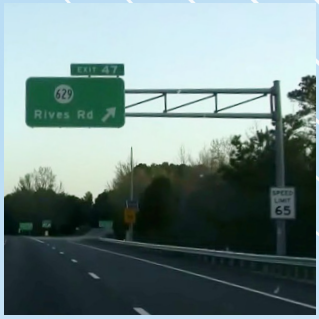
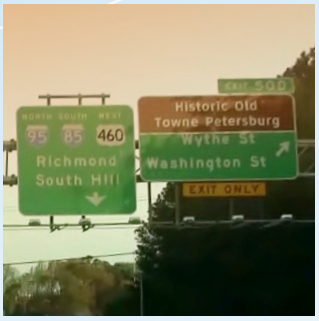
FINAL REPORT





I-95/I-85 INTERCHANGE ROADWAY SAFETY ASSESSMENT

Prepared for:

VDOT

Prepared by:

Kimley-Horn and Associates, Inc.

117306012.B

MARCH 2013

Final Report
March 2013

I-95/I-85 Interchange ROADWAY SAFETY ASSESSMENT

Prepared for:

VDOT
Virginia Department of Transportation

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EXECUTIVE SUMMARY

INTRODUCTION

Interstates 95 and 85, as well as Route 460 and US 301, converge in Petersburg, Virginia in a complex series of interchanges developed in the mid-1950's as part of the Richmond-Petersburg Turnpike. These interchanges have several features that create safety and operational challenges, which may have met design standards in the 1950's, but are deficient by current design standards. Examples of such features include short acceleration/deceleration lanes, tight turns, low-speed curves, and short weave/merge areas. A comprehensive planning study was conducted in the study area between 1998 and 2000 and identified a number of capacity and safety issues. The study recommendations are documented in the final report, "Final Report: I-85/95/Route 460 Interchange Study" dated December, 2000.

Since the initial study was completed, there has been significant traffic growth in the area due to the expansion of Fort Lee from the BRAC realignment as well as increased long distance traffic on I-95 and I-85. Additionally, the Route 460 Corridor Improvements Project is planned to connect to I-85, and is projected to significantly impact traffic in this interchange area.

This roadway safety assessment study is intended to be the first phase of an eventual larger I-95/I-85/Route 460 Interchange Area operations and conceptual design study that will update the aforementioned 2000 planning study using the latest available information and will consider the recent changes in traffic patterns and growth in the area. This study is a cooperative effort between the Virginia Department of Transportation (VDOT), the Crater Planning District Commission (CPDC), and Tri-Cities Metropolitan Planning Organization (MPO).

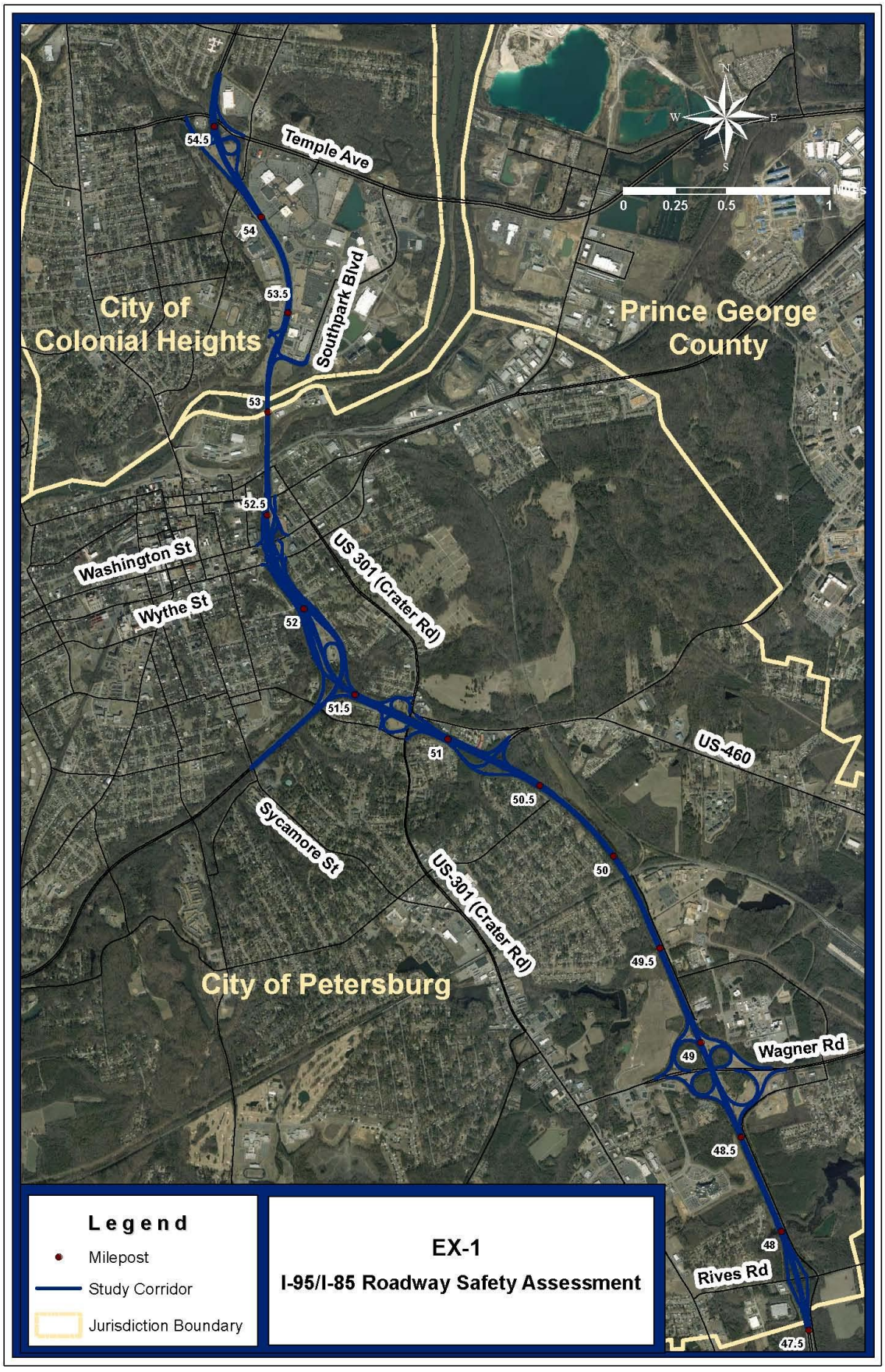
STUDY AREA

The study area includes two study corridors, an 8-mile segment of I-95 and a 1-mile segment of I-85 near Petersburg and Colonial Heights, Virginia. The overall study area is illustrated in **Figure EX-1**. The I-95 study corridor includes 8 interchanges with a northern limit 1,000 feet north of the Temple Avenue interchange (Exit 54) and a southern limit 1,000 feet south of the Rives Road interchange (Exit 47). The I-85 study corridor is approximately one mile in length and extends from the I-95/I-85 interchange (Exit 51) to the Sycamore Street overpass. With the exception of the I-95 junction, there are no interchanges on the I-85 study corridor.

STUDY PROCESS

The study process included data collection, crash analysis, field reviews, and the development of safety related improvements within the study area. The development of improvements focused on addressing the identified safety issues in the study area. An analysis of traffic operations was not conducted as part of this study; however, the previous "I-95/I-85/Route 460 Interchange Study" (conducted in 2000), which included a comprehensive operational analysis, was reviewed and its findings and recommendations considered throughout this study. In addition to the RSA assessment, VDOT requested the study team review safety issues at the following three areas of interest within the study area and propose mitigation measures.

1. Rives Road Interchange at I-95 (Exit 47)
2. The I-95 Southbound Off-Ramp to Washington Street (Exit 52)
3. The I-85 Northbound Off-Ramp to I-95 Southbound (Exit 68)


54.5
Temple Ave
54
53.5
Southpark Blvd
City of
Colonial Heights
Prince George
County
53
52.5
Washington St
US 301 (Crater Rd)
Wythe St
52
51.5
51
US-460
50.5
Sycamore St
US 301 (Crater Rd)
50
49.5
City of Petersburg
49
Wagner Rd
48.5
48
Rives Rd
47.5
N
W
E
S
0
0.25
0.5
1
Miles
Legend
Milepost
Study Corridor
Jurisdiction Boundary
EX-1
I-95/I-85 Roadway Safety Assessment

The study team conducted a meeting with the following stakeholders to discuss and gain input on the proposed recommendations:

- Virginia Department of Transportation (VDOT)
- Tri-Cities Metropolitan Planning Organization (MPO)
- City of Petersburg
- Federal Highway Administration (FHWA)

EXISTING CONDITIONS

The consultant team collected existing condition information in the study area by conducting field inventories and by obtaining historical crash, speed, and traffic count data from VDOT. The results of the existing conditions analyses were used as a basis for identifying safety issues and confirm the need for this study and future study efforts within the study area.

TRAFFIC VOLUMES

Daily traffic volumes for the I-95 and I-85 study corridors were derived from the 2010 VDOT published traffic counts.

- Based on the 2010 VDOT published traffic counts, I-95 carries approximately 96,000 vehicles per day on the north end of the corridor (Temple Road) and approximately 31,000 vehicles per day on the south end of the corridor (Rives Road).
- The highest traffic volumes on the I-95 study corridor are found between the Southpark Boulevard and Washington Street interchanges with approximately 101,000 vehicles per day.
- Truck percentages range from 10 to 15 percent on the I-95 study corridor.
- The I-85 study corridor carries approximately 54,000 vehicles per day with 13 to 14 percent trucks.

SPEED DATA

Existing speed data for the I-95 and I-85 study corridors was collected from three of VDOT's count stations located throughout the study area. This data, in addition to field reviews, was used to measure the level of congestion during the peak periods. Traffic counts included with the speed data were used to verify the peak periods. Speed data was analyzed to determine the average daily speed, average speed during the peak periods, and the 85th percentile speeds. The following conclusions were drawn based on an analysis of this data.

- The AM peak period extends from approximately 6:00 AM to 9:00 AM and the PM peak period extends from approximately 3:00 PM to 6:00 PM for both study corridors.

I-95 Corridor

- On both ends of the I-95 study corridor the 85th percentile speed, in both directions, fell between 60 and 65 mph, which is above the posted speed limit of 55 mph on the north end and below the posted speed limit of 65 mph on the south end.
- On the northern end of the I-95 corridor there was little variation (± 5 mph) from the posted speed limit during the peak periods; however, on the southern end of the corridor the peak period speeds range between 55 and 60 mph, which is 10 mph less than the posted speed limit.

I-85 Corridor

- On I-85 the 85th percentile speed in both directions fell between 65 and 70 mph, which is above the posted speed limit of 60 mph.
- On I-85 there was little variation (± 5 mph), from the posted speed limit during the peak periods.

CRASH ANALYSIS

Crash data was collected for a 3-year period, from January 1, 2007 through December 31, 2009, for both the I-95 and I-85 study corridors. The following crash trends were identified.

- The total number of reported crashes during 3 years was 405 with 135 (33%) of them resulting in injuries.
- Overall, injury, and fatal crash rates for the study corridors were less than the most recent published (2007) crash rates for statewide urban interstates. The exception is the fatal crash rate of 0.8 crashes per 100 million vehicle miles traveled (VMT) on I-95 southbound, which is 35% higher than the statewide interstate crash rate of 0.5 crashes per 100 million VMT.
- The current study corridors crash rates (calculated using data from 2007 to 2009) were compared to the crash rates calculated in the I-85/I-95/Route 460 Interchange Study from 2000 (calculated from 1996 to 1998) and show a reduction in the overall, injury, and fatal crash rates. Although the limits of the two studies were different; a comparison of the crash rates shows a downward trend through the study area.
- The primary crash type for both the I-95 and I-85 study corridors was fixed-object off-road, which is a prominent crash type on interstates.
- Sixty-four percent (64%) of the 152 roadway departure crashes in the study area (both study corridors) were to the left and 36% occurred to the right.
- The second highest crash type for the I-95 study corridor (including the collector-distributor roads and ramps) was rear end, which is an indication of possible traffic congestion, variable travel speeds, short deceleration and acceleration lane lengths, and inadequate ramp configurations.
- The highest number of reported crashes occurred at the Temple Avenue interchange. The on- and off-ramps at the interchange had a combined total of 28 crashes.
- Approximately 48% of all crashes occurred during AM and PM peak periods.
- Approximately 30% of the crashes occurred during dark conditions, which is often found in corridors without continuous roadway lighting. Of those crashes, 71% were reported as occurring on a segment of roadway without lighting.
- Crash histograms, developed on a half-mile basis, were used by the study team to identify high-crash locations or crash hot spots within the study corridor. The top three hot spots were near the Temple Avenue (northbound direction), Southpark Boulevard (southbound direction), and Washington/Wythe Street (southbound direction) interchanges. There were no crash hotspots identified in either direction on I-85.

GEOMETRIC DEFICIENCIES

Geometric data for various roadways in the study area was reviewed and tabulated. Each element was compared to AASHTO *A Policy on Geometric Design of Highways and Streets* standards. This section of I-95/I-85 was initially constructed in the late-1950s resulting in geometric conditions not meeting current design standards. The following key roadway deficiencies, which currently negatively impact operations and safety in the corridor, were documented:

- Thirteen of the 16 (81%) study segments do not meet the recommended one mile minimum spacing between interchanges on an urban interstate. Closely spaced interchanges within an urban area create friction and turbulence, which can result in increased congestion, bottlenecks, and corresponding crashes.
- Eleven of the 31 (35%) acceleration/deceleration lane lengths are deficient and do not meet current standards. Specifically, 8 of the 11 (73%) are deficient acceleration lanes and 3 of the 11 (27%) are deficient deceleration lanes.
- There are 14 overhead sign structures with unlit signs throughout the I-95 study corridor.
- Eight of the 9 bridges crossing over mainline I-95 and I-85 do not meet the 16.5-foot minimum bridge vertical clearance for urban interstates.

- The I-95 northbound to I-85 southbound, an interstate-to-interstate connection, is signed with a 25 mph advisory speed and a truck rollover warning sign.
- The I-85 northbound to I-95 southbound ramp, an interstate-to-interstate connection with a significant number of heavy vehicles, is controlled with a yield condition on a steep uphill grade and must yield to traffic exiting I-95 southbound.

PROPOSED IMPROVEMENTS

CORRIDOR-WIDE IMPROVEMENTS

Many of the safety issues observed along the study corridor were not localized to a single segment of roadway and, as a result, several corridor-wide improvements were recommended. The goal was to relate crash trends and deficiencies identified during the study process with improvements that will reduce crashes and risk throughout the corridor.

Rumble Strips: The existing crash pattern of roadway departure crashes along the study corridor justifies the corridor-wide installation of rumble strips along I-95 and I-85 on both the right and left shoulders where they do not currently exist.

Median Barrier:

- Due to the prevalence of roadway departure crashes to the left in roadway segments with median barriers, a corridor-wide assessment of traffic barriers is recommended. The study should assess the barrier design as it impacts vehicle deflection and the main travel way safety during crashes.
- It is recommended that reflectors be installed on the median barrier in locations were they do not currently exist, especially in locations where there are a significant number of crashes in dark conditions.

Pavement Markings: The installation of 6” wide pavement markings and in-pavement reflectors will improve visibility in the corridor and reduce the risk of crashes related to dark driving conditions, wet driving conditions and ultimately help reduce the number of roadway departure and sideswipe crashes.

Guardrail: A comprehensive guardrail assessment should be performed for the study corridor to identify areas where the guardrail should be upgraded to meet current VDOT standards and specifications. The guardrail should be upgraded or repaired as necessary, preferably in conjunction with other planned interstate maintenance projects.

Corridor Signing:

- The I-95 and I-85 study corridors have a numerous guide signs due to the complex configurations of the interchanges and associated CD roads. Proliferation of signs can reduce effectiveness of the information to be relayed and unnecessary signs should be removed. There are not enough crashes to warrant the existing Deer Crossing Warning (W11-13) signs and Slippery When Wet Warning (W8-5) signs; therefore, they should be removed.
- Install lighting on 14 overhead signs currently not lit. The 2009 MUTCD states that overhead signs should be lit unless there is an engineering study conducted that concludes lighting is not necessary.
- The I-95 southbound loop off-ramp to Wagner Road East does not have a Horizontal Alignment (W1-15) sign or an Advisory Exit and/or Ramp Speed (W13-2, W13-3) warning sign. The ballbank/limiting angle method as defined in the VDOT Traffic Engineering Memorandum (TE-363) should be conducted to determine if warning signs are warranted to be installed at this location.

- Replace the nonfunctioning continuous flashing beacons on the Truck Rollover Warning (W1-13) sign on the I-95 northbound off-ramp to I-85 southbound.

Bridge Vertical Clearances: Eight of the 9 bridge structures on the study corridors are vertically deficient and do not meet the minimum clearance requirement of 16.5 feet; thereby, creating potential hazards. There were a total of 19 reported bridge strikes located within the study corridor in a 13-year period.

Short-Term:

- Install Low Clearance with Arrows (W12-2) warning signs displaying the existing bridge heights on the 8 bridges with deficient vertical clearance.
- Install low bridge warning systems on the northbound and southbound I-95 approaches to the study area to advise drivers of over height vehicles to take an alternate route.

Long-Term:

- Replace bridge and/or overhead sign structures to meet minimum vertical clearance height requirements.

Corridor-Wide Operations Study: A corridor-wide operational analysis is recommended to identify the impacts of short interchange spacing and deficient acceleration/deceleration lanes have on corridor-wide operations. Such a study could be used to further justify the need for future long-term improvements throughout the I-95 study corridor.

Acceleration/Deceleration Lanes: Lengthen deficient acceleration/deceleration lanes to meet AASHTO standards.

Pavement: The middle segment of the corridor was not paved during the same timeframe as the adjacent segments leaving some inconsistent pavement sections. Based on discussions with VDOT, the study corridors are not currently on a paving schedule; however, it is recommended that the entire corridor be paved to improve roadway visibility and drivability. In addition, drainage, rumble strips, striping and in pavement reflectors should also be assessed and potentially upgraded at this time.

Corridor Lighting: Conduct a corridor-wide lighting warrant study and install additional lighting as appropriate. VDOT should also consider the addition of underbridge lighting systems for bridges in the corridor as an additional safety measure.

AREA OF INTEREST: RIVES ROAD INTERCHANGE

Rives Road is currently in the design phase to be widened from US 301 to the I-95 interchange. A traffic study was conducted as part of the widening project. Findings of the *Rives Road at I-95 Traffic Study* conducted as part of the current widening project concluded that the following improvements addressed intersection delays and queues for the projected design year (2036) traffic volumes. The improvements below are being included in the Rives Road widening project currently in the design stage at the time of this study:

- Construct southbound right-turn lane with 500’ storage and a 200’ taper at the intersection of Rives Road at I-95 southbound;
- Construct northbound right-turn lane with 200’ storage and 200’ taper at the intersection of Rives Road at I-95 Northbound;
- Junction boxes and conduit for a potential future signal at the intersection of Rives Road at I-95 Southbound will be constructed as part of the Rives Road widening; and

- VDOT should monitor the intersections of Rives Road at I-95 southbound and Rives Road at I-95 northbound to determine when/if traffic signal warrants are met.

The operational analysis conducted as part of this study was done using updated 2012 traffic volumes and 2035 traffic volumes developed using growth rates from the latest Richmond/Tri-Cities Regional travel demand model. Developing long-term solutions at the I-95/Rives Road interchange were not included in the scope of this study; however, the results of the operational analysis indicate long-term improvements will be necessary should traffic in the area be realized as projected.

AREA OF INTEREST: SOUTHBOUND I-95 OFF-RAMP TO WASHINGTON STREET

The southbound I-95 ramp has been identified as a lane utilization issue for vehicles travelling west on Washington Street and vehicles merging onto Washington Street from the southbound I-95 ramp. There were several reported crashes related to lane maneuvers. Rear end crashes were also reported on the off-ramp approach to Washington Street. Due to the conflicts created from this merging condition, queues from the ramp routinely impact southbound I-95 during the PM peak hours. Queuing on an interstate, where vehicles are traveling at high speeds and drivers are not expecting to stop, is a major safety concern. The following phased approached was proposed to mitigate this safety issue.

Short Term Recommendation

- Allow a free-flow movement from the southbound I-95 off-ramp onto Washington Street to reduce queuing on the ramp and impacts to the southbound I-95 mainlines.
- Reduce the number of lanes prior to the southbound I-95 off-ramp from four lanes to three lanes through the use of pavement markings across the overpass. Washington Street will operate adequately with 3 travel lanes.
- Close Madison Street and private driveways between the ramp and intersection, and eliminate the right-turn movements from Washington Street to improve access management on the corridor. This will also improve safety by reducing the weaving movements that were caused specifically by vehicles turning right on Madison Street.

Long-Term Recommendation

- Monitor traffic patterns and weave issues on Washington Street, upstream and downstream of the intersection. Should it be determined that a weaving and safety issue still exists by the lane changes between the ramp and Jefferson Street, then an additional analysis should be completed.
- A possible solution for this issue would be to install traffic barrier to separate the ramp free-flow lane from Washington Street through traffic. A barrier would shift the weaving area further to the west and away from the ramp. Note that this would only become a feasible recommendation once a study determined that operations and safety between the ramp and Jefferson Street achieved acceptable levels.

AREA OF INTEREST: RAMP FROM NORTHBOUND I-85 TO SOUTHBOUND I-95

The yield condition on the I-85 northbound off-ramp to I-95 southbound creates a safety issue due to the short weaving segment, steep uphill grade, and percent of heavy vehicles making this movement.

- Vehicles traveling from I-85 northbound to I-95 southbound are on a steep grade and must merge across the vehicles on the collector-distributor road exiting to Graham Road. The length of the weave segment is only 250 feet.
- A total of 12 crashes occurred 1/1/2007 to 12/31/2009. The number of crashes on this off-ramp has remained consistent based on a review of the previous I-85/I-95/Route 460 Interchange Study; from 1996 to 1998 a total of 10 crashes occurred on this ramp.

- A yield sign with continuous flashing beacons exists on the right shoulder of the I-85 off-ramp; however, it was observed that vehicles merging from the I-85 off-ramp onto the I-95 CD road frequently failed to yield. VDOT installed the yield pavement markings (shark's teeth) as a short-term countermeasure; however, the safety concern still exists.

The following phased approached was proposed to mitigate this safety issue.

Short Term Recommendation

- Increase existing Yield Sign (R1-2) size to 60"x60"x60" to improve visibility of traffic control device.

Long-Term Recommendation

- Reconfigure the I-95/I-85/Route 460 interchange to mitigate the deficient weaving movement at this location. A possible solution is provided in the Long-Term Concepts section of this study.

ADDITIONAL SHORT-TERM IMPROVEMENTS AND LONG-TERM CONCEPTS

The focus of this study was to conduct a roadway safety assessment; however, parallel VDOT efforts were conducted during the course of this study in anticipation of future efforts to identify additional short-term improvements and long-term concepts in the I-95/I-85/Route 460 Interchange area. Drawing from the previous 2000 study and the Tri-Cities MPO Constrained Long-Range Plan (CLRP) one short-term improvement and three long-term concepts were developed. The long-term concepts were included in this study to document the order of magnitude of projects required to meet future operational and safety needs in the area of the I-95/I-85/Route 460 interchange. These concepts will provide a starting point for future efforts to further identify and refine long-term concepts in the area. Planning level cost estimates for the short- and long-term projects ranged from $310,000 to $55,790,000 with a total of $67,040,000.

NEED FOR CONTINUED STUDY AND NEXT STEPS

There are a number of past, present, and/or future infrastructure projects/studies within the I-95/I-85/Route 460 study area. Specific efforts are listed below. As these efforts become real projects, it will be critical that VDOT continue to identify and refine short- and long-term solutions needed in the I-95/I-85 corridor to assure mobility throughout this growing and changing area.

- Final Report: I-85/95/Route 460 Interchange Study, 2000
- Temple Avenue Interchange Modification Report (VDOT UPC 85623)
- Rives Road Widening project (VDOT UPC 15832)
- Growth and impacts at Fort Lee (on-going Fort Lee Joint Land Use Study (JLUS))
- Route 460 Corridor Improvements Project Public-Private Partnership (PPTA) project

The I-95/I-85 Interchange Roadway Safety Assessment Study should be used as a planning tool to achieve the next steps of planning, programming, designing, and constructing the identified safety and operational improvements in the study corridor. Specific steps include:

1. VDOT should update the previous I-85/I-95/Route 460 Interchange Study and extend the study corridor and scope to include additional operational analysis. Identify projects from this updated study to prioritize and program regional needs. An example next step could be an interchange modification report (IMR) to advance an interchange project (some MPO's have been successful advancing IMR studies using Regional Surface Transportation Program (RSTP) funds).
2. VDOT should continue to study and refine the operational and environmental impacts of the recommended long-term concepts. This analysis should include investigating the possibility of a phased approach to programming the long-term concepts by developing a subset of smaller projects with

independent utility. This process should continue to involve the technical expertise of a study work group to evaluate alternatives while building consensus at the federal, state, and local levels.

3. VDOT should advance the recommended short-term improvement projects to the preliminary engineering design stage, so a cost estimate and schedule can be developed. If necessary, supplemental environmental and traffic engineering studies should be conducted to move these projects along the project development process.
4. VDOT should continue to coordinate with the Tri-Cities MPO, Crater Planning District Commission (CPDC), City of Petersburg, and within VDOT to cooperatively work towards the programming short-term projects and long-term concepts.

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APPENDIX

STUDY BACKGROUND

Interstates 95 and 85 as well as Route 460 and US 301 converge in Petersburg, Virginia in a complex series of interchanges developed in the mid-1950's as part of the Richmond-Petersburg Turnpike. These interchanges have several features that create safety and operational challenges, such as short acceleration/deceleration lanes, tight turns, low-speed curves, short weave/merge areas, which may have met design standards in the 1950's, but are deficient by modern design standards. A comprehensive planning study in this area was conducted between 1998 and 2000 identified a number of capacity and safety issues in the study area and provided study recommendations which are documented in the final report: "Final Report: I-85/95/Route 460 Interchange Study" from December, 2000. Since this study was completed, there has been significant growth in the area due to the expansion of Fort Lee from the BRAC realignment. Additionally, a new major roadway project called the Route 460 Corridor Improvements Project is planned to connect to I-85, which would significantly impact traffic in this interchange area.

This study effort is intended to be phase one of an eventual larger I-95/85 Interchange Area study that will update the aforementioned 2000 planning study using the latest available information. This new study will also consider the impacts of Fort Lee growth and the Route 460 Corridor Improvements Project on traffic operations and safety in the I-95/85 interchange area. This study is a cooperative effort between the Virginia Department of Transportation (VDOT), the Crater Planning District Commission (CPDC), and Tri-Cities Metropolitan Planning Organization (MPO).

STUDY PROCESS

The study process included data collection, crash analysis, field reviews, and the development of safety related improvements within the study area. The development of improvements focused on addressing the identified safety issues in the study area. An analysis of traffic operations was not conducted as part of this study; however, the previous "I-95/I-85/Route 460 Interchange Study" (conducted in 2000), which included a comprehensive operational analysis, was reviewed and its findings and recommendations considered throughout this study. In addition to the RSA assessment, VDOT requested the study team review safety issues at the following three areas of interest within the study area and propose mitigation measures.

1. Rives Road Interchange at I-95 (Exit 47)
2. The I-95 Southbound Off-Ramp to Washington Street (Exit 52)
3. The I-85 Northbound Off-Ramp to I-95 Southbound (Exit 68)

The study team conducted a meeting with the following stakeholders to discuss and gain input on the proposed recommendations:

- VDOT
- Tri-Cities MPO
- City of Petersburg
- FHWA

INFORMATION USED IN THE RSA

Information used for this roadway safety assessment on the northbound and southbound directions of both I-95 and I-85 included the following:

- FR-300 police crash reports (three years from 01/01/2007 through 12/31/2009)
- Summary of crash statistics (three years from 01/01/2007 through 12/31/2009)

- Two collision diagrams located at I-95 SB Ramps at Rives Road and I-95 NB Ramps at Rives Road (showing crashes occurring for three years from 01/01/2006 through 12/31/2008)
- Field review notes, video, and photos taken of the study corridor on Tuesday, March 27, 2012
- Notes from on-site field review with VDOT on Thursday, May 17, 2012
- Twenty-four hour directional traffic counts on the four ramps at the I-95 Rives Road interchange, the I-95 SB off ramp to Washington Street, and mainline Washington Street just east of the southbound I-95 off-ramp (collected on 03/28/2012)
- Twenty-four hour speed counts from VDOT count stations in the study corridor (collected on 6/27/2012)
- Average annual daily traffic (AADT) from the 2010 VDOT published traffic data
- Previous planning studies conducted in the vicinity of the study corridor and proposed design plans provided by VDOT

EXISTING CONDITIONS

A preliminary field review of the study corridor was conducted on Tuesday, March 27, 2012 to verify existing geometric conditions and traffic control devices; and observe peak hour traffic conditions and the driver behavior. A Roadway Safety Assessment (RSA) of the study corridor was conducted on Thursday, May 17, 2012. The following subsections describe the study area, geometric conditions, traffic control devices, traffic conditions, and field observations.

DESCRIPTION OF STUDY AREA

The study area includes an 8-mile segment of I-95 and a 1-mile segment of I-85 near Petersburg and Colonial Heights, Virginia and is illustrated in **Figure 1** to **8**. The I-95 study corridor extends from 1,000 feet north of the Temple Avenue interchange (Exit 54) to 1,000 feet south of the Rives Road interchange (Exit 47). I-95 has three lanes in each direction with paved shoulders on both sides of the road north of the I-95/I-85 interchange and two lanes in each direction with paved shoulders on both sides of the road south of the I-95/I-85 interchange. The posted speed limit on I-95 in the study corridor is 55 MPH north of milepost 49.6 (just south of the US 301/South Crater Road interchange) and 65 MPH south of milepost 49.6.

The I-95 study corridor contains the following eight (8) interchanges:

- Temple Avenue (Exit 54) – partial cloverleaf interchange
- Roslyn Road (Exit 53) – partial cloverleaf interchange
- Washington Street/Wythe Street (Exit 52) – modified diamond interchange
- I-95/I-85 (Exit 51) – partial cloverleaf interchange
- US 301/South Crater Road (Exit 50) – partial cloverleaf interchange
- Route 460/Winfield Road (Exit 50) – diamond interchange
- Wagner Road (Exit 48) – full cloverleaf interchange
- Rives Road (Exit 47) – diamond interchange

The I-85 study corridor is approximately one mile in length and extends from the I-95/I-85 interchange (Exit 51) to the Sycamore Street overpass. I-85 has two lanes in each direction with paved shoulders on both sides of the road. The posted speed limit along this segment is 55 MPH north of milepost 68.0 (just south of the I-95/I-85 interchange) and 60 MPH south of milepost 68.0. With the exception of the I-95 junction, there are no interchanges on the I-85 study corridor.


