

Route 2/17

CORRIDOR STUDY FINAL REPORT

SPOTSYLVANIA COUNTY, VIRGINIA

December 2018





Business Route 2 and 17 have seen a substantial increase in traffic during recent years. The traffic added to the area cause operational and safety issues, and with continuous development in the area, more traffic related issues are expected. In an attempt to address these challenges, the County conducted this corridor study (Rte. 2/17 Corridor Study) to evaluate the existing conditions of the corridor, identify any issues and study potential solutions. Recommended scenarios will be selected in terms of cost and support to the economic growth in the area, at the same time improve the overall travel experience for all modes of transportation (motorized and non-motorized). The study also aims in developing a corridor specific access management guideline.

The first task of the study is evaluating the existing conditions of the roadways and intersections within the vicinity of the study corridor. The main corridor in this study is Rte. 2/17 starting from the City of Fredericksburg at the north to the Caroline County Line at the south. This roadway is classified as Minor Arterial with various ADTs of (5,600-7,500-24,000) vpd. Most of the roadway is a two-lane undivided with some sections of two-way left-turn lanes. Speed limit starts at 35 mph from the beginning (just north of the City of Fredericksburg limits) to 45 mph south of the County limits, and 55 mph south of the intersection of US-17 to the Caroline County Line.

The existing condition evaluations consist of conducting traffic turning movement counts, crash analysis, access management assessment, evaluation of public transit and pedestrian/bicyclist facilities, traffic control device assessment, sensitive environmental identifications, and assessment of the existing bridges and culverts along the corridor. The microsimulation traffic model, VISSIM, was used to determine the capacity analysis of the roadways and the intersections in terms of Levels of Service (LOS) and the overall network (corridor) performance.



DRAWN BY:

BNG

INTRODUCTION

SCALE:

NTS

DATE:

08/30/2017

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

1

OF

1





LEGEND

xxxx AM Peak Hour Volume

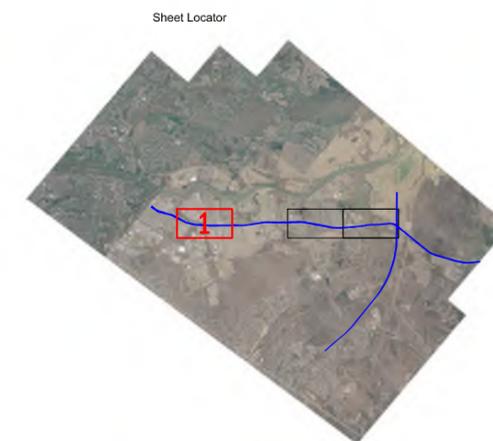
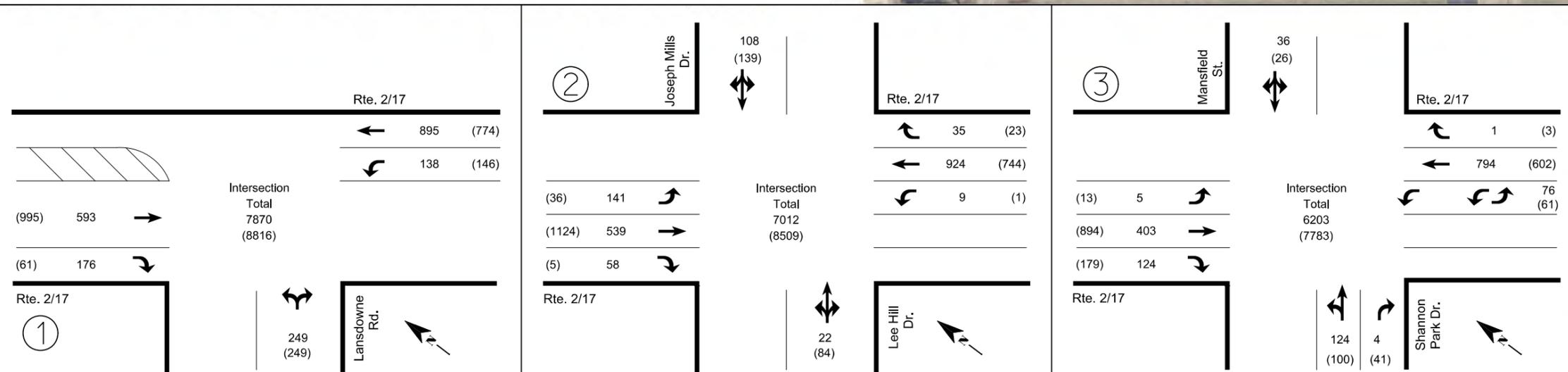
(xxxx) PM Peak Hour Volume

Traffic Movement

Two - Way Left - Turn Lane

Intersection Number

Traffic data for this project were collected when the Spotsylvania County schools were in session (March 2017). The tube counts along the corridor and the turning movement counts at the significant intersections were collected. The turning movement counts at three intersections were provided by VDOT which were counted on October 2016. The traffic data collected was analyzed to determine a universal peak hour for the entire corridor during weekday AM and PM. Although the traffic was balanced for the modeling purposes, the un-balanced turning movement counts for the corresponding peak hours are shown here.



DRAWN BY:

AG

2016 EXISTING PEAK HOUR VOLUMES

SCALE:

1:400

DATE:

04/05/2017

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

1

OF

3





LEGEND

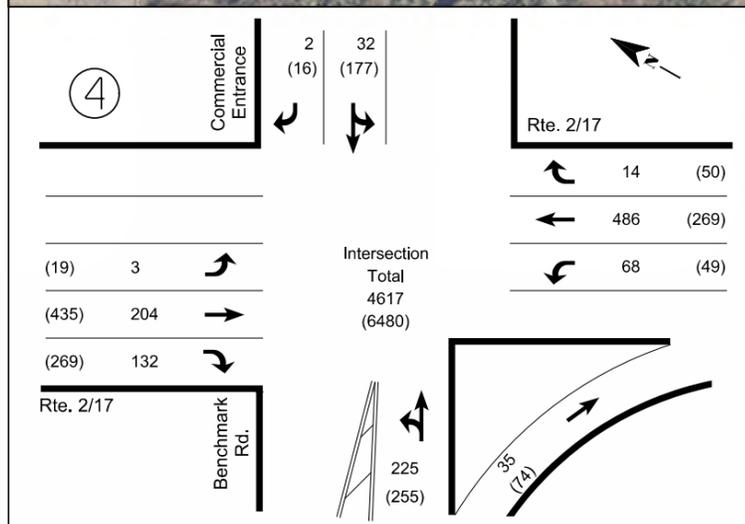
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(xxxx) PM Peak Hour Volume

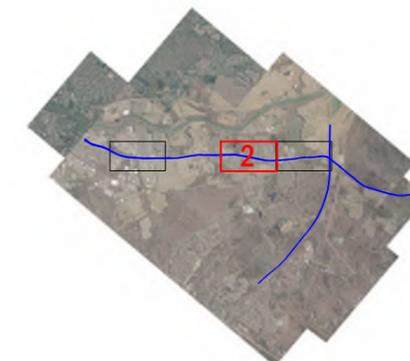
Traffic Movement

Two - Way Left - Turn Lane

Intersection Number



Sheet Locator



DRAWN BY:

AG

2017 EXISTING PEAK HOUR VOLUMES

SCALE:

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DATE:

04/05/2017

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

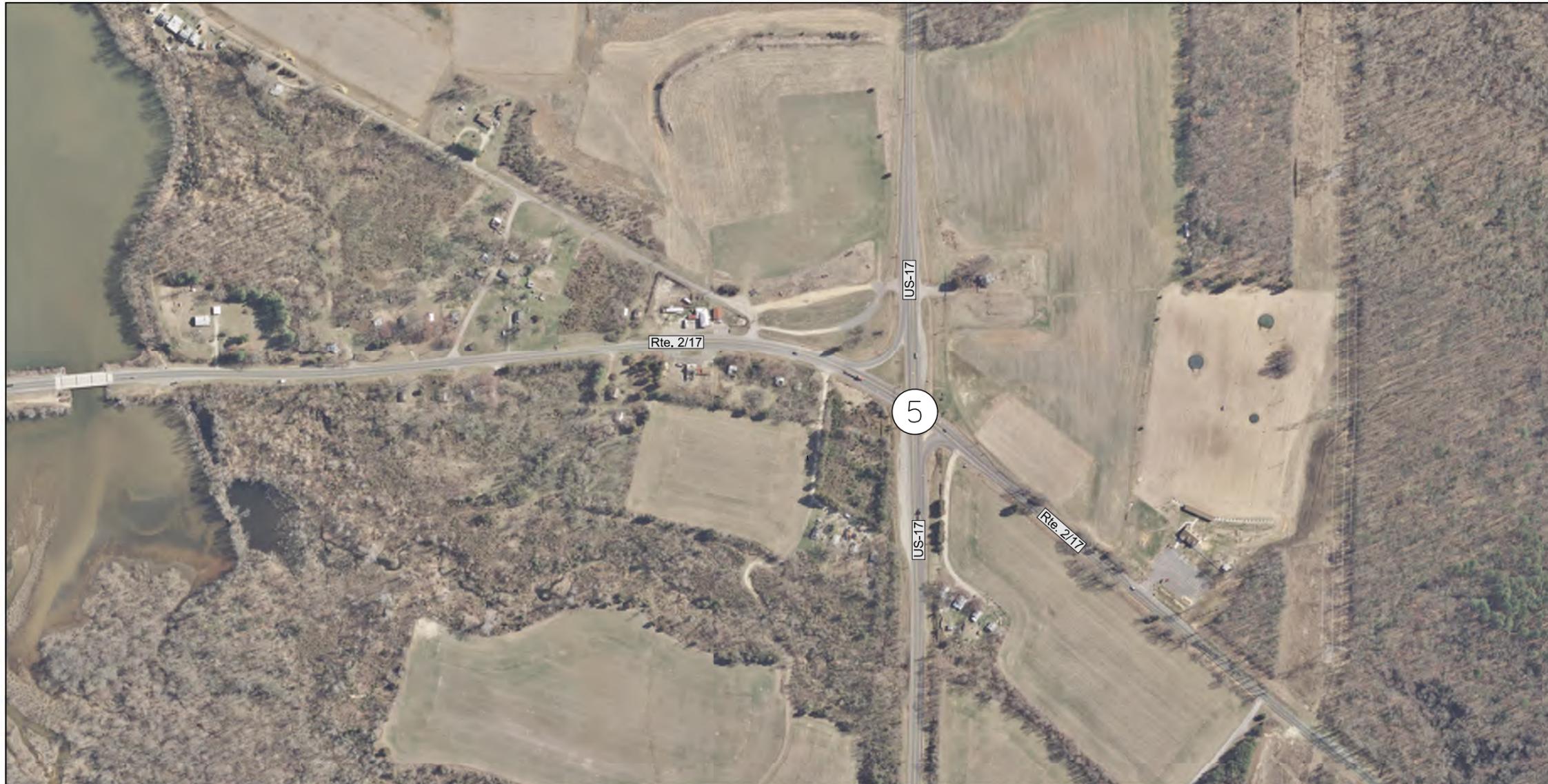
SHEET NO.:

2

OF

3





LEGEND

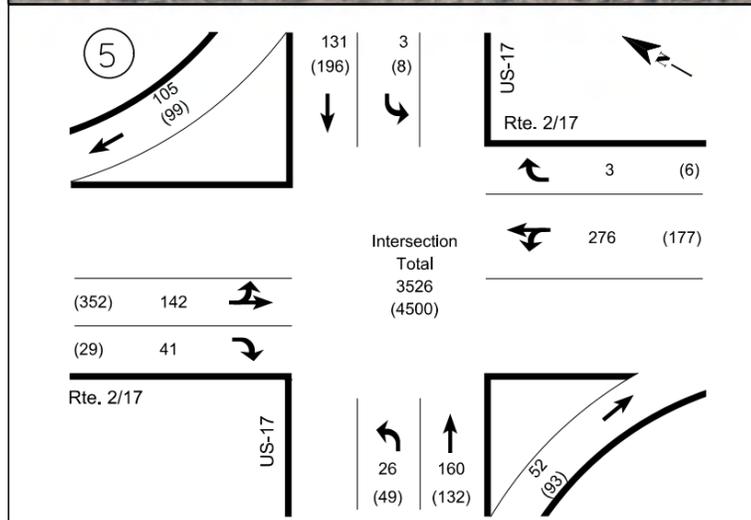
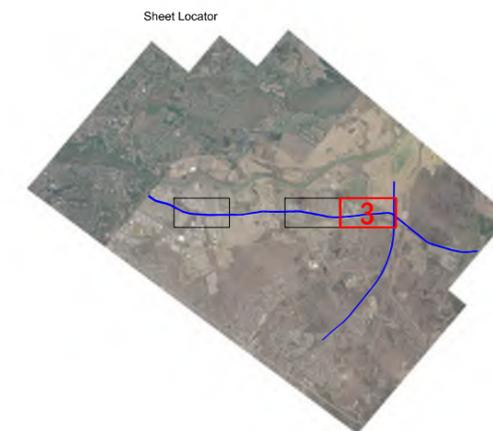
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(xxxx) PM Peak Hour Volume

