Eastern Shore

Safety Study

April 2016

VDOT
Virginia Department of Transportation

vhb

Acknowledgments

This plan was produced by

VHB

for

Virginia Department of Transportation (VDOT)

Table of Contents

Table of Contents i
List of Figures ii
List of Tables iii
Definition of Terms iv
Sources iv
Executive Summary v
E.1 2002 Study Comparison vii
E.2 Recommendations and Action Plan vii
1. Introduction 1
1.1 Study Area 3
1.2 Study Team and Coordination 3
1.3 Study Goals and Objectives 3
2. Methodology 5
2.1 Study Methodology 7
2.2 Public Involvement 7
2.3 Crash Modification Factors 8
3. Comparative Analysis 9
3.1 Crash History Comparison 11
3.2 Speed Limit Evaluation 14
4. Systemic Analysis 19
4.1 Introduction and Methodology 20
4.2 Systemic Risk Factor Analysis 20
4.3 Risk Factor Determination 21
4.4 Summary 26
4.5 Countermeasure Selection 28
5. Crossovers 45
5.1 Introduction 47
5.2 Evaluation 47
6. Site Specific Analysis 57
6.1 Introduction 59
6.2 Site Specific Location #1 North of Jonathans Landing Lane (MP 76.13) 62
6.3 Site Specific Location #2 Stone Road (MP 79.18 – 79.43) 63
6.4 Site Specific Location #3 Eyrehall Drive (MP 82.40) 64
6.5 Site Specific Location #4 Captain Howe Lane (MP 84.14) 66
6.6 Site Specific Location #5 Near Sylvan Scene Drive (MP 90.50 – 90.99) 68
6.7 Site Specific Location #6 Bayford Road (MP 93.28 – 94.04) 69
6.8 Site Specific Location #7 South of West Street (MP 106.14) 71
6.9 Site Specific Location #8 Dogwood Drive (MP 110.31) 72
6.10 Site Specific Location #9 North of Dogwood Drive (MP 110.95) 74
6.11 Site Specific Location #10 Chesapeake Square Shopping Center (MP 113.04) 75
6.12 Site Specific Location #11 Taylor Road (MP 113.69) 76
6.13 Site Specific Location #12 Daugherty Road (MP 113.99) 78
6.14 Site Specific Location #13 Courthouse Avenue (MP 115.94) 80
6.15 Site Specific Location #14 Mary N Smith Road/Front Street (MP 117.23 – 117.61) 81
6.16 Site Specific Location #15 Evans Road (MP 118.83) 82
6.17 Site Specific Location #16 Parksley Road (MP 119.55) 83
6.18 Site Specific Location #17 South of Whites Neck Road (MP 120.90 – 121.30) 84
6.19 Site Specific Location #18 Nelsonia Road (MP 124.23) 86
6.20 Site Specific Location #19 Groton Town Road (MP 126.74 – 127.33) 88
6.21 Site Specific Location #20 Hallwood Road (MP 128.23 - 128.37) 90
6.22 Site Specific Locations #21 and #22 Temperanceville Road (MP 129.64 – 130.47) 92
6.23 Site Specific Location #23 Chincoteague Road (MP 133.73) 96
6.24 Site Specific Location #24 East of U.S. Route 13 98
6.25 Site Specific Location #25 Bridge Crossing Wire Narrows 99
7. Recommendations 101
7.1 Study Recommendations 103

Appendix A Intersection Templates
Appendix B Citizen Comments
Appendix C USLIMITS2 Reports
Appendix D Crossover Analysis
Appendix E Site Specific Cost Estimate
Appendix F Restricted Crossing U-Turn Intersection

List of Figures

Figure ES.1 Crash Types vii
Figure 1.1 Study Area 4
Figure 2.1 Study Process 7
Figure 2.2 Systemic Analysis Process 7
Figure 3.1 Number of Crashes 11
Figure 3.2 Crash Rates 11
Figure 3.3 Fatal Crashes by Segment 11
Figure 3.4 Roadway Departure Crash Comparison 11
Figure 3.5 Histogram - Northampton County 12
Figure 3.6 Histogram - Accomack County 13
Figure 3.7 Crashes by Season 14
Figure 3.8 Segments with High Frequency of Speeding Crashes 15
Figure 3.9 Speed Survey Data Points 16
Figure 3.10 Speed Data Within Town Limits 17
Figure 4.1 Systemic Process 20
Figure 4.2 Potential for Safety Improvement Locations 31
Figure 4.3 Corridor Template Locations - Accomack County 32
Figure 4.4 Corridor Template Locations - Northampton County 33
Figure 4.5 Corridor Template Locations - Accomack County 34
Figure 4.6 Corridor Template Locations - Northampton County 35
Figure 4.7 Intersection Template Locations 36
Figure 4.8 Intersection Template Locations 37
Figure 4.9 Intersection Template Locations 38
Figure 4.10 Intersection Template Locations 39
Figure 4.11 Intersection Template Locations 40
Figure 4.12 Intersection Template Locations 41
Figure 4.13 Intersection Template Locations 42
Figure 4.14 Intersection Template Locations 43
Figure 4.15 Intersection Template Locations 44
Figure 5.1 RCUT Intersection Diagram 47
Figure 5.2 Recommended Median Closures 48
Figure 5.3 Recommended Median Closures 49
Figure 5.4 Recommended Median Closures 50
Figure 5.5 Recommended Median Closures 51
Figure 5.6 Recommended Median Closures 52
Figure 5.7 Recommended Median Closures 53
Figure 5.8 Recommended Median Closures 54
Figure 5.9 Recommended Median Closures 55
Figure 5.10 Recommended Median Closures 56
Figure 6.1 Site Specific Locations - Accomack County 58
Figure 6.2 Site Specific Locations - Northampton County 59
Figure 6.3 Concept Plan - Site Specific Location #3 65
Figure 6.4 Concept Plan - Site Specific Location #4 67
Figure 6.5 Concept Plan - Site Specific Location #8 73
Figure 6.6 Concept Plan - Site Specific Location #11 77
Figure 6.7 Concept Plan - Site Specific Location #12 79
Figure 6.8 Concept Plan - Site Specific Location #17 85
Figure 6.9 Concept Plan - Site Specific Location #18 87
Figure 6.10 Concept Plan - Site Specific Location #19 89
Figure 6.11 Concept Plan - Site Specific Location #20 91
Figure 6.12 Concept Plan - Site Specific Locations #21 & #22 95
Figure 6.13 Concept Plan - Site Specific Location #23 97

List of Tables

Table ES.1 Cost Summary of Recommendations vii
Table 2.1 Crash Modification Factors 8
Table 3.1 Speed Summary 14
Table 4.1 Focus Crash Types 20
Table 4.2 Focus Facility Types 21
Table 4.3 Crashes by Corridor Type and Shoulder Presence 21
Table 4.4 Roadway Departure Crashes by Curve and Tangent Segment 22
Table 4.5 Roadway Departure Crashes by Light Condition 22
Table 4.6 Crashes by Weather Conditions 23
Table 4.7 Roadway Departure Crashes by Corridor Type and Posted Speed 23
Table 4.8 Comparison of Roadway Departure Crashes for Tangent and Curve Segments 23
Table 4.9 Angle Crashes by Intersection Type 24
Table 4.10 Non-Intersection Angle Crashes and Crash Rates 24
Table 4.11 Light Conditions of Angle Crashes at Unsignalized Intersections 24
Table 4.12 Crashes by Posted Speed 25
Table 4.13 Driver Action in Angle Crashes at Unsignalized Intersections 25
Table 4.14 Divided and Undivided Curve Crashes 26
Table 4.15 Curve Crashes by Corridor Type and Direction of Travel 26
Table 4.16 Curve Crashes on Median Divided Corridors by Crash-Type and Light Condition 27
Table 4.17 Intersection Crashes on Median Divided Curves 27
Table 4.18 Roadway Departure Curve Crashes by Corridor Type and Shoulder Presence 27
Table 4.19 Light Conditions of Angle Crashes at Unsignalized Intersections 29
Table 4.20 Intersection Template Tier Summary 29
Table 4.21 Corridor Template Tier Summary 29
Table 6.1 U.S. Route 13 Segment Locations 47
Table 6.2 Location #1 Recommended Countermeasures 62
Table 6.3 Location #1 Cost Estimate 62
Table 6.4 Location #2 Recommended Countermeasures 63
Table 6.5 Location #2 Cost Estimate 63
Table 6.6 Location #3 Recommended Countermeasures 64
Table 6.7 Location #3 Cost Estimate 64
Table 6.8 Location #4 Recommended Countermeasures 66
Table 6.9 Location #4 Cost Estimate 66
Table 6.10 Location #5 Recommended Countermeasures 68
Table 6.11 Location #5 Cost Estimate 68
Table 6.12 Location #6 Recommended Countermeasures 69
Table 6.13 Location #6 Cost Estimate 69
Table 6.14 Location #7 Recommended Countermeasures 71
Table 6.15 Location #7 Cost Estimate 71
Table 6.16 Location #8 Recommended Countermeasures 72
Table 6.17 Location #8 Cost Estimate 73
Table 6.18 Location #9 Recommended Countermeasures 74
Table 6.19 Location #9 Cost Estimate 74
Table 6.20 Location #10 Recommended Countermeasures 75
Table 6.21 Location #10 Cost Estimate 75
Table 6.22 Location #11 Recommended Countermeasures 76
Table 6.23 Location #11 Cost Estimate 76
Table 6.24 Location #12 Recommended Countermeasures 78
Table 6.25 Location #12 Cost Estimate 79
Table 6.26 Location #13 Recommended Countermeasures 80
Table 6.27 Location #13 Cost Estimate 80
Table 6.28 Location #14 Recommended Countermeasures 81
Table 6.29 Location #14 Cost Estimate 81
Table 6.30 Location #15 Recommended Countermeasures 82
Table 6.31 Location #15 Cost Estimate 82
Table 6.32 Location #16 Recommended Countermeasures 83
Table 6.33 Location #16 Cost Estimate 83
Table 6.34 Location #17 Recommended Countermeasures 84
Table 6.35 Location #17 Cost Estimate 85
Table 6.36 Location #18 Recommended Countermeasures 86
Table 6.37 Location #18 Cost Estimate 87
Table 6.38 Location #19 Recommended Countermeasures 88
Table 6.39 Location #19 Cost Estimate 89
Table 6.40 Location #20 Recommended Countermeasures 90
Table 6.41 Location #20 Cost Estimate 91
Table 6.42 Locations #21 & #22 Recommended Countermeasures 93
Table 6.43 Locations #21 & #22 Cost Estimate 93
Table 6.44 Location #23 Recommended Countermeasures 97
Table 6.45 Location #23 Cost Estimate 97
Table 6.45 Location #24 Recommended Countermeasures 98
Table 6.46 Location #24 Cost Estimate 98
Table 6.48 Location #25 Recommended Countermeasures 99
Table 6.49 Location #25 Cost Estimate 99
Table 7.1 Recommended Improvements - U.S. Route 13 Segment #1 103
Table 7.2 Recommended Improvements - U.S. Route 13 Segment #2 104
Table 7.3 Recommended Improvements - U.S. Route 13 Segment #3 105
Table 7.4 Recommended Improvements - U.S. Route 13 Segment #4 106
Table 7.5 Recommended Improvements - U.S. Route 13 Segment #5 107
Table 7.6 Recommended Improvements - U.S. Route 13 Segment #6 108
Table 7.7 Recommended Improvements - U.S. Route 13 Segment #7 109
Table 7.8 Recommended Improvements - U.S. Route 13 Segment #8 110
Table 7.9 Recommended Improvements - U.S. Route 13 Segment #9 111
Table 7.10 Recommended Improvements - U.S. Route 13 Segment #10 112
Table 7.11 Recommended Improvements - U.S. Route 13 Segment #11 113
Table 7.12 Recommended Improvements - U.S. Route 13 Segment #12 114
Table 7.13 Recommended Improvements - U.S. Route 13 Segment #13 115
Table 7.14 Recommended Improvements - U.S. Route 13 Segment #14 116
Table 7.15 Recommended Improvements - U.S. Route 13 Segment #15 117
Table 7.16 Recommended Improvements - Route 175 118

Definition of Terms

Crossover - a break in the landscaped or concrete median

KAB Crashes - Fatal and severe crashes as noted by the KABCO scale: K = fatal crash; A = incapacitating injury; B = non-incapacitating injury; C = possible injury; and O = no injury.

Median Break - A break in the landscaped or concrete median often in association with a side street or entrance.

Median Shoulder - Shoulder provided on the left side of the travelway.

MUTCD – Manual on Uniform Traffic Control Devices for Streets and Highways. Published by the Federal Highway Administration (FHWA) to provide standardization of traffic control devices throughout the United States. Compliance with the MUTCD helps promote safe, orderly and efficient movement of traffic.

PSI – Potential for Safety Improvement. A statistical measurement providing an indication of where crashes may be reduced with intersection/corridor improvements or upgrades. It is the difference between expected crashes and actual crashes.

RCUT - Restricted Crossing U-Turn (RCUT) intersection. A geometric configuration at intersections where movements allowed include left turns, straight through, and right turns from the mainline; and right turns from the minor street. The minor street movements not allowed are left turns and straight through; those movements are accommodated by making a right turn and then a u-turn.

Roadway Departure - a crash where the vehicle ran off the road either to the right or to the left.

Safety Edge – a sloped pavement edge to the ground to aid vehicle recovery from a roadway departure.

Slip Lane – turn lane separated from the through travel lanes by a channelizing island

Vehicle Miles Traveled (VMT) - The number of miles collectively traveled by all vehicles on a specific stretch of roadway for one year.

Sources

American Association of State Highway and Transportation Officials. Highway Safety Manual. U.S. Department of Transportation, Federal Highway Administration.

Federal Highway Administration. Crash Modification Clearinghouse. Retrieved December 2015. < http://www.cmfclearinghouse.org/>

Federal Highway Administration. Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 Edition with Revision Numbers 1 and 2 incorporated, dated May 2012. U.S. Department of Transportation.

Federal Highway Administration Office of Safety. Systemic Safety Project Selection Tool. U.S. Department of Transportation, Federal Highway Administration.

Virginia Department of Transportation. Corridors of Statewide Significance Corridor Safety Assessment Process Guidelines. Commonwealth of Virginia.

Virginia Department of Transportation. Road Design Manual. Commonwealth of Virginia.

Virginia Department of Transportation. VDOT Tableau (2010-2014). VDOT Roadway Inventory. Commonwealth of Virginia.

GIS Data:

Intersections, rumble strips, light poles, signals, median crossover locations, mileposts, and horizontal curvature data created from a combination of aerial and field surveys, VHB.

Speed limit GIS data created by VHB from information on the VDOT website: http://virginiaroads.org/Mapping/#SpeedZones.

Traffic volumes and speed data received from Sabra Wang field data collection, 9/29/2015-10/1/2015 and Virginia Department of Transportation, January 2016.

GIS Mile markers, AADT, and street centerline received from VDOT.

GIS Shoulder width data created by VHB from Excel spreadsheet received from VDOT.

Crash records downloaded from VDOT via Tableaux data tool. <https://public.tableau.com> Crash narratives received from VDOT via email. The original source of these are the FR300 accident forms collected by Virginia State Police from multiple law enforcement agencies.

Top 100 VDOT ranked segments and intersections received as a KMZ file from VDOT.

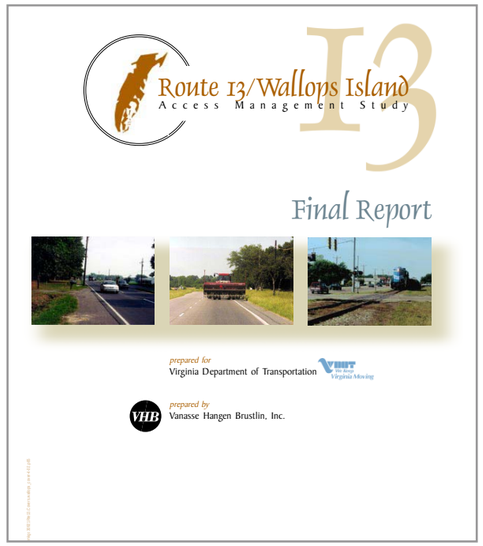
Base map data and graphics throughout this report were created using ArcGIS® software by Esri. ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright © Esri. All rights reserved.

Executive Summary

This page intentionally left blank.

The Virginia Department of Transportation (VDOT) identified the need to evaluate transportation deficiencies on U.S. Route 13 and portions of Route 175 on Virginia's Eastern Shore. This report documents the findings of the Eastern Shore Safety Study and presents the final recommendations and plan of action for the corridors. The goal of the study was to develop the basis of an action plan that VDOT can use to implement the countermeasures to make U.S. Route 13 and Route 175 safer transportation facilities for all who use them.

The study provided a historical safety comparison to the 2002 U.S. Route 13/ Wallops Island Access Management Study (2002 Study), produced a detailed tabulation of recommendations of safety treatments, and provided the corresponding information for implementation.



E.1 2002 Study Comparison

A crash data comparison between the three-year period from the 2002 Study (1997-1999) and the most recent three-year period (2012-2014) was prepared. The results show that there were 80 more crashes, a 10% increase, in the more recent period. Although there are more crashes, U.S. Route 13 and Route 175 serve more traffic on a daily basis. As a result, the crash rate calculations indicate that 13 of the 19 segments show a reduction in their crash rates.

Since 2002, some of the recommendations made in the earlier study to enhance safety and efficiency of the operation of the Eastern Shore corridors were implemented: 16 crossovers were closed, drainage grates were reconstructed, rumble strips on the left and right shoulder edges were installed where existing geometry could accommodate them, and advance intersection warning signs with beacons were installed. With the exception of the rumble strips, due to the timing and nature of the techniques applied, clear associated safety benefits from the measures could not be drawn. The enhanced safety of the corridors is recognized; however, the empirical data could not be used as documentation of lasting results. A comparison of 2010 versus 2014 roadway departure crashes showed a 27% reduction, attributed to the installation of the rumble strips.

E.2 Recommendations and Action Plan

The study utilized five years of crash data (2010 – 2014) to assess the current safety of the U.S. Route 13 and Route 175 corridors in accordance with the Corridor Safety Assessment (CSA) Process Guideline prepared for Corridors of Statewide Significance (CoSS). The data set included 1,574 crash records categorized as roadway departure, crash with an animal, angle, rear end, pedestrian, or other. The distribution by crash type is shown in Figure ES.1.

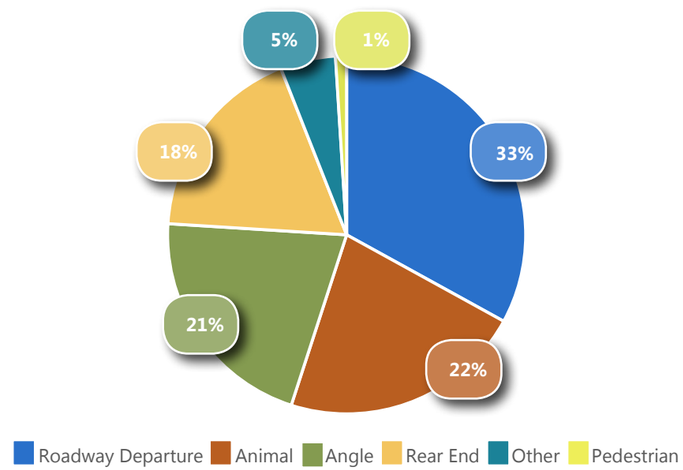


Figure ES.1.
Crash Types.

The data was processed from multiple perspectives to provide the most comprehensive evaluation of the roadway conditions. The results were used to prepare a set of countermeasures which can predictively produce facilities with reduced crash rates after implementation when referencing the Federal Highway Administration's (FHWA) Crash Modification Factors Clearinghouse (http://www.cmfclearinghouse.org).

The safety techniques can be organized into three categories. These categories including some examples are:

- Positive guidance and recovery measures – widening shoulders, installing safety edge, enhancing roadway delineation and lighting where needed;
- Unsignalized intersection measures – constructing left turn lanes at every median opening, if left-turn lane installation is not feasible, the median opening should be moved where turn lanes can be constructed or the opening closed, controlling access near all intersections, installing intersection warning signs; and
- Access management measures – modifying driveways and property frontage for improved control, consolidate and/or close median openings utilizing Restricted Crossing U-Turn (RCUT) intersections.

The countermeasures were assigned throughout the U.S. Route 13 and Route 175 corridors using the hybrid approach of crash history and compliance with the Virginia Supplement to the Manual of Uniform Traffic Control Devices (MUTCD). The safety analysis led to a series of recommendations which emerged from three processes: Systemic Evaluation, Crossover and Intersection Assessment, and Site Specific Evaluation. The associated costs within these categories are summarized in Table ES.1. All details can be found in the full document and appendices.

Table ES.1.
Cost Summary of Recommendations.

Treatment	Northampton County	Accomack County
Systemic Treatments	$4,224,613	$4,468,840
Crossover and Intersection Treatments	$5,022,934	$7,393,608
Site Specific Treatments	$2,304,607	$4,946,642
Total	**$11,552,154**	**$16,809,090**

The 2002 Study provided an access management evaluation and recommendations. This 2016 Study supersedes the 2002 Study recommendations with the exception of those discussed in Section 6.2.1 of the 2002 Study regarding U.S. Route 13 new roadway alignments and grade separated intersections.

This page intentionally left blank.

chapter

1

Introduction

This page intentionally left blank.

In 2002, the Virginia Department of Transportation (VDOT) and VHB developed the Route 13 / Wallops Island Access Management Study (2002 Study). The goal of the 2002 Study was to develop a plan that VDOT and the jurisdictions could implement to make U.S. Route 13 a safe and more efficient transportation facility for the traveling public over the next 20 years. Since then, the 2002 Study has served as guidance for the Eastern Shore.

Fifteen years later this study provides an assessment of the corridor following current design practice and methods of achieving higher levels of safety on the corridor. The 2002 Study included access management and safety improvement recommendations, some of which were implemented since the 2002 study. As a result, VDOT requested that VHB assess the current safety conditions of the corridors and determine if the implemented modifications improved safety. The assessment includes evaluation of recommendations implemented, which treatments were effective, and what should be programmed for future implementation. This report documents the findings of the study and presents the following: comparative analysis to the 2002 Study, systemic analysis of intersections and corridor segments, crossover and intersection assessment, site specific location evaluation, recommendations, and the plan of action for implementation.

1.1 Study Area

The study area is the U.S. Route 13 corridor from Route 600, just north of the Chesapeake Bay Bridge-Tunnel toll facility, north to the Virginia – Maryland state line, a distance of approximately 69 miles. In addition, Route 175, serving the NASA facility at Wallops Island, is included from its intersection with U.S. Route 13 east to the bridge to Chincoteague. Figure 1.1 on the following page depicts the study area.

Regionally, U.S. Route 13 is the principal north-south corridor linking Virginia Beach to the Eastern Shore north to Maryland. On the Eastern Shore of Virginia, U.S. Route 13 traverses both Northampton and Accomack Counties.

For many on the Eastern Shore, U.S. Route 13 is considered the "main street" and economic lifeline. Not only does it serve the municipalities of Cheriton, Eastville, Nassawadox, Exmore, Painter, Keller, Melfa, Onley, and Accomac but also the unincorporated communities of Treherneville, Birdsnest, Weirwood, Nelsonia, Mappsville, Temperanceville, Oak Hill, and New Church.

U.S. Route 13 is a four-lane highway with uncontrolled access that has a variable width median separating northbound and southbound traffic throughout most of the corridor. Speed limits vary from 45 miles per hour (mph) to 55 mph. Route 175 is a two-lane undivided corridor providing access from U.S. Route 13 to Chincoteague Island. It has a posted speed limit of 55 mph within the study area.

1.2 Study Team and Coordination

The Study Team includes local and regional staff from VDOT and VHB. A team of Project Stakeholders augments the Study Team to guide the consultant through the duration of the study, review all technical documents, and provide direct input on recommendations. The Stakeholders include representatives from VDOT's Transportation Planning, Traffic Engineering, and Location and Design Divisions, the Hampton Roads District and Accomack Residency, in addition to representatives from Accomack County, Northampton County, Chincoteague, Charles City, and the Accomack-Northampton Planning District Commission. The Project Stakeholders met at critical decision points, meeting on average every other month.

1.3 Study Goals and Objectives

Specific goals and objectives were developed at the outset based on field reviews of the corridor, information received during the initial scoping process, and input from the initial stakeholder meeting. The goal of the study was to set forth a set of tiered recommendations of signs, pavement markings, geometric changes, traffic control techniques and other improvements to enhance safety of the U.S. Route 13 and Route 175 corridors. The recommendations were determined through an evaluation of crash history and proactively applying templates of proven safety techniques in combination with site specific modifications with proven safety results.

The objectives in comprehensively assessing the safety of the corridors are as follows:

- Annotate the existing safety attributes;
- Identify key issues affecting travel safety along the corridors;
- Identify the implemented 2002 Study recommended improvements and their effectiveness;
- Synthesize crash data, existing conditions, median crossovers, bicycle and pedestrian accommodations, and speed limits; and
- Develop recommendations that address deficiencies, present phased implementation, and provide planning level cost estimates.

This report provides the documentation of the study, results, and recommendations. It is generally organized with the comparative analysis between the 2002 Study and existing conditions, systemic evaluation, crossover and intersection assessment, site specific location evaluation, recommendations, and the plan of action.

Figure 1.1
Study Area
Eastern Shore Safety Study

Methodology

chapter

2

This page intentionally left blank.

2.1 Study Methodology

The study follows VDOT's Corridor Safety Assessment (CSA) Process Guideline prepared for Corridors of Statewide Significance (CoSS). The CSA process is a systemic approach to proactively reduce potential crashes using a series of templates with tiered application for various geometric conditions. With the 2002 Study on file and used as a guiding document for more than a decade, the methodology for this study layered the nine step CSA process, see Figure 2.1, with a historic comparison to the 2002 Study, an assessment of crossover and intersection closure and treatments, and speed limit review. The comparative analysis has value in confirming the status of the corridor; however, the final recommendations are a product of the systemic analysis, crossover and intersection assessment, and the site specific location evaluation.

Figure 2.1.
Study Process.

The historic comparison to the 2002 Study was addressed in tandem with the CSA process. Implemented improvements from the 2002 Study have been documented in the Comparative Analysis (Chapter 3) of this report. Three-year (1997-1999 to 2012-2014) crash data was used to measure how well the implemented improvements achieved the reduction in the number of crashes or the severity of crashes. The field documentation was used to supplement database inventory of roadway attributes of the existing conditions used in the Comparative Analysis. Speed limits, shoulder widths, and rumble strips were the most thoroughly documented attributes, as the scope of this study did not include an asset inventory.

Analysis of speed related crashes and documentation of current travel speeds throughout the corridor were included within the original scope of the study. Since speed was a contributory factor on crashes outside town limits, VDOT supplemented the data for segments within town limits with posted speeds less than 55 miles per hour (mph). The results were used in the post-review data synthesis. The evaluation of the speed limit became a separate task and the results are presented in Chapter 3, Section 2.

VHB took a hybrid approach to evaluating the corridors using a process that was created by VHB for VDOT's CSA (see Figure 2.2), whereby systemic and site specific approaches were combined to comprehensively review the U.S. Route 13 corridor and Route 175 corridor. With this approach, VHB utilized the latest Highway Safety Improvement Program (HSIP) network screening results developed in early 2015 to identify key segment types, intersection types, and geometric features where systemic countermeasure packages developed for the CoSS could be deployed. The VDOT approved CoSS templates were modified to be specific to the Eastern Shore and were used to identify up to three tiers of countermeasure treatments to enhance safety. The Eastern Shore Templates are provided in Appendix A. The findings of the systemic analysis can be found in Chapter 4.

Through the public involvement process and legislative representation, the citizens in Northampton and Accomack Counties expressed concern on two major elements of the corridors: crossover closure and speed limits within towns. The 2002 Study had provided a list of crossovers to be closed, and 16 of those closures have been implemented by VDOT. As part of the current study, the crossover closures were reevaluated in conjunction with intersections and specific treatments recommended based on crash data, current design guidelines, and land use. The results and recommendations are discussed in Chapter 5.

GIS mapping tools and crash data analysis for a five-year period along with VDOT's Target Safety Need (TSN) were used to identify specific areas of concern or locations that have a potential for safety improvement. The more in-depth review was conducted at the 25 site specific locations which is described in detail in Chapter 6.

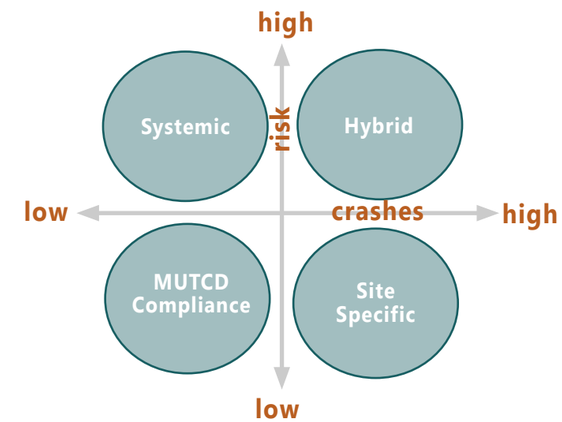


Figure 2.2.
Systemic Analysis Process.

The following items are detailed in the study report:

- Recommended upgrades of traffic control devices to meet current MUTCD standards outlined in the Virginia Supplement;
- Summarization of contributing driver behavior factors (e.g. DUI, occupant protection, and speed) where safety partners (e.g. Virginia State Police, local law enforcement, Department of Motor Vehicles) can be engaged to employ a comprehensive safety approach on U.S. Route 13 and Route 175;
- Recommended systemic countermeasure packages to address identified intersections and corridor segments;
- Recommended crossover and intersection closures and treatments; and
- Recommended site specific improvements for 25 locations along the corridor.

2.2 Public Involvement

This study relied heavily on the crash data to guide analysts to the site specific locations, to perform the systemic evaluation, and to apply the appropriate templates; nonetheless, there is always value in hearing citizens' perspectives and concerns. Crash history is a documentation of events, but does not capture the daily experience of the local community. The key components of the public involvement for this study were:

- Initial Scoping Meetings;
- Coordination with Elected Officials and Key Stakeholders; and
- Citizen Information Meetings.

Scoping meetings relied on VDOT's communication with multiple agencies, elected officials, and citizens over the past few years to define and refine the scope of the study. This process allowed the team to increase focus on the crossover and intersection assessment and on the speed limit evaluation.

Approximately every other month, coordination meetings with elected officials and key stakeholders were held to provide updates on the progress of the study. These meetings kept the leadership of the Eastern Shore informed and established a means for the leaders to provide input during the study process.

Additionally, two Citizen Information Meetings (CIM) were held; one during the initial investigation phase and one at the final stage. Citizen comments were solicited during the CIM#1 held on November 17, 2015 at the Eastern Shore Community College. A follow up CIM#2 was held on March 1, 2016 to report on analysis results and potential countermeasures which would be in the recommendations.

The CIM#1 included a 30-minute presentation about the study methodology and schedule. Boards were displayed for viewing and study team representatives engaged in conversation with citizens on their experiences along the corridors. A handout was provided for capturing comments which could be mailed in and was made available electronically after the meeting. The comment period was open until December 17, 2015.

Seventeen citizens provided comments (see Appendix B). Access management, especially near intersections, was mentioned several times. Seven comments referenced Location #2 requesting better access. The citizens recognize the value of connectivity between land uses so that local traffic can avoid using U.S. Route 13. Attentiveness to the needs of farmers was requested in recognition of the danger of the large, slow equipment mixing with the fast moving through traffic. Deficiencies of left turn lanes at median openings, and the subsequent danger, was highlighted as an issue, as well as the need for shoulders on Route 175.

Citizens expressed their concern of the Commonwealth's commitment to implement recommended treatments. Reference to public hearings in the past and the disappointment of not seeing more changes in making the corridors safer was included.

The comments received were reviewed during the analysis of the corridors and then again after the recommendations were drafted. The review was performed to ensure the concerns were taken into consideration during the study.

A second CIM (CIM#2) was held on March 1, 2016 as an update on the progress of the study. The study presentation provided an overview of the study process, some of the countermeasures which were in the recommendations, and the schedule. Additional comments were received and reviewed to ensure concerns were taken into consideration in the report.

2.3 Crash Modification Factors

A crash modification factor (CMF) is a factor, based on documented safety research studies, used to compute the expected number of crashes after implementing a given countermeasure at a specific site. CMFs provide some indication of the potential benefit, or lack thereof, associated with specific countermeasures. The Federal Highway Administration (FHWA) compiles CMF data from published safety studies and posts them in the CMF Clearinghouse (http://www.cmfclearinghouse.org/index.cfm) to help practitioners select the most effective safety treatments. While CMF data is not available for all potential countermeasures, the CMF Clearinghouse provides a useful and consolidated source of data to help engineers, planners, and project owners make informed decisions.

There are many countermeasure techniques recommended in this study and only some of them have CMFs associated with them. Table 2.1, below, is a sample of the techniques and the corresponding CMFs used in the study.

How do CMF's work?

CMFs are a multiplicative factor that can be used to estimate the number of crashes with implementation of the selected countermeasure. The following equation can be used to calculate the estimated crashes with the treatment:

$$\left(\text{Estimated Crashes WITH Treatment}\right) = \left(\text{CMF}\right) \times \left(\text{Estimated Crashes WITHOUT Treatment}\right)$$

Example:

A location had 10 crashes per year during the study period. The countermeasure has a CMF of 0.8, meaning according to research, this countermeasure may provide a 20% reduction in crashes. Therefore, the expected crashes after implementation of the countermeasure is 8 crashes per year.

$$\left(\text{Expected crashes}\right) = \left(0.8\right) \times \left(\text{10 crashes per year}\right) = \left(\text{8 crashes per year after implementation}\right)$$

Table 2.1.
Crash Modification Factors.

Countermeasure	CMF	Notes	Source
Install shoulder rumble strips	0.82 (18% reduction)	Roadway Departures - all severities	CMF Clearinghouse
Install center line rumble strips	0.82 (18% reduction)	All Crashes - fatal, serious injury	CMF Clearinghouse
Widen shoulder (paved) (from 2 to 4 ft)	0.89 (11% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Add dynamic intersection warning signs	0.814-0.918 (8.2%-18.6% reduction)	All Crashes - all severities	CMF Clearinghouse
Intersection lighting	0.881 - 0.92 (8 - 11.9% reduction)	Nighttime crashes - all severities	CMF Clearinghouse
Directional medians to allow left-turns and u-turns	0.77 (23% reduction)	All Crashes - all severities	CMF Clearinghouse
Replace a direct left turn with a right-turn/u-turn[1] (RCUT Intersection)	0.8 (20% reduction)	All Crashes - all severities	CMF Clearinghouse
Provide a right-turn lane on one major road approach	0.86 - 0.92 (8 - 14% reduction)	All Crashes - all severities	CMF Clearinghouse
Corridor Access Management	0.77 - 0.95 (5 - 23% reduction)		FHWA Proven Countermeasures

[1]RCUT: Restricted Crossing U-Turn (RCUT) Intersection.

Comparative Analysis

chapter

3

This page intentionally left blank.

In 2002, VDOT and VHB developed the Route 13 / Wallops Island Access Management Study (2002 Study). This chapter provides a historic comparison to the 2002 Study safety analysis of the corridor between the three-year periods of 1997-1999 to 2012-2014 in an effort to measure how well the implemented improvements achieved the reduction in the number of crashes or the severity of crashes. The 2002 Study presented recommended system-wide safety treatments: the installation of 10-foot outside shoulders, rumble strips on the outside and inside shoulders, milepost markers at each mile, crossover closures, and turn lane improvement. Since the 2002 Study, rumble strips were installed, 16 crossovers were closed, and some intersection improvements were implemented. On the following pages, Figures 3.5 and 3.6 present some of the improvements recommended in the 2002 Study and some of the 2015 existing conditions related to safety along the corridor.

3.1 Crash History Comparison

There were a total of 80 more crashes along the study corridor. A 10% increase in crashes was shown from 1997-1999 to 2012-2014, see Figure 3.1. It can be noted that there was an increase of crashes in the north end; see Site Specific Locations 10-12. In the evaluation, the total number of crashes does not reflect the safety of the corridor relative to the volume of traffic served. While there are more crashes than before, which moves away from a desired count of zero, the corridor served more vehicles on an average daily basis in 2012 compared to the 2002 Study volume. The safety of the corridor is more accurately reflected when the increase in traffic volume is used in the measurement of the crash rate, expressed as crashes per 100 million vehicles miles traveled.

The crash rate of a specific location or along a segment is more telling of the safety of the conditions. For example, 20 crashes at a location that serves 10,000 vehicles per day is less safe than 20 crashes at a location that serves 20,000 vehicles per day. In review of the crash rates along the study corridors (see Figure 3.2), crash rates fell in 13 of the 19 segments, a reduction in 68% of the segments.

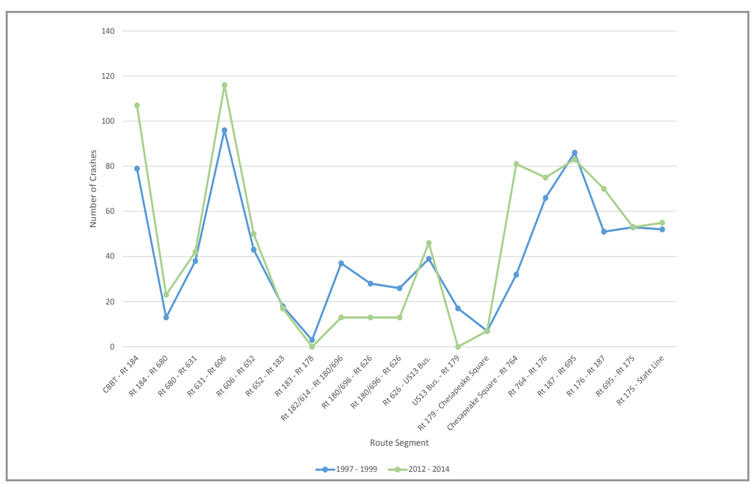


Figure 3.1.
Number of Crashes.

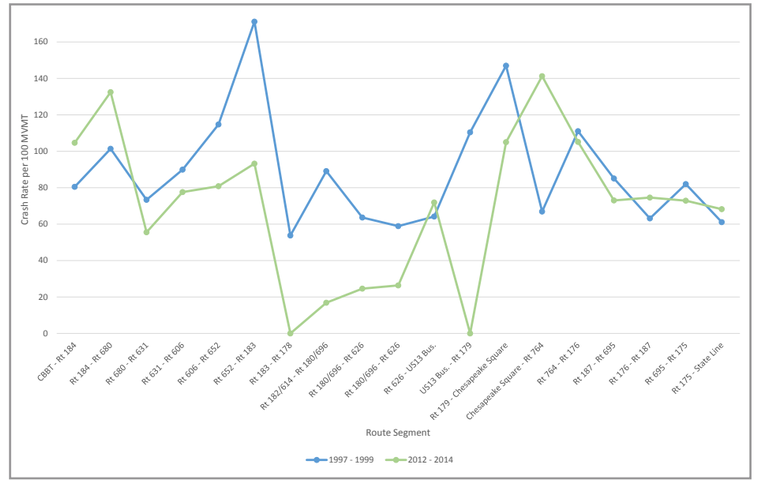


Figure 3.2.
Crash Rates.

3.1.1 Fatal Crash Evaluation

Fatal crashes are often random events; however, the locations where the events occur were investigated for environmental contributory factors. A comparison of 1997-1999 to 2012-2014 fatal crash data through the study area indicate that there has been a 54% reduction in fatal crashes. The location of the crashes are still concentrated between mileposts 115 and 125, and 135 and 140, see Figure 3.3. The site specific and systemic analyses included a detailed review of these areas and the recommendations incorporated from the findings are expected to enhance safety of these segments.

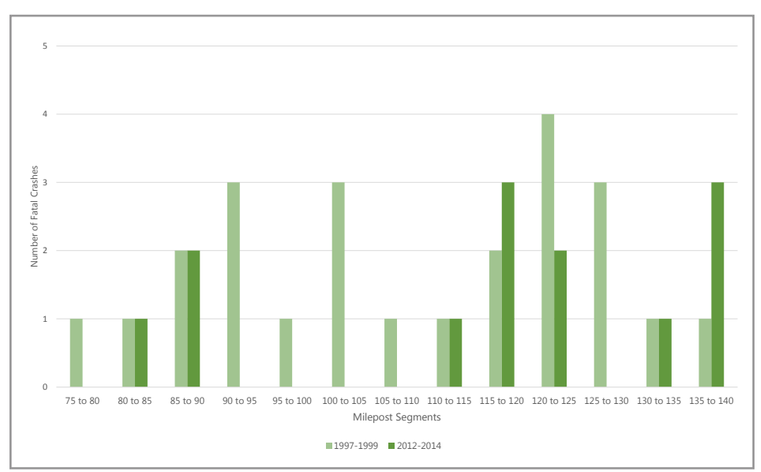


Figure 3.3.
Fatal Crashes by Segment.

3.1.2 Crossover Closure Effectiveness

The crash data at each of the 16 crossovers closed since 2002 did not show a dramatic effect on the reduction of the total crashes within the corridor. The crossovers which were closed were not heavily used and did not show repetitive crash history; therefore, the results are consistent with expectations having little to no effect on crash frequency. In recognition of the importance of how crossovers and intersections treatments are addressed within this study, Chapter 5 provides the detailed evaluation which leads to recommendations for implementation.

3.1.3 Rumble Strip Effectiveness

The rumble strips were installed just before 2014; therefore, the effectiveness of rumble strips in reducing roadway departure crashes on U.S. Route 13 was captured in data from 2010 versus 2014, see Figure 3.4. Rumble strips are the grooved edges of the travel lane which alert a driver through vibrational noise that the vehicle is drifting outside the travelway. VDOT installed rumble strips on both the left and right edges along U.S. Route 13 where it was feasible. This treatment is reported to have a crash modification factor of 0.82. It is reasonable to predict a reduction of roadway departure crashes over a three-year period by 18%. The analysis of the 2010 versus 2014 data showed an overall 27% reduction in roadway departure crashes, with reductions in nine of the 14 segments studied.

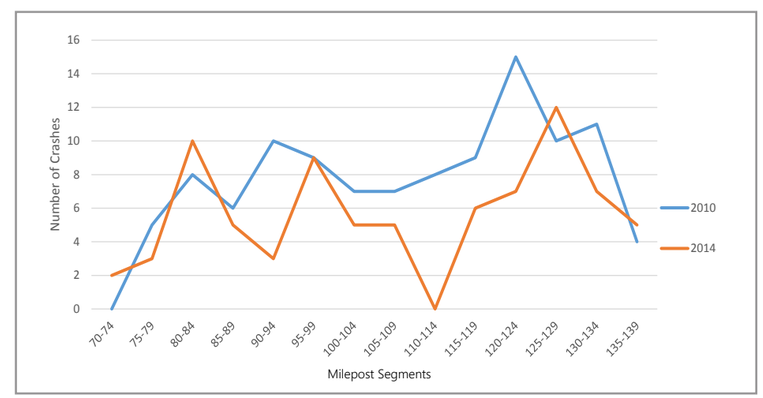
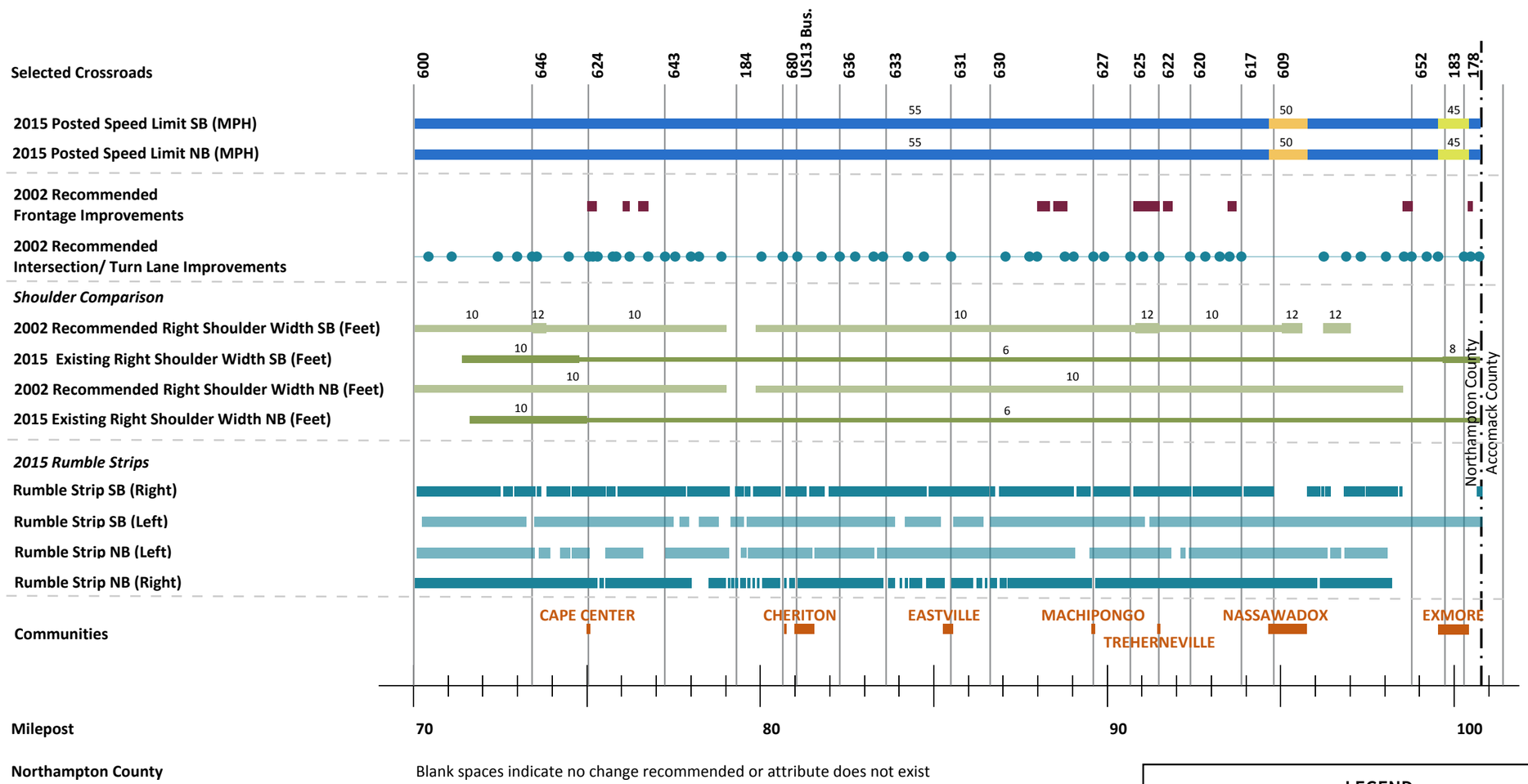


Figure 3.4.
Roadway Departure Crash Comparison.



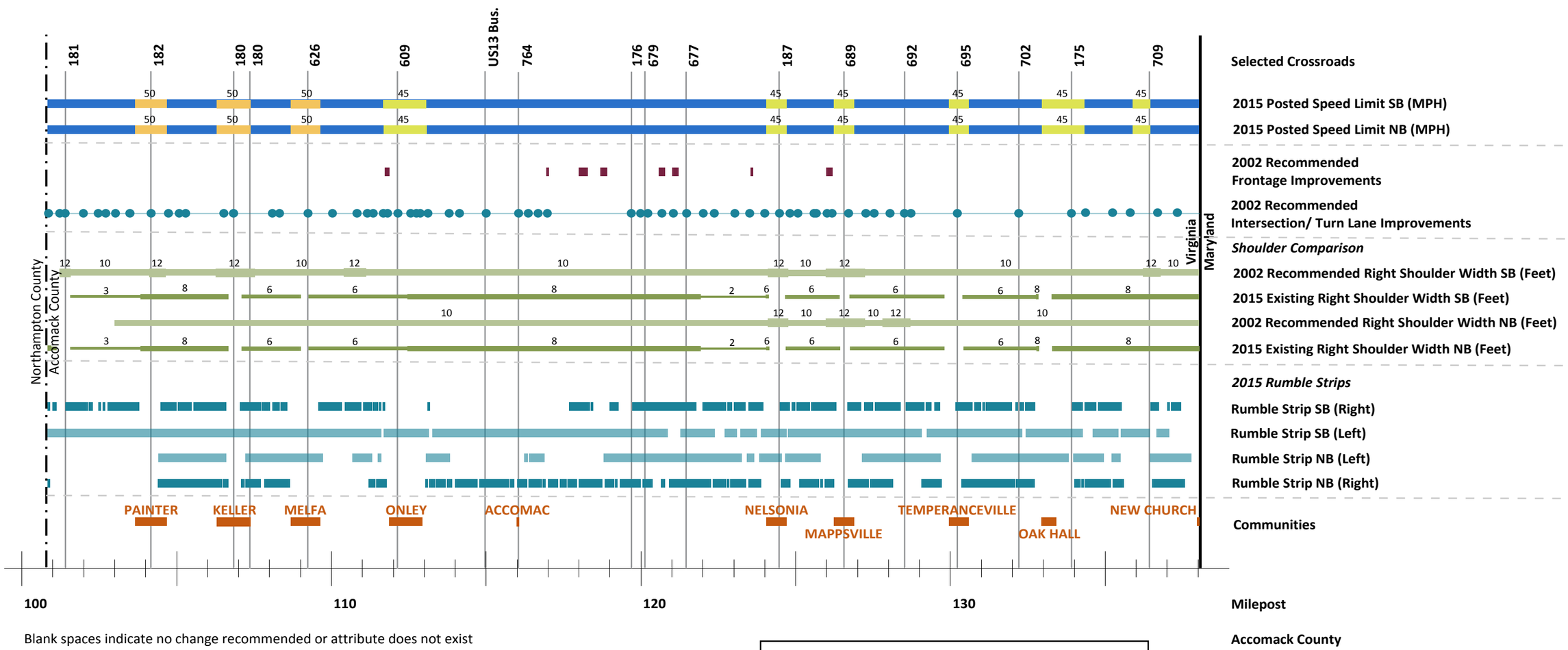
Northampton County

Blank spaces indicate no change recommended or attribute does not exist

LEGEND

- 2015 55 mph Posted Speed Limit
- 2015 50 mph Posted Speed Limit
- 2015 45 mph Posted Speed Limit
- 2002 Recommended Frontage Improvements
- 2002 Recommended Intersection / Turn Lane Improvements
- 2002 Recommended Right Shoulder Width SB & NB (FT)
- 2015 Existing Right Shoulder Width SB & NB (FT)
- 2015 Rumble Strip SB (Right)
- 2015 Rumble Strip SB & NB (Left)
- 2015 Rumble Strip NB (Right)

Figure 3.5
Histogram
Northampton County
Eastern Shore Safety Study



Blank spaces indicate no change recommended or attribute does not exist

LEGEND

- 2015 55 mph Posted Speed Limit
- 2015 50 mph Posted Speed Limit
- 2015 45 mph Posted Speed Limit
- 2002 Recommended Frontage Improvements
- 2002 Recommended Intersection / Turn Lane Improvements
- 2002 Recommended Right Shoulder Width SB & NB (FT)
- 2015 Existing Right Shoulder Width SB & NB (FT)
- 2015 Rumble Strip SB (Right)
- 2015 Rumble Strip SB & NB (Left)
- 2015 Rumble Strip NB (Right)

Figure 3.6
Histogram
Accomack County
Eastern Shore Safety Study

3.2 Speed Limit Evaluation

The systemic analysis approach in evaluating the safety of the corridors includes speed as a contributory factor; however, stakeholder and citizen feedback identified speeding as a key concern with merits to address speed independently as well. The overarching question is whether the posted speed limits on U.S. Route 13 and on Route 175 are appropriate for the conditions of the facilities.

U.S. Route 13 is mostly signed 55 mph with some areas posted 45 mph and 50 mph. The speed limit reductions are apparently based on geometric conditions and/or land use. For example, when the median transitions into a two-way left-turn lane, the speed limit reduces to 50 mph. Route 175 has a posted speed limit of 55 mph in the study area.

3.2.1 Data Collection

The first phase of the evaluation began with the crash history. The crash data from 2010 to 2014 identified 45 crashes of which the primary factor was speed. Forty-five crashes over a study area as large as this study was considered too small of a sample; therefore, expanding the sample to include other actions that may be speed-related such as improper passing, following too closely, and failure to maintain control, resulted in a total of 737 crashes. The larger sample size was used to identify the locations for speed data collection and analysis. The segments shown on the following page in Figure 3.8 represent the areas of the highest crashes directly attributable or may be related to speed.

The schedule to perform speed data collection was established based on the seasonal variation on when the most crashes related to speed occurred. As shown in Figure 3.7, 32% of speed related crashes occurred in the fall; therefore, the speed data was collected in September 2015, once school was back in session.

Since crash data led to data collection outside town limits, in January 2016, VDOT supplemented the first data set with segments within each of the town limits.

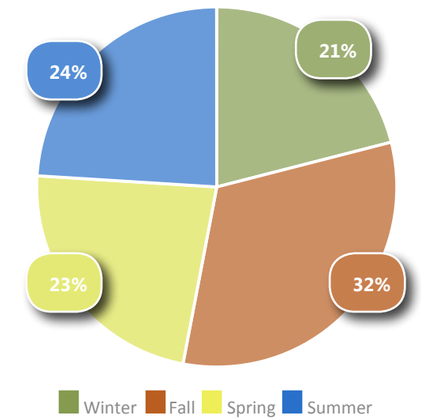


Figure 3.7.
Crashes by Season.

3.2.2 Evaluation

Speed limit evaluation on a facility such as U.S. Route 13 incorporates multiple considerations.

USLIMITS2, developed by the Federal Highway Administration (FHWA) and approved for use in the Manual of Uniform Traffic Control Devices (MUTCD), is a web based tool designed to help practitioners set reasonable, safe, and consistent speed limits for specific segments of roads. The tool utilizes statuary speed limits, 85th percentile speed data, traffic volume data, crash data, roadside conditions, development type, access points, and signalization to identify the posted speed limit for the studied segment (see Appendix C for USLIMITS2 Reports).

The two sets of data were processed and the 85th percentile speed was calculated. The 85th percentile speed is the speed at which 85 percent of the traffic is traveling at or below. The 85th percentile speed is used in establishing speed limits because it captures the speed at which a high majority of drivers feel comfortable driving based on the characteristics of the roadway. Lower speed limits are considered artificially set and are meaningless to drivers. This does not suggest that speed limits should be set to enable drivers to drive dangerously; however, it is an indicator that there are attributes of the roadway that may need to be modified to encourage drivers to feel more comfortable at a lower speed. The open flat terrain of the Eastern Shore poses a challenge on the issue of controlling speed.

On the U.S. Route 13 segments outside town limits, as shown in Figure 3.9, the 85th percentile speed exceeds 60 mph in 70 percent of the segments. The 85th percentile speed on Route 175 was between 51 and 55 mph. Inside the town limits, as presented in Figure 3.10 and Table 3.1, the 85th percentile speed was measured to be 50 mph or higher. These results are indicators that drivers are comfortable traveling at speeds higher than posted.

Based on the analyses, the posted speed limits on U.S. Route 13 are appropriate. The analysis further indicates that a 50 mph posted speed limit is appropriate for Route 175, therefore, it is recommended for the posted speed limit to be reduced from 55 mph to 50 mph.

Table 3.1.
Speed Summary.

Town	Current Speed Limit		85th Percentile Speeds		USLIMITS2 Calculated Speed		Recommended Speed Limit		Comments
	NB	SB	NB	SB	NB	SB	NB	SB	
Northampton County									
Exmore	45	45	53	53	55	55	45	45	Recommend no change.
Nassawadox	50	50	65	60	65	60	50	50	Recommend no change.
Accomack County									
Keller	50	50	64	64	65	65	50	50	Undivided with two-way left-turn. No change in speed limit recommended. Targeted speed enforcement recommended.
Mappsville	45	45	63	60	60	60	45	45	NB overall and injury crash rates exceed average for similar roads. SB crash rate is similar to average. No change in speed limit recommended. Targeted speed enforcement recommended instead.
Melfa	50	50	58	62	60	60	50	50	Undivided with two-way left-turn. No change in speed limit recommended. Targeted speed enforcement recommended.
Nelsonia	45	45	57	57	57	55	45	45	SB overall and injury crash rates exceed average for similar roads. No change in speed limit recommended. Targeted speed enforcement recommended instead.
New Church	45	45	58	58	55	55	45	45	NB and SB overall and injury crash rates exceed or equal average for similar roads. No change in speed limit recommended. Targeted speed enforcement recommended instead.
Oak Hill	45	45	56	59	55	60	45	45	NB and SB overall and injury crash rates exceed or equal average for similar roads. No change in speed limit recommended. Targeted speed enforcement recommended instead.
Onley	45	45	49	50	50	50	45	45	Recommend no change.
Painter	50	50	58	59	60	50	50	50	Undivided with two-way left-turn. No change in speed limit recommended. Targeted speed enforcement recommended.
Temperanceville	45	45	60	59	60	60	45	45	NB overall, NB injury crash and SB injury crash rates exceed average for similar roads, SB crash rate is similar to average. No change in speed limit recommended. Targeted speed enforcement for NB direction is recommended instead.

Figure 3.8
Segments with High Frequency of Speeding Crashes
Eastern Shore Safety Study

Figure 3.9
Speed Survey Data Points
Eastern Shore Safety Study

Figure 3.10
Speed Data Within Town Limits
Eastern Shore Safety Study

This page intentionally left blank.

Systemic Analysis

chapter

4

4.1 Introduction and Methodology

There are two primary approaches to addressing safety: using a site specific approach to address locations with a history of high or severe crashes, and using a systemic approach to proactively address safety by identifying and targeting specific risk factors. This chapter describes how the systemic analysis was applied to the study area.

The project team used the methodology created for the VDOT CSA for CoSS whereby a set of risk reducing templates are provided for intersections and for corridors throughout the study area. A full series of templates are provided in Appendix A. The countermeasures in the templates are grouped into tiers and are applied to the intersections and corridors based upon the presence of systemic risk factors, crash risk, and their Potential for Safety Improvement (PSI). Each of these three factors and how they impact tier selection are described in this chapter. The AASHTO Highway Safety Manual and FHWA systemic methodology guided the analysis and identification of systemic risk factors present throughout the study area.[1,2]

- The call-out boxes in this chapter highlight elements related to the focus area risk factor determination.

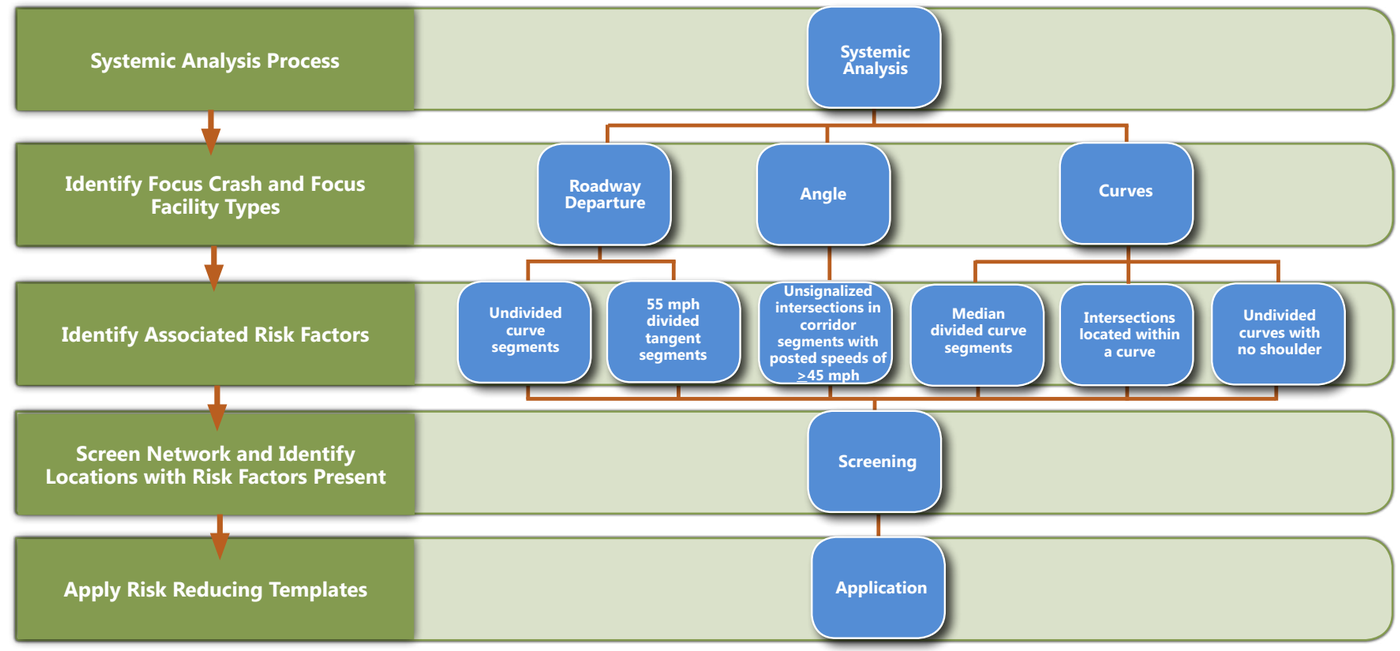


Figure 4.1.
Systemic Process.

