.1 | 100  | 0    | 99.2       | 100                     | 98.5 | 100  | 0    | 98.7       | 95.1                      | 96   | 98.6 | 0    | 97.7       | 96.7                     | 99.8 | 98.9 | 0    | 98.3       | 98.4       |
| Trucks          | 1                        | 3    | 0    | 0    | 4          | 0                       | 8    | 0    | 0    | 8          | 6                         | 5    | 9    | 0    | 20         | 21                       | 1    | 3    | 0    | 25         | 57         |
| % Trucks        | 0.2                      | 2.9  | 0    | 0    | 0.8        | 0                       | 1.5  | 0    | 0    | 1.3        | 4.9                       | 4    | 1.4  | 0    | 2.3        | 3.3                      | 0.2  | 1.1  | 0    | 1.7        | 1.6        |

# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and McConville

Site Code : 00101010

Start Date : 9/6/2017

Page No : 2

|                                                            | McConville<br>From North |           |          |      |            | Nationwide<br>From East |           |          |      |            | Graves Mill<br>From South |          |           |      |            | Graves Mill<br>From West |            |           |      |            |            |
|------------------------------------------------------------|--------------------------|-----------|----------|------|------------|-------------------------|-----------|----------|------|------------|---------------------------|----------|-----------|------|------------|--------------------------|------------|-----------|------|------------|------------|
| Start Time                                                 | Right                    | Thru      | Left     | Peds | App. Total | Right                   | Thru      | Left     | Peds | App. Total | Right                     | Thru     | Left      | Peds | App. Total | Right                    | Thru       | Left      | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1 |                          |           |          |      |            |                         |           |          |      |            |                           |          |           |      |            |                          |            |           |      |            |            |
| Peak Hour for Entire Intersection Begins at 07:30 AM       |                          |           |          |      |            |                         |           |          |      |            |                           |          |           |      |            |                          |            |           |      |            |            |
| 07:30 AM                                                   | <b>49</b>                | <b>13</b> | <b>5</b> | 0    | <b>67</b>  | 0                       | 6         | <b>1</b> | 0    | 7          | 14                        | <b>6</b> | 36        | 0    | 56         | 51                       | 67         | 10        | 0    | 128        | 258        |
| 07:45 AM                                                   | 30                       | 8         | 2        | 0    | 40         | 0                       | <b>18</b> | 1        | 0    | 19         | <b>30</b>                 | 2        | <b>41</b> | 0    | <b>73</b>  | <b>73</b>                | <b>114</b> | <b>12</b> | 0    | <b>199</b> | <b>331</b> |
| 08:00 AM                                                   | 27                       | 7         | 1        | 0    | 35         | <b>1</b>                | 14        | 0        | 0    | 15         | 15                        | 5        | 24        | 0    | 44         | 44                       | 65         | 6         | 0    | 115        | 209        |
| 08:15 AM                                                   | 10                       | 7         | 2        | 0    | 19         | 1                       | 18        | 1        | 0    | <b>20</b>  | 14                        | 3        | 29        | 0    | 46         | 38                       | 60         | 7         | 0    | 105        | 190        |
| Total Volume                                               | 116                      | 35        | 10       | 0    | 161        | 2                       | 56        | 3        | 0    | 61         | 73                        | 16       | 130       | 0    | 219        | 206                      | 306        | 35        | 0    | 547        | 988        |
| % App. Total                                               | 72                       | 21.7      | 6.2      | 0    |            | 3.3                     | 91.8      | 4.9      | 0    |            | 33.3                      | 7.3      | 59.4      | 0    |            | 37.7                     | 55.9       | 6.4       | 0    |            |            |
| PHF                                                        | .592                     | .673      | .500     | .000 | .601       | .500                    | .778      | .750     | .000 | .763       | .608                      | .667     | .793      | .000 | .750       | .705                     | .671       | .729      | .000 | .687       | .746       |
| Passenger Veh                                              | 116                      | 33        | 10       | 0    | 159        | 2                       | 52        | 3        | 0    | 57         | 70                        | 16       | 126       | 0    | 212        | 198                      | 306        | 35        | 0    | 539        | 967        |
| % Passenger Veh                                            | 100                      | 94.3      | 100      | 0    | 98.8       | 100                     | 92.9      | 100      | 0    | 93.4       | 95.9                      | 100      | 96.9      | 0    | 96.8       | 96.1                     | 100        | 100       | 0    | 98.5       | 97.9       |
| Trucks                                                     | 0                        | 2         | 0        | 0    | 2          | 0                       | 4         | 0        | 0    | 4          | 3                         | 0        | 4         | 0    | 7          | 8                        | 0          | 0         | 0    | 8          | 21         |
| % Trucks                                                   | 0                        | 5.7       | 0        | 0    | 1.2        | 0                       | 7.1       | 0        | 0    | 6.6        | 4.1                       | 0        | 3.1       | 0    | 3.2        | 3.9                      | 0          | 0         | 0    | 1.5        | 2.1        |

# Data Collection Group

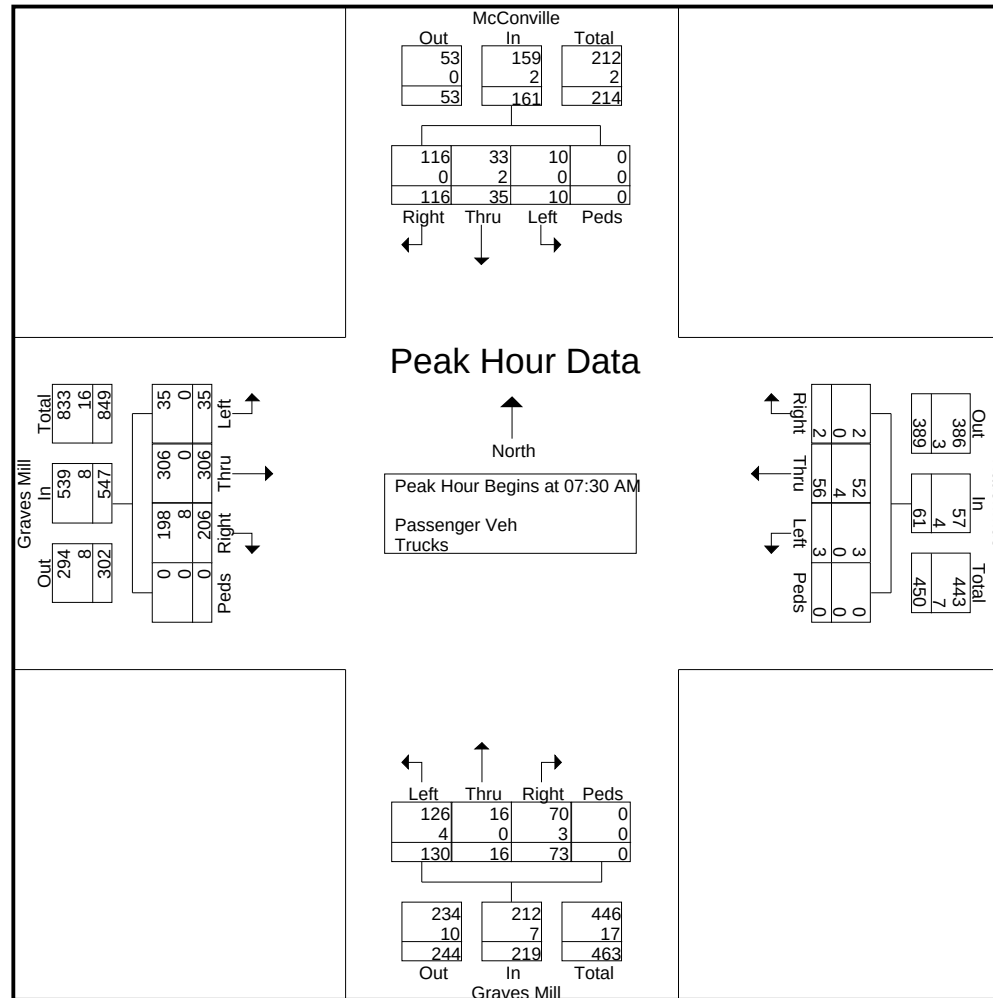
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and McConville

Site Code : 00101010

Start Date : 9/6/2017

Page No : 3





# Data Collection Group

## LSmith@DataCollectionGroup.net

File Name : Graves Mill and McConville

Site Code : 00101010

Start Date : 9/6/2017

Page No : 4

|                                                            | McConville<br>From North |      |      |      |            | Nationwide<br>From East |      |      |      |            | Graves Mill<br>From South |      |      |      |            | Graves Mill<br>From West |      |      |      |            |            |
|------------------------------------------------------------|--------------------------|------|------|------|------------|-------------------------|------|------|------|------------|---------------------------|------|------|------|------------|--------------------------|------|------|------|------------|------------|
| Start Time                                                 | Right                    | Thru | Left | Peds | App. Total | Right                   | Thru | Left | Peds | App. Total | Right                     | Thru | Left | Peds | App. Total | Right                    | Thru | Left | Peds | App. Total | Int. Total |
| Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1 |                          |      |      |      |            |                         |      |      |      |            |                           |      |      |      |            |                          |      |      |      |            |            |
| Peak Hour for Entire Intersection Begins at 04:30 PM       |                          |      |      |      |            |                         |      |      |      |            |                           |      |      |      |            |                          |      |      |      |            |            |
| 04:30 PM                                                   | 25                       | 5    | 0    | 0    | 30         | 2                       | 56   | 5    | 0    | 63         | 4                         | 11   | 50   | 0    | 65         | 31                       | 10   | 19   | 0    | 60         | 218        |
| 04:45 PM                                                   | 32                       | 7    | 0    | 0    | 39         | 1                       | 67   | 13   | 0    | 81         | 4                         | 12   | 57   | 0    | 73         | 35                       | 15   | 28   | 0    | 78         | 271        |
| 05:00 PM                                                   | 29                       | 9    | 0    | 0    | 38         | 3                       | 92   | 20   | 0    | 115        | 3                         | 16   | 82   | 0    | 101        | 53                       | 4    | 21   | 0    | 78         | 332        |
| 05:15 PM                                                   | 26                       | 3    | 0    | 0    | 29         | 2                       | 46   | 6    | 0    | 54         | 2                         | 14   | 62   | 0    | 78         | 36                       | 1    | 33   | 0    | 70         | 231        |
| Total Volume                                               | 112                      | 24   | 0    | 0    | 136        | 8                       | 261  | 44   | 0    | 313        | 13                        | 53   | 251  | 0    | 317        | 155                      | 30   | 101  | 0    | 286        | 1052       |
| % App. Total                                               | 82.4                     | 17.6 | 0    | 0    |            | 2.6                     | 83.4 | 14.1 | 0    |            | 4.1                       | 16.7 | 79.2 | 0    |            | 54.2                     | 10.5 | 35.3 | 0    |            |            |
| PHF                                                        | .875                     | .667 | .000 | .000 | .872       | .667                    | .709 | .550 | .000 | .680       | .813                      | .828 | .765 | .000 | .785       | .731                     | .500 | .765 | .000 | .917       | .792       |
| Passenger Veh                                              | 112                      | 24   | 0    | 0    | 136        | 8                       | 260  | 44   | 0    | 312        | 12                        | 53   | 250  | 0    | 315        | 151                      | 30   | 101  | 0    | 282        | 1045       |
| % Passenger Veh                                            | 100                      | 100  | 0    | 0    | 100        | 100                     | 99.6 | 100  | 0    | 99.7       | 92.3                      | 100  | 99.6 | 0    | 99.4       | 97.4                     | 100  | 100  | 0    | 98.6       | 99.3       |
| Trucks                                                     | 0                        | 0    | 0    | 0    | 0          | 0                       | 1    | 0    | 0    | 1          | 1                         | 0    | 1    | 0    | 2          | 4                        | 0    | 0    | 0    | 4          | 7          |
| % Trucks                                                   | 0                        | 0    | 0    | 0    | 0          | 0                       | 0.4  | 0    | 0    | 0.3        | 7.7                       | 0    | 0.4  | 0    | 0.6        | 2.6                      | 0    | 0    | 0    | 1.4        | 0.7        |

# Data Collection Group

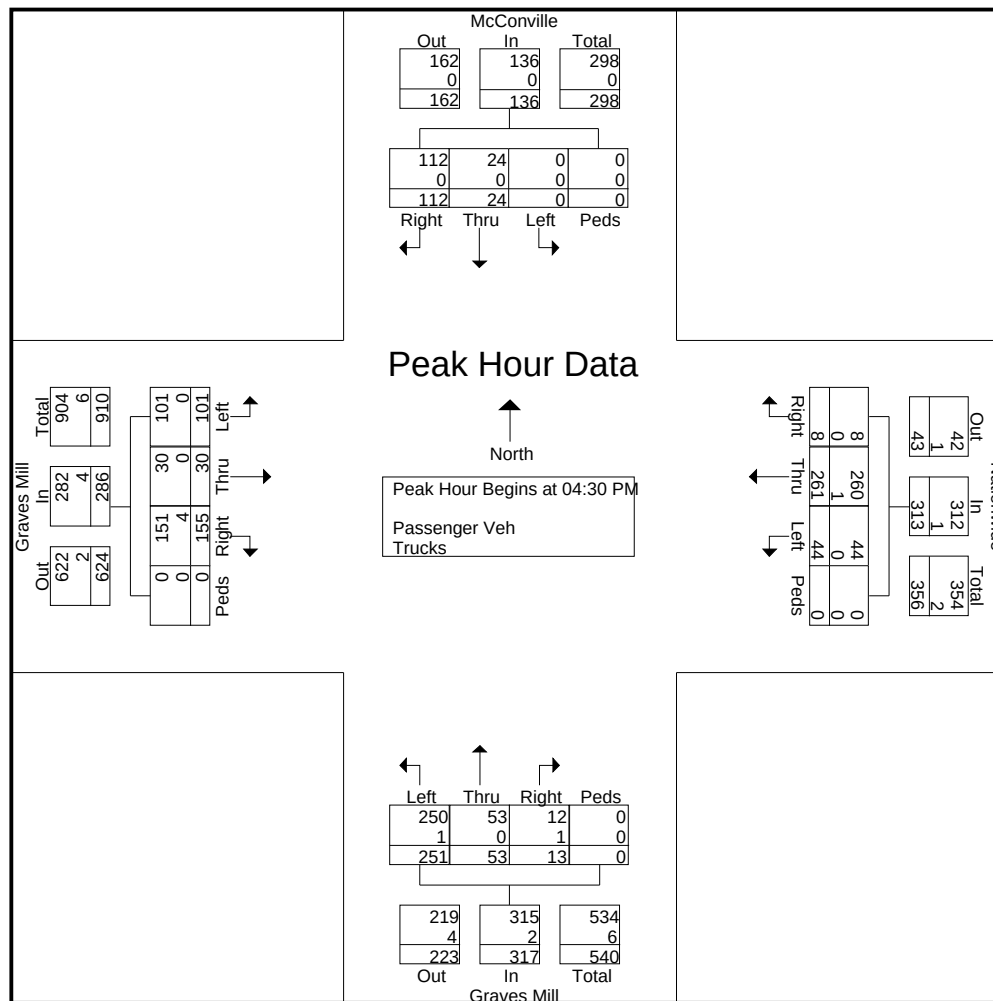
## LSmith@DataCollectionGroup.net

File Name : Graves Mill and McConville

Site Code : 00101010

Start Date : 9/6/2017

Page No : 5



# Appendix D

## Traffic Forecasting Memorandum



## MEMORANDUM

TO: W. SCOTT SMITH

FROM: DREW DRAPER, PTP  
BILL WUENSCH, P.E., PTOEORGANIZATION: VIRGINIA'S REGION 2000 LOCAL  
GOVERNMENT COUNCIL

DATE: OCTOBER 6, 2017

PHONE NUMBER:

SENDER'S REFERENCE NUMBER:

RE: GRAVES MILL ROAD CORRIDOR STUDY –  
TRAFFIC FORECASTING METHODOLOGY

YOUR REFERENCE NUMBER:

☐ URGENT   ☐ FOR YOUR USE   ☐ PLEASE COMMENT   ☐ PLEASE REPLY   ☐ PLEASE RECYCLE

The purpose of this memorandum is to summarize the method used to develop traffic projections for the Graves Mill Road Corridor Study in Lynchburg, Virginia. Multiple sources have been reviewed to determine an appropriate growth rate for a 23-year time horizon (2017 to 2040) including:

- Existing traffic demand
- Historical traffic demand
- Land use context (transportation analysis zones)
- Statewide Planning System
- Travel demand projections
- Planned development

The traffic projections methodology will be applied to existing traffic counts to develop traffic volumes for use in the analysis of future conditions for the study corridor. A map of the study area has been provided as an **Attachment**.

## Existing (2017) Traffic Demand

A traffic operational assessment is currently being completed for existing conditions and, to date, has identified pockets of congestion that experience high delays for typical weekdays. Due to heavy commuter traffic during the weekday AM and PM peak hours, the heaviest congestion during peak conditions along the corridor is experienced between Old Graves Mill Road and the ramp intersections. Additionally, the westbound approach to Gristmill Road experiences a lot of queuing due to heavy left turn demand and no dedicated turn lane. These results were confirmed with field observations.

As the economy improves and local and regional growth continues to increase, traffic demand will likely grow with it. This growth will exacerbate existing operational and safety issues. Traffic intersection turning movement counts collected during the weekday AM and PM peak hour are included as an **Attachment**.

## Historical Traffic Demand

The Virginia Department of Transportation (VDOT) maintains a statewide traffic count database that is updated on an annual basis. Recent average daily traffic (ADT) counts indicate Graves Mill Road west of the interchange serves approximately 22,000 to 27,000 vehicles per day (vpd) in the study area. However, it's important to recognize traffic demand has fluctuated over the last decade, perhaps due to the recent recession. **Table 1** illustrates the trends and annual changes in ADTs on Graves Mill Road over the last decade.

**Table 1: Graves Mill Road Traffic Trends**

| Location                                     | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | Average Growth Rate |
|----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------------|
| Between Expressway and Old Graves Mill Road  | 25,000 | 26,000 | 25,000 | 25,000 | 24,000 | 24,000 | 25,000 | 25,000 | 26,000 | 27,000 |                     |
|                                              |        | 4.0%   | -3.8%  | 0.0%   | -4.0%  | 0.0%   | 4.2%   | 0.0%   | 4.0%   | 3.8%   | 0.91%               |
| Between Old Graves Mill Road and City Limits | 19,000 | 20,000 | 19,000 | 19,000 | 19,000 | 19,000 | 20,000 | 20,000 | 21,000 | 22,000 |                     |
|                                              |        | 5.3%   | -5.0%  | 0.0%   | 0.0%   | 0.0%   | 5.3%   | 0.0%   | 5.0%   | 4.8%   | 1.70%               |
| Combined Locations                           | 44,000 | 46,000 | 44,000 | 44,000 | 43,000 | 43,000 | 45,000 | 45,000 | 47,000 | 49,000 |                     |
|                                              |        | 4.5%   | -4.3%  | 0.0%   | -2.3%  | 0.0%   | 4.7%   | 0.0%   | 4.4%   | 4.3%   | 1.25%               |

Source: VDOT's Count Program, between City Limits and the Expressway.

Considering the economic downturn, the historical trend indicates rather aggressive annual growth. In fact, positive annual changes range from 4% to 5%. When each location is combined, the annual growth rate (linear) equates to 1.25%.

## Land Use Context

The abutting land use context is another source to consider when determining an appropriate traffic growth rate. Changes in land use will ultimately impact traffic demand. The adjacent land use along the corridor is fairly undeveloped, but anchored on both ends by extensive commercial, retail and office uses. There are also some industrial and warehouse uses along the south side of the corridor.

Transportation analysis zones (TAZs) are a component of the regional travel demand model. The TAZs provide important land use information on population rates, number of households, and employment statistics for existing (2010), and future (2040). **Table 2** summarizes the six (6) primary TAZs that are adjacent to the corridor.

**Table 2: TAZ Summary**

| Location                       | Population   |              | Households   |              | Employment   |              | Population   | Households   | Employment   |
|--------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                                | 2010         | 2040         | 2010         | 2040         | 2010         | 2040         | 2040 Rate    | 2040 Rate    | 2040 Rate    |
| E/O the Expressway             | 695          | 695          | 323          | 323          | 1,200        | 1,700        | 0.00%        | 0.00%        | 1.39%        |
| S/O Old Graves and Mcconville  | 87           | 82           | 48           | 48           | 215          | 415          | -0.19%       | 0.00%        | 3.10%        |
| N/O Expressway and City Limits | 1,551        | 1,669        | 866          | 932          | 1,101        | 1,301        | 0.25%        | 0.25%        | 0.61%        |
| S/O Old Graves and City Limits | 363          | 775          | 168          | 359          | 1,875        | 2,025        | 3.78%        | 3.79%        | 0.27%        |
| N/O City Limits and 221        | 254          | 245          | 131          | 131          | 367          | 1,167        | -0.12%       | 0.00%        | 7.27%        |
| S/O City Limits and 221        | 177          | 177          | 113          | 113          | 755          | 955          | 0.00%        | 0.00%        | 0.88%        |
| <b>Totals</b>                  | <b>3,127</b> | <b>3,643</b> | <b>1,649</b> | <b>1,906</b> | <b>5,513</b> | <b>7,563</b> | <b>0.55%</b> | <b>0.52%</b> | <b>1.24%</b> |

Source: Regional Travel Demand Model

Based on this TAZ data, average growth rates for total population, households, and employment will range from approximately 0.5% annually to 1.24% annually. To note, these figures do not appear to reflect recent planned developments along the corridor. Furthermore, this data is localized and does not consider regional data.

## VDOT Statewide Planning System

VDOT's resources for statewide planning include a database of projected traffic volumes for key routes throughout the state. This database, referred to as the Statewide Planning System (SPS), provides guidance to planners relative to using a consistent system for traffic forecasting. The SPS data is generally derived through inspection of historical growth rates, and in areas that utilize a regional travel demand model, the SPS data considers the model output which corresponds to forecasted growth within the model area. Data from SPS for the Graves Mill Road corridor has been summarized in **Table 3**.

**Table 3: SPS Summary**

| Location                 | ADT           |                |                | 2035 Rate    | 2040 Rate    |
|--------------------------|---------------|----------------|----------------|--------------|--------------|
|                          | 2014          | 2035           | 2045           |              |              |
| McConville to Expressway | 8,938         | 16,418         | 19,070         | 3.99%        | 3.66%        |
| Expressway to Old Graves | 25,218        | 29,263         | 31,189         | 0.76%        | 0.76%        |
| Old Graves to Gristmill  | 25,218        | 41,579         | 48,819         | 3.09%        | 3.02%        |
| Gristmill to 221         | 19,976        | 25,500         | 28,130         | 1.32%        | 1.32%        |
| <b>Totals</b>            | <b>79,350</b> | <b>112,760</b> | <b>127,208</b> | <b>2.00%</b> | <b>1.95%</b> |

*Source:* VDOT SPS Data

Data on projected population and employment is subsequently converted to vehicle trips and included in the transportation network. The 2014 traffic counts on Graves Mill Road are estimated to increase by nearly 2.0% per year by 2040.

## Travel Demand Model Projections

The Central Virginia MPO maintains a regional travel demand model (TDM). A TDM is an analytical tool to support policy decision making and utilizes a traditional four-step trip-based model process consisting of trip generation, trip distribution, mode choice, and trip assignment. The model has a base year of 2007, a 2035 mid-year, and a planning horizon year of 2040. Growth rates are based on interpolation between the base year and 2040. Linear growth rates by segment along Graves Mill Road are summarized in **Table 4**.

**Table 4: TDM Summary**

| Location                           | ADT            |                | 2040 Rate    |
|------------------------------------|----------------|----------------|--------------|
|                                    | 2007           | 2040           |              |
| McConville to Expressway           | 4,315          | 11,095         | 4.76%        |
| Expressway to Old Graves           | 31,418         | 32,628         | 0.12%        |
| Old Graves and Commercial Entrance | 18,264         | 28,417         | 1.68%        |
| Commercial Entrance and Millrace   | 19,372         |                | 1.41%        |
| Millrace and Gristmill             | 21,277         | 24,900         | 0.52%        |
| Gristmill and 221                  | 20,514         | 24,900         | 0.65%        |
| <b>Totals</b>                      | <b>115,160</b> | <b>150,357</b> | <b>0.93%</b> |

*Source:* Central Virginia MPO TDM (2040)

The projected annual growth rates along Graves Mill Road range from nearly flat growth (0.12%) to nearly 5%. When averaged by all 2007 and 2040 ADTs, the annual rate is anticipated to be approximately 1% for the corridor.



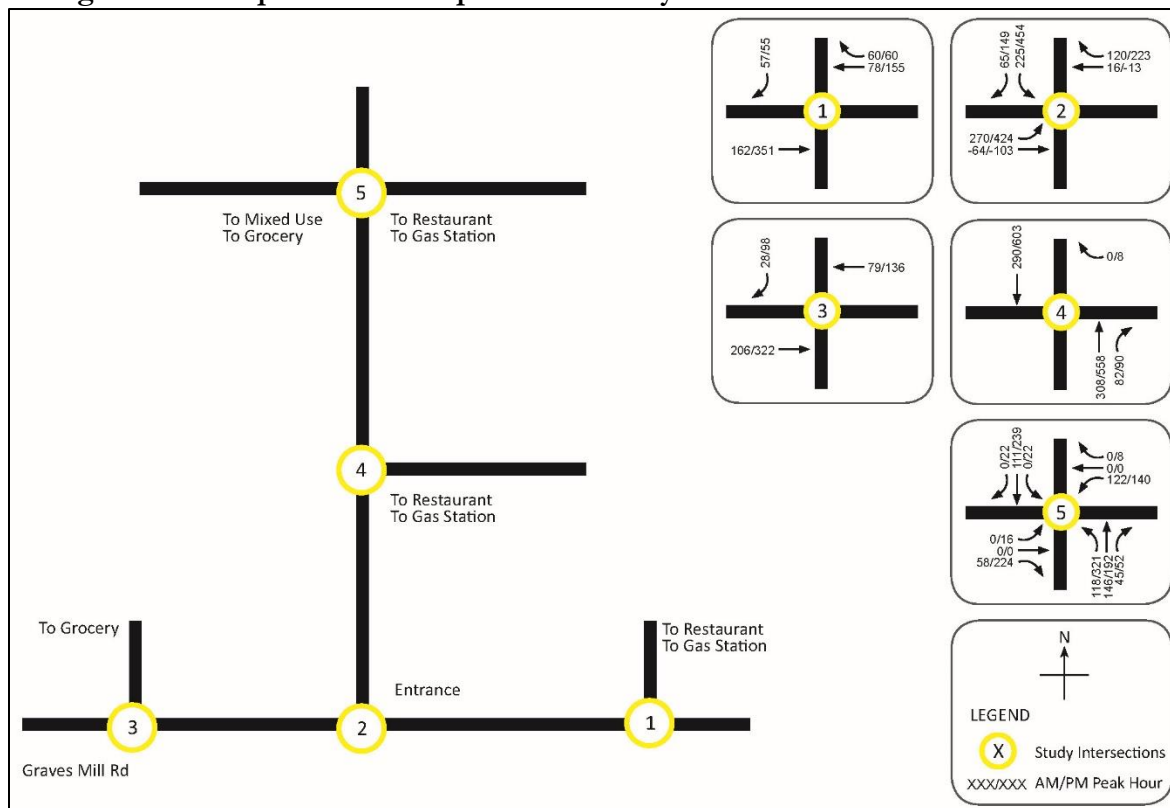
## Planned Development

Planned and approved developments adjacent to, or near the corridor should be considered when developing future traffic projects. At times, these developments are not accounted for in regional modeling efforts (i.e. TDM, SPS, TAZ); therefore, may need to be considered independently. There are two (2) developments currently planned along or near the corridor:

**Rosedale Farms Development** – The proposed development is located just west of the existing Home Depot side off of Graves Mill Road. The proposed site includes three entrance locations on Graves Mill Road – one right in only, one right out only and one full entrance. The site is planned to be constructed in three phases with an ultimate build-out year of 2024. The proposed land uses include a mix of residential, office, retail, grocery, service and restaurant land uses with the potential to generate over 15,000 new daily trips.<sup>1</sup>

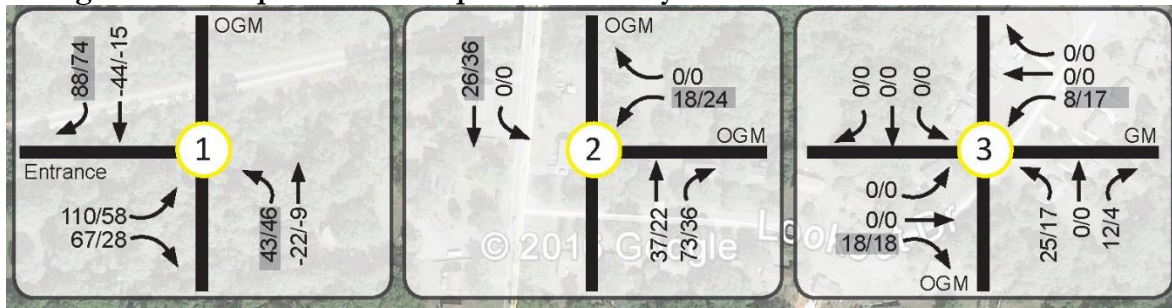
**Elements at Old Graves Mill Road** – The proposed development is located on Old Graves Mill Road, approximately 500' south of Graves Mill Road. The site will have one entrance to Old Graves Mill Road. The site is currently moving forward with construction and will include a mix of residential and office land uses with the potential to generate over 2,000 new daily trips. While many trips are expected to head south along Old Graves Mill Road, some will travel north to Graves Mill Road to access either Route 501 or Route 221.<sup>2</sup>

**Figure 1: Anticipated New Trips Generated by Rosedale Farms at Full Build-Out**



<sup>1</sup> Rosedale Farms Traffic Impact Analysis, November 2013 (revised January 2014).

<sup>2</sup> Elements at Old Graves Mill Road Traffic Impact Analysis, June 2016 (supplemental revision August 2016).

**Figure 2: Anticipated New Trips Generated by Rosedale Farms at Full Build-Out**

OGM: Old Graves Mill Road

GM: Graves Mill Road

## Recommendation

The purpose of this memorandum is to summarize the method used to develop traffic projections for the Graves Mill Road Corridor Study. Multiple sources were reviewed to determine an appropriate growth rate for a 23-year time horizon (2017 to 2040). Based on:

- 1) TAZ, SPS, and TDM linear growth rates that range from 0.5% to 2.0% annually (1.25% average rate),
- 2) new traffic anticipated from Rosedale Farms and Elements at Old Graves Mill Road, and
- 3) 1.25% annual historical growth likely to continue that is unrelated to planned developments,

A **1.25% annual background growth rate, plus the site generated traffic from the planned developments** is recommended through 2040. The 1.25% linear rate will be applied to all existing – or “background” – traffic counts collected in the study area that is unrelated to traffic generated specifically by developments proposed along Graves Mill Road. Then, site generated trips from each of the two (2) developments will be applied. To note, trips from Rosedale Farms will be distributed west through the study area based on existing travel patterns. With the application of a 1.25% rate, plus the addition of the site generated trips, the effective annual growth rate along the corridor will be approximately 2% in the morning peak, and 2.5% in the evening peak.

The following attachments are included:

**Attachment A: Study Area**

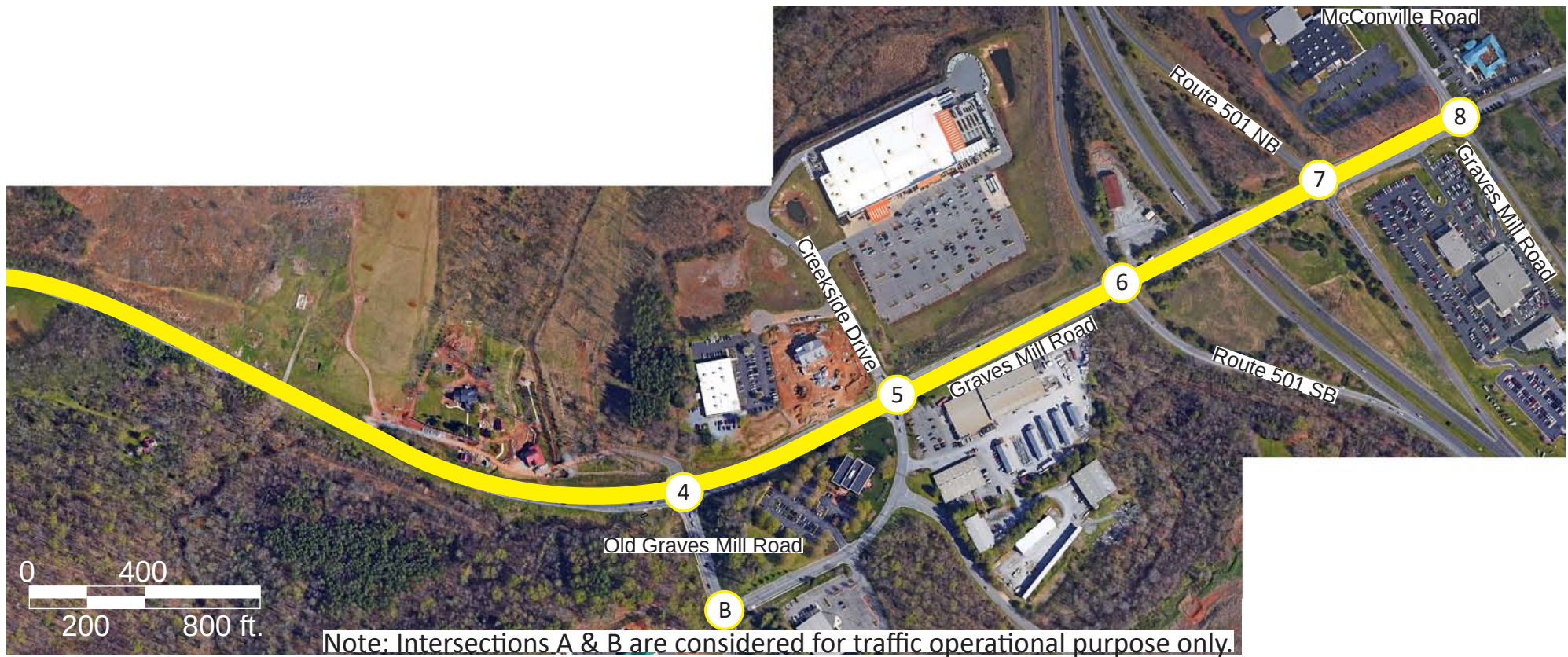
**Attachment B: Existing 2017 Traffic Volumes**

**Attachment C: Planned Development Site Generated Trips**

**Attachment D: Future 2040 Traffic Volumes (1.25% background rate, plus site generated trips)**

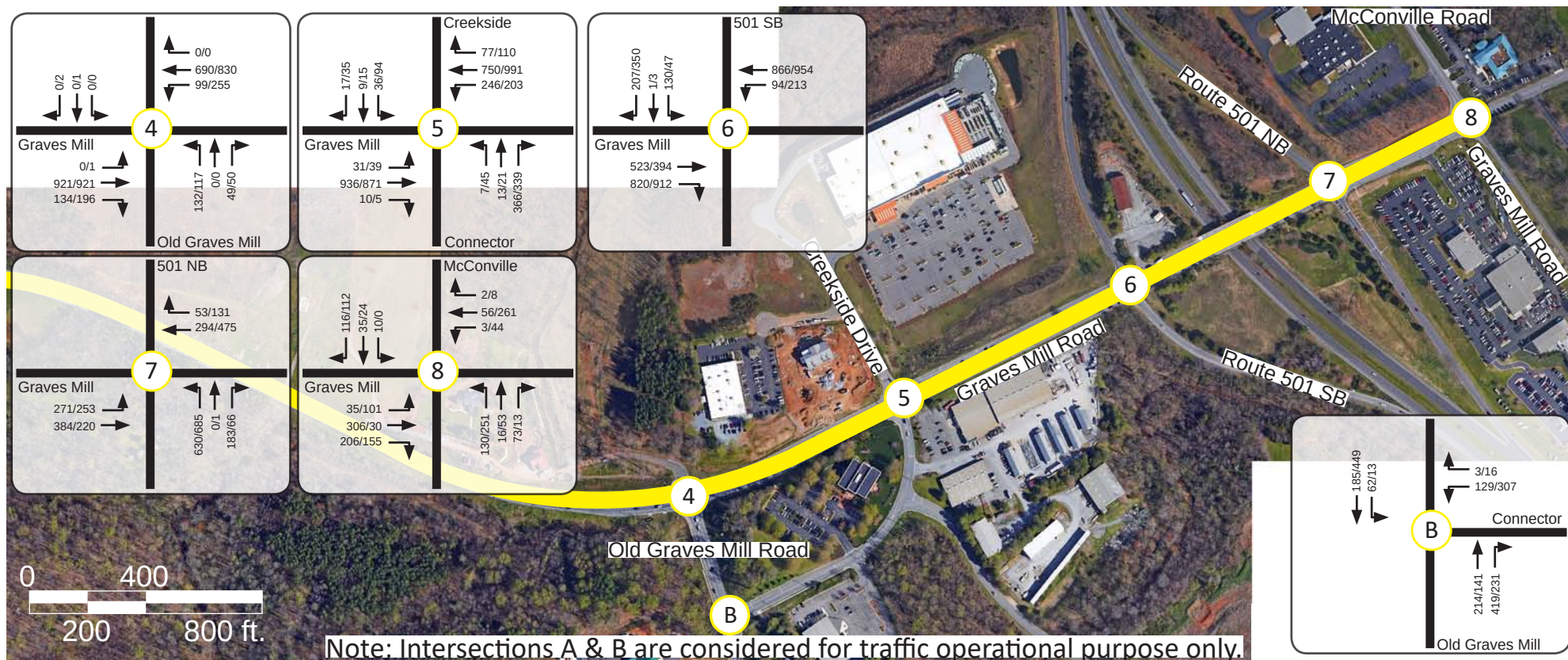
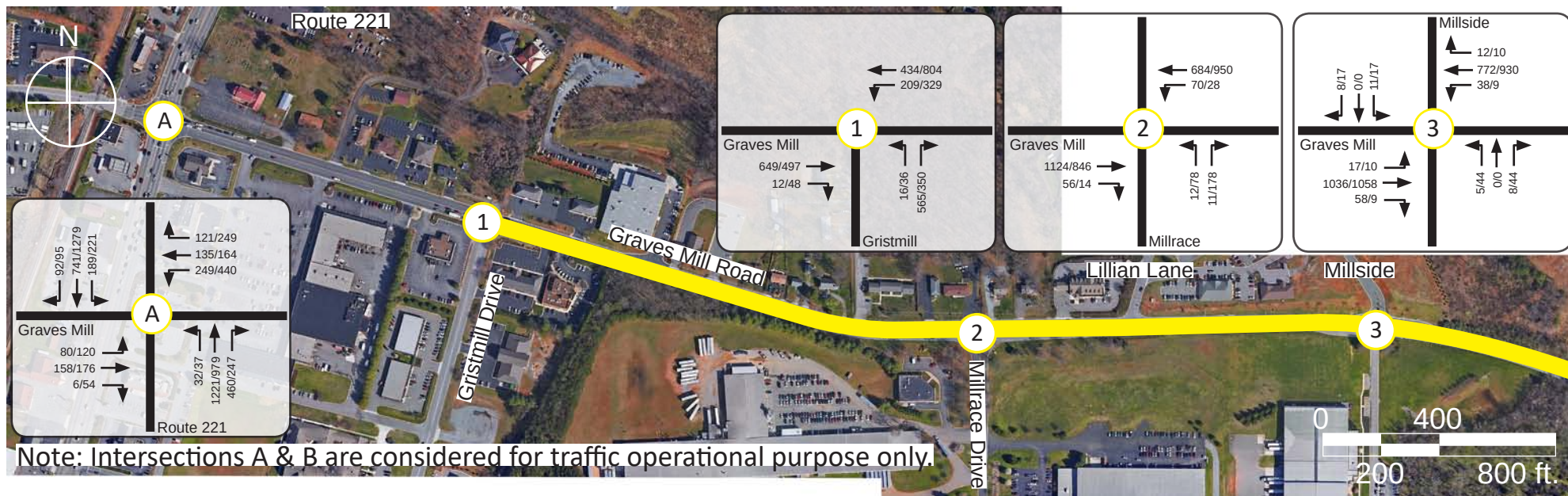


## Attachment A Study Area and Intersections



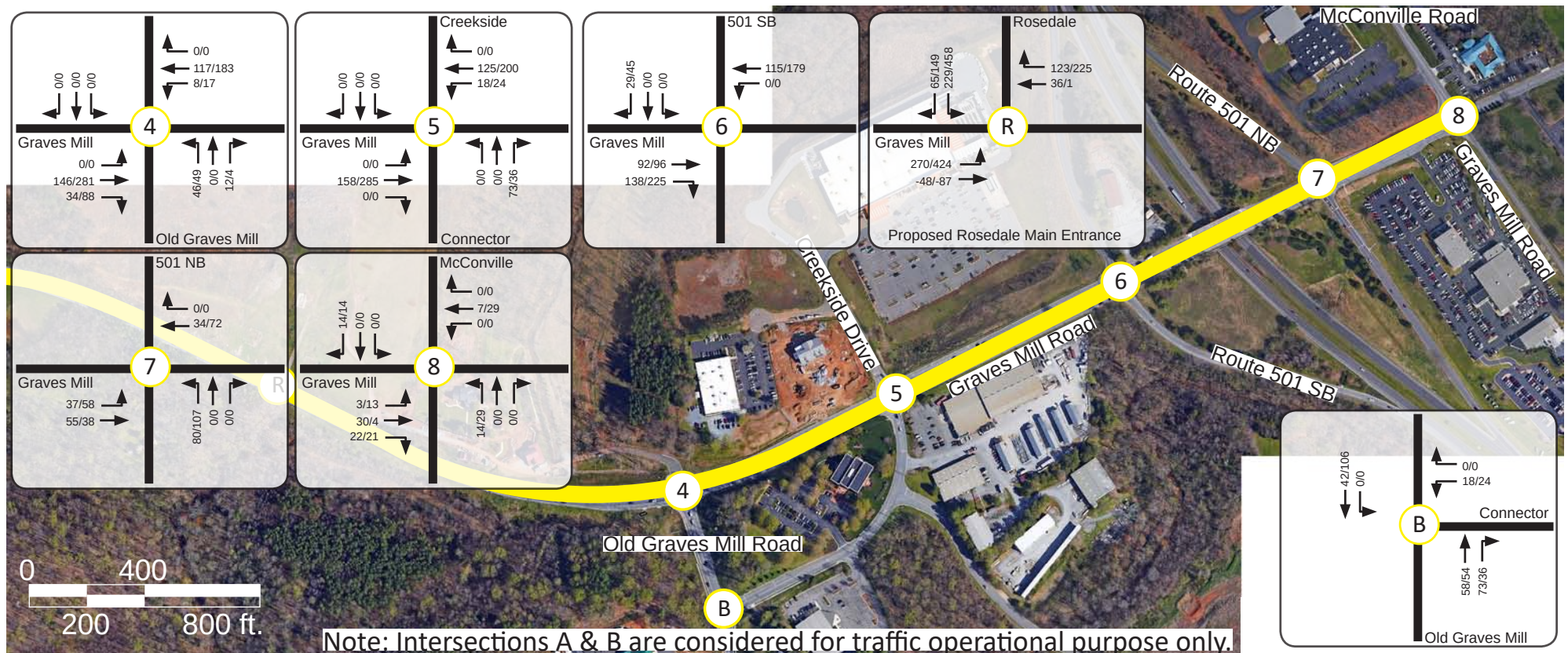
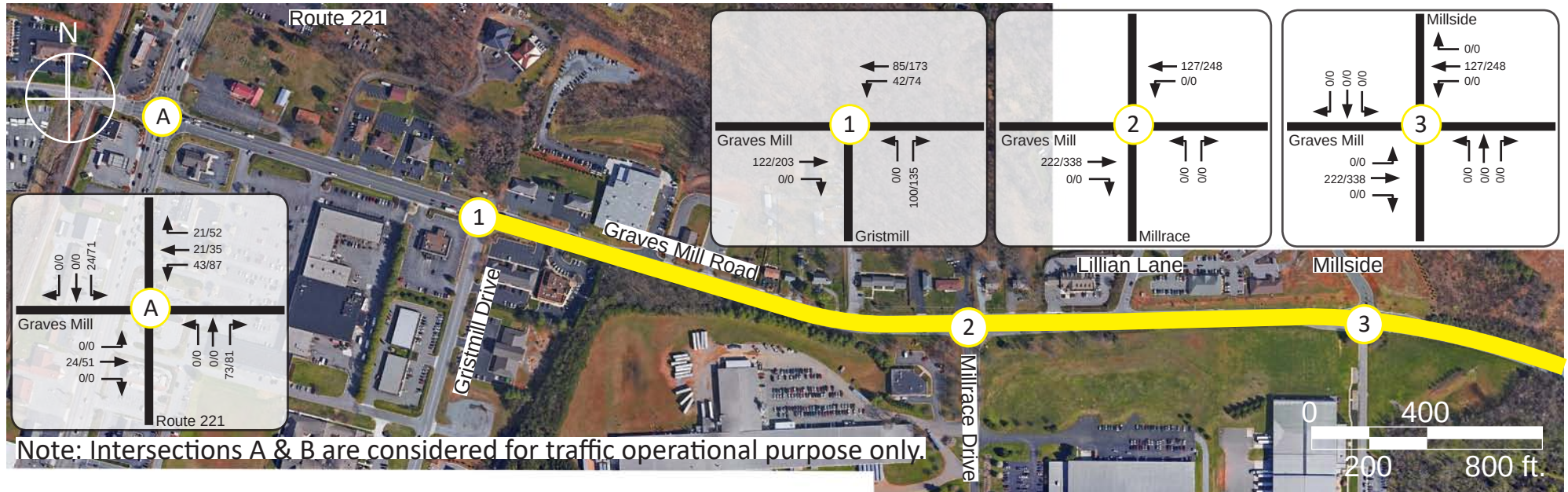


## Attachment B: Existing 2017 Traffic Volumes



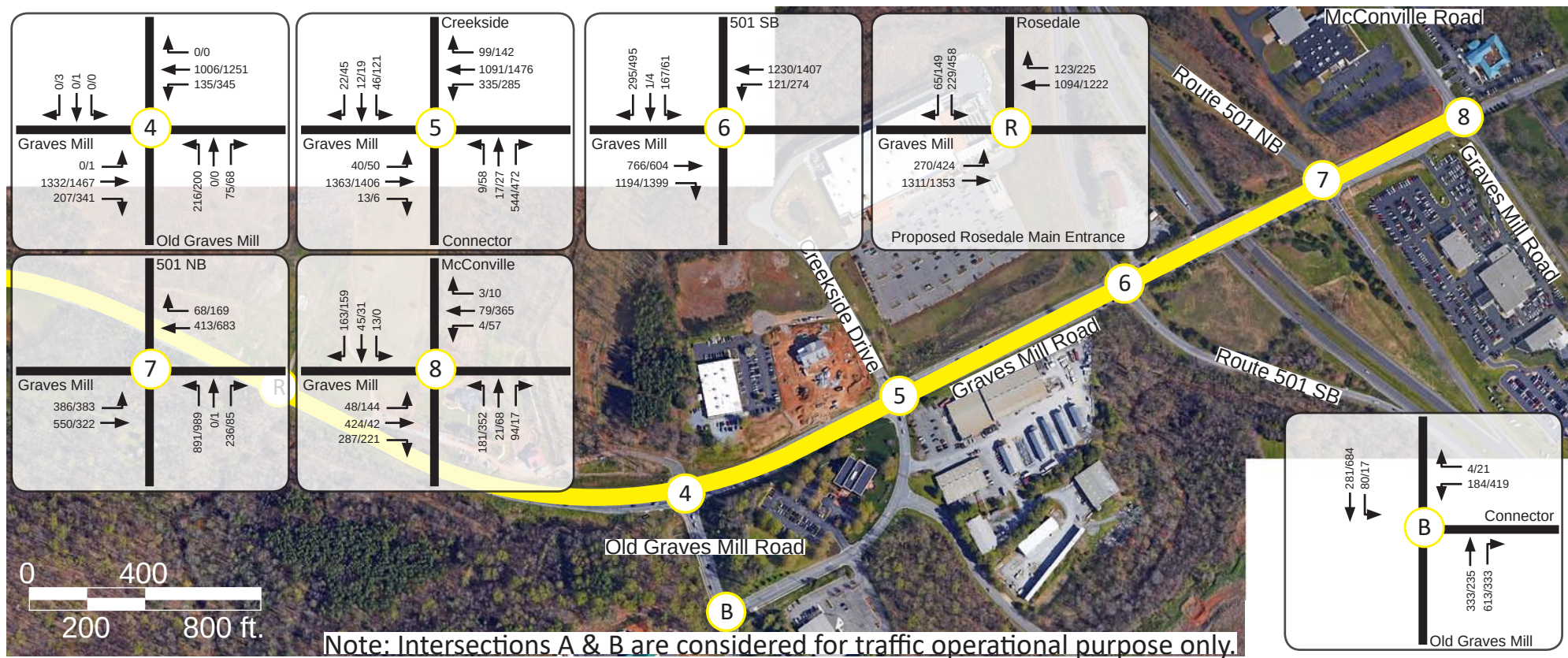
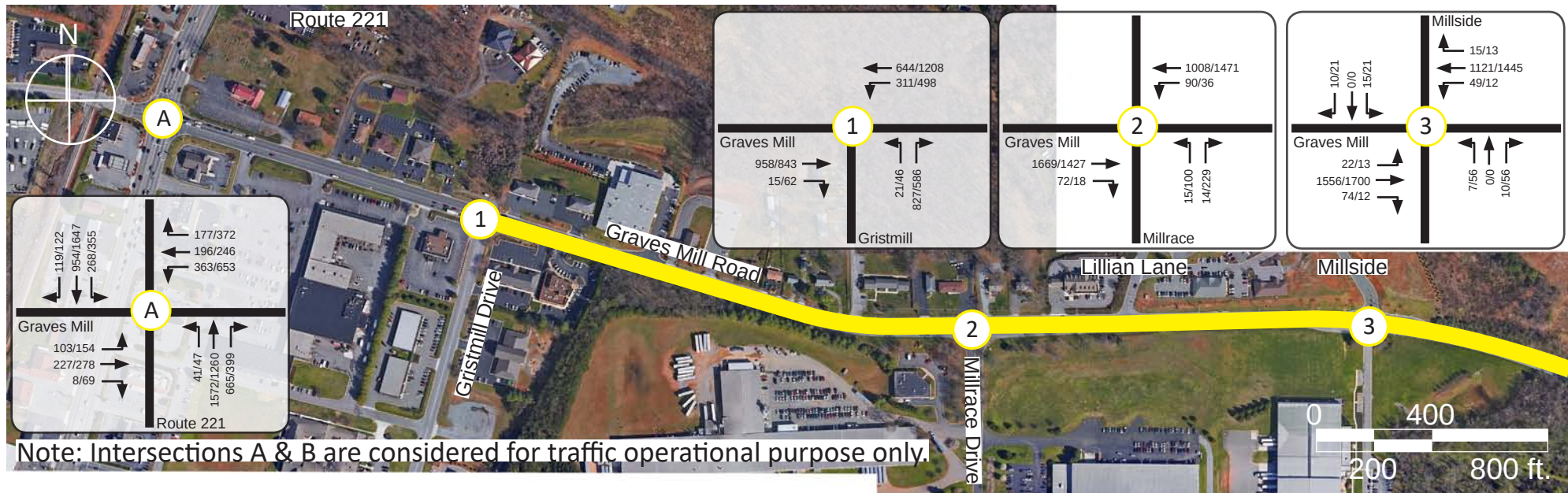


# Attachment C: Planned Development Site Generated Trips





# Attachment D: Future 2040 Traffic Volumes (1.25% background rate, plus site generated trips)



# Appendix E

## Public Meeting Summaries



## MEMORANDUM

TO: SCOTT SMITH

FROM: DREW DRAPER, PTP

BILL WUENSCH, P.E., PTOE

ORGANIZATION: VIRGINIA'S REGION 2000 LOCAL  
GOVERNMENT COUNCIL

DATE: JANUARY 4, 2018

PHONE NUMBER: 434-845-3491

SENDER'S REFERENCE NUMBER:

Re: MEETING SUMMARY – GRAVES MILL ROAD  
COMMUNITY MEETING #1

YOUR REFERENCE NUMBER:

☐ URGENT    ☒ FOR YOUR USE    ☐ PLEASE COMMENT    ☐ PLEASE REPLY    ☐ PLEASE RECYCLE

A public meeting for the Graves Mill Road Corridor Study was held on Tuesday, December 12, 2017 at the Lynchburg Humane Society in Lynchburg, Virginia. The meeting was organized as an open-house format and was open to the general public from 4:00 – 6:30 pm. Advertisement for the meeting included:

- Mail-outs to residents and businesses near the study area approximately two weeks in advance of the meeting
- Deployment of variable message signs on Graves Mill Road approximately one week in advance of the meeting
- Press release
- Advertisement via social media
- Advertisement via local news agencies
- Notice included on the project website ([www.gravesmillplan.com](http://www.gravesmillplan.com))

The goal of this meeting was for the public to 1) learn about the study, 2) review information about the corridor, and 3) share comments regarding concerns, opportunities, and improvement ideas. Attendees were encouraged to provide feedback and offer suggestions that would help to inform the project development process. Representatives from the Virginia Department of Transportation (VDOT), City of Lynchburg, Virginia's Region 2000 Local Government Council, and project consultants were available to explain materials, answer questions, and record feedback. Information boards were set up in the meeting space that presented the following subjects:

- Welcome and purpose of the meeting
- Information about the study
- Summary of existing and future traffic conditions
- Crash data (six years)
- Summary of multimodal conditions (sidewalks, transit stops, etc.)



- General information on innovative intersection ideas applicable to the corridor

In addition to the information boards, large table-top maps of the corridor were available for attendees to gather around and mark-up. Comment sheets were also made available for participants. The meeting was attended by approximately 50 people (that signed in), including business owners/representatives along the corridor. There were also several local news organizations that covered the meeting (WDBJ7, NewsAdvance, WSLs, and WLNI).

A consistent flow of attendees began right at 4:00 PM and continued through approximately 6:00 PM. Representatives were provided sufficient time to walk attendees through the study and answer questions, as needed. Several news organization interviews were provided by the public and agency representatives. Overall, attendees were very pleased City officials were attempting to stay in front of potential growth that could exceed 50% over the next 20 years. In addition to managing traffic congestion, attendees were also pleased attention was being paid to transit, pedestrian and bicycle accommodations along the corridor.



It was further suggested by multiple attendees the City (or other agencies) undergo a study along Old Graves Mill Road between Graves Mill Road and Timberlake Road.

### **Specific Public Comments**

The following public comments were **written on comment sheets** that were provided at the meeting, or **emailed via the project website** (specific identifying information has been removed, and at times, comments are paraphrased):

*I was not able to attend the meeting. One suggestion (and it might be a long shot) is to have Graves Mill Road 3 lanes each way. However, a more feasible suggestion would be signage. An issue with accidents in Lynchburg is the lack of signs. People from out of town that use Graves Mill to go to the expressway merge over at the very end and back end or swipe other cars. Every street that intersects with the expressway should have a sign like the one on Timberlake Rd. I have heard from transportation officials that "signs are expensive" but this is one of the key reasons for congestion from 3-6pm weekdays.*

*I have lived in this area since 1976. There used to be little traffic even though it was a cut thru. Now, I can hardly get out of my street. The traffic from Timberlake Road is awful. From McConville Rd to 221 there are too many lights & way too much traffic. Traffic isn't flowing, a light needs to be at Nationwide Dr., that "annex" is a nightmare, it's like crossing 3 lanes & you take your life in your hands using it. People block that light at Bella Rosa. Lots of times it*

*turns green but you can't go because of cars blocking it. People fly from 221 to just get to the exit for the expressway. There are lots of things that can be done to help traffic.*

*I was not able to attend the meeting, and I don't know if a stop light at Lillian Ln or Millside Center is part of the discussion, but there are currently a lot of senior citizens that are trying to access this area of Graves Mill with no safe and/or easy way to do it. I'm not sure if a turn lane in this stretch or a stop light is a good solution, but if there is a master plan being developed, I think something like this would be quite helpful.*

*Has any thought been given to a roundabout at the intersection of Graves Mill Rd. and McConville Rd.? With Lynchburg's consideration of roundabouts throughout the City, this seems to me to be one place that one would work well. The four-way stop is confusing at best and dangerous at worst, especially during times of heavy traffic.*

*Sync lights so the thru traffic doesn't have to stop at every light.*

*Plan a stop light for the Bella Rose community development.*

*Do not add sidewalks directly beside the road. Needs separation by 3' – 5' from road. The same goes for bike lanes.*

*Road milling contributes to uneven lanes and vehicles crashing.*

*Add lights so they are on both sides of the road.*

*Keep speed limit at 45 mph.*

*Access to highway is currently acceptable.*

*Roundabout absolutely needed at McConville Rd.*

*My concerns relate to Old Graves Mill Road. As the area has grown, there has been a tremendous increase in traffic on Old Graves Mill Road between Timberlake Road and Graves Mill Road. Old Graves Mill needs traffic control to better manage cars and commercial truck traffic. Sidewalks throughout the section should also be installed. Old Graves Mill Road is also too narrow and has not been updated since it was originally designed as a rural road.*

*I attended the recent public meeting at the Lynchburg Humane Society which presented the Graves Mill Road Plan. I was disappointed that the Plan did not include a study of Old Graves Mill Road between Timberlake Road and Graves Mill Road. As a homeowner off Old Graves Mill road, I have no choice but to travel this section of road daily and am increasingly concerned whether this section of road can safely handle traffic. Recent years have seen a marked increase in traffic along Old Graves Mill Road as more drivers use it as a short cut to and from the Graves Mill Road and Timberlake Road areas. Recent development of the Old Graves Mill Road and Graves Mill Road areas has also dramatically added to this traffic. The planned development of this corridor in the near future will surely further increase traffic on Old Graves Mill Road. As you know, the section of Old Graves Mill Road north of Timberlake Road still has a narrow section without shoulders or sidewalks that dates back to an earlier and rural age. In addition, there is considerable commercial truck traffic to and from the Tomahawk Industrial Park not to speak of the number of school buses that pick up children throughout this neighborhood. All this makes for periods of heavy, unregulated traffic that result in the neighbors having difficulty turning onto Old Graves Mill Road from side streets and driveways. Also, please note that the speed limit of 35 MPH is routinely and grossly exceeded. I personally have had cars pass me on Old Graves Mill Road while I am driving the speed limit! I hope that you, VDOT and Lynchburg engineers find my concern warrant further interest. Specifically, I hope that consideration will be given to regulating traffic flow with a*



*stoplight at the intersection of Tomahawk Industrial Park and Old Graves Mill Road. I believe that a traffic light at that intersection would greatly add to the safety along this stretch of road.*

The following public comments were **written on table top maps** that were provided at the meeting, or **on blank note boards** located between the informational boards. The comments are typically more specific and relate to intersection level improvements.

The memorandum ENDS after these comments. However, the following attachments are then included:

- Sign-in sheets
- Summary of news coverage

## Corridor-wide comments



## McConville Road to Gristmill Drive

- Finish & Connect Sidewalks  
→ along Old Graves Mill (OGM) as well
- Currently, no pedestrians (might walk if felt more protected from high speed traffic)
- More street lights at night
- Need a roundabout at OGM, McConville Rd, and Nationwide
- Eastbound: speed limit feels artificial
  - No posted speed limit signs other than the 35 mph and reduced speed ahead
- New expressway to connect 460 to 221
- Add lane along entire length (eastbound) dedicated to right turns



## Gristmill Drive & Graves Mill Road (T-Intersection)

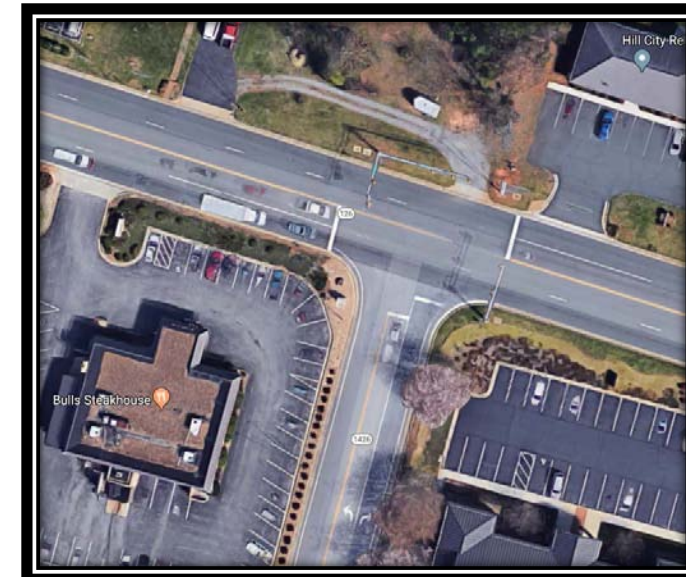
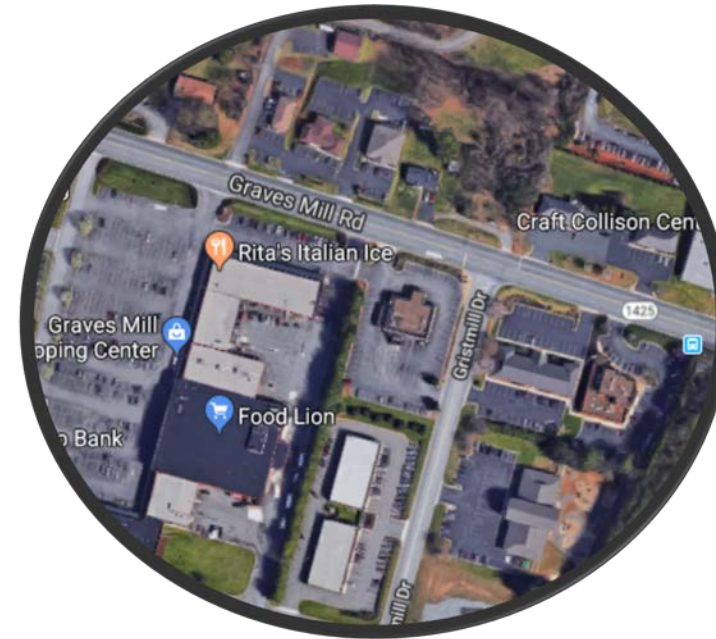
### Observed Conditions

- Water pools between intersections #1 & #2 (Millrace Drive) to the east

### Proposals

- Add center left turn lane (full length)
- Eliminate left turns entering/exiting Graves Mill Shopping Center parking lot
- Take away left turn on to 221 from Gristmill

### Intersection #1





## Intersection #2



## Millrace Drive & Graves Mill Road (T-Intersection)

### Observed Conditions

- Can't enter Graves Mill Rd from northside (State Farm Building) between 3-6pm
- High speeds

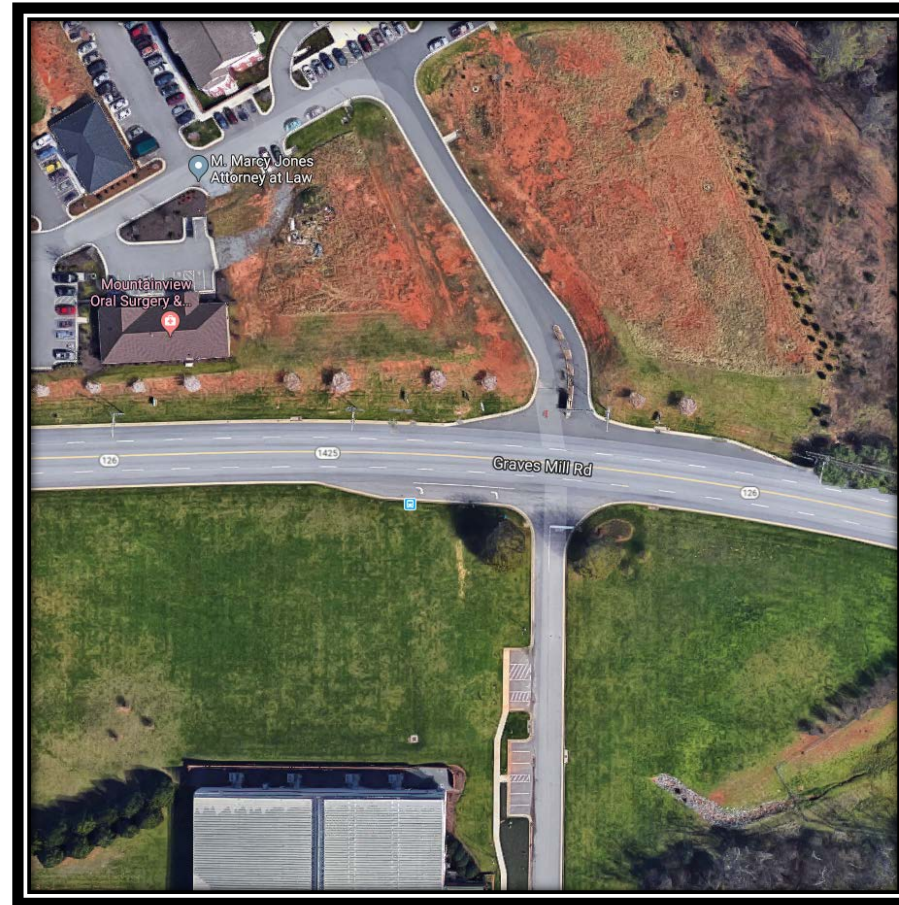


## Intersection #3

### Millside Drive & Graves Mill Road

### Observed Conditions

- Westbound right turn too abrupt
- Between #3 & I#4 → water pools
- Difficulty making a left across Graves Mill Road



## Intersection #4



## Old Graves Mill Road & Graves Mill Road

### Observed Conditions

- Danger: Westbound turning/veering left - cars have flipped
- From Old GM Rd., can't pull out onto GM Rd. during peak hours ('lacks gaps')
- Bumper to bumper towards Timberlake Rd. (southbound)
  - o Old GM Rd. shouldn't be a cut through

### Proposals

- Old Graves Mill Road → Need a Study!
- Add double left turn lanes Westbound
  - o Add permissive phase
- Open up the end of Tomahawk Dr.
- Change name of either Tomahawk Dr. or Tomahawk Industrial Park



## Creekside & Old Graves Mill Road

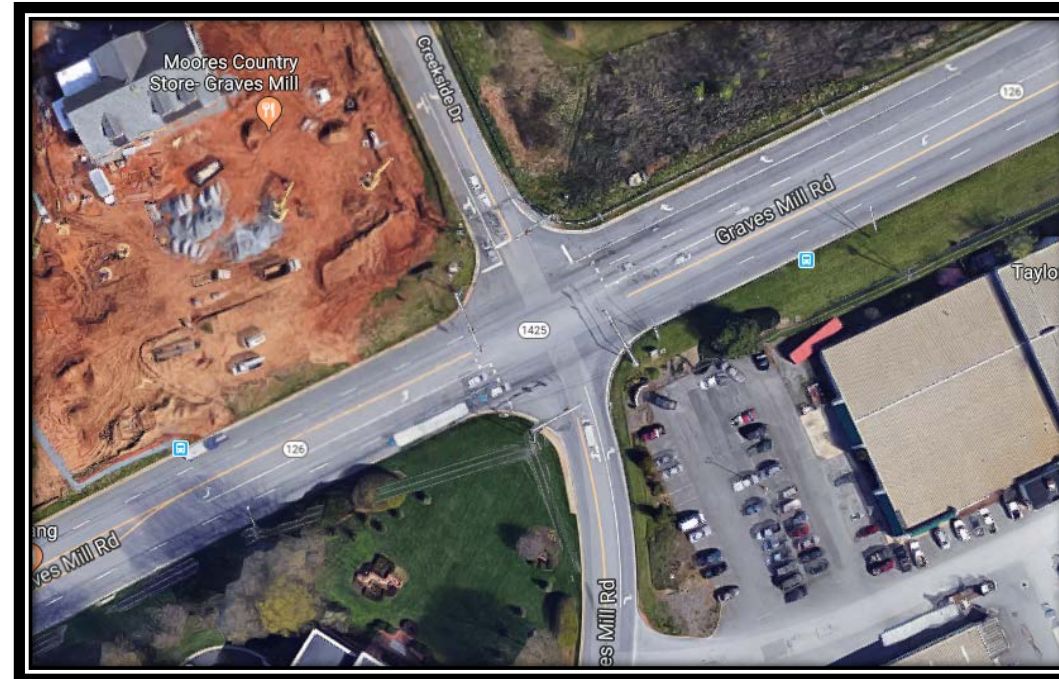
### Observed Conditions

- Not enough turn length on GM from interchange to OGM
- Gas station entrance at Creekside is challenging
- Heavy queuing

### Proposals

- The cut through from OGM to GM (that turns into Creekside Drive after GM) should be made one way
- GM/OGM – disconnect or right turn only
- Overpass for OGM to Creekside
- Creekside: extend around Rosedale to Millrace
- Extend Creekside north to 221 and Breezewood Drive (parallels 501)

## Intersection #5





## Intersection #6



## 501 Southbound & Graves Mill Road

### Observed Conditions

- Danger: LT/RT EB/WB conflicts → crashes → sight/distance issue
- Heavy queuing

### Proposals

- Add two right turn-only lanes eastbound onto Rt. 501 southbound
- Salt Facility needs to stay on this side of town
- Replace westbound left with a SB loop on the north side



## 501 Northbound & Graves Mill Road

### Intersection #7

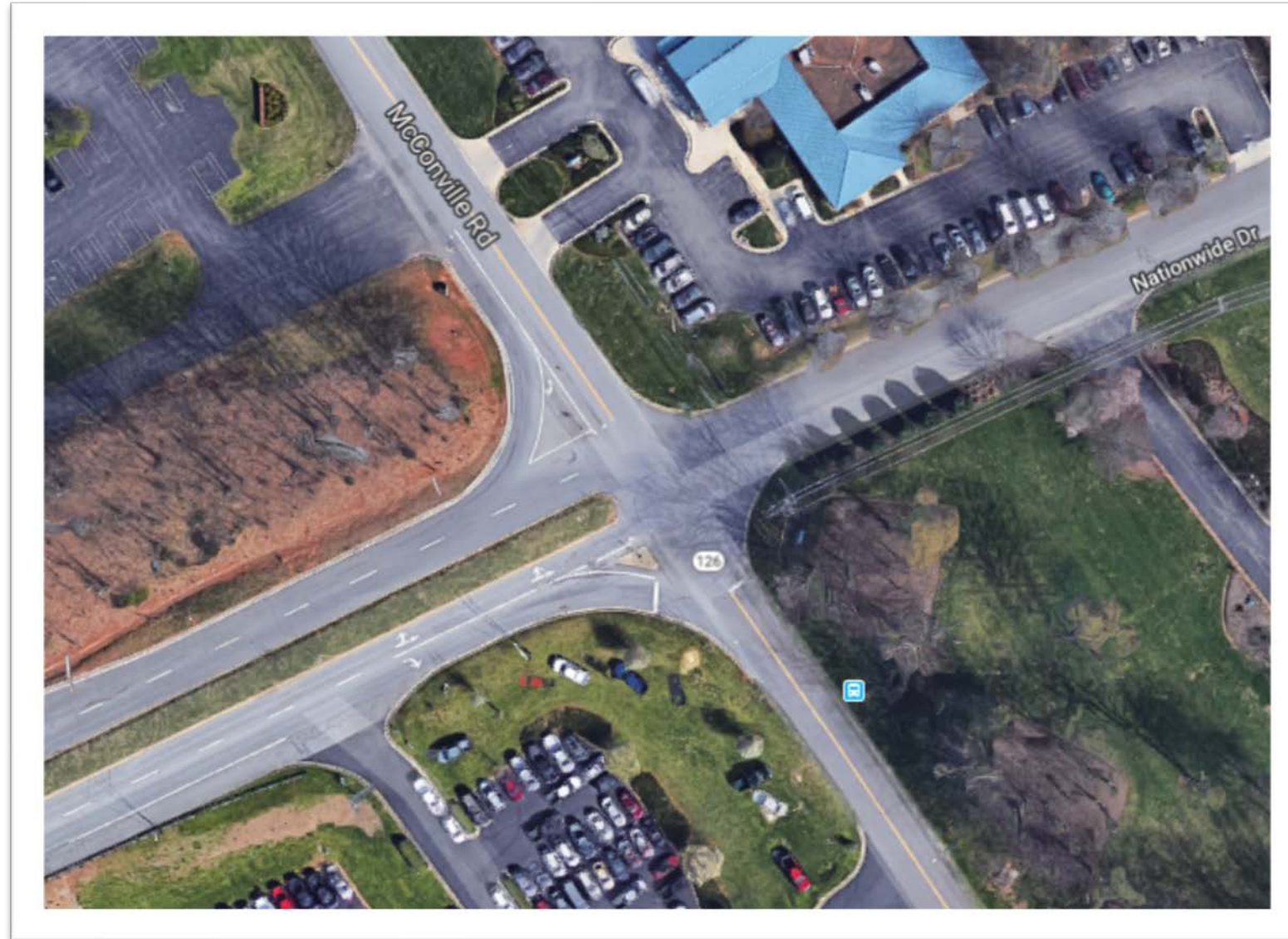
#### Observed Conditions

- While the southbound tends to be the problem, northbound queueing can be long
- Eastbound left queuing can spill back out of turn lane





## Intersection #8



## McConville Road & Graves Mill Road

### Observed Conditions

- Yield sign confusion
- 700 block is too narrow

### Proposals

- Consider a roundabout (multiple references)

# Graves Mill Road Corridor Study - Meeting #1 (December 12th, 2017)

| Name             | Representing      | Address                        | Phone #      | Email                      |
|------------------|-------------------|--------------------------------|--------------|----------------------------|
| Frank Patton     | _____             | 113 New Towne Rd               | 434-229-1984 | fpatt03@gmail.com          |
| Robert Wilson    | _____             | 324 Beverly Hills Cir.         | 434-237-4252 |                            |
| Rann Wilson      | _____             | "                              | "            |                            |
| Whitney Burney   | WSET              | 2320 Langhorne Rd              |              |                            |
| Dan Palm         | WSET              | "                              |              |                            |
| Brian Booth      | GLTC              | <del>419</del> 419 Bradley Dr. | 434-455-5084 | bbooth@gltc online.com     |
| Wayne Harris     | _____             | 1106 Tolleys Ln                | 434-288-2202 | at4me23@gmail.com          |
| Carla H. Ercmell | The Lester Group  | Taylor Bros. - Old Gwynn Rd    | 276-224-2842 | chccvowell@lestergroup.com |
| CATHY LAIRDADE   | GIRACE PROPERTIES | 1152 GIBBSIDE FOREST VA        | 434 841 8509 | cathyvp@livingsspace.com   |
| TERRY TAYLOR     | _____             | 323 RENO DR Lynchburg          | 434-660-8628 |                            |
| Mariel Fowler    | Bedford Co.       |                                |              |                            |
| Joe Dettner      | Forest            | 304 Foreston Dr Forest, VA     | 534-9333     |                            |
| Ren Parker       | Service Truck     | Trouble Tree Park              | 434 660-2337 |                            |
| STEVE CLARK      | Forest            | 1370 WINEWOOD RD, FOREST       | 434 525 5746 | vybwryter@msu.com          |



## Graves Mill Road Corridor Study - Meeting #1 (December 12th, 2017)

| Name             | Representing   | Address                       | Phone #      | Email                          |
|------------------|----------------|-------------------------------|--------------|--------------------------------|
| FRANK LONDENE    | RESIDENT       | 105 VALLEYDALE DR             | 434-851-5128 | Londeneesr@earthlink.net       |
| Perault, Dave    | PC             |                               |              | perault@hcnl.org.edu           |
| TJC              |                |                               |              |                                |
| Rob Chapman      | business owner | 1658 Graves Mill Rd. 24502    | (4) 385-4747 | robchapman.cv39@estatefarm.com |
| LEE NEWCOMB      | RESIDENT       | 900 CAVERST ST.               |              |                                |
| JAMES LA PRADÉ   | RESIDENT       | 1714 GRAVES MILL              | 546-7777     | JAMES.LAPRADE@bmsdirectinc.com |
| Chantal O'keeffe | resident /     |                               |              | cvokeeffe@gmail.com            |
| Lauren Balint    | Resident       | 1027 Tori Ct.                 |              | lauren.balint@gmail.com        |
| Monica Chavis    | Resident       | 111 Lookout Dr Lyfey VA 24502 |              | m.chavis1964@aol.com           |
| Rachael Smith    | News & Advance |                               |              |                                |
| Rick Reed        | CBC REED       | 101 ANJO CT. FOREST, VA       | 841-1642     |                                |
| GAYNELL HART     | CITY OF LYF    |                               |              |                                |
| Drew Draper      | EPR            | 902 E Jefferson St Lyle, VA   | 434-202-5082 | d.draper@epr-pl.com            |
|                  | Resident       | old government Rd             | 434-781-4500 | Bob10234@aol.com               |
|                  |                |                               |              |                                |



# Graves Mill Road Corridor Study - Meeting #1 (December 12th, 2017)

| Name             | Representing          | Address              | Phone #      | Email                         |
|------------------|-----------------------|----------------------|--------------|-------------------------------|
| Alexander Magid  | Mountainview Oralists | 1612 graves mill Rd. | 434-316-7111 | <del>the</del> Z4A162A@i.com  |
| Laura Dooley     | RED CROSS             | 1900 Tate Springs    | 540-204-6585 | Laura.1 Dooley @ Redcross.org |
| Don DeBerry      | COL                   | 900 Church           | 434-555-3935 | donald.deberry @ col.org      |
| Thyllis S. Brown |                       | 110 Hillview Dr.     | 434-237-1748 | —                             |
| MAKANA YARBROUGH | HUMAN Soc.            |                      |              |                               |
| Albert Turner    | resident              | 2308 Graves Mill Rd. | 434-316-5922 | sayemat@verizon.net           |
| Faye Turner      | "                     | " " "                | " " "        | "                             |
| Tom Regan        | PC                    |                      | 434-660-8731 |                               |
| Kelly Frazier    |                       |                      |              | KFRAZIER @ hermanape.com      |
| John Saille      |                       | 4127 Graves Mill Rd  | 434-239-2405 | john @ hsaera.com             |
| Serry Brooks     | Resident              | 117 Tenhawk Dr.      | 414-1398     | —                             |
| David Moore      |                       | 1576 Cuddington Lane | 434-610-4915 | dmore2487@gmail.com           |
| Mikael Blido     | Resident              | 2685 Besseville Rd   | 434-4851671  | mblido @ gmail.com            |
| Ray Hostutle     | resident              | 1155 Mont View       | 238-3877     |                               |
| Pat Nelson       | resident              | 122 Willow Bend      | 237-1389     |                               |

[illegible]

gov

# Media Summary

## Source 1: WDBJ7:

<http://www.wdbj7.com/content/news/Public-reacts-to-Graves-Mill-Study--463787483.html>

LYNCHBURG, Va. (WDBJ7) Region 2000 leaders are calling the Graves Mill Road Corridor a “congested corridor”.

Gristmill Drive in Bedford County to McConville Road in Lynchburg is a popular commuter road in the region and, with that congestion in mind, Region 2000 is looking to make a plan for the future.

The Graves Mill Study was launched three months ago. Region 2000 and the Central Virginia Metropolitan Planning Organization as well as Bedford County, the City of Lynchburg and the Virginia Department of Transportation have teamed up to conduct the study. EPR, a firm out of Charlottesville, has been brought in and paid about \$65,000 to conduct the study.

The study has revealed that while the corridor is congested now, the area surrounding it is expecting to grow more than 50 percent in the next 20 years. Current projects like the Rosedale development and a new apartment complex on Old Graves Mill Road will bring more traffic to the area.

“We really need to stay in front of that demand,” said Drew Draper, Principal Planner with EPR. “To create a safer...more multimodal environment.”

Tuesday night the public came out to learn more about the results of the study so far and to voice their opinions.

“In the morning and night there’s so much traffic you have to slow down,” said Albert Turner, who lives on Graves Mill Road.

“I try to avoid it sometimes of the day, but it’s not always possible,” said Laura Dooley, who travels the corridor daily.

The study not only showed how congested the corridor is, but also revealed higher than average crash rates. Leaders say high crash rates are typical of a congested corridor.



The study will be looking at short term and long term solutions. Ranging from signal lights and bike paths, to bigger projects like a roundabout or diverging diamond intersection.

This is the grassroots level of the study, they are working on things to consider moving forward with the future growth in mind.

"It seems as though they really understand that there's these issues because they are addressed in a lot of the pictures here so I'm kind of hopeful that something really good will come of this," said Dooley.

The leaders of the study will now take the public comments from Tuesday's meeting and evaluate them further. They will hold another meeting sometime in February for public input and are hoping to have the study finished by early springtime. The goal of the study is to help plan things out so the project can be prioritized and implemented sooner.

To learn more about the project, go to their website: [www.gravesmillplan.com](http://www.gravesmillplan.com)

## Source 1 Continued: WDBJ7:

<http://www.wdbj7.com/content/news/Corridor-study-underway-for-Graves-Mill-Road-in-Lynchburg-462389983.html>

LYNCHBURG, Va. (WDBJ7) -- Lynchburg City leaders are conducting a study on what is considered a congested stretch of road.

### Graves Mill Road (WDBJ7)

The corridor study is looking at Graves Mill Rd. to make improvements to help with traffic flow and the crash rate.

The stretch of road is traveled by more than 27,000 vehicles daily; an amount of traffic that doesn't surprise Sherei Scott, who works at Moore's County store at the corner of Graves Mill and Creekside Dr. "It's hectic. It can get hectic ... I mean you can sit at the light for five minutes just trying to get up the street," explained Scott.

That exact same intersection also has the highest crash rate on the corridor. So, now, city leaders want to make improvements. "We'll be looking at different lane configurations, different types of intersections, different types of signal configurations, pedestrian accommodations, bicycle accommodation," said Scott Smith, the Transportation Director with Region 2000.

The study includes the stretch of road from McConville to Grist Mill Rd., an area that is also seeing growth. "We have future developments that have been proposed. We want to get ahead of that make sure we can accommodate those developments," said Smith.

The new developments include Rosedale and a new apartment complex that is already under construction.

Smith says the study will help them determine what improvements to make to help with traffic flow and crash rates - which for most of the corridor is higher than other roads in the city and state. "If we can improve the through-put, the capacity of the corridor, while also reducing crashes then we're doing the right thing and that's what we're looking at," said Smith.

Project leaders will host a public workshop on Tuesday, Dec. 12 from 4:00 p.m. to 6:30 p.m. at the Lynchburg Humane Society.

## Source 2 - NewsAdvance

----

[http://www.newsadvance.com/news/local/regional-officials-look-to-alleviate-traffic-problems-on-graves-mill/article\\_eaa782a4-dfa0-11e7-9fd8-136b1fae48a7.html](http://www.newsadvance.com/news/local/regional-officials-look-to-alleviate-traffic-problems-on-graves-mill/article_eaa782a4-dfa0-11e7-9fd8-136b1fae48a7.html)

Graves Mill Road has served as a transportation corridor since the 1700s, and it has been growing with traffic and business ever since — and regional officials looked at shaping the road's future at a Tuesday public meeting at the Lynchburg Humane Society.

After Lynchburg and Bedford County planning and transportation officials informed Region 2000 Local Government Council about the concerns for high traffic volume and a higher-than-average vehicular crash rate, a plan to improve traffic in the corridor was developed.

"There is rather extensive growth in this area," Scott Smith, transportation planning director of Region 2000, said at Tuesday's meeting. "We wanted to get ahead of the growth and identify ways to address these issues."

The meeting allowed area residents to see data on possible plans for the road.

Region 2000 Local Government Council and Central Virginia Metropolitan Planning Organization, in partnership with Bedford County and the city of Lynchburg and with assistance from Charlottesville-based engineering company EPR P.C., are conducting the study of Graves Mill Road between Gristmill Road and McConville Road in Lynchburg. The study began this summer and will be concluded next spring.

The planning process began in the summer and cost \$65,000. It has been funded mostly by Region 2000, with some money from Lynchburg.

“Our job on a regional level is to help identify and prioritize projects and help get them ready for funding,” Smith said.

The area has grown during the past several years with new businesses like The Home Depot and Moore’s Country Store and will continue to grow with developments like Rosedale — a community that hopes to soon build and attract a hotel, grocery store, restaurants, a brewery and office space — as well as Elements at Old Graves Mill Road — new apartments being constructed.

“Graves Mill serves a larger purpose, and that is to get people from Forest to Lynchburg,” Smith said. “Forest is one of the fastest-growing areas of Bedford County and is one of the fastest-growing areas of Lynchburg metro. Even if no other businesses are proposed, we’re going to have increased traffic. It’s the connector of choice for most people.”

Every intersection between McConville Road and Gristmill Drive, except for one, has a higher than average crash rate than all of Lynchburg and the state, Smith said. There are seven signalized intersections and two with no signals in the corridor. The highest is Creekside Drive, where The Home Depot is located.

Bill Wuensch, principal transportation engineer and planner for EPR, has collected all of the data and looked at crash history.

Most crashes are caused by rear-ending and angle crashes — where drivers make turns and hit another vehicle. There is one reported fatality on Graves Mill Road since 2006, which occurred in 2013 near Bulls Steakhouse.

Kelly Duff Smith, of Amherst County — who works on Nationwide Drive, which intersects with Graves Mill Road — said she has to drive on the road on a daily basis.

There is a four-way stop sign at the intersection of Nationwide Drive, Graves Mill Road and McConville Road. In her opinion, she said drivers don’t know how to use it.

“When everyone is getting off at 5 o’clock p.m., it’s a madhouse and very dangerous because people don’t wait their turn to go, and it causes others to stop so they don’t get hit,” she said. “It has gotten worse and is more dangerous.”

She thinks there needs to be a stoplight instead of the four-way stop.



"These other stoplights truly do help out this traffic," she said. "It's a lot more people using the Graves Mill Road exit to cut through to get to [the U.S.] 221 Forest area or even Timberlake [Road.]"

Wuensch said based off of the data found, traffic is anticipated to grow 1.25 percent per year by 2040, when it will reach traffic capacity.

Don DeBerry, Lynchburg traffic engineer, said the city has submitted a grant application for \$500,000 to the Virginia Department of Transportation to install an adaptive signal system on the road that would consist of five signals that would coordinate signals and better utilize green light time during heavy traffic periods.

Smith said data only is being gathered now, but in the next few weeks, the team of transportation planners will be looking at possible solutions.

"It could be as simple as reprogramming traffic signals; it can be as complicated as building new roads," he said.

There will be another public meeting held in the spring on possible solutions, and then funding for the project will be applied for through VDOT. Since the study is underway, they haven't offered up figures for how much the traffic work will cost.

"We have to look at our biggest bang for our buck. These things cost a lot of money," he said.

## Source 3 - WSLS:

<https://www.wsls.com/news/virginia/lynchburg/lynchburg-officials-need-public-s-input-on-graves-mill-road-cooridor>

LYNCHBURG, Va. - Moore's Country Store has been on Creekside Lane in Lynchburg for almost two years.

Store manager, Mark Emerson says they have three exits for customers to get out onto Graves Mill Road.

"Other than the construction we had a few months ago. But when it got up here close, near the bottom there, it affected us a little bit with people getting in and out of the shop here. But we haven't experienced a lot of wrecks or anything," Emerson said.

Though Emerson said Moore's Country Store hasn't seen any accidents lately, officials with Virginia's Region 2000 say, the Creekside Lane -Graves Mill Road intersection has had the most accidents compared to the city and state average.

"As you can see, a majority of the crashes are rear-end crashes," said Scott Smith, transportation planning director for Virginia's Region 2000 Local Government Council, pointing to a Google image on their corridor study.

Graves Mill Road is a major connector between Lynchburg and Forest and many businesses have been developed over the years. And new developments are coming to the area soon.

"Because of the growth happening all along this corridor. We want to try to work out in the future and get ahead of that growth so that we can make plans to keep this corridor functioning well," Smith said.

Officials say the study will cost about \$60,000 paid for by the Local Government Council and a bit by Lynchburg. They will look from Nationwide Drive in Lynchburg to Gristmill Drive in Bedford County.

"We're going to be looking at the width of the lanes, can we add additional lanes without increasing the asphalt. We're going to be looking at synchronizing the traffic signals to make sure they're all working together properly. We're looking at pedestrian and transit accommodations to make sure other folks not using cars can get through here well," Smith said.

On Tuesday from 4 to 6:30 p.m. at the Lynchburg Humane Society, 1211 Old Graves Mill Road, officials will host an open-house format for members of the public to drop in and discuss concerns about Graves Mill Road.

To read more about the study, [click here](#).

## Source 4 - WLNI:

<https://wlni.com/local-news/public-information-meeting-set-for-graves-mill-road-corridor-study>

A public information workshop for the Graves Mill Road Corridor Study is scheduled for a week from tomorrow. The study is focusing on Graves Mill between McConville Road in Lynchburg and Gristmill Drive in Bedford County. The workshop is set for December 12th at the Lynchburg Humane Society on Old Graves Mill Road; it runs between 4:00 and 6:30 pm.

[Click here](#) for the Graves Mill Road Corridor Study website.

(Continue reading for the Region 2000 Local Government Council news release.)

LYNCHBURG— A public information workshop for the Graves Mill Road Corridor Study will be held between the hours of 4:00 p.m. and 6:30 p.m. on Tuesday December 12th, 2017 at the

Lynchburg Humane Society at 1211 Old Graves Mill Rd, Lynchburg, VA 24502. The meeting will be held in an open-house format; members of the public may stop by at any time during the event.

Area residents, employees, commuters, shoppers, and business and property owners are encouraged to attend the workshop to learn about the study, review information about the corridor, and share comments regarding concerns, opportunities, and improvement ideas.

The study, which focuses on the Graves Mill Road corridor between McConville Road in Lynchburg and Gristmill Drive in Bedford County, is being conducted by the Region 2000 Local Government Council and Central Virginia Metropolitan Planning Organization in partnership with Bedford County, the City of Lynchburg and the Virginia Department of Transportation. EPR, P.C. of Charlottesville is providing engineering and planning assistance on the project which began in August 2017 and will conclude next spring.

Graves Mill Road is an important roadway that serves heavy commuter traffic while also providing access to commercial interests. This corridor planning study will:

Investigate existing traffic conditions and consider what kinds of road improvements may be needed if future traffic continues to increase,

Assess existing and desired conditions for pedestrians, bicyclists, and users of transit, (multimodal options), and

Address safety issues.

The study effort will develop short and long-term recommendations that will help to minimize congestion and improve travel conditions and safety along this important corridor. Once the study is complete, the projects can be prioritized so that funding and implementation strategies can be pursued.

For more information on the study, please visit [www.gravesmillplan.com](http://www.gravesmillplan.com).

For more information about this public information workshop or the study, please contact Scott Smith (Transportation Planning Director, Region 2000 Local Government Council) prior to the meeting at 434-845-3491 or by email at [ssmith@region2000.org](mailto:ssmith@region2000.org).