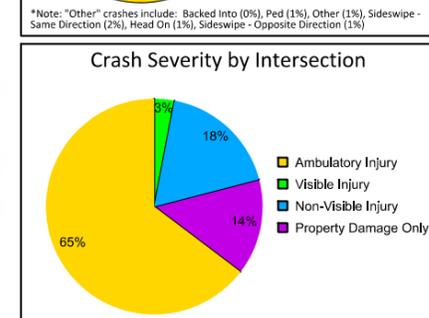
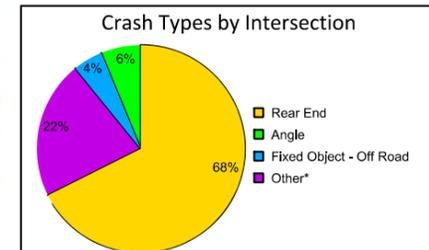
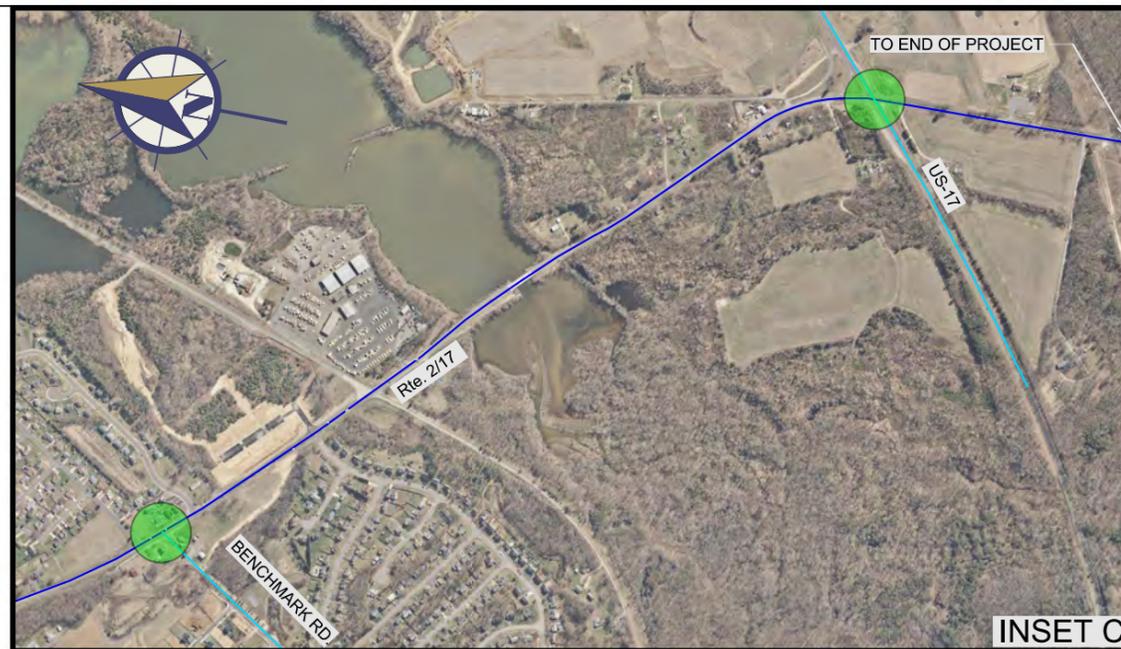
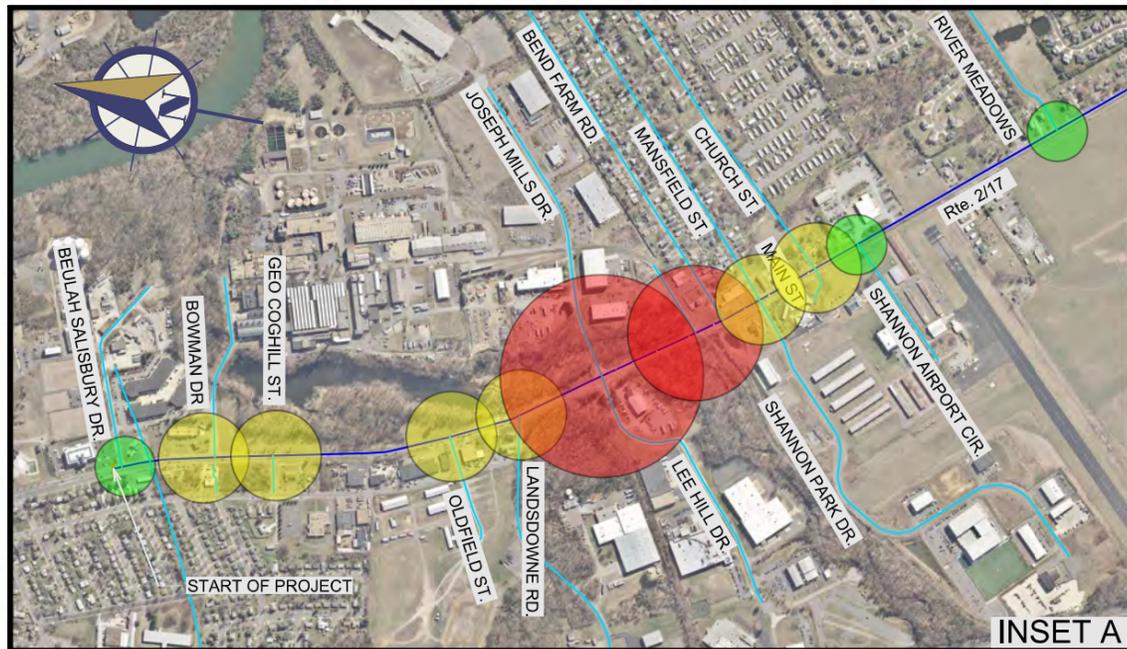
Traffic Movement

Two - Way Left - Turn Lane

Intersection Number

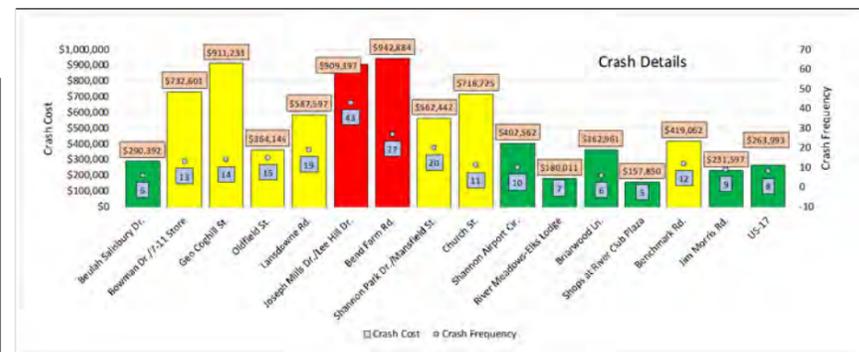
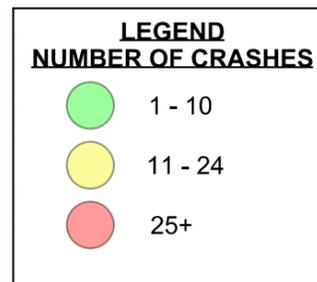
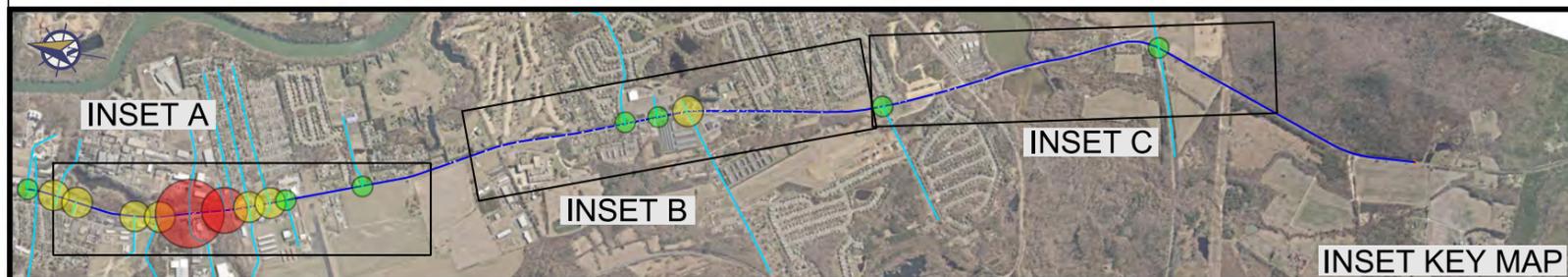


	DRAWN BY:	AG	2017 EXISTING PEAK HOUR VOLUMES RTE. 2/17 CORRIDOR STUDY	SCALE:	1:400	DATE:	04/05/2017	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	SHEET NO.:	3	OF	
				VDOT UPC PROJECT NO.:	107193			



The crash history from obtained using VDOT's Tableau Crashtool, recorded a total of 219 crashes at the studied intersections within the vicinity of the corridor. The intersections in this exhibit are considered significant intersections within the study area. On average, about 5% of all intersection crashes were alcohol related. The intersections at Benchmark Rd. and Briarwood Ln. had relatively the top two highest percentages of alcohol related crashes with 25% and 17%, respectively. Speed was a factor in about 6% of all crashes; however, Benchmark Rd. had a relatively higher percentage with 17% of crashes. About 35% of intersection crashes involved driver distractions. The intersections at Benchmark Rd. and the Shops at River Club Plaza had relatively higher percentages of crashes with 50% and 60%, respectively. About 23% of intersection crashes involved young drivers. The intersection at the Shops at River Club Plaza had a relatively high percentage of young drivers with 40%. About 14% of all intersection crashes involved a senior behind the wheel. The intersection at Jim Morris Rd. had a higher percentage of senior drivers at 33%. Adverse weather conditions attributed to about 13% of intersection crashes. On average, 19% of intersection crashes occurred during nighttime hours on unlighted roadways. The intersection at Briarwood Ln. had a significantly highest percentage of 50%. Crashes at these intersections cost the County millions of dollars each year as it is shown in the chart titled "Crash Details". For example, from 2011-2016, crashes at the intersection of Rte. 2/17 at Bend Farm Rd. estimated to have more than \$1M economical impact. The cost of crashes was based on the Highway Safety Manual crash cost estimates by Injury Severity Levels for year 2009. The Cost of crashes were projected to reflect the corresponding years analyzed due to inflation in the cost for the studied years.

The peak hours for this study area are from 7:15 - 8:15 AM and 4:30 - 5:30 PM on the weekdays. About 45-65% of the weekday crashes occurred during peak hours.



DRAWN BY:

RAM

INTERSECTION CRASH HISTORY (2011-2016)

SCALE:

NTS

DATE:

08/30/2017

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

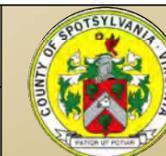
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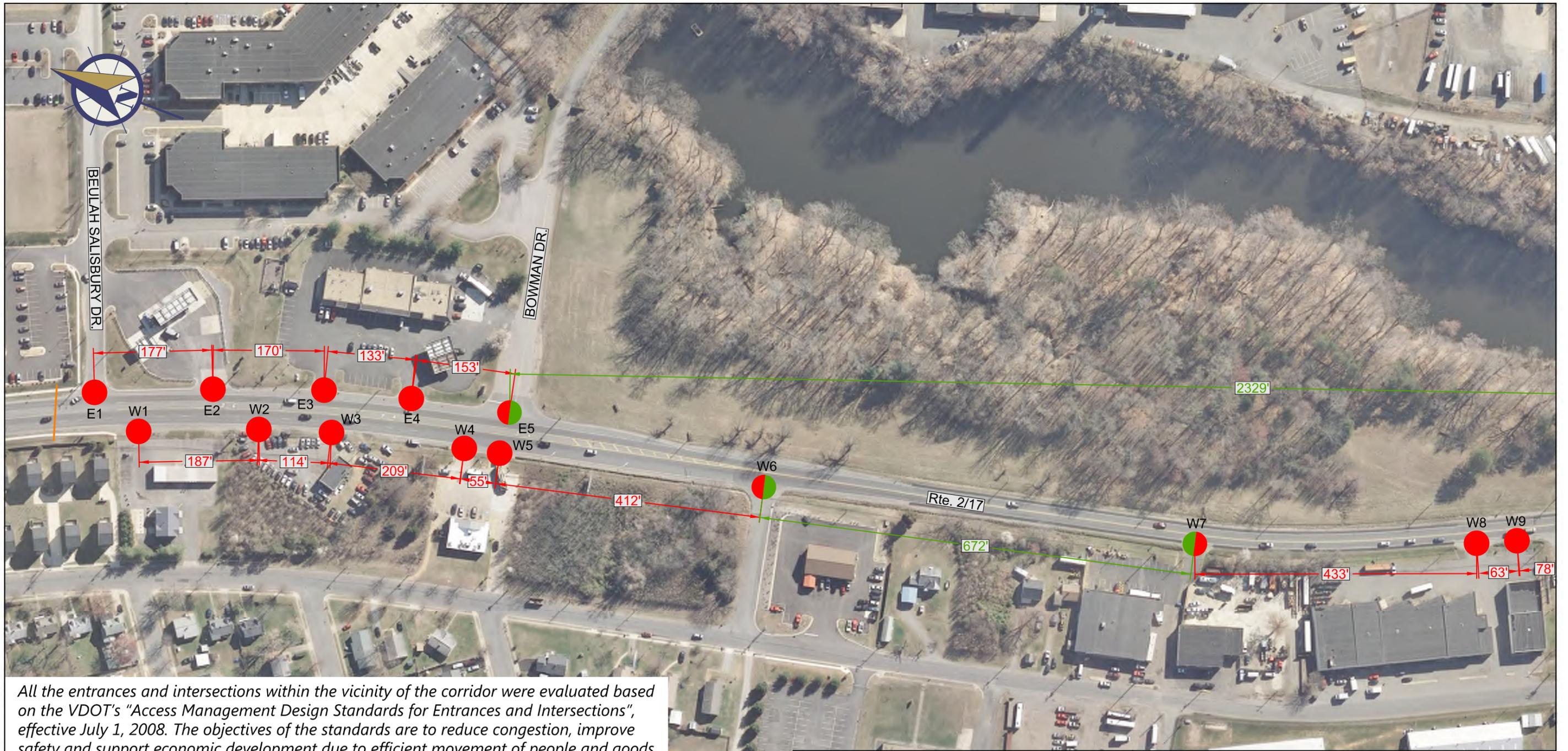
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OF

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VDOT UPC PROJECT NO.: 107193





All the entrances and intersections within the vicinity of the corridor were evaluated based on the VDOT's "Access Management Design Standards for Entrances and Intersections", effective July 1, 2008. The objectives of the standards are to reduce congestion, improve safety and support economic development due to efficient movement of people and goods.

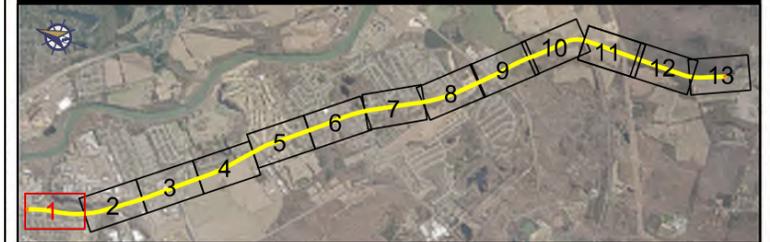
Based on the types of the entrances, intersections and the median openings, the roadway classifications and speed, the spacing was compared to the required spacing to evaluate the compliance with the standards. If an entrance or intersection meets the required spacing on one side only, it is considered as Partially Meets Standards. The Existing Access Management Evaluation sheets show the number and compliancy of the entrances and the intersections within the corridor. Detailed Access Management Evaluation tables shown in Appendix A.

LEGEND (ENTRANCES AND INTERSECTIONS)

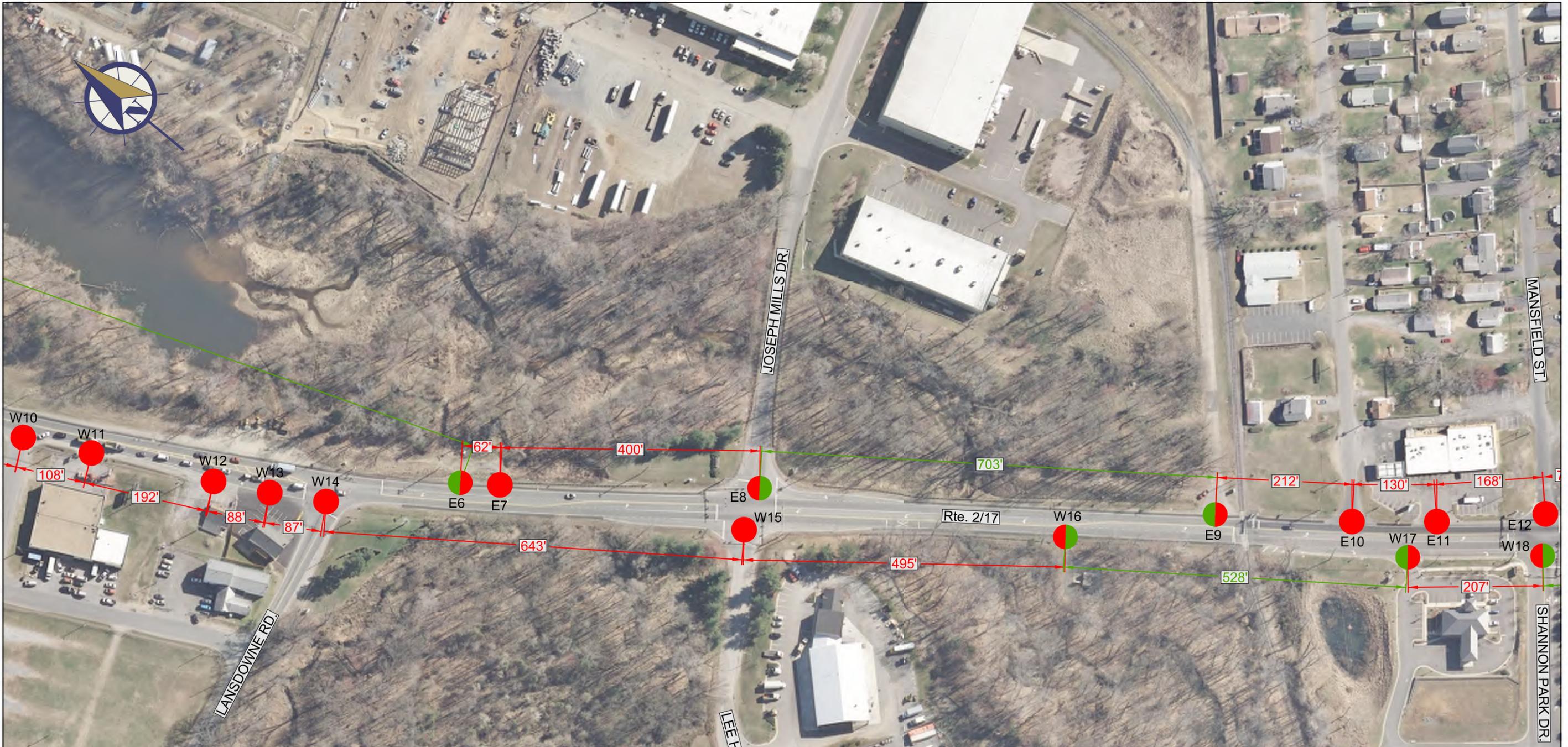
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- DOES NOT MEET STANDARDS
- MEETS STANDARDS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 2-2 OF THE VDOT 2017 ROAD DESIGN MANUAL.