State Hwy 144
Conduit Rd
54.6
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54.2
54.1
54
53.9
53.8
53.7
53.6
Location Map
Temple Ave
E Washington St
S Crater Rd
S Sycamore St
Wagner Rd
Rives Rd
Miles
0 0.5 1 2
Legend
Study Corridor
Milepost
Guardrail
Rumble Strips
Traffic Barriers
Jurisdiction Boundary
N
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Miles
0 0.05 0.1 0.2
Figure 1
I-95/I-85 Roadway Safety Assessment
City of Petersburg & City of Colonial Heights
I-95 MP 53.6 to MP 54.6
Aerials from Virginia Base Mapping Program (VBMP) 2011


53.5
53.4
53.3
53.2
53.1
53
52.9
52.8
52.7
52.6
52.5
Southpark Blvd
Stuart Ave
City of Colonial Heights
Chesterfield County
City of Petersburg
E Bank St
N Madison St
N Crater Rd
Location Map
Temple Ave
E Washington St
S Crater Rd
S Sycamore St
Wagner Rd
Rives Rd
Miles
0 0.5 1 2
Legend
Study Corridor
Milepost
Guardrail
Rumble Strips
Traffic Barriers
Jurisdiction Boundary
N
W
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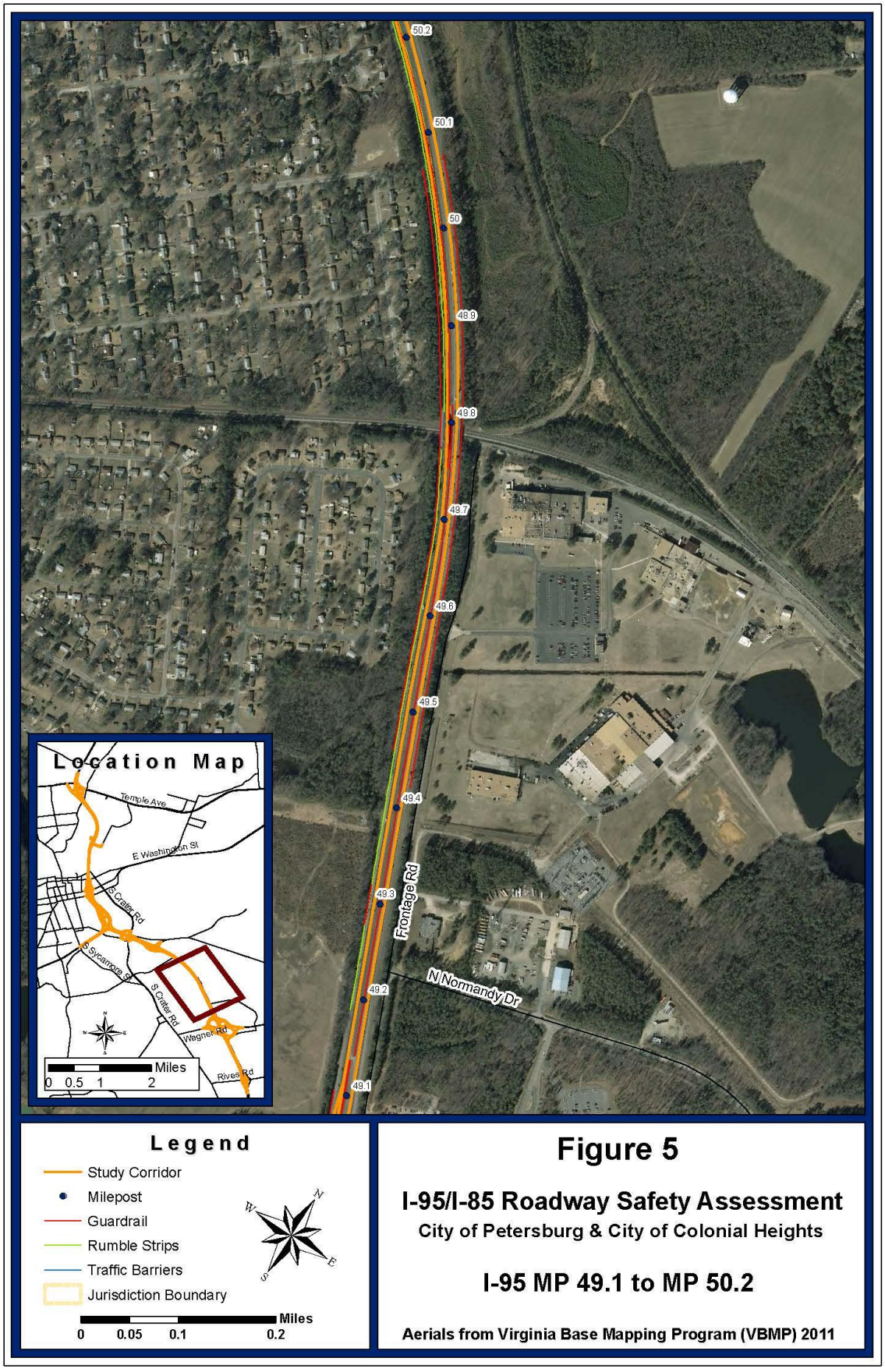
Miles
0 0.05 0.1 0.2
Figure 2
I-95/I-85 Roadway Safety Assessment
City of Petersburg & City of Colonial Heights
I-95 MP 52.5 to MP 53.5
Aerials from Virginia Base Mapping Program (VBMP) 2011


E Washington St
N Jefferson St
S Adams St
N Madison St
N Crater Rd
E Wythe St
Wythe St
S Crater Rd
S Jefferson St
52.4
52.3
52.2
52.1
52
51.9
51.8
51.7
51.6
51.5
51.4
51.3
Location Map
Temple Ave
E Washington St
S Crater Rd
S Sycamore St
Wagner Rd
Rives Rd
Miles
0 0.5 1 2
Legend
Study Corridor
Milepost
Guardrail
Rumble Strips
Traffic Barriers
Jurisdiction Boundary
Miles
0 0.05 0.1 0.2
Figure 3
I-95/I-85 Roadway Safety Assessment
City of Petersburg & City of Colonial Heights
I-95 MP 51.3 to MP 52.4
Aerials from Virginia Base Mapping Program (VBMP) 2011


Graham Rd
I85n I95s Graham Exit
S Crater Rd
S Crater Rd
Winfield Rd
County Dr
County Dr
County Dr
51.3
51.2
51.1
51
50.9
50.8
50.7
50.6
50.5
50.4
50.3
50.2
Location Map
Temple Ave
E Washington St
S Crater Rd
S Sycamore St
S Crater Rd
Wagner Rd
Rives Rd
Miles
0 0.5 1 2
Legend
Study Corridor
Milepost
Guardrail
Rumble Strips
Traffic Barriers
Jurisdiction Boundary
Miles
0 0.05 0.1 0.2
Figure 4
I-95/I-85 Roadway Safety Assessment
City of Petersburg & City of Colonial Heights
I-95 MP 50.2 to MP 51.3
Aerials from Virginia Base Mapping Program (VBMP) 2011


50.2
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49.9
49.8
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49.5
49.4
49.3
49.2
49.1
Frontage Rd
N Normandy Dr
Location Map
Temple Ave
E Washington St
S Crater Rd
S Sycamore St
S Crater Rd
Wagner Rd
Rives Rd
Miles
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Legend
Study Corridor
Milepost
Guardrail
Rumble Strips
Traffic Barriers
Jurisdiction Boundary
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Miles
0 0.05 0.1 0.2
Figure 5
I-95/I-85 Roadway Safety Assessment
City of Petersburg & City of Colonial Heights
I-95 MP 49.1 to MP 50.2
Aerials from Virginia Base Mapping Program (VBMP) 2011


48.1
48
48.9
48.8
Wagner Rd
48.7
48.6
48.5
48.4
48.3
Old Wagner Rd
48.2
48.1
48
Location Map
Temple Ave
E Washington St
S Crater Rd
S Sycamore St
S Crater Rd
Wagner Rd
Rives Rd
Miles
0 0.5 1 2
Legend
Study Corridor
Milepost
Guardrail
Rumble Strips
Traffic Barriers
Jurisdiction Boundary
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W
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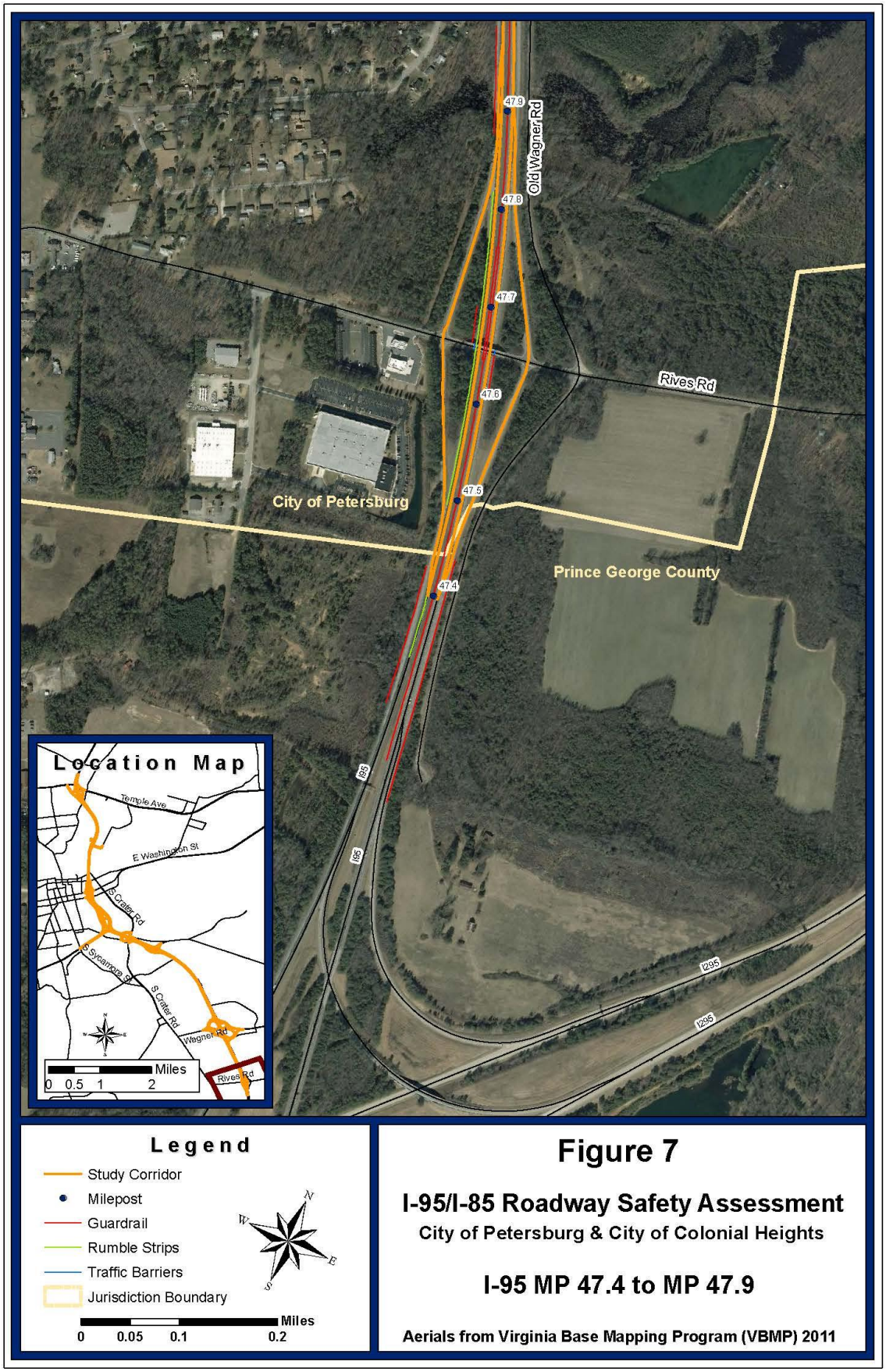
Miles
0 0.05 0.1 0.2
Figure 6
I-95/I-85 Roadway Safety Assessment
City of Petersburg & City of Colonial Heights
I-95 MP 48.0 to MP 49.1
Aerials from Virginia Base Mapping Program (VBMP) 2011


47.9
47.8
47.7
47.6
47.5
47.4
Old Wagner Rd
Rives Rd
City of Petersburg
Prince George County
I95
I295
Location Map
Temple Ave
E Washington St
S Crater Rd
S Sycamore St
Wagner Rd
Rives Rd
Miles
0 0.5 1 2
Legend
Study Corridor
Milepost
Guardrail
Rumble Strips
Traffic Barriers
Jurisdiction Boundary
N
W
E
S
Miles
0 0.05 0.1 0.2
Figure 7
I-95/I-85 Roadway Safety Assessment
City of Petersburg & City of Colonial Heights
I-95 MP 47.4 to MP 47.9
Aerials from Virginia Base Mapping Program (VBMP) 2011


Graham Rd
S Jefferson St
Location Map
Temple Ave
E Washington St
S Crater Rd
Wagner Rd
Rives Rd
Miles
0 0.5 1 2
Legend
Study Corridor
Milepost
Guardrail
Rumble Strips
Traffic Barriers
Jurisdiction Boundary
Miles
0 0.05 0.1 0.2
Figure 8
I-95/I-85 Roadway Safety Assessment
City of Petersburg & City of Colonial Heights
I-85 MP 68.1 to MP 69.1
Aerials from Virginia Base Mapping Program (VBMP) 2011

ROADWAY CONDITIONS

The following sections of this report detail the existing roadway conditions throughout the corridor. **Figure 1** through **8** above show the existing locations of guardrail, rumble strips and traffic barriers relative to the mileposts. These roadway properties and others will be discussed throughout this report and locations described throughout reference the mileposts in these figures.

I-95 and I-85 are functionally classified as urban interstates. The 2004 AASHTO *A Policy on Geometric Design of Highways and Streets*, Fifth Edition recommends a minimum interchange spacing of one mile for urban interstates. The spacing between I-95 interchanges in both the northbound and southbound directions is shown in **Table 1**. The segment of I-95 within the study corridor only meets this criterion in three locations (two locations in the northbound direction and one location in the southbound direction).

Table 1: Interchange Spacing

From	To	Distance (Miles)
I-95 Northbound Direction		
Rives Road On-Ramp	Wagner Road Off-Ramp	0.6
Wagner Road On-Ramp	US 460 (Winfield Road)/CD Road Off-Ramp	1.5
US 460 (Winfield Road)/CD Road Off-Ramp	US 301 (S Crater Road)/CD Road On-Ramp	1.0
US 301 (S Crater Road)/CD Road On-Ramp	I-85 Off-Ramp	0.2
I-85 On-Ramp	E Bank Street Off-Ramp	0.3
E Bank Street Off-Ramp	Washington Street/Wythe Street On-Ramp	0.3
Washington Street/Wythe Street On-Ramp	Southpark Boulevard Off-Ramp	0.6
Southpark Boulevard On-Ramp	Temple Avenue Off-Ramp	0.9
I-95 Southbound Direction		
Temple Avenue On-Ramp	Roslyn Road Off-Ramp	0.7
Roslyn Road On-Ramp	Washington Street/Wythe Street Off-Ramp	0.7
Washington Street/Wythe Street Off-Ramp	I-85 Off-Ramp	0.6
I-85 Off-Ramp	Washington Street/Wythe Street On-Ramp	0.5
Washington Street/Wythe Street On-Ramp	US 301 (S Crater Road)/CD Road Off-Ramp	0.1
US 301 (S Crater Road)/CD Road Off-Ramp	US 460 (Winfield Road)/CD Road On-Ramp	0.9
US 460 (Winfield Road)/CD Road On-Ramp	Wagner Road Off-Ramp	1.4
Wagner Road On-Ramp	Rives Road Off-Ramp	0.7

Note: Measurements taken from gore to gore of the associated ramps.

The 2004 AASHTO *A Policy on Geometric Design of Highways and Streets*, Fifth Edition provides guidance on acceleration and deceleration lane lengths based on the design speed of the ramp. The design speeds, measured lengths, and AASHTO standard lengths are shown for each of the acceleration and deceleration lanes in the study corridor on northbound and southbound I-95 in **Table 2** and **Table 3**, respectively. Acceleration and deceleration

lanes that do not meet the AASHTO standard are denoted as deficient. Of the 16 northbound ramps, 6 (38%) are deficient while 5 of the 15 (33%) southbound ramps are deficient. Eight of the 11 (73%) deficient ramps are acceleration lanes. In addition, **Table 2** and **Table 3** show AADTs for ramps where the data was available. AADT data was obtained from the VDOT Statewide Planning System (SPS) data with the exception of the Rives Road volumes, which were obtained from the 24-hour traffic counts collected on March 28, 2012.

Table 2: Northbound I-95 Acceleration and Deceleration Lane Lengths

I-95 NB						
Location		AADT	Ramp Speed (mph)	Measured Length (ft)	Standard Length (ft)	Deficient
Rives Rd						
	Decel Lane	726	35	895	440	
	Accel Lane	3,463	35*	695	1,000	X
Wagner Rd						
	EB Decel Lane	295	35	490	440	
	EB Accel Lane	-	25*	875	1,220	X
	WB Decel Lane	-	25	665	500	
	WB Accel Lane	-	35*	765	1,000	X
Winfield Rd/CD Road						
	Decel Lane	-	25	925	410	
CD Road						
	Accel Lane	-	35*	1,585	550	
I-85						
	Decel Lane	-	25	930	410	
Bank St						
	Decel Lane	-	30	235	380	X
Washington St/Wythe St						
	Accel Lane	-	25	1,725	780	
Southpark Boulevard						
	Decel Lane	10,477	25	270	410	X
	Accel Lane	-	20	650	810	X
Temple Ave						
	Decel Lane	5,915	35	405	350	
	Accel Lane	5,910	20	975	810	
	WB Accel Lane	-	35*	1,195	550	

Notes:

- ADT not available

* Ramp speed not posted - Speed assumed based on 2004 AASHTO A Policy on Geometric Design of Highways and Streets, Fifth Edition

Table 3: Southbound I-95 Acceleration and Deceleration Lane Lengths

I-95 SB						
Location		AADT	Ramp Speed (mph)	Measured Length (ft)	Standard Length (ft)	Deficient
Temple Ave						
	Decel Lane	10,017	25	580	410	
	Accel Lane	7,137	35*	2,150	550	
Roslyn Rd						
	Decel Lane	-	20	450	440	
	Accel Lane	-	20*	480	810	X
Washington St						
	Decel Lane	-	35	1,340	350	
Wyth St						
	Decel Lane	-	35	1,650	350	
Washington St/Wythe St						
	Accel Lane	-	35	1,045	550	
CD Road						
	Decel Lane	-	35	450	350	
CD Road						
	Accel Lane	-	35*	720	550	
Wagner Rd						
	WB Decel Lane	5,043	35	380	440	X
	WB Accel Lane	-	25*	805	1,220	X
	EB Decel Lane	-	25*	810	500	
	EB Accel Lane	-	35*	965	1,000	X
Rives Rd						
	Decel Lane	3,723	35	640	440	
	Accel Lane	756	35*	745	1,000	X

Notes:

- ADT not available

* Ramp speed not posted - Speed assumed based on 2004 AASHTO A Policy on Geometric Design of Highways and Streets, Fifth Edition

I-95 ROADWAY CONDITIONS

On I-95 there are three 12-foot lanes north of the I-95/I-85 interchange in one direction and two 12-foot lanes south of the I-95/I-85 interchange in one direction. The widths of the shoulders vary throughout the corridor. The left shoulder width varies from 3 to 12 feet and the right shoulder width varies from 8 to 12 feet. The AASHTO standard for left shoulders for a four-lane freeway is 4 to 8 feet and for right shoulders a minimum of 10 feet. For a six-lane freeway the left and right shoulder standard based on AASHTO is 10 feet. Guardrail was generally

observed at locations and areas where protection is typically required (i.e., bridge structures, sign structures, steep slopes, etc.), however a full guardrail assessment and length of need determination was not conducted as part of this study. The northbound and southbound travel lanes are separated by a concrete traffic barrier north of the Route 460/Winfield Road interchange, with the exception of the segment from milepost 51.9 to milepost 52.2, which is separated by double-faced guardrail. South of the Route 460/Winfield Road Interchange, the northbound and southbound travel lanes are separated by a variable width grass median with guardrail. In addition, a collector distributor road is located adjacent to I-95 in both the northbound and southbound directions between the Washington Street/Wythe Street interchange and the Route 460/Winfield Road interchange for approximately 1.5 miles. A concrete traffic barrier separates the collector-distributor lanes from the mainline lanes in both directions.

Additional field observations regarding roadway conditions on I-95 are summarized below:

- There are no rumble strips in the study corridor on the left or right shoulders on northbound I-95. On southbound I-95, there are rumble strips on both the left and right shoulders from milepost 47.4 to 50.0, but there are no rumble strips on either side of the interstate from milepost 50.0 to 54.6.
- Based on a visual assessment, the pavement was observed to be in fair condition throughout corridor, with few potholes and areas of severe cracking.
- No grades that would cause trucks to approach crawl speeds or sharp curves that would warrant curve warning signs were identified on the mainline roadway.
- The pavement markings (edge lines and lane lines) are 4” wide and were observed to be in fair condition, mostly visible with some fading.
- There is existing conventional roadway lighting along the I-95 corridor between milepost 53.0 and milepost 52.5 and between the I-95/I-85 interchange and the South Carter road interchange along both the northbound and southbound travel lanes. To supplement this lighting, there is high-mast lighting between the two segments of conventional lighting.

I-85 ROADWAY CONDITIONS

On I-85 there are two 12-foot lanes in both the northbound and southbound directions. The widths of the shoulders along I-85 vary throughout the corridor. The left shoulder varies from 5 to 12 feet and the right shoulder varies from 8 and 12 feet. Guardrail was generally observed at locations and areas where protection is typically required (i.e., bridge structures, sign structures, steep slopes, etc.); however, a full guardrail assessment and length of need determination was not conducted as part of this study. The northbound and southbound travel lanes are separated by a concrete traffic barrier along the entire stretch of I-85 within the study corridor.

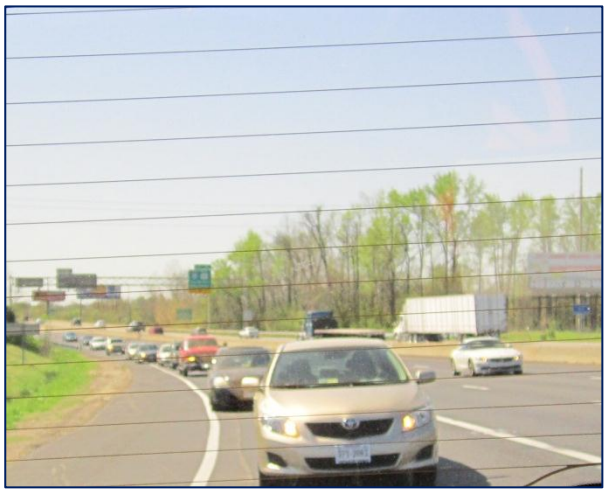
Additional field observations regarding roadway conditions on I-85 are summarized below:

- There are no rumble strips in the study corridor on the left or right shoulders along southbound I-85. On northbound I-85, there are rumble strips on both the left and right shoulders up to the I-95 interchange.
- Based on a visual assessment, the pavement was observed to be in fair condition throughout corridor, with few potholes and areas of severe cracking.
- No grade s that would cause trucks to approach crawl speeds or sharp curves that would warrant curve warning signs were identified on the mainline roadway.
- The pavement markings (edge lines and lane lines) are 4” wide and were observed to be in fair condition, mostly visible with some fading.
- There is conventional lighting north of milepost 68.0 and high mast lighting at the I-95/ I-85 interchange.

TRAFFIC CONDITIONS

- VDOT has received numerous reports of congestion and queuing on ramps throughout the study corridor. Congestion was observed during the field review conducted on Tuesday, March 27, 2012 on the I-95 northbound off-ramp to Southpark Boulevard during midday (between 11:30 AM and 12:30 PM). **Photographs 1** and 2 shows vehicles queued on the off-ramp back to the I-95 northbound mainline.

Photograph 1: I-95 Northbound Off-Ramp to Southpark Boulevard – Midday Queue (Looking North)



Photograph 2: I-95 Northbound Off-Ramp to Southpark Boulevard – Midday Queue (Looking South)

- Speed data was collected from VDOT count stations located throughout the study corridor for Wednesday, June 27, 2012 (traffic count data is provided in **Appendix A**). The data was collected in 5-minute increments and reported in varying ranges (e.g., less than 15 mph, 15-25 mph, 25-30 mph, etc.). Based on an analysis of this data, the AM peak period extends from approximately 6:00 AM to 9:00 AM and the PM peak period extends from approximately 3:00 PM to 6:00 PM. The data from three count stations were analyzed to find the average daily speed, average speed during the AM and PM peak periods, and the 85th percentile speeds. The median speed for the range was used (e.g., 57.5 mph was used as the speed for all vehicles in the 55-60 mph range) when the average speeds were calculated.
- Data from count station 781721, located on I-85 just north of the Squirrel Level Road interchange, was analyzed to determine speed conditions on both northbound and southbound I-85 in the study corridor. Currently, the posted speed limit is 60 mph at this location.
  - Along northbound I-85, the average daily speed, average AM peak period speed, and average PM peak period speed all fell in the 55-60 mph range. The 85th percentile speed fell in the 65-70 mph range.
  - Along southbound I-85, the average daily speed, average AM peak period speed, and average PM peak period speed all fell in the 60-65 mph range. The 85th percentile speed fell in the 65-70 mph range.
- Data from count station 789371, located on I-95 just north of the Wagner Road interchange, was analyzed to determine speed conditions on both northbound and southbound I-95 in the southern section of the study corridor. Currently, the posted speed limit is 65 mph at this location.
  - Along northbound I-95, the average daily speed, average AM peak period speed, and average PM peak period speed all fell in the 60-65 mph range. The 85th percentile speed fell in the 65-70 mph range.

  - Along southbound I-95, the average daily speed, average AM peak period speed, and average PM peak period speed all fell in the 55-60 mph range. The 85th percentile speed fell in the 65-70 mph range.
- Data from count station 789282, located on I-95 just south of the Southpark Boulevard interchange, was analyzed to understand speed conditions on both northbound and southbound I-95 in northern section the study corridor. Currently, the posted speed limit is 55 mph at this location.
  - Along northbound I-95, the average daily speed and average PM peak speed both fell in the 50-55 mph range, the average AM peak period speed fell in the 55-60 mph range, and the 85th percentile speed fell in the 60-65 mph range.
  - Along southbound I-95, the average daily speed, average AM peak period speed, and average PM peak period speed all fell in the 55-60 mph range. The 85th percentile speed fell in the 60-65 mph range.

I-95 TRAFFIC CONDITIONS

- Based on 2010 VDOT published traffic counts, both northbound and southbound I-95 carry approximately 44,000 vehicles per day on the north end of the corridor (Temple Road) and approximately 16,000 vehicles per day on the south end of the corridor (Rives Road).
- **Table 4** and **Figure 9** shows the AADT and truck percentages on I-95.
- The highest traffic volumes in the study corridor are found between the Southpark Boulevard and Washington Street interchanges. In this segment of the study corridor, northbound I-95 carries approximately 51,000 vehicles per day and southbound I-95 carries approximately 50,000 vehicles per day.
- Truck percentages range from 10 to 15 percent in the northbound direction of I-95 and 10 to 12 percent in the southbound direction.

I-85 TRAFFIC CONDITIONS

Northbound I-85 in the study corridor carries approximately 28,000 vehicles per day with a truck percentage of 13 percent. Southbound I-85 carries approximately 26,000 vehicles per day and has a truck percentage of 14 percent.

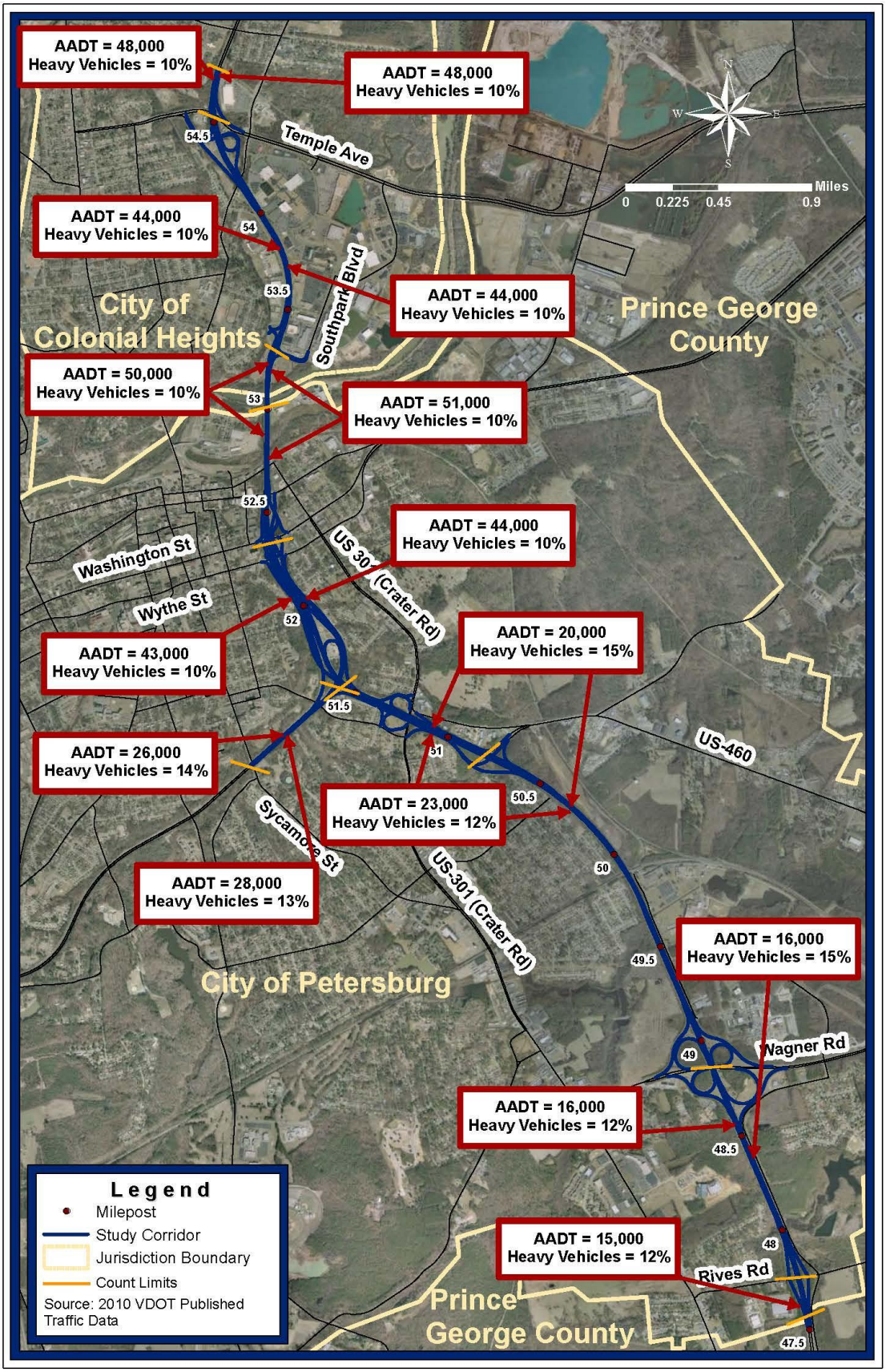
- **Table 4** and **Figure 9** shows the annual average daily traffic (AADT) and truck percentages on I-85.

Table 4: Annual Average Daily Traffic (AADT) and Heavy Vehicle Percentages

From	To	AADT	% Heavy Vehicles
I-95 Northbound Direction			
Rives Rd	Wagner Rd	16,000	15
Wagner Rd	US 460 West St/County Rd/US 301 Crater Rd	20,000	15
US 460 West St/County Rd/US 301 Crater Rd	I-85	20,000	15
I-85	US 301, Bus US 460 Washington St	44,000	10
US 301, Bus US 460 Washington St	NCL Petersburg/SCL Colonial Heights	51,000	10
NCL Petersburg/SCL Colonial Heights	Southpark Blvd	51,000	10
Southpark Blvd	Temple Ave	44,000	10
Temple Ave	NCL Colonial Heights	48,000	10
I-95 Southbound Direction			
NCL Colonial Heights	Temple Ave	48,000	10
Temple Ave	Southpark Blvd	44,000	10
Southpark Blvd	NCL Petersburg/SCL Colonial Heights	50,000	10
NCL Petersburg/SCL Colonial Heights	US 301, Bus US 460 Washington St	50,000	10
US 301, Bus US 460 Washington St	I-85	43,000	14
I-85	US 460 West St/County Rd/US 301 Crater Rd	23,000	12
US 460 West St/County Rd/US 301 Crater Rd	Wagner Rd	23,000	12
Wagner Rd	Rives Rd	16,000	12
Rives Rd	SCL Petersburg	15,000	12
I-85 Northbound Direction			
Squirrel Level Rd	I-95	28,000	13
I-85 Southbound Direction			
I-95	Squirrel Level Rd	26,000	14

Source: 2010 VDOT Published Traffic Counts

Figure 9: Annual Average Daily Traffic (AADT) and Heavy Vehicle Percentages



CRASH ANALYSIS

An evaluation of corridor safety was conducted based on crash summary information and field reconnaissance. Crash data analysis for the study corridors and the associated on- and off-ramps within the study area was conducted using the latest three years of available crash data between 1/1/2007 to 12/31/2009, which was obtained from VDOT. The following sections summarize corridor crash trends and segment-specific crash data. The primary goal of this study was to identify short- and long-term improvements specifically on the study corridors. Therefore, for purposes of this study, crash analysis was not conducted at the adjacent intersections.

CORRIDOR-WIDE CRASH TRENDS

CRASH RATES

The overall, injury, and fatal crash rates were calculated for the I-95 and I-85 study corridors and compared to the statewide urban interstate rate for 2007. Crash rates for the study corridors were based on the total number of crashes, the length, and the average daily traffic. Crash rates are reported based on 100 million vehicle miles of travel (VMT). For comparative purposes, the most recent statewide urban interstate crash rates published by VDOT (2007) were used in this study as shown in **Table 5**.

Table 5: Crash Rates per 100 Million Vehicle Miles Traveled (1/1/2007 to 12/31/2009)

Road Segment	Direction	Overall Crash Rate			Injury Crash Rate			Fatal Crash Rate		
		Corridor Rate	*Statewide Rate	% Difference	Corridor Rate	*Statewide Rate	% Difference	Corridor Rate	*Statewide Rate	% Difference
I-95 Urban Section (MP 47.4 to MP 54.6)	NB	56	93	-67%	19	41	-121%	0.0	0.5	0%
	SB	57	93	-62%	19	41	-117%	0.8	0.5	35%
I-85 Urban Section (MP 68.1 to MP 69.1)	NB	68	93	-36%	20	41	-110%	0.0	0.5	0%
	SB	35	93	-165%	11	41	-289%	0.0	0.5	0%

*Statewide Urban Interstate Rate (VDOT Published in 2007)
Study corridor crash rate period = from 1/1/2007 to 12/31/2009
VMT = Vehicle Miles Traveled
MP = Milepost

Based on an analysis of the data, the overall, injury, and fatal crash rates in both directions on I-95 and I-85 within the study limits, are all lower than the 2007 statewide crash rates for urban interstates. The one exception is the fatal crash rate of 0.8 on southbound I-95, which is 35% higher than the statewide interstate crash rate of 0.5. The current study corridors crash rates (calculated using data from 2007 to 2009) were compared to the crash rates calculated in the I-85/I-95/Route 460 Interchange Study (calculated from 1996 to 1998 and shown in **Table 6**) show a reduction in the overall, injury, and fatal crash rates. Although the limits of the two studies were different, a comparison of the crash rates shows a downward trend through the study area.

Table 6: Crash Rates per 100 Million Vehicle Miles Traveled (1/1/1996 to 12/31/1998)

Road Segment	Direction	Overall Crash Rate	Injury Crash Rate	Fatal Crash Rate
I-95 at the I-85/Route 460	NB	86	65	2.6
	SB	111	86	3.6
I-85 at the I-85/Route 460	NB	116	67	1.8
	SB	70	37	0.0

Crash rates from the I-85/I-95/Route 460 Interchange Study, December 2000
Study corridor crash rate period = from 1/1/1996 to 12/31/1998
VMT = Vehicle Miles Traveled

CRASH TYPE

The most predominant crash types in the study corridor are fixed-object off road and rear end crashes. Due to the limitations of the crash data provided, fixed-object off road crashes were the only crash type reviewed in detail to identify roadway departure crashes. Roadway departure crashes are frequently severe and account for the majority of highway fatalities. According to the Federal Highway Administration, a roadway departure crash is defined as a non-intersection crash that occurs after a vehicle crosses an edge line or a center line, or otherwise leaves the traveled way. The pattern of rear-end crashes throughout the corridor is an indication of possible traffic congestion; variable travel speeds; short deceleration and acceleration lane lengths; and inadequate ramp configurations.

ROADWAY SURFACE CONDITIONS

Most of the crashes in the corridor occurred under dry roadway surface conditions with 29% occurring under wet conditions. A summary of the corridor crashes by pavement condition is provided in **Table 7**. Surface conditions in the "other" category include snowy, icy, and roadway flooded.

Table 7: Crash Summary – Roadway Surface Conditions

Segment	Roadway Surface Conditions [Number of Crashes (Percentage of Crashes)]		
	Dry	Wet	Other
I-95 Southbound	95 (64%)	48 (32%)	5 (3%)
I-95 Northbound	89 (63%)	40 (28%)	12 (9%)
I-85 Southbound	5 (63%)	3 (38%)	0 (0%)
I-85 Northbound	16 (70%)	7 (30%)	0 (0%)
Ramps & CD Roads	61 (72%)	19 (22%)	5 (6%)
Corridor Total	**266 (66%)**	**117 (29%)**	**22 (5%)**

TIME OF DAY

Within the limits of the study corridor, approximately half of the crashes occur during the AM and PM peak periods and the other half occur during off peak periods. A summary of the corridor crashes by time of day is provided in **Table 8**.

Table 8: Crash Summary - Time of Day

Segment	Time of Day [Number of Crashes (Percentage of Crashes)]		
	AM Peak (6-10)	PM Peak (3-7)	Off Peak
I-95 Southbound	27 (18%)	38 (26%)	83 (56%)
I-95 Northbound	29 (21%)	38 (27%)	74 (52%)
I-85 Southbound	1 (13%)	3 (38%)	4 (50%)
I-85 Northbound	4 (17%)	7 (30%)	12 (52%)
Ramps & CD Roads	26 (31%)	25 (29%)	34 (40%)
Corridor Total	**87 (21%)**	**111 (27%)**	**207 (51%)**

LIGHTING CONDITIONS

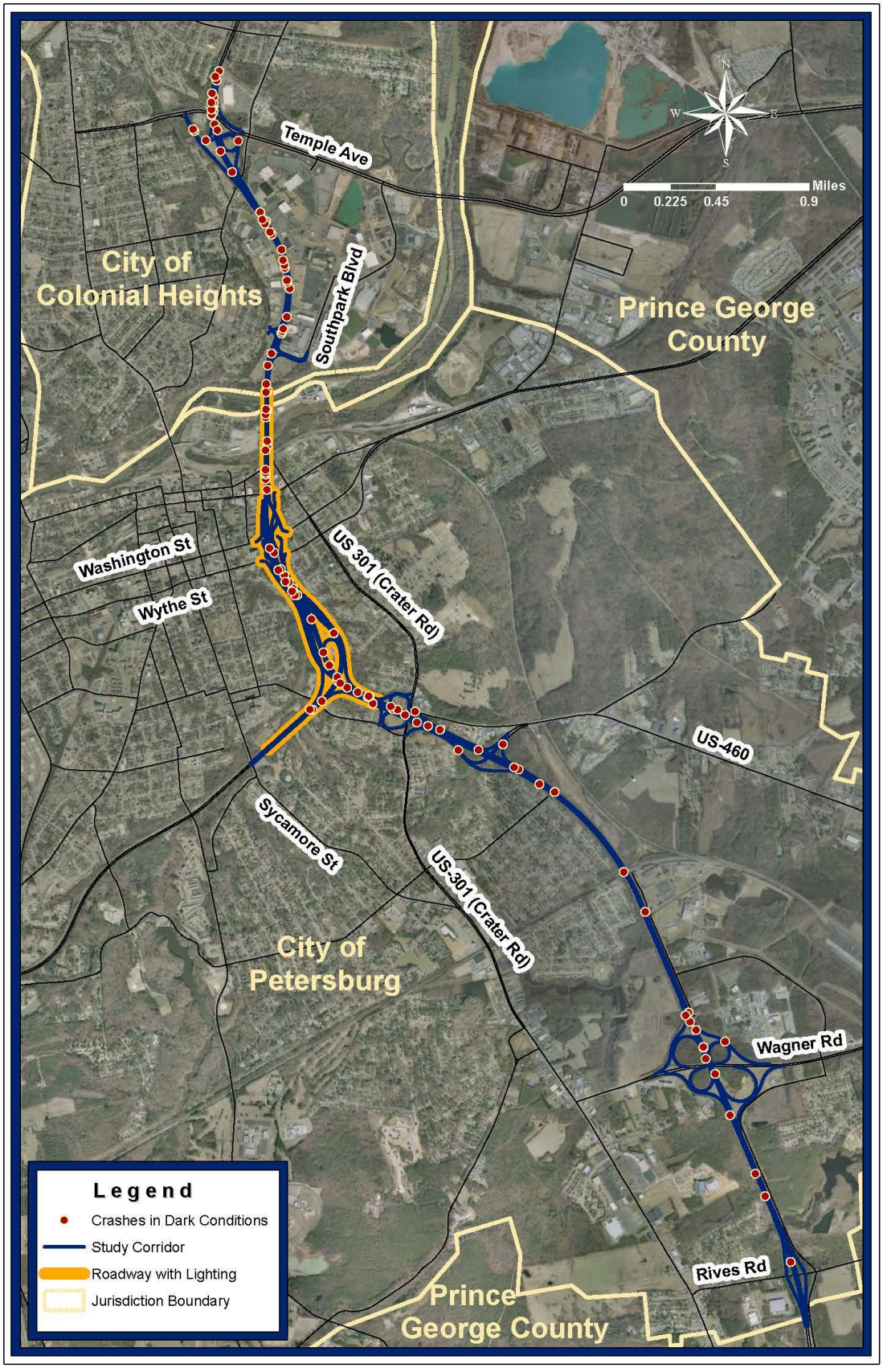
Most of the corridor crashes occurred during the day with 30% occurring under dark conditions. A summary of the corridor crashes by light conditions is provided in **Table 9**. Of the 123 crashes that occurred during dark conditions, 87 (71%) crashes were reported as occurring on a segment of roadway without lighting. The locations of all crashes occurring under dark conditions and the location of lighting along the study corridor are illustrated in **Figure 10**. As previously mentioned, the location of lighting in both corridors is not continuous. A description of the lighting locations is provided below.