## MEMORANDUM

TO: SCOTT SMITH

FROM: DREW DRAPER, PTP

BILL WUENSCH, P.E., PTOE

ORGANIZATION: VIRGINIA'S REGION 2000 LOCAL  
GOVERNMENT COUNCIL

DATE: MAY 9, 2018

PHONE NUMBER: 434-845-3491

SENDER'S REFERENCE NUMBER:

Re: MEETING SUMMARY – GRAVES MILL ROAD  
COMMUNITY MEETING #2

YOUR REFERENCE NUMBER:

☐ URGENT    ☒ FOR YOUR USE    ☐ PLEASE COMMENT    ☐ PLEASE REPLY    ☐ PLEASE RECYCLE

A public meeting for the Graves Mill Road Corridor Study was held on Monday, April 23, 2018 at the Lynchburg Humane Society in Lynchburg, Virginia. The meeting was organized as an open-house format and was open to the general public from 4:00 – 6:00 pm. Advertisement for the meeting included:

- Mail-outs to residents and businesses near the study area approximately two weeks in advance of the meeting
- Deployment of variable message signs on Graves Mill Road approximately one week in advance of the meeting
- Press release
- Advertisement via social media
- Advertisement via local news agencies
- Notice included on the project website ([www.gravesmillplan.com](http://www.gravesmillplan.com))

The goal of this meeting was for the public to **1) learn more about the study and progress to date, 2) review draft short- and long-term roadway improvements, and 3) share comments and thoughts on bicycle and pedestrian needs.** Attendees were encouraged to provide feedback and offer suggestions that would help to inform the project development process. Representatives from the Virginia Department of Transportation (VDOT), City of Lynchburg, Virginia's Region 2000 Local Government Council, and project consultants were available to explain materials, answer questions, and record feedback. Information boards were set up in the meeting space that presented the following subjects:

- Welcome and purpose of the meeting
- Information about the study
- Priority I recommendations



- Priority II recommendations
- Priority III recommendations
- Information on roundabout and diverging diamond interchanges
- Overview of existing multimodal conditions

In addition to the information boards, posters illustrating existing and future traffic conditions, and historical crash data that were shared at the first meeting were also available for review on surrounding tables. Large table-top maps of the corridor were available for attendees to gather around and mark-up regarding multimodal needs and desires. Comment sheets were also made available for participants. The meeting was attended by approximately 30 people (that signed in), including business owners/representatives along the corridor. Local news organizations covered the first meeting extensively, and gathered information via the project website and Virginia's Region 2000 Local Government Council for meeting #2.



A consistent flow of attendees began right at 4:00 PM and continued through approximately 5:30 PM. Representatives were provided sufficient time to walk attendees through the study recommendations and answer questions, as needed. Overall, attendees were very pleased of the recommendations presented and that transportation representatives were attempting to stay in front of potential growth that could exceed 50% over the next 20 years. A key topic that was discussed included project implementation and funding opportunities. While some focus was paid to transit, pedestrian and bicycle accommodations along the corridor, the majority of attention was on the draft recommendations. To note, this was consistent with the first meeting, as many participants recognize this is a higher speed, cut-through road. However, multimodal recommendations included additional sidewalks, signalized pedestrian crossings, and enhanced transit stop amenities.

It was further suggested, in this meeting and at the first, that City (or other agencies) undergo a study along Old Graves Mill Road between Graves Mill Road and Timberlake Road.

### **Specific Public Comments**

The following public comments were **written on comment sheets** that were provided at the meeting, or **emailed via the project website** (specific identifying information has been removed, and at times, comments are paraphrased):

*Please address no turn lanes from Graves Mill Road to Lillian. There are many rear end accidents that occur.*



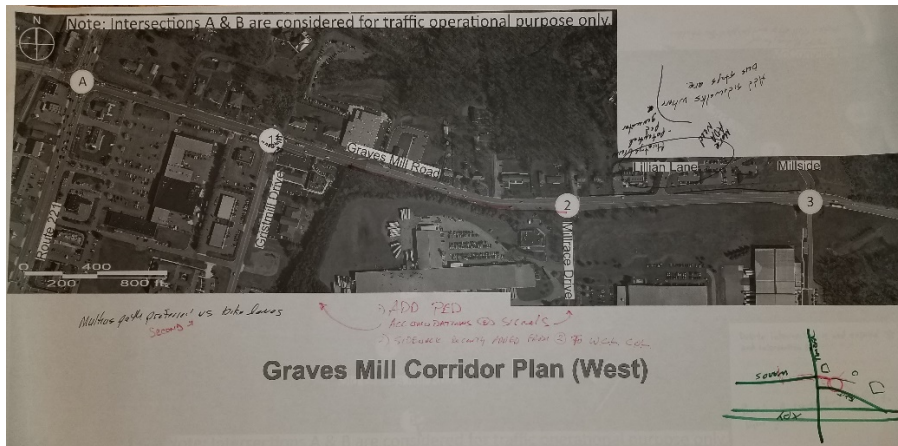
*Very difficult to make a left across Graves Mill Road from Lillian during rush hour.*

*The connector between Old Graves Mill Road and Graves Mill Road is a concern.*

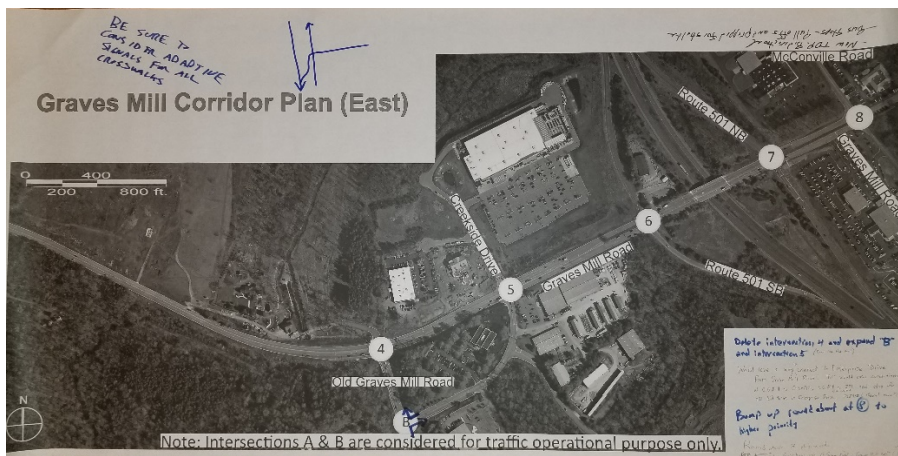
*Need a center turn lane on the western side of the project (west of Millside Drive).*

*Are there any current plans to connect all the sidewalks on Old Graves Mill Rd from humane society to Timberlake Road? A lot of pedestrians walk towards Kroger etc. and there are no sidewalks to accommodate.*

The following images depict public comments **provided on table top maps** located between the informational boards. A summary is provided under each.



The comments on this map indicate a greater desire for a multiuse path along portions of Graves Mill Road when compared to a sidewalk. This was a common theme heard from participants as residents feel it would be more utilized because it can also accommodate bikes. In addition to a multiuse path, enhanced pedestrian accommodations should be provided, including ADA. To note, intersection #1 includes a pedestrian crossing and signal as part of the study's Priority I recommendations.



The following comments were noted on the table top map above:

- Be sure to consider adaptive signals. To note, the City has applied for adaptive signal technology that covers the eastern intersections of Graves Mill Road.



- Consider connecting Enterprise Drive with Graves Mill Road. This would ease conditions from Old Graves Mill Road to 221. It would also add relief to Enterprise Drive.
- Bump up the roundabout priority.

End of the memorandum. However, the following attachments are included:

- Sign-in sheets

# Graves Mill Road Corridor Study - Meeting #2 (April 23, 2018)

| Name              | Representing        | Address                          | Phone #      | Email                        |
|-------------------|---------------------|----------------------------------|--------------|------------------------------|
| SCOTT SMITH       | CUMPO               | 828 MAIN ST 12TH FL              | 434-845-3491 | SSMITH@REGION2.COM           |
| Mariel Fowler     | BedCo               | 122 E Main St                    | 540-586-7616 | mfwler@bedfordcounty         |
| Dave Zeff         | Resident            | 515 Little Creek Rd              | 434-237-4502 |                              |
| Linda Zeff        | Resident            | 515 Little Creek Rd              | 434-237-4502 | thezeffs@yahoo.com           |
| David Cook        | VDOT                | 4219 Campbell Ave                | 434-856-8252 | david.cook@vdot.virginia.gov |
| Jeff Ross         | Resident            | 252 TowneCrier Rd                | 434-942-1185 | jeff.ross@franktome.com      |
| Mark Adam         | Resident            | 304 Reno Dr                      | 434-229-5127 | madams@73@gmail.com          |
| Janet Johnson     | Resident            | 104 Salisbury Cir                | 434-333-0554 |                              |
| GREG MARSH        | BULLS               | 1881 GRAVESMILL RD               | 434 841 7744 | GMDM7744@GMAIL.COM           |
| Connie Kelly      | Resident            | 109 Sandbridge Ct                | 434-945-0093 | Connie.Kelly2014@gmail.com   |
| Cham Light        | Planning<br>Commis. | 1505 Linden Ave<br>L-VRIS, 24503 | 434-384-8515 | chamlight777@yahoo.com       |
| Dan DeBerry       | City of Lynchburg   | COL                              | 455 3935     |                              |
| Lydia Tchividjian | Resident            | Swan Lane                        |              | lydiatch@jetbroadband.com    |
| ERIC BURKE        | SELF                |                                  | 804-297-4601 | eburke@moffatt.n.chil.com    |
| Sam Parsons       | Self                | 2315 Country Club Rd 24563       | 910-987-8309 |                              |
| Pat Nelson        | SELF                | 122 WILLOW BEND DR               | 434-237-1389 |                              |
| Joe Veltfner      | Self                | 304 Forester Dr Forest, VA       | 8534-9333    |                              |

**Graves Mill Road Corridor Study - Meeting #2 (April 23, 2018)**

[illegible]



**Graves Mill Road Corridor Study - Meeting #2 (April 23, 2018)**

[illegible]

# Appendix F

## HCM and Queuing Reports

# HCM Signalized Intersection Capacity Analysis

## 1: Gristmill & Graves Mill

02/23/2018

|                                   | →     | ↘    | ↙     | ←     | ↖                         | ↗     |
|-----------------------------------|-------|------|-------|-------|---------------------------|-------|
| Movement                          | EBT   | EBR  | WBL   | WBT   | NBL                       | NBR   |
| Lane Configurations               | ↑↑    |      |       | ↑↑    | ↖                         | ↗     |
| Traffic Volume (vph)              | 649   | 12   | 209   | 434   | 16                        | 565   |
| Future Volume (vph)               | 649   | 12   | 209   | 434   | 16                        | 565   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900  | 1900  | 1900                      | 1900  |
| Lane Width                        | 12    | 12   | 12    | 12    | 11                        | 12    |
| Grade (%)                         | 0%    |      |       | 0%    | 2%                        |       |
| Total Lost time (s)               | 6.5   |      |       | 6.5   | 5.3                       | 5.3   |
| Lane Util. Factor                 | 0.95  |      |       | 0.95  | 1.00                      | 1.00  |
| Frt                               | 1.00  |      |       | 1.00  | 1.00                      | 0.85  |
| Flt Protected                     | 1.00  |      |       | 0.98  | 0.95                      | 1.00  |
| Satd. Flow (prot)                 | 3565  |      |       | 3528  | 1630                      | 1583  |
| Flt Permitted                     | 1.00  |      |       | 0.54  | 0.95                      | 1.00  |
| Satd. Flow (perm)                 | 3565  |      |       | 1951  | 1630                      | 1583  |
| Peak-hour factor, PHF             | 0.84  | 0.84 | 0.84  | 0.84  | 0.84                      | 0.84  |
| Adj. Flow (vph)                   | 773   | 14   | 249   | 517   | 19                        | 673   |
| RTOR Reduction (vph)              | 2     | 0    | 0     | 0     | 0                         | 234   |
| Lane Group Flow (vph)             | 785   | 0    | 0     | 766   | 19                        | 439   |
| Heavy Vehicles (%)                | 1%    | 0%   | 0%    | 1%    | 6%                        | 1%    |
| Turn Type                         | NA    |      | pm+pt | NA    | Prot                      | Perm  |
| Protected Phases                  | 2     |      | 1     | 6     | 4                         |       |
| Permitted Phases                  |       |      | 6     |       |                           | 4     |
| Actuated Green, G (s)             | 19.5  |      |       | 34.5  | 14.8                      | 14.8  |
| Effective Green, g (s)            | 19.5  |      |       | 34.5  | 14.8                      | 14.8  |
| Actuated g/C Ratio                | 0.32  |      |       | 0.56  | 0.24                      | 0.24  |
| Clearance Time (s)                | 6.5   |      |       | 6.5   | 5.3                       | 5.3   |
| Vehicle Extension (s)             | 3.0   |      |       | 3.0   | 2.0                       | 2.0   |
| Lane Grp Cap (vph)                | 1137  |      |       | 1321  | 394                       | 383   |
| v/s Ratio Prot                    | c0.22 |      |       | c0.08 | 0.01                      |       |
| v/s Ratio Perm                    |       |      |       | 0.25  |                           | c0.28 |
| v/c Ratio                         | 0.69  |      |       | 0.58  | 0.05                      | 1.15  |
| Uniform Delay, d1                 | 18.2  |      |       | 8.6   | 17.7                      | 23.1  |
| Progression Factor                | 1.00  |      |       | 1.00  | 1.00                      | 1.00  |
| Incremental Delay, d2             | 1.8   |      |       | 0.6   | 0.0                       | 92.0  |
| Delay (s)                         | 20.0  |      |       | 9.2   | 17.8                      | 115.1 |
| Level of Service                  | B     |      |       | A     | B                         | F     |
| Approach Delay (s)                | 20.0  |      |       | 9.2   | 112.4                     |       |
| Approach LOS                      | B     |      |       | A     | F                         |       |
| <b>Intersection Summary</b>       |       |      |       |       |                           |       |
| HCM 2000 Control Delay            |       |      | 44.8  |       | HCM 2000 Level of Service | D     |
| HCM 2000 Volume to Capacity ratio |       |      | 0.86  |       |                           |       |
| Actuated Cycle Length (s)         |       |      | 61.1  |       | Sum of lost time (s)      | 18.3  |
| Intersection Capacity Utilization |       |      | 63.1% |       | ICU Level of Service      | B     |
| Analysis Period (min)             |       |      | 15    |       |                           |       |
| c Critical Lane Group             |       |      |       |       |                           |       |



# HCM Signalized Intersection Capacity Analysis

## 2: Millrace & Graves Mill

02/23/2018

|                                   | →     | ↘    | ↙     | ←     | ↖                         | ↗    |
|-----------------------------------|-------|------|-------|-------|---------------------------|------|
| Movement                          | EBT   | EBR  | WBL   | WBT   | NBL                       | NBR  |
| Lane Configurations               | ↑↑    |      | ↘     | ↑↑    | ↘                         | ↗    |
| Traffic Volume (vph)              | 1124  | 56   | 70    | 684   | 12                        | 11   |
| Future Volume (vph)               | 1124  | 56   | 70    | 684   | 12                        | 11   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900  | 1900  | 1900                      | 1900 |
| Lane Width                        | 12    | 12   | 11    | 12    | 11                        | 11   |
| Grade (%)                         | 0%    |      |       | 0%    | 3%                        |      |
| Total Lost time (s)               | 5.0   |      | 4.5   | 5.0   | 5.0                       | 5.0  |
| Lane Util. Factor                 | 0.95  |      | 1.00  | 0.95  | 1.00                      | 1.00 |
| Frt                               | 0.99  |      | 1.00  | 1.00  | 1.00                      | 0.85 |
| Flt Protected                     | 1.00  |      | 0.95  | 1.00  | 0.95                      | 1.00 |
| Satd. Flow (prot)                 | 3550  |      | 1728  | 3574  | 1719                      | 1411 |
| Flt Permitted                     | 1.00  |      | 0.12  | 1.00  | 0.95                      | 1.00 |
| Satd. Flow (perm)                 | 3550  |      | 225   | 3574  | 1719                      | 1411 |
| Peak-hour factor, PHF             | 0.85  | 0.85 | 0.85  | 0.85  | 0.85                      | 0.85 |
| Adj. Flow (vph)                   | 1322  | 66   | 82    | 805   | 14                        | 13   |
| RTOR Reduction (vph)              | 3     | 0    | 0     | 0     | 0                         | 13   |
| Lane Group Flow (vph)             | 1385  | 0    | 82    | 805   | 14                        | 0    |
| Heavy Vehicles (%)                | 1%    | 0%   | 1%    | 1%    | 0%                        | 9%   |
| Turn Type                         | NA    |      | pm+pt | NA    | Prot                      | Perm |
| Protected Phases                  | 6     |      | 5     | 2     | 4                         |      |
| Permitted Phases                  |       |      | 2     |       |                           | 4    |
| Actuated Green, G (s)             | 35.2  |      | 45.0  | 45.0  | 2.0                       | 2.0  |
| Effective Green, g (s)            | 35.2  |      | 45.0  | 45.0  | 2.0                       | 2.0  |
| Actuated g/C Ratio                | 0.62  |      | 0.79  | 0.79  | 0.04                      | 0.04 |
| Clearance Time (s)                | 5.0   |      | 4.5   | 5.0   | 5.0                       | 5.0  |
| Vehicle Extension (s)             | 3.5   |      | 2.0   | 3.5   | 2.0                       | 2.0  |
| Lane Grp Cap (vph)                | 2192  |      | 317   | 2821  | 60                        | 49   |
| v/s Ratio Prot                    | c0.39 |      | 0.02  | c0.23 | c0.01                     |      |
| v/s Ratio Perm                    |       |      | 0.18  |       |                           | 0.00 |
| v/c Ratio                         | 0.63  |      | 0.26  | 0.29  | 0.23                      | 0.01 |
| Uniform Delay, d1                 | 6.8   |      | 3.7   | 1.6   | 26.8                      | 26.5 |
| Progression Factor                | 1.00  |      | 1.00  | 1.00  | 1.00                      | 1.00 |
| Incremental Delay, d2             | 0.6   |      | 0.2   | 0.1   | 0.7                       | 0.0  |
| Delay (s)                         | 7.5   |      | 3.9   | 1.7   | 27.5                      | 26.6 |
| Level of Service                  | A     |      | A     | A     | C                         | C    |
| Approach Delay (s)                | 7.5   |      |       | 1.9   | 27.0                      |      |
| Approach LOS                      | A     |      |       | A     | C                         |      |
| <b>Intersection Summary</b>       |       |      |       |       |                           |      |
| HCM 2000 Control Delay            |       |      | 5.5   |       | HCM 2000 Level of Service | A    |
| HCM 2000 Volume to Capacity ratio |       |      | 0.58  |       |                           |      |
| Actuated Cycle Length (s)         |       |      | 57.0  |       | Sum of lost time (s)      | 14.5 |
| Intersection Capacity Utilization |       |      | 52.1% |       | ICU Level of Service      | A    |
| Analysis Period (min)             |       |      | 15    |       |                           |      |
| c Critical Lane Group             |       |      |       |       |                           |      |

# HCM Signalized Intersection Capacity Analysis

## 4: Old Graves Mill & Graves Mill

02/23/2018

|                                   |  |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                           |       |                                                                                   |                                                                                   |      |                                                                                   |      |
|-----------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------|-------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|------|
| Movement                          | EBL                                                                                | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                       | NBL   | NBT                                                                               | NBR                                                                               | SBL  | SBT                                                                               | SBR  |
| Lane Configurations               |   |  |  |  |  |                           |       |  |  |      |  |      |
| Traffic Volume (vph)              | 0                                                                                  | 921                                                                               | 134                                                                               | 99                                                                                | 690                                                                               | 0                         | 132   | 0                                                                                 | 49                                                                                | 0    | 0                                                                                 | 0    |
| Future Volume (vph)               | 0                                                                                  | 921                                                                               | 134                                                                               | 99                                                                                | 690                                                                               | 0                         | 132   | 0                                                                                 | 49                                                                                | 0    | 0                                                                                 | 0    |
| Ideal Flow (vphpl)                | 1900                                                                               | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                      | 1900  | 1900                                                                              | 1900                                                                              | 1900 | 1900                                                                              | 1900 |
| Lane Width                        | 12                                                                                 | 12                                                                                | 12                                                                                | 11                                                                                | 12                                                                                | 12                        | 12    | 13                                                                                | 13                                                                                | 12   | 16                                                                                | 12   |
| Grade (%)                         |                                                                                    | 3%                                                                                |                                                                                   |                                                                                   | -5%                                                                               |                           |       | -5%                                                                               |                                                                                   |      | 3%                                                                                |      |
| Total Lost time (s)               |                                                                                    | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                           |       | 5.0                                                                               | 5.0                                                                               |      |                                                                                   |      |
| Lane Util. Factor                 |                                                                                    | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              |                           |       | 1.00                                                                              | 1.00                                                                              |      |                                                                                   |      |
| Frt                               |                                                                                    | 1.00                                                                              | 0.85                                                                              | 1.00                                                                              | 1.00                                                                              |                           |       | 1.00                                                                              | 0.85                                                                              |      |                                                                                   |      |
| Flt Protected                     |                                                                                    | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                           |       | 0.95                                                                              | 1.00                                                                              |      |                                                                                   |      |
| Satd. Flow (prot)                 |                                                                                    | 3521                                                                              | 1544                                                                              | 1736                                                                              | 3664                                                                              |                           |       | 1856                                                                              | 1614                                                                              |      |                                                                                   |      |
| Flt Permitted                     |                                                                                    | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                           |       | 0.95                                                                              | 1.00                                                                              |      |                                                                                   |      |
| Satd. Flow (perm)                 |                                                                                    | 3521                                                                              | 1544                                                                              | 1736                                                                              | 3664                                                                              |                           |       | 1856                                                                              | 1614                                                                              |      |                                                                                   |      |
| Peak-hour factor, PHF             | 0.89                                                                               | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                      | 0.89  | 0.89                                                                              | 0.89                                                                              | 0.89 | 0.89                                                                              | 0.89 |
| Adj. Flow (vph)                   | 0                                                                                  | 1035                                                                              | 151                                                                               | 111                                                                               | 775                                                                               | 0                         | 148   | 0                                                                                 | 55                                                                                | 0    | 0                                                                                 | 0    |
| RTOR Reduction (vph)              | 0                                                                                  | 0                                                                                 | 79                                                                                | 0                                                                                 | 0                                                                                 | 0                         | 0     | 0                                                                                 | 46                                                                                | 0    | 0                                                                                 | 0    |
| Lane Group Flow (vph)             | 0                                                                                  | 1035                                                                              | 72                                                                                | 111                                                                               | 775                                                                               | 0                         | 0     | 148                                                                               | 9                                                                                 | 0    | 0                                                                                 | 0    |
| Heavy Vehicles (%)                | 0%                                                                                 | 1%                                                                                | 3%                                                                                | 3%                                                                                | 1%                                                                                | 0%                        | 3%    | 0%                                                                                | 6%                                                                                | 0%   | 0%                                                                                | 0%   |
| Turn Type                         | Prot                                                                               | NA                                                                                | Perm                                                                              | Prot                                                                              | NA                                                                                |                           | Split | NA                                                                                | Perm                                                                              |      |                                                                                   |      |
| Protected Phases                  | 5                                                                                  | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                           | 8     | 8                                                                                 |                                                                                   | 4    | 4                                                                                 |      |
| Permitted Phases                  |                                                                                    |                                                                                   | 2                                                                                 |                                                                                   |                                                                                   |                           |       |                                                                                   | 8                                                                                 |      |                                                                                   |      |
| Actuated Green, G (s)             |                                                                                    | 31.3                                                                              | 31.3                                                                              | 8.3                                                                               | 44.6                                                                              |                           |       | 11.1                                                                              | 11.1                                                                              |      |                                                                                   |      |
| Effective Green, g (s)            |                                                                                    | 31.3                                                                              | 31.3                                                                              | 8.3                                                                               | 44.6                                                                              |                           |       | 11.1                                                                              | 11.1                                                                              |      |                                                                                   |      |
| Actuated g/C Ratio                |                                                                                    | 0.48                                                                              | 0.48                                                                              | 0.13                                                                              | 0.68                                                                              |                           |       | 0.17                                                                              | 0.17                                                                              |      |                                                                                   |      |
| Clearance Time (s)                |                                                                                    | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                           |       | 5.0                                                                               | 5.0                                                                               |      |                                                                                   |      |
| Vehicle Extension (s)             |                                                                                    | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                           |       | 3.0                                                                               | 3.0                                                                               |      |                                                                                   |      |
| Lane Grp Cap (vph)                |                                                                                    | 1677                                                                              | 735                                                                               | 219                                                                               | 2487                                                                              |                           |       | 313                                                                               | 272                                                                               |      |                                                                                   |      |
| v/s Ratio Prot                    |                                                                                    | c0.29                                                                             |                                                                                   | c0.06                                                                             | 0.21                                                                              |                           |       | c0.08                                                                             |                                                                                   |      |                                                                                   |      |
| v/s Ratio Perm                    |                                                                                    |                                                                                   | 0.05                                                                              |                                                                                   |                                                                                   |                           |       |                                                                                   | 0.01                                                                              |      |                                                                                   |      |
| v/c Ratio                         |                                                                                    | 0.62                                                                              | 0.10                                                                              | 0.51                                                                              | 0.31                                                                              |                           |       | 0.47                                                                              | 0.03                                                                              |      |                                                                                   |      |
| Uniform Delay, d1                 |                                                                                    | 12.8                                                                              | 9.4                                                                               | 26.8                                                                              | 4.3                                                                               |                           |       | 24.7                                                                              | 22.8                                                                              |      |                                                                                   |      |
| Progression Factor                |                                                                                    | 1.00                                                                              | 1.00                                                                              | 1.00                                                                              | 1.00                                                                              |                           |       | 1.00                                                                              | 1.00                                                                              |      |                                                                                   |      |
| Incremental Delay, d2             |                                                                                    | 0.7                                                                               | 0.1                                                                               | 1.8                                                                               | 0.1                                                                               |                           |       | 1.1                                                                               | 0.1                                                                               |      |                                                                                   |      |
| Delay (s)                         |                                                                                    | 13.4                                                                              | 9.5                                                                               | 28.6                                                                              | 4.4                                                                               |                           |       | 25.8                                                                              | 22.9                                                                              |      |                                                                                   |      |
| Level of Service                  |                                                                                    | B                                                                                 | A                                                                                 | C                                                                                 | A                                                                                 |                           |       | C                                                                                 | C                                                                                 |      |                                                                                   |      |
| Approach Delay (s)                |                                                                                    | 12.9                                                                              |                                                                                   |                                                                                   | 7.4                                                                               |                           |       | 25.0                                                                              |                                                                                   |      | 0.0                                                                               |      |
| Approach LOS                      |                                                                                    | B                                                                                 |                                                                                   |                                                                                   | A                                                                                 |                           |       | C                                                                                 |                                                                                   |      | A                                                                                 |      |
| <b>Intersection Summary</b>       |                                                                                    |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                           |       |                                                                                   |                                                                                   |      |                                                                                   |      |
| HCM 2000 Control Delay            |                                                                                    |                                                                                   | 11.9                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service |       |                                                                                   | B                                                                                 |      |                                                                                   |      |
| HCM 2000 Volume to Capacity ratio |                                                                                    |                                                                                   | 0.63                                                                              |                                                                                   |                                                                                   |                           |       |                                                                                   |                                                                                   |      |                                                                                   |      |
| Actuated Cycle Length (s)         |                                                                                    |                                                                                   | 65.7                                                                              |                                                                                   |                                                                                   | Sum of lost time (s)      |       |                                                                                   | 20.0                                                                              |      |                                                                                   |      |
| Intersection Capacity Utilization |                                                                                    |                                                                                   | 51.1%                                                                             |                                                                                   |                                                                                   | ICU Level of Service      |       |                                                                                   | A                                                                                 |      |                                                                                   |      |
| Analysis Period (min)             |                                                                                    |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                           |       |                                                                                   |                                                                                   |      |                                                                                   |      |
| c Critical Lane Group             |                                                                                    |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                           |       |                                                                                   |                                                                                   |      |                                                                                   |      |

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |                                                                                     |
| Traffic Volume (vph)              | 31                                                                                | 936                                                                               | 10                                                                                | 246                                                                               | 750                                                                               | 77                                                                                | 7                                                                                   | 13                                                                                  | 366                                                                                 | 36                                                                                  | 9                                                                                   | 17                                                                                  |
| Future Volume (vph)               | 31                                                                                | 936                                                                               | 10                                                                                | 246                                                                               | 750                                                                               | 77                                                                                | 7                                                                                   | 13                                                                                  | 366                                                                                 | 36                                                                                  | 9                                                                                   | 17                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1662                                                                              | 3512                                                                              |                                                                                   | 1770                                                                              | 3539                                                                              | 1538                                                                              |                                                                                     | 1823                                                                                | 1464                                                                                | 1621                                                                                | 1566                                                                                |                                                                                     |
| Flt Permitted                     | 0.33                                                                              | 1.00                                                                              |                                                                                   | 0.13                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 575                                                                               | 3512                                                                              |                                                                                   | 233                                                                               | 3539                                                                              | 1538                                                                              |                                                                                     | 1823                                                                                | 1464                                                                                | 1621                                                                                | 1566                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.87                                                                              | 0.87                                                                              | 0.87                                                                              | 0.87                                                                              | 0.87                                                                              | 0.87                                                                              | 0.87                                                                                | 0.87                                                                                | 0.87                                                                                | 0.87                                                                                | 0.87                                                                                | 0.87                                                                                |
| Adj. Flow (vph)                   | 36                                                                                | 1076                                                                              | 11                                                                                | 283                                                                               | 862                                                                               | 89                                                                                | 8                                                                                   | 15                                                                                  | 421                                                                                 | 41                                                                                  | 10                                                                                  | 20                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 32                                                                                | 0                                                                                   | 0                                                                                   | 123                                                                                 | 0                                                                                   | 19                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 36                                                                                | 1086                                                                              | 0                                                                                 | 283                                                                               | 862                                                                               | 57                                                                                | 0                                                                                   | 23                                                                                  | 298                                                                                 | 41                                                                                  | 11                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 7%                                                                                | 1%                                                                                | 10%                                                                               | 2%                                                                                | 2%                                                                                | 5%                                                                                | 0%                                                                                  | 0%                                                                                  | 4%                                                                                  | 6%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pm+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 1                                                                                   | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 37.0                                                                              | 34.9                                                                              |                                                                                   | 58.0                                                                              | 50.9                                                                              | 50.9                                                                              |                                                                                     | 2.4                                                                                 | 20.5                                                                                | 4.3                                                                                 | 4.3                                                                                 |                                                                                     |
| Effective Green, g (s)            | 37.0                                                                              | 34.9                                                                              |                                                                                   | 58.0                                                                              | 50.9                                                                              | 50.9                                                                              |                                                                                     | 2.4                                                                                 | 20.5                                                                                | 4.3                                                                                 | 4.3                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.46                                                                              | 0.44                                                                              |                                                                                   | 0.73                                                                              | 0.64                                                                              | 0.64                                                                              |                                                                                     | 0.03                                                                                | 0.26                                                                                | 0.05                                                                                | 0.05                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 295                                                                               | 1537                                                                              |                                                                                   | 518                                                                               | 2260                                                                              | 982                                                                               |                                                                                     | 54                                                                                  | 468                                                                                 | 87                                                                                  | 84                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.00                                                                              | c0.31                                                                             |                                                                                   | 0.12                                                                              | 0.24                                                                              |                                                                                   |                                                                                     | 0.01                                                                                | c0.14                                                                               | c0.03                                                                               | 0.01                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.05                                                                              |                                                                                   |                                                                                   | 0.27                                                                              |                                                                                   | 0.04                                                                              |                                                                                     |                                                                                     | 0.06                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.12                                                                              | 0.71                                                                              |                                                                                   | 0.55                                                                              | 0.38                                                                              | 0.06                                                                              |                                                                                     | 0.43                                                                                | 0.64                                                                                | 0.47                                                                                | 0.13                                                                                |                                                                                     |
| Uniform Delay, d1                 | 11.7                                                                              | 18.2                                                                              |                                                                                   | 11.9                                                                              | 6.9                                                                               | 5.4                                                                               |                                                                                     | 38.0                                                                                | 26.3                                                                                | 36.6                                                                                | 35.9                                                                                |                                                                                     |
| Progression Factor                | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.2                                                                               | 1.5                                                                               |                                                                                   | 1.2                                                                               | 0.1                                                                               | 0.0                                                                               |                                                                                     | 5.3                                                                                 | 2.8                                                                                 | 4.0                                                                                 | 0.7                                                                                 |                                                                                     |
| Delay (s)                         | 11.9                                                                              | 19.7                                                                              |                                                                                   | 13.1                                                                              | 7.0                                                                               | 5.4                                                                               |                                                                                     | 43.3                                                                                | 29.1                                                                                | 40.6                                                                                | 36.6                                                                                |                                                                                     |
| Level of Service                  | B                                                                                 | B                                                                                 |                                                                                   | B                                                                                 | A                                                                                 | A                                                                                 |                                                                                     | D                                                                                   | C                                                                                   | D                                                                                   | D                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 19.5                                                                              |                                                                                   |                                                                                   | 8.3                                                                               |                                                                                   |                                                                                     | 29.9                                                                                |                                                                                     |                                                                                     | 38.9                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | A                                                                                 |                                                                                   |                                                                                     | C                                                                                   |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 16.8                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | B                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.72                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 79.7                                                                              |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 65.5%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |



# HCM Signalized Intersection Capacity Analysis

## 6: SB Ramp & Graves Mill

02/23/2018

|                                   |  |      |       |       |       |                           |      |      |      |       |       |      |
|-----------------------------------|------------------------------------------------------------------------------------|------|-------|-------|-------|---------------------------|------|------|------|-------|-------|------|
| Movement                          | EBL                                                                                | EBT  | EBR   | WBL   | WBT   | WBR                       | NBL  | NBT  | NBR  | SBL   | SBT   | SBR  |
| Lane Configurations               |                                                                                    | ↑↑   | ↗     | ↖     | ↑↑    |                           |      |      |      |       | ↖     | ↗    |
| Traffic Volume (vph)              | 0                                                                                  | 523  | 820   | 94    | 866   | 0                         | 0    | 0    | 0    | 130   | 1     | 207  |
| Future Volume (vph)               | 0                                                                                  | 523  | 820   | 94    | 866   | 0                         | 0    | 0    | 0    | 130   | 1     | 207  |
| Ideal Flow (vphpl)                | 1900                                                                               | 1900 | 1900  | 1900  | 1900  | 1900                      | 1900 | 1900 | 1900 | 1900  | 1900  | 1900 |
| Lane Width                        | 12                                                                                 | 12   | 12    | 12    | 12    | 12                        | 12   | 12   | 12   | 12    | 11    | 11   |
| Grade (%)                         |                                                                                    | 0%   |       |       | 0%    |                           |      | 3%   |      |       | 3%    |      |
| Total Lost time (s)               |                                                                                    | 5.0  | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   | 5.0  |
| Lane Util. Factor                 |                                                                                    | 0.95 | 1.00  | 1.00  | 0.95  |                           |      |      |      |       | 1.00  | 1.00 |
| Frt                               |                                                                                    | 1.00 | 0.85  | 1.00  | 1.00  |                           |      |      |      |       | 1.00  | 0.85 |
| Flt Protected                     |                                                                                    | 1.00 | 1.00  | 0.95  | 1.00  |                           |      |      |      |       | 0.95  | 1.00 |
| Satd. Flow (prot)                 |                                                                                    | 3574 | 1553  | 1787  | 3574  |                           |      |      |      |       | 1658  | 1451 |
| Flt Permitted                     |                                                                                    | 1.00 | 1.00  | 0.33  | 1.00  |                           |      |      |      |       | 0.95  | 1.00 |
| Satd. Flow (perm)                 |                                                                                    | 3574 | 1553  | 616   | 3574  |                           |      |      |      |       | 1658  | 1451 |
| Peak-hour factor, PHF             | 0.85                                                                               | 0.85 | 0.85  | 0.85  | 0.85  | 0.85                      | 0.85 | 0.85 | 0.85 | 0.85  | 0.85  | 0.85 |
| Adj. Flow (vph)                   | 0                                                                                  | 615  | 965   | 111   | 1019  | 0                         | 0    | 0    | 0    | 153   | 1     | 244  |
| RTOR Reduction (vph)              | 0                                                                                  | 0    | 496   | 0     | 0     | 0                         | 0    | 0    | 0    | 0     | 0     | 117  |
| Lane Group Flow (vph)             | 0                                                                                  | 615  | 469   | 111   | 1019  | 0                         | 0    | 0    | 0    | 0     | 154   | 127  |
| Heavy Vehicles (%)                | 0%                                                                                 | 1%   | 4%    | 1%    | 1%    | 0%                        | 0%   | 0%   | 0%   | 4%    | 0%    | 6%   |
| Turn Type                         |                                                                                    | NA   | Perm  | pm+pt | NA    |                           |      |      |      | Split | NA    | Perm |
| Protected Phases                  |                                                                                    | 2    |       | 1     | 6     |                           |      |      |      | 8     | 8     |      |
| Permitted Phases                  |                                                                                    |      | 2     | 6     |       |                           |      |      |      |       |       | 8    |
| Actuated Green, G (s)             |                                                                                    | 28.7 | 28.7  | 40.5  | 40.5  |                           |      |      |      |       | 11.8  | 11.8 |
| Effective Green, g (s)            |                                                                                    | 28.7 | 28.7  | 40.5  | 40.5  |                           |      |      |      |       | 11.8  | 11.8 |
| Actuated g/C Ratio                |                                                                                    | 0.46 | 0.46  | 0.65  | 0.65  |                           |      |      |      |       | 0.19  | 0.19 |
| Clearance Time (s)                |                                                                                    | 5.0  | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   | 5.0  |
| Vehicle Extension (s)             |                                                                                    | 5.0  | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   | 5.0  |
| Lane Grp Cap (vph)                |                                                                                    | 1646 | 715   | 528   | 2323  |                           |      |      |      |       | 314   | 274  |
| v/s Ratio Prot                    |                                                                                    | 0.17 |       | 0.02  | c0.29 |                           |      |      |      |       | c0.09 |      |
| v/s Ratio Perm                    |                                                                                    |      | c0.30 | 0.11  |       |                           |      |      |      |       |       | 0.09 |
| v/c Ratio                         |                                                                                    | 0.37 | 0.66  | 0.21  | 0.44  |                           |      |      |      |       | 0.49  | 0.46 |
| Uniform Delay, d1                 |                                                                                    | 10.9 | 13.0  | 4.6   | 5.3   |                           |      |      |      |       | 22.6  | 22.4 |
| Progression Factor                |                                                                                    | 1.00 | 1.00  | 1.00  | 1.00  |                           |      |      |      |       | 1.00  | 1.00 |
| Incremental Delay, d2             |                                                                                    | 0.3  | 2.9   | 0.4   | 0.3   |                           |      |      |      |       | 2.5   | 2.6  |
| Delay (s)                         |                                                                                    | 11.2 | 15.9  | 5.0   | 5.6   |                           |      |      |      |       | 25.1  | 25.0 |
| Level of Service                  |                                                                                    | B    | B     | A     | A     |                           |      |      |      |       | C     | C    |
| Approach Delay (s)                |                                                                                    | 14.1 |       |       | 5.6   |                           |      | 0.0  |      |       | 25.1  |      |
| Approach LOS                      |                                                                                    | B    |       |       | A     |                           |      | A    |      |       | C     |      |
| <b>Intersection Summary</b>       |                                                                                    |      |       |       |       |                           |      |      |      |       |       |      |
| HCM 2000 Control Delay            |                                                                                    |      | 12.4  |       |       | HCM 2000 Level of Service |      |      |      | B     |       |      |
| HCM 2000 Volume to Capacity ratio |                                                                                    |      | 0.61  |       |       |                           |      |      |      |       |       |      |
| Actuated Cycle Length (s)         |                                                                                    |      | 62.3  |       |       | Sum of lost time (s)      |      |      |      | 15.0  |       |      |
| Intersection Capacity Utilization |                                                                                    |      | 76.4% |       |       | ICU Level of Service      |      |      |      | D     |       |      |
| Analysis Period (min)             |                                                                                    |      | 15    |       |       |                           |      |      |      |       |       |      |
| c Critical Lane Group             |                                                                                    |      |       |       |       |                           |      |      |      |       |       |      |

# HCM Signalized Intersection Capacity Analysis

## 7: NB Ramp & Graves Mill

02/23/2018

|                                   |  |                                                                                    |  |  |                                                                                    |  |  |                                                                                      |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                                                                                                                 | EBR                                                                               | WBL                                                                               | WBT                                                                                                                                                                 | WBR                                                                               | NBL                                                                                 | NBT                                                                                                                                                                     | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |   |                                                                                   |                                                                                   |   |  |  |   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Traffic Volume (vph)              | 271                                                                               | 384                                                                                                                                                                 | 0                                                                                 | 0                                                                                 | 294                                                                                                                                                                 | 53                                                                                | 630                                                                                 | 0                                                                                                                                                                       | 183                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Future Volume (vph)               | 271                                                                               | 384                                                                                                                                                                 | 0                                                                                 | 0                                                                                 | 294                                                                                                                                                                 | 53                                                                                | 630                                                                                 | 0                                                                                                                                                                       | 183                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                                                                                                                | 1900                                                                              | 1900                                                                              | 1900                                                                                                                                                                | 1900                                                                              | 1900                                                                                | 1900                                                                                                                                                                    | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                                                                                                  | 12                                                                                | 12                                                                                | 12                                                                                                                                                                  | 12                                                                                | 11                                                                                  | 12                                                                                                                                                                      | 12                                                                                  | 12                                                                                  | 12                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 0%                                                                                                                                                                  |                                                                                   |                                                                                   | -3%                                                                                                                                                                 |                                                                                   |                                                                                     | 3%                                                                                                                                                                      |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 6.0                                                                                                                                                                 |                                                                                   |                                                                                   | 6.0                                                                                                                                                                 | 6.0                                                                               | 5.0                                                                                 | 5.0                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                                                                                                                |                                                                                   |                                                                                   | 0.95                                                                                                                                                                | 1.00                                                                              | 0.95                                                                                | 0.95                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                                                                                                                |                                                                                   |                                                                                   | 1.00                                                                                                                                                                | 0.85                                                                              | 1.00                                                                                | 0.93                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                                                                                                                |                                                                                   |                                                                                   | 1.00                                                                                                                                                                | 1.00                                                                              | 0.95                                                                                | 0.97                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (prot)                 | 1770                                                                              | 3574                                                                                                                                                                |                                                                                   |                                                                                   | 3523                                                                                                                                                                | 1546                                                                              | 1585                                                                                | 1586                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Flt Permitted                     | 0.36                                                                              | 1.00                                                                                                                                                                |                                                                                   |                                                                                   | 1.00                                                                                                                                                                | 1.00                                                                              | 0.95                                                                                | 0.97                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (perm)                 | 667                                                                               | 3574                                                                                                                                                                |                                                                                   |                                                                                   | 3523                                                                                                                                                                | 1546                                                                              | 1585                                                                                | 1586                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Peak-hour factor, PHF             | 0.81                                                                              | 0.81                                                                                                                                                                | 0.81                                                                              | 0.81                                                                              | 0.81                                                                                                                                                                | 0.81                                                                              | 0.81                                                                                | 0.81                                                                                                                                                                    | 0.81                                                                                | 0.81                                                                                | 0.81                                                                                | 0.81                                                                                |
| Adj. Flow (vph)                   | 335                                                                               | 474                                                                                                                                                                 | 0                                                                                 | 0                                                                                 | 363                                                                                                                                                                 | 65                                                                                | 778                                                                                 | 0                                                                                                                                                                       | 226                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                                                                                                   | 0                                                                                 | 0                                                                                 | 0                                                                                                                                                                   | 52                                                                                | 0                                                                                   | 88                                                                                                                                                                      | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 335                                                                               | 474                                                                                                                                                                 | 0                                                                                 | 0                                                                                 | 363                                                                                                                                                                 | 13                                                                                | 513                                                                                 | 403                                                                                                                                                                     | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 2%                                                                                | 1%                                                                                                                                                                  | 0%                                                                                | 0%                                                                                | 4%                                                                                                                                                                  | 6%                                                                                | 3%                                                                                  | 0%                                                                                                                                                                      | 0%                                                                                  | 2%                                                                                  | 2%                                                                                  | 2%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                                                                                                  |                                                                                   |                                                                                   | NA                                                                                                                                                                  | Perm                                                                              | Split                                                                               | NA                                                                                                                                                                      |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Protected Phases                  | 1                                                                                 | 6                                                                                                                                                                   |                                                                                   |                                                                                   | 2                                                                                                                                                                   |                                                                                   | 4                                                                                   | 4                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Permitted Phases                  | 6                                                                                 |                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                     | 2                                                                                 |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 24.5                                                                              | 24.5                                                                                                                                                                |                                                                                   |                                                                                   | 10.1                                                                                                                                                                | 10.1                                                                              | 15.1                                                                                | 15.1                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Effective Green, g (s)            | 24.5                                                                              | 24.5                                                                                                                                                                |                                                                                   |                                                                                   | 10.1                                                                                                                                                                | 10.1                                                                              | 15.1                                                                                | 15.1                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated g/C Ratio                | 0.48                                                                              | 0.48                                                                                                                                                                |                                                                                   |                                                                                   | 0.20                                                                                                                                                                | 0.20                                                                              | 0.30                                                                                | 0.30                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 6.0                                                                                                                                                                 |                                                                                   |                                                                                   | 6.0                                                                                                                                                                 | 6.0                                                                               | 5.0                                                                                 | 5.0                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Vehicle Extension (s)             | 2.5                                                                               | 2.5                                                                                                                                                                 |                                                                                   |                                                                                   | 2.5                                                                                                                                                                 | 2.5                                                                               | 2.5                                                                                 | 2.5                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Lane Grp Cap (vph)                | 527                                                                               | 1730                                                                                                                                                                |                                                                                   |                                                                                   | 703                                                                                                                                                                 | 308                                                                               | 472                                                                                 | 473                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Prot                    | c0.12                                                                             | 0.13                                                                                                                                                                |                                                                                   |                                                                                   | 0.10                                                                                                                                                                |                                                                                   | c0.32                                                                               | 0.25                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Perm                    | c0.19                                                                             |                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                     | 0.01                                                                              |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.64                                                                              | 0.27                                                                                                                                                                |                                                                                   |                                                                                   | 0.52                                                                                                                                                                | 0.04                                                                              | 1.09                                                                                | 0.85                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Uniform Delay, d1                 | 8.7                                                                               | 7.8                                                                                                                                                                 |                                                                                   |                                                                                   | 18.1                                                                                                                                                                | 16.3                                                                              | 17.8                                                                                | 16.7                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Progression Factor                | 1.00                                                                              | 1.00                                                                                                                                                                |                                                                                   |                                                                                   | 1.00                                                                                                                                                                | 1.00                                                                              | 1.00                                                                                | 1.00                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Incremental Delay, d2             | 2.2                                                                               | 0.1                                                                                                                                                                 |                                                                                   |                                                                                   | 0.5                                                                                                                                                                 | 0.0                                                                               | 66.9                                                                                | 13.7                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Delay (s)                         | 10.9                                                                              | 7.8                                                                                                                                                                 |                                                                                   |                                                                                   | 18.6                                                                                                                                                                | 16.4                                                                              | 84.7                                                                                | 30.4                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Level of Service                  | B                                                                                 | A                                                                                                                                                                   |                                                                                   |                                                                                   | B                                                                                                                                                                   | B                                                                                 | F                                                                                   | C                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Approach Delay (s)                |                                                                                   | 9.1                                                                                                                                                                 |                                                                                   |                                                                                   | 18.2                                                                                                                                                                |                                                                                   |                                                                                     | 58.1                                                                                                                                                                    |                                                                                     |                                                                                     | 0.0                                                                                 |                                                                                     |
| Approach LOS                      |                                                                                   | A                                                                                                                                                                   |                                                                                   |                                                                                   | B                                                                                                                                                                   |                                                                                   |                                                                                     | E                                                                                                                                                                       |                                                                                     |                                                                                     | A                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                                                                                                     | 32.8                                                                              |                                                                                   |                                                                                                                                                                     |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                                                                                                         | C                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                                                                                                     | 0.89                                                                              |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                                                                                                     | 50.6                                                                              |                                                                                   |                                                                                                                                                                     |                                                                                   | Sum of lost time (s)                                                                |                                                                                                                                                                         | 16.0                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                                                                                                     | 76.4%                                                                             |                                                                                   |                                                                                                                                                                     |                                                                                   | ICU Level of Service                                                                |                                                                                                                                                                         | D                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                                                                                                     | 15                                                                                |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 9: Forest & Graves Mill

02/23/2018

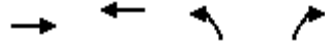
|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |                                                                                   |  |  |  |  |  |  |
| Traffic Volume (vph)              | 80                                                                                | 158                                                                               | 6                                                                                 | 249                                                                               | 135                                                                               | 121                                                                               | 32                                                                                  | 1221                                                                                | 460                                                                                 | 189                                                                                 | 741                                                                                 | 92                                                                                  |
| Future Volume (vph)               | 80                                                                                | 158                                                                               | 6                                                                                 | 249                                                                               | 135                                                                               | 121                                                                               | 32                                                                                  | 1221                                                                                | 460                                                                                 | 189                                                                                 | 741                                                                                 | 92                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 10                                                                                | 11                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                  | 12                                                                                  | 11                                                                                  | 11                                                                                  | 11                                                                                  | 11                                                                                  |
| Total Lost time (s)               | 6.7                                                                               | 6.7                                                                               |                                                                                   | 7.7                                                                               | 7.7                                                                               |                                                                                   | 7.7                                                                                 | 5.7                                                                                 | 7.7                                                                                 | 7.4                                                                                 | 5.8                                                                                 | 6.7                                                                                 |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |
| Frt                               | 1.00                                                                              | 0.99                                                                              |                                                                                   | 1.00                                                                              | 0.93                                                                              |                                                                                   | 1.00                                                                                | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 1.00                                                                                | 0.85                                                                                |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                |
| Satd. Flow (prot)                 | 1604                                                                              | 3333                                                                              |                                                                                   | 1687                                                                              | 1659                                                                              |                                                                                   | 1745                                                                                | 3505                                                                                | 1531                                                                                | 1694                                                                                | 3388                                                                                | 1473                                                                                |
| Flt Permitted                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                |
| Satd. Flow (perm)                 | 1604                                                                              | 3333                                                                              |                                                                                   | 1687                                                                              | 1659                                                                              |                                                                                   | 1745                                                                                | 3505                                                                                | 1531                                                                                | 1694                                                                                | 3388                                                                                | 1473                                                                                |
| Peak-hour factor, PHF             | 0.84                                                                              | 0.84                                                                              | 0.84                                                                              | 0.84                                                                              | 0.84                                                                              | 0.84                                                                              | 0.84                                                                                | 0.84                                                                                | 0.84                                                                                | 0.84                                                                                | 0.84                                                                                | 0.84                                                                                |
| Adj. Flow (vph)                   | 95                                                                                | 188                                                                               | 7                                                                                 | 296                                                                               | 161                                                                               | 144                                                                               | 38                                                                                  | 1454                                                                                | 548                                                                                 | 225                                                                                 | 882                                                                                 | 110                                                                                 |
| RTOR Reduction (vph)              | 0                                                                                 | 2                                                                                 | 0                                                                                 | 0                                                                                 | 26                                                                                | 0                                                                                 | 0                                                                                   | 0                                                                                   | 40                                                                                  | 0                                                                                   | 0                                                                                   | 45                                                                                  |
| Lane Group Flow (vph)             | 95                                                                                | 193                                                                               | 0                                                                                 | 296                                                                               | 279                                                                               | 0                                                                                 | 38                                                                                  | 1454                                                                                | 508                                                                                 | 225                                                                                 | 882                                                                                 | 65                                                                                  |
| Heavy Vehicles (%)                | 5%                                                                                | 4%                                                                                | 8%                                                                                | 7%                                                                                | 5%                                                                                | 8%                                                                                | 0%                                                                                  | 3%                                                                                  | 2%                                                                                  | 3%                                                                                  | 3%                                                                                  | 6%                                                                                  |
| Turn Type                         | Split                                                                             | NA                                                                                |                                                                                   | Split                                                                             | NA                                                                                |                                                                                   | Prot                                                                                | NA                                                                                  | pm+ov                                                                               | Prot                                                                                | NA                                                                                  | pm+ov                                                                               |
| Protected Phases                  | 4                                                                                 | 4                                                                                 |                                                                                   | 3                                                                                 | 3                                                                                 |                                                                                   | 1                                                                                   | 6                                                                                   | 3                                                                                   | 5                                                                                   | 2                                                                                   | 4                                                                                   |
| Permitted Phases                  |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     | 6                                                                                   |                                                                                     |                                                                                     | 2                                                                                   |
| Actuated Green, G (s)             | 12.2                                                                              | 12.2                                                                              |                                                                                   | 19.3                                                                              | 19.3                                                                              |                                                                                   | 5.9                                                                                 | 57.4                                                                                | 76.7                                                                                | 12.6                                                                                | 63.7                                                                                | 75.9                                                                                |
| Effective Green, g (s)            | 12.2                                                                              | 12.2                                                                              |                                                                                   | 19.3                                                                              | 19.3                                                                              |                                                                                   | 5.9                                                                                 | 57.4                                                                                | 76.7                                                                                | 12.6                                                                                | 63.7                                                                                | 75.9                                                                                |
| Actuated g/C Ratio                | 0.09                                                                              | 0.09                                                                              |                                                                                   | 0.15                                                                              | 0.15                                                                              |                                                                                   | 0.05                                                                                | 0.44                                                                                | 0.59                                                                                | 0.10                                                                                | 0.49                                                                                | 0.59                                                                                |
| Clearance Time (s)                | 6.7                                                                               | 6.7                                                                               |                                                                                   | 7.7                                                                               | 7.7                                                                               |                                                                                   | 7.7                                                                                 | 5.7                                                                                 | 7.7                                                                                 | 7.4                                                                                 | 5.8                                                                                 | 6.7                                                                                 |
| Vehicle Extension (s)             | 3.5                                                                               | 3.5                                                                               |                                                                                   | 3.5                                                                               | 3.5                                                                               |                                                                                   | 3.5                                                                                 | 5.0                                                                                 | 3.5                                                                                 | 3.5                                                                                 | 5.0                                                                                 | 3.5                                                                                 |
| Lane Grp Cap (vph)                | 151                                                                               | 315                                                                               |                                                                                   | 252                                                                               | 248                                                                               |                                                                                   | 79                                                                                  | 1559                                                                                | 910                                                                                 | 165                                                                                 | 1672                                                                                | 866                                                                                 |
| v/s Ratio Prot                    | c0.06                                                                             | 0.06                                                                              |                                                                                   | c0.18                                                                             | 0.17                                                                              |                                                                                   | 0.02                                                                                | c0.41                                                                               | 0.08                                                                                | c0.13                                                                               | c0.26                                                                               | 0.01                                                                                |
| v/s Ratio Perm                    |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     | 0.25                                                                                |                                                                                     |                                                                                     | 0.04                                                                                |
| v/c Ratio                         | 0.63                                                                              | 0.61                                                                              |                                                                                   | 1.17                                                                              | 1.13                                                                              |                                                                                   | 0.48                                                                                | 0.93                                                                                | 0.56                                                                                | 1.36                                                                                | 0.53                                                                                | 0.07                                                                                |
| Uniform Delay, d1                 | 56.2                                                                              | 56.1                                                                              |                                                                                   | 54.9                                                                              | 54.9                                                                              |                                                                                   | 60.1                                                                                | 34.0                                                                                | 15.9                                                                                | 58.2                                                                                | 22.3                                                                                | 11.4                                                                                |
| Progression Factor                | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |
| Incremental Delay, d2             | 8.3                                                                               | 3.7                                                                               |                                                                                   | 112.2                                                                             | 95.6                                                                              |                                                                                   | 5.4                                                                                 | 10.9                                                                                | 0.8                                                                                 | 197.5                                                                               | 0.6                                                                                 | 0.0                                                                                 |
| Delay (s)                         | 64.5                                                                              | 59.8                                                                              |                                                                                   | 167.1                                                                             | 150.5                                                                             |                                                                                   | 65.4                                                                                | 44.9                                                                                | 16.7                                                                                | 255.7                                                                               | 22.9                                                                                | 11.5                                                                                |
| Level of Service                  | E                                                                                 | E                                                                                 |                                                                                   | F                                                                                 | F                                                                                 |                                                                                   | E                                                                                   | D                                                                                   | B                                                                                   | F                                                                                   | C                                                                                   | B                                                                                   |
| Approach Delay (s)                |                                                                                   | 61.4                                                                              |                                                                                   |                                                                                   | 158.6                                                                             |                                                                                   |                                                                                     | 37.7                                                                                |                                                                                     |                                                                                     | 64.9                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | E                                                                                 |                                                                                   |                                                                                   | F                                                                                 |                                                                                   |                                                                                     | D                                                                                   |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 64.9                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 1.00                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 129.0                                                                             |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                     |                                                                                     | 27.9                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 88.3%                                                                             |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |



## Queues

### 1: Gristmill & Graves Mill

02/23/2018



| Lane Group              | EBT  | WBT  | NBL  | NBR  |
|-------------------------|------|------|------|------|
| Lane Group Flow (vph)   | 787  | 766  | 19   | 673  |
| v/c Ratio               | 0.69 | 0.58 | 0.05 | 1.09 |
| Control Delay           | 21.5 | 9.2  | 20.4 | 81.0 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 21.5 | 9.2  | 20.4 | 81.0 |
| Queue Length 50th (ft)  | 130  | 73   | 5    | ~193 |
| Queue Length 95th (ft)  | 165  | 93   | 20   | #367 |
| Internal Link Dist (ft) | 1043 | 605  | 674  |      |
| Turn Bay Length (ft)    |      |      |      | 180  |
| Base Capacity (vph)     | 1963 | 1775 | 393  | 616  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.40 | 0.43 | 0.05 | 1.09 |

#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

## Queues

## 2: Millrace &amp; Graves Mill

02/23/2018

|                         |  |  |  |  |  |
|-------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Lane Group              | EBT                                                                               | WBL                                                                               | WBT                                                                               | NBL                                                                               | NBR                                                                               |
| Lane Group Flow (vph)   | 1388                                                                              | 82                                                                                | 805                                                                               | 14                                                                                | 13                                                                                |
| v/c Ratio               | 0.56                                                                              | 0.22                                                                              | 0.25                                                                              | 0.08                                                                              | 0.09                                                                              |
| Control Delay           | 8.4                                                                               | 2.9                                                                               | 1.7                                                                               | 25.4                                                                              | 15.0                                                                              |
| Queue Delay             | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               |
| Total Delay             | 8.4                                                                               | 2.9                                                                               | 1.7                                                                               | 25.4                                                                              | 15.0                                                                              |
| Queue Length 50th (ft)  | 84                                                                                | 0                                                                                 | 0                                                                                 | 4                                                                                 | 0                                                                                 |
| Queue Length 95th (ft)  | 240                                                                               | 12                                                                                | 50                                                                                | 18                                                                                | 12                                                                                |
| Internal Link Dist (ft) | 952                                                                               |                                                                                   | 1251                                                                              | 593                                                                               |                                                                                   |
| Turn Bay Length (ft)    |                                                                                   | 330                                                                               |                                                                                   |                                                                                   | 240                                                                               |
| Base Capacity (vph)     | 2468                                                                              | 499                                                                               | 3234                                                                              | 507                                                                               | 425                                                                               |
| Starvation Cap Reductn  | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Spillback Cap Reductn   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Storage Cap Reductn     | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Reduced v/c Ratio       | 0.56                                                                              | 0.16                                                                              | 0.25                                                                              | 0.03                                                                              | 0.03                                                                              |
| Intersection Summary    |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |

## Queues

## 4: Old Graves Mill &amp; Graves Mill

02/23/2018



| Lane Group              | EBT  | EBR  | WBL  | WBT  | NBT  | NBR  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1035 | 151  | 111  | 775  | 148  | 55   |
| v/c Ratio               | 0.61 | 0.18 | 0.41 | 0.32 | 0.47 | 0.13 |
| Control Delay           | 16.0 | 2.2  | 32.1 | 4.9  | 31.6 | 0.6  |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 16.0 | 2.2  | 32.1 | 4.9  | 31.6 | 0.6  |
| Queue Length 50th (ft)  | 160  | 0    | 40   | 54   | 52   | 0    |
| Queue Length 95th (ft)  | 269  | 22   | 95   | 92   | 118  | 0    |
| Internal Link Dist (ft) | 1348 |      |      | 700  | 365  |      |
| Turn Bay Length (ft)    |      | 280  | 310  |      |      |      |
| Base Capacity (vph)     | 1955 | 936  | 413  | 2877 | 589  | 633  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.53 | 0.16 | 0.27 | 0.27 | 0.25 | 0.09 |
| Intersection Summary    |      |      |      |      |      |      |



## Queues

## 5: Connector/Creekside &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT  | NBR  | SBL  | SBT  |
|-------------------------|------|------|------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 36   | 1087 | 283  | 862  | 89   | 23   | 421  | 41   | 30   |
| v/c Ratio               | 0.09 | 0.71 | 0.49 | 0.32 | 0.07 | 0.13 | 0.74 | 0.22 | 0.15 |
| Control Delay           | 7.7  | 23.0 | 14.4 | 8.2  | 1.3  | 40.1 | 22.9 | 39.7 | 23.7 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 7.7  | 23.0 | 14.4 | 8.2  | 1.3  | 40.1 | 22.9 | 39.7 | 23.7 |
| Queue Length 50th (ft)  | 4    | 210  | 42   | 47   | 0    | 10   | 111  | 18   | 4    |
| Queue Length 95th (ft)  | 17   | 382  | 156  | 206  | 11   | 36   | 219  | 54   | 31   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519  |      |      | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      | 300  |      | 160  | 190  |      |
| Base Capacity (vph)     | 594  | 1960 | 719  | 2706 | 1204 | 582  | 692  | 284  | 291  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.06 | 0.55 | 0.39 | 0.32 | 0.07 | 0.04 | 0.61 | 0.14 | 0.10 |
| Intersection Summary    |      |      |      |      |      |      |      |      |      |

## Queues

## 6: SB Ramp &amp; Graves Mill

02/23/2018

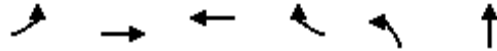


| Lane Group              | EBT  | EBR  | WBL  | WBT  | SBT  | SBR  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 615  | 965  | 111  | 1019 | 154  | 244  |
| v/c Ratio               | 0.37 | 0.79 | 0.20 | 0.45 | 0.48 | 0.62 |
| Control Delay           | 12.5 | 7.9  | 5.0  | 6.2  | 30.3 | 19.0 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 12.5 | 7.9  | 5.0  | 6.2  | 30.3 | 19.0 |
| Queue Length 50th (ft)  | 84   | 10   | 14   | 88   | 57   | 36   |
| Queue Length 95th (ft)  | 115  | 56   | 27   | 111  | 104  | 93   |
| Internal Link Dist (ft) | 797  |      |      | 663  | 620  |      |
| Turn Bay Length (ft)    |      | 280  | 250  |      |      | 125  |
| Base Capacity (vph)     | 1826 | 1242 | 591  | 2641 | 366  | 433  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.34 | 0.78 | 0.19 | 0.39 | 0.42 | 0.56 |
| Intersection Summary    |      |      |      |      |      |      |

## Queues

## 7: NB Ramp &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBT  | WBR  | NBL  | NBT  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 335  | 474  | 363  | 65   | 513  | 491  |
| v/c Ratio               | 0.62 | 0.27 | 0.52 | 0.16 | 1.09 | 0.88 |
| Control Delay           | 13.0 | 8.1  | 20.9 | 2.7  | 91.5 | 34.5 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 13.0 | 8.1  | 20.9 | 2.7  | 91.5 | 34.5 |
| Queue Length 50th (ft)  | 55   | 40   | 51   | 0    | ~191 | 108  |
| Queue Length 95th (ft)  | 85   | 54   | 74   | 7    | #329 | #245 |
| Internal Link Dist (ft) |      | 663  | 458  |      |      | 755  |
| Turn Bay Length (ft)    | 170  |      |      | 180  |      |      |
| Base Capacity (vph)     | 555  | 3120 | 2026 | 935  | 471  | 559  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.60 | 0.15 | 0.18 | 0.07 | 1.09 | 0.88 |

## Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.



## Queues

## 9: Forest &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBL   | WBT   | NBL  | NBT  | NBR  | SBL   | SBT  | SBR  |
|-------------------------|------|------|-------|-------|------|------|------|-------|------|------|
| Lane Group Flow (vph)   | 95   | 195  | 296   | 305   | 38   | 1454 | 548  | 225   | 882  | 110  |
| v/c Ratio               | 0.62 | 0.60 | 1.15  | 1.09  | 0.30 | 0.96 | 0.55 | 1.33  | 0.51 | 0.12 |
| Control Delay           | 72.1 | 62.2 | 148.6 | 125.4 | 61.5 | 51.0 | 13.1 | 225.8 | 23.9 | 1.6  |
| Queue Delay             | 0.0  | 0.0  | 0.0   | 0.0   | 0.0  | 0.0  | 0.0  | 0.0   | 0.0  | 0.0  |
| Total Delay             | 72.1 | 62.2 | 148.6 | 125.4 | 61.5 | 51.0 | 13.1 | 225.8 | 23.9 | 1.6  |
| Queue Length 50th (ft)  | 76   | 80   | ~287  | ~262  | 30   | 606  | 197  | ~241  | 275  | 0    |
| Queue Length 95th (ft)  | 125  | 112  | #422  | #401  | 61   | #644 | 257  | #367  | 323  | 12   |
| Internal Link Dist (ft) |      | 661  |       | 1043  |      | 1143 |      |       | 649  |      |
| Turn Bay Length (ft)    | 90   |      |       |       | 200  |      | 360  | 250   |      | 280  |
| Base Capacity (vph)     | 169  | 353  | 258   | 279   | 170  | 1511 | 1000 | 169   | 1713 | 933  |
| Starvation Cap Reductn  | 0    | 0    | 0     | 0     | 0    | 0    | 0    | 0     | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0     | 0     | 0    | 0    | 0    | 0     | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0     | 0     | 0    | 0    | 0    | 0     | 0    | 0    |
| Reduced v/c Ratio       | 0.56 | 0.55 | 1.15  | 1.09  | 0.22 | 0.96 | 0.55 | 1.33  | 0.51 | 0.12 |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM 2010 TWSC  
3: Graves Mill & Millside

02/23/2018

Intersection

Int Delay, s/veh 0.3

| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lane Configurations      |      | ↕↕   | ↗    |      | ↕↕   | ↗    |      | ↕    |      |      | ↕    |      |
| Traffic Vol, veh/h       | 4    | 1043 | 3    | 6    | 802  | 14   | 0    | 0    | 6    | 6    | 0    | 3    |
| Future Vol, veh/h        | 4    | 1043 | 3    | 6    | 802  | 14   | 0    | 0    | 6    | 6    | 0    | 3    |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized           | -    | -    | None | -    | -    | None | -    | -    | None | -    | -    | None |
| Storage Length           | -    | -    | 140  | -    | -    | 140  | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | -5   | -    | -    | 5    | -    | -    | 3    | -    | -    | -5   | -    |
| Peak Hour Factor         | 85   | 85   | 85   | 85   | 85   | 85   | 85   | 85   | 85   | 85   | 85   | 85   |
| Heavy Vehicles, %        | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Mvmt Flow                | 5    | 1227 | 4    | 7    | 944  | 16   | 0    | 0    | 7    | 7    | 0    | 4    |

| Major/Minor          | Major1 |   |   | Major2 |   |   | Minor1 |      |     | Minor2 |      |     |
|----------------------|--------|---|---|--------|---|---|--------|------|-----|--------|------|-----|
| Conflicting Flow All | 944    | 0 | 0 | 1227   | 0 | 0 | 1722   | 2194 | 614 | 1581   | 2194 | 472 |
| Stage 1              | -      | - | - | -      | - | - | 1236   | 1236 | -   | 958    | 958  | -   |
| Stage 2              | -      | - | - | -      | - | - | 486    | 958  | -   | 623    | 1236 | -   |
| Critical Hdwy        | 4.1    | - | - | 4.1    | - | - | 8.1    | 7.1  | 7.2 | 6.5    | 5.5  | 6.4 |
| Critical Hdwy Stg 1  | -      | - | - | -      | - | - | 7.1    | 6.1  | -   | 5.5    | 4.5  | -   |
| Critical Hdwy Stg 2  | -      | - | - | -      | - | - | 7.1    | 6.1  | -   | 5.5    | 4.5  | -   |
| Follow-up Hdwy       | 2.2    | - | - | 2.2    | - | - | 3.5    | 4    | 3.3 | 3.5    | 4    | 3.3 |
| Pot Cap-1 Maneuver   | 735    | - | - | 575    | - | - | 44     | 32   | 418 | 116    | 84   | 581 |
| Stage 1              | -      | - | - | -      | - | - | 154    | 204  | -   | 366    | 442  | -   |
| Stage 2              | -      | - | - | -      | - | - | 495    | 288  | -   | 529    | 353  | -   |
| Platoon blocked, %   |        | - | - |        | - | - |        |      |     |        |      |     |
| Mov Cap-1 Maneuver   | 735    | - | - | 575    | - | - | 42     | 30   | 418 | 110    | 80   | 581 |
| Mov Cap-2 Maneuver   | -      | - | - | -      | - | - | 42     | 30   | -   | 110    | 80   | -   |
| Stage 1              | -      | - | - | -      | - | - | 151    | 200  | -   | 358    | 431  | -   |
| Stage 2              | -      | - | - | -      | - | - | 479    | 281  | -   | 509    | 345  | -   |

| Approach             | EB  |  |  | WB  |  |  | NB   |  |  | SB   |  |  |
|----------------------|-----|--|--|-----|--|--|------|--|--|------|--|--|
| HCM Control Delay, s | 0.1 |  |  | 0.2 |  |  | 13.8 |  |  | 30.6 |  |  |
| HCM LOS              |     |  |  |     |  |  | B    |  |  | D    |  |  |

| Minor Lane/Major Mvmt | NBLn1 | EBL   | EBT | EBR | WBL   | WBT | WBR | SBLn1 |
|-----------------------|-------|-------|-----|-----|-------|-----|-----|-------|
| Capacity (veh/h)      | 418   | 735   | -   | -   | 575   | -   | -   | 151   |
| HCM Lane V/C Ratio    | 0.017 | 0.006 | -   | -   | 0.012 | -   | -   | 0.07  |
| HCM Control Delay (s) | 13.8  | 9.9   | 0.1 | -   | 11.3  | 0.1 | -   | 30.6  |
| HCM Lane LOS          | B     | A     | A   | -   | B     | A   | -   | D     |
| HCM 95th %tile Q(veh) | 0.1   | 0     | -   | -   | 0     | -   | -   | 0.2   |

Intersection

Intersection Delay, s/veh 20

Intersection LOS C

| Movement            | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lane Configurations |      | ↰    | ↱    |      | ↰    |      |      | ↰    |      |      | ↰    | ↱    |
| Traffic Vol, veh/h  | 35   | 306  | 206  | 3    | 56   | 2    | 130  | 16   | 73   | 10   | 35   | 116  |
| Future Vol, veh/h   | 35   | 306  | 206  | 3    | 56   | 2    | 130  | 16   | 73   | 10   | 35   | 116  |
| Peak Hour Factor    | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Heavy Vehicles, %   | 0    | 0    | 4    | 0    | 7    | 0    | 3    | 0    | 4    | 0    | 6    | 0    |
| Mvmt Flow           | 47   | 408  | 275  | 4    | 75   | 3    | 173  | 21   | 97   | 13   | 47   | 155  |
| Number of Lanes     | 0    | 1    | 1    | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 1    | 1    |

| Approach                      | EB   | WB | NB   | SB   |
|-------------------------------|------|----|------|------|
| Opposing Approach             | WB   | EB | SB   | NB   |
| Opposing Lanes                | 1    | 2  | 2    | 1    |
| Conflicting Approach Left SB  |      | NB | EB   | WB   |
| Conflicting Lanes Left        | 2    | 1  | 2    | 1    |
| Conflicting Approach Right NB |      | SB | WB   | EB   |
| Conflicting Lanes Right       | 1    | 2  | 1    | 2    |
| HCM Control Delay             | 23.9 | 12 | 18.5 | 11.9 |
| HCM LOS                       | C    | B  | C    | B    |

| Lane                   | NBLn1 | EBLn1 | EBLn2 | WBLn1 | SBLn1 | SBLn2 |
|------------------------|-------|-------|-------|-------|-------|-------|
| Vol Left, %            | 59%   | 10%   | 0%    | 5%    | 22%   | 0%    |
| Vol Thru, %            | 7%    | 90%   | 0%    | 92%   | 78%   | 0%    |
| Vol Right, %           | 33%   | 0%    | 100%  | 3%    | 0%    | 100%  |
| Sign Control           | Stop  | Stop  | Stop  | Stop  | Stop  | Stop  |
| Traffic Vol by Lane    | 219   | 341   | 206   | 61    | 45    | 116   |
| LT Vol                 | 130   | 35    | 0     | 3     | 10    | 0     |
| Through Vol            | 16    | 306   | 0     | 56    | 35    | 0     |
| RT Vol                 | 73    | 0     | 206   | 2     | 0     | 116   |
| Lane Flow Rate         | 292   | 455   | 275   | 81    | 60    | 155   |
| Geometry Grp           | 6     | 7     | 7     | 6     | 7     | 7     |
| Degree of Util (X)     | 0.56  | 0.806 | 0.429 | 0.169 | 0.125 | 0.29  |
| Departure Headway (Hd) | 6.904 | 6.382 | 5.619 | 7.479 | 7.476 | 6.75  |
| Convergence, Y/N       | Yes   | Yes   | Yes   | Yes   | Yes   | Yes   |
| Cap                    | 520   | 564   | 634   | 481   | 482   | 535   |
| Service Time           | 4.996 | 4.171 | 3.407 | 5.491 | 5.176 | 4.45  |
| HCM Lane V/C Ratio     | 0.562 | 0.807 | 0.434 | 0.168 | 0.124 | 0.29  |
| HCM Control Delay      | 18.5  | 30.7  | 12.6  | 12    | 11.2  | 12.2  |
| HCM Lane LOS           | C     | D     | B     | B     | B     | B     |
| HCM 95th-tile Q        | 3.4   | 7.9   | 2.2   | 0.6   | 0.4   | 1.2   |



Intersection

Int Delay, s/veh 4

| Movement                 | WBL                                                                               | WBR                                                                               | NBT                                                                               | NBR  | SBL  | SBT                                                                               |
|--------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------------------------------------------------------------------------------|
| Lane Configurations      |  |  |  |      |      |  |
| Traffic Vol, veh/h       | 129                                                                               | 3                                                                                 | 214                                                                               | 419  | 62   | 185                                                                               |
| Future Vol, veh/h        | 129                                                                               | 3                                                                                 | 214                                                                               | 419  | 62   | 185                                                                               |
| Conflicting Peds, #/hr   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0    | 0    | 0                                                                                 |
| Sign Control             | Stop                                                                              | Stop                                                                              | Free                                                                              | Free | Free | Free                                                                              |
| RT Channelized           | -                                                                                 | None                                                                              | -                                                                                 | None | -    | None                                                                              |
| Storage Length           | 255                                                                               | 0                                                                                 | -                                                                                 | -    | -    | -                                                                                 |
| Veh in Median Storage, # | 0                                                                                 | -                                                                                 | 0                                                                                 | -    | -    | 0                                                                                 |
| Grade, %                 | 0                                                                                 | -                                                                                 | 0                                                                                 | -    | -    | 0                                                                                 |
| Peak Hour Factor         | 89                                                                                | 89                                                                                | 89                                                                                | 89   | 89   | 89                                                                                |
| Heavy Vehicles, %        | 6                                                                                 | 0                                                                                 | 3                                                                                 | 2    | 2    | 5                                                                                 |
| Mvmt Flow                | 145                                                                               | 3                                                                                 | 240                                                                               | 471  | 70   | 208                                                                               |

| Major/Minor          | Minor1 | Major1 | Major2 |
|----------------------|--------|--------|--------|
| Conflicting Flow All | 823    | 476    | 0      |
| Stage 1              | 476    | -      | -      |
| Stage 2              | 347    | -      | -      |
| Critical Hdwy        | 6.46   | 6.2    | -      |
| Critical Hdwy Stg 1  | 5.46   | -      | -      |
| Critical Hdwy Stg 2  | 5.46   | -      | -      |
| Follow-up Hdwy       | 3.554  | 3.3    | -      |
| Pot Cap-1 Maneuver   | 338    | 593    | -      |
| Stage 1              | 617    | -      | -      |
| Stage 2              | 707    | -      | -      |
| Platoon blocked, %   |        | -      | -      |
| Mov Cap-1 Maneuver   | 308    | 593    | -      |
| Mov Cap-2 Maneuver   | 308    | -      | -      |
| Stage 1              | 617    | -      | -      |
| Stage 2              | 644    | -      | -      |

| Approach             | WB   | NB | SB  |
|----------------------|------|----|-----|
| HCM Control Delay, s | 26.3 | 0  | 2.4 |
| HCM LOS              | D    |    |     |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1WBLn2 | SBL   | SBT   |
|-----------------------|-----|---------------|-------|-------|
| Capacity (veh/h)      | -   | -             | 308   | 593   |
| HCM Lane V/C Ratio    | -   | -             | 0.471 | 0.006 |
| HCM Control Delay (s) | -   | -             | 26.7  | 11.1  |
| HCM Lane LOS          | -   | -             | D     | B     |
| HCM 95th %tile Q(veh) | -   | -             | 2.4   | 0     |

# HCM Signalized Intersection Capacity Analysis

## 1: Gristmill & Graves Mill

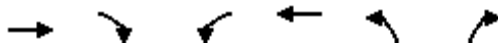
02/23/2018

|                                   |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Movement                          | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | NBL                                                                               | NBR                                                                               |
| Lane Configurations               | ↑↑                                                                                |                                                                                   |                                                                                   | ↑↑                                                                                | ↗                                                                                 | ↗                                                                                 |
| Traffic Volume (vph)              | 497                                                                               | 48                                                                                | 329                                                                               | 804                                                                               | 36                                                                                | 350                                                                               |
| Future Volume (vph)               | 497                                                                               | 48                                                                                | 329                                                                               | 804                                                                               | 36                                                                                | 350                                                                               |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                | 12                                                                                |
| Grade (%)                         | 0%                                                                                |                                                                                   |                                                                                   | 0%                                                                                | 2%                                                                                |                                                                                   |
| Total Lost time (s)               | 6.5                                                                               |                                                                                   |                                                                                   | 6.5                                                                               | 5.3                                                                               | 5.3                                                                               |
| Lane Util. Factor                 | 0.95                                                                              |                                                                                   |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |
| Frt                               | 0.99                                                                              |                                                                                   |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |
| Flt Protected                     | 1.00                                                                              |                                                                                   |                                                                                   | 0.99                                                                              | 0.95                                                                              | 1.00                                                                              |
| Satd. Flow (prot)                 | 3530                                                                              |                                                                                   |                                                                                   | 3533                                                                              | 1727                                                                              | 1599                                                                              |
| Flt Permitted                     | 1.00                                                                              |                                                                                   |                                                                                   | 0.59                                                                              | 0.95                                                                              | 1.00                                                                              |
| Satd. Flow (perm)                 | 3530                                                                              |                                                                                   |                                                                                   | 2099                                                                              | 1727                                                                              | 1599                                                                              |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              |
| Adj. Flow (vph)                   | 565                                                                               | 55                                                                                | 374                                                                               | 914                                                                               | 41                                                                                | 398                                                                               |
| RTOR Reduction (vph)              | 12                                                                                | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 329                                                                               |
| Lane Group Flow (vph)             | 608                                                                               | 0                                                                                 | 0                                                                                 | 1288                                                                              | 41                                                                                | 69                                                                                |
| Heavy Vehicles (%)                | 1%                                                                                | 0%                                                                                | 0%                                                                                | 1%                                                                                | 0%                                                                                | 0%                                                                                |
| Turn Type                         | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Prot                                                                              | Perm                                                                              |
| Protected Phases                  | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 | 4                                                                                 |                                                                                   |
| Permitted Phases                  |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   |                                                                                   | 4                                                                                 |
| Actuated Green, G (s)             | 17.6                                                                              |                                                                                   |                                                                                   | 32.7                                                                              | 7.8                                                                               | 7.8                                                                               |
| Effective Green, g (s)            | 17.6                                                                              |                                                                                   |                                                                                   | 32.7                                                                              | 7.8                                                                               | 7.8                                                                               |
| Actuated g/C Ratio                | 0.34                                                                              |                                                                                   |                                                                                   | 0.63                                                                              | 0.15                                                                              | 0.15                                                                              |
| Clearance Time (s)                | 6.5                                                                               |                                                                                   |                                                                                   | 6.5                                                                               | 5.3                                                                               | 5.3                                                                               |
| Vehicle Extension (s)             | 3.0                                                                               |                                                                                   |                                                                                   | 3.0                                                                               | 2.0                                                                               | 2.0                                                                               |
| Lane Grp Cap (vph)                | 1187                                                                              |                                                                                   |                                                                                   | 1548                                                                              | 257                                                                               | 238                                                                               |
| v/s Ratio Prot                    | 0.17                                                                              |                                                                                   |                                                                                   | c0.14                                                                             | 0.02                                                                              |                                                                                   |
| v/s Ratio Perm                    |                                                                                   |                                                                                   |                                                                                   | c0.38                                                                             |                                                                                   | c0.04                                                                             |
| v/c Ratio                         | 0.51                                                                              |                                                                                   |                                                                                   | 0.83                                                                              | 0.16                                                                              | 0.29                                                                              |
| Uniform Delay, d1                 | 13.9                                                                              |                                                                                   |                                                                                   | 7.7                                                                               | 19.4                                                                              | 19.8                                                                              |
| Progression Factor                | 1.00                                                                              |                                                                                   |                                                                                   | 1.00                                                                              | 1.00                                                                              | 1.00                                                                              |
| Incremental Delay, d2             | 0.4                                                                               |                                                                                   |                                                                                   | 4.0                                                                               | 0.1                                                                               | 0.2                                                                               |
| Delay (s)                         | 14.3                                                                              |                                                                                   |                                                                                   | 11.6                                                                              | 19.5                                                                              | 20.0                                                                              |
| Level of Service                  | B                                                                                 |                                                                                   |                                                                                   | B                                                                                 | B                                                                                 | C                                                                                 |
| Approach Delay (s)                | 14.3                                                                              |                                                                                   |                                                                                   | 11.6                                                                              | 20.0                                                                              |                                                                                   |
| Approach LOS                      | B                                                                                 |                                                                                   |                                                                                   | B                                                                                 | B                                                                                 |                                                                                   |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 13.9                                                                              |                                                                                   | HCM 2000 Level of Service                                                         | B                                                                                 |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.83                                                                              |                                                                                   |                                                                                   |                                                                                   |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 52.3                                                                              |                                                                                   | Sum of lost time (s)                                                              | 18.3                                                                              |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 67.3%                                                                             |                                                                                   | ICU Level of Service                                                              | C                                                                                 |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |

# HCM Signalized Intersection Capacity Analysis

## 2: Millrace & Graves Mill

02/23/2018



| Movement               | EBT   | EBR  | WBL   | WBT   | NBL   | NBR  |
|------------------------|-------|------|-------|-------|-------|------|
| Lane Configurations    | ↑↑    |      | ↵     | ↑↑    | ↵     | ↵    |
| Traffic Volume (vph)   | 846   | 14   | 28    | 950   | 78    | 178  |
| Future Volume (vph)    | 846   | 14   | 28    | 950   | 78    | 178  |
| Ideal Flow (vphpl)     | 1900  | 1900 | 1900  | 1900  | 1900  | 1900 |
| Lane Width             | 12    | 12   | 11    | 12    | 11    | 11   |
| Grade (%)              | 0%    |      |       | 0%    | 3%    |      |
| Total Lost time (s)    | 5.0   |      | 4.5   | 5.0   | 5.0   | 5.0  |
| Lane Util. Factor      | 0.95  |      | 1.00  | 0.95  | 1.00  | 1.00 |
| Frt                    | 1.00  |      | 1.00  | 1.00  | 1.00  | 0.85 |
| Flt Protected          | 1.00  |      | 0.95  | 1.00  | 0.95  | 1.00 |
| Satd. Flow (prot)      | 3552  |      | 1745  | 3574  | 1702  | 1508 |
| Flt Permitted          | 1.00  |      | 0.22  | 1.00  | 0.95  | 1.00 |
| Satd. Flow (perm)      | 3552  |      | 396   | 3574  | 1702  | 1508 |
| Peak-hour factor, PHF  | 0.92  | 0.92 | 0.92  | 0.92  | 0.92  | 0.92 |
| Adj. Flow (vph)        | 920   | 15   | 30    | 1033  | 85    | 193  |
| RTOR Reduction (vph)   | 1     | 0    | 0     | 0     | 0     | 164  |
| Lane Group Flow (vph)  | 934   | 0    | 30    | 1033  | 85    | 29   |
| Heavy Vehicles (%)     | 1%    | 0%   | 0%    | 1%    | 1%    | 2%   |
| Bus Blockages (#/hr)   | 2     | 0    | 0     | 0     | 0     | 0    |
| Turn Type              | NA    |      | pm+pt | NA    | Prot  | Perm |
| Protected Phases       | 6     |      | 5     | 2     | 4     |      |
| Permitted Phases       |       |      | 2     |       |       | 4    |
| Actuated Green, G (s)  | 23.6  |      | 29.9  | 29.9  | 7.0   | 7.0  |
| Effective Green, g (s) | 23.6  |      | 29.9  | 29.9  | 7.0   | 7.0  |
| Actuated g/C Ratio     | 0.50  |      | 0.64  | 0.64  | 0.15  | 0.15 |
| Clearance Time (s)     | 5.0   |      | 4.5   | 5.0   | 5.0   | 5.0  |
| Vehicle Extension (s)  | 3.5   |      | 2.0   | 3.5   | 2.0   | 2.0  |
| Lane Grp Cap (vph)     | 1787  |      | 304   | 2278  | 254   | 225  |
| v/s Ratio Prot         | c0.26 |      | 0.00  | c0.29 | c0.05 |      |
| v/s Ratio Perm         |       |      | 0.06  |       |       | 0.02 |
| v/c Ratio              | 0.52  |      | 0.10  | 0.45  | 0.33  | 0.13 |
| Uniform Delay, d1      | 7.9   |      | 3.9   | 4.3   | 17.9  | 17.3 |
| Progression Factor     | 1.00  |      | 1.00  | 1.00  | 1.00  | 1.00 |
| Incremental Delay, d2  | 0.3   |      | 0.1   | 0.2   | 0.3   | 0.1  |
| Delay (s)              | 8.2   |      | 4.0   | 4.5   | 18.1  | 17.4 |
| Level of Service       | A     |      | A     | A     | B     | B    |
| Approach Delay (s)     | 8.2   |      |       | 4.5   | 17.6  |      |
| Approach LOS           | A     |      |       | A     | B     |      |