SHEET LOCATOR



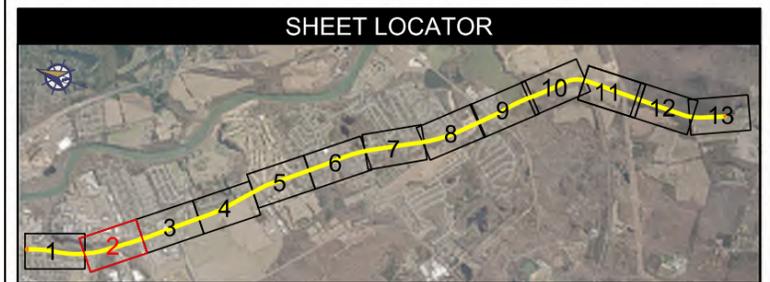
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				VDOT UPC PROJECT NO.:	107193					



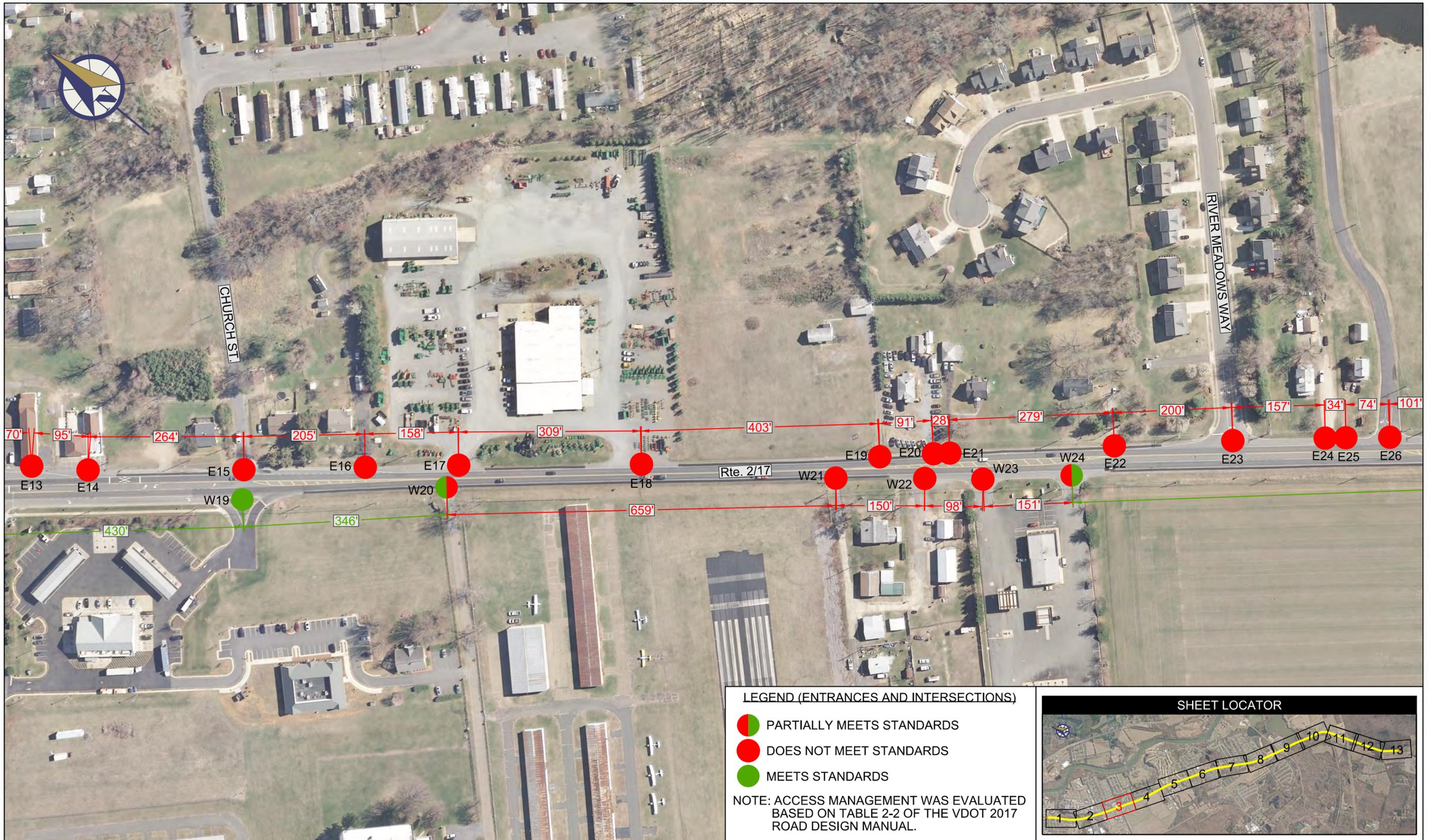
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- DOES NOT MEET STANDARDS
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NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 2-2 OF THE VDOT 2017 ROAD DESIGN MANUAL.



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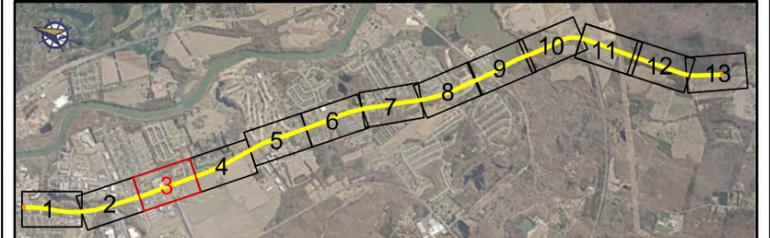


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- DOES NOT MEET STANDARDS
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NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 2-2 OF THE VDOT 2017 ROAD DESIGN MANUAL.

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12/26/2018
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BNG

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SCALE:

1:150

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09/01/2017

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RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

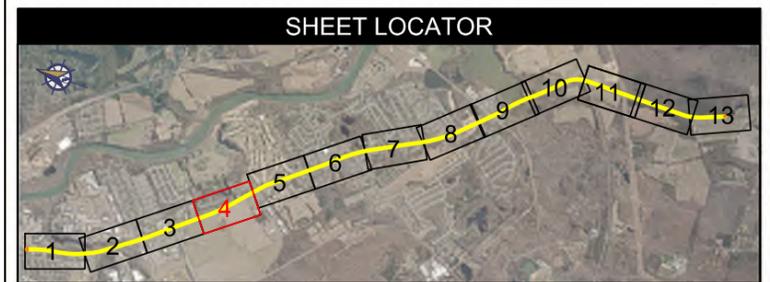
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				VDOT UPC PROJECT NO.: 107193					



11/27/2017 11:40:49 AM



DRAWN BY: BNG

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EXISTING ACCESS MANAGEMENT EVALUATIONS

RTE. 2/17 CORRIDOR STUDY

SCALE:

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DATE:

09/01/2017

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

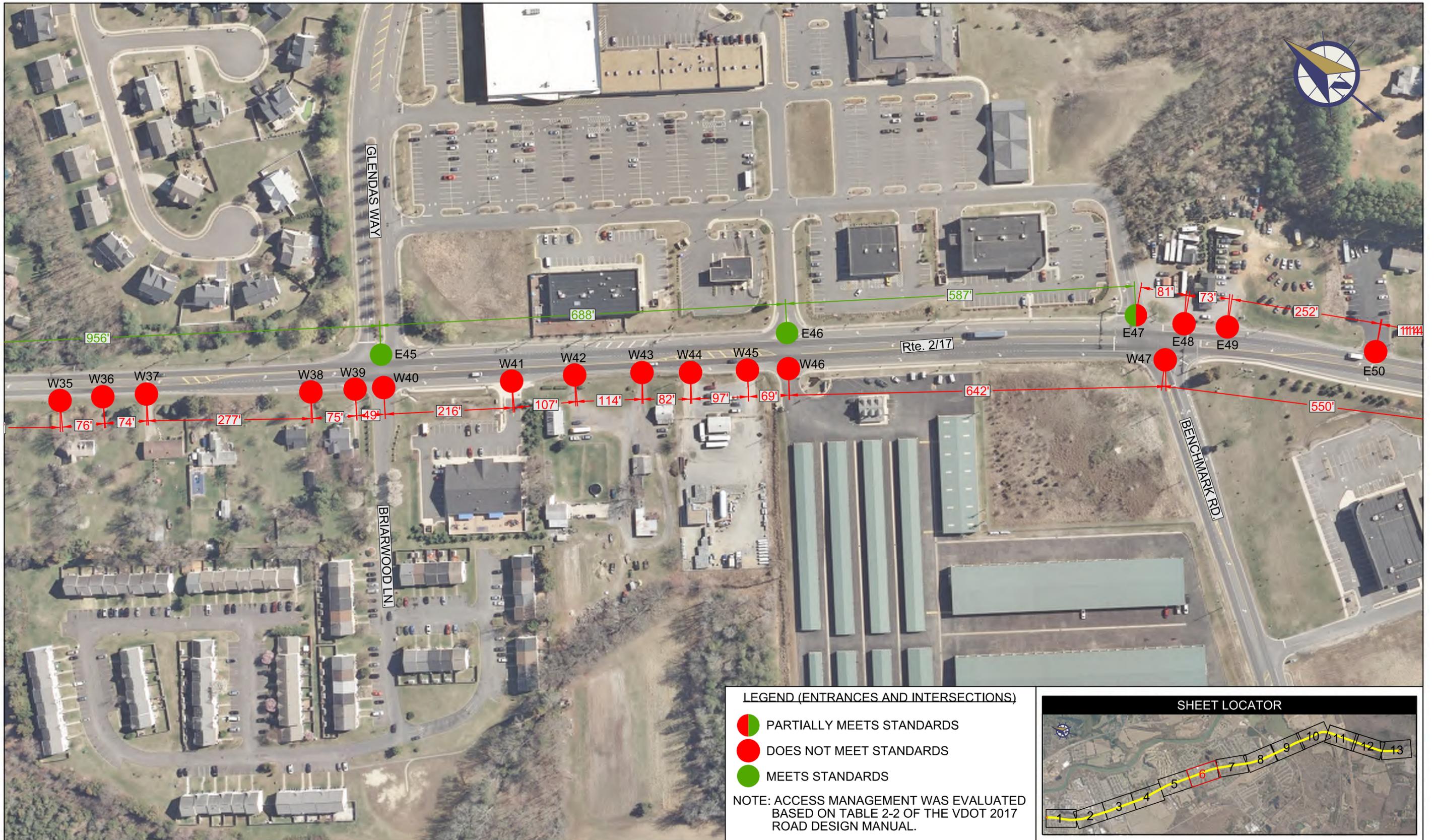
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OF

13

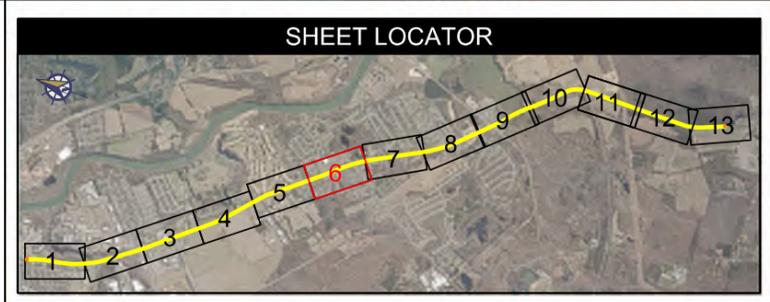




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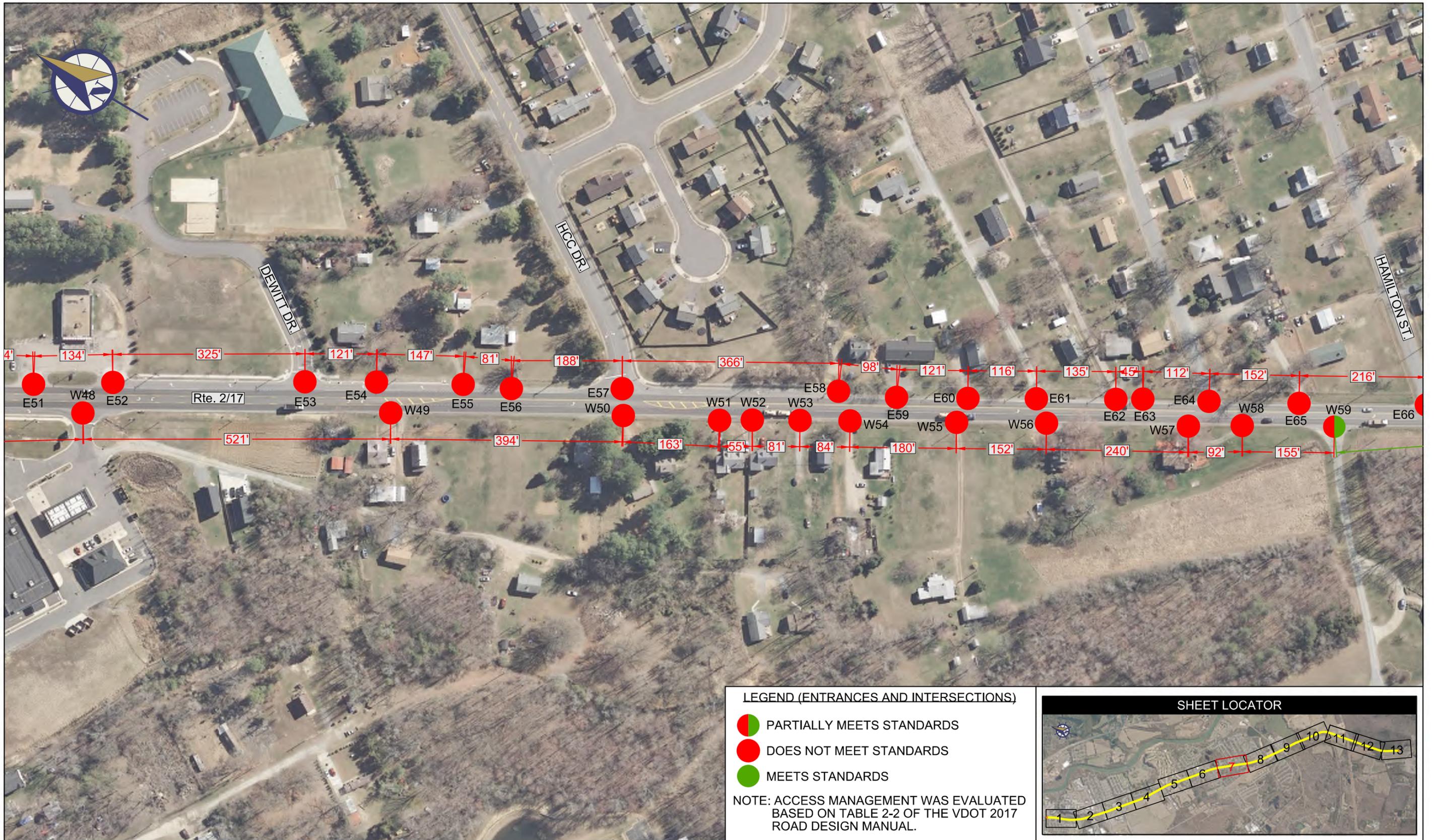
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- MEETS STANDARDS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 2-2 OF THE VDOT 2017 ROAD DESIGN MANUAL.