4.2 Systemic Risk Factor Analysis

The following analysis involves the identification of focus areas and the associated risk factors. The data set used in the analysis includes 1,574 crashes for the five year period 2010-2014 over 78 miles, an average of four crashes per year/mile.

4.2.1 Primary Focus Areas

There are two types of focus areas in systemic data analysis: focus crash types and focus facility types. The following describes which focus areas were selected and what factors were used in that determination.

4.2.2 Focus Crash Types

The highest proportion of crashes are roadway departure followed by angle crash types as shown in Table 4.1. Together these two crash types comprised 54 percent of the total crashes and 70 percent of the severe crashes within the study area. (Note: KAB Crashes are fatal and severe crashes as noted by the KABCO scale: K = fatal crash, A = incapacitating injury, B = non-incapacitating injury, C = possible injury, and O = no injury.) Animal related crashes were the second most prevalent crash type within the study area. However, the animal related crash type was not included as a focus crash type as animal crashes only comprised three percent (3%) of the KAB crashes.

- The highest proportion of crashes are roadway departure followed by angle crash types.

Table 4.1.
Focus Crash Types.

	Focus Crash Types													
	Rear End	Deer	Other Animal	Ped	Backed Into	Other	Angle	Head-On	Sideswipe - Same Direction	Sideswipe - Opposite Direction	Fixed Object in Road	Train	Roadway Departure	Total
All Crashes	276	343	5	15	4	13	333	12	45	2	7	1	518	1,574
KAB Crashes	75	11		13		5	129	10	11		1	1	169	425
% of Total (n=1,574)	18%	22%	0%	1%	0%	1%	21%	1%	3%	0%	0%	0%	33%	
KAB % of Total (n=425)	18%	3%	0%	3%	0%	1%	30%	2%	3%	0%	0%	0%	40%	

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

1 American Association of State Highway and Transportation Officials. Highway Safety Manual. U.S. Department of Transportation, Federal Highway Administration

2 Federal Highway Administration Office of Safety. Systemic Safety Project Selection Tool. U.S. Department of Transportation, Federal Highway Administration.

4.2.3 Focus Facility Types:

- Curves

Table 4.2 contains a summary of the crashes and crash rates by facility type. While median divided segments had the highest number of total crashes, when looking at the length of the facility type, curves had the highest crash rate with 7.1 crashes per mile. There were 429 crashes and 123 severe crashes on curve segments throughout the study area.

4.3 Risk Factor Determination

The following is a description and overview of the risk factor determination for the focus crash types, roadway departure and angle crashes, and the focus facility type, curves. Included with the analysis are callout boxes highlighting elements related to the focus area risk factors.

4.3.1 Roadway Departure Crashes

Roadway departure crashes were the most prevalent crash type with 33 percent of the total crashes and 40 percent of the severe crashes. There were 518 total roadway departure crashes of which 169 were severe roadway departure crashes. Table 4.3 presents roadway departure crashes and total crashes with respect to the corridor type (divided or undivided) and the presence of shoulder. The crash distribution between divided and undivided corridor segments is slightly different between all crashes in the study area and roadway departure crashes specifically; there are slightly more crashes on divided segments for roadway departure than there are for all crash types. It is important to note that most of the roadway departure crashes occurred on divided roadway segments and both the percentage of crashes and the crash rate are higher for this type of corridor.

Table 4.2.
Focus Facility Types.

	Focus Crash Types					
	Median Divided Segments	Undivided Segments	Curves	Unsignalized Intersections	Signalized Intersections	Crossovers
All Crashes	1,270	270	429	269	152	489
KAB Crashes	345	71	123	87	42	
Mileage	61.7	16.72	17.4	-	-	-
Crashes/Mile	20.6	16.2	24.7	-	-	-
KAB Crashes/Mile	5.6	4.3	7.1	-	-	-

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.3.
Crashes by Corridor Type and Shoulder Presence.

Shoulder Presence	(Unknown)		Divided		Undivided		Total		% of Total (n=518)		KAB Total		% of KAB Total (n=169)	
	Roadway Departure	All Crash Types	Roadway Departure	All Crash Types	Roadway Departure	All Crash Types	Roadway Departure	All Crash Types	Roadway Departure	All Crash Types	Roadway Departure	All Crash Types	Roadway Departure	All Crash Types
Both Sides			417	1,188	23	63	440	1,251	85%	79%	141	341	83%	80%
Left Side Only			2	3	2	4	4	7	1%	0%	2	3	1%	1%
No Shoulder	10	34	14	64	46	200	70	298	14%	19%	25	77	15%	18%
Right Side Only			3	15	1	3	4	18	1%	1%	1	4	1%	1%
Total	**10**	**34**	**436**	**1,270**	**72**	**270**	**518**	**1,574**			**169**	**425**		
% Total (n=518)	2%	2%	84%	81%	14%	17%					33%	27%		
Mileage			61.7	61.7	16.72	16.72								
Crashes/Mile			7.1	20.6	4.3	16.1								
KAB Total	**2**	**9**	**146**	**345**	**21**	**71**	**169**	**425**						
% of KAB (n=169)	1%	2%	86%	81%	12%	17%								
KAB Crashes/Mile			2.4	5.6	1.3	4.2								

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

- Roadway Departure Crashes on Curves

Table 4.4 contains a summary of roadway departure crashes by curve or tangent segments. The majority of roadway departure crashes occurred on divided tangent segments; however, the roadway departure crash rate was higher for curve segments. Divided curve segments had the highest crash rate with 7.78 crashes per mile followed by undivided curve segments with 7.73 crashes per mile. In undivided segments, curves have a crash rate that is over three times that of tangent segments.

> ♦ The majority of roadway departure crashes occurred on divided tangent segments; however, the roadway departure crash rate was higher for curve segments.

Regarding the light conditions for roadway departure crashes on curve and tangent segments, Table 4.5 presents the crash rate was highest for undivided curves followed by divided curves both in daylight.

A comparison of crashes by weather condition for all crash types and roadway departure crash types is provided in Table 4.6. The table presents that drivers are more susceptible to roadway departure crashes in adverse weather conditions. There was a higher percentage of roadway departure crashes during rain or snow conditions compared to total crashes.

Table 4.7 provides the crashes for each corridor type and posted speed. The highest percentage of total and severe roadway departure crashes occurred in zones with 55 mph posted speed limits. Of all the corridor types (divided and undivided) and speed limits, divided corridor segments with posted speed limits of 55 mph experienced the most crashes at 48 percent of the total crashes and 51 percent of the severe crashes. Table 4.8 further compares these results with corridor types (tangent versus curve) other roadway departure speed and severity combinations.

As shown in Table 4.8, of all severe crashes on divided corridors with a posted speed of 55 mph, the majority of the crashes occurred on tangent sections (82 percent) rather than curves (16 percent). Similarly, tangent sections had a higher proportion of crashes for all roadway departure crashes, all severe roadway departure crashes, all roadway departure crashes on divided corridors, and all severe roadway departure crashes on divided corridor.

> ♦ Roadway departure crashes on 55 mph divided tangent segments experienced the most crashes.

Table 4.4.
Roadway Departure Crashes by Curve and Tangent Segments.

	Unknown				Divided						Undivided						Total			
	Crashes	% of Total	KAB Crashes	KAB % of Total	Crashes	% of Total	Crashes/ Mi	KAB Crashes	KAB % of Total	KAB crashes/ Mi	Crashes	% of Total	Crashes/ Mi	KAB Crashes	KAB % of Total	KAB crashes/ Mi	Total	% of Total	KAB Total	KAB % of Total
Curve	0	0%	0	0%	105	20%	7.78	31	18%	2.30	30	6%	7.73	10	6%	2.58	135	26%	41	24%
Tangent	10	2%	2	0%	331	64%	5.36	115	68%	1.86	42	8%	2.51	11	7%	0.66	383	74%	128	76%
Total	**10**	**2%**	**2**	**0%**	**436**	**84%**		**146**	**86%**		**72**	**14%**		**21**	**12%**		**518**		**169**	
Curve Mileage					13.5						3.88									
Tangent Mileage					61.7						16.72									

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.5.
Roadway Departure Crashes by Light Condition.

	Light Conditions	Unknown		Divided				Undivided				Total		Total KAB	
		Crashes	KAB Crashes	Crashes	Crashes/ Mi	KAB Crashes	KAB Crashes/ Mi	Crashes	Crashes/ Mi	KAB Crashes	KAB Crashes/ Mi	Crashes	Crashes/ Mi	Crashes	Crashes/ Mi
Tangent	Dark	5		149	3.09	50	1.04	21	1.65	4	0.31	175	2.87	54	0.89
	Daylight	5	2	182	3.78	65	1.35	21	1.65	7	0.55	208	3.41	74	1.21
	Total	**10**	**2**	**331**	**6.87**	**115**	**2.39**	**42**	**3.30**	**11**	**0.86**	**383**	**6.28**	**128**	**2.10**
Curve	Dark	-	-	50	3.70	16	1.19	13	3.35	5	1.29	63	3.62	21	1.21
	Daylight	-	-	55	4.07	15	1.11	17	4.38	5	1.29	72	4.14	20	1.15
	Total	-	-	**105**	**7.78**	**31**	**2.30**	**30**	**7.73**	**10**	**2.58**	**135**	**7.77**	**41**	**2.36**

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.6.
Crashes by Weather Conditions.

Weather Conditions	All Crashes	% of Total (n=1,574)	All KAB Crashes	% of Total (n=425)	Roadway Departure Crashes	% of Total (n=518)	KAB Roadway Departure Crashes	% of Total (n=169)
No Adverse Condition (Clear/Cloudy)	1,359	86%	376	88%	414	80%	145	86%
Blowing Sand, Soil, Dirt, or Snow	5	0%	1	0%	4	1%	1	1%
Severe Crosswinds	3	0%	0	0%	0	0%	0	0%
Fog	10	1%	3	1%	3	1%	0	0%
Mist	17	1%	5	1%	6	1%	1	1%
Rain	140	9%	31	7%	64	12%	16	9%
Snow	32	2%	6	1%	23	4%	5	3%
Sleet/Hail	5	0%	2	0%	3	1%	1	1%
Smoke/Dust	2	0%	1	0%	1	0%	0	0%
Other	1	0%	0	0%	0	0%	0	0%
Total	**1,574**		**425**		**518**		**169**	

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.7.
Roadway Departure Crashes by Corridor Type and Posted Speed.

Posted Speed	Unknown				Divided				Undivided				Total			
	Crashes	% of Total (n=518)	KAB Crashes	% of KAB (n=169)	Crashes	% of Total (n=518)	KAB Crashes	% of KAB (n=169)	Crashes	% of Total (n-518)	KAB Crashes	% of KAB (n=169)	Crashes	% of Total (n-518)	KAB Crashes	% of KAB (n=169)
0	1	0%	0	0%	172	33%	54	32%	34	7%	10	6%	207	40%	64	38%
25	0	0%	0	0%	1	0%	1	1%	0	0%	0	0%	1	0%	1	1%
35	3	1%	2	1%	1	0%	1	1%	1	0%		0%	5	1%	3	2%
45	1	0%	0	0%	9	2%	3	2%	9	2%	2	1%	19	4%	5	3%
50	0	0%	0	0%	2	0%	0	0%	0	0%	0	0%	2	0%	0	0%
55	5	1%	0	0%	251	48%	87	51%	28	5%	9	5%	284	55%	96	57%
Total	**10**		**2**		**436**		**146**		**72**		**21**		**518**		**169**	

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.8.
Comparison of Roadway Departure Crashes for Tangent and Curve Segments.

	KAB Crashes - Divided Corridor - Posted Speed 55 MPH	% of Total (n=87)	All Roadway Departure	% of Total (n=518)	All KAB Roadway Departure	% of Total (n=169)	All Roadway Departure - Divided Corridor	% of Total (n=436)	All KAB Roadway Departure - Divided Corridor	% of Total (n=146)
Tangent	71	82%	383	74%	128	76%	331	76%	115	79%
Curve	16	18%	135	26%	41	24%	105	24%	31	21%
Grand Total	**87**		**518**		**169**		**436**		**146**	

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

4.3.2 Angle Crashes

Angle crashes were the second most prevalent crash type in the study area. There were 333 total angle crashes, of which 129 were severe angle crashes. Relative to all other crash types, angle crashes comprised 21 percent of all the total crashes and 30 percent of the severe crashes.

As shown in Table 4.9, approximately half of the total and severe angle crashes occurred at non-intersection locations, most likely driveways or crossovers. A slightly higher percentage of severe crashes occurred at unsignalized intersections than did total crashes (36 percent of severe crashes versus 33 percent of total crashes).

- Angle crashes most prevalent at non-intersection locations.
- Unsignalized intersections have higher percentage of KAB crashes.

- Angle Crashes at Non-Intersection Locations

Roughly half of all angle crashes occurred at non-intersection locations. Although there were more crashes on divided corridors, as shown in Table 4.10, the crash rate was roughly 1.75 times higher for undivided corridors. This difference was less pronounced for severe angle crashes. At non-intersection locations the areas most at risk are those locations with high driveway/access point density.

Implementing geometric changes, such as modifying/combining access points, are measures that could be used to address this risk factor. However, those are not systemic countermeasures that can be applied on a wide-spread scale and would instead be addressed through site specific analysis. Chapter 5 of this report addresses crossover and intersection crashes and suggestions for modifying median openings and Chapter 6 addresses site specific locations.

- Roughly half of angle crashes occurred at non-intersection locations and most of those crashes were on undivided corridors.

- Angle Crashes at Unsignalized Intersections

Roughly two thirds (68 percent) of all angle crashes at unsignalized intersections occurred during the daylight as shown in Table 4.11. That proportion increased for KAB crashes with 77 percent occurring during daylight hours. This indicates that lack of roadway lighting is not a significant contributory factor to the crashes in the study area.

Table 4.9.
Angle Crashes by Intersection Type.

Intersection Type	Total Angle Crashes					KAB Angle Crashes				
	Divided Corridor	Undivided Corridor	Unknown	Total	% of Total Angle Crashes	Divided	Undivided	Unknown	Total	% of Total KAB Angle Crashes
Signalized	46	6		52	16%	17			17	13%
Unsignalized	94	17		111	33%	40	7		47	36%
Non-intersection*	112	52	6	170	51%	49	14	2	65	50%
Total	**252**	**75**	**6**	**333**		**106**	**21**	**2**	**129**	

*Non-intersection is a driveway or crossover.
Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.10.
Non-Intersection Angle Crashes and Crash Rates.

Intersection Type	Total Angle Crashes		KAB Angle Crashes	
	Divided Corridor	Undivided Corridor	Divided	Undivided
Non-intersection*	112	52	49	14
Mileage	61.7	16.62	61.7	16.62
Crash Rate (Crashes/Mile)	1.82	3.13	0.79	0.84

*Non-intersection is a driveway or crossover.
Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.11.
Light Conditions of Angle Crashes at Unsignalized Intersections.

Light Condition	Total Angle Crashes				KAB Angle Crashes			
	Divided	Undivided	Total Crashes	% of Total (n=111)	Divided	Undivided	Grand Total	% of Total KAB (n=47)
Daylight	64	12	76	68%	30	6	36	77%
Dark	30	5	35	32%	10	1	11	23%
Total			**134**				**47**	

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.12 shows the crashes by posted speed limit for angle crashes at unsignalized intersections, all unsignalized intersection crashes, and all crashes in the study area. Angle crashes at unsignalized intersections are most prevalent in corridor segments with posted speeds of 55 mph; however, the percentage of severe angle crashes at unsignalized intersections with 45 mph posted speed limits is almost double the percentage for all crashes in the study area (13 percent versus 7 percent).

- Severe angle crashes at unsignalized intersections with 45 mph posted speed limits account for almost double those occurring throughout the rest of the study area.

In reviewing the driver actions in Table 4.13, the majority of total and severe angle crashes at unsignalized intersections (77 percent and 72 percent respectively) involved drivers failing to yield or failing to obey the intersection control. These actions are most likely tied to gaps in traffic; in periods of high volumes it may be difficult for drivers to find an acceptable gap to enter traffic and may be willing to enter traffic rather than wait for an acceptable gap, or high speeds may make it more difficult for drivers to judge acceptable gaps in traffic.

The factors influencing drivers' ability to judge acceptable gaps may be related to sight distance, speed, time of day, vehicle type, and point of departure/maneuver within the intersection. Review and evaluation of the posted speed limit is addressed in Chapter 3 of this report. Education and enforcement of the posted speed limit throughout the study area could also help to address speed related crashes. Implementing geometric changes, such as modifying access or realigning a skewed intersection, or changing the intersection control from stop controlled to signalized, or from full movement to a restricted crossing u-turn (RCUT) intersection, are measures that could be used to address these risk factors. However, except for education and enforcement targeting speeding, the other measures are not systemic-countermeasures that can be applied on a wide-spread scale and would instead be addressed through site specific analysis.

- The majority of total and severe angle crashes at unsignalized intersections involved drivers failing to yield or failing to obey the intersection control indicating there may be issues with gap judgment at unsignalized intersections.

Table 4.12.
Crashes by Posted Speed.

Posted Speed Limit	Angle - Unsignalized Intersection				All Unsignalized Intersection Crashes				All Crashes			
	All Crashes	% of Total (n=111)	KAB Crashes	% of Total (n=47)	All Crashes	Percent of Total (n=269)	KAB Crashes	% of Total (n=87)	All Crashes	Percent of Total (n=1,574)	KAB Crashes	% of Total (n=425)
(Unknown)	72	65%	27	57%	155	58%	42	48%	722	46%	195	46%
15	0	0%	0	0%	0	0%	0	0%	1	0%	0	0%
25	0	0%	0	0%	0	0%	0	0%	3	0%	1	0%
35	3	3%	3	6%	5	2%	3	3%	21	1%	8	2%
45	10	9%	6	13%	21	8%	10	11%	98	6%	29	7%
50	0	0%	0	0%	1	0%	1	1%	9	1%	3	1%
55	26	23%	11	23%	87	32%	31	36%	720	46%	189	44%
Total	**111**		**47**		**269**		**87**		**1,574**		**425**	

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.13.
Driver Action in Angle Crashes at Unsignalized Intersections.

Action (Driver 1)	All Crashes	% of Total (n=111)	KAB Crashes	% of KAB Total (n=47)
Did Not Have Right of Way	77	69%	29	62%
Disregarded Intersection Control	6	5%	4	9%
Fail to Stop at Through Highway - No Sign	1	1%	1	2%
Exceeded Speed Limit	1	1%	1	2%
Fail to maintain proper control	6	5%	4	9%
Following Too Close	2	2%	1	2%
Improper or unsafe lane change	2	2%	0	0%
Improper Turn from Wrong Lane	2	2%	1	2%
No Improper Action	12	11%	5	11%
Other	2	2%	1	2%
Grand Total	**111**		**47**	

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

4.3.3. Curves

There were 429 total and 123 severe crashes on curve segments. There are approximately 17 miles of curves resulting in 25.2 total crashes per mile and 7.1 severe crashes per mile as presented in Table 4.14. While the crashes per mile are fairly evenly split between crashes on divided and undivided segments for both fatal and severe crashes, there is a higher percentage of total and severe crashes on divided segments.

- The majority of curve crashes occurred on divided corridor segments.

As shown in Table 4.15, the direction of travel related to crashes on curves is relatively evenly split between the north and southbound directions with only 14 more crashes in the northbound direction. Between the east and westbound directions, there are significantly more crashes in the eastbound direction. However, after reviewing the crash information, it appears that many of the east and westbound direction of travel have been incorrectly identified in the crash reports.

Table 4.14.
Divided and Undivided Curve Crashes.

	Divided			Undivided			Total	
	Number of Crashes	% of Total	Crashes/Mile	Number of Crashes	% of Total	Crashes/Mile	Number of Crashes	Crashes/Mile
All Crashes	340	79%	25.2	89	21%	22.9	429	24.7
KAB Crashes	95	77%	7.0	28	23%	7.2	123	7.1
Mileage	13.5			3.9			17.4	

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

- Curves - Divided Corridor

There is little difference in light condition for crashes that occurred on median divided curve segments. For both total and severe crashes, roughly 50 percent of the crashes occurred during both dark and daylight conditions.

Within median divided curves the most prevalent crash types were related to intersections (rear end and angle crash types) and roadway departure with 49 percent and 33 percent of severe crashes respectively as shown in Table 4.17. A majority of the deer, pedestrian, head-on, and roadway departure crashes occurred during dark conditions.

Roadway departure crashes comprised 31 percent of total crashes and 33 percent of severe median divided curve crashes throughout the study area. Rumble strips are a countermeasure designed to reduce roadway departure crashes and were installed in various locations throughout the study area as recommended in the 2002 Study. The rumble strip installation was completed in 2014 and as such, it is too soon to determine the effect on crashes.

Shoulders can also have an effect on roadway departure crashes as they provide recovery area for drivers who leave their travel lane. Table 4.18 provides the number of roadway departure crashes on undivided and divided curve corridors by shoulder presence. On median divided curves almost all of the crashes occurred where both left and right shoulders were present. On undivided curve sections most of the crashes occurred on sections with no shoulder.

- On undivided curve sections most of the crashes occurred on sections with no shoulder.

4.4 Summary

The previous section discussed findings related to the focus crash and facility types and investigated trends and risk factors related to study area geometric features and crash data. The following is a summary of the systemic risk factors or locations where the risk factors are present along the corridor.

- Focus Crash Type: Roadway Departure
  - Undivided curve segments
  - 55 mph divided tangent segments
- Focus Crash Type: Angle
  - Unsignalized intersections in higher speed corridor segments (those with posted speeds of 45 mph or greater)
- Facility Types: Curves
  - Median divided curve segments
  - Intersections located within a curve
  - Undivided curves with no shoulder

Table 4.15.
Curve Crashes by Corridor Type and Direction of Travel.

Direction of Travel	Divided						Undivided						(Unknown)		Grand Total
	Total Crashes	KAB	% of Total	Curve Crashes	KAB Curve Crashes	KAB % of Total	Total Crashes	KAB	% of Total	Curve Crashes	KAB Curve Crashes	KAB % of Total	Total Crashes	KAB (Unknown) Crashes	
EB	1	0	0%	0	0	0%	112	33	29%	21	7	33%	0	0	113
WB	0	0	0%	0	0	0%	9	2	22%	1	0	0%	0	0	9
NB	620	167	27%	169	48	28%	85	20	24%	36	12	33%	25	7	730
SB	643	176	27%	170	47	28%	64	16	25%	31	9	29%	9	2	716
(blank)	6	2	0%	1											6
Total	**1,270**						**270**						**34**		**1,574**

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.16.
Curve Crashes on Median Divided Corridors by Crash-Type and Light Condition.

Crash Type	Total Crashes		Crashes During Dark Conditions		Crashes During Light Conditions		KAB Crashes		KAB Crashes During Dark Conditions		KAB Crashes During Light Conditions	
	Number of Crashes	% of Total Crashes	Number of Crashes	% of Total Crashes per Crash Type	Number of Crashes	% of Total Crashes per Crash Type	Number of Crashes	% of Crashes	Number of Crashes	% of Crashes per Crash Type	Number of Crashes	% of Crashes per Crash Type
Rear End	62	18%	12	19%	50	81%	14	15%	4	29%	10	71%
Deer	69	20%	60	87%	9	13%	3	3%	2	67%	1	33%
Ped	5	1%	3	60%	2	40%	5	5%	3	60%	2	40%
Other	4	1%	0	0%	4	100%	2	2%	0	0%	2	100%
Angle	79	23%	30	38%	49	62%	33	35%	11	33%	22	67%
Head On	2	1%	2	100%	0	0%	2	2%	2	100%	0	0%
Sideswipe - Same Direction	13	4%	5	38%	8	62%	5	5%	1	20%	4	80%
Fixed Object in Road	1	0%	0	0%	1	100%	0	0%	0	0%	0	0%
Roadway Departure	105	31%	50	48%	55	52%	31	33%	16	52%	15	48%
Total	**340**		**162**	**48%**	**178**	**52%**	**95**		**39**	**41%**	**56**	**59%**

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

	% of Total Crashes	% of KAB Crashes
Intersection-type crashes	41%	49%
Roadway Departure	31%	33%

Table 4.17.
Intersection Crashes on Median Divided Curves.

Intersection Type	Total Crashes	% of Total Crashes	Total Crashes During Dark Conditions	% of Crashes During Dark Conditions	KAB Crashes	% of KAB Crashes	KAB Crashes During Dark Conditions	% of Crashes During Dark Conditions
Signalized	51	15%	16	31%	16	17%	7	44%
Unsignalized	74	22%	32	43%	21	22%	5	24%
Non-intersection	215	63%	114	53%	58	61%	27	47%

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

	% of Total Crashes	% of KAB Crashes
Intersection-type crashes	37%	39%

Table 4.18.
Roadway Departure Curve Crashes by Corridor Type and Shoulder Presence.

Shoulder Presence	Divided Curve Crashes	Undivided Curve Crashes	Total Crashes
Both sides	100	5	105
No Shoulder	2	25	27
Right side only	3		3
Left side only	3		3
Total	**105**	**30**	**135**

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

4.5 Countermeasure Selection

The countermeasures to be applied are included in the risk reducing templates; a set of documents containing specific sets of sign, pavement marking, or other traffic control device applications that correspond to various roadway sections (i.e., intersection, curve, and corridor segment). Most templates have three (3) tiers or levels of measures. The first tier is the application of signs and pavement markings to be installed to bring the road section in compliance with the MUTCD and to provide a consistent look and feel to the corridor. Each subsequent tier includes additional signs, markings, Traffic Control Devices (TCD), or other safety mitigation measures that builds upon the base nature of Tier 1 in degree of investment. Any additional improvement measures would be considered on a site-by-site basis and are included in the site specific analysis in Chapter 6.

The following Templates are applied to the study area and are included in Appendix A:

- Template 1 – Unsignalized Intersection – 4-leg (2-way stop controlled), undivided
- Template 2 – Unsignalized Intersection – 4-leg (2-way stop controlled)
- Template 3 – Unsignalized Intersection – 3-leg (1-way stop controlled), undivided
- Template 4 – Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)
- Template 5 – Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)
- Template 7 – Signalized Intersection – 3-leg
- Template 8 – Signalized Intersection – 4-leg
- Template 9 – Corridor – Undivided Roadway
- Template 10 – Corridor – Divided Roadway
- Template 11 – Curve – Undivided Roadway
- Template 12 – Curve – Divided Roadway
- Template 16 – Pedestrian Measures

Selection of the tiers is based on combinations of the following elements: the systemic risk factors, Potential for Safety Improvement (PSI), and crash rate.

4.5.1 Systemic Risk Factors

Systemic risk factor selection is described in the systemic data analysis section of this chapter.

4.5.2 Potential for Safety Improvement

A PSI is the difference between the expected crashes of a roadway segment or intersection and the amount of crashes experienced. Locations with the greatest PSI, or the greatest difference between expected and experienced crashes, indicate a higher priority need for highway safety improvements.

The PSI locations used in this analysis relate to the risk factors shown in Figure 4.1 and were created by VDOT using the top 100 PSI locations for the Hampton Roads District between 2011 and 2013.

4.5.3 Crash Rate

Table 4.19 contains crash rate information related to the 2002 Study and current crash rates. The crash rates used to determine which tier of countermeasure to apply are those segments with high crash rates (see "2010-2014 Crash Rate") and also those segments where the crash rates have increased (see "Change in Crash Rate" and "% Change in Crash Rate").

4.5.4 Tier Selection

The tier selection methodology is as follows:

- **Tier 1:** This tier is applied to each corridor segment and intersection.
- **Tier 2:** This tier is applied anywhere a combination of two of the tier selection elements (PSI location and systemic risk factor present; crash risk and systemic risk factor present; or crash risk and PSI location).
- **Tier 3:** This tier is applied anywhere all three tier selection elements are present (crash risk, PSI location, and systemic risk factor present).

4.5.5 Results

Table 4.20 and Table 4.21 contain the summary of the template tier application for intersections and corridor segments. Figures 4.2 – 4.15 depict the intersection and corridor template and tiers by location. It is important to note that some of the corridor templates overlap each other resulting in the total length of template application being greater than the length of corridor found in the study area. A complete listing of template and tier application locations are provided in Appendix A.

Table 4.19.
Light Conditions of Angle Crashes at Unsignalized Intersections.

Segment	Miles	1997-1999 Crash Rate (Crashes per 100 Million VMT)	2010-2014 Crash Rate (Crashes per 100 Million VMT)	Crash Rate Difference	% Change in Crash Rate
Rt 175 - State Line	4.09	61	64	3	4.7%
Rt 695 - Rt 175	3.69	82	69	-13	-18.8%
Rt 187 - Rt 695	5.77	85	86	1	1.2%
Rt 176 - Rt 187	4.76	63	68	5	7.4%
Rt 764 - Rt 176	3.62	111	93	-18	-19.4%
Chesapeake Square - Rt 764	2.91	67	117	50	42.7%
Rt 179 - Chesapeake Square	0.29	147	90	-57	-63.3%
US13 Bus. - Rt 179	0.74	110	106	-4	-3.8%
Rt 626 - US13 Bus.	2.92	64	66	2	3.0%
Rt 180/696 - Rt 626	2.37	59	38	-21	-55.3%
Rt 180/696 - Rt 626	2.68	64	35	-29	-82.9%
Rt 182/614 - Rt 180/696	3.91	89	19	-70	-368.4%
Rt 183 - Rt 178	0.52	54	6	-48	-800.0%
Rt 652 - Rt 183	0.98	171	102	-69	-67.6%
Rt 606 - Rt 652	3.53	115	66	-49	-74.2%
Rt 631 - Rt 606	9.75	90	74	-16	-21.6%
Rt 680 - Rt 631	4.93	73	60	-13	-21.7%
Rt 184 - Rt 680	1.22	101	135	34	25.2%
CBBT - Rt 184	9.34	80	107	27	25.2%

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.20.
Intersection Template Tier Summary.

Template	Tier 1	Tier 2	Tier 3	Total
Template 1	5			5
Template 2	18	11	3	32
Template 3	27	1		28
Template 4	68	20		88
Template 5	63	26	1	90
Template 7	2			2
Template 8	18	7	2	27
Template 16	8			8
Total	**209**	**65**	**6**	**280**

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

Table 4.21.
Corridor Template Tier Summary.

Template	Tier 1 Length (Mi)	Tier 2 Length (Mi)	Tier 3 Length (Mi)	Total
Template 9	18	11	3	32
Corridor – Undivided Roadway	16.61	0	0	16.61
Template 10	68	20		88
Corridor – Divided Roadway	43.72	17.03	0.94	61.69
Template 11				
Curve – Undivided Roadway	3.88	0	0	3.88
Template 12				
Curve – Divided Roadway	8.63	4.53	0.34	13.5
Grand Total	**72.84**	**21.56**	**1.28**	**95.68**

Sources: VDOT Tableau (2010-2014), VDOT Roadway Inventory, VHB aerial and video data collection.

This page intentionally left blank.

Figure 4.2
Potential for Safety Improvement Locations
Eastern Shore Safety Study

Figure 4.3
Corridor Template Locations - Accomack County
Eastern Shore Safety Study

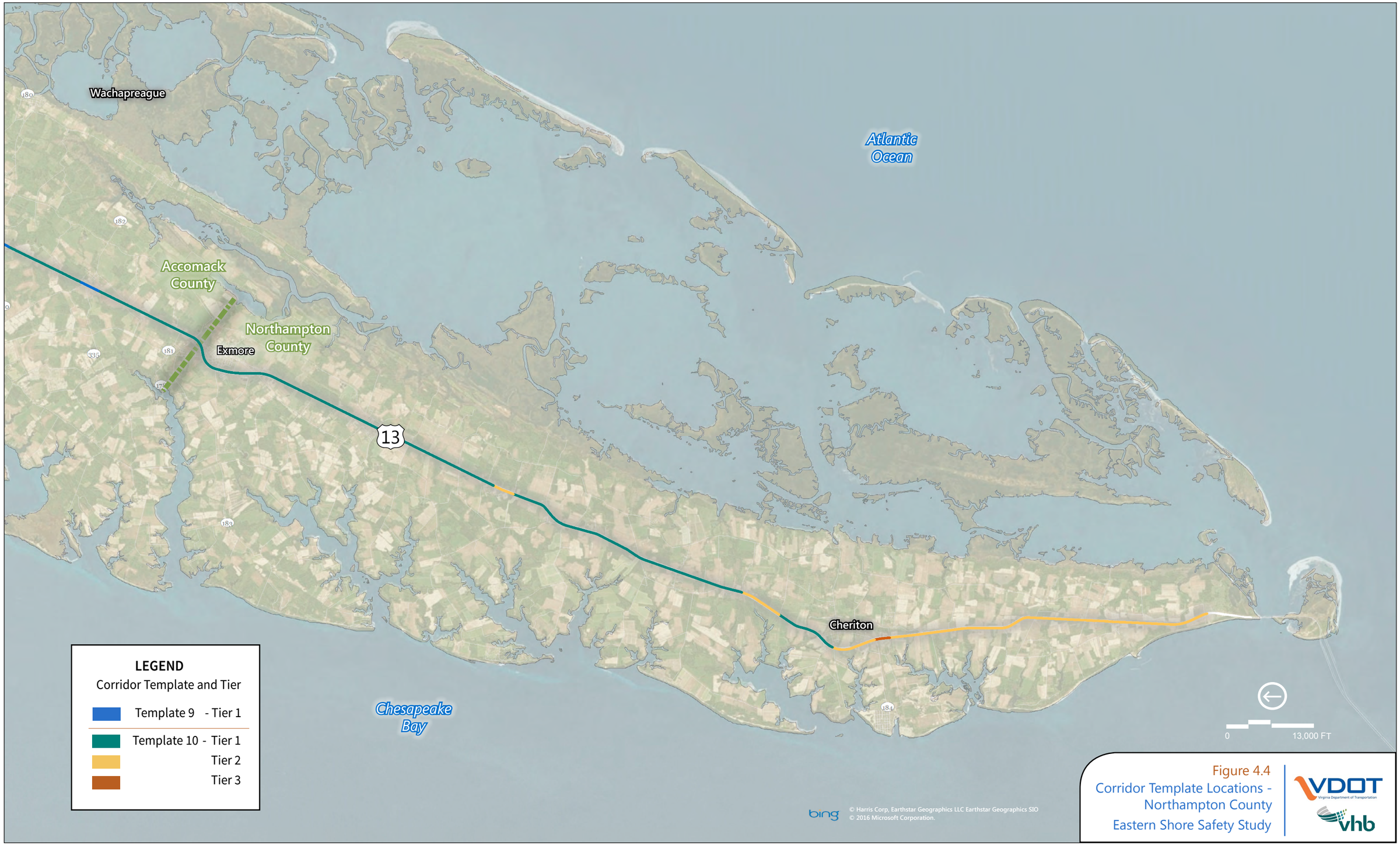


Figure 4.4
Corridor Template Locations - Northampton County
Eastern Shore Safety Study

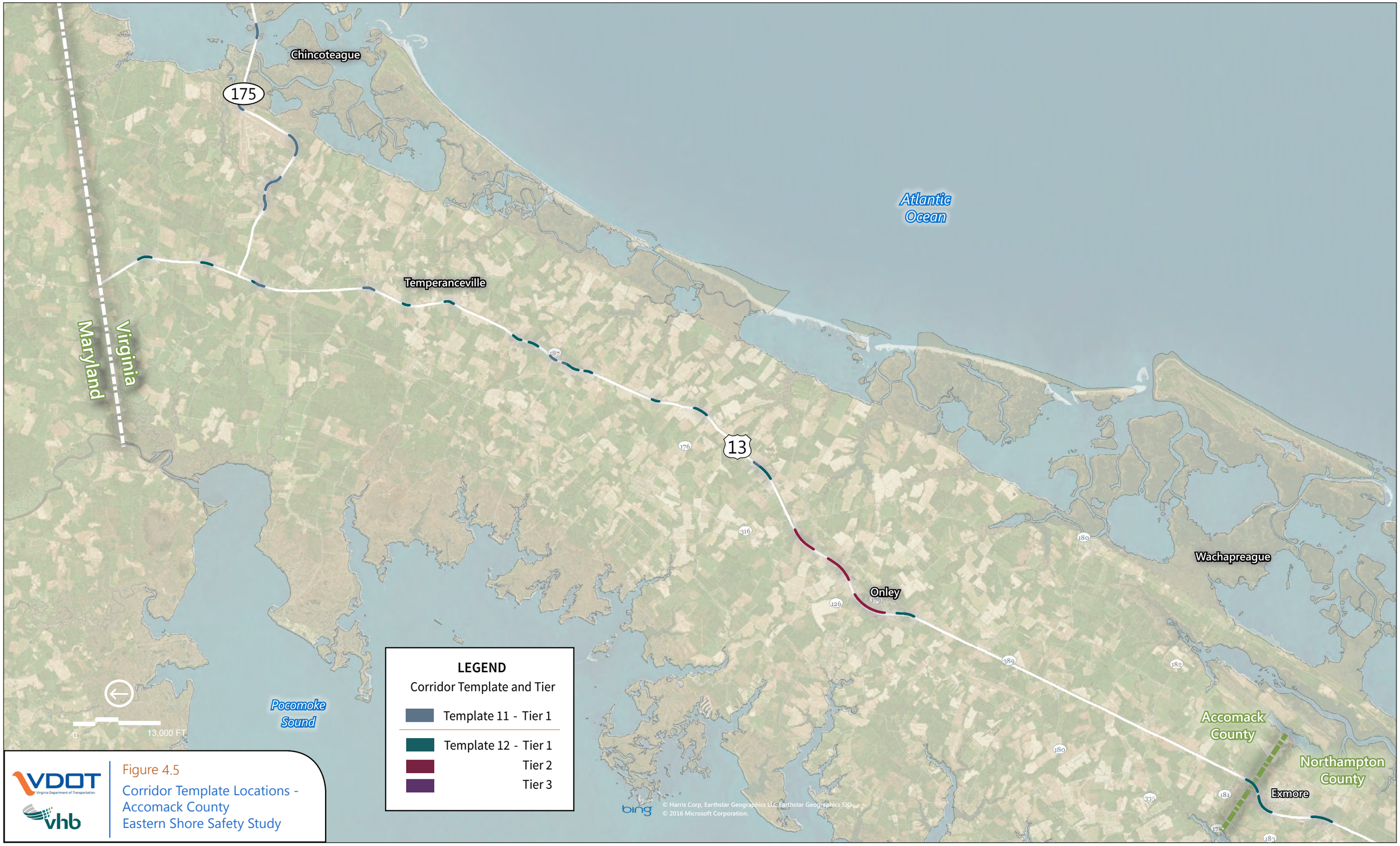


Figure 4.5
Corridor Template Locations - Accomack County
Eastern Shore Safety Study

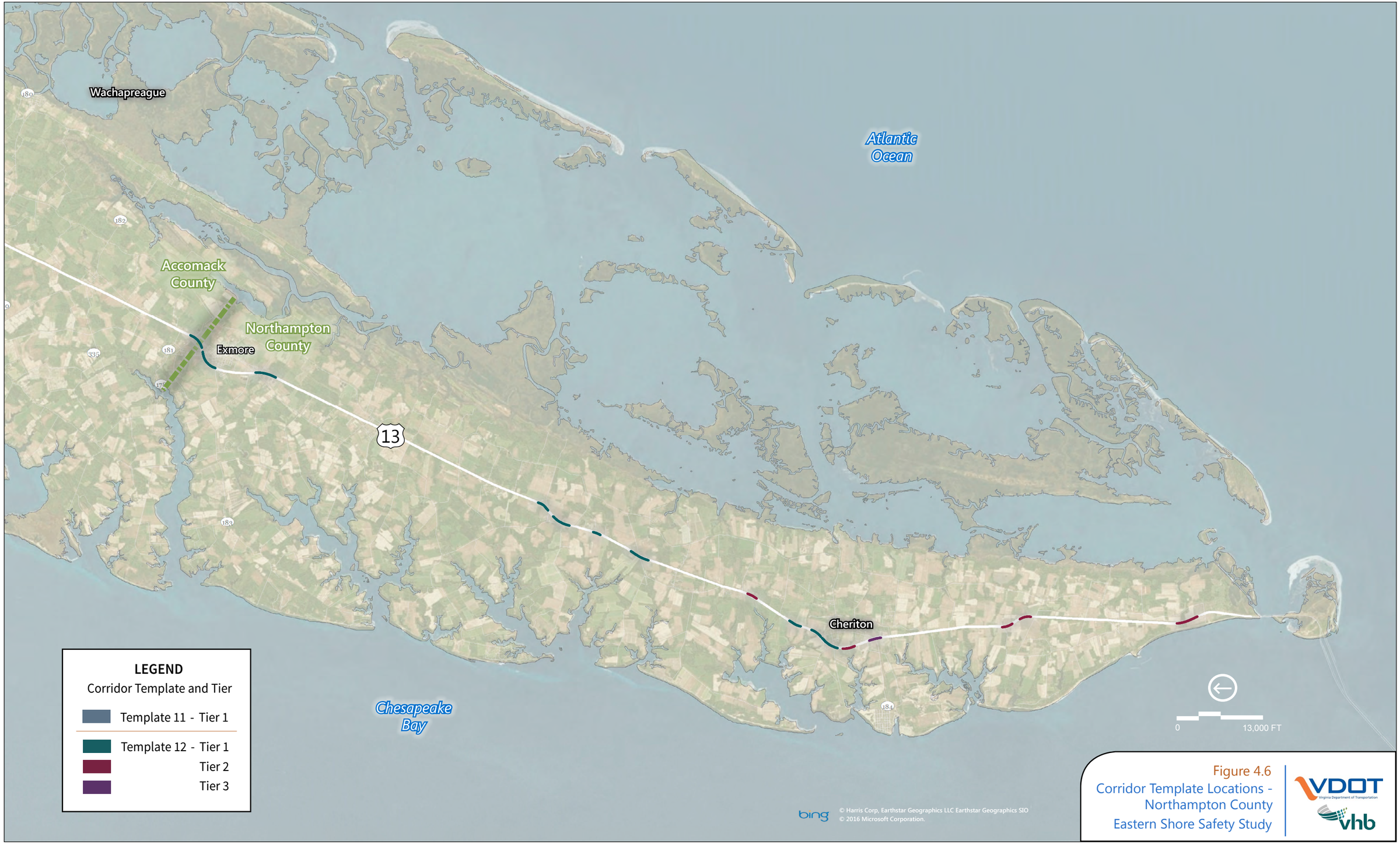


Figure 4.6
Corridor Template Locations - Northampton County
Eastern Shore Safety Study

Figure 4.7
Intersection Template Locations
Eastern Shore Safety Study

Figure 4.8
Intersection Template Locations
Eastern Shore Safety Study

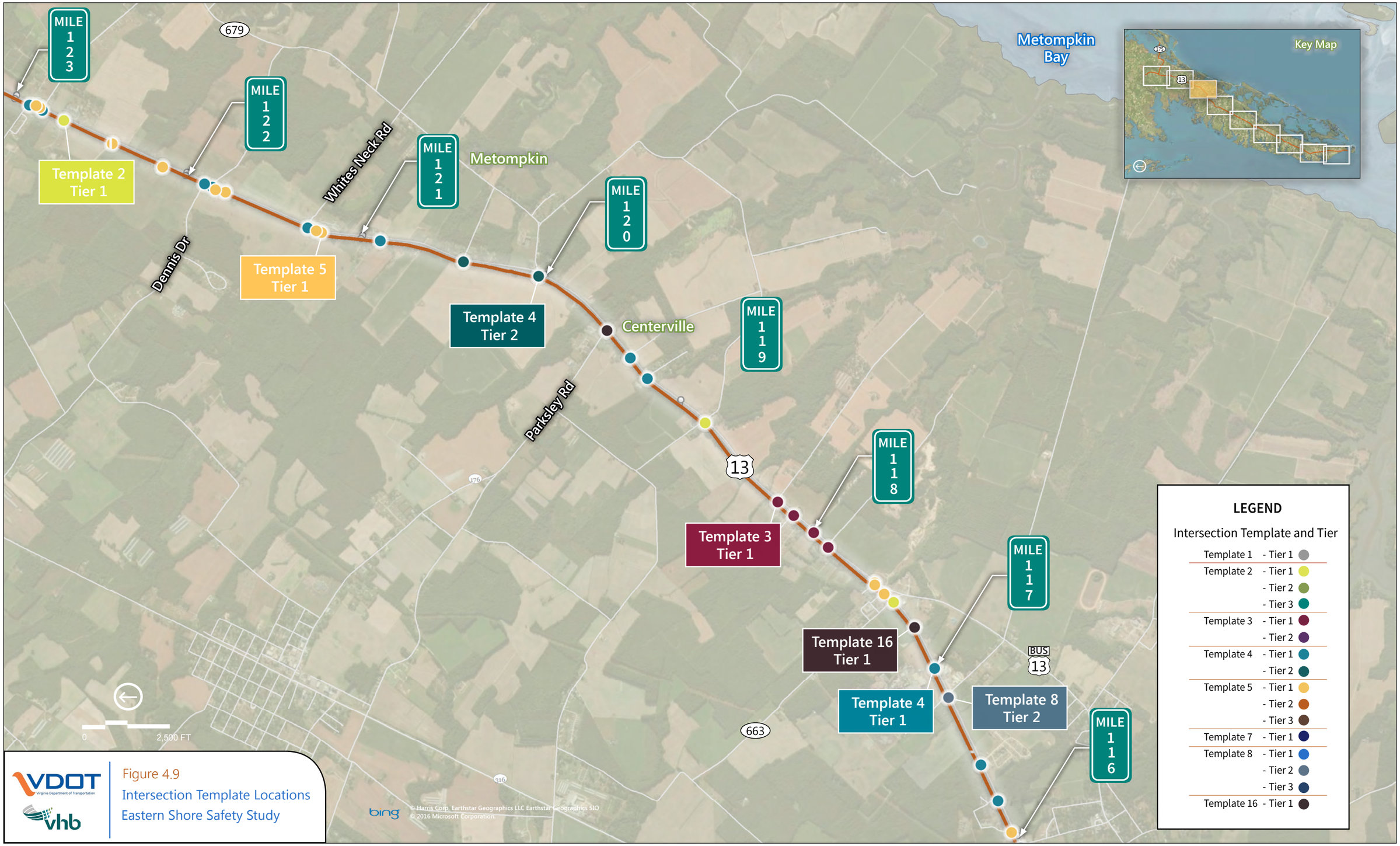


Figure 4.9
Intersection Template Locations
Eastern Shore Safety Study

Figure 4.10
Intersection Template Locations
Eastern Shore Safety Study

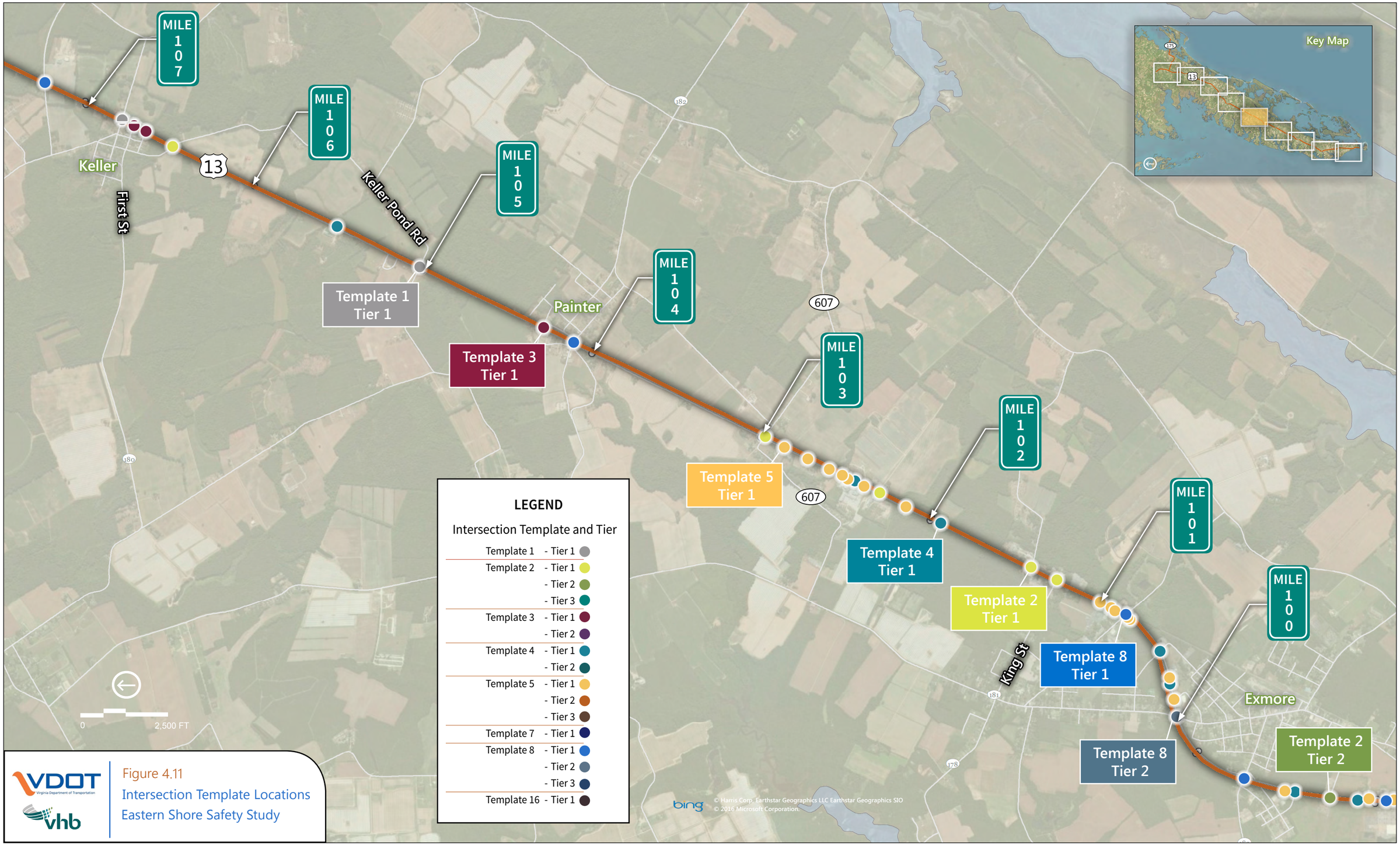


Figure 4.11
Intersection Template Locations
Eastern Shore Safety Study

Figure 4.12
Intersection Template Locations
Eastern Shore Safety Study

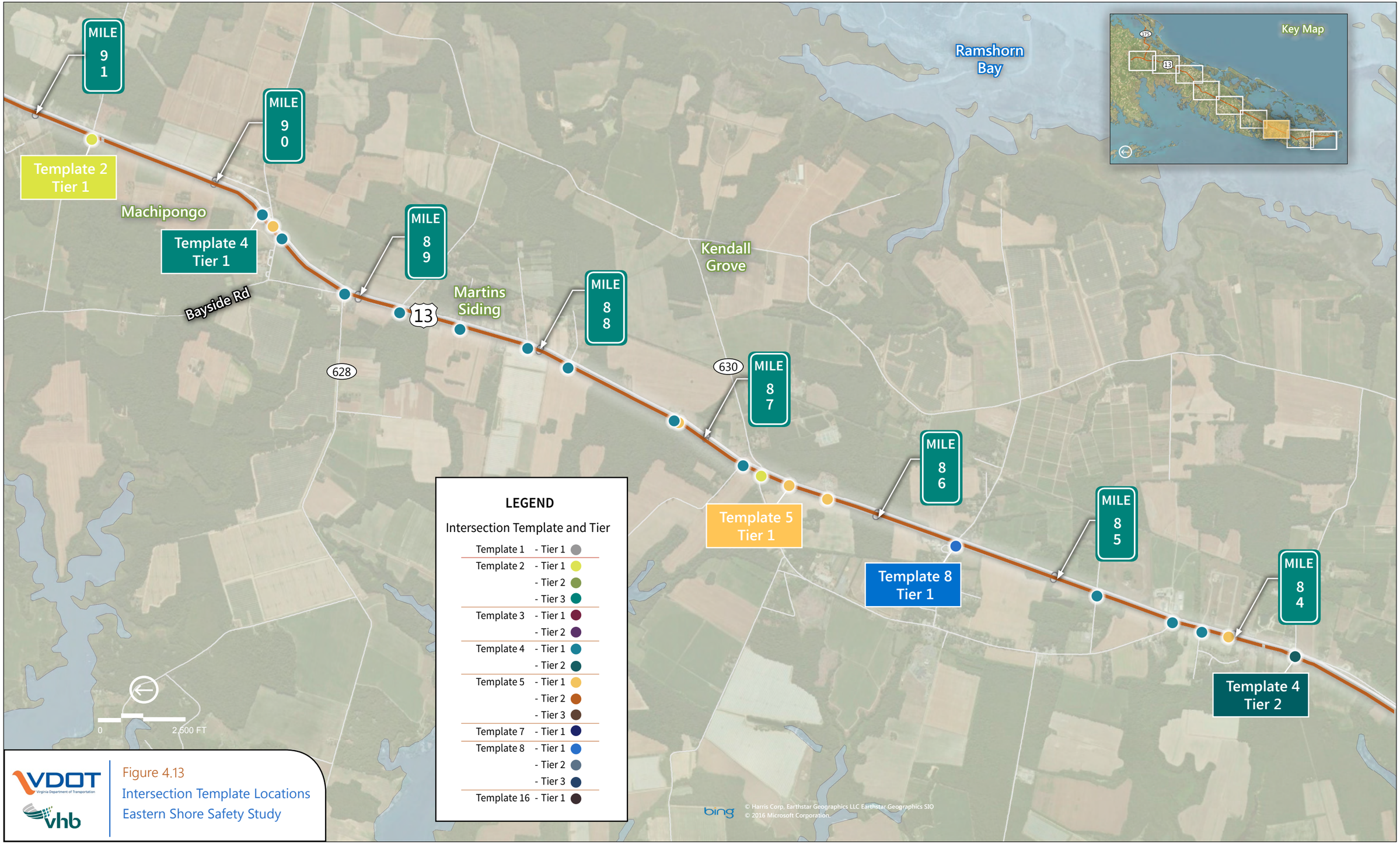


Figure 4.13
Intersection Template Locations
Eastern Shore Safety Study

Figure 4.14
Intersection Template Locations
Eastern Shore Safety Study

Figure 4.15
Intersection Template Locations
Eastern Shore Safety Study

Crossovers

chapter

5

This page intentionally left blank.

5.1 Introduction

Crossovers, or median openings, inherently create increased risk for crashes along a corridor due to the introduction of potential right-angle and rear end conflicts with other traffic. This risk is more significant when travel speeds are high and turn lanes are not sufficient to allow slower moving turning vehicles to move out of the main travel lane. Openings in a median can be classified in three manners: signalized intersection, unsignalized intersection or crossover. There are 268 openings in the median along the U.S. Route 13 corridor, of which, 169 are crossovers. Crossovers provide access to residential/commercial driveways, farm entrances, or areas for u-turns. The 2002 Study recommended that 101 crossovers be closed. Since that time, 16 crossovers have been closed. This chapter reevaluates the signalized intersections, unsignalized intersections and remaining crossovers to determine if any should be closed and if not, what improvements should be made at each opening.

5.2 Evaluation

Many of the crossovers along U.S. Route 13 do not have left turn lanes. If turn lanes do exist, the total turn lane storage and taper lengths are less than the 400 feet guideline provided in VDOT's Road Design manual for rural roads. During the evaluation of the crossovers, the study team examined the intersection and crossover spacing to determine if they were in compliance with VDOT's Access Management guidelines. The study team also took into account the usage of the crossover, crash history in the vicinity of the crossover, and the improvements necessary to improve the overall safety of the corridor. U.S. Route 13 was evaluated as a system of access management in balance with enhanced safety.

The general steps in the evaluation began in sequence with distance from the adjacent opening, direct land use access or connector to local roadway network, crash history, and convenience of the closest u-turn opportunity if closed. If closure was not recommended, then left turn lanes were recommended to be lengthened or added. The recommendations establish a standard for every median opening to have northbound and southbound left turn lanes with tapers.

A specific treatment recommendation in this Chapter is the use of the Restricted Crossing U-turn Intersection (RCUT) as shown in Figure 5.1. The RCUT, or superstreet intersection, removes the left-turn and through movements from the side street approaches. Instead, these movements are accommodated by a right turn onto the main road and then a u-turn maneuver approximately 400 feet after the intersection. Left turns from the main road remain unchanged. This is a proven technique in reducing crashes since the side street traffic is limited to right turns only whereas the driver only has to find acceptable gaps in one direction of traffic at a time instead of simultaneous gaps. Essentially, the complete maneuver is broken down into simpler steps. The FHWA RCUT Brief is provided in Appendix F.

Figures 5.2 to 5.10 present the location of all crossovers and intersections, the crossovers recommended for closure in the 2002 Study, the crossovers closed since 2002, recommendations from VDOT during a 2014 evaluation, and the recommended closure or treatment based on this current study. Of the 85 remaining crossovers identified to be closed in the previous study, only 45 are still recommended to be closed. There are also 15 partial closures or RCUT median openings recommended. The detailed tabulated results of the evaluation can be found in Appendix D.

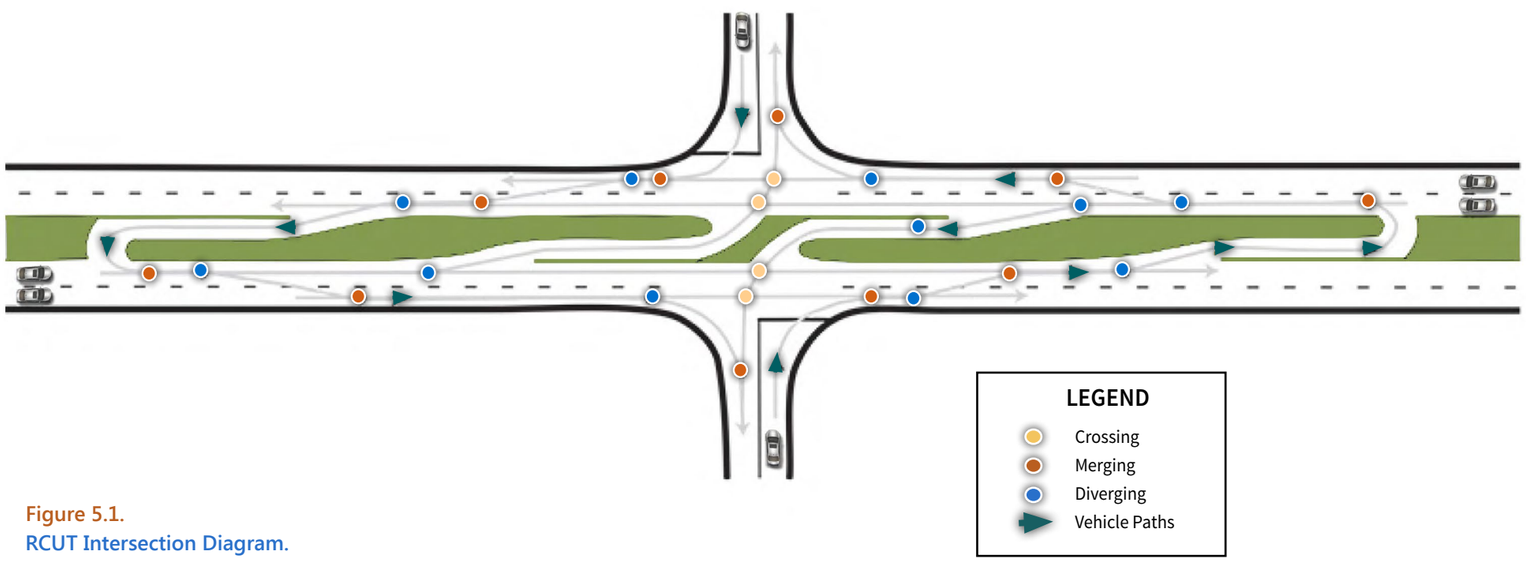


Figure 5.1.
RCUT Intersection Diagram.