### Intersection Summary

|                                   |       |                           |      |
|-----------------------------------|-------|---------------------------|------|
| HCM 2000 Control Delay            | 7.6   | HCM 2000 Level of Service | A    |
| HCM 2000 Volume to Capacity ratio | 0.51  |                           |      |
| Actuated Cycle Length (s)         | 46.9  | Sum of lost time (s)      | 14.5 |
| Intersection Capacity Utilization | 43.2% | ICU Level of Service      | A    |
| Analysis Period (min)             | 15    |                           |      |

c Critical Lane Group



# HCM Signalized Intersection Capacity Analysis

## 4: Old Graves Mill & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |  |  |  |                                                                                   |                                                                                    |  |  |                                                                                     |  |                                                                                     |
| Traffic Volume (vph)              | 1                                                                                 | 921                                                                               | 196                                                                               | 255                                                                               | 830                                                                               | 0                                                                                 | 117                                                                                | 0                                                                                   | 50                                                                                  | 0                                                                                   | 1                                                                                   | 2                                                                                   |
| Future Volume (vph)               | 1                                                                                 | 921                                                                               | 196                                                                               | 255                                                                               | 830                                                                               | 0                                                                                 | 117                                                                                | 0                                                                                   | 50                                                                                  | 0                                                                                   | 1                                                                                   | 2                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                 | 13                                                                                  | 13                                                                                  | 12                                                                                  | 16                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | -5%                                                                               |                                                                                   |                                                                                    | -5%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 0.85                                                                                |                                                                                     | 0.91                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 3521                                                                              | 1575                                                                              | 1753                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1874                                                                                | 1677                                                                                |                                                                                     | 1930                                                                                |                                                                                     |
| Flt Permitted                     | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 1778                                                                              | 3521                                                                              | 1575                                                                              | 1753                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1874                                                                                | 1677                                                                                |                                                                                     | 1930                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                               | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                |
| Adj. Flow (vph)                   | 1                                                                                 | 1012                                                                              | 215                                                                               | 280                                                                               | 912                                                                               | 0                                                                                 | 129                                                                                | 0                                                                                   | 55                                                                                  | 0                                                                                   | 1                                                                                   | 2                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 127                                                                               | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                  | 0                                                                                   | 48                                                                                  | 0                                                                                   | 2                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 1                                                                                 | 1012                                                                              | 88                                                                                | 280                                                                               | 912                                                                               | 0                                                                                 | 0                                                                                  | 129                                                                                 | 7                                                                                   | 0                                                                                   | 1                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                | 1%                                                                                | 2%                                                                                | 1%                                                                                | 0%                                                                                | 2%                                                                                 | 0%                                                                                  | 2%                                                                                  | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  |
| Turn Type                         | Prot                                                                              | NA                                                                                | Perm                                                                              | Prot                                                                              | NA                                                                                |                                                                                   | Split                                                                              | NA                                                                                  | Perm                                                                                |                                                                                     | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                  | 8                                                                                   |                                                                                     | 4                                                                                   | 4                                                                                   |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                   | 2                                                                                 |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 0.3                                                                               | 32.7                                                                              | 32.7                                                                              | 15.4                                                                              | 47.8                                                                              |                                                                                   |                                                                                    | 10.6                                                                                | 10.6                                                                                |                                                                                     | 1.0                                                                                 |                                                                                     |
| Effective Green, g (s)            | 0.3                                                                               | 32.7                                                                              | 32.7                                                                              | 15.4                                                                              | 47.8                                                                              |                                                                                   |                                                                                    | 10.6                                                                                | 10.6                                                                                |                                                                                     | 1.0                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.00                                                                              | 0.41                                                                              | 0.41                                                                              | 0.19                                                                              | 0.60                                                                              |                                                                                   |                                                                                    | 0.13                                                                                | 0.13                                                                                |                                                                                     | 0.01                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                   |                                                                                    | 3.0                                                                                 | 3.0                                                                                 |                                                                                     | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 6                                                                                 | 1444                                                                              | 646                                                                               | 338                                                                               | 2197                                                                              |                                                                                   |                                                                                    | 249                                                                                 | 223                                                                                 |                                                                                     | 24                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.00                                                                              | c0.29                                                                             |                                                                                   | c0.16                                                                             | 0.25                                                                              |                                                                                   |                                                                                    | c0.07                                                                               |                                                                                     |                                                                                     | c0.00                                                                               |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                   | 0.06                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 0.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.17                                                                              | 0.70                                                                              | 0.14                                                                              | 0.83                                                                              | 0.42                                                                              |                                                                                   |                                                                                    | 0.52                                                                                | 0.03                                                                                |                                                                                     | 0.04                                                                                |                                                                                     |
| Uniform Delay, d1                 | 39.6                                                                              | 19.5                                                                              | 14.7                                                                              | 30.9                                                                              | 8.5                                                                               |                                                                                   |                                                                                    | 32.2                                                                                | 30.1                                                                                |                                                                                     | 38.9                                                                                |                                                                                     |
| Progression Factor                | 1.00                                                                              | 1.00                                                                              | 1.00                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 12.8                                                                              | 1.6                                                                               | 0.1                                                                               | 15.3                                                                              | 0.1                                                                               |                                                                                   |                                                                                    | 1.8                                                                                 | 0.1                                                                                 |                                                                                     | 0.7                                                                                 |                                                                                     |
| Delay (s)                         | 52.3                                                                              | 21.0                                                                              | 14.8                                                                              | 46.2                                                                              | 8.6                                                                               |                                                                                   |                                                                                    | 34.0                                                                                | 30.1                                                                                |                                                                                     | 39.6                                                                                |                                                                                     |
| Level of Service                  | D                                                                                 | C                                                                                 | B                                                                                 | D                                                                                 | A                                                                                 |                                                                                   |                                                                                    | C                                                                                   | C                                                                                   |                                                                                     | D                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 19.9                                                                              |                                                                                   |                                                                                   | 17.4                                                                              |                                                                                   |                                                                                    | 32.8                                                                                |                                                                                     |                                                                                     | 39.6                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                    | C                                                                                   |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 19.7                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                    |                                                                                     | B                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.69                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 79.7                                                                              |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                    |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 65.2%                                                                             |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                    |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |                                                                                     |
| Traffic Volume (vph)              | 39                                                                                | 871                                                                               | 5                                                                                 | 203                                                                               | 991                                                                               | 110                                                                               | 45                                                                                  | 21                                                                                  | 339                                                                                 | 94                                                                                  | 15                                                                                  | 35                                                                                  |
| Future Volume (vph)               | 39                                                                                | 871                                                                               | 5                                                                                 | 203                                                                               | 991                                                                               | 110                                                                               | 45                                                                                  | 21                                                                                  | 339                                                                                 | 94                                                                                  | 15                                                                                  | 35                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 3474                                                                              |                                                                                   | 1770                                                                              | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 1507                                                                                | 1702                                                                                | 1555                                                                                |                                                                                     |
| Flt Permitted                     | 0.25                                                                              | 1.00                                                                              |                                                                                   | 0.16                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 459                                                                               | 3474                                                                              |                                                                                   | 292                                                                               | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 1507                                                                                | 1702                                                                                | 1555                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.95                                                                              | 0.95                                                                              | 0.90                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                |
| Adj. Flow (vph)                   | 41                                                                                | 917                                                                               | 6                                                                                 | 214                                                                               | 1043                                                                              | 116                                                                               | 47                                                                                  | 22                                                                                  | 357                                                                                 | 99                                                                                  | 16                                                                                  | 37                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 58                                                                                | 0                                                                                   | 0                                                                                   | 98                                                                                  | 0                                                                                   | 33                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 41                                                                                | 922                                                                               | 0                                                                                 | 214                                                                               | 1043                                                                              | 58                                                                                | 0                                                                                   | 69                                                                                  | 259                                                                                 | 99                                                                                  | 20                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 2%                                                                                | 40%                                                                               | 2%                                                                                | 1%                                                                                | 0%                                                                                | 4%                                                                                  | 10%                                                                                 | 1%                                                                                  | 1%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pm+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 1                                                                                   | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 31.8                                                                              | 28.7                                                                              |                                                                                   | 44.9                                                                              | 36.8                                                                              | 36.8                                                                              |                                                                                     | 6.6                                                                                 | 17.8                                                                                | 7.2                                                                                 | 7.2                                                                                 |                                                                                     |
| Effective Green, g (s)            | 31.8                                                                              | 28.7                                                                              |                                                                                   | 44.9                                                                              | 36.8                                                                              | 36.8                                                                              |                                                                                     | 6.6                                                                                 | 17.8                                                                                | 7.2                                                                                 | 7.2                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.43                                                                              | 0.39                                                                              |                                                                                   | 0.61                                                                              | 0.50                                                                              | 0.50                                                                              |                                                                                     | 0.09                                                                                | 0.24                                                                                | 0.10                                                                                | 0.10                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 253                                                                               | 1352                                                                              |                                                                                   | 402                                                                               | 1784                                                                              | 806                                                                               |                                                                                     | 151                                                                                 | 466                                                                                 | 166                                                                                 | 151                                                                                 |                                                                                     |
| v/s Ratio Prot                    | 0.01                                                                              | c0.27                                                                             |                                                                                   | 0.08                                                                              | c0.29                                                                             |                                                                                   |                                                                                     | 0.04                                                                                | c0.08                                                                               | c0.06                                                                               | 0.01                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.06                                                                              |                                                                                   |                                                                                   | 0.24                                                                              |                                                                                   | 0.04                                                                              |                                                                                     |                                                                                     | 0.09                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.16                                                                              | 0.68                                                                              |                                                                                   | 0.53                                                                              | 0.58                                                                              | 0.07                                                                              |                                                                                     | 0.46                                                                                | 0.56                                                                                | 0.60                                                                                | 0.13                                                                                |                                                                                     |
| Uniform Delay, d1                 | 12.3                                                                              | 18.7                                                                              |                                                                                   | 9.4                                                                               | 13.0                                                                              | 9.6                                                                               |                                                                                     | 31.8                                                                                | 24.5                                                                                | 31.9                                                                                | 30.4                                                                                |                                                                                     |
| Progression Factor                | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.3                                                                               | 1.4                                                                               |                                                                                   | 1.4                                                                               | 0.5                                                                               | 0.0                                                                               |                                                                                     | 2.2                                                                                 | 1.4                                                                                 | 5.7                                                                                 | 0.4                                                                                 |                                                                                     |
| Delay (s)                         | 12.6                                                                              | 20.1                                                                              |                                                                                   | 10.7                                                                              | 13.5                                                                              | 9.6                                                                               |                                                                                     | 34.0                                                                                | 25.9                                                                                | 37.5                                                                                | 30.8                                                                                |                                                                                     |
| Level of Service                  | B                                                                                 | C                                                                                 |                                                                                   | B                                                                                 | B                                                                                 | A                                                                                 |                                                                                     | C                                                                                   | C                                                                                   | D                                                                                   | C                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 19.8                                                                              |                                                                                   |                                                                                   | 12.8                                                                              |                                                                                   |                                                                                     | 27.2                                                                                |                                                                                     |                                                                                     | 35.2                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                     | C                                                                                   |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 18.4                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | B                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.68                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 73.7                                                                              |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 62.9%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | B                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 6: SB Ramp & Graves Mill

02/23/2018

|                                   |  |      |       |       |       |                           |      |      |      |       |      |       |
|-----------------------------------|------------------------------------------------------------------------------------|------|-------|-------|-------|---------------------------|------|------|------|-------|------|-------|
| Movement                          | EBL                                                                                | EBT  | EBR   | WBL   | WBT   | WBR                       | NBL  | NBT  | NBR  | SBL   | SBT  | SBR   |
| Lane Configurations               |                                                                                    | ↑↑   | ↗     | ↖     | ↑↑    |                           |      |      |      |       | ↖    | ↗     |
| Traffic Volume (vph)              | 0                                                                                  | 394  | 912   | 213   | 954   | 0                         | 0    | 0    | 0    | 47    | 3    | 350   |
| Future Volume (vph)               | 0                                                                                  | 394  | 912   | 213   | 954   | 0                         | 0    | 0    | 0    | 47    | 3    | 350   |
| Ideal Flow (vphpl)                | 1900                                                                               | 1900 | 1900  | 1900  | 1900  | 1900                      | 1900 | 1900 | 1900 | 1900  | 1900 | 1900  |
| Lane Width                        | 12                                                                                 | 12   | 12    | 12    | 12    | 12                        | 12   | 12   | 12   | 12    | 11   | 11    |
| Grade (%)                         |                                                                                    | 0%   |       |       | 0%    |                           |      | 3%   |      |       | 3%   |       |
| Total Lost time (s)               |                                                                                    | 5.0  | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0  | 5.0   |
| Lane Util. Factor                 |                                                                                    | 0.95 | 1.00  | 1.00  | 0.95  |                           |      |      |      |       | 1.00 | 1.00  |
| Frt                               |                                                                                    | 1.00 | 0.85  | 1.00  | 1.00  |                           |      |      |      |       | 1.00 | 0.85  |
| Flt Protected                     |                                                                                    | 1.00 | 1.00  | 0.95  | 1.00  |                           |      |      |      |       | 0.95 | 1.00  |
| Satd. Flow (prot)                 |                                                                                    | 3574 | 1583  | 1787  | 3574  |                           |      |      |      |       | 1665 | 1523  |
| Flt Permitted                     |                                                                                    | 1.00 | 1.00  | 0.42  | 1.00  |                           |      |      |      |       | 0.95 | 1.00  |
| Satd. Flow (perm)                 |                                                                                    | 3574 | 1583  | 788   | 3574  |                           |      |      |      |       | 1665 | 1523  |
| Peak-hour factor, PHF             | 0.93                                                                               | 0.93 | 0.93  | 0.93  | 0.93  | 0.93                      | 0.93 | 0.93 | 0.93 | 0.93  | 0.93 | 0.93  |
| Adj. Flow (vph)                   | 0                                                                                  | 424  | 981   | 229   | 1026  | 0                         | 0    | 0    | 0    | 51    | 3    | 376   |
| RTOR Reduction (vph)              | 0                                                                                  | 0    | 482   | 0     | 0     | 0                         | 0    | 0    | 0    | 0     | 0    | 113   |
| Lane Group Flow (vph)             | 0                                                                                  | 424  | 499   | 229   | 1026  | 0                         | 0    | 0    | 0    | 0     | 54   | 263   |
| Heavy Vehicles (%)                | 0%                                                                                 | 1%   | 2%    | 1%    | 1%    | 0%                        | 0%   | 0%   | 0%   | 4%    | 0%   | 1%    |
| Turn Type                         |                                                                                    | NA   | Perm  | pm+pt | NA    |                           |      |      |      | Split | NA   | Perm  |
| Protected Phases                  |                                                                                    | 2    |       | 1     | 6     |                           |      |      |      | 8     | 8    |       |
| Permitted Phases                  |                                                                                    |      | 2     | 6     |       |                           |      |      |      |       |      | 8     |
| Actuated Green, G (s)             |                                                                                    | 26.5 | 26.5  | 41.2  | 41.2  |                           |      |      |      |       | 13.1 | 13.1  |
| Effective Green, g (s)            |                                                                                    | 26.5 | 26.5  | 41.2  | 41.2  |                           |      |      |      |       | 13.1 | 13.1  |
| Actuated g/C Ratio                |                                                                                    | 0.41 | 0.41  | 0.64  | 0.64  |                           |      |      |      |       | 0.20 | 0.20  |
| Clearance Time (s)                |                                                                                    | 5.0  | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0  | 5.0   |
| Vehicle Extension (s)             |                                                                                    | 5.0  | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0  | 5.0   |
| Lane Grp Cap (vph)                |                                                                                    | 1472 | 652   | 655   | 2290  |                           |      |      |      |       | 339  | 310   |
| v/s Ratio Prot                    |                                                                                    | 0.12 |       | 0.05  | c0.29 |                           |      |      |      |       | 0.03 |       |
| v/s Ratio Perm                    |                                                                                    |      | c0.32 | 0.17  |       |                           |      |      |      |       |      | c0.17 |
| v/c Ratio                         |                                                                                    | 0.29 | 0.77  | 0.35  | 0.45  |                           |      |      |      |       | 0.16 | 0.85  |
| Uniform Delay, d1                 |                                                                                    | 12.6 | 16.2  | 5.1   | 5.8   |                           |      |      |      |       | 21.1 | 24.6  |
| Progression Factor                |                                                                                    | 1.00 | 1.00  | 1.00  | 1.00  |                           |      |      |      |       | 1.00 | 1.00  |
| Incremental Delay, d2             |                                                                                    | 0.2  | 6.3   | 0.7   | 0.3   |                           |      |      |      |       | 0.5  | 20.6  |
| Delay (s)                         |                                                                                    | 12.8 | 22.5  | 5.7   | 6.1   |                           |      |      |      |       | 21.5 | 45.3  |
| Level of Service                  |                                                                                    | B    | C     | A     | A     |                           |      |      |      |       | C    | D     |
| Approach Delay (s)                |                                                                                    | 19.6 |       |       | 6.0   |                           |      | 0.0  |      |       | 42.3 |       |
| Approach LOS                      |                                                                                    | B    |       |       | A     |                           |      | A    |      |       | D    |       |
| <b>Intersection Summary</b>       |                                                                                    |      |       |       |       |                           |      |      |      |       |      |       |
| HCM 2000 Control Delay            |                                                                                    |      | 17.2  |       |       | HCM 2000 Level of Service |      |      |      | B     |      |       |
| HCM 2000 Volume to Capacity ratio |                                                                                    |      | 0.75  |       |       |                           |      |      |      |       |      |       |
| Actuated Cycle Length (s)         |                                                                                    |      | 64.3  |       |       | Sum of lost time (s)      |      |      |      | 15.0  |      |       |
| Intersection Capacity Utilization |                                                                                    |      | 86.6% |       |       | ICU Level of Service      |      |      |      | E     |      |       |
| Analysis Period (min)             |                                                                                    |      | 15    |       |       |                           |      |      |      |       |      |       |
| c Critical Lane Group             |                                                                                    |      |       |       |       |                           |      |      |      |       |      |       |



# HCM Signalized Intersection Capacity Analysis

## 7: NB Ramp & Graves Mill

02/23/2018

|                                   |  |                                                                                       |  |  |                                                                                       |  |  |                                                                                         |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                                                                                                                    | EBR                                                                               | WBL                                                                               | WBT                                                                                                                                                                    | WBR                                                                               | NBL                                                                                 | NBT                                                                                                                                                                        | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  | <br> |                                                                                   |                                                                                   | <br> |  |  | <br> |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Traffic Volume (vph)              | 253                                                                               | 220                                                                                                                                                                    | 0                                                                                 | 0                                                                                 | 475                                                                                                                                                                    | 131                                                                               | 685                                                                                 | 1                                                                                                                                                                          | 66                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Future Volume (vph)               | 253                                                                               | 220                                                                                                                                                                    | 0                                                                                 | 0                                                                                 | 475                                                                                                                                                                    | 131                                                                               | 685                                                                                 | 1                                                                                                                                                                          | 66                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                                                                                                                   | 1900                                                                              | 1900                                                                              | 1900                                                                                                                                                                   | 1900                                                                              | 1900                                                                                | 1900                                                                                                                                                                       | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                                                                                                     | 12                                                                                | 12                                                                                | 12                                                                                                                                                                     | 12                                                                                | 11                                                                                  | 12                                                                                                                                                                         | 12                                                                                  | 12                                                                                  | 12                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 0%                                                                                                                                                                     |                                                                                   |                                                                                   | -3%                                                                                                                                                                    |                                                                                   |                                                                                     | 3%                                                                                                                                                                         |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 6.0                                                                                                                                                                    |                                                                                   |                                                                                   | 6.0                                                                                                                                                                    | 6.0                                                                               | 5.0                                                                                 | 5.0                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                                                                                                                   |                                                                                   |                                                                                   | 0.95                                                                                                                                                                   | 1.00                                                                              | 0.95                                                                                | 0.95                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                                                                                                                   |                                                                                   |                                                                                   | 1.00                                                                                                                                                                   | 0.85                                                                              | 1.00                                                                                | 0.97                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                                                                                                                   |                                                                                   |                                                                                   | 1.00                                                                                                                                                                   | 1.00                                                                              | 0.95                                                                                | 0.96                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (prot)                 | 1787                                                                              | 3574                                                                                                                                                                   |                                                                                   |                                                                                   | 3628                                                                                                                                                                   | 1623                                                                              | 1617                                                                                | 1649                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Flt Permitted                     | 0.30                                                                              | 1.00                                                                                                                                                                   |                                                                                   |                                                                                   | 1.00                                                                                                                                                                   | 1.00                                                                              | 0.95                                                                                | 0.96                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (perm)                 | 570                                                                               | 3574                                                                                                                                                                   |                                                                                   |                                                                                   | 3628                                                                                                                                                                   | 1623                                                                              | 1617                                                                                | 1649                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Peak-hour factor, PHF             | 0.91                                                                              | 0.91                                                                                                                                                                   | 0.91                                                                              | 0.91                                                                              | 0.91                                                                                                                                                                   | 0.91                                                                              | 0.91                                                                                | 0.91                                                                                                                                                                       | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                |
| Adj. Flow (vph)                   | 278                                                                               | 242                                                                                                                                                                    | 0                                                                                 | 0                                                                                 | 522                                                                                                                                                                    | 144                                                                               | 753                                                                                 | 1                                                                                                                                                                          | 73                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                                                                                                      | 0                                                                                 | 0                                                                                 | 0                                                                                                                                                                      | 108                                                                               | 0                                                                                   | 10                                                                                                                                                                         | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 278                                                                               | 242                                                                                                                                                                    | 0                                                                                 | 0                                                                                 | 522                                                                                                                                                                    | 36                                                                                | 414                                                                                 | 403                                                                                                                                                                        | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 1%                                                                                | 1%                                                                                                                                                                     | 0%                                                                                | 0%                                                                                | 1%                                                                                                                                                                     | 1%                                                                                | 1%                                                                                  | 0%                                                                                                                                                                         | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                                                                                                     |                                                                                   |                                                                                   | NA                                                                                                                                                                     | Perm                                                                              | Split                                                                               | NA                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Protected Phases                  | 1                                                                                 | 6                                                                                                                                                                      |                                                                                   |                                                                                   | 2                                                                                                                                                                      |                                                                                   | 4                                                                                   | 4                                                                                                                                                                          |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Permitted Phases                  | 6                                                                                 |                                                                                                                                                                        |                                                                                   |                                                                                   |                                                                                                                                                                        | 2                                                                                 |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 27.2                                                                              | 27.2                                                                                                                                                                   |                                                                                   |                                                                                   | 13.3                                                                                                                                                                   | 13.3                                                                              | 15.1                                                                                | 15.1                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Effective Green, g (s)            | 27.2                                                                              | 27.2                                                                                                                                                                   |                                                                                   |                                                                                   | 13.3                                                                                                                                                                   | 13.3                                                                              | 15.1                                                                                | 15.1                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated g/C Ratio                | 0.51                                                                              | 0.51                                                                                                                                                                   |                                                                                   |                                                                                   | 0.25                                                                                                                                                                   | 0.25                                                                              | 0.28                                                                                | 0.28                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 6.0                                                                                                                                                                    |                                                                                   |                                                                                   | 6.0                                                                                                                                                                    | 6.0                                                                               | 5.0                                                                                 | 5.0                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Vehicle Extension (s)             | 2.5                                                                               | 2.5                                                                                                                                                                    |                                                                                   |                                                                                   | 2.5                                                                                                                                                                    | 2.5                                                                               | 2.5                                                                                 | 2.5                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Lane Grp Cap (vph)                | 494                                                                               | 1823                                                                                                                                                                   |                                                                                   |                                                                                   | 905                                                                                                                                                                    | 404                                                                               | 458                                                                                 | 467                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Prot                    | c0.09                                                                             | 0.07                                                                                                                                                                   |                                                                                   |                                                                                   | 0.14                                                                                                                                                                   |                                                                                   | c0.26                                                                               | 0.24                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Perm                    | c0.19                                                                             |                                                                                                                                                                        |                                                                                   |                                                                                   |                                                                                                                                                                        | 0.02                                                                              |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.56                                                                              | 0.13                                                                                                                                                                   |                                                                                   |                                                                                   | 0.58                                                                                                                                                                   | 0.09                                                                              | 0.90                                                                                | 0.86                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Uniform Delay, d1                 | 8.1                                                                               | 6.9                                                                                                                                                                    |                                                                                   |                                                                                   | 17.5                                                                                                                                                                   | 15.4                                                                              | 18.4                                                                                | 18.1                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Progression Factor                | 1.00                                                                              | 1.00                                                                                                                                                                   |                                                                                   |                                                                                   | 1.00                                                                                                                                                                   | 1.00                                                                              | 1.00                                                                                | 1.00                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Incremental Delay, d2             | 1.2                                                                               | 0.0                                                                                                                                                                    |                                                                                   |                                                                                   | 0.7                                                                                                                                                                    | 0.1                                                                               | 20.9                                                                                | 15.0                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Delay (s)                         | 9.3                                                                               | 6.9                                                                                                                                                                    |                                                                                   |                                                                                   | 18.3                                                                                                                                                                   | 15.4                                                                              | 39.3                                                                                | 33.1                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Level of Service                  | A                                                                                 | A                                                                                                                                                                      |                                                                                   |                                                                                   | B                                                                                                                                                                      | B                                                                                 | D                                                                                   | C                                                                                                                                                                          |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Approach Delay (s)                |                                                                                   | 8.2                                                                                                                                                                    |                                                                                   |                                                                                   | 17.7                                                                                                                                                                   |                                                                                   |                                                                                     | 36.2                                                                                                                                                                       |                                                                                     |                                                                                     | 0.0                                                                                 |                                                                                     |
| Approach LOS                      |                                                                                   | A                                                                                                                                                                      |                                                                                   |                                                                                   | B                                                                                                                                                                      |                                                                                   |                                                                                     | D                                                                                                                                                                          |                                                                                     |                                                                                     | A                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   | 22.8                                                                                                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                                                                                                              |                                                                                   | C                                                                                   |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   | 0.75                                                                                                                                                                   |                                                                                   |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   | 53.3                                                                                                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                                                                                                   |                                                                                   | 16.0                                                                                |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   | 86.6%                                                                                                                                                                  |                                                                                   |                                                                                   | ICU Level of Service                                                                                                                                                   |                                                                                   | E                                                                                   |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   | 15                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 9: Forest & Graves Mill

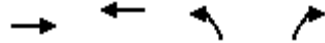
02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |                                                                                   |  |  |  |  |  |  |
| Traffic Volume (vph)              | 120                                                                               | 176                                                                               | 54                                                                                | 440                                                                               | 164                                                                               | 249                                                                               | 37                                                                                  | 979                                                                                 | 247                                                                                 | 221                                                                                 | 1279                                                                                | 95                                                                                  |
| Future Volume (vph)               | 120                                                                               | 176                                                                               | 54                                                                                | 440                                                                               | 164                                                                               | 249                                                                               | 37                                                                                  | 979                                                                                 | 247                                                                                 | 221                                                                                 | 1279                                                                                | 95                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 10                                                                                | 11                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                  | 12                                                                                  | 11                                                                                  | 11                                                                                  | 11                                                                                  | 11                                                                                  |
| Total Lost time (s)               | 6.7                                                                               | 6.7                                                                               |                                                                                   | 7.7                                                                               | 7.7                                                                               |                                                                                   | 7.7                                                                                 | 5.7                                                                                 | 7.7                                                                                 | 7.4                                                                                 | 5.8                                                                                 | 6.7                                                                                 |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |
| Flt Protected                     | 1.00                                                                              | 0.96                                                                              |                                                                                   | 1.00                                                                              | 0.91                                                                              |                                                                                   | 1.00                                                                                | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 1.00                                                                                | 0.85                                                                                |
| Flt Permitted                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                |
| Satd. Flow (prot)                 | 1636                                                                              | 3233                                                                              |                                                                                   | 1752                                                                              | 1711                                                                              |                                                                                   | 1694                                                                                | 3539                                                                                | 1473                                                                                | 1711                                                                                | 3421                                                                                | 1516                                                                                |
| Satd. Flow (perm)                 | 1636                                                                              | 3233                                                                              |                                                                                   | 1752                                                                              | 1711                                                                              |                                                                                   | 1694                                                                                | 3539                                                                                | 1473                                                                                | 1711                                                                                | 3421                                                                                | 1516                                                                                |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 136                                                                               | 200                                                                               | 61                                                                                | 500                                                                               | 186                                                                               | 283                                                                               | 42                                                                                  | 1112                                                                                | 281                                                                                 | 251                                                                                 | 1453                                                                                | 108                                                                                 |
| RTOR Reduction (vph)              | 0                                                                                 | 18                                                                                | 0                                                                                 | 0                                                                                 | 33                                                                                | 0                                                                                 | 0                                                                                   | 0                                                                                   | 74                                                                                  | 0                                                                                   | 0                                                                                   | 38                                                                                  |
| Lane Group Flow (vph)             | 136                                                                               | 243                                                                               | 0                                                                                 | 500                                                                               | 436                                                                               | 0                                                                                 | 42                                                                                  | 1113                                                                                | 207                                                                                 | 251                                                                                 | 1453                                                                                | 70                                                                                  |
| Heavy Vehicles (%)                | 3%                                                                                | 3%                                                                                | 8%                                                                                | 3%                                                                                | 1%                                                                                | 1%                                                                                | 3%                                                                                  | 2%                                                                                  | 6%                                                                                  | 2%                                                                                  | 2%                                                                                  | 3%                                                                                  |
| Turn Type                         | Split                                                                             | NA                                                                                |                                                                                   | Split                                                                             | NA                                                                                |                                                                                   | Prot                                                                                | NA                                                                                  | pm+ov                                                                               | Prot                                                                                | NA                                                                                  | pm+ov                                                                               |
| Protected Phases                  | 4                                                                                 | 4                                                                                 |                                                                                   | 3                                                                                 | 3                                                                                 |                                                                                   | 1                                                                                   | 6                                                                                   | 3                                                                                   | 5                                                                                   | 2                                                                                   | 4                                                                                   |
| Permitted Phases                  |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     | 6                                                                                   |                                                                                     |                                                                                     | 2                                                                                   |
| Actuated Green, G (s)             | 19.5                                                                              | 19.5                                                                              |                                                                                   | 37.4                                                                              | 37.4                                                                              |                                                                                   | 8.1                                                                                 | 55.2                                                                                | 92.6                                                                                | 17.6                                                                                | 64.3                                                                                | 83.8                                                                                |
| Effective Green, g (s)            | 19.5                                                                              | 19.5                                                                              |                                                                                   | 37.4                                                                              | 37.4                                                                              |                                                                                   | 8.1                                                                                 | 55.2                                                                                | 92.6                                                                                | 17.6                                                                                | 64.3                                                                                | 83.8                                                                                |
| Actuated g/C Ratio                | 0.12                                                                              | 0.12                                                                              |                                                                                   | 0.24                                                                              | 0.24                                                                              |                                                                                   | 0.05                                                                                | 0.35                                                                                | 0.59                                                                                | 0.11                                                                                | 0.41                                                                                | 0.53                                                                                |
| Clearance Time (s)                | 6.7                                                                               | 6.7                                                                               |                                                                                   | 7.7                                                                               | 7.7                                                                               |                                                                                   | 7.7                                                                                 | 5.7                                                                                 | 7.7                                                                                 | 7.4                                                                                 | 5.8                                                                                 | 6.7                                                                                 |
| Vehicle Extension (s)             | 3.5                                                                               | 3.5                                                                               |                                                                                   | 3.5                                                                               | 3.5                                                                               |                                                                                   | 3.5                                                                                 | 5.0                                                                                 | 3.5                                                                                 | 3.5                                                                                 | 5.0                                                                                 | 3.5                                                                                 |
| Lane Grp Cap (vph)                | 202                                                                               | 401                                                                               |                                                                                   | 416                                                                               | 407                                                                               |                                                                                   | 87                                                                                  | 1242                                                                                | 867                                                                                 | 191                                                                                 | 1399                                                                                | 808                                                                                 |
| v/s Ratio Prot                    | c0.08                                                                             | 0.08                                                                              |                                                                                   | c0.29                                                                             | 0.25                                                                              |                                                                                   | 0.02                                                                                | 0.31                                                                                | 0.06                                                                                | c0.15                                                                               | c0.42                                                                               | 0.01                                                                                |
| v/s Ratio Perm                    |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     | 0.08                                                                                |                                                                                     |                                                                                     | 0.04                                                                                |
| v/c Ratio                         | 0.67                                                                              | 0.60                                                                              |                                                                                   | 1.20                                                                              | 1.07                                                                              |                                                                                   | 0.48                                                                                | 0.90                                                                                | 0.24                                                                                | 1.31                                                                                | 1.04                                                                                | 0.09                                                                                |
| Uniform Delay, d1                 | 65.8                                                                              | 65.2                                                                              |                                                                                   | 59.9                                                                              | 59.9                                                                              |                                                                                   | 72.5                                                                                | 48.3                                                                                | 15.4                                                                                | 69.8                                                                                | 46.4                                                                                | 18.0                                                                                |
| Progression Factor                | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |
| Incremental Delay, d2             | 8.9                                                                               | 2.7                                                                               |                                                                                   | 111.8                                                                             | 65.1                                                                              |                                                                                   | 4.9                                                                                 | 9.3                                                                                 | 0.2                                                                                 | 173.5                                                                               | 34.7                                                                                | 0.1                                                                                 |
| Delay (s)                         | 74.7                                                                              | 67.9                                                                              |                                                                                   | 171.7                                                                             | 125.0                                                                             |                                                                                   | 77.4                                                                                | 57.6                                                                                | 15.6                                                                                | 243.3                                                                               | 81.1                                                                                | 18.0                                                                                |
| Level of Service                  | E                                                                                 | E                                                                                 |                                                                                   | F                                                                                 | F                                                                                 |                                                                                   | E                                                                                   | E                                                                                   | B                                                                                   | F                                                                                   | F                                                                                   | B                                                                                   |
| Approach Delay (s)                |                                                                                   | 70.2                                                                              |                                                                                   |                                                                                   | 149.1                                                                             |                                                                                   |                                                                                     | 49.9                                                                                |                                                                                     |                                                                                     | 99.8                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | E                                                                                 |                                                                                   |                                                                                   | F                                                                                 |                                                                                   |                                                                                     | D                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 92.1                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 1.10                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 157.2                                                                             |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                     |                                                                                     | 27.9                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 96.3%                                                                             |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

### 1: Gristmill & Graves Mill

02/23/2018



| Lane Group              | EBT  | WBT  | NBL  | NBR  |
|-------------------------|------|------|------|------|
| Lane Group Flow (vph)   | 620  | 1288 | 41   | 398  |
| v/c Ratio               | 0.52 | 0.83 | 0.16 | 0.70 |
| Control Delay           | 15.6 | 13.9 | 21.3 | 10.7 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 15.6 | 13.9 | 21.3 | 10.7 |
| Queue Length 50th (ft)  | 71   | 87   | 12   | 3    |
| Queue Length 95th (ft)  | 131  | #225 | 33   | 60   |
| Internal Link Dist (ft) | 1043 | 605  | 674  |      |
| Turn Bay Length (ft)    |      |      |      | 180  |
| Base Capacity (vph)     | 2285 | 2160 | 489  | 730  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.27 | 0.60 | 0.08 | 0.55 |

#### Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

## Queues

## 2: Millrace &amp; Graves Mill

02/23/2018

|                         |  |  |  |  |  |
|-------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Lane Group              | EBT                                                                               | WBL                                                                               | WBT                                                                               | NBL                                                                               | NBR                                                                               |
| Lane Group Flow (vph)   | 935                                                                               | 30                                                                                | 1033                                                                              | 85                                                                                | 193                                                                               |
| v/c Ratio               | 0.50                                                                              | 0.07                                                                              | 0.48                                                                              | 0.32                                                                              | 0.48                                                                              |
| Control Delay           | 9.0                                                                               | 3.8                                                                               | 5.7                                                                               | 21.8                                                                              | 8.8                                                                               |
| Queue Delay             | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               |
| Total Delay             | 9.0                                                                               | 3.8                                                                               | 5.7                                                                               | 21.8                                                                              | 8.8                                                                               |
| Queue Length 50th (ft)  | 48                                                                                | 2                                                                                 | 56                                                                                | 14                                                                                | 0                                                                                 |
| Queue Length 95th (ft)  | 162                                                                               | 9                                                                                 | 106                                                                               | 62                                                                                | 47                                                                                |
| Internal Link Dist (ft) | 952                                                                               |                                                                                   | 1251                                                                              | 593                                                                               |                                                                                   |
| Turn Bay Length (ft)    |                                                                                   | 330                                                                               |                                                                                   |                                                                                   | 240                                                                               |
| Base Capacity (vph)     | 2523                                                                              | 579                                                                               | 3309                                                                              | 603                                                                               | 659                                                                               |
| Starvation Cap Reductn  | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Spillback Cap Reductn   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Storage Cap Reductn     | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Reduced v/c Ratio       | 0.37                                                                              | 0.05                                                                              | 0.31                                                                              | 0.14                                                                              | 0.29                                                                              |
| Intersection Summary    |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |



## Queues

## 4: Old Graves Mill &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | EBR  | WBL  | WBT  | NBT  | NBR  | SBT  |
|-------------------------|------|------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1    | 1012 | 215  | 280  | 912  | 129  | 55   | 3    |
| v/c Ratio               | 0.02 | 0.72 | 0.29 | 0.74 | 0.37 | 0.47 | 0.14 | 0.02 |
| Control Delay           | 41.0 | 22.4 | 3.7  | 43.6 | 7.2  | 35.9 | 0.7  | 30.0 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 41.0 | 22.4 | 3.7  | 43.6 | 7.2  | 35.9 | 0.7  | 30.0 |
| Queue Length 50th (ft)  | 0    | 178  | 0    | 113  | 63   | 51   | 0    | 0    |
| Queue Length 95th (ft)  | 6    | 340  | 43   | #321 | 216  | 122  | 0    | 10   |
| Internal Link Dist (ft) |      | 1348 |      |      | 700  | 355  |      | 176  |
| Turn Bay Length (ft)    | 380  |      | 280  | 310  |      |      |      |      |
| Base Capacity (vph)     | 51   | 1770 | 898  | 377  | 2593 | 538  | 608  | 417  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.02 | 0.57 | 0.24 | 0.74 | 0.35 | 0.24 | 0.09 | 0.01 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

## Queues

## 5: Connector/Creekside &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT  | NBR  | SBL  | SBT  |
|-------------------------|------|------|------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 41   | 923  | 214  | 1043 | 116  | 69   | 357  | 99   | 53   |
| v/c Ratio               | 0.12 | 0.71 | 0.51 | 0.52 | 0.12 | 0.33 | 0.64 | 0.44 | 0.22 |
| Control Delay           | 10.3 | 26.2 | 14.2 | 16.7 | 2.1  | 36.7 | 18.7 | 38.3 | 18.0 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 10.3 | 26.2 | 14.2 | 16.7 | 2.1  | 36.7 | 18.7 | 38.3 | 18.0 |
| Queue Length 50th (ft)  | 8    | 196  | 47   | 207  | 0    | 30   | 86   | 43   | 7    |
| Queue Length 95th (ft)  | 23   | #368 | 99   | 296  | 20   | 72   | 164  | 96   | 40   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519  |      |      | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      | 300  |      | 160  | 190  |      |
| Base Capacity (vph)     | 339  | 1306 | 804  | 2340 | 1107 | 291  | 914  | 292  | 298  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.12 | 0.71 | 0.27 | 0.45 | 0.10 | 0.24 | 0.39 | 0.34 | 0.18 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

## Queues

## 6: SB Ramp &amp; Graves Mill

02/23/2018



| Lane Group              | EBT  | EBR  | WBL  | WBT  | SBT  | SBR  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 424  | 981  | 229  | 1026 | 54   | 376  |
| v/c Ratio               | 0.29 | 0.87 | 0.35 | 0.45 | 0.16 | 0.89 |
| Control Delay           | 13.0 | 13.2 | 6.2  | 6.4  | 24.3 | 43.0 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 13.0 | 13.2 | 6.2  | 6.4  | 24.3 | 43.0 |
| Queue Length 50th (ft)  | 56   | 40   | 31   | 89   | 19   | 98   |
| Queue Length 95th (ft)  | 84   | #356 | 55   | 122  | 47   | #256 |
| Internal Link Dist (ft) | 797  |      |      | 663  | 620  |      |
| Turn Bay Length (ft)    |      | 280  | 250  |      |      | 125  |
| Base Capacity (vph)     | 1677 | 1178 | 660  | 2517 | 338  | 423  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.25 | 0.83 | 0.35 | 0.41 | 0.16 | 0.89 |

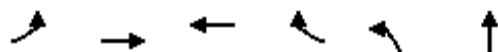
## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

## Queues

## 7: NB Ramp &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBT  | WBR  | NBL  | NBT  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 278  | 242  | 522  | 144  | 414  | 413  |
| v/c Ratio               | 0.55 | 0.13 | 0.58 | 0.28 | 0.91 | 0.87 |
| Control Delay           | 11.2 | 6.8  | 20.4 | 5.1  | 48.6 | 41.8 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 11.2 | 6.8  | 20.4 | 5.1  | 48.6 | 41.8 |
| Queue Length 50th (ft)  | 44   | 18   | 77   | 0    | 133  | 127  |
| Queue Length 95th (ft)  | 78   | 32   | 117  | 32   | #330 | #322 |
| Internal Link Dist (ft) |      | 663  | 458  |      |      | 755  |
| Turn Bay Length (ft)    | 170  |      |      | 180  |      |      |
| Base Capacity (vph)     | 530  | 2968 | 1986 | 953  | 457  | 476  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.52 | 0.08 | 0.26 | 0.15 | 0.91 | 0.87 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.



## Queues

## 9: Forest &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBL   | WBT   | NBL  | NBT  | NBR  | SBL   | SBT   | SBR  |
|-------------------------|------|------|-------|-------|------|------|------|-------|-------|------|
| Lane Group Flow (vph)   | 136  | 261  | 500   | 469   | 42   | 1113 | 281  | 251   | 1453  | 108  |
| v/c Ratio               | 0.67 | 0.62 | 1.19  | 1.06  | 0.39 | 0.91 | 0.29 | 1.30  | 1.03  | 0.13 |
| Control Delay           | 80.8 | 65.6 | 156.1 | 109.4 | 82.4 | 61.2 | 5.8  | 217.8 | 75.9  | 3.7  |
| Queue Delay             | 0.0  | 0.0  | 0.0   | 0.0   | 0.0  | 0.0  | 0.0  | 0.0   | 0.0   | 0.0  |
| Total Delay             | 80.8 | 65.6 | 156.1 | 109.4 | 82.4 | 61.2 | 5.8  | 217.8 | 75.9  | 3.7  |
| Queue Length 50th (ft)  | 135  | 124  | ~616  | ~491  | 42   | 570  | 40   | ~327  | ~864  | 8    |
| Queue Length 95th (ft)  | 206  | 169  | #877  | #747  | 87   | #731 | 92   | #528  | #1082 | 28   |
| Internal Link Dist (ft) |      | 661  |       | 1043  |      | 1143 |      |       | 649   |      |
| Turn Bay Length (ft)    | 90   |      |       |       | 200  |      | 360  | 250   |       | 280  |
| Base Capacity (vph)     | 298  | 606  | 420   | 443   | 134  | 1237 | 982  | 193   | 1413  | 909  |
| Starvation Cap Reductn  | 0    | 0    | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0    |
| Storage Cap Reductn     | 0    | 0    | 0     | 0     | 0    | 0    | 0    | 0     | 0     | 0    |
| Reduced v/c Ratio       | 0.46 | 0.43 | 1.19  | 1.06  | 0.31 | 0.90 | 0.29 | 1.30  | 1.03  | 0.12 |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM 2010 TWSC  
3: Graves Mill & Millside

02/23/2018

Intersection

Int Delay, s/veh 0.6

| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lane Configurations      |      | ↕↕   | ↗    |      | ↕↕   | ↗    |      | ↕    |      |      | ↕    |      |
| Traffic Vol, veh/h       | 3    | 1088 | 1    | 4    | 937  | 8    | 1    | 0    | 12   | 18   | 0    | 8    |
| Future Vol, veh/h        | 3    | 1088 | 1    | 4    | 937  | 8    | 1    | 0    | 12   | 18   | 0    | 8    |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized           | -    | -    | None | -    | -    | None | -    | -    | None | -    | -    | None |
| Storage Length           | -    | -    | 140  | -    | -    | 140  | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | -5   | -    | -    | 5    | -    | -    | 3    | -    | -    | -5   | -    |
| Peak Hour Factor         | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   |
| Heavy Vehicles, %        | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Mvmt Flow                | 3    | 1183 | 1    | 4    | 1018 | 9    | 1    | 0    | 13   | 20   | 0    | 9    |

| Major/Minor          | Major1 |   |   | Major2 |   |   | Minor1 |      |     | Minor2 |      |     |
|----------------------|--------|---|---|--------|---|---|--------|------|-----|--------|------|-----|
| Conflicting Flow All | 1018   | 0 | 0 | 1183   | 0 | 0 | 1707   | 2216 | 591 | 1625   | 2216 | 509 |
| Stage 1              | -      | - | - | -      | - | - | 1189   | 1189 | -   | 1027   | 1027 | -   |
| Stage 2              | -      | - | - | -      | - | - | 518    | 1027 | -   | 598    | 1189 | -   |
| Critical Hdwy        | 4.1    | - | - | 4.1    | - | - | 8.1    | 7.1  | 7.2 | 6.5    | 5.5  | 6.4 |
| Critical Hdwy Stg 1  | -      | - | - | -      | - | - | 7.1    | 6.1  | -   | 5.5    | 4.5  | -   |
| Critical Hdwy Stg 2  | -      | - | - | -      | - | - | 7.1    | 6.1  | -   | 5.5    | 4.5  | -   |
| Follow-up Hdwy       | 2.2    | - | - | 2.2    | - | - | 3.5    | 4    | 3.3 | 3.5    | 4    | 3.3 |
| Pot Cap-1 Maneuver   | 689    | - | - | 597    | - | - | 45     | 31   | 433 | 109    | 82   | 552 |
| Stage 1              | -      | - | - | -      | - | - | 166    | 216  | -   | 339    | 418  | -   |
| Stage 2              | -      | - | - | -      | - | - | 471    | 265  | -   | 544    | 367  | -   |
| Platoon blocked, %   | -      | - | - | -      | - | - | -      | -    | -   | -      | -    | -   |
| Mov Cap-1 Maneuver   | 689    | - | - | 597    | - | - | 43     | 30   | 433 | 103    | 80   | 552 |
| Mov Cap-2 Maneuver   | -      | - | - | -      | - | - | 43     | 30   | -   | 103    | 80   | -   |
| Stage 1              | -      | - | - | -      | - | - | 164    | 213  | -   | 335    | 411  | -   |
| Stage 2              | -      | - | - | -      | - | - | 456    | 261  | -   | 521    | 362  | -   |

| Approach             | EB | WB  | NB   | SB |
|----------------------|----|-----|------|----|
| HCM Control Delay, s | 0  | 0.1 | 19.9 | 38 |
| HCM LOS              |    |     | C    | E  |

| Minor Lane/Major Mvmt | NBLn1 | EBL   | EBT | EBR | WBL   | WBT | WBR | SBLn1 |
|-----------------------|-------|-------|-----|-----|-------|-----|-----|-------|
| Capacity (veh/h)      | 255   | 689   | -   | -   | 597   | -   | -   | 137   |
| HCM Lane V/C Ratio    | 0.055 | 0.005 | -   | -   | 0.007 | -   | -   | 0.206 |
| HCM Control Delay (s) | 19.9  | 10.2  | 0   | -   | 11.1  | 0.1 | -   | 38    |
| HCM Lane LOS          | C     | B     | A   | -   | B     | A   | -   | E     |
| HCM 95th %tile Q(veh) | 0.2   | 0     | -   | -   | 0     | -   | -   | 0.7   |

Intersection

Intersection Delay, s/veh31.9

Intersection LOS D

| Movement            | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lane Configurations |      | ↰    | ↱    |      | ↰    |      |      | ↰    |      |      | ↰    | ↱    |
| Traffic Vol, veh/h  | 101  | 30   | 155  | 44   | 261  | 8    | 251  | 53   | 13   | 0    | 24   | 112  |
| Future Vol, veh/h   | 101  | 30   | 155  | 44   | 261  | 8    | 251  | 53   | 13   | 0    | 24   | 112  |
| Peak Hour Factor    | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 | 0.79 |
| Heavy Vehicles, %   | 0    | 0    | 3    | 0    | 1    | 0    | 1    | 0    | 8    | 0    | 0    | 0    |
| Mvmt Flow           | 128  | 38   | 196  | 56   | 330  | 10   | 318  | 67   | 16   | 0    | 30   | 142  |
| Number of Lanes     | 0    | 1    | 1    | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 1    | 1    |

| Approach                      | EB   | WB   | NB   | SB   |
|-------------------------------|------|------|------|------|
| Opposing Approach             | WB   | EB   | SB   | NB   |
| Opposing Lanes                | 1    | 2    | 2    | 1    |
| Conflicting Approach Left SB  |      | NB   | EB   | WB   |
| Conflicting Lanes Left        | 2    | 1    | 2    | 1    |
| Conflicting Approach Right NB |      | SB   | WB   | EB   |
| Conflicting Lanes Right       | 1    | 2    | 1    | 2    |
| HCM Control Delay             | 15.3 | 41.3 | 45.6 | 13.5 |
| HCM LOS                       | C    | E    | E    | B    |

| Lane                   | NBLn1 | EBLn1 | EBLn2 | WBLn1 | SBLn1 | SBLn2 |
|------------------------|-------|-------|-------|-------|-------|-------|
| Vol Left, %            | 79%   | 77%   | 0%    | 14%   | 0%    | 0%    |
| Vol Thru, %            | 17%   | 23%   | 0%    | 83%   | 100%  | 0%    |
| Vol Right, %           | 4%    | 0%    | 100%  | 3%    | 0%    | 100%  |
| Sign Control           | Stop  | Stop  | Stop  | Stop  | Stop  | Stop  |
| Traffic Vol by Lane    | 317   | 131   | 155   | 313   | 24    | 112   |
| LT Vol                 | 251   | 101   | 0     | 44    | 0     | 0     |
| Through Vol            | 53    | 30    | 0     | 261   | 24    | 0     |
| RT Vol                 | 13    | 0     | 155   | 8     | 0     | 112   |
| Lane Flow Rate         | 401   | 166   | 196   | 396   | 30    | 142   |
| Geometry Grp           | 6     | 7     | 7     | 6     | 7     | 7     |
| Degree of Util (X)     | 0.877 | 0.384 | 0.393 | 0.851 | 0.072 | 0.306 |
| Departure Headway (Hd) | 7.866 | 8.33  | 7.208 | 7.732 | 8.493 | 7.766 |
| Convergence, Y/N       | Yes   | Yes   | Yes   | Yes   | Yes   | Yes   |
| Cap                    | 461   | 431   | 498   | 468   | 421   | 462   |
| Service Time           | 5.915 | 6.088 | 4.966 | 5.784 | 6.257 | 5.531 |
| HCM Lane V/C Ratio     | 0.87  | 0.385 | 0.394 | 0.846 | 0.071 | 0.307 |
| HCM Control Delay      | 45.6  | 16.2  | 14.6  | 41.3  | 11.9  | 13.9  |
| HCM Lane LOS           | E     | C     | B     | E     | B     | B     |
| HCM 95th-tile Q        | 9.2   | 1.8   | 1.9   | 8.6   | 0.2   | 1.3   |

Intersection

Int Delay, s/veh 19

| Movement                 | WBL                                                                               | WBR                                                                               | NBT                                                                               | NBR  | SBL  | SBT                                                                               |
|--------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------------------------------------------------------------------------------|
| Lane Configurations      |  |  |  |      |      |  |
| Traffic Vol, veh/h       | 307                                                                               | 16                                                                                | 141                                                                               | 231  | 13   | 449                                                                               |
| Future Vol, veh/h        | 307                                                                               | 16                                                                                | 141                                                                               | 231  | 13   | 449                                                                               |
| Conflicting Peds, #/hr   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0    | 0    | 0                                                                                 |
| Sign Control             | Stop                                                                              | Stop                                                                              | Free                                                                              | Free | Free | Free                                                                              |
| RT Channelized           | -                                                                                 | None                                                                              | -                                                                                 | None | -    | None                                                                              |
| Storage Length           | 255                                                                               | 0                                                                                 | -                                                                                 | -    | -    | -                                                                                 |
| Veh in Median Storage, # | 0                                                                                 | -                                                                                 | 0                                                                                 | -    | -    | 0                                                                                 |
| Grade, %                 | 0                                                                                 | -                                                                                 | 0                                                                                 | -    | -    | 0                                                                                 |
| Peak Hour Factor         | 92                                                                                | 92                                                                                | 92                                                                                | 92   | 92   | 92                                                                                |
| Heavy Vehicles, %        | 1                                                                                 | 0                                                                                 | 1                                                                                 | 3    | 8    | 3                                                                                 |
| Mvmt Flow                | 334                                                                               | 17                                                                                | 153                                                                               | 251  | 14   | 488                                                                               |

| Major/Minor          | Minor1 | Major1 | Major2 |   |       |
|----------------------|--------|--------|--------|---|-------|
| Conflicting Flow All | 795    | 279    | 0      | 0 | 404   |
| Stage 1              | 279    | -      | -      | - | -     |
| Stage 2              | 516    | -      | -      | - | -     |
| Critical Hdwy        | 6.41   | 6.2    | -      | - | 4.18  |
| Critical Hdwy Stg 1  | 5.41   | -      | -      | - | -     |
| Critical Hdwy Stg 2  | 5.41   | -      | -      | - | -     |
| Follow-up Hdwy       | 3.509  | 3.3    | -      | - | 2.272 |
| Pot Cap-1 Maneuver   | 358    | 765    | -      | - | 1123  |
| Stage 1              | 770    | -      | -      | - | -     |
| Stage 2              | 601    | -      | -      | - | -     |
| Platoon blocked, %   |        |        | -      | - | -     |
| Mov Cap-1 Maneuver   | 352    | 765    | -      | - | 1123  |
| Mov Cap-2 Maneuver   | 352    | -      | -      | - | -     |
| Stage 1              | 770    | -      | -      | - | -     |
| Stage 2              | 591    | -      | -      | - | -     |

| Approach             | WB   | NB | SB  |
|----------------------|------|----|-----|
| HCM Control Delay, s | 67.6 | 0  | 0.2 |
| HCM LOS              | F    |    |     |

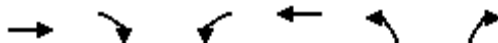
| Minor Lane/Major Mvmt | NBT | NBRWBLn1WBLn2       | SBL | SBT |
|-----------------------|-----|---------------------|-----|-----|
| Capacity (veh/h)      | -   | - 352 765 1123      | -   | -   |
| HCM Lane V/C Ratio    | -   | - 0.948 0.023 0.013 | -   | -   |
| HCM Control Delay (s) | -   | - 70.6 9.8 8.2      | 0   |     |
| HCM Lane LOS          | -   | - F A A             | A   | A   |
| HCM 95th %tile Q(veh) | -   | - 10.1 0.1 0        | -   | -   |



# HCM Signalized Intersection Capacity Analysis

## 1: Gristmill & Graves Mill

02/23/2018



| Movement               | EBT  | EBR  | WBL   | WBT    | NBL   | NBR   |
|------------------------|------|------|-------|--------|-------|-------|
| Lane Configurations    | ↑↑   |      |       | ↑↑     | ↵     | ↵     |
| Traffic Volume (vph)   | 958  | 15   | 311   | 644    | 21    | 827   |
| Future Volume (vph)    | 958  | 15   | 311   | 644    | 21    | 827   |
| Ideal Flow (vphpl)     | 1900 | 1900 | 1900  | 1900   | 1900  | 1900  |
| Lane Width             | 12   | 12   | 12    | 12     | 11    | 12    |
| Grade (%)              | 0%   |      |       | 0%     | 2%    |       |
| Total Lost time (s)    | 6.5  |      |       | 6.5    | 5.3   | 5.3   |
| Lane Util. Factor      | 0.95 |      |       | 0.95   | 1.00  | 1.00  |
| Frt                    | 1.00 |      |       | 1.00   | 1.00  | 0.85  |
| Flt Protected          | 1.00 |      |       | 0.98   | 0.95  | 1.00  |
| Satd. Flow (prot)      | 3567 |      |       | 3528   | 1630  | 1583  |
| Flt Permitted          | 1.00 |      |       | 0.52   | 0.95  | 1.00  |
| Satd. Flow (perm)      | 3567 |      |       | 1878   | 1630  | 1583  |
| Peak-hour factor, PHF  | 0.88 | 0.88 | 0.88  | 0.88   | 0.88  | 0.88  |
| Adj. Flow (vph)        | 1089 | 17   | 353   | 732    | 24    | 940   |
| RTOR Reduction (vph)   | 1    | 0    | 0     | 0      | 0     | 82    |
| Lane Group Flow (vph)  | 1105 | 0    | 0     | 1085   | 24    | 858   |
| Heavy Vehicles (%)     | 1%   | 0%   | 0%    | 1%     | 6%    | 1%    |
| Turn Type              | NA   |      | pm+pt | NA     | Prot  | Perm  |
| Protected Phases       | 2    |      | 1     | 6      | 4     |       |
| Permitted Phases       |      |      | 6     |        |       | 4     |
| Actuated Green, G (s)  | 41.9 |      |       | 53.5   | 44.7  | 44.7  |
| Effective Green, g (s) | 41.9 |      |       | 53.5   | 44.7  | 44.7  |
| Actuated g/C Ratio     | 0.38 |      |       | 0.49   | 0.41  | 0.41  |
| Clearance Time (s)     | 6.5  |      |       | 6.5    | 5.3   | 5.3   |
| Vehicle Extension (s)  | 3.0  |      |       | 3.0    | 2.0   | 2.0   |
| Lane Grp Cap (vph)     | 1358 |      |       | 989    | 662   | 643   |
| v/s Ratio Prot         | 0.31 |      |       | c0.05  | 0.01  |       |
| v/s Ratio Perm         |      |      |       | c0.48  |       | c0.54 |
| v/c Ratio              | 0.81 |      |       | 2.29dl | 0.04  | 1.33  |
| Uniform Delay, d1      | 30.5 |      |       | 28.2   | 19.7  | 32.6  |
| Progression Factor     | 1.01 |      |       | 0.39   | 1.00  | 1.00  |
| Incremental Delay, d2  | 1.9  |      |       | 58.4   | 0.0   | 161.0 |
| Delay (s)              | 32.7 |      |       | 69.5   | 19.7  | 193.6 |
| Level of Service       | C    |      |       | E      | B     | F     |
| Approach Delay (s)     | 32.7 |      |       | 69.5   | 189.3 |       |
| Approach LOS           | C    |      |       | E      | F     |       |

### Intersection Summary

|                                                                 |       |                           |      |
|-----------------------------------------------------------------|-------|---------------------------|------|
| HCM 2000 Control Delay                                          | 93.2  | HCM 2000 Level of Service | F    |
| HCM 2000 Volume to Capacity ratio                               | 1.27  |                           |      |
| Actuated Cycle Length (s)                                       | 110.0 | Sum of lost time (s)      | 18.3 |
| Intersection Capacity Utilization                               | 88.0% | ICU Level of Service      | E    |
| Analysis Period (min)                                           | 15    |                           |      |
| dl Defacto Left Lane. Recode with 1 though lane as a left lane. |       |                           |      |
| c Critical Lane Group                                           |       |                           |      |

# HCM Signalized Intersection Capacity Analysis

## 2: Millrace & Graves Mill

02/23/2018

|                                   | →     | ↘    | ↙     | ←    | ↖                         | ↗    |
|-----------------------------------|-------|------|-------|------|---------------------------|------|
| Movement                          | EBT   | EBR  | WBL   | WBT  | NBL                       | NBR  |
| Lane Configurations               | ↑↑    |      | ↘     | ↑↑   | ↘                         | ↗    |
| Traffic Volume (vph)              | 1669  | 72   | 90    | 1008 | 15                        | 14   |
| Future Volume (vph)               | 1669  | 72   | 90    | 1008 | 15                        | 14   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900  | 1900 | 1900                      | 1900 |
| Lane Width                        | 12    | 12   | 11    | 12   | 11                        | 11   |
| Grade (%)                         | 0%    |      |       | 0%   | 3%                        |      |
| Total Lost time (s)               | 5.0   |      | 4.5   | 5.0  | 5.0                       | 5.0  |
| Lane Util. Factor                 | 0.95  |      | 1.00  | 0.95 | 1.00                      | 1.00 |
| Frt                               | 0.99  |      | 1.00  | 1.00 | 1.00                      | 0.85 |
| Flt Protected                     | 1.00  |      | 0.95  | 1.00 | 0.95                      | 1.00 |
| Satd. Flow (prot)                 | 3554  |      | 1728  | 3574 | 1719                      | 1411 |
| Flt Permitted                     | 1.00  |      | 0.07  | 1.00 | 0.95                      | 1.00 |
| Satd. Flow (perm)                 | 3554  |      | 122   | 3574 | 1719                      | 1411 |
| Peak-hour factor, PHF             | 0.88  | 0.88 | 0.88  | 0.88 | 0.88                      | 0.88 |
| Adj. Flow (vph)                   | 1897  | 82   | 102   | 1145 | 17                        | 16   |
| RTOR Reduction (vph)              | 2     | 0    | 0     | 0    | 0                         | 16   |
| Lane Group Flow (vph)             | 1977  | 0    | 102   | 1145 | 17                        | 0    |
| Heavy Vehicles (%)                | 1%    | 0%   | 1%    | 1%   | 0%                        | 9%   |
| Turn Type                         | NA    |      | pm+pt | NA   | Prot                      | Perm |
| Protected Phases                  | 6     |      | 5     | 2    | 4                         |      |
| Permitted Phases                  |       |      | 2     |      |                           | 4    |
| Actuated Green, G (s)             | 85.5  |      | 96.6  | 96.6 | 3.4                       | 3.4  |
| Effective Green, g (s)            | 85.5  |      | 96.6  | 96.6 | 3.4                       | 3.4  |
| Actuated g/C Ratio                | 0.78  |      | 0.88  | 0.88 | 0.03                      | 0.03 |
| Clearance Time (s)                | 5.0   |      | 4.5   | 5.0  | 5.0                       | 5.0  |
| Vehicle Extension (s)             | 3.5   |      | 2.0   | 3.5  | 2.0                       | 2.0  |
| Lane Grp Cap (vph)                | 2762  |      | 203   | 3138 | 53                        | 43   |
| v/s Ratio Prot                    | c0.56 |      | c0.03 | 0.32 | c0.01                     |      |
| v/s Ratio Perm                    |       |      | 0.41  |      |                           | 0.00 |
| v/c Ratio                         | 0.72  |      | 0.50  | 0.36 | 0.32                      | 0.01 |
| Uniform Delay, d1                 | 6.1   |      | 11.5  | 1.2  | 52.2                      | 51.7 |
| Progression Factor                | 1.16  |      | 3.37  | 0.06 | 1.00                      | 1.00 |
| Incremental Delay, d2             | 0.1   |      | 0.6   | 0.3  | 1.3                       | 0.0  |
| Delay (s)                         | 7.3   |      | 39.2  | 0.3  | 53.4                      | 51.7 |
| Level of Service                  | A     |      | D     | A    | D                         | D    |
| Approach Delay (s)                | 7.3   |      |       | 3.5  | 52.6                      |      |
| Approach LOS                      | A     |      |       | A    | D                         |      |
| <b>Intersection Summary</b>       |       |      |       |      |                           |      |
| HCM 2000 Control Delay            |       |      | 6.3   |      | HCM 2000 Level of Service | A    |
| HCM 2000 Volume to Capacity ratio |       |      | 0.69  |      |                           |      |
| Actuated Cycle Length (s)         |       |      | 110.0 |      | Sum of lost time (s)      | 14.5 |
| Intersection Capacity Utilization |       |      | 68.8% |      | ICU Level of Service      | C    |
| Analysis Period (min)             |       |      | 15    |      |                           |      |
| c Critical Lane Group             |       |      |       |      |                           |      |

# HCM Signalized Intersection Capacity Analysis

## 4: Old Graves Mill & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |  |  |  |                                                                                   |                                                                                    |  |  |                                                                                     |  |                                                                                     |
| Traffic Volume (vph)              | 0                                                                                 | 1332                                                                              | 207                                                                               | 135                                                                               | 1006                                                                              | 0                                                                                 | 216                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Future Volume (vph)               | 0                                                                                 | 1332                                                                              | 207                                                                               | 135                                                                               | 1006                                                                              | 0                                                                                 | 216                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                 | 13                                                                                  | 13                                                                                  | 12                                                                                  | 16                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | -5%                                                                               |                                                                                   |                                                                                    | -5%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| Lane Util. Factor                 |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Frt                               |                                                                                   | 1.00                                                                              | 0.85                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 0.85                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Flt Protected                     |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (prot)                 |                                                                                   | 3521                                                                              | 1544                                                                              | 1736                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1856                                                                                | 1614                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Flt Permitted                     |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (perm)                 |                                                                                   | 3521                                                                              | 1544                                                                              | 1736                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1856                                                                                | 1614                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Peak-hour factor, PHF             | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                               | 0.89                                                                                | 0.89                                                                                | 0.89                                                                                | 0.89                                                                                | 0.89                                                                                |
| Adj. Flow (vph)                   | 0                                                                                 | 1497                                                                              | 233                                                                               | 152                                                                               | 1130                                                                              | 0                                                                                 | 243                                                                                | 0                                                                                   | 84                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 57                                                                                | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                  | 0                                                                                   | 69                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 0                                                                                 | 1497                                                                              | 176                                                                               | 152                                                                               | 1130                                                                              | 0                                                                                 | 0                                                                                  | 243                                                                                 | 15                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                | 3%                                                                                | 3%                                                                                | 1%                                                                                | 0%                                                                                | 3%                                                                                 | 0%                                                                                  | 6%                                                                                  | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  |
| Turn Type                         | Prot                                                                              | NA                                                                                | Perm                                                                              | Prot                                                                              | NA                                                                                |                                                                                   | Split                                                                              | NA                                                                                  | Perm                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                  | 8                                                                                   |                                                                                     | 4                                                                                   | 4                                                                                   |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                   | 2                                                                                 |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             |                                                                                   | 68.2                                                                              | 68.2                                                                              | 7.0                                                                               | 80.2                                                                              |                                                                                   |                                                                                    | 19.8                                                                                | 19.8                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Effective Green, g (s)            |                                                                                   | 68.2                                                                              | 68.2                                                                              | 7.0                                                                               | 80.2                                                                              |                                                                                   |                                                                                    | 19.8                                                                                | 19.8                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Actuated g/C Ratio                |                                                                                   | 0.62                                                                              | 0.62                                                                              | 0.06                                                                              | 0.73                                                                              |                                                                                   |                                                                                    | 0.18                                                                                | 0.18                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Clearance Time (s)                |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| Vehicle Extension (s)             |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                   |                                                                                    | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| Lane Grp Cap (vph)                |                                                                                   | 2183                                                                              | 957                                                                               | 110                                                                               | 2671                                                                              |                                                                                   |                                                                                    | 334                                                                                 | 290                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Prot                    |                                                                                   | c0.43                                                                             |                                                                                   | c0.09                                                                             | 0.31                                                                              |                                                                                   |                                                                                    | c0.13                                                                               |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                   | 0.11                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 0.01                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         |                                                                                   | 0.69                                                                              | 0.18                                                                              | 1.38                                                                              | 0.42                                                                              |                                                                                   |                                                                                    | 0.73                                                                                | 0.05                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Uniform Delay, d1                 |                                                                                   | 13.8                                                                              | 9.0                                                                               | 51.5                                                                              | 5.8                                                                               |                                                                                   |                                                                                    | 42.6                                                                                | 37.3                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Progression Factor                |                                                                                   | 0.70                                                                              | 0.67                                                                              | 0.67                                                                              | 0.12                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Incremental Delay, d2             |                                                                                   | 1.5                                                                               | 0.4                                                                               | 214.8                                                                             | 0.4                                                                               |                                                                                   |                                                                                    | 7.7                                                                                 | 0.1                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| Delay (s)                         |                                                                                   | 11.1                                                                              | 6.4                                                                               | 249.3                                                                             | 1.1                                                                               |                                                                                   |                                                                                    | 50.2                                                                                | 37.4                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Level of Service                  |                                                                                   | B                                                                                 | A                                                                                 | F                                                                                 | A                                                                                 |                                                                                   |                                                                                    | D                                                                                   | D                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Approach Delay (s)                |                                                                                   | 10.5                                                                              |                                                                                   |                                                                                   | 30.6                                                                              |                                                                                   |                                                                                    | 46.9                                                                                |                                                                                     |                                                                                     | 0.0                                                                                 |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | C                                                                                 |                                                                                   |                                                                                    | D                                                                                   |                                                                                     |                                                                                     | A                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 21.8                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                    |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.79                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 110.0                                                                             |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                    |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 68.8%                                                                             |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                    |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                    |  |  |  |  |                                                                                     |
| Traffic Volume (vph)              | 40                                                                                | 1363                                                                              | 13                                                                                | 335                                                                               | 1091                                                                              | 99                                                                                | 9                                                                                  | 17                                                                                  | 544                                                                                 | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Future Volume (vph)               | 40                                                                                | 1363                                                                              | 13                                                                                | 335                                                                               | 1091                                                                              | 99                                                                                | 9                                                                                  | 17                                                                                  | 544                                                                                 | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                 | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                    | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                    | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                    | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                    | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                    | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1662                                                                              | 3513                                                                              |                                                                                   | 1770                                                                              | 3539                                                                              | 1538                                                                              |                                                                                    | 1824                                                                                | 1464                                                                                | 1621                                                                                | 1575                                                                                |                                                                                     |
| Flt Permitted                     | 0.23                                                                              | 1.00                                                                              |                                                                                   | 0.08                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                    | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 394                                                                               | 3513                                                                              |                                                                                   | 149                                                                               | 3539                                                                              | 1538                                                                              |                                                                                    | 1824                                                                                | 1464                                                                                | 1621                                                                                | 1575                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                               | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 45                                                                                | 1549                                                                              | 15                                                                                | 381                                                                               | 1240                                                                              | 112                                                                               | 10                                                                                 | 19                                                                                  | 618                                                                                 | 52                                                                                  | 14                                                                                  | 25                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 32                                                                                | 0                                                                                  | 0                                                                                   | 43                                                                                  | 0                                                                                   | 24                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 45                                                                                | 1563                                                                              | 0                                                                                 | 381                                                                               | 1240                                                                              | 81                                                                                | 0                                                                                  | 29                                                                                  | 575                                                                                 | 52                                                                                  | 15                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 7%                                                                                | 1%                                                                                | 10%                                                                               | 2%                                                                                | 2%                                                                                | 5%                                                                                | 0%                                                                                 | 0%                                                                                  | 4%                                                                                  | 6%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                              | NA                                                                                  | pm+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                  | 8                                                                                   | 1                                                                                   | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                    |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 49.2                                                                              | 45.1                                                                              |                                                                                   | 88.0                                                                              | 78.9                                                                              | 78.9                                                                              |                                                                                    | 3.0                                                                                 | 40.9                                                                                | 4.0                                                                                 | 4.0                                                                                 |                                                                                     |
| Effective Green, g (s)            | 49.2                                                                              | 45.1                                                                              |                                                                                   | 88.0                                                                              | 78.9                                                                              | 78.9                                                                              |                                                                                    | 3.0                                                                                 | 40.9                                                                                | 4.0                                                                                 | 4.0                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.45                                                                              | 0.41                                                                              |                                                                                   | 0.80                                                                              | 0.72                                                                              | 0.72                                                                              |                                                                                    | 0.03                                                                                | 0.37                                                                                | 0.04                                                                                | 0.04                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                    | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                    | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 223                                                                               | 1440                                                                              |                                                                                   | 677                                                                               | 2538                                                                              | 1103                                                                              |                                                                                    | 49                                                                                  | 610                                                                                 | 58                                                                                  | 57                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.01                                                                              | c0.45                                                                             |                                                                                   | 0.19                                                                              | 0.35                                                                              |                                                                                   |                                                                                    | 0.02                                                                                | c0.32                                                                               | c0.03                                                                               | 0.01                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.08                                                                              |                                                                                   |                                                                                   | 0.26                                                                              |                                                                                   | 0.05                                                                              |                                                                                    |                                                                                     | 0.07                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.20                                                                              | 1.09                                                                              |                                                                                   | 0.56                                                                              | 0.49                                                                              | 0.07                                                                              |                                                                                    | 0.59                                                                                | 0.94                                                                                | 0.90                                                                                | 0.26                                                                                |                                                                                     |
| Uniform Delay, d1                 | 19.0                                                                              | 32.5                                                                              |                                                                                   | 22.8                                                                              | 6.8                                                                               | 4.6                                                                               |                                                                                    | 52.9                                                                                | 33.4                                                                                | 52.8                                                                                | 51.6                                                                                |                                                                                     |
| Progression Factor                | 0.41                                                                              | 0.64                                                                              |                                                                                   | 1.26                                                                              | 0.36                                                                              | 0.48                                                                              |                                                                                    | 1.03                                                                                | 0.96                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.3                                                                               | 48.2                                                                              |                                                                                   | 0.8                                                                               | 0.5                                                                               | 0.1                                                                               |                                                                                    | 17.7                                                                                | 23.0                                                                                | 80.9                                                                                | 2.4                                                                                 |                                                                                     |
| Delay (s)                         | 8.2                                                                               | 69.1                                                                              |                                                                                   | 29.5                                                                              | 3.0                                                                               | 2.3                                                                               |                                                                                    | 72.2                                                                                | 55.1                                                                                | 133.7                                                                               | 54.0                                                                                |                                                                                     |
| Level of Service                  | A                                                                                 | E                                                                                 |                                                                                   | C                                                                                 | A                                                                                 | A                                                                                 |                                                                                    | E                                                                                   | E                                                                                   | F                                                                                   | D                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 67.4                                                                              |                                                                                   |                                                                                   | 8.8                                                                               |                                                                                   |                                                                                    | 55.9                                                                                |                                                                                     |                                                                                     | 99.6                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | E                                                                                 |                                                                                   |                                                                                   | A                                                                                 |                                                                                   |                                                                                    | E                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 41.4                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                          |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 1.06                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 110.0                                                                             |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                               |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 88.4%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                               |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |



# HCM Signalized Intersection Capacity Analysis

## 6: SB Ramp & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |                                                                                   | ↑↑                                                                                | ↑                                                                                 | ↑                                                                                 | ↑↑                                                                                |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | ↑                                                                                   | ↑                                                                                   |
| Traffic Volume (vph)              | 0                                                                                 | 766                                                                               | 1194                                                                              | 121                                                                               | 1230                                                                              | 0                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   | 167                                                                                 | 1                                                                                   | 295                                                                                 |
| Future Volume (vph)               | 0                                                                                 | 766                                                                               | 1194                                                                              | 121                                                                               | 1230                                                                              | 0                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   | 167                                                                                 | 1                                                                                   | 295                                                                                 |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 12                                                                                  | 12                                                                                  | 12                                                                                  | 11                                                                                  | 11                                                                                  |
| Grade (%)                         |                                                                                   | 0%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | 3%                                                                                  |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |
| Lane Util. Factor                 |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 1.00                                                                                | 1.00                                                                                |
| Frt                               |                                                                                   | 1.00                                                                              | 0.85                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 1.00                                                                                | 0.85                                                                                |
| Flt Protected                     |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 0.95                                                                                | 1.00                                                                                |
| Satd. Flow (prot)                 |                                                                                   | 3574                                                                              | 1553                                                                              | 1787                                                                              | 3574                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 1657                                                                                | 1451                                                                                |
| Flt Permitted                     |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.27                                                                              | 1.00                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 0.95                                                                                | 1.00                                                                                |
| Satd. Flow (perm)                 |                                                                                   | 3574                                                                              | 1553                                                                              | 510                                                                               | 3574                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 1657                                                                                | 1451                                                                                |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 0                                                                                 | 870                                                                               | 1357                                                                              | 138                                                                               | 1398                                                                              | 0                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   | 190                                                                                 | 1                                                                                   | 335                                                                                 |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 319                                                                               | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   | 82                                                                                  |
| Lane Group Flow (vph)             | 0                                                                                 | 870                                                                               | 1038                                                                              | 138                                                                               | 1398                                                                              | 0                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   | 191                                                                                 | 253                                                                                 |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                | 4%                                                                                | 1%                                                                                | 1%                                                                                | 0%                                                                                | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  | 4%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         |                                                                                   | NA                                                                                | Perm                                                                              | pm+pt                                                                             | NA                                                                                |                                                                                   |                                                                                     |                                                                                     |                                                                                     | Split                                                                               | NA                                                                                  | Perm                                                                                |
| Protected Phases                  |                                                                                   | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   |                                                                                     |                                                                                     |                                                                                     | 8                                                                                   | 8                                                                                   |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                   | 2                                                                                 | 6                                                                                 |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 8                                                                                   |
| Actuated Green, G (s)             |                                                                                   | 72.0                                                                              | 72.0                                                                              | 84.0                                                                              | 84.0                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 16.0                                                                                | 16.0                                                                                |
| Effective Green, g (s)            |                                                                                   | 72.0                                                                              | 72.0                                                                              | 84.0                                                                              | 84.0                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 16.0                                                                                | 16.0                                                                                |
| Actuated g/C Ratio                |                                                                                   | 0.65                                                                              | 0.65                                                                              | 0.76                                                                              | 0.76                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 0.15                                                                                | 0.15                                                                                |
| Clearance Time (s)                |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |
| Vehicle Extension (s)             |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |
| Lane Grp Cap (vph)                |                                                                                   | 2339                                                                              | 1016                                                                              | 470                                                                               | 2729                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 241                                                                                 | 211                                                                                 |
| v/s Ratio Prot                    |                                                                                   | 0.24                                                                              |                                                                                   | 0.02                                                                              | c0.39                                                                             |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 0.12                                                                                |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                   | c0.67                                                                             | 0.21                                                                              |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     | c0.17                                                                               |
| v/c Ratio                         |                                                                                   | 0.37                                                                              | 1.02                                                                              | 0.29                                                                              | 0.51                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 0.79                                                                                | 1.20                                                                                |
| Uniform Delay, d1                 |                                                                                   | 8.7                                                                               | 19.0                                                                              | 4.3                                                                               | 5.0                                                                               |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 45.4                                                                                | 47.0                                                                                |
| Progression Factor                |                                                                                   | 0.58                                                                              | 1.96                                                                              | 1.05                                                                              | 1.58                                                                              |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 1.00                                                                                | 1.00                                                                                |
| Incremental Delay, d2             |                                                                                   | 0.1                                                                               | 19.4                                                                              | 0.4                                                                               | 0.4                                                                               |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 18.4                                                                                | 126.0                                                                               |
| Delay (s)                         |                                                                                   | 5.1                                                                               | 56.7                                                                              | 5.0                                                                               | 8.4                                                                               |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 63.8                                                                                | 173.0                                                                               |
| Level of Service                  |                                                                                   | A                                                                                 | E                                                                                 | A                                                                                 | A                                                                                 |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | E                                                                                   | F                                                                                   |
| Approach Delay (s)                |                                                                                   | 36.6                                                                              |                                                                                   |                                                                                   | 8.1                                                                               |                                                                                   |                                                                                     | 0.0                                                                                 |                                                                                     |                                                                                     | 133.3                                                                               |                                                                                     |
| Approach LOS                      |                                                                                   | D                                                                                 |                                                                                   |                                                                                   | A                                                                                 |                                                                                   |                                                                                     | A                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 38.2                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                     |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 1.03                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 110.0                                                                             |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                     |                                                                                     |                                                                                     | 15.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 102.4%                                                                            |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                     |                                                                                     |                                                                                     | G                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 7: NB Ramp & Graves Mill

02/23/2018

|                                   |  |                                                                                    |  |  |                                                                                    |  |  |                                                                                      |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                                                                                                                 | EBR                                                                               | WBL                                                                               | WBT                                                                                                                                                                 | WBR                                                                               | NBL                                                                                 | NBT                                                                                                                                                                     | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |   |                                                                                   |                                                                                   |   |  |  |   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Traffic Volume (vph)              | 386                                                                               | 550                                                                                                                                                                 | 0                                                                                 | 0                                                                                 | 413                                                                                                                                                                 | 68                                                                                | 891                                                                                 | 0                                                                                                                                                                       | 236                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Future Volume (vph)               | 386                                                                               | 550                                                                                                                                                                 | 0                                                                                 | 0                                                                                 | 413                                                                                                                                                                 | 68                                                                                | 891                                                                                 | 0                                                                                                                                                                       | 236                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                                                                                                                | 1900                                                                              | 1900                                                                              | 1900                                                                                                                                                                | 1900                                                                              | 1900                                                                                | 1900                                                                                                                                                                    | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                                                                                                  | 12                                                                                | 12                                                                                | 12                                                                                                                                                                  | 12                                                                                | 11                                                                                  | 12                                                                                                                                                                      | 12                                                                                  | 12                                                                                  | 12                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 0%                                                                                                                                                                  |                                                                                   |                                                                                   | -3%                                                                                                                                                                 |                                                                                   |                                                                                     | 3%                                                                                                                                                                      |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 6.0                                                                                                                                                                 |                                                                                   |                                                                                   | 6.0                                                                                                                                                                 | 6.0                                                                               | 5.0                                                                                 | 5.0                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                                                                                                                |                                                                                   |                                                                                   | 0.95                                                                                                                                                                | 1.00                                                                              | 0.95                                                                                | 0.95                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                                                                                                                |                                                                                   |                                                                                   | 1.00                                                                                                                                                                | 0.85                                                                              | 1.00                                                                                | 0.94                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                                                                                                                |                                                                                   |                                                                                   | 1.00                                                                                                                                                                | 1.00                                                                              | 0.95                                                                                | 0.97                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (prot)                 | 1770                                                                              | 3574                                                                                                                                                                |                                                                                   |                                                                                   | 3523                                                                                                                                                                | 1546                                                                              | 1585                                                                                | 1590                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Flt Permitted                     | 0.24                                                                              | 1.00                                                                                                                                                                |                                                                                   |                                                                                   | 1.00                                                                                                                                                                | 1.00                                                                              | 0.95                                                                                | 0.97                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (perm)                 | 438                                                                               | 3574                                                                                                                                                                |                                                                                   |                                                                                   | 3523                                                                                                                                                                | 1546                                                                              | 1585                                                                                | 1590                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                                                                                                                | 0.88                                                                              | 0.88                                                                              | 0.88                                                                                                                                                                | 0.88                                                                              | 0.88                                                                                | 0.88                                                                                                                                                                    | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 439                                                                               | 625                                                                                                                                                                 | 0                                                                                 | 0                                                                                 | 469                                                                                                                                                                 | 77                                                                                | 1012                                                                                | 0                                                                                                                                                                       | 268                                                                                 | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                                                                                                   | 0                                                                                 | 0                                                                                 | 0                                                                                                                                                                   | 63                                                                                | 0                                                                                   | 43                                                                                                                                                                      | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 439                                                                               | 625                                                                                                                                                                 | 0                                                                                 | 0                                                                                 | 469                                                                                                                                                                 | 14                                                                                | 658                                                                                 | 580                                                                                                                                                                     | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 2%                                                                                | 1%                                                                                                                                                                  | 0%                                                                                | 0%                                                                                | 4%                                                                                                                                                                  | 6%                                                                                | 3%                                                                                  | 0%                                                                                                                                                                      | 0%                                                                                  | 2%                                                                                  | 2%                                                                                  | 2%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                                                                                                  |                                                                                   |                                                                                   | NA                                                                                                                                                                  | Perm                                                                              | Split                                                                               | NA                                                                                                                                                                      |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Protected Phases                  | 1                                                                                 | 6                                                                                                                                                                   |                                                                                   |                                                                                   | 2                                                                                                                                                                   |                                                                                   | 4                                                                                   | 4                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Permitted Phases                  | 6                                                                                 |                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                     | 2                                                                                 |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 49.4                                                                              | 49.4                                                                                                                                                                |                                                                                   |                                                                                   | 20.7                                                                                                                                                                | 20.7                                                                              | 49.6                                                                                | 49.6                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Effective Green, g (s)            | 49.4                                                                              | 49.4                                                                                                                                                                |                                                                                   |                                                                                   | 20.7                                                                                                                                                                | 20.7                                                                              | 49.6                                                                                | 49.6                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated g/C Ratio                | 0.45                                                                              | 0.45                                                                                                                                                                |                                                                                   |                                                                                   | 0.19                                                                                                                                                                | 0.19                                                                              | 0.45                                                                                | 0.45                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 6.0                                                                                                                                                                 |                                                                                   |                                                                                   | 6.0                                                                                                                                                                 | 6.0                                                                               | 5.0                                                                                 | 5.0                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Vehicle Extension (s)             | 2.5                                                                               | 2.5                                                                                                                                                                 |                                                                                   |                                                                                   | 2.5                                                                                                                                                                 | 2.5                                                                               | 2.5                                                                                 | 2.5                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Lane Grp Cap (vph)                | 483                                                                               | 1605                                                                                                                                                                |                                                                                   |                                                                                   | 662                                                                                                                                                                 | 290                                                                               | 714                                                                                 | 716                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Prot                    | c0.20                                                                             | 0.17                                                                                                                                                                |                                                                                   |                                                                                   | 0.13                                                                                                                                                                |                                                                                   | c0.42                                                                               | 0.36                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Perm                    | c0.21                                                                             |                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                     | 0.01                                                                              |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.91                                                                              | 0.39                                                                                                                                                                |                                                                                   |                                                                                   | 0.71                                                                                                                                                                | 0.05                                                                              | 0.92                                                                                | 0.81                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Uniform Delay, d1                 | 23.8                                                                              | 20.2                                                                                                                                                                |                                                                                   |                                                                                   | 41.8                                                                                                                                                                | 36.6                                                                              | 28.4                                                                                | 26.1                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Progression Factor                | 0.85                                                                              | 0.56                                                                                                                                                                |                                                                                   |                                                                                   | 1.00                                                                                                                                                                | 1.00                                                                              | 1.00                                                                                | 1.00                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Incremental Delay, d2             | 19.3                                                                              | 0.7                                                                                                                                                                 |                                                                                   |                                                                                   | 6.3                                                                                                                                                                 | 0.3                                                                               | 17.3                                                                                | 6.6                                                                                                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Delay (s)                         | 39.6                                                                              | 11.9                                                                                                                                                                |                                                                                   |                                                                                   | 48.1                                                                                                                                                                | 36.9                                                                              | 45.7                                                                                | 32.7                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Level of Service                  | D                                                                                 | B                                                                                                                                                                   |                                                                                   |                                                                                   | D                                                                                                                                                                   | D                                                                                 | D                                                                                   | C                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Approach Delay (s)                |                                                                                   | 23.3                                                                                                                                                                |                                                                                   |                                                                                   | 46.5                                                                                                                                                                |                                                                                   |                                                                                     | 39.4                                                                                                                                                                    |                                                                                     |                                                                                     | 0.0                                                                                 |                                                                                     |
| Approach LOS                      |                                                                                   | C                                                                                                                                                                   |                                                                                   |                                                                                   | D                                                                                                                                                                   |                                                                                   |                                                                                     | D                                                                                                                                                                       |                                                                                     |                                                                                     | A                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   | 34.8                                                                                                                                                                |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                                                                                                           |                                                                                   |                                                                                     | C                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   | 0.94                                                                                                                                                                |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   | 110.0                                                                                                                                                               |                                                                                   |                                                                                   | Sum of lost time (s)                                                                                                                                                |                                                                                   |                                                                                     | 16.0                                                                                                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   | 102.4%                                                                                                                                                              |                                                                                   |                                                                                   | ICU Level of Service                                                                                                                                                |                                                                                   |                                                                                     | G                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   | 15                                                                                                                                                                  |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 9: Forest & Graves Mill

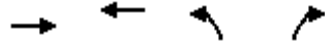
02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |  |  |  |  |  |  |
| Traffic Volume (vph)              | 103                                                                               | 227                                                                               | 8                                                                                 | 363                                                                               | 196                                                                               | 177                                                                               | 41                                                                                  | 1572                                                                                | 665                                                                                 | 268                                                                                 | 954                                                                                 | 119                                                                                 |
| Future Volume (vph)               | 103                                                                               | 227                                                                               | 8                                                                                 | 363                                                                               | 196                                                                               | 177                                                                               | 41                                                                                  | 1572                                                                                | 665                                                                                 | 268                                                                                 | 954                                                                                 | 119                                                                                 |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 10                                                                                | 11                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                  | 12                                                                                  | 11                                                                                  | 11                                                                                  | 11                                                                                  | 11                                                                                  |
| Total Lost time (s)               | 6.7                                                                               | 6.7                                                                               |                                                                                   | 7.7                                                                               | 7.7                                                                               | 7.7                                                                               | 7.7                                                                                 | 5.7                                                                                 | 7.7                                                                                 | 7.4                                                                                 | 5.8                                                                                 | 6.7                                                                                 |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 0.97                                                                              | 1.00                                                                              | 1.00                                                                              | 1.00                                                                                | 0.91                                                                                | 1.00                                                                                | 1.00                                                                                | 0.91                                                                                | 1.00                                                                                |
| Frt                               | 1.00                                                                              | 0.99                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              | 1.00                                                                                | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 1.00                                                                                | 0.85                                                                                |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                |
| Satd. Flow (prot)                 | 1604                                                                              | 3334                                                                              |                                                                                   | 3273                                                                              | 1810                                                                              | 1495                                                                              | 1745                                                                                | 5036                                                                                | 1531                                                                                | 1694                                                                                | 4868                                                                                | 1473                                                                                |
| Flt Permitted                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                |
| Satd. Flow (perm)                 | 1604                                                                              | 3334                                                                              |                                                                                   | 3273                                                                              | 1810                                                                              | 1495                                                                              | 1745                                                                                | 5036                                                                                | 1531                                                                                | 1694                                                                                | 4868                                                                                | 1473                                                                                |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 117                                                                               | 258                                                                               | 9                                                                                 | 412                                                                               | 223                                                                               | 201                                                                               | 47                                                                                  | 1786                                                                                | 756                                                                                 | 305                                                                                 | 1084                                                                                | 135                                                                                 |
| RTOR Reduction (vph)              | 0                                                                                 | 2                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 173                                                                               | 0                                                                                   | 0                                                                                   | 94                                                                                  | 0                                                                                   | 0                                                                                   | 61                                                                                  |
| Lane Group Flow (vph)             | 117                                                                               | 265                                                                               | 0                                                                                 | 413                                                                               | 223                                                                               | 28                                                                                | 47                                                                                  | 1786                                                                                | 662                                                                                 | 305                                                                                 | 1084                                                                                | 74                                                                                  |
| Heavy Vehicles (%)                | 5%                                                                                | 4%                                                                                | 8%                                                                                | 7%                                                                                | 5%                                                                                | 8%                                                                                | 0%                                                                                  | 3%                                                                                  | 2%                                                                                  | 3%                                                                                  | 3%                                                                                  | 6%                                                                                  |
| Turn Type                         | Split                                                                             | NA                                                                                |                                                                                   | Split                                                                             | NA                                                                                | Perm                                                                              | Prot                                                                                | NA                                                                                  | pm+ov                                                                               | Prot                                                                                | NA                                                                                  | pm+ov                                                                               |
| Protected Phases                  | 4                                                                                 | 4                                                                                 |                                                                                   | 3                                                                                 | 3                                                                                 |                                                                                   | 1                                                                                   | 6                                                                                   | 3                                                                                   | 5                                                                                   | 2                                                                                   | 4                                                                                   |
| Permitted Phases                  |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   | 3                                                                                 |                                                                                     |                                                                                     | 6                                                                                   |                                                                                     |                                                                                     | 2                                                                                   |
| Actuated Green, G (s)             | 9.1                                                                               | 9.1                                                                               |                                                                                   | 15.3                                                                              | 15.3                                                                              | 15.3                                                                              | 6.4                                                                                 | 38.9                                                                                | 54.2                                                                                | 19.2                                                                                | 51.3                                                                                | 60.4                                                                                |
| Effective Green, g (s)            | 9.1                                                                               | 9.1                                                                               |                                                                                   | 15.3                                                                              | 15.3                                                                              | 15.3                                                                              | 6.4                                                                                 | 38.9                                                                                | 54.2                                                                                | 19.2                                                                                | 51.3                                                                                | 60.4                                                                                |
| Actuated g/C Ratio                | 0.08                                                                              | 0.08                                                                              |                                                                                   | 0.14                                                                              | 0.14                                                                              | 0.14                                                                              | 0.06                                                                                | 0.35                                                                                | 0.49                                                                                | 0.17                                                                                | 0.47                                                                                | 0.55                                                                                |
| Clearance Time (s)                | 6.7                                                                               | 6.7                                                                               |                                                                                   | 7.7                                                                               | 7.7                                                                               | 7.7                                                                               | 7.7                                                                                 | 5.7                                                                                 | 7.7                                                                                 | 7.4                                                                                 | 5.8                                                                                 | 6.7                                                                                 |
| Vehicle Extension (s)             | 3.5                                                                               | 3.5                                                                               |                                                                                   | 3.5                                                                               | 3.5                                                                               | 3.5                                                                               | 3.5                                                                                 | 5.0                                                                                 | 3.5                                                                                 | 3.5                                                                                 | 5.0                                                                                 | 3.5                                                                                 |
| Lane Grp Cap (vph)                | 132                                                                               | 275                                                                               |                                                                                   | 455                                                                               | 251                                                                               | 207                                                                               | 101                                                                                 | 1780                                                                                | 754                                                                                 | 295                                                                                 | 2270                                                                                | 808                                                                                 |
| v/s Ratio Prot                    | 0.07                                                                              | c0.08                                                                             |                                                                                   | c0.13                                                                             | 0.12                                                                              |                                                                                   | 0.03                                                                                | c0.35                                                                               | 0.12                                                                                | c0.18                                                                               | 0.22                                                                                | 0.01                                                                                |
| v/s Ratio Perm                    |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   | 0.02                                                                              |                                                                                     |                                                                                     | 0.31                                                                                |                                                                                     |                                                                                     | 0.04                                                                                |
| v/c Ratio                         | 0.89                                                                              | 0.96                                                                              |                                                                                   | 0.91                                                                              | 0.89                                                                              | 0.14                                                                              | 0.47                                                                                | 1.00                                                                                | 0.88                                                                                | 1.03                                                                                | 0.48                                                                                | 0.09                                                                                |
| Uniform Delay, d1                 | 49.9                                                                              | 50.3                                                                              |                                                                                   | 46.7                                                                              | 46.5                                                                              | 41.5                                                                              | 50.1                                                                                | 35.5                                                                                | 24.9                                                                                | 45.4                                                                                | 20.1                                                                                | 11.8                                                                                |
| Progression Factor                | 1.00                                                                              | 1.00                                                                              |                                                                                   | 0.53                                                                              | 0.53                                                                              | 2.91                                                                              | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |
| Incremental Delay, d2             | 46.2                                                                              | 44.4                                                                              |                                                                                   | 8.4                                                                               | 11.6                                                                              | 0.1                                                                               | 4.0                                                                                 | 22.1                                                                                | 11.5                                                                                | 61.5                                                                                | 0.7                                                                                 | 0.1                                                                                 |
| Delay (s)                         | 96.2                                                                              | 94.6                                                                              |                                                                                   | 33.3                                                                              | 36.4                                                                              | 120.9                                                                             | 54.1                                                                                | 57.7                                                                                | 36.4                                                                                | 106.9                                                                               | 20.9                                                                                | 11.8                                                                                |
| Level of Service                  | F                                                                                 | F                                                                                 |                                                                                   | C                                                                                 | D                                                                                 | F                                                                                 | D                                                                                   | E                                                                                   | D                                                                                   | F                                                                                   | C                                                                                   | B                                                                                   |
| Approach Delay (s)                |                                                                                   | 95.1                                                                              |                                                                                   |                                                                                   | 55.2                                                                              |                                                                                   |                                                                                     | 51.4                                                                                |                                                                                     |                                                                                     | 37.3                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | F                                                                                 |                                                                                   |                                                                                   | E                                                                                 |                                                                                   |                                                                                     | D                                                                                   |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 51.1                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     | HCM 2000 Level of Service D                                                         |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.99                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 110.0                                                                             |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     | Sum of lost time (s) 27.9                                                           |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 85.2%                                                                             |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     | ICU Level of Service E                                                              |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

### 1: Gristmill & Graves Mill

02/23/2018



| Lane Group              | EBT  | WBT    | NBL  | NBR   |
|-------------------------|------|--------|------|-------|
| Lane Group Flow (vph)   | 1106 | 1085   | 24   | 940   |
| v/c Ratio               | 0.81 | 2.29dl | 0.04 | 1.30  |
| Control Delay           | 33.1 | 72.5   | 20.0 | 169.8 |
| Queue Delay             | 0.0  | 0.0    | 0.0  | 0.0   |
| Total Delay             | 33.1 | 72.5   | 20.0 | 169.8 |
| Queue Length 50th (ft)  | 352  | ~90    | 10   | ~794  |
| Queue Length 95th (ft)  | m384 | #407   | 27   | #1007 |
| Internal Link Dist (ft) | 1043 | 605    | 674  |       |
| Turn Bay Length (ft)    |      |        |      | 180   |
| Base Capacity (vph)     | 1360 | 990    | 662  | 725   |
| Starvation Cap Reductn  | 0    | 0      | 0    | 0     |
| Spillback Cap Reductn   | 0    | 0      | 0    | 0     |
| Storage Cap Reductn     | 0    | 0      | 0    | 0     |
| Reduced v/c Ratio       | 0.81 | 1.10   | 0.04 | 1.30  |

#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.
- dl Defacto Left Lane. Recode with 1 though lane as a left lane.