- On I-85 there is conventional lighting in both the northbound and southbound directions north of milepost 68 and high mast lighting surrounding the I-95 interchange.
- On I-95 conventional lighting is present in the study corridor between milepost 53.0 and milepost 52.5 and between milepost and between milepost 51.2 and 51.4. In addition, there is high mast lighting between the two segments of conventional lighting.

Table 9: Crash Summary – Lighting Conditions

Segment	Lighting Conditions [Number of Crashes (Percentage of Crashes)]		
	Day	Dawn/Dusk	Dark
I-95 Southbound	92 (62%)	7 (5%)	49 (33%)
I-95 Northbound	82 (58%)	8 (6%)	51 (36%)
I-85 Southbound	6 (75%)	1 (13%)	1 (13%)
I-85 Northbound	19 (83%)	0 (0%)	4 (17%)
Ramps & CD Roads	58 (69%)	9 (11%)	18 (21%)
Corridor Total	**257 (63%)**	**25 (6%)**	**123 (30%)**

Figure 10: Dark Crash Locations

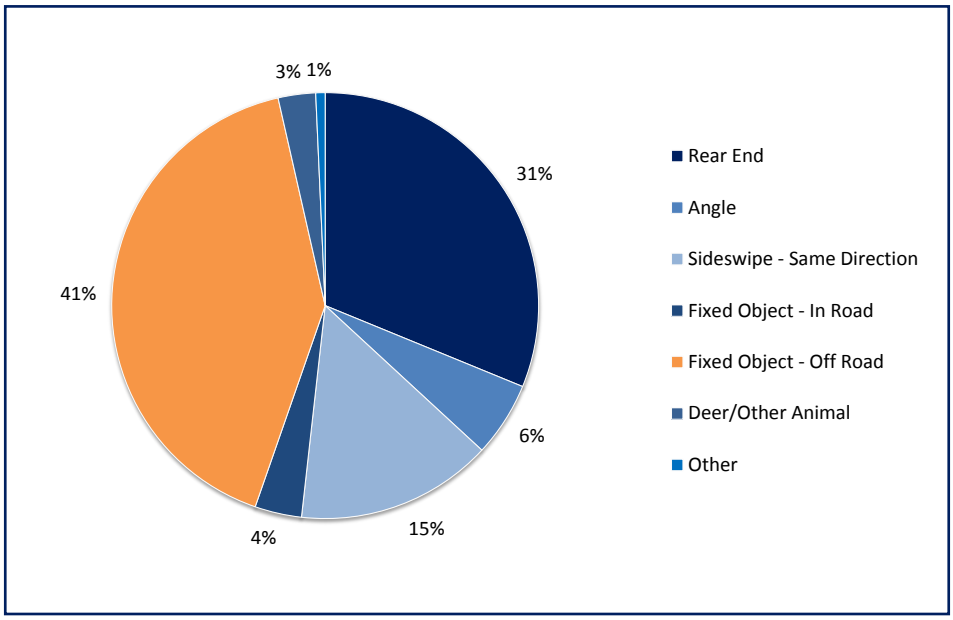


NORTHBOUND I-95 CRASH SUMMARY

- The total number of reported crashes is: 141 crashes
- The total number of reported injuries is: 47 injuries
- The total number of reported fatalities is: 0 fatalities

A summary of crashes by type on the northbound I-95 is shown in **Figure 11**. The most prevalent crash types in this direction are fixed-object off road and rear end.

Figure 11: Crash Type – Northbound I-95



A summary of roadway departure crashes on northbound I-95 is provided in **Table 10**. The frequency and direction of roadway departure crashes per half-mile segment on northbound I-95 are displayed in **Figure 12**. The following conclusions were developed based on a review of this crash data on southbound I-95.

- None of the roadway departure crashes on northbound I-95 resulted in a fatality.
- 30 (47%) of the roadway departure crashes on northbound I-95 resulted in injury.
- Injuries resulting from roadway departure crashes on northbound I-95 accounted for 38% of all injuries on northbound I-95.

Table 10: Northbound I-95 – Summary of Roadway Departure Crashes

Type of RD Crash	Number of Crashes	Percent of RD Crashes	Percent of Total I-95 NB Crashes
To the Right	25	39%	18%
To the Left	39	61%	28%
Total Number of RD Crashes	**64**	**100%**	**45%**

Notes:
Crash data from 2007 to 2009
RD = Roadway Departure

Figure 12: Northbound I-95 – Roadway Departure Crash Density

SOUTHBOUND I-95 CRASH SUMMARY

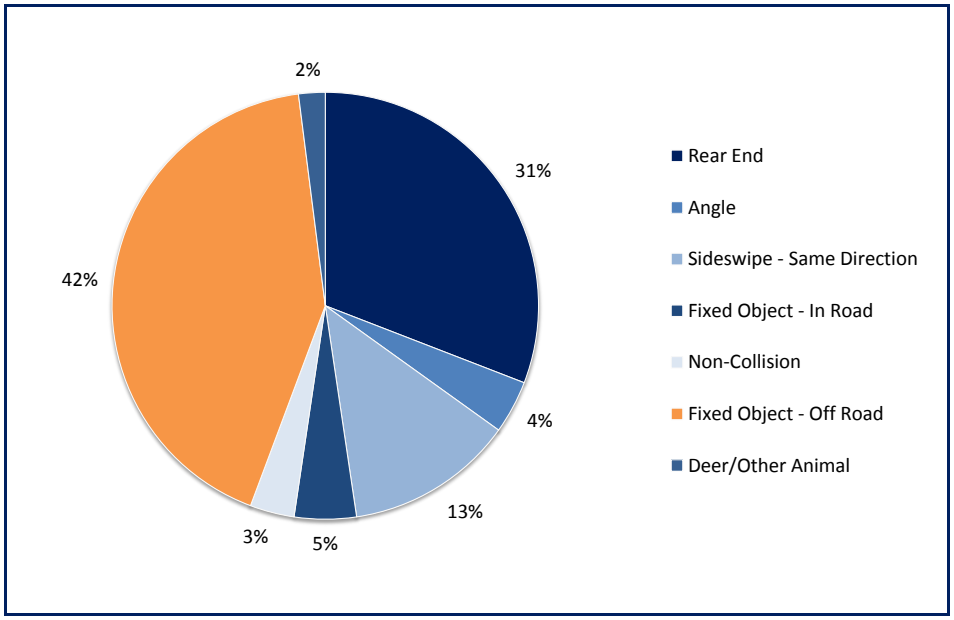
- The total number of reported crashes is: 148 crashes
- The total number of reported injuries is: 49 injuries
- The total number of reported fatalities is: 1 fatality

The one fatal crash along I-95 southbound occurred in 2009 at 5:53 AM approximately 150 feet north of the Southpark Boulevard interchange (Exit 53) at milepost 53.1. In addition to the fatality, there were two injuries also associated with the crash. It was a rear end crash in conditions with dry roadway surface, clear weather, and darkness. The contributing major factor was categorized as improper or unsafe lane change. The vehicles involved in the crash were three passenger cars.

Due to the random nature of fatal crashes, especially on interstate facilities, specific mitigation measures were not developed. However, corridor-wide roadside safety recommendations were developed based on the field review and a comprehensive analysis of speed data, crash data, traffic volumes, interchange spacing and roadway characteristics. These recommendations are summarized in the Corridor-Wide Recommendations section of the report.

A summary of crashes by type on southbound I-95 is provided in **Figure 13**. The most prevalent crash types in this direction are fixed-object off road and rear end.

Figure 13: Crash Type – Southbound I-95



A summary of roadway departure crashes on southbound I-95 is provided in **Table 11**. The frequency and direction of roadway departure crashes per half-mile segment on southbound I-95 are displayed in **Figure 14**.

Table 11: Southbound I-95 – Summary of Roadway Departure Crashes

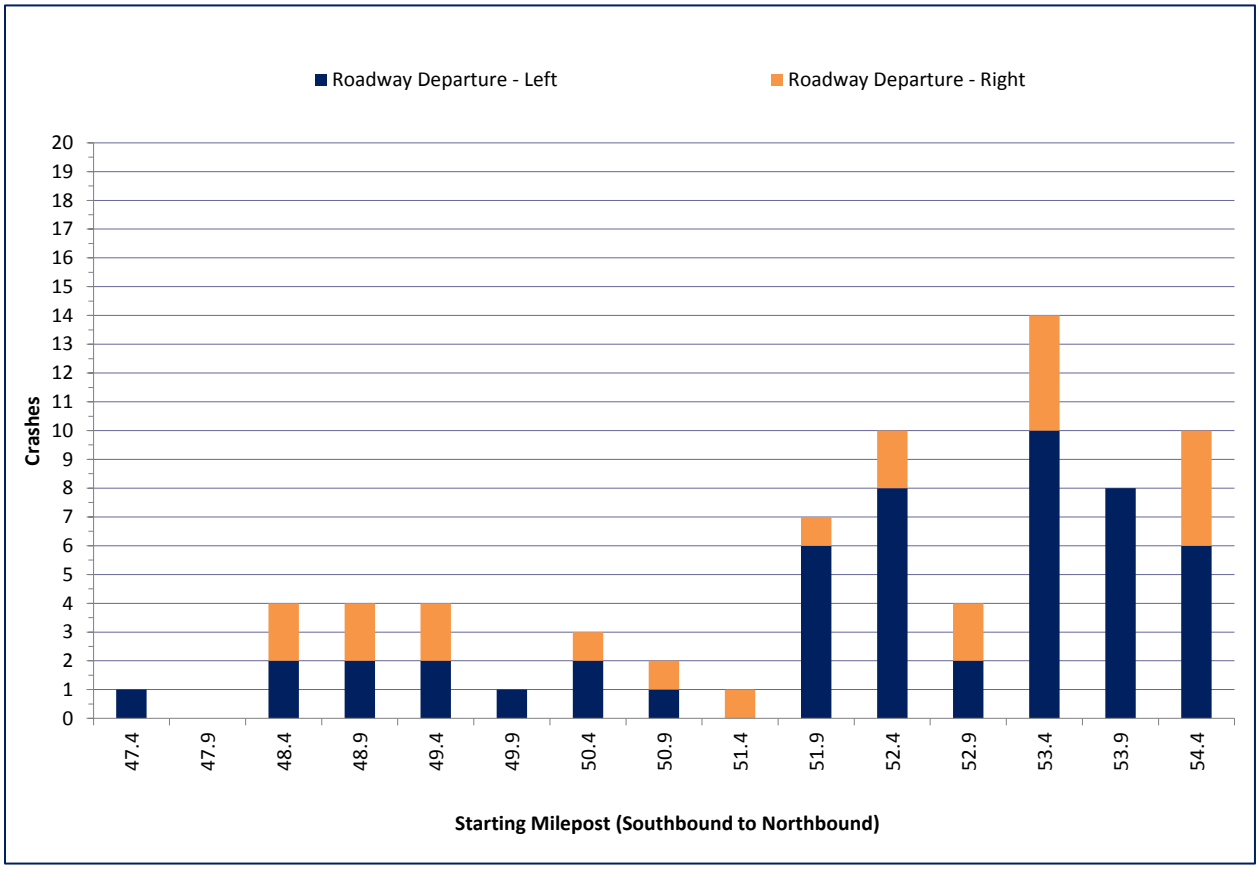
Type of RD Crash	Number of Crashes	Percent of RD Crashes	Percent of Total I-95 SB Crashes
To the Right	23	31%	15%
To the Left	51	69%	34%
Total Number of RD Crashes	**74**	**100%**	**50%**

Notes:
Crash data from 2007 to 2009
RD = Roadway Departure

The following conclusions were developed based on a review of this crash data on southbound I-95.

- None of the roadway departure crashes on southbound I-95 resulted in a fatality.
- 21 (28%) of the roadway departure crashes on southbound I-95 resulted in injury.
- Injuries resulting from roadway departure crashes on southbound I-95 accounted for 27% of all injuries on southbound I-95.

Figure 14: Southbound I-95 – Roadway Departure Crash Density



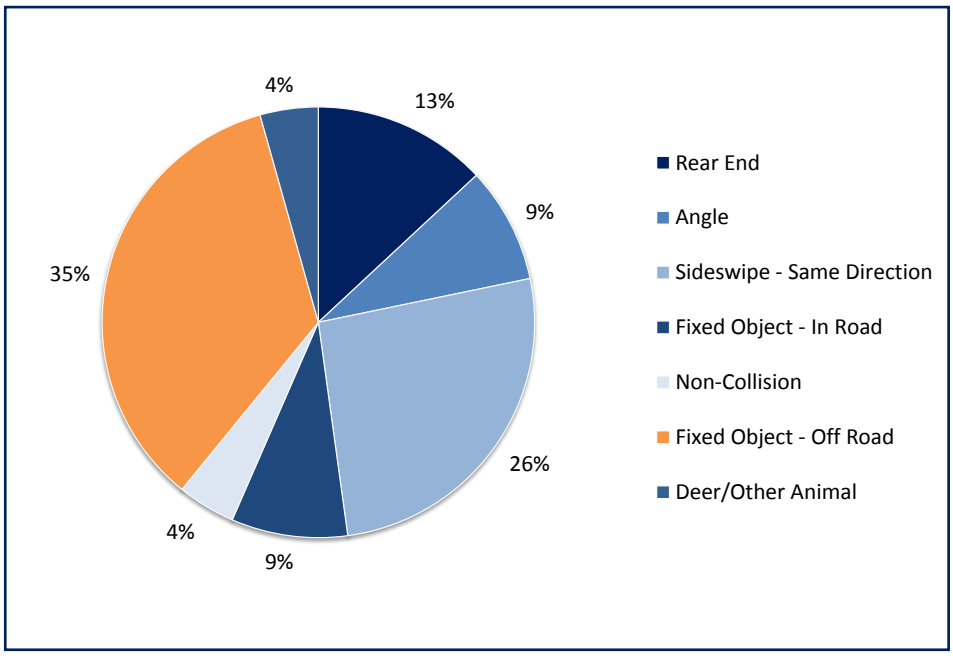
NORTHBOUND I-85 CRASH SUMMARY

The following crash statistics were computed for northbound I-85 using the three years of crash data provided by VDOT.

- The total number of reported crashes is: 23 crashes
- The total number of reported injuries is: 6 injuries
- The total number of reported fatalities is: 0 fatalities

A summary of crashes by type on northbound I-85 is provided in **Figure 15**. The most prevalent crash types in this direction are fixed-object off road and rear end.

Figure 15: Crash Type – Northbound I-85



A summary of roadway departure crashes on northbound I-85 is provided in **Table 12**. The frequency and direction of roadway departure crashes per half-mile segment of northbound I-95 are displayed in **Figure 16**. The following conclusions were developed based on a review of this crash data on northbound I-85.

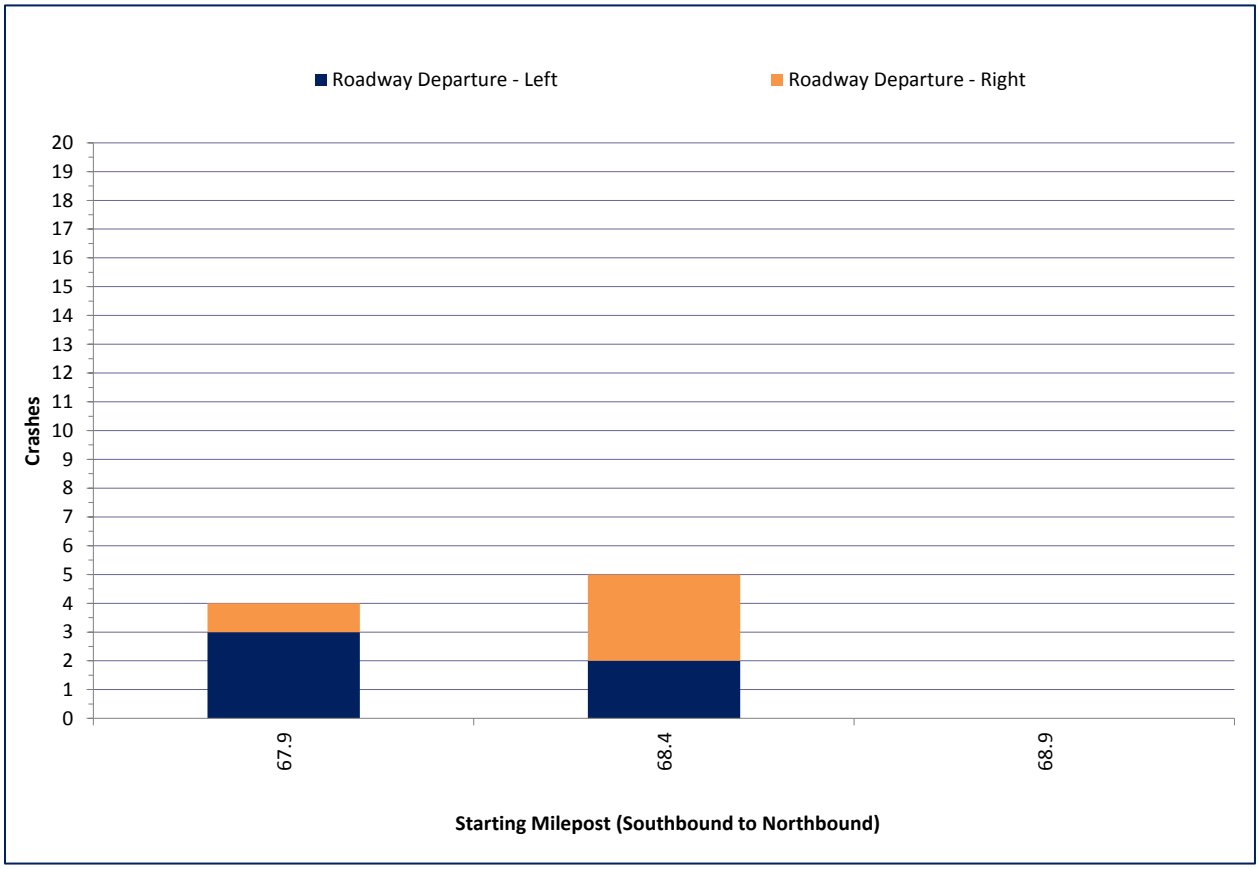
- None of the roadway departure crashes on northbound I-85 resulted in fatality.
- One (11%) of the roadway departure crashes on northbound I-85 resulted in injury.
- Injuries resulting from roadway departure crashes on northbound I-85 accounted for 14% of all injuries on northbound I-85.

Table 12: Northbound I-85 – Summary of Roadway Departure Crashes

Type of RD Crash	Number of Crashes	Percent of RD Crashes	Percent of Total I-85 NB Crashes
To the Right	4	44%	17%
To the Left	5	56%	22%
Total Number of RD Crashes	**9**	**100%**	**39%**

Notes:
Crash data from 2007 to 2009
RD = Roadway Departure

Figure 16: Northbound I-95 – Roadway Departure Crash Density



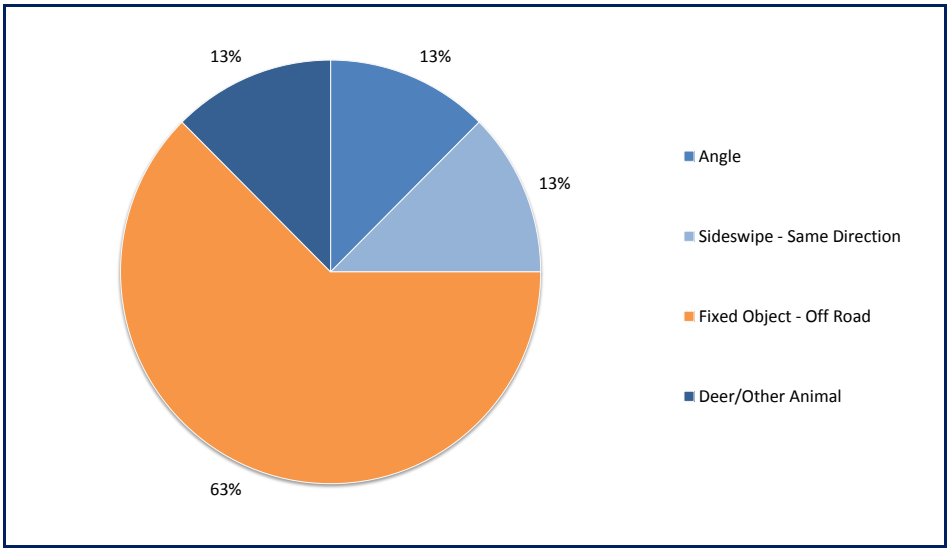
SOUTHBOUND I-85 CRASH SUMMARY

The following crash statistics were computed for southbound I-85 using the three years of crash data provided by VDOT.

- The total number of reported crashes is: 8 crashes
- The total number of reported injuries is: 3 injuries
- The total number of reported fatalities is: 0 fatalities

A summary of crashes by type in the southbound direction of I-85 is provided in **Figure 17**. The most prevalent crash type in this direction is fixed object – off road.

Figure 17: Crash Type – Southbound I-85



The frequency and direction of roadway departure crashes per half-mile segment of northbound I-95 are displayed in **Figure 18**. A summary of roadway departure crashes in the southbound direction of I-85 is provided in **Table 13**.

Figure 18: Southbound I-85 – Roadway Departure Crash Density

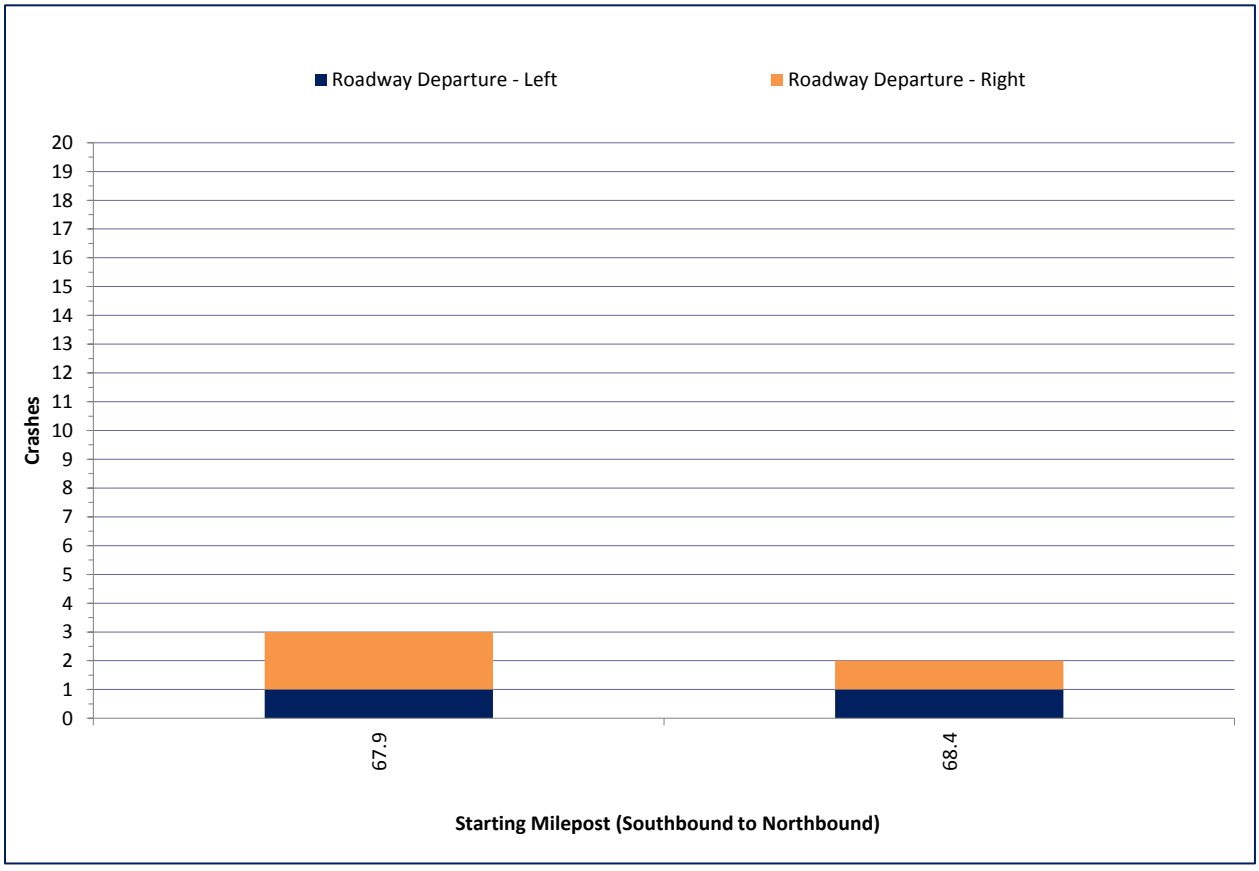


Table 13: Southbound I-85 – Summary of Roadway Departure Crashes

Type of RD Crash	Number of Crashes	Percent of RD Crashes	Percent of Total I-85 SB Crashes
To the Right	3	60%	38%
To the Left	2	40%	25%
Total Number of RD Crashes	**5**	**100%**	**63%**

Notes:
Crash data from 2007 to 2009
RD = Roadway Departure

I-85/I-95 RAMPS AND CD ROADS CRASH SUMMARY

While this study did not include a full crash analysis at each individual ramp, a summary of crashes were compiled for all of the ramps and collector-distributor (CD) roads within the study corridor. This summary was compiled to identify corridor-wide trends, most prevalent crash types, and safety issues related to the ramps and CD roads. A breakdown of the crashes for the ramps and CD roads throughout the study corridor is as follows:

- The total number of reported crashes on the ramps and CD roads along this corridor is: 85 crashes
- The total number of reported injuries on the ramps and CD roads along this corridor is: 30 injuries
- The total number of reported fatalities on the ramps and CD roads along this corridor is: 1 fatality

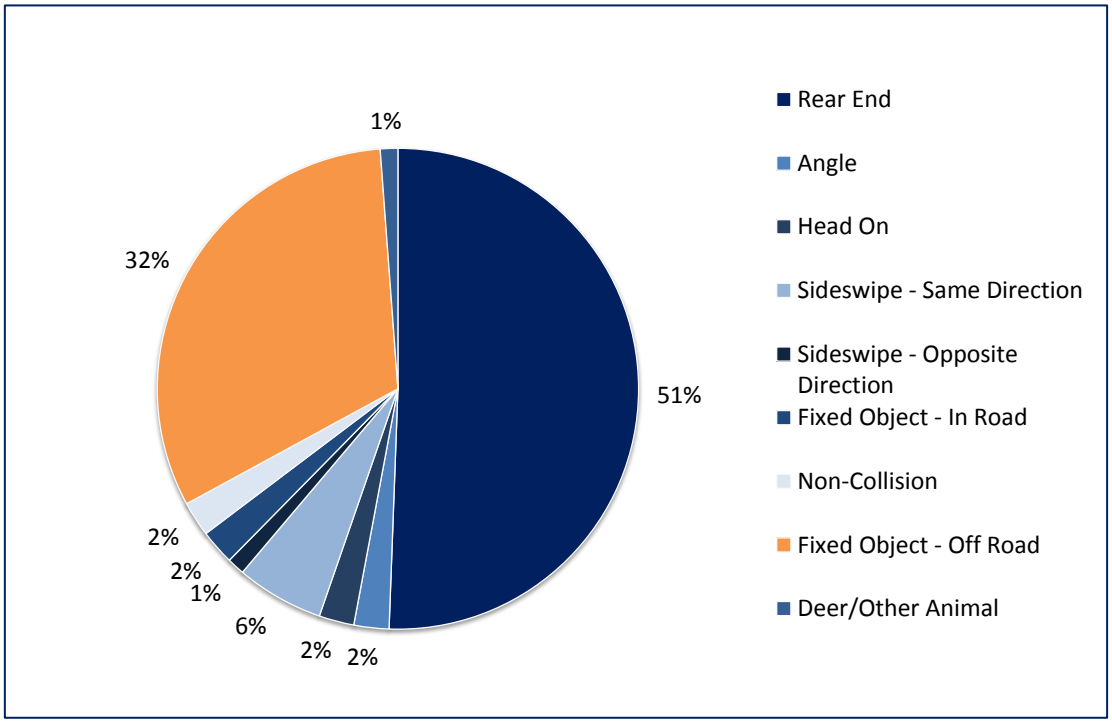
The interchange with the highest number of reported crashes occurred at Temple Avenue. The on-ramps and off-ramps in both the northbound and southbound directions combined for a total of 28 crashes.

The one crash involving a fatality occurred in 2009 at 3:19 AM on the southbound I-95 off-ramp to Wythe Street. It was a fixed-object off road crash in conditions with wet roadway surface and darkness. The major contributing factor was driver speeding. The vehicle involved in the crash was a passenger car.

Due to the random nature of fatal crashes, specific mitigation measures were not developed. However, corridor-wide roadside safety recommendations were developed based on the field review and a comprehensive analysis of speed data, crash data, traffic volumes, interchange spacing and roadway characteristics. These recommendations are summarized in the Recommendations section of the report.

A summary of crashes by type on the ramps is provided in **Figure 19**. The most prevalent crash type on the ramps is rear end. The pattern of rear-end crashes on ramps and along the collector-distributor roads is an indication of possible traffic congestion and/or substandard deceleration/acceleration lengths. A detailed summary of all the ramp and CD road crashes can be found in **Appendix B**.

Figure 19: Crash Type – Corridor Ramps and Collector-Distributor (CD) Roads



IDENTIFICATION OF CRASH HOT SPOTS

Crash activity by half-mile segments of roadway, or crash density, for the portions of I-85 and I-95 (both directions) in the study corridor between 2007 and 2009 are represented in **Figures 20** through **23**. The crash density of each half-mile segment was compared to the statistical mean, or average crash density, of the corresponding segment of the study corridor (I-95 SB, I-95 NB, I-85 SB, and I-85 NB) and also to the average crash density of all urban interstates in the Richmond District. The critical crash density (two standard deviations greater than the average crash density) for I-95 SB, I-95 NB, I-85 SB, and I-85 NB was computed for each segment of the study corridor. The half-mile segments with more crashes than the critical crash density were considered to be crash "hot spots" for which roadway safety assessments (RSAs) were conducted. Only one location was determined to be a hot spot based on the crash density criterion. Two additional hot spots were included in the analysis due to their close proximity to meeting the crash density criterion. One of the three hot spots is located on northbound I-95 and the other two are located on southbound I-95. The locations of the three hot spots are described below and are illustrated in **Figure 24**. There were no crash hotspots identified in either direction on I-85.