Table 5.1.
U.S. Route 13 Segment Locations.

Segment #	Start Mile Post	End Mile Post	Corridor
1	70.00	74.78	Route 600 (Kiptopeke) to Route 624 (Cape Charles)
2	74.78	78.91	Route 624 (Cape Charles) to Route 642 (Cape Charles)
3	78.91	86.55	Route 642 (Cape Charles) to Route 630 (Martin Siding)
4	86.55	89.03	Route 630 (Martin Siding) to Route 628 (Treherneville and Machipongo)
5	89.03	93.90	Route 628 (Treherneville and Machipongo) to Route 617 (Nassawadox)
6	93.90	98.48	Route 617 (Nassawadox) to Route 618 (Exmore)
7	98.48	103.03	Route 618 (Exmore) to Route 607 (Melfa, Keller, Painter)
8	103.03	110.41	Route 607 (Melfa, Keller, Painter) to Route 639 (Accomac and Onley)
9	110.41	117.54	Route 639 (Accomac and Onley) to Business 13/ Route 663 (Mary N Smith Area)
10	117.54	120.23	Business 13/Route 663 (Mary N Smith Area) to Route 679
11	120.23	123.47	Route 679 to Route 681 (Nelsonia)
12	123.47	125.57	Route 681 (Nelsonia) to Route 729 (Mappsville)
13	125.57	128.90	Route 729 (Mappsville) to Route 692 (Oak Hall and Temperanceville)
14	128.90	133.93	Route 692 (Oak Hall and Temperanceville) to Route 175
15	133.93	138.10	Route 175 to Maryland State Line
RT 175	0.00	6.98	Route 175 from US Route 13 to Mosquito Creek

Source: 2002 U.S. Route 13/Wallops Island Access Management Study..

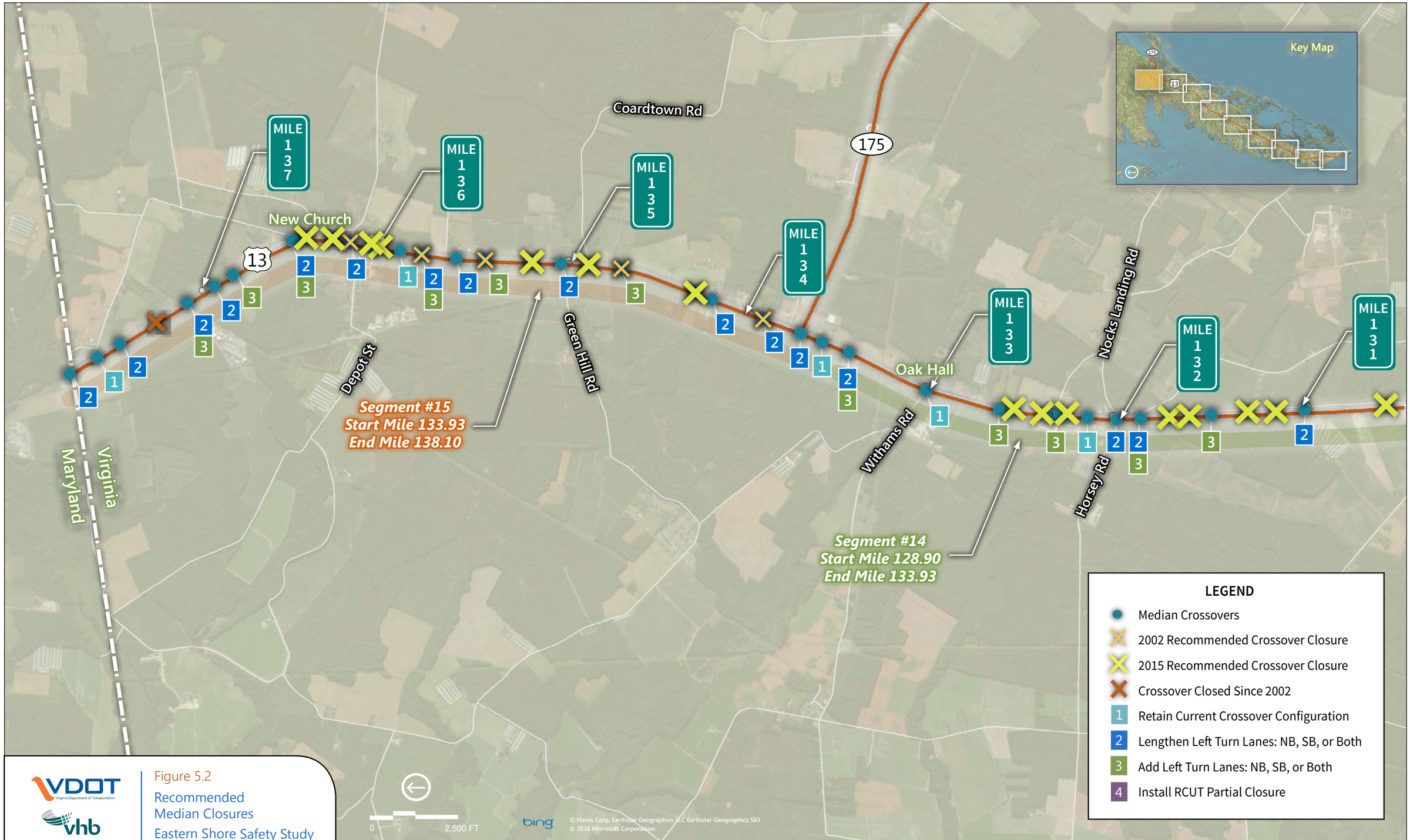
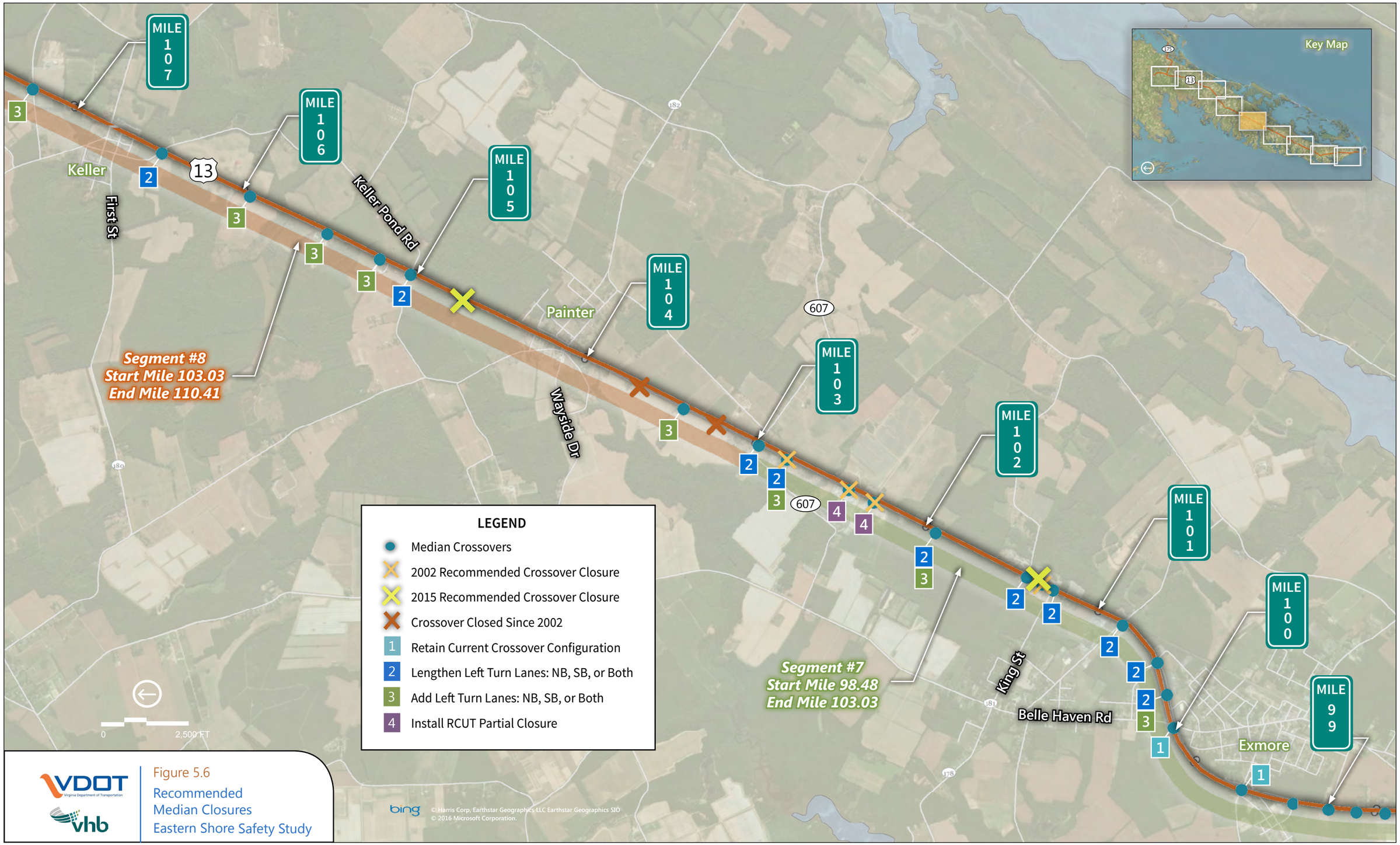


Figure 5.2
Recommended Median Closures
Eastern Shore Safety Study

Figure 5.3
Recommended Median Closures
Eastern Shore Safety Study

Figure 5.4
Recommended Median Closures
Eastern Shore Safety Study

Figure 5.5
Recommended
Median Closures
Eastern Shore Safety Study



VDOT Virginia Department of Transportation
vhb

Figure 5.6
Recommended
Median Closures
Eastern Shore Safety Study

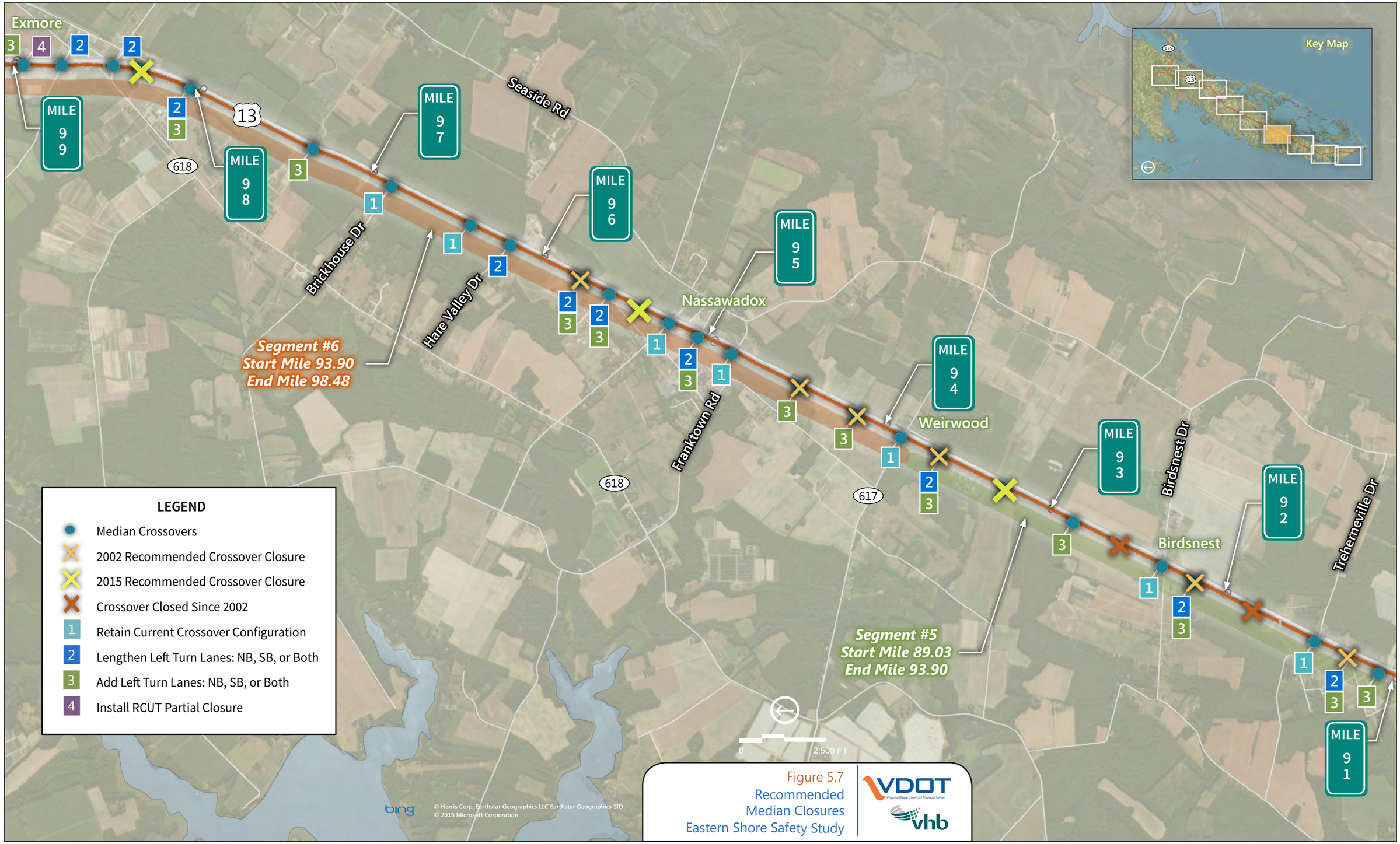


Figure 5.7
Recommended
Median Closures
Eastern Shore Safety Study

Figure 5.8
Recommended Median Closures
Eastern Shore Safety Study

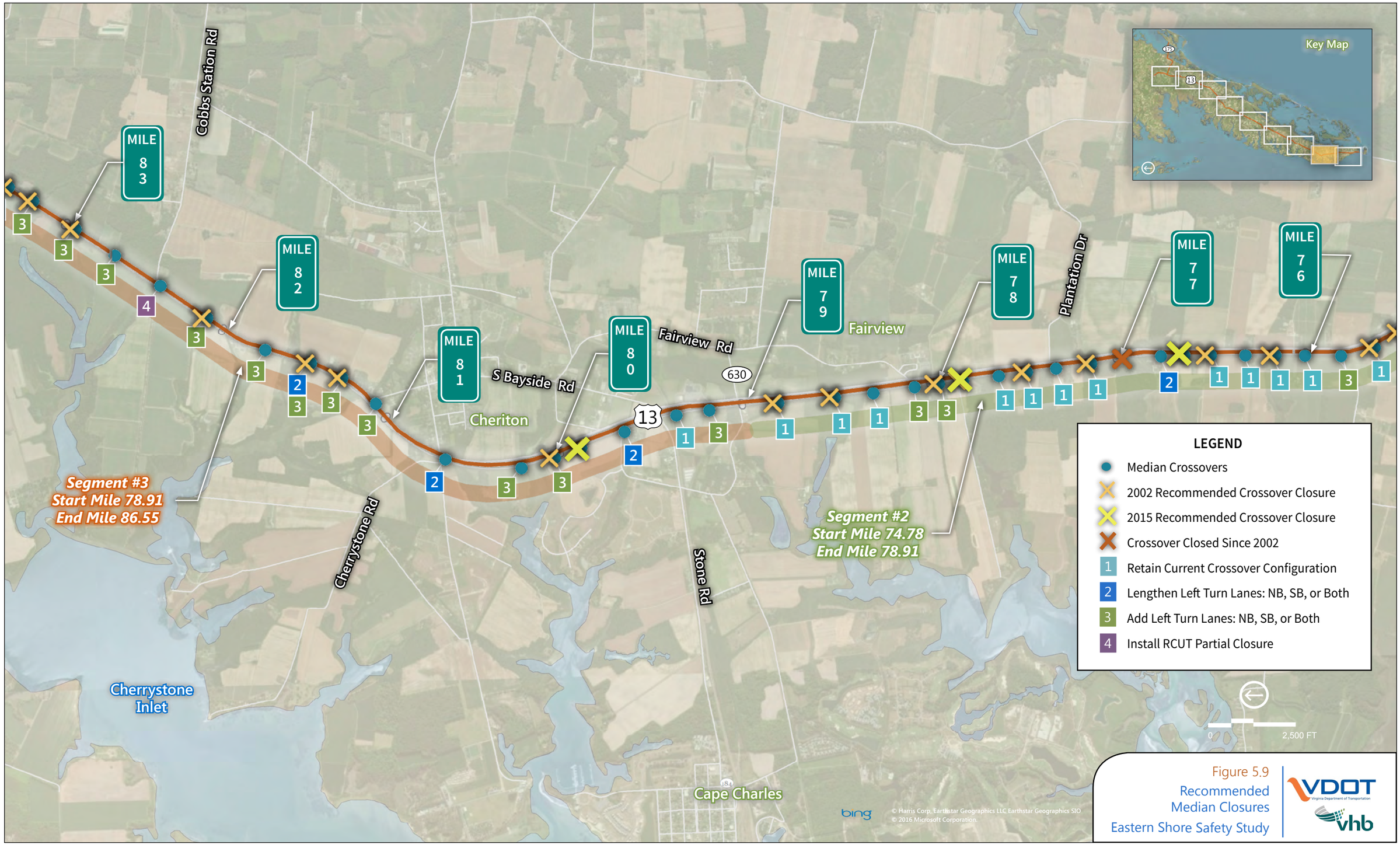


Figure 5.9
Recommended Median Closures
Eastern Shore Safety Study

Figure 5.10
Recommended Median Closures
Eastern Shore Safety Study

Site Specific Analysis

chapter

6

This page intentionally left blank.

6.1 Introduction

The third approach to addressing safety in the corridor is site specific analysis. In the CSA process, the pre-field review data analysis guided the approach to the field review and assessment. The analysis of a five-year period (2010-2014) of crash data led to the identification of 25 site specific locations due to their crash history and severity, see Figures 6.1 and 6.2. The site specific locations were chosen based on their potential to show reduced average crash frequency or severity. Once the locations were identified, field reviews were conducted in accordance with standard Road Safety Audit (RSA) practices of evaluation and documentation. In addition, a directional video recording of the corridors through the driver's perspective was generated. The 25 locations are listed in Table 6.1.

Table 6.1.
U.S. Route 13 Segment Locations.

1.	North of Jonathans Landing Lane
2.	Stone Road
3.	Eyrehall Drive
4.	Captain Howe Lane
5.	Near Sylvan Scene Drive
6.	Bayford Road
7.	South of West Street
8.	Dogwood Drive
9.	North of Dogwood Drive
10.	Chesapeake Square Shopping Center
11.	Taylor Road
12.	Daugherty Road
13.	Courthouse Avenue
14.	Mary N Smith Road / Front Street
15.	Evans Road
16.	Parksley Road
17.	South of Whites Neck Road
18.	Nelsonia Road
19.	Groton Town Road
20.	Hallwood Road
21.	Temperanceville Road
22.	New Temperanceville Road
23.	Chincoteague Road
24.	East of U.S. Route 13
25.	Bridge Crossing Wire Narrows

The 25 site specific locations are discussed in full detail on the following pages. For each site, the following information is included:

- Location of site along corridor;
- Aerial photo of location with crash locations shown;
- Description of existing conditions;
- Crash data;
- Key safety concerns;
- Recommended countermeasures and implementation plan for short-term, mid-term and long-term conditions;
- Summarized cost estimate using the templates as shown in Appendix A and other recommended countermeasures listed.
- Crash mitigation summary for recommended improvements; and
- Renderings of proposed geometric changes if recommended.

Additional details for the cost estimate can be found in Appendix E.

The recommendations are a result of the application of the Templates with the addition of site specific countermeasures. The recommendations are presented in three levels of implementation based on anticipated funding and potential completion. Generally, Tier 1 and Short-Term include countermeasures that are anticipated to be implemented quickly, possibly during maintenance using VDOT crews; Tier 2 and Mid-Term include countermeasures that would require more time to be implemented due to design or funding; and Tier 3 and Long-Term include countermeasures that would require longer lead time due to funding, property acquisition, public hearing, and/or longer construction time.

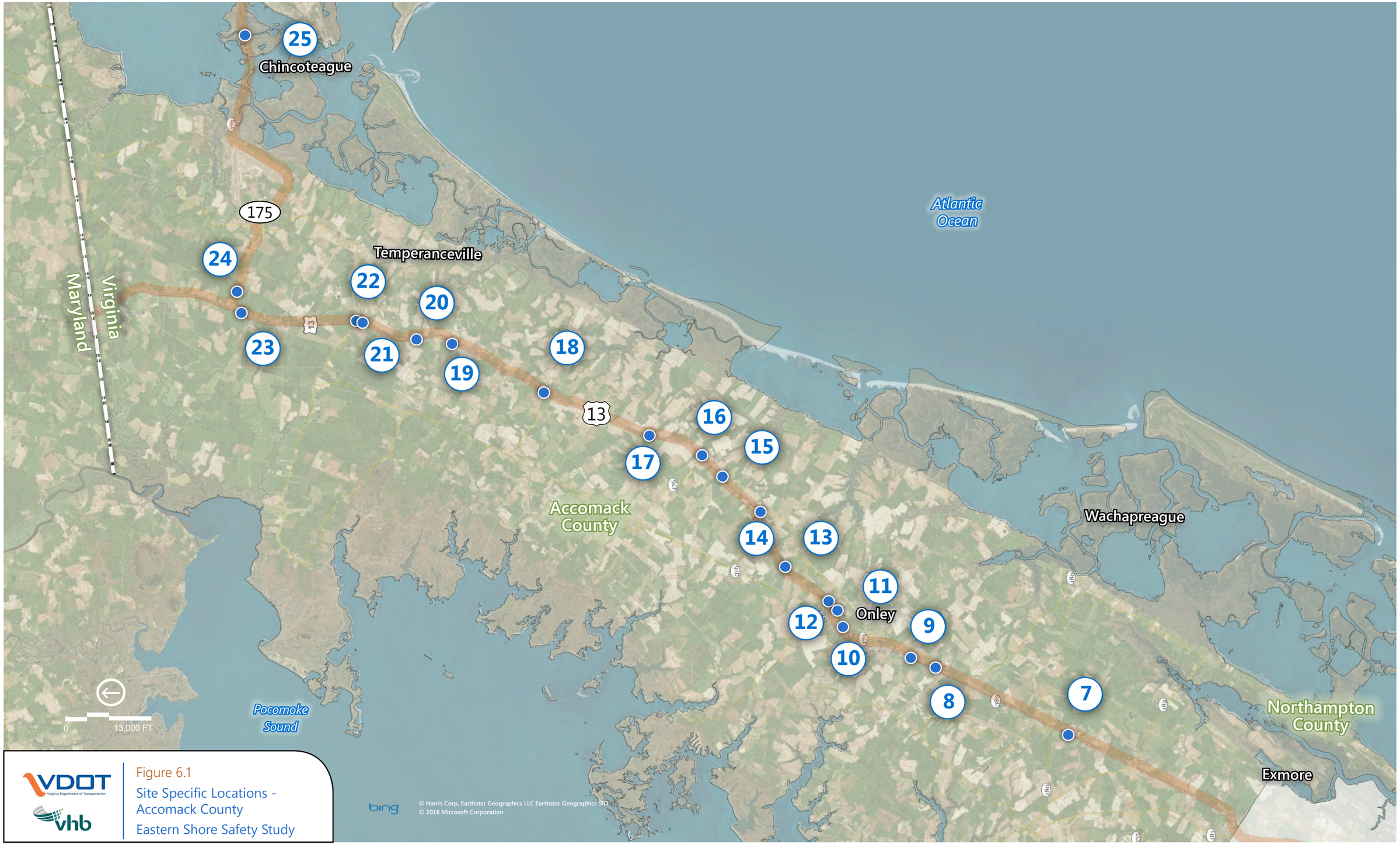
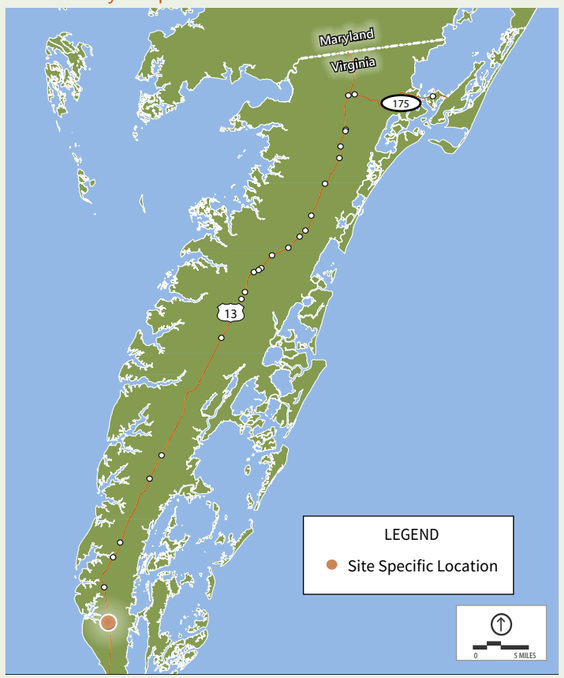


Figure 6.1
Site Specific Locations - Accomack County
Eastern Shore Safety Study

Figure 6.2
Site Specific Locations - Northampton County
Eastern Shore Safety Study

site specific location #1

Vicinity Map



Crash Sites

6.2 Site Specific Location #1 North of Jonathans Landing Lane (MP 76.13)

6.2.1 Existing Conditions

This location is approximately a third of a mile north of Arlington Road (Route 644) and a tenth of a mile north of Jonathans Landing Lane, and is in close proximity to a crossover on a four-lane divided section of U.S. Route 13. There are no intersecting roadways and no turn lanes present at the crossover.

The surrounding area is a mix of open fields and woods with some houses and field access. Outside shoulders are present for both north and southbound directions, and there are limited median shoulders present in either direction. Median and shoulder rumble strips are present in both north and southbound directions. There is no on-street parking or lighting. During the field review high truck traffic and vehicular speeds were observed.

6.2.2 Crash Data

Four crashes occurred during the five-year study period. The crashes were roadway departure crashes with one resulting in fatality, one resulting in non-incapacitating injury, and two in property damage only. Half of the crashes occurred during nighttime conditions and half were roadway departures into the median.

6.2.3 Key Safety Concerns

- Lack of positive guidance for drivers.
- Lack of recovery space for vehicles to stay on the road or recover from driving off the road.

6.2.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve positive guidance and warning through post mounted delineators along the roadside and at the median crossover, reflectorized sign posts, and wider 6-inch edge line and center line pavement markings.
- Implement safety edge during scheduled paving to provide an additional method for vehicles to recover from roadway departure crashes.

Long-Term:

- Widen outside shoulders to be at least eight feet wide and median shoulders to be four feet wide to provide additional space for vehicles that drive outside the travel lanes.
- Construct turn lanes with 200 feet of storage and 200 feet of taper at crossover.

Table 6.2. Location #1 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Widen paved shoulder from 3 ft to 8 ft	0.71 (29% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.3. Location #1 Cost Estimate.

	Item	Location #1
Tier 1	Signage	$5,585
	Pavement Markings	$8,882
	Signal	
	Other	$166
	TOTAL	$14,633
Tier 2	Signage	
	Pavement Markings	
	Signal	
	Other	$500
	TOTAL	$500
Tier 3	Signage	$2,345
	Pavement Markings	
	Signal	
	Other	$105,077
	TOTAL	$107,422

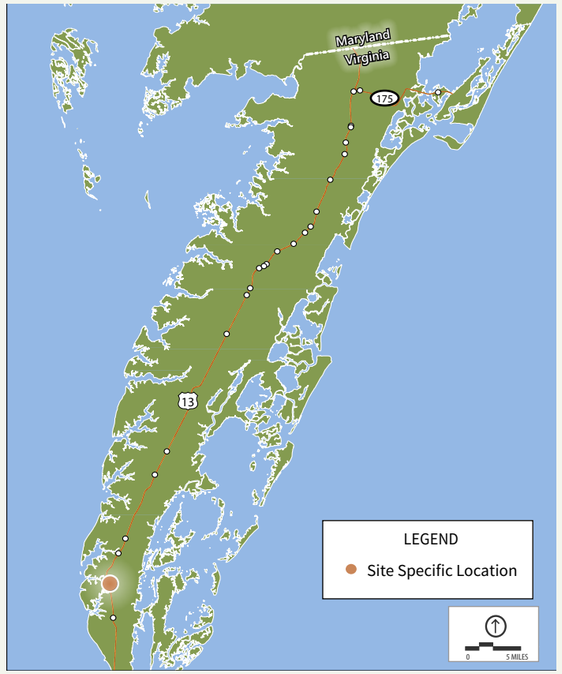
Note: See Templates in Appendix A for applicable items.

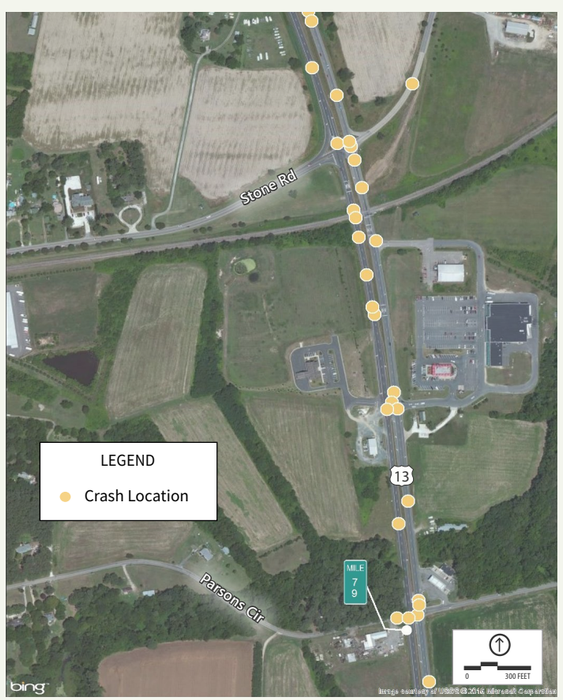
Facing east, a view of the median crossover on U.S. Route 13

U.S. Southbound Route 13

site specific location #2

Vicinity Map





Crash Sites

6.3 Site Specific Location #2 Stone Road (MP 79.18 – 79.43)

6.3.1 Existing Conditions

Location #2 is a segment from the Food Lion shopping center, north to Stone Road (Route 184). U.S. Route 13 and Stone Road is a four-legged, signalized intersection just north of a railroad crossing. There is a 120-foot northbound left turn lane with a 60-foot taper and a 120-foot northbound right turn lane with a 60-foot taper. Additionally, there is a 130-foot southbound left turn lane with a 60-foot taper and 325-foot southbound right slip lane with a 150-foot taper. Stone Road is a two-lane paved roadway. The outside shoulders are six (6) feet in the northbound and southbound directions.

U.S. Route 13 is four lanes with a grass median. At the shopping center there are right and left turn lanes in the north and southbound directions, two eastbound lanes entering the shopping center and one westbound/outbound lane. The southbound left turn lane has 185 feet of storage and 140 feet of taper and the southbound right turn lane has 200 feet of storage and 185 feet of taper. The northbound left turn lane has 210 feet of storage and 150 feet of taper and the northbound right turn lane has 220 feet of storage and 110 feet of taper. VDOT standard is 200/200 feet turn lane/taper. There is also a retail center located on the western side of the intersection with several access points, including one located at the median crossover for the shopping center entrance.

6.3.2 Crash Data

Twenty-six (26) crashes occurred within this quarter-mile segment during the five-year study period. Sixty (60) percent of the crashes were intersection related with 30 percent angle crashes and 30 percent rear end crashes. Fifteen (15) percent were deer crashes. The one pedestrian crash resulted in fatality. Half of the crashes resulted in injuries and half in property damage only. Four (4) of the crashes occurred at the shopping center driveway – all with injuries. Slightly less than half of the crashes occurred during nighttime conditions, and 60 percent occurred in the northbound direction.

6.3.3 Key Safety Concerns

- Buses stop unexpectedly at the railroad crossing that is adjacent to the traffic signal. Some of the rear end crashes were associated with buses stopping at the tracks.
- Nighttime crashes.

6.3.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve positive guidance and warning through post mounted delineators along the roadside and at the median crossover, reflectorized sign posts, and wider 6-inch edge line and center line pavement markings.
- Implement safety edge during scheduled paving to provide an additional method for vehicles to recover from roadway departure crashes.
- Install retroreflective tape on backplates or install retroreflective backplates to enhance signal conspicuity.
- Add a placard to the railroad track warning sign to watch for stopped vehicles.
- Evaluate truck turning radius at the southeast corner of the shopping center entrance and U.S. Route 13 to determine if it is possible to convert the two inbound lanes to one inbound lane and two outbound lanes, one for left-turning and one for right-turning vehicles.

Mid-Term:

- Conduct a signal warrant analysis to determine if signalization is a potential measure in reducing the angle crashes at the entrance to the Food Lion Shopping Center. Signalizing the entrance would provide dedicated movements for vehicles turning into and out of the shopping center if warranted. This cost is included in Tier 3, line "other".

Long-Term:

- Widen outside shoulders to be at least eight feet wide and median shoulders to be four feet wide to provide additional space for vehicles that drive outside the travel lanes.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.
- Consider adding intersection lighting at the shopping center and Stone Road to improve nighttime visibility.

Table 6.4. Location #2 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install retroreflective backplates	0.85 (15% reduction)	All Crashes - all severities	CMF Clearinghouse
Widen paved shoulder from 3 ft to 8 ft	0.71 (29% reduction)	All Crashes - all severities	CMF Clearinghouse
Directional medians to allow left-turns and u-turns	0.77 (23% reduction)	All Crashes - all severities	CMF Clearinghouse
Intersection lighting	0.881 - 0.92 (8 - 11.9% reduction)	Nighttime crashes - all severities	CMF Clearinghouse

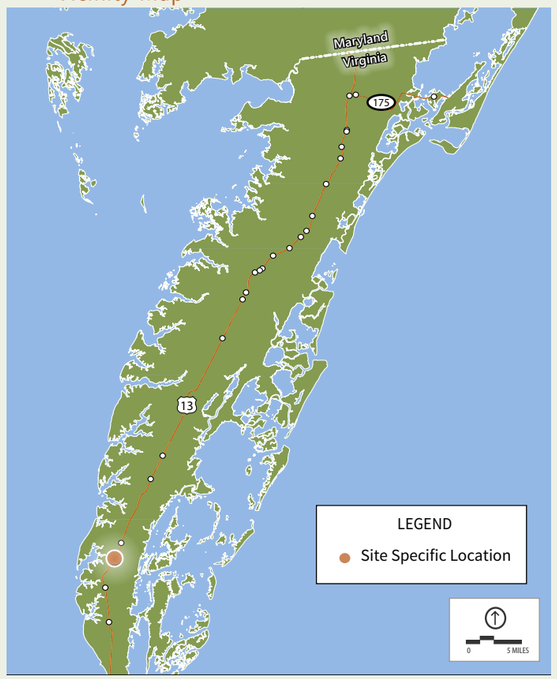
Table 6.5. Location #2 Cost Estimate.

	Item	Location #2
Tier 1	Signage	$71,167
	Pavement Markings	$31,039
	Signal	$792
	Other	$332
	TOTAL	$103,329
Tier 2	Signage	$24,275
	Pavement Markings	$1,663
	Signal	
	Other	$1,320
	TOTAL	$27,258
Tier 3	Signage	$22,420
	Pavement Markings	$417
	Signal	
	Other	$1,047,027
	TOTAL	$1,069,864

Note: See Templates in Appendix A for applicable items.

site specific location #3

Vicinity Map



Crash Sites

6.4 Site Specific Location #3 Eyrehall Drive (MP 82.40)

6.4.1 Existing Conditions

This location is a U.S. Route 13 corridor segment located near the stop controlled intersections of Eyrehall Drive and Cobbs Station Road (Route 636). The segment extends approximately 1,500 feet to the south and 2,000 feet to the north of Cobbs Station Road. The surrounding area type is agricultural and forest.

The intersections of Eyrehall Drive and Cobbs Station Road are offset T-intersections under stop control. Eyrehall Drive is a private driveway for several residences. This gravel road has an unpaved apron, and the approach has a steep downhill grade forcing vehicles to enter slowly. Cobbs Station Road is a paved local road. Edge line extensions are provided along U.S. Route 13 at Cobbs Station Road.

The only turn lane present at this location is a short, 155-foot southbound left turn lane with a 60-foot taper. Outside shoulders are present; however, median shoulders are narrow in both north and southbound directions. North and southbound median and shoulder rumble strips are present. During field review, drivers were heard driving over the rumble strips. Also, tire tracks were visible on and crossing the rumble strips. There was gravel on U.S. Route 13 from Eyrehall Drive.

6.4.2 Crash Data

Twenty (20) crashes occurred at this location including one fatal crash. Thirty-five (35) percent resulted in injuries. Half of the crashes involved deer, 30 percent were roadway departure crashes, and 20 percent were rear end crashes. Approximately half of the crashes occurred during dark or dawn conditions.

6.4.3 Key Safety Concerns

- Minimal positive guidance to drivers.
- Unpaved apron at intersecting road/driveway.
- Nighttime deer crashes.
- Offset intersections encourage drivers on Eyrehall Drive to travel against traffic towards the north to access the median crossover.
- Street signs are difficult to see from U.S. Route 13 due to the travel speeds.

6.4.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve positive guidance and warning through intersection warning signs, post mounted delineators, wider 6-inch pavement markings, dynamic speed warning signs, and deer warning signs.
- Pave driveway and road apron onto U.S. Route 13.
- Install 12-inch street name signs to conform to MUTCD recommendation.

Long-Term:

- Due to the alignment of the offset intersection, modify median access to provide channelization and restrict access to left turns from U.S. Route 13 south and Cobbs Station Road.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.6. Location #3 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Install dynamic speed feedback sign	0.93-0.95 (5-7% reduction)	All Crashes - all severities	CMF Clearinghouse
Directional medians to allow left-turns and u-turns	0.77 (23% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.7. Location #3 Cost Estimate.

	Item	Location #3
Tier 1	Signage	$28,302
	Pavement Markings	$30,717
	Signal	
	Other	$166
	TOTAL	$59,185
Tier 2	Signage	$2,657
	Pavement Markings	$185
	Signal	
	Other	
	TOTAL	$2,842
Tier 3	Signage	$11,694
	Pavement Markings	$417
	Signal	
	Other	$366,478
	TOTAL	$378,589

Note: See Templates in Appendix A for applicable items.

Looking north from Eyrehall Drive

Looking south from Cobbs Station Road

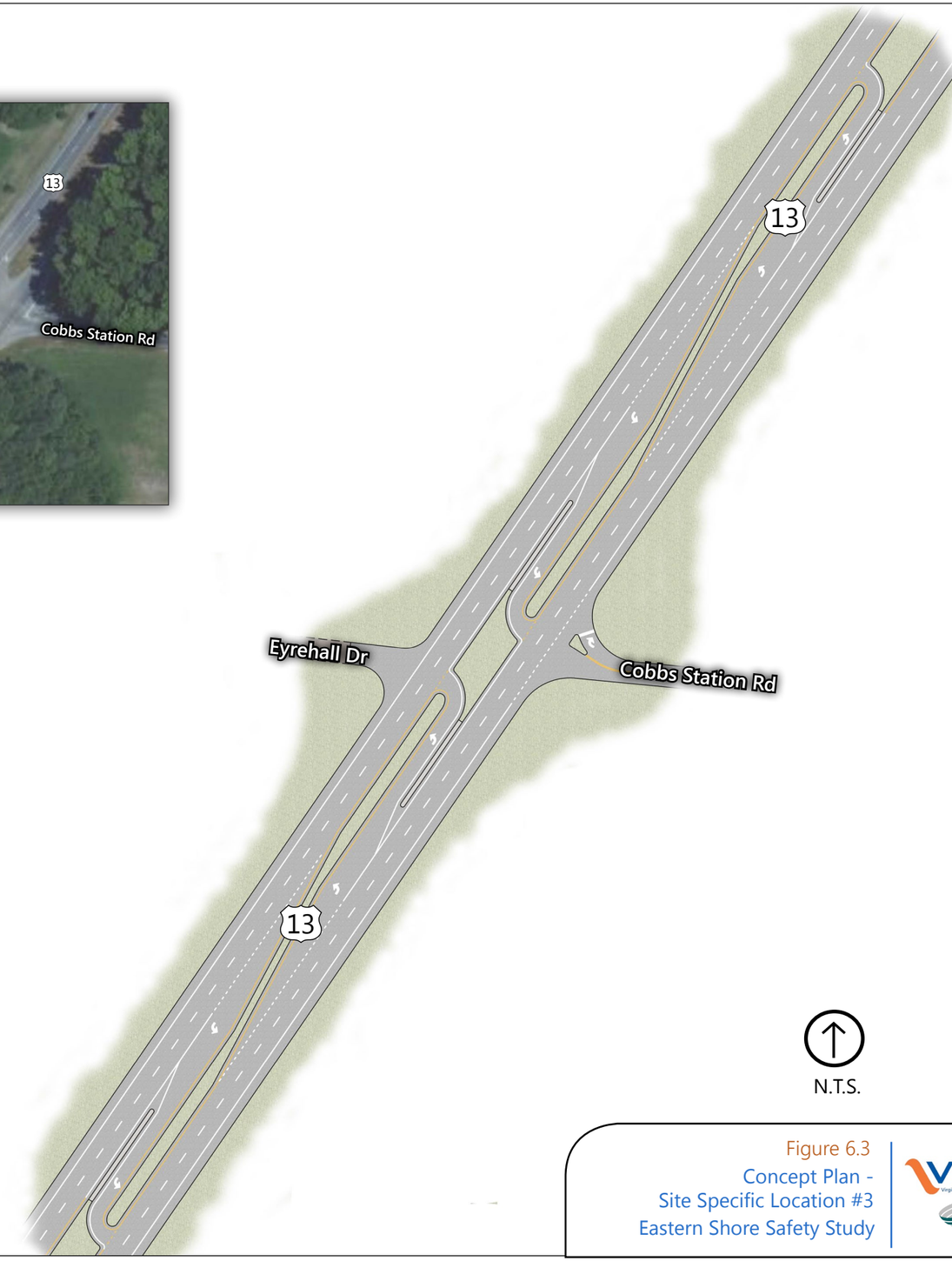
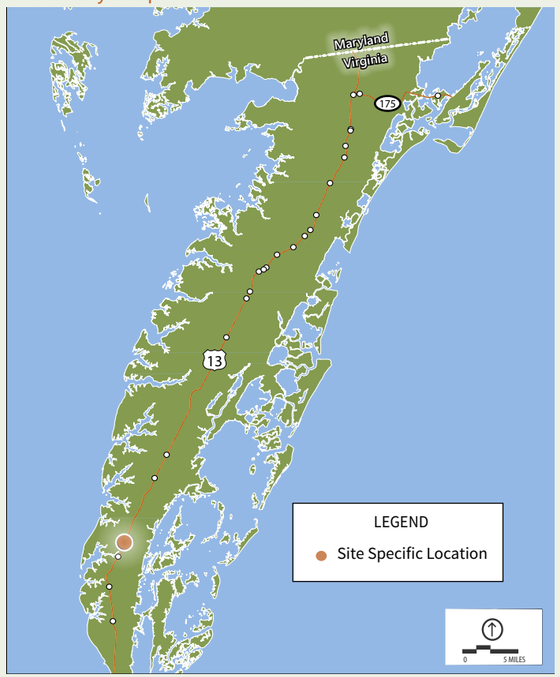


Figure 6.3
Concept Plan -
Site Specific Location #3
Eastern Shore Safety Study

site specific location #4

Vicinity Map



Crash Sites

6.5 Site Specific Location #4 Captain Howe Lane (MP 84.14)

6.5.1 Existing Conditions

This location is at the unsignalized, four-legged intersection of U.S. Route 13, Captain Howe Lane, and Eastville Commons. Captain Howe Lane is a paved local road, and Eastville Commons is an unused roadway leading to a vacant property.

A 235-foot left turn lane with a 45-foot taper is present in the northbound direction in addition to a 195-foot southbound left turn lane with a 150-foot taper. There is a 195-foot northbound right turn lane with 120 feet of taper provided at Eastville Commons; however, the turn lane is designated with arrows placed outside of the edge line. A southbound right turn lane is not present at this location.

Shoulder and median rumble strips are present in both directions. Outside and median shoulders are present in both directions; however, the median shoulders are narrow. Edge line extensions are provided for Captain Howe Lane along U.S. Route 13.

Waves of traffic were observed in the southbound direction due to upstream traffic signals providing gaps for traffic to enter from the side streets. However, northbound traffic is more evenly spread out making it difficult to find an acceptable gap. Waste management trucks use Courthouse Road/Indian Walk Lane to the north for dump access.

6.5.2 Crash Data

Seven (7) crashes occurred in the vicinity of Captain Howe Lane. Fifty-seven (57) percent of the crashes resulted in injury, including one fatal crash. Fifty-seven (57) percent of the crashes were intersection related crashes: angle, head-on, and rear end crashes. The remaining crashes were roadway departure and deer related crashes.

6.5.3 Key Safety Concerns

- Grade change in median at paving joint causes an uneven transition for drivers and traps debris which could cause drivers to lose traction.
- Lack of right turn lanes in southbound direction limit southbound drivers' ability to slow down before turning onto Captain Howe Lane. Additionally, the northbound right turn lane is not adequately marked.
- Street signs are difficult to see from U.S. Route 13 due to the travel speeds; a single stop sign was placed on the median island on Captain Howe Lane and no stop sign on the right side of the intersection. These signs are not MUTCD compliant.

6.5.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve positive guidance and warning through intersection warning signs, post mounted delineators, and wider 6-inch pavement markings.
- Smooth median crossover to prevent debris build-up.
- Install 12-inch street name signs, a right-hand stop sign on Captain Howe Lane, and MUTCD complaint median signage.

Mid-Term:

- Investigate potential to add right turn lane in southbound direction and if the Eastville Commons property is developed, improve right turn lane pavement markings.

Long-Term:

- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.8. Location #4 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Provide a right-turn lane on one major road approach	0.86 - 0.92 (8 - 14% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.9. Location #4 Cost Estimate.

	Item	Location #4
Tier 1	Signage	$22,717
	Pavement Markings	$8,215
	Signal	
	Other	$166
	TOTAL	$31,098
Tier 2	Signage	$2,657
	Pavement Markings	$554
	Signal	
	Other	
	TOTAL	$3,211
Tier 3	Signage	$9,349
	Pavement Markings	$417
	Signal	
	Other	$113,376
	TOTAL	$123,142

Note: See Templates in Appendix A for applicable items.

Looking south from Eastville Commons

Looking east at intersection of U.S. Route 13 and Captain Howe Lane

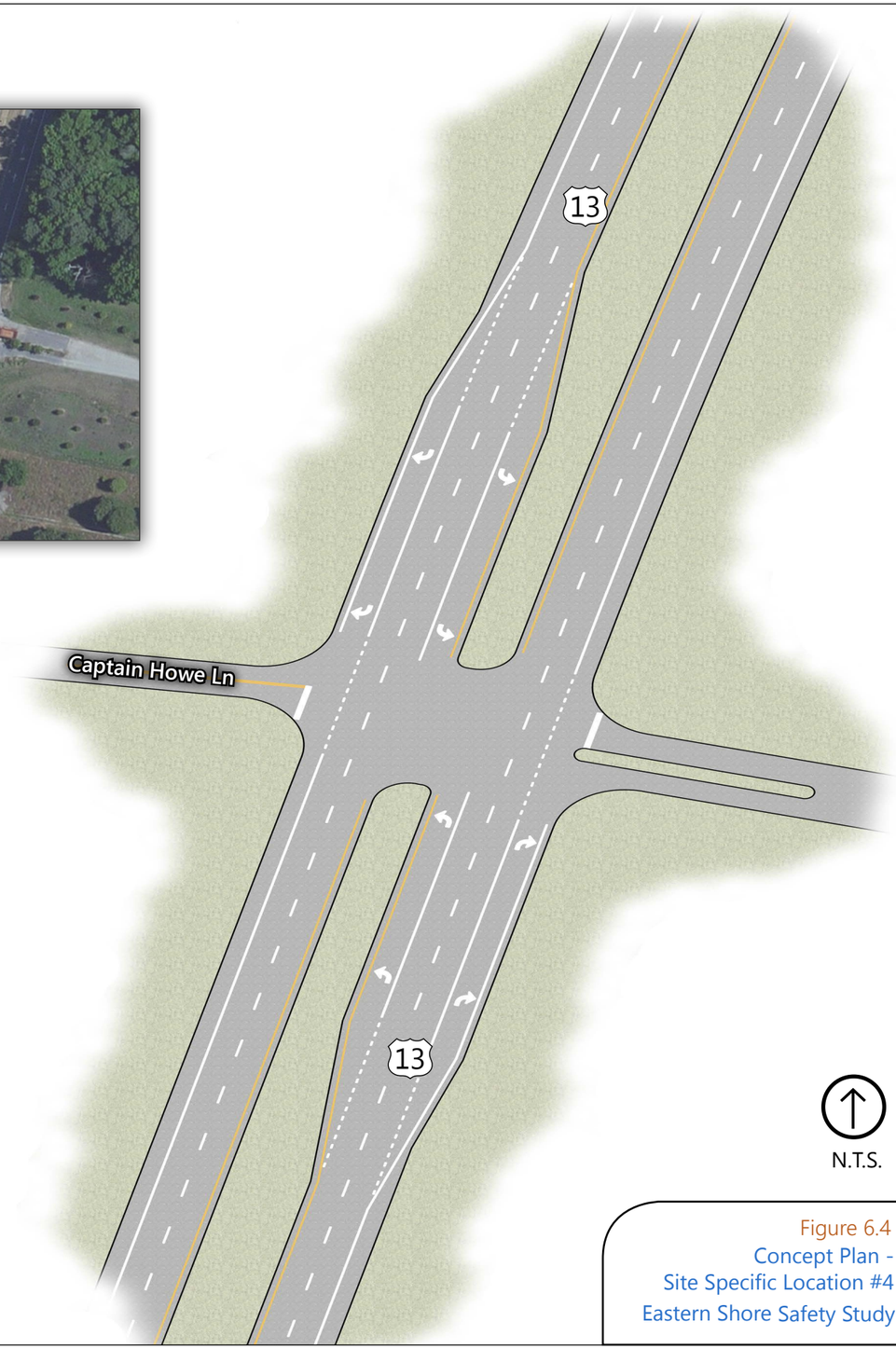
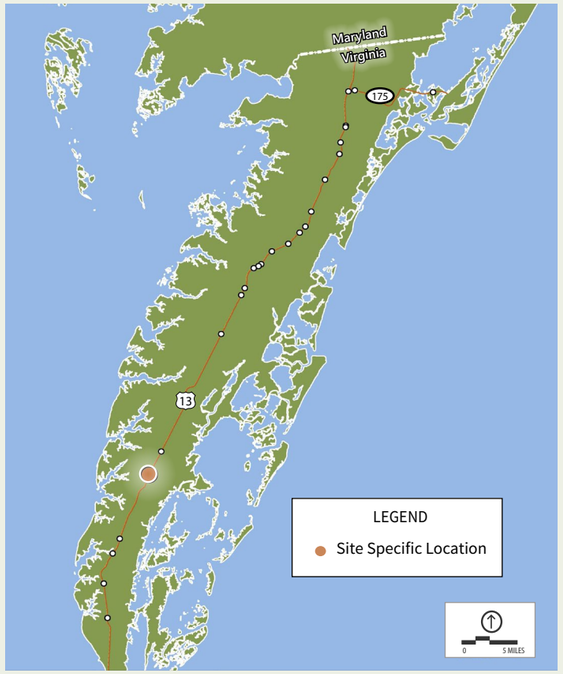
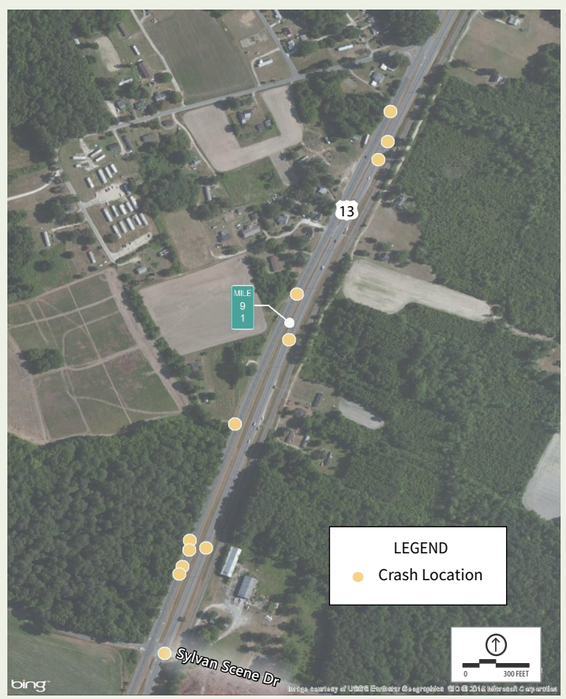


Figure 6.4
Concept Plan -
Site Specific Location #4
Eastern Shore Safety Study

site specific location #5

Vicinity Map





Crash Sites

6.6 Site Specific Location #5 Near Sylvan Scene Drive (MP 90.50 – 90.99)

6.6.1 Existing Conditions

This location is a U.S. Route 13 corridor segment extending from approximately 550 feet south to 1,800 feet north of Sylvan Scene Drive (Route 625). The intersection of Sylvan Scene Drive is a four-legged, two-way stop controlled intersection with a 115-foot northbound left turn lane with 60-foot taper. Additionally, there is a 115-foot southbound left turn lane with a 55-foot taper and a 240-foot southbound right turn lane with a 40-foot taper. Sylvan Scene Drive is a two-lane paved road.

Outside and median shoulders are present in both the north and southbound directions with rumble strips; however, the median shoulders are narrow. Vehicles park along the corridor to the north of Sylvan Scene Drive to access their homes on the eastern side of the railroad track.

6.6.2 Crash Data

There were 13 crashes within this half mile segment in the vicinity of the Sylvan Scene Drive intersection. Eighty-five (85) percent of the crashes were roadway departure or deer-related crashes. One fatal, rear end crash occurred in the northbound direction involving a parked car on the side of the road, and one angle crash occurred at the intersection of Sylvan Scene Drive.

Forty-six (46) percent of the crashes resulted in fatality or injury and 85 percent of the crashes occurred under dark conditions. The direction of travel was fairly evenly split with 54 percent occurring in the southbound direction and 46 percent occurring in the northbound direction.

6.6.3 Key Safety Concerns

- Parked vehicles on shoulder. There is a lack of expectancy for drivers on U.S. Route 13 as vehicles were not observed parking along the roadway on other parts of the corridor. These vehicles serve as fixed objects within the clear zone. Furthermore, these vehicles are parked in the grass requiring them to enter U.S. Route 13 at relatively slow speeds compared to the vehicles already traveling at higher speeds on U.S. Route 13.
- Lack of positive guidance for drivers, particularly at night. Difficult for vehicles to recover if they drive off the road due to narrow median shoulders.
- Nighttime crashes.

6.6.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Incorporating safety edge to provide an additional method for vehicles to recover from roadway departure crashes.
- Prohibit parking on grassy shoulder.
- Provide additional recovery area for drivers by widening median shoulders to four feet and incorporating safety edge.

Long-Term:

- Install roadway lighting if positive guidance does not reduce nighttime crashes.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.10. Location #5 Recommended Countermeasures.

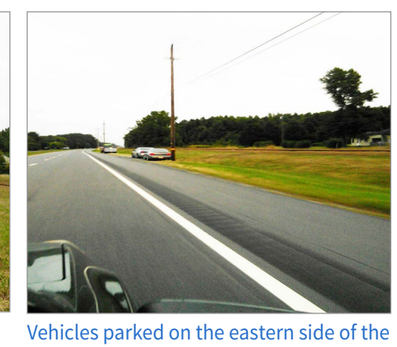
Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Corridor lighting	0.73 (27% reduction)	All Crashes - severe and minor injury	CMF Clearinghouse

Table 6.11. Location #5 Cost Estimate.

	Item	Location #5
Tier 1	Signage	$49,448
	Pavement Markings	$24,267
	Signal	
	Other	$332
	TOTAL	$74,046
Tier 2	Signage	$6,218
	Pavement Markings	$515
	Signal	
	Other	$1,320
	TOTAL	$8,053
Tier 3	Signage	$15,374
	Pavement Markings	$832
	Signal	
	Other	$94,993
	TOTAL	$111,199

Note: See Templates in Appendix A for applicable items.

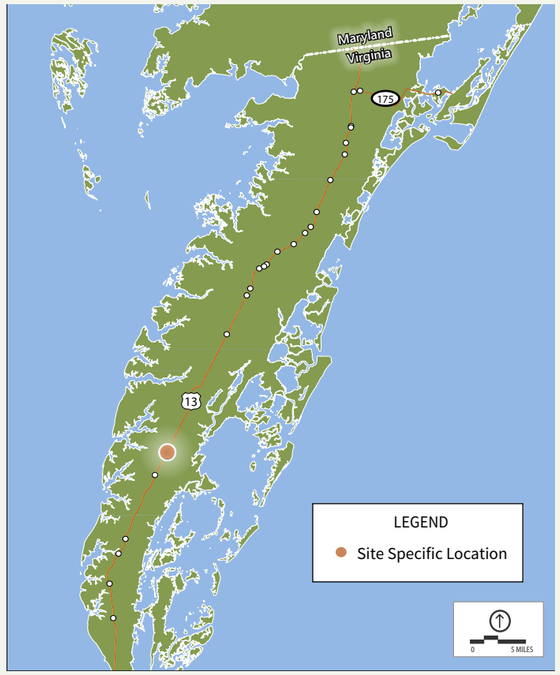
Looking north from westbound approach at Sylvan Scene Drive



Vehicles parked on the eastern side of the northbound travel lane on U.S. Route 13

site specific location #6

Vicinity Map



Crash Sites

6.7 Site Specific Location #6 Bayford Road (MP 93.28 – 94.04)

6.7.1 Existing Conditions

This location encompasses a stretch of U.S. Route 13 in the vicinity of Bayford Road (Route 617) extending from approximately 1,000 feet north to almost 3,000 feet south of the intersection. The area is a mix of fields and forests with some residential areas. During the field review, the RSA team viewed agricultural trucks entering and exiting from the western side of Bayford Road.

A 225-foot northbound left turn lane with a 195-foot taper and a 170-foot southbound left turn lane with 220-foot taper are present at the intersection with Bayford Road. A 170-foot southbound right turn lane with a 115-foot taper is also present at this location. Intersection warning signs are present in both north and southbound direction.

6.7.2 Crash Data

There were 22 crashes on this three-quarters of a mile segment. Seventy-three (73) percent of the crashes were roadway departure and deer-related crashes. One of the roadway departure crashes resulted in fatality. Half of the crashes occurred during dark, dawn, or dusk conditions. Eighty-six (86) percent of the crashes occurred on dry pavement. The roadway is level and half of the drivers were cited for exceeding the speed limit or failing to maintain proper control of the vehicle.

6.7.3 Key Safety Concerns

- Difficult for vehicles, particularly trucks, to turn from Bayford Road onto U.S. Route 13 due to necessary turning radii and high speeds on U.S. Route 13.

6.7.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Incorporating safety edge to provide an additional method for vehicles to recover from roadway departure crashes.

Mid-Term:

- Widen outside shoulders to be at least eight feet wide and median shoulders to be four feet wide to provide additional space for vehicles that drive outside the travel lanes.

Long-Term:

- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.12. Location #6 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Widen paved shoulder from 3 ft to 8 ft	0.71 (29% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.13. Location #6 Cost Estimate.

	Item	Location #6
Tier 1	Signage	$49,448
	Pavement Markings	$37,748
	Signal	
	Other	$332
	TOTAL	$87,528
Tier 2	Signage	$6,218
	Pavement Markings	$554
	Signal	
	Other	$660
	TOTAL	$7,432
Tier 3	Signage	$15,374
	Pavement Markings	$832
	Signal	
	Other	$79,071
	TOTAL	$95,277

Note: See Templates in Appendix A for applicable items.