## Queues

## 2: Millrace &amp; Graves Mill

02/23/2018

|                         |  |  |  |  |  |
|-------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Lane Group              | EBT                                                                               | WBL                                                                               | WBT                                                                               | NBL                                                                               | NBR                                                                               |
| Lane Group Flow (vph)   | 1979                                                                              | 102                                                                               | 1145                                                                              | 17                                                                                | 16                                                                                |
| v/c Ratio               | 0.70                                                                              | 0.50                                                                              | 0.35                                                                              | 0.21                                                                              | 0.20                                                                              |
| Control Delay           | 7.7                                                                               | 29.4                                                                              | 0.3                                                                               | 56.5                                                                              | 27.6                                                                              |
| Queue Delay             | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               |
| Total Delay             | 7.7                                                                               | 29.4                                                                              | 0.3                                                                               | 56.5                                                                              | 27.6                                                                              |
| Queue Length 50th (ft)  | 414                                                                               | 23                                                                                | 3                                                                                 | 12                                                                                | 0                                                                                 |
| Queue Length 95th (ft)  | m342                                                                              | m48                                                                               | 3                                                                                 | 35                                                                                | 23                                                                                |
| Internal Link Dist (ft) | 952                                                                               |                                                                                   | 1251                                                                              | 593                                                                               |                                                                                   |
| Turn Bay Length (ft)    |                                                                                   | 330                                                                               |                                                                                   |                                                                                   | 240                                                                               |
| Base Capacity (vph)     | 2831                                                                              | 267                                                                               | 3281                                                                              | 83                                                                                | 83                                                                                |
| Starvation Cap Reductn  | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Spillback Cap Reductn   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Storage Cap Reductn     | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Reduced v/c Ratio       | 0.70                                                                              | 0.38                                                                              | 0.35                                                                              | 0.20                                                                              | 0.19                                                                              |

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

## Queues

## 4: Old Graves Mill &amp; Graves Mill

02/23/2018



| Lane Group              | EBT  | EBR  | WBL   | WBT  | NBT  | NBR  |
|-------------------------|------|------|-------|------|------|------|
| Lane Group Flow (vph)   | 1497 | 233  | 152   | 1130 | 243  | 84   |
| v/c Ratio               | 0.69 | 0.23 | 1.38  | 0.42 | 0.73 | 0.20 |
| Control Delay           | 12.0 | 3.2  | 246.0 | 1.2  | 54.7 | 1.0  |
| Queue Delay             | 0.0  | 0.0  | 0.0   | 0.0  | 0.0  | 0.0  |
| Total Delay             | 12.0 | 3.2  | 246.0 | 1.2  | 54.7 | 1.0  |
| Queue Length 50th (ft)  | 132  | 4    | ~142  | 7    | 164  | 0    |
| Queue Length 95th (ft)  | 289  | 22   | #269  | 16   | 228  | 0    |
| Internal Link Dist (ft) | 1348 |      |       | 700  | 365  |      |
| Turn Bay Length (ft)    |      | 280  | 310   |      |      |      |
| Base Capacity (vph)     | 2182 | 1013 | 110   | 2670 | 506  | 563  |
| Starvation Cap Reductn  | 0    | 0    | 0     | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0     | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0     | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.69 | 0.23 | 1.38  | 0.42 | 0.48 | 0.15 |

## Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

## Queues

## 5: Connector/Creekside &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT  | NBR   | SBL  | SBT  |
|-------------------------|------|------|------|------|------|------|-------|------|------|
| Lane Group Flow (vph)   | 45   | 1564 | 381  | 1240 | 113  | 29   | 618   | 52   | 39   |
| v/c Ratio               | 0.18 | 1.02 | 0.56 | 0.46 | 0.09 | 0.35 | 0.99  | 0.71 | 0.41 |
| Control Delay           | 5.1  | 47.1 | 28.0 | 2.9  | 0.6  | 64.0 | 62.0  | 98.3 | 39.9 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0  | 0.0  |
| Total Delay             | 5.1  | 47.1 | 28.0 | 2.9  | 0.6  | 64.0 | 62.0  | 98.3 | 39.9 |
| Queue Length 50th (ft)  | 5    | ~641 | 162  | 31   | 0    | 20   | 397   | 37   | 10   |
| Queue Length 95th (ft)  | m7   | #750 | m226 | m88  | m4   | m49  | m#597 | #102 | 44   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519  |       |      | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      | 300  |      | 160   | 190  |      |
| Base Capacity (vph)     | 251  | 1536 | 682  | 2697 | 1200 | 84   | 626   | 73   | 95   |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| Reduced v/c Ratio       | 0.18 | 1.02 | 0.56 | 0.46 | 0.09 | 0.35 | 0.99  | 0.71 | 0.41 |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

## Queues

## 6: SB Ramp &amp; Graves Mill

02/23/2018



| Lane Group              | EBT  | EBR   | WBL  | WBT  | SBT  | SBR   |
|-------------------------|------|-------|------|------|------|-------|
| Lane Group Flow (vph)   | 870  | 1357  | 138  | 1398 | 191  | 335   |
| v/c Ratio               | 0.37 | 1.02  | 0.29 | 0.51 | 0.79 | 1.14  |
| Control Delay           | 5.2  | 28.3  | 4.5  | 8.5  | 69.3 | 128.3 |
| Queue Delay             | 0.0  | 3.6   | 0.0  | 0.3  | 0.0  | 0.0   |
| Total Delay             | 5.2  | 32.0  | 4.5  | 8.8  | 69.3 | 128.3 |
| Queue Length 50th (ft)  | 78   | ~372  | 21   | 278  | 132  | ~216  |
| Queue Length 95th (ft)  | m78  | m#340 | m31  | 311  | #238 | #383  |
| Internal Link Dist (ft) | 797  |       |      | 663  | 620  |       |
| Turn Bay Length (ft)    |      | 280   | 250  |      |      | 125   |
| Base Capacity (vph)     | 2339 | 1335  | 470  | 2729 | 241  | 293   |
| Starvation Cap Reductn  | 0    | 15    | 0    | 592  | 0    | 0     |
| Spillback Cap Reductn   | 0    | 0     | 0    | 0    | 0    | 0     |
| Storage Cap Reductn     | 0    | 0     | 0    | 0    | 0    | 0     |
| Reduced v/c Ratio       | 0.37 | 1.03  | 0.29 | 0.65 | 0.79 | 1.14  |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

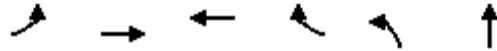
m Volume for 95th percentile queue is metered by upstream signal.



## Queues

## 7: NB Ramp &amp; Graves Mill

02/23/2018



| Lane Group              | EBL   | EBT  | WBT  | WBR  | NBL  | NBT  |
|-------------------------|-------|------|------|------|------|------|
| Lane Group Flow (vph)   | 439   | 625  | 469  | 77   | 658  | 623  |
| v/c Ratio               | 0.90  | 0.39 | 0.71 | 0.22 | 0.92 | 0.82 |
| Control Delay           | 42.8  | 12.4 | 49.8 | 10.8 | 47.8 | 32.6 |
| Queue Delay             | 0.0   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 42.8  | 12.4 | 49.8 | 10.8 | 47.8 | 32.6 |
| Queue Length 50th (ft)  | 207   | 73   | 170  | 0    | 428  | 334  |
| Queue Length 95th (ft)  | m#393 | 94   | #235 | 40   | #645 | 484  |
| Internal Link Dist (ft) |       | 663  | 458  |      |      | 755  |
| Turn Bay Length (ft)    | 170   |      |      | 180  |      |      |
| Base Capacity (vph)     | 497   | 1604 | 664  | 354  | 749  | 792  |
| Starvation Cap Reductn  | 0     | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0     | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0     | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.88  | 0.39 | 0.71 | 0.22 | 0.88 | 0.79 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

## Queues

## 9: Forest &amp; Graves Mill

02/23/2018



| Lane Group              | EBL   | EBT  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|-------------------------|-------|------|------|------|------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 117   | 267  | 413  | 223  | 201  | 47   | 1786 | 756  | 305  | 1084 | 135  |
| v/c Ratio               | 0.89  | 0.96 | 0.91 | 0.89 | 0.48 | 0.37 | 1.04 | 0.94 | 0.96 | 0.46 | 0.14 |
| Control Delay           | 103.7 | 96.3 | 36.5 | 41.4 | 8.8  | 57.6 | 69.9 | 34.3 | 86.3 | 20.7 | 2.1  |
| Queue Delay             | 0.0   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 103.7 | 96.3 | 36.5 | 41.4 | 8.8  | 57.6 | 69.9 | 34.3 | 86.3 | 20.7 | 2.1  |
| Queue Length 50th (ft)  | 83    | 100  | 138  | 144  | 37   | 32   | ~501 | 239  | 215  | 192  | 0    |
| Queue Length 95th (ft)  | #187  | #180 | m130 | m140 | m35  | 70   | #575 | #485 | #374 | 226  | 23   |
| Internal Link Dist (ft) |       | 661  |      | 1043 |      |      | 1143 |      |      | 649  |      |
| Turn Bay Length (ft)    | 90    |      | 300  |      | 300  | 200  |      | 360  | 250  |      | 280  |
| Base Capacity (vph)     | 132   | 277  | 455  | 251  | 418  | 126  | 1712 | 805  | 318  | 2338 | 958  |
| Starvation Cap Reductn  | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.89  | 0.96 | 0.91 | 0.89 | 0.48 | 0.37 | 1.04 | 0.94 | 0.96 | 0.46 | 0.14 |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM 2010 TWSC  
3: Graves Mill & Millside

02/23/2018

| Intersection             |        |       |      |        |       |      |        |       |      |        |      |      |
|--------------------------|--------|-------|------|--------|-------|------|--------|-------|------|--------|------|------|
| Int Delay, s/veh         | 2.5    |       |      |        |       |      |        |       |      |        |      |      |
| Movement                 | EBL    | EBT   | EBR  | WBL    | WBT   | WBR  | NBL    | NBT   | NBR  | SBL    | SBT  | SBR  |
| Lane Configurations      |        | ↕↕    | ↗    |        | ↕↕    | ↗    |        | ↕     |      |        | ↕    |      |
| Traffic Vol, veh/h       | 5      | 1565  | 4    | 8      | 1160  | 18   | 0      | 0     | 8    | 8      | 0    | 4    |
| Future Vol, veh/h        | 5      | 1565  | 4    | 8      | 1160  | 18   | 0      | 0     | 8    | 8      | 0    | 4    |
| Conflicting Peds, #/hr   | 0      | 0     | 0    | 0      | 0     | 0    | 0      | 0     | 0    | 0      | 0    | 0    |
| Sign Control             | Free   | Free  | Free | Free   | Free  | Free | Stop   | Stop  | Stop | Stop   | Stop | Stop |
| RT Channelized           | -      | -     | None | -      | -     | None | -      | -     | None | -      | -    | None |
| Storage Length           | -      | -     | 140  | -      | -     | 140  | -      | -     | -    | -      | -    | -    |
| Veh in Median Storage, # | -      | 0     | -    | -      | 0     | -    | -      | 0     | -    | -      | 0    | -    |
| Grade, %                 | -      | -5    | -    | -      | 5     | -    | -      | 3     | -    | -      | -5   | -    |
| Peak Hour Factor         | 88     | 88    | 88   | 88     | 88    | 88   | 88     | 88    | 88   | 88     | 88   | 88   |
| Heavy Vehicles, %        | 0      | 1     | 0    | 0      | 1     | 0    | 0      | 0     | 0    | 0      | 0    | 0    |
| Mvmt Flow                | 6      | 1778  | 5    | 9      | 1318  | 20   | 0      | 0     | 9    | 9      | 0    | 5    |
|                          |        |       |      |        |       |      |        |       |      |        |      |      |
| Major/Minor              | Major1 |       |      | Major2 |       |      | Minor1 |       |      | Minor2 |      |      |
| Conflicting Flow All     | 1318   | 0     | 0    | 1778   | 0     | 0    | 2467   | 3126  | 889  | 2237   | 3126 | 659  |
| Stage 1                  | -      | -     | -    | -      | -     | -    | 1790   | 1790  | -    | 1336   | 1336 | -    |
| Stage 2                  | -      | -     | -    | -      | -     | -    | 677    | 1336  | -    | 901    | 1790 | -    |
| Critical Hdwy            | 4.1    | -     | -    | 4.1    | -     | -    | 8.1    | 7.1   | 7.2  | 6.5    | 5.5  | 6.4  |
| Critical Hdwy Stg 1      | -      | -     | -    | -      | -     | -    | 7.1    | 6.1   | -    | 5.5    | 4.5  | -    |
| Critical Hdwy Stg 2      | -      | -     | -    | -      | -     | -    | 7.1    | 6.1   | -    | 5.5    | 4.5  | -    |
| Follow-up Hdwy           | 2.2    | -     | -    | 2.2    | -     | -    | 3.5    | 4     | 3.3  | 3.5    | 4    | 3.3  |
| Pot Cap-1 Maneuver       | 531    | -     | -    | 354    | -     | -    | 11     | 7     | 270  | 44     | 27   | 450  |
| Stage 1                  | -      | -     | -    | -      | -     | -    | 64     | 100   | -    | 239    | 325  | -    |
| Stage 2                  | -      | -     | -    | -      | -     | -    | 369    | 180   | -    | 390    | 221  | -    |
| Platoon blocked, %       |        | -     | -    |        | -     | -    |        |       |      |        |      |      |
| Mov Cap-1 Maneuver       | 531    | -     | -    | 354    | -     | -    | -      | 0     | 270  | -      | 0    | 450  |
| Mov Cap-2 Maneuver       | -      | -     | -    | -      | -     | -    | -      | 0     | -    | -      | 0    | -    |
| Stage 1                  | -      | -     | -    | -      | -     | -    | 64     | 0     | -    | 239    | 293  | -    |
| Stage 2                  | -      | -     | -    | -      | -     | -    | 329    | 162   | -    | -      | 0    | -    |
|                          |        |       |      |        |       |      |        |       |      |        |      |      |
|                          |        |       |      |        |       |      |        |       |      |        |      |      |
| Approach                 | EB     |       |      | WB     |       |      | NB     |       |      | SB     |      |      |
| HCM Control Delay, s     | 3.9    |       |      | 0.6    |       |      |        |       |      |        |      |      |
| HCM LOS                  |        |       |      |        |       |      | -      |       |      | -      |      |      |
|                          |        |       |      |        |       |      |        |       |      |        |      |      |
| Minor Lane/Major Mvmt    | NBLn1  | EBL   | EBT  | EBR    | WBL   | WBT  | WBR    | SBLn1 |      |        |      |      |
| Capacity (veh/h)         | -      | 531   | -    | -      | 354   | -    | -      | -     |      |        |      |      |
| HCM Lane V/C Ratio       | -      | 0.011 | -    | -      | 0.026 | -    | -      | -     |      |        |      |      |
| HCM Control Delay (s)    | -      | 11.9  | 3.9  | -      | 15.4  | 0.5  | -      | -     |      |        |      |      |
| HCM Lane LOS             | -      | B     | A    | -      | C     | A    | -      | -     |      |        |      |      |
| HCM 95th %tile Q(veh)    | -      | 0     | -    | -      | 0.1   | -    | -      | -     |      |        |      |      |

Intersection

Intersection Delay, s/veh37.5

Intersection LOS E

| Movement            | EBL  | EBT                                                                               | EBR                                                                               | WBL  | WBT                                                                               | WBR  | NBL  | NBT                                                                               | NBR  | SBL  | SBT                                                                                 | SBR                                                                                 |
|---------------------|------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|------|------|-----------------------------------------------------------------------------------|------|------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Lane Configurations |      |  |  |      |  |      |      |  |      |      |  |  |
| Traffic Vol, veh/h  | 48   | 424                                                                               | 287                                                                               | 4    | 79                                                                                | 3    | 181  | 21                                                                                | 94   | 13   | 45                                                                                  | 163                                                                                 |
| Future Vol, veh/h   | 48   | 424                                                                               | 287                                                                               | 4    | 79                                                                                | 3    | 181  | 21                                                                                | 94   | 13   | 45                                                                                  | 163                                                                                 |
| Peak Hour Factor    | 0.88 | 0.88                                                                              | 0.88                                                                              | 0.88 | 0.88                                                                              | 0.88 | 0.88 | 0.88                                                                              | 0.88 | 0.88 | 0.88                                                                                | 0.88                                                                                |
| Heavy Vehicles, %   | 0    | 0                                                                                 | 4                                                                                 | 0    | 7                                                                                 | 0    | 3    | 0                                                                                 | 4    | 0    | 6                                                                                   | 0                                                                                   |
| Mvmt Flow           | 55   | 482                                                                               | 326                                                                               | 5    | 90                                                                                | 3    | 206  | 24                                                                                | 107  | 15   | 51                                                                                  | 185                                                                                 |
| Number of Lanes     | 0    | 1                                                                                 | 1                                                                                 | 0    | 1                                                                                 | 0    | 0    | 1                                                                                 | 0    | 0    | 1                                                                                   | 1                                                                                   |

| Approach                     | EB   | WB   | NB   | SB   |
|------------------------------|------|------|------|------|
| Opposing Approach            | WB   | EB   | SB   | NB   |
| Opposing Lanes               | 1    | 2    | 2    | 1    |
| Conflicting Approach Left SB |      | NB   | EB   | WB   |
| Conflicting Lanes Left       | 2    | 1    | 2    | 1    |
| Conflicting Approach RightNB |      | SB   | WB   | EB   |
| Conflicting Lanes Right      | 1    | 2    | 1    | 2    |
| HCM Control Delay            | 51.8 | 13.5 | 25.4 | 13.7 |
| HCM LOS                      | F    | B    | D    | B    |

| Lane                   | NBLn1 | EBLn1 | EBLn2 | WBLn1 | SBLn1 | SBLn2 |
|------------------------|-------|-------|-------|-------|-------|-------|
| Vol Left, %            | 61%   | 10%   | 0%    | 5%    | 22%   | 0%    |
| Vol Thru, %            | 7%    | 90%   | 0%    | 92%   | 78%   | 0%    |
| Vol Right, %           | 32%   | 0%    | 100%  | 3%    | 0%    | 100%  |
| Sign Control           | Stop  | Stop  | Stop  | Stop  | Stop  | Stop  |
| Traffic Vol by Lane    | 296   | 472   | 287   | 86    | 58    | 163   |
| LT Vol                 | 181   | 48    | 0     | 4     | 13    | 0     |
| Through Vol            | 21    | 424   | 0     | 79    | 45    | 0     |
| RT Vol                 | 94    | 0     | 287   | 3     | 0     | 163   |
| Lane Flow Rate         | 336   | 536   | 326   | 98    | 66    | 185   |
| Geometry Grp           | 6     | 7     | 7     | 6     | 7     | 7     |
| Degree of Util (X)     | 0.688 | 1.03  | 0.557 | 0.218 | 0.145 | 0.37  |
| Departure Headway (Hd) | 7.49  | 6.915 | 6.149 | 8.215 | 8.084 | 7.352 |
| Convergence, Y/N       | Yes   | Yes   | Yes   | Yes   | Yes   | Yes   |
| Cap                    | 484   | 531   | 590   | 440   | 446   | 493   |
| Service Time           | 5.49  | 4.615 | 3.849 | 6.215 | 5.784 | 5.052 |
| HCM Lane V/C Ratio     | 0.694 | 1.009 | 0.553 | 0.223 | 0.148 | 0.375 |
| HCM Control Delay      | 25.4  | 73.4  | 16.3  | 13.5  | 12.2  | 14.3  |
| HCM Lane LOS           | D     | F     | C     | B     | B     | B     |
| HCM 95th-tile Q        | 5.2   | 15.2  | 3.4   | 0.8   | 0.5   | 1.7   |



Intersection

Int Delay, s/veh 26.7

| Movement                 | WBL                                                                               | WBR                                                                               | NBT                                                                               | NBR  | SBL  | SBT                                                                               |
|--------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------------------------------------------------------------------------------|
| Lane Configurations      |  |  |  |      |      |  |
| Traffic Vol, veh/h       | 184                                                                               | 4                                                                                 | 333                                                                               | 613  | 80   | 281                                                                               |
| Future Vol, veh/h        | 184                                                                               | 4                                                                                 | 333                                                                               | 613  | 80   | 281                                                                               |
| Conflicting Peds, #/hr   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0    | 0    | 0                                                                                 |
| Sign Control             | Stop                                                                              | Stop                                                                              | Free                                                                              | Free | Free | Free                                                                              |
| RT Channelized           | -                                                                                 | None                                                                              | -                                                                                 | None | -    | None                                                                              |
| Storage Length           | 255                                                                               | 0                                                                                 | -                                                                                 | -    | -    | -                                                                                 |
| Veh in Median Storage, # | 0                                                                                 | -                                                                                 | 0                                                                                 | -    | -    | 0                                                                                 |
| Grade, %                 | 0                                                                                 | -                                                                                 | 0                                                                                 | -    | -    | 0                                                                                 |
| Peak Hour Factor         | 89                                                                                | 89                                                                                | 89                                                                                | 89   | 89   | 89                                                                                |
| Heavy Vehicles, %        | 6                                                                                 | 0                                                                                 | 3                                                                                 | 2    | 2    | 5                                                                                 |
| Mvmt Flow                | 207                                                                               | 4                                                                                 | 374                                                                               | 689  | 90   | 316                                                                               |

| Major/Minor          | Minor1 | Major1 | Major2      |
|----------------------|--------|--------|-------------|
| Conflicting Flow All | 1215   | 719    | 0 0 1063 0  |
| Stage 1              | 719    | -      | - - - -     |
| Stage 2              | 496    | -      | - - - -     |
| Critical Hdwy        | 6.46   | 6.2    | - - 4.12 -  |
| Critical Hdwy Stg 1  | 5.46   | -      | - - - -     |
| Critical Hdwy Stg 2  | 5.46   | -      | - - - -     |
| Follow-up Hdwy       | 3.554  | 3.3    | - - 2.218 - |
| Pot Cap-1 Maneuver   | ~ 197  | 432    | - - 655 -   |
| Stage 1              | 475    | -      | - - - -     |
| Stage 2              | 604    | -      | - - - -     |
| Platoon blocked, %   |        |        | - - - -     |
| Mov Cap-1 Maneuver   | ~ 164  | 432    | - - 655 -   |
| Mov Cap-2 Maneuver   | ~ 164  | -      | - - - -     |
| Stage 1              | 475    | -      | - - - -     |
| Stage 2              | 503    | -      | - - - -     |

| Approach             | WB    | NB | SB  |
|----------------------|-------|----|-----|
| HCM Control Delay, s | 207.5 | 0  | 2.5 |
| HCM LOS              | F     |    |     |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1WBLn2 | SBL   | SBT |
|-----------------------|-----|---------------|-------|-----|
| Capacity (veh/h)      | -   | - 164 432     | 655   | -   |
| HCM Lane V/C Ratio    | -   | - 1.261 0.01  | 0.137 | -   |
| HCM Control Delay (s) | -   | - 211.7 13.4  | 11.4  | 0   |
| HCM Lane LOS          | -   | - F B         | B     | A   |
| HCM 95th %tile Q(veh) | -   | - 11.9 0      | 0.5   | -   |

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined \*: All major volume in platoon

# HCM Signalized Intersection Capacity Analysis

## 1: Gristmill & Graves Mill

02/23/2018

|                                   | →    | ↘     | ↙     | ←                         | ↖     | ↗     |
|-----------------------------------|------|-------|-------|---------------------------|-------|-------|
| Movement                          | EBT  | EBR   | WBL   | WBT                       | NBL   | NBR   |
| Lane Configurations               | ↑↑   |       |       | ↑↑                        | ↖     | ↗     |
| Traffic Volume (vph)              | 843  | 62    | 498   | 1208                      | 46    | 586   |
| Future Volume (vph)               | 843  | 62    | 498   | 1208                      | 46    | 586   |
| Ideal Flow (vphpl)                | 1900 | 1900  | 1900  | 1900                      | 1900  | 1900  |
| Lane Width                        | 12   | 12    | 12    | 12                        | 11    | 12    |
| Grade (%)                         | 0%   |       |       | 0%                        | 2%    |       |
| Total Lost time (s)               | 6.5  |       |       | 6.5                       | 5.3   | 5.3   |
| Lane Util. Factor                 | 0.95 |       |       | 0.95                      | 1.00  | 1.00  |
| Frt                               | 0.99 |       |       | 1.00                      | 1.00  | 0.85  |
| Flt Protected                     | 1.00 |       |       | 0.99                      | 0.95  | 1.00  |
| Satd. Flow (prot)                 | 3540 |       |       | 3533                      | 1727  | 1599  |
| Flt Permitted                     | 1.00 |       |       | 0.50                      | 0.95  | 1.00  |
| Satd. Flow (perm)                 | 3540 |       |       | 1791                      | 1727  | 1599  |
| Peak-hour factor, PHF             | 0.88 | 0.88  | 0.88  | 0.88                      | 0.88  | 0.88  |
| Adj. Flow (vph)                   | 958  | 70    | 566   | 1373                      | 52    | 666   |
| RTOR Reduction (vph)              | 6    | 0     | 0     | 0                         | 0     | 168   |
| Lane Group Flow (vph)             | 1022 | 0     | 0     | 1939                      | 52    | 498   |
| Heavy Vehicles (%)                | 1%   | 0%    | 0%    | 1%                        | 0%    | 0%    |
| Turn Type                         | NA   |       | pm+pt | NA                        | Prot  | Perm  |
| Protected Phases                  | 2    |       | 1     | 6                         | 4     |       |
| Permitted Phases                  |      |       | 6     |                           |       | 4     |
| Actuated Green, G (s)             | 57.7 |       |       | 108.5                     | 29.7  | 29.7  |
| Effective Green, g (s)            | 57.7 |       |       | 108.5                     | 29.7  | 29.7  |
| Actuated g/C Ratio                | 0.38 |       |       | 0.72                      | 0.20  | 0.20  |
| Clearance Time (s)                | 6.5  |       |       | 6.5                       | 5.3   | 5.3   |
| Vehicle Extension (s)             | 3.0  |       |       | 3.0                       | 2.0   | 2.0   |
| Lane Grp Cap (vph)                | 1361 |       |       | 1809                      | 341   | 316   |
| v/s Ratio Prot                    | 0.29 |       |       | c0.32                     | 0.03  |       |
| v/s Ratio Perm                    |      |       |       | c0.46                     |       | c0.31 |
| v/c Ratio                         | 0.75 |       |       | 1.07                      | 0.15  | 1.58  |
| Uniform Delay, d1                 | 39.9 |       |       | 20.8                      | 49.7  | 60.1  |
| Progression Factor                | 0.91 |       |       | 0.77                      | 1.00  | 1.00  |
| Incremental Delay, d2             | 1.9  |       |       | 42.1                      | 0.1   | 274.5 |
| Delay (s)                         | 38.4 |       |       | 58.1                      | 49.8  | 334.6 |
| Level of Service                  | D    |       |       | E                         | D     | F     |
| Approach Delay (s)                | 38.4 |       |       | 58.1                      | 314.0 |       |
| Approach LOS                      | D    |       |       | E                         | F     |       |
| <b>Intersection Summary</b>       |      |       |       |                           |       |       |
| HCM 2000 Control Delay            |      | 102.5 |       | HCM 2000 Level of Service |       | F     |
| HCM 2000 Volume to Capacity ratio |      | 1.23  |       |                           |       |       |
| Actuated Cycle Length (s)         |      | 150.0 |       | Sum of lost time (s)      | 18.3  |       |
| Intersection Capacity Utilization |      | 93.4% |       | ICU Level of Service      |       | F     |
| Analysis Period (min)             |      | 15    |       |                           |       |       |
| c Critical Lane Group             |      |       |       |                           |       |       |

# HCM Signalized Intersection Capacity Analysis

## 2: Millrace & Graves Mill

02/23/2018

|                                   | →     | ↘    | ↙     | ←     | ↖                         | ↗     |
|-----------------------------------|-------|------|-------|-------|---------------------------|-------|
| Movement                          | EBT   | EBR  | WBL   | WBT   | NBL                       | NBR   |
| Lane Configurations               | ↑↑    |      | ↘     | ↑↑    | ↘                         | ↗     |
| Traffic Volume (vph)              | 1427  | 18   | 36    | 1471  | 100                       | 229   |
| Future Volume (vph)               | 1427  | 18   | 36    | 1471  | 100                       | 229   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900  | 1900  | 1900                      | 1900  |
| Lane Width                        | 12    | 12   | 11    | 12    | 11                        | 11    |
| Grade (%)                         | 0%    |      |       | 0%    | 3%                        |       |
| Total Lost time (s)               | 5.0   |      | 4.5   | 5.0   | 5.0                       | 5.0   |
| Lane Util. Factor                 | 0.95  |      | 1.00  | 0.95  | 1.00                      | 1.00  |
| Frt                               | 1.00  |      | 1.00  | 1.00  | 1.00                      | 0.85  |
| Flt Protected                     | 1.00  |      | 0.95  | 1.00  | 0.95                      | 1.00  |
| Satd. Flow (prot)                 | 3554  |      | 1745  | 3574  | 1702                      | 1508  |
| Flt Permitted                     | 1.00  |      | 0.10  | 1.00  | 0.95                      | 1.00  |
| Satd. Flow (perm)                 | 3554  |      | 189   | 3574  | 1702                      | 1508  |
| Peak-hour factor, PHF             | 0.92  | 0.92 | 0.92  | 0.92  | 0.92                      | 0.92  |
| Adj. Flow (vph)                   | 1551  | 20   | 39    | 1599  | 109                       | 249   |
| RTOR Reduction (vph)              | 1     | 0    | 0     | 0     | 0                         | 93    |
| Lane Group Flow (vph)             | 1570  | 0    | 39    | 1599  | 109                       | 156   |
| Heavy Vehicles (%)                | 1%    | 0%   | 0%    | 1%    | 1%                        | 2%    |
| Bus Blockages (#/hr)              | 2     | 0    | 0     | 0     | 0                         | 0     |
| Turn Type                         | NA    |      | pm+pt | NA    | Prot                      | Perm  |
| Protected Phases                  | 6     |      | 5     | 2     | 4                         |       |
| Permitted Phases                  |       |      | 2     |       |                           | 4     |
| Actuated Green, G (s)             | 46.9  |      | 54.4  | 53.9  | 11.1                      | 11.1  |
| Effective Green, g (s)            | 46.9  |      | 54.4  | 53.9  | 11.1                      | 11.1  |
| Actuated g/C Ratio                | 0.63  |      | 0.73  | 0.72  | 0.15                      | 0.15  |
| Clearance Time (s)                | 5.0   |      | 4.5   | 5.0   | 5.0                       | 5.0   |
| Vehicle Extension (s)             | 3.5   |      | 2.0   | 3.5   | 2.0                       | 2.0   |
| Lane Grp Cap (vph)                | 2222  |      | 188   | 2568  | 251                       | 223   |
| v/s Ratio Prot                    | c0.44 |      | 0.01  | c0.45 | 0.06                      |       |
| v/s Ratio Perm                    |       |      | 0.14  |       |                           | c0.10 |
| v/c Ratio                         | 0.71  |      | 0.21  | 0.62  | 0.43                      | 0.70  |
| Uniform Delay, d1                 | 9.4   |      | 12.0  | 5.4   | 29.1                      | 30.4  |
| Progression Factor                | 1.75  |      | 1.21  | 1.25  | 1.00                      | 1.00  |
| Incremental Delay, d2             | 1.0   |      | 0.2   | 0.9   | 0.4                       | 7.8   |
| Delay (s)                         | 17.5  |      | 14.6  | 7.6   | 29.5                      | 38.2  |
| Level of Service                  | B     |      | B     | A     | C                         | D     |
| Approach Delay (s)                | 17.5  |      |       | 7.8   | 35.6                      |       |
| Approach LOS                      | B     |      |       | A     | D                         |       |
| <b>Intersection Summary</b>       |       |      |       |       |                           |       |
| HCM 2000 Control Delay            |       |      | 14.9  |       | HCM 2000 Level of Service | B     |
| HCM 2000 Volume to Capacity ratio |       |      | 0.72  |       |                           |       |
| Actuated Cycle Length (s)         |       |      | 75.0  |       | Sum of lost time (s)      | 14.5  |
| Intersection Capacity Utilization |       |      | 62.5% |       | ICU Level of Service      | B     |
| Analysis Period (min)             |       |      | 15    |       |                           |       |
| c Critical Lane Group             |       |      |       |       |                           |       |

# HCM Signalized Intersection Capacity Analysis

## 4: Old Graves Mill & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |  |  |  |                                                                                   |                                                                                    |  |  |                                                                                     |  |                                                                                     |
| Traffic Volume (vph)              | 1                                                                                 | 1467                                                                              | 341                                                                               | 345                                                                               | 1251                                                                              | 0                                                                                 | 200                                                                                | 0                                                                                   | 68                                                                                  | 0                                                                                   | 1                                                                                   | 3                                                                                   |
| Future Volume (vph)               | 1                                                                                 | 1467                                                                              | 341                                                                               | 345                                                                               | 1251                                                                              | 0                                                                                 | 200                                                                                | 0                                                                                   | 68                                                                                  | 0                                                                                   | 1                                                                                   | 3                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                 | 13                                                                                  | 13                                                                                  | 12                                                                                  | 16                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | -5%                                                                               |                                                                                   |                                                                                    | -5%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 0.85                                                                                |                                                                                     | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 3521                                                                              | 1575                                                                              | 1753                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1874                                                                                | 1677                                                                                |                                                                                     | 1906                                                                                |                                                                                     |
| Flt Permitted                     | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 1778                                                                              | 3521                                                                              | 1575                                                                              | 1753                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1874                                                                                | 1677                                                                                |                                                                                     | 1906                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                               | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                |
| Adj. Flow (vph)                   | 1                                                                                 | 1612                                                                              | 375                                                                               | 379                                                                               | 1375                                                                              | 0                                                                                 | 220                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 1                                                                                   | 3                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 90                                                                                | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                  | 0                                                                                   | 64                                                                                  | 0                                                                                   | 3                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 1                                                                                 | 1612                                                                              | 285                                                                               | 379                                                                               | 1375                                                                              | 0                                                                                 | 0                                                                                  | 220                                                                                 | 11                                                                                  | 0                                                                                   | 1                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                | 1%                                                                                | 2%                                                                                | 1%                                                                                | 0%                                                                                | 2%                                                                                 | 0%                                                                                  | 2%                                                                                  | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  |
| Turn Type                         | Prot                                                                              | NA                                                                                | Perm                                                                              | Prot                                                                              | NA                                                                                |                                                                                   | Split                                                                              | NA                                                                                  | Perm                                                                                |                                                                                     | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                  | 8                                                                                   |                                                                                     | 4                                                                                   | 4                                                                                   |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                   | 2                                                                                 |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 1.4                                                                               | 78.9                                                                              | 78.9                                                                              | 27.0                                                                              | 104.5                                                                             |                                                                                   |                                                                                    | 22.8                                                                                | 22.8                                                                                |                                                                                     | 1.3                                                                                 |                                                                                     |
| Effective Green, g (s)            | 1.4                                                                               | 78.9                                                                              | 78.9                                                                              | 27.0                                                                              | 104.5                                                                             |                                                                                   |                                                                                    | 22.8                                                                                | 22.8                                                                                |                                                                                     | 1.3                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.01                                                                              | 0.53                                                                              | 0.53                                                                              | 0.18                                                                              | 0.70                                                                              |                                                                                   |                                                                                    | 0.15                                                                                | 0.15                                                                                |                                                                                     | 0.01                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                   |                                                                                    | 3.0                                                                                 | 3.0                                                                                 |                                                                                     | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 16                                                                                | 1852                                                                              | 828                                                                               | 315                                                                               | 2552                                                                              |                                                                                   |                                                                                    | 284                                                                                 | 254                                                                                 |                                                                                     | 16                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.00                                                                              | c0.46                                                                             |                                                                                   | c0.22                                                                             | 0.38                                                                              |                                                                                   |                                                                                    | c0.12                                                                               |                                                                                     |                                                                                     | c0.00                                                                               |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                   | 0.18                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 0.01                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.06                                                                              | 0.87                                                                              | 0.34                                                                              | 1.20                                                                              | 0.54                                                                              |                                                                                   |                                                                                    | 0.77                                                                                | 0.04                                                                                |                                                                                     | 0.06                                                                                |                                                                                     |
| Uniform Delay, d1                 | 73.6                                                                              | 31.1                                                                              | 20.6                                                                              | 61.5                                                                              | 11.0                                                                              |                                                                                   |                                                                                    | 61.1                                                                                | 54.3                                                                                |                                                                                     | 73.7                                                                                |                                                                                     |
| Progression Factor                | 1.18                                                                              | 0.58                                                                              | 0.32                                                                              | 0.76                                                                              | 0.38                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 1.3                                                                               | 4.8                                                                               | 0.9                                                                               | 113.4                                                                             | 0.7                                                                               |                                                                                   |                                                                                    | 12.4                                                                                | 0.1                                                                                 |                                                                                     | 1.7                                                                                 |                                                                                     |
| Delay (s)                         | 88.5                                                                              | 22.7                                                                              | 7.5                                                                               | 160.1                                                                             | 4.8                                                                               |                                                                                   |                                                                                    | 73.5                                                                                | 54.4                                                                                |                                                                                     | 75.4                                                                                |                                                                                     |
| Level of Service                  | F                                                                                 | C                                                                                 | A                                                                                 | F                                                                                 | A                                                                                 |                                                                                   |                                                                                    | E                                                                                   | D                                                                                   |                                                                                     | E                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 19.9                                                                              |                                                                                   |                                                                                   | 38.4                                                                              |                                                                                   |                                                                                    | 68.7                                                                                |                                                                                     |                                                                                     | 75.4                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | D                                                                                 |                                                                                   |                                                                                    | E                                                                                   |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 31.5                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                    |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.91                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 150.0                                                                             |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                    |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 89.9%                                                                             |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                    |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |



# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |                                                                                     |
| Traffic Volume (vph)              | 50                                                                                | 1406                                                                              | 6                                                                                 | 285                                                                               | 1476                                                                              | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                 | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Future Volume (vph)               | 50                                                                                | 1406                                                                              | 6                                                                                 | 285                                                                               | 1476                                                                              | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                 | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.89                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 3478                                                                              |                                                                                   | 1770                                                                              | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 1507                                                                                | 1702                                                                                | 1553                                                                                |                                                                                     |
| Flt Permitted                     | 0.07                                                                              | 1.00                                                                              |                                                                                   | 0.05                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 136                                                                               | 3478                                                                              |                                                                                   | 99                                                                                | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 1507                                                                                | 1702                                                                                | 1553                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.95                                                                              | 0.95                                                                              | 0.90                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                |
| Adj. Flow (vph)                   | 53                                                                                | 1480                                                                              | 7                                                                                 | 300                                                                               | 1554                                                                              | 149                                                                               | 61                                                                                  | 28                                                                                  | 497                                                                                 | 127                                                                                 | 20                                                                                  | 47                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 53                                                                                | 0                                                                                   | 0                                                                                   | 35                                                                                  | 0                                                                                   | 43                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 53                                                                                | 1487                                                                              | 0                                                                                 | 300                                                                               | 1554                                                                              | 96                                                                                | 0                                                                                   | 89                                                                                  | 462                                                                                 | 127                                                                                 | 24                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 2%                                                                                | 40%                                                                               | 2%                                                                                | 1%                                                                                | 0%                                                                                | 4%                                                                                  | 10%                                                                                 | 1%                                                                                  | 1%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pm+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 1                                                                                   | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 81.4                                                                              | 70.4                                                                              |                                                                                   | 113.0                                                                             | 97.0                                                                              | 97.0                                                                              |                                                                                     | 9.2                                                                                 | 46.8                                                                                | 12.8                                                                                | 12.8                                                                                |                                                                                     |
| Effective Green, g (s)            | 81.4                                                                              | 70.4                                                                              |                                                                                   | 113.0                                                                             | 97.0                                                                              | 97.0                                                                              |                                                                                     | 9.2                                                                                 | 46.8                                                                                | 12.8                                                                                | 12.8                                                                                |                                                                                     |
| Actuated g/C Ratio                | 0.54                                                                              | 0.47                                                                              |                                                                                   | 0.75                                                                              | 0.65                                                                              | 0.65                                                                              |                                                                                     | 0.06                                                                                | 0.31                                                                                | 0.09                                                                                | 0.09                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 194                                                                               | 1632                                                                              |                                                                                   | 493                                                                               | 2311                                                                              | 1044                                                                              |                                                                                     | 103                                                                                 | 520                                                                                 | 145                                                                                 | 132                                                                                 |                                                                                     |
| v/s Ratio Prot                    | 0.02                                                                              | c0.43                                                                             |                                                                                   | 0.15                                                                              | 0.43                                                                              |                                                                                   |                                                                                     | 0.05                                                                                | c0.22                                                                               | c0.07                                                                               | 0.02                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.13                                                                              |                                                                                   |                                                                                   | 0.31                                                                              |                                                                                   | 0.06                                                                              |                                                                                     |                                                                                     | 0.08                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.27                                                                              | 0.91                                                                              |                                                                                   | 0.61                                                                              | 0.67                                                                              | 0.09                                                                              |                                                                                     | 0.86                                                                                | 0.89                                                                                | 0.88                                                                                | 0.18                                                                                |                                                                                     |
| Uniform Delay, d1                 | 46.8                                                                              | 36.9                                                                              |                                                                                   | 40.2                                                                              | 16.6                                                                              | 10.0                                                                              |                                                                                     | 69.8                                                                                | 49.1                                                                                | 67.8                                                                                | 63.7                                                                                |                                                                                     |
| Progression Factor                | 0.78                                                                              | 0.41                                                                              |                                                                                   | 1.03                                                                              | 0.32                                                                              | 0.25                                                                              |                                                                                     | 1.00                                                                                | 0.99                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.5                                                                               | 6.1                                                                               |                                                                                   | 1.3                                                                               | 1.0                                                                               | 0.1                                                                               |                                                                                     | 48.2                                                                                | 16.7                                                                                | 40.3                                                                                | 0.7                                                                                 |                                                                                     |
| Delay (s)                         | 37.0                                                                              | 21.2                                                                              |                                                                                   | 42.9                                                                              | 6.2                                                                               | 2.6                                                                               |                                                                                     | 117.7                                                                               | 65.2                                                                                | 108.1                                                                               | 64.4                                                                                |                                                                                     |
| Level of Service                  | D                                                                                 | C                                                                                 |                                                                                   | D                                                                                 | A                                                                                 | A                                                                                 |                                                                                     | F                                                                                   | E                                                                                   | F                                                                                   | E                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 21.8                                                                              |                                                                                   |                                                                                   | 11.4                                                                              |                                                                                   |                                                                                     | 73.1                                                                                |                                                                                     |                                                                                     | 93.0                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | C                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                     | E                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 27.1                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.93                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 150.0                                                                             |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 87.5%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 6: SB Ramp & Graves Mill

02/23/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |                                                                                   | ↑↑                                                                                | ↗                                                                                 | ↗                                                                                 | ↑↑                                                                                |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | ↖                                                                                   | ↖                                                                                   |
| Traffic Volume (vph)              | 0                                                                                 | 604                                                                               | 1399                                                                              | 274                                                                               | 1407                                                                              | 0                                                                                 | 0                                                                                  | 0                                                                                   | 0                                                                                   | 61                                                                                  | 4                                                                                   | 495                                                                                 |
| Future Volume (vph)               | 0                                                                                 | 604                                                                               | 1399                                                                              | 274                                                                               | 1407                                                                              | 0                                                                                 | 0                                                                                  | 0                                                                                   | 0                                                                                   | 61                                                                                  | 4                                                                                   | 495                                                                                 |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                 | 12                                                                                  | 12                                                                                  | 12                                                                                  | 11                                                                                  | 11                                                                                  |
| Grade (%)                         |                                                                                   | 0%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                    | 3%                                                                                  |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |
| Lane Util. Factor                 |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 1.00                                                                                | 1.00                                                                                |
| Frt                               |                                                                                   | 1.00                                                                              | 0.85                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 1.00                                                                                | 0.85                                                                                |
| Flt Protected                     |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 0.95                                                                                | 1.00                                                                                |
| Satd. Flow (prot)                 |                                                                                   | 3574                                                                              | 1583                                                                              | 1787                                                                              | 3574                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 1665                                                                                | 1523                                                                                |
| Flt Permitted                     |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.34                                                                              | 1.00                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 0.95                                                                                | 1.00                                                                                |
| Satd. Flow (perm)                 |                                                                                   | 3574                                                                              | 1583                                                                              | 643                                                                               | 3574                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 1665                                                                                | 1523                                                                                |
| Peak-hour factor, PHF             | 0.93                                                                              | 0.93                                                                              | 0.93                                                                              | 0.93                                                                              | 0.93                                                                              | 0.93                                                                              | 0.93                                                                               | 0.93                                                                                | 0.93                                                                                | 0.93                                                                                | 0.93                                                                                | 0.93                                                                                |
| Adj. Flow (vph)                   | 0                                                                                 | 649                                                                               | 1504                                                                              | 295                                                                               | 1513                                                                              | 0                                                                                 | 0                                                                                  | 0                                                                                   | 0                                                                                   | 66                                                                                  | 4                                                                                   | 532                                                                                 |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 393                                                                               | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   | 38                                                                                  |
| Lane Group Flow (vph)             | 0                                                                                 | 649                                                                               | 1111                                                                              | 295                                                                               | 1513                                                                              | 0                                                                                 | 0                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   | 70                                                                                  | 494                                                                                 |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                | 2%                                                                                | 1%                                                                                | 1%                                                                                | 0%                                                                                | 0%                                                                                 | 0%                                                                                  | 0%                                                                                  | 4%                                                                                  | 0%                                                                                  | 1%                                                                                  |
| Turn Type                         |                                                                                   | NA                                                                                | Perm                                                                              | pm+pt                                                                             | NA                                                                                |                                                                                   |                                                                                    |                                                                                     |                                                                                     | Split                                                                               | NA                                                                                  | Perm                                                                                |
| Protected Phases                  |                                                                                   | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   |                                                                                    |                                                                                     |                                                                                     | 8                                                                                   | 8                                                                                   |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                   | 2                                                                                 | 6                                                                                 |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     | 8                                                                                   |
| Actuated Green, G (s)             |                                                                                   | 88.0                                                                              | 88.0                                                                              | 100.0                                                                             | 100.0                                                                             |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 40.0                                                                                | 40.0                                                                                |
| Effective Green, g (s)            |                                                                                   | 88.0                                                                              | 88.0                                                                              | 100.0                                                                             | 100.0                                                                             |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 40.0                                                                                | 40.0                                                                                |
| Actuated g/C Ratio                |                                                                                   | 0.59                                                                              | 0.59                                                                              | 0.67                                                                              | 0.67                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 0.27                                                                                | 0.27                                                                                |
| Clearance Time (s)                |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |
| Vehicle Extension (s)             |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |
| Lane Grp Cap (vph)                |                                                                                   | 2096                                                                              | 928                                                                               | 482                                                                               | 2382                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 444                                                                                 | 406                                                                                 |
| v/s Ratio Prot                    |                                                                                   | 0.18                                                                              |                                                                                   | 0.03                                                                              | c0.42                                                                             |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 0.04                                                                                |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                   | c0.70                                                                             | 0.38                                                                              |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     | c0.32                                                                               |
| v/c Ratio                         |                                                                                   | 0.31                                                                              | 1.20                                                                              | 0.61                                                                              | 0.64                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 0.16                                                                                | 1.22                                                                                |
| Uniform Delay, d1                 |                                                                                   | 15.7                                                                              | 31.0                                                                              | 13.7                                                                              | 14.5                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 42.1                                                                                | 55.0                                                                                |
| Progression Factor                |                                                                                   | 0.59                                                                              | 1.62                                                                              | 0.64                                                                              | 0.91                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 1.00                                                                                | 1.00                                                                                |
| Incremental Delay, d2             |                                                                                   | 0.2                                                                               | 94.0                                                                              | 2.0                                                                               | 0.8                                                                               |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 0.3                                                                                 | 118.0                                                                               |
| Delay (s)                         |                                                                                   | 9.4                                                                               | 144.1                                                                             | 10.8                                                                              | 14.0                                                                              |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | 42.5                                                                                | 173.0                                                                               |
| Level of Service                  |                                                                                   | A                                                                                 | F                                                                                 | B                                                                                 | B                                                                                 |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     | D                                                                                   | F                                                                                   |
| Approach Delay (s)                |                                                                                   | 103.5                                                                             |                                                                                   |                                                                                   | 13.5                                                                              |                                                                                   |                                                                                    | 0.0                                                                                 |                                                                                     |                                                                                     | 157.8                                                                               |                                                                                     |
| Approach LOS                      |                                                                                   | F                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                    | A                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 75.0                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                    |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 1.19                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 150.0                                                                             |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                    |                                                                                     |                                                                                     | 15.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 120.1%                                                                            |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                    |                                                                                     |                                                                                     | H                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 7: NB Ramp & Graves Mill

02/23/2018

|                                   |  |                                                                                       |  |  |                                                                                       |  |  |                                                                                         |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                                                                                                                    | EBR                                                                               | WBL                                                                               | WBT                                                                                                                                                                    | WBR                                                                               | NBL                                                                                 | NBT                                                                                                                                                                        | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  | <br> |                                                                                   |                                                                                   | <br> |  |  | <br> |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Traffic Volume (vph)              | 383                                                                               | 322                                                                                                                                                                    | 0                                                                                 | 0                                                                                 | 683                                                                                                                                                                    | 169                                                                               | 989                                                                                 | 1                                                                                                                                                                          | 85                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Future Volume (vph)               | 383                                                                               | 322                                                                                                                                                                    | 0                                                                                 | 0                                                                                 | 683                                                                                                                                                                    | 169                                                                               | 989                                                                                 | 1                                                                                                                                                                          | 85                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                                                                                                                   | 1900                                                                              | 1900                                                                              | 1900                                                                                                                                                                   | 1900                                                                              | 1900                                                                                | 1900                                                                                                                                                                       | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                                                                                                     | 12                                                                                | 12                                                                                | 12                                                                                                                                                                     | 12                                                                                | 11                                                                                  | 12                                                                                                                                                                         | 12                                                                                  | 12                                                                                  | 12                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 0%                                                                                                                                                                     |                                                                                   |                                                                                   | -3%                                                                                                                                                                    |                                                                                   |                                                                                     | 3%                                                                                                                                                                         |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 6.0                                                                                                                                                                    |                                                                                   |                                                                                   | 6.0                                                                                                                                                                    | 6.0                                                                               | 5.0                                                                                 | 5.0                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                                                                                                                   |                                                                                   |                                                                                   | 0.95                                                                                                                                                                   | 1.00                                                                              | 0.95                                                                                | 0.95                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                                                                                                                   |                                                                                   |                                                                                   | 1.00                                                                                                                                                                   | 0.85                                                                              | 1.00                                                                                | 0.98                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                                                                                                                   |                                                                                   |                                                                                   | 1.00                                                                                                                                                                   | 1.00                                                                              | 0.95                                                                                | 0.96                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (prot)                 | 1787                                                                              | 3574                                                                                                                                                                   |                                                                                   |                                                                                   | 3628                                                                                                                                                                   | 1623                                                                              | 1617                                                                                | 1652                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Flt Permitted                     | 0.20                                                                              | 1.00                                                                                                                                                                   |                                                                                   |                                                                                   | 1.00                                                                                                                                                                   | 1.00                                                                              | 0.95                                                                                | 0.96                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (perm)                 | 379                                                                               | 3574                                                                                                                                                                   |                                                                                   |                                                                                   | 3628                                                                                                                                                                   | 1623                                                                              | 1617                                                                                | 1652                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Peak-hour factor, PHF             | 0.91                                                                              | 0.91                                                                                                                                                                   | 0.91                                                                              | 0.91                                                                              | 0.91                                                                                                                                                                   | 0.91                                                                              | 0.91                                                                                | 0.91                                                                                                                                                                       | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                |
| Adj. Flow (vph)                   | 421                                                                               | 354                                                                                                                                                                    | 0                                                                                 | 0                                                                                 | 751                                                                                                                                                                    | 186                                                                               | 1087                                                                                | 1                                                                                                                                                                          | 93                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                                                                                                      | 0                                                                                 | 0                                                                                 | 0                                                                                                                                                                      | 87                                                                                | 0                                                                                   | 5                                                                                                                                                                          | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 421                                                                               | 354                                                                                                                                                                    | 0                                                                                 | 0                                                                                 | 751                                                                                                                                                                    | 99                                                                                | 598                                                                                 | 578                                                                                                                                                                        | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 1%                                                                                | 1%                                                                                                                                                                     | 0%                                                                                | 0%                                                                                | 1%                                                                                                                                                                     | 1%                                                                                | 1%                                                                                  | 0%                                                                                                                                                                         | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                                                                                                     |                                                                                   |                                                                                   | NA                                                                                                                                                                     | Perm                                                                              | Split                                                                               | NA                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Protected Phases                  | 1                                                                                 | 6                                                                                                                                                                      |                                                                                   |                                                                                   | 2                                                                                                                                                                      |                                                                                   | 4                                                                                   | 4                                                                                                                                                                          |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Permitted Phases                  | 6                                                                                 |                                                                                                                                                                        |                                                                                   |                                                                                   |                                                                                                                                                                        | 2                                                                                 |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 80.3                                                                              | 79.3                                                                                                                                                                   |                                                                                   |                                                                                   | 45.8                                                                                                                                                                   | 45.8                                                                              | 59.7                                                                                | 59.7                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Effective Green, g (s)            | 80.3                                                                              | 79.3                                                                                                                                                                   |                                                                                   |                                                                                   | 45.8                                                                                                                                                                   | 45.8                                                                              | 59.7                                                                                | 59.7                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated g/C Ratio                | 0.54                                                                              | 0.53                                                                                                                                                                   |                                                                                   |                                                                                   | 0.31                                                                                                                                                                   | 0.31                                                                              | 0.40                                                                                | 0.40                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 6.0                                                                                                                                                                    |                                                                                   |                                                                                   | 6.0                                                                                                                                                                    | 6.0                                                                               | 5.0                                                                                 | 5.0                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Vehicle Extension (s)             | 2.5                                                                               | 2.5                                                                                                                                                                    |                                                                                   |                                                                                   | 2.5                                                                                                                                                                    | 2.5                                                                               | 2.5                                                                                 | 2.5                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Lane Grp Cap (vph)                | 470                                                                               | 1889                                                                                                                                                                   |                                                                                   |                                                                                   | 1107                                                                                                                                                                   | 495                                                                               | 643                                                                                 | 657                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Prot                    | c0.17                                                                             | 0.10                                                                                                                                                                   |                                                                                   |                                                                                   | 0.21                                                                                                                                                                   |                                                                                   | c0.37                                                                               | 0.35                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Perm                    | c0.31                                                                             |                                                                                                                                                                        |                                                                                   |                                                                                   |                                                                                                                                                                        | 0.06                                                                              |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.90                                                                              | 0.19                                                                                                                                                                   |                                                                                   |                                                                                   | 0.68                                                                                                                                                                   | 0.20                                                                              | 0.93                                                                                | 0.88                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Uniform Delay, d1                 | 43.5                                                                              | 18.5                                                                                                                                                                   |                                                                                   |                                                                                   | 45.6                                                                                                                                                                   | 38.6                                                                              | 43.2                                                                                | 41.8                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Progression Factor                | 0.65                                                                              | 0.43                                                                                                                                                                   |                                                                                   |                                                                                   | 1.00                                                                                                                                                                   | 1.00                                                                              | 1.00                                                                                | 1.00                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Incremental Delay, d2             | 18.8                                                                              | 0.2                                                                                                                                                                    |                                                                                   |                                                                                   | 3.4                                                                                                                                                                    | 0.9                                                                               | 20.1                                                                                | 13.0                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Delay (s)                         | 47.3                                                                              | 8.1                                                                                                                                                                    |                                                                                   |                                                                                   | 49.0                                                                                                                                                                   | 39.5                                                                              | 63.3                                                                                | 54.9                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Level of Service                  | D                                                                                 | A                                                                                                                                                                      |                                                                                   |                                                                                   | D                                                                                                                                                                      | D                                                                                 | E                                                                                   | D                                                                                                                                                                          |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Approach Delay (s)                |                                                                                   | 29.4                                                                                                                                                                   |                                                                                   |                                                                                   | 47.1                                                                                                                                                                   |                                                                                   |                                                                                     | 59.1                                                                                                                                                                       |                                                                                     |                                                                                     | 0.0                                                                                 |                                                                                     |
| Approach LOS                      |                                                                                   | C                                                                                                                                                                      |                                                                                   |                                                                                   | D                                                                                                                                                                      |                                                                                   |                                                                                     | E                                                                                                                                                                          |                                                                                     |                                                                                     | A                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   | 47.3                                                                                                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                                                                                                              |                                                                                   |                                                                                     | D                                                                                                                                                                          |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   | 0.94                                                                                                                                                                   |                                                                                   |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   | 150.0                                                                                                                                                                  |                                                                                   |                                                                                   | Sum of lost time (s)                                                                                                                                                   |                                                                                   |                                                                                     | 16.0                                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   | 120.1%                                                                                                                                                                 |                                                                                   |                                                                                   | ICU Level of Service                                                                                                                                                   |                                                                                   |                                                                                     | H                                                                                                                                                                          |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   | 15                                                                                                                                                                     |                                                                                   |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                   |                                                                                                                                                                        |                                                                                   |                                                                                     |                                                                                                                                                                            |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 9: Forest & Graves Mill

02/23/2018

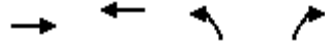
|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |  |  |  |  |  |  |
| Traffic Volume (vph)              | 154                                                                               | 278                                                                               | 69                                                                                | 653                                                                               | 246                                                                               | 372                                                                               | 47                                                                                 | 1260                                                                                | 399                                                                                 | 355                                                                                 | 1647                                                                                | 122                                                                                 |
| Future Volume (vph)               | 154                                                                               | 278                                                                               | 69                                                                                | 653                                                                               | 246                                                                               | 372                                                                               | 47                                                                                 | 1260                                                                                | 399                                                                                 | 355                                                                                 | 1647                                                                                | 122                                                                                 |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 10                                                                                | 11                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                 | 12                                                                                  | 11                                                                                  | 11                                                                                  | 11                                                                                  | 11                                                                                  |
| Total Lost time (s)               | 6.7                                                                               | 6.7                                                                               |                                                                                   | 7.7                                                                               | 7.7                                                                               | 7.7                                                                               | 7.7                                                                                | 5.7                                                                                 | 7.7                                                                                 | 7.4                                                                                 | 5.8                                                                                 | 6.7                                                                                 |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 0.97                                                                              | 1.00                                                                              | 1.00                                                                              | 1.00                                                                               | 0.91                                                                                | 1.00                                                                                | 1.00                                                                                | 0.91                                                                                | 1.00                                                                                |
| Frt                               | 1.00                                                                              | 0.97                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              | 1.00                                                                               | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 1.00                                                                                | 0.85                                                                                |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                               | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                |
| Satd. Flow (prot)                 | 1636                                                                              | 3256                                                                              |                                                                                   | 3400                                                                              | 1881                                                                              | 1599                                                                              | 1694                                                                               | 5085                                                                                | 1473                                                                                | 1711                                                                                | 4916                                                                                | 1516                                                                                |
| Flt Permitted                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                               | 1.00                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                | 1.00                                                                                |
| Satd. Flow (perm)                 | 1636                                                                              | 3256                                                                              |                                                                                   | 3400                                                                              | 1881                                                                              | 1599                                                                              | 1694                                                                               | 5085                                                                                | 1473                                                                                | 1711                                                                                | 4916                                                                                | 1516                                                                                |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                               | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 175                                                                               | 316                                                                               | 78                                                                                | 742                                                                               | 280                                                                               | 423                                                                               | 53                                                                                 | 1432                                                                                | 453                                                                                 | 403                                                                                 | 1872                                                                                | 139                                                                                 |
| RTOR Reduction (vph)              | 0                                                                                 | 14                                                                                | 0                                                                                 | 0                                                                                 | 0                                                                                 | 307                                                                               | 0                                                                                  | 0                                                                                   | 71                                                                                  | 0                                                                                   | 0                                                                                   | 61                                                                                  |
| Lane Group Flow (vph)             | 175                                                                               | 380                                                                               | 0                                                                                 | 742                                                                               | 280                                                                               | 116                                                                               | 53                                                                                 | 1432                                                                                | 382                                                                                 | 403                                                                                 | 1872                                                                                | 78                                                                                  |
| Heavy Vehicles (%)                | 3%                                                                                | 3%                                                                                | 8%                                                                                | 3%                                                                                | 1%                                                                                | 1%                                                                                | 3%                                                                                 | 2%                                                                                  | 6%                                                                                  | 2%                                                                                  | 2%                                                                                  | 3%                                                                                  |
| Turn Type                         | Split                                                                             | NA                                                                                |                                                                                   | Split                                                                             | NA                                                                                | Perm                                                                              | Prot                                                                               | NA                                                                                  | pm+ov                                                                               | Prot                                                                                | NA                                                                                  | pm+ov                                                                               |
| Protected Phases                  | 4                                                                                 | 4                                                                                 |                                                                                   | 3                                                                                 | 3                                                                                 |                                                                                   | 1                                                                                  | 6                                                                                   | 3                                                                                   | 5                                                                                   | 2                                                                                   | 4                                                                                   |
| Permitted Phases                  |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   | 3                                                                                 |                                                                                    |                                                                                     | 6                                                                                   |                                                                                     |                                                                                     | 2                                                                                   |
| Actuated Green, G (s)             | 16.6                                                                              | 16.6                                                                              |                                                                                   | 31.3                                                                              | 31.3                                                                              | 31.3                                                                              | 6.4                                                                                | 40.8                                                                                | 72.1                                                                                | 33.8                                                                                | 67.8                                                                                | 84.4                                                                                |
| Effective Green, g (s)            | 16.6                                                                              | 16.6                                                                              |                                                                                   | 31.3                                                                              | 31.3                                                                              | 31.3                                                                              | 6.4                                                                                | 40.8                                                                                | 72.1                                                                                | 33.8                                                                                | 67.8                                                                                | 84.4                                                                                |
| Actuated g/C Ratio                | 0.11                                                                              | 0.11                                                                              |                                                                                   | 0.21                                                                              | 0.21                                                                              | 0.21                                                                              | 0.04                                                                               | 0.27                                                                                | 0.48                                                                                | 0.23                                                                                | 0.45                                                                                | 0.56                                                                                |
| Clearance Time (s)                | 6.7                                                                               | 6.7                                                                               |                                                                                   | 7.7                                                                               | 7.7                                                                               | 7.7                                                                               | 7.7                                                                                | 5.7                                                                                 | 7.7                                                                                 | 7.4                                                                                 | 5.8                                                                                 | 6.7                                                                                 |
| Vehicle Extension (s)             | 3.5                                                                               | 3.5                                                                               |                                                                                   | 3.5                                                                               | 3.5                                                                               | 3.5                                                                               | 3.5                                                                                | 5.0                                                                                 | 3.5                                                                                 | 3.5                                                                                 | 5.0                                                                                 | 3.5                                                                                 |
| Lane Grp Cap (vph)                | 181                                                                               | 360                                                                               |                                                                                   | 709                                                                               | 392                                                                               | 333                                                                               | 72                                                                                 | 1383                                                                                | 708                                                                                 | 385                                                                                 | 2222                                                                                | 853                                                                                 |
| v/s Ratio Prot                    | 0.11                                                                              | c0.12                                                                             |                                                                                   | c0.22                                                                             | 0.15                                                                              |                                                                                   | 0.03                                                                               | c0.28                                                                               | 0.11                                                                                | c0.24                                                                               | 0.38                                                                                | 0.01                                                                                |
| v/s Ratio Perm                    |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   | 0.07                                                                              |                                                                                    |                                                                                     | 0.15                                                                                |                                                                                     |                                                                                     | 0.04                                                                                |
| v/c Ratio                         | 0.97                                                                              | 1.05                                                                              |                                                                                   | 1.05                                                                              | 0.71                                                                              | 0.35                                                                              | 0.74                                                                               | 1.04                                                                                | 0.54                                                                                | 1.05                                                                                | 0.84                                                                                | 0.09                                                                                |
| Uniform Delay, d1                 | 66.4                                                                              | 66.7                                                                              |                                                                                   | 59.4                                                                              | 55.2                                                                              | 50.6                                                                              | 71.0                                                                               | 54.6                                                                                | 27.3                                                                                | 58.1                                                                                | 36.4                                                                                | 15.1                                                                                |
| Progression Factor                | 1.00                                                                              | 1.00                                                                              |                                                                                   | 0.63                                                                              | 0.62                                                                              | 0.47                                                                              | 1.00                                                                               | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |
| Incremental Delay, d2             | 56.9                                                                              | 62.6                                                                              |                                                                                   | 25.2                                                                              | 0.6                                                                               | 0.1                                                                               | 32.9                                                                               | 33.9                                                                                | 0.9                                                                                 | 58.6                                                                                | 4.1                                                                                 | 0.1                                                                                 |
| Delay (s)                         | 123.3                                                                             | 129.3                                                                             |                                                                                   | 62.8                                                                              | 35.0                                                                              | 23.7                                                                              | 103.8                                                                              | 88.5                                                                                | 28.2                                                                                | 116.7                                                                               | 40.5                                                                                | 15.2                                                                                |
| Level of Service                  | F                                                                                 | F                                                                                 |                                                                                   | E                                                                                 | D                                                                                 | C                                                                                 | F                                                                                  | F                                                                                   | C                                                                                   | F                                                                                   | D                                                                                   | B                                                                                   |
| Approach Delay (s)                |                                                                                   | 127.5                                                                             |                                                                                   |                                                                                   | 45.9                                                                              |                                                                                   |                                                                                    | 74.8                                                                                |                                                                                     |                                                                                     | 51.7                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | F                                                                                 |                                                                                   |                                                                                   | D                                                                                 |                                                                                   |                                                                                    | E                                                                                   |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 64.2                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 1.05                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 150.0                                                                             |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 95.4%                                                                             |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |



## Queues

### 1: Gristmill & Graves Mill

02/23/2018



| Lane Group              | EBT  | WBT  | NBL  | NBR   |
|-------------------------|------|------|------|-------|
| Lane Group Flow (vph)   | 1028 | 1939 | 52   | 666   |
| v/c Ratio               | 0.75 | 1.07 | 0.15 | 1.38  |
| Control Delay           | 37.4 | 65.9 | 51.2 | 211.8 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0   |
| Total Delay             | 37.4 | 65.9 | 51.2 | 211.8 |
| Queue Length 50th (ft)  | 436  | ~776 | 43   | ~690  |
| Queue Length 95th (ft)  | m397 | #850 | 82   | #902  |
| Internal Link Dist (ft) | 1043 | 605  | 674  |       |
| Turn Bay Length (ft)    |      |      |      | 180   |
| Base Capacity (vph)     | 2262 | 1810 | 341  | 484   |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0     |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0     |
| Storage Cap Reductn     | 0    | 0    | 0    | 0     |
| Reduced v/c Ratio       | 0.45 | 1.07 | 0.15 | 1.38  |

#### Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

## Queues

## 2: Millrace &amp; Graves Mill

02/23/2018

|                         |  |  |  |  |  |
|-------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Lane Group              | EBT                                                                               | WBL                                                                               | WBT                                                                               | NBL                                                                               | NBR                                                                               |
| Lane Group Flow (vph)   | 1571                                                                              | 39                                                                                | 1599                                                                              | 109                                                                               | 249                                                                               |
| v/c Ratio               | 0.68                                                                              | 0.17                                                                              | 0.62                                                                              | 0.43                                                                              | 0.79                                                                              |
| Control Delay           | 18.2                                                                              | 7.4                                                                               | 8.4                                                                               | 33.2                                                                              | 34.5                                                                              |
| Queue Delay             | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               |
| Total Delay             | 18.2                                                                              | 7.4                                                                               | 8.4                                                                               | 33.2                                                                              | 34.5                                                                              |
| Queue Length 50th (ft)  | 672                                                                               | 7                                                                                 | 285                                                                               | 46                                                                                | 61                                                                                |
| Queue Length 95th (ft)  | m575                                                                              | m16                                                                               | 430                                                                               | 88                                                                                | 134                                                                               |
| Internal Link Dist (ft) | 952                                                                               |                                                                                   | 1251                                                                              | 593                                                                               |                                                                                   |
| Turn Bay Length (ft)    |                                                                                   | 330                                                                               |                                                                                   |                                                                                   | 240                                                                               |
| Base Capacity (vph)     | 2310                                                                              | 229                                                                               | 2568                                                                              | 340                                                                               | 388                                                                               |
| Starvation Cap Reductn  | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Spillback Cap Reductn   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Storage Cap Reductn     | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Reduced v/c Ratio       | 0.68                                                                              | 0.17                                                                              | 0.62                                                                              | 0.32                                                                              | 0.64                                                                              |

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

## Queues

## 4: Old Graves Mill &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | EBR  | WBL   | WBT  | NBT  | NBR  | SBT  |
|-------------------------|------|------|------|-------|------|------|------|------|
| Lane Group Flow (vph)   | 1    | 1612 | 375  | 379   | 1375 | 220  | 75   | 4    |
| v/c Ratio               | 0.01 | 0.79 | 0.38 | 1.41  | 0.50 | 0.77 | 0.21 | 0.05 |
| Control Delay           | 81.0 | 18.3 | 3.8  | 239.9 | 4.2  | 78.8 | 2.0  | 49.8 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0   | 0.1  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 81.0 | 18.4 | 3.8  | 239.9 | 4.2  | 78.8 | 2.0  | 49.8 |
| Queue Length 50th (ft)  | 1    | 493  | 14   | ~495  | 19   | 210  | 0    | 1    |
| Queue Length 95th (ft)  | m1   | #974 | 112  | m#705 | 196  | 290  | 6    | 14   |
| Internal Link Dist (ft) |      | 1348 |      |       | 700  | 355  |      | 176  |
| Turn Bay Length (ft)    | 380  |      | 280  | 310   |      |      |      |      |
| Base Capacity (vph)     | 82   | 2039 | 992  | 268   | 2747 | 374  | 434  | 383  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0     | 264  | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 16   | 0    | 0     | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0     | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.01 | 0.80 | 0.38 | 1.41  | 0.55 | 0.59 | 0.17 | 0.01 |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

## Queues

## 5: Connector/Creekside &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT   | NBR   | SBL   | SBT  |
|-------------------------|------|------|------|------|------|-------|-------|-------|------|
| Lane Group Flow (vph)   | 53   | 1487 | 300  | 1554 | 149  | 89    | 497   | 127   | 67   |
| v/c Ratio               | 0.26 | 0.90 | 0.62 | 0.67 | 0.13 | 0.86  | 0.91  | 0.88  | 0.38 |
| Control Delay           | 13.8 | 20.7 | 47.6 | 6.3  | 0.5  | 124.4 | 64.4  | 114.3 | 31.8 |
| Queue Delay             | 0.0  | 0.5  | 0.0  | 0.1  | 0.0  | 0.0   | 4.8   | 0.0   | 0.0  |
| Total Delay             | 13.8 | 21.2 | 47.6 | 6.4  | 0.5  | 124.4 | 69.2  | 114.3 | 31.8 |
| Queue Length 50th (ft)  | 6    | 635  | 255  | 216  | 0    | 87    | 426   | 125   | 18   |
| Queue Length 95th (ft)  | m14  | 164  | m252 | m210 | m5   | m#197 | m#647 | #248  | 70   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519   |       |       | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      | 300  |       | 160   | 190   |      |
| Base Capacity (vph)     | 208  | 1668 | 482  | 2481 | 1166 | 104   | 544   | 147   | 177  |
| Starvation Cap Reductn  | 0    | 31   | 0    | 178  | 0    | 0     | 0     | 0     | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0     | 24    | 0     | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0     | 0     | 0     | 0    |
| Reduced v/c Ratio       | 0.25 | 0.91 | 0.62 | 0.67 | 0.13 | 0.86  | 0.96  | 0.86  | 0.38 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



## Queues

## 6: SB Ramp &amp; Graves Mill

02/23/2018



| Lane Group              | EBT  | EBR   | WBL  | WBT  | SBT  | SBR   |
|-------------------------|------|-------|------|------|------|-------|
| Lane Group Flow (vph)   | 649  | 1504  | 295  | 1513 | 70   | 532   |
| v/c Ratio               | 0.31 | 1.14  | 0.61 | 0.64 | 0.16 | 1.20  |
| Control Delay           | 9.5  | 84.1  | 10.7 | 14.2 | 43.4 | 151.1 |
| Queue Delay             | 0.0  | 0.3   | 0.0  | 0.8  | 0.0  | 0.0   |
| Total Delay             | 9.5  | 84.4  | 10.7 | 15.0 | 43.4 | 151.1 |
| Queue Length 50th (ft)  | 97   | ~1467 | 72   | 437  | 53   | ~591  |
| Queue Length 95th (ft)  | m108 | #1698 | m77  | 372  | 96   | #826  |
| Internal Link Dist (ft) | 797  |       |      | 663  | 620  |       |
| Turn Bay Length (ft)    |      | 280   | 250  |      |      | 125   |
| Base Capacity (vph)     | 2096 | 1321  | 482  | 2382 | 444  | 444   |
| Starvation Cap Reductn  | 0    | 86    | 0    | 509  | 0    | 0     |
| Spillback Cap Reductn   | 0    | 0     | 0    | 0    | 0    | 0     |
| Storage Cap Reductn     | 0    | 0     | 0    | 0    | 0    | 0     |
| Reduced v/c Ratio       | 0.31 | 1.22  | 0.61 | 0.81 | 0.16 | 1.20  |

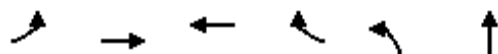
## Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

## Queues

## 7: NB Ramp &amp; Graves Mill

02/23/2018



| Lane Group              | EBL  | EBT  | WBT  | WBR  | NBL  | NBT  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 421  | 354  | 751  | 186  | 598  | 583  |
| v/c Ratio               | 0.90 | 0.19 | 0.68 | 0.32 | 0.93 | 0.88 |
| Control Delay           | 52.6 | 8.4  | 51.2 | 17.1 | 64.8 | 56.8 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 52.6 | 8.4  | 51.2 | 17.1 | 64.8 | 56.8 |
| Queue Length 50th (ft)  | 293  | 42   | 370  | 47   | 562  | 525  |
| Queue Length 95th (ft)  | #452 | 56   | 442  | 117  | #804 | #713 |
| Internal Link Dist (ft) |      | 663  | 458  |      |      | 755  |
| Turn Bay Length (ft)    | 170  |      |      | 180  |      |      |
| Base Capacity (vph)     | 517  | 1889 | 1116 | 586  | 679  | 698  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.81 | 0.19 | 0.67 | 0.32 | 0.88 | 0.84 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

## Queues

## 9: Forest &amp; Graves Mill

02/23/2018



| Lane Group              | EBL   | EBT   | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL   | SBT  | SBR  |
|-------------------------|-------|-------|------|------|------|------|------|------|-------|------|------|
| Lane Group Flow (vph)   | 175   | 394   | 742  | 280  | 423  | 53   | 1432 | 453  | 403   | 1872 | 139  |
| v/c Ratio               | 0.97  | 1.05  | 1.05 | 0.71 | 0.66 | 0.59 | 1.08 | 0.61 | 1.00  | 0.82 | 0.14 |
| Control Delay           | 123.9 | 120.8 | 62.7 | 35.9 | 3.8  | 94.9 | 99.1 | 14.7 | 101.9 | 39.7 | 2.3  |
| Queue Delay             | 0.0   | 0.0   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0  | 0.0  |
| Total Delay             | 123.9 | 120.8 | 62.7 | 35.9 | 3.8  | 94.9 | 99.1 | 14.7 | 101.9 | 39.7 | 2.3  |
| Queue Length 50th (ft)  | 173   | ~213  | ~396 | 216  | 15   | 52   | ~569 | 133  | ~398  | 598  | 0    |
| Queue Length 95th (ft)  | #319  | #314  | m321 | m194 | m12  | #109 | #641 | 194  | #600  | 642  | 27   |
| Internal Link Dist (ft) |       | 661   |      | 1043 |      |      | 1143 |      |       | 649  |      |
| Turn Bay Length (ft)    | 90    |       | 300  |      | 300  | 200  |      | 360  | 250   |      | 280  |
| Base Capacity (vph)     | 181   | 374   | 709  | 392  | 640  | 90   | 1332 | 747  | 402   | 2272 | 981  |
| Starvation Cap Reductn  | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| Spillback Cap Reductn   | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| Storage Cap Reductn     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    |
| Reduced v/c Ratio       | 0.97  | 1.05  | 1.05 | 0.71 | 0.66 | 0.59 | 1.08 | 0.61 | 1.00  | 0.82 | 0.14 |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM 2010 TWSC

## 3: Graves Mill & Millside

02/23/2018

### Intersection

Int Delay, s/veh 4.6

| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lane Configurations      |      | ↕↕   | ↕    |      | ↕↕   | ↕    |      | ↕    |      |      | ↕↕   |      |
| Traffic Vol, veh/h       | 4    | 1739 | 1    | 5    | 1454 | 10   | 1    | 0    | 15   | 23   | 0    | 10   |
| Future Vol, veh/h        | 4    | 1739 | 1    | 5    | 1454 | 10   | 1    | 0    | 15   | 23   | 0    | 10   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized           | -    | -    | None | -    | -    | None | -    | -    | None | -    | -    | None |
| Storage Length           | -    | -    | 140  | -    | -    | 140  | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | -5   | -    | -    | 5    | -    | -    | 3    | -    | -    | -5   | -    |
| Peak Hour Factor         | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   |
| Heavy Vehicles, %        | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Mvmt Flow                | 4    | 1890 | 1    | 5    | 1580 | 11   | 1    | 0    | 16   | 25   | 0    | 11   |

| Major/Minor          | Major1 |   |   | Major2 |   |   | Minor1 |      |     | Minor2 |      |     |
|----------------------|--------|---|---|--------|---|---|--------|------|-----|--------|------|-----|
| Conflicting Flow All | 1580   | 0 | 0 | 1890   | 0 | 0 | 2700   | 3490 | 945 | 2545   | 3490 | 790 |
| Stage 1              | -      | - | - | -      | - | - | 1899   | 1899 | -   | 1591   | 1591 | -   |
| Stage 2              | -      | - | - | -      | - | - | 801    | 1591 | -   | 954    | 1899 | -   |
| Critical Hdwy        | 4.1    | - | - | 4.1    | - | - | 8.1    | 7.1  | 7.2 | 6.5    | 5.5  | 6.4 |
| Critical Hdwy Stg 1  | -      | - | - | -      | - | - | 7.1    | 6.1  | -   | 5.5    | 4.5  | -   |
| Critical Hdwy Stg 2  | -      | - | - | -      | - | - | 7.1    | 6.1  | -   | 5.5    | 4.5  | -   |
| Follow-up Hdwy       | 2.2    | - | - | 2.2    | - | - | 3.5    | 4    | 3.3 | 3.5    | 4    | 3.3 |
| Pot Cap-1 Maneuver   | 422    | - | - | 321    | - | - | 7      | 4    | 246 | 28     | 17   | 376 |
| Stage 1              | -      | - | - | -      | - | - | 53     | 87   | -   | 178    | 263  | -   |
| Stage 2              | -      | - | - | -      | - | - | 305    | 129  | -   | 367    | 201  | -   |
| Platoon blocked, %   | -      | - | - | -      | - | - | -      | -    | -   | -      | -    | -   |
| Mov Cap-1 Maneuver   | 422    | - | - | 321    | - | - | 6      | 3    | 246 | ~ 23   | 15   | 376 |
| Mov Cap-2 Maneuver   | -      | - | - | -      | - | - | 6      | 3    | -   | ~ 23   | 15   | -   |
| Stage 1              | -      | - | - | -      | - | - | 53     | 87   | -   | 178    | 227  | -   |
| Stage 2              | -      | - | - | -      | - | - | 256    | 111  | -   | 343    | 201  | -   |

| Approach             | EB | WB  | NB   | SB       |
|----------------------|----|-----|------|----------|
| HCM Control Delay, s | 0  | 0.7 | 72.7 | \$ 384.5 |
| HCM LOS              |    |     | F    | F        |

| Minor Lane/Major Mvmt | NBLn1 | EBL  | EBT | EBR | WBL   | WBT | WBR | SBLn1    |
|-----------------------|-------|------|-----|-----|-------|-----|-----|----------|
| Capacity (veh/h)      | 70    | 422  | -   | -   | 321   | -   | -   | 32       |
| HCM Lane V/C Ratio    | 0.248 | 0.01 | -   | -   | 0.017 | -   | -   | 1.121    |
| HCM Control Delay (s) | 72.7  | 13.6 | 0   | -   | 16.4  | 0.7 | -   | \$ 384.5 |
| HCM Lane LOS          | F     | B    | A   | -   | C     | A   | -   | F        |
| HCM 95th %tile Q(veh) | 0.9   | 0    | -   | -   | 0.1   | -   | -   | 3.9      |

### Notes

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon



Intersection

Intersection Delay, s/veh84.5

Intersection LOS F

| Movement            | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Lane Configurations |      | ↔    | ↔    |      | ↔    |      |      | ↔    |      |      | ↔    | ↔    |
| Traffic Vol, veh/h  | 144  | 42   | 221  | 57   | 365  | 10   | 352  | 68   | 17   | 0    | 31   | 159  |
| Future Vol, veh/h   | 144  | 42   | 221  | 57   | 365  | 10   | 352  | 68   | 17   | 0    | 31   | 159  |
| Peak Hour Factor    | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Heavy Vehicles, %   | 0    | 0    | 3    | 0    | 1    | 0    | 1    | 0    | 8    | 0    | 0    | 0    |
| Mvmt Flow           | 164  | 48   | 251  | 65   | 415  | 11   | 400  | 77   | 19   | 0    | 35   | 181  |
| Number of Lanes     | 0    | 1    | 1    | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 1    | 1    |

| Approach                     | EB   | WB    | NB    | SB   |
|------------------------------|------|-------|-------|------|
| Opposing Approach            | WB   | EB    | SB    | NB   |
| Opposing Lanes               | 1    | 2     | 2     | 1    |
| Conflicting Approach Left SB |      | NB    | EB    | WB   |
| Conflicting Lanes Left       | 2    | 1     | 2     | 1    |
| Conflicting Approach RightNB |      | SB    | WB    | EB   |
| Conflicting Lanes Right      | 1    | 2     | 1     | 2    |
| HCM Control Delay            | 22.2 | 122.2 | 134.1 | 18.1 |
| HCM LOS                      | C    | F     | F     | C    |

| Lane                   | NBLn1 | EBLn1 | EBLn2 | WBLn1 | SBLn1  | SBLn2 |
|------------------------|-------|-------|-------|-------|--------|-------|
| Vol Left, %            | 81%   | 77%   | 0%    | 13%   | 0%     | 0%    |
| Vol Thru, %            | 16%   | 23%   | 0%    | 84%   | 100%   | 0%    |
| Vol Right, %           | 4%    | 0%    | 100%  | 2%    | 0%     | 100%  |
| Sign Control           | Stop  | Stop  | Stop  | Stop  | Stop   | Stop  |
| Traffic Vol by Lane    | 437   | 186   | 221   | 432   | 31     | 159   |
| LT Vol                 | 352   | 144   | 0     | 57    | 0      | 0     |
| Through Vol            | 68    | 42    | 0     | 365   | 31     | 0     |
| RT Vol                 | 17    | 0     | 221   | 10    | 0      | 159   |
| Lane Flow Rate         | 497   | 211   | 251   | 491   | 35     | 181   |
| Geometry Grp           | 6     | 7     | 7     | 6     | 7      | 7     |
| Degree of Util (X)     | 1.183 | 0.523 | 0.546 | 1.15  | 0.09   | 0.425 |
| Departure Headway (Hd) | 9.083 | 9.925 | 8.786 | 9.065 | 10.179 | 9.442 |
| Convergence, Y/N       | Yes   | Yes   | Yes   | Yes   | Yes    | Yes   |
| Cap                    | 402   | 366   | 414   | 403   | 354    | 385   |
| Service Time           | 7.083 | 7.625 | 6.486 | 7.065 | 7.879  | 7.142 |
| HCM Lane V/C Ratio     | 1.236 | 0.577 | 0.606 | 1.218 | 0.099  | 0.47  |
| HCM Control Delay      | 134.1 | 23    | 21.6  | 122.2 | 13.9   | 18.9  |
| HCM Lane LOS           | F     | C     | C     | F     | B      | C     |
| HCM 95th-tile Q        | 18.5  | 2.9   | 3.2   | 17.3  | 0.3    | 2.1   |

Intersection

Int Delay, s/veh 162.2

| Movement                 | WBL                                                                               | WBR                                                                               | NBT                                                                               | NBR  | SBL  | SBT                                                                               |
|--------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------------------------------------------------------------------------------|
| Lane Configurations      |  |  |  |      |      |  |
| Traffic Vol, veh/h       | 419                                                                               | 21                                                                                | 235                                                                               | 333  | 17   | 684                                                                               |
| Future Vol, veh/h        | 419                                                                               | 21                                                                                | 235                                                                               | 333  | 17   | 684                                                                               |
| Conflicting Peds, #/hr   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0    | 0    | 0                                                                                 |
| Sign Control             | Stop                                                                              | Stop                                                                              | Free                                                                              | Free | Free | Free                                                                              |
| RT Channelized           | -                                                                                 | None                                                                              | -                                                                                 | None | -    | None                                                                              |
| Storage Length           | 255                                                                               | 0                                                                                 | -                                                                                 | -    | -    | -                                                                                 |
| Veh in Median Storage, # | 0                                                                                 | -                                                                                 | 0                                                                                 | -    | -    | 0                                                                                 |
| Grade, %                 | 0                                                                                 | -                                                                                 | 0                                                                                 | -    | -    | 0                                                                                 |
| Peak Hour Factor         | 92                                                                                | 92                                                                                | 92                                                                                | 92   | 92   | 92                                                                                |
| Heavy Vehicles, %        | 1                                                                                 | 0                                                                                 | 1                                                                                 | 3    | 8    | 3                                                                                 |
| Mvmt Flow                | 455                                                                               | 23                                                                                | 255                                                                               | 362  | 18   | 743                                                                               |

| Major/Minor          | Minor1 | Major1 | Major2 |
|----------------------|--------|--------|--------|
| Conflicting Flow All | 1216   | 436    | 0      |
| Stage 1              | 436    | -      | -      |
| Stage 2              | 780    | -      | -      |
| Critical Hdwy        | 6.41   | 6.2    | -      |
| Critical Hdwy Stg 1  | 5.41   | -      | -      |
| Critical Hdwy Stg 2  | 5.41   | -      | -      |
| Follow-up Hdwy       | 3.509  | 3.3    | -      |
| Pot Cap-1 Maneuver   | ~ 201  | 625    | -      |
| Stage 1              | 654    | -      | -      |
| Stage 2              | ~ 454  | -      | -      |
| Platoon blocked, %   |        | -      | -      |
| Mov Cap-1 Maneuver   | ~ 194  | 625    | -      |
| Mov Cap-2 Maneuver   | ~ 194  | -      | -      |
| Stage 1              | 654    | -      | -      |
| Stage 2              | ~ 439  | -      | -      |

| Approach             | WB    | NB | SB  |
|----------------------|-------|----|-----|
| HCM Control Delay, s | 629.7 | 0  | 0.2 |
| HCM LOS              | F     |    |     |

| Minor Lane/Major Mvmt | NBT | NBRWBLn1WBLn2 | SBL  | SBT |
|-----------------------|-----|---------------|------|-----|
| Capacity (veh/h)      | -   | - 194 625     | 934  | -   |
| HCM Lane V/C Ratio    | -   | - 2.348 0.037 | 0.02 | -   |
| HCM Control Delay (s) | -   | - \$ 660.7 11 | 8.9  | 0   |
| HCM Lane LOS          | -   | - F B         | A    | A   |
| HCM 95th %tile Q(veh) | -   | - 37.3 0.1    | 0.1  | -   |