- Hot Spot 1 – northbound I-95 north of the Temple Avenue interchange (milepost 54.4 to 54.9)
- Hot Spot 2 – southbound I-95 north of the Washington Street/Wythe Street interchange (milepost 52.4 to 52.9)
- Hot Spot 3 – southbound I-95 between Temple Ave interchange and Southpark Boulevard interchange (milepost 53.4 to 53.9)

Figure 20: Northbound I-95 – Crash Density

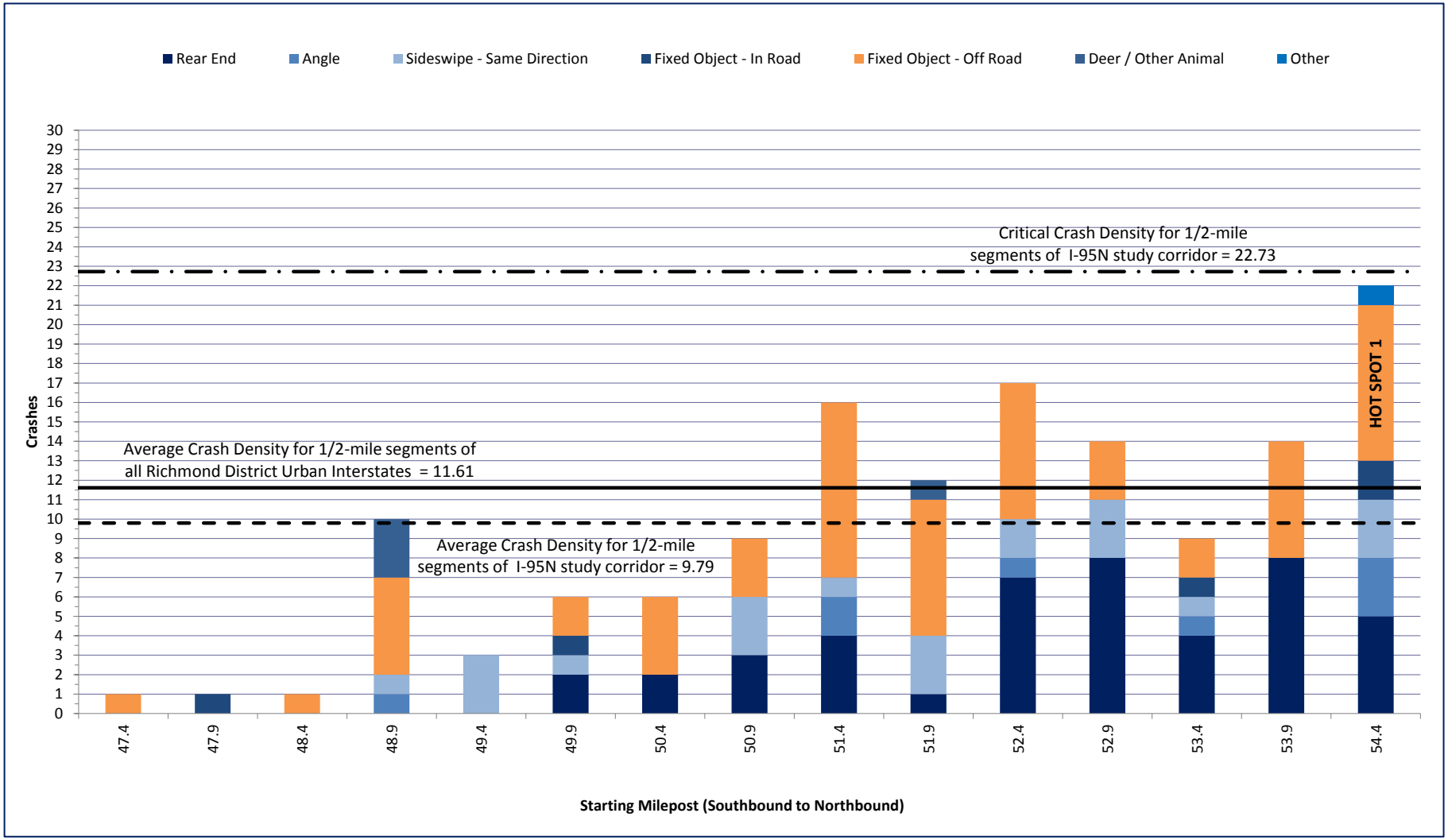


Figure 21: Southbound I-95 – Crash Density

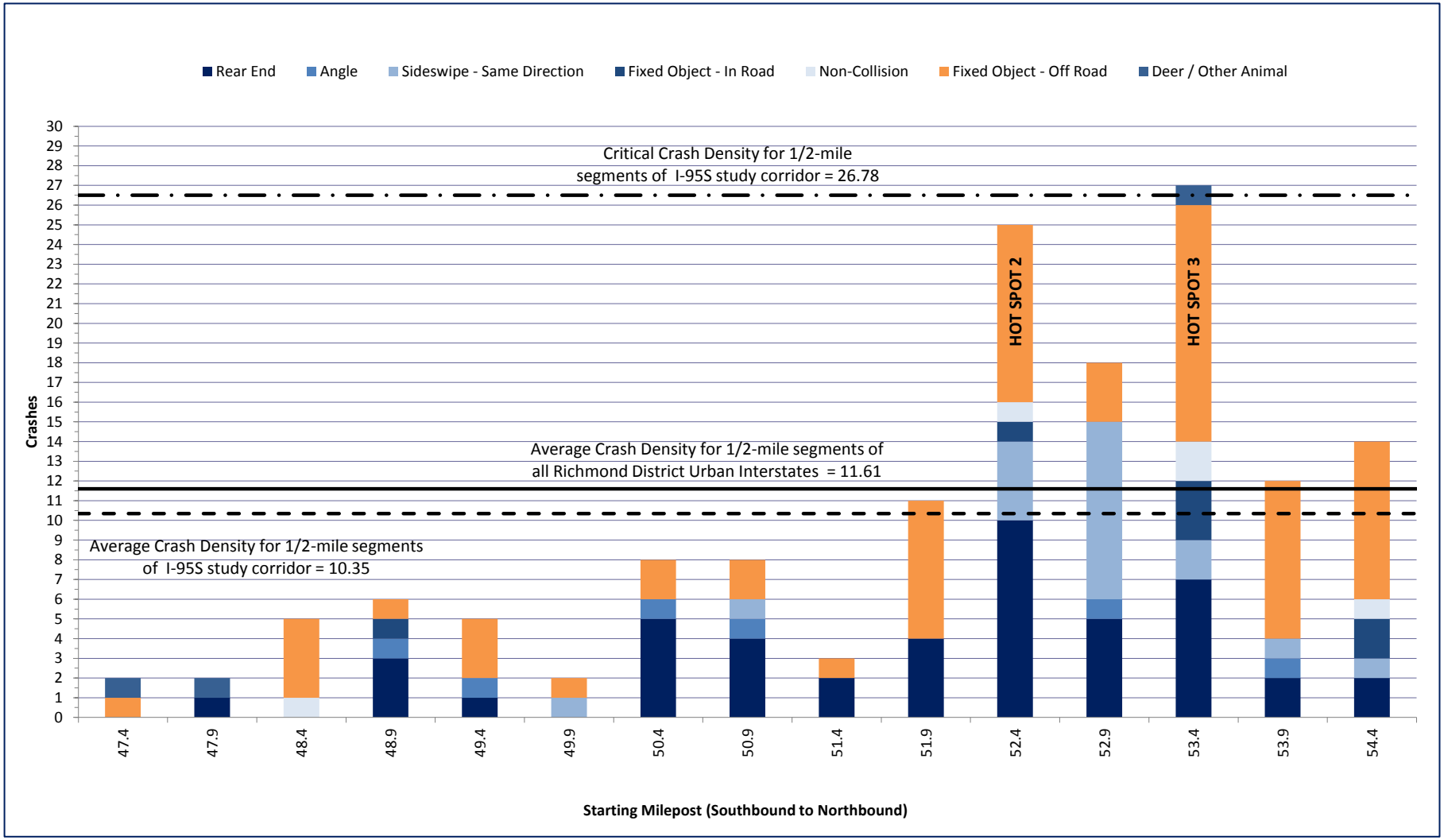


Figure 22: Northbound I-85 – Crash Density

Figure 23: Southbound I-85 – Crash Density

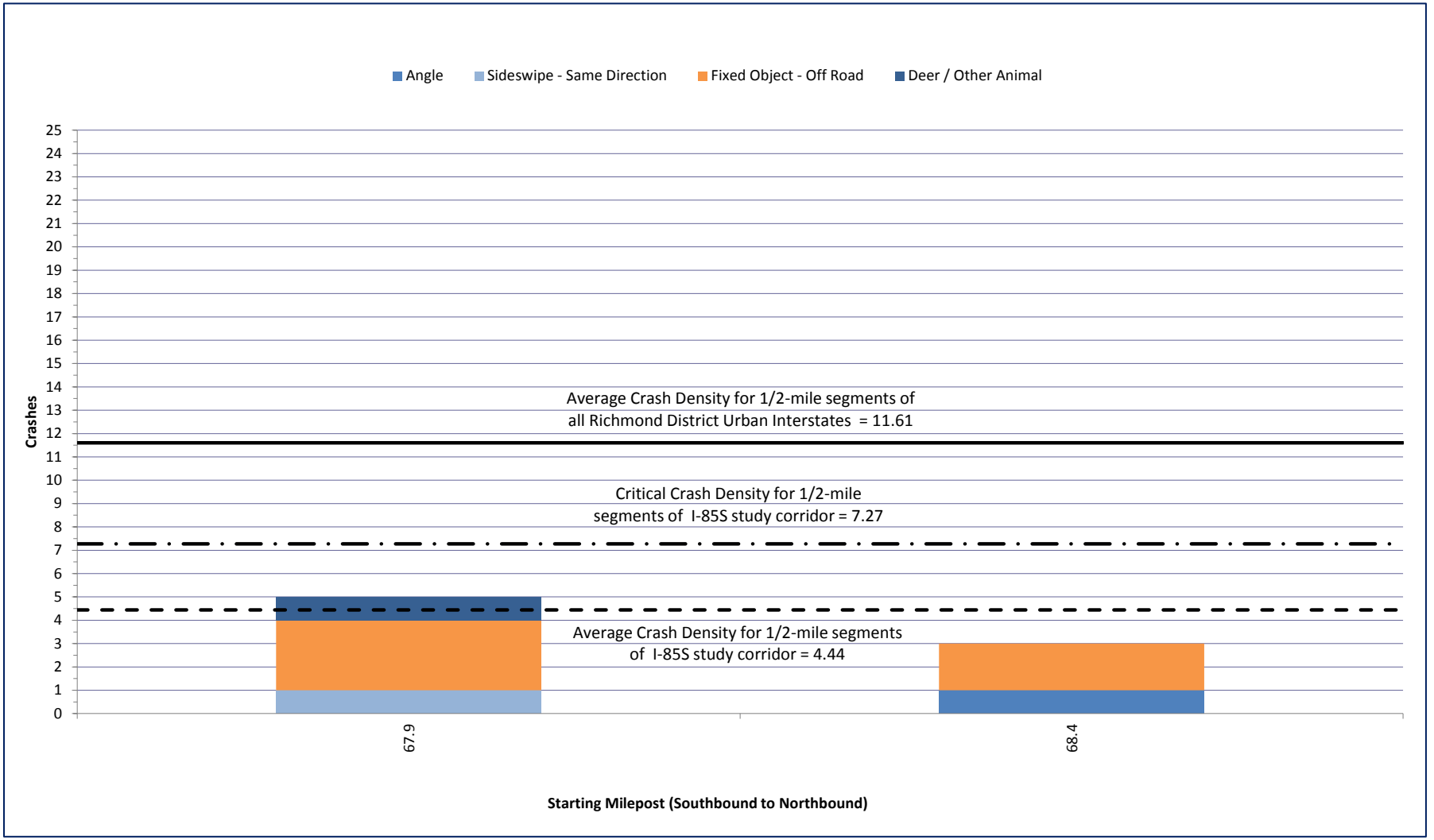
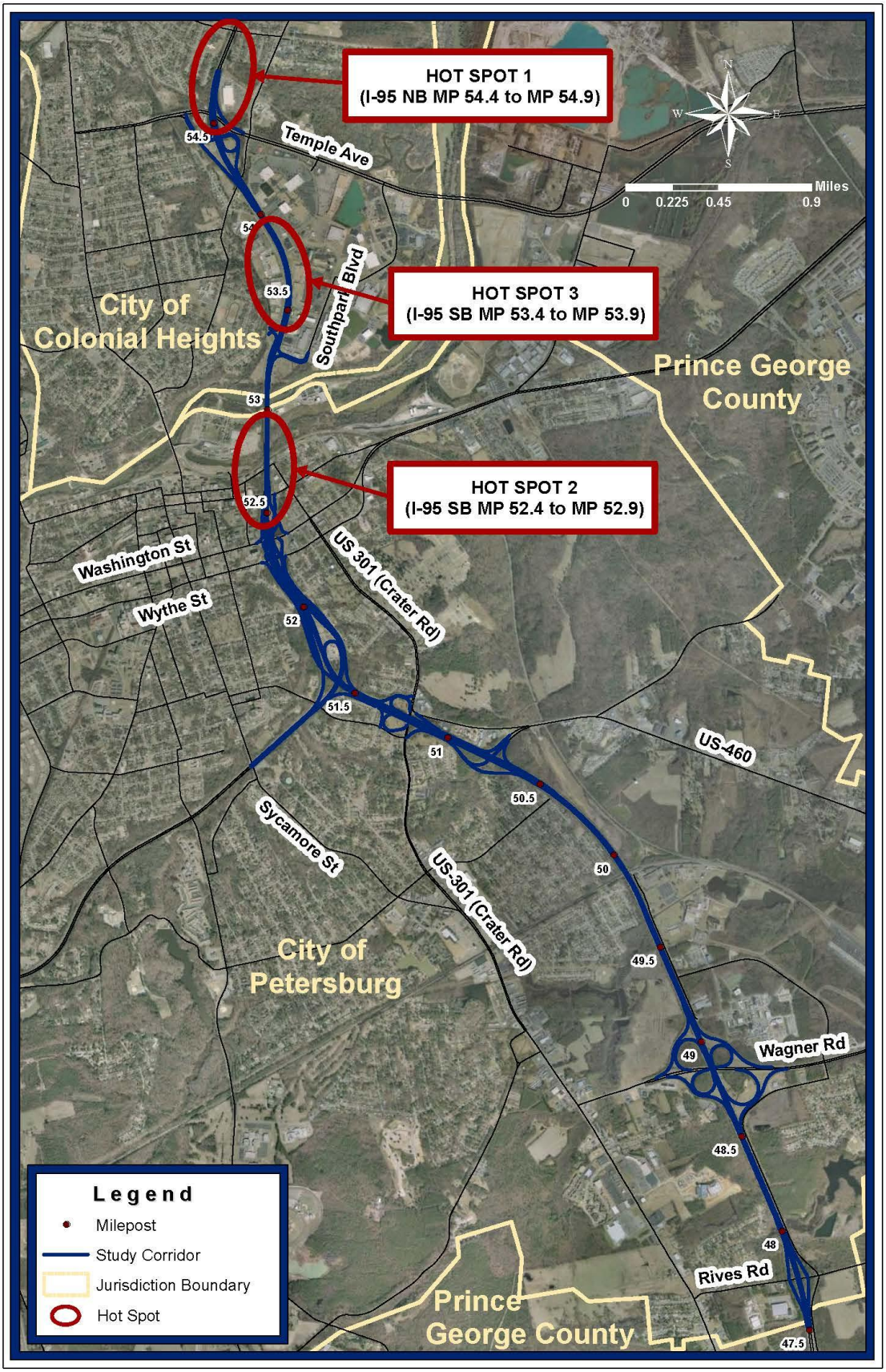


Figure 24: Crash Hot Spot Locations



RECOMMENDATIONS

CORRIDOR-WIDE RECOMMENDATIONS

Many of the safety issues observed along the study corridor were not localized to a single segment of roadway; as a result, several corridor-wide improvements were recommended. The goal to relate crash trends and deficiencies identified during the study process with improvements that will reduce crashes and risk throughout the corridor. Further recommendations specific to hot spot locations will be discussed in later sections of the report.

ISSUE 1: ROADWAY DEPARTURE CRASH PATTERN

Roadway departure crashes are frequently severe and account for the majority of highway fatalities. According to the Federal Highway Administration, a roadway departure crash is defined as a non-intersection crash that occurs after a vehicle crosses an edge line or a center line, or otherwise leaves the traveled way.

- 9 roadway departure crashes on northbound I-85 (56% to the left, 44% to the right)
- 5 fixed object off-road on southbound I-85 (40% to the left, 60% to the right)
- 64 fixed object off-road on northbound I-95 (61% to the left, 39% to the right))
- 74 fixed object off-road on southbound I-95 (69% to the left, 31% to the right)

A significant portion of the 152 roadway departure crashes along the study corridor were fixed-object off road crashes.

COUNTERMEASURE 1A: RUMBLE STRIPS

The existing crash pattern of roadway departure crashes along the study corridor justifies the corridor-wide installation of rumble strips along both the right and left shoulders where they do not currently exist, which is on the following sections:

- Northbound I-95 throughout entire study corridor, from milepost 47.4 to milepost 54.7
- Southbound I-95 from milepost 50.0 to milepost 54.7
- Southbound I-85 throughout entire study corridor, from milepost 67.9 to 68.8
- Rumble strips currently exist along the entire length of northbound I-85 within the study corridor – no rumble strips are necessary on northbound I-85

COUNTERMEASURE 1B: MEDIAN BARRIER

Numerous roadway departure crashes to the left were reported along I-95 at locations where median barriers currently exist. Median traffic barriers are present on I-95 between mileposts 50.9 and 51.9 and from milepost 52.3 to milepost 54.7. During the three-year study period, the roadway departure crash experience on I-95 is summarized as follows:

- On northbound I-95, 26 roadway departure crashes to the left were reported in the segment where median barriers exist.
- On southbound I-95, 35 roadway departure crashes to the left were reported in the segment where median barriers exist.

Due to the prevalence of roadway departure crashes to the left in roadway segments with median barriers, a corridor-wide assessment of traffic barriers is recommended. The study should assess the barrier design as it impacts vehicle deflection and the main travel way safety during crashes.

COUNTERMEASURE 1C: GUARDRAIL

Perform a guardrail assessment to review guardrail condition and location needs in the corridor. An additional guardrail discussion is included below under Issue 2.

COUNTERMEASURE 1D: REFLECTORS ON MEDIAN BARRIERS

Reflectors on median barriers exist along certain stretches of the study corridor; however, there are some areas where reflectors on median barriers are not present. It is recommended that reflectors be installed on the median barrier in locations were they do not currently exist, especially in locations where there are a significant number of crashes in dark conditions.

COUNTERMEASURE 1E: PAVEMENT MARKINGS

The installation of 6" wide pavement markings and in-pavement reflectors will improve visibility in the corridor and reduce the risk of crashes related to dark driving conditions, wet driving conditions and ultimately help reduce the number of roadway departure and sideswipe crashes.

ISSUE 2: SUBSTANDARD GUARDRAIL

During the RSA field review, segments containing deficient and substandard guardrail were observed. Examples of deficient guardrail included guardrail that was installed under an earlier version of VDOT standards or guardrail sections that have been damaged.

COUNTERMEASURE 2A: GUARDRAIL ASSESSMENT

A comprehensive guardrail assessment should be performed for the study corridor to identify areas where the guardrail should be upgraded to meet current VDOT standards and specifications. The guardrail should be upgraded or repaired as necessary, preferably in conjunction with other planned interstate maintenance projects.

ISSUE 3: CORRIDOR SIGNING

The I-95 and I-85 study corridors have a numerous guide signs due to the complex configurations of the interchanges and associated CD roads. The 2009 *Manual on Uniform Traffic Control Devices (*MUTCD) indicates that too much signing can reduce effectiveness of the information to be relayed and should be as concise as possible while still meeting the needs of the traveling public.

COUNTERMEASURE 3A: REMOVAL OF UNNECESSARY SIGNS

According to the VDOT Traffic Engineering Memorandum TE-369.0 dated 12/1/2011, Deer Crossing Warning (W11-13) signs should be installed when there are five or more deer crashes over two years in a mile long segment and when the speed limit is greater than 45 mph. These requirements are not met along any segment of the study corridor. It is recommended that the existing W11-13 signs be removed. Deer Crossing Warning (W11-3) signs are currently located at:

- Northbound I-95 near milepost 49.8
- Southbound I-95 near milepost 50.7

In addition, there are not enough crashes related to slick pavement where Slippery When Wet Warning (W8-5) signs are currently present. It is recommended that the W8-5 signs be removed from the study corridor. Slippery When Wet Warning (W8-5) signs are currently located at:

- Northbound I-95 near milepost 51.1 and milepost 53.3

COUNTERMEASURE 3B: OVERHEAD SIGN LIGHTING

The 2009 MUTCD states that overhead signs should be lit unless there is an engineering study conducted that concludes lighting is not necessary. Throughout the study corridor there are several overhead sign structures with unlit signs. The signs without lighting are listed below and photos of the signs can be found in **Appendix C**.

- On northbound I-95, there are 5 overhead sign structures with unlit signs with the following messages:
  - Exit 47 Rives Rd (MP 47.4)
  - Exit 48B Wagner Rd West ¼ Mile & Exit 48A Wagner Rd East (MP 48.4)
  - Exit 48B Wagner Rd West (MP 48.7)
  - Exit 53 Southpark Blvd Exit ¼ Mile (MP 52.9)
  - Colonial Hgts Next 3 Exits (MP 53.0)

- On southbound I-95, there are 9 overhead sign structures with unlit signs with the following messages:
  - Petersburg Tourist Information Center Use Exit 52 (MP 54.3)
  - Exit 51 I-85S/Route 460W South Hill Blackstone (MP 53.0)
  - Exit 52 Historic Old Towne Petersburg Washington St Wythe St (MP 52.5)
  - To 460 West (MP 50.3)
  - Exit 49B Wagner Rd West ½ Mile (MP 49.5)
  - Exit 47 Rives Road 1 ½ Miles (MP 49.3)
  - Exit 48A Wagner Rd East ¼ Mile & Exit 48B Wagner Rd West (MP 49.1)
  - Exit 47 Rives Rd ½ Mile (MP 48.3)
  - Exit 47 Rives Rd (MP 48.1)

COUNTERMEASURE 3C: ADDITIONAL SIGNING IMPROVEMENTS

The I-95 southbound loop off-ramp to Wagner Road East does not have a Horizontal Alignment (W1-15) sign or an Advisory Exit and/or Ramp Speed (W13-2, W13-3) warning sign. The ballbank/limiting angle method as defined in the VDOT Traffic Engineering Memorandum (TE-363) should be conducted to determine if warning signs are warranted to be installed at this location.

The continuous flashing beacons on the Truck Rollover Warning (W1-13) sign on the I-95 northbound off-ramp to I-85 southbound (milepost 51.7) were observed to be nonfunctioning during the field review conducted on March 27, 2012. This sign is shown in **Photograph 3**. Replacing the continuous flashing beacons are recommended as part of the corridor-wide improvements.

Photograph 3: Continuous Flashing Beacons on Truck Rollover Warning Sign

ISSUE 4: VERTICAL CLEARANCES

There are a total of 6 bridge structures over I-95 and 3 bridge structures over I-85 in the study area. According to the VDOT *Manual of the Structure and Bridge Division – Volume V – Part 2 Design Aids* (Chapter 6 Geometrics), the minimum bridge vertical clearance is 16' 6" for urban interstates. Eight of the 9 bridge crossings, summarized in **Table 14**, are vertically deficient, thereby creating potential hazards to vehicles that require 16.5 feet of vertical clearance.

Historical bridge strike information, shown in **Table 14**, was provided by VDOT Richmond District for a 13-year period from 1999 to 2011. There were a total of 19 reported bridge strikes located within the study corridor in the 13-year period. The highest number of bridge strikes was recorded at the E. Washington Street and I-95 bridges over I-95 with 5 strikes each, followed by the Southpark Boulevard bridge over I-95 with 3 strikes. VDOT noted the actual number of bridge strikes may be higher as many of the impacts do not stop the vehicle and the damage is not discovered until the next bridge inspection is conducted.

Table 14: Historical Bridge Strike Information from 1999 to 2011

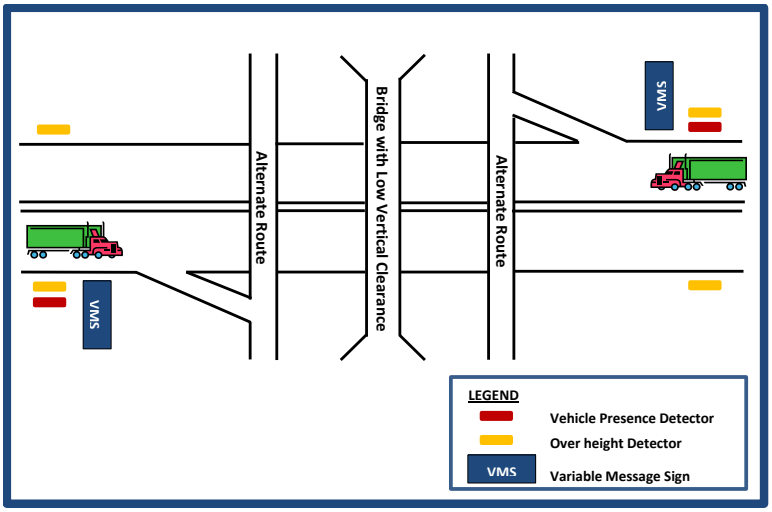
Bridge Crossing	Number of Bridge Strikes	Bridge Height	
		Existing	< 16' 6"^
Over I-95			
E. Ellerslie Avenue	1	14' 6"	✓
Conduit Road	1	14' 3"	✓
Southpark Boulevard	3	14' 3"	✓
E. Washington Street	5	13' 3"	✓
Wagner Road	1	16' 8"	
Rives Road	1	15' 2"	✓
Over I-85			
I-95 (over northbound I-85)	1	14' 6"	✓
I-95 (over southbound I-85)	5	14' 9"	✓
S. Sycamore Street	1	14' 7"	✓
Total =	**19**		

^ Minimum bridge vertical clearance is 16.5 feet for urban interstates (Source: VDOT *Manual of the Structure and Bridge Division – Volume V – Part 2 Design Aids* (Chapter 6 Geometrics)

COUNTERMEASURE 4A: LOW BRIDGE WARNING SYSTEM

Install low bridge warning systems on the northbound and southbound I-95 approaches to the study area. Each system will consists of a pole mounted vehicle presence detector and an over height vehicle sensor installed upstream of the low bridge structure. When an over height vehicle is detected, a signal is transmitted to a variable message sign (VMS) which then displays a message advising the driver to take an alternate route. A conceptual layout of a low bridge warning system is provided in **Figure 25**. Potential locations on I-95 may include prior to the I-295 Interchange in the northbound direction and prior to the Route 10 interchange (Exit 61) in the southbound direction, both provide access to I-295 which could serve as an alternate route around study corridor which contains a number of low bridge structures. Final locations should consider low bridges adjacent to the study corridor and alternate routes that can accommodate heavy vehicle traffic.

Figure 25: Conceptual Layout of Low Bridge Warning System



The benefits of installing a low bridge warning system include improvements to safety and operations throughout the corridor.

- Minimizes the risk of high vehicles striking low bridges
- Avoids traffic delays experienced due to a bridge strike

COUNTERMEASURE 4B: STRUCTURE REPLACEMENT

Replace bridge and/or overhead sign structures to meet minimum vertical clearance height requirements.

COUNTERMEASURE 4C: SIGNING

Install Low Clearance with arrows (W12-2) warning signs on the following bridges displaying the existing bridge heights shown in **Table 14**.

ISSUE 5: INTERCHANGE SPACING & ACCELERATION/DECELERATION LANE LENGTHS

As shown in **Table 1** in the Existing Conditions section of the report, three segments do not meet the *2004 AASHTO A Policy on Geometric Design of Highways and Streets*, Fifth Edition minimum interchange spacing recommendation of one mile between interchanges on an urban interstate. Closely spaced interchanges within an urban area create friction and turbulence, which can result in increased congestion, bottlenecks, and corresponding crashes.

On northbound I-95, the segments with less than one mile between adjacent interchanges are listed below:

- Between Rives Road on-ramp and Wagner Road off-ramp
- Between S Crater Road/CD Road on-ramp and I-85 off-ramp
- Between I-85 on-ramp and E Bank Street off-ramp
- Between E Bank Street off-ramp and Washington Street/Wythe Street on-ramp
- Between Washington Street/Wythe Street on-ramp and Southpark Boulevard off-ramp
- Between Southpark Boulevard on-ramp and Temple Avenue off-ramp

On southbound I-95, the segments with less than one mile between adjacent interchanges are listed below:

- Between Temple Avenue on-ramp and Roslyn Road off-ramp
- Between Roslyn Road on-ramp and Washington Street/Wythe Street off-ramp
- Between Washington Street/Wythe Street off-ramp and I-85 off-ramp

- Between I-85 off-ramp and Washington Street/Wythe Street on-ramp
- Between Washington Street/Wythe Street on-ramp and S Crater Road/CD Road off-ramp
- Between S Crater Road/CD Road off-ramp and Winfield Road/CD Road on-ramp
- Between Wagner Road on-ramp and Rives Road off-ramp

As summarized in **Table 15**, several of the acceleration and deceleration lane lengths do not meet the standards given in the *2004 AASHTO A Policy on Geometric Design of Highways and Streets*, Fifth Edition.

Table 15: Acceleration and Deceleration Lane Deficient Lengths

Ramp	Measured Length (ft)	Standard Length (ft)	Deficient Length (Feet)
I-95 Northbound Direction			
Rives Road On-Ramp	695	1,000	305
Eastbound Wagner Road On-Ramp	875	1,220	345
Westbound Wagner Road On-Ramp	765	1,000	235
E. Bank Street Off-Ramp	235	380	145
Southpark Boulevard Off-Ramp	270	410	140
Southpark Boulevard On-Ramp	650	810	160
I-95 Southbound Direction			
Roslyn Road On-Ramp	480	810	330
Westbound Wagner Road Off-Ramp	380	440	60
Westbound Wagner Road On-Ramp	805	1,220	415
Eastbound Wagner Road On-Ramp	965	1,000	35
Rives Road On-Ramp	745	1,000	255

COUNTERMEASURE 5A: CORRIDOR-WIDE OPERATIONS STUDY

A corridor-wide operational analysis is recommended to identify the impacts of short interchange spacing and deficient acceleration/deceleration lanes have on corridor-wide operations. Such a study could be used to further justify the need for future long-term improvements throughout the I-95 study corridor.

COUNTERMEASURE 5B: LENGTHEN ACCELERATION/DECELERATION LANES

Lengthen the deficient acceleration and deceleration lanes to meet AASHTO standards. The lengths by which each acceleration or deceleration lane should be increased to meet current standards are given in **Table 15**.

ISSUE 6: PAVEMENT CONDITION

Overall the pavement condition in the corridor is in fair to good condition. Some segments, specifically the south end of the corridor and the north end of the corridor, have recently been paved. The middle segment of the corridor was not paved during the same timeframe as the adjacent segments leaving some inconsistent pavement sections.

COUNTERMEASURE 6A: PAVING SCHEDULE

Based on discussions with VDOT, the study corridors are not currently on a paving schedule; however, it is recommended that the entire corridor be paved to improve roadway visibility and drivability. In addition, drainage, rumble strips, striping and in pavement reflectors should also be assessed and potentially upgraded at this time.

ISSUE 7: CORRIDOR LIGHTING

Approximately 30% of all crashes in the corridors occurred under dark conditions. Of those crashes, 71% were reported as occurring on a segment of roadway without lighting. **Figure 10** illustrates the locations of the "dark" crashes relative to the location of lighting in the corridor. Roadway lighting will improve visibility in the corridor and can help with driver response time in segments where there are high traffic volumes and closely spaced interchanges.

COUNTERMEASURE 7A: CONDUCT LIGHTING STUDY

Conduct a corridor-wide lighting warrant study and install additional lighting as appropriate. Typically, it is recommended that interchanges have high mast lighting and other segments have conventional lighting types. VDOT should also consider the addition of underbridge lighting systems for bridges in the corridor as an additional safety measure.

HOT SPOT 1 – NORTHBOUND I-95 FROM MILEPOST 54.4 TO 54.9

Hot Spot 1 is located on northbound I-95 and extends from just south of the Temple Avenue on-ramp to the northern limits of the study corridor (1000 feet north of Temple Avenue). Hot Spot 1 includes the roadway segment that contains both on-ramps from eastbound and westbound Temple Avenue; however, it does not include the off-ramp to Temple Avenue.

CRASH ANALYSIS

Crashes within Hot Spot 1 are summarized in **Table 16**. The major conclusions that can be drawn from the information in this table are:

- Six injury crashes out of 22 total crashes were reported, accounting for 27% of total crashes.
- The predominate crash type is fixed-object off road, accounting for 8 out of 22 total crashes or 36%.
- Four of the fixed-object off road crashes departed the road to the right – guardrail exists on the right side of the road along the Temple Avenue on-ramp in this segment but does not exist north of the merge point.
- Four of the fixed-object off road crashes departed the road to the left – a traffic barrier exists on the left side of the road throughout this segment.`
- Eleven, or 50%, of the crashes occurred in dark conditions – lighting does not exist along this segment of roadway.

SAFETY ISSUES TO BE ADDRESSED

- The percentage (50%) of crashes occurring in dark conditions suggests that visibility is an issue in this area.
- Five crashes involved slick pavement or hydroplaning, resulting in three fixed object – off road crashes and two angle crashes.
- There were a total of five crashes related to merging maneuvers from the Temple Avenue on-ramps (both ramps) to northbound I-95, resulting in three sideswipe - same direction crashes, one fixed-object off road crash, and one angle crash.

Table 16: Crash Summary – Hot Spot 1 (I-95 NB, Milepost 54.4 to 54.9)

Crash Characteristic	Year 2007	2008	2009	Total	
	Number of Crashes			#	%
Total	7	7	8	22	-
Fatal	0	0	0	0	0%
Property Damage	7	3	6	16	73%
By Severity:					
Total Injury	0	4	2	6	27%
Type A	0	1	0	1	5%
Type B	0	0	2	2	9%
Type C	0	3	0	3	14%
By Weather:					
Clear & Cloudy	6	5	3	14	64%
Rain	0	2	3	5	23%
All Other (Mist/Sleet/Hail)	1	0	2	3	14%
By Roadway Surface Conditions:					
Dry	6	5	3	14	64%
Wet	0	1	2	3	14%
All Other	1	1	3	5	23%
By Light Conditions:					
Day	3	5	3	11	50%
Dawn/Dusk	0	0	0	0	0%
Dark	4	2	5	11	50%
By Type of Collision:					
Rear-End	1	3	1	5	23%
Sideswipe - Same Direction	2	1	0	3	14%
Fixed Object Off Road - Right	0	2	2	4	18%
Fixed Object Off Road - Left	3	0	1	4	18%
All Other	1	1	4	6	27%
By Number of Vehicles Involved:					
One	4	2	3	9	41%
Two	2	5	5	12	55%
Three and Greater	1	0	0	1	5%
By Time of Day:					
AM Peak (6-10)	0	2	1	3	14%
PM Peak (3-7)	2	3	1	6	27%
Off Peak	5	2	6	13	59%

Photograph 4: End of Northbound Temple Avenue Acceleration Lane (Northern On-Ramp)

PROPOSED RECOMMENDATIONS

There is currently a proposed project to reconstruct the Temple Avenue interchange. This project would involve the construction of a roundabout at the intersection of the I-95 on- and off-ramps and Temple Avenue. A conceptual layout displaying the proposed interchange design is shown in **Figure 26** to the right. It is recommended that the following improvements be implemented, if possible, with the Temple Avenue intersection reconstruction project.

Figure 26: Proposed Temple Roundabout

- Conduct a lighting study for the interchange and install high mast lighting in the vicinity of the interchange. A lighting study for this interchange should also be performed in conjuncture with a lighting study for the entire study corridor (see corridor-wide recommendations above). Lighting installation will improve driver visibility in dark conditions.
- Conduct a more detailed drainage assessment in the vicinity of the Temple Avenue interchange.
- Conduct a pavement friction test in the vicinity of the Temple Avenue interchange in conjuncture with the detailed drainage assessment.
- Install Lane Ends Merge Left (W9-2) signs at the ends of both northbound I-95 on-ramps from Temple Avenue to warn drivers that the lane is ending.

HOT SPOT 2 – SOUTHBOUND I-95 FROM MILEPOST 52.4 TO 52.9

Hot Spot 2 is located on southbound I-95 and extends from the northern city limit of Petersburg to just south of the off-ramp to Washington Street/Wythe Street (Exit 52).

CRASH ANALYSIS

Crashes within Hot Spot 2 are summarized in **Table 17**. The major conclusions that can be drawn from the information in this table are:

- Seven injury crashes out of 25 total crashes were reported accounting for 28% of injury crashes.
- The predominate crash types are rear end and fixed-object off road. Rear end crashes accounted for 10 out of 25 total crashes or 40% and fixed-object off road crashes accounted for 9 out of 25 total crashes or 36%.
- Two of the fixed-object off road crashes departed the road to the right – guardrail or traffic barriers exists on the right side of the road throughout this segment.
- Seven of the fixed-object off road crashes departed the road to the left – a traffic barrier exists on the left side of the road throughout this segment.

Table 17: Crash Summary – Hot Spot 2 (I-95 SB, Milepost 52.4 to 52.9)

Crash Characteristic	Year			Total	
	2007	2008	2009		
	Number of Crashes			#	%
Total	11	8	6	25	-
Fatal	0	0	0	0	0%
Property Damage	10	4	4	18	72%
By Severity:					
Total Injury	1	4	2	7	28%
Type A	0	1	1	2	8%
Type B	0	1	1	2	8%
Type C	1	2	0	3	12%
By Weather:					
Clear & Cloudy	5	6	5	16	64%
Rain	4	2	1	7	28%
All Other (Mist/Sleet/Hail)	2	0	0	2	8%
By Roadway Surface Conditions:					
Dry	5	6	5	16	64%
Wet	4	2	1	7	28%
All Other	2	0	0	2	8%
By Light Conditions:					
Day	10	7	3	20	80%
Dawn/Dusk	0	0	1	1	4%
Dark	1	1	2	4	16%
By Type of Collision:					
Rear-End	5	3	2	10	40%
Sideswipe - Same Direction	1	3	0	4	16%
Fixed Object Off Road - Right	0	1	1	2	8%
Fixed Object Off Road - Left	5	1	1	7	28%
All Other	0	0	2	2	8%
By Number of Vehicles Involved:					
One	4	2	3	9	36%
Two	6	5	2	13	52%
Three and Greater	1	1	1	3	12%
By Time of Day:					
AM Peak (6-10)	2	1	0	3	12%
PM Peak (3-7)	5	4	1	10	40%
Off Peak	4	3	5	12	48%

SAFETY ISSUES TO BE ADDRESSED

- The existing crash pattern of rear-end crashes suggests congestion, insufficient deceleration/acceleration lengths, and/or short weave segments as possible contributing factors.
- Congestion was not observed during the field review, but the RSA team did note the Washington Street off-ramp has a history of recurring congestion. Specifically, it was noted that queuing on the Washington Street off-ramp often backs up onto the interstate during the PM peak.
- A 24-hour traffic count conducted on March 3, 2012 had an AM peak hour volume of 491 vehicles and a PM peak hour volume of 535 vehicles. The AM peak hour occurred from 7:30 AM to 8:30 AM and the PM peak hour occurred from 4:00 PM to 5:00 PM.

PROPOSED RECOMMENDATIONS

Recommendations for this location are consistent with the corridor-wide recommendations described above.

HOT SPOT 3 – SOUTHBOUND I-95 FROM MILEPOST 53.4 TO 53.9

Hot Spot 3 is located on southbound I-95 and extends from the Temple Avenue on-ramp to the Southpark Boulevard off-ramp.

CRASH ANALYSIS

Crashes within Hot Spot 3 are summarized in **Table 18**. The major conclusions that can be drawn from the information in this table are:

- Six injury crashes out of 27 total crashes were reported, accounting for 29% of total crashes.
- The predominate crash type is fixed-object off road, accounting for 12 out of 27 total crashes or 44%.
- Three of the fixed-object off road crashes departed the road to the right – guardrail exists on the right side of the roadway north of milepost 53.8 and surrounding the overhead sign structure located between milepost 53.5 and milepost 53.6 in this segment.
- Nine of the fixed-object off road crashes departed the road to the left – a traffic barrier exists on the left side of the road throughout this segment.
- Thirteen or 48% of the crashes occurred in dark conditions – lighting does not exist along this segment of roadway.