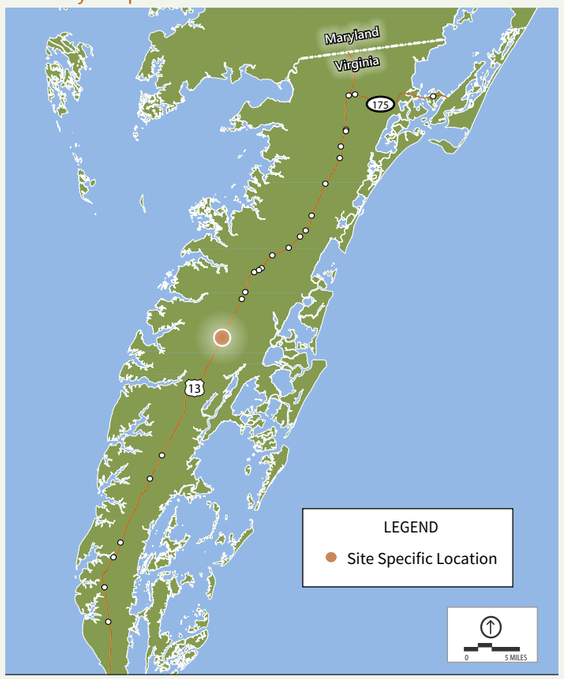
Looking northbound from the median at Bayford Road

Bus entering onto U.S. Route 13 from Bayford Road

This page intentionally left blank.

site specific location #7

Vicinity Map



Crash Sites

6.8 Site Specific Location #7 South of West Street (MP 106.14)

6.8.1 Existing Conditions

This location is approximately 1,700 feet south of West Street/Keller Pond Road (VA 620). The area is predominantly comprised of fields with some wooded portions.

Outside shoulders with rumble strips are present in both north and southbound directions. There are narrow median shoulders and a median rumble strip in the northbound direction but no median shoulders or rumble strip/stripe in the southbound direction.

6.8.2 Crash Data

Six (6) crashes occurred at this location including a fatal roadway departure crash. Five other crashes occurred within 2,500 feet of the intersection. Sixty-seven (67) percent of the crashes were roadway departure. Four (4) of the crashes were in the southbound direction and two (2) in the northbound direction. Four of the six crashes occurred during daylight.

6.8.3 Key Safety Concerns

- Lack of positive guidance.
- Lack of warning/recovery space in the median, particularly in the southbound direction.
- Deep ditch on roadside within clear zone.

6.8.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve positive guidance through post mounted delineators and replace pavement markings with wider 6-inch pavement markings.

Mid-Term:

- Widen/add median shoulders to four feet and add rumble strips. If shoulders are not possible then incorporate rumble stripes in the southbound direction.
- Review ditches to see if the depth and slope can be reduced. If not, widen shoulder and add guardrail or pipe ditch to eliminate hazard within clear zone.

Table 6.14. Location #7 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Install shoulder rumble strips	0.73-0.83 (17-27% reduction)	Run-off-the-road crashes - all severities	CMF Clearinghouse

Table 6.15. Location #7 Cost Estimate.

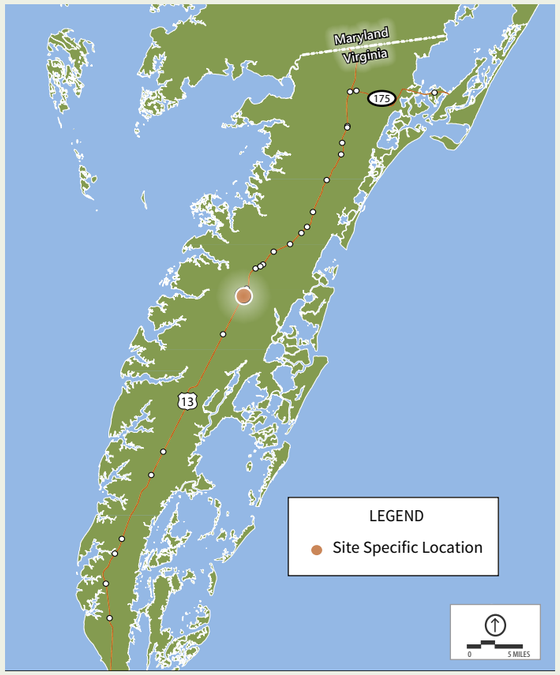
	Item	Location #7
Tier 1	Signage	$5,585
	Pavement Markings	$4,798
	Signal	
	Other	$166
	TOTAL	$10,549
Tier 2	Signage	
	Pavement Markings	
	Signal	
	Other	$660
	TOTAL	$660
Tier 3	Signage	$2,345
	Pavement Markings	
	Signal	
	Other	$117,913
	TOTAL	$120,258

Note: See Templates in Appendix A for applicable items.

Looking north from the western side of U.S. Route 13

site specific location #8

Vicinity Map



Crash Sites

6.9 Site Specific Location #8 Dogwood Drive (MP 110.31)

6.9.1 Existing Conditions

Site Specific Location #8 is at the intersection of U.S. Route 13 with Dogwood and Phillips Drives (Route 639) in Accomack County. This is an unsignalized intersection, and U.S. Route 13 has a posted speed of 55 mph. There is a 125-foot northbound left turn lane, a 100-foot southbound left turn lane and a 125-foot southbound right turn lane at this intersection.

Dogwood and Phillips Drives are two-lane rural local roads. Dogwood Drive intersects on the west side of the U.S. Route 13, and Phillips Drive intersects on the east side.

Texaco Town Road is a frontage road that runs parallel to U.S. Route 13 on the east side. It terminates at Phillips Drive approximately 90 feet from the U.S. Route 13 intersection. In addition to Texaco Town Road, there is a deep ditch and railroad tracks running parallel to U.S. Route 13 on the east side of the road at this location.

Directly adjacent to U.S. Route 13 on the west side of the intersection are the Virginia State Police Area Office and Tammy and Johnny's Restaurant. Both buildings have access from U.S. Route 13 as well as from Dogwood Drive.

6.9.2 Crash Data

There were 23 crashes reported within the vicinity of the intersection. These crashes included one fatal crash and the remainder of crashes were split between injury and property damage only. Forty-eight (48) percent of crashes were roadway departure crashes and 30 percent were angle crashes. Fifty-seven (57) percent of the crashes occurred during daylight with one-third of all crashes occurring in the afternoon between the hours of noon and 5 pm.

6.9.3 Key Safety Concerns

- High number of conflict points due the numerous intersections and driveways within the intersection footprint.
- Wide access points/driveway entrances that reduce driver expectancy
- High travel speeds on U.S. Route 13 lead to difficulty for drivers entering U.S. Route 13 to identify sufficient gaps to enter traffic flow and/or drivers to slow down adequately to safely enter driveways or intersecting roads due to insufficient turn lane and taper lengths
  - Increased potential for higher severity crashes
- Limited auxiliary lanes
  - Short southbound right turn lane
  - No northbound right turn lane
  - Insufficient space for drivers to slow down before turning onto intersecting streets or parking lot entrances.
- U-turn prohibition due to narrow median and speeds.
  - Signage is present but vehicles still conduct maneuver.
- Unclear signage
  - Some of the signs or sign posts are bent/damaged.
  - Street signs are difficult to see traveling at speed on U.S. Route 13.

6.9.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Repair or replace damaged signs and sign posts.
- Install 12-inch street name signs to conform to MUTCD recommendation.
- Improve intersection expectancy and visibility through advance intersection warning signs, flashing/dynamic warning beacons on warning signs or at intersection, reflective strips on signs posts, reflective post mounted delineators on intersection approaches and median.

Long-Term:

- Reduce the entrance width and consolidate entrances at Tammy and Johnny's Restaurant through use of curbing, landscaping, etc., to close access points and reduce the number of conflict points.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.
- The installation of a northbound right turn lane is recommended; however, it is not feasible to construct the turn lane due to the limited space and elevation change between the existing travel lanes and the railroad tracks. The mainline would require a significant shift or elevation adjustment to add in the right turn lane.

Table 6.16. Location #8 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Add dynamic intersection warning signs	0.814-0.918 (18.6%-8.2% reduction)	All Crashes - all severities	CMF Clearinghouse
Corridor Access Management	0.77 - 0.95 (5 - 23% reduction)	All Crashes - all severities	FHWA Proven Countermeasures
Directional Medians to allow left-turns and u-turns	0.77 (23% reduction)	All Crashes - all severities	CMF Clearinghouse
Intersection lighting	0.881 - 0.92 (8 - 11.9% reduction)	Nighttime crashes - all severities	CMF Clearinghouse

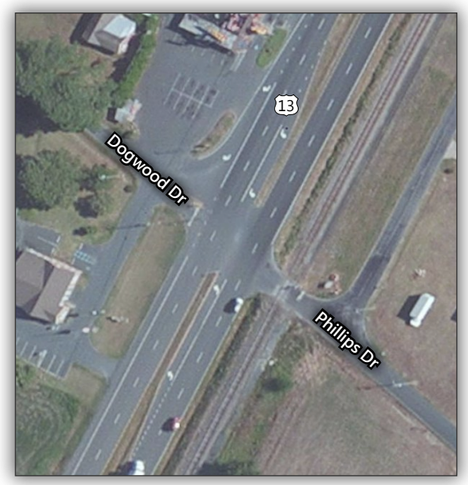
Table 6.17. Location #8 Cost Estimate.

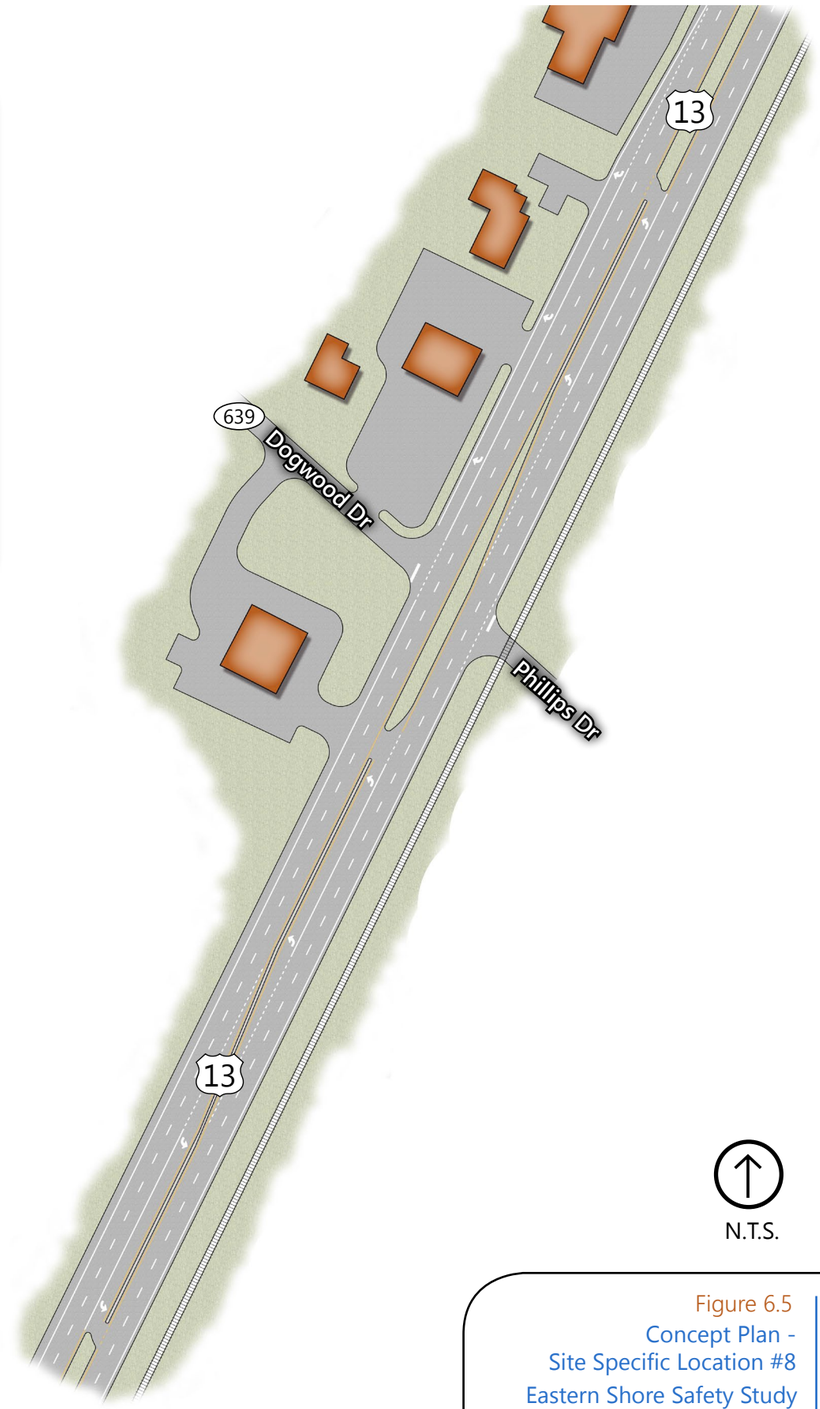
	Item	Location #8
Tier 1	Signage	$43,862
	Pavement Markings	$9,527
	Signal	
	Other	$166
	TOTAL	$53,555
Tier 2	Signage	$6,218
	Pavement Markings	$554
	Signal	
	Other	$660
	TOTAL	$7,432
Tier 3	Signage	$13,029
	Pavement Markings	$832
	Signal	
	Other	$74,337
	TOTAL	$88,198

Note: See Templates in Appendix A for applicable items.

Looking south from Tammy and Johnny's restaurant

Looking north from southwest quadrant of intersection



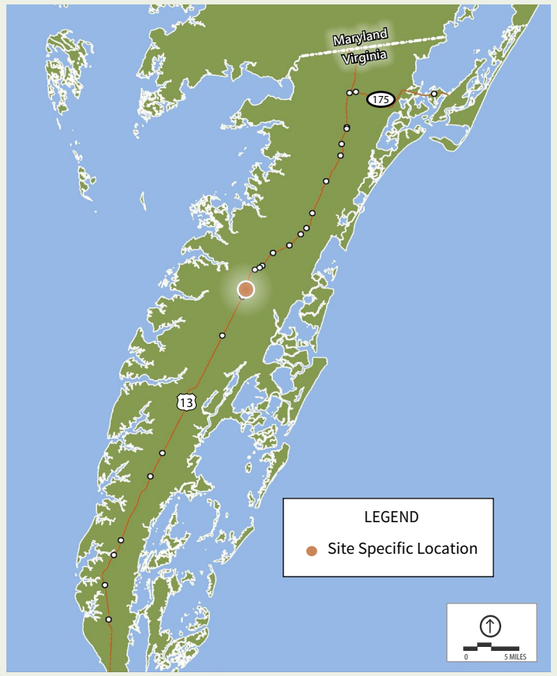


N.T.S.

Figure 6.5
Concept Plan -
Site Specific Location #8
Eastern Shore Safety Study

site specific location #9

Vicinity Map



Crash Sites

6.10 Site Specific Location #9 North of Dogwood Drive (MP 110.95)

6.10.1 Existing Conditions

This location approximately 3,375 feet north of Dogwood Drive, just south of Nandua High School and is in an area with residential and retail land uses.

In the southbound direction there is an outside shoulder with rumble strip and a narrow median shoulder with a narrow rumble strip. Tire tracks were on the southbound shoulder and off the road on the northbound grass and gravel roadside.

A gravel access road provides access from the residential area to the east, over the railroad tracks, and onto U.S. Route 13. The apron was not paved and gravel was in the roadway. Also, vehicles were observed using this access and did not have room to accelerate when entering U.S. Route 13.

6.10.2 Crash Data

Eight (8) crashes occurred in this area including one fatal crash involving a pedestrian. Of the eight crashes, half resulted in fatality or injury. Thirty-eight (38) percent were roadway departure crashes with one of each of the following crash types: deer-related, fixed object in road, pedestrian, rear end, and train. Approximately half of the crashes occurred during dark conditions.

6.10.3 Key Safety Concerns

- Lack of positive guidance.
- Lack of warning/recovery space on both the outside and median, particularly in the northbound direction.
- Lack of space to slow down to make turns off of U.S. Route 13 or onto U.S. Route 13.
- Deep ditches on roadside within clear zone, particularly adjacent to the railroad tracks.
- Unpaved access from eastern side of corridor.
- Lack of dedicated pedestrian space or crossing measures. Due to the proximity of the school, businesses including an ice cream shop on the western side of U.S. Route 13 and the residential area on the eastern side of U.S. Route 13, pedestrian activity should be investigated to determine if dedicated facilities or crossing measures are necessary.

6.10.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Pave the apron of the access road on the eastern side of U.S. Route 13.
- Review ditches to see if the depth and slope can be reduced. If not, widen shoulder and add guardrail or pipe ditch to eliminate hazard within clear zone.

Mid-Term:

- Widen/add median shoulders to four feet with rumble strips. If shoulders are not possible then incorporate rumble stripes in the southbound direction.

Table 6.18. Location #9 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Widen shoulder (paved) (from 2 to 4 ft)	0.89 (11% reduction)	All Crashes - all severities	CMF Clearinghouse
Install median guardrail	0.22 (78% reduction)	Cross median - all severities	CMF Clearinghouse

Table 6.19. Location #9 Cost Estimate.

	Item	Location #9
Tier 1	Signage	$28,302
	Pavement Markings	$15,302
	Signal	
	Other	$332
	TOTAL	$43,936
Tier 2	Signage	$2,657
	Pavement Markings	$370
	Signal	
	Other	$1,320
	TOTAL	$4,347
Tier 3	Signage	$11,694
	Pavement Markings	$417
	Signal	
	Other	$36,327
	TOTAL	$48,438

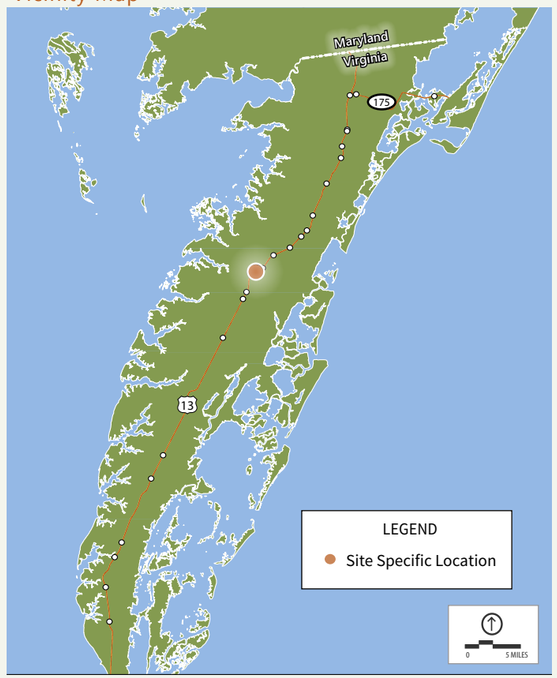
Note: See Templates in Appendix A for applicable items.

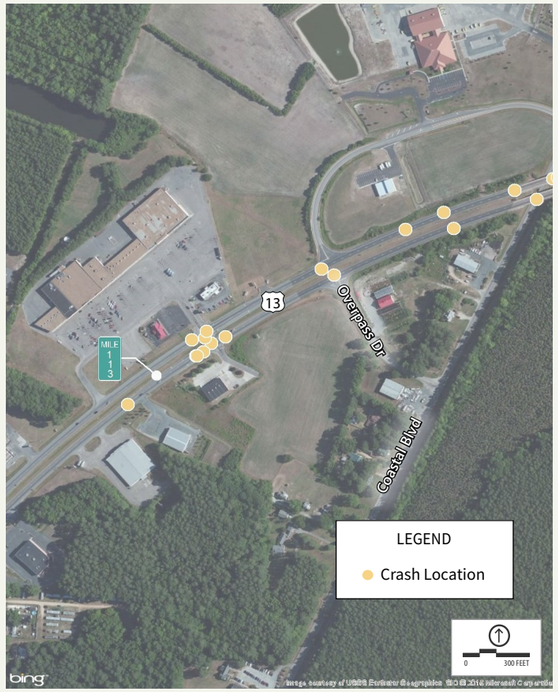
Looking north from the western side of U.S. Route 13

Gravel access road on eastern side of U.S. Route 13

site specific location #10

Vicinity Map





Crash Sites

6.11 Site Specific Location #10 Chesapeake Square Shopping Center (MP 113.04)

6.11.1 Existing Conditions

This site is located at the northern signal for Chesapeake Square Shopping Center (near Pizza Hut). This is a four-legged, signalized intersection. There is a 240-foot northbound left turn lane with a 160-foot taper and a 170-foot northbound right turn lane with an 80-foot taper. Additionally, there is a 205-foot southbound left turn lane with a 175-foot taper and a 200-foot southbound right turn lane with a 135-foot taper.

This intersection is located on a horizontal and vertical curve. There are no additional signals in close proximity to the north; however, there are signals directly to the south. Pedestrians were observed walking along U.S. Route 13 to access the shopping centers, although no pedestrian accommodations were present.

Speed reduction warning signs are double posted north of the intersection for southbound vehicles. Speed reduces to 45 mph prior to the intersection.

Field observations noted long queues on the southbound approach. The northwest corner of the section was worn away from southbound vehicles driving over the corner which could potentially be due to high vehicle speeds or inadequate turning radius for large trucks.

6.11.2 Crash Data

There were ten (10) crashes at this intersection; over half of the crashes resulted in injury. Six (6) of the crashes were rear end crashes and four (4) were angle crashes. Seventy-five (75) percent of the angle crashes were a result of red-light running. All of the crashes occurred during the day.

6.11.3 Key Safety Concerns

- No intersection warning.
- Horizontal and vertical curvature reduces intersection sight distance for southbound vehicles.
- Lack of facilities for pedestrians.
- Red-light running.
- Drivers encroaching on intersection corner damaging curb and potentially encroaching on pedestrians at signal.

6.11.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Add dynamic intersection warning and signal ahead signs in the southbound direction.
- Install retroreflective tape on backplates or install retroreflective backplates to enhance day and nighttime signal conspicuity.
- Review signal timing to minimize queuing.
- Increase targeted signal enforcement to discourage red-light running.
- Review intersection radii and reconstruct intersection corner as necessary.

Mid-Term:

- Review pedestrian activity to determine if dedicated pedestrian facilities and crossing measures should be provided.

Long-Term:

- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.20. Location #10 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Add dynamic intersection warning signs	0.814-0.918 (18.6%-8.2% reduction)	All Crashes - all severities	CMF Clearinghouse
Install retroreflective backplates	0.85 (15% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.21. Location #10 Cost Estimate.

	Item	Location #10
Tier 1	Signage	$29,114
	Pavement Markings	$9,375
	Signal	$950
	Other	$79,366
	TOTAL	$118,804
Tier 2	Signage	$10,534
	Pavement Markings	$1,188
	Signal	
	Other	$660
	TOTAL	$12,382
Tier 3	Signage	$7,441
	Pavement Markings	
	Signal	
	Other	$65,376
	TOTAL	$72,817

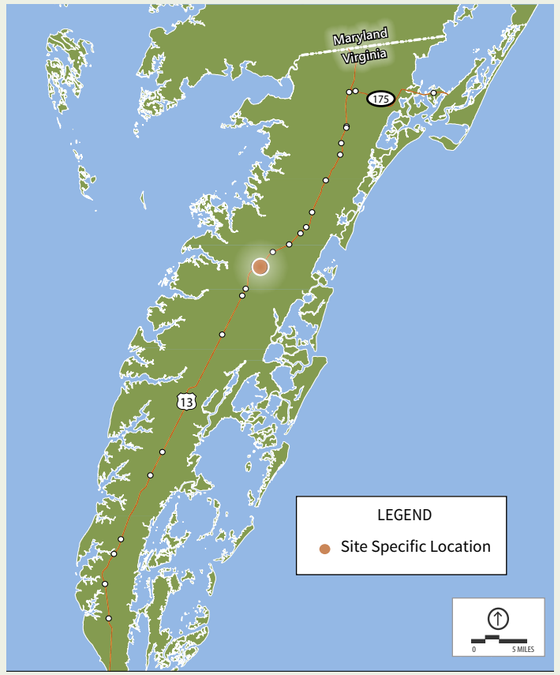
Note: See Templates in Appendix A for applicable items.

Looking north from the eastbound approach at Chesapeake Square Shopping Center

Vehicles queuing on the southbound approach of U.S. Route 13 at Chesapeake Square Shopping Center

site specific location #11

Vicinity Map



Crash Sites

6.12 Site Specific Location #11 Taylor Road (MP 113.69)

6.12.1 Existing Conditions

This location is the unsignalized four-legged intersection of Taylor Road (VA 650) and U.S. Route 13, and is located just south of site specific location #12 (intersection of Daugherty Road and U.S. Route 13). At this location, U.S. Route 13 is median divided. The intersection is located on a horizontal curve in a primarily wooded area. There is a 130-foot northbound left turn lane with a 75-foot taper and a 165-foot northbound right turn lane with a 140-foot taper. Additionally, there is a 120-foot southbound left turn lane with a 90-foot taper and a 135-foot southbound right turn lane with a 95-foot taper.

Due to the horizontal curve and trees, the Taylor Road intersection is difficult to see for southbound drivers. The northbound approach is downhill allowing drivers to increase speed through the intersection.

At Taylor Road, the street name signs were obscured by other signage. Stop signs on the side streets were also placed in the median island rather than on the right hand side of the road.

6.12.2 Crash Data

There were 12 crashes at Taylor Road with 33 percent of those crashes resulting in fatality or injury. Over half of the crashes were intersection–type crashes (33 percent angle and 24 percent rear end crashes). Other crash types included deer-related (24 percent) and roadway departure (19 percent) crashes.

Fifty-eight (58) percent of the crashes occurred in daylight.

6.12.3 Key Safety Concerns

- No intersection warning.
- Lack of intersection expectancy due to lack of intersection warning along with horizontal curvature and trees reducing intersection sight distance in the southbound direction.
- Observed high travel speeds.
- Street and stop sign placement is not MUTCD compliant.

6.12.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Install 12-inch street name signs to conform with MUTCD recommendations and revise placement to ensure they are visible from U.S. Route 13. Add stop signs on the right side of the street on Taylor Road, and add intersection warning signs on U.S. Route 13.

Mid-Term:

- Consider extending speed reduction zone from the south to north of Daugherty Road.

Long-Term:

- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.22. Location #11 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Replace a direct left turn with a right-turn/u-turn (RCUT)	0.8 (20% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.23. Location #11 Cost Estimate.

	Item	Location #11
Tier 1	Signage	$43,862
	Pavement Markings	$9,969
	Signal	
	Other	$166
	TOTAL	$53,997
Tier 2	Signage	$6,218
	Pavement Markings	$739
	Signal	
	Other	$660
	TOTAL	$7,617
Tier 3	Signage	$13,029
	Pavement Markings	$832
	Signal	
	Other	$86,376
	TOTAL	$100,237

Note: See Templates in Appendix A for applicable items.

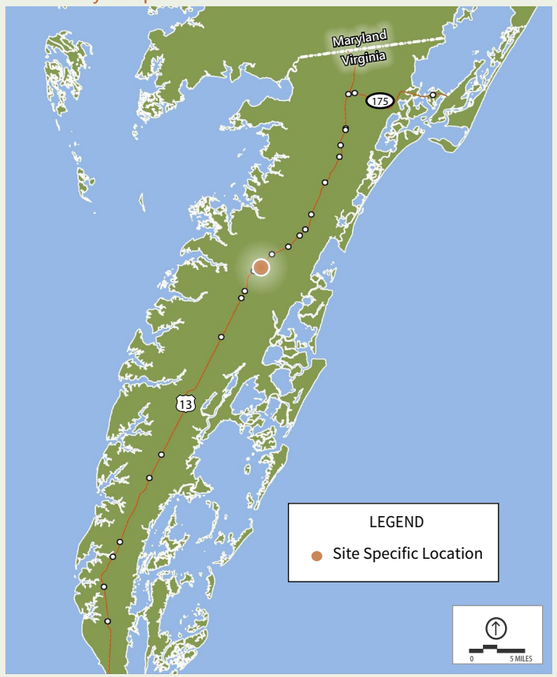
Looking south on U.S. Route 13 from the westbound approach at Taylor Road

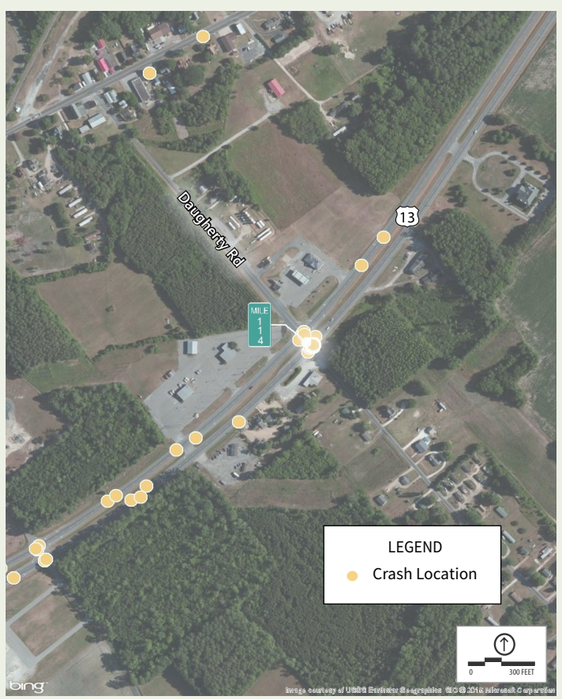
Looking north on U.S. Route 13 from eastbound approach at Taylor Road

Figure 6.6
Concept Plan -
Site Specific Location #11
Eastern Shore Safety Study

site specific location #12

Vicinity Map





Crash Sites

6.13 Site Specific Location #12 Daugherty Road (MP 113.99)

6.13.1 Existing Conditions

This location is the unsignalized four-legged intersection of U.S. Route 13 and Daugherty Road (VA 648). The northbound direction has a 140-foot left turn lane with a 70-foot taper and a 185-foot left turn lane with a 155-foot taper. The southbound has a 130-foot left turn lane with an 85-foot taper and a 125-foot left turn lane with 120-foot taper.

An intersection warning sign with dynamic flashing beacons were added recently in both the north and southbound directions based on recommendation in the 2002 report. The detection loops are placed on both east and west Daugherty Road approaches.

Retail spaces are located on the northwestern, southwestern, and southeastern corners of the intersection. Large, double posted stop signs have been placed on both east and westbound approaches of Daugherty Road. Many vehicles were viewed stopping in the median waiting for an acceptable gap in traffic.

6.13.2 Crash Data

Fourteen (14) crashes occurred in the vicinity of the Daugherty Road intersection. Seventy-nine (79) percent of the crashes resulted in fatality or injury, and 71 percent of those occurred in the northbound direction. Most of the crashes were intersection-type crashes: 86 percent angle crashes and seven (7) percent rear end crashes. Of all of the crashes in the intersection, 64 percent of the total crashes occurred during daylight conditions; 73 percent of fatal and injury crashes also occurred during the daylight.

Dynamic intersection warning signs were installed in recent years. The effectiveness of the signs is inconclusive without more recent crash data availability; however, it is anticipated that a reduction in angle crashes can be expected since the installation of the signs.

6.13.3 Key Safety Concerns

- Insufficient turn lane and taper lengths.
- Horizontal curvature reduces intersection sight distance for southbound vehicles.
- Observed high travel speeds.
- Lack of median crossover delineation.
- Access management of adjacent properties, particularly those properties on the southwestern and southeastern corners. These properties have multiple consecutive entrances on U.S. Route 13 and Daugherty Road. There are eight (8) driveway accesses south of the intersection: three (3) on U.S. Route 13 southbound and five (5) on U.S. Route 13 northbound, and one north of the intersection on the southbound approach.

6.13.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Provide additional positive guidance and median delineation through pavement markings to allow drivers to visually see the boundaries.
- Investigate pedestrian activity in the area, particularly as related to the schools and bus stop locations and consider providing dedicated and separate pedestrian facilities and crossing measures installed if a signal is installed.

Mid-Term:

- Conduct a signal warrant analysis to determine if signalization is the best measure in reducing the angle crashes.

Long-Term:

- Install a Restricted Crossing U-Turn (RCUT) intersection by modifying median access so that vehicles can only turn right from Daugherty Road with an available subsequent u-turn opportunity. Access for emergency responders that currently use this intersection can use an alternative route to the north to avoid the u-turn. Response time should be confirmed as a part of advancement of this recommendation.
- Implement access management measures on the properties adjacent to the intersection to consolidate access points onto U.S. Route 13.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.24. Location #12 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Directional Medians to allow left-turns and u-turns (RCUT)	0.77 (23% reduction)	All Crashes - all severities	CMF Clearinghouse
Corridor Access Management	0.77 - 0.95 (5 - 23% reduction)	All Crashes - all severities	FHWA Proven Countermeasures

Table 6.25. Location #12 Cost Estimate.

	Item	Location #12
Tier 1	Signage	$43,862
	Pavement Markings	$10,115
	Signal	
	Other	$166
	TOTAL	$54,143
Tier 2	Signage	$6,218
	Pavement Markings	$739
	Signal	
	Other	$660
	TOTAL	$7,617
Tier 3	Signage	$13,029
	Pavement Markings	$832
	Signal	
	Other	$298,691
	TOTAL	$312,552

Note: See Templates in Appendix A for applicable items.

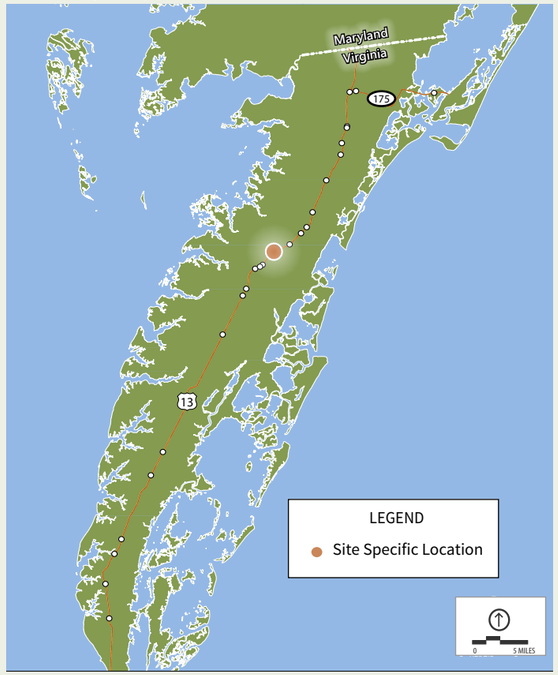
Vehicle traveling southbound on U.S. Route 13 approaching Daugherty Road

Vehicle turning right on U.S. Route 13 from westbound approach at Daugherty Road

Figure 6.7
Concept Plan -
Site Specific Location #12
Eastern Shore Safety Study

site specific location #13

Vicinity Map



Crash Sites

6.14 Site Specific Location #13 Courthouse Avenue (MP 115.94)

6.14.1 Existing Conditions

This location includes the signalized intersection at U.S. Route 13, Courthouse Avenue and Accomac Road, and the portion of U.S. Route 13 extending roughly 2,500 feet to the south. Courthouse Avenue and Accomac Road are two-lane paved roads.

The northbound direction has a 130-foot left turn lane with a 70-foot taper and a 145-foot right turn lane with a 145-foot taper. Additionally, the southbound direction has a 140-foot left turn lane with a 60-foot taper and a 140-foot right turn lane with a 90-foot taper.

The intersection is located on the northern end of a horizontal curve in an area that is wooded to the west with retail locations to the east.

There are outside shoulders with rumble strips and minimal median shoulders in both the north and southbound directions.

6.14.2 Crash Data

There were 20 crashes at this location. Thirty (30) percent of the crashes resulted in fatality and injury. Thirty-five (35) percent of the crashes occurred at the Courthouse Avenue intersection and were comprised of angle and rear end crashes. One roadway departure fatal crash occurred in the northbound direction, approximately 2,000 feet south of the intersection.

6.14.3 Key Safety Concerns

- Horizontal curve and wooded area prior to intersection on northbound approach limits intersection visibility and expectancy.
- Observed high travel speeds on U.S. Route 13.
- Lack of recovery area along median and positive guidance.

6.14.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Provide additional positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Provide additional intersection warning through measures such as next signal ahead and intersection warning signs, particularly in the northbound direction.
- Install retroreflective tape on backplates or install retroreflective backplates to enhance day and nighttime signal conspicuity.
- Incorporate safety edge to provide an additional method for vehicles to recover from roadway departure crashes.

Long-Term:

- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.26. Location #13 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Install retroreflective backplates	0.85 (15% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.27. Location #13 Cost Estimate.

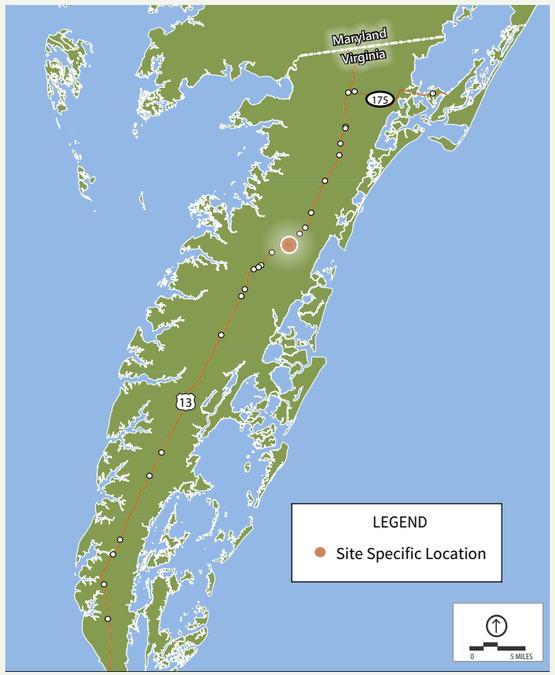
	Item	Location #13
Tier 1	Signage	$34,699
	Pavement Markings	$25,848
	Signal	$792
	Other	$332
	TOTAL	$61,671
Tier 2	Signage	$10,534
	Pavement Markings	$739
	Signal	
	Other	$1,320
	TOTAL	$12,593
Tier 3	Signage	$9,785
	Pavement Markings	
	Signal	
	Other	$186,289
	TOTAL	$196,074

Note: See Templates in Appendix A for applicable items.

Looking south on U.S. Route 13 from the westbound approach on Courthouse Avenue

site specific location #14

Vicinity Map



Crash Sites

6.15 Site Specific Location #14 Mary N Smith Road/Front Street (MP 117.23 – 117.61)

6.15.1 Existing Conditions

This location includes an approximately 2,000-foot corridor segment extending approximately 1,000 feet to the south and 1,000 feet to the north of the unsignalized intersection at U.S. Route 13 and Mary N Smith Road (Route 663). This segment also includes the intersection of Front Street/U.S. 13 Business and U.S. Route 13.

The intersection of U.S. Route 13 and Mary N Smith Road is a two-way stop controlled unsignalized intersection. There is a 250-foot northbound left turn lane with a 170-foot taper and a 155-foot northbound right turn lane with 140-foot taper. Additionally, there is a 210-foot southbound left turn lane with 170-foot taper and a 195-foot southbound right turn lane with a 180-foot taper.

The intersection of Front Street and U.S. Route 13 is a yield controlled, skewed intersection that provides northbound access onto U.S. Route 13. There are outside shoulders with rumble strips and minimal median shoulders in both the north and southbound directions. Rumble strips are present in the northbound direction. The intersections are located on a horizontal curve, just north of a large Purdue factory. During the field observation it was noted that work-shift pedestrians access the Purdue factory at various times of the day from the residential community on U.S. Route 13 south of Mary N Smith Road.

6.15.2 Crash Data

There were 17 crashes in this segment with over 50 percent of the crashes resulting in fatality and injury. Thirty-five (35) percent of the crashes were rear end and 30 percent were roadway departure. Sixty (60) percent of the crashes occurred during dark conditions. One fatal pedestrian crash occurred approximately 1,000 feet south of the Mary N Smith Road intersection.

6.15.3 Key Safety Concerns

- Horizontal curves and skewed intersections limits intersection sight distance.
- Lack of intersection warning.
- Nighttime crashes.
- Lack of recovery space along the median, particularly in the southbound direction on the inside of the curve.
- Lack of pedestrian accommodations.

6.15.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Provide additional positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Provide intersection warning signs.
- Incorporate safety edge to provide an additional method for vehicles to recover from roadway departure crashes.
- Investigate pedestrian activity and routes and investigate potential countermeasures, such as separate and dedicated space and enhanced crossings, if necessary.

Mid-Term:

- Provide improved recovery area along median by widening shoulder to four feet and installing rumble strips/stripes in the southbound direction.

Long-Term:

- Consider adding intersection lighting, particularly at the intersection of Front Street.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.28. Location #14 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install shoulder rumble strips	0.73-0.83 (17-27% reduction)	Run-off-the-road crashes - all severities	CMF Clearinghouse
Intersection lighting	0.881 - 0.92 (8 - 11.9% reduction)	Nighttime crashes - all severities	CMF Clearinghouse

Table 6.29. Location #14 Cost Estimate.

	Item	Location #14
Tier 1	Signage	$71,511
	Pavement Markings	$28,606
	Signal	
	Other	$830
	TOTAL	$100,947
Tier 2	Signage	$15,841
	Pavement Markings	$739
	Signal	
	Other	$3,300
	TOTAL	$19,880
Tier 3	Signage	$30,957
	Pavement Markings	$2,083
	Signal	
	Other	$194,865
	TOTAL	$227,905

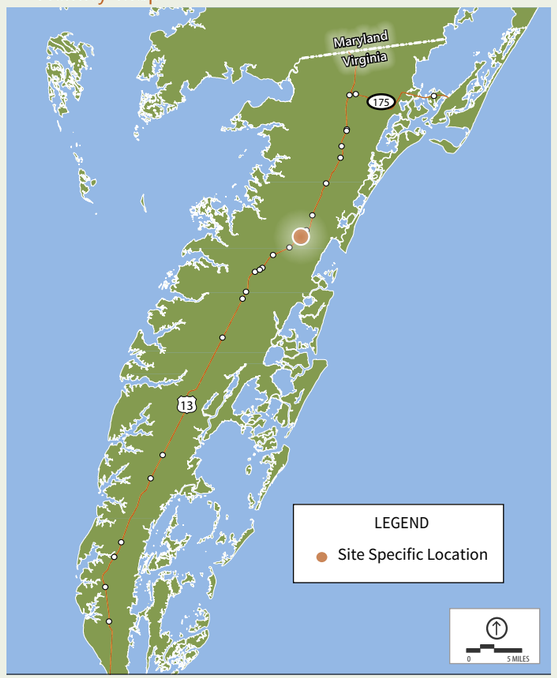
Note: See Templates in Appendix A for applicable items.

Northbound right turn lane onto Front Street from U.S. Route 13

Looking north from the southeast corner of the intersection

site specific location #15

Vicinity Map



Crash Sites

6.16 Site Specific Location #15 Evans Road (MP 118.83)

6.16.1 Existing Conditions

This location is at the unsignalized intersection of Evans Road and Johnson Road (Route 661).

The northbound direction has a 275-foot left turn lane with a 105-foot taper and a 185-foot right turn lane with a 140-foot taper. Additionally, the southbound direction only has a 130-foot left turn lane with a 140-foot taper.

The intersection is located along a horizontal curve and is bordered by fields, trees, and some residential access points. There are curve warning signs in the southbound direction.

Outside shoulders are present with rumble strips in both the north and southbound directions. There is a minimal median shoulder with narrow rumble strips in the northbound direction and no median shoulder in the southbound direction. Steep roadside ditches are present with driveway culverts, particularly in the southbound direction south of the intersection.

6.16.2 Crash Data

Thirteen (13) crashes occurred in the vicinity of the intersection. Thirty (30) percent resulted in fatal or injury crashes. The fatal injury crash was a roadway departure crash which occurred roughly 500 feet south of the intersection in the southbound direction. Over 60 percent of the crashes were roadway departure, 30 percent were deer-related, and there was one angle crash. Over half of the crashes occurred during dark conditions.

6.16.3 Key Safety Concerns

- Horizontal curvature.
- Nighttime crashes.
- Lack of recovery space along the median, particularly in the southbound direction.
- Stop sign installed too low on westbound approach on Johnson Road.
- Unmarked roadside hazards within clear zones.

6.16.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Provide additional positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Incorporate safety edge to provide an additional method for vehicles to recover from roadway departure crashes.
- Install Johnson Road stop sign at appropriate height.
- Mark steep ditches and culverts with object markers.
- Review ditches to see if the depth and slope can be reduced. If not, widen shoulder and add guardrail or pipe ditch to eliminate hazard within clear zone.

Mid-Term:

- Provide improved recovery area along median by widening shoulder to four feet and installing rumble strips/stripes in the southbound direction.

Long-Term:

- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.30. Location #15 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install median guardrail	0.22 (78% reduction)	Cross median - all severities	
Install shoulder rumble strips	0.73-0.83 (17-27% reduction)	Run-off-the-road crashes - all severities	CMF Clearinghouse

Table 6.31. Location #15 Cost Estimate.

	Item	Location #15
Tier 1	Signage	$53,727
	Pavement Markings	$9,837
	Signal	
	Other	$166
	TOTAL	$63,731
Tier 2	Signage	$19,603
	Pavement Markings	$554
	Signal	
	Other	$660
	TOTAL	$20,817
Tier 3	Signage	$15,374
	Pavement Markings	$1,664
	Signal	
	Other	$150,850
	TOTAL	$167,888

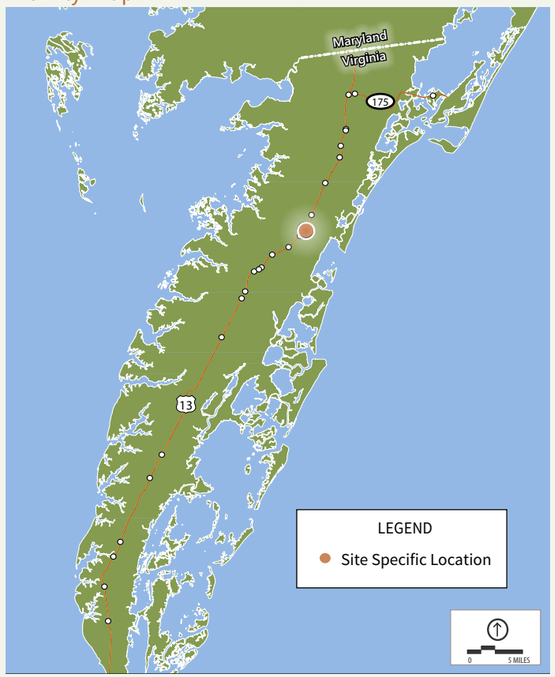
Note: See Templates in Appendix A for applicable items.

Raised pavement markers are present on U.S. Route 13 at the intersection of Evans Road

Looking south on U.S. Route 13 from westbound approach on Johnson Road

site specific location #16

Vicinity Map



Crash Sites

6.17 Site Specific Location #16 Parksley Road (MP 119.55)

6.17.1 Existing Conditions

This location is at the signalized intersection of Parksley Road (Route 176) and U.S. Route 13. Parksley Road is a wide two-lane paved roadway; however, pavement markings have been installed to define and narrow the travel lanes.

At this intersection there is a 190-foot northbound left turn lane with a 50-foot taper, a 210-foot southbound left turn lane with a 130-foot taper, and a 275-foot southbound right turn lane with a 175-foot taper. At the time of the field review the southbound lanes were recently paved and the pavement markings were only partially replaced.

A gas station and convenience store are located at the southwest corner of the intersection, and a seasonal farm stand is located east of the intersection.

Recent signal improvements were evident, including new mast arms with street name signs, pedestrian pushbuttons, curb/landing area on the eastern side of the intersection, high visibility pavement markings, and accessible ramps.

Double posted dynamic warning signs are present north of the intersection. Comments from law enforcement were that the northbound left turn bays were too short, particularly in the summer when traffic volumes are higher.

It was evident that trucks encroach on the southwest corner pedestrian space and run over the ramp when making a right turn from the eastbound approach. The field review team noted that trucks were barely making the turn and were very close to driving into the grassy median. The RSA team also witnessed southbound right turning trucks barely making the turn without encroaching into the eastbound through lane.

6.17.2 Crash Data

There were 17 crashes in the vicinity of the intersection with roughly 65 percent resulting in injuries. The majority of the crashes were angle crashes (47 percent) followed by rear end crashes (29 percent). There was one pedestrian crash. Over 70 percent of the crashes occurred during the day.

Five of the eight angle crashes involved drivers running red lights. Three of the angle crashes appear to involve drivers turning right on red and failing to yield to oncoming traffic.

6.17.3 Key Safety Concerns

- Inadequate intersection radii.
- Red-light running.
- Difficult for drivers to judge acceptable gaps to turn right on red.
- Intersection expectancy and high speeds on U.S. Route 13.
- Lack of connected/continuous pedestrian space.

6.17.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Analyze necessary truck turning radii, particularly at southwest corner.
- Increase targeted enforcement for red-light running.
- Restrict right turns on red for eastbound approach.
- Install intersection warning signs in the northbound direction and next signal signs in both north and southbound directions.
- Install retroreflective tape on backplates or install retroreflective backplates to enhance day and nighttime signal conspicuity.
- Investigate pedestrian activity to determine if dedicated pedestrian facilities are necessary.

Long-Term:

- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.32. Location #16 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Add dynamic intersection warning signs	0.814-0.918 (18.6%-8.2% reduction)	All Crashes - all severities	CMF Clearinghouse
Install retroreflective backplates	0.85 (15% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.33. Location #16 Cost Estimate.

	Item	Location #16
Tier 1	Signage	$12,129
	Pavement Markings	$9,557
	Signal	$634
	Other	$166
	TOTAL	$22,486
Tier 2	Signage	$2,771
	Pavement Markings	$554
	Signal	
	Other	$660
	TOTAL	$3,985
Tier 3	Signage	$11,670
	Pavement Markings	$417
	Signal	
	Other	$44,376
	TOTAL	$56,463

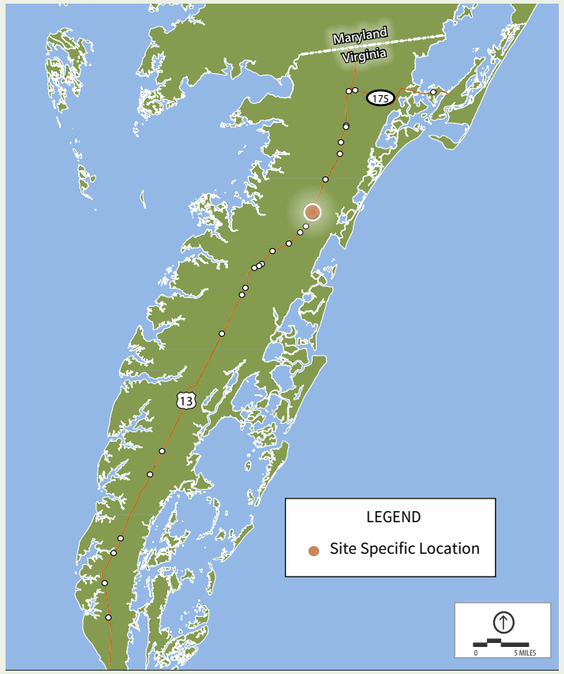
Note: See Templates in Appendix A for applicable items.

Eastbound approach on Parksley Road

U.S. Route 13/Parksley Road intersection from southwest corner

site specific location #17

Vicinity Map



Crash Sites

6.18 Site Specific Location #17 South of Whites Neck Road (MP 120.90 – 121.30)

6.18.1 Existing Conditions

This location is an approximately 2,000-foot corridor segment extending from Johnson Wharton Lane to the south to Whites Neck Road (Route 677) to the north. This section of the corridor is located on a horizontal curve that is median divided. The area-type is generally agricultural; however, there are numerous driveway access points and a business located at the Whites Neck Road intersection with wide open accesses into the parking lot.

A 130-foot northbound left turn lane with a 65-foot taper and a 140-foot southbound left turn lane with an 80-foot taper are present at the intersection of U.S. Route 13 and Whites Neck Road. The northbound right turn lane at Whites Neck Road and entrance to the restaurant on the southeast corner of the intersection blend together. It can be difficult for drivers to decipher where vehicles should turn onto Whites Neck Road.

North and southbound outside shoulders with rumble strips and narrow median shoulders with rumble strips were present. There were steep roadside drop-offs within the clear zone that were not visible due to high grass. Object markers were placed in the ditch but were low and hidden by the grass. Mowing operations were occurring along the corridor throughout the field review, so this area may have been trimmed. Large signs, vegetation, and horizontal curve limits sight distance to the south from the Whites Neck Road intersection.

A law enforcement officer commented that he felt the rumble strips in the area have helped to reduce crashes, but speeds were still a concern.

6.18.2 Crash Data

There were eight (8) crashes on this segment. Thirty-eight (38) percent resulted in injury or fatality. There was one fatal, angle crash that occurred approximately 950 feet south of the Whites Neck Road intersection. Forty (40) percent of crashes were angle type crashes and 40 percent were animal-related. There was also one rear end and one roadway departure crash. All but one of the crashes occurred during dark conditions.

6.18.3 Key Safety Concerns

- Nighttime crashes.
- High speeds.
- Intersection expectancy and high speeds on U.S. Route 13.
- Access management at Whites Neck Road.
- Roadside conditions and ability for drivers to recover.

6.18.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Provide additional positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Incorporate safety edge to provide an additional method for vehicles to recover from roadway departure crashes.
- Schedule mowing operations to be conducted regularly and at intervals that ensure grass does not obscure roadside hazards and signs.
- Place roadside object marker signs at appropriate height, so that they are visible to drivers.
- Review ditches to see if the depth and slope can be reduced. If not, widen shoulder and add guardrail or pipe ditch to eliminate hazard within clear zone.
- Conduct targeted speed enforcement, particularly during the nighttime when most of the crashes occurred.
- Install intersection warning signs for both Johnson Wharton Lane and Whites Neck Road.

Mid-Term:

- Provide improved recovery area along median by widening shoulder to four feet.
- Consider implementing street lighting.

Long-Term:

- Implement access management measures at Whites Neck Road by defining the parking lot and limiting access onto U.S. Route 13 to specific entry and exit points.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.34. Location #17 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install median guardrail	0.22 (78% reduction)	Cross median - all severities	CMF Clearinghouse
Corridor lighting	0.73 (27% reduction)	All Crashes - severe and minor injury	CMF Clearinghouse
Corridor Access Management	0.77 - 0.95 (5 - 23% reduction)	All Crashes - all severities	FHWA Proven Countermeasures

Table 6.35. Location #17 Cost Estimate.

	Item	Location #17
Tier 1	Signage	$58,374
	Pavement Markings	$23,014
	Signal	
	Other	$498
	TOTAL	$81,885
Tier 2	Signage	$8,521
	Pavement Markings	$185
	Signal	
	Other	$1,980
	TOTAL	$10,686
Tier 3	Signage	$26,238
	Pavement Markings	$834
	Signal	
	Other	$347,065
	TOTAL	$374,137

Note: See Templates in Appendix A for applicable items.

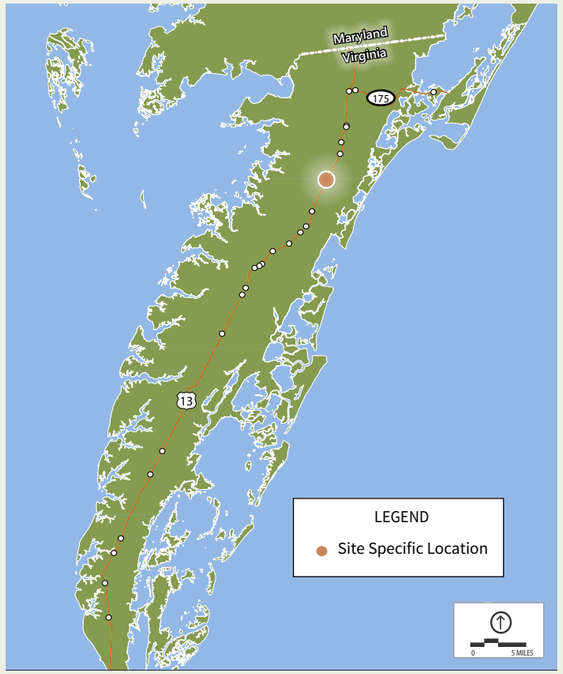
Tall grass grows along eastern side and center median of U.S. Route 13

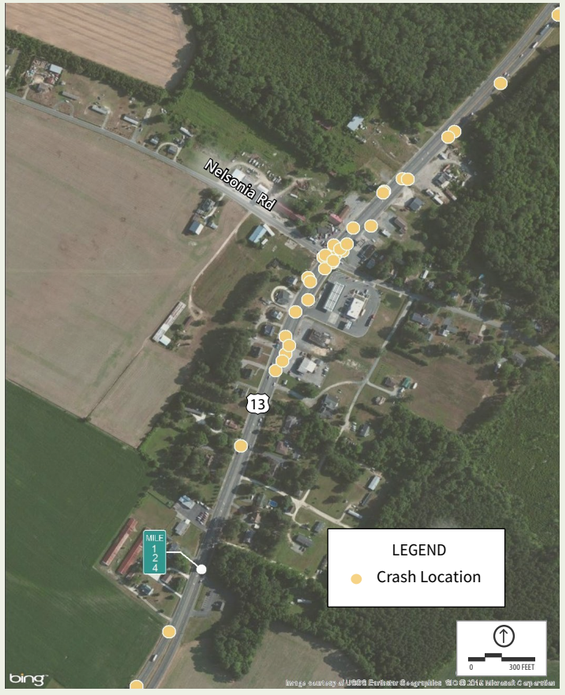
Looking south from the median on U.S. Route 13

Figure 6.8
Concept Plan -
Site Specific Location #17
Eastern Shore Safety Study

site specific location #18

Vicinity Map





Crash Sites

6.19 Site Specific Location #18 Nelsonia Road (MP 124.23)

6.19.1 Existing Conditions

This location is at the four-legged, signalized intersection of U.S. Route 13 and Nelsonia Road (Route 187). Nelsonia Road is a two-lane paved road. The intersection is located on a curve in a more urbanized area with residential housing and businesses. There are three businesses at the southeast, northeast, and northwest corners of the intersection.

This intersection is undivided with left turn lanes in the north and southbound directions. In the northbound direction the left turn lane is 250 feet leading into the two-way left-turn lane while the southbound left turn lane is 250 feet also leading into the two-way left-turn lane. Some southbound drivers will pass through the intersection and turn left across the two northbound lanes to access the Royal Farms gas station instead of turning left at the signal and making a right into the gas station.

There are fixed objects such as poles and mailboxes close to the roadway. Curb and sidewalk are present at the intersection but no crosswalks or pedestrian signal enhancements. During field review, pedestrians were observed walking on the shoulder.

The hillside at Royal Farms limits sight distance for the westbound intersection approach. Street signs were less visible to drivers as they were post mounted rather than mast arm mounted. Drivers were observed cutting through the Sunoco parking lot on the northeastern corner of the intersection to avoid the traffic signal. Heavy truck traffic and high vehicle speeds were also observed on U.S. Route 13. It was also noted that many westbound approach drivers turning north onto U.S. Route 13 look left before entering the roadway on their green signal indicating hesitation regarding drivers obeying the traffic signal. Northbound trucks traveling at high speeds may not see the signal as they come around curve to the intersection.

6.19.2 Crash Data

There were 27 crashes at this intersection. Forty-one (41) percent of those resulted in fatality or injury. The most predominant crash types were intersection type crashes: 48 percent angle and 30 percent rear end. Over 80 percent of the crashes occurred during the day. Of the 13 angle crashes, three of those involved red-light running and eight (8) may be attributed to drivers misjudging gaps.

6.19.3 Key Safety Concerns

- Reduced intersection sight distance due to horizontal curve.
- Limited sight distance for westbound approach due to vertical grade at Royal Farms.
- Red-light running.
- Cut through traffic on adjacent properties.
- Intersection expectancy and high speeds on U.S. Route 13.
- Access management due to the numerous driveways on intersection approaches and wide open access on the northwest corner.
- Lack of continuous pedestrian space and crossing measures.

6.19.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Restrict right turn on red for westbound approach.
- Conduct targeted speeding and signal enforcement in the vicinity of the intersection.
- Install intersection warning signs and next signal ahead warning signs in both the north and southbound directions and replace post mounted with mast arm mounted street name signs.
- Install retroreflective tape on backplates or install retroreflective backplates to enhance day and nighttime signal conspicuity.
- Investigate pedestrian activity to determine if sidewalks should be extended and crossing measures installed at the intersection.

Long-Term:

- Implement access management measures at the northwest corner of the intersection to better define access points. Consider installing narrow raised concrete medians to prevent left turns from U.S. Route 13 onto corner businesses as those can be accessed from Nelsonia Road.
- Construct right turn lanes with 200 feet of storage and a 200-foot taper.