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				VDOT UPC PROJECT NO.: 107193						

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CHECKED BY: KHB

EXISTING ACCESS MANAGEMENT EVALUATIONS

RTE. 2/17 CORRIDOR STUDY

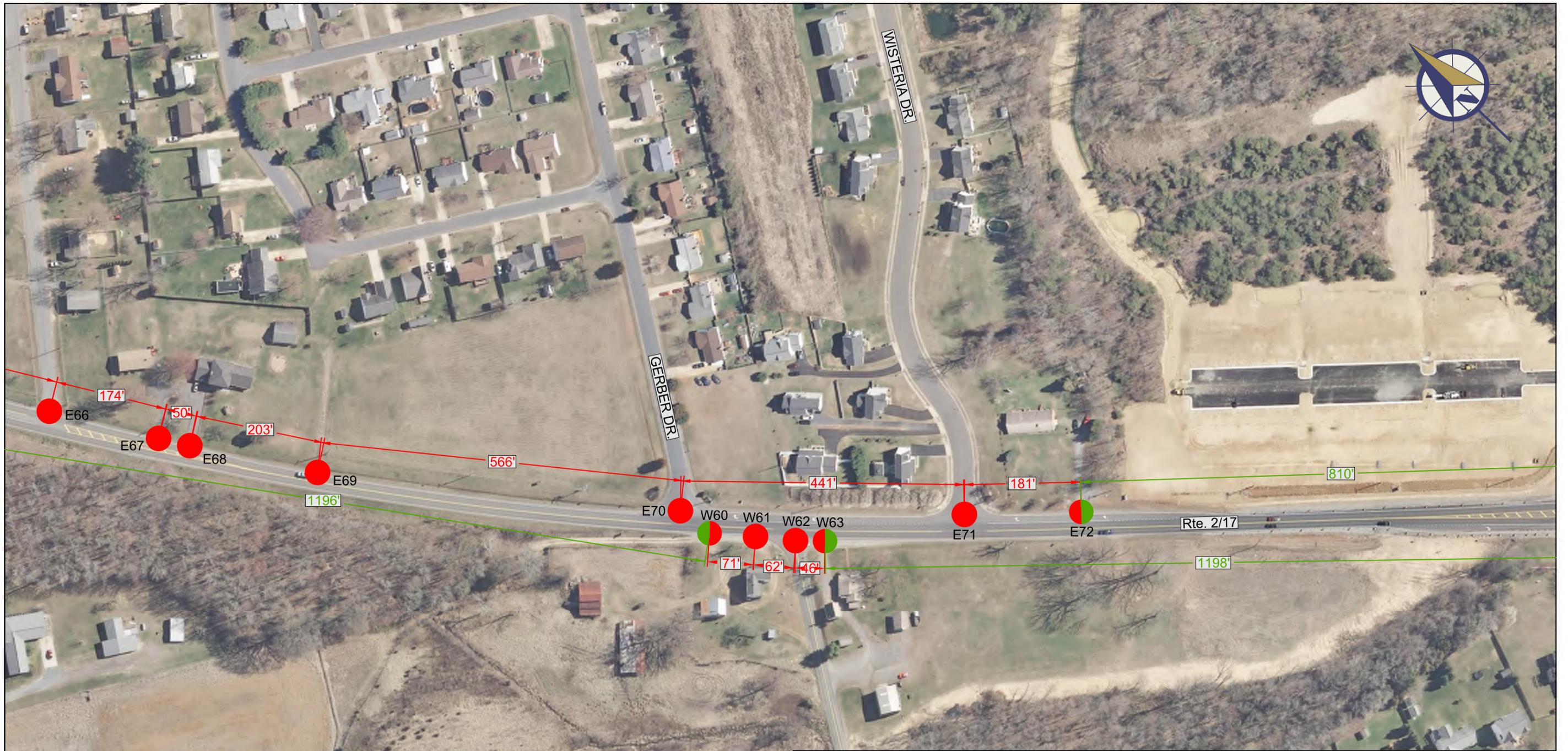
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JMT PROJECT NO.: 15-0038-002
VDOT UPC PROJECT NO.: 107193

DATE: 09/01/2017

SHEET NO.: 7 OF 13





LEGEND (ENTRANCES AND INTERSECTIONS)

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- DOES NOT MEET STANDARDS
- MEETS STANDARDS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 2-2 OF THE VDOT 2017 ROAD DESIGN MANUAL.

SHEET LOCATOR



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EXISTING ACCESS MANAGEMENT EVALUATIONS

SCALE:

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DATE:

09/01/2017

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RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

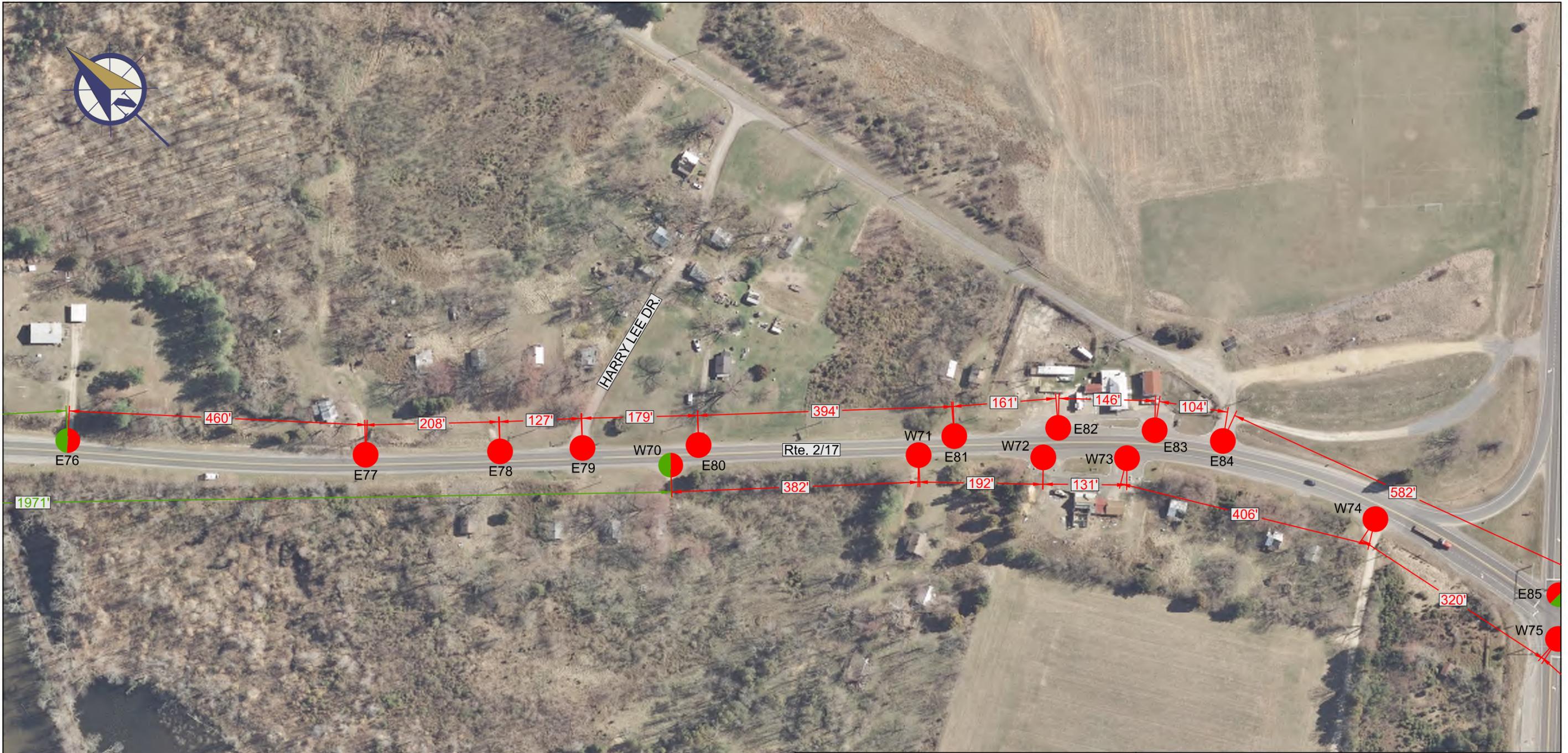
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OF

13



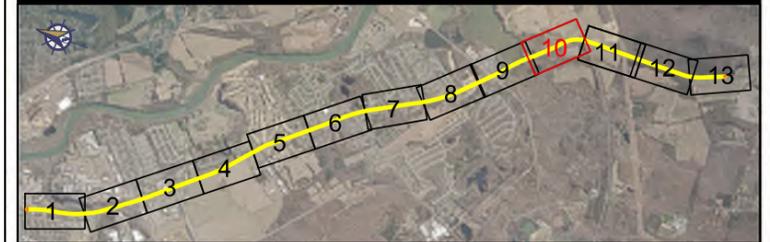


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NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 2-2 OF THE VDOT 2017 ROAD DESIGN MANUAL.

SHEET LOCATOR



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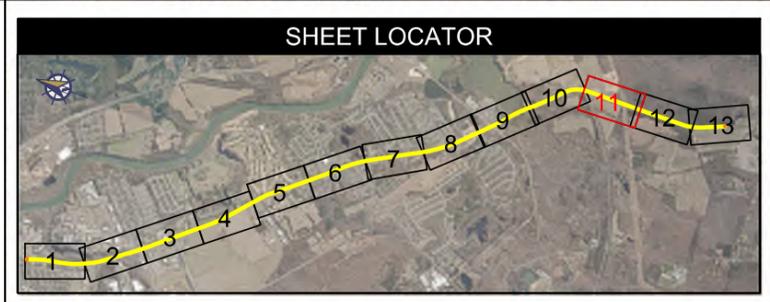
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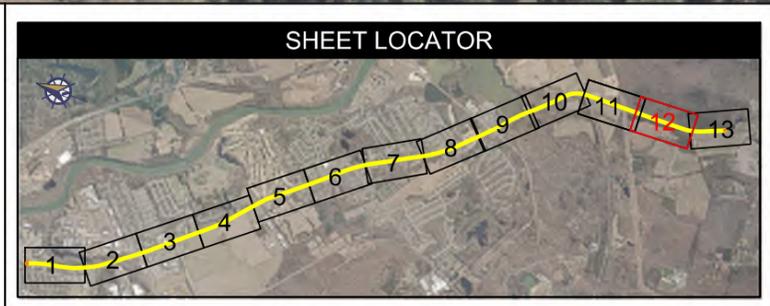
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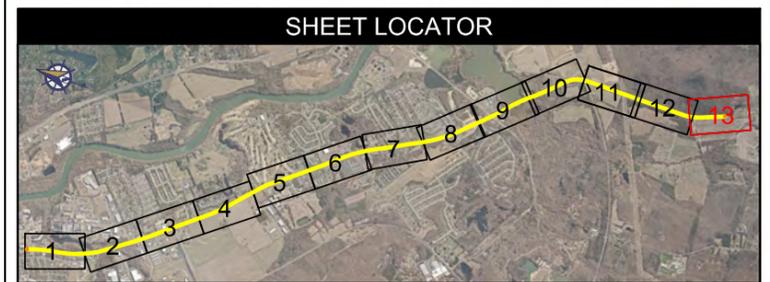
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- DOES NOT MEET STANDARDS
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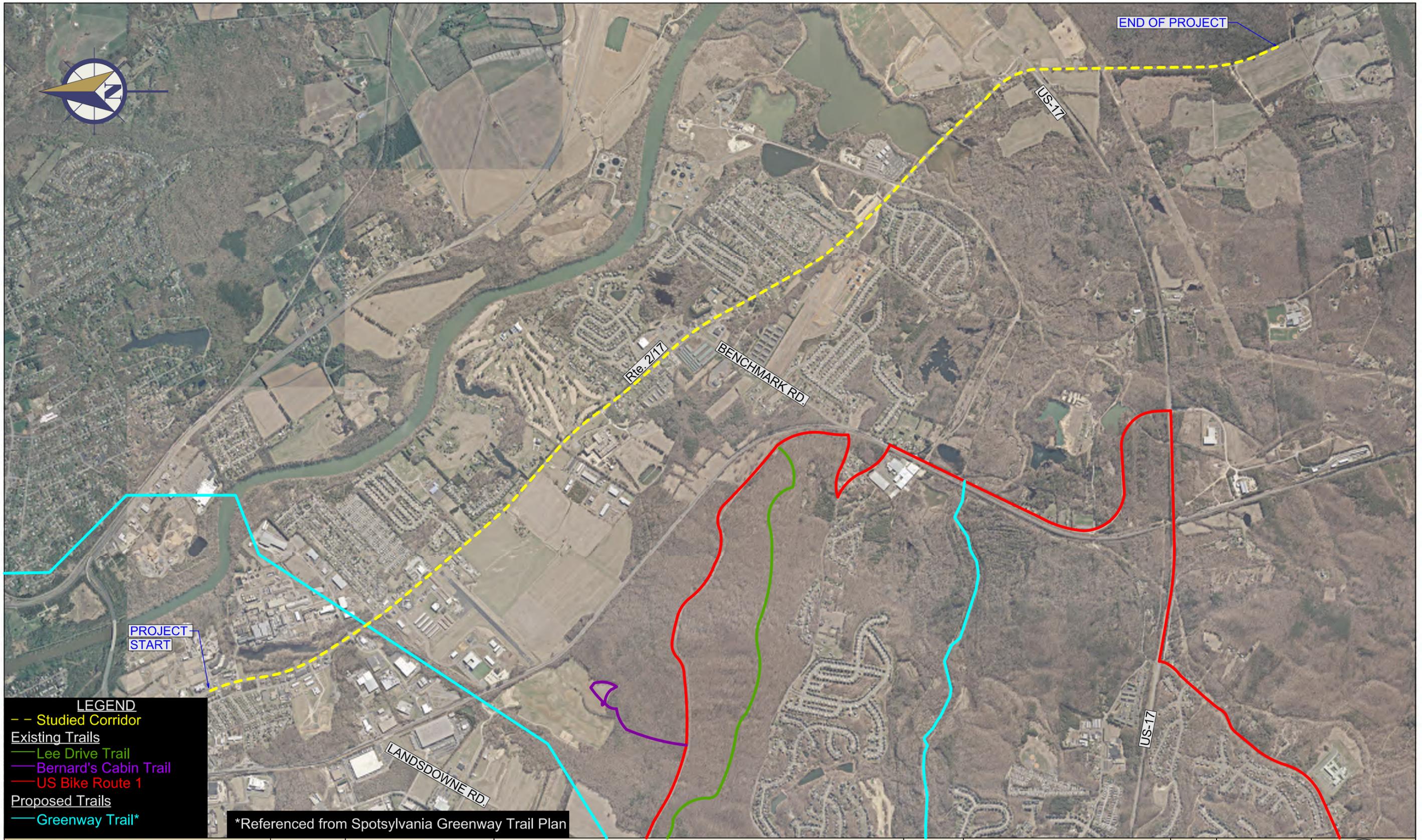


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				VDOT UPC PROJECT NO.: 107193						

10/29/2018 8:28:56 AM



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	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	VDOT UPC PROJECT NO.: 107193	SHEET NO.:	1	OF	1	