SAFETY ISSUES TO BE ADDRESSED

- The percent of crashes occurring in dark conditions suggest that lighting is inadequate along this segment of roadway.
- There are no reflectors on the median barrier – 5 of the 9 fixed-object off road crashes to the left occurred in darkness.

PROPOSED RECOMMENDATIONS

Recommendations for this location are consistent with the corridor-wide recommendations described above.

- Conduct a lighting study for the interchange and install high mast lighting in the vicinity of the interchange. A lighting study for this interchange should also be performed in conjuncture with a lighting study for the entire study corridor (see corridor-wide recommendations above). Lighting installation will improve driver visibility in dark conditions.

AREA OF INTEREST – RIVES ROAD INTERCHANGE

Rives Road is currently in the design phase to be widened from US 301 to the I-95 interchange. A traffic study was conducted as part of the widening project. 2011 turning movement counts from at the I-96 Rives Road interchange were reviewed and used as a basis to develop Existing (2012) and Future (2035) traffic volumes to be used in an operational analysis for purposes of this study. Development of Existing (2012) and Future (2035) traffic volumes are provided in **Appendix D**. A supplemental crash analysis and operational analysis using Existing (2012) and Future (2035) traffic volumes was conducted to build on the efforts of the previous traffic study and further justify the need to identify long-term improvements at the Rives Road Interchange.

Table 18: Crash Summary – Hot Spot 3 (I-95 SB, Milepost 53.4 to 53.9)

Crash Characteristic	Year			Total	
	2007	2008	2009		
	Number of Crashes			#	%
Total	6	13	8	27	-
Fatal	0	0	0	0	0%
Property Damage	4	9	8	21	78%
By Severity:					
Total Injury	2	4	0	6	22%
Type A	0	3	0	3	11%
Type B	1	0	0	1	4%
Type C	1	1	0	2	7%
By Weather:					
Clear & Cloudy	5	11	7	23	85%
Rain	1	2	1	4	15%
All Other (Mist/Sleet/Hail)	0	0	0	0	0%
By Roadway Surface Conditions:					
Dry	5	11	7	23	85%
Wet	1	2	1	4	15%
All Other	0	0	0	0	0%
By Light Conditions:					
Day	2	6	4	12	44%
Dawn/Dusk	0	1	1	2	7%
Dark	4	6	3	13	48%
By Type of Collision:					
Rear-End	3	3	1	7	26%
Sideswipe - Same Direction	0	2	0	2	7%
Fixed Object Off Road - Right	1	0	2	3	11%
Fixed Object Off Road - Left	2	6	1	9	33%
All Other	0	2	4	6	22%
By Number of Vehicles Involved:					
One	2	7	4	13	48%
Two	3	5	3	11	41%
Three and Greater	1	1	1	3	11%
By Time of Day:					
AM Peak (6-10)	0	5	3	8	30%
PM Peak (3-7)	1	1	2	4	15%
Off Peak	5	7	3	15	56%

EXISTING CONDITIONS

- The Rives Road interchange (Exit 47) has a diamond configuration with the northbound and southbound ramp approaches operating as stop controlled.
- 24-hour traffic counts were collected on March 28, 2012 for all four ramps of the interchange. The peak hour ramp volumes at the interchange are summarized in Figure 27 and the 24-hour traffic volumes are shown in Figure 28 .
- Mainline I-95 volumes were obtained from VDOT permanent count stations for June 27, 2012. Volumes from count station 789276 were used as the mainline I-95 volumes north of the Rives Road interchange and traffic volumes from count station 789275 were used as the mainline I-95 volumes south of the Rives Road interchange.
- For all traffic counts the peak hour volumes reported correspond to the highest one hour volume occurring between 7:00 AM and 9:00 AM and between 4:00 PM and 6:00 PM.

Figure 27: Rives Road Interchange - Peak Hour Ramp Traffic Volumes

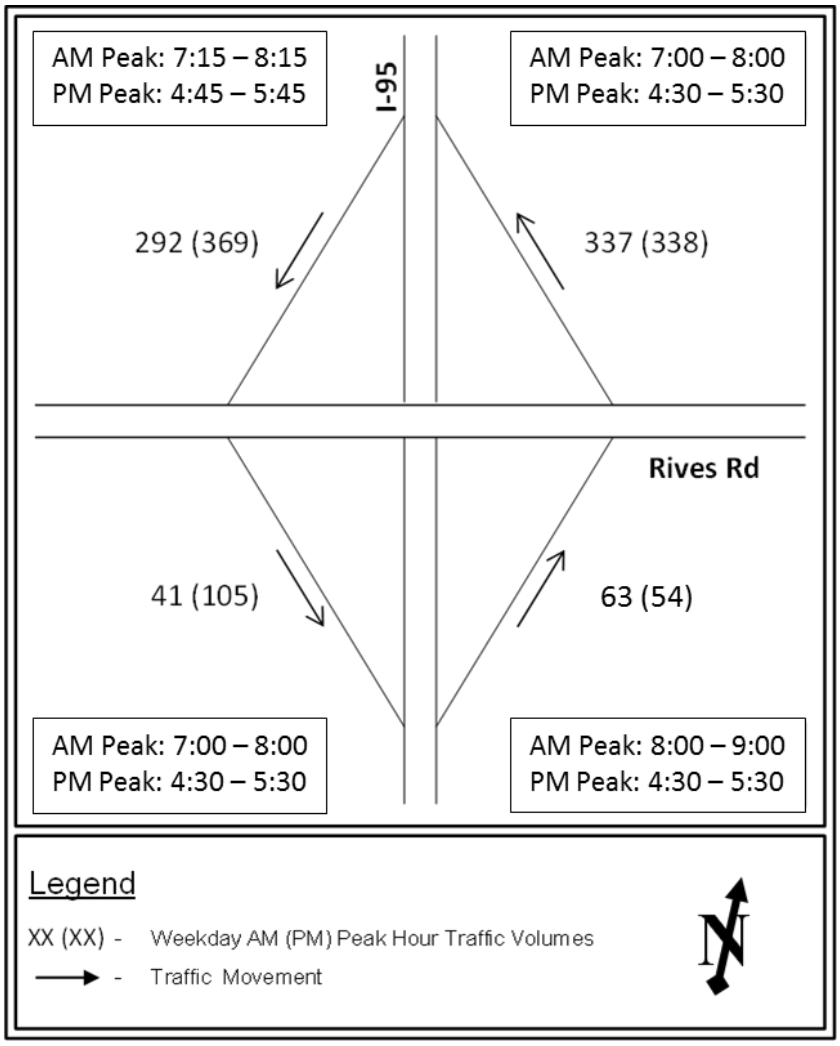
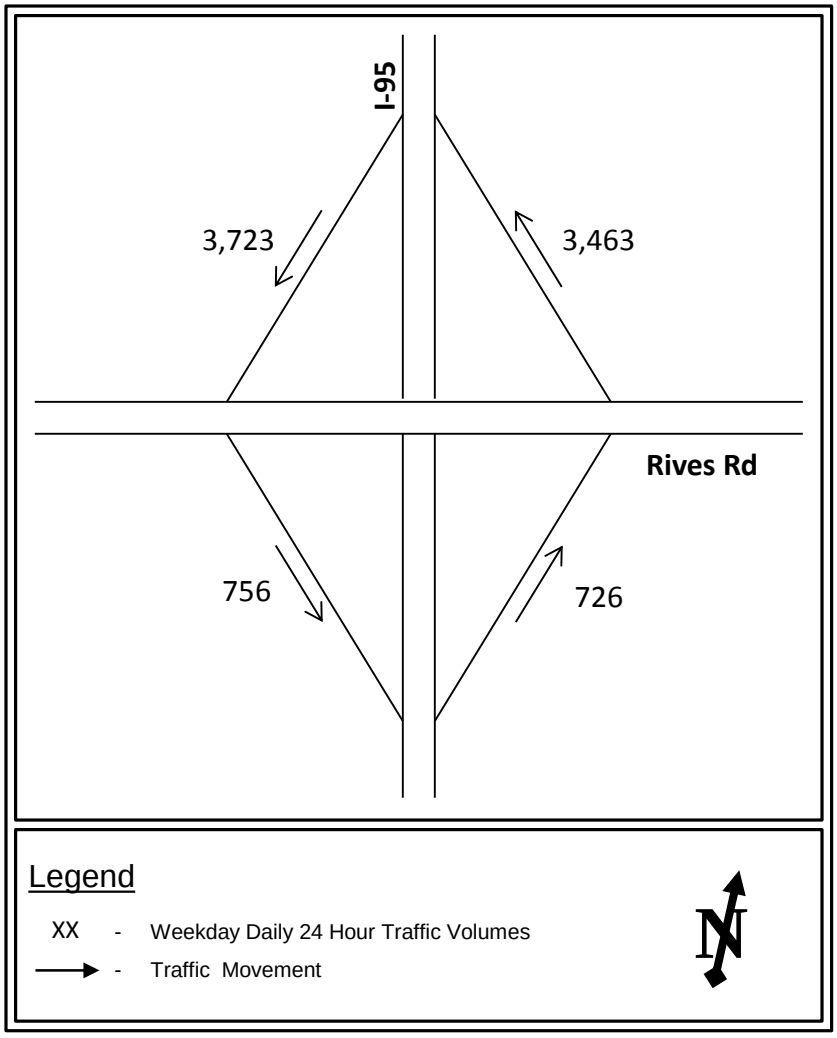


Figure 28: Rives Road Interchange - 24-Hour Ramp Traffic Volumes



CRASH ANALYSIS

According to an incident event list provided by the Petersburg Police Department, approximately 20 crashes occurred between January 1, 2007 and December 31, 2009 at the intersections of the northbound and southbound I-95 ramps to Rives Road. Crash reports were requested for all 20 events; however, only 10 of the reports were obtained. These 10 crashes are displayed in the collision diagrams in **Figure 29** and **30**. The major conclusions that can be drawn from the information in these figures are:

- Four of the five total crashes at the intersection of Rives Road and I-95 southbound ramps were angle crashes.

Figure 29: Collision Diagram - Rives Road and I-95 Northbound

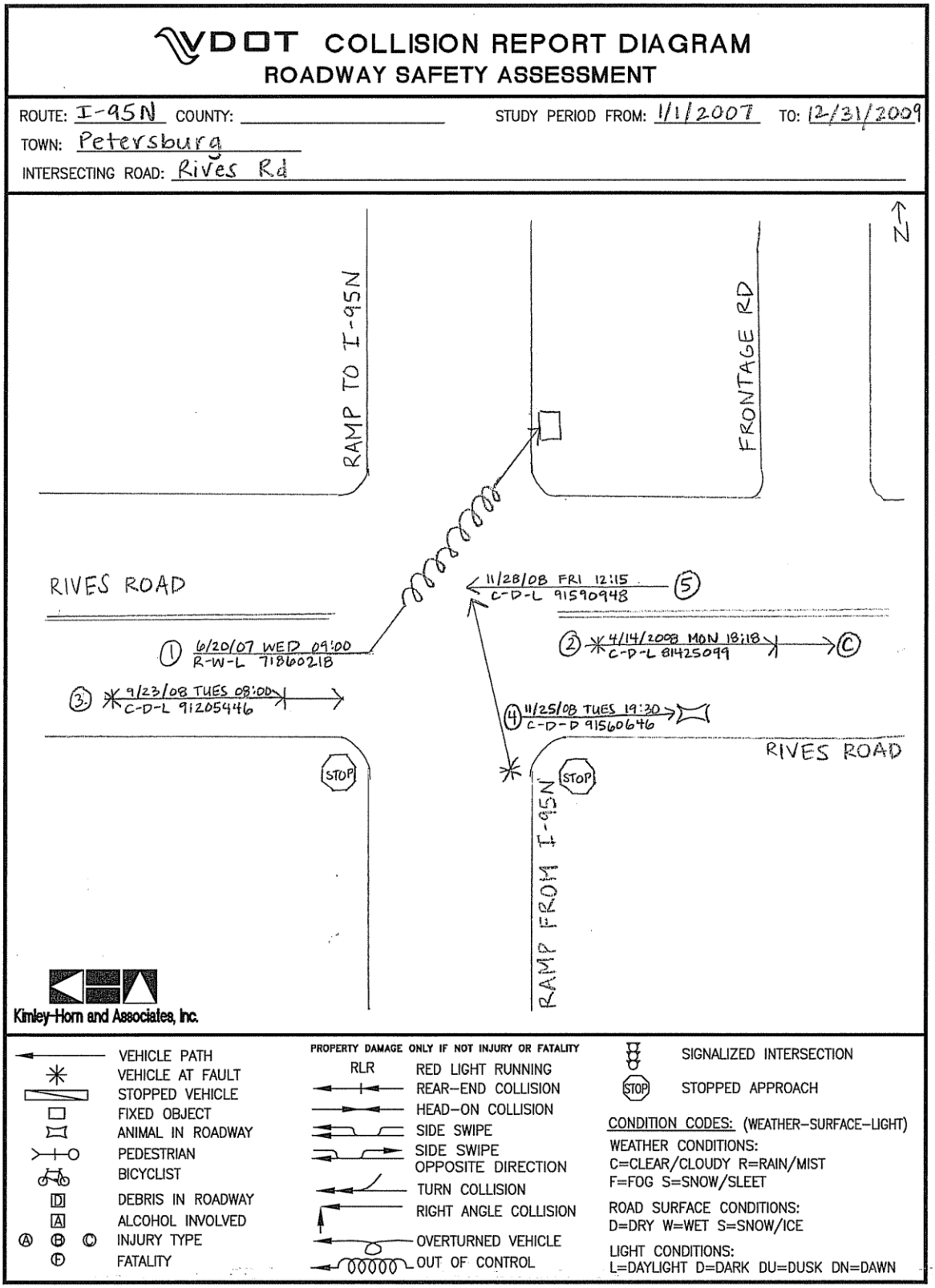
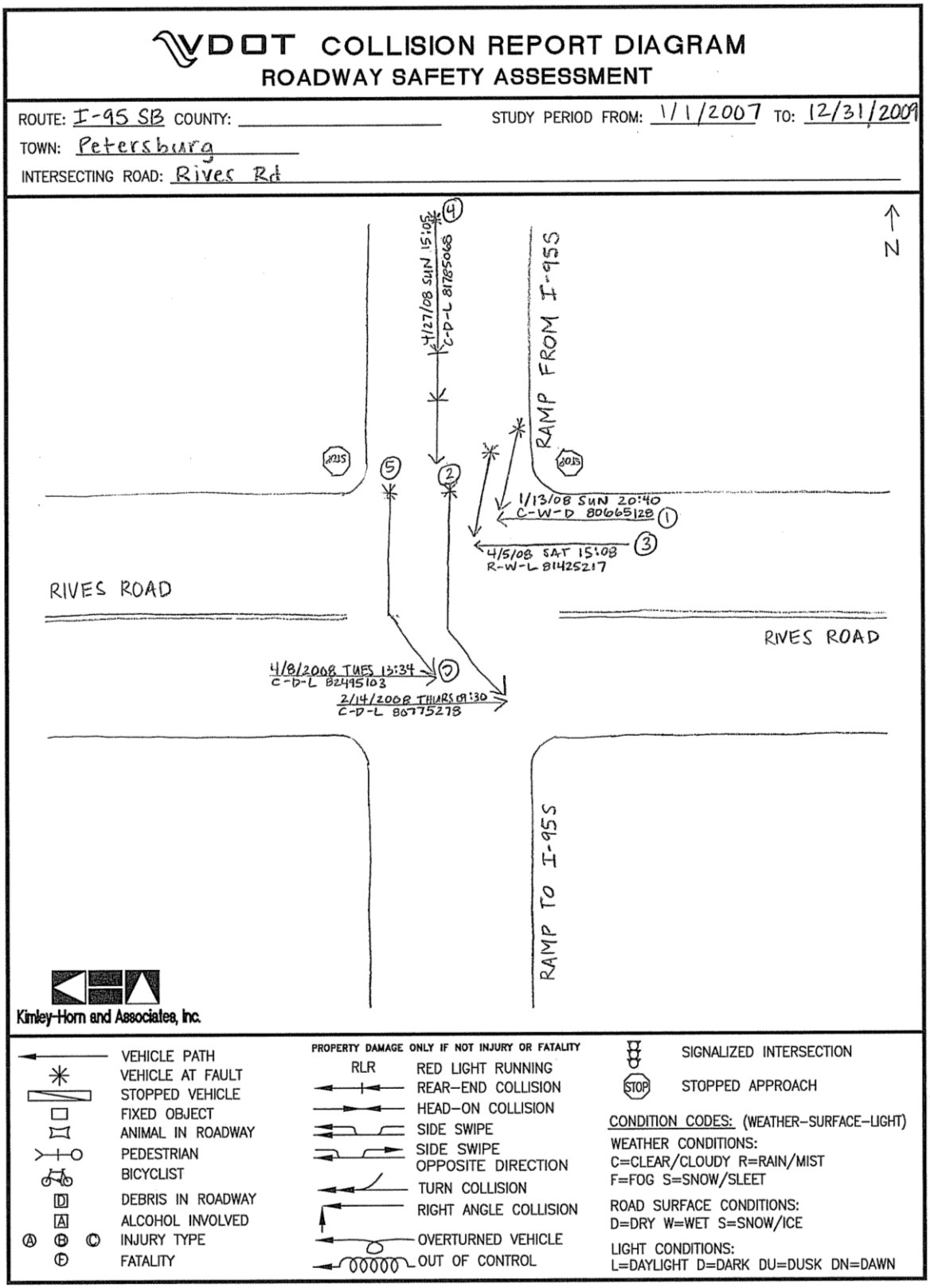


Figure 30: Collision Diagram - Rives Road and I-95 Southbound



- Rives Road is currently in the design phase to be widened from a two-lane undivided roadway to a four-lane undivided roadway from US 301 to the I-95 interchange. Findings of the Rives Road at I-95 Traffic Study conducted as part of the current widening project concluded that the following improvements addressed intersection delays and queues for the projected design year (2036) traffic volumes. The improvements below are being included in the Rives Road widening project currently in the design stage at the time of this study:
  - Construct southbound right-turn lane with 500' storage and a 200' taper at the intersection of Rives Road at I-95 southbound;
  - Construct northbound right-turn lane with 200' storage and 200' taper at the intersection of Rives Road at I-95 Northbound;
  - Junction boxes and conduit for a potential future signal at the intersection of Rives Road at I-95 Southbound will be constructed as part of the Rives Road widening; and
  - VDOT should monitor the intersections of Rives Road at I-95 southbound and Rives Road at I-95 northbound to determine when/if traffic signal warrants are met.

For analysis results of the aforementioned improvements, refer to the Rives Road at I-95 Traffic Study.

- Highway Capacity Software (HCS) was used to analyze the existing (2012) and future (2035) levels of service (LOS) for Rives Road on- and off-ramps during both the AM and PM peak time. The existing HCS analysis was conducted using the existing roadway network with Rives Road as a two-lane undivided roadway. Future year analysis was conducted assuming Rives Road has been widened to a four-lane roadway and right-turn lanes have been constructed on the northbound and southbound I-95 Ramps. Results of the HCS analysis are provided in **Table 19** below. All ramps operate at LOS B or better during both the existing and future years. HCS output sheets are provided in **Appendix D**.

Table 19: Rives Road at I-95 - Existing (2012) and Future (2035) HCS Results

Ramp		Existing (2012)				Future (2035)			
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
From	To	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
I-95 Southbound Off-Ramp	Rives Road	6.8	A	10.3	B	8.4	A	14.8	B
Rives Road	I-95 Southbound Off-Ramp	7.3	A	10.2	B	8.8	A	14.2	B
I-95 Northbound Off-Ramp	Rives Road	3.7	A	3.6	A	6.5	A	6.5	A
Rives Road	I-95 Northbound Off-Ramp	12.8	B	12.7	B	19.0	B	19.1	**B**

LOS = Level of Service
pc/mi/ln = passenger car/mile/lane

- Synchro was used to analyze the LOS at the unsignalized intersections of the northbound and southbound I-95 off-ramps and Rives Road given existing and future traffic volumes. The existing Synchro analysis was conducted using the existing roadway network with Rives Road as a two-lane undivided roadway. Future year analysis was conducted assuming Rives Road has been widened to a four-lane roadway and right-turn lanes have been constructed on the northbound and southbound I-95 Ramps. Results of the Synchro analysis are provided in the **Table 20** below. The one-lane approach ramps operate at LOS E or better under 2012 existing traffic volumes. Both ramps are projected to operate at LOS F during future (2035) traffic conditions. Synchro output sheets are provided in **Appendix D**.
- The HCS and Synchro operational analysis conducted as part of this study is supplemental to the traffic analysis conducted as part of the Rives Road widening project. The operational analysis conducted as part of this study was done using updated 2012 traffic volumes and 2035 traffic volumes developed using growth rates from the latest Richmond Regional travel demand model. Developing long-term solutions at

the I-95/Rives Road interchange were not included in the scope of this study; however, the results of the operational analysis indicate long-term improvements will be necessary should traffic in the area be realized as projected.

Table 20: Rives Road at I-95 - Existing (2012) and Future (2035) Synchro Results

Intersection	Intersection Control	Approach/ Intersection	Existing (2012)			Future (2035)		
			Delay (sec/veh)	LOS	95th Percentile Queue (feet)	Delay (sec/veh)	LOS	95th Percentile Queue (feet)
AM Peak Hour								
I-95 NB Ramp at Rives Road	Unsignalized	EBTL	4.6	A	16	9.5	A	56
		WBTR	0.0	A	0	0.0	A	0
		NBLTR	28.6	D	33			
		NBLT				247.3	F	175
		NBR*				-	-	-
		Intersection	**28.6**	**D**		**247.3**	**F**	
I-95 SB Ramp at Rives Road	Unsignalized	EBTR	0.0	A	0	0.0	A	0
		WBLT	0.8	A	1	0.8	A	1
		SBLTR	19.0	C	83			
		SBLT				24.1	C	142
		SBR*				-	-	-
		Intersection	**19.0**	**C**		**24.1**	**C**	
PM Peak Hour								
I-95 NB Ramp at Rives Road	Unsignalized	EBTL	3.4	A	12	7.8	A	40
		WBTR	0.0	A	0	0.0	A	0
		NBLTR	36.5	E	43			
		NBLT				369.7	F	199
		NBR*				-	-	-
		Intersection	**36.5**	**E**		**369.7**	**F**	
I-95 SB Ramp at Rives Road	Unsignalized	EBTR	0.0	A	0	0.0	A	0
		WBLT	0.8	A	1	0.9	A	2
		SBLTR	32.7	D	171			
		SBLT				43.5	E	325
		SBR*				-	-	-
		Intersection	**32.7**	**D**		**43.5**	**E**	

* No delay or queue reported

SAFETY ISSUES TO BE ADDRESSED

- The Rives Road interchange has been identified to have insufficient sight distance at the ramp intersections on Rives Road. Sight distance looking across the bridge over I-95 from either ramp is negatively impacted by the bridge abutments and poses as a safety issues. This issue will be furthered compounded with potential traffic growth through the study area.
- **Photograph 5** - **8** were taken at the stop bars of the northbound and southbound off-ramps to Rives Road show and show the reduced sight distance.

Photograph 5: I-95 Northbound Ramp at Rives Road – Looking to the West

Photograph 6: I-95 Northbound Ramp at Rives Road – Looking to the East

Photograph 7: I-95 Southbound Ramp at Rives Road – Looking to the East

Photograph 8: I-95 Southbound Ramp at Rives Road - Looking to the West

AREA OF INTEREST – I-95 SOUTHBOUND OFF-RAMP TO WASHINGTON STREET

EXISTING CONDITIONS

- The southbound I-95 off-ramp to Washington Street (Exit 52) is currently controlled by a stop sign. Washington Street is a one-way, four lane roadway at the intersection with the I-95 Southbound off-ramp. The ramp extends 750 feet before splitting into Washington Street (to the right) and Wythe Street (straight) exits. The Washington Street ramp extends an additional 700 feet before reaching a Stop sign.
- With current traffic patterns, traffic must stop at the end of the ramp, and there is no acceleration or merge lane available onto Washington Street. The angle for viewing the approaching (travelling westbound) traffic increases risk of crashes at this location.
- The adjacent section of I-95 Southbound has a posted speed limit of 55 mph, and Washington Street has a posted speed limit of 35 mph at the intersection.
- Washington Street has a functional classification as an urban principal arterial.
- Approximately 200 feet downstream of the southbound I-95 off-ramp is the unsignalized intersection of Washington Street and Madison Street. The next intersection to the west is Jefferson Street and it is spaced approximately 1,000 feet from the ramp. Based on Appendix F of the VDOT Road Design Manual,

the Madison Street intersection is located too close to the ramp by approximately 550' to comply with VDOT Access Management Regulations.

- Crash data was obtained from VDOT for the I-95 SB off-ramp and Washington Street intersection. Based on the available data, there were several crashes that occurred in the vicinity of the intersection. The two main factors determined from the crash reports were that the crashes were related to a lane change movement or were a rear end crash on the ramp.
- A 24-hour traffic count was conducted on March 28, 2012 on the I-95 Southbound off-ramp to Washington Street and on Washington Street just east of the I-95 Southbound off-ramp. The AM and PM peak hour volumes collected at the interchange are summarized in **Figure 31**.
- During a field visit on March 27, 2012, a 15-minute traffic count was conducted to determine lane utilization as a percent of total ramp volume. The number of vehicles in each lane on Washington Street that originated from the southbound I-95 off-ramp were counted to also determine lane utilization as a percent of total mainline volume. The peak hour lane utilization volumes were derived using these percentages and are illustrated in **Figure 32**.

Photograph 9: Southbound I-95 Off-Ramp to Washington Street

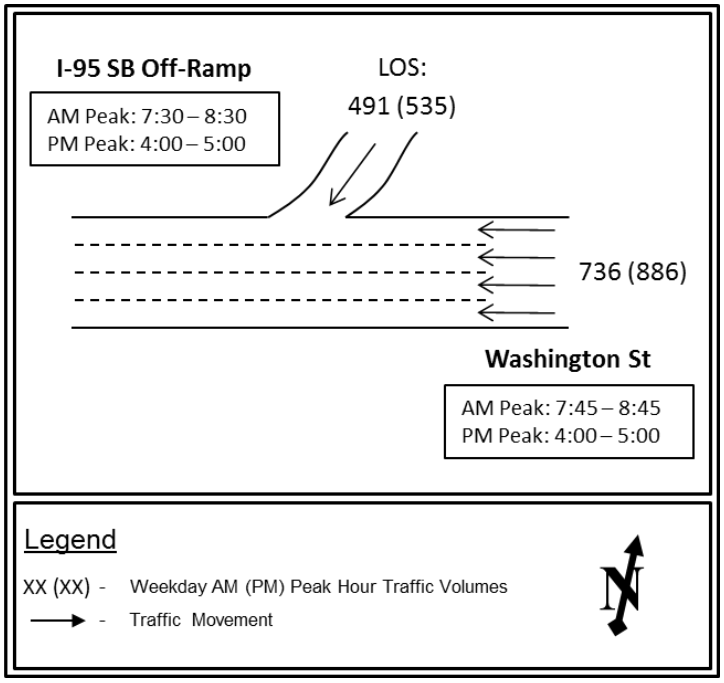
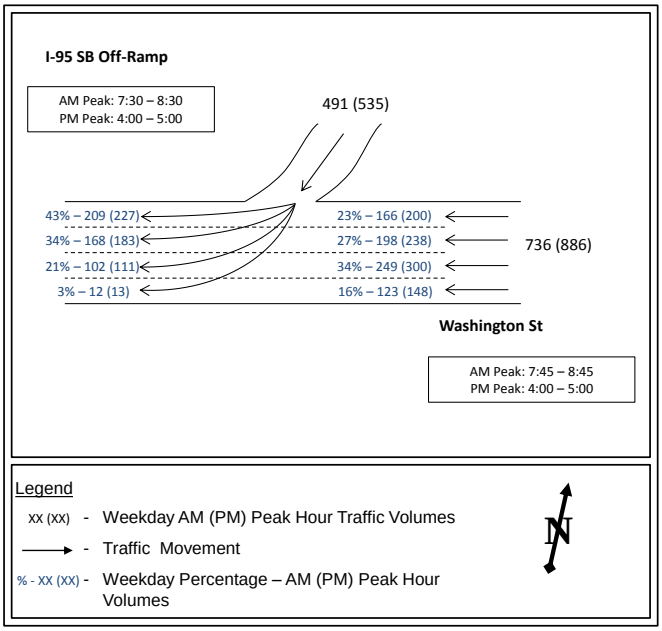


Figure 31: Southbound I-95 Off-Ramp to Washington Street - Peak Hour Volumes

Figure 32: Southbound I-95 Off-Ramp to Washington Street - Volumes by Lane



SAFETY ISSUES TO BE ADDRESSED

- The southbound I-95 ramp has been identified as a lane utilization issue for vehicles travelling west on Washington Street and vehicles merging onto Washington Street from the southbound I-95 ramp.
- There were several reported crashes related to lane maneuvers. Rear end crashes were also reported on the off-ramp approach to Washington Street.
- Due to the conflicts created from this merging condition, queues from the ramp routinely impact southbound I-95 during the PM peak hours.
- Queuing of vehicles on the southbound I-95 off-ramp to Washington Street was not observed during the field review but was cited as an issue by members of the RSA team.
- Queuing on an interstate, where vehicles are traveling at high speeds and drivers are not expecting to stop, is a major safety concern.

PROPOSED RECOMMENDATIONS

Short Term Recommendations

- Allow for a free-flow movement from the southbound I-95 off-ramp onto Washington Street
  - Reduce queuing on the ramp, reduce impacts to the I-95 travel way
  - Reduce the number of lanes prior to the southbound I-95 off-ramp from four lanes to three lanes through the use of pavement markings across the overpass
  - Washington Street will operate adequately with 3 travel lanes
- Close Madison Street and private driveways between the ramp and intersection, and eliminate the right-turn movements from Washington Street.
  - Improve corridor access management
  - Reduce the weaving movements that were caused specifically by vehicles turning right on Madison Street

Figure 33 shows a graphical depiction of the short-term recommendation described above.

Figure 33: Washington Street - Short-Term Recommendation

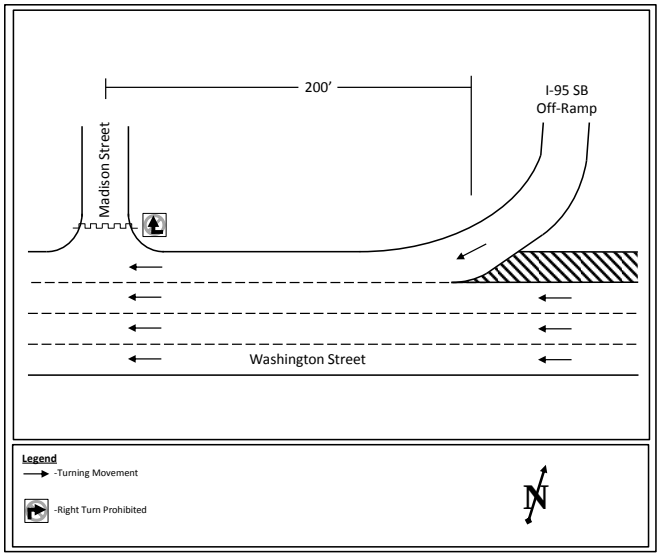
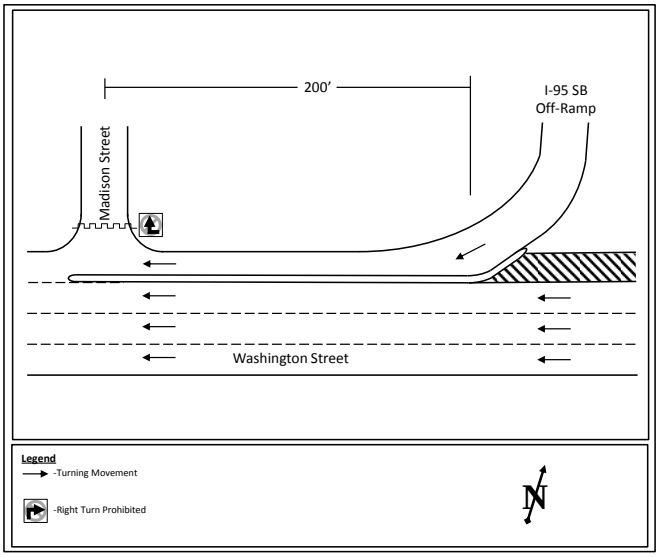


Figure 34: Washington Street - Long-Term Recommendation



Long-Term Recommendations

- Monitor traffic patterns and weave issues on Washington Street, upstream and downstream of the intersection. Should it be determined that a weaving and safety issue still exists by the lane changes between the ramp and Jefferson Street, then an additional analysis should be completed.
- A possible solution for this issue would be to install traffic barrier to separate the ramp free-flow lane from Washington Street through traffic. A barrier would shift the weaving area further to the west and away from the ramp. Note that this would only become a feasible recommendation once a study determined that operations and safety between the ramp and Jefferson Street achieved acceptable levels.

A possible configuration for the long-term recommendation is shown in Figure 34.

AREA OF INTEREST – I-85 NORTHBOUND OFF-RAMP TO I-95 SOUTHBOUND

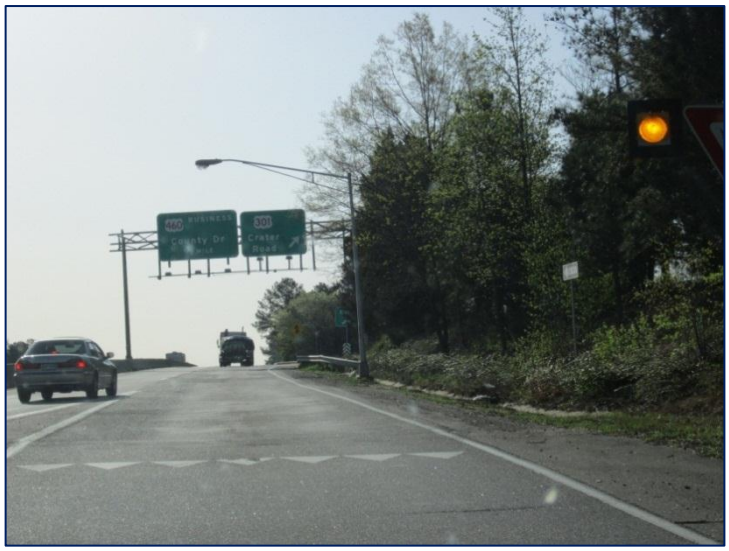
The yield condition on the I-85 northbound off-ramp to I-95 southbound creates a safety issue due to the short weaving segment, steep uphill grade, and percent of heavy vehicles making this movement.

EXISTING CONDITIONS

- Vehicles traveling from I-85 northbound to I-95 southbound are on a steep grade and must merge across the vehicles on the collector-distributor road exiting to Graham Road. The length of this weaving segment is 250 feet.
- A total of 12 crashes occurred on the northbound I-85 to southbound I-95 off-ramp from 1/1/2007 to 12/31/2009, specifically:
  - Rear – end (9)
  - Non – collision (1)
  - Fixed object – off road (1)
  - Sideswipe – same direction (1)
- The number of crashes on this off-ramp has remained consistent based on a review of the I-85/I-95/Route 460 Interchange Study. From 1996 to 1998 a total of 10 crashes occurred on this ramp with the following broken down by crash type:
  - Rear – end (2)

- Fixed object – off road (7)
- Sideswipe – same direction (1)

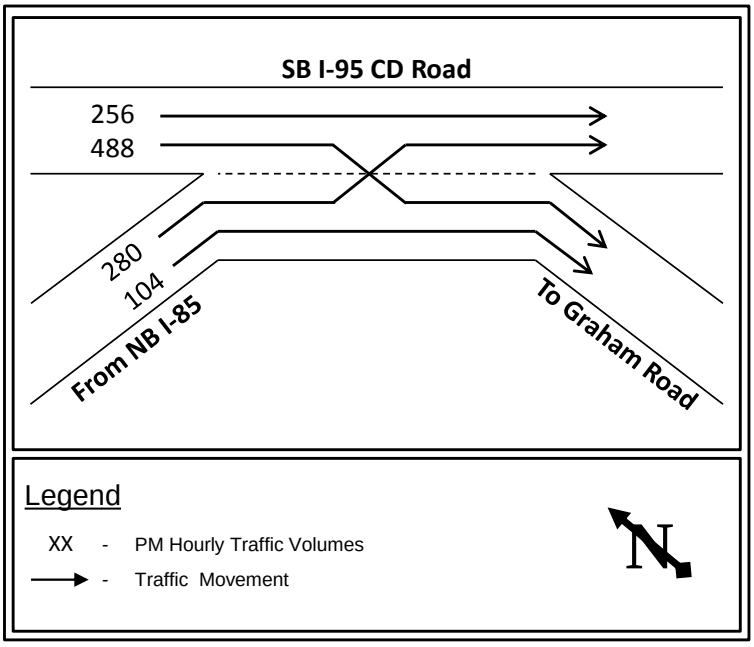
- A yield sign with continuous flashing beacons exists on the right shoulder of the I-85 off-ramp; however, it was observed that vehicles merging from the I-85 off-ramp onto the I-95 CD road frequently failed to yield. VDOT installed the yield pavement markings (shark's teeth) as a short-term countermeasure; however the safety concern still exists.