Notes

~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

# HCM Signalized Intersection Capacity Analysis

## 6: SB Ramp & Graves Mill

06/07/2018

|                                   |  |       |       |       |       |                           |      |      |      |       |       |       |
|-----------------------------------|------------------------------------------------------------------------------------|-------|-------|-------|-------|---------------------------|------|------|------|-------|-------|-------|
| Movement                          | EBL                                                                                | EBT   | EBR   | WBL   | WBT   | WBR                       | NBL  | NBT  | NBR  | SBL   | SBT   | SBR   |
| Lane Configurations               |                                                                                    | ↑     | ↑↑    | ↑     | ↑↑    |                           |      |      |      |       | ↑     | ↑     |
| Traffic Volume (vph)              | 0                                                                                  | 766   | 1194  | 121   | 1230  | 0                         | 0    | 0    | 0    | 167   | 1     | 295   |
| Future Volume (vph)               | 0                                                                                  | 766   | 1194  | 121   | 1230  | 0                         | 0    | 0    | 0    | 167   | 1     | 295   |
| Ideal Flow (vphpl)                | 1900                                                                               | 1900  | 1900  | 1900  | 1900  | 1900                      | 1900 | 1900 | 1900 | 1900  | 1900  | 1900  |
| Lane Width                        | 12                                                                                 | 12    | 12    | 12    | 12    | 12                        | 12   | 12   | 12   | 12    | 11    | 11    |
| Grade (%)                         |                                                                                    | 0%    |       |       | 0%    |                           |      | 3%   |      |       | 3%    |       |
| Total Lost time (s)               |                                                                                    | 5.0   | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   | 4.0   |
| Lane Util. Factor                 |                                                                                    | 1.00  | 0.88  | 1.00  | 0.95  |                           |      |      |      |       | 1.00  | 1.00  |
| Frt                               |                                                                                    | 1.00  | 0.85  | 1.00  | 1.00  |                           |      |      |      |       | 1.00  | 0.85  |
| Flt Protected                     |                                                                                    | 1.00  | 1.00  | 0.95  | 1.00  |                           |      |      |      |       | 0.95  | 1.00  |
| Satd. Flow (prot)                 |                                                                                    | 1881  | 2733  | 1787  | 3574  |                           |      |      |      |       | 1657  | 1451  |
| Flt Permitted                     |                                                                                    | 1.00  | 1.00  | 0.16  | 1.00  |                           |      |      |      |       | 0.95  | 1.00  |
| Satd. Flow (perm)                 |                                                                                    | 1881  | 2733  | 298   | 3574  |                           |      |      |      |       | 1657  | 1451  |
| Peak-hour factor, PHF             | 0.88                                                                               | 0.88  | 0.88  | 0.88  | 0.88  | 0.88                      | 0.88 | 0.88 | 0.88 | 0.88  | 0.88  | 0.88  |
| Adj. Flow (vph)                   | 0                                                                                  | 870   | 1357  | 138   | 1398  | 0                         | 0    | 0    | 0    | 190   | 1     | 335   |
| RTOR Reduction (vph)              | 0                                                                                  | 0     | 516   | 0     | 0     | 0                         | 0    | 0    | 0    | 0     | 0     | 0     |
| Lane Group Flow (vph)             | 0                                                                                  | 870   | 841   | 138   | 1398  | 0                         | 0    | 0    | 0    | 0     | 191   | 335   |
| Heavy Vehicles (%)                | 0%                                                                                 | 1%    | 4%    | 1%    | 1%    | 0%                        | 0%   | 0%   | 0%   | 4%    | 0%    | 6%    |
| Turn Type                         |                                                                                    | NA    | Perm  | pm+pt | NA    |                           |      |      |      | Split | NA    | Free  |
| Protected Phases                  |                                                                                    | 2     |       | 1     | 6     |                           |      |      |      | 8     | 8     |       |
| Permitted Phases                  |                                                                                    |       | 2     | 6     |       |                           |      |      |      |       |       | Free  |
| Actuated Green, G (s)             |                                                                                    | 68.2  | 68.2  | 81.7  | 81.7  |                           |      |      |      |       | 18.3  | 110.0 |
| Effective Green, g (s)            |                                                                                    | 68.2  | 68.2  | 81.7  | 81.7  |                           |      |      |      |       | 18.3  | 110.0 |
| Actuated g/C Ratio                |                                                                                    | 0.62  | 0.62  | 0.74  | 0.74  |                           |      |      |      |       | 0.17  | 1.00  |
| Clearance Time (s)                |                                                                                    | 5.0   | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   |       |
| Vehicle Extension (s)             |                                                                                    | 5.0   | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   |       |
| Lane Grp Cap (vph)                |                                                                                    | 1166  | 1694  | 336   | 2654  |                           |      |      |      |       | 275   | 1451  |
| v/s Ratio Prot                    |                                                                                    | c0.46 |       | 0.03  | c0.39 |                           |      |      |      |       | c0.12 |       |
| v/s Ratio Perm                    |                                                                                    |       | 0.31  | 0.27  |       |                           |      |      |      |       |       | 0.23  |
| v/c Ratio                         |                                                                                    | 0.75  | 0.50  | 0.41  | 0.53  |                           |      |      |      |       | 0.69  | 0.23  |
| Uniform Delay, d1                 |                                                                                    | 14.8  | 11.5  | 12.8  | 6.0   |                           |      |      |      |       | 43.2  | 0.0   |
| Progression Factor                |                                                                                    | 0.67  | 0.07  | 1.59  | 1.81  |                           |      |      |      |       | 1.00  | 1.00  |
| Incremental Delay, d2             |                                                                                    | 1.0   | 0.2   | 1.0   | 0.5   |                           |      |      |      |       | 9.3   | 0.4   |
| Delay (s)                         |                                                                                    | 10.9  | 1.1   | 21.4  | 11.3  |                           |      |      |      |       | 52.5  | 0.4   |
| Level of Service                  |                                                                                    | B     | A     | C     | B     |                           |      |      |      |       | D     | A     |
| Approach Delay (s)                |                                                                                    | 4.9   |       |       | 12.2  |                           |      | 0.0  |      |       | 19.3  |       |
| Approach LOS                      |                                                                                    | A     |       |       | B     |                           |      | A    |      |       | B     |       |
| <b>Intersection Summary</b>       |                                                                                    |       |       |       |       |                           |      |      |      |       |       |       |
| HCM 2000 Control Delay            |                                                                                    |       | 9.3   |       |       | HCM 2000 Level of Service |      |      |      | A     |       |       |
| HCM 2000 Volume to Capacity ratio |                                                                                    |       | 0.73  |       |       |                           |      |      |      |       |       |       |
| Actuated Cycle Length (s)         |                                                                                    |       | 110.0 |       |       | Sum of lost time (s)      |      |      |      | 15.0  |       |       |
| Intersection Capacity Utilization |                                                                                    |       | 78.0% |       |       | ICU Level of Service      |      |      |      | D     |       |       |
| Analysis Period (min)             |                                                                                    |       | 15    |       |       |                           |      |      |      |       |       |       |
| c Critical Lane Group             |                                                                                    |       |       |       |       |                           |      |      |      |       |       |       |

## Queues

## 6: SB Ramp &amp; Graves Mill

06/07/2018



| Lane Group              | EBT  | EBR  | WBL  | WBT  | SBT  | SBR  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 870  | 1357 | 138  | 1398 | 191  | 335  |
| v/c Ratio               | 0.75 | 0.61 | 0.41 | 0.53 | 0.69 | 0.23 |
| Control Delay           | 11.9 | 0.3  | 9.2  | 12.1 | 56.4 | 0.4  |
| Queue Delay             | 0.9  | 0.0  | 0.0  | 0.4  | 0.0  | 0.0  |
| Total Delay             | 12.7 | 0.3  | 9.2  | 12.4 | 56.4 | 0.4  |
| Queue Length 50th (ft)  | 283  | 0    | 33   | 388  | 127  | 0    |
| Queue Length 95th (ft)  | m279 | m0   | m48  | 458  | 196  | 0    |
| Internal Link Dist (ft) | 797  |      |      | 663  | 620  |      |
| Turn Bay Length (ft)    |      |      | 250  |      |      | 300  |
| Base Capacity (vph)     | 1165 | 2209 | 336  | 2653 | 316  | 1451 |
| Starvation Cap Reductn  | 103  | 0    | 0    | 632  | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.82 | 0.61 | 0.41 | 0.69 | 0.60 | 0.23 |

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 6: SB Ramp & Graves Mill

06/07/2018

|                                   |  |       |       |       |       |                           |      |      |      |       |       |       |
|-----------------------------------|------------------------------------------------------------------------------------|-------|-------|-------|-------|---------------------------|------|------|------|-------|-------|-------|
| Movement                          | EBL                                                                                | EBT   | EBR   | WBL   | WBT   | WBR                       | NBL  | NBT  | NBR  | SBL   | SBT   | SBR   |
| Lane Configurations               |                                                                                    | ↑     | ↑↑    | ↑     | ↑↑    |                           |      |      |      |       | ↑     | ↑     |
| Traffic Volume (vph)              | 0                                                                                  | 604   | 1399  | 274   | 1407  | 0                         | 0    | 0    | 0    | 61    | 4     | 495   |
| Future Volume (vph)               | 0                                                                                  | 604   | 1399  | 274   | 1407  | 0                         | 0    | 0    | 0    | 61    | 4     | 495   |
| Ideal Flow (vphpl)                | 1900                                                                               | 1900  | 1900  | 1900  | 1900  | 1900                      | 1900 | 1900 | 1900 | 1900  | 1900  | 1900  |
| Lane Width                        | 12                                                                                 | 12    | 12    | 12    | 12    | 12                        | 12   | 12   | 12   | 12    | 11    | 11    |
| Grade (%)                         |                                                                                    | 0%    |       |       | 0%    |                           |      | 3%   |      |       | 3%    |       |
| Total Lost time (s)               |                                                                                    | 5.0   | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   | 4.0   |
| Lane Util. Factor                 |                                                                                    | 1.00  | 0.88  | 1.00  | 0.95  |                           |      |      |      |       | 1.00  | 1.00  |
| Frt                               |                                                                                    | 1.00  | 0.85  | 1.00  | 1.00  |                           |      |      |      |       | 1.00  | 0.85  |
| Flt Protected                     |                                                                                    | 1.00  | 1.00  | 0.95  | 1.00  |                           |      |      |      |       | 0.95  | 1.00  |
| Satd. Flow (prot)                 |                                                                                    | 1881  | 2787  | 1787  | 3574  |                           |      |      |      |       | 1665  | 1523  |
| Flt Permitted                     |                                                                                    | 1.00  | 1.00  | 0.34  | 1.00  |                           |      |      |      |       | 0.95  | 1.00  |
| Satd. Flow (perm)                 |                                                                                    | 1881  | 2787  | 644   | 3574  |                           |      |      |      |       | 1665  | 1523  |
| Peak-hour factor, PHF             | 0.93                                                                               | 0.93  | 0.93  | 0.93  | 0.93  | 0.93                      | 0.93 | 0.93 | 0.93 | 0.93  | 0.93  | 0.93  |
| Adj. Flow (vph)                   | 0                                                                                  | 649   | 1504  | 295   | 1513  | 0                         | 0    | 0    | 0    | 66    | 4     | 532   |
| RTOR Reduction (vph)              | 0                                                                                  | 0     | 294   | 0     | 0     | 0                         | 0    | 0    | 0    | 0     | 0     | 0     |
| Lane Group Flow (vph)             | 0                                                                                  | 649   | 1210  | 295   | 1513  | 0                         | 0    | 0    | 0    | 0     | 70    | 532   |
| Heavy Vehicles (%)                | 0%                                                                                 | 1%    | 2%    | 1%    | 1%    | 0%                        | 0%   | 0%   | 0%   | 4%    | 0%    | 1%    |
| Turn Type                         |                                                                                    | NA    | Perm  | pm+pt | NA    |                           |      |      |      | Split | NA    | Free  |
| Protected Phases                  |                                                                                    | 2     |       | 1     | 6     |                           |      |      |      | 8     | 8     |       |
| Permitted Phases                  |                                                                                    |       | 2     | 6     |       |                           |      |      |      |       |       | Free  |
| Actuated Green, G (s)             |                                                                                    | 112.2 | 112.2 | 129.0 | 129.0 |                           |      |      |      |       | 11.0  | 150.0 |
| Effective Green, g (s)            |                                                                                    | 112.2 | 112.2 | 129.0 | 129.0 |                           |      |      |      |       | 11.0  | 150.0 |
| Actuated g/C Ratio                |                                                                                    | 0.75  | 0.75  | 0.86  | 0.86  |                           |      |      |      |       | 0.07  | 1.00  |
| Clearance Time (s)                |                                                                                    | 5.0   | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   |       |
| Vehicle Extension (s)             |                                                                                    | 5.0   | 5.0   | 5.0   | 5.0   |                           |      |      |      |       | 5.0   |       |
| Lane Grp Cap (vph)                |                                                                                    | 1406  | 2084  | 643   | 3073  |                           |      |      |      |       | 122   | 1523  |
| v/s Ratio Prot                    |                                                                                    | 0.34  |       | 0.04  | c0.42 |                           |      |      |      |       | c0.04 |       |
| v/s Ratio Perm                    |                                                                                    |       | c0.43 | 0.36  |       |                           |      |      |      |       |       | 0.35  |
| v/c Ratio                         |                                                                                    | 0.46  | 0.58  | 0.46  | 0.49  |                           |      |      |      |       | 0.57  | 0.35  |
| Uniform Delay, d1                 |                                                                                    | 7.3   | 8.4   | 4.2   | 2.5   |                           |      |      |      |       | 67.2  | 0.0   |
| Progression Factor                |                                                                                    | 0.53  | 0.00  | 0.23  | 0.42  |                           |      |      |      |       | 1.00  | 1.00  |
| Incremental Delay, d2             |                                                                                    | 0.5   | 0.5   | 0.6   | 0.3   |                           |      |      |      |       | 10.0  | 0.6   |
| Delay (s)                         |                                                                                    | 4.4   | 0.6   | 1.6   | 1.4   |                           |      |      |      |       | 77.2  | 0.6   |
| Level of Service                  |                                                                                    | A     | A     | A     | A     |                           |      |      |      |       | E     | A     |
| Approach Delay (s)                |                                                                                    | 1.7   |       |       | 1.4   |                           |      | 0.0  |      |       | 9.5   |       |
| Approach LOS                      |                                                                                    | A     |       |       | A     |                           |      | A    |      |       | A     |       |
| <b>Intersection Summary</b>       |                                                                                    |       |       |       |       |                           |      |      |      |       |       |       |
| HCM 2000 Control Delay            |                                                                                    |       | 2.6   |       |       | HCM 2000 Level of Service |      |      |      | A     |       |       |
| HCM 2000 Volume to Capacity ratio |                                                                                    |       | 0.58  |       |       |                           |      |      |      |       |       |       |
| Actuated Cycle Length (s)         |                                                                                    |       | 150.0 |       |       | Sum of lost time (s)      |      |      |      | 15.0  |       |       |
| Intersection Capacity Utilization |                                                                                    |       | 83.4% |       |       | ICU Level of Service      |      |      |      | E     |       |       |
| Analysis Period (min)             |                                                                                    |       | 15    |       |       |                           |      |      |      |       |       |       |
| c Critical Lane Group             |                                                                                    |       |       |       |       |                           |      |      |      |       |       |       |

## Queues

## 6: SB Ramp &amp; Graves Mill

06/07/2018



| Lane Group              | EBT  | EBR  | WBL  | WBT  | SBT  | SBR  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 649  | 1504 | 295  | 1513 | 70   | 532  |
| v/c Ratio               | 0.46 | 0.63 | 0.46 | 0.48 | 0.49 | 0.35 |
| Control Delay           | 4.9  | 0.6  | 1.9  | 1.5  | 77.0 | 0.6  |
| Queue Delay             | 0.4  | 0.3  | 0.0  | 0.4  | 0.0  | 0.0  |
| Total Delay             | 5.3  | 0.9  | 1.9  | 1.9  | 77.0 | 0.6  |
| Queue Length 50th (ft)  | 116  | 0    | 0    | 0    | 66   | 0    |
| Queue Length 95th (ft)  | m159 | 0    | m0   | 0    | 119  | 0    |
| Internal Link Dist (ft) | 797  |      |      | 663  | 620  |      |
| Turn Bay Length (ft)    |      |      | 250  |      |      | 300  |
| Base Capacity (vph)     | 1418 | 2388 | 732  | 3120 | 166  | 1523 |
| Starvation Cap Reductn  | 335  | 289  | 0    | 914  | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.60 | 0.72 | 0.40 | 0.69 | 0.42 | 0.35 |

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 1: Gristmill & Graves Mill

06/07/2018

|                                   | →     | ↘    | ↙     | ←    | ↖                         | ↗     |
|-----------------------------------|-------|------|-------|------|---------------------------|-------|
| Movement                          | EBT   | EBR  | WBL   | WBT  | NBL                       | NBR   |
| Lane Configurations               | ↑↑    |      | ↘     | ↑↑   | ↘                         | ↗     |
| Traffic Volume (vph)              | 958   | 15   | 311   | 644  | 21                        | 827   |
| Future Volume (vph)               | 958   | 15   | 311   | 644  | 21                        | 827   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900  | 1900 | 1900                      | 1900  |
| Lane Width                        | 12    | 12   | 12    | 12   | 11                        | 12    |
| Grade (%)                         | 0%    |      |       | 0%   | 2%                        |       |
| Total Lost time (s)               | 6.5   |      | 6.5   | 6.5  | 5.3                       | 6.5   |
| Lane Util. Factor                 | 0.95  |      | 1.00  | 0.95 | 1.00                      | 0.88  |
| Frt                               | 1.00  |      | 1.00  | 1.00 | 1.00                      | 0.85  |
| Flt Protected                     | 1.00  |      | 0.95  | 1.00 | 0.95                      | 1.00  |
| Satd. Flow (prot)                 | 3567  |      | 1805  | 3574 | 1630                      | 2786  |
| Flt Permitted                     | 1.00  |      | 0.14  | 1.00 | 0.95                      | 1.00  |
| Satd. Flow (perm)                 | 3567  |      | 262   | 3574 | 1630                      | 2786  |
| Peak-hour factor, PHF             | 0.88  | 0.88 | 0.88  | 0.88 | 0.88                      | 0.88  |
| Adj. Flow (vph)                   | 1089  | 17   | 353   | 732  | 24                        | 940   |
| RTOR Reduction (vph)              | 1     | 0    | 0     | 0    | 0                         | 39    |
| Lane Group Flow (vph)             | 1105  | 0    | 353   | 732  | 24                        | 901   |
| Heavy Vehicles (%)                | 1%    | 0%   | 0%    | 1%   | 6%                        | 1%    |
| Turn Type                         | NA    |      | pm+pt | NA   | Prot                      | pm+ov |
| Protected Phases                  | 2     |      | 1     | 6    | 4                         | 1     |
| Permitted Phases                  |       |      | 6     |      |                           | 4     |
| Actuated Green, G (s)             | 52.5  |      | 94.3  | 94.3 | 3.9                       | 39.2  |
| Effective Green, g (s)            | 52.5  |      | 94.3  | 94.3 | 3.9                       | 39.2  |
| Actuated g/C Ratio                | 0.48  |      | 0.86  | 0.86 | 0.04                      | 0.36  |
| Clearance Time (s)                | 6.5   |      | 6.5   | 6.5  | 5.3                       | 6.5   |
| Vehicle Extension (s)             | 3.0   |      | 1.5   | 3.0  | 2.0                       | 1.5   |
| Lane Grp Cap (vph)                | 1702  |      | 719   | 3063 | 57                        | 992   |
| v/s Ratio Prot                    | c0.31 |      | 0.16  | 0.20 | 0.01                      | c0.29 |
| v/s Ratio Perm                    |       |      | 0.26  |      |                           | 0.03  |
| v/c Ratio                         | 0.65  |      | 0.49  | 0.24 | 0.42                      | 0.91  |
| Uniform Delay, d1                 | 21.8  |      | 13.9  | 1.4  | 51.9                      | 33.7  |
| Progression Factor                | 0.96  |      | 2.99  | 0.74 | 1.00                      | 1.00  |
| Incremental Delay, d2             | 0.6   |      | 0.2   | 0.2  | 1.8                       | 11.5  |
| Delay (s)                         | 21.6  |      | 41.8  | 1.2  | 53.8                      | 45.2  |
| Level of Service                  | C     |      | D     | A    | D                         | D     |
| Approach Delay (s)                | 21.6  |      |       | 14.4 | 45.4                      |       |
| Approach LOS                      | C     |      |       | B    | D                         |       |
| <b>Intersection Summary</b>       |       |      |       |      |                           |       |
| HCM 2000 Control Delay            |       |      | 26.4  |      | HCM 2000 Level of Service | C     |
| HCM 2000 Volume to Capacity ratio |       |      | 0.76  |      |                           |       |
| Actuated Cycle Length (s)         |       |      | 110.0 |      | Sum of lost time (s)      | 18.3  |
| Intersection Capacity Utilization |       |      | 66.7% |      | ICU Level of Service      | C     |
| Analysis Period (min)             |       |      | 15    |      |                           |       |
| c Critical Lane Group             |       |      |       |      |                           |       |

## Queues

### 1: Gristmill & Graves Mill

06/07/2018



| Lane Group              | EBT  | WBL  | WBT  | NBL  | NBR  |
|-------------------------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1106 | 353  | 732  | 24   | 940  |
| v/c Ratio               | 0.62 | 0.49 | 0.23 | 0.26 | 0.85 |
| Control Delay           | 21.7 | 29.7 | 1.1  | 56.8 | 36.1 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 21.7 | 29.7 | 1.1  | 56.8 | 36.1 |
| Queue Length 50th (ft)  | 320  | 176  | 50   | 17   | 304  |
| Queue Length 95th (ft)  | m350 | 230  | 15   | 44   | 352  |
| Internal Link Dist (ft) | 1043 |      | 605  | 674  |      |
| Turn Bay Length (ft)    |      | 300  |      |      | 180  |
| Base Capacity (vph)     | 1772 | 769  | 3221 | 96   | 1189 |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.62 | 0.46 | 0.23 | 0.25 | 0.79 |

#### Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 1: Gristmill & Graves Mill

06/07/2018

|                                   | →    | ↘    | ↙     | ←     | ↖                         | ↗     |
|-----------------------------------|------|------|-------|-------|---------------------------|-------|
| Movement                          | EBT  | EBR  | WBL   | WBT   | NBL                       | NBR   |
| Lane Configurations               | ↑↑   |      | ↘     | ↑↑    | ↘                         | ↗     |
| Traffic Volume (vph)              | 843  | 62   | 498   | 1208  | 46                        | 586   |
| Future Volume (vph)               | 843  | 62   | 498   | 1208  | 46                        | 586   |
| Ideal Flow (vphpl)                | 1900 | 1900 | 1900  | 1900  | 1900                      | 1900  |
| Lane Width                        | 12   | 12   | 12    | 12    | 11                        | 12    |
| Grade (%)                         | 0%   |      |       | 0%    | 2%                        |       |
| Total Lost time (s)               | 6.5  |      | 6.5   | 6.5   | 5.3                       | 6.5   |
| Lane Util. Factor                 | 0.95 |      | 1.00  | 0.95  | 1.00                      | 0.88  |
| Frt                               | 0.99 |      | 1.00  | 1.00  | 1.00                      | 0.85  |
| Flt Protected                     | 1.00 |      | 0.95  | 1.00  | 0.95                      | 1.00  |
| Satd. Flow (prot)                 | 3540 |      | 1805  | 3574  | 1727                      | 2814  |
| Flt Permitted                     | 1.00 |      | 0.21  | 1.00  | 0.95                      | 1.00  |
| Satd. Flow (perm)                 | 3540 |      | 407   | 3574  | 1727                      | 2814  |
| Peak-hour factor, PHF             | 0.88 | 0.88 | 0.88  | 0.88  | 0.88                      | 0.88  |
| Adj. Flow (vph)                   | 958  | 70   | 566   | 1373  | 52                        | 666   |
| RTOR Reduction (vph)              | 3    | 0    | 0     | 0     | 0                         | 57    |
| Lane Group Flow (vph)             | 1025 | 0    | 566   | 1373  | 52                        | 609   |
| Heavy Vehicles (%)                | 1%   | 0%   | 0%    | 1%    | 0%                        | 0%    |
| Turn Type                         | NA   |      | pm+pt | NA    | Prot                      | pm+ov |
| Protected Phases                  | 2    |      | 1     | 6     | 4                         | 1     |
| Permitted Phases                  |      |      | 6     |       |                           | 4     |
| Actuated Green, G (s)             | 85.4 |      | 130.3 | 130.3 | 7.9                       | 46.3  |
| Effective Green, g (s)            | 85.4 |      | 130.3 | 130.3 | 7.9                       | 46.3  |
| Actuated g/C Ratio                | 0.57 |      | 0.87  | 0.87  | 0.05                      | 0.31  |
| Clearance Time (s)                | 6.5  |      | 6.5   | 6.5   | 5.3                       | 6.5   |
| Vehicle Extension (s)             | 3.0  |      | 1.5   | 3.0   | 2.0                       | 1.5   |
| Lane Grp Cap (vph)                | 2015 |      | 711   | 3104  | 90                        | 990   |
| v/s Ratio Prot                    | 0.29 |      | c0.20 | 0.38  | 0.03                      | c0.16 |
| v/s Ratio Perm                    |      |      | c0.49 |       |                           | 0.06  |
| v/c Ratio                         | 0.51 |      | 0.80  | 0.44  | 0.58                      | 0.62  |
| Uniform Delay, d1                 | 19.6 |      | 18.6  | 2.1   | 69.4                      | 44.3  |
| Progression Factor                | 0.91 |      | 0.68  | 1.07  | 1.00                      | 1.00  |
| Incremental Delay, d2             | 0.4  |      | 5.0   | 0.4   | 5.5                       | 0.8   |
| Delay (s)                         | 18.2 |      | 17.6  | 2.6   | 74.9                      | 45.1  |
| Level of Service                  | B    |      | B     | A     | E                         | D     |
| Approach Delay (s)                | 18.2 |      |       | 7.0   | 47.2                      |       |
| Approach LOS                      | B    |      |       | A     | D                         |       |
| <b>Intersection Summary</b>       |      |      |       |       |                           |       |
| HCM 2000 Control Delay            |      |      | 18.0  |       | HCM 2000 Level of Service | B     |
| HCM 2000 Volume to Capacity ratio |      |      | 0.82  |       |                           |       |
| Actuated Cycle Length (s)         |      |      | 150.0 |       | Sum of lost time (s)      | 18.3  |
| Intersection Capacity Utilization |      |      | 73.1% |       | ICU Level of Service      | D     |
| Analysis Period (min)             |      |      | 15    |       |                           |       |
| c Critical Lane Group             |      |      |       |       |                           |       |

## Queues

### 1: Gristmill & Graves Mill

06/07/2018



| Lane Group              | EBT  | WBL  | WBT  | NBL  | NBR  |
|-------------------------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1028 | 566  | 1373 | 52   | 666  |
| v/c Ratio               | 0.50 | 0.79 | 0.43 | 0.50 | 0.67 |
| Control Delay           | 20.0 | 23.4 | 2.8  | 83.6 | 38.9 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 20.0 | 23.4 | 2.8  | 83.6 | 38.9 |
| Queue Length 50th (ft)  | 308  | 260  | 158  | 50   | 278  |
| Queue Length 95th (ft)  | m372 | 206  | 51   | 94   | 269  |
| Internal Link Dist (ft) | 1043 |      | 605  | 674  |      |
| Turn Bay Length (ft)    |      | 300  |      |      | 180  |
| Base Capacity (vph)     | 2044 | 948  | 3169 | 129  | 1208 |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.50 | 0.60 | 0.43 | 0.40 | 0.55 |

#### Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

03/07/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |                                                                                     |
| Traffic Volume (vph)              | 40                                                                                | 1363                                                                              | 13                                                                                | 335                                                                               | 1091                                                                              | 99                                                                                | 9                                                                                   | 17                                                                                  | 544                                                                                 | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Future Volume (vph)               | 40                                                                                | 1363                                                                              | 13                                                                                | 335                                                                               | 1091                                                                              | 99                                                                                | 9                                                                                   | 17                                                                                  | 544                                                                                 | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1662                                                                              | 3513                                                                              |                                                                                   | 1770                                                                              | 3539                                                                              | 1538                                                                              |                                                                                     | 1824                                                                                | 1464                                                                                | 1621                                                                                | 1575                                                                                |                                                                                     |
| Flt Permitted                     | 0.23                                                                              | 1.00                                                                              |                                                                                   | 0.08                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 394                                                                               | 3513                                                                              |                                                                                   | 149                                                                               | 3539                                                                              | 1538                                                                              |                                                                                     | 1824                                                                                | 1464                                                                                | 1621                                                                                | 1575                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 45                                                                                | 1549                                                                              | 15                                                                                | 381                                                                               | 1240                                                                              | 112                                                                               | 10                                                                                  | 19                                                                                  | 618                                                                                 | 52                                                                                  | 14                                                                                  | 25                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 32                                                                                | 0                                                                                   | 0                                                                                   | 43                                                                                  | 0                                                                                   | 24                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 45                                                                                | 1563                                                                              | 0                                                                                 | 381                                                                               | 1240                                                                              | 81                                                                                | 0                                                                                   | 29                                                                                  | 575                                                                                 | 52                                                                                  | 15                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 7%                                                                                | 1%                                                                                | 10%                                                                               | 2%                                                                                | 2%                                                                                | 5%                                                                                | 0%                                                                                  | 0%                                                                                  | 4%                                                                                  | 6%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pm+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 1                                                                                   | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 49.2                                                                              | 45.1                                                                              |                                                                                   | 88.0                                                                              | 78.9                                                                              | 78.9                                                                              |                                                                                     | 3.0                                                                                 | 40.9                                                                                | 4.0                                                                                 | 4.0                                                                                 |                                                                                     |
| Effective Green, g (s)            | 49.2                                                                              | 45.1                                                                              |                                                                                   | 88.0                                                                              | 78.9                                                                              | 78.9                                                                              |                                                                                     | 3.0                                                                                 | 40.9                                                                                | 4.0                                                                                 | 4.0                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.45                                                                              | 0.41                                                                              |                                                                                   | 0.80                                                                              | 0.72                                                                              | 0.72                                                                              |                                                                                     | 0.03                                                                                | 0.37                                                                                | 0.04                                                                                | 0.04                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 223                                                                               | 1440                                                                              |                                                                                   | 677                                                                               | 2538                                                                              | 1103                                                                              |                                                                                     | 49                                                                                  | 610                                                                                 | 58                                                                                  | 57                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.01                                                                              | c0.45                                                                             |                                                                                   | 0.19                                                                              | 0.35                                                                              |                                                                                   |                                                                                     | 0.02                                                                                | c0.32                                                                               | c0.03                                                                               | 0.01                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.08                                                                              |                                                                                   |                                                                                   | 0.26                                                                              |                                                                                   | 0.05                                                                              |                                                                                     |                                                                                     | 0.07                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.20                                                                              | 1.09                                                                              |                                                                                   | 0.56                                                                              | 0.49                                                                              | 0.07                                                                              |                                                                                     | 0.59                                                                                | 0.94                                                                                | 0.90                                                                                | 0.26                                                                                |                                                                                     |
| Uniform Delay, d1                 | 19.0                                                                              | 32.5                                                                              |                                                                                   | 22.8                                                                              | 6.8                                                                               | 4.6                                                                               |                                                                                     | 52.9                                                                                | 33.4                                                                                | 52.8                                                                                | 51.6                                                                                |                                                                                     |
| Progression Factor                | 0.40                                                                              | 0.52                                                                              |                                                                                   | 1.32                                                                              | 0.72                                                                              | 1.56                                                                              |                                                                                     | 1.03                                                                                | 0.96                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.3                                                                               | 48.2                                                                              |                                                                                   | 1.0                                                                               | 0.6                                                                               | 0.1                                                                               |                                                                                     | 17.7                                                                                | 23.0                                                                                | 80.9                                                                                | 2.4                                                                                 |                                                                                     |
| Delay (s)                         | 7.9                                                                               | 65.2                                                                              |                                                                                   | 31.1                                                                              | 5.5                                                                               | 7.3                                                                               |                                                                                     | 72.0                                                                                | 55.2                                                                                | 133.7                                                                               | 54.0                                                                                |                                                                                     |
| Level of Service                  | A                                                                                 | E                                                                                 |                                                                                   | C                                                                                 | A                                                                                 | A                                                                                 |                                                                                     | E                                                                                   | E                                                                                   | F                                                                                   | D                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 63.6                                                                              |                                                                                   |                                                                                   | 11.2                                                                              |                                                                                   |                                                                                     | 56.0                                                                                |                                                                                     |                                                                                     | 99.6                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | E                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                     | E                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 40.9                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 1.06                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 110.0                                                                             |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 88.4%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 5: Connector/Creekside &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT  | NBR   | SBL   | SBT  |
|-------------------------|------|------|------|------|------|------|-------|-------|------|
| Lane Group Flow (vph)   | 45   | 1564 | 381  | 1240 | 113  | 29   | 618   | 52    | 39   |
| v/c Ratio               | 0.18 | 1.02 | 0.56 | 0.46 | 0.09 | 0.35 | 0.99  | 0.71  | 0.41 |
| Control Delay           | 5.0  | 43.9 | 29.6 | 5.4  | 1.7  | 63.8 | 62.1  | 98.3  | 39.9 |
| Queue Delay             | 0.0  | 1.7  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0   | 5.2   | 0.0  |
| Total Delay             | 5.0  | 45.6 | 29.6 | 5.4  | 1.7  | 63.8 | 62.1  | 103.5 | 39.9 |
| Queue Length 50th (ft)  | 5    | ~633 | 193  | 64   | 0    | 20   | 397   | 37    | 10   |
| Queue Length 95th (ft)  | m7   | #747 | 288  | 184  | 14   | m49  | m#596 | #102  | 44   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519  |       |       | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      |      |      | 160   | 190   |      |
| Base Capacity (vph)     | 251  | 1536 | 682  | 2697 | 1200 | 84   | 626   | 73    | 95   |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0     | 0    |
| Spillback Cap Reductn   | 0    | 8    | 0    | 0    | 0    | 0    | 0     | 5     | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0     | 0     | 0    |
| Reduced v/c Ratio       | 0.18 | 1.02 | 0.56 | 0.46 | 0.09 | 0.35 | 0.99  | 0.76  | 0.41 |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

03/07/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |                                                                                     |
| Traffic Volume (vph)              | 50                                                                                | 1406                                                                              | 6                                                                                 | 285                                                                               | 1476                                                                              | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                 | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Future Volume (vph)               | 50                                                                                | 1406                                                                              | 6                                                                                 | 285                                                                               | 1476                                                                              | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                 | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.89                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 3478                                                                              |                                                                                   | 1770                                                                              | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 1507                                                                                | 1702                                                                                | 1553                                                                                |                                                                                     |
| Flt Permitted                     | 0.07                                                                              | 1.00                                                                              |                                                                                   | 0.05                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 136                                                                               | 3478                                                                              |                                                                                   | 99                                                                                | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 1507                                                                                | 1702                                                                                | 1553                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.95                                                                              | 0.95                                                                              | 0.90                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                |
| Adj. Flow (vph)                   | 53                                                                                | 1480                                                                              | 7                                                                                 | 300                                                                               | 1554                                                                              | 149                                                                               | 61                                                                                  | 28                                                                                  | 497                                                                                 | 127                                                                                 | 20                                                                                  | 47                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 53                                                                                | 0                                                                                   | 0                                                                                   | 35                                                                                  | 0                                                                                   | 43                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 53                                                                                | 1487                                                                              | 0                                                                                 | 300                                                                               | 1554                                                                              | 96                                                                                | 0                                                                                   | 89                                                                                  | 462                                                                                 | 127                                                                                 | 24                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 2%                                                                                | 40%                                                                               | 2%                                                                                | 1%                                                                                | 0%                                                                                | 4%                                                                                  | 10%                                                                                 | 1%                                                                                  | 1%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pm+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 1                                                                                   | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 81.4                                                                              | 70.4                                                                              |                                                                                   | 113.0                                                                             | 97.0                                                                              | 97.0                                                                              |                                                                                     | 9.2                                                                                 | 46.8                                                                                | 12.8                                                                                | 12.8                                                                                |                                                                                     |
| Effective Green, g (s)            | 81.4                                                                              | 70.4                                                                              |                                                                                   | 113.0                                                                             | 97.0                                                                              | 97.0                                                                              |                                                                                     | 9.2                                                                                 | 46.8                                                                                | 12.8                                                                                | 12.8                                                                                |                                                                                     |
| Actuated g/C Ratio                | 0.54                                                                              | 0.47                                                                              |                                                                                   | 0.75                                                                              | 0.65                                                                              | 0.65                                                                              |                                                                                     | 0.06                                                                                | 0.31                                                                                | 0.09                                                                                | 0.09                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 194                                                                               | 1632                                                                              |                                                                                   | 493                                                                               | 2311                                                                              | 1044                                                                              |                                                                                     | 103                                                                                 | 520                                                                                 | 145                                                                                 | 132                                                                                 |                                                                                     |
| v/s Ratio Prot                    | 0.02                                                                              | c0.43                                                                             |                                                                                   | 0.15                                                                              | 0.43                                                                              |                                                                                   |                                                                                     | 0.05                                                                                | c0.22                                                                               | c0.07                                                                               | 0.02                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.13                                                                              |                                                                                   |                                                                                   | 0.31                                                                              |                                                                                   | 0.06                                                                              |                                                                                     |                                                                                     | 0.08                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.27                                                                              | 0.91                                                                              |                                                                                   | 0.61                                                                              | 0.67                                                                              | 0.09                                                                              |                                                                                     | 0.86                                                                                | 0.89                                                                                | 0.88                                                                                | 0.18                                                                                |                                                                                     |
| Uniform Delay, d1                 | 46.8                                                                              | 36.9                                                                              |                                                                                   | 40.2                                                                              | 16.6                                                                              | 10.0                                                                              |                                                                                     | 69.8                                                                                | 49.1                                                                                | 67.8                                                                                | 63.7                                                                                |                                                                                     |
| Progression Factor                | 0.76                                                                              | 0.37                                                                              |                                                                                   | 0.97                                                                              | 0.41                                                                              | 0.04                                                                              |                                                                                     | 1.00                                                                                | 0.99                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.5                                                                               | 6.1                                                                               |                                                                                   | 1.9                                                                               | 1.4                                                                               | 0.2                                                                               |                                                                                     | 48.2                                                                                | 16.7                                                                                | 40.3                                                                                | 0.7                                                                                 |                                                                                     |
| Delay (s)                         | 36.1                                                                              | 19.8                                                                              |                                                                                   | 41.0                                                                              | 8.2                                                                               | 0.6                                                                               |                                                                                     | 117.8                                                                               | 65.2                                                                                | 108.1                                                                               | 64.4                                                                                |                                                                                     |
| Level of Service                  | D                                                                                 | B                                                                                 |                                                                                   | D                                                                                 | A                                                                                 | A                                                                                 |                                                                                     | F                                                                                   | E                                                                                   | F                                                                                   | E                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 20.3                                                                              |                                                                                   |                                                                                   | 12.5                                                                              |                                                                                   |                                                                                     | 73.2                                                                                |                                                                                     |                                                                                     | 93.0                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | C                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                     | E                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 27.2                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.93                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 150.0                                                                             |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 87.5%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 5: Connector/Creekside &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT   | NBR   | SBL   | SBT  |
|-------------------------|------|------|------|------|------|-------|-------|-------|------|
| Lane Group Flow (vph)   | 53   | 1487 | 300  | 1554 | 149  | 89    | 497   | 127   | 67   |
| v/c Ratio               | 0.26 | 0.90 | 0.62 | 0.67 | 0.13 | 0.86  | 0.91  | 0.88  | 0.38 |
| Control Delay           | 13.5 | 19.2 | 46.7 | 8.2  | 0.3  | 124.4 | 64.5  | 114.3 | 31.8 |
| Queue Delay             | 0.0  | 0.5  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0   | 0.0   | 0.0  |
| Total Delay             | 13.5 | 19.8 | 46.7 | 8.3  | 0.3  | 124.4 | 64.5  | 114.3 | 31.8 |
| Queue Length 50th (ft)  | 3    | 644  | 244  | 287  | 0    | 87    | 425   | 125   | 18   |
| Queue Length 95th (ft)  | m14  | 164  | 350  | 214  | 0    | m#197 | m#647 | #248  | 70   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519   |       |       | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      |      |       | 160   | 190   |      |
| Base Capacity (vph)     | 208  | 1668 | 482  | 2481 | 1166 | 104   | 544   | 147   | 177  |
| Starvation Cap Reductn  | 0    | 31   | 0    | 17   | 0    | 0     | 0     | 0     | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0     | 0     | 0     | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0     | 0     | 0     | 0    |
| Reduced v/c Ratio       | 0.25 | 0.91 | 0.62 | 0.63 | 0.13 | 0.86  | 0.91  | 0.86  | 0.38 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

03/07/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |  |
| Traffic Volume (vph)              | 40                                                                                | 1363                                                                              | 13                                                                                | 335                                                                               | 1091                                                                              | 99                                                                                | 9                                                                                   | 17                                                                                  | 544                                                                                 | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Future Volume (vph)               | 40                                                                                | 1363                                                                              | 13                                                                                | 335                                                                               | 1091                                                                              | 99                                                                                | 9                                                                                   | 17                                                                                  | 544                                                                                 | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 0.88                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1662                                                                              | 3513                                                                              |                                                                                   | 1770                                                                              | 3539                                                                              | 1538                                                                              |                                                                                     | 1824                                                                                | 2576                                                                                | 1621                                                                                | 1575                                                                                |                                                                                     |
| Flt Permitted                     | 0.23                                                                              | 1.00                                                                              |                                                                                   | 0.07                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 394                                                                               | 3513                                                                              |                                                                                   | 129                                                                               | 3539                                                                              | 1538                                                                              |                                                                                     | 1824                                                                                | 2576                                                                                | 1621                                                                                | 1575                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 45                                                                                | 1549                                                                              | 15                                                                                | 381                                                                               | 1240                                                                              | 112                                                                               | 10                                                                                  | 19                                                                                  | 618                                                                                 | 52                                                                                  | 14                                                                                  | 25                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 36                                                                                | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   | 24                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 45                                                                                | 1563                                                                              | 0                                                                                 | 381                                                                               | 1240                                                                              | 77                                                                                | 0                                                                                   | 29                                                                                  | 618                                                                                 | 52                                                                                  | 15                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 7%                                                                                | 1%                                                                                | 10%                                                                               | 2%                                                                                | 2%                                                                                | 5%                                                                                | 0%                                                                                  | 0%                                                                                  | 4%                                                                                  | 6%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pt+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 8 1                                                                                 | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 56.8                                                                              | 52.8                                                                              |                                                                                   | 84.0                                                                              | 75.0                                                                              | 75.0                                                                              |                                                                                     | 7.0                                                                                 | 38.2                                                                                | 4.0                                                                                 | 4.0                                                                                 |                                                                                     |
| Effective Green, g (s)            | 56.8                                                                              | 52.8                                                                              |                                                                                   | 84.0                                                                              | 75.0                                                                              | 75.0                                                                              |                                                                                     | 7.0                                                                                 | 38.2                                                                                | 4.0                                                                                 | 4.0                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.52                                                                              | 0.48                                                                              |                                                                                   | 0.76                                                                              | 0.68                                                                              | 0.68                                                                              |                                                                                     | 0.06                                                                                | 0.35                                                                                | 0.04                                                                                | 0.04                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 |                                                                                     | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 249                                                                               | 1686                                                                              |                                                                                   | 489                                                                               | 2412                                                                              | 1048                                                                              |                                                                                     | 116                                                                                 | 894                                                                                 | 58                                                                                  | 57                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.01                                                                              | c0.45                                                                             |                                                                                   | c0.19                                                                             | 0.35                                                                              |                                                                                   |                                                                                     | 0.02                                                                                | c0.24                                                                               | c0.03                                                                               | 0.01                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.09                                                                              |                                                                                   |                                                                                   | 0.41                                                                              |                                                                                   | 0.05                                                                              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.18                                                                              | 0.93                                                                              |                                                                                   | 0.78                                                                              | 0.51                                                                              | 0.07                                                                              |                                                                                     | 0.25                                                                                | 0.69                                                                                | 0.90                                                                                | 0.26                                                                                |                                                                                     |
| Uniform Delay, d1                 | 14.5                                                                              | 26.8                                                                              |                                                                                   | 31.6                                                                              | 8.6                                                                               | 5.9                                                                               |                                                                                     | 49.0                                                                                | 30.8                                                                                | 52.8                                                                                | 51.6                                                                                |                                                                                     |
| Progression Factor                | 0.36                                                                              | 0.43                                                                              |                                                                                   | 1.14                                                                              | 0.65                                                                              | 1.56                                                                              |                                                                                     | 1.03                                                                                | 0.96                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.3                                                                               | 8.3                                                                               |                                                                                   | 6.9                                                                               | 0.7                                                                               | 0.1                                                                               |                                                                                     | 1.1                                                                                 | 2.3                                                                                 | 80.9                                                                                | 2.4                                                                                 |                                                                                     |
| Delay (s)                         | 5.5                                                                               | 19.7                                                                              |                                                                                   | 42.9                                                                              | 6.3                                                                               | 9.2                                                                               |                                                                                     | 51.4                                                                                | 31.8                                                                                | 133.7                                                                               | 54.0                                                                                |                                                                                     |
| Level of Service                  | A                                                                                 | B                                                                                 |                                                                                   | D                                                                                 | A                                                                                 | A                                                                                 |                                                                                     | D                                                                                   | C                                                                                   | F                                                                                   | D                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 19.3                                                                              |                                                                                   |                                                                                   | 14.5                                                                              |                                                                                   |                                                                                     | 32.7                                                                                |                                                                                     |                                                                                     | 99.6                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                     | C                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 21.2                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.90                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 110.0                                                                             |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 78.4%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 5: Connector/Creekside &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT  | NBR  | SBL  | SBT  |
|-------------------------|------|------|------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 45   | 1564 | 381  | 1240 | 113  | 29   | 618  | 52   | 39   |
| v/c Ratio               | 0.17 | 0.91 | 0.78 | 0.50 | 0.10 | 0.25 | 0.69 | 0.71 | 0.41 |
| Control Delay           | 4.0  | 21.0 | 40.3 | 5.9  | 1.7  | 58.0 | 33.6 | 98.3 | 39.9 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 4.0  | 21.0 | 40.3 | 5.9  | 1.7  | 58.0 | 33.6 | 98.3 | 39.9 |
| Queue Length 50th (ft)  | 3    | 288  | 197  | 64   | 0    | 20   | 205  | 37   | 10   |
| Queue Length 95th (ft)  | m7   | #747 | 296  | 184  | 14   | m49  | m234 | #102 | 44   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519  |      |      | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      |      |      | 160  | 190  |      |
| Base Capacity (vph)     | 268  | 1719 | 606  | 2476 | 1112 | 115  | 1077 | 73   | 95   |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.17 | 0.91 | 0.63 | 0.50 | 0.10 | 0.25 | 0.57 | 0.71 | 0.41 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

03/07/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |  |
| Traffic Volume (vph)              | 50                                                                                | 1406                                                                              | 6                                                                                 | 285                                                                               | 1476                                                                              | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                 | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Future Volume (vph)               | 50                                                                                | 1406                                                                              | 6                                                                                 | 285                                                                               | 1476                                                                              | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                 | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 0.88                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.89                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 3478                                                                              |                                                                                   | 1770                                                                              | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 2653                                                                                | 1702                                                                                | 1553                                                                                |                                                                                     |
| Flt Permitted                     | 0.08                                                                              | 1.00                                                                              |                                                                                   | 0.06                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 148                                                                               | 3478                                                                              |                                                                                   | 108                                                                               | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 2653                                                                                | 1702                                                                                | 1553                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.95                                                                              | 0.95                                                                              | 0.90                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                |
| Adj. Flow (vph)                   | 53                                                                                | 1480                                                                              | 7                                                                                 | 300                                                                               | 1554                                                                              | 149                                                                               | 61                                                                                  | 28                                                                                  | 497                                                                                 | 127                                                                                 | 20                                                                                  | 47                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 52                                                                                | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   | 43                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 53                                                                                | 1487                                                                              | 0                                                                                 | 300                                                                               | 1554                                                                              | 97                                                                                | 0                                                                                   | 89                                                                                  | 497                                                                                 | 127                                                                                 | 24                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 2%                                                                                | 40%                                                                               | 2%                                                                                | 1%                                                                                | 0%                                                                                | 4%                                                                                  | 10%                                                                                 | 1%                                                                                  | 1%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pt+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 8 1                                                                                 | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 81.1                                                                              | 74.3                                                                              |                                                                                   | 109.6                                                                             | 97.8                                                                              | 97.8                                                                              |                                                                                     | 12.0                                                                                | 47.3                                                                                | 13.4                                                                                | 13.4                                                                                |                                                                                     |
| Effective Green, g (s)            | 81.1                                                                              | 74.3                                                                              |                                                                                   | 109.6                                                                             | 97.8                                                                              | 97.8                                                                              |                                                                                     | 12.0                                                                                | 47.3                                                                                | 13.4                                                                                | 13.4                                                                                |                                                                                     |
| Actuated g/C Ratio                | 0.54                                                                              | 0.50                                                                              |                                                                                   | 0.73                                                                              | 0.65                                                                              | 0.65                                                                              |                                                                                     | 0.08                                                                                | 0.32                                                                                | 0.09                                                                                | 0.09                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 |                                                                                     | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 153                                                                               | 1722                                                                              |                                                                                   | 414                                                                               | 2330                                                                              | 1052                                                                              |                                                                                     | 135                                                                                 | 836                                                                                 | 152                                                                                 | 138                                                                                 |                                                                                     |
| v/s Ratio Prot                    | 0.02                                                                              | c0.43                                                                             |                                                                                   | c0.15                                                                             | 0.43                                                                              |                                                                                   |                                                                                     | 0.05                                                                                | c0.19                                                                               | c0.07                                                                               | 0.02                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.17                                                                              |                                                                                   |                                                                                   | 0.38                                                                              |                                                                                   | 0.06                                                                              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.35                                                                              | 0.86                                                                              |                                                                                   | 0.72                                                                              | 0.67                                                                              | 0.09                                                                              |                                                                                     | 0.66                                                                                | 0.59                                                                                | 0.84                                                                                | 0.18                                                                                |                                                                                     |
| Uniform Delay, d1                 | 46.4                                                                              | 33.4                                                                              |                                                                                   | 43.1                                                                              | 16.1                                                                              | 9.7                                                                               |                                                                                     | 67.0                                                                                | 43.3                                                                                | 67.2                                                                                | 63.2                                                                                |                                                                                     |
| Progression Factor                | 0.66                                                                              | 0.34                                                                              |                                                                                   | 0.86                                                                              | 0.29                                                                              | 0.03                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.9                                                                               | 3.9                                                                               |                                                                                   | 5.6                                                                               | 1.4                                                                               | 0.2                                                                               |                                                                                     | 11.1                                                                                | 1.1                                                                                 | 30.9                                                                                | 0.6                                                                                 |                                                                                     |
| Delay (s)                         | 31.4                                                                              | 15.1                                                                              |                                                                                   | 42.8                                                                              | 6.1                                                                               | 0.4                                                                               |                                                                                     | 78.1                                                                                | 44.2                                                                                | 98.1                                                                                | 63.8                                                                                |                                                                                     |
| Level of Service                  | C                                                                                 | B                                                                                 |                                                                                   | D                                                                                 | A                                                                                 | A                                                                                 |                                                                                     | E                                                                                   | D                                                                                   | F                                                                                   | E                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 15.6                                                                              |                                                                                   |                                                                                   | 11.2                                                                              |                                                                                   |                                                                                     | 49.4                                                                                |                                                                                     |                                                                                     | 86.3                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                     | D                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 21.3                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.82                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 150.0                                                                             |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 80.7%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 5: Connector/Creekside &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT   | NBR  | SBL   | SBT  |
|-------------------------|------|------|------|------|------|-------|------|-------|------|
| Lane Group Flow (vph)   | 53   | 1487 | 300  | 1554 | 149  | 89    | 497  | 127   | 67   |
| v/c Ratio               | 0.32 | 0.85 | 0.75 | 0.66 | 0.13 | 0.66  | 0.61 | 0.84  | 0.37 |
| Control Delay           | 12.7 | 15.1 | 50.6 | 6.1  | 0.3  | 88.8  | 47.0 | 106.6 | 31.3 |
| Queue Delay             | 0.0  | 0.3  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0  | 0.0   | 0.0  |
| Total Delay             | 12.7 | 15.4 | 50.6 | 6.1  | 0.3  | 88.8  | 47.0 | 106.6 | 31.3 |
| Queue Length 50th (ft)  | 3    | 640  | 242  | 287  | 0    | 83    | 223  | 125   | 18   |
| Queue Length 95th (ft)  | m12  | 164  | 244  | 214  | 0    | m#197 | m285 | #248  | 70   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519   |      |       | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      |      |       | 160  | 190   |      |
| Base Capacity (vph)     | 168  | 1748 | 482  | 2482 | 1166 | 135   | 811  | 153   | 182  |
| Starvation Cap Reductn  | 0    | 31   | 0    | 17   | 0    | 0     | 0    | 0     | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0     | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0     | 0    |
| Reduced v/c Ratio       | 0.32 | 0.87 | 0.62 | 0.63 | 0.13 | 0.66  | 0.61 | 0.83  | 0.37 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Intersection

|                           |      |
|---------------------------|------|
| Intersection Delay, s/veh | 37.5 |
| Intersection LOS          | E    |

| Movement            | EBL  | EBT                                                                               | EBR                                                                               | WBL  | WBT                                                                               | WBR  | NBL  | NBT                                                                                 | NBR  | SBL  | SBT                                                                                 | SBR                                                                                 |
|---------------------|------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|------|------|-------------------------------------------------------------------------------------|------|------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Lane Configurations |      |  |  |      |  |      |      |  |      |      |  |  |
| Traffic Vol, veh/h  | 48   | 424                                                                               | 287                                                                               | 4    | 79                                                                                | 3    | 181  | 21                                                                                  | 94   | 13   | 45                                                                                  | 163                                                                                 |
| Future Vol, veh/h   | 48   | 424                                                                               | 287                                                                               | 4    | 79                                                                                | 3    | 181  | 21                                                                                  | 94   | 13   | 45                                                                                  | 163                                                                                 |
| Peak Hour Factor    | 0.88 | 0.88                                                                              | 0.88                                                                              | 0.88 | 0.88                                                                              | 0.88 | 0.88 | 0.88                                                                                | 0.88 | 0.88 | 0.88                                                                                | 0.88                                                                                |
| Heavy Vehicles, %   | 0    | 0                                                                                 | 4                                                                                 | 0    | 7                                                                                 | 0    | 3    | 0                                                                                   | 4    | 0    | 6                                                                                   | 0                                                                                   |
| Mvmt Flow           | 55   | 482                                                                               | 326                                                                               | 5    | 90                                                                                | 3    | 206  | 24                                                                                  | 107  | 15   | 51                                                                                  | 185                                                                                 |
| Number of Lanes     | 0    | 1                                                                                 | 1                                                                                 | 0    | 1                                                                                 | 0    | 0    | 1                                                                                   | 0    | 0    | 1                                                                                   | 1                                                                                   |

| Approach                   | EB   | WB   | NB   | SB   |
|----------------------------|------|------|------|------|
| Opposing Approach          | WB   | EB   | SB   | NB   |
| Opposing Lanes             | 1    | 2    | 2    | 1    |
| Conflicting Approach Left  | SB   | NB   | EB   | WB   |
| Conflicting Lanes Left     | 2    | 1    | 2    | 1    |
| Conflicting Approach Right | NB   | SB   | WB   | EB   |
| Conflicting Lanes Right    | 1    | 2    | 1    | 2    |
| HCM Control Delay          | 51.8 | 13.5 | 25.4 | 13.7 |
| HCM LOS                    | F    | B    | D    | B    |

| Lane                   | NBLn1 | EBLn1 | EBLn2 | WBLn1 | SBLn1 | SBLn2 |
|------------------------|-------|-------|-------|-------|-------|-------|
| Vol Left, %            | 61%   | 10%   | 0%    | 5%    | 22%   | 0%    |
| Vol Thru, %            | 7%    | 90%   | 0%    | 92%   | 78%   | 0%    |
| Vol Right, %           | 32%   | 0%    | 100%  | 3%    | 0%    | 100%  |
| Sign Control           | Stop  | Stop  | Stop  | Stop  | Stop  | Stop  |
| Traffic Vol by Lane    | 296   | 472   | 287   | 86    | 58    | 163   |
| LT Vol                 | 181   | 48    | 0     | 4     | 13    | 0     |
| Through Vol            | 21    | 424   | 0     | 79    | 45    | 0     |
| RT Vol                 | 94    | 0     | 287   | 3     | 0     | 163   |
| Lane Flow Rate         | 336   | 536   | 326   | 98    | 66    | 185   |
| Geometry Grp           | 6     | 7     | 7     | 6     | 7     | 7     |
| Degree of Util (X)     | 0.688 | 1.03  | 0.557 | 0.218 | 0.145 | 0.37  |
| Departure Headway (Hd) | 7.49  | 6.915 | 6.149 | 8.215 | 8.084 | 7.352 |
| Convergence, Y/N       | Yes   | Yes   | Yes   | Yes   | Yes   | Yes   |
| Cap                    | 484   | 531   | 590   | 440   | 446   | 493   |
| Service Time           | 5.49  | 4.615 | 3.849 | 6.215 | 5.784 | 5.052 |
| HCM Lane V/C Ratio     | 0.694 | 1.009 | 0.553 | 0.223 | 0.148 | 0.375 |
| HCM Control Delay      | 25.4  | 73.4  | 16.3  | 13.5  | 12.2  | 14.3  |
| HCM Lane LOS           | D     | F     | C     | B     | B     | B     |
| HCM 95th-tile Q        | 5.2   | 15.2  | 3.4   | 0.8   | 0.5   | 1.7   |

Intersection

|                           |      |
|---------------------------|------|
| Intersection Delay, s/veh | 84.5 |
| Intersection LOS          | F    |

| Movement            | EBL  | EBT                                                                               | EBR                                                                               | WBL  | WBT                                                                               | WBR  | NBL  | NBT                                                                                 | NBR  | SBL  | SBT                                                                                 | SBR                                                                                 |
|---------------------|------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|------|------|-------------------------------------------------------------------------------------|------|------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Lane Configurations |      |  |  |      |  |      |      |  |      |      |  |  |
| Traffic Vol, veh/h  | 144  | 42                                                                                | 221                                                                               | 57   | 365                                                                               | 10   | 352  | 68                                                                                  | 17   | 0    | 31                                                                                  | 159                                                                                 |
| Future Vol, veh/h   | 144  | 42                                                                                | 221                                                                               | 57   | 365                                                                               | 10   | 352  | 68                                                                                  | 17   | 0    | 31                                                                                  | 159                                                                                 |
| Peak Hour Factor    | 0.88 | 0.88                                                                              | 0.88                                                                              | 0.88 | 0.88                                                                              | 0.88 | 0.88 | 0.88                                                                                | 0.88 | 0.88 | 0.88                                                                                | 0.88                                                                                |
| Heavy Vehicles, %   | 0    | 0                                                                                 | 3                                                                                 | 0    | 1                                                                                 | 0    | 1    | 0                                                                                   | 8    | 0    | 0                                                                                   | 0                                                                                   |
| Mvmt Flow           | 164  | 48                                                                                | 251                                                                               | 65   | 415                                                                               | 11   | 400  | 77                                                                                  | 19   | 0    | 35                                                                                  | 181                                                                                 |
| Number of Lanes     | 0    | 1                                                                                 | 1                                                                                 | 0    | 1                                                                                 | 0    | 0    | 1                                                                                   | 0    | 0    | 1                                                                                   | 1                                                                                   |

| Approach                   | EB   | WB    | NB    | SB   |
|----------------------------|------|-------|-------|------|
| Opposing Approach          | WB   | EB    | SB    | NB   |
| Opposing Lanes             | 1    | 2     | 2     | 1    |
| Conflicting Approach Left  | SB   | NB    | EB    | WB   |
| Conflicting Lanes Left     | 2    | 1     | 2     | 1    |
| Conflicting Approach Right | NB   | SB    | WB    | EB   |
| Conflicting Lanes Right    | 1    | 2     | 1     | 2    |
| HCM Control Delay          | 22.2 | 122.2 | 134.1 | 18.1 |
| HCM LOS                    | C    | F     | F     | C    |

| Lane                   | NBLn1 | EBLn1 | EBLn2 | WBLn1 | SBLn1  | SBLn2 |
|------------------------|-------|-------|-------|-------|--------|-------|
| Vol Left, %            | 81%   | 77%   | 0%    | 13%   | 0%     | 0%    |
| Vol Thru, %            | 16%   | 23%   | 0%    | 84%   | 100%   | 0%    |
| Vol Right, %           | 4%    | 0%    | 100%  | 2%    | 0%     | 100%  |
| Sign Control           | Stop  | Stop  | Stop  | Stop  | Stop   | Stop  |
| Traffic Vol by Lane    | 437   | 186   | 221   | 432   | 31     | 159   |
| LT Vol                 | 352   | 144   | 0     | 57    | 0      | 0     |
| Through Vol            | 68    | 42    | 0     | 365   | 31     | 0     |
| RT Vol                 | 17    | 0     | 221   | 10    | 0      | 159   |
| Lane Flow Rate         | 497   | 211   | 251   | 491   | 35     | 181   |
| Geometry Grp           | 6     | 7     | 7     | 6     | 7      | 7     |
| Degree of Util (X)     | 1.183 | 0.523 | 0.546 | 1.15  | 0.09   | 0.425 |
| Departure Headway (Hd) | 9.083 | 9.925 | 8.786 | 9.065 | 10.179 | 9.442 |
| Convergence, Y/N       | Yes   | Yes   | Yes   | Yes   | Yes    | Yes   |
| Cap                    | 402   | 366   | 414   | 403   | 354    | 385   |
| Service Time           | 7.083 | 7.625 | 6.486 | 7.065 | 7.879  | 7.142 |
| HCM Lane V/C Ratio     | 1.236 | 0.577 | 0.606 | 1.218 | 0.099  | 0.47  |
| HCM Control Delay      | 134.1 | 23    | 21.6  | 122.2 | 13.9   | 18.9  |
| HCM Lane LOS           | F     | C     | C     | F     | B      | C     |
| HCM 95th-tile Q        | 18.5  | 2.9   | 3.2   | 17.3  | 0.3    | 2.1   |



HCM 2010 Roundabout  
8: Graves Mill & Nationwide & McConville

03/07/2018

| Intersection                |       |        |       |       |       |
|-----------------------------|-------|--------|-------|-------|-------|
| Intersection Delay, s/veh   | 8.1   |        |       |       |       |
| Intersection LOS            | A     |        |       |       |       |
| Approach                    | EB    | WB     | NB    | SB    |       |
| Entry Lanes                 | 1     | 1      | 1     | 1     |       |
| Conflicting Circle Lanes    | 1     | 1      | 1     | 1     |       |
| Adj Approach Flow, veh/h    | 863   | 98     | 337   | 251   |       |
| Demand Flow Rate, veh/h     | 876   | 104    | 347   | 254   |       |
| Vehicles Circulating, veh/h | 74    | 291    | 552   | 313   |       |
| Vehicles Exiting, veh/h     | 493   | 608    | 59    | 82    |       |
| Follow-Up Headway, s        | 3.186 | 3.186  | 3.186 | 3.186 |       |
| Ped Vol Crossing Leg, #/h   | 0     | 0      | 0     | 0     |       |
| Ped Cap Adj                 | 1.000 | 1.000  | 1.000 | 1.000 |       |
| Approach Delay, s/veh       | 5.9   | 5.8    | 14.7  | 7.9   |       |
| Approach LOS                | A     | A      | B     | A     |       |
| Lane                        | Left  | Bypass | Left  | Left  | Left  |
| Designated Moves            | LT    | R      | LTR   | LTR   | LTR   |
| Assumed Moves               | LT    | R      | LTR   | LTR   | LTR   |
| RT Channelized              | Free  |        |       |       |       |
| Lane Util                   | 1.000 |        | 1.000 | 1.000 | 1.000 |
| Critical Headway, s         | 5.193 |        | 5.193 | 5.193 | 5.193 |
| Entry Flow, veh/h           | 537   | 339    | 104   | 347   | 254   |
| Cap Entry Lane, veh/h       | 1049  | 1976   | 845   | 651   | 826   |
| Entry HV Adj Factor         | 1.000 | 0.962  | 0.940 | 0.971 | 0.988 |
| Flow Entry, veh/h           | 537   | 326    | 98    | 337   | 251   |
| Cap Entry, veh/h            | 1049  | 1900   | 794   | 632   | 816   |
| V/C Ratio                   | 0.512 | 0.172  | 0.123 | 0.533 | 0.307 |
| Control Delay, s/veh        | 9.5   | 0.0    | 5.8   | 14.7  | 7.9   |
| LOS                         | A     | A      | A     | B     | A     |
| 95th %tile Queue, veh       | 3     | 1      | 0     | 3     | 1     |

HCM 2010 Roundabout  
8: Graves Mill & Nationwide & McConville

03/07/2018

| Intersection                |       |        |       |       |       |
|-----------------------------|-------|--------|-------|-------|-------|
| Intersection Delay, s/veh   | 16.2  |        |       |       |       |
| Intersection LOS            | C     |        |       |       |       |
| Approach                    | EB    | WB     | NB    | SB    |       |
| Entry Lanes                 | 1     | 1      | 1     | 1     |       |
| Conflicting Circle Lanes    | 1     | 1      | 1     | 1     |       |
| Adj Approach Flow, veh/h    | 463   | 491    | 496   | 216   |       |
| Demand Flow Rate, veh/h     | 471   | 495    | 502   | 216   |       |
| Vehicles Circulating, veh/h | 100   | 645    | 212   | 888   |       |
| Vehicles Exiting, veh/h     | 1004  | 69     | 100   | 252   |       |
| Follow-Up Headway, s        | 3.186 | 3.186  | 3.186 | 3.186 |       |
| Ped Vol Crossing Leg, #/h   | 0     | 0      | 0     | 0     |       |
| Ped Cap Adj                 | 1.000 | 1.000  | 1.000 | 1.000 |       |
| Approach Delay, s/veh       | 2.5   | 33.8   | 11.5  | 16.6  |       |
| Approach LOS                | A     | D      | B     | C     |       |
| Lane                        | Left  | Bypass | Left  | Left  | Left  |
| Designated Moves            | LT    | R      | LTR   | LTR   | LTR   |
| Assumed Moves               | LT    | R      | LTR   | LTR   | LTR   |
| RT Channelized              | Free  |        |       |       |       |
| Lane Util                   | 1.000 |        | 1.000 | 1.000 | 1.000 |
| Critical Headway, s         | 5.193 |        | 5.193 | 5.193 | 5.193 |
| Entry Flow, veh/h           | 212   | 259    | 495   | 502   | 216   |
| Cap Entry Lane, veh/h       | 1022  | 1957   | 593   | 914   | 465   |
| Entry HV Adj Factor         | 1.000 | 0.971  | 0.992 | 0.988 | 1.000 |
| Flow Entry, veh/h           | 212   | 251    | 491   | 496   | 216   |
| Cap Entry, veh/h            | 1022  | 1900   | 588   | 903   | 465   |
| V/C Ratio                   | 0.207 | 0.132  | 0.835 | 0.549 | 0.465 |
| Control Delay, s/veh        | 5.5   | 0.0    | 33.8  | 11.5  | 16.6  |
| LOS                         | A     | A      | D     | B     | C     |
| 95th %tile Queue, veh       | 1     | 0      | 9     | 3     | 2     |

# HCM Signalized Intersection Capacity Analysis

## 2: Millrace & Graves Mill

03/07/2018

|                                   | →     | ↘    | ↙     | ←    | ↖                         | ↗    |
|-----------------------------------|-------|------|-------|------|---------------------------|------|
| Movement                          | EBT   | EBR  | WBL   | WBT  | NBL                       | NBR  |
| Lane Configurations               | ↑↑    |      | ↘     | ↑↑   | ↘                         | ↗    |
| Traffic Volume (vph)              | 1669  | 72   | 90    | 1008 | 15                        | 14   |
| Future Volume (vph)               | 1669  | 72   | 90    | 1008 | 15                        | 14   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900  | 1900 | 1900                      | 1900 |
| Lane Width                        | 12    | 12   | 11    | 12   | 11                        | 11   |
| Grade (%)                         | 0%    |      |       | 0%   | 3%                        |      |
| Total Lost time (s)               | 5.0   |      | 4.5   | 5.0  | 5.0                       | 5.0  |
| Lane Util. Factor                 | 0.95  |      | 1.00  | 0.95 | 1.00                      | 1.00 |
| Frt                               | 0.99  |      | 1.00  | 1.00 | 1.00                      | 0.85 |
| Flt Protected                     | 1.00  |      | 0.95  | 1.00 | 0.95                      | 1.00 |
| Satd. Flow (prot)                 | 3554  |      | 1728  | 3574 | 1719                      | 1411 |
| Flt Permitted                     | 1.00  |      | 0.07  | 1.00 | 0.95                      | 1.00 |
| Satd. Flow (perm)                 | 3554  |      | 122   | 3574 | 1719                      | 1411 |
| Peak-hour factor, PHF             | 0.88  | 0.88 | 0.88  | 0.88 | 0.88                      | 0.88 |
| Adj. Flow (vph)                   | 1897  | 82   | 102   | 1145 | 17                        | 16   |
| RTOR Reduction (vph)              | 2     | 0    | 0     | 0    | 0                         | 16   |
| Lane Group Flow (vph)             | 1977  | 0    | 102   | 1145 | 17                        | 0    |
| Heavy Vehicles (%)                | 1%    | 0%   | 1%    | 1%   | 0%                        | 9%   |
| Turn Type                         | NA    |      | pm+pt | NA   | Prot                      | Perm |
| Protected Phases                  | 6     |      | 5     | 2    | 4                         |      |
| Permitted Phases                  |       |      | 2     |      |                           | 4    |
| Actuated Green, G (s)             | 85.5  |      | 96.6  | 96.6 | 3.4                       | 3.4  |
| Effective Green, g (s)            | 85.5  |      | 96.6  | 96.6 | 3.4                       | 3.4  |
| Actuated g/C Ratio                | 0.78  |      | 0.88  | 0.88 | 0.03                      | 0.03 |
| Clearance Time (s)                | 5.0   |      | 4.5   | 5.0  | 5.0                       | 5.0  |
| Vehicle Extension (s)             | 3.5   |      | 2.0   | 3.5  | 2.0                       | 2.0  |
| Lane Grp Cap (vph)                | 2762  |      | 203   | 3138 | 53                        | 43   |
| v/s Ratio Prot                    | c0.56 |      | c0.03 | 0.32 | c0.01                     |      |
| v/s Ratio Perm                    |       |      | 0.41  |      |                           | 0.00 |
| v/c Ratio                         | 0.72  |      | 0.50  | 0.36 | 0.32                      | 0.01 |
| Uniform Delay, d1                 | 6.1   |      | 11.5  | 1.2  | 52.2                      | 51.7 |
| Progression Factor                | 0.69  |      | 3.32  | 0.06 | 1.00                      | 1.00 |
| Incremental Delay, d2             | 1.1   |      | 0.6   | 0.3  | 1.3                       | 0.0  |
| Delay (s)                         | 5.4   |      | 38.6  | 0.3  | 53.4                      | 51.7 |
| Level of Service                  | A     |      | D     | A    | D                         | D    |
| Approach Delay (s)                | 5.4   |      |       | 3.5  | 52.6                      |      |
| Approach LOS                      | A     |      |       | A    | D                         |      |
| <b>Intersection Summary</b>       |       |      |       |      |                           |      |
| HCM 2000 Control Delay            |       |      | 5.1   |      | HCM 2000 Level of Service | A    |
| HCM 2000 Volume to Capacity ratio |       |      | 0.69  |      |                           |      |
| Actuated Cycle Length (s)         |       |      | 110.0 |      | Sum of lost time (s)      | 14.5 |
| Intersection Capacity Utilization |       |      | 68.8% |      | ICU Level of Service      | C    |
| Analysis Period (min)             |       |      | 15    |      |                           |      |
| c Critical Lane Group             |       |      |       |      |                           |      |

## Queues

## 2: Millrace &amp; Graves Mill

03/07/2018

|                                                                   |  |  |  |  |  |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Lane Group                                                        | EBT                                                                               | WBL                                                                               | WBT                                                                               | NBL                                                                               | NBR                                                                               |
| Lane Group Flow (vph)                                             | 1979                                                                              | 102                                                                               | 1145                                                                              | 17                                                                                | 16                                                                                |
| v/c Ratio                                                         | 0.70                                                                              | 0.50                                                                              | 0.35                                                                              | 0.21                                                                              | 0.20                                                                              |
| Control Delay                                                     | 5.6                                                                               | 29.1                                                                              | 0.3                                                                               | 56.5                                                                              | 27.6                                                                              |
| Queue Delay                                                       | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               | 0.0                                                                               |
| Total Delay                                                       | 5.6                                                                               | 29.1                                                                              | 0.3                                                                               | 56.5                                                                              | 27.6                                                                              |
| Queue Length 50th (ft)                                            | 119                                                                               | 25                                                                                | 3                                                                                 | 12                                                                                | 0                                                                                 |
| Queue Length 95th (ft)                                            | 410                                                                               | m47                                                                               | 3                                                                                 | 35                                                                                | 23                                                                                |
| Internal Link Dist (ft)                                           | 952                                                                               |                                                                                   | 1251                                                                              | 593                                                                               |                                                                                   |
| Turn Bay Length (ft)                                              |                                                                                   | 330                                                                               |                                                                                   |                                                                                   | 240                                                                               |
| Base Capacity (vph)                                               | 2831                                                                              | 267                                                                               | 3281                                                                              | 83                                                                                | 83                                                                                |
| Starvation Cap Reductn                                            | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Spillback Cap Reductn                                             | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Storage Cap Reductn                                               | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 |
| Reduced v/c Ratio                                                 | 0.70                                                                              | 0.38                                                                              | 0.35                                                                              | 0.20                                                                              | 0.19                                                                              |
| <b>Intersection Summary</b>                                       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |
| m Volume for 95th percentile queue is metered by upstream signal. |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |



# HCM Signalized Intersection Capacity Analysis

## 2: Millrace & Graves Mill

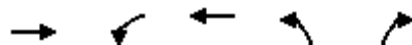
03/07/2018

|                                   | →     | ↘    | ↙     | ←     | ↖                         | ↗     |
|-----------------------------------|-------|------|-------|-------|---------------------------|-------|
| Movement                          | EBT   | EBR  | WBL   | WBT   | NBL                       | NBR   |
| Lane Configurations               | ↑↑    |      | ↘     | ↑↑    | ↘                         | ↗     |
| Traffic Volume (vph)              | 1427  | 18   | 36    | 1471  | 100                       | 229   |
| Future Volume (vph)               | 1427  | 18   | 36    | 1471  | 100                       | 229   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900  | 1900  | 1900                      | 1900  |
| Lane Width                        | 12    | 12   | 11    | 12    | 11                        | 11    |
| Grade (%)                         | 0%    |      |       | 0%    | 3%                        |       |
| Total Lost time (s)               | 5.0   |      | 4.5   | 5.0   | 5.0                       | 5.0   |
| Lane Util. Factor                 | 0.95  |      | 1.00  | 0.95  | 1.00                      | 1.00  |
| Frt                               | 1.00  |      | 1.00  | 1.00  | 1.00                      | 0.85  |
| Flt Protected                     | 1.00  |      | 0.95  | 1.00  | 0.95                      | 1.00  |
| Satd. Flow (prot)                 | 3554  |      | 1745  | 3574  | 1702                      | 1508  |
| Flt Permitted                     | 1.00  |      | 0.10  | 1.00  | 0.95                      | 1.00  |
| Satd. Flow (perm)                 | 3554  |      | 189   | 3574  | 1702                      | 1508  |
| Peak-hour factor, PHF             | 0.92  | 0.92 | 0.92  | 0.92  | 0.92                      | 0.92  |
| Adj. Flow (vph)                   | 1551  | 20   | 39    | 1599  | 109                       | 249   |
| RTOR Reduction (vph)              | 1     | 0    | 0     | 0     | 0                         | 93    |
| Lane Group Flow (vph)             | 1570  | 0    | 39    | 1599  | 109                       | 156   |
| Heavy Vehicles (%)                | 1%    | 0%   | 0%    | 1%    | 1%                        | 2%    |
| Bus Blockages (#/hr)              | 2     | 0    | 0     | 0     | 0                         | 0     |
| Turn Type                         | NA    |      | pm+pt | NA    | Prot                      | Perm  |
| Protected Phases                  | 6     |      | 5     | 2     | 4                         |       |
| Permitted Phases                  |       |      | 2     |       |                           | 4     |
| Actuated Green, G (s)             | 46.9  |      | 54.4  | 53.9  | 11.1                      | 11.1  |
| Effective Green, g (s)            | 46.9  |      | 54.4  | 53.9  | 11.1                      | 11.1  |
| Actuated g/C Ratio                | 0.63  |      | 0.73  | 0.72  | 0.15                      | 0.15  |
| Clearance Time (s)                | 5.0   |      | 4.5   | 5.0   | 5.0                       | 5.0   |
| Vehicle Extension (s)             | 3.5   |      | 2.0   | 3.5   | 2.0                       | 2.0   |
| Lane Grp Cap (vph)                | 2222  |      | 188   | 2568  | 251                       | 223   |
| v/s Ratio Prot                    | c0.44 |      | 0.01  | c0.45 | 0.06                      |       |
| v/s Ratio Perm                    |       |      | 0.14  |       |                           | c0.10 |
| v/c Ratio                         | 0.71  |      | 0.21  | 0.62  | 0.43                      | 0.70  |
| Uniform Delay, d1                 | 9.4   |      | 12.0  | 5.4   | 29.1                      | 30.4  |
| Progression Factor                | 1.22  |      | 1.20  | 1.27  | 1.00                      | 1.00  |
| Incremental Delay, d2             | 1.7   |      | 0.2   | 0.9   | 0.4                       | 7.8   |
| Delay (s)                         | 13.2  |      | 14.5  | 7.7   | 29.5                      | 38.2  |
| Level of Service                  | B     |      | B     | A     | C                         | D     |
| Approach Delay (s)                | 13.2  |      |       | 7.9   | 35.6                      |       |
| Approach LOS                      | B     |      |       | A     | D                         |       |
| <b>Intersection Summary</b>       |       |      |       |       |                           |       |
| HCM 2000 Control Delay            |       |      | 13.0  |       | HCM 2000 Level of Service | B     |
| HCM 2000 Volume to Capacity ratio |       |      | 0.72  |       |                           |       |
| Actuated Cycle Length (s)         |       |      | 75.0  |       | Sum of lost time (s)      | 14.5  |
| Intersection Capacity Utilization |       |      | 62.5% |       | ICU Level of Service      | B     |
| Analysis Period (min)             |       |      | 15    |       |                           |       |
| c Critical Lane Group             |       |      |       |       |                           |       |

## Queues

## 2: Millrace &amp; Graves Mill

03/07/2018



| Lane Group              | EBT  | WBL  | WBT  | NBL  | NBR  |
|-------------------------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1571 | 39   | 1599 | 109  | 249  |
| v/c Ratio               | 0.68 | 0.17 | 0.62 | 0.43 | 0.79 |
| Control Delay           | 13.5 | 7.4  | 8.5  | 33.2 | 34.5 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 13.5 | 7.4  | 8.5  | 33.2 | 34.5 |
| Queue Length 50th (ft)  | 155  | 7    | 250  | 46   | 61   |
| Queue Length 95th (ft)  | 562  | m16  | 429  | 88   | 134  |
| Internal Link Dist (ft) | 952  |      | 1251 | 593  |      |
| Turn Bay Length (ft)    |      | 330  |      |      | 240  |
| Base Capacity (vph)     | 2310 | 229  | 2568 | 340  | 388  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.68 | 0.17 | 0.62 | 0.32 | 0.64 |

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 2: Millrace & Graves Mill

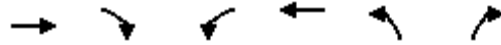
03/07/2018

|                                   | →     | ↘    | ↶      | ↙     | ←                         | ↗     | ↘    |
|-----------------------------------|-------|------|--------|-------|---------------------------|-------|------|
| Movement                          | EBT   | EBR  | WBU    | WBL   | WBT                       | NBL   | NBR  |
| Lane Configurations               | ↑↑    | ↑    |        | ↘     | ↑↑                        | ↘     | ↑    |
| Traffic Volume (vph)              | 1669  | 72   | 8      | 90    | 1008                      | 15    | 14   |
| Future Volume (vph)               | 1669  | 72   | 8      | 90    | 1008                      | 15    | 14   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900   | 1900  | 1900                      | 1900  | 1900 |
| Lane Width                        | 12    | 12   | 12     | 11    | 12                        | 11    | 11   |
| Grade (%)                         | 0%    |      |        |       | 0%                        | 3%    |      |
| Total Lost time (s)               | 5.0   | 5.0  |        | 4.5   | 5.0                       | 5.0   | 5.0  |
| Lane Util. Factor                 | 0.95  | 1.00 |        | 1.00  | 0.95                      | 1.00  | 1.00 |
| Frt                               | 1.00  | 0.85 |        | 1.00  | 1.00                      | 1.00  | 0.85 |
| Flt Protected                     | 1.00  | 1.00 |        | 0.95  | 1.00                      | 0.95  | 1.00 |
| Satd. Flow (prot)                 | 3574  | 1615 |        | 1726  | 3574                      | 1719  | 1411 |
| Flt Permitted                     | 1.00  | 1.00 |        | 0.08  | 1.00                      | 0.95  | 1.00 |
| Satd. Flow (perm)                 | 3574  | 1615 |        | 141   | 3574                      | 1719  | 1411 |
| Peak-hour factor, PHF             | 0.88  | 0.88 | 0.88   | 0.88  | 0.88                      | 0.88  | 0.88 |
| Adj. Flow (vph)                   | 1897  | 82   | 9      | 102   | 1145                      | 17    | 16   |
| RTOR Reduction (vph)              | 0     | 18   | 0      | 0     | 0                         | 0     | 16   |
| Lane Group Flow (vph)             | 1897  | 64   | 0      | 111   | 1145                      | 17    | 0    |
| Heavy Vehicles (%)                | 1%    | 0%   | 2%     | 1%    | 1%                        | 0%    | 9%   |
| Turn Type                         | NA    | Perm | custom | pm+pt | NA                        | Prot  | Perm |
| Protected Phases                  | 6     |      |        | 5     | 2                         | 4     |      |
| Permitted Phases                  |       | 6    | 5      | 2     |                           |       | 4    |
| Actuated Green, G (s)             | 85.7  | 85.7 |        | 96.6  | 96.6                      | 3.4   | 3.4  |
| Effective Green, g (s)            | 85.7  | 85.7 |        | 96.6  | 96.6                      | 3.4   | 3.4  |
| Actuated g/C Ratio                | 0.78  | 0.78 |        | 0.88  | 0.88                      | 0.03  | 0.03 |
| Clearance Time (s)                | 5.0   | 5.0  |        | 4.5   | 5.0                       | 5.0   | 5.0  |
| Vehicle Extension (s)             | 3.5   | 3.5  |        | 2.0   | 3.5                       | 2.0   | 2.0  |
| Lane Grp Cap (vph)                | 2784  | 1258 |        | 216   | 3138                      | 53    | 43   |
| v/s Ratio Prot                    | c0.53 |      |        | c0.03 | 0.32                      | c0.01 |      |
| v/s Ratio Perm                    |       | 0.04 |        | 0.42  |                           |       | 0.00 |
| v/c Ratio                         | 0.68  | 0.05 |        | 0.51  | 0.36                      | 0.32  | 0.01 |
| Uniform Delay, d1                 | 5.7   | 2.8  |        | 9.4   | 1.2                       | 52.2  | 51.7 |
| Progression Factor                | 0.74  | 0.83 |        | 3.62  | 0.06                      | 1.00  | 1.00 |
| Incremental Delay, d2             | 1.0   | 0.1  |        | 0.7   | 0.3                       | 1.3   | 0.0  |
| Delay (s)                         | 5.2   | 2.4  |        | 34.8  | 0.3                       | 53.4  | 51.7 |
| Level of Service                  | A     | A    |        | C     | A                         | D     | D    |
| Approach Delay (s)                | 5.1   |      |        |       | 3.4                       | 52.6  |      |
| Approach LOS                      | A     |      |        |       | A                         | D     |      |
| <b>Intersection Summary</b>       |       |      |        |       |                           |       |      |
| HCM 2000 Control Delay            |       |      | 4.9    |       | HCM 2000 Level of Service |       | A    |
| HCM 2000 Volume to Capacity ratio |       |      | 0.66   |       |                           |       |      |
| Actuated Cycle Length (s)         |       |      | 110.0  |       | Sum of lost time (s)      |       | 14.5 |
| Intersection Capacity Utilization |       |      | 67.0%  |       | ICU Level of Service      |       | C    |
| Analysis Period (min)             |       |      | 15     |       |                           |       |      |
| c Critical Lane Group             |       |      |        |       |                           |       |      |

## Queues

## 2: Millrace &amp; Graves Mill

03/07/2018



| Lane Group              | EBT  | EBR  | WBL  | WBT  | NBL  | NBR  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1897 | 82   | 111  | 1145 | 17   | 16   |
| v/c Ratio               | 0.67 | 0.06 | 0.51 | 0.35 | 0.21 | 0.20 |
| Control Delay           | 5.4  | 0.8  | 25.3 | 0.3  | 56.5 | 27.6 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 5.4  | 0.8  | 25.3 | 0.3  | 56.5 | 27.6 |
| Queue Length 50th (ft)  | 145  | 1    | 28   | 3    | 12   | 0    |
| Queue Length 95th (ft)  | 362  | m2   | m44  | 3    | 35   | 23   |
| Internal Link Dist (ft) | 952  |      |      | 1251 | 593  |      |
| Turn Bay Length (ft)    |      | 300  | 330  |      |      | 240  |
| Base Capacity (vph)     | 2849 | 1303 | 281  | 3281 | 83   | 83   |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.67 | 0.06 | 0.40 | 0.35 | 0.20 | 0.19 |

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 2: Millrace & Graves Mill

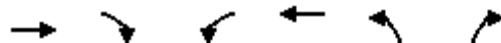
03/07/2018

|                                   | →     | ↘    | ↶      | ↙     | ←                         | ↗    | ↘     |
|-----------------------------------|-------|------|--------|-------|---------------------------|------|-------|
| Movement                          | EBT   | EBR  | WBU    | WBL   | WBT                       | NBL  | NBR   |
| Lane Configurations               | ↑↑    | ↑    |        | ↓     | ↑↑                        | ↓    | ↑     |
| Traffic Volume (vph)              | 1427  | 18   | 23     | 36    | 1471                      | 100  | 229   |
| Future Volume (vph)               | 1427  | 18   | 23     | 36    | 1471                      | 100  | 229   |
| Ideal Flow (vphpl)                | 1900  | 1900 | 1900   | 1900  | 1900                      | 1900 | 1900  |
| Lane Width                        | 12    | 12   | 12     | 11    | 12                        | 11   | 11    |
| Grade (%)                         | 0%    |      |        |       | 0%                        | 3%   |       |
| Total Lost time (s)               | 5.0   | 5.0  |        | 4.5   | 5.0                       | 5.0  | 5.0   |
| Lane Util. Factor                 | 0.95  | 1.00 |        | 1.00  | 0.95                      | 1.00 | 1.00  |
| Frt                               | 1.00  | 0.85 |        | 1.00  | 1.00                      | 1.00 | 0.85  |
| Flt Protected                     | 1.00  | 1.00 |        | 0.95  | 1.00                      | 0.95 | 1.00  |
| Satd. Flow (prot)                 | 3560  | 1615 |        | 1731  | 3574                      | 1702 | 1508  |
| Flt Permitted                     | 1.00  | 1.00 |        | 0.10  | 1.00                      | 0.95 | 1.00  |
| Satd. Flow (perm)                 | 3560  | 1615 |        | 189   | 3574                      | 1702 | 1508  |
| Peak-hour factor, PHF             | 0.92  | 0.92 | 0.92   | 0.92  | 0.92                      | 0.92 | 0.92  |
| Adj. Flow (vph)                   | 1551  | 20   | 25     | 39    | 1599                      | 109  | 249   |
| RTOR Reduction (vph)              | 0     | 8    | 0      | 0     | 0                         | 0    | 75    |
| Lane Group Flow (vph)             | 1551  | 12   | 0      | 64    | 1599                      | 109  | 174   |
| Heavy Vehicles (%)                | 1%    | 0%   | 2%     | 0%    | 1%                        | 1%   | 2%    |
| Bus Blockages (#/hr)              | 2     | 0    | 0      | 0     | 0                         | 0    | 0     |
| Turn Type                         | NA    | Perm | custom | pm+pt | NA                        | Prot | Perm  |
| Protected Phases                  | 6     |      |        | 5     | 2                         | 4    |       |
| Permitted Phases                  |       | 6    | 5      | 2     |                           |      | 4     |
| Actuated Green, G (s)             | 46.2  | 46.2 |        | 53.7  | 53.2                      | 11.8 | 11.8  |
| Effective Green, g (s)            | 46.2  | 46.2 |        | 53.7  | 53.2                      | 11.8 | 11.8  |
| Actuated g/C Ratio                | 0.62  | 0.62 |        | 0.72  | 0.71                      | 0.16 | 0.16  |
| Clearance Time (s)                | 5.0   | 5.0  |        | 4.5   | 5.0                       | 5.0  | 5.0   |
| Vehicle Extension (s)             | 3.5   | 3.5  |        | 2.0   | 3.5                       | 2.0  | 2.0   |
| Lane Grp Cap (vph)                | 2192  | 994  |        | 186   | 2535                      | 267  | 237   |
| v/s Ratio Prot                    | c0.44 |      |        | 0.01  | c0.45                     | 0.06 |       |
| v/s Ratio Perm                    |       | 0.01 |        | 0.23  |                           |      | c0.12 |
| v/c Ratio                         | 0.71  | 0.01 |        | 0.34  | 0.63                      | 0.41 | 0.73  |
| Uniform Delay, d1                 | 9.8   | 5.6  |        | 13.7  | 5.7                       | 28.5 | 30.1  |
| Progression Factor                | 1.17  | 1.60 |        | 1.21  | 1.53                      | 1.00 | 1.00  |
| Incremental Delay, d2             | 1.7   | 0.0  |        | 0.3   | 0.9                       | 0.4  | 9.7   |
| Delay (s)                         | 13.2  | 8.9  |        | 16.9  | 9.7                       | 28.8 | 39.8  |
| Level of Service                  | B     | A    |        | B     | A                         | C    | D     |
| Approach Delay (s)                | 13.1  |      |        |       | 10.0                      | 36.5 |       |
| Approach LOS                      | B     |      |        |       | A                         | D    |       |
| <b>Intersection Summary</b>       |       |      |        |       |                           |      |       |
| HCM 2000 Control Delay            |       |      | 14.0   |       | HCM 2000 Level of Service |      | B     |
| HCM 2000 Volume to Capacity ratio |       |      | 0.73   |       |                           |      |       |
| Actuated Cycle Length (s)         |       |      | 75.0   |       | Sum of lost time (s)      |      | 14.5  |
| Intersection Capacity Utilization |       |      | 69.0%  |       | ICU Level of Service      |      | C     |
| Analysis Period (min)             |       |      | 15     |       |                           |      |       |
| c Critical Lane Group             |       |      |        |       |                           |      |       |

## Queues

## 2: Millrace &amp; Graves Mill

03/07/2018



| Lane Group              | EBT  | EBR  | WBL  | WBT  | NBL  | NBR  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1551 | 20   | 64   | 1599 | 109  | 249  |
| v/c Ratio               | 0.68 | 0.02 | 0.28 | 0.63 | 0.41 | 0.80 |
| Control Delay           | 13.3 | 4.6  | 10.3 | 10.5 | 32.0 | 38.4 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 13.3 | 4.6  | 10.3 | 10.5 | 32.0 | 38.4 |
| Queue Length 50th (ft)  | 153  | 1    | 13   | 348  | 45   | 70   |
| Queue Length 95th (ft)  | 553  | m7   | m22  | 428  | 88   | #160 |
| Internal Link Dist (ft) | 952  |      |      | 1251 | 593  |      |
| Turn Bay Length (ft)    |      | 300  | 330  |      |      | 240  |
| Base Capacity (vph)     | 2281 | 1041 | 229  | 2536 | 340  | 372  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.68 | 0.02 | 0.28 | 0.63 | 0.32 | 0.67 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM 2010 TWSC  
3: Graves Mill & Millside