LEGEND

-- Studied Corridor

Existing Trails

Lee Drive Trail

Bernard's Cabin Trail

US Bike Route 1

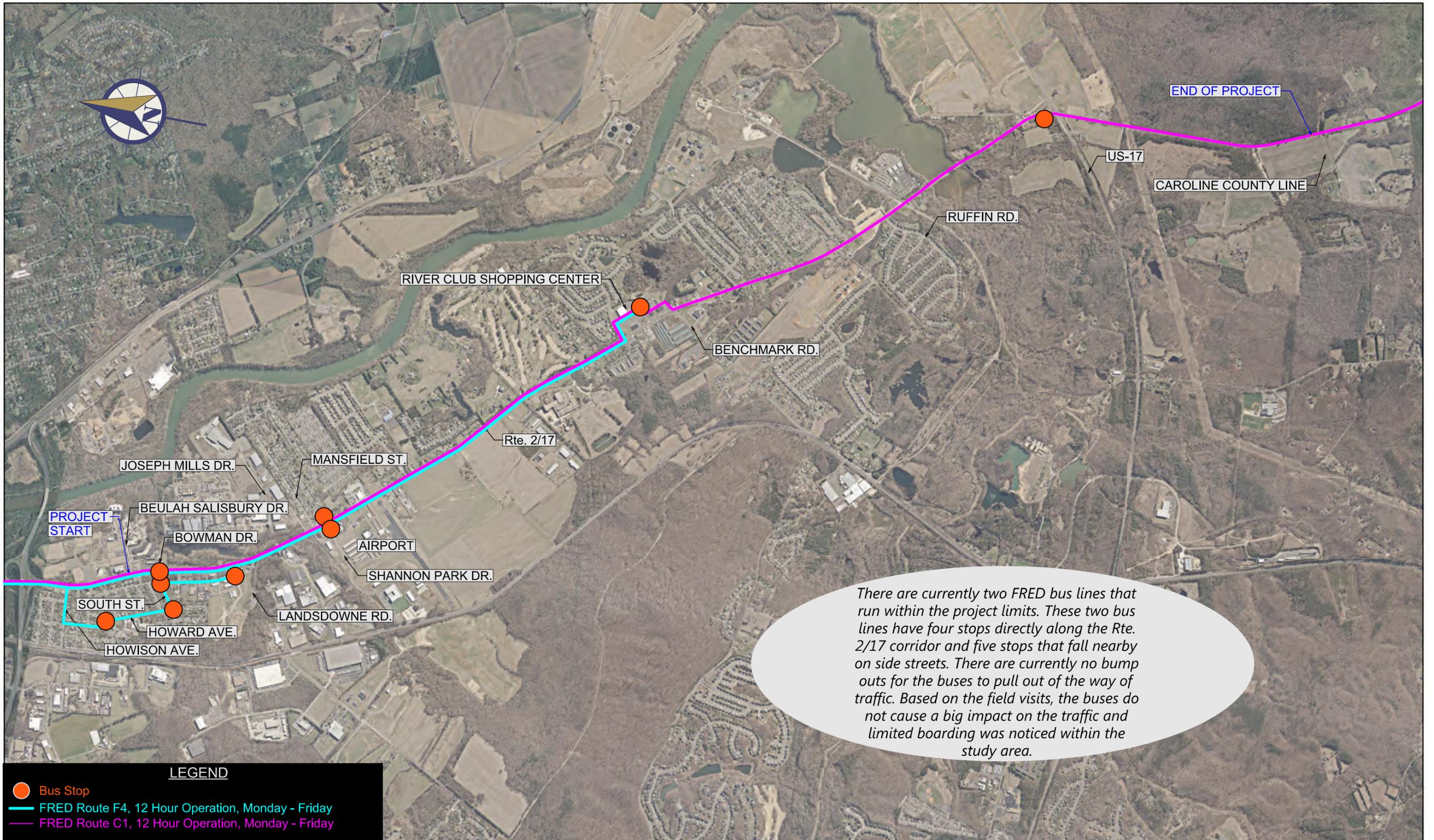
Proposed Trails

Greenway Trail*

*Referenced from Spotsylvania Greenway Trail Plan

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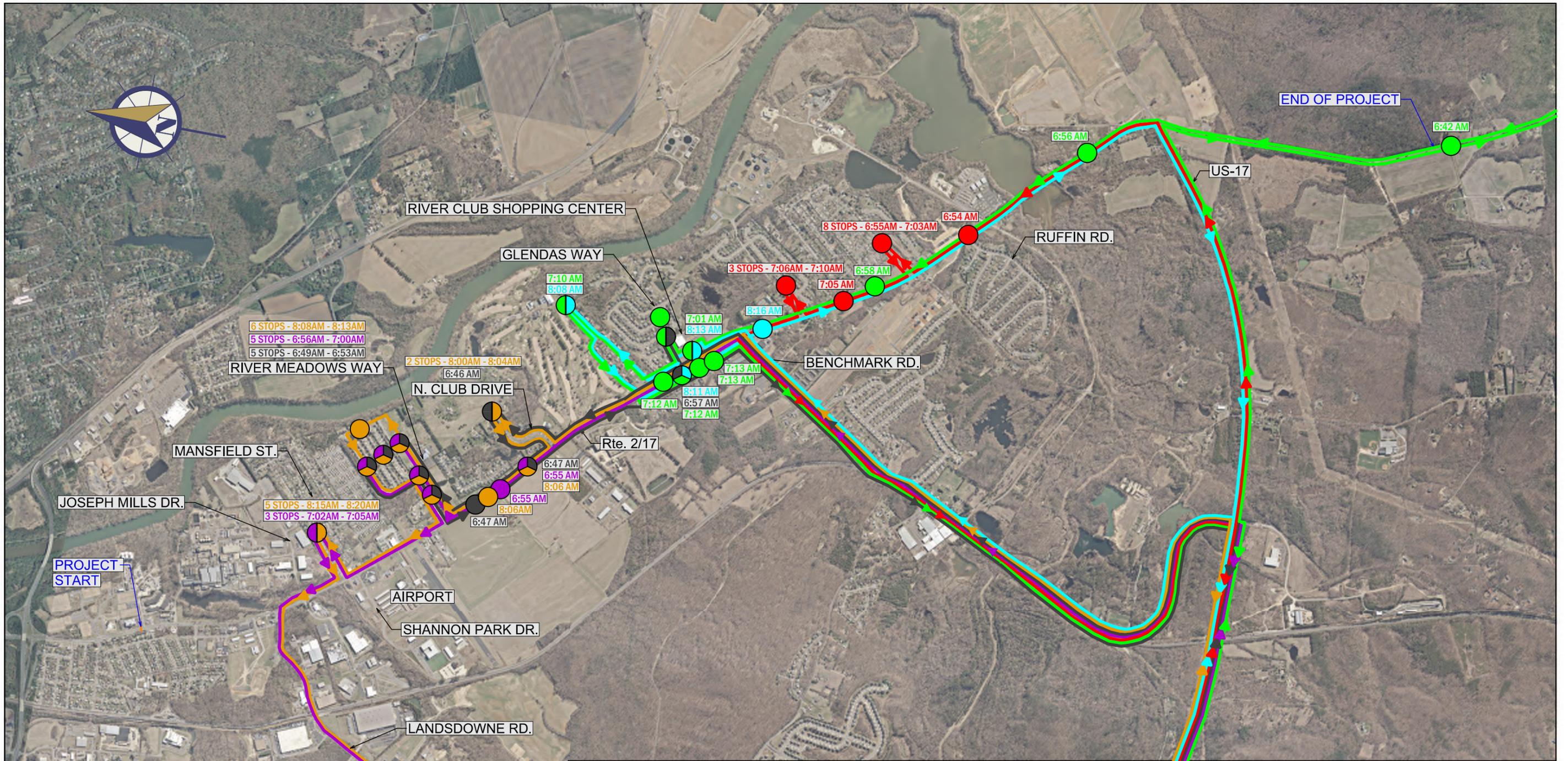
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	CHECKED BY:	KHB			JMT PROJECT NO.:	15-0038-002	SHEET NO.:	1	OF	1	
					VDOT UPC PROJECT NO.:	107193					



LEGEND

- Bus Stop
- FRED Route F4, 12 Hour Operation, Monday - Friday
- FRED Route C1, 12 Hour Operation, Monday - Friday

	DRAWN BY:	RAM	TRANSIT ROUTES	SCALE:	1:2000	DATE:	08/30/2017			
	CHECKED BY:	KHB	RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002	SHEET NO.:	1	OF	1		
				VDOT UPC PROJECT NO.: 107193						



NOTES:

- 1 - INFORMATION BASED ON SPOTSYLVANIA COUNTY PUBLIC SCHOOLS TRANSPORTATION WEBSITE: (<https://www.spotsylvania.k12.va.us/domain/279>).
- 2 - ROUTE #'S 511.003, 506.006, AND 511.009 ALL HAVE NO STOPS ALONG RTE. 2/17 CORRIDOR. ALL STOPS ARE ON SIDE STREETS (INCLUDING BENCHMARK RD).
- 3 - ASSUMED ALL AM TRIPS START FROM THE SCHOOL.

LEGEND

- X:XX AM BUS STOP(S)/TIME
- ROUTE #511.005 - CEDAR FOREST ELEMENTARY
- ROUTE #506.028 - MASSAPONAX HIGH
- ROUTE #502.013 - THORNBURG MIDDLE
- ROUTE #050.021 - BATTLEFIELD MIDDLE
- ROUTE #511.004 - CEDAR FOREST ELEMENTARY
- ROUTE #502.022 - THORNBURG MIDDLE



DRAWN BY: MAF

CHECKED BY: KHB

SCHOOL BUS ROUTES/SCHEDULE (AM)

RTE. 2/17 CORRIDOR STUDY

SCALE:

1:2000

DATE:

12/11/2017

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

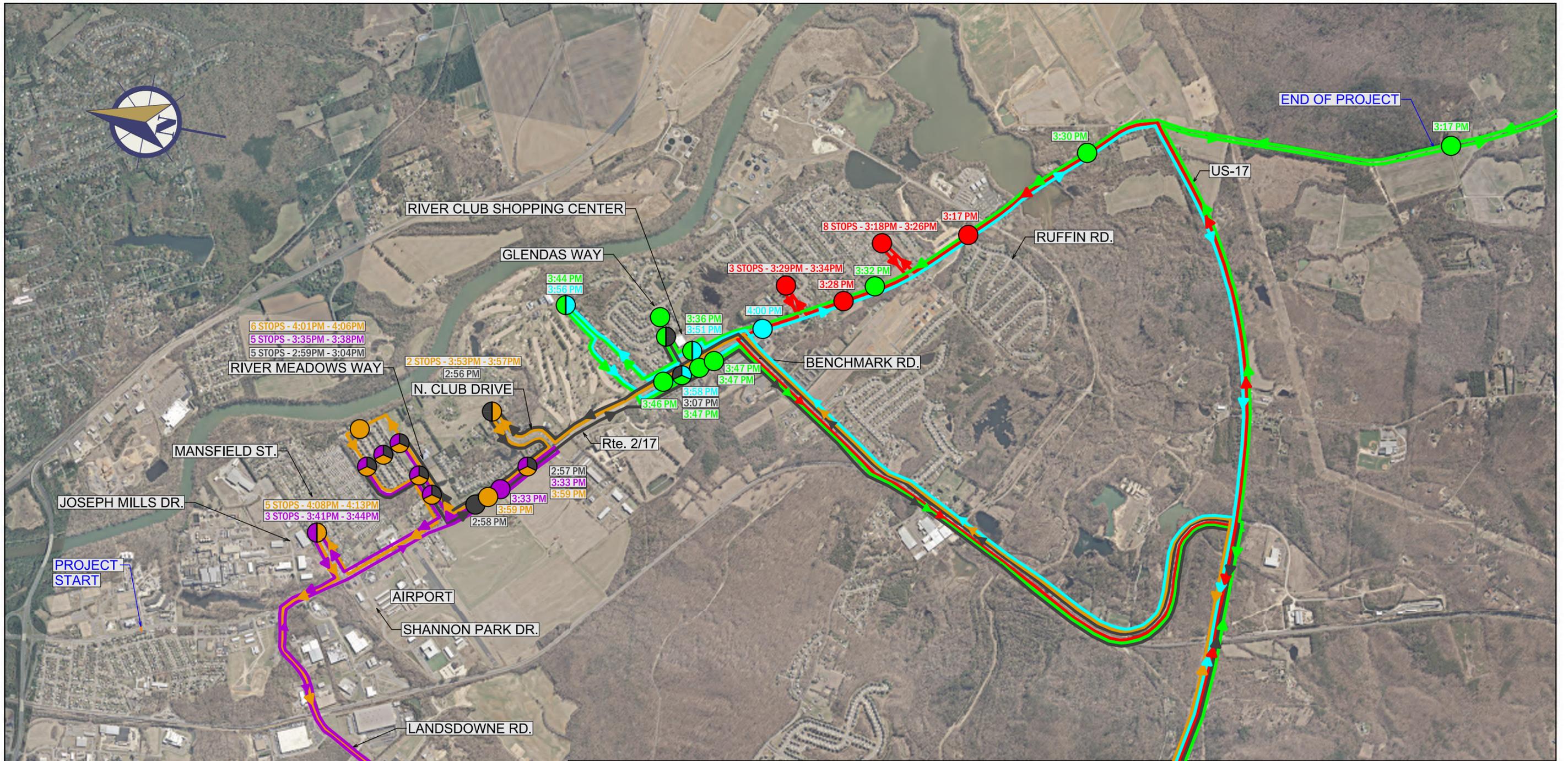
SHEET NO.:

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OF

1





NOTES:

- 1 - INFORMATION BASED ON SPOTSYLVANIA COUNTY PUBLIC SCHOOLS TRANSPORTATION WEBSITE: (<https://www.spotsylvania.k12.va.us/domain/279>).
- 2 - ROUTE #'S 511.003, 506.006, AND 511.009 ALL HAVE NO STOPS ALONG RTE. 2/17 CORRIDOR. ALL STOPS ARE ON SIDE STREETS (INCLUDING BENCHMARK RD).
- 3 - ASSUMED ALL AM TRIPS START FROM THE SCHOOL.