Photograph 10: Northbound I-85 to Southbound I-95 Weave

- During the preliminary field review, video was recorded of the weave segment to determine the origin and destination of vehicles. The video was recorded for a 7.5 minute period and the observed volumes were multiplied by eight to get the hourly volumes shown in **Figure 35**.

Figure 35: I-95 SB/I-85 NB Weave – PM Peak Hour Traffic Volumes



SAFETY ISSUES TO BE ADDRESSED

- Ten crashes were reported at the I-85 northbound/I-95 southbound weave segment during the period from 1/1/2007 to 12/31/2009. Of these ten crashes, eight were rear-end crashes, one was a fixed object-off road crash, and one was a sideswipe-opposite direction.

PROPOSED RECOMMENDATIONS

Short Term Recommendation

- Increase existing Yield Sign (R1-2) size to 60”x60”x60” to improve visibility of traffic control device.

Long-Term Recommendation

- Reconfigure the I-95/I-85/Route 460 interchange to mitigate the deficient weaving movement at this location. A possible solution is provided in subsequent section of this study.

ADDITIONAL SHORT-TERM IMPROVEMENTS AND LONG-TERM CONCEPTS

The focus of this study was to conduct a roadway safety assessment; however, parallel VDOT efforts were conducted during the course of this study in anticipation of future efforts to identify additional short-term improvements and long-term concepts in the I-95/I-85/Route 460 interchange area. Drawing from the previous 2000 study and the Tri-Cities MPO Constrained Long-Range Plan (CLRP) one short-term improvement and three long-term concepts were developed. The long-term concepts were included in this study to document the order of magnitude of projects required to meet future operational and safety needs in the area of the I-95/I-85/Route 460 interchange. These concepts will provide a jumping off point for future efforts to further identify and refine long-term concepts in the area. This section of the report documents the methodology and recommendations from VDOT’s in-house planning efforts.

FUTURE TRAFFIC VOLUMES

For the purpose of developing future traffic for 2035 for the I-95/I-85 Interchange Study, VDOT staff reviewed available travel demand modeling and Statewide Planning System (SPS) data for principal study mainline and cross street locations. Traffic volumes were taken from the most recent Richmond/Tri-Cities travel demand model based on the 2035 MPO CLRP effort for both the Richmond and Tri-Cities MPOs. SPS is an oracle database tool which VDOT uses to develop planning level traffic forecasts based on historical trend line analysis for roadways throughout Virginia. SPS results for this effort included all available VDOT Traffic Monitoring System (TMS) traffic counts through 2011.

VDOT staff conducted a review of traffic forecasts for the I-95/I-85/Route 460 interchange area using both SPS and the Richmond/Tri-Cities travel demand model. The purpose of this review was to create a comparison between the 2000 I-95/I-85/Route 460 Interchange study forecasts with those now available from the latest data and model. The 2000 study had a base year of 2000 and a forecast year of 2020. The new model has a base year of 2008 and a forecast year of 2035. SPS was used to document existing traffic for 2008 and the travel demand model was used to develop growth rates from 2008 to 2035. These growth rates were then used to develop traffic forecasts for both 2020 and 2035 based on 2008 existing traffic.

In addition to the forecasts developed for the I-95/I-85/Route 460 interchange area, growth rates were developed for the Rives Road Interchange area using the Richmond/Tri-Cities Travel Demand Model in order to review potential future capacity concerns at this interchange. The growth rates were developed based on 2008 to 2035 projected growth and rounded to the nearest tenth of a percentage point. Future traffic volumes for 2035 were

then developed using these growth rates and are shown in **Figure 36**. Future 2035 traffic volumes are projected to reach over 100,000 ADT on I-95 and 89,000 ADT on I-85 in the area of the I-95/I-85/Route 460 interchange. The projected future traffic volumes coupled with the documented roadway deficiencies and safety issues further indicate the need for long-term improvements to be identified and implemented within the study area.

CRITICAL RAMP MOVEMENTS

I-85, I-95, Route 460, and US 301 converge in the City of Petersburg, Virginia in a complex series of interchanges. Within a two-mile length, I-95 intersects with four separate roadways through a network of ramps and collector-distributor roads, many of which are deficient by today's standards. First developed in the late 1950's as part of the Richmond-Petersburg Turnpike, many ramps and weaving areas of the I-85/95/Route 460 interchange do not have the capacity adequately support today's traffic volumes. The I-95/I-85/Route 460 Interchange Study conducted in 2000 documented in detail the traffic safety and operations concerns for the corridor and should traffic volumes continue to grow the issues will intensify.

The following three ramp movements along the I-95/I-85/Route 460 study corridor were identified as critical based on the following roadway geometrics and operational movements and are illustrated on **Figure 37**.

A. Short weave/merge (250 feet) at I-85 northbound to I-95 southbound movement at Graham Road
B. Short weave/merge (360 feet) from S. Crater Rd to I-95 northbound
C. Tight turning radius and low bridge clearance at I-95 northbound to I-85 southbound ramp movement

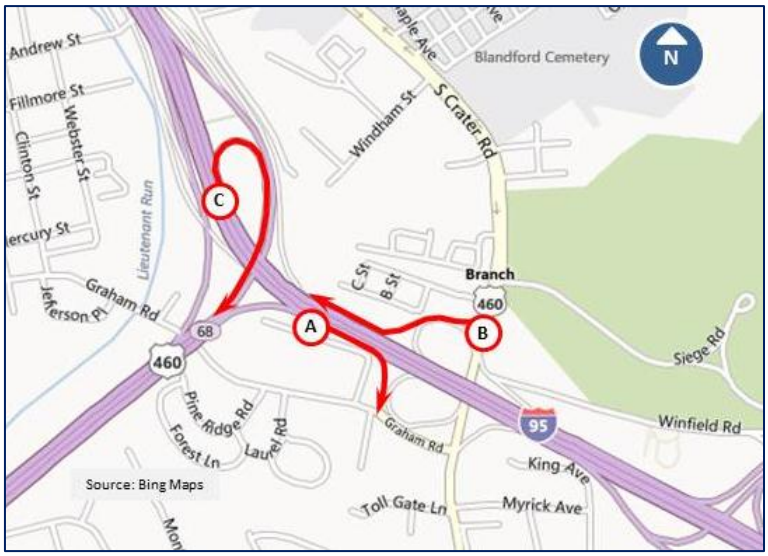


Figure 37: Critical Ramp Movements

DESCRIPTION OF ADDITIONAL IMPROVEMENTS AND CONCEPTS

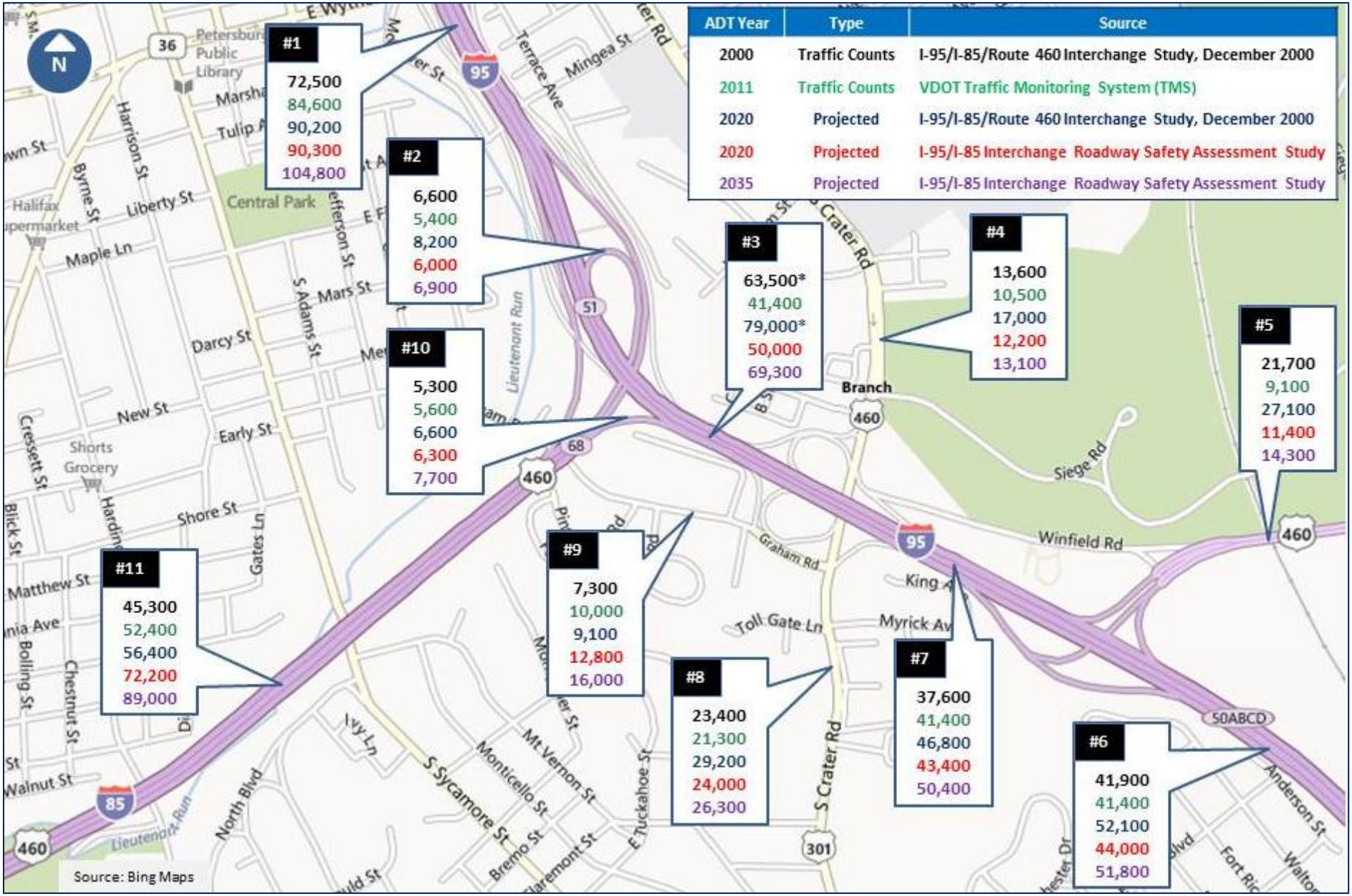
SHORT-TERM IMPROVEMENTS

Short-Term Improvement #1 – Wagner Road Alternate Route Feasibility Study

The previous I-95/I-85/Route 460 Interchange Study from 2000 recommended that a study be conducted to determine the feasibility of designating Wager Road or I-295 as alternate roadways to alleviate traffic congestion through the I-95/I-85/Route 46 interchange. The feasibility study should consider the following:

- Determine if the geometric configuration of Wagner Road warrants an increase to the speed limit currently posted at 40 mph.
- Determine if increasing the speed limit on Wagner Road between I-95 and Route 460 would increase/impact the projected diverted traffic volume.
- Determine the required signing improvements to reroute the through traffic on Route 460 to Wager Road or I-295.

Figure 36: Traffic Comparison for I-95/I-85/Route 460 Interchange Area



The City of Petersburg is responsible for operating and maintaining the section of Wagner Road from I-95 to Route 460 recommended for review in the feasibility study. The City does not currently maintain any roadways with speed limits higher than 40 mph. Should a speed limit higher than 40 mph be recommended for Wagner Road, the City would be required to purchase, or secure the use of, a maintenance vehicle equipped with a truck-mounted attenuator to continue the operation and maintenance of such a roadway under the requirements of the current VDOT Work Area Protection Manual.

LONG-TERM CONCEPTS

Potential long-term concepts that could address the current safety and operational issues associated with the three critical ramp movements are summarized below and illustrated graphically on **Figure 38**.

Long-Term Concept #1 - I-85 Northbound to I-95 Southbound Ramp Movement

1. Close the existing I-95 southbound off-ramp to Graham Road.
2. Close the existing I-95 southbound on-ramp from S. Crater Road.
3. Improve intersection of Graham Road and S. Crater Road and the on-ramp to southbound I-95 to allow southbound left-turn movement from S. Crater Road.
4. Construct new I-95 off-ramp to S. Crater Road. Preliminary engineering (30% plans) would need to be conducted to determine environmental feasibility.

Long-Term Concept #2 - S. Crater Road to I-95 Northbound Ramp Movement

1. Close the existing I-95 northbound on-ramp from S. Crater Road and reusing the existing Winfield Road to move northbound on-ramp connection to County Drive.
2. Improve two intersections, one at the intersection of Winfield Road and County Drive and the other at the intersection of Winfield Road and S. Crater Road to facilitate new traffic movements.

Long-Term Concept #3 - I-95 Northbound to I-85 Southbound Ramp Movement

1. Close the existing I-95 northbound off-ramp to I-85 southbound and construct a new flyover ramp from I-95 northbound to I-85 southbound.

PLANNING LEVEL COST ESTIMATES

Planning level cost estimates were developed for the following short-term improvements and long-term concepts:

- Short-term area of interest improvement at I-95 southbound off-ramp at Washington Street
- Additional short-term improvement - Wagner Road Alternate Route Feasibility Study
- Three long-term concepts to address critical ramp movements at the I-95/I-85/Route 460 interchange

The long-term concepts were developed to understand the order of magnitude required to fund larger scaled projects throughout the I-95/I-85/Route 460 study area. VDOT staff used a combination of the Statewide Planning Level Cost Estimates and the Project Cost Estimating System (PCES) as the primary tool for estimating project costs for the long-term concepts. PCES is the project cost estimation tool used in Virginia for project cost development and accounts for the full range of potential project costs including preliminary engineering (PE), right of way (ROW), construction (CN), utilities, signing, bridge, and other miscellaneous project costs. Planning level cost estimates were developed in context to the level of detail available in this study. Projected costs were rounded to the nearest $10,000 and are summarized in **Table 21**. Estimated project costs ranged from $310,000 to $55,790,000 with a total of $67,040,000 needed for both the short- and long-term projects. These planning level cost estimates are intended for use by VDOT, project stakeholders, and local officials to pursue funding allocations for additional study of the improvements. Stakeholders should considering a phased approach to programming the long-term concepts.

Figure 38: I-95/I-85/Route 460 Long-Term Concepts

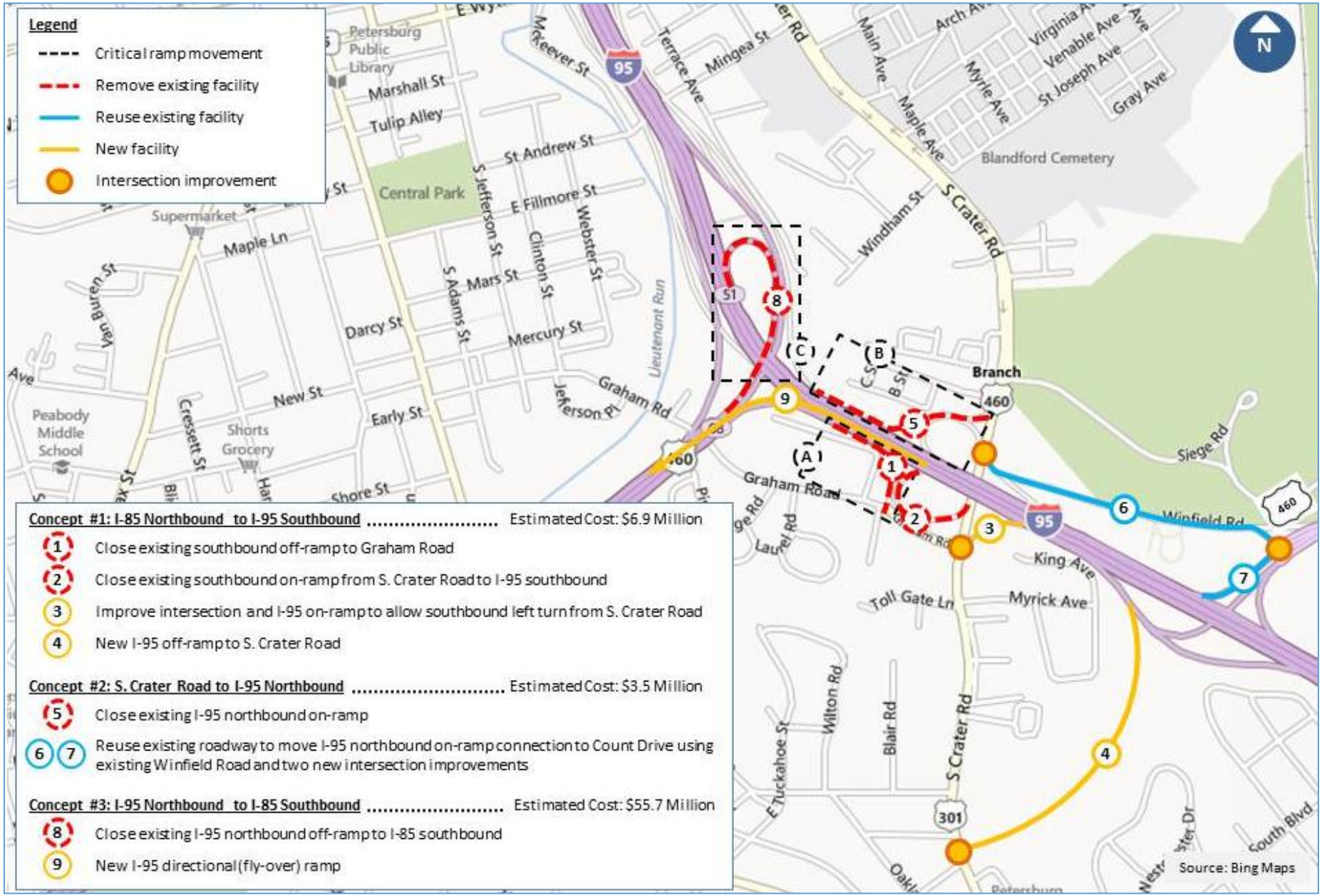


Table 21: Planning Level Cost Estimates

No.	Location	Planning Level Cost Estimate (000s)			
		PE	ROW	CN	Total
Short-Term Improvements					
1	Wagner Road Alternate Route Feasibility Study	$ 80	$ -	$ 230	$ 310
2	I-95 Southbound Off-Ramp at Washington Street	$ 120	$ -	$ 350	$ 470
Long-Term Concepts					
1	I-85 Northbound to I-95 Southbound Ramp Movement	$ 1,240	$ 2,100	$ 3,590	$ 6,930
2	S. Crater Road to I-95 Northbound Ramp Movement	$ 880	$ -	$ 2,660	$ 3,540
3	I-95 Northbound to I-85 Southbound Ramp Movement	$ 13,920	$ 50	$ 41,820	$ 55,790
				Total =	**$ 67,040**

Notes: All costs are in Year 2019 dollars

NEED FOR CONTINUED STUDY

There are a number of past, present, and future infrastructure projects and studies within the I-95/I-85/Route 460 study area. Specific efforts are listed below. As these efforts become real projects, it will be critical that VDOT continue to identify and refine short- and long-term solutions needed in the I-95/I-85 corridor to assure mobility throughout this growing and changing area.

- Final Report: I-85/95/Route 460 Interchange Study, 2000
- Temple Avenue Interchange Modification Report (VDOT UPC 85623)
- Rives Road Widening project (VDOT UPC 15832)
- Growth and impacts at Fort Lee (on-going Fort Lee Joint Land Use Study (JLUS))
- Route 460 Corridor Improvements Project Public-Private Partnership (PPTA) project

RECOMMENDED NEXT STEPS

The I-95/I-85 Interchange Roadway Safety Assessment Study should be used as a planning tool to achieve the next steps of planning, programming, designing, and constructing the identified safety and operational improvements in the study corridor. Specific steps include:

1. VDOT should update the previous I-85/I-95/Route 460 Interchange Study and extend the study corridor and scope to include additional operational analysis. Identify projects from this updated study to prioritize and program regional needs. An example next step could be an interchange modification report (IMR) to advance an interchange project (some metropolitan planning organizations (MPOs) have been successful advancing IMR studies using Regional Surface Transportation Program (RSTP) funds).
2. VDOT should continue to study and refine the operational and environmental impacts of the recommended long-term concepts. This analysis should include investigating the possibility of a phased approach to programming the long-term concepts by developing a subset of smaller projects with independent utility. This process should continue to involve the technical expertise of a study work group to evaluate alternatives while building consensus at the federal, state, and local levels.
3. VDOT should advance the recommended short-term improvement projects identified in this study to the preliminary engineering design stage, so a cost estimate and schedule can be developed. If necessary, supplemental environmental and traffic engineering studies should be conducted to move these projects along the project development process.
4. VDOT should continue to coordinate with the Tri-Cities Metropolitan Planning Organization (MPO), Crater Planning District Commission (CPDC), City of Petersburg, and within VDOT to cooperatively work towards the programming short-term projects and long-term concepts.

APPENDIX

APPENDIX A: TRAFFIC COUNT DATA

Malone & Associates Inc.
CLASSIFICATION SUMMARY
Wed 3/28/2012

Site Ref: Site 1
Site ID: 000000003730
Loc: I-95 SB Off to Rives Rd.
Direction: SOUTH
Lane: 1

File: D0328002.prn
Info: 12-051 TO/RS Max
GPS: 37.17777 77.35262

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
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Site ID: 000000003730
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Direction: SOUTH
Lane: 1

File: D0328002.prn
Info: 12-051 TO/RS Max
GPS: 37.17777 77.35262

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Site ID: 000000003730
Loc: I-95 SB Off to Rives Rd.
Direction: SOUTH
Lane: 1

File: D0328002.prn
Info: 12-051 TO/RS Max
GPS: 37.17777 77.35262

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
17:15	0	69	12	0	1	0	0	0	0	0	0	0	0	0	0	82
17:30	0	79	22	0	0	1	0	0	0	0	0	0	0	0	0	102
17:45	1	81	16	0	1	0	0	0	0	0	0	0	0	0	0	99
18:00	0	61	17	0	1	0	0	0	1	0	0	0	0	0	0	80
Hour Total	1	290	67	0	3	1	0	0	1	0	0	0	0	0	0	363
18:15	0	53	7	0	0	1	0	0	0	0	0	0	0	0	0	61
18:30	1	54	7	0	0	0	0	0	0	0	0	0	0	0	0	62
18:45	1	33	11	0	0	0	0	0	0	0	0	0	0	0	0	45
19:00	0	54	8	0	0	0	0	0	0	0	0	0	0	0	0	62
Hour Total	2	194	33	0	0	1	0	0	0	0	0	0	0	0	0	230
19:15	0	44	15	0	0	0	0	0	0	0	0	0	0	0	0	59
19:30	0	41	8	0	0	0	0	0	0	0	0	0	0	0	0	49
19:45	0	53	6	0	0	0	0	0	1	0	0	0	0	0	0	60
20:00	0	44	8	0	0	0	0	0	0	0	0	0	0	0	0	52
Hour Total	0	182	37	0	0	0	0	0	1	0	0	0	0	0	0	220
20:15	0	41	6	0	1	0	0	0	0	0	0	0	0	0	0	48
20:30	0	31	4	0	0	0	0	0	0	0	0	0	0	0	0	35
20:45	0	49	5	0	0	0	0	0	0	0	0	0	0	0	0	54
21:00	0	46	13	0	0	0	0	0	0	0	0	0	0	0	0	59
Hour Total	0	167	28	0	1	0	0	0	0	0	0	0	0	0	0	196
21:15	0	26	3	0	0	0	0	0	0	0	0	0	0	0	0	29
21:30	0	14	3	0	0	0	0	0	0	0	0	0	0	0	0	17
21:45	0	30	3	0	0	0	0	0	0	0	0	0	0	0	0	33
22:00	0	14	4	0	0	0	0	0	0	0	0	0	0	0	0	18
Hour Total	0	84	13	0	0	0	0	0	0	0	0	0	0	0	0	97
22:15	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	19
22:30	0	22	2	0	0	0	0	0	0	0	0	0	0	0	0	24
22:45	0	6	0	0	0	0	0	1	0	0	0	0	0	0	0	7
23:00	0	11	4	0	0	0	0	0	0	0	0	0	0	0	0	15
Hour Total	0	58	6	0	0	0	0	1	0	0	0	0	0	0	0	65
23:15	0	16	4	0	0	0	0	0	0	0	0	0	0	0	0	20
23:30	0	11	1	0	0	0	0	0	0	0	0	0	0	0	0	12
23:45	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	10
24:00	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	9
Hour Total	0	44	7	0	0	0	0	0	0	0	0	0	0	0	0	51
DAY TOTAL	14	2862	710	3	33	14	4	14	59	9	0	0	1	0	0	3723
PERCENTS	0.4%	76.9%	19.1%	0.1%	0.9%	0.4%	0.2%	0.3%	1.5%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Passenger Vehicles 96.3% Trucks & Buses 3.6%

AM Times	11:00	07:30	07:30	04:00	07:45	09:45	10:15	07:45	10:15	08:15						07:30
AM Peaks	3	229	51	1	4	2	2	2	9	3						292
PM Times	16:00	17:00	15:15		14:00	14:30		14:15	12:15				12:15			17:00
PM Peaks	2	295	75		8	3		3	4				1			369

GRAND TOTAL	14	2862	710	3	33	14	4	14	59	9	0	0	1	0	0	3723
PERCENTS	0.4%	76.9%	19.1%	0.1%	0.9%	0.4%	0.2%	0.3%	1.5%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Site Ref: Site 2
Site ID: 000000003560
Loc: I-95 NB On from Rives Rd.
Direction: NORTH
Lane: 1

File: D0328005.prn
Info: 12-051 TO/RS Max
GPS: 37.17704 77.35158

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
00:15	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
00:30	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
00:45	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hour Total	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	14
01:15	0	8	1	0	0	0	0	1	0	0	0	0	0	0	0	10
01:30	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
01:45	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	9
02:00	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hour Total	0	23	3	0	0	0	0	1	0	0	0	0	0	0	0	27
02:15	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	5
02:30	0	6	0	0	1	0	0	0	1	0	0	0	0	0	0	8
02:45	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hour Total	0	14	1	0	1	0	0	0	1	0	0	0	0	0	0	17
03:15	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
03:30	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
03:45	0	5	0	0	0	0	0	1	1	0	0	0	0	0	0	7
04:00	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	12
Hour Total	0	25	2	0	0	0	0	1	1	0	0	0	0	0	0	29
04:15	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0	10
04:30	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	7
04:45	0	11	2	0	0	0	0	0	1	0	0	0	0	0	0	14
05:00	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	9
Hour Total	0	33	6	0	0	0	0	0	1	0	0	0	0	0	0	40
05:15	0	8	6	0	0	0	0	0	2	0	0	0	0	0	0	16
05:30	0	11	2	0	1	0	0	0	0	0	0	0	0	0	0	14
05:45	0	25	4	0	0	0	0	0	0	0	0	0	0	0	0	29
06:00	0	24	5	0	0	1	0	0	0	0	0	0	0	0	0	30
Hour Total	0	68	17	0	1	1	0	0	2	0	0	0	0	0	0	89
06:15	0	26	4	0	0	0	0	0	1	0	0	0	0	0	0	31
06:30	0	41	10	0	0	0	0	0	0	0	0	0	0	0	0	51
06:45	0	41	13	0	0	0	0	0	0	0	0	0	0	0	0	54
07:00	0	38	14	0	1	0	0	0	0	0	0	0	0	0	0	53
Hour Total	0	146	41	0	1	0	0	0	1	0	0	0	0	0	0	189
07:15	0	76	8	0	0	0	0	0	0	0	0	0	0	0	0	84
07:30	0	60	14	1	0	0	0	1	2	0	0	0	0	0	0	78
07:45	0	72	14	0	0	0	0	1	0	0	0	0	0	0	0	87
08:00	0	64	19	1	0	0	0	0	4	0	0	0	0	0	0	88
Hour Total	0	272	55	2	0	0	0	2	6	0	0	0	0	0	0	337
08:15	1	57	12	1	0	0	0	1	0	0	0	0	0	0	0	72
08:30	0	51	9	1	2	0	0	0	2	0	0	0	0	0	0	65
08:45	0	49	16	0	0	0	0	0	2	0	0	0	0	0	0	67
09:00	0	58	10	0	1	0	0	0	1	0	0	0	0	0	0	70

Site Ref: Site 2
Site ID: 000000003560
Loc: I-95 NB On from Rives Rd.
Direction: NORTH
Lane: 1

File: D0328005.prn
Info: 12-051 TO/RS Max
GPS: 37.17704 77.35158

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Hour Total	1	215	47	2	3	0	0	1	5	0	0	0	0	0	0	274
09:15	0	27	10	0	2	0	0	0	0	0	0	0	0	0	0	39
09:30	0	39	8	0	0	0	0	0	0	0	0	0	0	0	0	47
09:45	0	33	9	0	1	0	0	0	4	0	0	0	0	0	0	47
10:00	0	41	5	1	0	0	0	0	0	0	0	0	0	0	0	47
Hour Total	0	140	32	1	3	0	0	0	4	0	0	0	0	0	0	180
10:15	0	34	6	0	0	0	0	0	0	0	0	0	0	0	0	40
10:30	0	31	14	0	0	0	0	0	2	0	0	0	0	0	0	47
10:45	0	33	5	0	0	1	0	0	2	0	0	0	0	0	0	41
11:00	0	30	8	0	0	0	0	0	1	0	0	0	0	0	0	39
Hour Total	0	128	33	0	0	1	0	0	5	0	0	0	0	0	0	167
11:15	0	36	9	0	1	0	0	0	2	0	0	0	0	0	0	48
11:30	0	25	7	2	1	0	0	0	2	0	0	0	0	0	0	37
11:45	0	27	8	0	0	0	0	0	0	0	0	0	0	0	0	35
12:00	0	25	9	0	1	1	0	0	0	0	0	0	0	0	0	36
Hour Total	0	113	33	2	3	1	0	0	4	0	0	0	0	0	0	156
12:15	0	25	7	0	0	1	0	0	1	0	0	0	0	0	0	34
12:30	1	24	4	0	0	0	0	0	1	0	0	0	0	0	0	30
12:45	0	31	6	0	0	1	0	0	3	0	0	0	0	0	0	41
13:00	1	26	10	0	0	0	0	1	1	0	0	0	0	0	0	39
Hour Total	2	106	27	0	0	2	0	1	6	0	0	0	0	0	0	144
13:15	0	25	6	0	0	2	0	0	1	0	0	0	0	0	0	34
13:30	0	39	13	0	2	0	0	1	2	0	0	0	0	0	0	57
13:45	1	33	8	0	1	0	0	0	2	0	0	0	0	0	0	45
14:00	0	36	13	0	0	0	0	0	1	0	0	0	0	0	0	50
Hour Total	1	133	40	0	3	2	0	1	6	0	0	0	0	0	0	186
14:15	0	32	7	0	1	1	0	0	0	0	0	0	0	0	0	41
14:30	0	48	11	0	0	0	0	0	1	0	0	0	0	0	0	60
14:45	2	44	7	0	2	0	0	0	0	0	0	0	0	0	0	55
15:00	0	36	14	0	0	1	0	1	1	0	0	0	0	0	0	53
Hour Total	2	160	39	0	3	2	0	1	2	0	0	0	0	0	0	209
15:15	0	39	16	0	0	0	0	2	0	0	0	0	0	0	0	57
15:30	1	50	15	0	0	0	0	0	0	0	0	0	0	0	0	66
15:45	0	70	14	0	0	0	0	1	0	0	0	0	0	0	0	85
16:00	0	52	13	0	0	1	0	0	0	0	0	0	0	0	0	66
Hour Total	1	211	58	0	0	1	0	3	0	0	0	0	0	0	0	274
16:15	0	56	16	0	0	0	0	0	1	0	0	0	0	0	0	73
16:30	0	58	12	0	1	0	0	0	1	0	0	0	0	0	0	72
16:45	0	70	16	0	0	0	0	0	0	0	0	0	0	0	0	86
17:00	2	68	12	0	1	0	0	0	1	0	0	0	0	0	0	84
Hour Total	2	252	56	0	2	0	0	0	3	0	0	0	0	0	0	315

Site Ref: Site 2
Site ID: 000000003560
Loc: I-95 NB On from Rives Rd.
Direction: NORTH
Lane: 1

File: D0328005.prn
Info: 12-051 TO/RS Max
GPS: 37.17704 77.35158

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
17:15	0	83	8	0	0	0	0	0	0	0	0	0	0	0	0	91
17:30	0	64	13	0	0	0	0	0	0	0	0	0	0	0	0	77
17:45	0	46	8	0	0	0	0	0	1	0	0	0	0	0	0	55
18:00	0	38	10	0	0	0	0	0	1	0	0	0	0	0	0	49
Hour Total	0	231	39	0	0	0	0	0	2	0	0	0	0	0	0	272
18:15	1	47	6	0	1	0	0	0	0	0	0	0	0	0	0	55
18:30	0	50	8	0	2	0	0	0	2	0	0	0	0	0	0	62
18:45	1	34	6	0	0	0	0	1	1	0	0	0	0	0	0	43
19:00	0	34	4	0	0	0	0	1	0	0	0	0	0	0	0	39
Hour Total	2	165	24	0	3	0	0	2	3	0	0	0	0	0	0	199
19:15	0	39	7	0	0	0	0	0	1	0	0	0	0	0	0	47
19:30	0	22	6	0	0	0	0	0	2	0	0	0	0	0	0	30
19:45	0	14	3	0	1	0	0	1	0	0	0	0	0	0	0	19
20:00	0	16	4	0	0	0	0	0	0	0	0	0	0	0	0	20
Hour Total	0	91	20	0	1	0	0	1	3	0	0	0	0	0	0	116
20:15	0	25	5	0	0	0	0	0	0	0	0	0	0	0	0	30
20:30	0	16	6	0	0	0	0	0	0	0	0	0	0	0	0	22
20:45	0	14	6	0	1	0	0	0	1	0	0	0	0	0	0	22
21:00	1	9	2	0	1	0	0	0	0	0	0	0	0	0	0	13
Hour Total	1	64	19	0	2	0	0	0	1	0	0	0	0	0	0	87
21:15	0	18	4	0	0	0	0	0	0	0	0	0	0	0	0	22
21:30	0	14	3	0	0	0	0	0	0	0	0	0	0	0	0	17
21:45	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	9
22:00	0	11	1	0	0	1	0	0	1	0	0	0	0	0	0	14
Hour Total	0	50	10	0	0	1	0	0	1	0	0	0	0	0	0	62
22:15	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	9
22:30	0	11	4	0	0	0	0	0	0	0	0	0	0	0	0	15
22:45	0	13	1	0	0	0	0	0	0	0	0	0	0	0	0	14
23:00	1	13	2	0	0	0	0	0	1	0	0	0	0	0	0	17
Hour Total	1	44	9	0	0	0	0	0	1	0	0	0	0	0	0	55
23:15	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	4
23:30	1	5	1	0	0	0	0	0	1	0	0	0	0	0	0	8
23:45	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
24:00	0	5	2	0	0	0	0	0	1	0	0	0	0	0	0	8
Hour Total	1	18	4	0	0	0	0	0	2	0	0	0	0	0	0	25
DAY TOTAL	14	2716	615	7	26	11	0	14	60	0	0	0	0	0	0	3463
PERCENTS	0.5%	78.5%	17.7%	0.2%	0.7%	0.3%	0.0%	0.4%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Passenger Vehicles 96.5% Trucks & Buses 3.4%