Table 6.36. Location #18 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install retroreflective backplates	0.85 (15% reduction)	All Crashes - all severities	CMF Clearinghouse
Corridor Access Management	0.77 - 0.95 (5 - 23% reduction)	All Crashes - all severities	FHWA Proven Countermeasures
Provide a right-turn lane on one major road approach	0.86 - 0.92 (8 - 14% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.37. Location #18 Cost Estimate.

	Item	Location #18
Tier 1	Signage	$29,114
	Pavement Markings	$11,728
	Signal	$792
	Other	$79,366
	TOTAL	$121,000
Tier 2	Signage	$10,534
	Pavement Markings	$370
	Signal	
	Other	$660
	TOTAL	$11,564
Tier 3	Signage	$7,441
	Pavement Markings	$832
	Signal	
	Other	$114,589
	TOTAL	$122,862

Note: See Templates in Appendix A for applicable items.

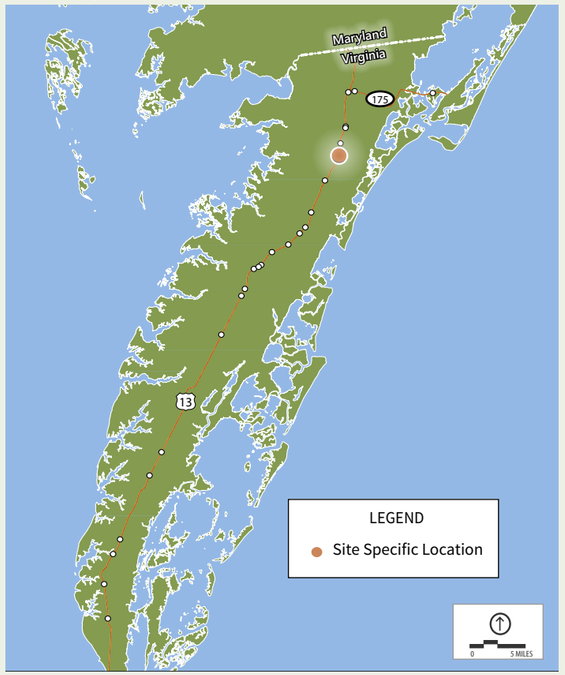
Vehicles traveling north on U.S. Route 13

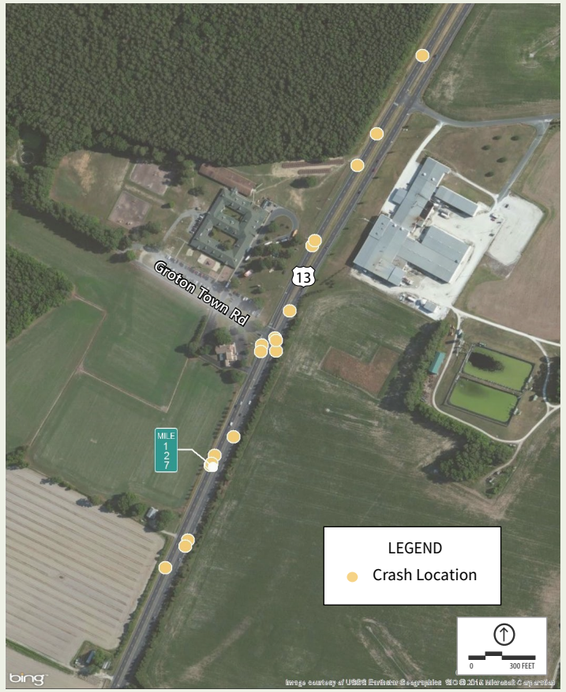
Traffic signals for vehicles traveling southbound on U.S. Route 13

Figure 6.9
Concept Plan -
Site Specific Location #18
Eastern Shore Safety Study

site specific location #19

Vicinity Map





Crash Sites

6.20 Site Specific Location #19 Groton Town Road (MP 126.74 – 127.33)

6.20.1 Existing Conditions

This corridor segment is roughly 3,100 feet extending from approximately 1,100 feet north of the Groton Town Road (Route 691) intersection to 2,000 feet south of the intersection. The Groton Town Road intersection is a signalized, undivided three-legged intersection with a 205-foot right turn lane with a 100-foot taper in the southbound direction and a 375-foot left turn lane leading into the two-way left-turn lane in the northbound direction. Groton Town Road is a two-lane paved road. This location is surrounded by forest and fields with a bank at the southwest corner, an elementary school in the northwest corner, and an industrial facility to the northeast corner of the intersection.

South of Groton Town Road, U.S. Route 13 has four travel lanes and a two-way left-turn lane. There are shoulders and rumble strips in both the north and southbound directions. North of Groton Town Road, U.S. Route 13 is median divided with outside shoulders and rumble strips and narrow median shoulders and rumble strips in both the north and southbound directions. There is a steep ditch along the northwest quadrant of the intersection within the clear zone and indicated by object marker signs. Street signs are post mounted rather than mast arm mounted.

There are no dedicated pedestrian facilities or pedestrian signal enhancements in the vicinity of the school or at the signal. The field review team observed a young pedestrian walking from the school in the northwest corner headed north by walking on the grass and roadway shoulder. The field review also noted StarTRANSIT orange line buses stopping in the bank parking lot to pick-up and drop-off passengers.

6.20.2 Crash Data

There were 18 crashes on this segment; 28 percent resulted in fatality or injury. Forty-four (44) percent of the crashes were angle crashes, one of which resulted in a fatality. Twenty-eight (28) percent were deer-related. Two of the crashes involved pedestrians, one at the Groton Town Road intersection and one approximately 800 feet to the south of the same intersection.

6.20.3 Key Safety Concerns

- Post rather than mast arm mounted street name signs.
- Lack of continuous pedestrian space and crossing measures.
- Lack of recovery space for drivers along median.
- Lack of positive guidance.
- Access management: between Davis Drive and Groton Town Road there are minimal access points, but a two-way left-turn lane is present for the entire corridor segment increasing the amount of potential conflict points and the potential for head-on crashes.

6.20.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Provide additional positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Replace post mounted street name signs with mast arm mounted signs.
- Install safety edge to provide an additional method for vehicles to recover from roadway departure crashes.
- Install retroreflective tape on backplates or install retroreflective backplates to enhance day and nighttime signal conspicuity.
- Investigate pedestrian activity in the area, particularly as related to the schools and bus stop locations and consider providing dedicated and separate pedestrian facilities and crossing measures installed at the signal.

Mid-Term:

- Provide improved recovery area along median by widening shoulder to four feet and installing rumble strips/stripes in the southbound direction.
- Review ditches to see if the depth and slope can be reduced. If not, widen shoulder and add guardrail or pipe ditch to eliminate hazard within clear zone.

Long-Term:

- Implement access management measures by converting the two-way left-turn lane between Groton Town Road and Davis Drive into a grass median with crossovers and turn lanes at necessary locations. Add an east bound right-turn lane on Groton Town Road and close driveway closest to intersection.
- Lengthen substandard turn lane to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.38. Location #19 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install retroreflective backplates	0.85 (15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install median guardrail	0.22 (78% reduction)	Cross median - all severities	CMF Clearinghouse
Corridor Access Management	0.77 - 0.95 (5 - 23% reduction)	All Crashes - all severities	FHWA Proven Countermeasures

Table 6.39. Location #19 Cost Estimate.

	Item	Location #19
Tier 1	Signage	$65,799
	Pavement Markings	$38,577
	Signal	$554
	Other	$79,698
	TOTAL	$184,628
Tier 2	Signage	$68,596
	Pavement Markings	$4,911
	Signal	
	Other	$1,980
	TOTAL	$75,487
Tier 3	Signage	$88,710
	Pavement Markings	$417
	Signal	
	Other	$399,974
	TOTAL	$489,101

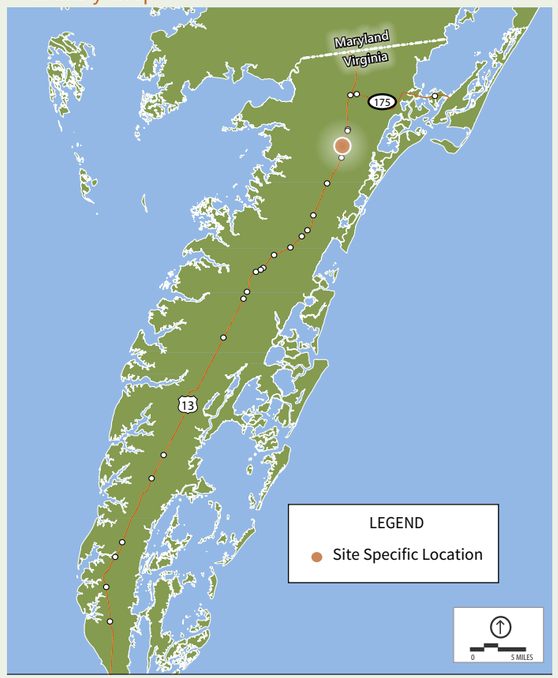
Note: See Templates in Appendix A for applicable items.

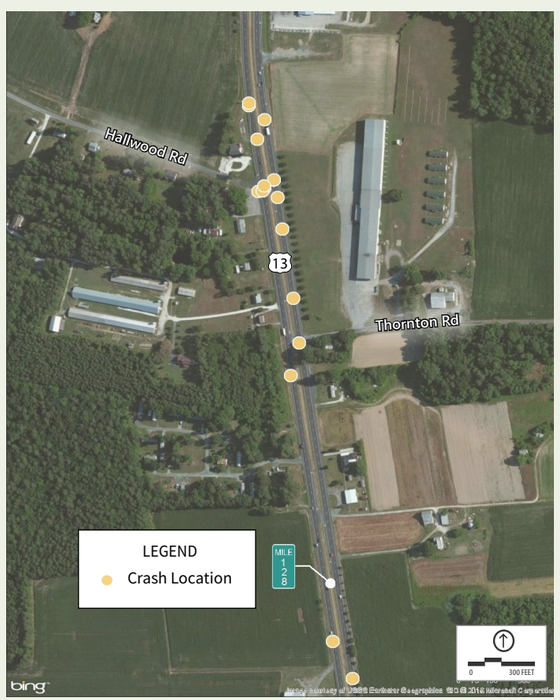
Vehicles stopped at the eastbound approach on Groton Town Road

Figure 6.10
Concept Plan -
Site Specific Location #19
Eastern Shore Safety Study

site specific location #20

Vicinity Map





Crash Sites

6.21 Site Specific Location #20 Hallwood Road (MP 128.23 - 128.37)

6.21.1 Existing Conditions

This location is an approximately 1,400-foot segment of U.S. Route 13 in the vicinity of Hallwood (Route 692) and Thorton Roads (Route 790). Hallwood Road and Thorton Road intersections are both three-legged, unsignalized intersections with median crossovers. At the Hallwood Road intersection there is a 210-foot southbound right turn lane with a 75-foot taper and a 115-foot northbound left turn lane with a 120-foot taper. A business is located at the northwest corner of the intersection.

At the Thorton Road intersection there is a 70' northbound right turn lane with a 65' taper and a 175' southbound left turn lane with a 175' taper. Thorton Road serves as the primary access for the Campbell Farms facility.

In between these intersections, U.S. Route 13 is a median divided roadway with outside shoulders and rumble strips and narrow median shoulders and rumble strips in both the north and southbound directions. There is a residential area on the western side and fields on the eastern side.

At the Hallwood Road intersection, vehicles in the southbound right turn lane obstruct the sight distance of drivers on the eastbound approach. There is a steep drop-off at the northwest corner of the Hallwood Road intersection.

6.11.2 Crash Data

There were 15 crashes in this quarter-mile segment. Forty-seven (47) percent of those resulted in fatality or injury. Sixty-seven (67) percent of the crashes were angle crashes and occurred during the day. Seventy (70) percent of the angle crashes involved vehicles disregarding stop signs or misjudging gaps after stopping at the stop sign. There were seven (7) angle crashes at the Hallwood Road intersection including one fatality. There were two (2) rear end crashes in the northbound direction, one prior to Thorton Road and one prior to Hallwood Road.

6.21.3 Key Safety Concerns

- Short northbound right turn lane at Thorton Road intersection. Trees obscure the intersection in northbound direction, and the intersection is located immediately after on-street market parking.
- Lack of expectancy at both Hallwood and Thorton Road intersections.
- Ability of drivers from side streets to judge acceptable gaps.
- Hallwood Road and U.S. Route 13 intersection is skewed limiting the northbound sight distance.
- At Hallwood Road the stop sign is posted in the median island. There is no right-side posted stop sign as recommended in the MUTCD.
- Wide open access to parking lot at the southwestern corner of the Hallwood Road intersection.

6.21.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Improve intersection expectancy and warning at both Hallwood Road and Thorton Road intersections. Install intersection warning signs in the northbound direction prior to Thorton Road intersection and southbound prior to Hallwood Road intersection. Due to the prevalence and severity of angle crashes, consider installing a dynamic warning sign at the Hallwood Road intersection.
- Trim vegetation on southeast corner of the Thorton Road intersection and eliminate parking for market within the right-of-way to allow for an extension of the northbound right turn lane.
- Use pavement markings to define available space in median crossover.
- Install a stop sign on the right side of the Hallwood Road intersection approach.
- Install 12-inch street name signs to conform to MUTCD recommendation.

Mid-Term:

- Review ditches to see if the depth and slope can be reduced. If not, widen shoulder and add guardrail or pipe ditch to eliminate hazard within clear zone.

Long-Term:

- Investigate geometric changes to improve sight distance and reduce conflict points at intersections. This could include realigning the Hallwood Road intersection to reduce/eliminate the skew and improve sight distance to the north. Another alternative is to modify the intersections from full access to a pair of restricted movement intersections so that drivers can only make right turns. In order to turn left, drivers would have to perform a subsequent u-turn 700 feet south at Thornton Road.
- Define parking lot access at the southwestern corner of the Hallwood Road intersection through use of curbing/landscaping.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.40. Location #20 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install median guardrail	0.22 (78% reduction)	Cross median - all severities	CMF Clearinghouse
Directional Medians to allow left-turns and u-turns	0.77 (23% reduction)	All Crashes - all severities	CMF Clearinghouse
Corridor Access Management	0.77 - 0.95 (5 - 23% reduction)	All Crashes - all severities	FHWA Proven Countermeasures

Table 6.41. Location #20 Cost Estimate.

	Item	Location #20
Tier 1	Signage	$51,019
	Pavement Markings	$17,302
	Signal	
	Other	$498
	TOTAL	$68,819
Tier 2	Signage	$5,314
	Pavement Markings	$740
	Signal	
	Other	$1,980
	TOTAL	$8,034
Tier 3	Signage	$21,043
	Pavement Markings	$834
	Signal	
	Other	$333,443
	TOTAL	$355,320

Note: See Templates in Appendix A for applicable items.

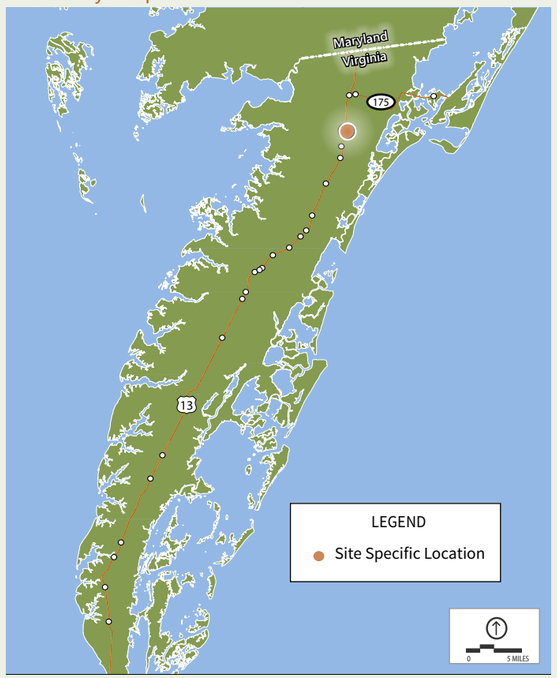
Vehicle traveling northbound on U.S. Route 13 approaching Thorton Road

Vehicle traveling southbound on U.S. Route 13 approaching Holland Road

Figure 6.11
Concept Plan -
Site Specific Location #20
Eastern Shore Safety Study

site specific location #21 & #22

Vicinity Map



Crash Sites

6.22 Site Specific Locations #21 and #22 Temperanceville Road (MP 129.64 – 130.47)

6.22.1 Existing Conditions

Location 21 is the intersection of Temperanceville Road and U.S. Route 13 and Location 22 is the intersection of New Temperanceville Road (Route 695) and U.S. Route 13. Due to their proximity, geometry, area type, and crash similarities, they are discussed together. The segment of U.S. Route 13 encompassed by these two locations extends from the beginning of the two-way left-turn lane, approximately 1,800 feet south of the Temperanceville Road intersection, to the beginning of the median divided roadway, approximately 2,000 feet to the north of the New Temperanceville Road intersection.

The Temperanceville Road intersection is a one-way stop controlled, three-legged intersection with a 140-foot southbound left turn lane with a 130-foot taper on U.S. Route 13. Temperanceville Road is a two-lane paved road with a gas station located on the northeastern corner of the intersection.

The New Temperanceville Road intersection is a two-way stop controlled, four-legged intersection. In the northbound direction, there is a 170-foot left turn lane with a 120-foot taper and a 425-foot right turn lane spanning the entire distance between Temperanceville Road and New Temperanceville Road. In the southbound direction there is a 190-foot left turn lane with a 95-foot taper and a 210-foot right turn lane with an 80-foot taper. New Temperanceville Road is on the eastern side of U.S. Route 13 and Saxis Road is on the west of the intersection. Both intersecting roads are two-lane paved roads. There is a business located on the southeastern corner of the intersection with two entrances onto U.S. Route 13; the northernmost entrance is located approximately 125 feet to the south of the intersection. It does not appear that this building is currently in use.

Approximately 1,800 feet south of the Temperanceville Road and U.S. Route 13 intersection, the concrete median transitions to a two-way left-turn lane. In between Temperanceville Road and New Temperanceville Road the two-way left-turn lane transitions to two left-turn lanes. North of New Temperanceville Road there is a southbound left turn lane preceded by a two-way left-turn lane that extends to approximately 2,000 feet north of the intersection before returning to a median divided roadway.

Throughout this roughly 3,800-foot corridor segment of U.S. Route 13, there is gutter pan located on both sides of the roadway. During a night field review, the RSA team noted the lack of positive roadside guidance for drivers unlike other parts of the corridor where edge line and raised pavement markers were present.

Narrow sidewalks are present throughout this portion of the corridor. Beginning at New Temperanceville Road and extending approximately 1,500 feet south of Temperanceville Road, the sidewalk is present along both sides of the road. The sidewalk is present along the eastern side of U.S. Route 13 from New Temperanceville Road to approximately 1,200 feet to the north of New Temperanceville Road. During the field review no pedestrians were viewed and a local resident noted that there is only the occasional pedestrian.

6.22.2 Crash Data

There were 38 crashes in the vicinity of the two intersections. Thirty-seven (37) percent resulted in fatality or injury. There were a total of three (3) fatal, angle crashes. Two fatal crashes occurred at the New Temperanceville Road (VA 695) and U.S. Route 13 intersection and one fatal crash occurred roughly 200 feet south of the Temperanceville Road and U.S. Route 13 intersection.

Fifty-five (55) percent of the crashes were angle crashes and 32 percent were roadway departure crashes. Of the 12 angle crashes, eight (8) involved drivers misjudging available gaps when turning from the side street, driveway, or making a left-turn off of U.S. Route 13. Six (6) of the angle crashes involved vehicles crossing the center line and hitting a vehicle in the opposite direction or losing control and hitting a vehicle traveling in the same direction. Five (5) of the angle crashes had incomplete narrative to determine the sequence of events; however, it was noted for all five of these that the driver did not have the right of way. Two (2) of the crashes involved vehicles turning right off of U.S. Route 13 when they were struck by another vehicle.

Of the 38 total crashes, 39 percent of those occurred during dark conditions. The majority of the crashes that occurred during dark periods were fixed object off road (53 percent) and 33 percent were angle crashes. In total, 67 percent of fixed object-off road crashes occurred during dark conditions.

6.22.3 Key Safety Concerns

- Lack of adequate gaps for vehicles attempting to turn onto U.S. Route 13 or drivers turning left off of U.S. Route 13 and on to a side street/driveway.
- Horizontal curve and high speeds reduce driver's ability to maintain control.
- Horizontal curve also limits intersection sight distance.
- Lack of positive roadside guidance.
- Pedestrian facilities with narrow sidewalk in poor condition. Ramps did not appear to meet ADA standards and no pedestrian crossing measures were present.
- Debris in gutter pan, within intersections/driveway entrances, and on sidewalk.
- Numerous conflict points due to number of lanes on U.S. Route 13 along with the proximity of intersections and driveway entrances.
- Eastbound approach at New Temperanceville Road intersection has a limited sight distance to the north due to horizontal curve.

6.22.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Investigate pedestrian activity to determine if the facilities need to be upgraded to meet ADA standards and to determine if crossing measures should be installed. Clear debris and trim vegetation growing over the sidewalk to provide additional width and a smoother surface.
- Consider measures to reduce speeds through the area through targeted enforcement or implementing a speed reduction zone throughout this section of the corridor. With the amount of closely spaced residential and retail driveways, intersections, and horizontal curve, reducing the speeds would allow drivers on U.S. Route 13 the ability to slow down and respond to vehicles turning off or onto U.S. Route 13. Slower speeds would also help drivers from driveways or side streets to better judge adequate gaps for entering or crossing U.S. Route 13.
- Trim/remove vegetation on the northeast corner of the New Temperanceville intersection to improve sight distance to the north.
- Install 12-inch street name signs at both intersections to conform to MUTCD recommendation.
- Clear debris from roadway gutter pan to help drivers maintain control.
- Provide enhanced roadside delineation through post mounted delineators to provide nighttime guidance to drivers.
- Provide additional intersection warning through intersection warning signs. Beacons could be added to the static warning signs to provide further enhancement or the warning signs could be dynamic and warn drivers when a vehicle is approaching a stop sign.

Mid-Term:

- Consider installation of high friction surface treatment through the horizontal curve.

Long-Term:

- Extending the concrete or grass median and providing turn lane pockets would reduce the number of potential conflict points and could help reduce the number of crossover and angle crashes. Additionally, closing Temperanceville Road would further reduce the number of potential conflict points.
- If the angle crashes are not reduced through the intersection warning and access management measures then investigate additional measures, such as the implementation of RCUTs, which could help to further reduce the number of conflict points, particularly as intersection sight distance is limited due to the horizontal curve.
- Lengthen remaining substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.42. Locations #21 & #22 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Add dynamic intersection warning signs	0.814-0.918 (18.6%-8.2% reduction)	All Crashes - all severities	CMF Clearinghouse
High friction surface treatment	0.67-1.27	All Crashes - all severities	CMF Clearinghouse
Directional Medians to allow left-turns and u-turns	0.77 (23% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.43. Locations #21 and #22 Cost Estimate.

	Item	Locations #21 & #22
Tier 1	Signage	$127,335
	Pavement Markings	$40,008
	Signal	
	Other	$12,958
	TOTAL	$180,301
Tier 2	Signage	$148,786
	Pavement Markings	$555
	Signal	
	Other	$1,980
	TOTAL	$151,321
Tier 3	Signage	$165,194
	Pavement Markings	$1,249
	Signal	
	Other	$287,230
	TOTAL	$453,673

Note: See Templates in Appendix A for applicable items.

Looking south on U.S. Route 13

Looking north on U.S. Route 13 at New Temperanceville Road

This page intentionally left blank.

Figure 6.12
Concept Plan -
Site Specific Locations #21 & #22
Eastern Shore Safety Study

site specific location #23

Vicinity Map

Crash Sites

6.23 Site Specific Location #23 Chincoteague Road (MP 133.73)

6.23.1 Existing Conditions

This location is at the four-legged signalized intersection of U.S. Route 13 and Chincoteague Road (VA 175). At this location, U.S. Route 13 is median separated with a 200-foot northbound left turn lane with a 155-foot taper and a 230-foot northbound right turn lane with a 185-foot taper. Additionally, there is a 250-foot southbound left turn lane with a 125-foot taper. Route 175 is a two-lane undivided roadway with a westbound right and left turn lane. The area is primarily residential and retail. At the intersection there is a restaurant and bank on the northeast corner, a gas station and shopping center in the southeast corner, a gas station on the western side of the intersection, and a small shopping center on the southwestern corner of the intersection.

In the southbound direction there is an outside shoulder and a narrow median shoulder, both without rumble strips. In the northbound direction, there is an outside shoulder and a narrow median shoulder. Approaching the intersection, there are no shoulder or median rumble strips, but past the intersection there are median rumble strips. On the northbound approach there are also transverse rumble strips. On Route 175, there is minimal or no shoulder with no rumble strips/stripes.

6.23.2 Crash Data

Fifty-eight (58) crashes occurred In the vicinity of the intersection. Twenty-eight (28) percent of those crashes resulted in injury crashes. The primary crash types were rear end (47 percent) and angle crashes (31 percent). Seventy-eight (78) percent of the crashes occurred during the day.

Twelve of the 27 rear end crashes were related to the inability of drivers to stop for traffic stopped at the signal, and three of the crashes were related to vehicles slowing down to make a turn. The action of most of the remaining crashes were noted as "following too close". Forty (40) percent of the rear end crashes occurred on eastbound Route 175, heading away from the traffic signal.

Of the 18 angle crashes, eight (8) involved drivers misjudging gaps when making turns, five (5) crashes were from vehicles running the red light, and five (5) crashes involved drivers failing to maintain control or performing improper or unsafe lane changes. Angle crashes were most prevalent on U.S. Route 13 northbound; however, Route 175 eastbound and U.S. Route 13 southbound each had 30 percent of the angle crashes.

6.23.3 Key Safety Concerns

- Median crossover is sloped in a manner that prevents proper drainage, trapping debris and water in crossover.
- Access management: Many of the rear end crashes occurred eastbound on Route 175, past the traffic signal. Also many of the angle crashes occurred at access points near the intersection.
- Speed along Routes 13 and 175 and the speed differential between trucks and other vehicles. Drivers are not able to stop in time for stopped or turning vehicles, particularly slower moving trucks. Additionally, with higher speeds it is more difficult for drivers entering U.S. Route 13 and Route 175 to judge and find acceptable gaps in traffic.
- Lack of advance intersection warning.
- Street name mounted to signal pole versus mast arm.

6.23.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Revise slope to promote drainage at median crossover to improve vehicle traction.
- Implement targeted enforcement of speed on the intersection approaches so that drivers are better able to respond to stopped or slowing traffic and red light running enforcement at the signal.
- Install transverse rumble strips on the southbound U.S. Route 13 approach and static or dynamic intersection warning signs in both north and southbound approaches.
- Install retroreflective tape on backplates or install retroreflective backplates to enhance signal conspicuity.
- Move street name signs to mast arm rather than signal pole to enhance visibility.

Mid-Term:

- Consider installing lighting at the intersection and on the intersection approaches to improve nighttime visibility at the intersection and the adjacent driveways.

Long-Term:

- Evaluate methods to reduce, condense, and better define access points in the vicinity of the intersection to improve driver expectancy and reduce unexpected stopping due to drivers entering and exiting the roadway. The gas station on the southeastern corner of the intersection has wide open access. Through curb and landscaping strips, the access points could be defined and potentially moved away from the traffic signal. There are two additional access points to the east on Route 175 that could be combined. Similarly, there are access points less than 500 feet on the western side of the intersection. By minimizing and defining accesses onto Routes 13 and 175 the conflict points can be greatly reduced.
- Lengthen substandard turn lanes to provide 200 feet of storage and 200 feet of taper for an overall minimum length of 400 feet.

Table 6.44. Location #23 Recommended Countermeasures.

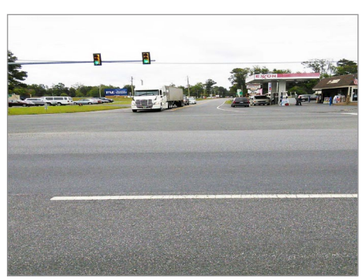
Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install centerline & shoulder rumble strips	0.82 (18% reduction)	All Crashes - fatal, serious injury	CMF Clearinghouse
Curve warning signage	0.56 - 0.69 (31 - 44% reduction)	All Crashes - all severities	CMF Clearinghouse
Slope flattening	0.58-0.78 (22 - 42% reduction)	All Crashes - all severities	CMF Clearinghouse
Widen paved shoulder from 3 ft to 8 ft	0.71 (29% reduction)	All Crashes - all severities	CMF Clearinghouse
Install center line & shoulder rumble strips	0.82 (18% reduction)	All Crashes - fatal, serious injury	CMF Clearinghouse

Table 6.45. Location #23 Cost Estimate.

	Item	Location #23
Tier 1	Signage	$29,114
	Pavement Markings	$10,126
	Signal	$871
	Other	$166
	TOTAL	$40,277
Tier 2	Signage	$10,534
	Pavement Markings	$924
	Signal	
	Other	$660
	TOTAL	$12,118
Tier 3	Signage	$7,441
	Pavement Markings	$417
	Signal	
	Other	$85,535
	TOTAL	$93,393

Note: See Templates in Appendix A for applicable items.

Vehicles traveling northbound on U.S. Route 13

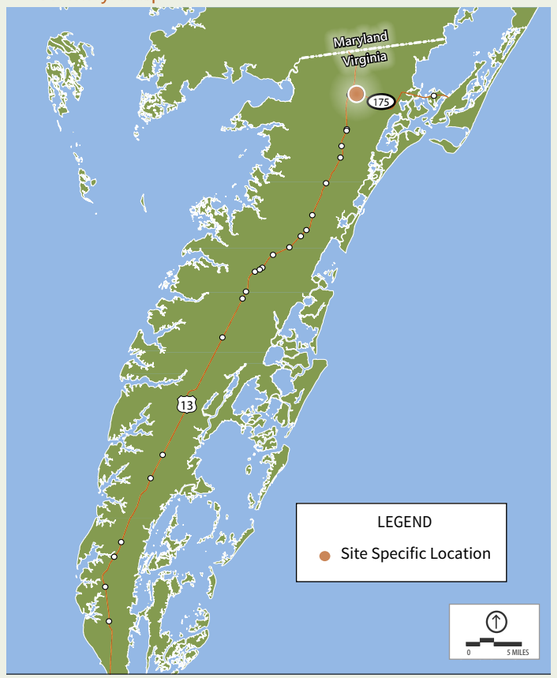


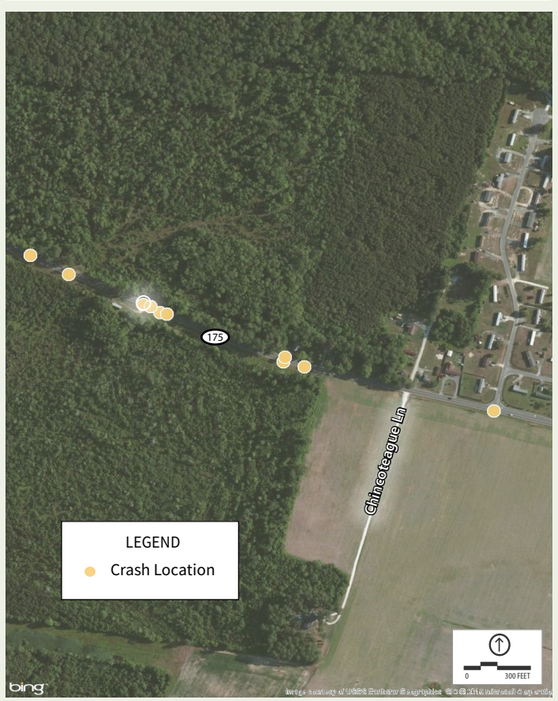
Vehicles stopped in the westbound approach at U.S. Route 13 and Chincoteague Road

Figure 6.13
Concept Plan -
Site Specific Location #23
Eastern Shore Safety Study

site specific location #24

Vicinity Map





Crash Sites

6.24 Site Specific Location #24 East of U.S. Route 13

6.24.1 Existing Conditions

This corridor segment is roughly 1,750 feet of Route 175 starting approximately 2,500 feet east of the U.S. Route 13 and Route 175 intersection.

The section of the corridor is a two-lane paved road with minimal to no shoulder and a passing lane in the westbound direction. The area is wooded with steep slopes on both sides of the road.

6.24.2 Crash Data

There were 11 crashes within this segment; four (4) crashes were deer-related, three (3) crashes were roadway departure, three (3) crashes were rear end, and one (1) fatal was a head-on crash. Thirty-six (36) percent resulted in fatal or injury crashes. Fifty-five (55) percent of the crashes occurred during dark conditions.

6.24.3 Key Safety Concerns

- Roadway departure crashes at the curve on the eastern side, near the edge of the woods.
- Limited sight distance at curve.
- During the field review a local homeowner noted that he witnessed two recent crashes involved drivers traveling west and misjudging the length of the horizontal curve. The homeowner also noted that many drivers are texting while driving.

6.24.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Provide additional positive guidance through post mounted delineators and wider 6-inch pavement markings.
- Implement safety edge to provide an additional method for vehicles to recover from roadway departure crashes.
- Install edge and center line rumble strips.
- Install curve warning signage in both the east and westbound directions.
- Use a ball bank test to determine if chevrons are appropriate.
- Improve sight distance by trimming/removing vegetation on the inside of the curve.

Mid-Term:

- Increase drivers' opportunity to stay on the road or to recover if they drive off the road. Methods include shoulder slope flattening, widening paved outside shoulder to eight feet, and application of center and edge line rumble strips.

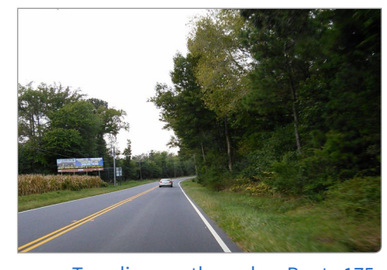
Table 6.46. Location #24 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install wider edge lines (4 in to 6 in)	0.83 (17% reduction)	All Crashes - all severities	CMF Clearinghouse
Installation of safety edge treatment	0.85 - 1.00 (0 - 15% reduction)	All Crashes - all severities	CMF Clearinghouse
Install center line & shoulder rumble strips	0.82 (18% reduction)	All Crashes - fatal, serious injury	CMF Clearinghouse
Curve warning signage	0.56 - 0.69 (31 - 44% reduction)	All Crashes - all severities	CMF Clearinghouse
Slope flattening	0.58-0.78 (22 - 42% reduction)	All Crashes - all severities	CMF Clearinghouse
Widen paved shoulder from 3 ft to 8 ft	0.71 (29% reduction)	All Crashes - all severities	CMF Clearinghouse

Table 6.47. Location #24 Cost Estimate.

	Item	Location #24
Tier 1	Signage	$5,075
	Pavement Markings	
	Signal	
	Other	$166
	TOTAL	$5,241
Tier 2	Signage	$5,817
	Pavement Markings	
	Signal	
	Other	$660
	TOTAL	$6,477
Tier 3	Signage	$3,620
	Pavement Markings	$832
	Signal	
	Other	$8,477
	TOTAL	$12,929

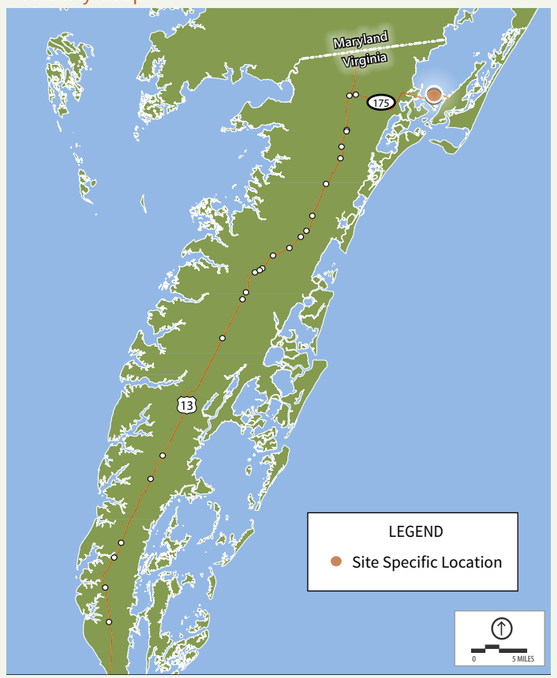
Note: See Templates in Appendix A for applicable items.



Traveling westbound on Route 175

site specific location #25

Vicinity Map



Crash Sites

6.25 Site Specific Location #25 Bridge Crossing Wire Narrows

6.25.1 Existing Conditions

This location is a corridor segment of Route 175 located approximately 5,500 feet west of the intersection with Marsh Island Drive and extending roughly 1,000 feet to the west. This portion of the corridor is a two-lane paved road with shoulders in the east and westbound directions with a guardrail on the southern side of the roadway, and a passing zone for westbound drivers.

This section of the corridor is open and surrounded by water on both the north and south with a bridge to the east. During the field review it was noted that many drivers drove very closely to the vehicles ahead and were willing to perform passing maneuvers with limited available space due to vehicles traveling in opposite direction.

6.25.2 Crash Data

There were two (2) crashes at this location; one head-on fatal crash and one rear end incapacitating injury crash. Both occurred during the day. The rear end crash involved a vehicle passing in the westbound direction.

6.25.3 Key Safety Concerns

- Lack of positive guidance.
- Location of passing zone.
- Speed and aggressive driving.

6.25.4 Recommended Countermeasures and Implementation Plan

Short-Term:

- Install shoulder and center line rumble strips.
- Re-evaluate passing zones. Due to the water on both sides of the road, there is limited recovery space if other drivers conduct passing without having adequate space.
- Conduct targeted enforcement of aggressive driving. Also implement public educational campaigns about the risks associated with aggressive driving.

Table 6.48. Location #25 Recommended Countermeasures.

Countermeasure	CMF	Notes	Source
Install center line & shoulder rumble strips	0.82 (18% reduction)	All Crashes - fatal, serious injury	CMF Clearinghouse

Table 6.49. Location #25 Cost Estimate.

	Item	Location #25
Tier 1	Signage	
	Pavement Markings	$5,940
	Signal	
	Other	$166
	TOTAL	$6,106
Tier 2	Signage	
	Pavement Markings	$3,630
	Signal	
	Other	$660
	TOTAL	$4,290
Tier 3	Signage	
	Pavement Markings	$2,640
	Signal	
	Other	$2,376
	TOTAL	$5,016

Note: See Templates in Appendix A for applicable items.

This page intentionally left blank.

chapter

7

Recommendations

This page intentionally left blank.

7.1 Study Recommendations

The Eastern Shore Safety Study provided a comprehensive evaluation of the U.S. Route 13 and Route 175 corridors with the express purpose of developing a series of recommended treatments which have proven safety benefits. The range of treatments address existing, short-term, and long-term corridor needs. The study incorporated systemic template application, crossover and intersection evaluation, and site specific assessment toward the development of the recommendations. The recommendations supersede the 2002 Study recommendations except for those discussed in Section 6.2.1 of the 2002 Study regarding new U.S. Route 13 alignments and recommended grade separated intersections.

Through the approach presented in this report, the most prevalent and most severe crash types have been comprehensively considered and addressed.

- The most common crash type during the 2010-2014 study period was roadway departure accounting for 33 percent or 520 reported crashes. The rumble strips installed by 2014 demonstrate a 27 percent reduction in roadway departure crashes in the one-year comparison. Widening shoulders, installing safety edge, enhancing roadway delineation, and lighting in select locations provides additional guidance and recovery measures for enhanced safety.
- Animal related crashes were the second most prevalent crash type within the study area representing 22 percent of total crashes. However, this crash type only represented three percent of fatal and severe crashes. These crashes are widespread, random, and difficult to predict; therefore, more typical and expensive measures such as fencing, separated animal crossings, or dynamic warning systems were not included. The effectiveness of other less costly measures, such as installation of deer reflectors or deer warning signs is limited and as such, were not included in the recommendations. As animal crashes represented such a small portion of the severe and fatal crashes, they were not included as a focus crash type in the systemic analysis. Some of the measures identified as a result of the site specific analysis, such as lighting, improved roadway delineation, shoulder widening, and installation of safety edge, have the potential to help address animal related crashes by improving drivers' ability to see, respond, and recover from wildlife in the roadway.
- Intersection-type crashes (angle crashes and rear end crashes) represent 39 percent of all crashes or 614 reported crashes. Crossover and intersection modifications as well as the access management strategies presented in this report, address these crash types and based on available research, could potentially have the most impact on enhancing the safety of the corridor.

The recommendations are presented in tables divided into 15 U.S. Route 13 segments and one Route 175 segment (see Table 5.1). The tables present the costs associated with the treatments and provide the detail on the cost for each tier of implementation, see Tables 7.1 – 7.16. See Appendix E for additional details.

The spreadsheets used to create the following tables have been provided as a supplement to this study report. The spreadsheets are tools that can be used in planning the implementation of the countermeasures. Considerations for implementation include the most influential techniques in reducing the most severe crash types, the time frame in which countermeasures can be installed, and the funding source identified. This study and the spreadsheets provide a basis for an action plan that VDOT can use to implement the countermeasures to make U.S. Route 13 and Route 175 safer transportation facilities for all who use them.

Table 7.1.
Recommended Improvements - U.S. Route 13 Segment #1.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
1	70.00	74.78	Route 600 (Kiptopeke) to Route 624 (Cape Charles)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$267,102	$34,924		$302,026
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$74,038	$6,854		$80,892
			Template 10 - Corridor – Divided Roadway				$190,683	$1,500		$192,183
			Template 12 - Curve – Divided Roadway				$6,080	$14,386		$20,466
Crossover and Intersection Treatments										
			Retain	8						
			Close with 2 left turn lanes	1	$29,532	$29,532				$29,532
			Install 1 Left Turn Lane	1	$48,000	$48,000				$48,000
Site Specific Treatments										
			None							
Total Segment #1						$77,532	$537,903	$57,664		$673,099

Table 7.2.
Recommended Improvements - U.S. Route 13 Segment #2

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
2	74.78	78.91	Route 624 (Cape Charles) to Route 642 (Cape Charles)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$53,440	$6,985	$14,761	$75,186
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$155,980	$16,210		$172,190
			Template 10 - Corridor – Divided Roadway				$154,377	$1,500		$155,877
			Template 12 - Curve – Divided Roadway				$12,160	$28,771		$40,931
Crossover and Intersection Treatments										
			Retain	14						
			Close with No Left Turn Lanes	3	$4,102	$12,306				$12,306
			Close with 1 turn left lane	1	$17,106	$17,106				$17,106
			Lengthen Existing Left Turn Lane	2	$21,000	$42,000				$42,000
			Install 1 Left Turn Lane	3	$48,000	$144,000				$144,000
			Install 2 Left Turn Lanes	2	$96,000	$192,000				$192,000
Site Specific Treatments										
			Location #1				$14,633	$500	$107,422	$122,555
Total Segment #2						$407,412	$390,590	$53,966	$122,183	$974,151

Table 7.3.
Recommended Improvements - U.S. Route 13 Segment #3.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
3	78.91	86.55	Route 642 (Cape Charles) to Route 630 (Martin Siding)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$211,064	$27,940		$239,004
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$155,980	$6,484		$162,464
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$110,228	$14,547		$124,775
			Template 8 - Signalized Intersection – 4-leg				$40,422			$40,422
			Template 10 - Corridor – Divided Roadway				$211,667	$500	$4,145	$216,312
			Template 12 - Curve – Divided Roadway				$42,559	$43,157	$109,356	$195,072
Crossover and Intersection Treatments										
			Retain	5						
			Close with No Left Turn Lanes	2	$4,102	$8,204				$8,204
			Lengthen Existing Left Turn Lane	10	$21,000	$210,000				$210,000
			Install 1 Left Turn Lane	4	$48,000	$192,000				$192,000
			Install 2 Left Turn Lanes	10	$96,000	$960,000				$960,000
			Install RCUT Intersection Treatment	1	$196,102	$196,102				$196,102
Site Specific Treatments										
			Location #2				$103,329	$27,258	$1,069,864	$1,200,451
			Location #3				$59,185	$2,842	$378,589	$440,616
			Location #4				$31,098	$3,211	$123,142	$157,451
Total Segment #3						$1,566,306	$965,532	$125,939	$1,685,096	$4,342,873

Table 7.4.
Recommended Improvements - U.S. Route 13 Segment #4.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
4	86.55	89.03	Route 630 (Martin Siding) to Route 628 (Treherneville and Machipongo)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$53,440			$53,440
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$218,372			$218,372
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$4,471			$4,471
			Template 10 - Corridor – Divided Roadway				$173,575			$173,575
			Template 12 - Curve – Divided Roadway				$18,240			$18,240
Crossover and Intersection Treatments										
			Retain	0						
			Close with No Left Turn Lanes	1	$4,102	$4,102				$4,102
			Close with 1 turn left lane	2	$17,106	$34,212				$34,212
			Lengthen Existing Left Turn Lane	7	$21,000	$147,000				$147,000
			Install 1 Left Turn Lane	6	$48,000	$288,000				$288,000
			Install 2 Left Turn Lanes	2	$96,000	$192,000				$192,000
Site Specific Treatments										
			None							
Total Segment #4						$665,314	$468,098			$1,133,412

Table 7.5.
Recommended Improvements - U.S. Route 13 Segment #5.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
5	89.03	93.9	Route 628 (Treherneville and Machipongo) to Route 617 (Nassawadox)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$160,319			$160,319
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$62,534	$6,484		$69,018
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$5,451			$5,451
			Template 10 - Corridor – Divided Roadway				$147,070	$500		$147,570
Crossover and Intersection Treatments										
			Retain	3						
			Close with No Left Turn Lanes	1	$4,102	$4,102				$4,102
			Lengthen Existing Left Turn Lane	7	$21,000	$147,000				$147,000
			Install 1 Left Turn Lane	5	$48,000	$240,000				$240,000
			Install 2 Left Turn Lanes	4	$96,000	$384,000				$384,000
			Access Management	2	$16,213	$32,426				$32,426
Site Specific Treatments										
			Location #5				$74,046	$8,053	$111,199	$193,298
			Location #6				$87,528	$7,432	$95,277	$190,236
	Total Segment #5					$807,528	$536,948	$22,469	$206,475	$1,573,420

Table 7.6.
Recommended Improvements - U.S. Route 13 Segment #6.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
6	93.9	98.48	Route 617 (Nassawadox) to Route 618 (Exmore)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$53,440			$53,440
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$125,068	$3,242		$128,310
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$4,559			$4,559
			Template 8 - Signalized Intersection – 4-leg				$80,844			$80,844
			Template 10 - Corridor – Divided Roadway				$165,781			$165,781
			Template 12 - Curve – Divided Roadway				$6,080			$6,080
Crossover and Intersection Treatments										
			Retain	4						
			Close with No Left Turn Lanes	1	$4,102	$4,102				$4,102
			Close with 2 left turn lanes	1	$29,532	$29,532				$29,532
			Lengthen Existing Left Turn Lane	8	$21,000	$168,000				$168,000
			Install 1 Left Turn Lane	4	$48,000	$192,000				$192,000
			Install 2 Left Turn Lanes	3	$96,000	$288,000				$288,000
Site Specific Treatments										
			None							
	Total Segment #6					$681,634	$435,772	$3,242		$1,120,648

Table 7.7.
Recommended Improvements - U.S. Route 13 Segment #7.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
7	98.48	103.03	Route 618 (Exmore) to Route 607 (Melfa, Keller, Painter)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$267,197	$6,985		$274,182
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$187,602			$187,602
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$150,164			$150,164
			Template 8 - Signalized Intersection – 4-leg				$202,108	$11,620		$213,728
			Template 10 - Corridor – Divided Roadway				$73,427			$73,427
			Template 12 - Curve – Divided Roadway				$18,240			$18,240
Crossover and Intersection Treatments										
			Retain	3						
			Close with 1 turn left lane	1	$17,106	$17,106				$17,106
			Lengthen Existing Left Turn Lane	14	$21,000	$294,000				$294,000
			Install 1 Left Turn Lane	5	$48,000	$240,000				$240,000
			Install RCUT Intersection Treatment	1	$196,102	$196,102				$196,102
			Remove Signal	1	$10,000	$10,000				$10,000
			Pedestrian Crossing Improvement	1	$60,000	$60,000				$60,000
Site Specific Treatments										
			None							
Total Segment #7						$817,208	$898,738	$18,605		$1,734,551

Table 7.8.
Recommended Improvements - U.S. Route 13 Segment #8.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
8	103.03	110.41	Route 607 (Melfa, Keller, Painter) to Route 639 (Accomac and Onley)							
Systemic Treatments										
			Template 1 - Unsignalized Intersection – 4-leg (2-way stop controlled), undivided				$46,013			$46,013
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$53,440			$53,440
			Template 3 - Unsignalized Intersection – 3-leg (1-way stop controlled), undivided				$88,226			$88,226
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$136,056			$136,056
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$18,464			$18,464
			Template 8 - Signalized Intersection – 4-leg				$121,265			$121,265
			Template 9 - Corridor – Undivided Roadway				$54,166			$54,166
			Template 10 - Corridor – Divided Roadway				$193,000			$193,000
Crossover and Intersection Treatments										
			Retain	0						
			Close with No Left Turn Lanes	1	$4,102	$4,102				$4,102
			Close with 1 turn left lane	1	$17,106	$17,106				$17,106
			Lengthen Existing Left Turn Lane	9	$21,000	$189,000				$189,000
			Install 1 Left Turn Lane	3	$48,000	$144,000				$144,000
			Install 2 Left Turn Lanes	6	$96,000	$576,000				$576,000
			Install RCUT Intersection Treatment	3	$196,102	$588,306				$588,306
			Pedestrian Crossing Improvement	1	$60,000	$60,000				$60,000
Site Specific Treatments										
			Location #7				$10,549	$660	$120,258	$131,467
			Location #8				$53,555	$7,432	$88,198	$149,185
Total Segment #8						$1,578,514	$774,734	$8,092	$208,456	$2,569,796

Table 7.9.
Recommended Improvements - U.S. Route 13 Segment #9.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
9	110.41	117.54	Route 639 (Accomac and Onley) to Business 13/Route 663 (Mary N Smith Area)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$160,319	$20,955	$29,522	$210,796
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$187,602	$3,242		$190,844
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$186,259	$28,754		$215,013
			Template 8 - Signalized Intersection – 4-leg				$242,530	$34,860		$277,390
			Template 10 - Corridor – Divided Roadway				$134,105	$500	$4,145	$138,750
			Template 12 - Curve – Divided Roadway				$30,400	$43,157		$73,557
Crossover and Intersection Treatments										
			Retain	6						
			Close with No Left Turn Lanes	1	$4,102	$4,102				$4,102
			Lengthen Existing Left Turn Lane	20	$21,000	$420,000				$420,000
			Install 1 Left Turn Lane	6	$48,000	$288,000				$288,000
			Install RCUT Intersection Treatment	1	$196,102	$196,102				$196,102
			Access Management	3	$16,213	$48,639				$48,639
			Remove Signal	1	$10,000	$10,000				$10,000
Site Specific Treatments										
			Location #9				$43,936	$4,347	$48,438	$96,721
			Location #10				$118,804	$12,382	$72,817	$204,003
			Location #11				$53,997	$7,617	$100,237	$161,851
			Location #12				$54,143	$7,617	$312,552	$374,312
			Location #13				$61,671	$12,593	$196,074	$270,338
			Location #14				$100,947	$19,880	$227,905	$348,732
Total Segment #9						$966,843	$1,374,713	$195,904	$991,690	$3,529,150

Table 7.10.
Recommended Improvements - U.S. Route 13 Segment #10.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
10	117.54	120.23	Business 13/Route 663 (Mary N Smith Area) to Route 679							
Systemic Treatments										
			Template 3 - Unsignalized Intersection – 3-leg (1-way stop controlled), undivided				$66,893			$66,893
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$93,801	$3,242		$97,043
			Template 9 - Corridor – Undivided Roadway				$22,000			$22,000
			Template 10 - Corridor – Divided Roadway				$55,741	$500		$56,241
			Template 11 - Curve – Undivided Roadway				$13,751			$13,751
			Template 12 - Curve – Divided Roadway				$12,160			$12,160
Crossover and Intersection Treatments										
			Retain	0						
			Close with No Left Turn Lanes	1	$4,102	$4,102				$4,102
			Lengthen Existing Left Turn Lane	7	$21,000	$147,000				$147,000
			Install 1 Left Turn Lane	2	$48,000	$96,000				$96,000
Site Specific Treatments										
			Location #15				$63,731	$20,817	$167,888	$252,436
			Location #16				$22,486	$3,985	$56,463	$82,934
	Total Segment #10					$247,102	$350,563	$28,544	$224,351	$850,560

Table 7.11.
Recommended Improvements - U.S. Route 13 Segment #11.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
11	120.23	123.47	Route 679 to Route 681 (Nelsonia)							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$53,440			$53,440
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$175,580	$3,242		$178,822
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$54,617			$54,617
			Template 10 - Corridor – Divided Roadway				$87,773	$500		$88,273
			Template 12 - Curve – Divided Roadway				$12,160			$12,160
Crossover and Intersection Treatments										
			Retain	0						
			Close with No Left Turn Lanes	1	$4,102	$4,102				$4,102
			Close with 1 turn left lane	3	$17,106	$51,318				$51,318
			Close with 2 left turn lanes	3	$29,532	$88,596				$88,596
			Lengthen Existing Left Turn Lane	5	$21,000	$105,000				$105,000
			Install 2 Left Turn Lanes	5	$96,000	$480,000				$480,000
			Install RCUT Intersection Treatment	3	$196,102	$588,306				$588,306
			Access Management	1	$16,213	$16,213				$16,213
Site Specific Treatments										
			Location #17				$81,885	$10,686	$374,137	$466,708
	Total Segment #11					$1,333,535	$465,455	$14,428	$374,137	$2,187,555

Table 7.12.
Recommended Improvements - U.S. Route Segment #12.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
12	123.47	125.57	Route 681 (Nelsonia) to Route 729 (Mappsville)							
Systemic Treatments										
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$72,753			$72,753
			Template 9 - Corridor – Undivided Roadway				$35,052			$35,052
			Template 10 - Corridor – Divided Roadway				$67,949	$500		$68,449
			Template 11 - Curve – Undivided Roadway				$13,751			$13,751
			Template 12 - Curve – Divided Roadway				$24,320			$24,320
Crossover and Intersection Treatments										
			Retain	0						
			Close with 1 turn left lane	2	$17,106	$34,212				$34,212
			Lengthen Existing Left Turn Lane	3	$21,000	$63,000				$63,000
			Install 1 Left Turn Lane	1	$48,000	$48,000				$48,000
			Install 2 Left Turn Lanes	3	$96,000	$288,000				$288,000
			Install RCUT Intersection Treatment	1	$196,102	$196,102				$196,102
			Access Management	1	$16,213	$16,213				$16,213
Site Specific Treatments										
			Location #18				$121,000	$11,564	$122,862	$255,426
Total Segment #12						$645,527	$334,825	$12,064	$122,862	$1,115,278

Table 7.13.
Recommended Improvements - U.S. Route Segment #13.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
13	125.57	128.9	Route 729 (Mappsville) to Route 692 (Oak Hall and Temperanceville)							
Systemic Treatments										
			Template 1 - Unsignalized Intersection – 4-leg (2-way stop controlled), undivided				$23,007			$23,007
			Template 3 - Unsignalized Intersection – 3-leg (1-way stop controlled), undivided				$25,611			$25,611
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$187,176			$187,176
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$5,492			$5,492
			Template 9 - Corridor – Undivided Roadway				$14,560			$14,560
			Template 10 - Corridor – Divided Roadway				$56,053			$56,053
			Template 12 - Curve – Divided Roadway				$18,240			$18,240
Crossover and Intersection Treatments										
			Retain	2						
			Close with No Left Turn Lanes	1	$4,102	$4,102				$4,102
			Close with 2 left turn lanes	1	$29,532	$29,532				$29,532
			Lengthen Existing Left Turn Lane	4	$21,000	$84,000				$84,000
			Install 1 Left Turn Lane	4	$48,000	$192,000				$192,000
			Install 2 Left Turn Lanes	1	$96,000	$96,000				$96,000
			Install RCUT Intersection Treatment	3	$196,102	$588,306				$588,306
Site Specific Treatments										
			Location #19				$189,628	$75,487	$489,101	$749,216
			Location #20				$68,819	$8,034	$355,320	$432,173
	Total Segment #13					$993,940	$583,586	$83,520	$844,421	$2,505,468

Table 7.14.
Recommended Improvements - U.S. Route Segment #14.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
14	128.9	133.93	Route 692 (Oak Hall and Temperanceville) to Route 175							
Systemic Treatments										
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$164,732	$6,484		$171,216
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$20,123	$1,374		$21,497
			Template 8 - Signalized Intersection – 4-leg				$80,844			$80,844
			Template 9 - Corridor – Undivided Roadway				$19,104			$19,104
			Template 10 - Corridor – Divided Roadway				$118,468			$118,468
			Template 11 - Curve – Undivided Roadway				$13,751			$13,751
			Template 12 - Curve – Divided Roadway				$12,160			$12,160
Crossover and Intersection Treatments										
			Retain	3						
			Close with No Left Turn Lanes	7	$4,102	$28,714				$28,714
			Close with 1 turn left lane	1	$17,106	$17,106				$17,106
			Close with 2 left turn lanes	1	$29,532	$29,532				$29,532
			Lengthen Existing Left Turn Lane	13	$21,000	$273,000				$273,000
			Install 1 Left Turn Lane	4	$48,000	$192,000				$192,000
			Install 2 Left Turn Lanes	3	$96,000	$288,000				$288,000
Site Specific Treatments										
			Locations #21 & #22				$180,301	$151,321	$453,673	$785,295
Total Segment #14						$828,352	$609,483	$159,179	$453,673	$2,050,687

Table 7.15.
Recommended Improvements - U.S. Route Segment #15.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
15	133.93	138.1	Route 175 to Maryland State Line							
Systemic Treatments										
			Template 2 - Unsignalized Intersection – 4-leg (2-way stop controlled)				$53,440			$53,440
			Template 4 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (with crossover)				$297,494	$3,242		$300,736
			Template 5 - Unsignalized Intersection – 3-leg (1-way stop controlled), median separated (no crossover)				$17,673			$17,673
			Template 10 - Corridor – Divided Roadway				$133,615			$133,615
Crossover and Intersection Treatments										
			Retain	1						
			Close with No Left Turn Lanes	3	$4,102	$12,306				$12,306
			Close with 1 turn left lane	2	$17,106	$34,212				$34,212
			Close with 2 left turn lanes	2	$29,532	$59,064				$59,064
			Lengthen Existing Left Turn Lane	14	$21,000	$294,000				$294,000
			Install 1 Left Turn Lane	4	$48,000	$192,000				$192,000
			Install 2 Left Turn Lanes	2	$96,000	$192,000				$192,000
			Access Management	1	$16,213	$16,213				$16,213
Site Specific Treatments										
			Location #23				$40,277	$12,118	$93,393	$145,788
	Total Segment #15					$799,795	$542,499	$15,360	$93,393	$1,451,047

Table 7.16.
Recommended Improvements - Route 175.