LEGEND

- X:XX PM BUS STOP(S)/TIME
- ROUTE #511.105 - CEDAR FOREST ELEMENTARY
- ROUTE #506.128 - MASSAPONAX HIGH
- ROUTE #502.113 - THORNBURG MIDDLE
- ROUTE #050.121 - BATTLEFIELD MIDDLE
- ROUTE #511.104 - CEDAR FOREST ELEMENTARY
- ROUTE #502.122 - THORNBURG MIDDLE



DRAWN BY: MAF

CHECKED BY: KHB

SCHOOL BUS ROUTES/SCHEDULE (PM)

RTE. 2/17 CORRIDOR STUDY

SCALE:

1:2000

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

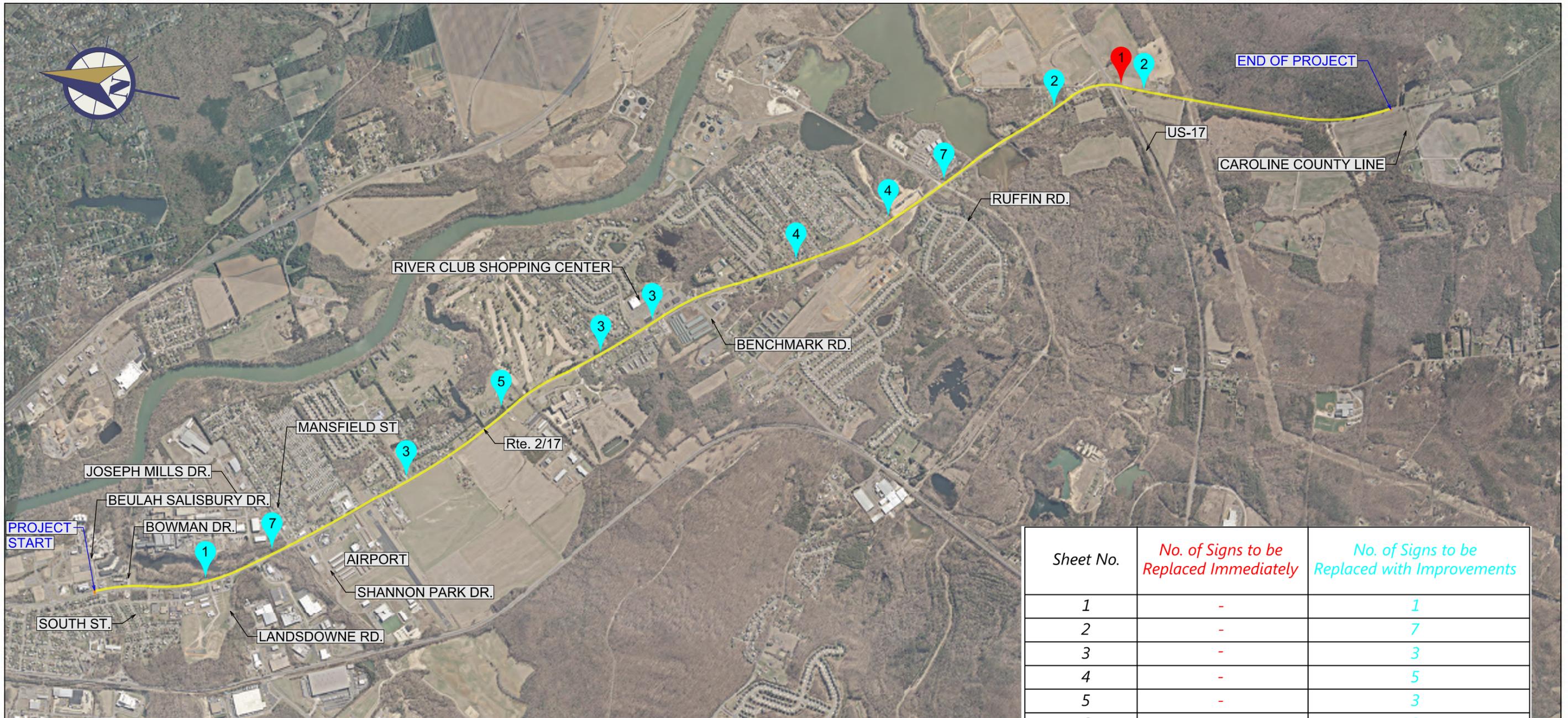
DATE:

12/18/2017

SHEET NO.:

1 OF 1





Sheet No.	No. of Signs to be Replaced Immediately	No. of Signs to be Replaced with Improvements
1	-	1
2	-	7
3	-	3
4	-	5
5	-	3
6	-	3
7	-	4
8	-	4
9	-	7
10	-	2
11	1	2
12	-	-
Total	1	41

All the roadway signs within the vicinity of the corridor were evaluated to check the compliance with Manual on Uniform Traffic Control Devices (MUTCD-2009), Virginia Standard Highway Signs Book, Revision 1 (2011) and the Supplement to the 2004 Edition of the Standard Highway Signs Book (2012). The roadway signs that need replacement are identified. The red colored marks are signs that need to be replaced immediately, while the blue colored marks are signs that need to be replaced with any roadway improvements. Detailed sign evaluation sheets for the entire corridor are shown in the Appendix B.

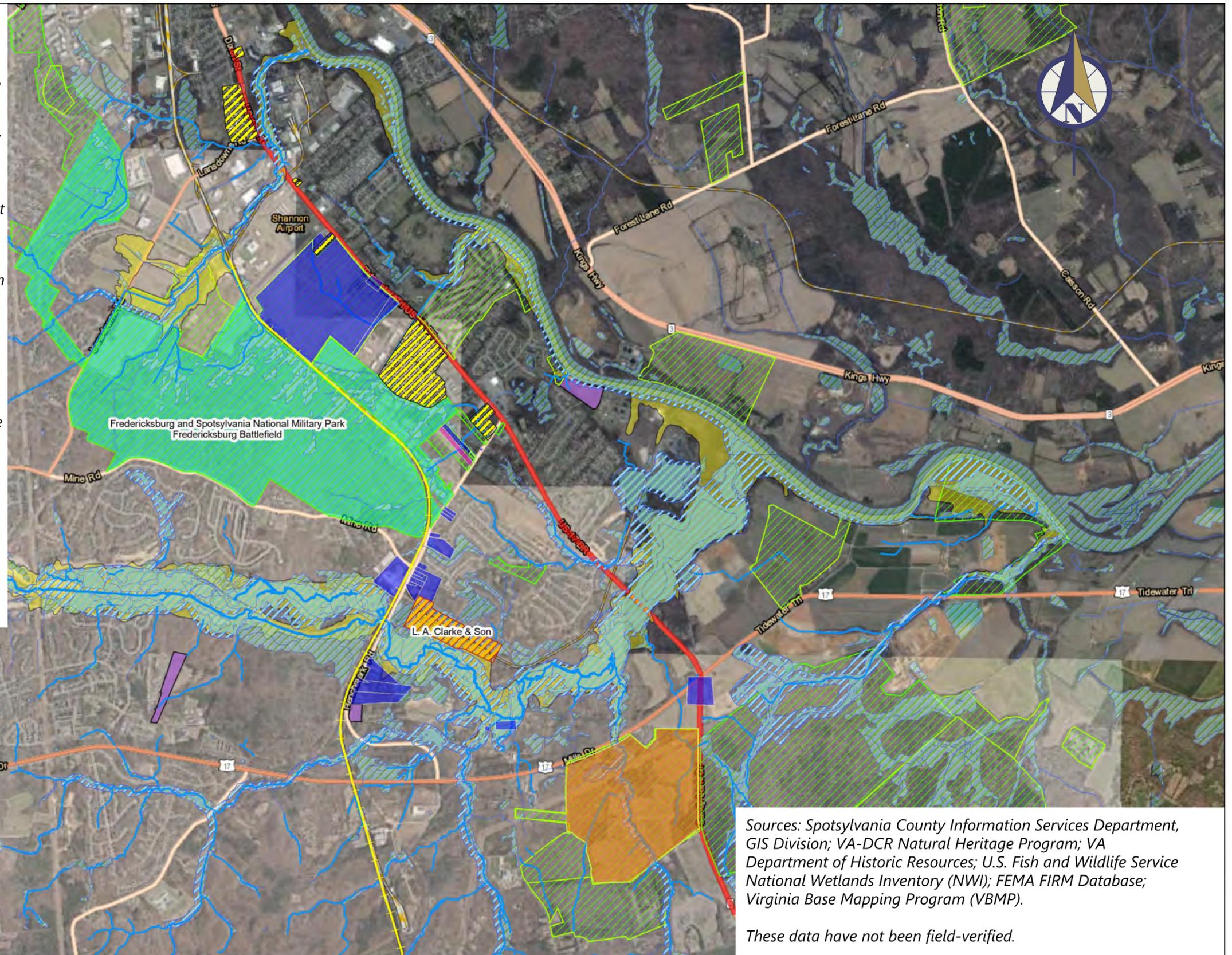
	DRAWN BY:	MAF	TRAFFIC CONTROL DEVICES ASSESSMENT RTE. 2/17 CORRIDOR STUDY	SCALE:	1:2000	DATE:	12/07/2017	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	SHEET NO.:	1	OF	
				VDOT UPC PROJECT NO.:	107193			

Hazardous Materials Sites - Includes areas that could require additional studies to further evaluate possible issues and the extent of the contamination. VDOT will require a Phase I Environmental Site Assessment (ESA) of the corridor to comply with the EQ121 requirements. The Phase I ESA includes limited fieldwork and research to identify potential or existing environmental contamination liabilities of sites that may be impacted by the proposed improvements.

Historic Resources - Includes both historic structures and archaeological sites. The resources identified in the project area could require additional studies to identify and evaluate the resources within the project area. Given the rich cultural resources in the area, it is possible that a Phase II survey could be required. A Phase II investigation involves a complete, subsurface survey and testing of identified sites sufficient to determine their boundaries, their cultural and scientific importance, and the sites' eligibility for listing on the National Register of Historic Places. These studies can be expensive and time consuming.

Natural Resources - Includes wetlands, streams, Resource Protection Areas, floodplains, and parks/conservation easements. Environmental permits and regulatory coordination could be required if these resources are located within or adjacent to the project's limits of disturbance, depending on the proposed improvements.

Note: Historic areas that were not evaluated have been surveyed, but have not officially evaluated by the Department of Historic Resources. Typically, these sites are not eligible for Listing on the Register of Historic Places



Project Corridor
 Project Corridor

Hazardous Materials
 Hazardous Materials Sites
 National Priorities List Site

Historic Rail Evaluation Status
 Eligible for National Register of Historic Places (NRHP) Listing
 Potentially Eligible for National Register of Historic Places (NRHP) Listing

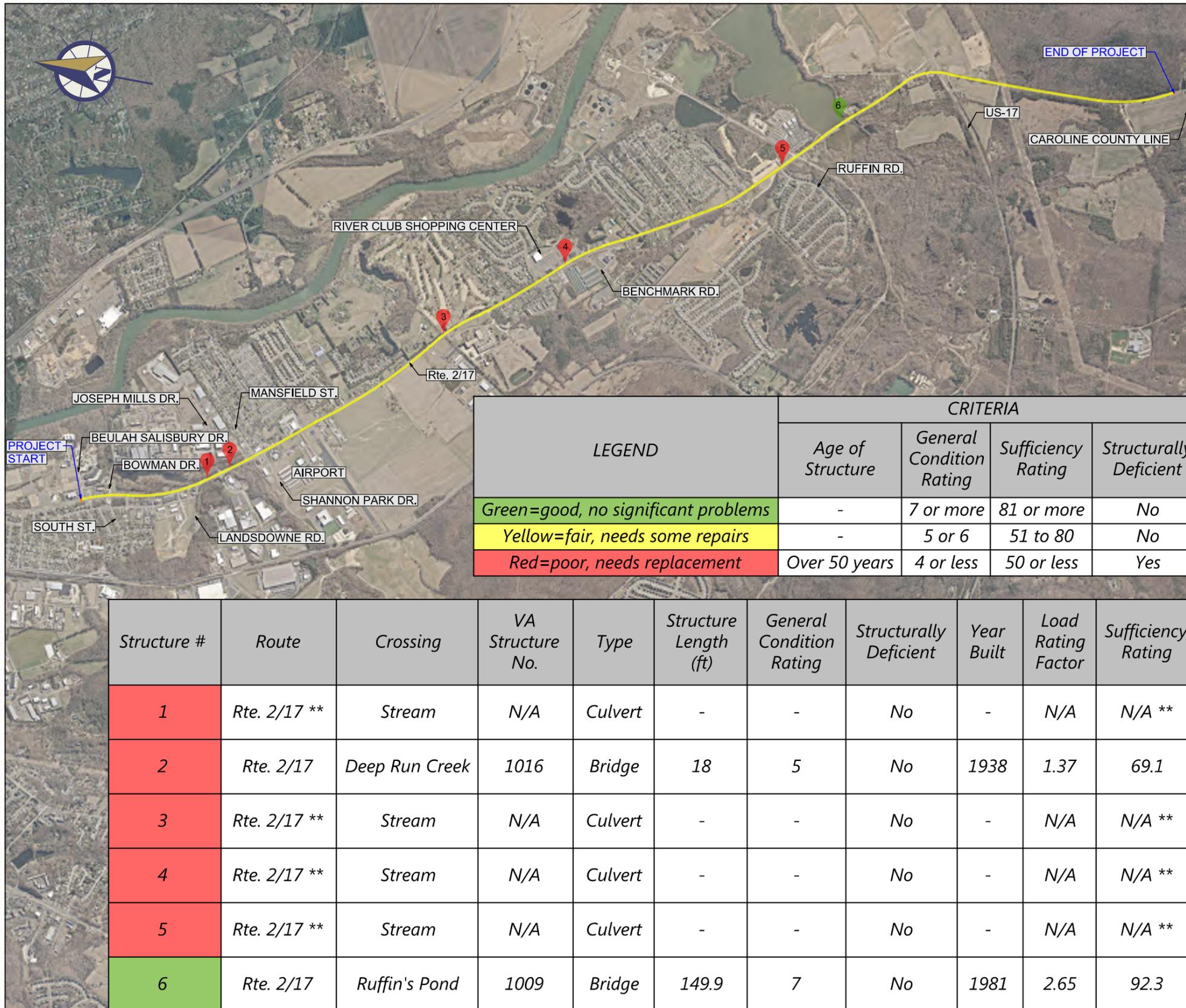
Historic Areas Evaluation Status
 National Register of Historic Places (NRHP) Listing
 Not Evaluated
 Potentially Eligible for National Register of Historic Places (NRHP) Listing

Natural Resources
 Stream
 Wetland
 Resource Protection Area
 100-Year Flood/Zone A
 Virginia Conservation Lands
 National Park Service Lands (Battlefields)
 State Parks
 County Parks

Sources: Spotsylvania County Information Services Department, GIS Division; VA-DCR Natural Heritage Program; VA Department of Historic Resources; U.S. Fish and Wildlife Service National Wetlands Inventory (NWI); FEMA FIRM Database; Virginia Base Mapping Program (VBMP).

These data have not been field-verified.

	DRAWN BY:	ADW	EXISTING SENSITIVE ENVIRONMENTAL FEATURES	SCALE:	NTS		DATE:	09/18/2017			
	CHECKED BY:	CMT		RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.:	15-0038-002	SHEET NO.:	1	OF	1	
				VDOT UPC PROJECT NO.:	107193						



Information compiled from VDOT Individual Bridge Inspection Reports and VDOT's Fredericksburg District Bridge Maintenance Report.

DEFINITIONS

General Condition Rating - condition ratings are used to describe an existing bridge or culvert compared with its condition if it were new. The ratings are based on the materials, physical condition of the deck (riding surface), the superstructure (beams immediately beneath the driving surface) and the substructure (foundations and supporting caps and piers). General condition ratings range from 0 (failed condition) to 9 (excellent).

Structurally Deficient Bridges have elements that need to be monitored and/or repaired. A Structurally Deficient bridge may be restricted to light vehicles, closed to traffic or require rehabilitation. The fact that a bridge is "structurally deficient" does not imply that it is likely to collapse or that it is unsafe.

Load Rating Factor the calculated vehicle weight that the bridge is capable of carrying divided by the weight of the Virginia Legal Load Single Unit Truck (27 tons). If the rating factor is greater than 1 then the bridge can support the Virginia Legal Load vehicle.

Sufficiency Rating summarizes several indicators including condition, safety, importance, and how well the bridge geometry and carrying capacity meet current needs. The rating varies from 0 percent (failing) to 100 percent (very good). Sufficiency ratings serve as a prioritization tool to allocate funds.

NOTES * Bridge is structurally deficient and scheduled to be replaced with a wider structure (UPC 107140)
 ** There is a planned upstream extension of existing box culvert (UPC 110914)
 *** If the structure has been carrying highway traffic and shows no signs of distress, it can be assumed that the structure can carry legal loads (VDOT II&M 86).
 **** Information compiled from VDOT Individual Bridge Inspection Reports and VDOT's Fredericksburg District Bridge Maintenance Report.



DRAWN BY:

BNG

BRIDGES/CULVERTS ASSESSMENT

SCALE:

1:2600

DATE:

07/27/2017

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

1 OF 1



Existing Operational Capacity

The Capacity analysis for the corridor was evaluated using the microsimulation program, VISSIM. The process of building the corridor model in VISSIM up to the extractions of the results in terms of Levels of Service (LOS), density and speed involved multiple stages, as follows:

Roadway geometry was modeled using the built-in Bing map in VISSIM, other publicly available sources (Google Maps®) and the County's GIS. Multiple areas were verified during the field visits to model the updated roadway geometry. The geometry of the roadway network in the model includes the number of lanes, lane width, and lane configurations for all the traffic movements.

Traffic counts were conducted at the key intersections and balanced for modeling purposes. The balancing process accounts for the traffic gained/lost between these intersections. Traffic Operations and Safety Analysis Manual 1.0 (TOSAM) requires traffic balancing if the volume difference is greater than 10 percent between two adjacent intersections, however, in this study and due to the capability of VISSIM, traffic was balanced up to a single vehicle. The total entering and exiting traffic at two adjacent intersections were calculated and the difference was assigned to the roadways and driveways in between to balance the vehicles entering and exiting the network. The volume assigned based on filed observations, land use and the movements. The balanced traffic was then coded into the VISSIM model for each peak hour.