AM Times	07:30	07:15	07:30	07:30	08:30	05:15		07:30	08:00							07:15
AM Peaks	1	272	59	3	5	1		3	8							337
PM Times	14:45	16:45	15:00		13:30	12:30		15:00	12:45							16:45
PM Peaks	3	285	59		4	3		4	7							338

GRAND TOTAL	14		615		26		0		60		0		0		0	
	2716		7		11		14		0		0		0		3463	
PERCENTS	0.5%	78.5%	17.7%	0.2%	0.7%	0.3%	0.0%	0.4%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Malone & Associates Inc.
CLASSIFICATION SUMMARY
Wed 3/28/2012

Site Ref: Site 3
Site ID: 000000009391
Loc: I-95 SB On from Rives Rd.
Direction: SOUTH
Lane: 1

File: D0328003.prn
Info: 12-051 TO/RS Max
GPS: 37.17432 77.35189

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
00:15	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
00:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
00:45	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
01:15	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
01:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Hour Total	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	3
02:15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
02:30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
02:45	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hour Total	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
03:15	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
03:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:45	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	3
04:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hour Total	0	5	1	0	0	0	0	0	0	1	0	0	0	0	0	7
04:15	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	3
04:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
05:00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Hour Total	0	3	0	0	0	0	1	0	1	0	0	0	0	0	0	5
05:15	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	3
05:30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
05:45	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
06:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hour Total	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	8
06:15	0	4	2	0	0	0	0	0	0	1	0	0	0	0	0	7
06:30	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	4
06:45	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
07:00	0	3	2	0	1	0	0	0	0	0	0	0	0	0	0	6
Hour Total	0	11	5	0	1	1	0	0	0	1	0	0	0	0	0	19
07:15	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	8
07:30	0	9	4	0	0	0	0	0	0	0	0	0	0	0	0	13
07:45	0	11	3	0	0	0	0	0	0	0	0	0	0	0	0	14
08:00	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Hour Total	0	33	8	0	0	0	0	0	0	0	0	0	0	0	0	41
08:15	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	6
08:30	0	5	1	0	1	0	0	0	0	0	0	0	0	0	0	7
08:45	0	5	1	0	1	1	0	0	0	0	0	0	0	0	0	8
09:00	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	6

Site Ref: Site 3
Site ID: 000000009391
Loc: I-95 SB On from Rives Rd.
Direction: SOUTH
Lane: 1

File: D0328003.prn
Info: 12-051 TO/RS Max
GPS: 37.17432 77.35189

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Hour Total	0	20	3	0	2	2	0	0	0	0	0	0	0	0	0	27
09:15	0	4	3	0	0	0	0	0	0	1	0	0	0	0	0	8
09:30	0	7	3	0	0	0	0	0	0	0	0	0	0	0	0	10
09:45	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	4
10:00	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Hour Total	0	19	7	0	0	0	0	0	0	1	0	0	0	0	0	27
10:15	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	5
10:30	0	6	0	0	1	0	0	0	0	0	0	0	0	0	0	7
10:45	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	6
11:00	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	7
Hour Total	0	20	4	0	1	0	0	0	0	0	0	0	0	0	0	25
11:15	0	9	6	0	0	0	0	0	0	0	0	0	0	0	0	15
11:30	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	5
11:45	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	4
12:00	1	7	1	0	0	0	0	0	0	0	0	0	0	0	0	9
Hour Total	1	22	10	0	0	0	0	0	0	0	0	0	0	0	0	33
12:15	0	7	1	0	0	0	0	0	1	0	0	0	0	0	0	9
12:30	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
12:45	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	12
13:00	0	9	1	0	0	0	0	0	1	0	0	0	0	0	0	11
Hour Total	0	31	4	0	0	0	0	0	2	0	0	0	0	0	0	37
13:15	0	7	2	0	0	0	0	0	1	0	0	0	0	0	0	10
13:30	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8
13:45	0	4	2	0	0	1	0	0	0	0	0	0	0	0	0	7
14:00	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Hour Total	0	27	4	0	0	1	0	0	1	0	0	0	0	0	0	33
14:15	0	6	4	0	0	0	0	0	1	0	0	0	0	0	0	11
14:30	0	15	1	0	0	0	0	0	0	0	0	0	0	0	0	16
14:45	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0	10
15:00	0	6	2	0	1	0	0	0	0	0	0	0	0	0	0	9
Hour Total	0	35	9	0	1	0	0	0	1	0	0	0	0	0	0	46
15:15	0	15	5	0	1	0	0	0	0	0	0	0	0	0	0	21
15:30	0	16	6	0	0	0	0	0	0	0	0	0	0	0	0	22
15:45	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
16:00	0	15	3	0	0	0	0	0	0	0	0	0	0	0	0	18
Hour Total	0	52	14	0	1	0	0	0	0	0	0	0	0	0	0	67
16:15	0	14	3	0	1	0	0	0	1	0	0	0	0	0	0	19
16:30	0	16	1	0	0	0	0	0	0	0	0	0	0	0	0	17
16:45	0	21	5	0	0	0	0	0	0	0	0	0	0	0	0	26
17:00	0	24	5	0	0	0	0	0	0	0	0	0	0	0	0	29
Hour Total	0	75	14	0	1	0	0	0	1	0	0	0	0	0	0	91

Site Ref: Site 3
Site ID: 000000009391
Loc: I-95 SB On from Rives Rd.
Direction: SOUTH
Lane: 1

File: D0328003.prn
Info: 12-051 TO/RS Max
GPS: 37.17432 77.35189

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
17:15	0	21	5	0	0	0	0	0	0	0	0	0	0	0	0	26
17:30	0	20	4	0	0	0	0	0	0	0	0	0	0	0	0	24
17:45	0	12	5	0	0	0	0	0	0	0	0	0	0	0	0	17
18:00	1	15	3	0	0	0	0	0	0	0	0	0	0	0	0	19
Hour Total	1	68	17	0	0	0	0	0	0	0	0	0	0	0	0	86
18:15	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	14
18:30	0	14	3	0	0	0	0	0	0	0	0	0	0	0	0	17
18:45	1	2	5	0	0	0	0	0	0	0	0	0	0	0	0	8
19:00	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	10
Hour Total	1	39	9	0	0	0	0	0	0	0	0	0	0	0	0	49
19:15	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	11
19:30	0	6	3	0	0	0	0	0	0	0	0	0	0	0	0	9
19:45	0	8	3	0	0	0	0	0	0	0	0	0	0	0	0	11
20:00	0	17	3	0	0	0	0	0	0	0	0	0	0	0	0	20
Hour Total	0	42	9	0	0	0	0	0	0	0	0	0	0	0	0	51
20:15	0	11	2	0	0	0	0	0	0	0	0	0	0	0	0	13
20:30	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0	14
20:45	0	11	4	0	0	0	0	0	0	1	0	0	0	0	0	16
21:00	0	14	1	0	0	0	0	0	0	0	0	0	0	0	0	15
Hour Total	0	46	11	0	0	0	0	0	0	1	0	0	0	0	0	58
21:15	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
21:30	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	5
21:45	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	5
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	9	4	0	0	0	0	0	0	0	0	0	0	0	0	13
22:15	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
22:30	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	7
22:45	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	12	0	0	0	0	0	0	1	0	0	0	0	0	0	13
23:15	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	5
23:30	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
23:45	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
24:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hour Total	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	10
DAY TOTAL	3	591	139	0	7	4	1	0	7	4	0	0	0	0	0	756
PERCENTS	0.4%	78.2%	18.4%	0.0%	1.0%	0.5%	0.1%	0.0%	0.9%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Passenger Vehicles 97.9% Trucks & Buses 3.0%

AM Times	11:15	07:15	11:00	08:00	08:15	03:30	04:15	03:00							07:00	
AM Peaks	1	33	11	2	2	1	1	1							41	
PM Times	18:00	16:45	16:45	14:30	13:00		12:15	20:00							16:45	
PM Peaks	2	86	19	2	1		2	1							105	

GRAND TOTAL	3	591	139	0	7	4	1	0	7	4	0	0	0	0	0	756
PERCENTS	0.4%	78.2%	18.4%	0.0%	1.0%	0.5%	0.1%	0.0%	0.9%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Malone & Associates Inc.
CLASSIFICATION SUMMARY
Wed 3/28/2012

Site Ref: Site 4
Site ID: 000000009376
Loc: I-95 NB Off to Rives Rd.
Direction: NORTH
Lane: 1

File: D0328004.prn
Info: 12-051 TO/RS Max
GPS: 37.17356 77.35084

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
00:15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
00:30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
00:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
01:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:15	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
02:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:45	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	4
03:15	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
03:30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
03:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
04:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hour Total	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
05:15	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
05:30	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
05:45	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
06:00	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hour Total	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	9
06:15	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	10
06:30	0	13	3	0	0	0	1	0	0	0	0	0	0	0	0	17
06:45	0	10	5	0	0	0	0	0	0	0	0	0	0	0	0	15
07:00	0	9	3	0	0	0	0	0	0	0	0	0	0	0	0	12
Hour Total	0	41	12	0	0	0	1	0	0	0	0	0	0	0	0	54
07:15	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8
07:30	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	10
07:45	0	14	1	0	0	0	0	0	0	0	0	0	0	0	0	15
08:00	0	12	1	0	0	0	0	0	0	0	0	0	0	0	0	13
Hour Total	0	43	3	0	0	0	0	0	0	0	0	0	0	0	0	46
08:15	0	13	4	0	1	0	0	0	0	0	0	0	0	0	0	18
08:30	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0	10
08:45	0	13	3	0	0	0	0	1	0	0	0	0	0	0	0	17
09:00	1	11	6	0	0	0	0	0	0	0	0	0	0	0	0	18

Site Ref: Site 4
Site ID: 000000009376
Loc: I-95 NB Off to Rives Rd.
Direction: NORTH
Lane: 1

File: D0328004.prn
Info: 12-051 TO/RS Max
GPS: 37.17356 77.35084

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Hour Total	1	45	15	0	1	0	0	1	0	0	0	0	0	0	0	63
09:15	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7
09:30	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	12
09:45	0	8	1	0	0	0	0	0	1	0	0	0	0	0	0	10
10:00	0	15	3	0	0	0	0	0	0	0	0	0	0	0	0	18
Hour Total	0	42	4	0	0	0	0	0	1	0	0	0	0	0	0	47
10:15	0	14	4	0	0	0	0	0	0	0	0	0	0	0	0	18
10:30	0	9	2	0	0	0	0	0	0	0	0	0	0	0	0	11
10:45	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	6
11:00	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	10
Hour Total	0	36	9	0	0	0	0	0	0	0	0	0	0	0	0	45
11:15	0	6	8	0	0	0	0	0	0	0	0	0	0	0	0	14
11:30	0	6	3	0	0	0	0	0	1	0	0	0	0	0	0	10
11:45	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	9
12:00	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	10
Hour Total	0	29	13	0	0	0	0	0	1	0	0	0	0	0	0	43
12:15	0	7	3	0	0	0	0	0	0	0	0	0	0	0	0	10
12:30	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7
12:45	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	7
13:00	0	10	4	1	0	0	0	0	0	0	0	0	0	0	0	15
Hour Total	0	30	8	1	0	0	0	0	0	0	0	0	0	0	0	39
13:15	0	8	3	0	0	0	0	0	0	0	0	0	0	0	0	11
13:30	0	10	1	0	0	0	0	0	0	0	0	0	0	0	0	11
13:45	0	10	3	0	0	0	0	0	0	0	0	0	0	0	0	13
14:00	0	12	3	0	0	0	0	0	0	0	0	0	0	0	0	15
Hour Total	0	40	10	0	0	0	0	0	0	0	0	0	0	0	0	50
14:15	0	13	2	0	1	0	0	0	0	0	0	0	0	0	0	16
14:30	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0	10
14:45	0	7	1	0	0	0	0	0	1	0	0	0	0	0	0	9
15:00	0	11	4	0	0	0	0	0	0	0	0	0	0	0	0	15
Hour Total	0	39	9	0	1	0	0	0	1	0	0	0	0	0	0	50
15:15	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	12
15:30	0	9	3	0	0	0	0	0	0	0	0	0	0	0	0	12
15:45	0	11	2	0	0	0	0	0	0	0	0	0	0	0	0	13
16:00	0	13	3	0	0	0	0	0	0	0	0	0	0	0	0	16
Hour Total	0	43	10	0	0	0	0	0	0	0	0	0	0	0	0	53
16:15	0	6	3	0	0	0	0	0	0	0	0	0	0	0	0	9
16:30	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
16:45	0	12	2	0	0	0	0	0	0	0	0	0	0	0	0	14
17:00	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	8
Hour Total	0	28	7	0	0	0	0	0	0	0	0	0	0	0	0	35

Site Ref: Site 4
Site ID: 000000009376
Loc: I-95 NB Off to Rives Rd.
Direction: NORTH
Lane: 1

File: D0328004.prn
Info: 12-051 TO/RS Max
GPS: 37.17356 77.35084

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
17:15	0	14	4	0	0	0	0	0	0	0	0	0	0	0	0	18
17:30	0	11	3	0	0	0	0	0	0	0	0	0	0	0	0	14
17:45	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	11
18:00	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Hour Total	0	41	7	0	0	0	0	0	0	0	0	0	0	0	0	48
18:15	0	9	5	0	0	0	0	0	0	0	0	0	0	0	0	14
18:30	0	13	2	0	0	0	0	0	0	0	0	0	0	0	0	15
18:45	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7
19:00	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	11
Hour Total	1	39	7	0	0	0	0	0	0	0	0	0	0	0	0	47
19:15	0	7	3	0	0	0	0	0	0	0	0	0	0	0	0	10
19:30	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	9
19:45	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	5
20:00	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	6
Hour Total	0	20	10	0	0	0	0	0	0	0	0	0	0	0	0	30
20:15	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	8
20:30	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	4
20:45	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	4
21:00	0	6	2	0	0	0	0	0	1	0	0	0	0	0	0	9
Hour Total	0	18	5	0	0	0	0	0	2	0	0	0	0	0	0	25
21:15	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
21:30	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
21:45	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
22:00	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	7
Hour Total	1	9	3	0	0	0	0	0	0	0	0	0	0	0	0	13
22:15	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
22:30	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	5
22:45	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
23:00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hour Total	0	7	3	0	0	0	0	0	0	0	0	0	0	0	0	10
23:15	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
23:30	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
23:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24:00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hour Total	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	6
DAY TOTAL	4	574	138	1	2	0	1	1	5	0	0	0	0	0	0	726
PERCENTS	0.6%	79.1%	19.1%	0.2%	0.2%	0.0%	0.1%	0.1%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Passenger Vehicles 98.6% Trucks & Buses 1.3%

AM Times	08:15	09:30	08:15		07:30		05:45	08:00	09:00							08:15
AM Peaks	1	49	15		1		1	1	1							63
PM Times	18:15	13:30	13:00	12:15	13:30				20:15							13:30
PM Peaks	1	45	11	1	1				2							55

GRAND TOTAL	4	574	138	1	2	0	1	1	5	0	0	0	0	0	0	726
PERCENTS	0.6%	79.1%	19.1%	0.2%	0.2%	0.0%	0.1%	0.1%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Site Ref: Site 5
Site ID: 000000009353
Loc: I-95 SB Off to WB E. Washington St.
Direction: SOUTH
Lane: 1

File: D0328001.prn
Info: 12-051 TO/RS Max
GPS: 37.23044 77.39619

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
00:15	0	17	3	0	0	0	0	0	0	0	0	0	0	0	0	20
00:30	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17
00:45	0	10	5	0	0	0	0	0	0	0	0	0	0	0	0	15
01:00	0	11	2	0	0	0	0	0	0	0	0	0	0	0	0	13
Hour Total	0	55	10	0	0	0	0	0	0	0	0	0	0	0	0	65
01:15	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	14
01:30	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	9
01:45	0	5	1	1	0	0	0	0	0	0	0	0	0	0	0	7
02:00	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	9
Hour Total	0	36	2	1	0	0	0	0	0	0	0	0	0	0	0	39
02:15	0	5	1	0	0	0	0	1	0	0	0	0	0	0	0	7
02:30	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
02:45	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
03:00	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Hour Total	0	18	1	0	0	0	0	1	0	0	0	0	0	0	0	20
03:15	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	5
03:30	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	4
03:45	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
04:00	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Hour Total	0	15	2	0	0	0	0	0	0	0	0	0	0	0	0	17
04:15	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
04:30	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
04:45	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	6
05:00	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	7
Hour Total	0	17	4	0	0	0	0	0	0	0	0	0	0	0	0	21
05:15	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	4
05:30	0	7	1	0	0	0	0	0	1	0	0	0	0	0	0	9
05:45	0	9	1	1	0	0	0	0	0	0	0	0	0	0	0	11
06:00	0	15	3	1	0	0	0	0	0	0	0	0	0	0	0	19
Hour Total	0	34	6	2	0	0	0	0	1	0	0	0	0	0	0	43
06:15	0	18	6	0	0	0	0	0	0	0	0	0	0	0	0	24
06:30	0	18	7	1	0	0	0	0	0	0	0	0	0	0	0	26
06:45	0	31	5	0	1	0	0	0	0	0	0	0	0	0	0	37
07:00	1	41	9	1	0	0	1	0	1	0	0	0	0	0	0	54
Hour Total	1	108	27	2	1	0	1	0	1	0	0	0	0	0	0	141
07:15	0	44	16	1	0	1	0	0	0	0	0	0	0	0	0	62
07:30	0	62	13	2	0	0	0	0	0	0	0	0	0	0	0	77
07:45	0	82	17	0	2	0	0	1	0	0	0	0	0	0	0	102
08:00	0	114	20	0	0	1	0	0	0	0	0	0	0	0	0	135
Hour Total	0	302	66	3	2	2	0	1	0	0	0	0	0	0	0	376
08:15	0	97	23	2	1	1	0	0	0	0	0	0	0	0	0	124
08:30	0	107	19	1	2	0	0	1	0	0	0	0	0	0	0	130
08:45	0	72	22	0	3	0	0	0	1	0	0	0	0	0	0	98
09:00	0	90	20	0	0	0	0	0	1	0	0	0	0	0	0	111

Site Ref: Site 5
Site ID: 000000009353
Loc: I-95 SB Off to WB E. Washington St.
Direction: SOUTH
Lane: 1

File: D0328001.prn
Info: 12-051 TO/RS Max
GPS: 37.23044 77.39619

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Hour Total	0	366	84	3	6	1	0	1	2	0	0	0	0	0	0	463
09:15	0	58	23	0	0	1	0	1	1	0	0	0	0	0	0	84
09:30	0	66	18	0	1	0	0	0	0	0	0	0	0	0	0	85
09:45	0	52	21	0	2	0	0	0	1	0	0	0	0	0	0	76
10:00	0	67	17	1	1	0	0	0	2	0	0	0	0	0	0	88
Hour Total	0	243	79	1	4	1	0	1	4	0	0	0	0	0	0	333
10:15	0	84	15	0	1	2	0	0	1	0	0	0	0	0	0	103
10:30	0	59	14	0	3	1	0	0	0	0	0	0	0	0	0	77
10:45	0	51	17	0	1	1	0	1	0	0	0	0	0	0	0	71
11:00	0	70	22	0	0	0	0	0	0	0	0	0	0	0	0	92
Hour Total	0	264	68	0	5	4	0	1	1	0	0	0	0	0	0	343
11:15	0	59	15	0	3	0	0	0	1	0	0	0	0	0	0	78
11:30	0	65	12	1	3	1	0	0	0	0	0	0	0	0	0	82
11:45	0	71	15	0	2	0	0	1	1	0	0	0	0	0	0	90
12:00	1	78	26	0	0	1	0	0	0	0	0	0	0	0	0	106
Hour Total	1	273	68	1	8	2	0	1	2	0	0	0	0	0	0	356
12:15	0	76	16	0	0	1	0	0	0	0	0	0	0	0	0	93
12:30	0	78	22	0	0	0	0	0	1	0	0	0	0	0	0	101
12:45	0	71	13	0	2	2	0	0	0	0	0	0	0	0	0	88
13:00	0	67	20	0	1	1	0	0	0	0	0	0	0	0	0	89
Hour Total	0	292	71	0	3	4	0	0	1	0	0	0	0	0	0	371
13:15	0	82	21	2	2	0	0	0	0	0	0	0	0	0	0	107
13:30	0	82	28	1	0	0	0	0	1	0	0	0	0	0	0	112
13:45	0	88	24	0	2	0	0	0	0	0	0	0	0	0	0	114
14:00	0	73	21	0	1	1	0	1	0	0	0	0	0	0	0	97
Hour Total	0	325	94	3	5	1	0	1	1	0	0	0	0	0	0	430
14:15	0	88	25	0	1	1	0	0	0	0	0	0	0	0	0	115
14:30	0	89	19	1	2	0	0	1	0	0	0	0	0	0	0	112
14:45	0	91	35	0	1	1	0	1	0	0	0	0	0	0	0	129
15:00	0	99	24	1	2	0	0	0	0	0	0	0	0	0	0	126
Hour Total	0	367	103	2	6	2	0	2	0	0	0	0	0	0	0	482
15:15	0	100	21	2	1	1	0	0	1	0	0	0	0	0	0	126
15:30	0	111	28	0	2	0	0	0	0	0	0	0	0	0	0	141
15:45	1	111	19	0	2	1	0	0	1	0	0	0	0	0	0	135
16:00	0	98	23	0	2	0	0	0	0	0	0	0	0	0	0	123
Hour Total	1	420	91	2	7	2	0	0	2	0	0	0	0	0	0	525
16:15	1	97	21	1	1	0	0	0	1	0	0	0	0	0	0	122
16:30	0	124	25	1	4	0	0	0	0	0	0	0	0	0	0	154
16:45	0	101	18	2	2	0	0	0	1	0	0	0	0	0	0	124
17:00	1	118	16	0	0	0	0	0	0	0	0	0	0	0	0	135
Hour Total	2	440	80	4	7	0	0	0	2	0	0	0	0	0	0	535

Site Ref: Site 5
Site ID: 000000009353
Loc: I-95 SB Off to WB E. Washington St.
Direction: SOUTH
Lane: 1

File: D0328001.prn
Info: 12-051 TO/RS Max
GPS: 37.23044 77.39619

TIME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
17:15	0	98	22	0	1	0	0	0	0	0	0	0	0	0	0	121
17:30	0	106	18	0	0	0	0	0	0	0	0	0	0	0	0	124
17:45	0	133	12	1	2	0	0	1	0	0	0	0	0	0	0	149
18:00	0	110	19	1	0	1	0	0	0	0	0	0	0	0	0	131
Hour Total	0	447	71	2	3	1	0	1	0	0	0	0	0	0	0	525
18:15	0	106	10	0	1	0	0	0	0	0	0	0	0	0	0	117
18:30	1	116	17	1	2	0	0	0	0	0	0	0	0	0	0	137
18:45	2	94	16	0	1	0	0	1	0	0	0	0	0	0	0	114
19:00	0	89	8	1	0	0	0	0	0	0	0	0	0	0	0	98
Hour Total	3	405	51	2	4	0	0	1	0	0	0	0	0	0	0	466
19:15	1	85	9	0	1	0	0	0	0	0	0	0	0	0	0	96
19:30	1	87	19	0	0	0	0	0	0	0	0	0	0	0	0	107
19:45	0	69	11	0	1	0	0	0	0	0	0	0	0	0	0	81
20:00	0	68	20	0	0	0	0	0	0	0	0	0	0	0	0	88
Hour Total	2	309	59	0	2	0	0	0	0	0	0	0	0	0	0	372
20:15	0	58	12	0	0	0	0	0	0	0	0	0	0	0	0	70
20:30	0	49	6	0	0	0	0	1	0	0	0	0	0	0	0	56
20:45	0	48	8	0	0	0	0	0	0	0	0	0	0	0	0	56
21:00	0	66	5	0	0	0	0	0	0	0	0	0	0	0	0	71
Hour Total	0	221	31	0	0	0	0	1	0	0	0	0	0	0	0	253
21:15	0	50	9	0	1	0	0	0	1	0	0	0	0	0	0	61
21:30	0	45	8	0	0	0	0	0	0	0	0	0	0	0	0	53
21:45	0	37	5	0	0	0	0	0	0	0	0	0	0	0	0	42
22:00	0	42	7	0	0	0	0	0	0	0	0	0	0	0	0	49
Hour Total	0	174	29	0	1	0	0	0	1	0	0	0	0	0	0	205
22:15	0	42	3	0	0	0	0	0	0	0	0	0	0	0	0	45
22:30	0	33	3	0	0	0	0	0	0	0	0	0	0	0	0	36
22:45	0	23	3	0	0	0	0	0	0	0	0	0	0	0	0	26
23:00	0	22	1	1	0	0	0	0	0	0	0	0	0	0	0	24
Hour Total	0	120	10	1	0	0	0	0	0	0	0	0	0	0	0	131
23:15	0	28	9	0	0	0	0	0	0	0	0	0	0	0	0	37
23:30	0	40	1	0	1	0	0	0	0	0	0	0	0	0	0	42
23:45	0	23	3	0	0	0	0	1	0	0	0	0	0	0	0	27
24:00	0	22	0	1	0	0	0	0	0	0	0	0	0	0	0	23
Hour Total	0	113	13	1	1	0	0	1	0	0	0	0	0	0	0	129
DAY TOTAL	10	5364	1120	30	65	20	1	13	18	0	0	0	0	0	0	6641
PERCENTS	0.2%	80.8%	16.9%	0.5%	1.0%	0.3%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Passenger Vehicles 97.7% Trucks & Buses 2.2%

AM Times	06:15	07:45	08:00	06:45	11:00	10:00	06:15	07:45	09:15							07:45
AM Peaks	1	400	84	4	8	4	1	2	4							491
PM Times	18:30	17:45	14:45	14:30	15:45	12:15		14:00	15:00							16:15
PM Peaks	4	465	108	4	9	4		3	2							535

GRAND TOTAL	10	5364	1120	30	65	20	1	13	18	0	0	0	0	0	0	6641
PERCENTS	0.2%	80.8%	16.9%	0.5%	1.0%	0.3%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

PEGGY MALONE & ASSOCIATES
TRAFFIC DATA COLLECTION

Study Name	E. Washington St ADT, btwn I-95 SB off and SB on ramps					
Start Date	03/28/2012					
Start Time	12:00 AM					
Site Code	Lane 1					
Channel	Vehicles	Buses	Medium Trucks	Heavy Trucks	Total	Total Trucks/Buses
Direction	Westbound	Westbound	Westbound	Westbound	Westbound	Westbound
Start Time						
12:00 AM	27	0	1	0	28	1
12:15 AM	28	0	0	0	28	0
12:30 AM	18	0	0	0	18	0
12:45 AM	18	0	1	0	19	1
1:00 AM	14	0	0	0	14	0
1:15 AM	28	0	0	0	28	0
1:30 AM	12	0	0	1	13	1
1:45 AM	21	0	0	0	21	0
2:00 AM	14	0	0	0	14	0
2:15 AM	12	0	0	0	12	0
2:30 AM	8	0	0	1	9	1
2:45 AM	12	0	0	0	12	0
3:00 AM	11	0	0	0	11	0
3:15 AM	14	0	0	1	15	1
3:30 AM	8	0	0	0	8	0
3:45 AM	8	0	0	0	8	0
4:00 AM	9	0	0	1	10	1
4:15 AM	6	0	0	0	6	0
4:30 AM	7	0	0	0	7	0
4:45 AM	14	0	1	0	15	1
5:00 AM	13	0	0	1	14	1
5:15 AM	17	1	0	2	20	3
5:30 AM	31	0	2	0	33	2
5:45 AM	45	0	0	1	46	1
6:00 AM	40	0	1	0	41	1
6:15 AM	65	0	0	0	65	0
6:30 AM	87	3	2	2	94	7
6:45 AM	100	0	1	2	103	3
7:00 AM	85	2	1	1	89	4
7:15 AM	118	0	4	1	123	5
7:30 AM	144	4	4	0	152	8
7:45 AM	201	9	6	0	216	15
8:00 AM	169	7	6	0	182	13
8:15 AM	163	3	3	1	170	7
8:30 AM	167	1	0	0	168	1
8:45 AM	149	4	3	0	156	7
9:00 AM	125	6	8	0	139	14
9:15 AM	130	1	8	0	139	9
9:30 AM	133	0	3	0	136	3
9:45 AM	136	1	2	0	139	3
10:00 AM	118	1	3	0	122	4

PEGGY MALONE & ASSOCIATES
TRAFFIC DATA COLLECTION

Study Name	E. Washington St ADT, btwn I-95 SB off and SB on ramps					
Start Date	03/28/2012					
Start Time	12:00 AM					
Site Code	Lane 1					
Channel	Vehicles	Buses	Medium Trucks	Heavy Trucks	Total	Total Trucks/Buses
Direction	Westbound	Westbound	Westbound	Westbound	Westbound	Westbound
10:15 AM	123	0	3	0	126	3
10:30 AM	142	0	6	1	149	7
10:45 AM	150	0	2	0	152	2
11:00 AM	119	2	5	2	128	9
11:15 AM	134	1	1	2	138	4
11:30 AM	158	1	4	0	163	5
11:45 AM	176	0	4	1	181	5
12:00 PM	180	4	5	1	190	10
12:15 PM	148	1	6	2	157	9
12:30 PM	154	3	3	1	161	7
12:45 PM	153	1	2	1	157	4
1:00 PM	145	2	4	1	152	7
1:15 PM	167	1	4	2	174	7
1:30 PM	159	0	4	1	164	5
1:45 PM	152	0	3	3	158	6
2:00 PM	149	3	8	1	161	12
2:15 PM	158	0	5	0	163	5
2:30 PM	182	7	3	2	194	12
2:45 PM	155	3	10	0	168	13
3:00 PM	189	4	5	3	201	12
3:15 PM	184	4	6	0	194	10
3:30 PM	169	0	5	0	174	5
3:45 PM	221	5	5	1	232	11
4:00 PM	242	4	5	1	252	10
4:15 PM	217	0	2	1	220	3
4:30 PM	204	3	1	0	208	4
4:45 PM	204	1	1	0	206	2
5:00 PM	216	1	2	1	220	4
5:15 PM	213	2	0	2	217	4
5:30 PM	182	0	6	0	188	6
5:45 PM	212	2	1	0	215	3
6:00 PM	178	1	2	0	181	3
6:15 PM	171	1	3	0	175	4
6:30 PM	157	3	0	0	160	3
6:45 PM	171	2	1	1	175	4
7:00 PM	158	0	0	0	158	0
7:15 PM	129	0	0	1	130	1
7:30 PM	155	0	0	2	157	2
7:45 PM	108	0	0	0	108	0
8:00 PM	114	0	0	0	114	0
8:15 PM	102	0	1	0	103	1
8:30 PM	117	0	0	0	117	0

Study Name	***E. Washington St ADT, btwn I-95 SB off and SB on ramps***					
Start Date	***03/28/2012***					
Start Time	***12:00 AM***					
Site Code	***Lane 1***					
Channel	Vehicles	Buses	Medium Trucks	Heavy Trucks	Total	Total Trucks/Buses
Direction	Westbound	Westbound	Westbound	Westbound	Westbound	Westbound
8:45 PM	110	0	0	0	110	0
9:00 PM	93	1	1	0	95	2
9:15 PM	70	1	0	0	71	1
9:30 PM	66	0	0	0	66	0
9:45 PM	66	0	2	0	68	2
10:00 PM	42	0	0	0	42	0
10:15 PM	35	0	0	0	35	0
10:30 PM	60	0	0	1	61	1
10:45 PM	58	0	0	0	58	0
11:00 PM	30	0	0	0	30	0
11:15 PM	41	0	0	0	41	0
11:30 PM	30	0	0	0	30	0
11:45 PM	48	0	0	1	49	1
	10191	107	191	51	10540	349
AM Times	8:00	9:00	6:45	7:45	8:00	
AM Peaks	700	22	6	23	736	
PM Times	16:00	14:15	13:15	14:45	16:00	
PM Peaks	884	26	7	18	912	

APPENDIX B: CRASH DATA

I-95/I-85 RSA
Summary of Corridor Crash Data
Crash Data: Jan. 1, 2007 - Dec. 31, 2009
I-95 Southbound

Total Comparison

Location	Year	Peak Hour			Light Conditions			Pavement Condition			Type of Collision											Severity						TOTAL
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - Same Direction	Sideswipe - Opposite Direction	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury	
I-95S from	2007	8	16	29	35	1	17	31	20	2	18	0	0	11	0	0	0	24	0	0	0	0	0	6	4	8	35	18	**53**
Temple Avenue	2008	12	13	28	34	4	15	36	17	0	16	3	0	8	0	0	3	20	3	0	0	0	0	9	4	7	33	20	**53**
to	2009	7	9	26	23	2	17	28	11	3	12	3	0	0	0	7	2	18	0	0	0	0	1	7	2	2	30	11	**42**
Rives Road	**TOTAL**	**27**	**38**	**83**	**92**	**7**	**49**	**95**	**48**	**5**	**46**	**6**	**0**	**19**	**0**	**7**	**5**	**62**	**3**	**0**	**0**	**0**	**1**	**22**	**10**	**17**	**98**	**49**	**148**

Percentage Comparison

Location	Year	% Peak Hour			% Light Conditions			% Pavement Condition			% Type of Collision											% Severity					
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - same dir.	Sideswipe - Opp. Dir.	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury
I-95S from	2007	15%	30%	55%	66%	2%	32%	58%	38%	4%	34%	0%	0%	21%	0%	0%	0%	45%	0%	0%	0%	0%	0%	11%	8%	15%	66%	**34%**
Temple Avenue	2008	23%	25%	53%	64%	8%	28%	68%	32%	0%	30%	6%	0%	15%	0%	0%	6%	38%	6%	0%	0%	0%	0%	17%	8%	13%	62%	**38%**
to	2009	17%	21%	62%	55%	5%	40%	67%	26%	7%	29%	7%	0%	0%	0%	17%	5%	43%	0%	0%	0%	0%	2%	17%	5%	5%	71%	**26%**
Rives Road	**TOTAL**	**18%**	**26%**	**56%**	**62%**	**5%**	**33%**	**64%**	**32%**	**3%**	**31%**	**4%**	**0%**	**13%**	**0%**	**5%**	**3%**	**42%**	**2%**	**0%**	**0%**	**0%**	**1%**	**15%**	**7%**	**11%**	**66%**	**33%**

I-95/I-85 RSA
Summary of Corridor Crash Data
Crash Data: Jan. 1, 2007 - Dec. 31, 2009
I-95 Northbound

Total Comparison

Location	Year	Peak Hour			Light Conditions			Pavement Condition			Type of Collision											Severity						TOTAL
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - Same Direction	Sideswipe - Opposite Direction	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury	
I-95N from	2007	12	11	25	32	1	15	33	9	6	17	0	0	11	0	1	0	19	0	0	0	0	0	6	2	8	32	16	**48**
Temple Avenue	2008	11	15	24	26	4	20	29	20	1	16	2	0	10	0	1	0	19	2	0	0	0	0	7	2	8	33	17	**50**
to	2009	6	12	25	24	3	16	27	11	5	11	6	0	0	0	3	0	20	2	0	0	1	0	3	4	7	29	14	**43**
Rives Road	**TOTAL**	**29**	**38**	**74**	**82**	**8**	**51**	**89**	**40**	**12**	**44**	**8**	**0**	**21**	**0**	**5**	**0**	**58**	**4**	**0**	**0**	**1**	**0**	**16**	**8**	**23**	**94**	**47**	**141**