Segment #	Start Mile Post	"End Mile Post"	Corridor	Qty	Unit Cost	Crossovers and Intersections	Tier 1	Tier 2	Tier 3	Total
16	0	6.98	Route 175 from U.S. Route 13 to Mosquito Creek							
Systemic Treatments										
			Template 1 - Unsignalized Intersection – 4-leg (2-way stop controlled), undivided				$23,007			$23,007
			Template 3 - Unsignalized Intersection – 3-leg (1-way stop controlled), undivided				$180,968			$180,968
			Template 8 - Signalized Intersection – 4-leg				$40,422			$40,422
			Template 9 - Corridor – Undivided Roadway				$251,344			$251,344
			Template 11 - Curve – Undivided Roadway				$13,751			$13,751
Site Specific Treatments										
			Location #24				$5,241	$6,477	$12,929	$24,647
			Location #25				$6,106	$4,290	$5,016	$15,412
Total Route 175							$520,839	$10,767	$17,945	$549,551

Appendix A

CONTENTS

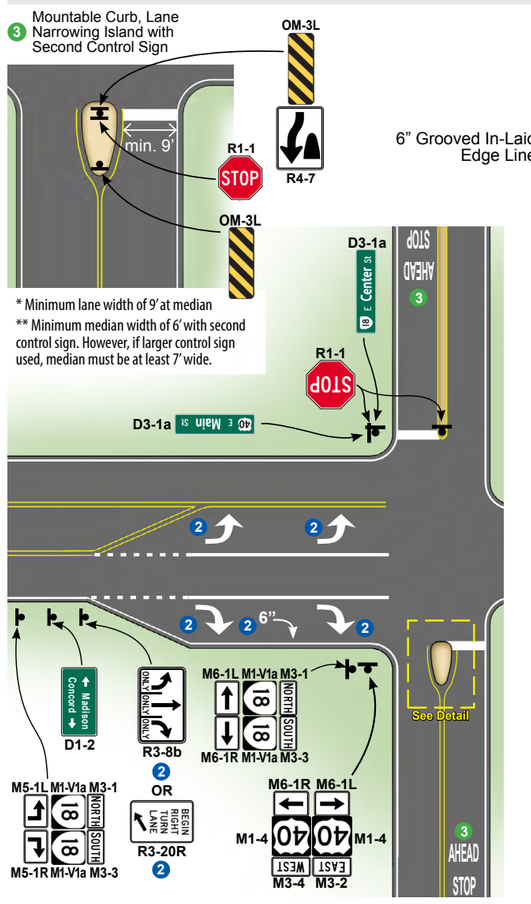
Intersection Templates

Criteria for Placement of Edge Line Markings (Source: Virginia Supplement Chapter 3B)

Pave-ment Width	Traffic Volume	Roadway Type: Undi-vided Limited Access	Bi-directional multi-lane	Two-lane Paved Roads with Center Line & without Curb and Gutter	Other Rural Arterials and Collectors	Local Residential	All Other Paved Roadway Segments
≥ 20 feet	≥ 3,000 vpd	Required	Required	Required	Recommended	Not Recommended unless primarily serving through traffic	May be considered only where Engineering Study indicates a need
	< 3,000 vpd	Required	Required	Required	May be considered only where Engineering Study indicates a need		
< 20 feet	≥ 3,000 vpd	Required	Required	May be consid-ered only where Engineering Study indicates a need			
	< 3,000 vpd	Required	Required				

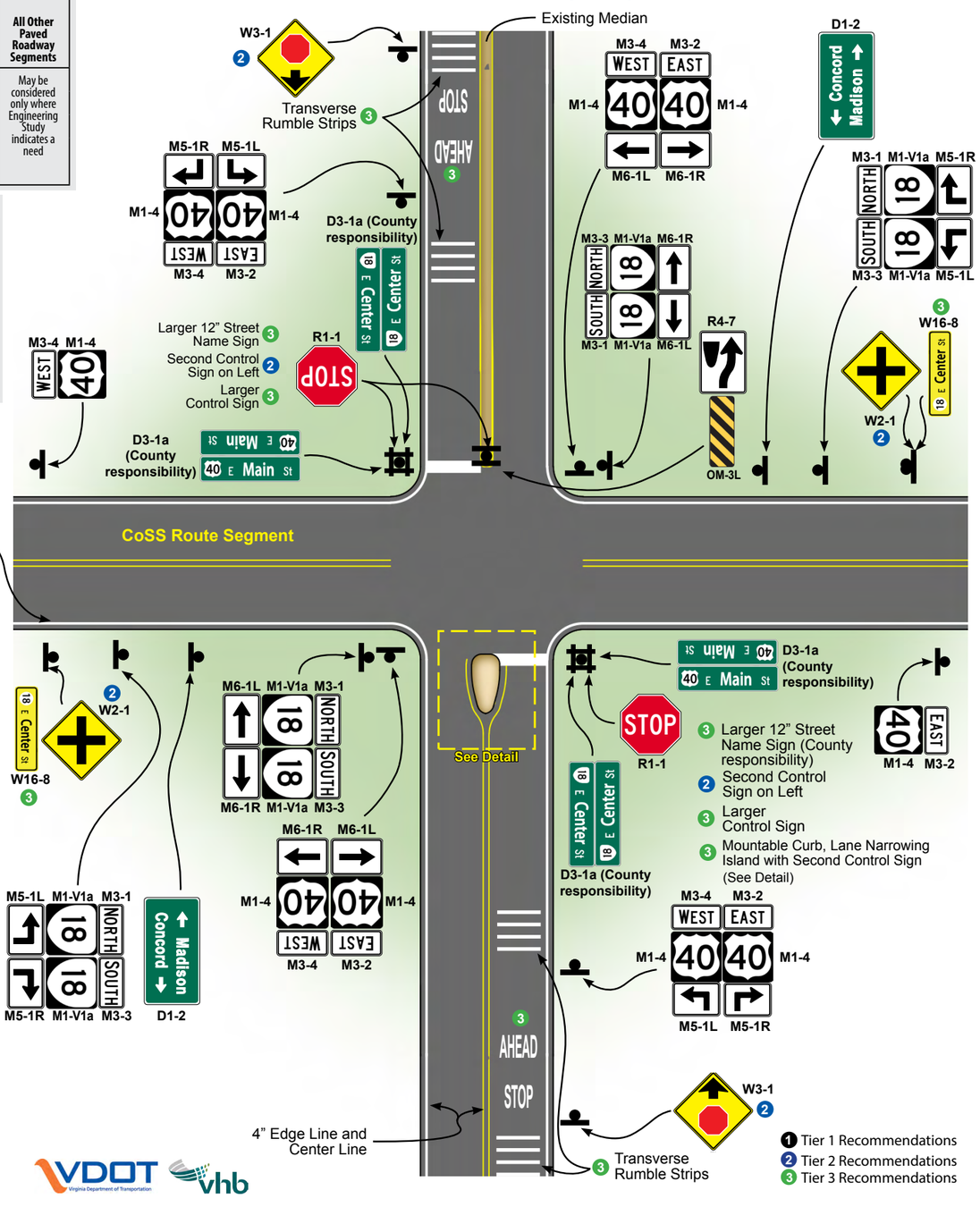
Criteria for Placement of Center Line Markings (Source: Virginia Supplement Chapter 3B))

Pave-ment Width	Traffic Volume	Roadway Type: Undivided Limited Access	Bi-directional multi-lane	Other Non-Local Residential	Other Local Residential	Local Residential
≥ 18 feet	≥ 500 vpd	Required	Required	Required	Recommended	Recommended
	< 500 vpd	Required	Required	Optional (if warranted)	Optional	Recommended
< 18 feet	≥ 500 vpd	Required	Required	May be considered only where Engineering Study indicates a need		Recommended
	< 500 vpd	Required	Required			Recommended



Template 1 - Unsignalized Intersection - 4-leg (2-way stop controlled), Undivided (3 Tiers)

Eastern Shore Safety Study



NOTES:

Signage

1. Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
1. Fluorescent yellow sheeting on change of Direction Warning signs
1. Street Name sign (D3-1a or D3-1 for local roads) (County responsibility)
3. Larger 12" Street Name sign (D3-1a) (County responsibility)
1. Control sign (R1 Series)
2. Second Control sign (R1 Series) on left if median is present and is greater than 6' in width, with a "Keep Right" sign (R4-7) and an Object Marker (OM3-L) facing opposite direction
3. Larger Control sign (R1 Series)
3. Mountable curb, lane narrowing island with second control sign (see detail)
1. OM3-L object marker and R4-7 "Keep Right" sign at end of mountable curb island
1. Intersecting Route and Directional sign (M1, M3, & M6 Series). Include signs for through movements on primary routes only where through movement is a different route number
1. Advance Intersecting Route and Directional sign (M1, M3, & M5 Series) on primary routes and secondary routes with AADT ≥ 2000 vpd
1. Confirmation Route signs (M1 and M3 series) on primary routes
1. Destination/guide sign (D1 series) on primary routes
2. Advance Intersection Lane Control signs (R3-8 Series) on approaches with turn lanes, or "Begin Right Turn Lane" sign (R3-20R) where only a right-turn lane is present
2. Intersection Warning sign (W2 series) on approaches that are not stop-controlled
3. Street Name (W16-8 series) signs on CoSS approaches
2. Stop Ahead sign (W3-1) on stop-controlled approaches

Pavement Markings

1. Stop bar/yield line (MUTCD Section 3B.16)
1. 6" grooved/in-laid edge line on primary routes
1. 4" edge line on secondary routes (see table for application guidance)
1. 4" center line pavement markings on secondary routes (see table for application guidance)
1. Solid lane and center line approaching intersection
1. Mini-skip marks delineating turn lanes through the intersection when dual turn lanes are present
1. Mini-skip marks at turn lane when taper length is greater than 100'
2. Lane use pavement markings (MUTCD Section 3B.20)
3. "Stop Ahead" or "Yield Ahead" pavement markings (MUTCD Section 3B.20)
3. Use rumble stripe for 6" markings

Other

1. If pedestrian accommodations are present, ensure minimum requirements for crossing (6" solid lines offset minimum 6' and placed 4' in advance of the stop bar) and crosswalk warning sign
3. Reflectorized sign posts (MUTCD Section 2A.15)
3. Add transverse rumble strips on stop-controlled approach to CoSS
1. Trim vegetation to provide adequate sight distance
2. Mark obstructions within clear zone (OM1, 2, or 3 series)
3. Remove or provide a barrier for obstructions within clear zone

NOTE: Signage and pavement marking placement is not to scale. Depending upon site conditions, signs should share the same post to the extent possible in order to reduce sign clutter. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

Criteria for Placement of Edge Line Markings (Source: Virginia Supplement Chapter 3B)

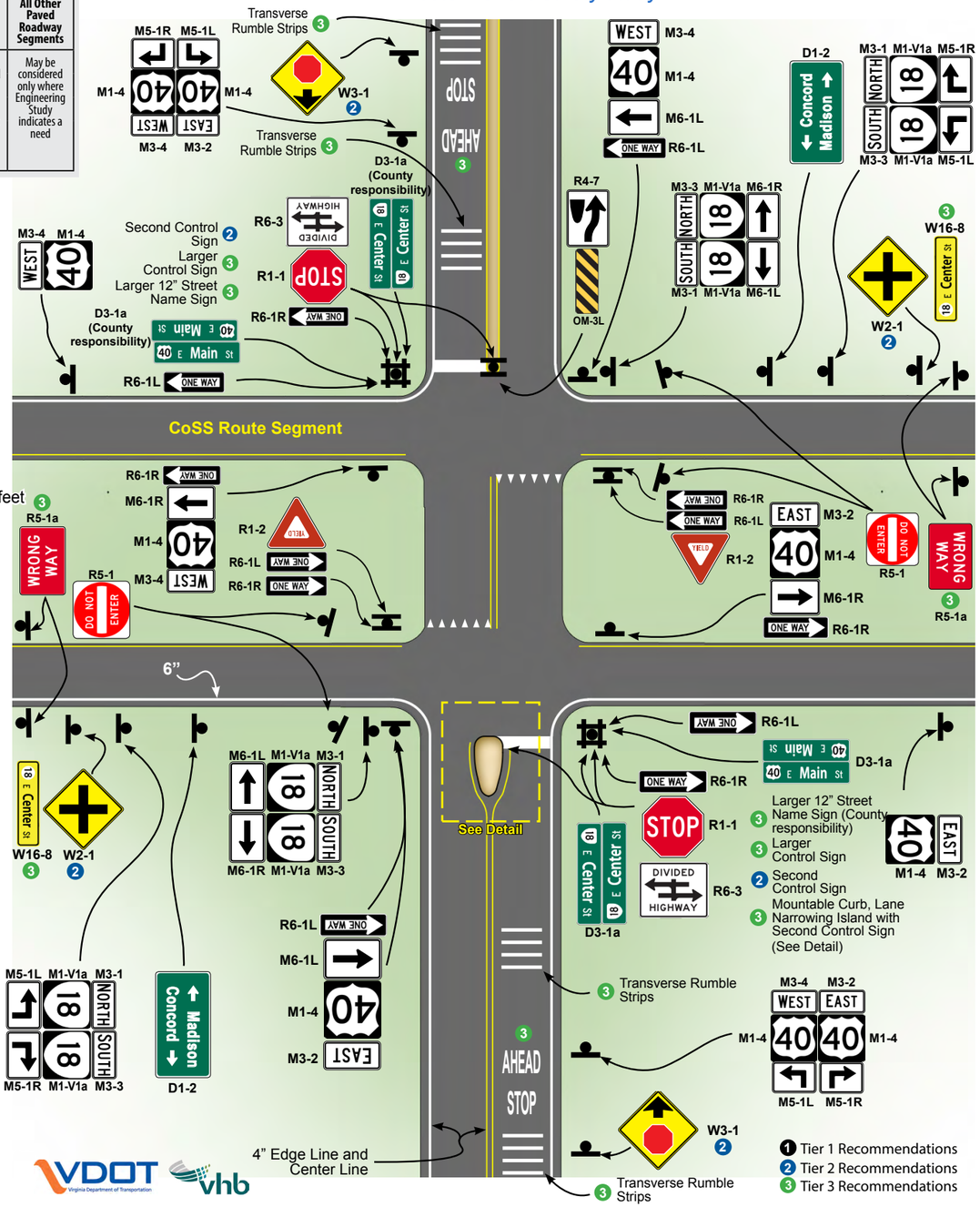
Pavement Width	Traffic Volume	Roadway Type: Undivided Limited Access	Bi-directional multi-lane	Two-lane Paved Roads with Center Line & without Curb and Gutter	Other Rural Arterials and Collectors	Local Residential	All Other Paved Roadway Segments
≥ 20 feet	≥ 3,000 vpd	Required	Required	Required	Recommended	Not Recommended unless primarily serving through traffic	May be considered only where Engineering Study indicates a need
	< 3,000 vpd	Required	Required	Required	May be considered only where Engineering Study indicates a need		
< 20 feet	≥ 3,000 vpd	Required	Required	May be considered only where Engineering Study indicates a need			
	< 3,000 vpd	Required	Required				

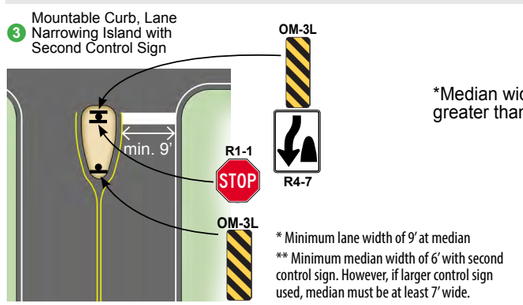
Criteria for Placement of Center Line Markings (Source: Virginia Supplement Chapter 3B))

Pavement Width	Traffic Volume	Roadway Type: Undivided Limited Access	Bi-directional multi-lane	Other Non-Local Residential	Other Local Residential	Local Residential
≥ 18 feet	≥ 500 vpd	Required	Required	Required	Recommended	Recommended
	< 500 vpd	Required	Required	Optional (if warranted)	Optional	Recommended
< 18 feet	≥ 500 vpd	Required	Required	May be considered only where Engineering Study indicates a need		Recommended
	< 500 vpd	Required	Required			Recommended

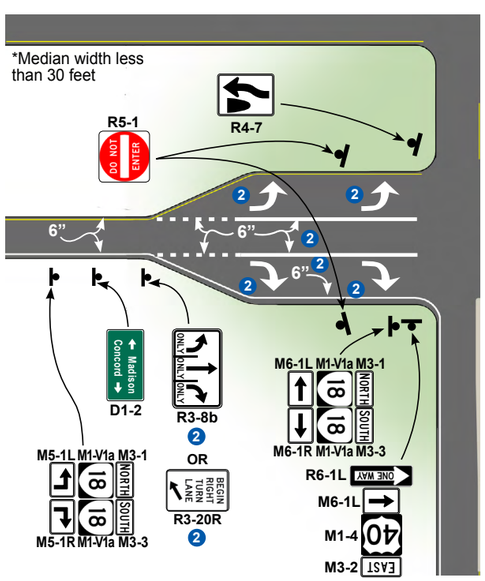
Template 2 - Unsignalized Intersection - 4-leg (2-way stop controlled), Median Separated (3 Tiers)

Eastern Shore Safety Study





*Median width greater than 30 feet



NOTES:

Signage

- 1 Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
- 1 Fluorescent yellow sheeting on change of Direction Warning signs
- 1 Control sign (R1Series)
- 2 Second Control sign (R1 Series) on left, if median is present and is greater than 6' in width, with a "Keep Right" sign (R4-7) and Object Marker (OM3-L) facing opposite direction
- 3 Larger Control sign (R1 Series)
- 3 Mountable curb, lane narrowing island with second control sign (see detail)
- 1 OM3-L Object Marker and R4-7 "Keep Right" sign at end of mountable curb island
- 1 Street Name sign (D3-1a or D3-1 for local roads) (County responsibility)
- 3 Larger 12" Street Name sign (D3-1a)
- 1 Intersecting Route and Directional sign (M1, M3, & M6 Series). Include signs for through movement on primary routes only where through movement is a different route number.
- 1 Advance Intersecting Route and Directional sign on primary routes and secondary routes with an AADT > 2000 vpd (M1, M3, & M5 Series)
- 1 Confirmation Route signs (M1 & M3 Series) on primary routes
- 1 Destination/guide sign (D1 Series) on primary routes
- 2 Advance Intersection Lane Control signs (R3-8 Series) on approaches with turn lanes, or "Begin Right Turn Lane" sign (R3-20R) where only a right-turn lane is present
- 2 Intersection Warning sign (W2 series) on approaches that are not controlled
- 3 Street Name (W16-8) signs on CoSS approaches
- 2 Stop Ahead sign (W3-1) on stop controlled approaches
- 1 "One Way" and "Do Not Enter" (R6 Series & R5-1) signs per VA Supplement
- 1 "Keep Right" sign and Median Object Marker (OM3 Series) on raised medians where it is not readily apparent that traffic is required to keep to the right (MUTCD Figure 2B-10)
- 1 Divided Highway (R6 Series)(see application details)
- 3 "Wrong Way" (R5-1a) signs on divided highway

Pavement Markings

- 1 Stop bar/yield line on all stop/yield controlled approaches, including median crossovers greater than 30' in width (MUTCD Section 3B.16)
- 1 6" grooved/in-laid edge line on primary routes
- 1 6" edge line on primary routes (see table for application guidance)
- 1 4" center line pavement markings on secondary routes (see table for application guidance)
- 1 Solid lane and center line approaching intersection
- 1 Mini-skip marks delineating turn lanes through the intersection when dual turn lanes are present
- 1 Mini-skip marks at turn lane taper when taper length is greater than 100'
- 2 Lane use pavement markings (MUTCD Section 3B.20)
- 3 "Stop Ahead" or "Yield Ahead" pavement markings (MUTCD Section 3B.20)
- 3 Use rumble stripe for 6" markings

Other

- 1 If pedestrian accommodations are present, ensure minimum requirements for crossing (6" solid lines offset minimum 6 ' and placed 4 ' in advance of the stop bar) and crosswalk warning sign
- 3 Reflectorized sign posts (MUTCD Section 2A.15)
- 1 Trim vegetation to provide adequate sight distance
- 2 Mark obstructions within clear zone (OM1, 2, or 3 series)
- 3 Remove or provide a barrier for obstructions within clear zone
- 3 Transverse rumble strips on stop controlled approach to CoSS

NOTE: Signage and pavement marking placement is not to scale. Depending upon site conditions, signs should share the same post to the extent possible in order to reduce sign clutter. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

Divided Highway Crossing Sign Application (R6-3, R6-3a)

When to use:

Unsignalized minor-street approaches from which both left turns and right turns are permitted onto a divided highway with a median width of > 30'

May be omitted if:

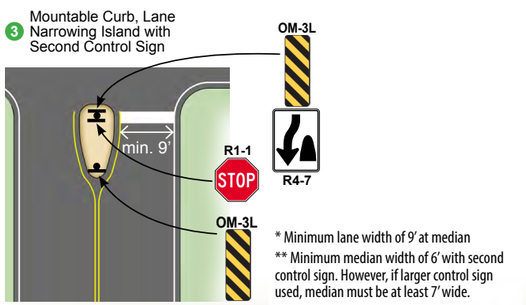
If divided highway traffic volume > 400 AADT & Speed limit > 25 MPH

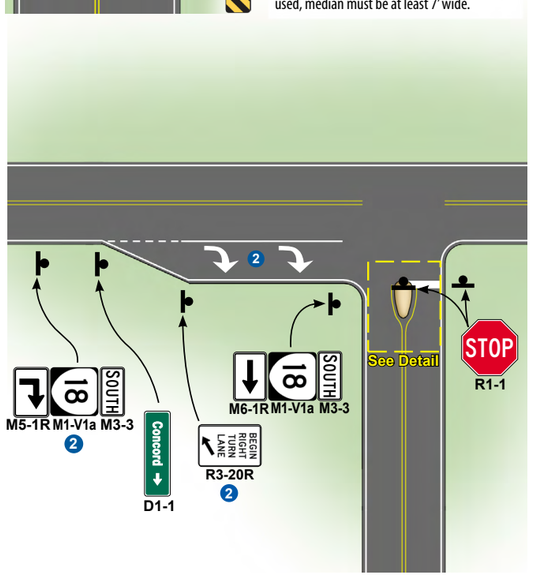
Criteria for Placement of Edge Line Markings (Source: Virginia Supplement Chapter 3B)

Pave-ment Width	Traffic Volume	Roadway Type: Undi-vided Limited Access	Bi-directional multi-lane	Two-lane Paved Roads with Center Line & without Curb and Gutter	Other Rural Arterials and Collectors	Local Residential	All Other Paved Roadway Segments
≥ 20 feet	≥ 3,000 vpd	Required	Required	Required	Recommended	Not Recommended unless primarily serving through traffic	May be considered only where Engineering Study indicates a need
	< 3,000 vpd	Required	Required	Required	May be considered only where Engineering Study indicates a need		
< 20 feet	≥ 3,000 vpd	Required	Required	May be consid-ered only where Engineering Study indicates a need			
	< 3,000 vpd	Required	Required				

Criteria for Placement of Center Line Markings (Source: Virginia Supplement Chapter

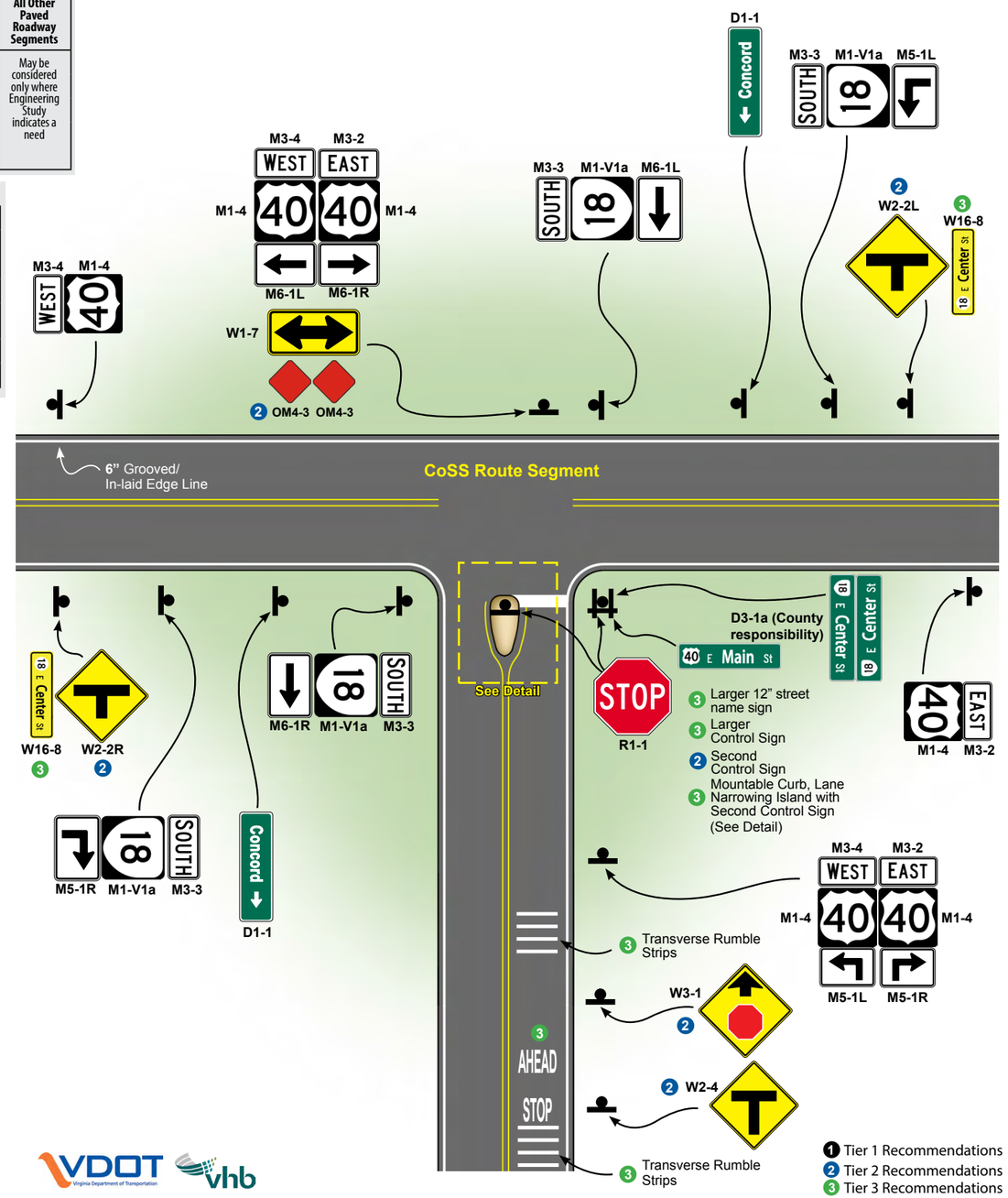
Pave-ment Width	Traffic Volume	Roadway Type: Undivided Limited Access	Bi-directional multi-lane	Other Non-Local Residential	Other Local Residential	Local Residential
≥ 18 feet	≥ 500 vpd	Required	Required	Required	Recommended	Recommended
	< 500 vpd	Required	Required	Optional (if warranted)	Optional	Recommended
< 18 feet	≥ 500 vpd	Required	Required	May be considered only where Engineering Study indicates a need		Recommended
	< 500 vpd	Required	Required			Recommended





Template 3 - Unsignalized Intersection - 3-leg (1-way stop controlled) Undivided (3 Tiers)

Eastern Shore Safety Study



NOTES:

Signage

1. Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
1. Fluorescent yellow sheeting on changes of Direction Warning signs
1. Control sign (R1 Series)
2. Second Control sign (R1 Series) on left, if median is present and is greater than 6' in width, with a "Keep Right" sign (R4-7) and Object Marker (OM3-L) facing opposite direction
3. Larger Control sign (R1 Series)
1. Street Name sign (D3-1a or D3-1 for local roads) (County responsibility)
3. Larger 12" Street Name sign (D3-1, 1a) (County responsibility)
3. Mountable curb, lane narrowing island with second control sign (see detail)
1. OM3-L Object Marker and R4-7 "Keep Right" sign at end of mountable curb island
1. Intersecting Route and Directional sign (M1, M3, & M6 Series). Include signs for through movements on primary routes only where through movement is a different route number.
1. Advance Intersecting Route and Directional sign on primary routes (M1, M3, & M5 Series)
1. Confirmation Route signs (M1 and M3 Series) on primary routes
1. Destination/guide sign (D1 Series) on CoSS
2. "Begin Right Turn Lane" sign (R3-20R)
2. Intersection Warning sign (W2 series)
3. Street Name (W16-8)) signs on CoSS approaches
2. Stop Ahead sign (W3-1) on stop controlled approach
1. Two-Direction Large Arrow sign at T-intersection (W1-7)
2. Add two OM4-3 Object Markers below the Two Direction Large Arrow (W1-7) sign

Pavement Markings

1. Stop bar/yield line (MUTCD Section 3B.16)
1. 6" grooved/in-laid edge line on primary routes
2. 4" edge line on secondary routes (see table for application guidance)
1. 4" center line pavement markings on secondary routes (see table for application guidance)
1. Solid lane and center line approaching intersection
1. Mini-skip marks delineating turn lanes through the intersection when dual turn lanes are present
1. Mini-skip marks at turn lane taper when taper length is greater than 100'
2. Lane use pavement markings (MUTCD Section 3B.20)
3. "Stop Ahead" or "Yield Ahead" pavement markings (MUTCD Section 3B.20)
3. Use rumble stripe for 6" markings

Other

1. If pedestrian accommodations are present, ensure minimum requirements for crossing (6" solid lines offset minimum 6' and placed 4' in advance of the stop bar) and crosswalk warning sign
3. Reflectorized sign posts (MUTCD Section 2A.15)
1. Trim vegetation to provide adequate sight distance
2. Mark obstructions within clear zone (OM1, 2, or 3 series)
3. Remove or provide a barrier for obstructions within clear zone
3. Add transverse rumble strips on stop controlled approach to CoSS

NOTE: Signage and pavement marking placement is not to scale. Depending upon site conditions, signs should share the same post to the extent possible in order to reduce sign clutter. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

Criteria for Placement of Edge Line Markings (Source: Virginia Supplement Chapter 3B)

Pave-ment Width	Traffic Volume	Roadway Type: Undi-vided Limited Access	Bi-directional multi-lane	Two-lane Paved Roads with Center Line & without Curb and Gutter	Other Rural Arterials and Collectors	Local Residential	All Other Paved Roadway Segments
≥ 20 feet	≥ 3,000 vpd	Required	Required	Required	Recommended	Not Recommended unless primarily serving through traffic	May be considered only where Engineering Study indicates a need
	< 3,000 vpd	Required	Required	Required	May be considered only where Engineering Study indicates a need		
< 20 feet	≥ 3,000 vpd	Required	Required	May be considered only where Engineering Study indicates a need			
	< 3,000 vpd	Required	Required				

Criteria for Placement of Center Line Markings (Source: Virginia Supplement Chapter 3B))

Pave-ment Width	Traffic Volume	Roadway Type: Undivided Limited Access	Bi-directional multi-lane	Other Non-Local Residential	Other Local Residential	Local Residential
≥ 18 feet	≥ 500 vpd	Required	Required	Required	Recommended	Recommended
	< 500 vpd	Required	Required	Optional (if warranted)	Optional	Recommended
< 18 feet	≥ 500 vpd	Required	Required	May be considered only where Engineering Study indicates a need		Recommended
	< 500 vpd	Required	Required			Recommended

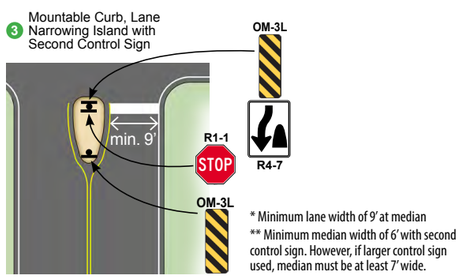
Divided Highway Crossing Sign Application (R6-3, R6-3a)

When to use:

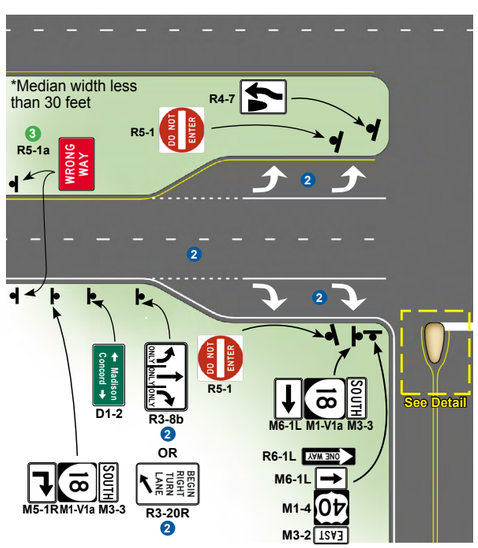
- Unsignalized minor-street approaches from which both left turns and right turns are permitted onto a divided highway with a median width of > 30'

May be omitted if:

- If divided highway traffic volume > 400 AADT & Speed limit > 25 MPH

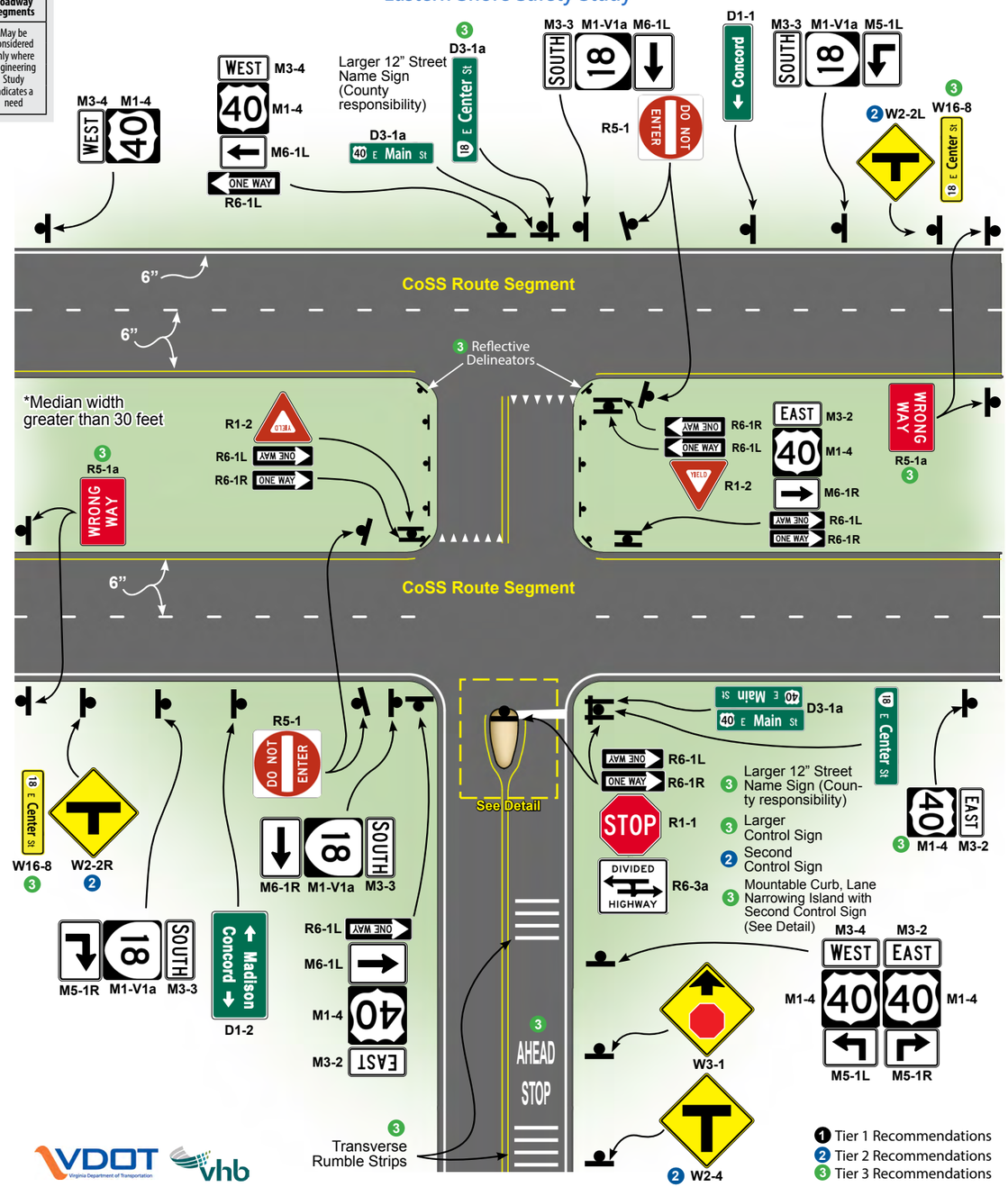


* Minimum lane width of 9' at median
** Minimum median width of 6' with second control sign. However, if larger control sign used, median must be at least 7' wide.



Template 4 - Unsignalized Intersection - 3-leg (1-way stop controlled), Median Separated (with crossover) (3 Tiers)

Eastern Shore Safety Study



NOTES:

Signage

1. Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
1. Fluorescent yellow sheeting on change of Direction Warning signs
1. Control sign (R1 Series)
2. Second Control sign (R1 Series) on left, if median is present and is greater than 6' in width, with a "Keep Right" sign (R4-7) and Object Marker (OM3-L) facing opposite direction
3. Larger Control sign
3. Mountable curb, lane narrowing island with second control sign (see detail)
1. OM3-L object marker and R4-7 "Keep Right" sign at end of mountable curb island
1. Yield sign on median crossover (R1-2)
1. Street Name sign (D3-1a or D3-1 for local roads) (County responsibility)
3. Larger 12" Street Name sign (D3-1a) (County responsibility)
1. Intersecting Route and Directional sign (M1, M3, & M6 Series). Include signs for through movements on primary routes only where through movement is a different route number.
1. Advance Intersecting Route and Directional sign (M1, M3, & M5 Series) on primary routes and secondary routes with an AADT > 2000 vpd
1. Confirmation route signs (M1 & M3 Series)
1. Destination/guide sign (D1 Series) on primary routes
2. Advance Intersection Lane Control signs (R3-8 Series) on approaches with turn lanes, or "Begin Right Turn Lane" sign (R3-20R) where only a right-turn lane is present
2. Intersection Warning sign (W2 series)
3. Street Name (W16-8) signs on CoSS approaches
1. Stop Ahead sign (W3-1) on stop controlled approach
1. "Keep Right" sign and Median Object Marker (OM3 Series) on raised medians where it is not readily apparent that traffic is required to keep to the right (MUTCD Figure 2B-10)
1. "One Way" and "Do Not Enter" (R6 Series & R5-1) signs per VA Supplement
1. Divided Highway (R6 Series)(see application details)
3. "Wrong Way" (R5-1a) signs on divided highway

Pavement Markings

1. Stop bar/yield line on all stop/yield controlled approaches, including median crossovers greater than 30' in width (MUTCD Section 3B.16)
1. 6" grooved/in-laid edge line on CoSS (see corridor template)
1. Standard double yellow center line in median crossover (MUTCD Chapter 3B) if median is greater than 30' wide
1. 6" edge line on all primary routes (see table for application guidance)
1. 4" pavement markings on secondary routes (see table for application guidance)
1. Solid lane and center line approaching intersection
1. Mini-skip marks delineating turn lanes through the intersection when dual turn lanes are present
1. Mini-skip marks at turn lane taper when taper length is greater than 100'
3. "Stop Ahead" or "Yield Ahead" pavement markings (MUTCD Section 3B.20)
2. Lane use pavement markings (MUTCD Section 3B.20)
3. Use rumble stripe for 6" markings

Other

1. If pedestrian accommodations are present, ensure minimum requirements for crossing (6" solid lines offset minimum 6' and placed 4' in advance of the stop bar) and crosswalk warning sign.
3. Reflectorized sign posts (MUTCD Section 2A.15)
3. Transverse rumble strips on stop controlled approach to CoSS
1. Trim vegetation to provide adequate sight distance
2. Mark obstructions within clear zone (OM1, 2, or 3 Series)
3. Remove or provide a barrier for obstructions within clear zone

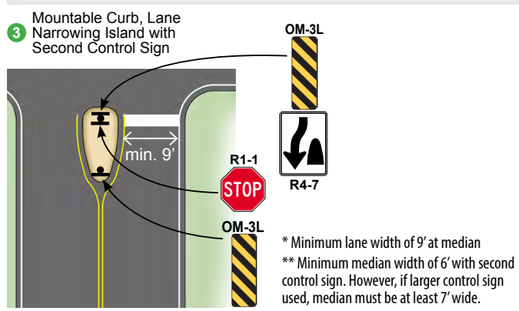
NOTE: Signage and pavement marking placement is not to scale. Depending upon site conditions, signs should share the same post to the extent possible in order to reduce sign clutter. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

Criteria for Placement of Edge Line Markings (Source: Virginia Supplement Chapter 3B)

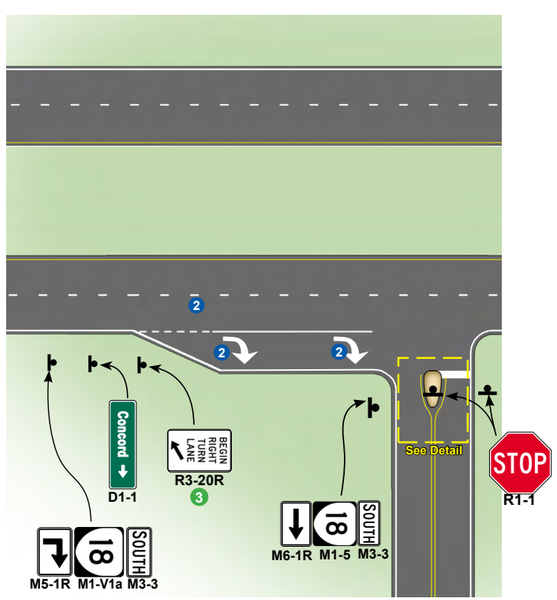
Pave-ment Width	Traffic Volume	Roadway Type: Undi-vided Limited Access	Bi-directional multi-lane	Two-lane Paved Roads with Center Line & without Curb and Gutter	Other Rural Arterials and Collectors	Local Residential	All Other Paved Roadway Segments
≥ 20 feet	≥ 3,000 vpd	Required	Required	Required	Recommended	Not Recommended unless primarily serving through traffic	May be considered only where Engineering Study indicates a need
	< 3,000 vpd	Required	Required	Required	May be considered only where Engineering Study indicates a need		
< 20 feet	≥ 3,000 vpd	Required	Required	May be consid-ered only where Engineering Study indicates a need			
	< 3,000 vpd	Required	Required				

Criteria for Placement of Center Line Markings (Source: Virginia Supplement Chapter 3B))

Pave-ment Width	Traffic Volume	Roadway Type: Undivided Limited Access	Bi-directional multi-lane	Other Non-Local Residential	Other Local Residential	Local Residential
≥ 18 feet	≥ 500 vpd	Required	Required	Required	Recommended	Recommended
	< 500 vpd	Required	Required	Optional (if warranted)	Optional	Recommended
< 18 feet	≥ 500 vpd	Required	Required	May be considered only where Engineering Study indicates a need		Recommended
	< 500 vpd	Required	Required			Recommended

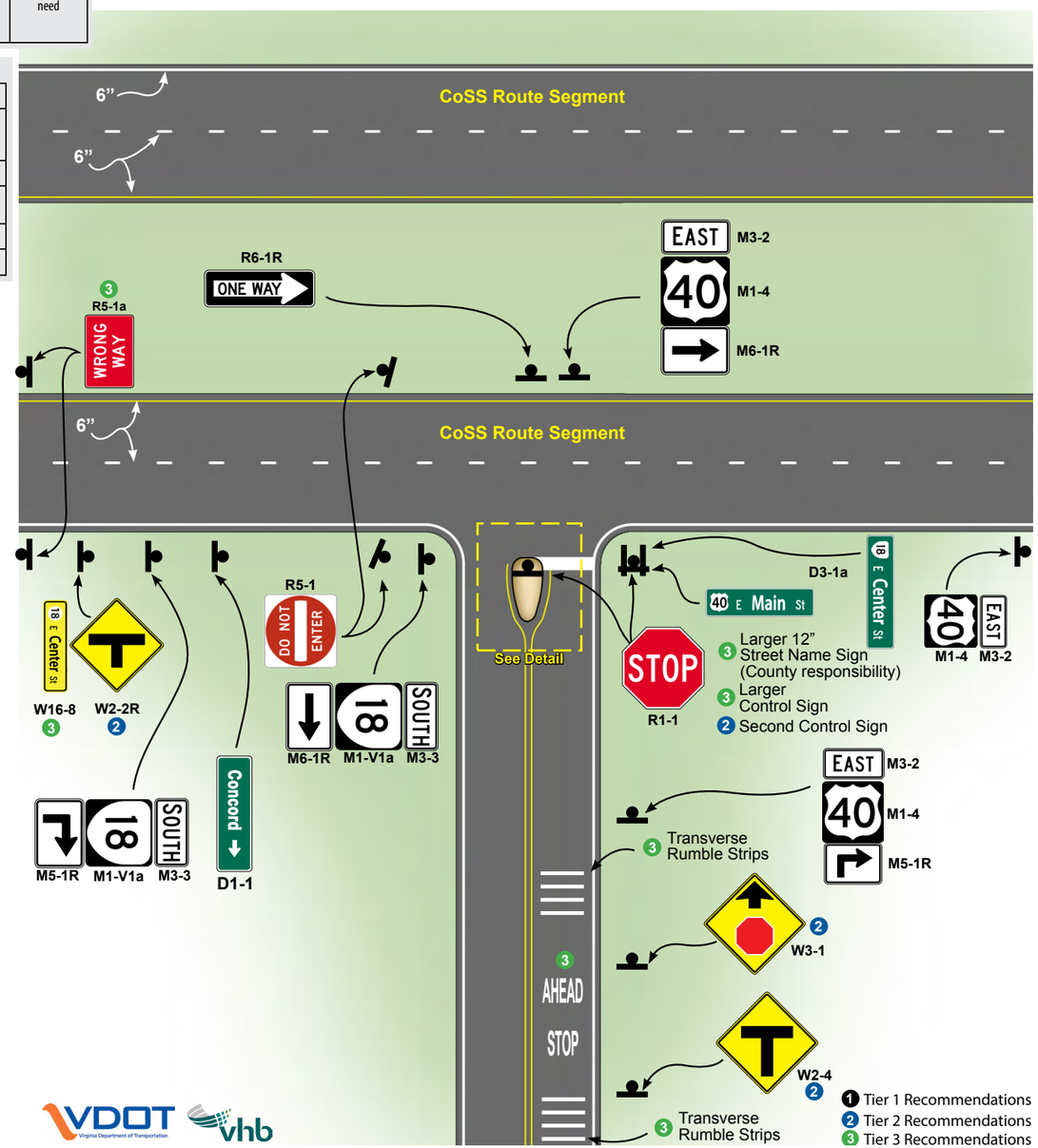


* Minimum lane width of 9' at median
** Minimum median width of 6' with second control sign. However, if larger control sign used, median must be at least 7' wide.



Template 5 - Unsignalized Intersection - 3-leg (1-way stop controlled), Median Separated (no crossover) (3 Tiers)

Eastern Shore Safety Study



1 Tier 1 Recommendations
2 Tier 2 Recommendations
3 Tier 3 Recommendations

NOTES:

Signage

1. Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
1. Fluorescent yellow sheeting on change of Direction Warning signs
1. Street Name sign (D3-1a) (County responsibility)
3. Larger 12" Street Name Sign (D3-1a) (County responsibility)
1. Control signs (R1 Series)
2. Second Control sign (R1 Series) on left, if median is present and is greater than 6' in width, with a "Keep Right" sign (R4-7) and Object Marker (OM3-L) facing opposite direction
3. Larger control sign (R1 Series)
3. Mountable curb, lane narrowing island with second control sign (see detail)
1. OM3-L Object Marker and R4-7 "Keep Right" sign at end of mountable curb island
1. Intersecting Route and Directional sign (M1, M3, & M6 Series). Include signs for through movements on primary routes only where through movement is a different route number.
1. Advance Intersecting Route and Directional sign on primary routes and on secondary routes with an AADT ≥ 2000 VOD (M1, M3, & M5 Series)
1. Confirmation Route signs (M1 & M3 Series) on primary routes
1. "One Way" and "Do Not Enter" signs per MUTCD VA Supplement (R6-1 Series and R5-1)
1. Destination/guide sign (D1 Series) on primary routes
3. "Begin Right Turn Lane" sign (R3-20R)
2. Intersection Warning sign (W2 series) on intersecting approaches
3. Street Name signs (W16-8) on CoSS approaches
2. Stop Ahead sign (W3-1) on stop-controlled approach
3. "Wrong Way" (R5-1a) signs on divided highway

Pavement Markings

1. Stop bar/yield line (MUTCD Section 3B.16)
1. 6" grooved/in-laid edge line on primary routes
1. 6" pavement marking on primary routes (see table for application guidance)
1. 4" pavement markings on secondary routes (see table for application guidance)
1. Solid lane and center line approaching intersection
1. Mini-skip marks delineating turn lanes through the intersection when dual turn lanes are present
1. Mini-skip marks at turn lane taper when taper length is greater than 100'
2. Lane use pavement markings (MUTCD Section 3B.20)
3. "Stop Ahead" or "Yield Ahead" pavement markings (MUTCD Section 3B.20)
3. Use rumble stripe for 6" markings

Other

1. If pedestrian accommodations are present, ensure minimum requirements for crossing (6" solid lines offset minimum 6' and placed 4' in advance of the stop bar) and crosswalk warning sign.
3. Reflectorized sign posts (MUTCD Section 2A.15)
3. Transverse rumble strips on stop controlled approach to CoSS
1. Trim vegetation to provide adequate sight distance
2. Mark obstructions with clear zone (OM1, 2, or 3 Series)
3. Remove or provide a barrier for obstructions within clear zone

NOTE: Signage and pavement marking placement is not to scale. Depending upon site conditions, signs should share the same post to the extent possible in order to reduce sign clutter. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

Criteria for Placement of Edge Line Markings (Source: Virginia Supplement Chapter

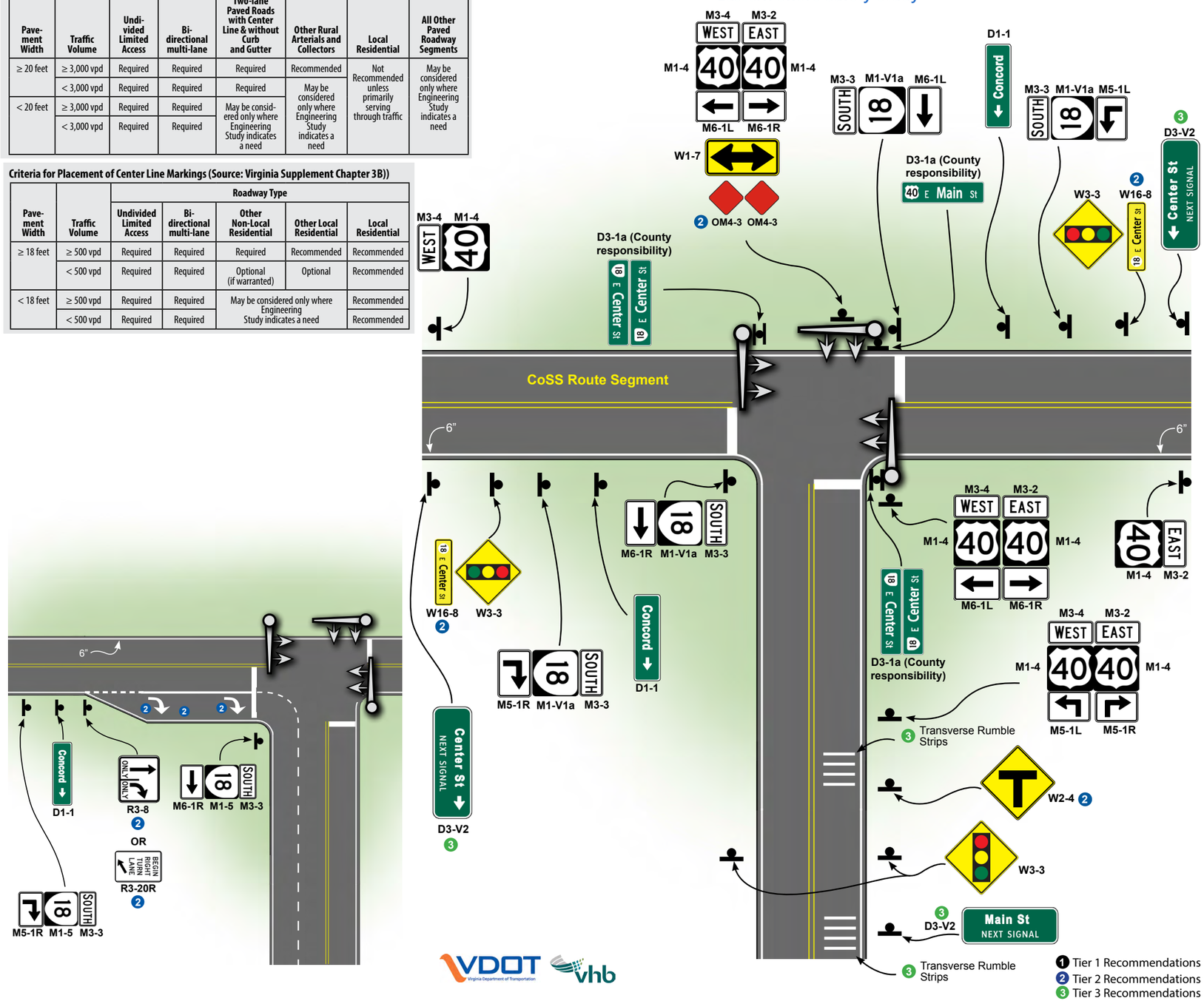
Pave-ment Width	Traffic Volume	Roadway Type: Undi-vided Limited Access	Bi-directional multi-lane	Two-lane Paved Roads with Center Line & without Curb and Gutter	Other Rural Arterials and Collectors	Local Residential	All Other Paved Roadway Segments
≥ 20 feet	≥ 3,000 vpd	Required	Required	Required	Recommended	Not Recommended unless primarily serving through traffic	May be considered only where Engineering Study indicates a need
	< 3,000 vpd	Required	Required	Required	May be considered only where Engineering Study indicates a need		
< 20 feet	≥ 3,000 vpd	Required	Required	May be consid-ered only where Engineering Study indicates a need			
	< 3,000 vpd	Required	Required				

Criteria for Placement of Center Line Markings (Source: Virginia Supplement Chapter 3B))

Pave-ment Width	Traffic Volume	Roadway Type: Undivided Limited Access	Bi-directional multi-lane	Other Non-Local Residential	Other Local Residential	Local Residential
≥ 18 feet	≥ 500 vpd	Required	Required	Required	Recommended	Recommended
	< 500 vpd	Required	Required	Optional (if warranted)	Optional	Recommended
< 18 feet	≥ 500 vpd	Required	Required	May be considered only where Engineering Study indicates a need		Recommended
	< 500 vpd	Required	Required			Recommended

Template 7 - Signalized Intersection - 3-leg (3 Tiers)

Eastern Shore Safety Study



NOTES:

Signage

1 Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)

1 Fluorescent yellow sheeting on change of Direction Warning signs

Post-Mounted

1 Street Name sign (D3-1a or D3-1 for local roads) (County responsibility)

1 Two-Direction Large Arrow Warning sign at T-intersection (W1-7)

1 Intersecting Route and Directional sign (M1, M3, & M6 Series). Include signs for through movements on primary routes only where through movement is a different route number.

1 Advance Intersecting Route and Directional sign (M1, M3, & M5 Series) on primary routes

1 Confirmation Route signs (M1& M3 Series) on primary routes

1 Destination/guide sign (D1 Series) on CoSS

2 Advance Intersection Lane Control signs (R3-8 Series) on approaches with turn lanes, or "Begin Right Turn Lane" sign (R3-20R) where only a right-turn lane is present

3 Advances Street Name signs (D3-2 & D3-V2)

2 Add two OM4-3 Object Markers below the Two Direction Large Arrow (W1-7) sign

1 Signal Ahead warning sign (W3-3) on CoSS

1 Signal Ahead warning sign (W3-3) on non-CoSS roads

2 Street Name (W16-8) signs on CoSS approaches

2 Intersection Warning sign (W2-4) on approach that does not continue through intersection

Overhead

3 Overhead Lane Use signs and Left Turn Regulatory signs

1 Mast arm mounted 12" Street Name sign (D3-1a or D3-V1 for local roads)

Pavement Markings

1 Stop bar/yield line (MUTCD Section 3B.16)

1 6" grooved/in-laid edge line on primary routes

1 4" edge line on secondary routes (see table for application guidance)

1 4" center line pavement markings on secondary routes (see table for application guidance)

1 Mini-skip marks delineating turn lanes through the intersection when dual turn lanes are present

1 Mini-skip marks at turn lane taper when taper length is greater than 100'

2 Lane use pavement markings (MUTCD Section 3B.20)

3 Use rumble stripe for 6" markings

Signal

1 Check signal sight distance

1 12" LED signal lenses

1 Red and yellow arrow lenses for protected movements

1 Signal backplates with retroreflective border

1 Check for proper red clearance and yellow change intervals (VDOT TE 306.1)

1 One signal head per approach (where structural loading permits)

2 Provide near side signal heads if minimum signal sight distance is not provided

3 Provide actuated signals

Other

1 If pedestrian accommodations are present, ensure minimum requirements for crossing (6" solid lines offset minimum 6' and placed 4' in advance of the stop bar), Pedestrian Warning sign, and Right Turn Yield to Pedestrian signs.

1 If pedestrian phase is present, provide pedestrian countdown signals with pushbutton activation and appropriate pedestrian crossing clearance interval.

1 Restrict parking near intersection

3 Reflectorized sign posts (MUTCD Section 2A.15)

3 Transverse rumble strips on approach to CoSS

1 Trim vegetation to provide adequate sight distance

2 Mark obstructions within clear zone (OM1, 2, or 3 Series)

3 Remove or provide a barrier for obstructions.

NOTE: Signage and pavement marking placement is not to scale. Depending upon site conditions, signs should share the same post to the extent possible in order to reduce sign clutter. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

Criteria for Placement of Edge Line Markings (Source: Virginia Supplement Chapter 3B)

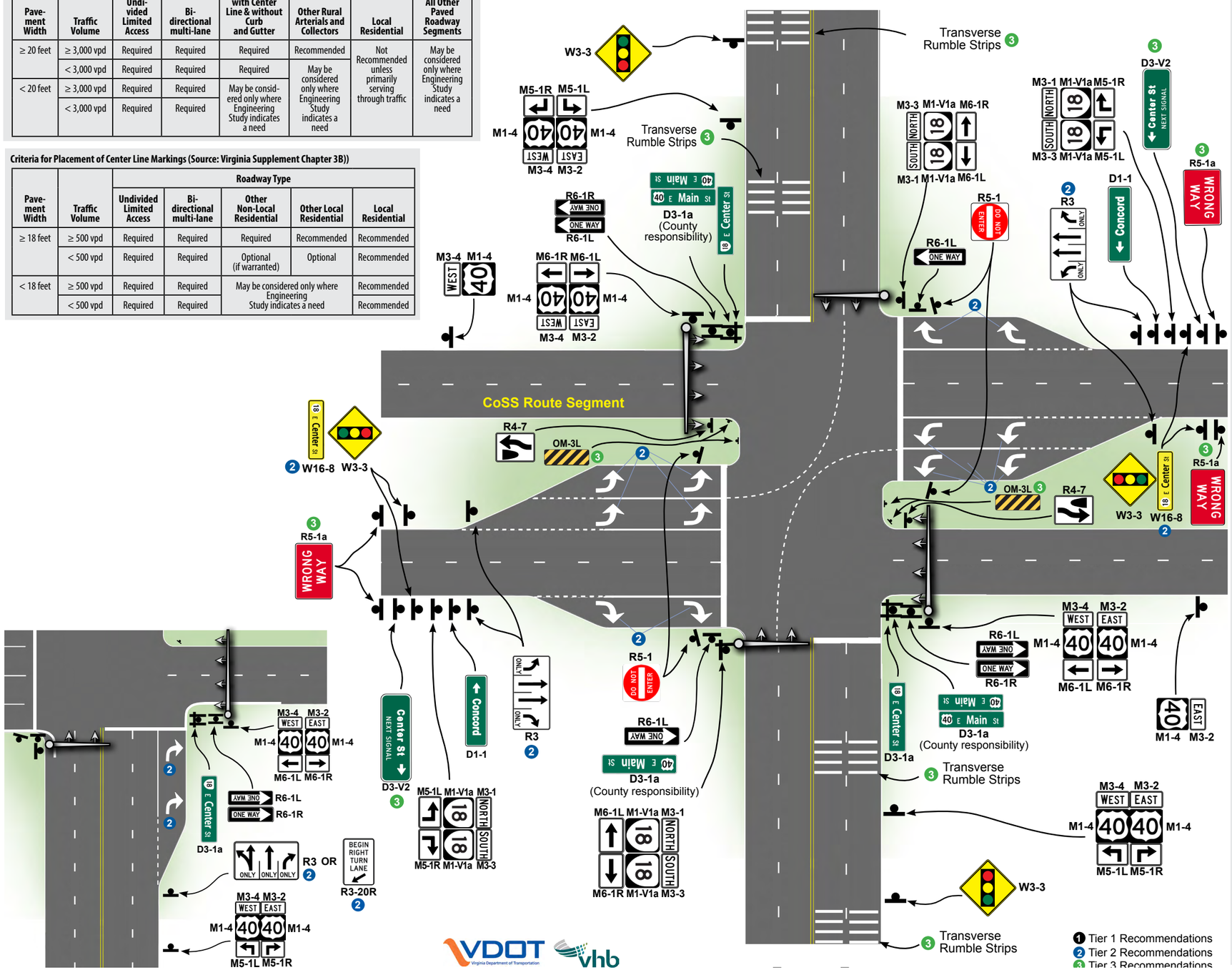
Pave-ment Width	Traffic Volume	Roadway Type: Undi-vided Limited Access	Bi-directional multi-lane	Two-lane Paved Roads with Center Line & without Curb and Gutter	Other Rural Arterials and Collectors	Local Residential	All Other Paved Roadway Segments
≥ 20 feet	≥ 3,000 vpd	Required	Required	Required	Recommended	Not Recommended unless primarily serving through traffic	May be considered only where Engineering Study indicates a need
	< 3,000 vpd	Required	Required	Required	May be considered only where Engineering Study indicates a need		
< 20 feet	≥ 3,000 vpd	Required	Required	May be consid-ered only where Engineering Study indicates a need			
	< 3,000 vpd	Required	Required				

Criteria for Placement of Center Line Markings (Source: Virginia Supplement Chapter 3B))

Pave-ment Width	Traffic Volume	Roadway Type: Undivided Limited Access	Bi-directional multi-lane	Other Non-Local Residential	Other Local Residential	Local Residential
≥ 18 feet	≥ 500 vpd	Required	Required	Required	Recommended	Recommended
	< 500 vpd	Required	Required	Optional (if warranted)	Optional	Recommended
< 18 feet	≥ 500 vpd	Required	Required	May be considered only where Engineering Study indicates a need		Recommended
	< 500 vpd	Required	Required			Recommended

Template 8 - Signalized Intersection - 4-leg (3 Tiers)

Eastern Shore Safety Study



NOTES:

Signage

1 Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)

1 Fluorescent yellow sheeting on change of Direction Warning signs

Post-Mounted

1 Street Name sign (D3-1a or D3-1 for local roads) - County responsibility

1 Intersecting Route and Directional sign (M1, M3, & M6 Series) on primary routes

1 "Keep Right" sign for median separated roads (R4-7 or R4-8 Series) on raised medians where it is not readily apparent that traffic is required to keep to the right (MUTCD Figure 2B-10)

3 Add Object Marker on same post as R4-7 or on separate post closer to road (OM3-L)

1 Advance Intersecting Route and Directional sign (M1, M3, & M5 Series) on primary routes and secondary routes with AADT ≥ 2000 vpd

1 Confirmation Route signs (M1-M3 Series) on primary routes

1 Destination/guide sign (D1-1) on primary routes

2 Advance Intersection Lane Control signs (R3-8 Series) on approaches with turn lanes, or "Begin Right Turn Lane" sign (R3-20R) where only a right-turn lane is present

3 Advance Street Name signs on CoSS (D3-2 & D3-V2)

1 Signal Ahead Warning sign (left and right)(W3-3)

2 Street Name (W16-8 series) signs on CoSS approaches

1 "One Way" and "Do Not Enter" signs per VA Supplement

3 "Wrong Way" (R5-1a) signs on divided highway

Overhead

2 Overhead Lane Use signs and Left Turn Regulatory signs

1 Mast arm mounted 12" Street Name sign (D3-1a or D3-V1 for local roads) per TE-379 memorandum

Pavement Markings

1 Stop bar/yield line (MUTCD Section 3B.16)

1 6" grooved/in-laid edge line on primary routes

1 4" edge line on secondary routes (see table for application guidance)

1 4" center line pavement markings on secondary routes (see table for application guidance)

1 Solid lane and center line approaching intersection

1 Mini-Skip marks delineating turn lanes through the intersection when dual turn lanes are present

1 Mini-Skip marks at turn lane taper when taper length is greater than 100'

2 Lane use pavement markings (MUTCD Section 3B.20)

3 Use rumble stripe for 6" markings

Signal

1 Check signal sight distance

1 12" LED signal lenses

1 Red and yellow arrow lenses for protected movements

1 Signal backplates with retroreflective border

1 Check for proper red clearance and yellow change intervals (VDOT TE 306.1)

1 One signal head per approach (where structural loading permits)

2 Provide near side signal heads if minimum signal sight distance is not provided

3 Provide actuated signals

Other

1 If pedestrian accommodations are present, ensure minimum requirements for crossing (6" solid lines offset minimum 6' and placed 4' in advance of the stop bar), Pedestrian Warning sign, and Right Turn Yield to Pedestrian signs.