Traffic characteristics were modeled per TOSAM guidelines such as, reduced speed areas for left and right-turn movements, speed distributions, driver behavior parameters, arrival type, priority rules, conflict areas, etc. Additionally, the traffic signal timing (for each peak hour) were obtained from VDOT. Other traffic controls, such as stop signs, yield signs and no lane changes were also coded in the VISSIM to replicate the existing condition.

The number of model runs required was determined from the results of the test simulation run (10 iterations). During the test run, speed, the selected Measure of Effectiveness (MOE), was collected to check for adequacy of the sample size using VDOT's Sample Size Determination Tool, Version 2.0. The results showed that with 10 iterations the averaged value of the Speed was within $\pm 10\%$ or less of the mean value with a 95% Confidence Level. For that reason, all the models were run for at least 11 runs.

Calibration was conducted for the model by collecting queue lengths, travel times and speeds at selected key intersections/segments along the corridor from field visits during AM & PM peak hours. The VISSIM model was run, the volumes and queues extracted at these locations to compare with the field measured data (the simulated traffic volume and queue lengths are the MOEs required for calibration by TOSAM for intersections and arterial sections). Proper adjustments on speed distributions and driver behaviors were made to calibrate the model and new results were collected. The process was repeated until similar values were achieved (within the allowable thresholds in TOSAM) and the model was considered calibrated. The calibrated model is used as the base for the existing conditions capacity analyses.

Operational Capacity for the existing condition at the corridor was determined from the data collected at the key intersections from running the calibrated models for each peak hour. The delay at these intersections were used to determine the operating LOS for each movement as well as the entire intersection, using the threshold values from Highway Capacity Manual (HCM) 2000.

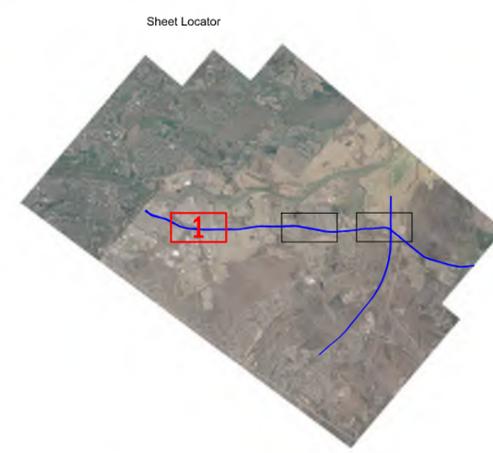
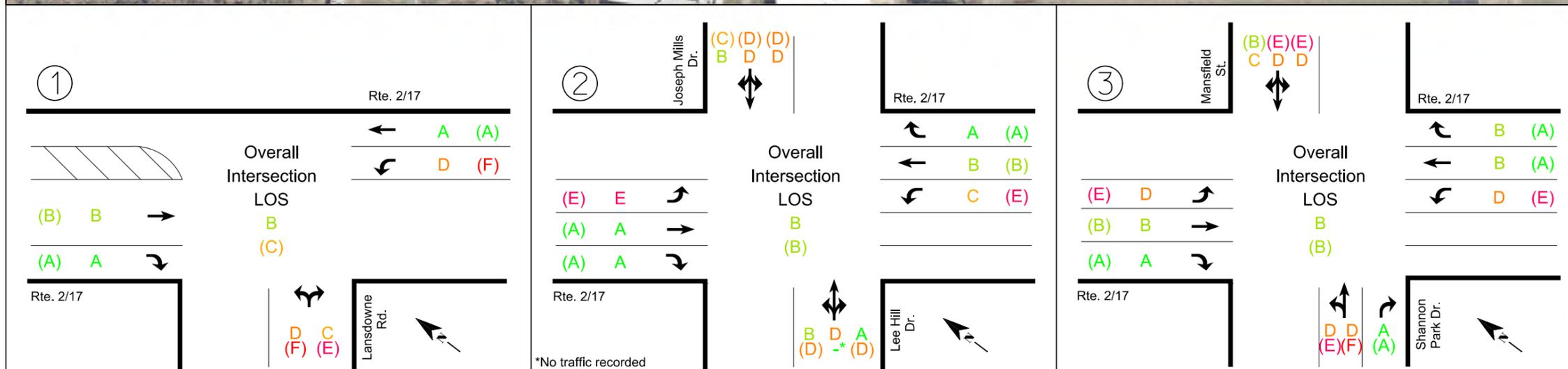


Figure 1: Rte. 2/17 Corridor Density - PM Peak Hour



LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
-
- LOS COLOR RAMP

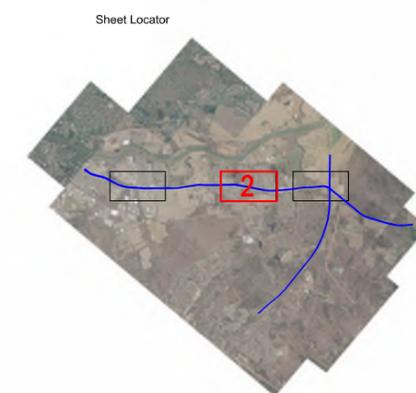
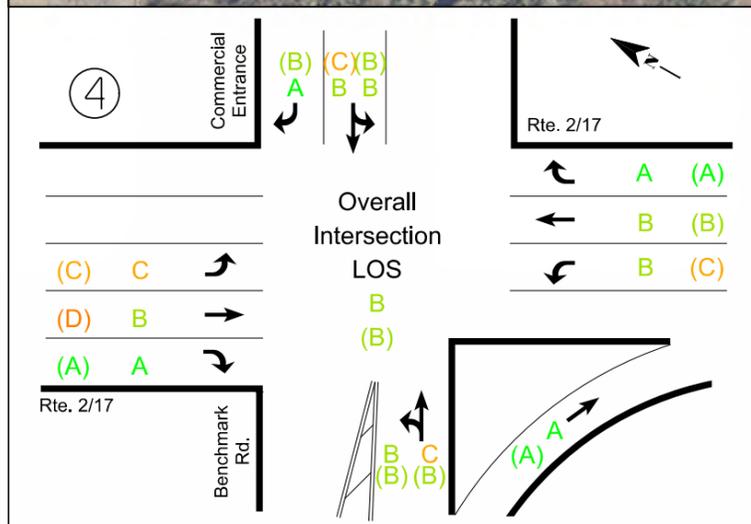


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	CHECKED BY:	KHB	RTE. 2/17 CORRIDOR STUDY		JMT PROJECT NO.: 15-0038-002	SHEET NO.:	1	OF	3	
					VDOT UPC PROJECT NO.: 107193					

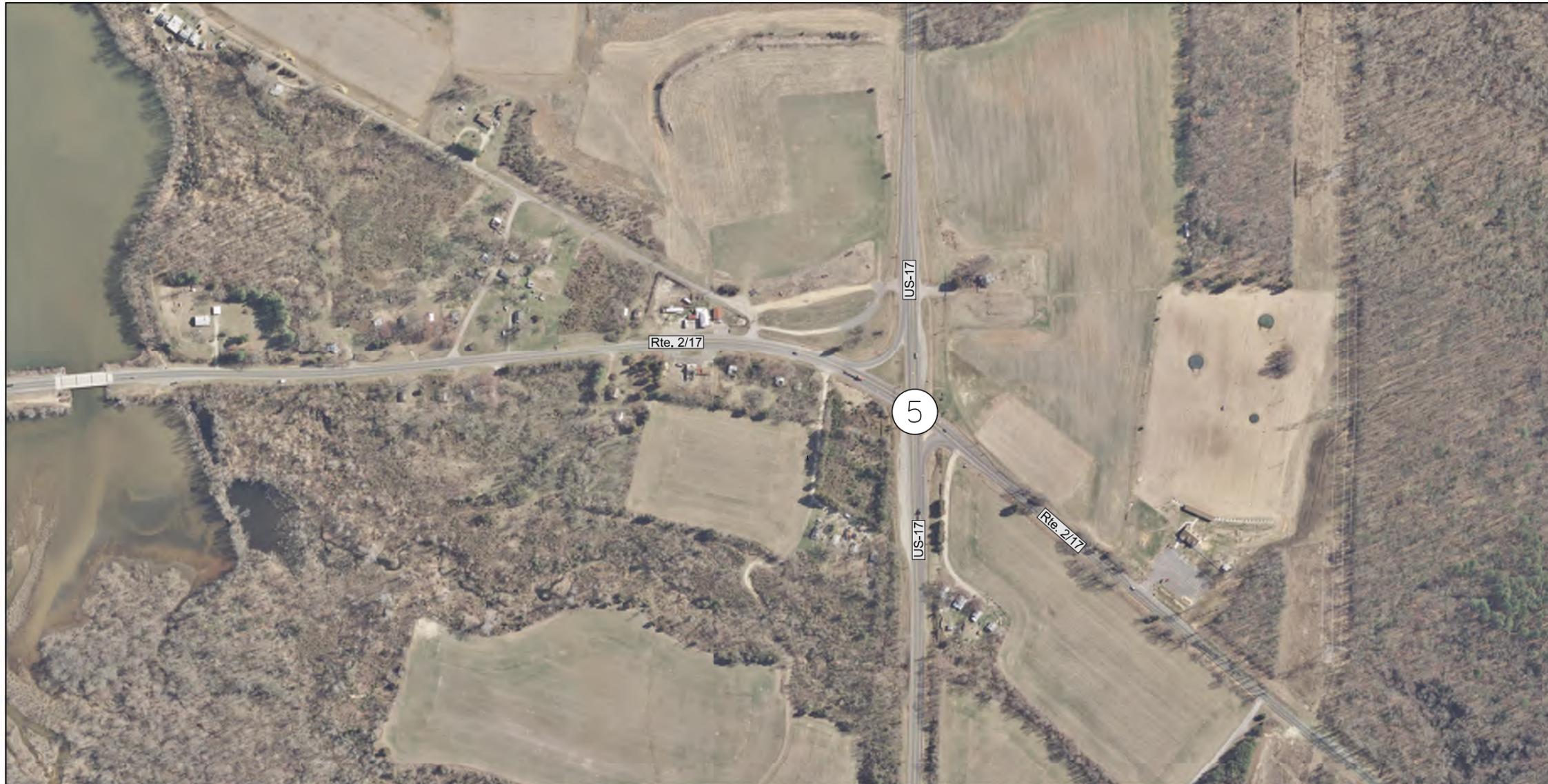


LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP



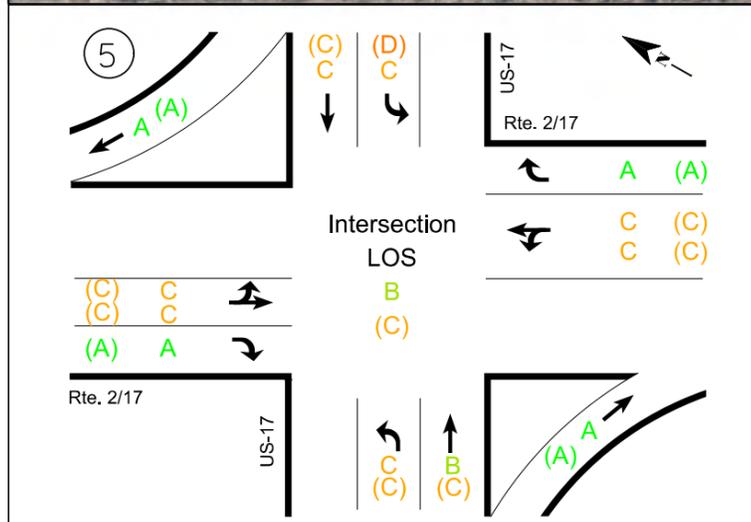
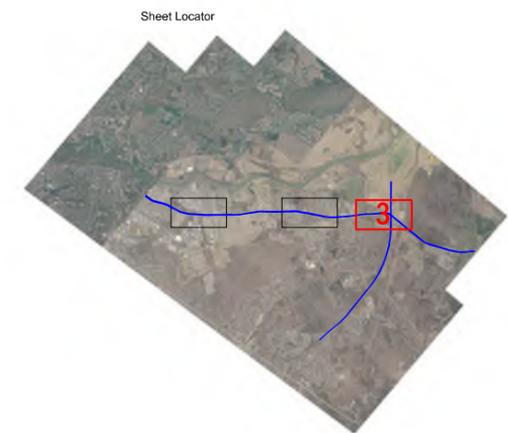
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	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	2	OF	



LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F

 LOS COLOR RAMP



	DRAWN BY:	RAM	2017 EXISTING LEVELS OF SERVICE RTE. 2/17 CORRIDOR STUDY	SCALE:	1:400	DATE:	11/10/2017	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	SHEET NO.:	3	OF	
				VDOT UPC PROJECT NO.:	107193			

List of Identified Issues from Existing Conditions Evaluations

Existing conditions of the corridor were evaluated based on the traffic operations, roadway geometry, lane configurations, crash data, traffic control devices, access management, public transit, pedestrian and bicyclist facilities and accommodations, environmental assessment, and bridges and culverts evaluations. The following is a list of identified issues that might be considered for any future improvements:

1. Volume: relatively high traffic demand in the northern portion of the corridor, from Fredericksburg City limits to the intersection of Rte. 2/17 at Shannon Park Dr./Mansfield St.

2. Lane configurations:

a. Long portions of the corridor (from Mansfield Club Dr. to Powell St.) has a two-way left-turn lane (TWLTL). Although this lane is beneficial for left-turn maneuvers from the mainline to side roads, it increases the distance (and conflict) for left-turning vehicles from side roads to the mainline. The conflict and complexity of the left-turn maneuvers will increase at four-leg intersections compared to the T-intersections.



Figure 2: Rte. 2/17 at Pierson Dr./N. Club Dr.

b. On Rte. 2/17 at Benchmark Rd., the northbound left-turn lane movement may cause driver confusing due to the skew angle of the Benchmark Rd. and the striping at the southwest corner.



Figure 3: Rte. 2/17 at Benchmark Rd.

c. The single shared left- and right-turn lane at Lansdowne Rd. prevents the right-turning traffic from making a right-turn on red. The approach has relatively high traffic during the AM and PM peak hours causing unnecessary queuing for this approach.



Figure 4: Rte. 2/17 at Lansdowne Rd.

3. Crashes:

a. Crashes at key intersections: relatively high crashes especially at the following intersections along Rte. 2/17:

- i. Joseph Mills Dr./Lee Hill Dr.
- ii. Shannon Park Dr./Mansfield St.
- iii. Lansdowne Rd.
- iv. Bend Farm Rd.
- v. Benchmark Rd.



Figure 5: Crashes at key intersections

4. Access Management: about 85% noncompliant access points along the corridor, especially the following sections along Rte. 2/17:

a. From Fredericksburg City Limits to N. Club Dr./Pierson Dr. (Including 3 signalized intersections).

- b. From Rosser St. to Wisteria Dr.
- c. From Ruffin Dr. to US-17/Rte. 2/17.
- d. The intersection of Rte. 2/17 at Lansdowne Rd. and Rte. 2/17 at Lee Hill Dr./Joseph Mills Dr. spacing is 643' causing queues to spill back to the upstream intersection. The required minimum spacing is 1,050' per VDOT's Access Management Guidelines.



Figure 6: Access Management Evaluations

5. Pedestrian & Bicyclists accommodations: In general, the following was observed:

a. One existing crossing with push-button actuation for Rte. 2/17 at Glendas Way/Briarwood Ln.



Figure 7: Crosswalk on Rte. 2/17 at Glendas Way

- b. No pedestrian phasing, crossing or push-buttons at the signalized intersections.
- c. Limited sidewalk presence and continuity.
- d. No bike routes within the vicinity of the corridor (Proposed Greenway Trail crosses the corridor near the intersection of Rte. 2/17 at Lee Hill Dr./Joseph Mills Dr.)
- e. Limited ridership for public transit.
- f. Predominately car-dependent trips within the corridor.