03/07/2018

| Intersection             |        |       |      |        |       |      |        |       |      |        |      |      |
|--------------------------|--------|-------|------|--------|-------|------|--------|-------|------|--------|------|------|
| Int Delay, s/veh         | 2.5    |       |      |        |       |      |        |       |      |        |      |      |
| Movement                 | EBL    | EBT   | EBR  | WBL    | WBT   | WBR  | NBL    | NBT   | NBR  | SBL    | SBT  | SBR  |
| Lane Configurations      |        | ↕↕    | ↗    |        | ↕↕    | ↗    |        | ↕↕    |      |        | ↕↕   |      |
| Traffic Vol, veh/h       | 5      | 1565  | 4    | 8      | 1160  | 18   | 0      | 0     | 8    | 8      | 0    | 4    |
| Future Vol, veh/h        | 5      | 1565  | 4    | 8      | 1160  | 18   | 0      | 0     | 8    | 8      | 0    | 4    |
| Conflicting Peds, #/hr   | 0      | 0     | 0    | 0      | 0     | 0    | 0      | 0     | 0    | 0      | 0    | 0    |
| Sign Control             | Free   | Free  | Free | Free   | Free  | Free | Stop   | Stop  | Stop | Stop   | Stop | Stop |
| RT Channelized           | -      | -     | None | -      | -     | None | -      | -     | None | -      | -    | None |
| Storage Length           | -      | -     | 140  | -      | -     | 140  | -      | -     | -    | -      | -    | -    |
| Veh in Median Storage, # | -      | 0     | -    | -      | 0     | -    | -      | 0     | -    | -      | 0    | -    |
| Grade, %                 | -      | -5    | -    | -      | 5     | -    | -      | 3     | -    | -      | -5   | -    |
| Peak Hour Factor         | 88     | 88    | 88   | 88     | 88    | 88   | 88     | 88    | 88   | 88     | 88   | 88   |
| Heavy Vehicles, %        | 0      | 1     | 0    | 0      | 1     | 0    | 0      | 0     | 0    | 0      | 0    | 0    |
| Mvmt Flow                | 6      | 1778  | 5    | 9      | 1318  | 20   | 0      | 0     | 9    | 9      | 0    | 5    |
|                          |        |       |      |        |       |      |        |       |      |        |      |      |
| Major/Minor              | Major1 |       |      | Major2 |       |      | Minor1 |       |      | Minor2 |      |      |
| Conflicting Flow All     | 1318   | 0     | 0    | 1778   | 0     | 0    | 2467   | 3126  | 889  | 2237   | 3126 | 659  |
| Stage 1                  | -      | -     | -    | -      | -     | -    | 1790   | 1790  | -    | 1336   | 1336 | -    |
| Stage 2                  | -      | -     | -    | -      | -     | -    | 677    | 1336  | -    | 901    | 1790 | -    |
| Critical Hdwy            | 4.1    | -     | -    | 4.1    | -     | -    | 8.1    | 7.1   | 7.2  | 6.5    | 5.5  | 6.4  |
| Critical Hdwy Stg 1      | -      | -     | -    | -      | -     | -    | 7.1    | 6.1   | -    | 5.5    | 4.5  | -    |
| Critical Hdwy Stg 2      | -      | -     | -    | -      | -     | -    | 7.1    | 6.1   | -    | 5.5    | 4.5  | -    |
| Follow-up Hdwy           | 2.2    | -     | -    | 2.2    | -     | -    | 3.5    | 4     | 3.3  | 3.5    | 4    | 3.3  |
| Pot Cap-1 Maneuver       | 531    | -     | -    | 354    | -     | -    | 11     | 7     | 270  | 44     | 27   | 450  |
| Stage 1                  | -      | -     | -    | -      | -     | -    | 64     | 100   | -    | 239    | 325  | -    |
| Stage 2                  | -      | -     | -    | -      | -     | -    | 369    | 180   | -    | 390    | 221  | -    |
| Platoon blocked, %       |        | -     | -    |        | -     | -    |        |       |      |        |      |      |
| Mov Cap-1 Maneuver       | 531    | -     | -    | 354    | -     | -    | -      | 0     | 270  | -      | 0    | 450  |
| Mov Cap-2 Maneuver       | -      | -     | -    | -      | -     | -    | -      | 0     | -    | -      | 0    | -    |
| Stage 1                  | -      | -     | -    | -      | -     | -    | 64     | 0     | -    | 239    | 293  | -    |
| Stage 2                  | -      | -     | -    | -      | -     | -    | 329    | 162   | -    | -      | 0    | -    |
|                          |        |       |      |        |       |      |        |       |      |        |      |      |
| Approach                 | EB     |       |      | WB     |       |      | NB     |       |      | SB     |      |      |
| HCM Control Delay, s     | 3.9    |       |      | 0.6    |       |      |        |       |      |        |      |      |
| HCM LOS                  |        |       |      |        |       |      | -      |       |      | -      |      |      |
|                          |        |       |      |        |       |      |        |       |      |        |      |      |
| Minor Lane/Major Mvmt    | NBLn1  | EBL   | EBT  | EBR    | WBL   | WBT  | WBR    | SBLn1 |      |        |      |      |
| Capacity (veh/h)         | -      | 531   | -    | -      | 354   | -    | -      | -     |      |        |      |      |
| HCM Lane V/C Ratio       | -      | 0.011 | -    | -      | 0.026 | -    | -      | -     |      |        |      |      |
| HCM Control Delay (s)    | -      | 11.9  | 3.9  | -      | 15.4  | 0.5  | -      | -     |      |        |      |      |
| HCM Lane LOS             | -      | B     | A    | -      | C     | A    | -      | -     |      |        |      |      |
| HCM 95th %tile O(veh)    | -      | 0     | -    | -      | 0.1   | -    | -      | -     |      |        |      |      |

HCM 2010 TWSC  
3: Graves Mill & Millside

03/07/2018

| Intersection             |      |      |      |      |      |      |      |      |      |      |      |      |
|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Int Delay, s/veh         | 4.6  |      |      |      |      |      |      |      |      |      |      |      |
| Movement                 | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
| Lane Configurations      |      | ↔↔   | ↗    |      | ↔↔   | ↗    |      | ↔    |      |      | ↔    |      |
| Traffic Vol, veh/h       | 4    | 1739 | 1    | 5    | 1454 | 10   | 1    | 0    | 15   | 23   | 0    | 10   |
| Future Vol, veh/h        | 4    | 1739 | 1    | 5    | 1454 | 10   | 1    | 0    | 15   | 23   | 0    | 10   |
| Conflicting Peds, #/hr   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Sign Control             | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized           | -    | -    | None | -    | -    | None | -    | -    | None | -    | -    | None |
| Storage Length           | -    | -    | 140  | -    | -    | 140  | -    | -    | -    | -    | -    | -    |
| Veh in Median Storage, # | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    | -    | 0    | -    |
| Grade, %                 | -    | -5   | -    | -    | 5    | -    | -    | 3    | -    | -    | -5   | -    |
| Peak Hour Factor         | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   | 92   |
| Heavy Vehicles, %        | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Mvmt Flow                | 4    | 1890 | 1    | 5    | 1580 | 11   | 1    | 0    | 16   | 25   | 0    | 11   |

| Major/Minor          | Major1 |   |   | Major2 |   |   | Minor1 |      |     | Minor2 |      |     |
|----------------------|--------|---|---|--------|---|---|--------|------|-----|--------|------|-----|
| Conflicting Flow All | 1580   | 0 | 0 | 1890   | 0 | 0 | 2700   | 3490 | 945 | 2545   | 3490 | 790 |
| Stage 1              | -      | - | - | -      | - | - | 1899   | 1899 | -   | 1591   | 1591 | -   |
| Stage 2              | -      | - | - | -      | - | - | 801    | 1591 | -   | 954    | 1899 | -   |
| Critical Hdwy        | 4.1    | - | - | 4.1    | - | - | 8.1    | 7.1  | 7.2 | 6.5    | 5.5  | 6.4 |
| Critical Hdwy Stg 1  | -      | - | - | -      | - | - | 7.1    | 6.1  | -   | 5.5    | 4.5  | -   |
| Critical Hdwy Stg 2  | -      | - | - | -      | - | - | 7.1    | 6.1  | -   | 5.5    | 4.5  | -   |
| Follow-up Hdwy       | 2.2    | - | - | 2.2    | - | - | 3.5    | 4    | 3.3 | 3.5    | 4    | 3.3 |
| Pot Cap-1 Maneuver   | 422    | - | - | 321    | - | - | 7      | 4    | 246 | 28     | 17   | 376 |
| Stage 1              | -      | - | - | -      | - | - | 53     | 87   | -   | 178    | 263  | -   |
| Stage 2              | -      | - | - | -      | - | - | 305    | 129  | -   | 367    | 201  | -   |
| Platoon blocked, %   | -      | - | - | -      | - | - | -      | -    | -   | -      | -    | -   |
| Mov Cap-1 Maneuver   | 422    | - | - | 321    | - | - | 6      | 3    | 246 | ~ 23   | 15   | 376 |
| Mov Cap-2 Maneuver   | -      | - | - | -      | - | - | 6      | 3    | -   | ~ 23   | 15   | -   |
| Stage 1              | -      | - | - | -      | - | - | 53     | 87   | -   | 178    | 227  | -   |
| Stage 2              | -      | - | - | -      | - | - | 256    | 111  | -   | 343    | 201  | -   |

| Approach             | EB | WB  | NB   | SB       |
|----------------------|----|-----|------|----------|
| HCM Control Delay, s | 0  | 0.7 | 72.7 | \$ 384.5 |
| HCM LOS              |    |     | F    | F        |

| Minor Lane/Major Mvmt | NBLn1 | EBL  | EBT | EBR | WBL   | WBT | WBR | SBLn1    |
|-----------------------|-------|------|-----|-----|-------|-----|-----|----------|
| Capacity (veh/h)      | 70    | 422  | -   | -   | 321   | -   | -   | 32       |
| HCM Lane V/C Ratio    | 0.248 | 0.01 | -   | -   | 0.017 | -   | -   | 1.121    |
| HCM Control Delay (s) | 72.7  | 13.6 | 0   | -   | 16.4  | 0.7 | -   | \$ 384.5 |
| HCM Lane LOS          | F     | B    | A   | -   | C     | A   | -   | F        |
| HCM 95th %tile Q(veh) | 0.9   | 0    | -   | -   | 0.1   | -   | -   | 3.9      |

| Notes                      |                        |                            |                                |
|----------------------------|------------------------|----------------------------|--------------------------------|
| ~: Volume exceeds capacity | \$: Delay exceeds 300s | +: Computation Not Defined | *: All major volume in platoon |



HCM 2010 TWSC  
3: Graves Mill & Millside

03/07/2018

| Intersection             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |      |      |                                                                                   |      |      |                                                                                     |
|--------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-----------------------------------------------------------------------------------|------|------|-------------------------------------------------------------------------------------|
| Int Delay, s/veh         | 0.1                                                                               |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |      |      |                                                                                   |      |      |                                                                                     |
| Movement                 | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL  | NBT  | NBR                                                                               | SBL  | SBT  | SBR                                                                                 |
| Lane Configurations      |  |  |  |  |  |  |      |      |  |      |      |  |
| Traffic Vol, veh/h       | 5                                                                                 | 1573                                                                              | 4                                                                                 | 8                                                                                 | 1160                                                                              | 18                                                                                | 0    | 0    | 8                                                                                 | 0    | 0    | 4                                                                                   |
| Future Vol, veh/h        | 5                                                                                 | 1573                                                                              | 4                                                                                 | 8                                                                                 | 1160                                                                              | 18                                                                                | 0    | 0    | 8                                                                                 | 0    | 0    | 4                                                                                   |
| Conflicting Peds, #/hr   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0    | 0    | 0                                                                                 | 0    | 0    | 0                                                                                   |
| Sign Control             | Free                                                                              | Free                                                                              | Free                                                                              | Free                                                                              | Free                                                                              | Free                                                                              | Stop | Stop | Stop                                                                              | Stop | Stop | Stop                                                                                |
| RT Channelized           | -                                                                                 | -                                                                                 | None                                                                              | -                                                                                 | -                                                                                 | None                                                                              | -    | -    | None                                                                              | -    | -    | None                                                                                |
| Storage Length           | 300                                                                               | -                                                                                 | 140                                                                               | 300                                                                               | -                                                                                 | 140                                                                               | -    | -    | 0                                                                                 | -    | -    | 0                                                                                   |
| Veh in Median Storage, # | -                                                                                 | 0                                                                                 | -                                                                                 | -                                                                                 | 0                                                                                 | -                                                                                 | -    | 0    | -                                                                                 | -    | 0    | -                                                                                   |
| Grade, %                 | -                                                                                 | -5                                                                                | -                                                                                 | -                                                                                 | 5                                                                                 | -                                                                                 | -    | 3    | -                                                                                 | -    | -5   | -                                                                                   |
| Peak Hour Factor         | 88                                                                                | 88                                                                                | 88                                                                                | 88                                                                                | 88                                                                                | 88                                                                                | 88   | 88   | 88                                                                                | 88   | 88   | 88                                                                                  |
| Heavy Vehicles, %        | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0    | 0    | 0                                                                                 | 0    | 0    | 0                                                                                   |
| Mvmt Flow                | 6                                                                                 | 1788                                                                              | 5                                                                                 | 9                                                                                 | 1318                                                                              | 20                                                                                | 0    | 0    | 9                                                                                 | 0    | 0    | 5                                                                                   |

| Major/Minor          | Major1 |   |   | Major2 |   |   | Minor1 |   |     | Minor2 |   |     |
|----------------------|--------|---|---|--------|---|---|--------|---|-----|--------|---|-----|
| Conflicting Flow All | 1318   | 0 | 0 | 1788   | 0 | 0 | -      | - | 894 | -      | - | 659 |
| Stage 1              | -      | - | - | -      | - | - | -      | - | -   | -      | - | -   |
| Stage 2              | -      | - | - | -      | - | - | -      | - | -   | -      | - | -   |
| Critical Hdwy        | 4.1    | - | - | 4.1    | - | - | -      | - | 7.2 | -      | - | 6.4 |
| Critical Hdwy Stg 1  | -      | - | - | -      | - | - | -      | - | -   | -      | - | -   |
| Critical Hdwy Stg 2  | -      | - | - | -      | - | - | -      | - | -   | -      | - | -   |
| Follow-up Hdwy       | 2.2    | - | - | 2.2    | - | - | -      | - | 3.3 | -      | - | 3.3 |
| Pot Cap-1 Maneuver   | 531    | - | - | 351    | - | - | 0      | 0 | 267 | 0      | 0 | 450 |
| Stage 1              | -      | - | - | -      | - | - | 0      | 0 | -   | 0      | 0 | -   |
| Stage 2              | -      | - | - | -      | - | - | 0      | 0 | -   | 0      | 0 | -   |
| Platoon blocked, %   | -      | - | - | -      | - | - | -      | - | -   | -      | - | -   |
| Mov Cap-1 Maneuver   | 531    | - | - | 351    | - | - | -      | - | 267 | -      | - | 450 |
| Mov Cap-2 Maneuver   | -      | - | - | -      | - | - | -      | - | -   | -      | - | -   |
| Stage 1              | -      | - | - | -      | - | - | -      | - | -   | -      | - | -   |
| Stage 2              | -      | - | - | -      | - | - | -      | - | -   | -      | - | -   |

| Approach             | EB |  |  | WB  |  |  | NB |  |  | SB   |  |  |
|----------------------|----|--|--|-----|--|--|----|--|--|------|--|--|
| HCM Control Delay, s | 0  |  |  | 0.1 |  |  | 19 |  |  | 13.1 |  |  |
| HCM LOS              |    |  |  |     |  |  | C  |  |  | B    |  |  |

| Minor Lane/Major Mvmt | NBLn1 | EBL   | EBT | EBR | WBL   | WBT | WBR | SBLn1 |
|-----------------------|-------|-------|-----|-----|-------|-----|-----|-------|
| Capacity (veh/h)      | 267   | 531   | -   | -   | 351   | -   | -   | 450   |
| HCM Lane V/C Ratio    | 0.034 | 0.011 | -   | -   | 0.026 | -   | -   | 0.01  |
| HCM Control Delay (s) | 19    | 11.9  | -   | -   | 15.5  | -   | -   | 13.1  |
| HCM Lane LOS          | C     | B     | -   | -   | C     | -   | -   | B     |
| HCM 95th %tile Q(veh) | 0.1   | 0     | -   | -   | 0.1   | -   | -   | 0     |

HCM 2010 TWSC  
3: Graves Mill & Millside

03/07/2018

| Intersection             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |      |       |                                                                                   |      |      |                                                                                     |
|--------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|-------|-----------------------------------------------------------------------------------|------|------|-------------------------------------------------------------------------------------|
| Int Delay, s/veh         | 0.3                                                                               |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |      |       |                                                                                   |      |      |                                                                                     |
| Movement                 | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL  | NBT   | NBR                                                                               | SBL  | SBT  | SBR                                                                                 |
| Lane Configurations      |  |  |  |  |  |  |      |       |  |      |      |  |
| Traffic Vol, veh/h       | 4                                                                                 | 1762                                                                              | 1                                                                                 | 5                                                                                 | 1455                                                                              | 10                                                                                | 0    | 0     | 16                                                                                | 0    | 0    | 33                                                                                  |
| Future Vol, veh/h        | 4                                                                                 | 1762                                                                              | 1                                                                                 | 5                                                                                 | 1455                                                                              | 10                                                                                | 0    | 0     | 16                                                                                | 0    | 0    | 33                                                                                  |
| Conflicting Peds, #/hr   | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0    | 0     | 0                                                                                 | 0    | 0    | 0                                                                                   |
| Sign Control             | Free                                                                              | Free                                                                              | Free                                                                              | Free                                                                              | Free                                                                              | Free                                                                              | Stop | Stop  | Stop                                                                              | Stop | Stop | Stop                                                                                |
| RT Channelized           | -                                                                                 | -                                                                                 | None                                                                              | -                                                                                 | -                                                                                 | None                                                                              | -    | -     | None                                                                              | -    | -    | None                                                                                |
| Storage Length           | 300                                                                               | -                                                                                 | 140                                                                               | 300                                                                               | -                                                                                 | 140                                                                               | -    | -     | 0                                                                                 | -    | -    | 0                                                                                   |
| Veh in Median Storage, # | -                                                                                 | 0                                                                                 | -                                                                                 | -                                                                                 | 0                                                                                 | -                                                                                 | -    | 0     | -                                                                                 | -    | 0    | -                                                                                   |
| Grade, %                 | -                                                                                 | -5                                                                                | -                                                                                 | -                                                                                 | 5                                                                                 | -                                                                                 | -    | 3     | -                                                                                 | -    | -5   | -                                                                                   |
| Peak Hour Factor         | 92                                                                                | 92                                                                                | 92                                                                                | 92                                                                                | 92                                                                                | 92                                                                                | 92   | 92    | 92                                                                                | 92   | 92   | 92                                                                                  |
| Heavy Vehicles, %        | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0    | 0     | 0                                                                                 | 0    | 0    | 0                                                                                   |
| Mvmt Flow                | 4                                                                                 | 1915                                                                              | 1                                                                                 | 5                                                                                 | 1582                                                                              | 11                                                                                | 0    | 0     | 17                                                                                | 0    | 0    | 36                                                                                  |
|                          |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |      |       |                                                                                   |      |      |                                                                                     |
| Major/Minor              | Major1                                                                            |                                                                                   | Major2                                                                            |                                                                                   |                                                                                   | Minor1                                                                            |      |       | Minor2                                                                            |      |      |                                                                                     |
| Conflicting Flow All     | 1582                                                                              | 0                                                                                 | 0                                                                                 | 1915                                                                              | 0                                                                                 | 0                                                                                 | -    | -     | 958                                                                               | -    | -    | 791                                                                                 |
| Stage 1                  | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -    | -     | -                                                                                 | -    | -    | -                                                                                   |
| Stage 2                  | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -    | -     | -                                                                                 | -    | -    | -                                                                                   |
| Critical Hdwy            | 4.1                                                                               | -                                                                                 | -                                                                                 | 4.1                                                                               | -                                                                                 | -                                                                                 | -    | -     | 7.2                                                                               | -    | -    | 6.4                                                                                 |
| Critical Hdwy Stg 1      | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -    | -     | -                                                                                 | -    | -    | -                                                                                   |
| Critical Hdwy Stg 2      | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -    | -     | -                                                                                 | -    | -    | -                                                                                   |
| Follow-up Hdwy           | 2.2                                                                               | -                                                                                 | -                                                                                 | 2.2                                                                               | -                                                                                 | -                                                                                 | -    | -     | 3.3                                                                               | -    | -    | 3.3                                                                                 |
| Pot Cap-1 Maneuver       | 421                                                                               | -                                                                                 | -                                                                                 | 314                                                                               | -                                                                                 | -                                                                                 | 0    | 0     | 241                                                                               | 0    | 0    | 376                                                                                 |
| Stage 1                  | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | 0    | 0     | -                                                                                 | 0    | 0    | -                                                                                   |
| Stage 2                  | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | 0    | 0     | -                                                                                 | 0    | 0    | -                                                                                   |
| Platoon blocked, %       |                                                                                   | -                                                                                 | -                                                                                 |                                                                                   | -                                                                                 | -                                                                                 |      |       |                                                                                   |      |      |                                                                                     |
| Mov Cap-1 Maneuver       | 421                                                                               | -                                                                                 | -                                                                                 | 314                                                                               | -                                                                                 | -                                                                                 | -    | -     | 241                                                                               | -    | -    | 376                                                                                 |
| Mov Cap-2 Maneuver       | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -    | -     | -                                                                                 | -    | -    | -                                                                                   |
| Stage 1                  | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -    | -     | -                                                                                 | -    | -    | -                                                                                   |
| Stage 2                  | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -                                                                                 | -    | -     | -                                                                                 | -    | -    | -                                                                                   |
|                          |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |      |       |                                                                                   |      |      |                                                                                     |
|                          |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |      |       |                                                                                   |      |      |                                                                                     |
| Approach                 | EB                                                                                |                                                                                   | WB                                                                                |                                                                                   |                                                                                   | NB                                                                                |      |       | SB                                                                                |      |      |                                                                                     |
| HCM Control Delay, s     | 0                                                                                 |                                                                                   | 0.1                                                                               |                                                                                   |                                                                                   | 21.1                                                                              |      |       | 15.6                                                                              |      |      |                                                                                     |
| HCM LOS                  |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   | C                                                                                 |      |       | C                                                                                 |      |      |                                                                                     |
|                          |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |      |       |                                                                                   |      |      |                                                                                     |
| Minor Lane/Major Mvmt    | NBLn1                                                                             | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR  | SBLn1 |                                                                                   |      |      |                                                                                     |
| Capacity (veh/h)         | 241                                                                               | 421                                                                               | -                                                                                 | -                                                                                 | 314                                                                               | -                                                                                 | -    | 376   |                                                                                   |      |      |                                                                                     |
| HCM Lane V/C Ratio       | 0.072                                                                             | 0.01                                                                              | -                                                                                 | -                                                                                 | 0.017                                                                             | -                                                                                 | -    | 0.095 |                                                                                   |      |      |                                                                                     |
| HCM Control Delay (s)    | 21.1                                                                              | 13.6                                                                              | -                                                                                 | -                                                                                 | 16.7                                                                              | -                                                                                 | -    | 15.6  |                                                                                   |      |      |                                                                                     |
| HCM Lane LOS             | C                                                                                 | B                                                                                 | -                                                                                 | -                                                                                 | C                                                                                 | -                                                                                 | -    | C     |                                                                                   |      |      |                                                                                     |
| HCM 95th %tile Q(veh)    | 0.2                                                                               | 0                                                                                 | -                                                                                 | -                                                                                 | 0.1                                                                               | -                                                                                 | -    | 0.3   |                                                                                   |      |      |                                                                                     |

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

03/07/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |  |
| Traffic Volume (vph)              | 40                                                                                | 1363                                                                              | 13                                                                                | 335                                                                               | 1091                                                                              | 99                                                                                | 9                                                                                   | 17                                                                                  | 544                                                                                 | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Future Volume (vph)               | 40                                                                                | 1363                                                                              | 13                                                                                | 335                                                                               | 1091                                                                              | 99                                                                                | 9                                                                                   | 17                                                                                  | 544                                                                                 | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 0.88                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1662                                                                              | 3513                                                                              |                                                                                   | 1770                                                                              | 3539                                                                              | 1538                                                                              |                                                                                     | 1824                                                                                | 2576                                                                                | 1621                                                                                | 1575                                                                                |                                                                                     |
| Flt Permitted                     | 0.23                                                                              | 1.00                                                                              |                                                                                   | 0.07                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 394                                                                               | 3513                                                                              |                                                                                   | 129                                                                               | 3539                                                                              | 1538                                                                              |                                                                                     | 1824                                                                                | 2576                                                                                | 1621                                                                                | 1575                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                              | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 45                                                                                | 1549                                                                              | 15                                                                                | 381                                                                               | 1240                                                                              | 112                                                                               | 10                                                                                  | 19                                                                                  | 618                                                                                 | 52                                                                                  | 14                                                                                  | 25                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 1                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 36                                                                                | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   | 24                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 45                                                                                | 1563                                                                              | 0                                                                                 | 381                                                                               | 1240                                                                              | 77                                                                                | 0                                                                                   | 29                                                                                  | 618                                                                                 | 52                                                                                  | 15                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 7%                                                                                | 1%                                                                                | 10%                                                                               | 2%                                                                                | 2%                                                                                | 5%                                                                                | 0%                                                                                  | 0%                                                                                  | 4%                                                                                  | 6%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pt+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 8 1                                                                                 | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 56.8                                                                              | 52.8                                                                              |                                                                                   | 84.0                                                                              | 75.0                                                                              | 75.0                                                                              |                                                                                     | 7.0                                                                                 | 38.2                                                                                | 4.0                                                                                 | 4.0                                                                                 |                                                                                     |
| Effective Green, g (s)            | 56.8                                                                              | 52.8                                                                              |                                                                                   | 84.0                                                                              | 75.0                                                                              | 75.0                                                                              |                                                                                     | 7.0                                                                                 | 38.2                                                                                | 4.0                                                                                 | 4.0                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.52                                                                              | 0.48                                                                              |                                                                                   | 0.76                                                                              | 0.68                                                                              | 0.68                                                                              |                                                                                     | 0.06                                                                                | 0.35                                                                                | 0.04                                                                                | 0.04                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 |                                                                                     | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 249                                                                               | 1686                                                                              |                                                                                   | 489                                                                               | 2412                                                                              | 1048                                                                              |                                                                                     | 116                                                                                 | 894                                                                                 | 58                                                                                  | 57                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.01                                                                              | c0.45                                                                             |                                                                                   | c0.19                                                                             | 0.35                                                                              |                                                                                   |                                                                                     | 0.02                                                                                | c0.24                                                                               | c0.03                                                                               | 0.01                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.09                                                                              |                                                                                   |                                                                                   | 0.41                                                                              |                                                                                   | 0.05                                                                              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.18                                                                              | 0.93                                                                              |                                                                                   | 0.78                                                                              | 0.51                                                                              | 0.07                                                                              |                                                                                     | 0.25                                                                                | 0.69                                                                                | 0.90                                                                                | 0.26                                                                                |                                                                                     |
| Uniform Delay, d1                 | 14.5                                                                              | 26.8                                                                              |                                                                                   | 31.6                                                                              | 8.6                                                                               | 5.9                                                                               |                                                                                     | 49.0                                                                                | 30.8                                                                                | 52.8                                                                                | 51.6                                                                                |                                                                                     |
| Progression Factor                | 0.36                                                                              | 0.43                                                                              |                                                                                   | 1.14                                                                              | 0.65                                                                              | 1.56                                                                              |                                                                                     | 1.03                                                                                | 0.96                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.3                                                                               | 8.3                                                                               |                                                                                   | 6.9                                                                               | 0.7                                                                               | 0.1                                                                               |                                                                                     | 1.1                                                                                 | 2.3                                                                                 | 80.9                                                                                | 2.4                                                                                 |                                                                                     |
| Delay (s)                         | 5.5                                                                               | 19.7                                                                              |                                                                                   | 42.9                                                                              | 6.3                                                                               | 9.2                                                                               |                                                                                     | 51.4                                                                                | 31.8                                                                                | 133.7                                                                               | 54.0                                                                                |                                                                                     |
| Level of Service                  | A                                                                                 | B                                                                                 |                                                                                   | D                                                                                 | A                                                                                 | A                                                                                 |                                                                                     | D                                                                                   | C                                                                                   | F                                                                                   | D                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 19.3                                                                              |                                                                                   |                                                                                   | 14.5                                                                              |                                                                                   |                                                                                     | 32.7                                                                                |                                                                                     |                                                                                     | 99.6                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                     | C                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 21.2                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.90                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 110.0                                                                             |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 78.4%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 5: Connector/Creekside &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT  | NBR  | SBL  | SBT  |
|-------------------------|------|------|------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 45   | 1564 | 381  | 1240 | 113  | 29   | 618  | 52   | 39   |
| v/c Ratio               | 0.17 | 0.91 | 0.78 | 0.50 | 0.10 | 0.25 | 0.69 | 0.71 | 0.41 |
| Control Delay           | 4.0  | 21.0 | 40.3 | 5.9  | 1.7  | 58.0 | 33.6 | 98.3 | 39.9 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 4.0  | 21.0 | 40.3 | 5.9  | 1.7  | 58.0 | 33.6 | 98.3 | 39.9 |
| Queue Length 50th (ft)  | 3    | 288  | 197  | 64   | 0    | 20   | 205  | 37   | 10   |
| Queue Length 95th (ft)  | m7   | #747 | 296  | 184  | 14   | m49  | m234 | #102 | 44   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519  |      |      | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      |      |      | 160  | 190  |      |
| Base Capacity (vph)     | 268  | 1719 | 606  | 2476 | 1112 | 115  | 1077 | 73   | 95   |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.17 | 0.91 | 0.63 | 0.50 | 0.10 | 0.25 | 0.57 | 0.71 | 0.41 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 4: Old Graves Mill & Graves Mill

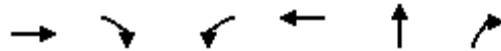
03/07/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |  |  |  |                                                                                   |                                                                                    |  |  |                                                                                     |  |                                                                                     |
| Traffic Volume (vph)              | 0                                                                                 | 1332                                                                              | 207                                                                               | 135                                                                               | 1006                                                                              | 0                                                                                 | 216                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Future Volume (vph)               | 0                                                                                 | 1332                                                                              | 207                                                                               | 135                                                                               | 1006                                                                              | 0                                                                                 | 216                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                 | 13                                                                                  | 13                                                                                  | 12                                                                                  | 16                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | -5%                                                                               |                                                                                   |                                                                                    | -5%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| Lane Util. Factor                 |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Frt                               |                                                                                   | 1.00                                                                              | 0.85                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 0.85                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Flt Protected                     |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (prot)                 |                                                                                   | 3521                                                                              | 1544                                                                              | 1736                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1856                                                                                | 1614                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Flt Permitted                     |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Satd. Flow (perm)                 |                                                                                   | 3521                                                                              | 1544                                                                              | 1736                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1856                                                                                | 1614                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Peak-hour factor, PHF             | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                              | 0.89                                                                               | 0.89                                                                                | 0.89                                                                                | 0.89                                                                                | 0.89                                                                                | 0.89                                                                                |
| Adj. Flow (vph)                   | 0                                                                                 | 1497                                                                              | 233                                                                               | 152                                                                               | 1130                                                                              | 0                                                                                 | 243                                                                                | 0                                                                                   | 84                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 57                                                                                | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                  | 0                                                                                   | 69                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 0                                                                                 | 1497                                                                              | 176                                                                               | 152                                                                               | 1130                                                                              | 0                                                                                 | 0                                                                                  | 243                                                                                 | 15                                                                                  | 0                                                                                   | 0                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                | 3%                                                                                | 3%                                                                                | 1%                                                                                | 0%                                                                                | 3%                                                                                 | 0%                                                                                  | 6%                                                                                  | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  |
| Turn Type                         | Prot                                                                              | NA                                                                                | Perm                                                                              | Prot                                                                              | NA                                                                                |                                                                                   | Split                                                                              | NA                                                                                  | Perm                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                  | 8                                                                                   |                                                                                     | 4                                                                                   | 4                                                                                   |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                   | 2                                                                                 |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             |                                                                                   | 68.2                                                                              | 68.2                                                                              | 7.0                                                                               | 80.2                                                                              |                                                                                   |                                                                                    | 19.8                                                                                | 19.8                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Effective Green, g (s)            |                                                                                   | 68.2                                                                              | 68.2                                                                              | 7.0                                                                               | 80.2                                                                              |                                                                                   |                                                                                    | 19.8                                                                                | 19.8                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Actuated g/C Ratio                |                                                                                   | 0.62                                                                              | 0.62                                                                              | 0.06                                                                              | 0.73                                                                              |                                                                                   |                                                                                    | 0.18                                                                                | 0.18                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Clearance Time (s)                |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| Vehicle Extension (s)             |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                   |                                                                                    | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| Lane Grp Cap (vph)                |                                                                                   | 2183                                                                              | 957                                                                               | 110                                                                               | 2671                                                                              |                                                                                   |                                                                                    | 334                                                                                 | 290                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Prot                    |                                                                                   | c0.43                                                                             |                                                                                   | c0.09                                                                             | 0.31                                                                              |                                                                                   |                                                                                    | c0.13                                                                               |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                   | 0.11                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 0.01                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         |                                                                                   | 0.69                                                                              | 0.18                                                                              | 1.38                                                                              | 0.42                                                                              |                                                                                   |                                                                                    | 0.73                                                                                | 0.05                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Uniform Delay, d1                 |                                                                                   | 13.8                                                                              | 9.0                                                                               | 51.5                                                                              | 5.8                                                                               |                                                                                   |                                                                                    | 42.6                                                                                | 37.3                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Progression Factor                |                                                                                   | 0.56                                                                              | 0.49                                                                              | 0.67                                                                              | 0.12                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Incremental Delay, d2             |                                                                                   | 1.5                                                                               | 0.4                                                                               | 213.9                                                                             | 0.4                                                                               |                                                                                   |                                                                                    | 7.7                                                                                 | 0.1                                                                                 |                                                                                     |                                                                                     |                                                                                     |
| Delay (s)                         |                                                                                   | 9.2                                                                               | 4.7                                                                               | 248.5                                                                             | 1.1                                                                               |                                                                                   |                                                                                    | 50.2                                                                                | 37.4                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Level of Service                  |                                                                                   | A                                                                                 | A                                                                                 | F                                                                                 | A                                                                                 |                                                                                   |                                                                                    | D                                                                                   | D                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Approach Delay (s)                |                                                                                   | 8.6                                                                               |                                                                                   |                                                                                   | 30.5                                                                              |                                                                                   |                                                                                    | 46.9                                                                                |                                                                                     |                                                                                     | 0.0                                                                                 |                                                                                     |
| Approach LOS                      |                                                                                   | A                                                                                 |                                                                                   |                                                                                   | C                                                                                 |                                                                                   |                                                                                    | D                                                                                   |                                                                                     |                                                                                     | A                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 20.8                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                    |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.79                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 110.0                                                                             |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                    |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 68.8%                                                                             |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                    |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 4: Old Graves Mill &amp; Graves Mill

03/07/2018



| Lane Group              | EBT  | EBR  | WBL   | WBT  | NBT  | NBR  |
|-------------------------|------|------|-------|------|------|------|
| Lane Group Flow (vph)   | 1497 | 233  | 152   | 1130 | 243  | 84   |
| v/c Ratio               | 0.69 | 0.23 | 1.38  | 0.42 | 0.73 | 0.20 |
| Control Delay           | 9.9  | 2.4  | 245.1 | 1.2  | 54.7 | 1.0  |
| Queue Delay             | 0.0  | 0.0  | 0.0   | 0.0  | 0.0  | 0.0  |
| Total Delay             | 9.9  | 2.4  | 245.1 | 1.2  | 54.7 | 1.0  |
| Queue Length 50th (ft)  | 171  | 7    | ~139  | 13   | 164  | 0    |
| Queue Length 95th (ft)  | 263  | 20   | #268  | 16   | 228  | 0    |
| Internal Link Dist (ft) | 1348 |      |       | 700  | 365  |      |
| Turn Bay Length (ft)    |      | 280  | 310   |      |      |      |
| Base Capacity (vph)     | 2182 | 1013 | 110   | 2670 | 506  | 563  |
| Starvation Cap Reductn  | 0    | 0    | 0     | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0     | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0     | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.69 | 0.23 | 1.38  | 0.42 | 0.48 | 0.15 |

## Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

03/07/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |                                                                                   |  |  |  |                                                                                     |  |  |  |  |  |
| Traffic Volume (vph)              | 50                                                                                | 1406                                                                              | 6                                                                                 | 285                                                                               | 1476                                                                              | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                 | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Future Volume (vph)               | 50                                                                                | 1406                                                                              | 6                                                                                 | 285                                                                               | 1476                                                                              | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                 | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                  | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | 0%                                                                                |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              |                                                                                   | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                     | 1.00                                                                                | 0.88                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              |                                                                                   | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                | 1.00                                                                                | 0.89                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              |                                                                                   | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 3478                                                                              |                                                                                   | 1770                                                                              | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 2653                                                                                | 1702                                                                                | 1553                                                                                |                                                                                     |
| Flt Permitted                     | 0.08                                                                              | 1.00                                                                              |                                                                                   | 0.06                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 148                                                                               | 3478                                                                              |                                                                                   | 108                                                                               | 3574                                                                              | 1615                                                                              |                                                                                     | 1694                                                                                | 2653                                                                                | 1702                                                                                | 1553                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.95                                                                              | 0.95                                                                              | 0.90                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                              | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                |
| Adj. Flow (vph)                   | 53                                                                                | 1480                                                                              | 7                                                                                 | 300                                                                               | 1554                                                                              | 149                                                                               | 61                                                                                  | 28                                                                                  | 497                                                                                 | 127                                                                                 | 20                                                                                  | 47                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 52                                                                                | 0                                                                                   | 0                                                                                   | 0                                                                                   | 0                                                                                   | 43                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 53                                                                                | 1487                                                                              | 0                                                                                 | 300                                                                               | 1554                                                                              | 97                                                                                | 0                                                                                   | 89                                                                                  | 497                                                                                 | 127                                                                                 | 24                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 2%                                                                                | 40%                                                                               | 2%                                                                                | 1%                                                                                | 0%                                                                                | 4%                                                                                  | 10%                                                                                 | 1%                                                                                  | 1%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                |                                                                                   | pm+pt                                                                             | NA                                                                                | Perm                                                                              | Split                                                                               | NA                                                                                  | pt+ov                                                                               | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                   | 8                                                                                   | 8 1                                                                                 | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                   |                                                                                   | 6                                                                                 |                                                                                   | 6                                                                                 |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 81.1                                                                              | 74.3                                                                              |                                                                                   | 109.6                                                                             | 97.8                                                                              | 97.8                                                                              |                                                                                     | 12.0                                                                                | 47.3                                                                                | 13.4                                                                                | 13.4                                                                                |                                                                                     |
| Effective Green, g (s)            | 81.1                                                                              | 74.3                                                                              |                                                                                   | 109.6                                                                             | 97.8                                                                              | 97.8                                                                              |                                                                                     | 12.0                                                                                | 47.3                                                                                | 13.4                                                                                | 13.4                                                                                |                                                                                     |
| Actuated g/C Ratio                | 0.54                                                                              | 0.50                                                                              |                                                                                   | 0.73                                                                              | 0.65                                                                              | 0.65                                                                              |                                                                                     | 0.08                                                                                | 0.32                                                                                | 0.09                                                                                | 0.09                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               |                                                                                   | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                     | 5.0                                                                                 |                                                                                     | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               |                                                                                   | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                     | 3.0                                                                                 |                                                                                     | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 153                                                                               | 1722                                                                              |                                                                                   | 414                                                                               | 2330                                                                              | 1052                                                                              |                                                                                     | 135                                                                                 | 836                                                                                 | 152                                                                                 | 138                                                                                 |                                                                                     |
| v/s Ratio Prot                    | 0.02                                                                              | c0.43                                                                             |                                                                                   | c0.15                                                                             | 0.43                                                                              |                                                                                   |                                                                                     | 0.05                                                                                | c0.19                                                                               | c0.07                                                                               | 0.02                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.17                                                                              |                                                                                   |                                                                                   | 0.38                                                                              |                                                                                   | 0.06                                                                              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.35                                                                              | 0.86                                                                              |                                                                                   | 0.72                                                                              | 0.67                                                                              | 0.09                                                                              |                                                                                     | 0.66                                                                                | 0.59                                                                                | 0.84                                                                                | 0.18                                                                                |                                                                                     |
| Uniform Delay, d1                 | 46.4                                                                              | 33.4                                                                              |                                                                                   | 43.1                                                                              | 16.1                                                                              | 9.7                                                                               |                                                                                     | 67.0                                                                                | 43.3                                                                                | 67.2                                                                                | 63.2                                                                                |                                                                                     |
| Progression Factor                | 0.66                                                                              | 0.34                                                                              |                                                                                   | 0.86                                                                              | 0.29                                                                              | 0.03                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.9                                                                               | 3.9                                                                               |                                                                                   | 5.6                                                                               | 1.4                                                                               | 0.2                                                                               |                                                                                     | 11.1                                                                                | 1.1                                                                                 | 30.9                                                                                | 0.6                                                                                 |                                                                                     |
| Delay (s)                         | 31.4                                                                              | 15.1                                                                              |                                                                                   | 42.8                                                                              | 6.1                                                                               | 0.4                                                                               |                                                                                     | 78.1                                                                                | 44.2                                                                                | 98.1                                                                                | 63.8                                                                                |                                                                                     |
| Level of Service                  | C                                                                                 | B                                                                                 |                                                                                   | D                                                                                 | A                                                                                 | A                                                                                 |                                                                                     | E                                                                                   | D                                                                                   | F                                                                                   | E                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 15.6                                                                              |                                                                                   |                                                                                   | 11.2                                                                              |                                                                                   |                                                                                     | 49.4                                                                                |                                                                                     |                                                                                     | 86.3                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                 |                                                                                   |                                                                                   | B                                                                                 |                                                                                   |                                                                                     | D                                                                                   |                                                                                     |                                                                                     | F                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 21.3                                                                              |                                                                                   |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.82                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 150.0                                                                             |                                                                                   |                                                                                   |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 80.7%                                                                             |                                                                                   |                                                                                   |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                     | D                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 5: Connector/Creekside &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT   | NBR  | SBL   | SBT  |
|-------------------------|------|------|------|------|------|-------|------|-------|------|
| Lane Group Flow (vph)   | 53   | 1487 | 300  | 1554 | 149  | 89    | 497  | 127   | 67   |
| v/c Ratio               | 0.32 | 0.85 | 0.75 | 0.66 | 0.13 | 0.66  | 0.61 | 0.84  | 0.37 |
| Control Delay           | 12.7 | 15.1 | 50.6 | 6.1  | 0.3  | 88.8  | 47.0 | 106.6 | 31.3 |
| Queue Delay             | 0.0  | 0.3  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0  | 0.0   | 0.0  |
| Total Delay             | 12.7 | 15.4 | 50.6 | 6.1  | 0.3  | 88.8  | 47.0 | 106.6 | 31.3 |
| Queue Length 50th (ft)  | 3    | 640  | 242  | 287  | 0    | 83    | 223  | 125   | 18   |
| Queue Length 95th (ft)  | m12  | 164  | 244  | 214  | 0    | m#197 | m285 | #248  | 70   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519   |      |       | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      |      |       | 160  | 190   |      |
| Base Capacity (vph)     | 168  | 1748 | 482  | 2482 | 1166 | 135   | 811  | 153   | 182  |
| Starvation Cap Reductn  | 0    | 31   | 0    | 17   | 0    | 0     | 0    | 0     | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0     | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0     | 0    |
| Reduced v/c Ratio       | 0.32 | 0.87 | 0.62 | 0.63 | 0.13 | 0.66  | 0.61 | 0.83  | 0.37 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 4: Old Graves Mill & Graves Mill

03/07/2018

|                                   |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                               | EBR                                                                               | WBL                                                                               | WBT                                                                               | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |  |  |  |  |                                                                                   |                                                                                    |  |  |                                                                                     |  |                                                                                     |
| Traffic Volume (vph)              | 1                                                                                 | 1467                                                                              | 341                                                                               | 345                                                                               | 1251                                                                              | 0                                                                                 | 200                                                                                | 0                                                                                   | 68                                                                                  | 0                                                                                   | 1                                                                                   | 3                                                                                   |
| Future Volume (vph)               | 1                                                                                 | 1467                                                                              | 341                                                                               | 345                                                                               | 1251                                                                              | 0                                                                                 | 200                                                                                | 0                                                                                   | 68                                                                                  | 0                                                                                   | 1                                                                                   | 3                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                | 12                                                                                | 11                                                                                | 12                                                                                | 12                                                                                | 12                                                                                 | 13                                                                                  | 13                                                                                  | 12                                                                                  | 16                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                |                                                                                   |                                                                                   | -5%                                                                               |                                                                                   |                                                                                    | -5%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                              | 0.85                                                                              | 1.00                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 0.85                                                                                |                                                                                     | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 3521                                                                              | 1575                                                                              | 1753                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1874                                                                                | 1677                                                                                |                                                                                     | 1906                                                                                |                                                                                     |
| Flt Permitted                     | 0.95                                                                              | 1.00                                                                              | 1.00                                                                              | 0.95                                                                              | 1.00                                                                              |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 1778                                                                              | 3521                                                                              | 1575                                                                              | 1753                                                                              | 3664                                                                              |                                                                                   |                                                                                    | 1874                                                                                | 1677                                                                                |                                                                                     | 1906                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                              | 0.91                                                                               | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                |
| Adj. Flow (vph)                   | 1                                                                                 | 1612                                                                              | 375                                                                               | 379                                                                               | 1375                                                                              | 0                                                                                 | 220                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 1                                                                                   | 3                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                 | 90                                                                                | 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                  | 0                                                                                   | 64                                                                                  | 0                                                                                   | 3                                                                                   | 0                                                                                   |
| Lane Group Flow (vph)             | 1                                                                                 | 1612                                                                              | 285                                                                               | 379                                                                               | 1375                                                                              | 0                                                                                 | 0                                                                                  | 220                                                                                 | 11                                                                                  | 0                                                                                   | 1                                                                                   | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                | 1%                                                                                | 2%                                                                                | 1%                                                                                | 0%                                                                                | 2%                                                                                 | 0%                                                                                  | 2%                                                                                  | 0%                                                                                  | 0%                                                                                  | 0%                                                                                  |
| Turn Type                         | Prot                                                                              | NA                                                                                | Perm                                                                              | Prot                                                                              | NA                                                                                |                                                                                   | Split                                                                              | NA                                                                                  | Perm                                                                                |                                                                                     | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                 |                                                                                   | 1                                                                                 | 6                                                                                 |                                                                                   | 8                                                                                  | 8                                                                                   |                                                                                     | 4                                                                                   | 4                                                                                   |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                   | 2                                                                                 |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 8                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 1.4                                                                               | 78.9                                                                              | 78.9                                                                              | 27.0                                                                              | 104.5                                                                             |                                                                                   |                                                                                    | 22.8                                                                                | 22.8                                                                                |                                                                                     | 1.3                                                                                 |                                                                                     |
| Effective Green, g (s)            | 1.4                                                                               | 78.9                                                                              | 78.9                                                                              | 27.0                                                                              | 104.5                                                                             |                                                                                   |                                                                                    | 22.8                                                                                | 22.8                                                                                |                                                                                     | 1.3                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.01                                                                              | 0.53                                                                              | 0.53                                                                              | 0.18                                                                              | 0.70                                                                              |                                                                                   |                                                                                    | 0.15                                                                                | 0.15                                                                                |                                                                                     | 0.01                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               | 5.0                                                                               |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               | 3.0                                                                               |                                                                                   |                                                                                    | 3.0                                                                                 | 3.0                                                                                 |                                                                                     | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 16                                                                                | 1852                                                                              | 828                                                                               | 315                                                                               | 2552                                                                              |                                                                                   |                                                                                    | 284                                                                                 | 254                                                                                 |                                                                                     | 16                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.00                                                                              | c0.46                                                                             |                                                                                   | c0.22                                                                             | 0.38                                                                              |                                                                                   |                                                                                    | c0.12                                                                               |                                                                                     |                                                                                     | c0.00                                                                               |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                   | 0.18                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     | 0.01                                                                                |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.06                                                                              | 0.87                                                                              | 0.34                                                                              | 1.20                                                                              | 0.54                                                                              |                                                                                   |                                                                                    | 0.77                                                                                | 0.04                                                                                |                                                                                     | 0.06                                                                                |                                                                                     |
| Uniform Delay, d1                 | 73.6                                                                              | 31.1                                                                              | 20.6                                                                              | 61.5                                                                              | 11.0                                                                              |                                                                                   |                                                                                    | 61.1                                                                                | 54.3                                                                                |                                                                                     | 73.7                                                                                |                                                                                     |
| Progression Factor                | 0.98                                                                              | 0.71                                                                              | 0.39                                                                              | 0.83                                                                              | 0.48                                                                              |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 1.3                                                                               | 4.8                                                                               | 0.9                                                                               | 113.6                                                                             | 0.7                                                                               |                                                                                   |                                                                                    | 12.4                                                                                | 0.1                                                                                 |                                                                                     | 1.7                                                                                 |                                                                                     |
| Delay (s)                         | 73.4                                                                              | 26.9                                                                              | 8.9                                                                               | 164.9                                                                             | 6.0                                                                               |                                                                                   |                                                                                    | 73.5                                                                                | 54.4                                                                                |                                                                                     | 75.4                                                                                |                                                                                     |
| Level of Service                  | E                                                                                 | C                                                                                 | A                                                                                 | F                                                                                 | A                                                                                 |                                                                                   |                                                                                    | E                                                                                   | D                                                                                   |                                                                                     | E                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 23.5                                                                              |                                                                                   |                                                                                   | 40.3                                                                              |                                                                                   |                                                                                    | 68.7                                                                                |                                                                                     |                                                                                     | 75.4                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | C                                                                                 |                                                                                   |                                                                                   | D                                                                                 |                                                                                   |                                                                                    | E                                                                                   |                                                                                     |                                                                                     | E                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                   | 34.2                                                                              |                                                                                   |                                                                                   | HCM 2000 Level of Service                                                         |                                                                                    |                                                                                     | C                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                   | 0.91                                                                              |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                   | 150.0                                                                             |                                                                                   |                                                                                   | Sum of lost time (s)                                                              |                                                                                    |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                   | 89.9%                                                                             |                                                                                   |                                                                                   | ICU Level of Service                                                              |                                                                                    |                                                                                     | E                                                                                   |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                   | 15                                                                                |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 4: Old Graves Mill &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | EBR  | WBL   | WBT  | NBT  | NBR  | SBT  |
|-------------------------|------|------|------|-------|------|------|------|------|
| Lane Group Flow (vph)   | 1    | 1612 | 375  | 379   | 1375 | 220  | 75   | 4    |
| v/c Ratio               | 0.01 | 0.79 | 0.38 | 1.41  | 0.50 | 0.77 | 0.21 | 0.05 |
| Control Delay           | 67.0 | 21.6 | 4.4  | 242.4 | 5.2  | 78.8 | 2.0  | 49.8 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0   | 0.1  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 67.0 | 21.7 | 4.4  | 242.4 | 5.2  | 78.8 | 2.0  | 49.8 |
| Queue Length 50th (ft)  | 1    | 407  | 9    | ~494  | 47   | 210  | 0    | 1    |
| Queue Length 95th (ft)  | m1   | #974 | 113  | #706  | 250  | 290  | 6    | 14   |
| Internal Link Dist (ft) |      | 1348 |      |       | 700  | 355  |      | 176  |
| Turn Bay Length (ft)    | 380  |      | 280  | 310   |      |      |      |      |
| Base Capacity (vph)     | 82   | 2039 | 992  | 268   | 2747 | 374  | 434  | 383  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0     | 264  | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 16   | 0    | 0     | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0     | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.01 | 0.80 | 0.38 | 1.41  | 0.55 | 0.59 | 0.17 | 0.01 |

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

03/07/2018

|                                   |  |                                                                                                                                                                      |  |  |                                                                                    |  |  |  |                                                                                      |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                                                                                                                                                                                                   | EBR                                                                               | WBL                                                                               | WBT                                                                                                                                                                 | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                                                                                                     | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |    |                                                                                   |  |   |  |                                                                                     |  |   |  |  |                                                                                     |
| Traffic Volume (vph)              | 40                                                                                | 1363                                                                                                                                                                                                                                                  | 13                                                                                | 335                                                                               | 1091                                                                                                                                                                | 99                                                                                | 9                                                                                   | 17                                                                                  | 544                                                                                                                                                                     | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Future Volume (vph)               | 40                                                                                | 1363                                                                                                                                                                                                                                                  | 13                                                                                | 335                                                                               | 1091                                                                                                                                                                | 99                                                                                | 9                                                                                   | 17                                                                                  | 544                                                                                                                                                                     | 46                                                                                  | 12                                                                                  | 22                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                                                                                                                                                                                                  | 1900                                                                              | 1900                                                                              | 1900                                                                                                                                                                | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                                                                                                    | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                                                                                                                                                                                    | 12                                                                                | 12                                                                                | 12                                                                                                                                                                  | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                                                                                                      | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                                                                                                                                                                                    |                                                                                   |                                                                                   | 0%                                                                                                                                                                  |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                                                                                                         |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                                                                                                                                                                                                   |                                                                                   | 5.0                                                                               | 5.0                                                                                                                                                                 | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                                                                                                     | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.91                                                                                                                                                                                                                                                  |                                                                                   | 1.00                                                                              | 0.95                                                                                                                                                                | 1.00                                                                              |                                                                                     | 1.00                                                                                | 0.88                                                                                                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                                                                                                                                                                                                  |                                                                                   | 1.00                                                                              | 1.00                                                                                                                                                                | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                                                                                                    | 1.00                                                                                | 0.90                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                                                                                                                                                                                                  |                                                                                   | 0.95                                                                              | 1.00                                                                                                                                                                | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1662                                                                              | 5047                                                                                                                                                                                                                                                  |                                                                                   | 1770                                                                              | 3539                                                                                                                                                                | 1538                                                                              |                                                                                     | 1824                                                                                | 2576                                                                                                                                                                    | 1621                                                                                | 1575                                                                                |                                                                                     |
| Flt Permitted                     | 0.23                                                                              | 1.00                                                                                                                                                                                                                                                  |                                                                                   | 0.07                                                                              | 1.00                                                                                                                                                                | 1.00                                                                              |                                                                                     | 0.98                                                                                | 1.00                                                                                                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 394                                                                               | 5047                                                                                                                                                                                                                                                  |                                                                                   | 137                                                                               | 3539                                                                                                                                                                | 1538                                                                              |                                                                                     | 1824                                                                                | 2576                                                                                                                                                                    | 1621                                                                                | 1575                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.88                                                                              | 0.88                                                                                                                                                                                                                                                  | 0.88                                                                              | 0.88                                                                              | 0.88                                                                                                                                                                | 0.88                                                                              | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                                                                                                    | 0.88                                                                                | 0.88                                                                                | 0.88                                                                                |
| Adj. Flow (vph)                   | 45                                                                                | 1549                                                                                                                                                                                                                                                  | 15                                                                                | 381                                                                               | 1240                                                                                                                                                                | 112                                                                               | 10                                                                                  | 19                                                                                  | 618                                                                                                                                                                     | 52                                                                                  | 14                                                                                  | 25                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 1                                                                                                                                                                                                                                                     | 0                                                                                 | 0                                                                                 | 0                                                                                                                                                                   | 40                                                                                | 0                                                                                   | 0                                                                                   | 0                                                                                                                                                                       | 0                                                                                   | 24                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 45                                                                                | 1563                                                                                                                                                                                                                                                  | 0                                                                                 | 381                                                                               | 1240                                                                                                                                                                | 73                                                                                | 0                                                                                   | 29                                                                                  | 618                                                                                                                                                                     | 52                                                                                  | 15                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 7%                                                                                | 1%                                                                                                                                                                                                                                                    | 10%                                                                               | 2%                                                                                | 2%                                                                                                                                                                  | 5%                                                                                | 0%                                                                                  | 0%                                                                                  | 4%                                                                                                                                                                      | 6%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                                                                                                                                                                                    |                                                                                   | pm+pt                                                                             | NA                                                                                                                                                                  | Perm                                                                              | Split                                                                               | NA                                                                                  | pt+ov                                                                                                                                                                   | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                                                                                                                                                                                     |                                                                                   | 1                                                                                 | 6                                                                                                                                                                   |                                                                                   | 8                                                                                   | 8                                                                                   | 8 1                                                                                                                                                                     | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                                                                                                                                                                                       |                                                                                   | 6                                                                                 |                                                                                                                                                                     | 6                                                                                 |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 53.8                                                                              | 49.8                                                                                                                                                                                                                                                  |                                                                                   | 80.3                                                                              | 71.3                                                                                                                                                                | 71.3                                                                              |                                                                                     | 9.1                                                                                 | 39.6                                                                                                                                                                    | 5.6                                                                                 | 5.6                                                                                 |                                                                                     |
| Effective Green, g (s)            | 53.8                                                                              | 49.8                                                                                                                                                                                                                                                  |                                                                                   | 80.3                                                                              | 71.3                                                                                                                                                                | 71.3                                                                              |                                                                                     | 9.1                                                                                 | 39.6                                                                                                                                                                    | 5.6                                                                                 | 5.6                                                                                 |                                                                                     |
| Actuated g/C Ratio                | 0.49                                                                              | 0.45                                                                                                                                                                                                                                                  |                                                                                   | 0.73                                                                              | 0.65                                                                                                                                                                | 0.65                                                                              |                                                                                     | 0.08                                                                                | 0.36                                                                                                                                                                    | 0.05                                                                                | 0.05                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                                                                                                                                                                                                   |                                                                                   | 5.0                                                                               | 5.0                                                                                                                                                                 | 5.0                                                                               |                                                                                     | 5.0                                                                                 |                                                                                                                                                                         | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                                                                                                                                                                                                   |                                                                                   | 3.0                                                                               | 3.0                                                                                                                                                                 | 3.0                                                                               |                                                                                     | 3.0                                                                                 |                                                                                                                                                                         | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 238                                                                               | 2284                                                                                                                                                                                                                                                  |                                                                                   | 478                                                                               | 2293                                                                                                                                                                | 996                                                                               |                                                                                     | 150                                                                                 | 927                                                                                                                                                                     | 82                                                                                  | 80                                                                                  |                                                                                     |
| v/s Ratio Prot                    | 0.01                                                                              | 0.31                                                                                                                                                                                                                                                  |                                                                                   | c0.18                                                                             | 0.35                                                                                                                                                                |                                                                                   |                                                                                     | 0.02                                                                                | c0.24                                                                                                                                                                   | c0.03                                                                               | 0.01                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.09                                                                              |                                                                                                                                                                                                                                                       |                                                                                   | c0.40                                                                             |                                                                                                                                                                     | 0.05                                                                              |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.19                                                                              | 0.68                                                                                                                                                                                                                                                  |                                                                                   | 0.80                                                                              | 0.54                                                                                                                                                                | 0.07                                                                              |                                                                                     | 0.19                                                                                | 0.67                                                                                                                                                                    | 0.63                                                                                | 0.19                                                                                |                                                                                     |
| Uniform Delay, d1                 | 14.8                                                                              | 23.9                                                                                                                                                                                                                                                  |                                                                                   | 29.9                                                                              | 10.5                                                                                                                                                                | 7.1                                                                               |                                                                                     | 47.0                                                                                | 29.6                                                                                                                                                                    | 51.2                                                                                | 50.0                                                                                |                                                                                     |
| Progression Factor                | 0.43                                                                              | 0.45                                                                                                                                                                                                                                                  |                                                                                   | 1.13                                                                              | 0.77                                                                                                                                                                | 1.72                                                                              |                                                                                     | 1.03                                                                                | 0.97                                                                                                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 0.4                                                                               | 1.5                                                                                                                                                                                                                                                   |                                                                                   | 8.1                                                                               | 0.8                                                                                                                                                                 | 0.1                                                                               |                                                                                     | 0.6                                                                                 | 1.8                                                                                                                                                                     | 14.9                                                                                | 1.2                                                                                 |                                                                                     |
| Delay (s)                         | 6.6                                                                               | 12.4                                                                                                                                                                                                                                                  |                                                                                   | 42.0                                                                              | 8.9                                                                                                                                                                 | 12.4                                                                              |                                                                                     | 49.2                                                                                | 30.5                                                                                                                                                                    | 66.1                                                                                | 51.2                                                                                |                                                                                     |
| Level of Service                  | A                                                                                 | B                                                                                                                                                                                                                                                     |                                                                                   | D                                                                                 | A                                                                                                                                                                   | B                                                                                 |                                                                                     | D                                                                                   | C                                                                                                                                                                       | E                                                                                   | D                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 12.2                                                                                                                                                                                                                                                  |                                                                                   |                                                                                   | 16.4                                                                                                                                                                |                                                                                   |                                                                                     | 31.4                                                                                |                                                                                                                                                                         |                                                                                     | 59.7                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                                                                                                                                                                                     |                                                                                   |                                                                                   | B                                                                                                                                                                   |                                                                                   |                                                                                     | C                                                                                   |                                                                                                                                                                         |                                                                                     | E                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                                                                                                                                                                                       |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                                                                                                                                                                                       | 18.1                                                                              |                                                                                   |                                                                                                                                                                     |                                                                                   | HCM 2000 Level of Service                                                           |                                                                                     |                                                                                                                                                                         | B                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                                                                                                                                                                                       | 0.82                                                                              |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                                                                                                                                                                                       | 110.0                                                                             |                                                                                   |                                                                                                                                                                     |                                                                                   | Sum of lost time (s)                                                                |                                                                                     |                                                                                                                                                                         | 20.0                                                                                |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                                                                                                                                                                                       | 66.9%                                                                             |                                                                                   |                                                                                                                                                                     |                                                                                   | ICU Level of Service                                                                |                                                                                     |                                                                                                                                                                         | C                                                                                   |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                                                                                                                                                                                       | 15                                                                                |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                                                                                                                                                                                       |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 5: Connector/Creekside &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT  | NBR  | SBL  | SBT  |
|-------------------------|------|------|------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 45   | 1564 | 381  | 1240 | 113  | 29   | 618  | 52   | 39   |
| v/c Ratio               | 0.17 | 0.67 | 0.79 | 0.53 | 0.11 | 0.19 | 0.67 | 0.52 | 0.32 |
| Control Delay           | 5.1  | 12.4 | 41.2 | 8.2  | 1.9  | 55.5 | 32.5 | 70.0 | 34.0 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 5.1  | 12.4 | 41.2 | 8.2  | 1.9  | 55.5 | 32.5 | 70.0 | 34.0 |
| Queue Length 50th (ft)  | 5    | 193  | 200  | 123  | 1    | 20   | 205  | 35   | 9    |
| Queue Length 95th (ft)  | m9   | 305  | 292  | 184  | 14   | m49  | 238  | #102 | 44   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519  |      |      | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      |      |      | 160  | 190  |      |
| Base Capacity (vph)     | 259  | 2335 | 606  | 2453 | 1102 | 149  | 1125 | 100  | 121  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.17 | 0.67 | 0.63 | 0.51 | 0.10 | 0.19 | 0.55 | 0.52 | 0.32 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 4: Old Graves Mill & Graves Mill

03/07/2018

|                                   |  |                                                                                                                                                                      |  |                                                                                    |                                                                                    |  |  |  |  |  |                                                                                      |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                                                                                                                                                                                                   | EBR                                                                               | WBL                                                                                                                                                                 | WBT                                                                                                                                                                 | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                                                                                                     | SBR                                                                                 |
| Lane Configurations               |  |    |  |   |   |                                                                                   |                                                                                    |  |  |                                                                                     |   |                                                                                     |
| Traffic Volume (vph)              | 0                                                                                 | 1332                                                                                                                                                                                                                                                  | 207                                                                               | 135                                                                                                                                                                 | 1006                                                                                                                                                                | 0                                                                                 | 216                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 0                                                                                                                                                                       | 0                                                                                   |
| Future Volume (vph)               | 0                                                                                 | 1332                                                                                                                                                                                                                                                  | 207                                                                               | 135                                                                                                                                                                 | 1006                                                                                                                                                                | 0                                                                                 | 216                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 0                                                                                                                                                                       | 0                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                                                                                                                                                                                                  | 1900                                                                              | 1900                                                                                                                                                                | 1900                                                                                                                                                                | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                                                                                                    | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                                                                                                                                                                                    | 12                                                                                | 11                                                                                                                                                                  | 12                                                                                                                                                                  | 12                                                                                | 12                                                                                 | 13                                                                                  | 13                                                                                  | 12                                                                                  | 16                                                                                                                                                                      | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                                                                                                                                                                                    |                                                                                   |                                                                                                                                                                     | -5%                                                                                                                                                                 |                                                                                   |                                                                                    | -5%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                                                                                                      |                                                                                     |
| Total Lost time (s)               |                                                                                   | 5.0                                                                                                                                                                                                                                                   | 5.0                                                                               | 5.0                                                                                                                                                                 | 5.0                                                                                                                                                                 |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Lane Util. Factor                 |                                                                                   | 0.91                                                                                                                                                                                                                                                  | 1.00                                                                              | 0.97                                                                                                                                                                | 0.95                                                                                                                                                                |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Frt                               |                                                                                   | 1.00                                                                                                                                                                                                                                                  | 0.85                                                                              | 1.00                                                                                                                                                                | 1.00                                                                                                                                                                |                                                                                   |                                                                                    | 1.00                                                                                | 0.85                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Flt Protected                     |                                                                                   | 1.00                                                                                                                                                                                                                                                  | 1.00                                                                              | 0.95                                                                                                                                                                | 1.00                                                                                                                                                                |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Satd. Flow (prot)                 |                                                                                   | 5059                                                                                                                                                                                                                                                  | 1544                                                                              | 3369                                                                                                                                                                | 3664                                                                                                                                                                |                                                                                   |                                                                                    | 1856                                                                                | 1614                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Flt Permitted                     |                                                                                   | 1.00                                                                                                                                                                                                                                                  | 1.00                                                                              | 0.95                                                                                                                                                                | 1.00                                                                                                                                                                |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Satd. Flow (perm)                 |                                                                                   | 5059                                                                                                                                                                                                                                                  | 1544                                                                              | 3369                                                                                                                                                                | 3664                                                                                                                                                                |                                                                                   |                                                                                    | 1856                                                                                | 1614                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Peak-hour factor, PHF             | 0.89                                                                              | 0.89                                                                                                                                                                                                                                                  | 0.89                                                                              | 0.89                                                                                                                                                                | 0.89                                                                                                                                                                | 0.89                                                                              | 0.89                                                                               | 0.89                                                                                | 0.89                                                                                | 0.89                                                                                | 0.89                                                                                                                                                                    | 0.89                                                                                |
| Adj. Flow (vph)                   | 0                                                                                 | 1497                                                                                                                                                                                                                                                  | 233                                                                               | 152                                                                                                                                                                 | 1130                                                                                                                                                                | 0                                                                                 | 243                                                                                | 0                                                                                   | 84                                                                                  | 0                                                                                   | 0                                                                                                                                                                       | 0                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                                                                                                                                                                                     | 82                                                                                | 0                                                                                                                                                                   | 0                                                                                                                                                                   | 0                                                                                 | 0                                                                                  | 0                                                                                   | 69                                                                                  | 0                                                                                   | 0                                                                                                                                                                       | 0                                                                                   |
| Lane Group Flow (vph)             | 0                                                                                 | 1497                                                                                                                                                                                                                                                  | 151                                                                               | 152                                                                                                                                                                 | 1130                                                                                                                                                                | 0                                                                                 | 0                                                                                  | 243                                                                                 | 15                                                                                  | 0                                                                                   | 0                                                                                                                                                                       | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                                                                                                                                                                                    | 3%                                                                                | 3%                                                                                                                                                                  | 1%                                                                                                                                                                  | 0%                                                                                | 3%                                                                                 | 0%                                                                                  | 6%                                                                                  | 0%                                                                                  | 0%                                                                                                                                                                      | 0%                                                                                  |
| Turn Type                         | Prot                                                                              | NA                                                                                                                                                                                                                                                    | Perm                                                                              | Prot                                                                                                                                                                | NA                                                                                                                                                                  |                                                                                   | Split                                                                              | NA                                                                                  | Perm                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                                                                                                                                                                                     |                                                                                   | 1                                                                                                                                                                   | 6                                                                                                                                                                   |                                                                                   | 8                                                                                  | 8                                                                                   |                                                                                     | 4                                                                                   | 4                                                                                                                                                                       |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                                                                                                                                                                                       | 2                                                                                 |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     | 8                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Actuated Green, G (s)             |                                                                                   | 68.2                                                                                                                                                                                                                                                  | 68.2                                                                              | 7.0                                                                                                                                                                 | 80.2                                                                                                                                                                |                                                                                   |                                                                                    | 19.8                                                                                | 19.8                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Effective Green, g (s)            |                                                                                   | 68.2                                                                                                                                                                                                                                                  | 68.2                                                                              | 7.0                                                                                                                                                                 | 80.2                                                                                                                                                                |                                                                                   |                                                                                    | 19.8                                                                                | 19.8                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Actuated g/C Ratio                |                                                                                   | 0.62                                                                                                                                                                                                                                                  | 0.62                                                                              | 0.06                                                                                                                                                                | 0.73                                                                                                                                                                |                                                                                   |                                                                                    | 0.18                                                                                | 0.18                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Clearance Time (s)                |                                                                                   | 5.0                                                                                                                                                                                                                                                   | 5.0                                                                               | 5.0                                                                                                                                                                 | 5.0                                                                                                                                                                 |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Vehicle Extension (s)             |                                                                                   | 3.0                                                                                                                                                                                                                                                   | 3.0                                                                               | 3.0                                                                                                                                                                 | 3.0                                                                                                                                                                 |                                                                                   |                                                                                    | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Lane Grp Cap (vph)                |                                                                                   | 3136                                                                                                                                                                                                                                                  | 957                                                                               | 214                                                                                                                                                                 | 2671                                                                                                                                                                |                                                                                   |                                                                                    | 334                                                                                 | 290                                                                                 |                                                                                     |                                                                                                                                                                         |                                                                                     |
| v/s Ratio Prot                    |                                                                                   | c0.30                                                                                                                                                                                                                                                 |                                                                                   | c0.05                                                                                                                                                               | 0.31                                                                                                                                                                |                                                                                   |                                                                                    | c0.13                                                                               |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                                                                                                                                                                                       | 0.10                                                                              |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     | 0.01                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| v/c Ratio                         |                                                                                   | 0.48                                                                                                                                                                                                                                                  | 0.16                                                                              | 0.71                                                                                                                                                                | 0.42                                                                                                                                                                |                                                                                   |                                                                                    | 0.73                                                                                | 0.05                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Uniform Delay, d1                 |                                                                                   | 11.3                                                                                                                                                                                                                                                  | 8.8                                                                               | 50.5                                                                                                                                                                | 5.8                                                                                                                                                                 |                                                                                   |                                                                                    | 42.6                                                                                | 37.3                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Progression Factor                |                                                                                   | 0.58                                                                                                                                                                                                                                                  | 0.53                                                                              | 0.72                                                                                                                                                                | 0.16                                                                                                                                                                |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Incremental Delay, d2             |                                                                                   | 0.4                                                                                                                                                                                                                                                   | 0.3                                                                               | 9.4                                                                                                                                                                 | 0.4                                                                                                                                                                 |                                                                                   |                                                                                    | 7.7                                                                                 | 0.1                                                                                 |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Delay (s)                         |                                                                                   | 7.0                                                                                                                                                                                                                                                   | 4.9                                                                               | 45.9                                                                                                                                                                | 1.4                                                                                                                                                                 |                                                                                   |                                                                                    | 50.2                                                                                | 37.4                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Level of Service                  |                                                                                   | A                                                                                                                                                                                                                                                     | A                                                                                 | D                                                                                                                                                                   | A                                                                                                                                                                   |                                                                                   |                                                                                    | D                                                                                   | D                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Approach Delay (s)                |                                                                                   | 6.7                                                                                                                                                                                                                                                   |                                                                                   |                                                                                                                                                                     | 6.7                                                                                                                                                                 |                                                                                   |                                                                                    | 46.9                                                                                |                                                                                     |                                                                                     | 0.0                                                                                                                                                                     |                                                                                     |
| Approach LOS                      |                                                                                   | A                                                                                                                                                                                                                                                     |                                                                                   |                                                                                                                                                                     | A                                                                                                                                                                   |                                                                                   |                                                                                    | D                                                                                   |                                                                                     |                                                                                     | A                                                                                                                                                                       |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                                                                                                                                                                                       |                                                                                   |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                                                                                                                                                                                       | 10.6                                                                              |                                                                                                                                                                     |                                                                                                                                                                     | HCM 2000 Level of Service                                                         |                                                                                    |                                                                                     | B                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                                                                                                                                                                                       | 0.58                                                                              |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                                                                                                                                                                                       | 110.0                                                                             |                                                                                                                                                                     |                                                                                                                                                                     | Sum of lost time (s)                                                              |                                                                                    |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                                                                                                                                                                                       | 58.1%                                                                             |                                                                                                                                                                     |                                                                                                                                                                     | ICU Level of Service                                                              |                                                                                    |                                                                                     | B                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                                                                                                                                                                                       | 15                                                                                |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                                                                                                                                                                                       |                                                                                   |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |

## Queues

## 4: Old Graves Mill &amp; Graves Mill

03/07/2018



| Lane Group              | EBT  | EBR  | WBL  | WBT  | NBT  | NBR  |
|-------------------------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1497 | 233  | 152  | 1130 | 243  | 84   |
| v/c Ratio               | 0.48 | 0.22 | 0.71 | 0.42 | 0.73 | 0.20 |
| Control Delay           | 7.4  | 1.5  | 53.7 | 1.5  | 54.7 | 1.0  |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 7.4  | 1.5  | 53.7 | 1.5  | 54.7 | 1.0  |
| Queue Length 50th (ft)  | 116  | 4    | 55   | 5    | 164  | 0    |
| Queue Length 95th (ft)  | 147  | 14   | #96  | 16   | 228  | 0    |
| Internal Link Dist (ft) | 1348 |      |      | 700  | 365  |      |
| Turn Bay Length (ft)    |      | 280  | 310  |      |      |      |
| Base Capacity (vph)     | 3135 | 1038 | 214  | 2670 | 506  | 563  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.48 | 0.22 | 0.71 | 0.42 | 0.48 | 0.15 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

# HCM Signalized Intersection Capacity Analysis

## 5: Connector/Creekside & Graves Mill

03/07/2018

|                                   |  |                                                                                                                                                                      |  |  |                                                                                    |  |  |  |                                                                                                                                                                          |  |  |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                                                                                                                                                                                                   | EBR                                                                               | WBL                                                                               | WBT                                                                                                                                                                 | WBR                                                                               | NBL                                                                                 | NBT                                                                                 | NBR                                                                                                                                                                                                                                                         | SBL                                                                                 | SBT                                                                                 | SBR                                                                                 |
| Lane Configurations               |  |    |                                                                                   |  |   |  |                                                                                     |  |    |  |  |                                                                                     |
| Traffic Volume (vph)              | 50                                                                                | 1406                                                                                                                                                                                                                                                  | 6                                                                                 | 285                                                                               | 1476                                                                                                                                                                | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                                                                                                                                                                                         | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Future Volume (vph)               | 50                                                                                | 1406                                                                                                                                                                                                                                                  | 6                                                                                 | 285                                                                               | 1476                                                                                                                                                                | 142                                                                               | 58                                                                                  | 27                                                                                  | 472                                                                                                                                                                                                                                                         | 121                                                                                 | 19                                                                                  | 45                                                                                  |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                                                                                                                                                                                                  | 1900                                                                              | 1900                                                                              | 1900                                                                                                                                                                | 1900                                                                              | 1900                                                                                | 1900                                                                                | 1900                                                                                                                                                                                                                                                        | 1900                                                                                | 1900                                                                                | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                                                                                                                                                                                    | 12                                                                                | 12                                                                                | 12                                                                                                                                                                  | 12                                                                                | 12                                                                                  | 11                                                                                  | 10                                                                                                                                                                                                                                                          | 11                                                                                  | 11                                                                                  | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                                                                                                                                                                                    |                                                                                   |                                                                                   | 0%                                                                                                                                                                  |                                                                                   |                                                                                     | -2%                                                                                 |                                                                                                                                                                                                                                                             |                                                                                     | 3%                                                                                  |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                                                                                                                                                                                                   |                                                                                   | 5.0                                                                               | 5.0                                                                                                                                                                 | 5.0                                                                               |                                                                                     | 5.0                                                                                 | 5.0                                                                                                                                                                                                                                                         | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.91                                                                                                                                                                                                                                                  |                                                                                   | 1.00                                                                              | 0.95                                                                                                                                                                | 1.00                                                                              |                                                                                     | 1.00                                                                                | 0.88                                                                                                                                                                                                                                                        | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                                                                                                                                                                                                  |                                                                                   | 1.00                                                                              | 1.00                                                                                                                                                                | 0.85                                                                              |                                                                                     | 1.00                                                                                | 0.85                                                                                                                                                                                                                                                        | 1.00                                                                                | 0.89                                                                                |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                                                                                                                                                                                                  |                                                                                   | 0.95                                                                              | 1.00                                                                                                                                                                | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                                                                                                                                                                                        | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 4997                                                                                                                                                                                                                                                  |                                                                                   | 1770                                                                              | 3574                                                                                                                                                                | 1615                                                                              |                                                                                     | 1694                                                                                | 2653                                                                                                                                                                                                                                                        | 1702                                                                                | 1553                                                                                |                                                                                     |
| Flt Permitted                     | 0.07                                                                              | 1.00                                                                                                                                                                                                                                                  |                                                                                   | 0.09                                                                              | 1.00                                                                                                                                                                | 1.00                                                                              |                                                                                     | 0.97                                                                                | 1.00                                                                                                                                                                                                                                                        | 0.95                                                                                | 1.00                                                                                |                                                                                     |
| Satd. Flow (perm)                 | 131                                                                               | 4997                                                                                                                                                                                                                                                  |                                                                                   | 176                                                                               | 3574                                                                                                                                                                | 1615                                                                              |                                                                                     | 1694                                                                                | 2653                                                                                                                                                                                                                                                        | 1702                                                                                | 1553                                                                                |                                                                                     |
| Peak-hour factor, PHF             | 0.95                                                                              | 0.95                                                                                                                                                                                                                                                  | 0.90                                                                              | 0.95                                                                              | 0.95                                                                                                                                                                | 0.95                                                                              | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                                                                                                                                                                                        | 0.95                                                                                | 0.95                                                                                | 0.95                                                                                |
| Adj. Flow (vph)                   | 53                                                                                | 1480                                                                                                                                                                                                                                                  | 7                                                                                 | 300                                                                               | 1554                                                                                                                                                                | 149                                                                               | 61                                                                                  | 28                                                                                  | 497                                                                                                                                                                                                                                                         | 127                                                                                 | 20                                                                                  | 47                                                                                  |
| RTOR Reduction (vph)              | 0                                                                                 | 1                                                                                                                                                                                                                                                     | 0                                                                                 | 0                                                                                 | 0                                                                                                                                                                   | 52                                                                                | 0                                                                                   | 0                                                                                   | 0                                                                                                                                                                                                                                                           | 0                                                                                   | 42                                                                                  | 0                                                                                   |
| Lane Group Flow (vph)             | 53                                                                                | 1486                                                                                                                                                                                                                                                  | 0                                                                                 | 300                                                                               | 1554                                                                                                                                                                | 97                                                                                | 0                                                                                   | 89                                                                                  | 497                                                                                                                                                                                                                                                         | 127                                                                                 | 25                                                                                  | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 2%                                                                                                                                                                                                                                                    | 40%                                                                               | 2%                                                                                | 1%                                                                                                                                                                  | 0%                                                                                | 4%                                                                                  | 10%                                                                                 | 1%                                                                                                                                                                                                                                                          | 1%                                                                                  | 0%                                                                                  | 6%                                                                                  |
| Turn Type                         | pm+pt                                                                             | NA                                                                                                                                                                                                                                                    |                                                                                   | pm+pt                                                                             | NA                                                                                                                                                                  | Perm                                                                              | Split                                                                               | NA                                                                                  | pt+ov                                                                                                                                                                                                                                                       | Split                                                                               | NA                                                                                  |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                                                                                                                                                                                     |                                                                                   | 1                                                                                 | 6                                                                                                                                                                   |                                                                                   | 8                                                                                   | 8                                                                                   | 8 1                                                                                                                                                                                                                                                         | 7                                                                                   | 7                                                                                   |                                                                                     |
| Permitted Phases                  | 2                                                                                 |                                                                                                                                                                                                                                                       |                                                                                   | 6                                                                                 |                                                                                                                                                                     | 6                                                                                 |                                                                                     |                                                                                     |                                                                                                                                                                                                                                                             |                                                                                     |                                                                                     |                                                                                     |
| Actuated Green, G (s)             | 72.5                                                                              | 67.4                                                                                                                                                                                                                                                  |                                                                                   | 107.7                                                                             | 97.6                                                                                                                                                                | 97.6                                                                              |                                                                                     | 12.7                                                                                | 53.0                                                                                                                                                                                                                                                        | 14.6                                                                                | 14.6                                                                                |                                                                                     |
| Effective Green, g (s)            | 72.5                                                                              | 67.4                                                                                                                                                                                                                                                  |                                                                                   | 107.7                                                                             | 97.6                                                                                                                                                                | 97.6                                                                              |                                                                                     | 12.7                                                                                | 53.0                                                                                                                                                                                                                                                        | 14.6                                                                                | 14.6                                                                                |                                                                                     |
| Actuated g/C Ratio                | 0.48                                                                              | 0.45                                                                                                                                                                                                                                                  |                                                                                   | 0.72                                                                              | 0.65                                                                                                                                                                | 0.65                                                                              |                                                                                     | 0.08                                                                                | 0.35                                                                                                                                                                                                                                                        | 0.10                                                                                | 0.10                                                                                |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                                                                                                                                                                                                   |                                                                                   | 5.0                                                                               | 5.0                                                                                                                                                                 | 5.0                                                                               |                                                                                     | 5.0                                                                                 |                                                                                                                                                                                                                                                             | 5.0                                                                                 | 5.0                                                                                 |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                                                                                                                                                                                                   |                                                                                   | 3.0                                                                               | 3.0                                                                                                                                                                 | 3.0                                                                               |                                                                                     | 3.0                                                                                 |                                                                                                                                                                                                                                                             | 3.0                                                                                 | 3.0                                                                                 |                                                                                     |
| Lane Grp Cap (vph)                | 119                                                                               | 2245                                                                                                                                                                                                                                                  |                                                                                   | 501                                                                               | 2325                                                                                                                                                                | 1050                                                                              |                                                                                     | 143                                                                                 | 937                                                                                                                                                                                                                                                         | 165                                                                                 | 151                                                                                 |                                                                                     |
| v/s Ratio Prot                    | 0.02                                                                              | 0.30                                                                                                                                                                                                                                                  |                                                                                   | 0.14                                                                              | c0.43                                                                                                                                                               |                                                                                   |                                                                                     | 0.05                                                                                | c0.19                                                                                                                                                                                                                                                       | c0.07                                                                               | 0.02                                                                                |                                                                                     |
| v/s Ratio Perm                    | 0.20                                                                              |                                                                                                                                                                                                                                                       |                                                                                   | 0.29                                                                              |                                                                                                                                                                     | 0.06                                                                              |                                                                                     |                                                                                     |                                                                                                                                                                                                                                                             |                                                                                     |                                                                                     |                                                                                     |
| v/c Ratio                         | 0.45                                                                              | 0.66                                                                                                                                                                                                                                                  |                                                                                   | 0.60                                                                              | 0.67                                                                                                                                                                | 0.09                                                                              |                                                                                     | 0.62                                                                                | 0.53                                                                                                                                                                                                                                                        | 0.77                                                                                | 0.16                                                                                |                                                                                     |
| Uniform Delay, d1                 | 54.3                                                                              | 32.4                                                                                                                                                                                                                                                  |                                                                                   | 31.7                                                                              | 16.2                                                                                                                                                                | 9.7                                                                               |                                                                                     | 66.3                                                                                | 38.6                                                                                                                                                                                                                                                        | 66.1                                                                                | 62.1                                                                                |                                                                                     |
| Progression Factor                | 0.90                                                                              | 0.45                                                                                                                                                                                                                                                  |                                                                                   | 0.69                                                                              | 0.35                                                                                                                                                                | 0.05                                                                              |                                                                                     | 1.00                                                                                | 1.00                                                                                                                                                                                                                                                        | 1.00                                                                                | 1.00                                                                                |                                                                                     |
| Incremental Delay, d2             | 2.3                                                                               | 1.3                                                                                                                                                                                                                                                   |                                                                                   | 1.8                                                                               | 1.4                                                                                                                                                                 | 0.2                                                                               |                                                                                     | 8.2                                                                                 | 0.6                                                                                                                                                                                                                                                         | 19.2                                                                                | 0.5                                                                                 |                                                                                     |
| Delay (s)                         | 51.1                                                                              | 15.8                                                                                                                                                                                                                                                  |                                                                                   | 23.7                                                                              | 7.1                                                                                                                                                                 | 0.7                                                                               |                                                                                     | 74.7                                                                                | 39.1                                                                                                                                                                                                                                                        | 85.3                                                                                | 62.6                                                                                |                                                                                     |
| Level of Service                  | D                                                                                 | B                                                                                                                                                                                                                                                     |                                                                                   | C                                                                                 | A                                                                                                                                                                   | A                                                                                 |                                                                                     | E                                                                                   | D                                                                                                                                                                                                                                                           | F                                                                                   | E                                                                                   |                                                                                     |
| Approach Delay (s)                |                                                                                   | 17.0                                                                                                                                                                                                                                                  |                                                                                   |                                                                                   | 9.1                                                                                                                                                                 |                                                                                   |                                                                                     | 44.5                                                                                |                                                                                                                                                                                                                                                             |                                                                                     | 77.4                                                                                |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                                                                                                                                                                                     |                                                                                   |                                                                                   | A                                                                                                                                                                   |                                                                                   |                                                                                     | D                                                                                   |                                                                                                                                                                                                                                                             |                                                                                     | E                                                                                   |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                                                                                                                                                                                       |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                     |                                                                                                                                                                                                                                                             |                                                                                     |                                                                                     |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                                                                                                                                                                                       | 19.8                                                                              |                                                                                   |                                                                                                                                                                     | HCM 2000 Level of Service                                                         |                                                                                     |                                                                                     |                                                                                                                                                                                                                                                             | B                                                                                   |                                                                                     |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                                                                                                                                                                                       | 0.69                                                                              |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                     |                                                                                                                                                                                                                                                             |                                                                                     |                                                                                     |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                                                                                                                                                                                       | 150.0                                                                             |                                                                                   |                                                                                                                                                                     | Sum of lost time (s)                                                              |                                                                                     |                                                                                     | 20.0                                                                                                                                                                                                                                                        |                                                                                     |                                                                                     |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                                                                                                                                                                                       | 70.8%                                                                             |                                                                                   |                                                                                                                                                                     | ICU Level of Service                                                              |                                                                                     |                                                                                     | C                                                                                                                                                                                                                                                           |                                                                                     |                                                                                     |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                                                                                                                                                                                       | 15                                                                                |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                     |                                                                                                                                                                                                                                                             |                                                                                     |                                                                                     |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                                                                                                                                                                                       |                                                                                   |                                                                                   |                                                                                                                                                                     |                                                                                   |                                                                                     |                                                                                     |                                                                                                                                                                                                                                                             |                                                                                     |                                                                                     |                                                                                     |

## Queues

## 5: Connector/Creekside &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | WBL  | WBT  | WBR  | NBT   | NBR  | SBL  | SBT  |
|-------------------------|------|------|------|------|------|-------|------|------|------|
| Lane Group Flow (vph)   | 53   | 1487 | 300  | 1554 | 149  | 89    | 497  | 127  | 67   |
| v/c Ratio               | 0.40 | 0.65 | 0.61 | 0.66 | 0.13 | 0.62  | 0.54 | 0.77 | 0.35 |
| Control Delay           | 26.1 | 16.1 | 30.6 | 7.2  | 0.3  | 84.3  | 41.0 | 93.8 | 30.0 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0  | 0.0  | 0.0  |
| Total Delay             | 26.1 | 16.1 | 30.6 | 7.2  | 0.3  | 84.3  | 41.0 | 93.8 | 30.0 |
| Queue Length 50th (ft)  | 9    | 351  | 125  | 311  | 0    | 83    | 210  | 120  | 18   |
| Queue Length 95th (ft)  | m52  | 102  | 206  | 214  | 0    | m#197 | 268  | #248 | 70   |
| Internal Link Dist (ft) |      | 700  |      | 797  |      | 519   |      |      | 443  |
| Turn Bay Length (ft)    | 250  |      | 420  |      |      |       | 160  | 190  |      |
| Base Capacity (vph)     | 134  | 2492 | 536  | 2482 | 1167 | 143   | 919  | 167  | 195  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 17   | 0    | 0     | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0     | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.40 | 0.60 | 0.56 | 0.63 | 0.13 | 0.62  | 0.54 | 0.76 | 0.34 |