Percentage Comparison

Location	Year	% Peak Hour			% Light Conditions			% Pavement Condition			% Type of Collision											% Severity					
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - same dir.	Sideswipe - Opp. Dir.	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury
I-95N from	2007	25%	23%	52%	67%	2%	31%	69%	19%	13%	35%	0%	0%	23%	0%	2%	0%	40%	0%	0%	0%	0%	0%	13%	4%	17%	67%	**33%**
Temple Avenue	2008	22%	30%	48%	52%	8%	40%	58%	40%	2%	32%	4%	0%	20%	0%	2%	0%	38%	4%	0%	0%	0%	0%	14%	4%	16%	66%	**34%**
to	2009	14%	28%	58%	56%	7%	37%	63%	26%	12%	26%	14%	0%	0%	0%	7%	0%	48%	5%	0%	0%	2%	0%	7%	9%	16%	67%	**33%**
Rives Road	**TOTAL**	**21%**	**27%**	**52%**	**58%**	**6%**	**36%**	**63%**	**28%**	**9%**	**31%**	**6%**	**0%**	**15%**	**0%**	**4%**	**0%**	**41%**	**3%**	**0%**	**0%**	**1%**	**0%**	**11%**	**6%**	**16%**	**67%**	**33%**

I-95/I-85 RSA
Summary of Corridor Crash Data
Crash Data: Jan. 1, 2007 - Dec. 31, 2009
I-85 Southbound

Total Comparison

Location	Year	Peak Hour			Light Conditions			Pavement Condition			Type of Collision												Severity						TOTAL
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - Same Direction	Sideswipe - Opposite Direction	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury	
I-85S from	2007	1	1	1	2	1	0	1	2	0	0	0	0	1	0	0	0	2	0	0	0	0	0	1	0	0	2	1	**3**
I-95/I-85 interchange	2008	0	2	1	3	0	0	2	1	0	0	1	0	0	0	0	0	2	0	0	0	0	0	1	0	0	2	1	**3**
to	2009	0	0	2	1	0	1	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1	**2**
Sycamore Street overpass	**TOTAL**	**1**	**3**	**4**	**6**	**1**	**1**	**5**	**3**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**5**	**1**	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**5**	**3**	**8**

Percentage Comparison

Location	Year	% Peak Hour			% Light Conditions			% Pavement Condition			% Type of Collision												% Severity					
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - same dir.	Sideswipe - Opp. Dir.	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury
I-85S from	2007	33%	33%	33%	67%	33%	0%	33%	67%	0%	0%	0%	0%	33%	0%	0%	0%	67%	0%	0%	0%	0%	0%	33%	0%	0%	67%	**33%**
I-95/I-85 interchange	2008	0%	67%	33%	100%	0%	0%	67%	33%	0%	0%	33%	0%	0%	0%	0%	0%	67%	0%	0%	0%	0%	0%	33%	0%	0%	67%	**33%**
to	2009	0%	0%	100%	50%	0%	50%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	50%	0%	0%	0%	0%	0%	50%	0%	50%	**50%**
Sycamore Street overpass	**TOTAL**	**13%**	**38%**	**50%**	**75%**	**13%**	**13%**	**63%**	**38%**	**0%**	**0%**	**13%**	**0%**	**13%**	**0%**	**0%**	**0%**	**63%**	**13%**	**0%**	**0%**	**0%**	**0%**	**25%**	**13%**	**0%**	**63%**	**38%**

I-95/I-85 RSA
Summary of Corridor Crash Data
Crash Data: Jan. 1, 2007 - Dec. 31, 2009
I-85 Northbound

Total Comparison

Location	Year	Peak Hour			Light Conditions			Pavement Condition			Type of Collision											Severity						TOTAL
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - Same Direction	Sideswipe - Opposite Direction	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury	
I-85N from	2007	1	3	6	7	0	3	5	5	0	0	0	0	3	0	0	1	5	1	0	0	0	0	1	1	1	7	3	**10**
I-95/I-85 interchange	2008	3	2	2	6	0	1	6	1	0	1	1	0	3	0	0	0	2	0	0	0	0	0	3	0	0	4	3	**7**
to	2009	0	2	4	6	0	0	5	1	0	2	1	0	0	0	2	0	1	0	0	0	0	0	0	0	0	6	0	**6**
Sycamore Street overpass	**TOTAL**	**4**	**7**	**12**	**19**	**0**	**4**	**16**	**7**	**0**	**3**	**2**	**0**	**6**	**0**	**2**	**1**	**8**	**1**	**0**	**0**	**0**	**0**	**4**	**1**	**1**	**17**	**6**	**23**

Percentage Comparison

Location	Year	% Peak Hour			% Light Conditions			% Pavement Condition			% Type of Collision											% Severity					
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - same dir.	Sideswipe - Opp. Dir.	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury
I-85N from	2007	10%	30%	60%	70%	0%	30%	50%	50%	0%	0%	0%	0%	30%	0%	0%	10%	50%	10%	0%	0%	0%	0%	10%	10%	10%	70%	**30%**
I-95/I-85 interchange	2008	43%	29%	29%	86%	0%	14%	86%	14%	0%	14%	14%	0%	43%	0%	0%	0%	29%	0%	0%	0%	0%	0%	43%	0%	0%	57%	**43%**
to	2009	0%	33%	67%	100%	0%	0%	83%	17%	0%	33%	17%	0%	0%	0%	33%	0%	17%	0%	0%	0%	0%	0%	0%	0%	0%	100%	**0%**
Sycamore Street overpass	**TOTAL**	**17%**	**30%**	**52%**	**83%**	**0%**	**17%**	**70%**	**30%**	**0%**	**13%**	**9%**	**0%**	**26%**	**0%**	**9%**	**4%**	**35%**	**4%**	**0%**	**0%**	**0%**	**0%**	**17%**	**4%**	**4%**	**74%**	**26%**

I-95/I-85 RSA
Summary of Corridor Crash Data
Crash Data: Jan. 1, 2007 - Dec. 31, 2009
All Ramps in Study Corridor

Total Comparison

Location	Year	Peak Hour			Light Conditions			Pavement Condition			Type of Collision											Severity						TOTAL
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - Same Direction	Sideswipe - Opposite Direction	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury	
All Ramps in Study Corridor	2007	10	11	15	30	1	5	26	7	3	14	0	2	5	0	0	1	13	1	0	0	0	0	3	0	7	26	10	**36**
	2008	9	5	4	12	2	4	14	4	0	13	0	0	0	1	0	0	4	0	0	0	0	0	4	0	4	10	8	**18**
	2009	7	9	15	16	6	9	21	8	2	16	2	0	0	0	2	1	10	0	0	0	0	1	3	2	7	18	12	**31**
	TOTAL	**26**	**25**	**34**	**58**	**9**	**18**	**61**	**19**	**5**	**43**	**2**	**2**	**5**	**1**	**2**	**2**	**27**	**1**	**0**	**0**	**0**	**1**	**10**	**2**	**18**	**54**	**30**	**85**

Percentage Comparison

Location	Year	% Peak Hour			% Light Conditions			% Pavement Condition			% Type of Collision											% Severity					
		AM (6 - 10)	PM (3 - 7)	Off Peak	Day	Dawn / Dusk	Dark	Dry	Wet	Misc	Rear End	Angle	Head On	Sideswipe - same dir.	Sideswipe - Opp. Dir.	Fixed Object - In Road	Non-Collision	Fixed Object - Off Road	Deer / Other Animal	Backed Into	Pedestrian/ Bicyclist	Other	K (1)	A (2)	B (3)	C (4)	None (0)	Total Injury
All Ramps in Study Corridor	2007	28%	31%	42%	83%	3%	14%	72%	19%	8%	39%	0%	6%	14%	0%	0%	3%	36%	3%	0%	0%	0%	0%	8%	0%	19%	72%	**28%**
	2008	50%	28%	22%	67%	11%	22%	78%	22%	0%	72%	0%	0%	0%	6%	0%	0%	22%	0%	0%	0%	0%	0%	22%	0%	22%	56%	**44%**
	2009	23%	29%	48%	52%	19%	29%	68%	26%	6%	52%	6%	0%	0%	0%	6%	3%	32%	0%	0%	0%	0%	3%	10%	6%	23%	58%	**39%**
	TOTAL	**31%**	**29%**	**40%**	**68%**	**11%**	**21%**	**72%**	**22%**	**6%**	**51%**	**2%**	**2%**	**6%**	**1%**	**2%**	**2%**	**32%**	**1%**	**0%**	**0%**	**0%**	**1%**	**12%**	**2%**	**21%**	**64%**	**35%**

APPENDIX C: INVENTORY OF OVERHEAD SIGNS

OVERHEAD SIGNS WITHOUT LIGHTING

I-95 NB

Located at MP 47.4

Located at MP 52.9

Located at MP 48.4

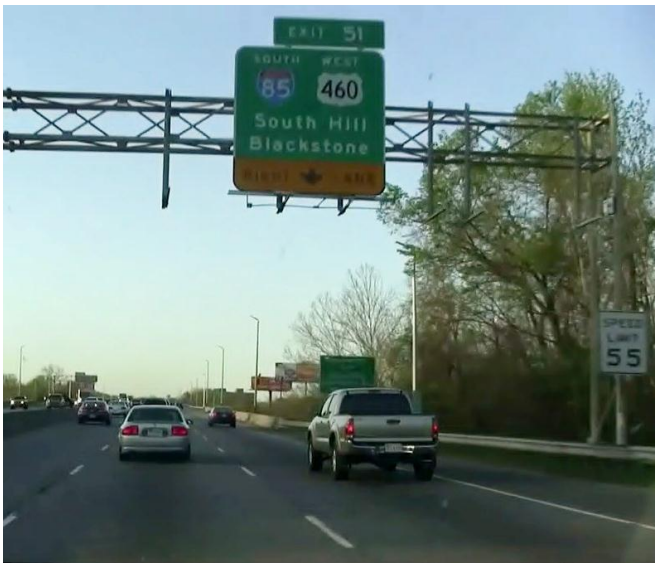
Located at MP 53.0

Located at MP 48.7

I-95 SB

Located at MP 54.3

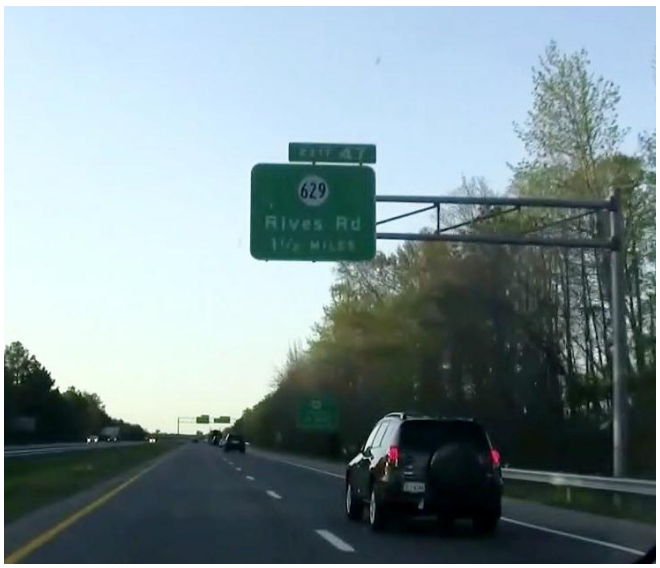
Located at MP 50.3



Located at MP 53.0

Located at MP 49.5

Located at MP 52.5



Located at MP 49.3

I-95 SB

Located at MP 49.1

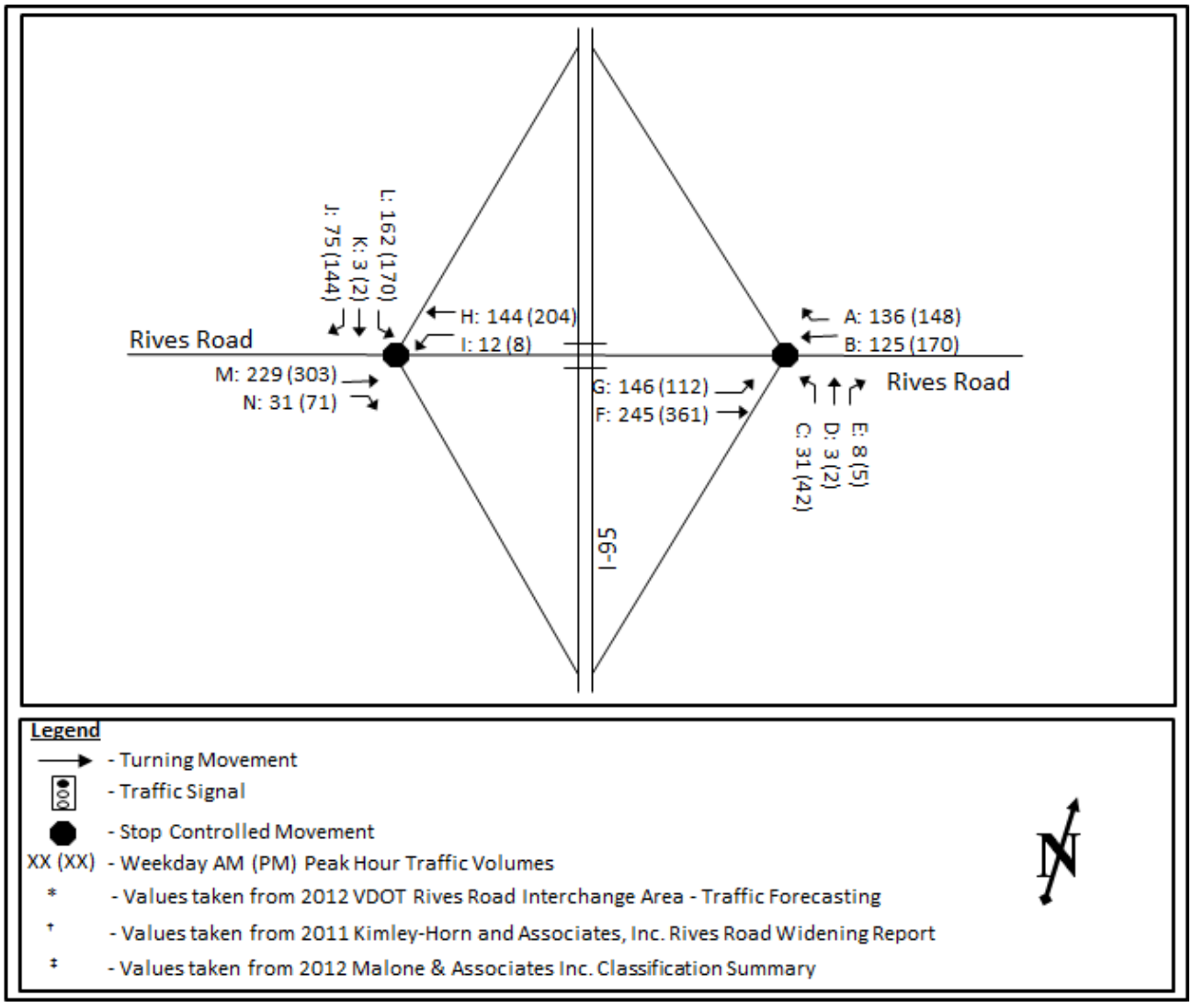
Located at MP 48.3

Located at MP 48.1

APPENDIX D: AREA OF INTEREST – RIVES ROAD INTERCHANGE

Rives Road and I-95 Ramps Traffic Volumes

Roadway	From	To	2011 AM Peak Hour Traffic Volumes†	2011 PM Peak Hour Traffic Volumes†	Annual Linear Growth Rate*	2012 AM Peak Hour Traffic Volumes‡	2012 PM Peak Hour Traffic Volumes‡	2035 AM Peak Hour Traffic Volumes	2035 PM Peak Hour Traffic Volumes	2012 AM Peak Hour Factor	2012 PM Peak Hour Factor	% Heavy Vehicles
Ramps												
SB	I-95	Rives Rd	-	-	1.00%	292	369	367	464	0.95	0.90	4%
SB	Rives Rd	I-95	-	-	3.00%	41	105	81	207	0.73	0.91	3%
NB	I-95	Rives Rd	-	-	1.00%	63	54	79	68	0.88	0.75	1%
NB	Rives Rd	I-95	-	-	3.00%	337	338	665	667	0.96	0.93	3%
Intersections												
	A	-	136	148	3.00%	140	152	276	301	0.77	0.72	2%
	B	-	125	170	1.50%	127	173	179	243	0.61	0.77	2%
	C	-	31	42	1.00%	31	42	39	53	0.64	0.70	2%
	D	-	3	2	1.00%	3	2	4	3	0.38	0.50	2%
	E	-	8	5	1.00%	8	5	10	6	0.50	0.63	2%
	F	-	245	361	1.50%	249	366	350	516	0.82	0.80	2%
	G	-	146	112	3.00%	150	115	297	228	0.79	0.73	2%
	H	-	144	204	1.50%	146	207	206	292	0.81	0.91	2%
	I	-	12	8	1.50%	12	8	17	11	0.75	0.40	2%
	J	-	75	144	3.00%	77	148	152	293	0.72	0.90	4%
	K	-	3	2	1.00%	3	2	4	3	0.25	0.25	4%
	L	-	162	170	1.00%	164	172	206	216	0.86	0.82	4%
	M	-	229	303	1.50%	232	308	327	433	0.87	0.97	2%
	N	-	31	71	3.00%	32	73	63	144	0.71	0.74	2%
Mainline												
NB	Rives Rd	I-95	-	-	1.20%	1,023	1,026	1,346	1350	0.95	0.99	15%
NB	I-95	Rives Rd	-	-	1.20%	777	781	1,022	1028	0.96	0.97	15%
SB	Rives Rd	I-95	-	-	1.20%	609	970	801	1276	0.83	0.94	12%
SB	I-95	Rives Rd	-	-	1.20%	762	1,248	1,003	1642	0.84	0.96	12%



RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	Sarah Sciarrino	Freeway/Dir of Travel	I-95 N
Agency or Company	Kimley-Horn	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	Petersburg
Analysis Time Period	AM Peak	Analysis Year	2012

Project Description I-95/I-85 RSA

Site Information

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A:	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D: 895	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 777	V_D = veh/h
	Ramp Volume, V_R: 63	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	777	0.96	Level	15	0	0.930	1.00	870
Ramp	63	0.88	Level	1	0	0.995	1.00	72
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R = mph (Exhibit 13-11)

S_0 = mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 870 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	870	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	798	Exhibit 13-8	4700	No
V_R	72	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	870	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 3.7 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.434 (Exhibit 13-12)

S_R = 55.0 mph (Exhibit 13-12)

S_0 = N/A mph (Exhibit 13-12)

S = 55.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	Sarah Sciarrino	Freeway/Dir of Travel	I-95 N
Agency or Company	Kimley-Horn	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	Petersburg
Analysis Time Period	PM Peak	Analysis Year	2012

Project Description I-95/I-85 RSA

Site Information

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A:	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D: 895	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 781	V_D = veh/h
	Ramp Volume, V_R: 54	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	781	0.97	Level	15	0	0.930	1.00	866
Ramp	54	0.75	Level	1	0	0.995	1.00	72
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 866 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	866	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	794	Exhibit 13-8	4700	No
V_R	72	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	866	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 3.6 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.434 (Exhibit 13-12)

S_R= 55.0 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 55.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Sarah Sciarrino	Freeway/Dir of Travel	I-95 N
Agency or Company	Kimley-Horn	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	Petersburg
Analysis Time Period	AM Peak	Analysis Year	2035

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A:	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D: 895	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1022	V_D = veh/h
	Ramp Volume, V_R: 80	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1022	0.92	Level	15	0	0.930	1.00	1194
Ramp	80	0.92	Level	1	0	0.995	1.00	87
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1194 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1194	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	1107	Exhibit 13-8	4700	No
V_R	87	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1194	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 6.5 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.436 (Exhibit 13-12)

S_R= 55.0 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 55.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	Sarah Sciarrino	Freeway/Dir of Travel	I-95 N
Agency or Company	Kimley-Horn	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	Petersburg
Analysis Time Period	PM Peak	Analysis Year	2035

Project Description I-95/I-85 RSA

Site Information

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A:	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D: 895	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1028	V_D = veh/h
	Ramp Volume, V_R: 68	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1028	0.92	Level	15	0	0.930	1.00	1201
Ramp	68	0.92	Level	1	0	0.995	1.00	74
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1201 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1201	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	1127	Exhibit 13-8	4700	No
V_R	74	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1201	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 6.5 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.435 (Exhibit 13-12)

S_R= 55.0 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 55.0 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Sarah Sciarrino	Freeway/Dir of Travel	I-95 S
Agency or Company	Kimley-Horn	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	Petersburg
Analysis Time Period	AM Peak	Analysis Year	2012

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A:	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D: 640	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 762	V_D = veh/h
	Ramp Volume, V_R: 292	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	762	0.84	Level	12	0	0.943	1.00	962
Ramp	292	0.95	Level	4	0	0.980	1.00	314
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 962 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	962	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	648	Exhibit 13-8	4700	No
V_R	314	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	962	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 6.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.456 (Exhibit 13-12)

S_R= 54.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	Sarah Sciarrino	Freeway/Dir of Travel	I-95 S
Agency or Company	Kimley-Horn	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	Petersburg
Analysis Time Period	PM Peak	Analysis Year	2012

Project Description I-95/I-85 RSA

Site Information

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A:	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D: 640	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1248	V_D = veh/h
	Ramp Volume, V_R: 369	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1248	0.96	Level	12	0	0.943	1.00	1378
Ramp	369	0.90	Level	4	0	0.980	1.00	418
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1378 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1378	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	960	Exhibit 13-8	4700	No
V_R	418	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1378	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 10.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.466 (Exhibit 13-12)

S_R= 54.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Sarah Sciarrino	Freeway/Dir of Travel	I-95 S
Agency or Company	Kimley-Horn	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	Petersburg
Analysis Time Period	AM Peak	Analysis Year	2035

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A:	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D: 640	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1003	V_D = veh/h
	Ramp Volume, V_R: 371	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1003	0.92	Level	12	0	0.943	1.00	1156
Ramp	371	0.92	Level	4	0	0.980	1.00	411
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1156 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1156	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	745	Exhibit 13-8	4700	No
V_R	411	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1156	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 8.4 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.465 (Exhibit 13-12)

S_R= 54.3 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.3 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	Sarah Sciarrino	Freeway/Dir of Travel	I-95 S
Agency or Company	Kimley-Horn	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	Petersburg
Analysis Time Period	PM Peak	Analysis Year	2035

Project Description I-95/I-85 RSA

Site Information

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A:	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D: 640	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1642	V_D = veh/h
	Ramp Volume, V_R: 469	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1642	0.92	Level	12	0	0.943	1.00	1892
Ramp	469	0.92	Level	4	0	0.980	1.00	520
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1892 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1892	Exhibit 13-8	4700	No
$V_{FO} = V_F - V_R$	1372	Exhibit 13-8	4700	No
V_R	520	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1892	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 14.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.475 (Exhibit 13-12)

S_R= 54.1 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Ben Martin	Freeway/Dir of Travel	I-95 NB
Agency or Company	Kimley-Horn and Associates	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	City of Petersburg
Analysis Time Period	AM Peak	Analysis Year	2012

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A: 695	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D:	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1023	V_D = veh/h
	Ramp Volume, V_R: 337	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1023	0.95	Level	15	0	0.930	1.00	1158
Ramp	337	0.96	Level	3	0	0.985	1.00	356
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1158 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1514	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1514	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 12.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.290 (Exibit 13-11)

S_R = 58.3 mph (Exhibit 13-11)

S_0 = N/A mph (Exhibit 13-11)

S = 58.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Ben Martin	Freeway/Dir of Travel	I-95 NB
Agency or Company	Kimley-Horn and Associates	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	City of Petersburg
Analysis Time Period	PM Peak	Analysis Year	2012

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A: 695	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D:	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1026	V_D = veh/h
	Ramp Volume, V_R: 338	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1026	0.97	Level	15	0	0.930	1.00	1137
Ramp	338	0.93	Level	3	0	0.985	1.00	369
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1137 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1506	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1506	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 12.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.290 (Exibit 13-11)

S_R = 58.3 mph (Exhibit 13-11)

S_0 = N/A mph (Exhibit 13-11)

S = 58.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Ben Martin	Freeway/Dir of Travel	I-95 NB
Agency or Company	Kimley-Horn and Associates	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	City of Petersburg
Analysis Time Period	AM Peak	Analysis Year	2035

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A: 695	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D:	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1346	V_D = veh/h
	Ramp Volume, V_R: 665	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1346	0.90	Level	15	0	0.930	1.00	1608
Ramp	665	0.92	Level	3	0	0.985	1.00	734
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1608 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2342	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2342	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 19.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.313 (Exibit 13-11)

S_R = 57.8 mph (Exhibit 13-11)

S_0 = N/A mph (Exhibit 13-11)

S = 57.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Ben Martin	Freeway/Dir of Travel	I-95 NB
Agency or Company	Kimley-Horn and Associates	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	City of Petersburg
Analysis Time Period	PM Peak	Analysis Year	2035

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A: 695	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D:	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1350	V_D = veh/h
	Ramp Volume, V_R: 667	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1350	0.90	Level	15	0	0.930	1.00	1612
Ramp	667	0.92	Level	3	0	0.985	1.00	736
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1612 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2348	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2348	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 19.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.313 (Exibit 13-11)

S_R = 57.8 mph (Exhibit 13-11)

S_0 = N/A mph (Exhibit 13-11)

S = 57.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Ben Martin	Freeway/Dir of Travel	I-95 NB
Agency or Company	Kimley-Horn and Associates	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	City of Petersburg
Analysis Time Period	AM Peak	Analysis Year	2012

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A: 745	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D:	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 609	V_D = veh/h
	Ramp Volume, V_R: 41	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	609	0.83	Level	12	0	0.943	1.00	778
Ramp	41	0.73	Level	3	0	0.985	1.00	57
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 778 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	835	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	835	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 7.3 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.278 (Exibit 13-11)

S_R = 58.6 mph (Exhibit 13-11)

S_0 = N/A mph (Exhibit 13-11)

S = 58.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Ben Martin	Freeway/Dir of Travel	I-95 NB
Agency or Company	Kimley-Horn and Associates	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	City of Petersburg
Analysis Time Period	PM Peak	Analysis Year	2012

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A: 745	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D:	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 970	V_D = veh/h
	Ramp Volume, V_R: 105	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	970	0.94	Level	12	0	0.943	1.00	1094
Ramp	105	0.91	Level	3	0	0.985	1.00	117
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1094 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1211	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1211	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 10.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.282 (Exibit 13-11)

S_R = 58.5 mph (Exhibit 13-11)

S_0 = N/A mph (Exhibit 13-11)

S = 58.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Ben Martin	Freeway/Dir of Travel	I-95 NB
Agency or Company	Kimley-Horn and Associates	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	City of Petersburg
Analysis Time Period	AM Peak	Analysis Year	2035

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A: 745	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D:	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 801	V_D = veh/h
	Ramp Volume, V_R: 81	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	801	0.90	Level	12	0	0.943	1.00	943
Ramp	81	0.92	Level	3	0	0.985	1.00	89
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 943 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1032	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1032	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 8.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.280 (Exibit 13-11)

S_R = 58.6 mph (Exhibit 13-11)

S_0 = N/A mph (Exhibit 13-11)

S = 58.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	Ben Martin	Freeway/Dir of Travel	I-95 NB
Agency or Company	Kimley-Horn and Associates	Junction	Rives Road
Date Performed	7/10/2012	Jurisdiction	City of Petersburg
Analysis Time Period	PM Peak	Analysis Year	2035

Project Description I-95/I-85 RSA

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Number of Lanes, N: 2	☐ Yes ☐ On
☑ No ☐ Off	Acceleration Lane Length, L_A: 745	☑ No ☐ Off
L_{up} = ft	Deceleration Lane Length L_D:	L_{down} = ft
V_u = veh/h	Freeway Volume, V_F: 1276	V_D = veh/h
	Ramp Volume, V_R: 207	
	Freeway Free-Flow Speed, S_{FF}: 65.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1276	0.90	Level	12	0	0.943	1.00	1503
Ramp	207	0.92	Level	3	0	0.985	1.00	228
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1503 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1731	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1731	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.291 (Exibit 13-11)

S_R = 58.3 mph (Exhibit 13-11)

S_0 = N/A mph (Exhibit 13-11)

S = 58.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

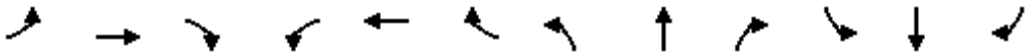
S_R = mph (Exhibit 13-12)

S_0 = mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

HCM Unsignalized Intersection Capacity Analysis
400: Rives Road & I-95 Northbound Ramps

8/1/2012



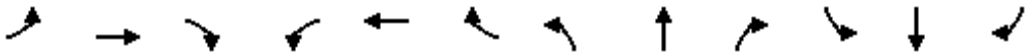
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	150	249	0	0	127	140	31	3	8	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.73	0.82	0.90	0.90	0.61	0.77	0.65	0.38	0.50	0.90	0.90	0.90
Hourly flow rate (vph)	205	304	0	0	208	182	48	8	16	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	390			304			1014	1105	304	1034	1014	299
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	390			304			1014	1105	304	1034	1014	299
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	82			100			75	95	98	100	100	100
cM capacity (veh/h)	1168			1257			188	174	736	172	197	740

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	509	390	72
Volume Left	205	0	48
Volume Right	0	182	16
cSH	1168	1700	223
Volume to Capacity	0.18	0.23	0.32
Queue Length 95th (ft)	16	0	33
Control Delay (s)	4.6	0.0	28.6
Lane LOS	A		D
Approach Delay (s)	4.6	0.0	28.6
Approach LOS			D

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	50.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
300: Rives Road & I-95 Southbound Ramps

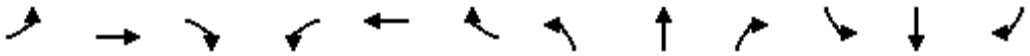
8/1/2012



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	232	32	12	146	0	0	0	0	164	3	77
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.87	0.71	0.75	0.81	0.90	0.90	0.90	0.90	0.86	0.25	0.72
Hourly flow rate (vph)	0	267	45	16	180	0	0	0	0	191	12	107
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	180			312			614	501	289	501	524	180
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	180			312			614	501	289	501	524	180
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			100	100	100	60	97	88
cM capacity (veh/h)	1395			1249			343	466	750	475	452	862

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	312	196	310
Volume Left	0	16	191
Volume Right	45	0	107
cSH	1700	1249	561
Volume to Capacity	0.18	0.01	0.55
Queue Length 95th (ft)	0	1	83
Control Delay (s)	0.0	0.8	19.0
Lane LOS		A	C
Approach Delay (s)	0.0	0.8	19.0
Approach LOS			C

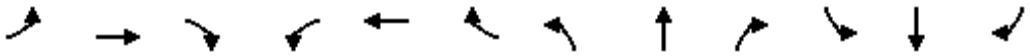
Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	38.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	308	79	8	207	0	0	0	0	172	2	148
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.97	0.74	0.40	0.91	0.90	0.90	0.90	0.90	0.82	0.25	0.90
Hourly flow rate (vph)	0	318	107	20	227	0	0	0	0	210	8	164
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	227			424			807	638	371	638	692	227
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	227			424			807	638	371	638	692	227
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			100	100	100	45	98	80
cM capacity (veh/h)	1341			1135			232	387	675	384	361	812

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	424	247	382
Volume Left	0	20	210
Volume Right	107	0	164
cSH	1700	1135	496
Volume to Capacity	0.25	0.02	0.77
Queue Length 95th (ft)	0	1	171
Control Delay (s)	0.0	0.8	32.7
Lane LOS		A	D
Approach Delay (s)	0.0	0.8	32.7
Approach LOS			D

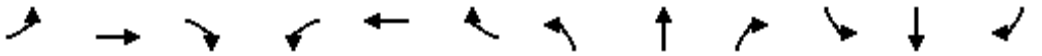
Intersection Summary			
Average Delay	12.0		
Intersection Capacity Utilization	46.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	115	366	0	0	173	152	42	2	5	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.74	0.80	0.90	0.90	0.77	0.73	0.70	0.50	0.63	0.90	0.90	0.90
Hourly flow rate (vph)	155	458	0	0	225	208	60	4	8	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	433			458			1097	1201	458	1107	1097	329
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	433			458			1097	1201	458	1107	1097	329
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	86			100			65	97	99	100	100	100
cM capacity (veh/h)	1127			1103			170	159	603	162	184	713

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	613	433	72
Volume Left	155	0	60
Volume Right	0	208	8
cSH	1127	1700	184
Volume to Capacity	0.14	0.25	0.39
Queue Length 95th (ft)	12	0	43
Control Delay (s)	3.4	0.0	36.5
Lane LOS	A		E
Approach Delay (s)	3.4	0.0	36.5
Approach LOS			E

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	327	63	17	201	0	0	0	0	206	4	152
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.87	0.71	0.75	0.81	0.90	0.90	0.90	0.90	0.86	0.25	0.72
Hourly flow rate (vph)	0	376	89	23	248	0	0	0	0	240	16	211
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												32
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	248			376			677	669	376	669	669	248
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	248			376			677	669	376	669	669	248
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			100	100	100	34	96	73
cM capacity (veh/h)	1318			1183			256	371	671	366	371	791

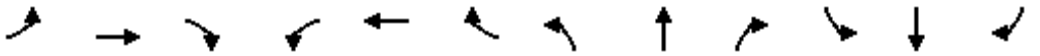
Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	376	89	271	467
Volume Left	0	0	23	240
Volume Right	0	89	0	211
cSH	1700	1700	1183	668
Volume to Capacity	0.22	0.05	0.02	0.70
Queue Length 95th (ft)	0	0	1	142
Control Delay (s)	0.0	0.0	0.8	24.1
Lane LOS			A	C
Approach Delay (s)	0.0		0.8	24.1
Approach LOS				C

Intersection Summary			
Average Delay	9.5		
Intersection Capacity Utilization	42.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	297	236	0	0	179	276	39	4	10	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.73	0.82	0.90	0.90	0.61	0.77	0.65	0.38	0.50	0.90	0.90	0.90
Hourly flow rate (vph)	407	288	0	0	293	358	60	11	20	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)									32			
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	652			288			1574	1753	288	1589	1574	473
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	652			288			1574	1753	288	1589	1574	473
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	56			100			0	78	97	100	100	100
cM capacity (veh/h)	935			1274			59	48	751	47	62	591

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	695	652	91
Volume Left	407	0	60
Volume Right	0	358	20
cSH	935	1700	73
Volume to Capacity	0.44	0.38	1.23
Queue Length 95th (ft)	56	0	175
Control Delay (s)	9.5	0.0	247.3
Lane LOS	A		F
Approach Delay (s)	9.5	0.0	247.3
Approach LOS			F

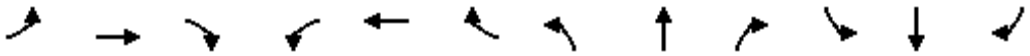
Intersection Summary			
Average Delay	20.2		
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	433	144	11	285	0	0	0	0	216	3	293
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.97	0.74	0.40	0.91	0.90	0.90	0.90	0.90	0.82	0.25	0.90
Hourly flow rate (vph)	0	446	195	28	313	0	0	0	0	263	12	326
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												32
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	313			446			821	815	446	815	815	313
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	313			446			821	815	446	815	815	313
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			100	100	100	9	96	55
cM capacity (veh/h)	1247			1114			154	304	612	291	304	727

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	446	195	341	601
Volume Left	0	0	28	263
Volume Right	0	195	0	326
cSH	1700	1700	1114	636
Volume to Capacity	0.26	0.11	0.02	0.95
Queue Length 95th (ft)	0	0	2	325
Control Delay (s)	0.0	0.0	0.9	43.5
Lane LOS			A	E
Approach Delay (s)	0.0		0.9	43.5
Approach LOS				E

Intersection Summary			
Average Delay	16.7		
Intersection Capacity Utilization	46.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	228	421	0	0	243	301	53	3	6	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.74	0.80	0.90	0.90	0.77	0.73	0.70	0.50	0.63	0.90	0.90	0.90
Hourly flow rate (vph)	308	526	0	0	316	412	76	6	10	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)									32			
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	728			526			1664	1870	526	1672	1664	522
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	728			526			1664	1870	526	1672	1664	522
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	65			100			0	87	98	100	100	100
cM capacity (veh/h)	876			1041			56	47	552	49	63	555

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	834	728	91
Volume Left	308	0	76
Volume Right	0	412	10
cSH	876	1700	62
Volume to Capacity	0.35	0.43	1.48
Queue Length 95th (ft)	40	0	199
Control Delay (s)	7.8	0.0	369.7
Lane LOS	A		F
Approach Delay (s)	7.8	0.0	369.7
Approach LOS			F

Intersection Summary			
Average Delay	24.3		
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15