1 If pedestrian phase is present, provide pedestrian countdown signals with pushbutton activation and appropriate pedestrian crossing clearance interval.

1 Restrict parking near intersection

3 Reflectorized sign posts

3 Transverse rumble strips on approach to CoSS

1 Trim vegetation to provide adequate sight distance within clear zone

2 Mark obstructions within clear zone (OM1, 2, or 3 Series)

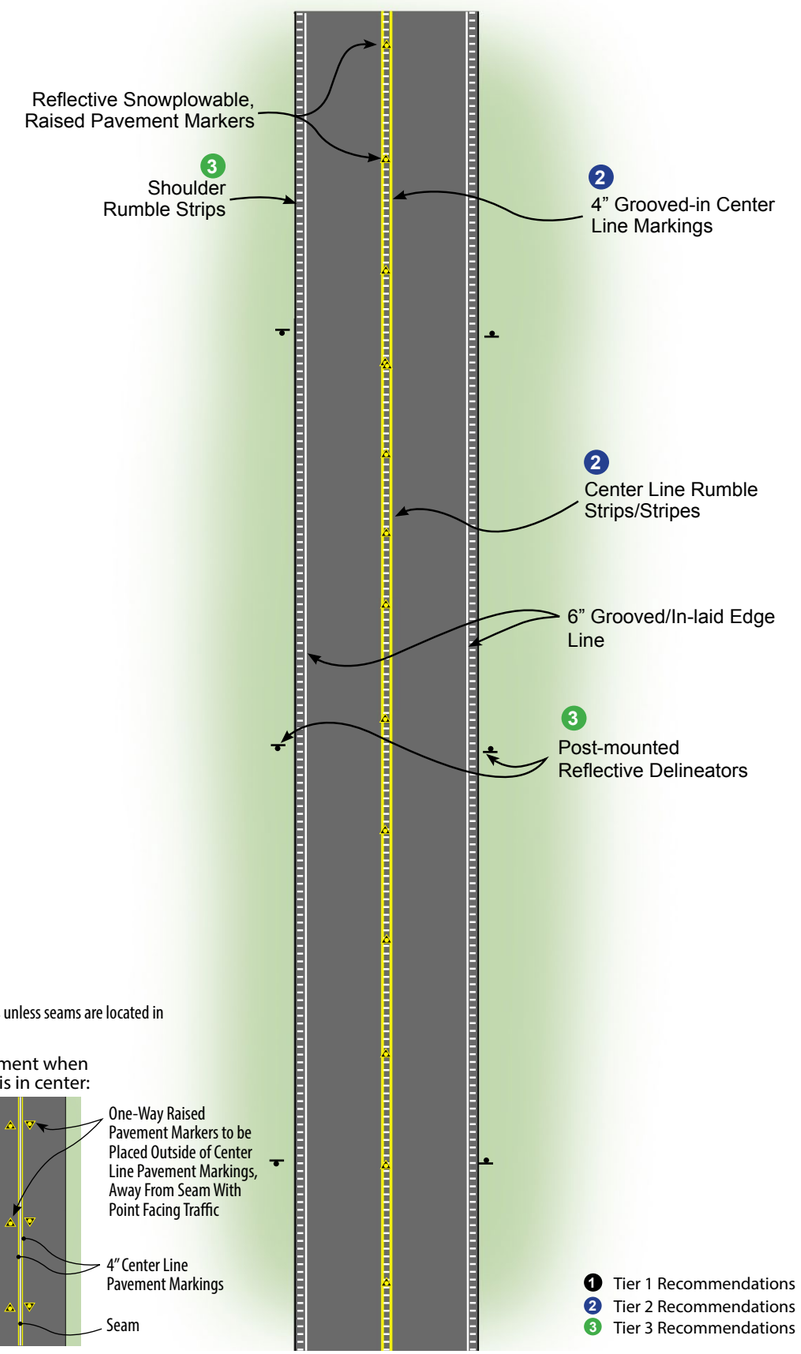
3 Remove, mark, or provide a barrier for obstructions within clear zone

NOTE: Signage and pavement marking placement is not to scale. Depending upon site conditions, signs should share the same post to the extent possible in order to reduce sign clutter. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

1 Tier 1 Recommendations
2 Tier 2 Recommendations
3 Tier 3 Recommendations

Template 9 - Corridor - Undivided Roadway (3 Tiers)

Eastern Shore Safety Study



Criteria for Placement of Edge Line Markings (Source: Virginia Supplement Chapter 3B)

Pave-ment Width	Traffic Volume	Roadway Type					
		Undi-vided Limited Access	Bi-directional multi-lane	Two-lane Paved Roads with Center Line & without Curb and Gutter	Other Rural Arterials and Collectors	Local Residential	All Other Paved Roadway Segments
≥ 20 feet	≥ 3,000 vpd	Required	Required	Required	Recommended	Not Recommended unless primarily serving through traffic	May be considered only where Engineering Study indicates a need
	< 3,000 vpd	Required	Required	Required	May be considered only where Engineering Study indicates a need		
< 20 feet	≥ 3,000 vpd	Required	Required	May be consid-ered only where Engineering Study indicates a need			
	< 3,000 vpd	Required	Required				

Criteria for Placement of Center Line Markings (Source: Virginia Supplement Chapter

Pave-ment Width	Traffic Volume	Roadway Type				
		Undivided Limited Access	Bi-directional multi-lane	Other Non-Local Residential	Other Local Residential	Local Residential
≥ 18 feet	≥ 500 vpd	Required	Required	Required	Recommended	Recommended
	< 500 vpd	Required	Required	Optional (if warranted)	Optional	Recommended
< 18 feet	≥ 500 vpd	Required	Required	May be considered only where Engineering Study indicates a need		Recommended
	< 500 vpd	Required	Required			Recommended

Raised Pavement Marker Application (Source: MUTCD VA Supplement Section 3B.11)

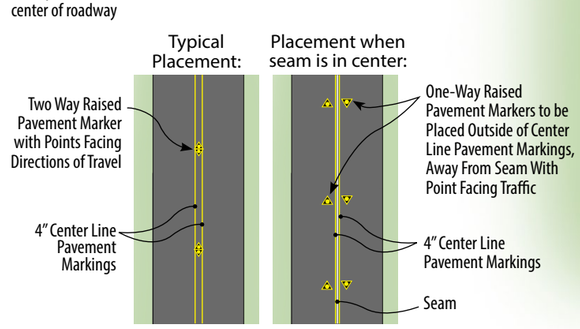
Tier	CoSS Facility Type	AADT	Posted Speed Limit	Lighting	Application
1	All Roadway Facilities	-	≥ 60 MPH	-	SRPMs shall be installed continuously.
1	Two-Lane, Two-Way Roadways	≥ 15,000	-	No roadway lighting	SRPMs shall be installed continuously.
1	Multilane Roadways	≥ 25,000	≥ 45 MPH	No roadway lighting	SRPMs shall be installed continuously.
2	Multilane Roadways	15,000 ≤ AADT < 25,000	45-55 mph	-	SRPMs shall be installed continuously.
3	Two-Lane, Two-Way Roadways (Only if the sections DO NOT have multiple horizontal curves with Posted Speed Limit < 55 MPH)	5,000 ≤ AADT < 15,000			SRPMs shall be installed continuously.
3	Two-Lane, Two-Way Roadways	≥ 15,000		Roadway lighting present	SRPMs shall be installed continuously.
3	Multilane Roadways	≥ 25,000	45-55 mph	Roadway lighting present	SRPMs shall be installed continuously.

Delineator Placement and Spacing (Source Section 3F.04 MUTCD VA Supplement)

Type	Placement	Spacing
D-1	On the right of through roadways	300 feet*
D-1	Interchange ramps	100 feet (except on horizontal curve sections)
D-2	On acceleration and deceleration lanes	100 feet
Delineators on barrier or guardrail		80 feet (may vary on interchange ramp horizontal curve sections although maximum spacing = 80 feet)

*Spacing may take into consideration other sources of reflection (such as signs)(modification to MUTCD guidance)

Raised Pavement Markers:
Place pavement markers between double solid lines unless seams are located in center of roadway



NOTES:

Signage

1. Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
1. Fluorescent yellow sheeting on change of Direction Warning signs

Pavement Markings

1. 6" center line pavement markings on primary routes
2. 6" grooved-in center line markings on primary routes
1. 6" grooved/in-laid edge line (MUTCD Section 3B.01 and 3B.o6) on primary routes
1. Reflective, snowplowable, raised pavement markers (Section 3B.11 MUTCD VA Supplement)(see table for application guidance and template tier)

Other

1. Trim vegetation provide adequate sight distance within clear zone
2. Mark obstructions within clear zone (OM1, 2, or 3 Series)
3. Remove or provide a barrier for obstructions within clear zone
3. Post-mounted reflective delineators (Chapter 3F MUTCD VA Supplement)(see table for application guidance)
1. Reflective delineation of barriers (Chapter 3F MUTCD VA Supplement)
2. If bike route is present install signs and pavement markings (shared lane markings) (Chapter 9 MUTCD VA Supplement)
3. Shoulder rumble strips/stripes (MUTCD Chapter 3J.01) on corridors with a high number of roadway departure crashes per IIM #212.5. (see notes for application details)
2. Center line rumble strips/stripes (Section 3J.01 MUTCD) on corridors with a high number of head-on crashes or crashes involving vehicles crossing the centerline (see notes for application details)
3. Reflectorized sign posts (MUTCD Section 2A.15)

NOTE: Signage and pavement marking placement is not to scale. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

Rumble Strips and Stripes:

If it is determined that rumble strips/stripes should be applied to a corridor, utilize the following application guidance:

- Shoulder rumble strips shall be placed continuously on outside paved shoulders of CoSS where the shoulder has a minimum width of four (4) feet where bicycles are prohibited and eight (8) feet where bicycles are permitted. Rumble strips shall not be placed within limits of bridge drainage aprons or special design shoulder slot inlets.
- Shoulder rumble stripes shall be placed with an intermittent pattern on outside paved shoulders of CoSS where shoulders are at least two (2) feet wide. Rumble stripes shall not be placed in the following locations: within 50' of any intersection, turn lane, acceleration/deceleration lane, or gore area; bridge drainage aprons; or, special design shoulder slot inlets.
- Center line rumble strips shall not be placed in the following locations: within limits of bridges; on narrow, unmarked road sections without pavement markings; within the limits of center two-way turn lanes; or, in passing zones.

Additional rumble strip/stripe application guidance can be found in the VDOT Road and Bridge Standards. Pavement markings shall be placed in accordance with current MUTCD and/or VA Supplement standards.

Template 10 - Corridor - Divided Roadway (3 Tiers)

*Median width greater than 30 feet

Eastern Shore Safety Study

Edge Line Application* (Source: MUTCD Chapter 3B)

Functional Class	Pavement Width	AADT
Rural Arterials & Collectors	>= 20'	>= 3,000
Local	Where curb is not present	>= 3,000

*Where pavement is less than three years old and in good conditions, groove pavement and install 6" in-laid edge line on all CoSS with speed limits of 45 mph or greater.

Center Line Application (Source: MUTCD Chapter 3B)

Functional Class	Pavement Width	AADT
Urban Arterials & Collectors	>=20'	>= 4,000
Rural Arterials & Collectors	>= 18'	>= 3,000
Local	>=16'	N/A

Raised Pavement Marker Application (Source: MUTCD VA Supplement Section 3B.11)

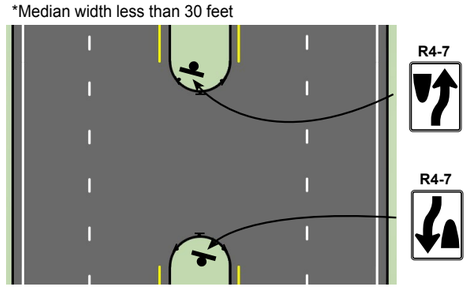
Tier	CoSS Facility Type	AADT	Posted Speed Limit	Lighting	Application
1	All Roadway Facilities	-	≥ 60 MPH	-	SRPMs shall be installed continuously.
1	Two-Lane, Two-Way Roadways	≥ 15,000	-	No roadway lighting	SRPMs shall be installed continuously.
1	Multilane Roadways	≥ 25,000	≥ 45 MPH	No roadway lighting	SRPMs shall be installed continuously.
2	Multilane Roadways	15,000 ≤ AADT < 25,000	45-55 mph	-	SRPMs shall be installed continuously.
3	Two-Lane, Two-Way Roadways (Only if the sections DO NOT have multiple horizontal curves with Posted Speed Limit < 55 MPH)	5,000 ≤ AADT < 15,000			SRPMs shall be installed continuously.
3	Two-Lane, Two-Way Roadways	≥ 15,000		Roadway lighting present	SRPMs shall be installed continuously.
3	Multilane Roadways	≥ 25,000	45-55 mph	Roadway lighting present	SRPMs shall be installed continuously.

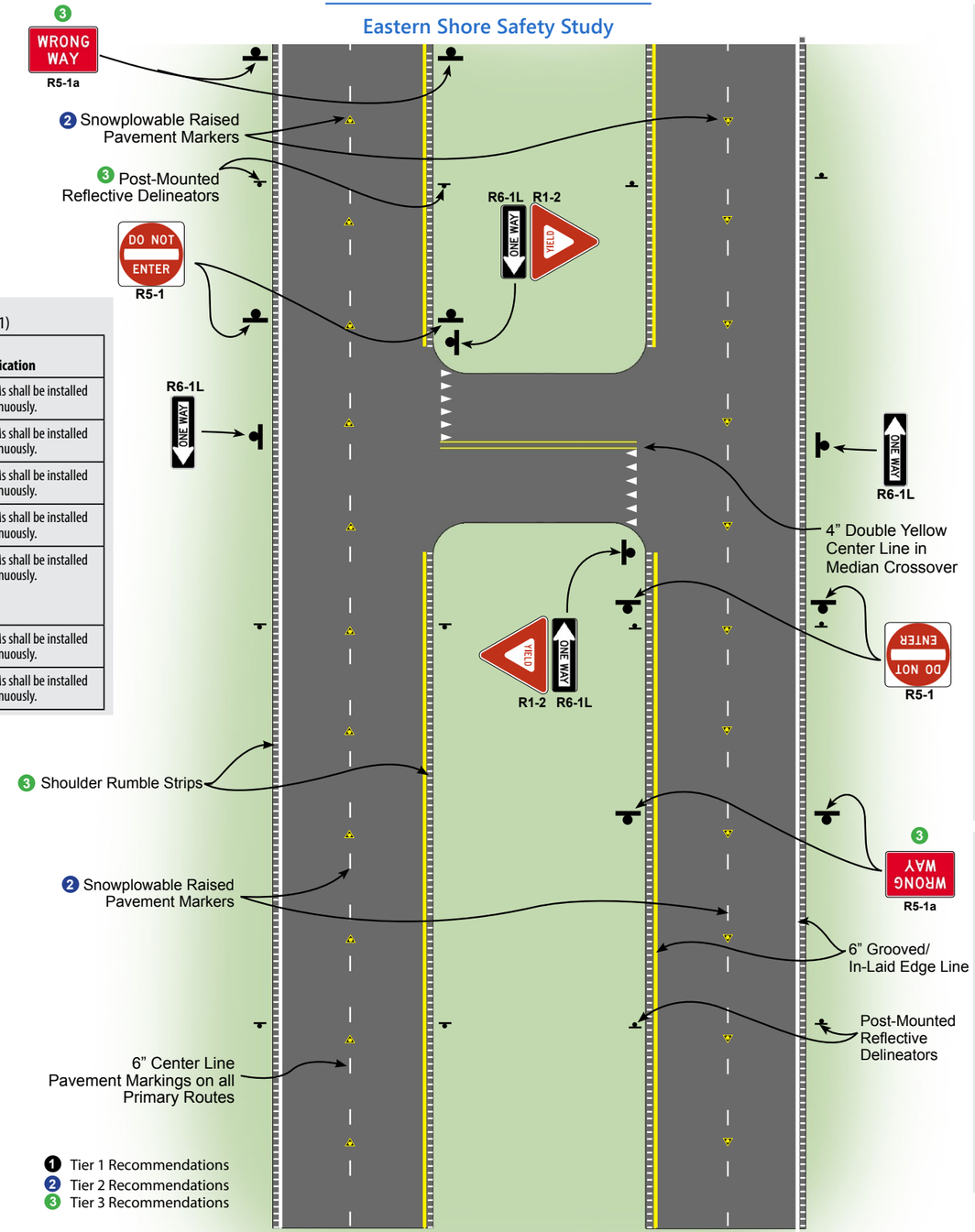
Delineator Placement and Spacing (Source Section 3F.04 MUTCD VA Supplement)

Type	Placement	Spacing
D-1	On the right of through roadways	300 feet*
D-1	Interchange ramps	100 feet (except on horizontal curve sections)
D-2	On acceleration and deceleration lanes	100 feet
Delineators on barrier or guardrail		80 feet (may vary on interchange ramp horizontal curve sections although maximum spacing = 80 feet)

*Spacing may take into consideration other sources of reflection (such as signs)(modification to MUTCD guidance)

*Median width less than 30 feet





NOTES:

Signage

1. Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
1. Fluorescent yellow sheeting on change of direction warning signs
1. Yield sign on median crossover (R1-2)
1. "One Way" and "Do Not Enter" signs (R6 Series and R5-1) per MUTCD VA Supplement
3. "Wrong Way" (R5-1a) signs along roadway
1. Keep Right (R4-7) sign

Pavement Markings

1. 4" center line pavement markings (including the double yellow center line in median crossover) (MUTCD Sections 3B.01 and 3B.06)
1. 6" pavement markings on all primary routes (excluding a double yellow center line in median crossover) (MUTCD Sections 3B.01 and 3B.06)
1. 6" grooved/in-laid edge line, per IIM #212.5
1. Reflective, snowplowable, raised pavement markers (Section 3B.11 MUTCD) VA Supplement)
1. Yield line on median crossover (MUTCD Section 3B.16)

Other

1. Trim vegetation to provide adequate sight distance and clear zone
2. Mark obstructions within clear zone (OM-1, 2, or 3 Series)
3. Remove or provide a barrier for obstructions within clear zone
3. Post-mounted reflective delineators (Chapter 3F MUTCD VA Supplement) along CoSS roadway
3. Reflective delineation of barriers (Chapter 3F MUTCD VA Supplement)
1. If bike route is present install signs and pavement markings (shared lane markings) (Chapter 9 MUTCD VA Supplement)
3. Shoulder rumble strips/stripes (MUTCD Section 3J.01) on corridors with a high number of roadway departure crashes per IIM #212.5. (see notes for application details)
3. Reflectorized sign posts (MUTCD Section 2A.15)

NOTE: Signage and pavement marking placement is not to scale. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

Rumble Strips and Stripes:

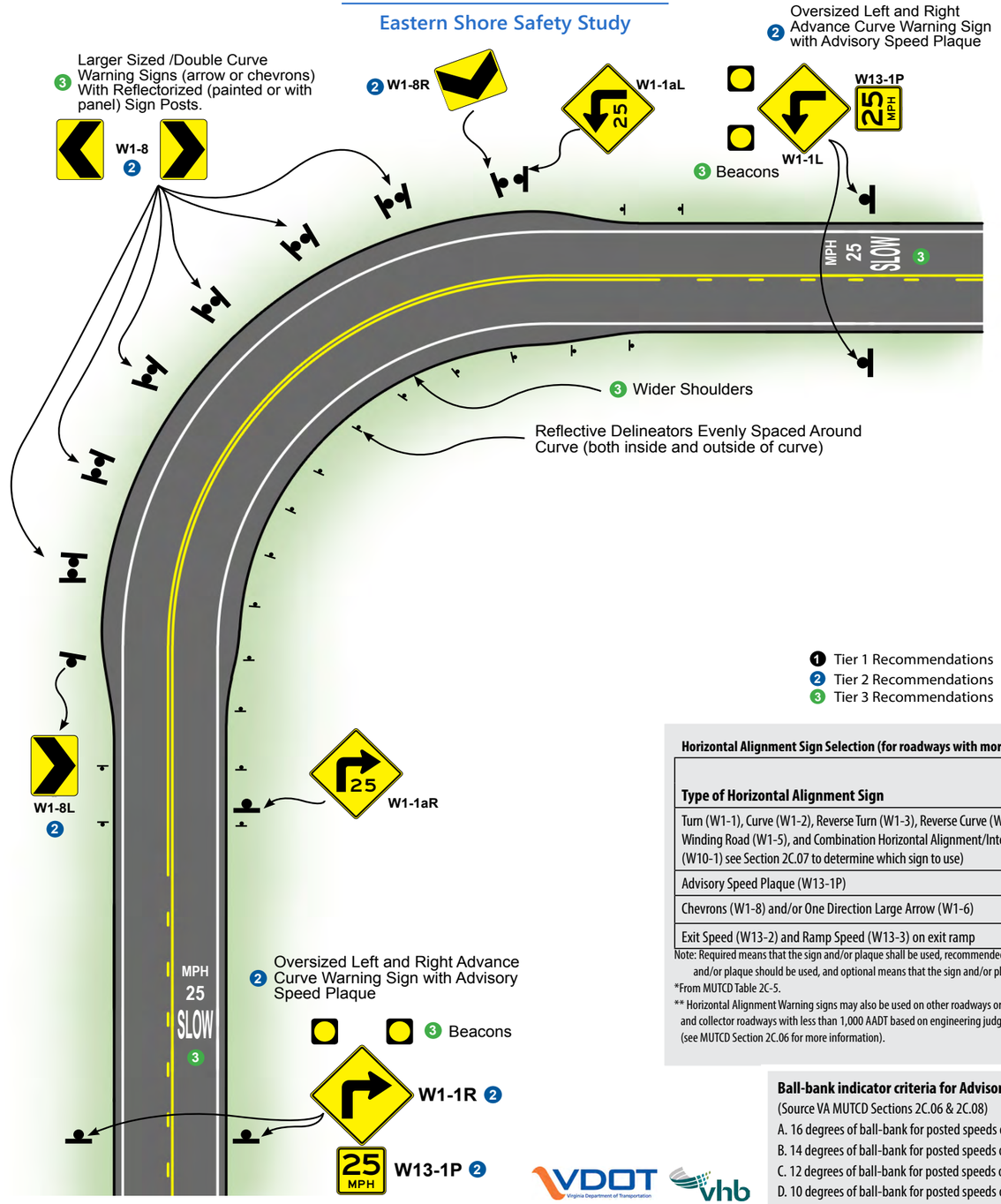
If it is determined that rumble strips/stripes should be applied to a corridor, utilize the following application guidance:

- Shoulder rumble strips shall be placed continuously on outside paved shoulders of CoSS where the shoulder has a minimum width of four (4) feet where bicycles are prohibited and eight (8) feet where bicycles are permitted. Rumble strips shall not be placed within limits of bridge drainage aprons or special design shoulder slot inlets.
- Shoulder rumble stripes shall be placed with an intermittent pattern on outside paved shoulders of CoSS where shoulders are at least two (2) feet wide. Rumble stripes shall not be placed in the following locations: within 50 feet of any intersection, turn lane, acceleration/deceleration lane, or gore area; bridge drainage aprons; or, special design shoulder slot inlets.

Additional rumble strip/stripe application guidance can be found in the VDOT Road and Bridge Standards. Pavement markings shall be placed in accordance with current MUTCD VA Supplement standards.

Template 11 - Curve - Undivided Roadway (3 Tiers)

Eastern Shore Safety Study



No Passing Zones:

(Source: MUTCD Section 3B.02)

On two-way, two- or three-lane roadways at vertical and horizontal curves and other locations where an engineering study indicates that passing must be prohibited because of inadequate sight distances or other special conditions.

At horizontal or vertical curves where:

A. The passing sight distance is less than the minimum shown in the following table for the 85th-percentile speed or the posted or statutory speed limit.

B. The passing sight distance on a vertical curve is the distance at which an object 3.5 feet above the pavement surface can be seen from a point 3.5 feet above the pavement.

C. the passing sight distance on a horizontal curve is the distance measured along the center line (or right-hand lane line of a three-lane roadway) between two points 3.5 feet above the pavement on a line tangent to the embankment or other obstruction that cuts off the view on the inside of the curve

A short stretch of depressed alignment that might momentarily hide a vehicle should be treated as a no-passing zone when center line striping is provided on a two-lane or three-lane road

85th Percentile or Posted or Statutory Speed Limit	Minimum Passing Sight Distance
25 mph	450 feet
30 mph	500 feet
35 mph	550 feet
40 mph	600 feet
45 mph	700 feet
50 mph	800 feet
55 mph	900 feet
60 mph	1,000 feet
65 mph	1,100 feet
70 mph	1,200 feet

Approximate Spacing for Delineators on Horizontal Curves (Including Interchange Ramps)
(Source Section 3F.04 MUTCD VA Supplement)

Placement	Spacing
Radius of curve = 50 feet	20 feet
Radius of curve = 115 feet	25 feet
Radius of curve = 180 feet	35 feet
Radius of curve = 250 feet	40 feet
Radius of curve = 300 feet	50 feet
Radius of curve = 400 feet	55 feet
Radius of curve = 500 feet	65 feet
Radius of curve = 600 feet	70 feet
Radius of curve = 700 feet	75 feet
Radius of curve = 800 feet	80 feet
Radius of curve = 900 feet	85 feet
Radius of curve = 1,000 feet	90 feet

NOTES:

The following templates should only be applied at curves based on differential of speed limit and advisory speed and ball-bank testing as specified by MUTCD requirements. See MUTCD Tables 2C-5 and 2C-6 along with Section 2C.08. Other measures identified in corridor or segment templates may be applied as well.

Signage

1. Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
1. Minimize driver distraction in curve by relocating wayfinding/informational signs so they are not placed on the curve.
1. Horizontal alignment signs (W1 Series)
3. Larger sized /double Curve Warning signs (arrow or chevrons – W1-8, W1-6) with reflectorized (painted or with panel sign posts (MUTCD Section 2A.15)
1. Left and Right Advance Curve Warning sign with Advisory Speed Plague (W1 Series with W13-1P)
2. Oversized Left and Right Advance Curve Warning Sign with Advisory Speed plaque (W1 Series with W13-1P)
1. Fluorescent yellow sheeting on change in Direction Warning signs

Pavement Markings

3. "SLOW" and "XX mph" pavement markings (MUTCD Section 3B.20)

Other

1. Post-mounted delineators except in locations with chevrons (e.g. if chevrons are present on outside of curve, place delineators on inside of curve only) (MUTCD Section 3B.20)
3. Shoulder widening (engineering study required to determine exact widths)
3. Reflectorized sign posts (MUTCD Section 2A.15)
3. Flashing beacons on top of curve warning signs

NOTE: Signage and pavement marking placement is not to scale. Depending upon site conditions, signs should share the same post to the extent possible in order to reduce sign clutter. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

1 Tier 1 Recommendations
2 Tier 2 Recommendations
3 Tier 3 Recommendations

Horizontal Alignment Sign Selection (for roadways with more than 1,000 AADT)

Type of Horizontal Alignment Sign	Difference Between Speed Limit and Advisory Speed				
	5 mph	10 mph	15 mph	20 mph	25 mph or more
Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road (W1-5), and Combination Horizontal Alignment/Intersection (W10-1) see Section 2C.07 to determine which sign to use)	Recommended	Required	Required	Required	Required
Advisory Speed Plaque (W13-1P)	Recommended	Required	Required	Required	Required
Chevrons (W1-8) and/or One Direction Large Arrow (W1-6)	Optional	Recommended	Required	Required	Required
Exit Speed (W13-2) and Ramp Speed (W13-3) on exit ramp	Optional	Optional	Recommended	Required	Required

Note: Required means that the sign and/or plaque shall be used, recommended means that the sign and/or plaque should be used, and optional means that the sign and/or plaque may be used.
*From MUTCD Table 2C-5.
** Horizontal Alignment Warning signs may also be used on other roadways or on arterial and collector roadways with less than 1,000 AADT based on engineering judgment (see MUTCD Section 2C.06 for more information).

Ball-bank indicator criteria for Advisory Speed Plaques:
(Source VA MUTCD Sections 2C.06 & 2C.08)

A. 16 degrees of ball-bank for posted speeds of 20 mph or less
B. 14 degrees of ball-bank for posted speeds of 25 or 30 mph
C. 12 degrees of ball-bank for posted speeds of 35 mph to 45 mph
D. 10 degrees of ball-bank for posted speeds of 50 mph or greater

Typical Spacing of Chevron Alignment Signs on Horizontal Curves: (Source: MUTCD Table 2C-6)

Advisory Speed	Curve Radius	Sign Spacing
15 mph or less	Less than 200 feet	40 feet
20 to 30 mph	200 to 400 feet	80 feet
35 to 45 mph	401 to 700 feet	120 feet
50 to 60 mph	701 to 1,250 feet	160 feet
more than 60 mph	More than 1,250 feet	200 feet

Note: The relationship between the curve radius and the advisory speed shown in the table should not be used to determine advisory speed*

Template 12 - Curve - Divided Roadway (3 Tiers)

Eastern Shore Safety Study

Ball-bank indicator criteria for Advisory Speed Plaques:
(Source VA MUTCD Sections 2C.06 & 2C.08)
A. 16 degrees of ball-bank for posted speeds of 20 mph or less
B. 14 degrees of ball-bank for posted speeds of 25 or 30 mph
C. 12 degrees of ball-bank for posted speeds of 35 mph to 45 mph
D. 10 degrees of ball-bank for posted speeds of 50 mph or greater

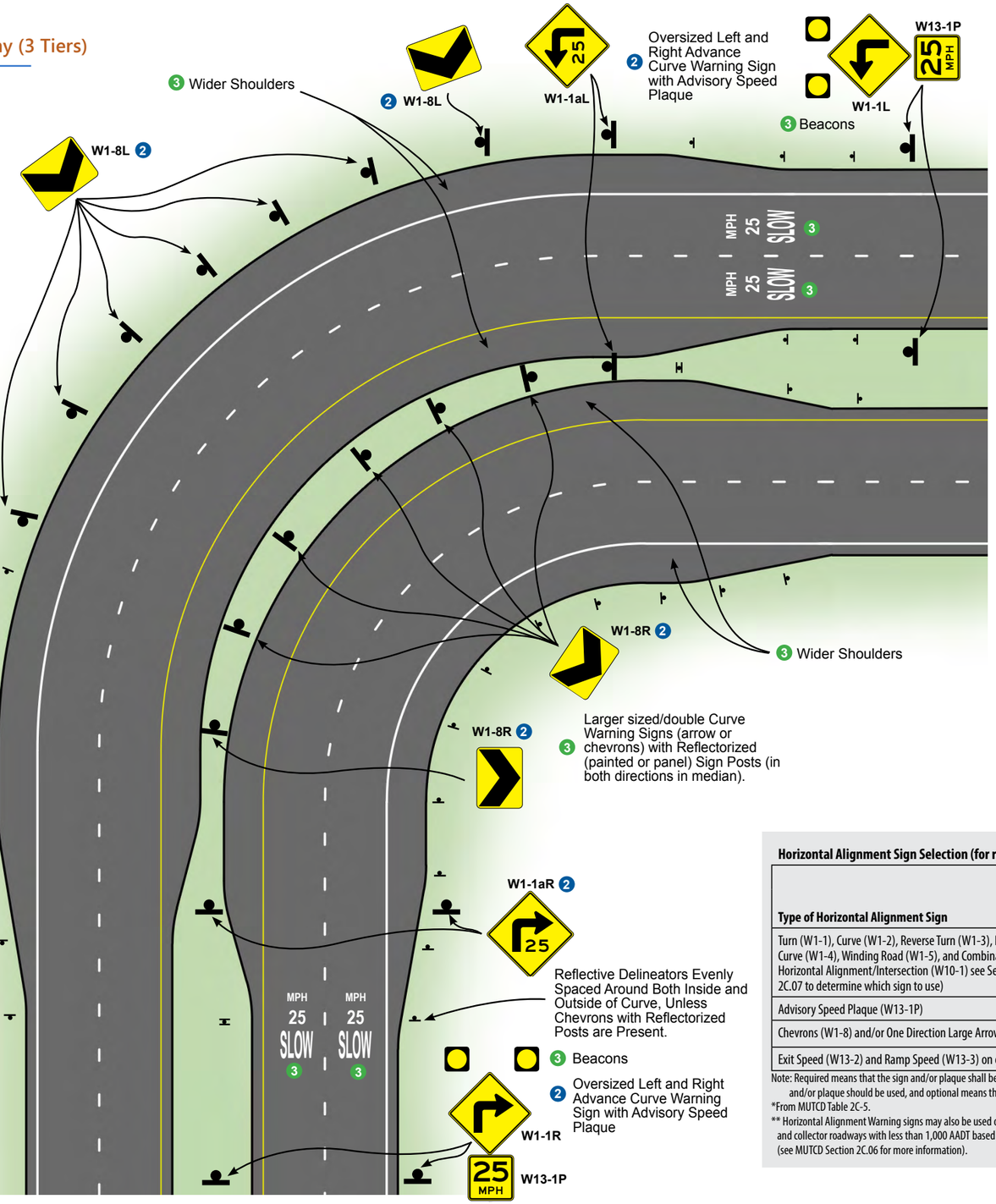
Typical Spacing of Chevron Alignment Signs on Horizontal Curves:
(Source: MUTCD Table 2C-6)

Advisory Speed	Curve Radius	Sign Spacing
15 mph or less	Less than 200 feet	40 feet
20 to 30 mph	200 to 400 feet	80 feet
35 to 45 mph	401 to 700 feet	120 feet
50 to 60 mph	701 to 1,250 feet	160 feet
more than 60 mph	More than 1,250 feet	200 feet

Note: The relationship between the curve radius and the advisory speed shown in the table should not be used to determine advisory speed*
From MUTCD Table 2C-6

Approximate Spacing for Delineators on Horizontal Curves (Including Interchange Ramps)
(Source Section 3F.04 MUTCD VA Supplement)

Placement	Spacing
Radius of curve = 50 feet	20 feet
Radius of curve = 115 feet	25 feet
Radius of curve = 180 feet	35 feet
Radius of curve = 250 feet	40 feet
Radius of curve = 300 feet	50 feet
Radius of curve = 400 feet	55 feet
Radius of curve = 500 feet	65 feet
Radius of curve = 600 feet	70 feet
Radius of curve = 700 feet	75 feet
Radius of curve = 800 feet	80 feet
Radius of curve = 900 feet	85 feet
Radius of curve = 1,000 feet	90 feet



NOTES:

The following templates should only be applied at curves based on differential of speed limit and advisory speed and ball-bank testing as specified by MUTCD requirements. See MUTCD Tables 2C-5 and 2C-6 along with Section 2C.08. Other measures identified in corridor segment templates may be applied as well.

Signage

1. Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
1. Minimize driver distraction in curve by relocating wayfinding/ informational signs so they are not placed on the curve.
1. Horizontal alignment signs (W1 Series)
3. Larger sized/double Curve Warning signs (arrow or chevrons – W1-8, W1-6) with painted/retroreflective sign posts (MUTCD Section 2A.15)(in both directions in median)
1. Left and Right Advance Curve Warning sign with Advisory Speed plaque (W1 Series with W13-1P)
2. Oversized Left and Right Advance Curve Warning sign with Advisory Speed plaque (W1 Series with W13-1P)
1. Fluorescent yellow sheeting on change of Directions Warning signs

Pavement Markings

3. "SLOW" and "XX mph" pavement markings (MUTCD Section 3B.20)

Other

1. Post-mounted delineators except in locations with chevrons (e.g. if chevrons are present on outside of curve, place delineators on inside of curve only) (MUTCD Chapter 3F)
3. Shoulder widening (engineering study required to determine exact widths)
3. Reflectorized signs posts (in both directions in median) (MUTCD Section 2A.15)
3. Flashing beacons on top of curve warning signs

NOTE: Signage and pavement marking placement is not to scale. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance. Signs should not be placed in the median unless the median is ≥ 4' wide and the sign is smaller than the median.

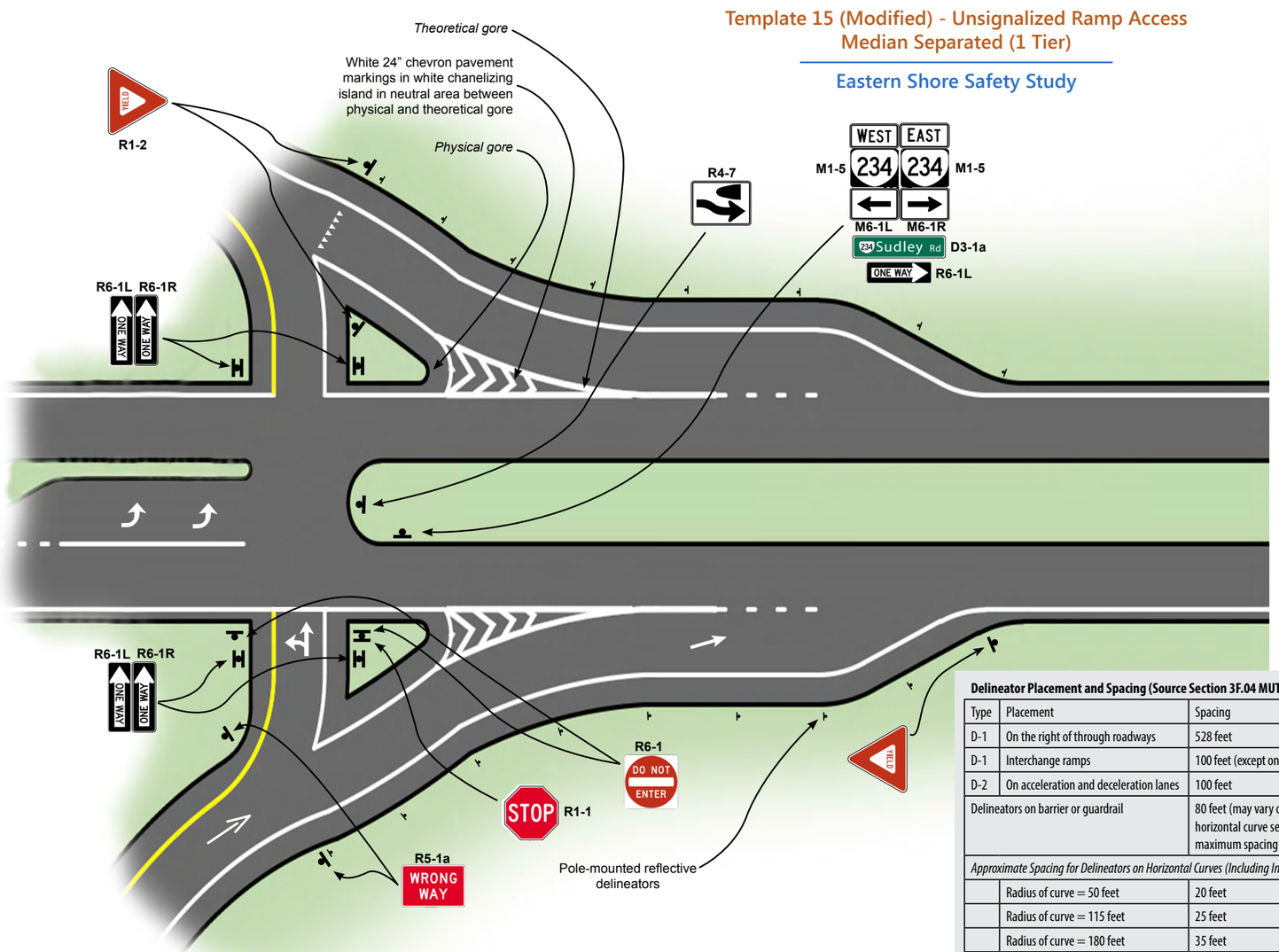
Horizontal Alignment Sign Selection (for roadways with more than 1,000 AADT)

Type of Horizontal Alignment Sign	Difference Between Speed Limit and Advisory Speed				
	5 mph	10 mph	15 mph	20 mph	25 mph or more
Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road (W1-5), and Combination Horizontal Alignment/Intersection (W10-1) see Section 2C.07 to determine which sign to use)	Recommended	Required	Required	Required	Required
Advisory Speed Plaque (W13-1P)	Recommended	Required	Required	Required	Required
Chevrons (W1-8) and/or One Direction Large Arrow (W1-6)	Optional	Recommended	Required	Required	Required
Exit Speed (W13-2) and Ramp Speed (W13-3) on exit ramp	Optional	Optional	Recommended	Required	Required

Note: Required means that the sign and/or plaque shall be used, recommended means that the sign and/or plaque should be used, and optional means that the sign and/or plaque may be used.
*From MUTCD Table 2C-5.
** Horizontal Alignment Warning signs may also be used on other roadways or on arterial and collector roadways with less than 1,000 AADT based on engineering judgment (see MUTCD Section 2C.06 for more information).

Template 15 (Modified) - Unsignalized Ramp Access Median Separated (1 Tier)

Eastern Shore Safety Study



Delineator Placement and Spacing (Source Section 3F.04 MUTCD VA Supplement)

Type	Placement	Spacing
D-1	On the right of through roadways	528 feet
D-1	Interchange ramps	100 feet (except on horizontal curve sections)
D-2	On acceleration and deceleration lanes	100 feet
Delineators on barrier or guardrail		80 feet (may vary on interchange ramp horizontal curve sections although maximum spacing = 80 feet)
Approximate Spacing for Delineators on Horizontal Curves (Including Interchange Ramps)		
	Radius of curve = 50 feet	20 feet
	Radius of curve = 115 feet	25 feet
	Radius of curve = 180 feet	35 feet
	Radius of curve = 250 feet	40 feet
	Radius of curve = 300 feet	50 feet
	Radius of curve = 400 feet	55 feet
	Radius of curve = 500 feet	65 feet
	Radius of curve = 600 feet	70 feet
	Radius of curve = 700 feet	75 feet
	Radius of curve = 800 feet	80 feet
	Radius of curve = 900 feet	85 feet
	Radius of curve = 1,000 feet	90 feet

NOTES:

Merge/Diverge:

Signage

- Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
- Fluorescent yellow sheeting on change of direction warning signs
- Ramp warning signs (W4 series)
- Advisory speed signs (W13 Series)
- Gore signs (E5-1 Series)

Pavement Markings

- 6" center/lane/edge line pavement markings. Terminate 6" at a logical temini of the off-ramp
- White 24" chevron pavement markings in white channelizing island in neutral area between physical and theoretical gore
- Wider 6" solid white deceleration/acceleration lane line leading to theoretical exit gore
- Dotted extension of right-hand edge line
- Snowplowable raised pavement markers

Other

- Post mounted delineators around nose of physical gore and both sides of ramp, unless guardrail is prsent. If guardrail is present, delineators to be place on top (Chapter 3F MUTCD VA Supplement.
- Reflectorized sign posts (MUTCD Section 24.15)

Ramp/Intersection with Arterial:

Signage

- Upgraded signs with current MUTCD standards (font, size, retroreflectivity, placement, message, etc.)
- Fluorescent yellow sheeting on warning signs
- Advisory speed signs and curve warning signs as appropriate on ramp
- Destination/Guide Sign (D1 series)
- Control sign at intersection (R1 series)
- Intersecting route and directional sign (M1, M3, & M6 Series)
- Street name sign (D3-1a)
- "One Way", "Do Not Enter", and "Wrong Way" signs per VA Supplement
- Add Object Marker on same post as R4-7 or on separate post closer to road (OM3-L)

Pavement Markings

- Stop bar/yield line (MUTCD Section 3B.16)
- Lane use pavement markings (MUTCD Section 3B.20)
- Wrong-way arrows (MUTCD Figures 2B-18 and 3B-24)

Other

- Reflectorized (painted or with panel) sign posts (MUTCD Section 24.15)

NOTE: Signage and pavement marking placement is not to scale. Actual placement will be determined on a site by site basis based on MUTCD and/or VA Supplement design standards and guidance.

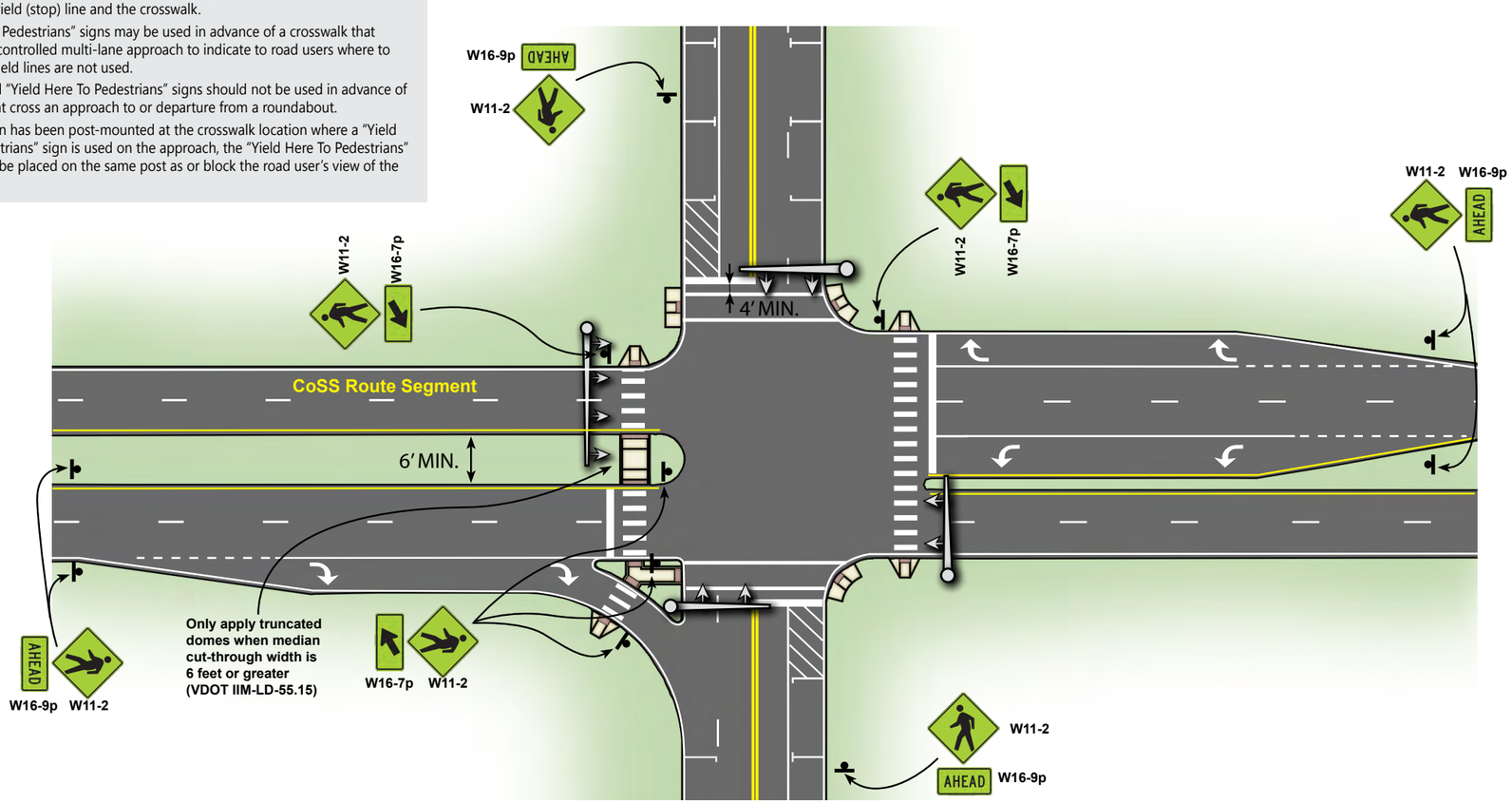
Raised Pavement Markers:
Raised pavement markers shall be spaced every 20' and extend a minimum of 80' beyond the physical gore. (See Section 3B.13 and Drawing F of Figure 3B V-2.)

Yield Here to Pedestrian Signs (R1-5, R1-5A)
(Source: Section 2B.11 MUTCD VA Supplement)

- If yield lines and "Yield Here To Pedestrians" signs are used in advance of a crosswalk that crosses an uncontrolled multi-lane approach, they should be placed 20 to 50 feet in advance of the nearest crosswalk line (see Section 3B.16 and Figure 3B-17(VA) in this Supplement), and parking should be prohibited in the area between the yield (stop) line and the crosswalk.
- "Yield Here to Pedestrians" signs may be used in advance of a crosswalk that crosses an uncontrolled multi-lane approach to indicate to road users where to yield even if yield lines are not used.
- Yield lines and "Yield Here To Pedestrians" signs should not be used in advance of crosswalks that cross an approach to or departure from a roundabout.
- If a W11-2 sign has been post-mounted at the crosswalk location where a "Yield Here To Pedestrians" sign is used on the approach, the "Yield Here To Pedestrians" sign shall not be placed on the same post as or block the road user's view of the W11-2 sign.

Template 16 - Pedestrian Measures

Eastern Shore Safety Study



PEDESTRIAN MEASURES:

Where crosswalks and pedestrian signal phases do not already exist, they shall not be installed except where justified. **Crosswalks across uncontrolled locations should not be installed without an engineering study as per VDOT's Guidelines for the Installation of Marked Crosswalks document.** Determination of a new crosswalk or pedestrian signal can be considered on a site-specific basis if observations during the CSA suggest the need and the proper study/analysis is performed. Where pedestrian facilities already exist, the following measures shall be placed:

- Pedestrian warning signs. The W11-2 sign and related supplemental plaques shall have a fluorescent yellow-green background with a black legend and border (see Section 2C.50 of the MUTCD VA Supplement).
- Crosswalk pavement markings of a minimum 6" or maximum 24" in width.
- Crosswalk markings located so that the curb ramps are within the extension of the crosswalk markings.
- Detectable warning surface and ramps consistent with VDOT's Road and Bridge Standards.
- Pedestrian signals that are accessible and have countdowns.
- Parking restrictions near crosswalks.
- If determined that new ramps are necessary or need to be redesigned, they shall meet ADA standards per VDOT Road and Bridge standards and IIM 55.14.

PEDESTRIAN CONTROL FEATURES:

For information and design guidelines for accessible pedestrian signals, refer to Chapter 4E of the MUTCD, the VA Supplement, and the VDOT Guidelines for the Retrofit Installation of Accessible Pedestrian Signals.

APPLICATION OF PEDESTRIAN SIGNAL HEADS:

Pedestrian signal heads shall be used in conjunction with vehicular traffic control signals under any of the following conditions:

A. If a traffic control signal is justified by an engineering study and meets either Warrant 4, Pedestrian Volume or Warrant 5, School Crossing (see Chapter 4C);

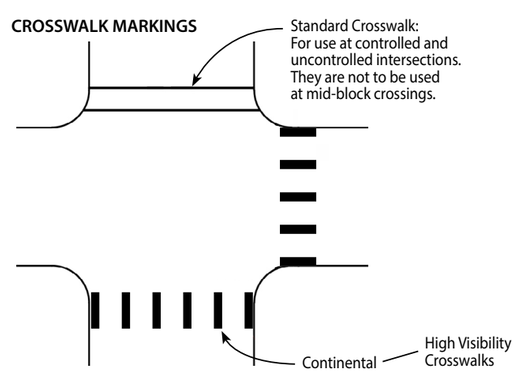
B. If an exclusive signal phase is provided or made available for pedestrian movements in one or more directions, with all conflicting vehicular movements being stopped;

C. At an established school crossing at any signalized location; or

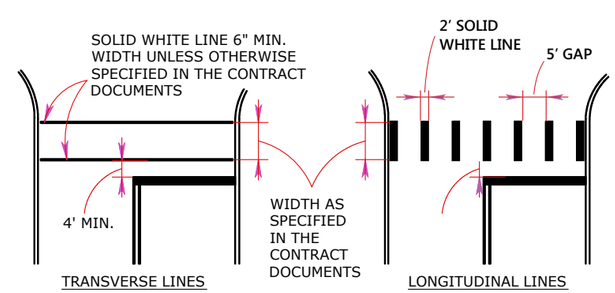
D. Where engineering judgment determines that multi-phase signal indications (as with split-phase timing) would tend to confuse or cause conflicts with pedestrians using a crosswalk guided only by vehicular signal indications. (Source: MUTCD Section 4E.03)

Supplemental Warning Plaques (W16-2/3/4 Series, W16-7P,W16-9P)
(Source 2C.53)

- Supplemental warning plaques shall be used only in combination with warning or regulatory signs; installed on the same post(s) as the warning or regulatory sign that it supplements and with the same legend, border, and background color as the warning sign with which it is displayed. A supplemental warning plaque used with a regulatory sign shall have a black legend and border on a yellow background.
- The Distance Ahead (W16-2 series and W16-3 series) plaques may be used to inform the road user of the distance to the condition indicated by the warning sign. These plaques can be used to indicate the distance to a specific crossing.
- The Next Distance (W16-4P) plaque may be used to inform road users of the length of roadway over which the condition indicated by the warning sign exists. This plaque can be used to indicate a specific length of road with multiple crossings.



See Section 3B.18 of the MUTCD VA Supplement and VDOT TE Guidelines for the installation of marked crosswalks for application and design Guidance.



DETAIL FOR TYPICAL CROSSWALK APPLICATIONS

Appendix B

CONTENTS

Citizen Comments

Citizen Information Meeting #1 Comments:
Location 23: Extend the 5 mile No Passing Zone on Rt.175 from Rt.13 to Main St. Chincoteague. Put up No U-turn/No Left Turn, in some cases, at intersections with no turn lanes. Police could be more visible, especially in towns with lowered speed limits, and not just traveling 65 to 70 mph in the passing lanes.
Location 3: The intersection of US 13 and Rt 636, (Cobbs Station Road). There are 2 historical signs on the south side of 636, which obstructs a drivers view looking left for US 13 northbound traffic. It is hard to see an opening in the oncoming traffic.
Location 2: Fact - Folks (not all) travel at 75mph. Need access roads installed at public eating and shopping areas to existing side roads managed by a traffic signal. Locals can't get out on 13 with fast herds of traffic. An example is Cape Charles light should manage Dollar General/Food Lion traffic.
Location 23: The left turn lane on Route 13 Southbound going to Route 175 backs up and a it can take multiple signals to get through this intersection. This causes people to run the light and or speed through it, making the intersection dangerous. The turn signal should run for longer during periods of high volume. Location 23: T's Corner does not have any curb along most of its boundaries and traffic will make dangerous merges in and out of the lot, making it hard to know where traffic is coming from. There should be a curb or physical boundary that focuses traffic into specific entrances and exits instead of making it a free for all next to a high traffic intersection. Location 23: There are 5 business entrances on Route 175 in the first 400 feet from US 13. There is 1 for Pizza Hut, 1 for the shopping center, 1 for PNC and a farm, and 2 to T's Corner. If these were consolidated it would make traffic much more predictable and significantly decrease the chance of a crash with so much traffic merging/exiting next to a high volume intersection. Location 23: Please consider lowering the speed limit on 175 West as it approaches this intersection. Cars waiting to pull out on to 175 often cut off traffic approaching 13 and cause people to slam on the brakes. Rear end accidents are too common on 175 West here. Location 24: Route 175 desperately needs a shoulder here as traffic often speeds and there is little room to move if someone drifts towards your lane. Route 175 from 13 to 798 would be much safer if it had a shoulder. Bicycle tourism is becoming a big draw on the Delmarva Peninsula and 175 should have a wide enough shoulder to allow bikes to safely travel along it to Chincoteague. Not only would it be a safety improvement, it would also help the local economy.
This is in regards to road safety to develop a plan to make the highway which bisects Virginia from Eastern Shore from north to south, safer. What is really needed is a limited access bypass. Think safety. This will alleviate the traffic and get the trucks off our backs and the accidents and deaths. The trucks would be happy and people would be happy and safer. Small businesses will still get business from locals and the tourists. It's up to you to make Route 13 safer for all of us.
I have seen in other counties that there are “keep to the right” “Left lane is for passing” signs. This would be a tremendous help to keep the traffic flowing.