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



# HCM Signalized Intersection Capacity Analysis

## 4: Old Graves Mill & Graves Mill

03/07/2018

|                                   |  |                                                                                                                                                                      |  |                                                                                    |                                                                                    |  |  |  |  |  |                                                                                      |  |
|-----------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Movement                          | EBL                                                                               | EBT                                                                                                                                                                                                                                                   | EBR                                                                               | WBL                                                                                                                                                                 | WBT                                                                                                                                                                 | WBR                                                                               | NBL                                                                                | NBT                                                                                 | NBR                                                                                 | SBL                                                                                 | SBT                                                                                                                                                                     | SBR                                                                                 |
| Lane Configurations               |  |    |  |   |   |                                                                                   |                                                                                    |  |  |                                                                                     |   |                                                                                     |
| Traffic Volume (vph)              | 1                                                                                 | 1467                                                                                                                                                                                                                                                  | 341                                                                               | 345                                                                                                                                                                 | 1251                                                                                                                                                                | 0                                                                                 | 200                                                                                | 0                                                                                   | 68                                                                                  | 0                                                                                   | 1                                                                                                                                                                       | 3                                                                                   |
| Future Volume (vph)               | 1                                                                                 | 1467                                                                                                                                                                                                                                                  | 341                                                                               | 345                                                                                                                                                                 | 1251                                                                                                                                                                | 0                                                                                 | 200                                                                                | 0                                                                                   | 68                                                                                  | 0                                                                                   | 1                                                                                                                                                                       | 3                                                                                   |
| Ideal Flow (vphpl)                | 1900                                                                              | 1900                                                                                                                                                                                                                                                  | 1900                                                                              | 1900                                                                                                                                                                | 1900                                                                                                                                                                | 1900                                                                              | 1900                                                                               | 1900                                                                                | 1900                                                                                | 1900                                                                                | 1900                                                                                                                                                                    | 1900                                                                                |
| Lane Width                        | 12                                                                                | 12                                                                                                                                                                                                                                                    | 12                                                                                | 11                                                                                                                                                                  | 12                                                                                                                                                                  | 12                                                                                | 12                                                                                 | 13                                                                                  | 13                                                                                  | 12                                                                                  | 16                                                                                                                                                                      | 12                                                                                  |
| Grade (%)                         |                                                                                   | 3%                                                                                                                                                                                                                                                    |                                                                                   |                                                                                                                                                                     | -5%                                                                                                                                                                 |                                                                                   |                                                                                    | -5%                                                                                 |                                                                                     |                                                                                     | 3%                                                                                                                                                                      |                                                                                     |
| Total Lost time (s)               | 5.0                                                                               | 5.0                                                                                                                                                                                                                                                   | 5.0                                                                               | 5.0                                                                                                                                                                 | 5.0                                                                                                                                                                 |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     | 5.0                                                                                                                                                                     |                                                                                     |
| Lane Util. Factor                 | 1.00                                                                              | 0.91                                                                                                                                                                                                                                                  | 1.00                                                                              | 0.97                                                                                                                                                                | 0.95                                                                                                                                                                |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                                                                                                    |                                                                                     |
| Frt                               | 1.00                                                                              | 1.00                                                                                                                                                                                                                                                  | 0.85                                                                              | 1.00                                                                                                                                                                | 1.00                                                                                                                                                                |                                                                                   |                                                                                    | 1.00                                                                                | 0.85                                                                                |                                                                                     | 0.90                                                                                                                                                                    |                                                                                     |
| Flt Protected                     | 0.95                                                                              | 1.00                                                                                                                                                                                                                                                  | 1.00                                                                              | 0.95                                                                                                                                                                | 1.00                                                                                                                                                                |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                                                                                                    |                                                                                     |
| Satd. Flow (prot)                 | 1778                                                                              | 5059                                                                                                                                                                                                                                                  | 1575                                                                              | 3402                                                                                                                                                                | 3664                                                                                                                                                                |                                                                                   |                                                                                    | 1874                                                                                | 1677                                                                                |                                                                                     | 1906                                                                                                                                                                    |                                                                                     |
| Flt Permitted                     | 0.95                                                                              | 1.00                                                                                                                                                                                                                                                  | 1.00                                                                              | 0.95                                                                                                                                                                | 1.00                                                                                                                                                                |                                                                                   |                                                                                    | 0.95                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                                                                                                    |                                                                                     |
| Satd. Flow (perm)                 | 1778                                                                              | 5059                                                                                                                                                                                                                                                  | 1575                                                                              | 3402                                                                                                                                                                | 3664                                                                                                                                                                |                                                                                   |                                                                                    | 1874                                                                                | 1677                                                                                |                                                                                     | 1906                                                                                                                                                                    |                                                                                     |
| Peak-hour factor, PHF             | 0.91                                                                              | 0.91                                                                                                                                                                                                                                                  | 0.91                                                                              | 0.91                                                                                                                                                                | 0.91                                                                                                                                                                | 0.91                                                                              | 0.91                                                                               | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                | 0.91                                                                                                                                                                    | 0.91                                                                                |
| Adj. Flow (vph)                   | 1                                                                                 | 1612                                                                                                                                                                                                                                                  | 375                                                                               | 379                                                                                                                                                                 | 1375                                                                                                                                                                | 0                                                                                 | 220                                                                                | 0                                                                                   | 75                                                                                  | 0                                                                                   | 1                                                                                                                                                                       | 3                                                                                   |
| RTOR Reduction (vph)              | 0                                                                                 | 0                                                                                                                                                                                                                                                     | 124                                                                               | 0                                                                                                                                                                   | 0                                                                                                                                                                   | 0                                                                                 | 0                                                                                  | 0                                                                                   | 64                                                                                  | 0                                                                                   | 3                                                                                                                                                                       | 0                                                                                   |
| Lane Group Flow (vph)             | 1                                                                                 | 1612                                                                                                                                                                                                                                                  | 251                                                                               | 379                                                                                                                                                                 | 1375                                                                                                                                                                | 0                                                                                 | 0                                                                                  | 220                                                                                 | 11                                                                                  | 0                                                                                   | 1                                                                                                                                                                       | 0                                                                                   |
| Heavy Vehicles (%)                | 0%                                                                                | 1%                                                                                                                                                                                                                                                    | 1%                                                                                | 2%                                                                                                                                                                  | 1%                                                                                                                                                                  | 0%                                                                                | 2%                                                                                 | 0%                                                                                  | 2%                                                                                  | 0%                                                                                  | 0%                                                                                                                                                                      | 0%                                                                                  |
| Turn Type                         | Prot                                                                              | NA                                                                                                                                                                                                                                                    | Perm                                                                              | Prot                                                                                                                                                                | NA                                                                                                                                                                  |                                                                                   | Split                                                                              | NA                                                                                  | Perm                                                                                |                                                                                     | NA                                                                                                                                                                      |                                                                                     |
| Protected Phases                  | 5                                                                                 | 2                                                                                                                                                                                                                                                     |                                                                                   | 1                                                                                                                                                                   | 6                                                                                                                                                                   |                                                                                   | 8                                                                                  | 8                                                                                   |                                                                                     | 4                                                                                   | 4                                                                                                                                                                       |                                                                                     |
| Permitted Phases                  |                                                                                   |                                                                                                                                                                                                                                                       | 2                                                                                 |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     | 8                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Actuated Green, G (s)             | 1.4                                                                               | 81.1                                                                                                                                                                                                                                                  | 81.1                                                                              | 24.8                                                                                                                                                                | 104.5                                                                                                                                                               |                                                                                   |                                                                                    | 22.8                                                                                | 22.8                                                                                |                                                                                     | 1.3                                                                                                                                                                     |                                                                                     |
| Effective Green, g (s)            | 1.4                                                                               | 81.1                                                                                                                                                                                                                                                  | 81.1                                                                              | 24.8                                                                                                                                                                | 104.5                                                                                                                                                               |                                                                                   |                                                                                    | 22.8                                                                                | 22.8                                                                                |                                                                                     | 1.3                                                                                                                                                                     |                                                                                     |
| Actuated g/C Ratio                | 0.01                                                                              | 0.54                                                                                                                                                                                                                                                  | 0.54                                                                              | 0.17                                                                                                                                                                | 0.70                                                                                                                                                                |                                                                                   |                                                                                    | 0.15                                                                                | 0.15                                                                                |                                                                                     | 0.01                                                                                                                                                                    |                                                                                     |
| Clearance Time (s)                | 5.0                                                                               | 5.0                                                                                                                                                                                                                                                   | 5.0                                                                               | 5.0                                                                                                                                                                 | 5.0                                                                                                                                                                 |                                                                                   |                                                                                    | 5.0                                                                                 | 5.0                                                                                 |                                                                                     | 5.0                                                                                                                                                                     |                                                                                     |
| Vehicle Extension (s)             | 3.0                                                                               | 3.0                                                                                                                                                                                                                                                   | 3.0                                                                               | 3.0                                                                                                                                                                 | 3.0                                                                                                                                                                 |                                                                                   |                                                                                    | 3.0                                                                                 | 3.0                                                                                 |                                                                                     | 3.0                                                                                                                                                                     |                                                                                     |
| Lane Grp Cap (vph)                | 16                                                                                | 2735                                                                                                                                                                                                                                                  | 851                                                                               | 562                                                                                                                                                                 | 2552                                                                                                                                                                |                                                                                   |                                                                                    | 284                                                                                 | 254                                                                                 |                                                                                     | 16                                                                                                                                                                      |                                                                                     |
| v/s Ratio Prot                    | 0.00                                                                              | c0.32                                                                                                                                                                                                                                                 |                                                                                   | c0.11                                                                                                                                                               | 0.38                                                                                                                                                                |                                                                                   |                                                                                    | c0.12                                                                               |                                                                                     |                                                                                     | c0.00                                                                                                                                                                   |                                                                                     |
| v/s Ratio Perm                    |                                                                                   |                                                                                                                                                                                                                                                       | 0.16                                                                              |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     | 0.01                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| v/c Ratio                         | 0.06                                                                              | 0.59                                                                                                                                                                                                                                                  | 0.29                                                                              | 0.67                                                                                                                                                                | 0.54                                                                                                                                                                |                                                                                   |                                                                                    | 0.77                                                                                | 0.04                                                                                |                                                                                     | 0.06                                                                                                                                                                    |                                                                                     |
| Uniform Delay, d1                 | 73.6                                                                              | 23.2                                                                                                                                                                                                                                                  | 18.8                                                                              | 58.8                                                                                                                                                                | 11.0                                                                                                                                                                |                                                                                   |                                                                                    | 61.1                                                                                | 54.3                                                                                |                                                                                     | 73.7                                                                                                                                                                    |                                                                                     |
| Progression Factor                | 0.98                                                                              | 0.65                                                                                                                                                                                                                                                  | 0.33                                                                              | 0.83                                                                                                                                                                | 0.49                                                                                                                                                                |                                                                                   |                                                                                    | 1.00                                                                                | 1.00                                                                                |                                                                                     | 1.00                                                                                                                                                                    |                                                                                     |
| Incremental Delay, d2             | 1.3                                                                               | 0.8                                                                                                                                                                                                                                                   | 0.7                                                                               | 2.6                                                                                                                                                                 | 0.7                                                                                                                                                                 |                                                                                   |                                                                                    | 12.4                                                                                | 0.1                                                                                 |                                                                                     | 1.7                                                                                                                                                                     |                                                                                     |
| Delay (s)                         | 73.4                                                                              | 16.0                                                                                                                                                                                                                                                  | 6.8                                                                               | 51.5                                                                                                                                                                | 6.1                                                                                                                                                                 |                                                                                   |                                                                                    | 73.5                                                                                | 54.4                                                                                |                                                                                     | 75.4                                                                                                                                                                    |                                                                                     |
| Level of Service                  | E                                                                                 | B                                                                                                                                                                                                                                                     | A                                                                                 | D                                                                                                                                                                   | A                                                                                                                                                                   |                                                                                   |                                                                                    | E                                                                                   | D                                                                                   |                                                                                     | E                                                                                                                                                                       |                                                                                     |
| Approach Delay (s)                |                                                                                   | 14.3                                                                                                                                                                                                                                                  |                                                                                   |                                                                                                                                                                     | 15.9                                                                                                                                                                |                                                                                   |                                                                                    | 68.7                                                                                |                                                                                     |                                                                                     | 75.4                                                                                                                                                                    |                                                                                     |
| Approach LOS                      |                                                                                   | B                                                                                                                                                                                                                                                     |                                                                                   |                                                                                                                                                                     | B                                                                                                                                                                   |                                                                                   |                                                                                    | E                                                                                   |                                                                                     |                                                                                     | E                                                                                                                                                                       |                                                                                     |
| <b>Intersection Summary</b>       |                                                                                   |                                                                                                                                                                                                                                                       |                                                                                   |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |
| HCM 2000 Control Delay            |                                                                                   |                                                                                                                                                                                                                                                       | 19.0                                                                              |                                                                                                                                                                     |                                                                                                                                                                     | HCM 2000 Level of Service                                                         |                                                                                    |                                                                                     | B                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |
| HCM 2000 Volume to Capacity ratio |                                                                                   |                                                                                                                                                                                                                                                       | 0.63                                                                              |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Actuated Cycle Length (s)         |                                                                                   |                                                                                                                                                                                                                                                       | 150.0                                                                             |                                                                                                                                                                     |                                                                                                                                                                     | Sum of lost time (s)                                                              |                                                                                    |                                                                                     | 20.0                                                                                |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Intersection Capacity Utilization |                                                                                   |                                                                                                                                                                                                                                                       | 70.7%                                                                             |                                                                                                                                                                     |                                                                                                                                                                     | ICU Level of Service                                                              |                                                                                    |                                                                                     | C                                                                                   |                                                                                     |                                                                                                                                                                         |                                                                                     |
| Analysis Period (min)             |                                                                                   |                                                                                                                                                                                                                                                       | 15                                                                                |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |
| c Critical Lane Group             |                                                                                   |                                                                                                                                                                                                                                                       |                                                                                   |                                                                                                                                                                     |                                                                                                                                                                     |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                                                                                                         |                                                                                     |

## Queues

## 4: Old Graves Mill &amp; Graves Mill

03/07/2018



| Lane Group              | EBL  | EBT  | EBR  | WBL  | WBT  | NBT  | NBR  | SBT  |
|-------------------------|------|------|------|------|------|------|------|------|
| Lane Group Flow (vph)   | 1    | 1612 | 375  | 379  | 1375 | 220  | 75   | 4    |
| v/c Ratio               | 0.01 | 0.54 | 0.36 | 0.80 | 0.50 | 0.77 | 0.21 | 0.05 |
| Control Delay           | 67.0 | 13.6 | 2.5  | 63.2 | 5.3  | 78.8 | 2.0  | 49.8 |
| Queue Delay             | 0.0  | 0.0  | 0.0  | 0.0  | 0.1  | 0.0  | 0.0  | 0.0  |
| Total Delay             | 67.0 | 13.6 | 2.5  | 63.2 | 5.4  | 78.8 | 2.0  | 49.8 |
| Queue Length 50th (ft)  | 1    | 265  | 6    | 185  | 36   | 210  | 0    | 1    |
| Queue Length 95th (ft)  | m1   | 369  | 71   | 236  | 250  | 290  | 6    | 14   |
| Internal Link Dist (ft) |      | 1348 |      |      | 700  | 355  |      | 176  |
| Turn Bay Length (ft)    | 380  |      | 280  | 310  |      |      |      |      |
| Base Capacity (vph)     | 82   | 3004 | 1045 | 521  | 2747 | 374  | 434  | 383  |
| Starvation Cap Reductn  | 0    | 0    | 0    | 0    | 320  | 0    | 0    | 0    |
| Spillback Cap Reductn   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Storage Cap Reductn     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Reduced v/c Ratio       | 0.01 | 0.54 | 0.36 | 0.73 | 0.57 | 0.59 | 0.17 | 0.01 |

## Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

# Appendix G

## Turn Lane Warrants

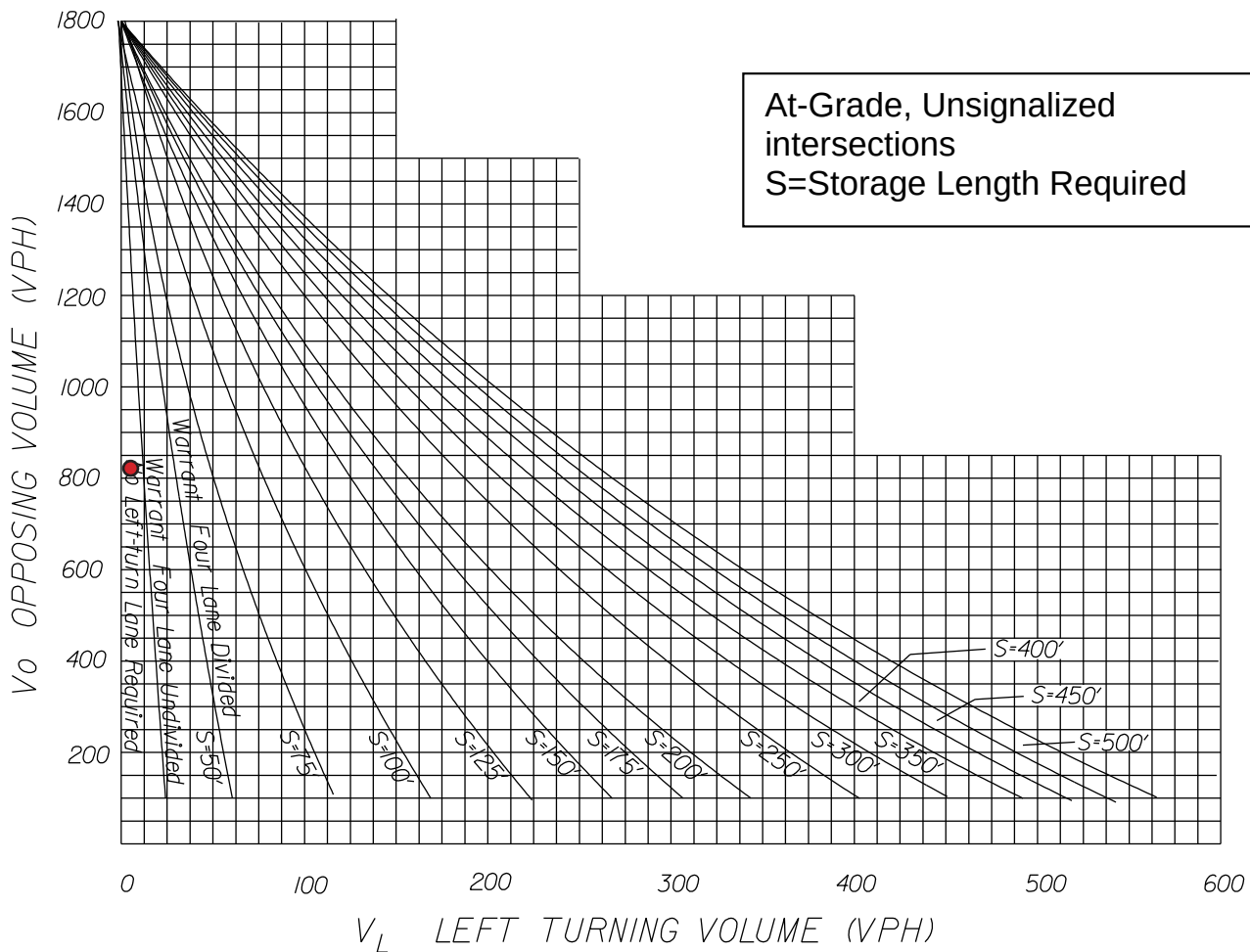
# Warrant for Left-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study  
Intersection: Graves Mill Road/Millside

Approach Direction: Graves Mill Road EB  
Peak Hour: AM

Peak Hour Left Turns ( $V_L$ ): 4 vph  
Opposing Volume ( $V_O$ ): 822 vph

Conclusion: No Left Turn Storage Lane Required





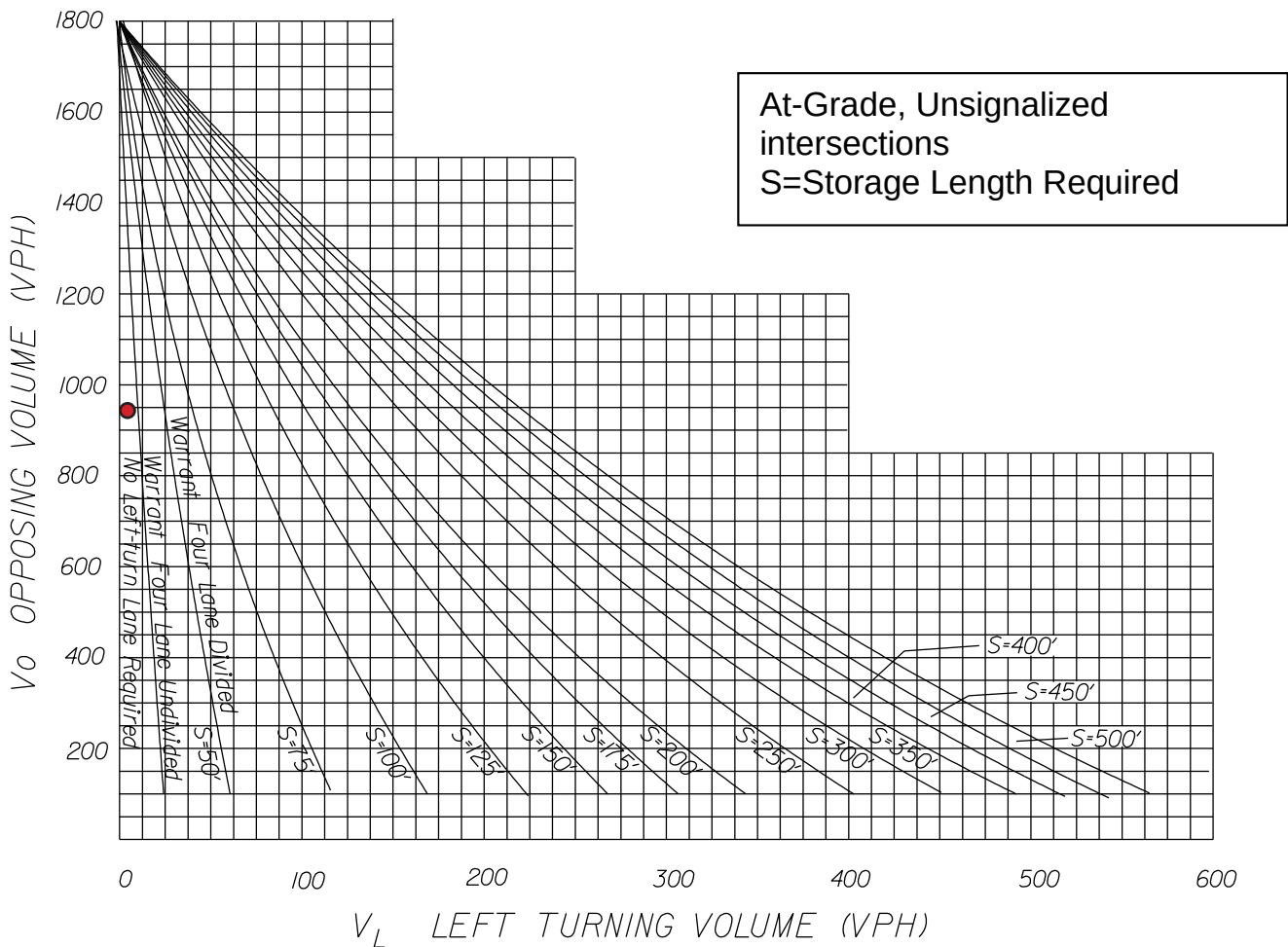
# Warrant for Left-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study  
Intersection: Graves Mill Road/Millside

Approach Direction: Graves Mill Road EB  
Peak Hour: PM

Peak Hour Left Turns ( $V_L$ ): 3 vph  
Opposing Volume ( $V_O$ ): 949 vph

Conclusion: No Left Turn Storage Lane Required



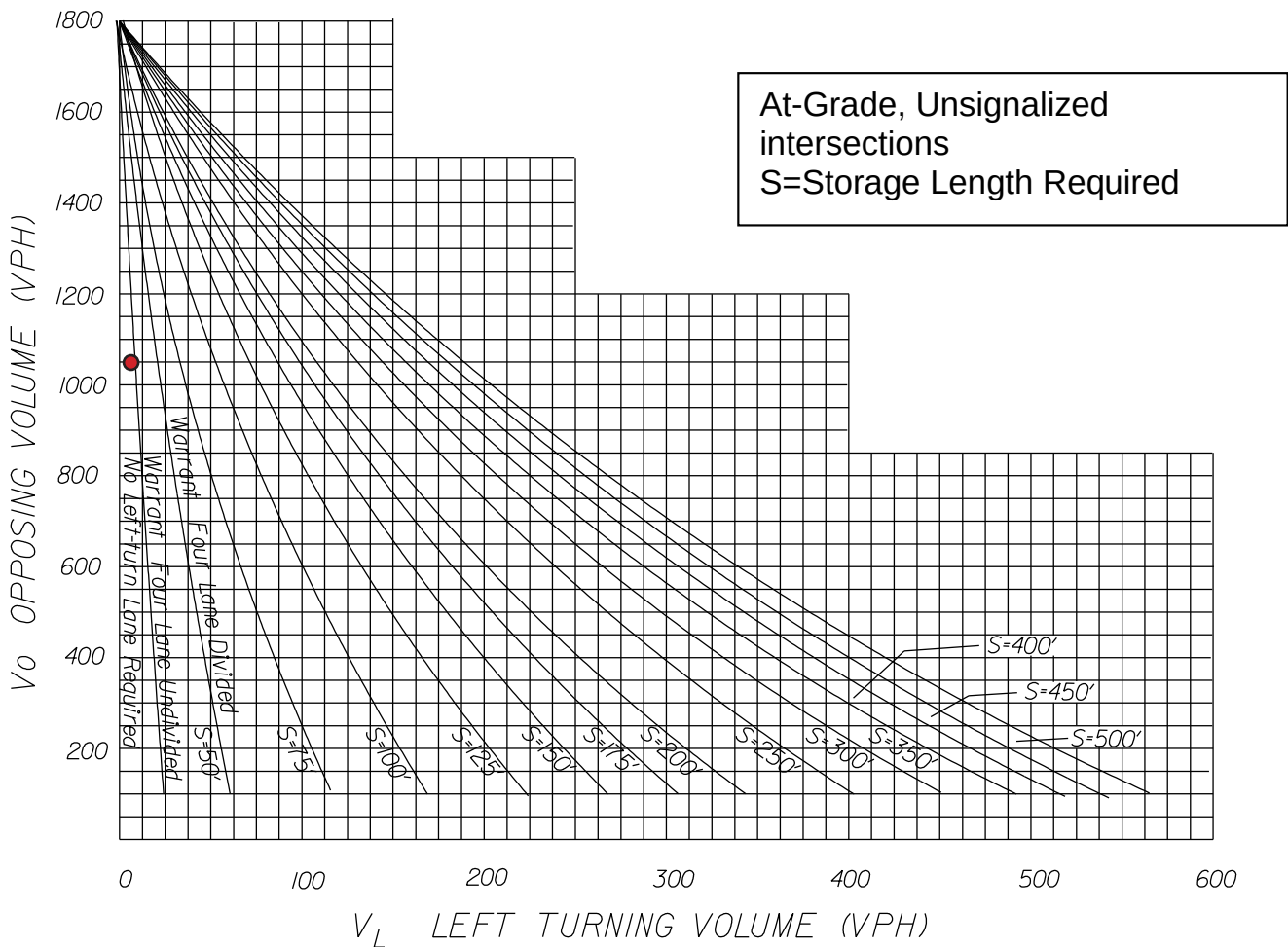
# Warrant for Left-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study  
Intersection: Graves Mill Road/Millside

Approach Direction: Graves Mill Road WB  
Peak Hour: AM

Peak Hour Left Turns ( $V_L$ ): 6 vph  
Opposing Volume ( $V_O$ ): 1050 vph

Conclusion: No Left Turn Storage Lane Required



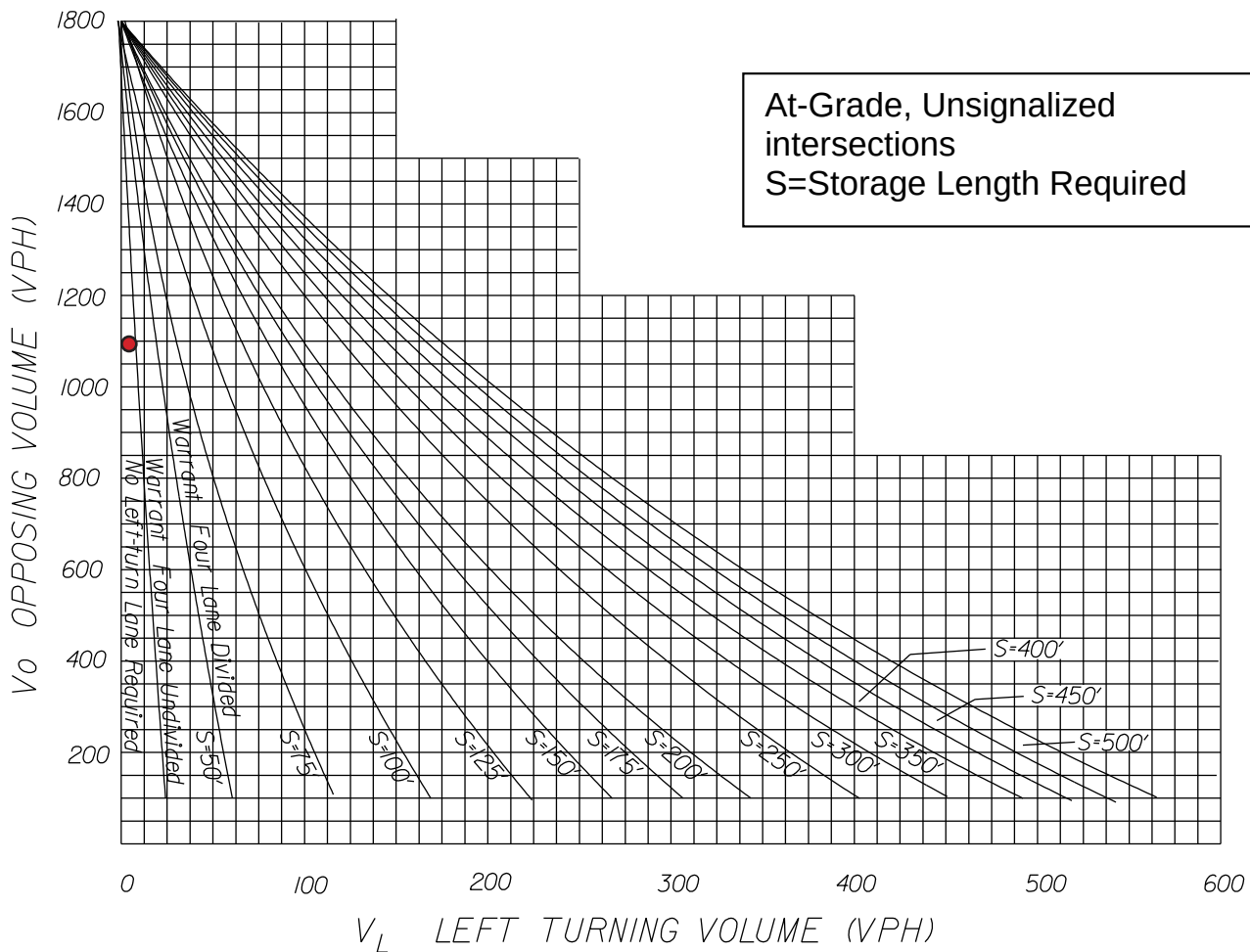
# Warrant for Left-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study  
Intersection: Graves Mill Road/Millside

Approach Direction: Graves Mill Road WB  
Peak Hour: PM

Peak Hour Left Turns ( $V_L$ ): 4 vph  
Opposing Volume ( $V_O$ ): 1092 vph

Conclusion: No Left Turn Storage Lane Required



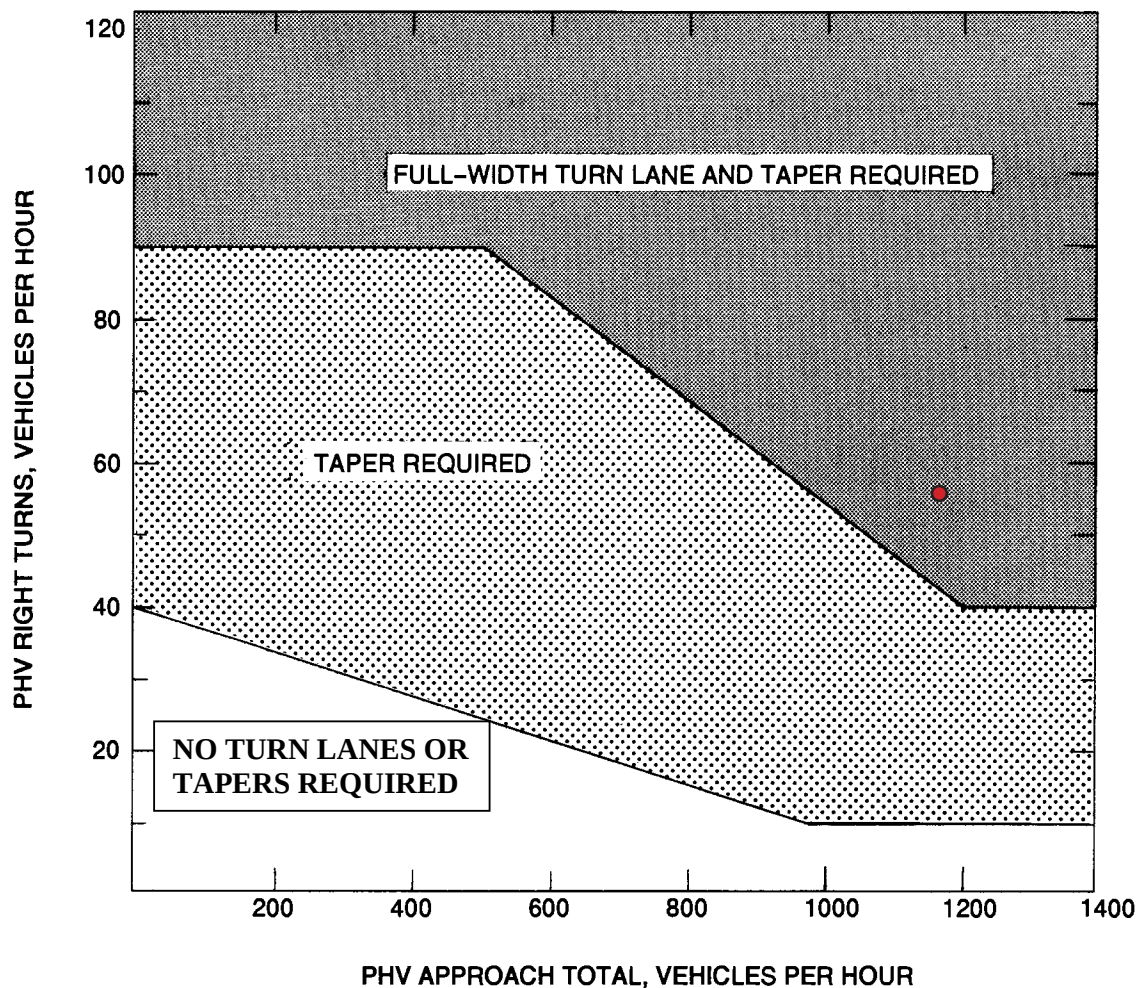
# Warrant for Right-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study  
Intersection: Graves Mill Road/Millrace Drive

Approach Direction: Graves Mill Road EB  
Peak Hour: AM

Peak Hour Volume Right Turns: 56 vph  
Peak Hour Volume Approach Total: 1180 vph

Conclusion: Full-width Turn Lane and Taper Required





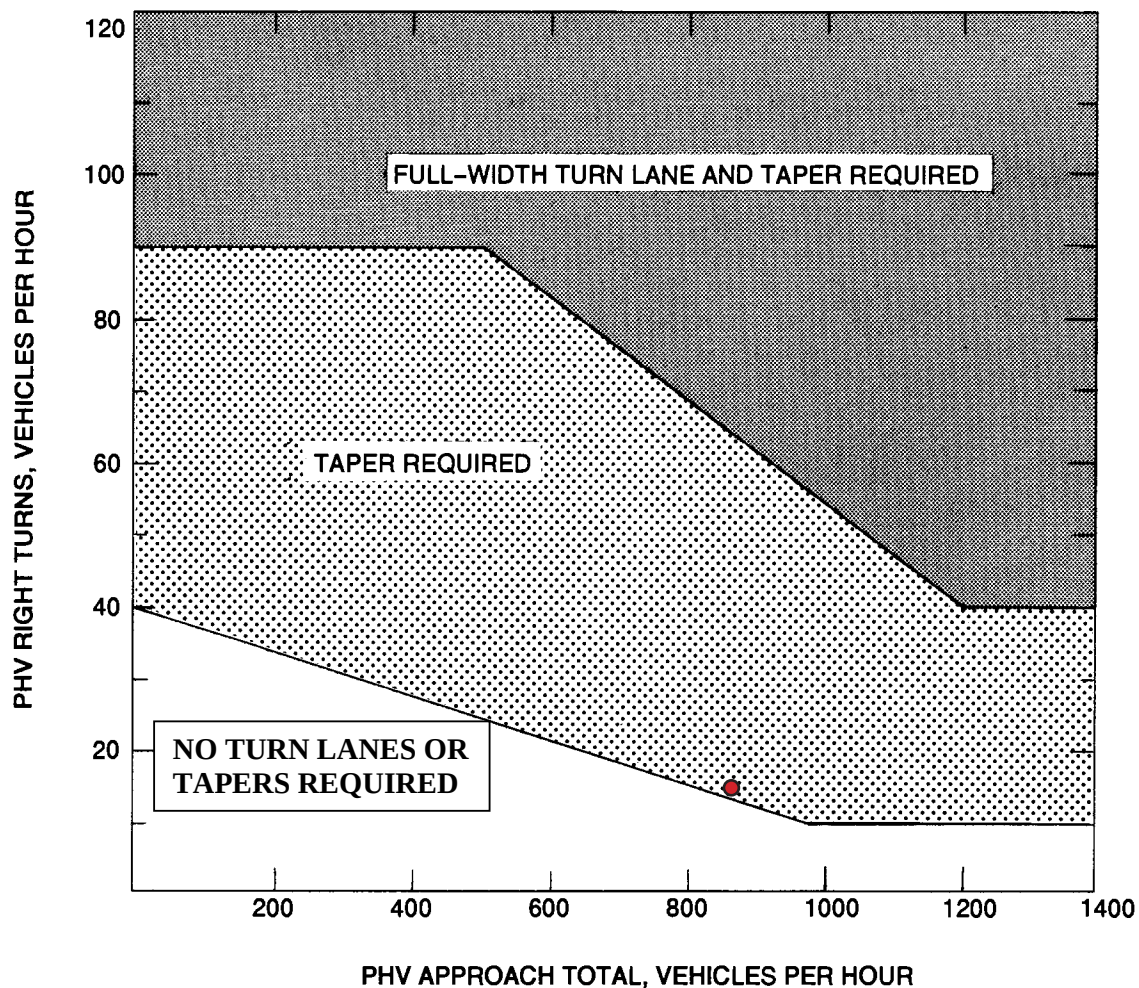
# Warrant for Right-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study  
Intersection: Graves Mill Road/Millrace Drive

Approach Direction: Graves Mill Road EB  
Peak Hour: PM

Peak Hour Volume Right Turns: 14 vph  
Peak Hour Volume Approach Total: 860 vph

Conclusion: Taper Required



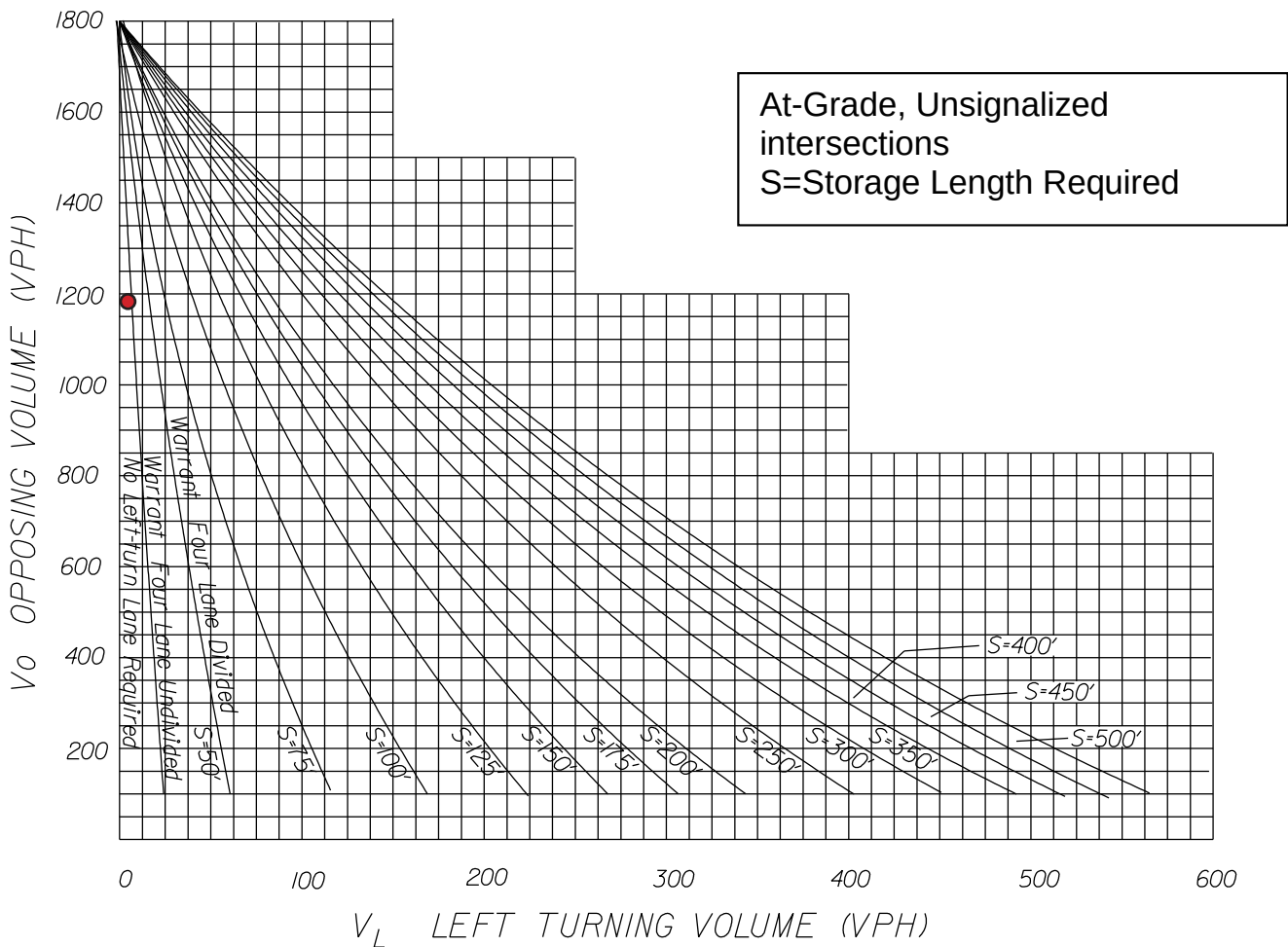
# Warrant for Left-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study (2040 No Build Scenario)  
Intersection: Graves Mill Road/Millside

Approach Direction: Graves Mill Road EB  
Peak Hour: AM

Peak Hour Left Turns ( $V_L$ ): 5 vph  
Opposing Volume ( $V_O$ ): 1186 vph

Conclusion: No Left Turn Storage Lane Required



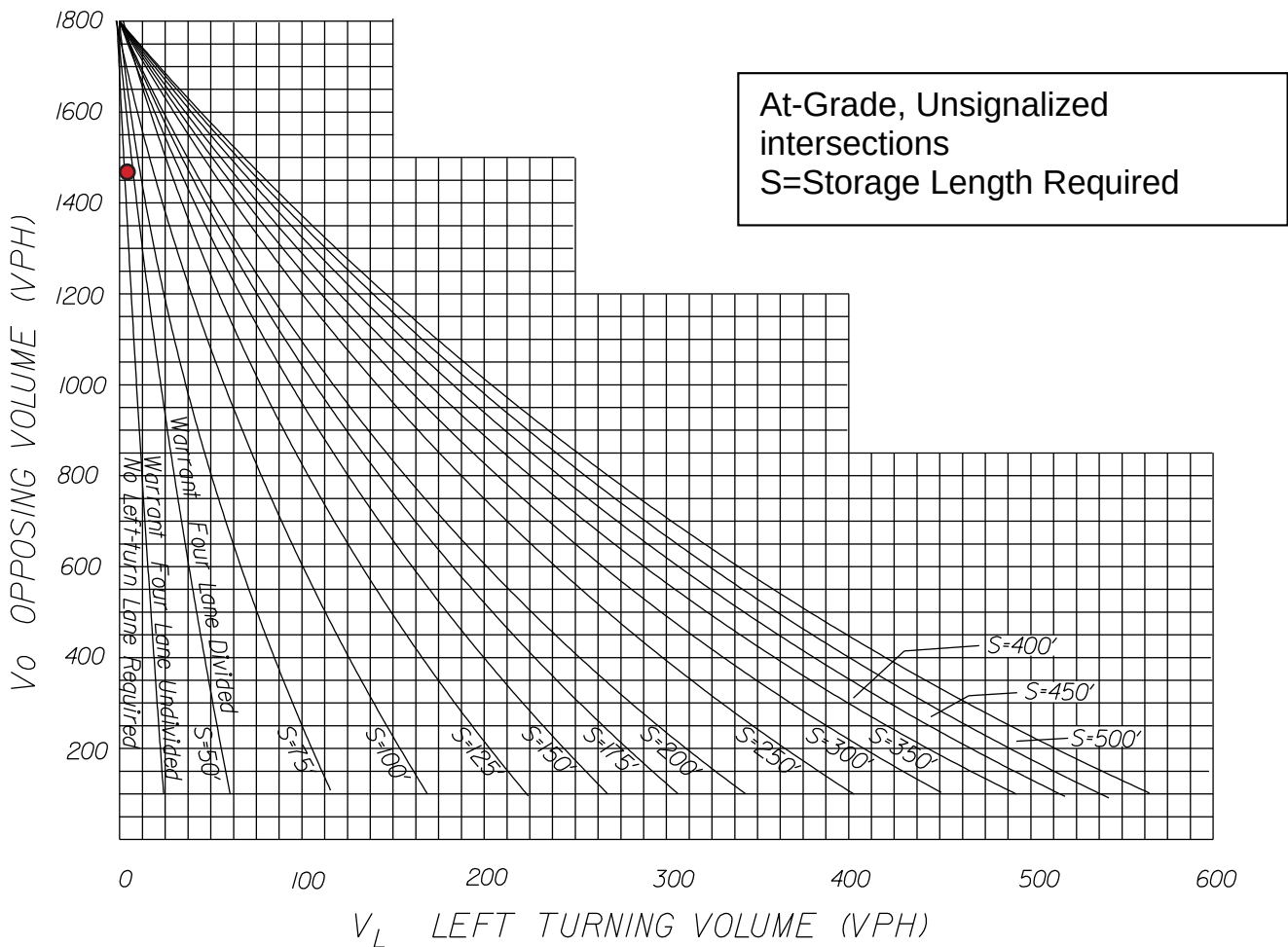
# Warrant for Left-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study (2040 No Build Scenario)  
Intersection: Graves Mill Road/Millside

Approach Direction: Graves Mill Road EB  
Peak Hour: PM

Peak Hour Left Turns ( $V_L$ ): 4 vph  
Opposing Volume ( $V_O$ ): 1469 vph

Conclusion: 50' Left Turn Storage Lane Required



# Warrant for Left-Turn Storage Lanes on Four-Lane Highway

**Project:** Graves Mill Corridor Study (2040 No Build Scenario)

**Intersection:** Graves Mill Road/Millside

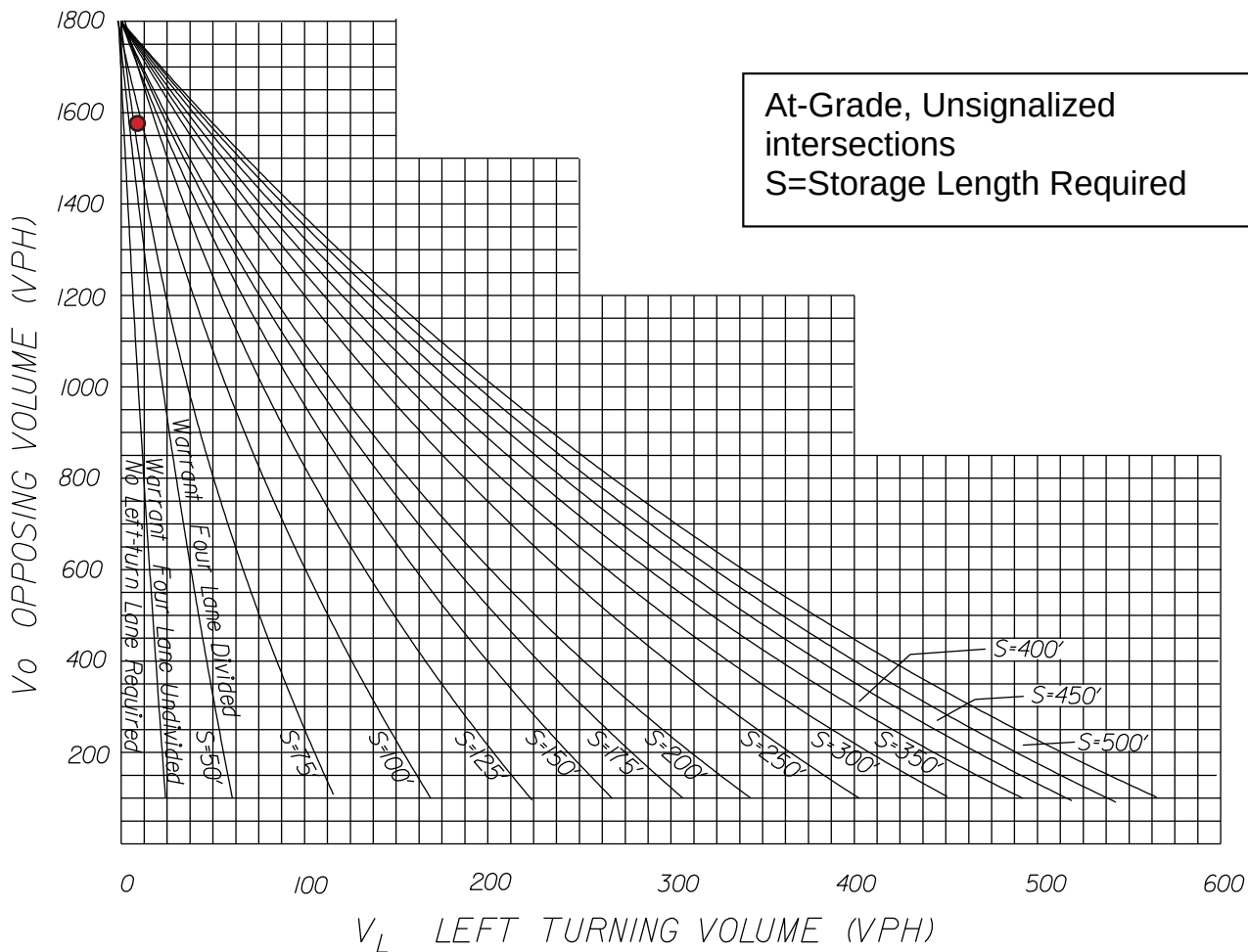
**Approach Direction:** Graves Mill Road WB

**Peak Hour:** AM

**Peak Hour Left Turns ( $V_L$ ):** 8 vph

**Opposing Volume ( $V_O$ ):** 1574 vph

**Conclusion:** 100' Left Turn Storage Lane Required





# Warrant for Left-Turn Storage Lanes on Four-Lane Highway

**Project:** Graves Mill Corridor Study (2040 No Build Scenario)

**Intersection:** Graves Mill Road/Millside

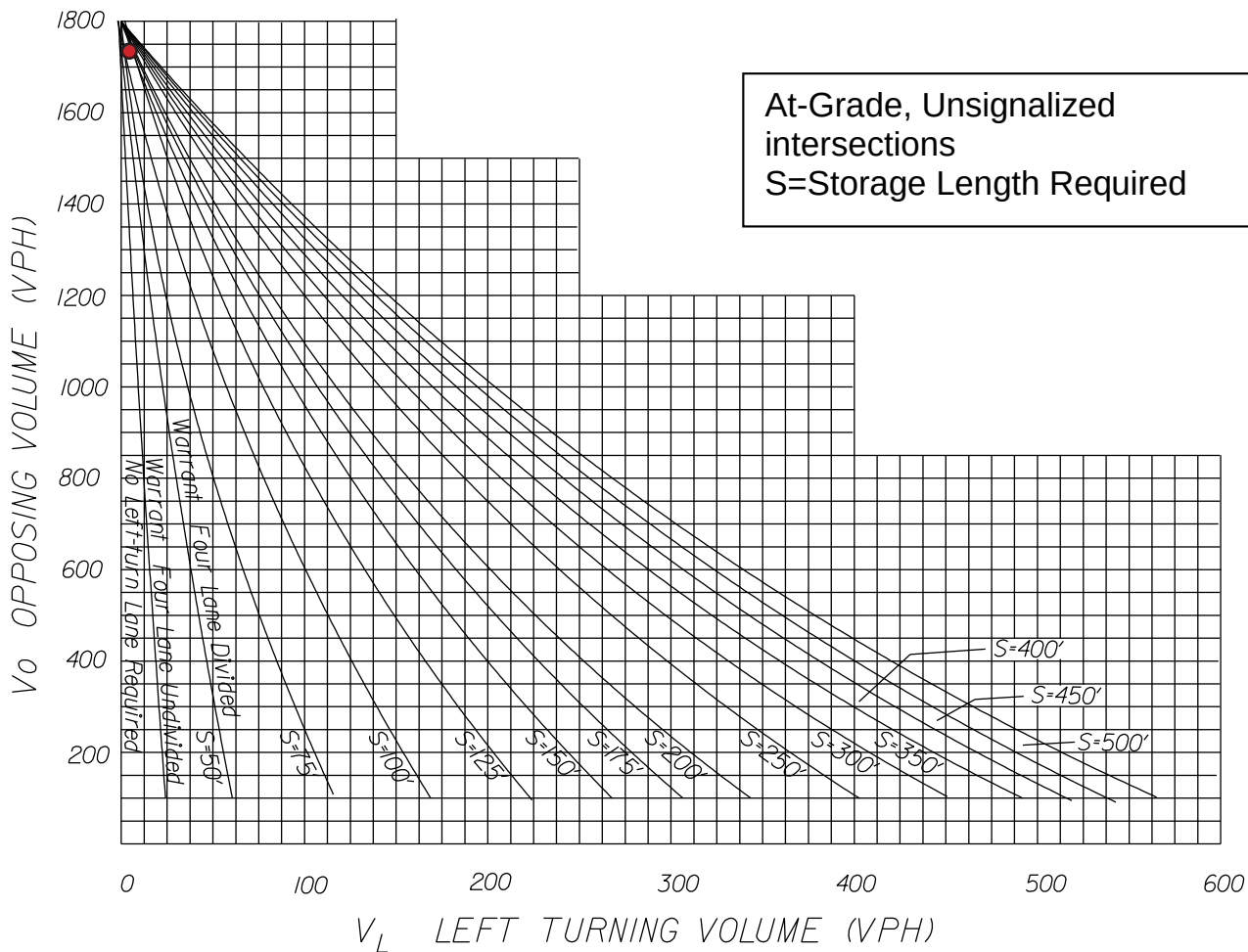
**Approach Direction:** Graves Mill Road WB

**Peak Hour:** PM

**Peak Hour Left Turns ( $V_L$ ):** 5 vph

**Opposing Volume ( $V_O$ ):** 1744 vph

**Conclusion:** 125' Left Turn Storage Lane Required



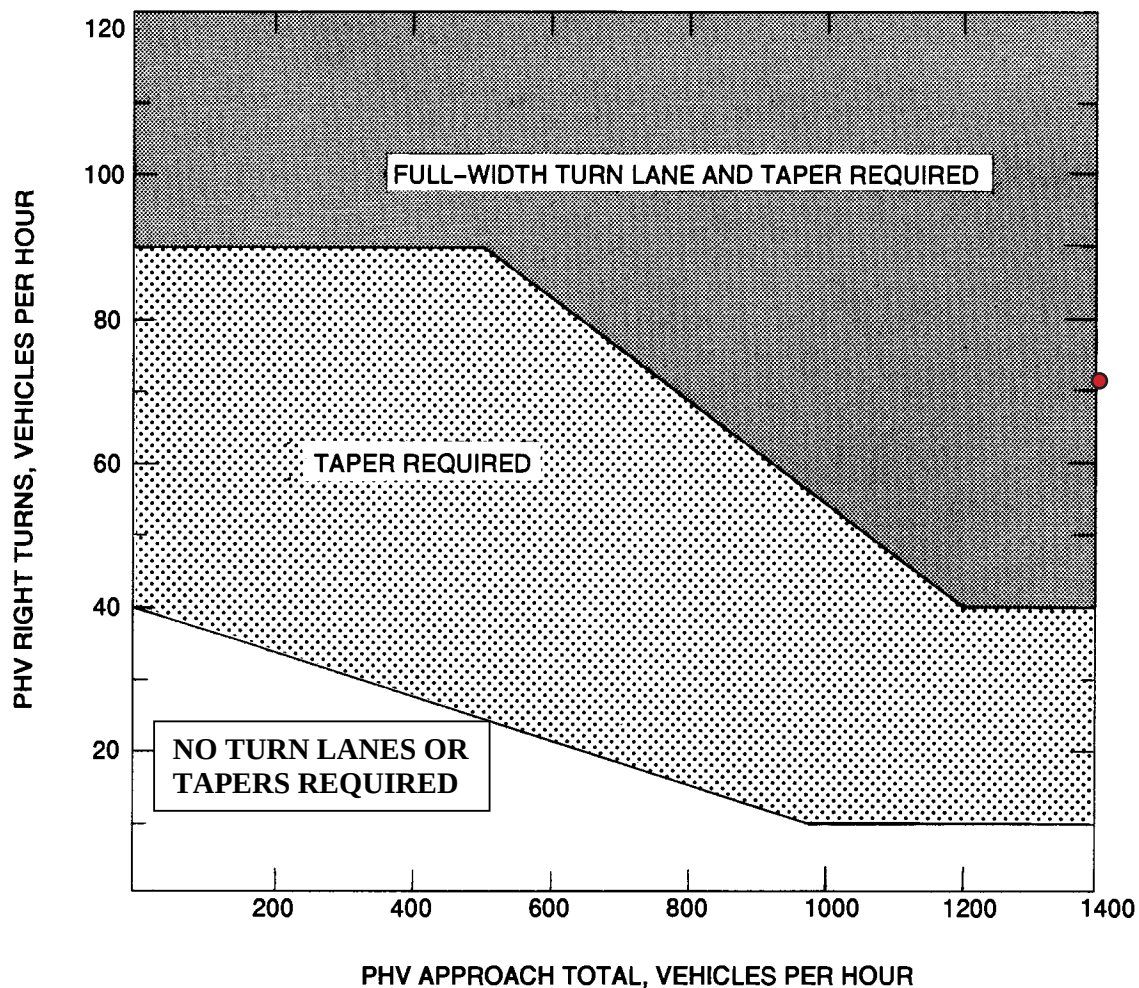
# Warrant for Right-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study (2040 No Build Scenario)  
Intersection: Graves Mill Road/Millrace Drive

Approach Direction: Graves Mill Road EB  
Peak Hour: AM

Peak Hour Volume Right Turns: 72 vph  
Peak Hour Volume Approach Total: 1741 vph

Conclusion: Full-width Turn Lane and Taper Required



# Warrant for Right-Turn Storage Lanes on Four-Lane Highway

Project: Graves Mill Corridor Study (2040 No Build Scenario)

Intersection: Graves Mill Road/Millrace Drive

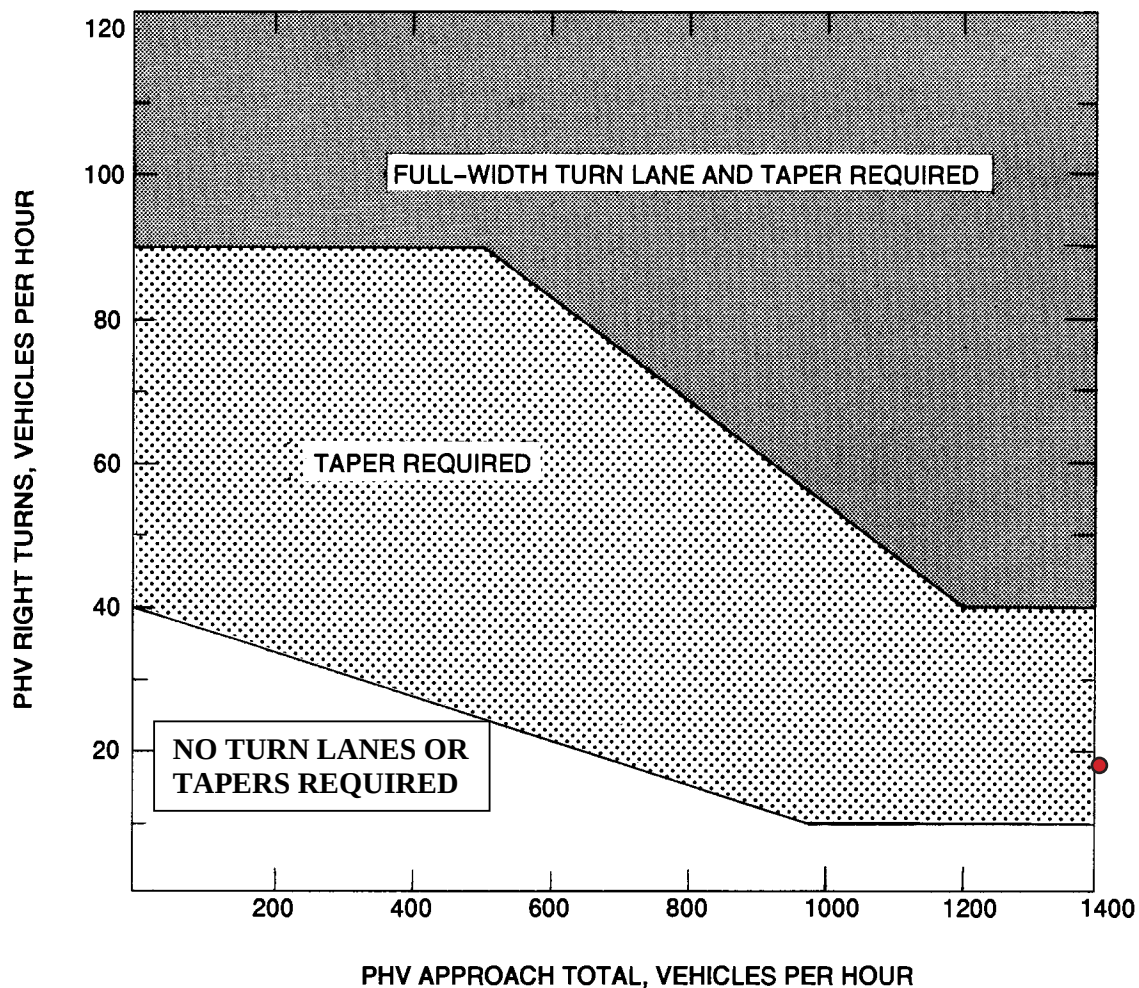
Approach Direction: Graves Mill Road EB

Peak Hour: PM

Peak Hour Volume Right Turns: 18 vph

Peak Hour Volume Approach Total: 1445 vph

Conclusion: Taper Required



# Appendix H

## Detailed Cost Estimates





## Project Cost Estimating System SUMMARY PAGE

|                                   |                           |                          |        |
|-----------------------------------|---------------------------|--------------------------|--------|
| DISTRICT                          | LYNCBURG                  |                          |        |
| PROJECT NUMBER                    | Graves Mill and Gristmill |                          |        |
| CONSTRUCTION END YEAR             | FY2018                    | UPC                      | 109702 |
| AD YEAR                           | FY2018                    | RATE OF INFLATION TO AD  | N/A    |
| ESTIMATE YEAR                     | FY2018                    | INFLATION RATE DURING CN | N/A    |
| Date of previous estimate         | 09/21/17                  |                          |        |
| PROJECT MANAGER / DESIGNER        | Bill Wuensch              |                          |        |
| Preliminary Engineering Estimate: | PCES                      |                          |        |
| Construction Estimate:            | PCES                      |                          |        |
| Right-of-Way Estimate:            | PCES                      |                          |        |
| Utilities Estimate:               | PCES                      |                          |        |
| DATE                              | 6/8/2018                  |                          |        |

THE FOLLOWING DATA WILL BE PROVIDED UPON COMPLETION OF THE REMAINDER OF THE WORKBOOK, WHICH IS ACCESSED BY SELECTING THE CONST, RW, & UTIL TABS BELOW

|                                                        |             |
|--------------------------------------------------------|-------------|
| Bridge PE ESTIMATE                                     | \$0         |
| Bridge CN ESTIMATE                                     | \$0         |
| Bridge RW ESTIMATE                                     | \$0         |
| PRELIMINARY ENGINEERING ESTIMATE (excluding Bridge PE) | \$430,568   |
| CONSTRUCTION ESTIMATE (excluding Bridge CN)            | \$2,289,807 |
| RIGHT-OF-WAY & UTILITIES ESTIMATE(excluding Bridge RW) | \$132,632   |
| TOTAL PROJECT ESTIMATE (excluding Bridge estimate)     | \$2,853,007 |



## Project Cost Estimating System SUMMARY PAGE

|                                   |                     |                          |     |
|-----------------------------------|---------------------|--------------------------|-----|
| DISTRICT                          | LYNCBURG            |                          |     |
| PROJECT NUMBER                    | Graves Mill and 501 |                          |     |
| CONSTRUCTION END YEAR             | FY2018              | UPC                      |     |
| AD YEAR                           | FY2018              | RATE OF INFLATION TO AD  | N/A |
| ESTIMATE YEAR                     | FY2018              | INFLATION RATE DURING CN | N/A |
| Date of previous estimate         | 09/21/17            |                          |     |
| PROJECT MANAGER / DESIGNER        | Bill Wuensch        |                          |     |
| Preliminary Engineering Estimate: | PCES                |                          |     |
| Construction Estimate:            | PCES                |                          |     |
| Right-of-Way Estimate:            | PCES                |                          |     |
| Utilities Estimate:               | PCES                |                          |     |
| DATE                              | 6/8/2018            |                          |     |

THE FOLLOWING DATA WILL BE PROVIDED UPON COMPLETION OF THE REMAINDER OF THE WORKBOOK, WHICH IS ACCESSED BY SELECTING THE CONST, RW, & UTIL TABS BELOW

|                                                        |             |
|--------------------------------------------------------|-------------|
| Bridge PE ESTIMATE                                     | \$0         |
| Bridge CN ESTIMATE                                     | \$0         |
| Bridge RW ESTIMATE                                     | \$0         |
| PRELIMINARY ENGINEERING ESTIMATE (excluding Bridge PE) | \$697,821   |
| CONSTRUCTION ESTIMATE (excluding Bridge CN)            | \$4,993,528 |
| RIGHT-OF-WAY & UTILITIES ESTIMATE(excluding Bridge RW) | \$473,149   |
| TOTAL PROJECT ESTIMATE (excluding Bridge estimate)     | \$6,164,498 |

From: Shahady, Thomas [shahady@lynchburg.edu](mailto:shahady@lynchburg.edu)  
Sent: Tuesday, August 14, 2018  
To: Chambers, Valeria  
Subject: Re: Presentation to Council Concerning College Lake

I would like to request the opportunity to present to council at the next available public meeting information related to the draining of College Lake. I am a Professor of Environmental Science at University of Lynchburg, have studied College Lake and surrounding streams for over 15 years and will be representing several groups that are deeply concerned over the current discharge of water.

Thank you and look forward to this opportunity. Please inform me when this meeting will occur.

Thomas Shahady  
Professor of Environmental Science  
University of Lynchburg

096K

**From:** Melinda Tennis <melindasframe@gmail.com>  
**Sent:** Wednesday, August 29, 2018 11:42 AM  
**To:** Chambers, Valeria  
**Subject:** Speak at Sept. 11th City Council

I would like to speak at the Sept. 11<sup>th</sup> City Council meeting. I will be speaking about the proposed 2-way traffic and paid on-street parking.

Thank you.

--

Melinda Tennis  
Melinda's  
Distinctive Custom Picture Framing  
1019 Church St.  
Lynchburg, VA. 24504  
4345281329  
[www.melindasframe.com](http://www.melindasframe.com)  
[melindasframe@gmail.com](mailto:melindasframe@gmail.com)

097K



# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018**

AGENDA ITEM #: **14**

CONSENT:  
ACTION: **X**

REGULAR: **X**  
INFORMATION:

WORK SESSION:

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: Review and Reaffirm the City's Finance Committee Guidelines**

KEY ELEMENTS:

\_\_\_Economic Development XExcellent Government \_\_\_Natural and Built Environment \_\_\_Safe Community \_\_\_Vibrant Community

RECOMMENDATION: Approve the guidelines for the operation of the City Council's Finance Committee.

SUMMARY: The Finance Committee Guidelines are reviewed by the Committee for relevance bi-annually with the appointment of the Finance Committee Chairman. The guidelines were reviewed by the Finance Committee on August 14, 2018 and require Council approval.

PRIOR ACTION(S): Finance Committee, August 14, 2018

FISCAL IMPACT: None

CONTACT(S): Donna S. Witt, Director of Financial Services, 455-3968

ATTACHMENT(S): Finance Committee Guidelines (Revised August 9, 2016)

REVIEWED BY: raw

098K

## **Finance Committee Guidelines** *(Revised, August 2016)*

### **General Purpose Statement**

To guide the City in the execution of Council-adopted financial policies; to review and serve as a filter in determining specific budget/financial actions to be considered by City Council; and, to review financial reports on a quarterly basis to determine if any revenue or expenditure adjustments are necessary during the fiscal year.

To better facilitate the Finance Committee meetings, the agenda format is divided into two sections: General Business and Other Information. Following is a sample of items that may be included in each of these sections:

#### **I. Items considered as General Business**

1. A review of the status of the General Fund Reserve for Contingencies
2. Any item requesting an appropriation from:
  - Reserve for Contingencies-All Funds
  - Fund Balance-All Funds
3. Review of grant applications:  
Prior to submitting grant applications, the grant application or concept will be reviewed by the Finance Committee if local funding is required during or following the end of the grant period. Departments applying for grants must include a strategy for consideration by the Committee outlining what action will occur when the grant funding expires.
4. Discuss quarterly financial reports for the General, Water, Sewer, Stormwater, Airport, Juvenile Detention Home, Children's Services Act (CSA) Funds, and Greater Lynchburg Transit Company (GLTC).
5. Proposed Amendments to Fiscal Management Policies.
6. The structure and timing of proposed bond sales.
7. Other items deemed appropriate by the City Manager.

#### **II. Items Considered as Other Information**

1. Items that do not require immediate Council action but are to advise Council on future items, issues, or simply information sharing. Examples include: reports from bond rating agencies, changes in Virginia Retirement System costs, changes in accounting identified by the Governmental Accounting Standards Board (GASB), grants that are fully reimbursable, requiring no current or local funding.

#### **III. Financial items to be considered by the full City Council**

1. Input into the planning and approach for the annual Capital Improvement Program and Operating Budget.
2. Review and deliberations regarding the Proposed Capital Improvement Program and Operating Budget.
3. Requests for funding by outside agencies.
4. First Quarter Adjustments
5. Third Quarter Adjustments
6. Use of Contingency
7. Financial Trend Indicator Reports
8. New programs or changes in programs creating a current or future budget impact, to include both revenue and expenditure impact.

#### **IV. Roll Call Items**

# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018**

AGENDA ITEM #: **14**

CONSENT:  
ACTION: **X**

REGULAR: **X**  
INFORMATION:

WORK SESSION:

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: Physical Development Committee Guidelines**

KEY ELEMENTS:

\_\_\_Economic Development **X**Excellent Government \_\_\_Natural and Built Environment \_\_\_Safe Community \_\_\_Vibrant Community

RECOMMENDATION:

Approve the attached guidelines for the operation of City Council's Physical Development Committee (PDC).

SUMMARY:

The Physical Development Committee (PDC) reviews the guidelines every two years to ensure the committee is organized for a high degree of effectiveness and efficiency. No changes were made to the previous guidelines after the PDC's review at the August 14, 2018.

PRIOR ACTION(S): Physical Development Committee August 14, 2018

FISCAL IMPACT: None

CONTACT(S): Lee Newland – City Engineer – 455-3947  
Don DeBerry – City Traffic Engineer – 455-3935

ATTACHMENT(S): Physical Development Committee Guidelines

REVIEWED BY: raw

099K

# **Lynchburg City Council**

## **Physical Development Committee Guidelines**

### **2018**

#### **General Purpose Statement**

To guide the City in the execution of Council-adopted physical development policies; to review and serve as a filter in determining specific physical development actions to be considered by City Council; and, to review reports regarding physical development and capital projects to determine if any adjustments are necessary during the fiscal year.

To better facilitate the Physical Development Committee meetings, there are three types of agenda items: General Business, Other Information and Items to be considered later by the full City Council. Following are examples of items that may be included in each of these sections:

#### **I. Items considered as General Business include:**

1. Presentations by and requests from City departments, citizens, outside agencies and private entities including those seeking relief from City Code requirements (preliminary review) and City policies, such as utility connection fees;
2. Petitions for non-routine utility line extensions;
3. Reallocations (greater than \$100,000) of non-project specific Capital Budget appropriations.

#### **II. Items considered as Other Information include:**

Items that do not require immediate Committee action, but are to advise the Committee on upcoming items or issues. Examples include: quarterly and special reports regarding the status of the City's physical development including City capital projects and other items relating to the City's water and wastewater systems, including the Combined Sewer Overflow (CSO) program.

#### **III. Items to be considered later by the full City Council at a Regular City Council Meeting or Work Session include:**

1. Street vacations and disposition of other real property;
2. Input into the planning and approach for the annual Capital Improvement Program;
3. Review and deliberations regarding the Proposed Capital Improvement Program;
4. Changes to the City Code relating to the physical development of the City;
5. City Council reports relating to the physical development of the City;
6. Demolition of City owned buildings;
7. Waivers of municipal property liens;
8. Leases and terms of leases (renewals will not come to PDC unless terms change);
9. License Agreements for R/W use (setting fees);
10. Grant applications for infrastructure;
11. Contracts that exceed 25% of bid amount.

#### **IV. Committee Procedures Regarding Items from the General Public**

In order to make the best use of the Committee's meeting time, requests for new items from the general public should be provided, preferably in writing, to the City Engineer two weeks prior to the Committee's scheduled meeting date. This schedule will provide City staff with adequate time to prepare background information, if necessary, and provide this information to the Committee prior its meeting. Exceptions to this procedure will be made in emergency situations. The Chair of the Committee makes the final decision about which items are on the agenda. If the Chair is not available, the decision will be made by the City Engineer, who will contact the Chair as soon as he or she is available. The Chair of the Committee may require that citizens/petitioners hold their opening statements/remarks to five minutes.



# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018**

AGENDA ITEM #: **16**

CONSENT:  
ACTION: **X**

REGULAR: **X**  
INFORMATION: **X**

WORK SESSION:

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: Region 2000 Local Government Council (LGC) Annual Report and Request to Change the Names of the LGC, Region 2000 Workforce Development Area Council, the Region 2000 Workforce Development Board and Region 2000 Radio Communications Board**

**KEY ELEMENTS:**

☐ Economic Development ☒ Excellent Government ☐ Natural and Built Environment ☐ Safe Community ☐ Vibrant Community

**RECOMMENDATION:** Hear an Annual Report from the Region 2000 Local Government Council (LGC) and approve the request to change the names of the LGC, Region 2000 Workforce Development Area Council, the Region 2000 Workforce Development Board and Region 2000 Radio Communications Board.

**SUMMARY:** As noted in the attached letter, the intent of this request to replace Region 2000 with Central Virginia for these organizations is to make it clearer and more consistent with the mission and purpose of the organizations. The governing documents for each of these organizations are attached as well as an amendment noting the name change for the Region 2000 Radio Communications Board.

**PRIOR ACTION(S):** None

**FISCAL IMPACT:** None

**CONTACT(S):** Gary Christie, Executive Director, Region 2000 Local Government Council - 845-3491  
Bonnie Svrcek, City Manager - 455-3990

**ATTACHMENT(S):** Resolution  
Letter from Gary Christie, Executive Director, Region 2000 Local Government Council  
Name Change Documents

**REVIEWED BY:** bms

## RESOLUTION

BE IT RESOLVED That the Lynchburg City Council approves the renaming of the Region 2000 Local Government Council to the Central Virginia Planning District Commission; the Region 2000 Workforce Development Area Council to the Central Virginia Workforce Development Area Council; the Region 2000 Workforce Development Board to the Central Virginia Workforce Development Board; and the Region 2000 Radio Communications Board to the Central Virginia Radio Communications Board and approves the changes or amendment to the documents that govern each of these organizations.

Adopted:

Certified:

\_\_\_\_\_  
Clerk of Council

095K

828 Main Street  
12th Floor  
Lynchburg, VA 24504



Office: 434.845.3491  
Fax: 434.845.3493  
[www.region2000.org](http://www.region2000.org)

July 25, 2018

Bonnie Svrcek  
Lynchburg City Manager  
900 Church Street  
Lynchburg, Virginia 24504

Dear Bonnie:

The Virginia's Region 2000 Local Government is proud to serve the City of Lynchburg as the Planning District Commission for this region since 1969. Over that time the organization has had various names to reflect organizational changes and evolving missions. We began as the Central Virginia Planning District Commission, grew to become the Region 2000 Regional Commission and now are called the Virginia's Region 2000 Partnership Regional Council: Local Government Council.

We believe that we are at a point now that it is time to evolve a name change once more. With the merger of the Region 2000 Economic Development Council and the Lynchburg Regional Chamber of Commerce into the Lynchburg Regional Business Alliance, we no longer have the Partnership organization that utilized the Region 2000 brand. Although the "Region 2000" brand is now recognized by state officials as a geographic identifier for the Counties/City/Towns in this area, it is also identified as the economic development marketing agency for the region. Although we support the work of the Regional Alliance in their economic development marketing, that's not what we do. But as long as we carry the Region 2000 brand, there's a possibility of confusion about our role and mission among our localities and our stakeholders.

### **Central Virginia Planning District Commission**

After several months of discussion and consideration, the Local Government Council seeks your approval to change our charter and drop the Region 2000 brand and return to our original organization name, the Central Virginia Planning District Commission. Every organizational name change takes time for people to learn, but over time our government customers and business and non-profit stakeholders will better understand what we do and who they are dealing with by this more accurate reflection of who we are.

A change in our charter requires the approval of localities in the region. A black-lined version and a clean version of the Local Government Council charter is included showing the proposed name changes.

### **Central Virginia Workforce Development Council and Central Virginia Workforce Development Board**

Over the past several months state workforce officials have been working to standardize the state and region's workforce branding and logos. It's always been difficult for a business or a potential worker to know where to go for technical assistance and currently there's a hodge-podge of brands and logos across the Commonwealth that are not consistent and that are locally driven. State workforce officials are now mandating that Workforce Boards and Councils use a common branding and marketing program. Driven by these new requirements, the Region 2000 Workforce Development Council and the Region 2000 Workforce Development Board also ask that the 2015 agreement be amended so that they can drop the Region 2000 brand and use Central Virginia in their name.

A black-lined version and a clean version of the amendments to the 2015 Workforce Area Development Agreement is included showing the proposed name changes.

### **Central Virginia Radio Communications Board**

The Radio Communication Board started in 1996 as the Central Virginia Radio Communications Board. When the member localities authorized a new bond in 2011 we adopted the Region 2000 name for consistency with the other agencies staffed by the Local Government Council. The Radio Board now asks that we return to the original name, Central Virginia Radio Communications Board.

An amendment to the Region 2000 Emergency Communications Regional Cooperative Agreement is included for your consideration.

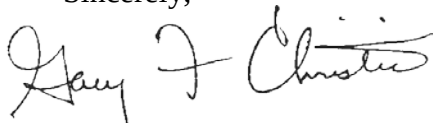
### **Summary**

In all of these documents, our intent is to only change the names of these organizations to make it clearer and more consistent with the mission and purpose of the organizations.

We ask that you share with us any comments that you have on these changes by August 31, 2018 and take action on our request by the end of November 2018. Ben Bowman, our Workforce Development Director and I would be happy to join you for the discussion and to answer questions for Council or staff, and to provide our annual report when Council considers these agreement changes.

Thank you for your consideration and the staff and I look forward to continued service to the City of Lynchburg, to the community and to the region.

Sincerely,

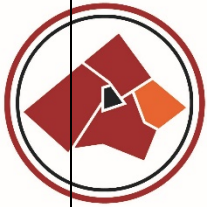


Gary F. Christie, Executive Director  
[gchristie@region2000.org](mailto:gchristie@region2000.org)  
434 845-5678 x 211



## **~ TABLE OF CONTENTS ~**

|                                                       |    |
|-------------------------------------------------------|----|
| Local Government Council Charter, Black Line .....    | 2  |
| Local Government Council Charter, Clean .....         | 11 |
| Workforce Development Council/Board, Black Line ..... | 19 |
| Workforce Development Council/Board, Clean .....      | 33 |
| Radio Board Amendment .....                           | 47 |



# CENTRAL VIRGINIA PLANNING DISTRICT COMMISSION

## **CHARTER AGREEMENT**

### Table of Contents:

|              |   |                                                                 |
|--------------|---|-----------------------------------------------------------------|
| ARTICLE I    | - | Name, Location, Authority, Purpose                              |
| ARTICLE II   | - | Membership                                                      |
| ARTICLE III  | - | Terms of Office and Voting Rights                               |
| ARTICLE IV   | - | Officers                                                        |
| ARTICLE V    | - | Planning District Commission-<br>Consortium Merger              |
| ARTICLE VI   | - | Addition or Withdrawal of Members                               |
| ARTICLE VII  | - | Appointment of an Executive<br>Committee and Adoption of Bylaws |
| ARTICLE VIII | - | Meetings                                                        |
| ARTICLE IX   | - | Amendments                                                      |
| ARTICLE X    | - | Date of Organization                                            |

# CHARTER AGREEMENT OF THE

## CENTRAL VIRGINIA PLANNING DISTRICT COMMISSION

This Charter Agreement to organize a regional commission made this first day of August, 2000, and subsequently amended, by and between the undersigned governmental subdivisions as authorized by the Regional Cooperation Act, 15.2-4200, et seq., Code of Virginia (1998), as amended);

**NOW, THEREFORE, BE IT AGREED THAT:**

### ARTICLE I

#### Name, Location, Authority, Purpose

Section 1. The name of this organization shall be the Virginia's Region 2000 Partnership - Regional Council, hereinafter called the "Local Government Council." Central Virginia Planning District Commission (amendment approved 2005, amendment approved 2018)

Section 2. The principal office of the LOCAL GOVERNMENT COUNCIL-Commission shall be in Lynchburg, Virginia. The location of the principal office may be changed by the concurrence of three-fourths of the LOCAL GOVERNMENT COUNCIL-Commission —members present at a regular meeting, provided that the clerk of the governing body of each member governmental subdivision has been notified of the contemplated relocation in writing at least thirty days before such meeting.

Section 3. The LOCAL GOVERNMENT COUNCIL-Commission shall be a public body corporate and politic with all the powers and duties granted to it by the Regional Cooperation Act.

Section 4. The purpose of the ~~LOCAL GOVERNMENT COUNCIL~~ Commission shall be to promote the orderly and efficient development of the physical, social and economic elements of the planning district by planning, and encouraging and assisting governmental subdivisions to plan for the future, and to carryout duties desired by the member jurisdictions, as permitted by law.

## ARTICLE II

### Membership

Section 1. ~~LOCAL GOVERNMENT COUNCIL~~ Commission members shall be appointed by the respective governing bodies of those political subdivisions which are parties to this charter agreement provided, however, that at least a majority of the ~~LOCAL GOVERNMENT COUNCIL'S~~ Commission's members shall be elected officials of the governing bodies of the governmental subdivisions, or members of the General Assembly, within the planning district.

Section 2. Each governmental subdivision which is either a city or county and a party to this charter agreement shall appoint two members to the ~~LOCAL GOVERNMENT COUNCIL~~ Commission, one of whom shall be the Chief elected member of the governing body, or their elected designee. The other appointee shall be the Chief Appointed Official of each governmental subdivision, or their appointed designee. Additionally, one member of the ~~Local Government Council~~ Commission shall represent Virginia's Region 2000 as appointed by that Board and two members shall represent Virginia's General Assembly. The General Assembly members shall serve two-year alternating terms so that all General Assembly members within the region shall be members of the ~~Local Government Council~~ Commission on a rotating basis on a schedule as approved by the ~~Local Government Council~~ Commission.



Section 3. Vacancies on the ~~LOCAL GOVERNMENT COUNCIL~~ Commission shall be filled for the un-expired term in the same manner as the original appointment was made.

Section 4. Any member of the ~~LOCAL GOVERNMENT COUNCIL~~ Commission shall be eligible for reappointment but may be removed for cause by the governing body which appointed him.

### **ARTICLE III**

#### **Terms of Office and Voting Rights**

Section 1. The terms of office of ~~LOCAL GOVERNMENT COUNCIL~~ Commission members who are also elected officials shall be coincident with their elected terms of office or such shorter term as their governing bodies shall determine. The terms of office of the appointed members shall be as determined by the member jurisdiction and coincident with their appointment with the member jurisdiction. The term of office for General Assembly members shall be two-years. General Assembly members shall not succeed themselves.

Section 2. Each member of the ~~LOCAL GOVERNMENT COUNCIL~~ Commission shall have one equal vote in all matters before the LOCAL GOVERNMENT COUNCIL.

### **ARTICLE IV**

#### **Officers**

Section 1. Officers of the ~~LOCAL GOVERNMENT COUNCIL~~ Commission shall consist of a Chairman, Vice-Chairman, and Treasurer who shall be elected by the membership of the ~~LOCAL GOVERNMENT COUNCIL~~ Council.

Section 2. ~~LOCAL GOVERNMENT COUNCIL~~ Commission officers shall be elected for terms of one-year or

until their successors are elected, and shall be eligible for reelection.

Section 3. The LOCAL GOVERNMENT COUNCIL Commission shall appoint an Executive Director who shall be an employee of the LOCAL GOVERNMENT COUNCIL Commission and shall serve at the pleasure of a majority of the membership.

## ARTICLE V

### Planning District Commission - Regional Consortium Merger

Section 1. Upon the ratification of this Charter Agreement of the Region 2000 Regional Local Government Council, the Central Virginia Planning District Commission and the Region 2000 Consortium shall merge and become the Region 2000 Local Government Council. All assets, liabilities, and personnel of the Central Virginia Planning District Commission shall be transferred to the Region 2000 Regional Commission.

Section 2. Upon the ratification of the 2018 amendment, all assets of the Virginia's Region 2000 Local Government Council shall become assets of the Central Virginia Planning District Commission.

## ARTICLE VI

### Addition or Withdrawal of Members

Section 1. Any governmental subdivision within Planning District Number 11 which is not a party to this Charter Agreement at the effective date thereof may thereafter join the LOCAL GOVERNMENT COUNCIL Commission provided that: (a) any city, county or town of more than 3,500 population adopts and executes this agreement; or (b) any town of 3,500 or less population, after petition to the LOCAL GOVERNMENT COUNCIL Commission and acceptance of the petition to

grant representation to such town by majority vote of the members of the LOCAL GOVERNMENT COUNCIL Commission, adopts and executes this agreement.

Section 2. Any governmental subdivision may withdraw from the LOCAL GOVERNMENT COUNCIL Commission by submitting to the LOCAL GOVERNMENT COUNCIL Commission in writing, at least 90 days before the end of the LOCAL GOVERNMENT COUNCIL'S Commission's —then current fiscal year, a notice of intent to withdraw. Such withdrawal shall not become effective until the LOCAL GOVERNMENT COUNCIL'S Commission's fiscal year has ended.

## ARTICLE VII

### Appointment of an Executive Committee and Adoption of Bylaws

Section 1. The LOCAL GOVERNMENT COUNCIL Commission may designate an Executive Committee and delegate to it such powers as the LOCAL GOVERNMENT COUNCIL Commission may determine, provided that these powers are not inconsistent with provisions of the Regional Cooperation Act.

Section 2. The LOCAL GOVERNMENT COUNCIL Commission may adopt bylaws and such other rules as it deems necessary to govern its operations.

## ARTICLE VIII

### Meetings

Section 1. The LOCAL GOVERNMENT COUNCIL Commission shall hold regular meetings on a schedule which will be determined by the membership.

Section 2. Meetings of the LOCAL GOVERNMENT COUNCIL Commission shall be open to the public; however, the LOCAL GOVERNMENT COUNCIL Commission may hold closed meetings.

## ARTICLE IX

### Amendments

Section 1. This Charter Agreement may be amended, supplemented or superseded only by concurring resolutions from any combination of member governmental subdivisions whose aggregate representation on the LOCAL GOVERNMENT COUNCIL Commission constitutes a quorum. All proposed amendments shall be submitted to the LOCAL GOVERNMENT COUNCIL Commission for its review and comment to the member governmental subdivisions.

## ARTICLE X

### Date of Organization

Section 1. The organization of the Region 2000 Local Government Council, now called the Central Virginia Planning District Commission, shall be effective on the fifteenth day of September, 2000, or at such time after this date when the Charter Agreement has been adopted and signed by that governmental subdivision whose population when added to the aggregate population of those who have already adopted and signed the Charter Agreement embraces the majority of the population within Planning District Number 11.

### DATES OF ADOPTION/RESCISSION/AMENDMENTS TO THE CHARTER AGREEMENT

|                   |                                                      |
|-------------------|------------------------------------------------------|
| August 12, 1969   | - Adopted by the Bedford City Council                |
| September 2, 1969 | - Adopted by the Campbell Board of Supervisors       |
| September 8, 1969 | - Adopted by the Bedford County Board of Supervisors |
| September 9, 1969 | - Adopted by the Lynchburg City Council              |



|                    |                                                                                                                                                                                                                          |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| September 12, 1969 | - Adopted by the Appomattox County Board of Supervisors                                                                                                                                                                  |
| June 7, 1971       | - Adopted by the Amherst County Board of Supervisors                                                                                                                                                                     |
| June 4, 1980       | - Rescinded by the Campbell County Board of Supervisors, effective July 1, 1981                                                                                                                                          |
| March 10, 1981     | - Rescinded by the Bedford County Board of Supervisors, effective July 1, 1981                                                                                                                                           |
| April 24, 1981     | - Readopted by the Campbell County Board of Supervisors                                                                                                                                                                  |
| July 1, 1982       | - Automatically rescinded by the Campbell County Board of Supervisors because of non-payment of dues                                                                                                                     |
| July 6, 1982       | - Amended by the Amherst County Board of Supervisors to allow towns under 3,500 to become members, to designate town representation and to eliminate the ceiling on the number of elected officials as voting members    |
| July 9, 1982       | - Amended by the Appomattox County Board of Supervisors to allow towns under 3,500 to become members, to designate town representation and to eliminate the ceiling on the number of elected officials as voting members |
| July 13, 1982      | - Amended by the Lynchburg City Council to allow towns under 3,500 to become members, to designate town representation and to eliminate the ceiling on the number of elected officials as voting members                 |
| August 10, 1982    | - Amended by the Bedford City Council to allow towns under 3,500 to become members, to designate town representation and to eliminate the ceiling on the number of elected officials as voting members                   |
| September 7, 1982  | - Readopted by the Campbell County Board of Supervisors                                                                                                                                                                  |
| October 11, 1982   | - Adopted by the Appomattox Town Council                                                                                                                                                                                 |
| October 13, 1982   | - Adopted by the Amherst Town Council                                                                                                                                                                                    |
| December 8, 1982   | - Amended by the Amherst Town Council to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                                                                 |
| December 10, 1982  | - Amended by the Appomattox County Board of Supervisors to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                                               |
| December 14, 1982  | - Amended by the Lynchburg City Council to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                                                               |
| January 4, 1983    | - Amended by the Amherst County Board of Supervisors to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                                                  |
| January 18, 1983   | - Amended by the Campbell County Board of Supervisors to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                                                 |
| February 8, 1983   | - Amended by the Bedford City Council to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                                                                 |

---

Amendments to the Region 2000 Regional Commission Charter

|                |                                                                                                                 |
|----------------|-----------------------------------------------------------------------------------------------------------------|
| March 1, 2005  | - Amended by the County of Amherst to change the name to the Virginia's Region 2000 Local Government Council    |
| March 9, 2005  | - Amended by the Town of Amherst to change the name to the Virginia's Region 2000 Local Government Council      |
| March 21, 2005 | - Amended by the County of Campbell to change the name to the Virginia's Region 2000 Local Government Council   |
| April 18, 2005 | - Amended by the County of Appomattox to change the name to the Virginia's Region 2000 Local Government Council |
| April 25, 2005 | - Amended by the County of Bedford to change the name to the Virginia's Region 2000 Local Government Council    |
| April 26, 2005 | - Amended by the City of Lynchburg to change the name to the Virginia's Region 2000 Local Government Council    |
| May 9, 2005    | - Amended by the Town of Appomattox to change the name to the Virginia's Region 2000 Local Government Council   |
| May 10, 2005   | - Amended by the Town of Altavista to change the name to the Virginia's Region 2000 Local Government Council    |
| June 14, 2005  | - Amended by the Bedford City Council to change the name to the Virginia's Region 2000 Local Government Council |
| June 14, 2005  | - Amended by Town of Brookneal to change the name to the Virginia's Region 2000 Local Government Council        |



# CENTRAL VIRGINIA PLANNING DISTRICT COMMISSION CHARTER AGREEMENT

## Table of Contents:

|              |   |                                                                 |
|--------------|---|-----------------------------------------------------------------|
| ARTICLE I    | - | Name, Location, Authority, Purpose                              |
| ARTICLE II   | - | Membership                                                      |
| ARTICLE III  | - | Terms of Office and Voting Rights                               |
| ARTICLE IV   | - | Officers                                                        |
| ARTICLE V    | - | Planning District Commission-<br>Consortium Merger              |
| ARTICLE VI   | - | Addition or Withdrawal of Members                               |
| ARTICLE VII  | - | Appointment of an Executive<br>Committee and Adoption of Bylaws |
| ARTICLE VIII | - | Meetings                                                        |
| ARTICLE IX   | - | Amendments                                                      |
| ARTICLE X    | - | Date of Organization                                            |

**CHARTER AGREEMENT OF THE  
CENTRAL VIRGINIA PLANNING DISTRICT COMMISSION**

This Charter Agreement to organize a regional commission made this first day of August, 2000, and subsequently amended, by and between the undersigned governmental subdivisions as authorized by the Regional Cooperation Act, 15.2-4200, et seq., Code of Virginia (1998), as amended);

**NOW, THEREFORE, BE IT AGREED THAT:**

**ARTICLE I**

**Name, Location, Authority, Purpose**

- Section 1. The name of this organization shall be the Central Virginia Planning District Commission, amendment approved 2018)
- Section 2. The principal office of the Commission shall be in Lynchburg, Virginia. The location of the principal office may be changed by the concurrence of three-fourths of the Commission members present at a regular meeting, provided that the clerk of the governing body of each member governmental subdivision has been notified of the contemplated relocation in writing at least thirty days before such meeting.
- Section 3. The Commission shall be a public body corporate and politic with all the powers and duties granted to it by the Regional Cooperation Act.
- Section 4. The purpose of the Commission shall be to promote the orderly and efficient development of the physical, social and economic elements of the planning district by planning, and encouraging and assisting governmental subdivisions to plan for the future, and to



carryout duties desired by the member jurisdictions, as permitted by law.

## **ARTICLE II**

### **Membership**

- Section 1. Commission members shall be appointed by the respective governing bodies of those political subdivisions which are parties to this charter agreement provided, however, that at least a majority of the Commission's members shall be elected officials of the governing bodies of the governmental subdivisions, or members of the General Assembly, within the planning district.
- Section 2. Each governmental subdivision which is either a city or county and a party to this charter agreement shall appoint two members to the Commission, one of whom shall be the Chief elected member of the governing body, or their elected designee. The other appointee shall be the Chief Appointed Official of each governmental subdivision, or their appointed designee. Additionally, one member of the Commission shall represent Virginia's Region 2000 as appointed by that Board and two members shall represent Virginia's General Assembly. The General Assembly members shall serve two-year alternating terms so that all General Assembly members within the region shall be members of the Commission on a rotating basis on a schedule as approved by the Commission.
- Section 3. Vacancies on the Commission shall be filled for the un-expired term in the same manner as the original appointment was made.
- Section 4. Any member of the Commission shall be eligible for reappointment but may be removed for cause by the governing body which appointed him.

## **ARTICLE III**

### **Terms of Office and Voting Rights**

- Section 1. The terms of office of Commission members who are also elected officials shall be coincident with their elected terms of office or such shorter term as their governing bodies shall determine. The terms of office of the appointed members shall be as determined by the member jurisdiction and coincident with their appointment with the member jurisdiction. The term of office for General Assembly members shall be two-years. General Assembly members shall not succeed themselves.
- Section 2. Each member of the Commission shall have one equal vote in all matters before the LOCAL GOVERNMENT COUNCIL.

## **ARTICLE IV**

### **Officers**

- Section 1. Officers of the Commission shall consist of a Chairman, Vice-Chairman, and Treasurer who shall be elected by the membership of the Council.
- Section 2. Commission officers shall be elected for terms of one-year or until their successors are elected, and shall be eligible for reelection.
- Section 3. The Commission shall appoint an Executive Director who shall be an employee of the Commission and shall serve at the pleasure of a majority of the membership.

## **ARTICLE V**

### **Planning District Commission - Regional Consortium Merger**

- Section 1. Upon the ratification of this Charter Agreement of the Region 2000 Regional Local Government Council, the Central Virginia

Planning District Commission and the Region 2000 Consortium shall merge and become the Region 2000 Local Government Council. All assets, liabilities, and personnel of the Central Virginia Planning District Commission shall be transferred to the Region 2000 Regional Commission.

Section 2. Upon the ratification of the 2018 amendment, all assets of the Virginia's Region 2000 Local Government Council shall become assets of the Central Virginia Planning District Commission.

## **ARTICLE VI**

### **Addition or Withdrawal of Members**

Section 1. Any governmental subdivision within Planning District Number 11 which is not a party to this Charter Agreement at the effective date thereof may thereafter join the Commission provided that: (a) any city, county or town of more than 3,500 population adopts and executes this agreement; or (b) any town of 3,500 or less population, after petition to the Commission and acceptance of the petition to grant representation to such town by majority vote of the members of the Commission, adopts and executes this agreement.

Section 2. Any governmental subdivision may withdraw from the Commission by submitting to the Commission in writing, at least 90 days before the end of the Commission's then current fiscal year, a notice of intent to withdraw. Such withdrawal shall not become effective until the Commission's fiscal year has ended.

## **ARTICLE VII**

### **Appointment of an Executive Committee and Adoption of Bylaws**

Section 1. The Commission may designate an Executive Committee and delegate to it such powers as the Commission may determine, provided that these powers are not inconsistent with provisions of the Regional Cooperation Act.

Section 2. The Commission may adopt bylaws and such other rules as it deems necessary to govern its operations.

## **ARTICLE VIII**

### **Meetings**

Section 1. The Commission shall hold regular meetings on a schedule which will be determined by the membership.

Section 2. Meetings of the Commission shall be open to the public; however, the Commission may hold closed meetings.

## **ARTICLE IX**

### **Amendments**

Section 1. This Charter Agreement may be amended, supplemented or superseded only by concurring resolutions from any combination of member governmental subdivisions whose aggregate representation on the Commission constitutes a quorum. All proposed amendments shall be submitted to the Commission for its review and comment to the member governmental subdivisions.

## **ARTICLE X**

### **Date of Organization**

Section 1. The organization of the Region 2000 Local Government Council, now called the Central Virginia Planning District Commission, shall be effective on the fifteenth day of



September, 2000, or at such time after this date when the Charter Agreement has been adopted and signed by that governmental subdivision whose population when added to the aggregate population of those who have already adopted and signed the Charter Agreement embraces the majority of the population within Planning District Number 11.

#### **DATES OF ADOPTION/RESCISSION/AMENDMENTS TO THE CHARTER AGREEMENT**

|                    |                                                                                                                                                                                                                          |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| August 12, 1969    | - Adopted by the Bedford City Council                                                                                                                                                                                    |
| September 2, 1969  | - Adopted by the Campbell Board of Supervisors                                                                                                                                                                           |
| September 8, 1969  | - Adopted by the Bedford County Board of Supervisors                                                                                                                                                                     |
| September 9, 1969  | - Adopted by the Lynchburg City Council                                                                                                                                                                                  |
| September 12, 1969 | - Adopted by the Appomattox County Board of Supervisors                                                                                                                                                                  |
| June 7, 1971       | - Adopted by the Amherst County Board of Supervisors                                                                                                                                                                     |
| June 4, 1980       | - Rescinded by the Campbell County Board of Supervisors, effective July 1, 1981                                                                                                                                          |
| March 10, 1981     | - Rescinded by the Bedford County Board of Supervisors, effective July 1, 1981                                                                                                                                           |
| April 24, 1981     | - Readopted by the Campbell County Board of Supervisors                                                                                                                                                                  |
| July 1, 1982       | - Automatically rescinded by the Campbell County Board of Supervisors because of non-payment of dues                                                                                                                     |
| July 6, 1982       | - Amended by the Amherst County Board of Supervisors to allow towns under 3,500 to become members, to designate town representation and to eliminate the ceiling on the number of elected officials as voting members    |
| July 9, 1982       | - Amended by the Appomattox County Board of Supervisors to allow towns under 3,500 to become members, to designate town representation and to eliminate the ceiling on the number of elected officials as voting members |
| July 13, 1982      | - Amended by the Lynchburg City Council to allow towns under 3,500 to become members, to designate town representation and to eliminate the ceiling on the number of elected officials as voting members                 |
| August 10, 1982    | - Amended by the Bedford City Council to allow towns under 3,500 to become members, to designate town representation and to eliminate the ceiling on the number of elected officials as voting members                   |
| September 7, 1982  | - Readopted by the Campbell County Board of Supervisors                                                                                                                                                                  |
| October 11, 1982   | - Adopted by the Appomattox Town Council                                                                                                                                                                                 |
| October 13, 1982   | - Adopted by the Amherst Town Council                                                                                                                                                                                    |

|                   |                                                                                                                                                                            |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| December 8, 1982  | - Amended by the Amherst Town Council to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                   |
| December 10, 1982 | - Amended by the Appomattox County Board of Supervisors to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member |
| December 14, 1982 | - Amended by the Lynchburg City Council to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                 |
| January 4, 1983   | - Amended by the Amherst County Board of Supervisors to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member    |
| January 18, 1983  | - Amended by the Campbell County Board of Supervisors to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member   |
| February 8, 1983  | - Amended by the Bedford City Council to allow member jurisdictions the option of having an elected official appointed in lieu of the non-elected member                   |

---

Amendments to the Region 2000 Regional Commission Charter

|                |                                                                                                                 |
|----------------|-----------------------------------------------------------------------------------------------------------------|
| March 1, 2005  | - Amended by the County of Amherst to change the name to the Virginia's Region 2000 Local Government Council    |
| March 9, 2005  | - Amended by the Town of Amherst to change the name to the Virginia's Region 2000 Local Government Council      |
| March 21, 2005 | - Amended by the County of Campbell to change the name to the Virginia's Region 2000 Local Government Council   |
| April 18, 2005 | - Amended by the County of Appomattox to change the name to the Virginia's Region 2000 Local Government Council |
| April 25, 2005 | - Amended by the County of Bedford to change the name to the Virginia's Region 2000 Local Government Council    |
| April 26, 2005 | - Amended by the City of Lynchburg to change the name to the Virginia's Region 2000 Local Government Council    |
| May 9, 2005    | - Amended by the Town of Appomattox to change the name to the Virginia's Region 2000 Local Government Council   |
| May 10, 2005   | - Amended by the Town of Altavista to change the name to the Virginia's Region 2000 Local Government Council    |
| June 14, 2005  | - Amended by the Bedford City Council to change the name to the Virginia's Region 2000 Local Government Council |
| June 14, 2005  | - Amended by Town of Brookneal to change the name to the Virginia's Region 2000 Local Government Council        |

# Amended and Restated Workforce Development Area Agreement

July 2018

~~REGION 2000~~ Central Virginia

WORKFORCE DEVELOPMENT AREA

(LWDA 7)

## COUNCIL AGREEMENT

April, 2000

Revised July 21, 2000

~~Proposed~~ Revision October, 2015

Proposed Revision July, 2018

## Council Agreement

### ~~REGION 2000~~CENTRAL VIRGINIA WORKFORCE DEVELOPMENT AREA

#### PREAMBLE

The ~~communities~~Central Virginia Region of ~~Region 2000~~Lynchburg and the surrounding communities recognize that the development of a vibrant, effective workforce is important to the economic competitiveness and resiliency of our communities. We understand that workforce development is an educational process occurring at all ages and is lifelong. We recognize that by working together we can build a stronger workforce development program.

The communities of this region seek to create organizations which will be the focal point of the region's workforce development initiatives. We look for these organizations to both utilize federal Workforce Development funds and also seek other partner organizations to develop a well-rounded, successful program to provide training and education programs appropriate for all ages and for the skills needed by the community's businesses and industries.

To implement this effort, we authorize the creation of the ~~Region 2000~~Central Virginia Workforce Development Area and the ~~Region 2000~~Central Virginia Workforce Development Board in accordance with the WORKFORCE INNOVATION AND OPPORTUNITY ACT (WIOA)(Public Law 113-128), hereinafter referred to as the "ACT", and all federal and state guidelines for the ACT. It is Made and Entered into by and between the County of AMHERST, the County of APPOMATTOX, the County of BEDFORD, the County of CAMPBELL and the City of LYNCHBURG.

WITNESSETH:

WHEREAS, the respective Boards of Supervisors of the Counties of AMHERST, APPOMATTOX, BEDFORD and CAMPBELL and the City Council of the City of LYNCHBURG in the Commonwealth of Virginia, have adopted resolutions authorizing the execution of this Council Agreement;



NOW THEREFORE THIS AGREEMENT FURTHER WITNESSETH: That for and in consideration of the promises and of the mutual benefits to be derived hereunder, that each and all of the jurisdictions enumerated immediately above, do hereby reciprocally agree as follows:

### **SECTION 1: CREATION OF THE COUNCIL.**

THERE IS HEREBY CREATED, by the undersigned Chief Local Elected Official of the Counties and City, the ~~REGION 2000~~CENTRAL VIRGINIA WORKFORCE DEVELOPMENT AREA COUNCIL, hereinafter referred to as the "COUNCIL ", which shall exist under and be subject to the terms and conditions of this Council Agreement, and which shall be deemed to constitute the agreement authorized by Section 15.2-1300 of the Code of Virginia (Repl. Vol. 1997) as amended, for the joint exercise of powers by participating political subdivisions of the Commonwealth of Virginia.

The purpose of the COUNCIL shall be to plan, establish, and operate a LOCAL WORKFORCE DEVELOPMENT AREA and Workforce Development Services Delivery System according to the provisions of the ACT, and the Federal Regulations hereinafter referred to as the "Regulations", issued by the U.S. Department of Labor, for the implementation of the ACT together with any and all other subsequent and relevant federal and Commonwealth of Virginia statutes, policies and interpretations.

### **SECTION 2: AREA AND POPULATION TO BE SERVED.**

The area to be served shall be called the ~~REGION 2000~~CENTRAL VIRGINIA WORKFORCE DEVELOPMENT AREA, hereinafter referred to as the "WDA", and shall include the jurisdictions noted in this section and consisting of the 2,000 square miles of land in the Counties of Amherst, Appomattox, Bedford and Campbell and the City of Lynchburg (Lynchburg Area). The Weldon Cooper Center for Public Services Demographics Research Group population estimates published on January 27, 2015 indicates the Lynchburg ~~Metro~~ Area has a population of 259,487.

### **SECTION 3: RESPONSIBILITIES OF THE COUNCIL.**

On behalf of each and all parties hereto, the COUNCIL powers shall include, but not be limited to the following:

A. Providing overall governance for implementing the provisions of the ACT and Regulations for the WDA to include creation of, and appointment of all members to, the ~~REGION 2000~~CENTRAL VIRGINIA WORKFORCE DEVELOPMENT BOARD, hereinafter referred to as the "BOARD".

B. Approving policies, priorities, goals, and objectives of the BOARD and the

programs and services to be provided by the BOARD, either directly or by contract with political subdivisions or public or private service providers.

C. The COUNCIL, in partnership with the Board, shall submit to the Governor a regional strategic workforce development plan that meets the requirements in Section 108 of the ACT.

D. The COUNCIL shall approve the Board budget annually and receive the BOARD's annual report.

E. The COUNCIL shall enter into an agreement with the BOARD that clearly details the partnership between the two entities for the governance and oversight of activities under the ACT.

### **3.01: MEMBERSHIP.**

The voting members of the COUNCIL shall be the Chief Local Elected Official of each of the jurisdictions that are party to this agreement, or that official's duly appointed elected designee.

### **3.02: TERMS OF OFFICE.**

The term of office for each COUNCIL member shall coincide with the term of office for which the member was elected to public office in the particular jurisdiction the member represents.

### **3.03: VOTING RIGHTS.**

Each COUNCIL member shall have one (1) equal vote on all matters before the COUNCIL. Voting by proxy shall not be permitted except when the Council member is represented by a duly appointed elected designee.

### **3.04: MEETINGS.**

The COUNCIL shall hold meetings from time to time as may be required in order to conduct the affairs of the COUNCIL. At least one meeting shall be held each year.

### **3.05: BY-LAWS.**

The COUNCIL may adopt by-laws and such other rules as it deems necessary to govern its operations.

## **SECTION 4: WORKFORCE DEVELOPMENT BOARD.**

#### **4.01: CREATION of the ~~REGION 2000~~CENTRAL VIRGINIA WORKFORCE DEVELOPMENT BOARD.**

There is hereby created, the ~~REGION 2000~~CENTRAL VIRGINIA WORKFORCE DEVELOPMENT BOARD, referred to as the "BOARD".

#### **4.02: APPOINTMENT of MEMBERS to the BOARD.**

The COUNCIL, shall appoint the members of the BOARD in accordance with the process required by Section 107 of the ACT pertaining to Local Workforce Development Boards and related Commonwealth of Virginia Policy as described immediately below.

The COUNCIL, acting together, shall appoint representatives from each of the following categories:

- A. A majority of the members of each local Board shall be representatives of business in the local area, who shall reflect, to the extent possible, employment opportunities in the region and who:
  - (i) Are owners of businesses, chief executives or operating officers of businesses, or other business executives or employers with optimum policymaking or hiring authority;
  - (ii) Represent businesses, including small businesses, or organizations representing businesses described in this clause, that provide employment opportunities that, at a minimum, include high-quality, work-relevant training and development in in-demand industry sectors or occupations in the local area; and
  - (iii) Are appointed from among individuals nominated by local businesses, business organizations and business trade associations;
- B. Not fewer than twenty (20) percent of the members of each Board shall be representatives of the workforce within the local area, who:
  - (i) Shall include representatives of labor organizations (for a local area in which employees are represented by labor organizations), who have been nominated by local labor federations, or (for a local area in which no employees are represented by such organizations) other representatives of employees;
  - (ii) Shall include a representative who shall be a member of a

- labor organization or a training director, form a joint labor-management apprenticeship program, and if no such joint program exists in the area, such a representative of an apprenticeship program in the area, if such a program exists;
- (iii) May include representatives of community-based organizations that have demonstrated experience and expertise in addressing the employment needs of individuals with barriers to employment, including organizations that serve veterans or that provide or support competitive integrated employment for individuals with disabilities; and
  - (iv) May include representatives of organizations that have demonstrated experience and expertise in addressing the employment, training or education needs of eligible youth, including representatives of organizations that serve out-of-school youth;

C. Each local Board shall include representatives of entities administering education and training activities in the local area, who:

- (i) Shall include a representative of eligible providers administering adult education and literacy activities under Title II;
- (ii) Shall include a representative of institutions of higher education providing workforce development activities (including community colleges);
- (iii) May include representatives of local educational agencies, and of community-based organizations with demonstrated experience and expertise in addressing the education or training needs of individuals with barriers to employment;
- (iv) If there are multiple eligible providers serving the local area by administering adult education and literacy activities under Title II, or multiple institutions of higher education serving the local area by providing workforce development activities, each representative on the Board shall be appointed from among individuals nominated by local providers representing such providers or institutions, respectively;



- D. Each local Board shall include representatives of governmental and economic and community development entities serving the local area who:
- (i) Shall include a representative of economic and community development entities;
  - (ii) Shall include an appropriate representative from the State employment service office under the Wagner-Peyser Act (29 U.S.C. 720 et seq.), other than section 122 or part C of that title (29 U.S.C. 732, 741) serving the local area;
  - (iii) May include representatives of agencies or entities administering programs serving the local area relating to transportation, housing, and public assistance; and
  - (iv) May include representatives of philanthropic organizations serving the local area; and
- E. Each local board may include such other individuals or representatives of entities as the chief elected official in the local area may determine to be appropriate.

#### **4.03: PURPOSE AND POWERS.**

The functions and responsibilities of the BOARD shall include, but are not limited to:

- A. Development of all plans and priorities for service and subsequent modifications.
- B. Development and implementation of policies and operating guidelines as required by the Cooperative Agreement by and between the BOARD and the COUNCIL for the administration of the workforce development programs operated, or proposed, within the WDA.
- C. Approval of all proposed program designs and delivery systems for the purpose of providing workforce development services for the WDA.
- D. Evaluation of the performance of individual services providers pursuant to relevant federal and state statutes, regulations and policy interpretations as revised or amended.
- E. Development of the vision, goals, objectives, and policies for the regional workforce development area. The vision should be aligned with both the region's Comprehensive Economic Development Strategy and the Virginia Board of Workforce Development's goals. The Board shall solicit support and comment

from the general public in providing a comprehensive plan for workforce development programs for this local workforce development area.

F. Serve as sub recipient of all funds disbursed under the ACT for the local WDA and the subsequent disbursement of such funds to designated service providers and/or subcontractors in accordance with the approved Workforce Development Plan and, pursuant to approved procedures as provided for in the Cooperative Agreement by and between the COUNCIL and the BOARD.

G. Advising the COUNCIL of problems that may arise from time to time that may impact policy considerations of the COUNCIL and recommend corrective action.

H. Reporting at least annually to the COUNCIL on the state of the Workforce Development Program and the matters related to carrying out the requirements of the Workforce Development Plan.

I. Such other functions as the BOARD may deem appropriate provided such functions are allowable under the ACT and Regulations, as amended.

#### **4.04: NOMINATION PROCESS.**

The Chief Local Elected Officials must contact the appropriate entities in the local area for nominations to appoint members and/or to fill vacancies on the local Board from business, local educational entities, and labor representatives. Chief Local Elected Officials may also design a process for nominations of individuals and other types of representation the officials would like to include on the local Board. Vacancies subsequent to the establishment of the local Board must be filled in the same manner as the original appointments.

Private sector representatives are to be selected from among individuals nominated by local business organizations (ex. business trade associations, chamber of commerce, economic development agencies). Individual businesses may also nominate themselves or provide nominations of other businesses to the Chief Local Elected Officials. Private sector representatives can include owners of businesses, chief executives or operating officers of businesses, and other business executives with optimum policy making or hiring authority.

Local educational entity representatives must be selected from among individuals nominated by regional or local educational agencies, institutions, or organizations representing such local educational entities including local school boards, entities providing vocational education, entities providing secondary adult education and literacy activities, and postsecondary educational institutions (including representatives of community colleges, where such entities exist). Members of the board that represent organizations, agencies, or other entities shall be individuals with optimum policymaking

authority within the organizations, agencies, or entities. The members of the board shall represent diverse geographic areas within the local area.

Labor representatives must be selected from among individuals nominated by local labor federations (or in a local area in which no employees are represented by such organizations, other representatives of employees, such as employee organizations and/or the state AFL-CIO).

For all other members, local chief elected officials should consult with the appropriate groups in the local area for possible individuals to serve including:

- Representatives of community-based organizations, including organizations representing individuals with disabilities and veterans where such organizations exist in the area.
- Representatives of local economic development agencies, including private sector economic development entities.

Nomination for membership to the BOARD shall be accomplished in accordance with the provisions of the ACT and Regulations, as amended. The nomination process under this agreement shall be for the Member Jurisdictions, as defined in Section 2, to seek and receive nominations and submit the list of nominees to the COUNCIL. The COUNCIL shall review the nominations and any other recommendations from member jurisdictions that may be received and make the appointments in accordance with Section 4.02 herein above.

#### **4.05: TERMS OF OFFICE.**

The term of office for BOARD members shall be two (2) years and members may be eligible for reappointment. The initial terms of members of the BOARD shall be staggered and the manner and method of staggering the term of office shall be set forth in the by-laws of the BOARD. Individuals serving on the local Board who subsequently retire or no longer hold the position that made them eligible board members may not continue to serve on the local Board. The entity affiliated with the vacating board member may nominate a new representative to the local Board. Vacancies resulting from resignations or removal of mandatory members should be filled within ninety (90) days.

#### **4.06: VOTING RIGHTS.**

Each BOARD member shall have one (1) equal vote on all matters before the BOARD. Voting by proxy shall not be permitted.

#### **4.07: OFFICERS.**

A Chair and Vice Chair shall be elected by and from the membership of the BOARD; and, shall serve for terms of one (1) year and may be eligible for re-election for one additional term of one year. Eligibility for election of both the Chair and Vice Chair shall be limited to the private sector business category of BOARD membership as referenced in Section 4.02(A) of this Agreement. The Chair serves as the Executive committee chair and selects the Chairs for all standing committees and special committees of the BOARD.

#### **4.08: MEETINGS.**

The BOARD shall hold regular or called meetings at such times, dates, and places as may be established in the by-laws of the BOARD.

#### **4.09: STANDING COMMITTEES.**

A. IN GENERAL.—the BOARD may designate and direct the activities of standing committees to provide information and to assist the local board in carrying out activities under this section. Such standing committees shall be chaired by a member of the local board, may include other members of the local board, and shall include other individuals appointed by the local board who are not members of the local board and who the local board determines have appropriate experience and expertise. At a minimum, the local board may designate each of the following:

(i) A standing committee to provide information and assist with operational and other issues relating to the one-stop delivery system, which may include as members representatives of the one-stop partners.

(ii) A standing committee to provide information and to assist with planning, operational, and other issues relating to the provision of services to youth, which shall include community-based organizations with a demonstrated record of success in serving eligible youth.

(iii) A standing committee to provide information and to assist with operational and other issues relating to the provision of services to individuals with disabilities, including issues relating to compliance with section 188, if applicable, and applicable provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) regarding providing programmatic and physical access to the services, programs, and activities



of the one-stop delivery system, as well as appropriate training for staff on providing supports for or accommodations to, and finding employment opportunities for, individuals with disabilities.

B. ADDITIONAL COMMITTEES.—The Board may designate standing committees in addition to the standing committees specified in subparagraph (A).

#### **4.10: BY-LAWS.**

The Board shall adopt by-laws and such other rules or operational procedures as it deems necessary to govern its operations.

### **SECTION 5: ADMINISTRATION.**

#### **5.01: GRANT RECIPIENT.**

The City of Lynchburg has been designated by the COUNCIL to be the grant recipient for the ~~Region 2000~~ Central Virginia Workforce Development Area COUNCIL, and is responsible for ensuring compliance with the terms and conditions of the WDA grant. Therefore, the City shall have the ability, for cause, to terminate the appointment of the fiscal agent selected if the City, in its sole discretion, determines there is good cause to do so by giving written notice of termination and specifying the cause for the termination and the effective date thereof. In the event the City terminates the appointment of the fiscal agent as provided herein, the fiscal agent will be paid for the reasonable services provided and the allowable expenses incurred by the fiscal agent prior to the termination of the appointment. If the City terminates the appointment of the fiscal agent the BOARD with the advice and consent of the COUNCIL shall appoint a new fiscal agent.

#### **5.02: FISCAL AGENT.**

In order to facilitate and expedite the process of implementing the workforce development system in ~~Region 2000~~ Central Virginia, the COUNCIL has determined it to be appropriate to make the initial appointment of the Fiscal Agent for both the COUNCIL and the BOARD. Future appointment of the Fiscal Agent shall be by the BOARD with the advice and consent of the COUNCIL. Pursuant to the ACT, this Agreement, and the Cooperative Agreement between the COUNCIL, and the BOARD, the Fiscal Agent shall be the responsible to the BOARD for management and control. The Fiscal Agent shall provide administrative and staff support to both the COUNCIL and the BOARD performing those duties and responsibilities as may be required to carry out the requirements of the ACT as prescribed by the BOARD and approved by the COUNCIL. Additionally, the ACT prohibits the Fiscal Agent from providing direct services.

Accordingly, the COUNCIL does hereby appoint the ~~Virginia's Region 2000 Local Government Council (Region 2000)~~Central Virginia Planning District Commission as the Fiscal Agent for the WDA.

### **5.03: DUTIES AND RESPONSIBILITIES OF THE FISCAL AGENT.**

The FISCAL AGENT shall have the following duties and responsibilities and such other duties as may be assigned by the COUNCIL initially and the BOARD subsequently:

- A. Prepare the Workforce Development plans as directed by the BOARD;
- B. Develop a program budget for submission to the BOARD prepared in accordance with federal and state guidelines and provisions of the ACT;
- C. Develop an Administrative Budget for submission to the BOARD for the purpose of carrying out the responsibilities as may be assigned by the BOARD;
- D. Provide professional, technical, and clerical support to the COUNCIL under the direction of the BOARD on all matters relating to planning, operation, monitoring, oversight, and evaluation of Workforce Development programs and activities in and for the WDA;
- E. Develop and carry out monitoring procedures necessary to meet the requirements of the Workforce Development Plan and the ACT;
- F. Provide for the operation of all programs and activities which are carried out for the COUNCIL under the authority of the BOARD; and
- G. To perform such other duties as may be assigned from time to time.

### **SECTION 6: SPECIAL COMMITTEES.**

The BOARD and the COUNCIL, jointly or separately, shall from time to time establish such special committees as deemed necessary to effectively plan for and efficiently respond to the workforce needs of the WDA.

### **SECTION 7: RESOLUTION OF CONFLICT.**

In the event there is an unresolved dispute between the BOARD and the COUNCIL, the Governor of the Commonwealth of Virginia shall exercise the authority vested in the state governor by the ACT and Regulations, as amended.

### **SECTION 8: LIABILITY.**

The COUNCIL as a unit and distinguished from the sum or any number of its individual members shall indemnify, and hold harmless, the individual members of the BOARD and COUNCIL from the restitution of any funds required by the misapplication, erroneous expenditure or other action by the BOARD or COUNCIL which results in a claim against any individual member or combination of members of the COUNCIL or the BOARD to the extent allowed by law; this duty to indemnify is subject to all immunities that inure to any individual COUNCIL member as an officer, agent or employee of any political subdivision of the Commonwealth of Virginia and to the immunities that inure to the benefit of any political subdivision of the Commonwealth of Virginia who is a party hereto or a beneficiary hereof, its officers, agents and employees to include sovereign immunity.

#### **8.01: LIMITATION OF LIABILITY.**

The extent of liability of any single jurisdiction in this COUNCIL, for any of the funds appropriated to the WDA, shall be limited to the prorated share of the total funds allocated the particular jurisdiction during the particular fiscal year in which an issue of liability may arise.

#### **8.02: INSURANCE REQUIREMENT.**

The Fiscal Agent shall procure and maintain appropriate Public Liability and Errors and Omissions Insurance policies sufficient to protect the COUNCIL from potential errors and omissions in the ordinary administration and use of these particular public funds and provide proof thereof to the COUNCIL prior to entering into its duties as Fiscal Agent.

### **SECTION 9: DURATION.**

This Council Agreement shall be terminated upon the repeal of the ACT and other related legislation regarding Workforce Development or upon mutual consent of at least two-thirds (2/3) of the members of the COUNCIL.

### **SECTION 10: MEMBERSHIP ADDITIONS AND WITHDRAWALS.**

#### **10.01: ADDITIONS.**

Any local jurisdiction which is not a party to this Council Agreement on the effective date thereof may thereafter join the COUNCIL provided that such local jurisdiction is made a part of a Local Workforce Development Area designated by the Governor of the Commonwealth of Virginia in accordance with the provisions of the ACT and Regulations, as amended; and that, that jurisdiction adopts and executes this Council Agreement.

#### **10.02: WITHDRAWALS.**

Any party to this Council Agreement shall have the right to withdraw at any time after written notification of at least ninety (90) days to the COUNCIL of the party's intention to withdraw from the Council Agreement. In the event that any locality that is a party to this agreement exercises its right to withdrawal then the term of any BOARD member appointed by such locality as well as the term of the Chief Elected Official representing the locality on the COUNCIL shall end on the date of the withdrawal.

#### **10.03: DISPOSITION OF PROPERTY UPON TERMINATION.**

Upon termination of this agreement any property owned by the Council or the Fiscal Agent shall be distributed to the local jurisdictions on a proportionate basis equal to the amount of funding through grant receipts or otherwise during the period of time when the agreement was in effect.

#### **SECTION 11: AMENDMENTS.**

This Council Agreement may be amended only by concurring resolutions by the governing bodies of two-thirds (2/3) of the members of this Council Agreement.

#### **SECTION 12: EFFECTIVE DATE.**

This Council Agreement shall become effective on the ~~final date appearing immediately below~~ that two-thirds (2/3) of the members agree.-



# Amended and Restated Workforce Development Area Agreement

July 2018

Central Virginia

WORKFORCE DEVELOPMENT AREA

*(LWDA 7)*

## **COUNCIL AGREEMENT**

April, 2000

Revised July 21, 2000

Revision October, 2015

Proposed Revision July, 2018

**Council Agreement**

## **CENTRAL VIRGINIA WORKFORCE DEVELOPMENT AREA**

### **PREAMBLE**

The Central Virginia Region of Lynchburg and the surrounding communities recognize that the development of a vibrant, effective workforce is important to the economic competitiveness and resiliency of our communities. We understand that workforce development is an educational process occurring at all ages and is lifelong. We recognize that by working together we can build a stronger workforce development program.

The communities of this region seek to create organizations which will be the focal point of the region's workforce development initiatives. We look for these organizations to both utilize federal Workforce Development funds and also seek other partner organizations to develop a well-rounded, successful program to provide training and education programs appropriate for all ages and for the skills needed by the community's businesses and industries.

To implement this effort, we authorize the creation of the Central Virginia Workforce Development Area and the Central Virginia Workforce Development Board in accordance with the WORKFORCE INNOVATION AND OPPORTUNITY ACT (WIOA)(Public Law 113-128), hereinafter referred to as the "ACT", and all federal and state guidelines for the ACT. It is Made and Entered into by and between the County of AMHERST, the County of APPOMATTOX, the County of BEDFORD, the County of CAMPBELL and the City of LYNCHBURG.

WITNESSETH:

WHEREAS, the respective Boards of Supervisors of the Counties of AMHERST, APPOMATTOX, BEDFORD and CAMPBELL and the City Council of the City of LYNCHBURG in the Commonwealth of Virginia, have adopted resolutions authorizing the execution of this Council Agreement;

NOW THEREFORE THIS AGREEMENT FURTHER WITNESSETH: That for and in consideration of the promises and of the mutual benefits to be derived hereunder, that each and all of the jurisdictions enumerated immediately above, do hereby reciprocally agree as follows:

### **SECTION 1: CREATION OF THE COUNCIL.**

THERE IS HEREBY CREATED, by the undersigned Chief Local Elected Official of the Counties and City, the CENTRAL VIRGINIA WORKFORCE DEVELOPMENT AREA COUNCIL, hereinafter referred to as the "COUNCIL ", which shall exist under and be subject to the terms and conditions of this Council Agreement, and which shall be deemed to constitute the

agreement authorized by Section 15.2-1300 of the Code of Virginia (Repl. Vol. 1997) as amended, for the joint exercise of powers by participating political subdivisions of the Commonwealth of Virginia.

The purpose of the COUNCIL shall be to plan, establish, and operate a LOCAL WORKFORCE DEVELOPMENT AREA and Workforce Development Services Delivery System according to the provisions of the ACT, and the Federal Regulations hereinafter referred to as the "Regulations", issued by the U.S. Department of Labor, for the implementation of the ACT together with any and all other subsequent and relevant federal and Commonwealth of Virginia statutes, policies and interpretations.

## **SECTION 2: AREA AND POPULATION TO BE SERVED.**

The area to be served shall be called the CENTRAL VIRGINIA WORKFORCE DEVELOPMENT AREA, hereinafter referred to as the "WDA", and shall include the jurisdictions noted in this section and consisting of the 2,000 square miles of land in the Counties of Amherst, Appomattox, Bedford and Campbell and the City of Lynchburg (Lynchburg Area). The Weldon Cooper Center for Public Services Demographics Research Group population estimates published on January 27, 2015 indicates the Lynchburg Area has a population of 259,487.

## **SECTION 3: RESPONSIBILITIES OF THE COUNCIL.**

On behalf of each and all parties hereto, the COUNCIL powers shall include, but not be limited to the following:

- A. Providing overall governance for implementing the provisions of the ACT and Regulations for the WDA to include creation of, and appointment of all members to, the CENTRAL VIRGINIA WORKFORCE DEVELOPMENT BOARD, hereinafter referred to as the "BOARD".
- B. Approving policies, priorities, goals, and objectives of the BOARD and the programs and services to be provided by the BOARD, either directly or by contract with political subdivisions or public or private service providers.
- C. The COUNCIL, in partnership with the Board, shall submit to the Governor a regional strategic workforce development plan that meets the requirements in Section 108 of the ACT.
- D. The COUNCIL shall approve the Board budget annually and receive the BOARD's annual report.

E. The COUNCIL shall enter into an agreement with the BOARD that clearly details the partnership between the two entities for the governance and oversight of activities under the ACT.

### **3.01: MEMBERSHIP.**

The voting members of the COUNCIL shall be the Chief Local Elected Official of each of the jurisdictions that are party to this agreement, or that official's duly appointed elected designee.

### **3.02: TERMS OF OFFICE.**

The term of office for each COUNCIL member shall coincide with the term of office for which the member was elected to public office in the particular jurisdiction the member represents.

### **3.03: VOTING RIGHTS.**

Each COUNCIL member shall have one (1) equal vote on all matters before the COUNCIL. Voting by proxy shall not be permitted except when the Council member is represented by a duly appointed elected designee.

### **3.04: MEETINGS.**

The COUNCIL shall hold meetings from time to time as may be required in order to conduct the affairs of the COUNCIL. At least one meeting shall be held each year.

### **3.05: BY-LAWS.**

The COUNCIL may adopt by-laws and such other rules as it deems necessary to govern its operations.

## **SECTION 4: WORKFORCE DEVELOPMENT BOARD.**

### **4.01: CREATION of the CENTRAL VIRGINIA WORKFORCE DEVELOPMENT BOARD.**

There is hereby created, the CENTRAL VIRGINIA WORKFORCE DEVELOPMENT BOARD, referred to as the "BOARD".

### **4.02: APPOINTMENT of MEMBERS to the BOARD.**

The COUNCIL, shall appoint the members of the BOARD in accordance with the process required by Section 107 of the ACT pertaining to Local Workforce Development Boards and related Commonwealth of Virginia Policy as described immediately below.



The COUNCIL, acting together, shall appoint representatives from each of the following categories:

- A. A majority of the members of each local Board shall be representatives of business in the local area, who shall reflect, to the extent possible, employment opportunities in the region and who:
  - (i) Are owners of businesses, chief executives or operating officers of businesses, or other business executives or employers with optimum policymaking or hiring authority;
  - (ii) Represent businesses, including small businesses, or organizations representing businesses described in this clause, that provide employment opportunities that, at a minimum, include high-quality, work-relevant training and development in in-demand industry sectors or occupations in the local area; and
  - (iii) Are appointed from among individuals nominated by local businesses, business organizations and business trade associations;
  
- B. Not fewer than twenty (20) percent of the members of each Board shall be representatives of the workforce within the local area, who:
  - (i) Shall include representatives of labor organizations (for a local area in which employees are represented by labor organizations), who have been nominated by local labor federations, or (for a local area in which no employees are represented by such organizations) other representatives of employees;
  - (ii) Shall include a representative who shall be a member of a labor organization or a training director, form a joint labor-management apprenticeship program, and if no such joint program exists in the area, such a representative of an apprenticeship program in the area, if such a program exists;
  - (iii) May include representatives of community-based organizations that have demonstrated experience and expertise in addressing the employment needs of individuals with barriers to employment, including organizations that serve veterans or that provide or support competitive integrated employment for individuals with disabilities; and

- (iv) May include representatives of organizations that have demonstrated experience and expertise in addressing the employment, training or education needs of eligible youth, including representatives of organizations that serve out-of-school youth;

C. Each local Board shall include representatives of entities administering education and training activities in the local area, who:

- (i) Shall include a representative of eligible providers administering adult education and literacy activities under Title II;
- (ii) Shall include a representative of institutions of higher education providing workforce development activities (including community colleges);
- (iii) May include representatives of local educational agencies, and of community-based organizations with demonstrated experience and expertise in addressing the education or training needs of individuals with barriers to employment;
- (iv) If there are multiple eligible providers serving the local area by administering adult education and literacy activities under Title II, or multiple institutions of higher education serving the local area by providing workforce development activities, each representative on the Board shall be appointed from among individuals nominated by local providers representing such providers or institutions, respectively;

D. Each local Board shall include representatives of governmental and economic and community development entities serving the local area who:

- (i) Shall include a representative of economic and community development entities;
- (ii) Shall include an appropriate representative from the State employment service office under the Wagner-Peyser Act (29 U.S.C. 720 et seq.), other than section 122 or part C of that title (29 U.S.C. 732, 741) serving the local area;
- (iii) May include representatives of agencies or entities administering programs serving the local area relating to

- transportation, housing, and public assistance; and
- (iv) May include representatives of philanthropic organizations serving the local area; and

E. Each local board may include such other individuals or representatives of entities as the chief elected official in the local area may determine to be appropriate.

#### **4.03: PURPOSE AND POWERS.**

The functions and responsibilities of the BOARD shall include, but are not limited to:

- A. Development of all plans and priorities for service and subsequent modifications.
- B. Development and implementation of policies and operating guidelines as required by the Cooperative Agreement by and between the BOARD and the COUNCIL for the administration of the workforce development programs operated, or proposed, within the WDA.
- C. Approval of all proposed program designs and delivery systems for the purpose of providing workforce development services for the WDA.
- D. Evaluation of the performance of individual services providers pursuant to relevant federal and state statutes, regulations and policy interpretations as revised or amended.
- E. Development of the vision, goals, objectives, and policies for the regional workforce development area. The vision should be aligned with both the region's Comprehensive Economic Development Strategy and the Virginia Board of Workforce Development's goals. The Board shall solicit support and comment from the general public in providing a comprehensive plan for workforce development programs for this local workforce development area.
- F. Serve as sub recipient of all funds disbursed under the ACT for the local WDA and the subsequent disbursement of such funds to designated service providers and/or subcontractors in accordance with the approved Workforce Development Plan and, pursuant to approved procedures as provided for in the Cooperative Agreement by and between the COUNCIL and the BOARD.
- G. Advising the COUNCIL of problems that may arise from time to time that may impact policy considerations of the COUNCIL and recommend corrective action.

H. Reporting at least annually to the COUNCIL on the state of the Workforce Development Program and the matters related to carrying out the requirements of the Workforce Development Plan.

I. Such other functions as the BOARD may deem appropriate provided such functions are allowable under the ACT and Regulations, as amended.

#### **4.04: NOMINATION PROCESS.**

The Chief Local Elected Officials must contact the appropriate entities in the local area for nominations to appoint members and/or to fill vacancies on the local Board from business, local educational entities, and labor representatives. Chief Local Elected Officials may also design a process for nominations of individuals and other types of representation the officials would like to include on the local Board. Vacancies subsequent to the establishment of the local Board must be filled in the same manner as the original appointments.

Private sector representatives are to be selected from among individuals nominated by local business organizations (ex. business trade associations, chamber of commerce, economic development agencies). Individual businesses may also nominate themselves or provide nominations of other businesses to the Chief Local Elected Officials. Private sector representatives can include owners of businesses, chief executives or operating officers of businesses, and other business executives with optimum policy making or hiring authority.

Local educational entity representatives must be selected from among individuals nominated by regional or local educational agencies, institutions, or organizations representing such local educational entities including local school boards, entities providing vocational education, entities providing secondary adult education and literacy activities, and postsecondary educational institutions (including representatives of community colleges, where such entities exist). Members of the board that represent organizations, agencies, or other entities shall be individuals with optimum policymaking authority within the organizations, agencies, or entities. The members of the board shall represent diverse geographic areas within the local area.

Labor representatives must be selected from among individuals nominated by local labor federations (or in a local area in which no employees are represented by such organizations, other representatives of employees, such as employee organizations and/or the state AFL-CIO).

For all other members, local chief elected officials should consult with the appropriate groups in the local area for possible individuals to serve including:



- Representatives of community-based organizations, including organizations representing individuals with disabilities and veterans where such organizations exist in the area.
- Representatives of local economic development agencies, including private sector economic development entities.

Nomination for membership to the BOARD shall be accomplished in accordance with the provisions of the ACT and Regulations, as amended. The nomination process under this agreement shall be for the Member Jurisdictions, as defined in Section 2, to seek and receive nominations and submit the list of nominees to the COUNCIL. The COUNCIL shall review the nominations and any other recommendations from member jurisdictions that may be received and make the appointments in accordance with Section 4.02 herein above.

#### **4.05: TERMS OF OFFICE.**

The term of office for BOARD members shall be two (2) years and members may be eligible for reappointment. The initial terms of members of the BOARD shall be staggered and the manner and method of staggering the term of office shall be set forth in the by-laws of the BOARD. Individuals serving on the local Board who subsequently retire or no longer hold the position that made them eligible board members may not continue to serve on the local Board. The entity affiliated with the vacating board member may nominate a new representative to the local Board. Vacancies resulting from resignations or removal of mandatory members should be filled within ninety (90) days.

#### **4.06: VOTING RIGHTS.**

Each BOARD member shall have one (1) equal vote on all matters before the BOARD. Voting by proxy shall not be permitted.

#### **4.07: OFFICERS.**

A Chair and Vice Chair shall be elected by and from the membership of the BOARD; and, shall serve for terms of one (1) year and may be eligible for re-election for one additional term of one year. Eligibility for election of both the Chair and Vice Chair shall be limited to the private sector business category of BOARD membership as referenced in Section 4.02(A) of this Agreement. The Chair serves as the Executive committee chair and selects the Chairs for all standing committees and special committees of the BOARD.

#### **4.08: MEETINGS.**

The BOARD shall hold regular or called meetings at such times, dates, and places as may be established in the by-laws of the BOARD.

#### **4.09: STANDING COMMITTEES.**

A. IN GENERAL.—the BOARD may designate and direct the activities of standing committees to provide information and to assist the local board in carrying out activities under this section. Such standing committees shall be chaired by a member of the local board, may include other members of the local board, and shall include other individuals appointed by the local board who are not members of the local board and who the local board determines have appropriate experience and expertise. At a minimum, the local board may designate each of the following:

- (i) A standing committee to provide information and assist with operational and other issues relating to the one-stop delivery system, which may include as members representatives of the one-stop partners.
- (ii) A standing committee to provide information and to assist with planning, operational, and other issues relating to the provision of services to youth, which shall include community-based organizations with a demonstrated record of success in serving eligible youth.
- (iii) A standing committee to provide information and to assist with operational and other issues relating to the provision of services to individuals with disabilities, including issues relating to compliance with section 188, if applicable, and applicable provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) regarding providing programmatic and physical access to the services, programs, and activities of the one-stop delivery system, as well as appropriate training for staff on providing supports for or accommodations to, and finding employment opportunities for, individuals with disabilities.

B. ADDITIONAL COMMITTEES.—The Board may designate standing committees in addition to the standing committees specified in subparagraph (A).

#### **4.10: BY-LAWS.**

The Board shall adopt by-laws and such other rules or operational procedures as it deems necessary to govern its operations.

## **SECTION 5: ADMINISTRATION.**

### **5.01: GRANT RECIPIENT.**

The City of Lynchburg has been designated by the COUNCIL to be the grant recipient for the Central Virginia Workforce Development Area COUNCIL, and is responsible for ensuring compliance with the terms and conditions of the WDA grant. Therefore, the City shall have the ability, for cause, to terminate the appointment of the fiscal agent selected if the City, in its sole discretion, determines there is good cause to do so by giving written notice of termination and specifying the cause for the termination and the effective date thereof. In the event the City terminates the appointment of the fiscal agent as provided herein, the fiscal agent will be paid for the reasonable services provided and the allowable expenses incurred by the fiscal agent prior to the termination of the appointment. If the City terminates the appointment of the fiscal agent the BOARD with the advice and consent of the COUNCIL shall appoint a new fiscal agent.

### **5.02: FISCAL AGENT.**

In order to facilitate and expedite the process of implementing the workforce development system in Central Virginia, the COUNCIL has determined it to be appropriate to make the initial appointment of the Fiscal Agent for both the COUNCIL and the BOARD. Future appointment of the Fiscal Agent shall be by the BOARD with the advice and consent of the COUNCIL. Pursuant to the ACT, this Agreement, and the Cooperative Agreement between the COUNCIL, and the BOARD, the Fiscal Agent shall be the responsible to the BOARD for management and control. The Fiscal Agent shall provide administrative and staff support to both the COUNCIL and the BOARD performing those duties and responsibilities as may be required to carry out the requirements of the ACT as prescribed by the BOARD and approved by the COUNCIL. Additionally, the ACT prohibits the Fiscal Agent from providing direct services.

Accordingly, the COUNCIL does hereby appoint the Central Virginia Planning District Commission as the Fiscal Agent for the WDA.

### **5.03: DUTIES AND RESPONSIBILITIES OF THE FISCAL AGENT.**

The FISCAL AGENT shall have the following duties and responsibilities and such other duties as may be assigned by the COUNCIL initially and the BOARD subsequently:

- A. Prepare the Workforce Development plans as directed by the BOARD;
- B. Develop a program budget for submission to the BOARD prepared in accordance with federal and state guidelines and provisions of the ACT;

- C. Develop an Administrative Budget for submission to the BOARD for the purpose of carrying out the responsibilities as may be assigned by the BOARD;
- D. Provide professional, technical, and clerical support to the COUNCIL under the direction of the BOARD on all matters relating to planning, operation, monitoring, oversight, and evaluation of Workforce Development programs and activities in and for the WDA;
- E. Develop and carry out monitoring procedures necessary to meet the requirements of the Workforce Development Plan and the ACT;
- F. Provide for the operation of all programs and activities which are carried out for the COUNCIL under the authority of the BOARD; and
- G. To perform such other duties as may be assigned from time to time.

#### **SECTION 6: SPECIAL COMMITTEES.**

The BOARD and the COUNCIL, jointly or separately, shall from time to time establish such special committees as deemed necessary to effectively plan for and efficiently respond to the workforce needs of the WDA.

#### **SECTION 7: RESOLUTION OF CONFLICT.**

In the event there is an unresolved dispute between the BOARD and the COUNCIL, the Governor of the Commonwealth of Virginia shall exercise the authority vested in the state governor by the ACT and Regulations, as amended.

#### **SECTION 8: LIABILITY.**

The COUNCIL as a unit and distinguished from the sum or any number of its individual members shall indemnify, and hold harmless, the individual members of the BOARD and COUNCIL from the restitution of any funds required by the misapplication, erroneous expenditure or other action by the BOARD or COUNCIL which results in a claim against any individual member or combination of members of the COUNCIL or the BOARD to the extent allowed by law; this duty to indemnify is subject to all immunities that inure to any individual COUNCIL member as an officer, agent or employee of any political subdivision of the Commonwealth of Virginia and to the immunities that inure to the benefit of any political subdivision of the Commonwealth of Virginia who is a party hereto or a beneficiary hereof, its officers, agents and employees to include sovereign immunity.



#### **8.01: LIMITATION OF LIABILITY.**

The extent of liability of any single jurisdiction in this COUNCIL, for any of the funds appropriated to the WDA, shall be limited to the prorated share of the total funds allocated the particular jurisdiction during the particular fiscal year in which an issue of liability may arise.

#### **8.02: INSURANCE REQUIREMENT.**

The Fiscal Agent shall procure and maintain appropriate Public Liability and Errors and Omissions Insurance policies sufficient to protect the COUNCIL from potential errors and omissions in the ordinary administration and use of these particular public funds and provide proof thereof to the COUNCIL prior to entering into its duties as Fiscal Agent.

### **SECTION 9: DURATION.**

This Council Agreement shall be terminated upon the repeal of the ACT and other related legislation regarding Workforce Development or upon mutual consent of at least two-thirds (2/3) of the members of the COUNCIL.

### **SECTION 10: MEMBERSHIP ADDITIONS AND WITHDRAWALS.**

#### **10.01: ADDITIONS.**

Any local jurisdiction which is not a party to this Council Agreement on the effective date thereof may thereafter join the COUNCIL provided that such local jurisdiction is made a part of a Local Workforce Development Area designated by the Governor of the Commonwealth of Virginia in accordance with the provisions of the ACT and Regulations, as amended; and that, that jurisdiction adopts and executes this Council Agreement.

#### **10.02: WITHDRAWALS.**

Any party to this Council Agreement shall have the right to withdraw at any time after written notification of at least ninety (90) days to the COUNCIL of the party's intention to withdraw from the Council Agreement. In the event that any locality that is a party to this agreement exercises its right to withdrawal then the term of any BOARD member appointed by such locality as well as the term of the Chief Elected Official representing the locality on the COUNCIL shall end on the date of the withdrawal.

#### **10.03: DISPOSITION OF PROPERTY UPON TERMINATION.**

Upon termination of this agreement any property owned by the Council or the Fiscal Agent shall be distributed to the local jurisdictions on a proportionate basis equal to the

amount of funding through grant receipts or otherwise during the period of time when the agreement was in effect.

**SECTION 11: AMENDMENTS.**

This Council Agreement may be amended only by concurring resolutions by the governing bodies of two-thirds (2/3) of the members of this Council Agreement.

**SECTION 12: EFFECTIVE DATE.**

This Council Agreement shall become effective on the date that two-thirds (2/3) of the members agree.

**AMENDMENT TO  
REGION 2000 EMERGENCY COMMUNICATIONS  
REGIONAL COOPERATIVE AGREEMENT  
IN ORDER TO CHANGE THE NAME TO  
CENTRAL VIRGINIA EMERGENCY COMMUNICATIONS  
REGIONAL COOPERATIVE AGREEMENT**

This Agreement is entered into by and between Amherst County, Virginia, Bedford County, Virginia, the Town of Bedford, Virginia, and the City of Lynchburg, Virginia, collectively the “Member Jurisdictions”, and Central Virginia Planning District Commission (“CVPDC”), all political subdivisions or public bodies corporate and politic of the Commonwealth of Virginia, and all of which collectively may be referred to as the “Parties”.

**RECITALS**

WHEREAS, the Parties previously entered into the Region 2000 Emergency Communications Regional Cooperative Agreement in order to create and operate the Region 2000 Radio Communications Board; and,

WHEREAS, the parties have determined to change the name of the Region 2000 Radio Communications Board to the Central Virginia Radio Communications Board; and,

WHEREAS, the Parties, by their execution hereof, have approved and made the change of the Region 2000 Radio Communications Board to the Central Virginia Radio Communications Board.

**NOW, THEREFORE, THIS AGREEMENT FURTHER WITNESSETH:**

That upon the execution hereof by all Parties, the Region 2000 Radio Communications Board shall be and become, by change of name, the Central Virginia Radio Communications Board.

In all other respects, the aforesaid Region 2000 Emergency Communications Regional Cooperative Agreement shall continue in full force and effect until otherwise agreed to by the Parties or as required by law.

IN WITNESS WHEREOF, the Parties have each caused this Amendment to the former Region 2000 Emergency Communications Regional Cooperative Agreement to be executed and dated as follows:

**AMHERST COUNTY, VIRGINIA**

By: \_\_\_\_\_  
Chair, Board of Supervisors

\_\_\_\_\_  
Date signed

**BEDFORD COUNTY, VIRGINIA**

By: \_\_\_\_\_  
Chairman, Board of Supervisors

\_\_\_\_\_ Date signed

**TOWN OF BEDFORD, VIRGINIA**

By: \_\_\_\_\_  
Mayor

\_\_\_\_\_ Date signed

**CITY OF LYNCHBURG, VIRGINIA**

By: \_\_\_\_\_  
City Manager

\_\_\_\_\_ Date signed

**REGION 2000 LOCAL GOVERNMENT COUNCIL  
(now CENTRAL VIRGINIA PLANNING DISTRICT COMMISSION)**

By: \_\_\_\_\_  
Executive Director

\_\_\_\_\_ Date signed



# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018**

AGENDA ITEM #: **17**

CONSENT:  
ACTION: X

REGULAR: X  
INFORMATION:

WORK SESSION:

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: Proposed Utility Vehicle Code changes requested by Spring Hill Cemetery**

KEY ELEMENTS:

\_\_\_Economic Development \_\_\_Excellent Government \_\_\_Natural and Built Environment X Safe Community \_\_\_Vibrant Community

**RECOMMENDATION:** Approve Spring Hill Cemetery's request for the use of utility vehicles on roads and sidewalks as shown on the attached drawing, with the exception of Stadium Road from Blackburn Street to Gordon Street. The Physical Development Committee recommended approval of the request, with the exception of the noted section at their August 14, 2018.

**SUMMARY:** The Physical Development Committee discussed the request from Spring Hill Cemetery. At this meeting PDC heard from representatives of the Cemetery as to their need to utilize public right of way for their maintenance activities. Additionally, the committee received staff concerns. After discussion, PDC recommended the requested revisions and additions to City Code Section 25-188.3 as follows:

Addition of section (5) to the current code to allow utility vehicles use of the following:

(5) In the area of Springhill Cemetery, as follows:

(a) Wythe Road (sidewalk only; must yield to pedestrians), from Fort Avenue to Rives Street;

(b) Rives Street, from Wythe Road to James Street;

(c) Blackburn Street, from Rives Street to Stadium Road;

(d) James Street, from Rives Street to Stadium Road;

(e) Gordon Street, from Stadium Road to Rives Street;

(f) Rives Street, from Gordon Street to Lancaster Street;

(g) Lancaster Street, from Rives Street to Fort Avenue; and

(h) Fort Avenue (sidewalk only; must yield to pedestrians), from Wythe Road to Lancaster Street.

**PRIOR ACTION(S):** August 14 Physical Development Committee  
April 12, 2016 City Council; Ord. No. O-16-035, § 1, 4-12-16

**FISCAL IMPACT:** None.

**CONTACT(S):** Don DeBerry, City Transportation Engineer – 455-3935  
Lee Newland, City Engineer – 455-3947  
Gaynelle Hart, Director Public Works – 455-4406

**ATTACHMENT(S):** Ordinance  
Map

**REVIEWED BY:** raw

AN ORDINANCE TO AMEND AND REENACT SECTION 25-188.3 OF THE CODE OF THE CITY OF LYNCHBURG, 1981, THE AMENDED SECTION RELATING TO THE OPERATION OF GOLF CARTS AND UTILITY VEHICLES ON THE PUBLIC STREETS.

BE IT ORDAINED BY THE COUNCIL OF THE CITY OF LYNCHBURG:

1. That Section 25-188.3 of the Code of the City of Lynchburg, 1981, be and the same is hereby amended and reenacted as follows:

Sec. 25-188.3. - Public highways designated for golf cart and utility vehicle operations.

(a)The city council hereby designates the following public highways within the city upon which golf carts and utility vehicles may be operated in accordance with the provisions of this article.

(1) In the area of Randolph College, as follows:

- a. Rivermont Avenue (sidewalk only; must yield to pedestrians), from North Princeton Circle to 2470 Rivermont Avenue.
- b. The signalized crossing at Rivermont Avenue and North Princeton Circle.
- c. The crosswalk at the intersection of Rivermont Avenue and Norfolk Avenue.
- d. South Princeton Circle, from Rivermont Avenue to 220 South Princeton Circle.
- e. North Princeton Circle, from Rivermont Avenue to 80 North Princeton Circle.
- f. Norfolk Avenue, from the rear driveway at 2601 Rivermont Avenue to Cedar Drive.
- g. Westmoreland Street, from Rivermont Avenue to 227 Westmoreland Street.
- h. Arlington Street, from Rivermont Avenue to the driveway serving 2615 Rivermont Avenue.

(2) In the area of Lynchburg College, as follows:

- a. Faculty Drive, from Lakeside Drive to its end.
- b. Hood Street, from Lakeside Drive to Bristol Street.
- c. Bristol Street, from Hood Street to Monticello Avenue.
- d. Monticello Avenue, from Bristol Street to Lakeside Drive.
- e. The signalized crossing at the intersection of Monticello Avenue, Oakley Avenue and Lakeside Drive.
- f. Jubal Street, from Oakley Avenue to College Street.
- g. Hood Street, from Jubal Street to Lakeside Drive.
- h. Blue Ridge Street, from Jubal Street to Lakeside Drive.
- i. College Drive, from Lakeside Drive to Vernon Street.
- j. Vernon Street, from College Street to Richmond Street.
- k. Brevard Street, from College Street to Thomas Road.
- l. Westwood Avenue, from College Street to Thomas Road.
- m. College Street, from Vernon Street to its end.
- n. McCausland Street, from College Street to Thomas Road.
- o. Lakewood Street, from McCausland Street to Thomas Road.

(3) In the area of Liberty University, as follows:

- a. Candler's Mountain Road (sidewalk only; must yield to pedestrians), from Hershey-Esbenshade to University Boulevard
- b. The signalized crossing at Hershey-Esbenshade and Candler's Mountain Road.
- c. The signalized crossing at Candler's Mountain Road and University Boulevard.
- d. University Boulevard, from Candler's Mountain Road to Liberty Mountain Drive.
- e. Liberty Mountain Drive, from Candler's Mountain Road to the City boundary with Campbell County.
- f. Liberty Mountain Drive, from Candler's Mountain Road to the north at the end of the City right of way.

- g. A crossing of Candler's Mountain Road at the intersection with Liberty Mountain Drive and the hotel driveway.
- h. Regents Parkway from Liberty Mountain Drive to University Boulevard

(4) In the area of Central Virginia Community College, as follows:

- a. Harvard Street (State Route 368), from Wards Road to Wards Ferry Road.

(5) In the area of Springhill Cemetery, as follows:

- (a) Wythe Road (sidewalk only; must yield to pedestrians), from Fort Avenue to Rives Street;
- (b) Rives Street, from Wythe Road to James Street;
- (c) Blackburn Street, from Rives Street to Stadium Road;
- (d) James Street, from Rives Street to Stadium Road;
- (e) Gordon Street, from Stadium Road to Rives Street;
- (f) Rives Street, from Gordon Street to Lancaster Street;
- (g) Lancaster Street, from Rives Street to Fort Avenue; and
- (h) Fort Avenue (sidewalk only; must yield to pedestrians), from Wythe Road to Lancaster Street.

Even if the city council has approved the operation of a golf cart or utility vehicle on a designated public highway, if the designated public highway is maintained by the Virginia Department of Transportation, no person shall operate any golf cart or utility vehicle on such public highway until the Virginia Department of Transportation also approves the operation of golf carts and utility vehicles on such public highway.

(b) With regard to each of the public highways listed in subsection (a) above, the city council has considered the factors set forth in subsection 25-188.2(b) above, as required by Section 46.2-916.2 of the Code of Virginia.

2. That this ordinance shall become effective upon its adoption.

Adopted:

Certified:

\_\_\_\_\_  
Clerk of Council

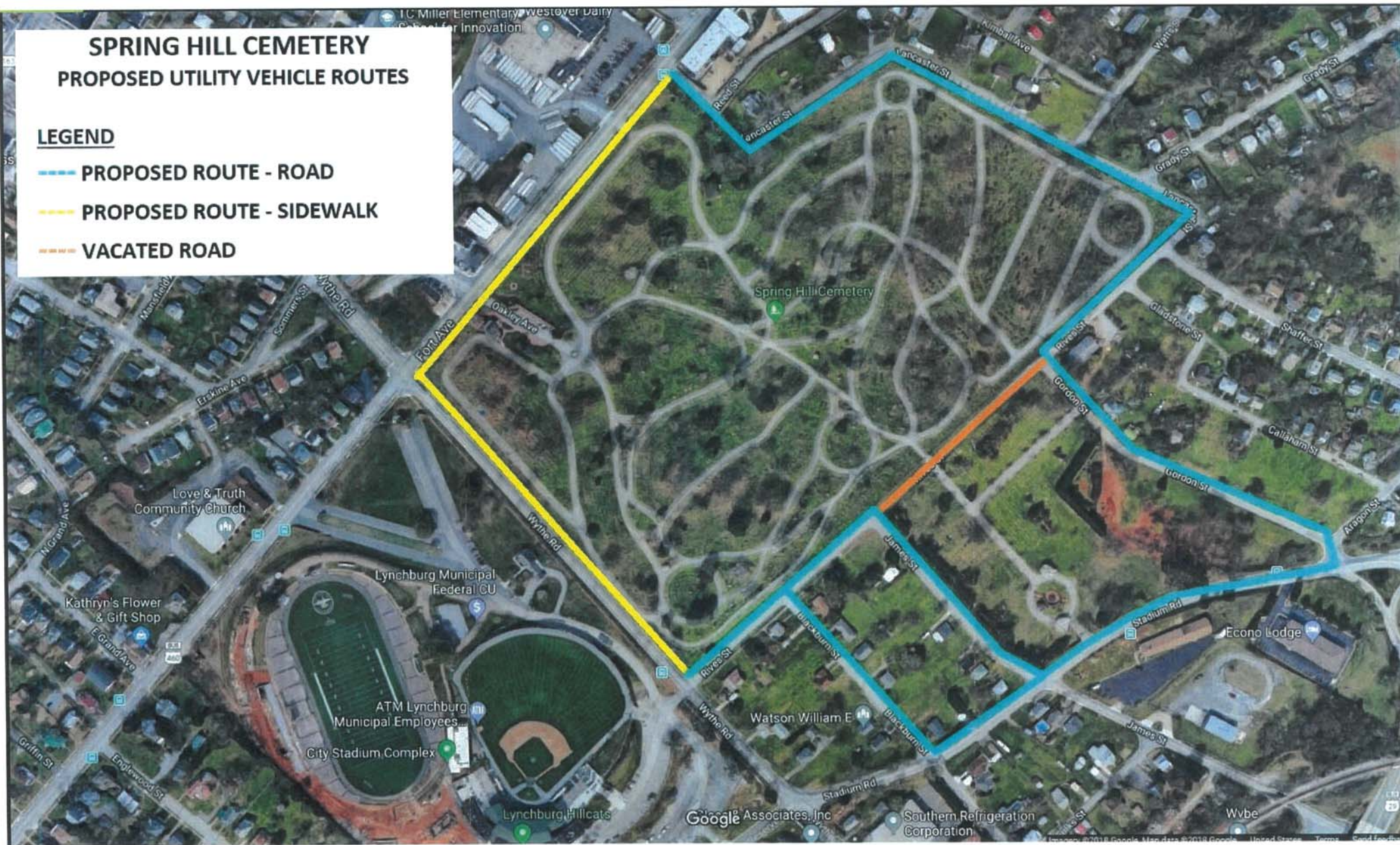
092K



# SPRING HILL CEMETERY PROPOSED UTILITY VEHICLE ROUTES

## LEGEND

- PROPOSED ROUTE - ROAD
- PROPOSED ROUTE - SIDEWALK
- VACATED ROAD





# LYNCHBURG CITY COUNCIL

## Agenda Item Summary

MEETING DATE: **September 11, 2018**

AGENDA ITEM #: **18**

CONSENT:  
ACTION: **X**

REGULAR: **X**  
INFORMATION:

WORK SESSION:

CLOSED SESSION:  
(Confidential)

**ITEM TITLE: FY 2018 Fourth Quarter and FY 2019 First Quarter Adjustments**

KEY ELEMENTS:

\_\_\_Economic Development **X**Excellent Government \_\_\_Natural and Built Environment \_\_\_Safe Community \_\_\_Vibrant Community

**RECOMMENDATION:** Adopt a resolution amending the FY 2018 Operating Budget and appropriating funds to reflect the FY 2018 Fourth Quarter Adjustments as listed in Attachment A. Adopt a resolution amending the FY 2019 Operating and Capital Budgets and appropriating or rescinding funds to reflect the FY 2019 First Quarter Adjustments as listed in Attachment B.

**SUMMARY:** The General, City/Federal/State Aid, and Detention Operating Budgets are amended to reflect the FY 2018 Fourth Quarter Adjustments.

The General, City/Federal/State Aid, Community Development Block Grant (CDBG), Forfeited Assets, Home Investment Trust, Technology, Fleet, as well as the City Capital Projects and Schools Capital Projects Fund are amended to reflect the FY 2019 First Quarter Adjustments.

**PRIOR ACTION(S):** Adoption of the FY 2018 Operating and Capital Budgets: May 23, 2017  
First Quarter Adjustments: October 10, 2017  
Third Quarter Adjustments: April 10, 2018  
Adoption of the FY 2019 Operating and Capital Budgets: May 22, 2018

**FISCAL IMPACT:** As noted on Attachment A and B.

**CONTACT(S):** Donna Witt, Director of Financial Services, 455-3968

**ATTACHMENT(S):** Resolutions; Attachment A: FY 2018 Fourth Quarter Adjustments – Summary and Detail; and Attachment B: FY 2019 First Quarter Adjustments – Summary and Detail

**REVIEWED BY:** raw

RESOLUTION: BE IT RESOLVED That the FY 2018 Adopted Budget is amended and funds are appropriated to reflect the Fourth Quarter Adjustments in the General, City/Federal/State Aid, and Detention Operating Budgets as reflected in Attachment A.

And, BE IT RESOLVED that the funds shall be used as identified in Attachment A.

Introduced:

Adopted:

Certified:

\_\_\_\_\_  
Clerk of Council

093K

RESOLUTION: BE IT RESOLVED That the FY 2019 Adopted Budget is amended and funds are appropriated or rescinded to reflect the First Quarter Adjustments in the General, City/Federal/State Aid, Community Development Block Grant (CDBG), Forfeited Assets, Home Investment Trust, Technology, Fleet, as well as the City Capital Projects and Schools Capital Projects Fund as reflected in Attachment B.

And, BE IT RESOLVED that the funds shall be used as identified in Attachment B.

Introduced:

Adopted:

Certified:

\_\_\_\_\_  
Clerk of Council

094K

**FY 2018 Fourth Quarter Adjustment  
SUMMARY BY FUND**

|                             | Expenditures       | Additional<br>Revenues | Use of Unassigned Fund<br>Balance | Transfer or<br>Use of<br>Committed/<br>Assigned<br>Fund Balance |
|-----------------------------|--------------------|------------------------|-----------------------------------|-----------------------------------------------------------------|
| GENERAL FUND                | 1,352,227          | 52,227                 | -                                 | 1,300,000                                                       |
| CITY/FEDERAL/STATE AID FUND | 6,490              | 6,490                  | -                                 | -                                                               |
| DETENTION HOME FUND         | 229,493            | 229,493                | -                                 | -                                                               |
| <b>TOTALS</b>               | <b>\$1,588,210</b> | <b>\$288,210</b>       | <b>\$0</b>                        | <b>\$1,300,000</b>                                              |

| Department/Division                | Amount    | Source of Funding   |                                |                                                    | Purpose                                                                                                                                                                                    |
|------------------------------------|-----------|---------------------|--------------------------------|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                    |           | Additional Revenues | Use of Unassigned Fund Balance | Transfer or Use of Committed/Assigned Fund Balance |                                                                                                                                                                                            |
| GENERAL FUND                       |           |                     |                                |                                                    |                                                                                                                                                                                            |
| Non-Departmental - Medical Benefit | 1,300,000 |                     |                                | 1,300,000                                          | To appropriate funds from the Medical Benefits reserve for additional costs incurred in FY 2018. Attributed to a bad claims year; leaving a remaining balance in the reserve of \$112,000. |

|         |        |        |  |  |                                                            |
|---------|--------|--------|--|--|------------------------------------------------------------|
| Sheriff | 52,227 | 52,227 |  |  | Appropriate additional State revenues received in FY 2018. |
|---------|--------|--------|--|--|------------------------------------------------------------|

**GENERAL FUND**

|                                         |                  |
|-----------------------------------------|------------------|
| FY 2018 Additional Revenues             | \$ 52,227        |
| <b>GENERAL FUND Appropriation Total</b> | <b>1,352,227</b> |

**CITY/FEDERAL/STATE AID FUND**

|                |       |       |  |  |                                                               |
|----------------|-------|-------|--|--|---------------------------------------------------------------|
| Human Services | 6,490 | 6,490 |  |  | To appropriate Adoption Incentive Funds awarded by the State. |
|----------------|-------|-------|--|--|---------------------------------------------------------------|

|                                          |                 |
|------------------------------------------|-----------------|
| <b>CITY/FEDERAL/STATE AID FUND Total</b> | <b>\$ 6,490</b> |
|------------------------------------------|-----------------|

**DETENTION HOME FUND**

|                |         |         |  |  |                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------|---------|---------|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Detention Home | 229,493 | 229,493 |  |  | Appropriate funds related to the approved reclassifications of Detention Center employees not included in the FY 2018 budget. Additional appropriation needed to fund unanticipated expenses related to the maintenance of the HVAC System and the repair of the hot water heater. Funding is available to support the above expenditures but was not requested in Third Quarter. |
|----------------|---------|---------|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                  |                   |
|----------------------------------|-------------------|
| <b>DETENTION HOME FUND Total</b> | <b>\$ 229,493</b> |
|----------------------------------|-------------------|



**FY 2019 First Quarter Adjustment  
SUMMARY BY FUND**

|                                               | <b>Expenditures</b> | <b>Additional<br/>Revenues</b> | <b>Use of Unassigned Fund<br/>Balance</b> | <b>Transfer or<br/>Use of<br/>Committed/<br/>Assigned<br/>Fund Balance</b> |
|-----------------------------------------------|---------------------|--------------------------------|-------------------------------------------|----------------------------------------------------------------------------|
| GENERAL FUND                                  | 1,101,713           | 543,045                        | 450,400                                   | 108,268                                                                    |
| CITY/FEDERAL/STATE AID FUND                   | 30,572              | 30,572                         | -                                         | -                                                                          |
| COMMUNITY DEVELOPMENT BLOCK GRANT (CDBG) FUND | 71,349              | 71,349                         | -                                         | -                                                                          |
| FORFEITED ASSETS FUND                         | 42,389              | -                              | -                                         | 42,389                                                                     |
| HOME INVESTMENT TRUST FUND                    | 137,821             | 137,821                        | -                                         | -                                                                          |
| TECHNOLOGY FUND                               | 392,569             | 53,084                         | -                                         | 339,485                                                                    |
| CITY CAPITAL PROJECTS FUND                    | (277,321)           | (326,956)                      | 49,635                                    | -                                                                          |
| SCHOOLS CAPITAL PROJECTS FUND                 | 9,600               | 9,600                          | -                                         | -                                                                          |
| FLEET SERVICES FUND                           | 90,000              | -                              | -                                         | 90,000                                                                     |
| <b>TOTALS</b>                                 | <b>\$1,598,692</b>  | <b>\$518,515</b>               | <b>\$500,035</b>                          | <b>\$580,142</b>                                                           |

## FY 2019 First Quarter Adjustment Details

## ATTACHMENT B

| Department/Division                      | Amount  | Source of Funding   |                                |                                                    | Purpose                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------|---------|---------------------|--------------------------------|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          |         | Additional Revenues | Use of Unassigned Fund Balance | Transfer or Use of Committed/Assigned Fund Balance |                                                                                                                                                                                                                                                                                                                                                                    |
| GENERAL FUND                             |         |                     |                                |                                                    |                                                                                                                                                                                                                                                                                                                                                                    |
| City Assessor                            | 5,500   |                     | 5,500                          |                                                    | Carry forward remaining funds to upgrade to a new version of the current Computer-Assisted Mass Appraisal (CAMA) system ProVal.                                                                                                                                                                                                                                    |
| Council/Manager Offices                  | 549     |                     | 549                            |                                                    | Remaining funds from fundraiser in FY 2012 for United Way Campaign expenses.                                                                                                                                                                                                                                                                                       |
| Court Service Unit<br>24th District      | 380     |                     | 380                            |                                                    | Carry forward remaining funds to purchase additional door locks for safety purposes.                                                                                                                                                                                                                                                                               |
| Economic Development and Tourism         | 282,570 |                     | 282,570                        |                                                    | Request to appropriate additional funds for the revenue estimate for The Virginian per the performance agreement. The Adopted FY 2019 budget included \$168,250 for the revenue estimate however based on current collections and an estimate provided by The Virginian Hotel, LLC owners staff believes this number will be considerably higher than anticipated. |
| Economic Development and Tourism/Museums | 10,570  |                     | 10,570                         |                                                    | Carry forward remaining funds to purchase software and technology items and provide acting pay for the Assistant Curator for temporarily filling the Curator position.                                                                                                                                                                                             |
| Emergency Services                       | 3,000   |                     | 3,000                          |                                                    | Carry forward remaining funds to purchase the Disaster Management module for the Crisis Track Damage Assessment Software.                                                                                                                                                                                                                                          |
| Human Resources - Non-Departmental       | 10,524  | 389                 | 10,135                         |                                                    | Carry forward remaining funds and unspent vending machine proceeds to fund employee recognition events.                                                                                                                                                                                                                                                            |
| Library                                  | 3,428   | 3,428               |                                |                                                    | Appropriate additional State Aid from the Library of Virginia funds and increase the Volunteer Coordinator annual hours with additional funds from the Friends of the Lynchburg Library.                                                                                                                                                                           |
| Parks and Recreation                     | 25,000  |                     | 25,000                         |                                                    | Carry forward remaining funds to purchase appliances and furniture for College Hill and Daniels Hill Centers in conjunction with the center renovations.                                                                                                                                                                                                           |
| Parks and Recreation                     | 21,267  | 13,332              | 7,935                          |                                                    | To appropriate funds for the unspent balance of the We Got The Beet campaign funded by the Health Department.                                                                                                                                                                                                                                                      |
| Police - Range                           | 1,451   |                     | 450                            | 1,001                                              | Carry forward remaining funds and revenues received over adopted budget to be used for firing range purposes in FY 2019.                                                                                                                                                                                                                                           |

| Department/Division | Amount  | Source of Funding   |                                |                                                    | Purpose                                                                                                                                                                                                                                                                                                                       |
|---------------------|---------|---------------------|--------------------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     |         | Additional Revenues | Use of Unassigned Fund Balance | Transfer or Use of Committed/Assigned Fund Balance |                                                                                                                                                                                                                                                                                                                               |
| Poverty Initiative  | 91,108  |                     | 91,108                         |                                                    | Request to carry forward remaining FY 2018 Poverty Initiative Funds.                                                                                                                                                                                                                                                          |
| Public Works        | 426,261 | 426,261             |                                |                                                    | Request to adjust the FY 2019 budget based on Virginia Department of Transportation (VDOT) lane mileage reimbursement rate changes and overweight permit fee revenues. Funds will be used to purchase equipment, increase temporary personnel wages to address retention, and address additional landscape maintenance needs. |
| Public Works        | 50,000  |                     |                                | 50,000                                             | Appropriate committed funds for Concord Turnpike Landfill Maintenance to replace the blower at the recommendation of the Regional Authority.                                                                                                                                                                                  |
| Registrar           | 861     |                     |                                | 861                                                | Carry forward remaining funds to purchase two desktop scanners to scan in voter registration cards to provide Statewide access on the Virginia Elections and Registration System.                                                                                                                                             |

| Department/Division                                                                   | Amount | Source of Funding   |                                |                                                    | Purpose                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------|--------|---------------------|--------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                       |        | Additional Revenues | Use of Unassigned Fund Balance | Transfer or Use of Committed/Assigned Fund Balance |                                                                                                                                                                                                                                                                                                           |
| TRANSFERS                                                                             |        |                     |                                |                                                    |                                                                                                                                                                                                                                                                                                           |
| Transfer to City/Federal/State Aid Fund from General Fund Operating Budget            | 13,203 |                     | 13,203                         |                                                    | Transfer from General Fund to City/Federal State Aid Fund to appropriate the amount collected from a percentage of Amusement Tax in the Arts and Cultural District that relates to the Arts Grant.                                                                                                        |
| Transfer to City/Federal/State Aid Fund from General Fund Operating Budget            | 92     |                     |                                | 92                                                 | Transfer from General Fund to City/Federal State Aid Fund to appropriate probation fee funds to offset the reduction in the grant award from the Department of Criminal Justice (DCJS) for Community Corrections and Pre-Trial Services.                                                                  |
| Transfer to City/Federal/State Aid Fund from General Fund Operating Budget            | 3,230  |                     |                                | 3,230                                              | Transfer from General Fund to City/Federal State Aid Fund to appropriate probation fee funds to cover the cost of bonuses and associated benefits for full-time employees because Community Corrections and Pre-Trial Services is fully grant funded, bonuses are not allowed to be charged to the grant. |
| Transfer from City Capital Fund to General Fund Operating Budget                      | 41,645 | 41,645              |                                |                                                    | Transfer to General Fund from City Capital Projects Fund to appropriate funds received from Liberty University to cover City staff labor and benefits charged to the Liberty University Intramural Road, Phase I project.                                                                                 |
| Transfer from City Capital Fund to General Fund Operating Budget                      | 7,990  | 7,990               |                                |                                                    | Transfer to General Fund from City Capital Projects Fund to appropriate funds received from Liberty University to cover City staff labor and benefits charged to the Liberty University Intramural Road, Phase II project.                                                                                |
| Transfer from Technology Fund to Human Resources General Fund Operating Budget        | 50,000 | 50,000              |                                |                                                    | Transfer from Technology Fund to General Fund for Human Resources Performance Management Tracking Software originally budgeted in in FY 2018 for Government Financial Intelligence and Transparency Software.                                                                                             |
| Transfer to Technology Fund from Information Technology General Fund Operating Budget | 53,084 |                     |                                | 53,084                                             | Transfer from General Fund to Technology Fund of non-personnel unexpended funds to the Technology Fund per June 2000 Council approved Information Technology Policy.                                                                                                                                      |

**GENERAL FUND**

|                                                                            |                  |
|----------------------------------------------------------------------------|------------------|
| FY 2018 Additional Revenues                                                | \$ 543,045       |
| Amount Funded with Use of FY 2018 Unassigned Year End Fund Balance         | 450,400          |
| Amount Funded with a Transfer of Use of Committed or Assigned Fund Balance | 108,268          |
| <b>GENERAL FUND Appropriation Total</b>                                    | <b>1,101,713</b> |



| Department/Division                          | Amount | Source of Funding   |                                |                                                    | Purpose                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------|--------|---------------------|--------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                              |        | Additional Revenues | Use of Unassigned Fund Balance | Transfer or Use of Committed/Assigned Fund Balance |                                                                                                                                                                                                                                                                                                           |
| CITY/FEDERAL/STATE AID FUND                  |        |                     |                                |                                                    |                                                                                                                                                                                                                                                                                                           |
| Commonwealth's Attorney Office               | 7,315  | 7,315               |                                |                                                    | Appropriate additional revenues received from the Virginia Department of Criminal Justice Services.                                                                                                                                                                                                       |
| Community Corrections and Pre-Trial Services | (92)   | (92)                |                                |                                                    | True-up the FY 2019 grant award from Department of Criminal Justice Services (DCJS); during the City budget process \$502,793 was appropriated, \$502,701 was awarded in July 2018.                                                                                                                       |
| Community Corrections and Pre-Trial Services | 92     | 92                  |                                |                                                    | Transfer to City/Federal State Aid Fund from General Fund to appropriate probation fee funds to offset the reduction in the grant award from the Department of Criminal Justice (DCJS) for Community Corrections and Pre-Trial Services.                                                                  |
| Community Corrections and Pre-Trial Services | 3,230  | 3,230               |                                |                                                    | Transfer to City/Federal State Aid Fund from General Fund to appropriate probation fee funds to cover the cost of bonuses and associated benefits for full-time employees because Community Corrections and Pre-Trial Services is fully grant funded, bonuses are not allowed to be charged to the grant. |
| Economic Development                         | (500)  | (500)               |                                |                                                    | True-up the Arts and Cultural District grant to reflect the actual award of FY 2019 State funding.                                                                                                                                                                                                        |
| Economic Development                         | 13,203 | 13,203              |                                |                                                    | Transfer to City/Federal State Aid Fund from General Fund to appropriate the amount collected from a percentage of Amusement Tax in the Arts and Cultural District that relates to the Arts Grant true up FY 2018.                                                                                        |
| Fire                                         | 761    | 761                 |                                |                                                    | True-up the Fire Program Grant (4-for-Life) funding, during the FY 2018 budget process \$55,000 was appropriated, \$55,761 was received in June 2018.                                                                                                                                                     |
| Fire                                         | 6,563  | 6,563               |                                |                                                    | True-up the Fire Program Grant funding (Fire Funding), during the FY 2019 budget process \$255,000 was appropriated, \$261,563 was received in June 2018.                                                                                                                                                 |
| CITY/FEDERAL/STATE AID FUND Total            |        |                     | \$ 30,572                      |                                                    |                                                                                                                                                                                                                                                                                                           |

| Department/Division                           | Amount | Source of Funding   |                                |                                                    | Purpose                                                                                                                         |
|-----------------------------------------------|--------|---------------------|--------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
|                                               |        | Additional Revenues | Use of Unassigned Fund Balance | Transfer or Use of Committed/Assigned Fund Balance |                                                                                                                                 |
| COMMUNITY DEVELOPMENT BLOCK GRANT (CDBG) FUND |        |                     |                                |                                                    |                                                                                                                                 |
| Community Development                         | 71,349 | 71,349              |                                |                                                    | True-up the FY 2019 grant award; during the City budget process \$662,564 was appropriated, \$733,913 was awarded in June 2018. |

|                 |           |
|-----------------|-----------|
| CDBG FUND Total | \$ 71,349 |
|-----------------|-----------|

**FORFEITED ASSETS FUND**

|                                |        |  |  |        |                                                    |
|--------------------------------|--------|--|--|--------|----------------------------------------------------|
| Commonwealth's Attorney Office | 22,353 |  |  | 22,353 | To appropriate Asset Forfeiture revenues received. |
| Police Department              | 20,036 |  |  | 20,036 | To appropriate Asset Forfeiture revenues received. |

|                             |           |
|-----------------------------|-----------|
| FORFEITED ASSETS FUND Total | \$ 42,389 |
|-----------------------------|-----------|

**HOME INVESTMENT TRUST FUND**

|                       |         |         |  |  |                                                                                                                                 |
|-----------------------|---------|---------|--|--|---------------------------------------------------------------------------------------------------------------------------------|
| Community Development | 137,821 | 137,821 |  |  | True-up the FY 2019 grant award; during the City budget process \$300,951 was appropriated, \$438,772 was awarded in June 2018. |
|-----------------------|---------|---------|--|--|---------------------------------------------------------------------------------------------------------------------------------|

|                                  |            |
|----------------------------------|------------|
| HOME INVESTMENT TRUST FUND Total | \$ 137,821 |
|----------------------------------|------------|

| Department/Division    | Amount | Source of Funding   |                                |                                                     | Purpose                                                                                                                                                                                                    |
|------------------------|--------|---------------------|--------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        |        | Additional Revenues | Use of Unassigned Fund Balance | Transfer or Use of Committed/ Assigned Fund Balance |                                                                                                                                                                                                            |
| TECHNOLOGY FUND        |        |                     |                                |                                                     |                                                                                                                                                                                                            |
| Information Technology | 50,000 |                     |                                | 50,000                                              | Appropriate funds for IT system consulting fees to support Solid Waste process reengineering                                                                                                               |
| Information Technology | 18,319 |                     |                                | 18,319                                              | Appropriate funds to continue TrakIT 9 (business application for Community Planning Dept) implementation (Phase II)                                                                                        |
| Information Technology | 50,000 |                     |                                | 50,000                                              | Appropriate funds for anticipated upgrade to PCI/RBS (personal property tax system)                                                                                                                        |
| Information Technology | 5,000  |                     |                                | 5,000                                               | Appropriate funds for New World System enhancements-Badger interface (water meter reading software)                                                                                                        |
| Information Technology | 65,000 |                     |                                | 65,000                                              | Appropriate funds to support further implementation of Cherwell (IT service management system)                                                                                                             |
| Information Technology | 22,800 |                     |                                | 22,800                                              | Appropriate funds for interns or hourly employees to support IT initiatives                                                                                                                                |
| Information Technology | 20,000 |                     |                                | 20,000                                              | Appropriate funds to replace aged audio/visual equipment in IT conference rooms; install 1st Floor water fountain                                                                                          |
| Information Technology | 8,366  |                     |                                | 8,366                                               | Appropriate funds for building maintenance and furnishing needs                                                                                                                                            |
| Information Technology | 35,000 |                     |                                | 35,000                                              | Appropriate funds for Network Security IT systems consulting                                                                                                                                               |
| Information Technology | 15,000 |                     |                                | 15,000                                              | Appropriate funds for Network Security software                                                                                                                                                            |
| Information Technology | 50,000 |                     |                                | 50,000                                              | Transfer from Technology Fund to General Fund for Human Resources Performance Management Tracking Software originally budgeted in FY 2018 for Government Financial Intelligence and Transparency Software. |
| Information Technology | 53,084 | 53,084              |                                |                                                     | Transfer to Technology Fund from General Fund for non-personnel unexpended General Fund balance.                                                                                                           |

|                                                                            |                   |
|----------------------------------------------------------------------------|-------------------|
| FY 2018 Additional Revenues                                                | \$ 53,084         |
| Amount Funded with a Transfer of Use of Committed or Assigned Fund Balance | 339,485           |
| <b>TECHNOLOGY FUND Total</b>                                               | <b>\$ 392,569</b> |

| Department/Division                                              | Amount    | Source of Funding   |                                |                                                    | Purpose                                                                                                                                                                                                                           |
|------------------------------------------------------------------|-----------|---------------------|--------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                  |           | Additional Revenues | Use of Unassigned Fund Balance | Transfer or Use of Committed/Assigned Fund Balance |                                                                                                                                                                                                                                   |
| CITY CAPITAL PROJECTS FUND                                       |           |                     |                                |                                                    |                                                                                                                                                                                                                                   |
| Public Works - Engineering                                       | (102,174) | (102,174)           |                                |                                                    | Rescind Virginia Department of Transportation (VDOT) Revenue Share Program funds for the Downtown Streetscapes project to equal amount of award.                                                                                  |
| Public Works - Engineering                                       | (81,739)  | (81,739)            |                                |                                                    | Rescind Virginia Department of Transportation (VDOT) Revenue Share Program funds for the Route 221 Intersection Improvements (One Way Pairs) project to equal the amount of the award.                                            |
| Public Works - Engineering                                       | (143,043) | (143,043)           |                                |                                                    | Rescind Virginia Department of Transportation (VDOT) Revenue Share Program funds for the John Capron Road extension project to equal the amount of the award.                                                                     |
| Transfer from City Capital Fund to General Fund Operating Budget | 41,645    |                     | 41,645                         |                                                    | <i>Transfer to General Fund from City Capital Projects Fund</i> to appropriate funds received from Liberty University to cover City staff labor and benefits charged to the Liberty University Intramural Road, Phase I project.  |
| Transfer from City Capital Fund to General Fund Operating Budget | 7,990     |                     | 7,990                          |                                                    | <i>Transfer to General Fund from City Capital Projects Fund</i> to appropriate funds received from Liberty University to cover City staff labor and benefits charged to the Liberty University Intramural Road, Phase II project. |

|                                                                    |                     |
|--------------------------------------------------------------------|---------------------|
| FY 2018 Additional Revenues                                        | \$ (326,956)        |
| Amount Funded with Use of FY 2018 Unassigned Year End Fund Balance | 49,635              |
| <b>CITY CAPITAL PROJECTS FUND Total</b>                            | <b>\$ (277,321)</b> |

**SCHOOLS CAPITAL PROJECTS FUND**

|         |       |       |  |  |                                                                                                                 |
|---------|-------|-------|--|--|-----------------------------------------------------------------------------------------------------------------|
| Schools | 9,600 | 9,600 |  |  | To appropriate funds received from the Rooftop Lease agreement for a cell tower on top of Dunbar Middle School. |
|---------|-------|-------|--|--|-----------------------------------------------------------------------------------------------------------------|

|                                            |                 |
|--------------------------------------------|-----------------|
| FY 2018 Additional Revenues                | \$ 9,600        |
| <b>SCHOOLS CAPITAL PROJECTS FUND Total</b> | <b>\$ 9,600</b> |

**FLEET SERVICES FUND**

|                |        |  |  |        |                                                                                                               |
|----------------|--------|--|--|--------|---------------------------------------------------------------------------------------------------------------|
| Fleet Services | 90,000 |  |  | 90,000 | To purchase Fleet Management Information System software to interact with Automatic Vehicle Locator software. |
|----------------|--------|--|--|--------|---------------------------------------------------------------------------------------------------------------|

|                                                                            |                  |
|----------------------------------------------------------------------------|------------------|
| Amount Funded with a Transfer of Use of Committed or Assigned Fund Balance | 90,000           |
| <b>FLEET SERVICES FUND Total</b>                                           | <b>\$ 90,000</b> |