Citizen Information Meeting #1 Comments:
Location 2: I live in Cape Charles so I utilize this intersection quite often. It is an impossible area in the summer, but poses issues all year. In 2011, my Toyota Corolla was totaled at that intersection. My boyfriend and I were heading home to Cape Charles (northbound) on Rt 13 from VA Beach in the afternoon. It was still light outside and we were traveling at about 55mph. We had gotten in the left lane to be able to turn left into Cape Charles at the traffic light. However, we never made it that far. Upon approaching the intersection, a Mitsubishi Eclipse coming out of the Food Lion/McDonald’s intersection to turn left (southbound) pulled right out in front of us and all the oncoming traffic. She barely missed the truck that was in the slow lane next to us. We hit her in the rear and we lost all brakes and were lucky to not hit any other vehicle in the process of slowing down in the median. This accident could have been a lot worse and I am thankful it wasn’t even though my car was totaled. Location 2: This intersection is extremely dangerous for those who want to leave Food Lion/McDonald’s and make a left turn to head South. There is not enough room in the median for a vehicle, especially a truck or SUV. For those who know the area, it’s easier and safer to leave McDonald’s/Food Lion and exit out the Dollar General intersection. Also, there is a restaurant (Captain Pete’s) on the opposite side which has become increasingly busy as it gains popularity. This will be especially busy in the summer, therefore increasing the traffic coming through that intersection. The ice machine is also over there by Captain Pete’s and it is busy in the summer as well. Location 2: This intersection could really use a traffic light. I realize this is not feasible as the traffic light at Stone Road and South Bayside Road is too close. I am really surprised that there isn’t a service road behind Food Lion for tractor trailers. The current intersection must be dangerous and difficult to maneuver in a tractor trailer. A service road could run from Food Lion to South Bayside Road. This would alleviate some traffic at the other intersection as I’m sure most locals would utilize this service road. Another option would be to have a right turn lane only and another lane for left turns and traffic going straight coming out of Food Lion. People trying to turn left hold up the people trying to turn right. This is not my favorite option as this would not have prevented my accident. The best option I feel for this current intersection would be to have the dividers in the median intersection that prevent you from driving straight through and allow you to only make a left turn or U-turn. Therefore, the people coming out of Food Lion can only make a right turn and would have to go to the traffic light to make a U-turn to head back south or to go across the street. I think people struggle with having to evaluate northbound and southbound traffic simultaneously. If they only had to think about one direction of traffic I think it would be a lot safer and there would be less accidents at this specific location.
I would like to see the flashing yellow lights approaching red light signals reinstalled. Also please cut roadside and median grass in summer when needed, not in December when not needed.

Citizen Information Meeting #1 Comments:
Location 23: Route 175 floods during storms as it crosses the marsh land causeway and has no border to pull off when someone passes on the solid line, which I have personally observed often. There is not even shoulder room for state police to set up for speeders. A lady whose son was killed trying to ride a bicycle across this causeway protested to the Accomack County Board of Supervisors to put in shoulders with negative results. A well known local waterman was killed in a head on collision on this part of 175 because there was no way to avoid it. I had a personal experience traveling north on Route 13 between the intersection of 702 and 175 next to the cemetery. The right lane had flooded and froze over night. I hit it and found myself in the Southbound lane of 13, fortunately I didn't hit anybody. I know of 3 fatalities at the intersection of route 702 (Horsey Road) and 693 (Neil Parker Road). One was a neighbor (Mr. Miles) and another was an employee of VDOT. The stop sign isn't very noticeable. I have been told that no charges were filed against the drivers who hit and killed the occupant of the other vehicle because of this dangerous condition. I live adjacent to where Route 702 ends at Route 701 (Jenkins Bridge Road). The bridge at this location as one turns left floods often as does the road next to it. As one is heading East they travel around a dangerous curve (many accidents) and hit the flooded bridge with no way to turn around and go back. School buses, farm vehicles, tractor trailers traverse this route. In regard to small cars, I have seen water go over their hood as they attempt to cross this bridge. The water is brackish. I see tractor trailers and other vehicles coming upon the many intersections and business turn offs on Route 13 at high rates of speed and run the lights often. Traffic lights and sudden turn offs in 55 mph speed zones with many long distance commuters is a recipe for disaster. Thank you for your attention to this matter. I hope that improvements are going to be made soon. I attended a public forum on this Route 13 issue many years ago but nothing was done. The safety of the citizens must be a priority over business and political interests. If I can be of any assistance, please let me know.
Location 2: My husband and I live on Poplar Grove Lane in Seaview of the Cape Charles area, and we access Route 13 via Bayview Circle if we are traveling north. The spot where the entrances to the Food Lion shopping center, the Shore Bank, the restaurant, and the ice dispenser converge is quite dangerous, especially in the summer months. When I am leaving the Food Lion center at that time of the year, I have found that making a right turn and then either a U-turn at the light or traveling the back roads are much safer alternatives than trying to make a left onto 13. I definitely support the installation of a traffic signal at that location. I would also suggest that an access road from Bayview Circle directly to the shopping center be considered as well. I don't know the ownership of that property but I do remember that idea being discussed at earlier planning sessions.
Tasley overpass going South on 13 leaving a dark area then hit by spot lights from Hardees. Please have them adjust there aim away from 13. Right in drivers eyes. Chesapeake Square coming North to turn into Food Lion. Turning lights letting the line of cars gets so long last cars are in traffic lane. Have trouble at night finding North bound lane when leaving Cape Charles. Please do some of the study at night because there is a difference.

Citizen Information Meeting #1 Comments:
Location 1: There's nothing there and very little traffic use. This would likely only encourage future development and more traffic problems. Location 3: This is a private road with only a handul of residents and little traffic. This is a waste of money. The only location in the first six locations where improvements are needed is the Food Lion intersection (2).
CBBT @ S.R. 600 (Recent application to expand Campground, issue is extended length vehicles having direct access blocking traffic) Mile Post 73 (Royal Farms application 12 years old, question of diligent Pursuit, issue is extended length vehicles having direct access blocking traffic) U.S. 13 @ Townsend (Existing Request for a Traffic Activated Caution Light for Crossing Traffic, issue is extended length vehicles having direct access blocking traffic) U.S. 13 @ Cape Center restaurant (issues with Extended Length vehicles having direct access to median crossing) U.S. 13 @ Mile Post 78 Kiptopeke Elementary School (Median Narrow, School Buses block Traffic) U.S. 13 @ Mile Post 79 Corner Mart, Median Crossing at Strip Mall (Potential for Stop Light, issue is extended length vehicles having direct access blocking traffic) U.S. 13 @ Mile Post 80.8± Caution Sign for Light Change to RED (Cheriton) U.S. 13 @ Mile Post 100± Caution Sign for light Change to RED (Exmore) Several Median Crossings within County to possibly be closed that maybe should not be closed as there is need for public Safety vehicles to turn around and other issues.
We need a turn lane at Paige Scott to go South for safety of farm equipment, large delivery trucks, Tractors with grain trailers. Need a turn lane in front of David Smith to go North for access to farm and house 26104 and 26103 (Farm Equipment) If the above two were put in place the intersection in front of 26104 could be closed. Show them on maps. Stat not included: 1. Indian Gas Station 2. Cape center 3. Food Lion, MOD, Bank. # of accidents at these median turn arounds, if < 8, it is statistically insignificant.

Citizen Information Meeting #1 Comments:

I am concerned about excessive lights in businesses and in shopping areas at night. Specifically, I would like to see you or someone do something about the blinding lights on the Hardee's in Onley. When traveling in the southbound lanes, one comes over the business Route 13 overpass bridge and is nearly blinded by the extreme amount of lights at Hardee's that seem to be aimed at eye level. I know that adequate security lighting can be provided for a site without the lights having to shine out in all directions, especially into drivers eyes. This issue should be of concern on all roads, not just the extreme example I have sited.

My family lives in Accomac and we frequently have to cross Route 13. We are alway wary when crossing and make sure that traffic has actually stopped at lights before venturing out from the side roads.

The left turn onto Business Route 13 from the southbound travel lanes, north of Accomac is especially scary. We have aborted this turn more than once because of aggressive tailgaters. When we pass the traffic light at Parksley, we feel that we must be especially alert to the movement of other vehicles in this section of the road as drivers seem jockey for position in this stretch of highway. There needs to be more room for getting into the left lane and slowing down in this location so that people turning do not get mowed down.

Finally, and for what it is worth, the up and down speed limits in the narrower areas of the road as it passes through communities often seem to be ignored.

Location 2: The Food Lion Shopping center entrance is dangerous for people driving across lanes of traffic for the South bound drivers.

Please feel free to call and talk to my husband Chuck Tankard (he spoke to Chris Isdol) for more clarification.

PLEASE SPEAK TO THE FARMERS. Farm equipment is dangerous. You need to find the turn arounds used by this large equipment. Ursula Deitch North Hampton County Extention Agent may be able to make suggestions. Daughter is extension agent- good resource for outreach to farmers. Map is attached showing where land is located in relation to Cape Center's Stingray's.

Citizen Information Meeting #2 Comments:

Thank you for this opportunity. Have long been very concerned with Food Lion. Have driven 13 for 38 years, beginning with one traffic light in Northampton County. I share potential concern at Jonathan's Landing due to volume occupancy increase extraordinarily at new campground, especially in season.

18-wheelers are a menace or intimidating throughout the shore. We know they run lights. Route 13 was not built with them in mind nor in expectation of driving populace or drive thru % increase, what also with CBBT expansion imminent.

Here in Northampton County and Accomack too: large elderly population in old autos add hazards. Throughout Shore consider restrictions on cell phone usage please, statewide.

18-wheelers and increase in the number of large SUV's and host of pickups in the area made us consider upgrading from a small sedan.

Thank you for the chance to insert reminder of over a decade: could there please be consideration for an attractive North End- Northampton County welcome sign versus the puny one scarcely noticed? It would elevate the community yes even roadways have self respect. So overdue, pride. There just must be a way! Thanks again.

Wish we could've had the option to type or email in, so as not to suffer through this hard to read.

Trying to conjure the 18-wheelers' u-turns is mighty uncomfortable.

Total miles of your study? 309 incidents per annum.

The four corner plaza area is a 30 year old bypass that is extremely congested, especially in the summer/holidays tourist traffic. The bypass needs to be by-passed.

The ES railroad used to have two tracks, northbound and southbound. From Nassawadox north to Exmore, then from Belle Haven to Melfa at the Nandua H.S. - it is impossible to put in northbound right turn lanes due to the proximity of the tracks. If the tracks were moved eastward in these areas, even if only at the intersections, then turn lanes could be installed.

Reinstall the red light warning signs.

Interested in traffic efficiency alternatives across 175 Causeway.

The following comments are transcribed from sketches with notes:

Proposed road to reduce accidents of US 13, like at T's Corner (road drawn north from the the Food Lion shopping center).

5 weeks ago I almost was in a horrendous accident. A former student had the same thing happen to him but he was hit. Having farm equipment waiting to turn left is dangerous. Just try driving a tractor on the road and wait to turn left. Create a new lane for farm equipment to get them off the road.

Lots of crashes in front of Cape Center Sting Ray's.

Appendix C

CONTENTS

USLIMITS2 Reports

This page intentionally left blank.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Exmore Town NB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Northampton County
City: Exmore town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .88 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: Divided
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 5710 veh/day
Total Number of Crashes: 2
Total Number of Injury Crashes: 0
Section Crash Rate: 22 per 100 MVM
Section Injury Crash Rate: 0 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 53 mph
50th Percentile Speed: 47 mph
AADT: 5710 veh/day

Recommended Speed Limit: **55**

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Exmore Town SB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Northampton County
City: Exmore town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .88 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: Divided
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6008 veh/day
Total Number of Crashes: 1
Total Number of Injury Crashes: 0
Section Crash Rate: 10 per 100 MVM
Section Injury Crash Rate: 0 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 53 mph
50th Percentile Speed: 47 mph
AADT: 6008 veh/day

Recommended Speed Limit: **55**

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Nassawadox Town NB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 33995.06
Route Name: Route 13
State: Virginia
County: Northampton County
City: Nassawadox town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .98 mile(s)
Statutory Speed Limit: 50 mph
Adverse Alignment: No
Divided/Undivided: Divided
Number of Lanes: 4
Roadside Hazard Rating: 1
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6180 veh/day
Total Number of Crashes: 3
Total Number of Injury Crashes: 2
Section Crash Rate: 27 per 100 MVM
Section Injury Crash Rate: 18 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 65 mph
50th Percentile Speed: 56 mph
AADT: 6180 veh/day

Recommended Speed Limit: **65**

Note: The final recommended speed limit is higher than the statutory speed limit of **50 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Nassawadox Town SB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Northampton County
City: Nassawadox town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .98 mile(s)
Statutory Speed Limit: 50 mph
Adverse Alignment: No
Divided/Undivided: Divided
Number of Lanes: 4
Roadside Hazard Rating: 1
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 5646 veh/day
Total Number of Crashes: 2
Total Number of Injury Crashes: 1
Section Crash Rate: 20 per 100 MVM
Section Injury Crash Rate: 10 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 60 mph
50th Percentile Speed: 53 mph
AADT: 5646 veh/day

Recommended Speed Limit: **60**

Note: The final recommended speed limit is higher than the statutory speed limit of **50 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Keller Town NB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Keller town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .83 mile(s)
Statutory Speed Limit: 50 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6823 veh/day
Total Number of Crashes: 3
Total Number of Injury Crashes: 1
Section Crash Rate: 29 per 100 MVM
Section Injury Crash Rate: 10 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 64 mph
50th Percentile Speed: 57 mph
AADT: 6823 veh/day

Recommended Speed Limit: 65

Note: The final recommended speed limit is higher than the statutory speed limit of **50 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Keller Town SB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Keller town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .83 mile(s)
Statutory Speed Limit: 50 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 7306 veh/day
Total Number of Crashes: 1
Total Number of Injury Crashes: 0
Section Crash Rate: 9 per 100 MVM
Section Injury Crash Rate: 0 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 64 mph
50th Percentile Speed: 57 mph
AADT: 7306 veh/day

Recommended Speed Limit: 65

Note: The final recommended speed limit is higher than the statutory speed limit of **50 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Mappsville NB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.2 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 1
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6908 veh/day
Total Number of Crashes: 17
Total Number of Injury Crashes: 7
Section Crash Rate: 112 per 100 MVM
Section Injury Crash Rate: 46 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 63 mph
50th Percentile Speed: 56 mph
AADT: 6908 veh/day

Recommended Speed Limit: 60

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Mappsville SB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.2 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 1
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6995 veh/day
Total Number of Crashes: 14
Total Number of Injury Crashes: 2
Section Crash Rate: 91 per 100 MVM
Section Injury Crash Rate: 13 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 60 mph
50th Percentile Speed: 54 mph
AADT: 6995 veh/day

Recommended Speed Limit: 60

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Melfa Town NB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Melfa town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .87 mile(s)
Statutory Speed Limit: 50 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 7549 veh/day
Total Number of Crashes: 1
Total Number of Injury Crashes: 0
Section Crash Rate: 8 per 100 MVM
Section Injury Crash Rate: 0 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 58 mph
50th Percentile Speed: 46 mph
AADT: 7549 veh/day

Recommended Speed Limit: 60

Note: The final recommended speed limit is higher than the statutory speed limit of **50 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Melfa Town SB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Melfa town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .87 mile(s)
Statutory Speed Limit: 50 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 7763 veh/day
Total Number of Crashes: 2
Total Number of Injury Crashes: 2
Section Crash Rate: 16 per 100 MVM
Section Injury Crash Rate: 16 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 62 mph
50th Percentile Speed: 57 mph
AADT: 7763 veh/day

Recommended Speed Limit: 60

Note: The final recommended speed limit is higher than the statutory speed limit of **50 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Nelsonia NB

Analyst: VHB

Date: 02-16-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.47 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6883 veh/day
Total Number of Crashes: 34
Total Number of Injury Crashes: 16
Section Crash Rate: 184 per 100 MVM
Section Injury Crash Rate: 87 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 57 mph
50th Percentile Speed: 50 mph
AADT: 6883 veh/day

Recommended Speed Limit: 50

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Nelsonia SB

Analyst: VHB

Date: 02-16-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.47 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6796 veh/day
Total Number of Crashes: 28
Total Number of Injury Crashes: 6
Section Crash Rate: 154 per 100 MVM
Section Injury Crash Rate: 33 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 57 mph
50th Percentile Speed: 50 mph
AADT: 6796 veh/day

Recommended Speed Limit: 55

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - New Church NB

Analyst: VHB

Date: 02-16-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.4 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: Divided
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6570 veh/day
Total Number of Crashes: 21
Total Number of Injury Crashes: 8
Section Crash Rate: 125 per 100 MVM
Section Injury Crash Rate: 48 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 58 mph
50th Percentile Speed: 53 mph
AADT: 6570 veh/day

Recommended Speed Limit: **55**

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - New Church SB

Analyst: VHB

Date: 02-16-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.4 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: Divided
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6627 veh/day
Total Number of Crashes: 15
Total Number of Injury Crashes: 7
Section Crash Rate: 89 per 100 MVM
Section Injury Crash Rate: 41 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 58 mph
50th Percentile Speed: 52 mph
AADT: 6627 veh/day

Recommended Speed Limit: **55**

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Oak Hall NB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.29 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 7264 veh/day
Total Number of Crashes: 19
Total Number of Injury Crashes: 7
Section Crash Rate: 111 per 100 MVM
Section Injury Crash Rate: 41 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 56 mph
50th Percentile Speed: 50 mph
AADT: 7264 veh/day

Recommended Speed Limit: **55**

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Oak Hall SB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.29 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 7348 veh/day
Total Number of Crashes: 19
Total Number of Injury Crashes: 5
Section Crash Rate: 110 per 100 MVM
Section Injury Crash Rate: 29 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 59 mph
50th Percentile Speed: 53 mph
AADT: 7348 veh/day

Recommended Speed Limit: **60**

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Onley Town NB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Onley town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.17 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: Divided
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 8046 veh/day
Total Number of Crashes: 4
Total Number of Injury Crashes: 0
Section Crash Rate: 23 per 100 MVM
Section Injury Crash Rate: 0 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 49 mph
50th Percentile Speed: 41 mph
AADT: 8046 veh/day

Recommended Speed Limit: **50**

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Onley Town SB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Onley town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 1.17 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: Divided
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 8203 veh/day
Total Number of Crashes: 1
Total Number of Injury Crashes: 1
Section Crash Rate: 6 per 100 MVM
Section Injury Crash Rate: 6 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 50 mph
50th Percentile Speed: 39 mph
AADT: 8203 veh/day

Recommended Speed Limit: **50**

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Painter Town NB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Painter town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .89 mile(s)
Statutory Speed Limit: 50 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6694 veh/day
Total Number of Crashes: 3
Total Number of Injury Crashes: 0
Section Crash Rate: 28 per 100 MVM
Section Injury Crash Rate: 0 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 58 mph
50th Percentile Speed: 49 mph
AADT: 6694 veh/day

Recommended Speed Limit: **60**

Note: The final recommended speed limit is higher than the statutory speed limit of **50 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Painter Town SB

Analyst: VHB

Date: 02-04-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Painter town
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: .89 mile(s)
Statutory Speed Limit: 50 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 1
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 7032 veh/day
Total Number of Crashes: 1
Total Number of Injury Crashes: 1
Section Crash Rate: 9 per 100 MVM
Section Injury Crash Rate: 9 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 59 mph
50th Percentile Speed: 51 mph
AADT: 7032 veh/day

Recommended Speed Limit: **60**

Note: The final recommended speed limit is higher than the statutory speed limit of **50 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Temperanceville NB

Analyst: VHB

Date: 02-16-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 2.2 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 6656 veh/day
Total Number of Crashes: 37
Total Number of Injury Crashes: 13
Section Crash Rate: 138 per 100 MVM
Section Injury Crash Rate: 49 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 60 mph
50th Percentile Speed: 54 mph
AADT: 6656 veh/day

Recommended Speed Limit: 60

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

USLIMITS2 Speed Zoning Report

Project Name: Route 13 - Temperanceville SB

Analyst: VHB

Date: 02-16-2016

Basic Project Information
Project Number: 39955.06
Route Name: Route 13
State: Virginia
County: Accomack County
City: Rural/Other
Route Type: Road Section in Undeveloped Area
Route Status: Existing

Roadway Information
Section Length: 2.2 mile(s)
Statutory Speed Limit: 45 mph
Adverse Alignment: No
Divided/Undivided: TWLTL
Number of Lanes: 4
Roadside Hazard Rating: 2
Transition Zone: No

Crash Data Information
Crash Data Years: 5.00
Crash AADT: 7238 veh/day
Total Number of Crashes: 23
Total Number of Injury Crashes: 11
Section Crash Rate: 79 per 100 MVM
Section Injury Crash Rate: 38 per 100 MVM
Crash Rate Average for Similar Roads: 101
Injury Rate Average for Similar Roads: 31

Traffic Information
85th Percentile Speed: 59 mph
50th Percentile Speed: 54 mph
AADT: 7238 veh/day

Recommended Speed Limit: 60

Note: The final recommended speed limit is higher than the statutory speed limit of **45 mph** for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

Appendix D

CONTENTS

Crossover Analysis

Appendix D

Segment #1

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #1							
600/Wise Point Ln/Seaside Rd	70.09			Retain	3,221	Unsignalized	2
681/Latimers Bluff Rd	70.70			Retain	2,957	Unsignalized	0
718/Latimers Siding Rd	71.26			Retain	6,758	Unsignalized	0
645/Arlington Rd/Short St/Cedar Grove Rd	72.54	Close		Retain	1,320	Unsignalized	0
704/Kiptopeke Dr.	72.79	Close		Realign Intersection or relocate	317	Unsignalized	1
704/Kiptopeke Dr.	72.85			entrance to 645/Arlington	1,267	Unsignalized	0
	73.09	Close		Close	686	Commercial	0
	73.22	Close		Add turn lanes	1,373	Farm	0
646/Townsend Dr.	73.48			Retain	845	Unsignalized	6
	73.64			Retain	1,742	Commercial	1
	73.97			Retain	3,062	Farm	0
	74.55			Retain	1,637	Commercial	0

Segment #2

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #2							
	74.78	CLOSED					
683/Capeville Rd.	74.86			Retain	739	Unsignalized	4
	75.00	Close		Close	792	Commercial	0
	75.15	Close		Retain	634	Commercial	0
	75.27	Close		Close & Modify Frontage	317	Stingray's	2
	75.33			Add turn lanes	845	Joint Use Dr	4
	75.49	Close		Add SB Left turn lane	845	Commercial	2
	75.65	Close		Retain	950	Median Break	0
644/Arlington Rd	75.83			Add SB Left turn lane	1,003	Unsignalized	1
	76.02			Retain	845	Residential	0
	76.18	Close		Retain	792	Residential	0
	76.33			Retain	1,003	Farm	0
	76.52	Close		Retain	739	Farm	0
	76.66	Close		Close	634	Commercial	1
	76.78			Lengthen left turn lanes	1,954	Commercial	0
	76.96	CLOSED					
	77.15	Close		Retain	1,003	Median Break	0
643/Holly Dale/Plantation	77.34			Retain	792	Unsignalized	1
	77.49	Close		Retain	792	Median Break	0
	77.64			Retain	1,003	Church	0
682/Jacobia Ln	77.83	Close		Retain	686	Unsignalized	0
Edwin Farm Rd	77.96	Close		Close	686	Farm	0
684/Fairview Rd	78.09			Add NB left turn lane	1,162	Unsignalized	0
	78.31			Add turn lanes	1,056	Farm	1
	78.51	Close		Retain	1,584	Commercial	0
	78.81	Close		Retain	950	Residential	0

Segment #3

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #3							
641/Parsons Cir/Bayview Cir	78.99			Retain	1,003	Unsignalized	4
	79.18			Widen median for two-stage left	1,214	Commercial	4
184/Stone Rd/S Bayside Rd	79.41			Retain	1,214	Signalized	5
641/Parsons Cir/Bayview Cir	79.64			Lengthen SB left turn lane	1,267	Unsignalized	3
	79.88	Close		Close	792	Median Break	0
	80.03	Close		Add NB left turn lanes	950	Commercial	2
	80.21			Add left turn lanes	2,165	Connector Rd	1
680?/Townefield/Cherrystone Rd	80.62			Lengthen left turn lanes	2,482	Signalized	2
13 Bus/N Bayside Rd	81.09			Add NB left turn lane	1,214	Unsignalized	0
	81.32	Close		Add left turn lanes	950	Farm	0
	81.50	Close		Lengthen SB left turn lane. Add NB LTL	1,320	Commercial	0
	81.75			Add left turn lanes	1,848	Farm	2
	82.10	Close		Add left turn lanes	1,584	Farm	0
636/Eyrehall Dr(Pvt)/Cobbs Station Rd	82.40			Create RCUT treatment	1,531	Unsignalized	2
	82.69			Add left turn lanes	1,320	Farm	0
	82.94	Close		Add left turn lanes	1,426	Farm	0
	83.21	Close		Add left turn lanes	792	Residential	2
	83.36	Close		Retain	1,373	Commercial	0
633/Eyreville Dr(Pvt)/Simpkins Dr	83.62			Lengthen left turn lanes. Frontage	1,426	Unsignalized	2
	83.89	Close		Add left turn lanes	1,320	Commercial	0
Captain Howe Ln	84.14	Close		Retain	845	Connector Rd	1
13 Bus/Courthouse Rd/632/Indian Walk Ln	84.30			Retain	2,218	Unsignalized	1
648/Stumptown Dr	84.72			Lengthen left turn lanes	2,112	Unsignalized	0
	85.12	Close		Add left turn lanes	2,059	Median Break	0
631/Willow Oak Rd	85.51			Lengthen left turn lanes	1,162	Signalized	0
	85.73	Close		Add NB left turn lane	3,274	Commercial	0
	86.35	Close		Move crossing south. Add LTLs	1,373	Median Break	0

Segment #4

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #4							
13 Bus/Courthouse Rd/630/Cherrydale Dr	86.61			Lengthen NB left turn lanes	581	Unsignalized	2
674/Kendall Grove Rd	86.72	Close		Close	1,426	Unsignalized	0
	86.99	Close		Add left turn lanes	898	Median Break	1
	87.16			Lengthen SB left turn lane. Add NB LTL	1,267	Church	0
	87.40	Close		Add left turn lanes	634	Farm	0
	87.52	Close		Close	1,373	Median Break	0
Reedtown Ln	87.78			Lengthen SB left turn lane. Add NB LTL	1,267	Farm	0
Bell Ln	88.02			Lengthen SB left turn lane. Add NB LTL	1,214	Residential	0
	88.25	Close		Close	739	Residential	0
T-1702	88.39	Close		Lengthen SB left turn lane. Add NB LTL	1,742	Connector Rd	0
628/James Allen Dr	88.72			Lengthen SB left turn lane. Add NB LTL	1,637	Unsignalized	2
628/Wilsonia Neck Dr	89.03			Lengthen NB left turn lane. Add SB LTL	2,323	Unsignalized	1

Segment #5

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #5							
	89.24	CLOSED					
627/Young St	89.47			Lengthen NB left turn lane. Add SB LTL	898	Unsignalized	0
626/connector road to Machipongo Dr	89.64			Lengthen SB left turn lane. Add NB LTL. Access management of commercial property	1,531	Unsignalized	1
	89.93		Close	Add left turn lanes	2,323	Farm	1
	90.37	Close		Add left turn lanes	1,426	Farm	0
625/Sylvan Scene Dr	90.64			Lengthen left turn lanes	2,112	Unsignalized	1
	91.04			Add left turn lanes	1,003	Residential	0
T-1502	91.23	Close		Lengthen NB left turn lane. Add SB LTL	1,003	Unsignalized	0
622/Treherneville Dr	91.42			Retain	3,749	Unsignalized	3
	91.79	CLOSED					
	92.13	Close		Lengthen NB left turn lane. Add SB LTL	1,003	Commercial	0
620/Birds Nest Dr	92.32			Retain	2,746	Unsignalized	0
	92.57	CLOSED					
	92.84		Close	Add left turn lanes	2,165	Farm	0
	93.25		Close	Close	2,006	Median Break	0
	93.63	Close		Lengthen NB left turn lane. Add SB LTL. Perform access management	1,162	Mix of Access	0
617/Bayford Rd/Red Bank Rd	93.85			Retain	1,373	Unsignalized	1

Segment #6

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #6							
	94.11	Close		Add turn lanes	1,795	Farm	0
	94.45	Close	Close	Add turn lanes	2,112	Farm	0
609/Franktown Rd	94.85			Retain	1,003	Unsignalized	0
601/Mill St	95.04			Lengthen SB left turn lane. Add NB LTL	898	Unsignalized	0
606/Rogers Dr	95.21			Retain	898	Signalized	3
	95.38			Close	950	Median Break	0
T-678/Pine Ave	95.56			Lengthen NB left turn lane. Add SB LTL	898	Unsignalized	0
	95.73	Close		Lengthen NB left turn lane. Add SB LTL	2,165	Commercial	0
688/Hare Valley Dr	96.14			Lengthen left turn lanes	1,267	Unsignalized	1
	96.38			Retain	2,429	Church	1
605/Brickhouse Dr	96.84			Retain	2,429	Unsignalized	0
Oakland Dr	97.30			Add left turn lanes	3,802	Farm	0
	98.02			Lengthen NB left turn lane. Add SB LTL	1,531	Farm	0
13 Bus/Main St	98.31			Close	739	Unsignalized	2
618/Hadlock Ln/604/Oakland Dr	98.45			Lengthen left turn lanes	1,426	Signalized	9

Segment #7

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #7							
652/Broadwater Rd/Cathey Ave	98.72			Lengthen SB left turn lane	1,109	Signalized	10
	98.93			Remove Signal. Install RCUT - or - Add ped crossings	792	Signalized	5
	99.08			Add NB left turn lane	739	Commercial	0
T-1043/ Benjamin St	99.22			Retain	1,003	Unsignalized	1
Sojourner Truth Rd	99.41			Add SB Left turn lane	1,478	Community	1
183/Occohannock Neck Rd	99.69			Retain	2,640	Signalized	0
178/Belle Haven Rd/Main St	100.19			Retain	950	Signalized	1
	100.37			Lengthen SB left turn lane. Add NB LTL	950	Commercial	0
687/Tower Way/Lincoln Ave	100.55			Lengthen left turn lanes	1,426	Unsignalized	5
601/Merry Cat Ln	100.82			Lengthen left turn lanes	2,165	Signalized	3
181/King St	101.23			Lengthen left turn lanes	370	Unsignalized	3
	101.30	Close		Close	475	Commercial	3
603/Savagetown Rd	101.39			Lengthen left turn lanes	2,798	Unsignalized	0
	101.92			Lengthen NB left turn lane. Add SB LTL	1,954	Commercial	0
	102.29	Close		Confirm land use. Access mngt? RCUT?	739	Commercial	1
	102.43	Close		Confirm land use. Access mngt? RCUT?	1,954	Commercial	1
	102.80	Close		Lengthen NB left turn lane. Add SB LTL	845	Church	0
607/Coal Kiln Rd	102.96			Lengthen left turn lanes	2,323	Unsignalized	0

♦ Segment #8

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #8							
	103.21	CLOSED		'mj,			
	103.40			Add left turn lanes	3,643	Residential	2
	103.66	CLOSED					
	103.76				Flush Median		
614/Wayside Dr/Rte 1203	104.09					Signalized	1
	104.35						
	104.69		Close	Close	1,637	Farm	0
620/Keller Pond Rd	105.00			Lengthen left turn lanes	686	Unsignalized	1
	105.13			close	317	Civic	0
	105.19			Add left turn lanes	1,584	Civic	0
	105.49			Add SB Left turn lane	2,376	Commercial	0
	105.94			Add left turn lanes	2,746	Residential	0
620/West St/Keller Pond Rd	106.46			Lengthen left turn lanes	898	Unsignalized	0
	106.58						
1403/Second St	106.63					Unsignalized	1
1402/First St	106.70				Flush Median	Unsignalized	0
1401/180/N.R. North St/696/N.R. St	106.77			Access Mgmt		Unsignalized	1
	106.95						
623/Adams Crossing/Wachapreague Rd	107.22			Lengthen left turn lanes.	2,006	Signalized	3
	107.60			Add left turn lanes	845	Residential	1
734/Gospel Temple Road	107.76	Close		RCUT Partial Closure. Lengthen NB LTL	317	Unsignalized	2
734/connector road to Rack Track Rd	107.82	Close		RCUT Partial Closure. Lengthen SB LTL	1,056	Unsignalized	1
Airport Access	108.02			Add SB Left turn lane	1,426	Commercial	1
Eastern Shore Community College	108.29			Lengthen NB left turn. Add SB LTL		Civic	1
	108.62				Flush Median		
626/Main St	109.12			Add pedestrian crossing		Signalized	1
	109.70						
	109.94		Close	Add left turn lanes	1,954	Farm	0
639/Dogwood Dr/Phillips Dr	110.31			RCUT	1,003	Unsignalized	8

♦ Segment #9

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #9							
	110.50	Close		Add SB left turn lane	950	Commercial	2
	110.68			Lengthen SB left turn lane	1,901	Commercial	1
	111.04			Lengthen NB left turn lane	1,056	Commercial	0
	111.24			Lengthen NB left turn lane. Add SB LTL	1,373	Civic	1
716/Warrior Dr	111.50	Close		Retain	1,056	Unsignalized	2
Onley Rd	111.70			Lengthen left turn lanes.	1,003	Signalized	8
South of the Wal-mart	111.89	Close			845	Connector Rd	0
609/Coastal Blvd	112.05			Lengthen left turn lanes. Improve gtry	1,848	Signalized	0
1610/Washington St	112.40			Lengthen NB left turn lane. Acces mgmt	1,109	Unsignalized	0
Bank St	112.61			Remove signal. RCUT partial closure	792	Signalized	2
179/Market St	112.76			Retain	1,478	Signalized	1
Chesapeake Square/AutoZone	113.04			Retain	3,432	Signalized	8
650/Taylor Rd	113.69			Lengthen left turn lanes	845	Unsignalized	5
	113.85	Close		Lengthen left turn lanes	739	Commercial	2
648/Daugherty Rd	113.99			RCUT partial closure	1,162	Unsignalized	13
	114.21	Close		Lengthen SB left turn. Add NB left turn	898	Residential	0
	114.38		Close	Close	1,003	Farm	0
657/Edgar Thomas Rd	114.57	Close		Lengthen NB left turn lane. Add SB LTL	1,373	Unsignalized	2
13 Bus/Tasley Rd/Front St	114.83			Lengthen left turn lanes. Check signal visibility.	1,214	Signalized	5
	115.06	Close		Add left turn lanes	4,646	Farm	2
	115.40	CLOSED					
764/Accomac Rd/Courthouse Ave	115.94			Lengthen left turn lanes. Check signal visibility.	1,478	Signalized	6
Accomack Office Center	116.22			Lengthen NB left turn lane. Add SB LTL	1,109	Commercial	0

Segment #10

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #10							
	117.69				Flush Median		
	118.68						
661/Evans Rd/Johnson Rd	118.83			Lengthen SB left turn lane	2,059	Unsignalized	1
	119.03	CLOSED					
Cardinal Acres Dr	119.22	Close		Lengthen SB left turn lane	739	Residential	1
665/Orchard Rd	119.36	Close		Add NB left turn lane	1,003	Unsignalized	0
176/Parksley Rd	119.55			Lengthen left turn lanes	1,214	Signalized	9
Head Start	119.78			Lengthen left turn lanes	528	Civic	0
	119.88			Close	792	Farm	2
679/Metompkin Rd	120.03			Lengthen SB left turn lane. Add NB left turn lane	2,165	Unsignalized	2
	120.23	CLOSED					

Segment #11

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #11							
Kinsey Dr	120.44			Add left turn lanes	1,742	Unsignalized	0
	120.61	CLOSED					
	120.77	Close		Close	686	Commercial	0
Johnson Warton Ln	120.90			Add left turn lanes	2,112	Residential	0
	121.12	CLOSED					
	121.22	CLOSED					
677/Whites Neck Rd	121.30			Lengthen left turn lanes. Access mgmt	2,218	Unsignalized	1
	121.43	CLOSED					
	121.72	Close		Add left turn lanes	686	Residential	0
676/Mutton Hunk Rd	121.85			Close	264	Unsignalized	5
676/Dennis Dr	121.90	Close		Close. Add RCUT north of Dennis Dr	1,531	Unsignalized	5
	122.19			Lengthen NB left turn lane	1,003	Commercial	1
	122.38		Close	Close	1,320	Median Break	1
	122.63	Close		Add left turn lanes	475	Commercial	1
Residential/Medical Office	122.72			RCUT partial closure	686	Residential	0
680/Gargatha Landing Rd	122.85	Close		Lengthen left turn lanes	370	Unsignalized	4
680/Berry Rd	122.92			Close	739	Unsignalized	1
	123.06			Add left turn lanes	1,373	Median Break	0
681/Mason Rd	123.32			Close	528	Unsignalized	0
681/Littleton Rd	123.42	Close		Close. Add RCUT north of Littleton Rd	1,267	Unsignalized	0

Segment #12

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #12							
	123.66	Close		Add left turn lanes	898	Residential	0
	123.83			Add left turn lanes	4,330	Residential	1
	123.94				Flush Median		
187/Nelsonia Rd	124.23			Access Mgmt		Signalized	
	124.36						
	124.65			Lengthen SB left turn lane	1,109	Commercial	0
	124.86	Close		Close. Add RCUT south of driveway	528	Commercial	0
775/Sherwood Dr	124.96			Lengthen the SB left turn lane	1,109	Unsignalized	1
	125.17	Close		Add left turn lanes	1,320	Residential	0
	125.33	CLOSED					
729/Finney Mason Ln	125.42			Lengthen NB left turn lane. Add SB LTL	422	Unsignalized	2
Gillespie Ln	125.50	Close		Close	1,056	Farm	1

Segment #13

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #13							
	128.94			Add left turn lanes	845	Median Break	0
	129.10	Close		Lengthen NB left turn lane. Add SB LTL	950	Farm	0
	129.28			Close	686	Median Break	0
	129.41			Lengthen NB left turn lane. Add SB LTL	739	Commercial	2
	129.55			Widen roadway to provide left	Flush Median	Residential	0
695/Old Temperanceville Rd	129.98			Close roadway access completely		Unsignalized	8
695/Saxis Rd/Temperanceville Rd	130.08			Lengthhen NB left turn lane		Unsignalized	8
	130.32						
	130.42			Widen roadway to provide left turn lanes	845	Residential	
	130.58		Close	Close	2,270	Median Break	0
	131.01			Lengthen left turn lanes	792	Poultry Farm	0
	131.16			Close	792	Median Break	0
	131.31		Close	Close	1,003	Median Break	0
	131.50		Close	Add left turn lanes	739	Median Break	0
	131.64		Close	Close	475	Median Break	0
	131.73		Close	Close	739	Median Break	0
694/Jesusalem Rd	131.87			Lengthen SB left turn lane. Add NB LTL	686	Unsignalized	2
702/Horsey Rd/Nocks Landing Rd	132.00			Lengthen left turn lanes	792	Signalized	8
	132.15			Retain	634	Civic	1
	132.27			Close	264	Civic	3
705/Paige Fisher Rd	132.32			Lengthen left turn lanes	264	Unsignalized	5
	132.37			Close	898	Commercial	1
	132.54			Close	370	Commercial	1
	132.61			Add left turn lanes	317	Farm	0
	132.67				Flush Median		
703/Withams Rd	133.01			Retain		Unsignalized	
	133.27						
	133.46			Lengthen the NB left turn lane. Add SB LTL	792	Median Break	2
Oak Hall	133.61			Retain	634	Signalized	5
175/Chincoteague Rd	133.73			Lengthen left turn lanes	1,109	Signalized	19

♦ Segment #14

Intersection/Route #	Mile Post	2002 Recommendation	2014 VDOT Recommendation	2015 Study Recommendation	Distance to Crossover North (ft)	Notes	Total Number of Crashes 2010-2014
SEGMENT #14							
	133.94	Close		Lengthen left turn lanes	1,531	Commercial	2
	134.23			Lengthen NB left turn lane. Access mgmt	475	Commercial	1
	134.32	Close		Close	2,165	Residential	0
	134.73	Close		Add left turn lanes	950	Median Break	0
704/Coardtown Rd	134.91	Close		Close	739	Unsignalized	1
704/Green Hill Rd	135.05			Lengthen left turn lanes	845	Unsignalized	0
Riverside	135.21	Close	Close	Close	1,267	Commercial	0
	135.45	Close		Add left turn lanes	792	Residential	1
	135.60			Lengthen NB left turn lane	950	Commercial	1
710/Nelson Rd	135.78	Close		Lengthen NB left lane. Add SB LTL	581	Unsignalized	1
Weigh Station	135.89	Retain for Authorized Vehicles Only. Consider moving north. If truck is on scales, it obstructs driver's sight line.			528		1
	135.99	Close		Close	317	Commercial	1
2304/Hudson St	136.05			Close	581	Unsignalized	2
709/Horntown Rd	136.16	Close		Lengthen NB left turn lane.	475	Unsignalized	4
	136.25	Close		Close	792	Residential	1
710/Nelson Rd	136.40	Close		Close	370	Unsignalized	1
710/Davis Rd	136.47			Lengthen SB left turn lane. Add NB LTL	1,901	Unsignalized	3
Rest Area	136.83			Add SB left turn lane	581	Rest Area	0
Rest Area	136.94			Lengthen NB left turn lane	898	Rest Area	0
Substation	137.11			Lengthen NB left turn lane. Add SB LTL	2,165	Commercial	2
	137.30	CLOSED					
	137.52			Lengthen left turn lanes	739	Commercial	0
710/Davis Rd	137.66			Retain	845	Unsignalized	1
780/Sparrow Rd/MarVa Rd	137.82			Length NB left turn lane		Unsignalized	3

Appendix E

CONTENTS

Site Specific Cost Estimate

This page intentionally left blank.

		Location 1	Location 2	Location 3	Location 4	Location 5	Location 6	Location 7	Location 8	Location 9	Location 10	Location 11	Location 12	Location 13
Tier 1	Signage	$ 5,585	$ 71,167	$ 28,302	$ 22,717	$ 49,448	$49,448	$ 5,585	$ 43,862	$28,302	$ 29,114	$ 43,862	$ 43,862	$ 34,699
	Pavement Markings	$ 8,882	$ 31,039	$ 30,717	$ 8,215	$ 24,267	$37,748	$ 4,798	$ 9,527	$15,302	$ 9,375	$ 9,969	$ 10,115	$ 25,848
	Signal	$ -	$ 792	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 950	$ -	$ -	$ 792
	Other	$ 166	$ 332	$ 166	$ 166	$ 332	$ 332	$ 166	$ 166	$ 332	$ 79,366	$ 166	$ 166	$ 332
	Total	**$ 14,633**	**$ 103,329**	**$ 59,185**	**$ 31,098**	**$ 74,046**	**$87,528**	**$ 10,549**	**$ 53,555**	**$43,936**	**$ 118,804**	**$ 53,997**	**$ 54,143**	**$ 61,671**
Tier 2	Signage	$ -	$ 24,275	$ 2,657	$ 2,657	$ 6,218	$ 6,218	$ -	$ 6,218	$ 2,657	$ 10,534	$ 6,218	$ 6,218	$ 10,534
	Pavement Markings	$ -	$ 1,663	$ 185	$ 554	$ 515	$ 554	$ -	$ 554	$ 370	$ 1,188	$ 739	$ 739	$ 739
	Signal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Other	$ 500	$ 1,320	$ -	$ -	$ 1,320	$ 660	$ 660	$ 660	$ 1,320	$ 660	$ 660	$ 660	$ 1,320
	Total	**$ 500**	**$ 27,258**	**$ 2,842**	**$ 3,211**	**$ 8,053**	**$ 7,432**	**$ 660**	**$ 7,432**	**$ 4,347**	**$ 12,382**	**$ 7,617**	**$ 7,617**	**$ 12,593**
Tier 3	Signage	$ 2,345	$ 22,420	$ 11,694	$ 9,349	$ 15,374	$15,374	$ 2,345	$ 13,029	$11,694	$ 7,441	$ 13,029	$ 13,029	$ 9,785
	Pavement Markings	$ -	$ 417	$ 417	$ 417	$ 832	$ 832	$ -	$ 832	$ 417	$ -	$ 832	$ 832	$ -
	Signal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Other	$ 9,077	$ 6,653	$ 2,376	$ 2,376	$ 11,993	$16,253	$ 4,277	$ 951	$ 3,327	$ 2,376	$ 2,376	$ 2,376	$ 18,653
	Lengthen Turn Lanes		$ 147,000	$ 21,000	$ 63,000	$ 63,000	$21,000		$ 57,173		$ 63,000	$ 84,000	$ 84,000	$ 84,000
	Install Turn Lanes	$ 96,000		$ 144,000	$ 48,000									
	Access Management								$ 16,213				$ 16,213	
	Pave Driveway Apron			$ 3,000						$ 3,000				
	Roadway Lighting		$ 40,000			$ 20,000								
	Widen Shoulder & Add Guardrail							$ 30,000		$30,000				
	Widening		$ 167,272				$41,818	$ 83,636						$ 83,636
	New Signal		$ 490,000											
	RCUT		$ 196,102	$ 196,102									$ 196,102	
	Total	**$ 107,422**	**$ 1,069,864**	**$ 378,589**	**$ 123,142**	**$ 111,199**	**$95,277**	**$ 120,258**	**$ 88,198**	**$48,438**	**$ 72,817**	**$ 100,237**	**$ 312,552**	**$ 196,074**

		Location 14	Location 15	Location 16	Location 17	Location 18	Location 19	Location 20	Location 21 Location 22	Location 23	Location 24	Location 25
Tier 1	Signage	$ 71,511	$ 53,727	$ 12,129	$ 58,374	$ 29,114	$ 65,799	$ 51,019	$ 127,335	$29,114	$ 5,075	$ -
	Pavement Markings	$ 28,606	$ 9,837	$ 9,557	$ 23,014	$ 11,728	$ 38,577	$ 17,302	$ 40,008	$10,126	$ -	$ 5,940
	Signal	$ -	$ -	$ 634	$ -	$ 792	$ 554	$ -	$ -	$ 871	$ -	$ -
	Other	$ 830	$ 166	$ 166	$ 498	$ 79,366	$ 79,698	$ 498	$ 12,958	$ 166	$ 166	$ 166
	Total	**$ 100,947**	**$ 63,731**	**$ 22,486**	**$ 81,885**	**$ 121,000**	**$ 184,628**	**$ 68,819**	**$ 180,301**	**$40,277**	**$ 5,241**	**$ 6,106**
Tier 2	Signage	$ 15,841	$ 19,603	$ 2,771	$ 8,521	$ 10,534	$ 68,596	$ 5,314	$ 148,786	$10,534	$ 5,817	-
	Pavement Markings	$ 739	$ 554	$ 554	$ 185	$ 370	$ 4,911	$ 740	$ 555	$ 924	$ -	$ 3,630
	Signal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Other	$ 3,300	$ 660	$ 660	$ 1,980	$ 660	$ 1,980	$ 1,980	$ 1,980	$ 660	$ 660	$ 660
	Total	**$ 19,880**	**$ 20,817**	**$ 3,985**	**$ 10,686**	**$ 11,564**	**$ 75,487**	**$ 8,034**	**$ 151,321**	**$12,118**	**$ 6,477**	**$ 4,290**
Tier 3	Signage	$ 30,957	$ 15,374	$ 11,670	$ 26,238	$ 7,441	$ 88,710	$ 21,043	$ 165,194	$ 7,441	$ 3,620	-
	Pavement Markings	$ 2,083	$ 1,664	$ 417	$ 834	$ 832	$ 417	$ 834	$ 1,249	$ 417	$ 832	$ 2,640
	Signal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Other	$ 28,229	$ 16,032	$ 2,376	$ 18,216	$ 2,376	$ 20,650	$ 7,128	$ 7,128	$ 2,535	$ 8,477	$ 2,376
	Lengthen Turn Lanes	$ 63,000	$ 63,000	$ 42,000	$ 63,000		$ 21,000	$ 84,000	$ 84,000	$63,000		
	Install Turn Lanes				$ 96,000	$ 96,000						
	Access Management				$ 16,213	$ 16,213	$ 244,688	$ 16,213				
	Pave Driveway Apron											
	Roadway Lighting	$ 20,000			$ 40,000					$20,000		
	Widen Shoulder & Add Guardrail		$ 30,000		$ 30,000		$ 30,000	$ 30,000				
	Widening	$ 83,636	$ 41,818		$ 83,636		$ 83,636					
	New Signal											
	RCUT							$ 196,102	$ 196,102			
	Total	**$ 227,905**	**$ 167,888**	**$ 56,463**	**$ 374,137**	**$ 122,862**	**$ 489,101**	**$ 355,320**	**$ 453,673**	**$93,393**	**$12,929**	**$ 5,016**

This page intentionally left blank.

Appendix F

CONTENTS

Restricted Crossing U-Turn Intersection

TECHBRIEF

Restricted Crossing U-Turn Intersection

FHWA Publication No.: FHWA-HRT-09-059

FHWA Contact: Joe Bared, HRDS-05, (202) 493-3314, joe.bared@dot.gov

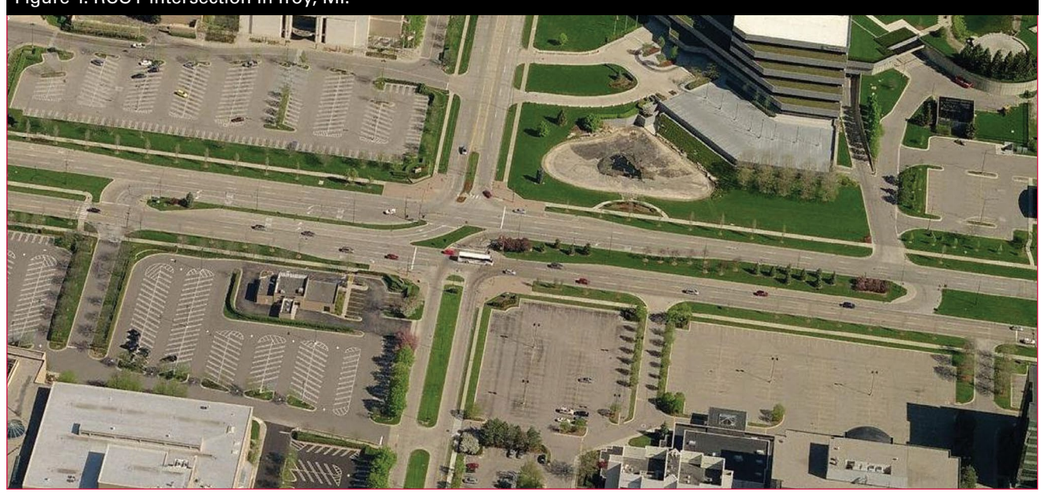
This document is a technical summary of the Federal Highway Administration report, *Alternative Intersections/Interchanges: Information Report (AIIR)* (FHWA-HRT-09-060).

Objective

Today's transportation professionals, with limited resources available to them, are challenged to meet the mobility needs of an increasing population. At many highway junctions, congestion continues to worsen, and drivers, pedestrians, and bicyclists experience increasing delays and heightened exposure to risk. Today's traffic volumes and travel demands often lead to safety problems that are too complex for conventional junction designs to properly handle. Consequently, more engineers are considering various innovative treatments as they seek solutions to these complex problems.

The corresponding report, *Alternative Intersections/Interchanges: Informational Report (AIIR)* (FHWA-HRT-09-060), covers four intersection designs and two interchange designs. These designs offer substantial advantages over conventional at-grade intersections and grade-separated diamond interchanges. The *AIIR* provides information on each alternative treatment and covers salient geometric design features, operational and safety issues, access management, costs, construction sequencing, and applicability. This TechBrief summarizes information on one alternative intersection design—the restricted crossing U-turn (RCUT) intersection (see figure 1).

Figure 1. RCUT intersection in Troy, MI.

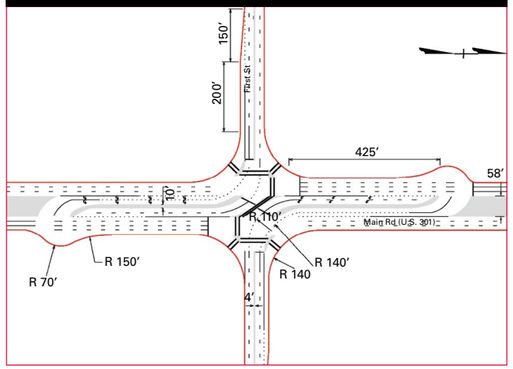


U.S. Department of Transportation
Federal Highway Administration
www.tfhrc.gov
Research, Development, and Technology Turner-Fairbank Highway Research Center 300 Georgetown Pike, McLean, VA 22101-2296

Introduction

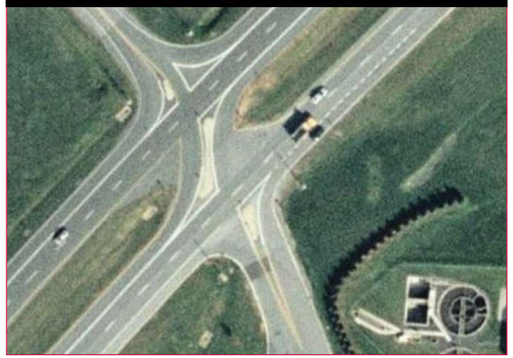
The RCUT, also referred to as the superstreet intersection or J-turn intersection, is characterized by the prohibition of left-turn and through movements from side street approaches as permitted in conventional designs. Instead, the RCUT intersection accommodates these movements by requiring drivers to turn right onto the main road and then make a U-turn maneuver at a one-way median opening 400 to 1,000 ft after the intersection. Left turns from the main road approaches are executed in a manner similar to left turns at conventional intersections and are unchanged in this design (see figure 2). Left-turn movements from the major road could also be removed at primarily rural unsignalized RCUT designs.

Figure 2.Typical RCUT plan view with crossovers on mainline approaches.



RCUT intersections have been constructed in several States following the introduction of the concept in the early 1980s.[1] An RCUT at a location in Michigan is shown in figure 1. Other installations include three unsignalized RCUT intersections on U.S. Route 301 on Maryland's Eastern Shore and two on U.S. Route 15 in Emmitsburg, MD. One of the Emmitsburg, MD, installations is shown in figure 3. RCUT intersections have also been recently installed at several locations in North Carolina, including a 2.5-mi stretch of U.S. Route 23/74 in Haywood County, where three RCUT intersections were installed. Five RCUTs were also installed on Route 1 in Lee and Moore Counties, and three were installed on a signalized corridor of U.S. Route 17 in Brunswick County.

Figure 3. U.S. Route 15 RCUT intersection in Emmitsburg, MD.



Geometric Design

Geometric aspects of RCUT intersections can vary, but a typical design is shown in figure 2 and discussed as follows:

- The RCUT intersection has either no median openings at the intersection or has only one-way median openings for the exclusive use of left-turning traffic from the main road.
- Desirable minimum median widths between 40 and 60 ft are typically needed to accommodate large trucks so that they do not encroach on curbs or shoulders. RCUT intersections with narrower medians need bulb-outs or loons at U-turn crossovers (see figure 4).
- The spacing from the main intersection to the U-turn crossover varies in practice. The American Association of State Highway and Transportation Officials recommends spacing of 400 to 600 ft based on signal timing.[2] The Michigan Department of Transportation recommends 660 ft ±100 ft, and the North Carolina Department Transportation standard minimum spacing between main intersections and crossovers is 800 ft.
- Driveways should not be allowed near the main intersection or on the opposite side of

Figure 4. Movement in a loon at a crossover that features two U-turn lanes.

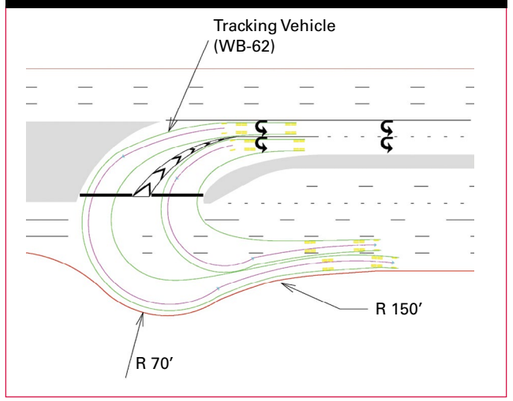
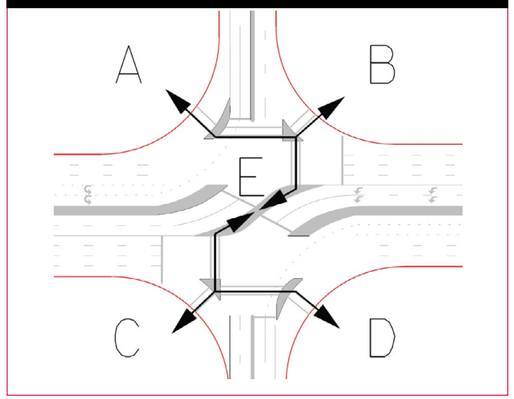


Figure 5. Pedestrian movements in an RCUT intersection.



the arterial from the median U-turn (MUT) to reduce the chance of wrong-way movements in the crossover.

- Pedestrian crossings of the major road at the RCUT intersection are usually accommodated on one diagonal path from one corner to the opposite corner (see figure 5).

Traffic Signal Control

One typical design (as in figure 2) of an RCUT intersection may have three distinct intersections operating under traffic signal control with just two phases and relatively short cycles. Signal warrants provided in the *Manual on Uniform Traffic Control Devices (MUTCD)* provide key guidance on the justification for signal control at the locations where U-turns are made.[3] One theoretical benefit of the RCUT intersection is that signal controllers for one direction of the arterial could be operated independently of the signal controllers for the opposite direction of the arterial. It is also feasible to use one controller for the three signal locations.

Operational Performance

The traffic simulation software VISSIM was used to compare the operational performance of RCUTs to conventional intersections. Five RCUT designs were modeled for three traffic scenarios and compared to conventional intersections. For the case where the minor flow was less than 0.2 of the total flow, simulation results indicated the following:

- Up to a 30-percent increase in throughput (i.e., the number of vehicles exiting the intersection).
- Up to a 40-percent reduction in network intersection travel time.

Safety Performance

RCUT intersections have 18 conflict points compared to 32 at conventional intersections. The RCUT intersection appears to offer substantial safety advantages over conventional intersections. For example, for the RCUT intersections on the U.S. Route 23/74 corridor in North Carolina, there was a 17-percent decrease in total crashes, a 31-percent decrease in total crash rate, a 41-percent decrease in fatal/injury crashes, and a 51-percent decrease in fatal injury crash rate. Higher reductions were observed for the three unsignalized RCUTs that replaced conventional intersections on the Eastern Shore of Maryland. For the U.S. Route 17 corridor in North Carolina, total crash rates were found to be lower than the 10-year average for 25 signalized conventional intersections in Charlotte, NC, with comparable annual average daily traffic.

Applicability

RCUT intersections are typically implemented as part of a corridor treatment; however, they can be used at isolated intersections. Unsignalized RCUT intersections preserve corridor capacity and can be installed without the adverse effects of signal control. Scenarios where RCUT intersections are most applicable include the following:

- Relatively low to medium side-street through volumes and heavy left-turn volumes from the major road.
- The minor road total volume to total intersection volume ratio is typically less than or equal to 0.20.
- Areas where median widths are greater than 40 ft. For narrower medians, loons on the shoulders need to be constructed.
- For intersections with very high left-turn and through volumes from the side road approaches, RCUT intersection design is not the optimum choice. Refer to the *AIIR* for other alternative treatments.

Summary

RCUT intersections reroute minor street left-turn and through movements to an MUT crossover and thereby provide major advantages, including reduced delay and congestion for through traffic on the major road and reduced opportunities for crashes compared to conventional designs. More details on the RCUT intersection can be found in the full *AIIR* available from the Federal Highway Administration.

References

1. Kramer, R.P. (1987). "New Combinations of Old Techniques to Rejuvenate Jammed Suburban Arterials, Strategies to Alleviate Traffic Congestion," Conference Proceedings, *Institute of Transportation Engineers*, 139–148, Washington, DC.
2. American Association of State Highway and Transportation Officials. (2004). *A Policy on Geometric Design of Highways and Streets*, Washington, DC.
3. Federal Highway Administration. (2003). *The Manual on Uniform Traffic Control Devices (MUTCD)*, Washington, DC.

Researchers—This study was performed by Principal Investigators Warren Hughes and Ram Jagannathan. For more information about this research, contact Joe Bared, FHWA Project Manager, HRDS-05 at (202) 493-3314, joe.bared@dot.gov.

Distribution—This TechBrief is being distributed according to a standard distribution. Direct distribution is being made to the Divisions and Resource Center.

Availability—This TechBrief may be obtained from the FHWA Product Distribution Center by e-mail to report.center@dot.gov, fax to (814) 239-2156, phone to (814) 239-1160, or online at http://www.tfhrc.gov/safety.

Key Words—Superstreet, Alternative intersection, Restricted crossing U-turn, and RCUT.

Notice—This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document. The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

Quality Assurance Statement—The Federal Highway Administration (FHWA) provides high-quality information to serve the Government, industry, and public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

OCTOBER 2009

FHWA-HRT-09-059
HRDS-05/10-09(3M)E

www.vhb.com

vhb

VDOT
Virginia Department of Transportation