6. Traffic control devices:

- a. Multiple signs need replacement within the vicinity of the corridor.



Figure 8: Deficient Sign

7. Environmental assessment:

- a. No issues for existing conditions; potential issues for future improvements from Hazardous Materials Sites, Historic Resources and Natural Resources will be assessed further based on the recommended alternatives.



Figure 9: Environmental Assessment

8. Bridges & Culverts:

- a. There are 4 culverts along Rte. 2/17 crossing streams that are classified as poor and needs replacement (There is a planned upstream extension of existing box culvert). The bridge along Rte. 2/17 crossing Deep Run Creek is in poor condition. This structure could be considered within the influence of the key intersections.



Figure 10: Rte. 2/17 Bridge/Culvert Assessment

9. LOS:

based on the results from the simulation model, the operational LOS for the key intersections can be summarized as follows:

- a. The PM peak hour is expected to operate at the worst (lower LOS) for most of the movements and overall intersections.
- b. The overall intersection LOS during PM peak hour is considered for evaluating the corridor. Total of Three intersections operated at LOS B, and two intersections at LOS C.

Intersection of Rte. 2/17 at	Peak Period	
	AM 7:15 - 8:00	PM 4:30 - 5:15
Lansdowne Rd.	B	C
Lee Hill Dr./Joseph Mills Dr.	B	B
Shannon Park Dr./Mansfield St.	B	B
Benchmark Ln./Commercial Entr.	B	B
US-17	B	C

Table 1: Overall intersection Level of Service

- c. The three intersections with LOS B are the Rte. 2/17 at US-17, and Rte. 2/17 at Lansdowne Rd. The signal timing and lane configurations are in favor of the through movements causing LOS E or worse for turning movements along the Rte. 2/17 and/or crossing roads.
- d. The two intersections with LOS C have turning movements (especially shared left/right-turn, left-turn and shared lanes – through/right or through/left – at LOS D or worse).
- e. Due to the spacing of the signalized intersections of Rte. 2/17 and Lansdowne Rd. and Rte. 2/17 at Lee Hill Dr./Joseph Mills Dr. being inadequate (643'), queueing for the Northbound thru movement at Lansdowne exceeds the current storage and extends through the intersection of Rte. 2/17 at Lee Hill Dr./Joseph Mills Dr. and continues towards the intersection of Rte. 2/17 at Shannon Park Dr./Mansfield St.
- f. It can be concluded that the critical intersections at this corridor are operating at moderate to near capacity and any additional traffic from normal growth and trips from approved developments will cause failures and bottlenecks along the corridor that will impact the nearby intersections.

10. Developments:

- a. There is a proposed Industrial Park Connection that will connect Shannon Park Dr./Lansdowne Rd. to Belman Rd. A connection road would remove traffic from using Rte. 2/17 near the city limits all together allowing access to both industrial parks from Belman Rd. on the City of Fredericksburg side and Lansdowne Rd. on the Spotsylvania side.
- b. The southern portion of Rte. 2/17 at US-17 is undeveloped except for the New Post Apartments currently under construction on Rte. 2/17 and US-17. The area could be developed in the future due to the 2040 land designations of Employment Centers and Mixed Land Use.

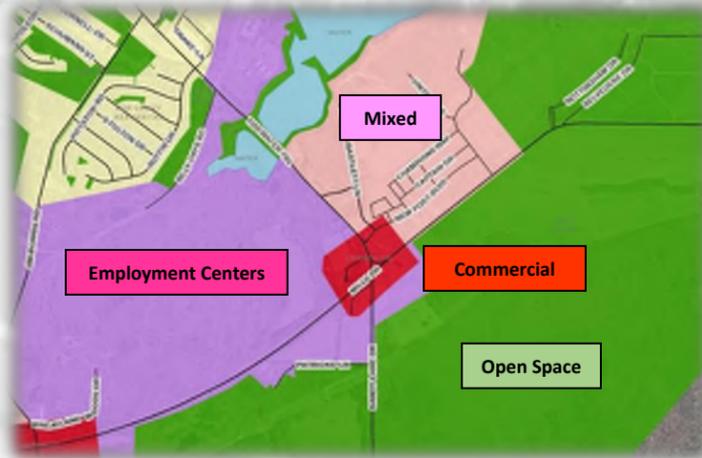


Figure 11: 2040 Future Land Use Map

- c. A proposed roundabout at the Fredericksburg Country Club and iDX would impact the progression of that portion of Rte. 2/17. A roundabout would impact the speed for the through traffic while allowing vehicles to access the two entrances.



Figure 12: Roundabout at Fredericksburg Country Club and iDX

Future Conditions Analysis

The future year for this study was considered by the County to be 2035. The future conditions traffic analysis included forecasting the growth of traffic for 2035 to determine the anticipated issues in the current roadway system (future no-build) and proposed alternative solutions. For this study, a total of three alternatives were evaluated. Alternative 1, in compliance with the County's Comprehensive Plan, proposed widening the corridor into a four-lane divided roadway, from the City of Fredericksburg Line to US-17, with a shared use path on one side of the roadway. Alternative 2 proposed two-lanes in the southbound direction, from the City line to Shannon Airport Circle, and proposed improvements at two intersections along Rte. 2/17, Benchmark Rd. and US 17, with a shared use path on one side of the roadway. Alternative 3 is all the improvements proposed for Alternative 2 in addition to widening Benchmark Road into a four-lane undivided roadway, from Rte. 2/17 to US 17. It is recommended to re-evaluate the ped/bike activities after the full build-out of the shared use path to determine the need for pedestrian crossings within the corridor (mid-block and/or intersections). The following are brief descriptions about steps considered to build and evaluate these three alternatives. Detailed exhibits and discussions about future no-build, Alternatives 1, 2, and 3 will follow.

Future Traffic Volume data for the year 2035 was determined from 2017 counts multiplied by the average growth factors. Roadway specific and regional growth factors were calculated from the comparison of the 2017 (Base Year) and the 2035 (Future Year) Travel Demand Models. The Base Year was developed from the County's model and it was validated using VDOT published ADTs, 2017 directional counts and turning movement counts. The validation was according to the guidelines of the VDOT's Travel Demand Modeling Policies and Procedures, June 2014 version. Future Year model was developed from Base Year model by including the planned residential and commercial developments and land use changes at each Transportation Analysis Zone (TAZs).

Operational Capacity of the corridor for future year (2035) was analyzed in VISSIM. Delays at the intersections were used to determine the operating Level of Service (LOS) at the study intersections. Also, the density and speeds were considered for evaluating the performance of the roadway segments between the intersections within the limits of the study corridor. A total of three alternatives were evaluated, in addition to the future no-build scenario.

Future No-Build scenario was considered to be the base for comparison with proposed alternatives as well as to identify problematic roadway sections and intersections within the corridor boundary. The scenario consisted of loading the existing (2017) roadways and intersections with the projected future traffic volumes (2035). The analysis was conducted for the weekday AM and PM peak hours.

Alternative 1 included widening the corridor to a four 12'-lane divided roadway, from the City of Fredericksburg Line to the intersection of Rte. 2/17 at US-17, with a shared used path on one side of the roadway. This alternative was based on the County's Comprehensive Plan. The section south of the US-17 intersection to Caroline County Line will remain as existing due to relatively lower traffic. In addition to widening the corridor, improvements were proposed at the five study intersections. The improvements were adding and/or changing lane configurations based on the issues identified from the future no-build scenario. Also, the alternative includes adding bus pullouts at the current bus stops to minimize the impact on the through traffic. All the entrances and access points along the divided portion of the corridor are considered to be partial while providing U-turns at the main intersections. Figure F 1 shows the proposed configuration for pedestrian, bus, and vehicles.



Figure F 1: Alternative 1 Proposed Lane Configurations (VISSIM)

Alternative 2 addressed the capacity issues identified from future no-build and proposed widening the southbound direction into two lanes, from the City Line to Shannon Airport Circle, keeping the northbound as one lane. Additionally, improvements were proposed at the five study intersections to achieve acceptable LOS. This alternative also included re-evaluation of the access points throughout the corridor which can be used by the County for consolidating existing entrances, and as a guidance for approval of new access points, if future developments occurred along the corridor. Detailed evaluation for existing and future access points are shown in "Alternative 2 Access Management Evaluation" exhibits. This alternative also includes a shared use path on one side and bus pullouts at the existing bus stops. Figure F 2 shows the proposed configurations for the northern portion of the corridor.



Figure F 2: Alternative 2 Lane Configurations (Looking South) – (VISSIM)

Alternative 3 includes all the proposed improvements from Alternative 2 and proposed widening Benchmark Rd. into four-lane undivided roadway. Similar to Alternative 2, this alternative included a shared used path and bus pullouts. All the access management evaluations considered for Alternative 2 will be applicable for this alternative too. The proposed cross section for Benchmark Rd. is shown in Figure F 3.

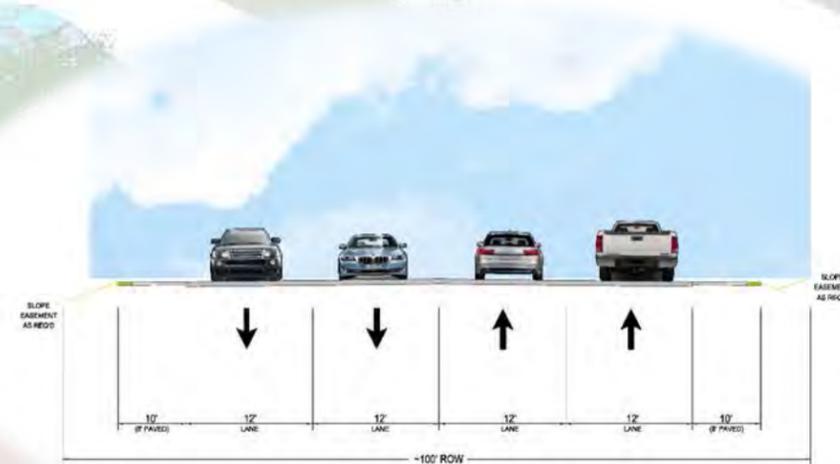


Figure F 3: Benchmark Road Cross Section

Future No-Build Scenario

Future Year (2035) traffic volumes considered for this scenario were determined from the County's Travel Demand Model. Capacity analysis was conducted in VISSIM using the projected future traffic volumes and the existing (2017) roadway/intersection geometry. Additionally, the traffic signal timings were kept unchanged from the existing signal timings. The purpose of this analysis was to identify the issues that will occur if no roadway improvements are implemented by 2035. This scenario will help in determining problematic areas within the corridor, in general, and for each of the study intersections, specifically. Additionally, it was used as a base scenario for comparison with the three proposed alternatives.

Capacity analyses were conducted for the weekday AM and PM peak hours. Operational LOS of the five study intersections were identified from simulation results of 12 runs using VISSIM. The number of runs was based on VDOT's Traffic Operations and Safety Analysis (TOSAM) manual. The average delays of all 12 runs, for the intersections as well as individual movements, were compared with Exhibit 18-4 of Highway Capacity Manual (HCM), 2010 to determine the corresponding LOS. The overall intersection LOS are shown in Table F 1 and the single movements LOS details are shown on individual sheets.

As it can be noted from Table F 1, the intersections within the corridor are performing at poor LOS during the PM peak hour. In general, the following can be concluded from the capacity analysis results of the no-build scenario:

1. Three intersections performed at LOS C or better during the AM peak hour, except the intersections of Rte. 2/17 at Lansdowne Rd. and Rte. 2/17 at Shannon Park Dr./Mansfield St. which performed at LOS E.
2. Three intersections performed at LOS F during the PM peak hour. The intersection of Rte. 2/17 at Benchmark Rd. performed at LOS D, and the intersection of Rte. 2/17 at Lee Hill Dr./Joseph Mills Dr. performed at LOS C.
3. The severity of congestion at some of the intersections, especially in the PM peak hour, created bottlenecks that prohibited the flow of traffic to the adjacent intersections resulting in acceptable LOS (LOS D or better) at some of these intersections. Improvements at the problematic intersections will increase the flow of traffic and may cause the intersections to perform worse than what is reported herein as acceptable.

Table F 1: Future no-build Intersection LOS

#	Intersection of Rte. 2/17 at	Peak Hour	
		AM 7:15 - 8:15	PM 4:30 - 5:30
1	Lansdowne Road	E	F
2	Lee Hill Drive/Joseph Mills Drive	C	C
3	Shannon Park Drive/Mansfield Street	E	F
4	Benchmark Road/Commercial Entrance	B	D
5	US-17	B	F



LEGEND

xxxx AM Peak Hour Volume

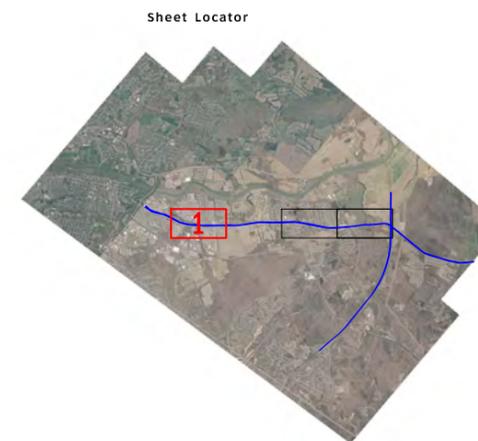
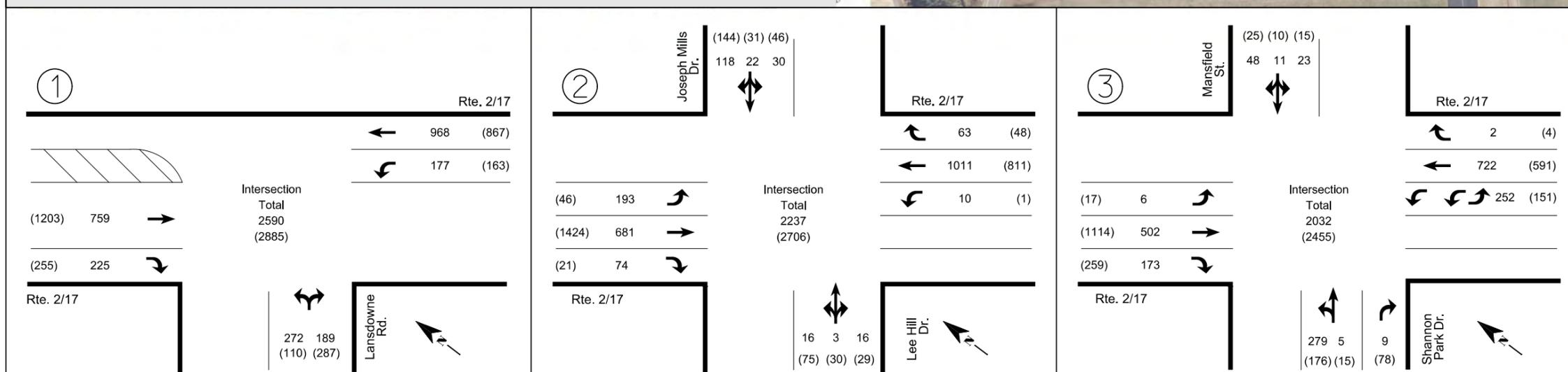
(xxxx) PM Peak Hour Volume

Traffic Movement

Two - Way Left - Turn Lane

Intersection Number

Future traffic volumes for the 2035 no-build scenario were determined from the 2035 Traffic Demand Model that included forecasted socioeconomic information, planned residential and commercial developments, and land use changes within each Transportation Analysis Zone.



DRAWN BY:

MAF

2035 NO-BUILD PEAK HOUR VOLUMES

SCALE:

1:400

DATE:

09/21/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

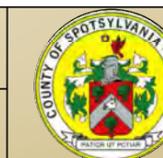
VDOT UPC PROJECT NO.: 107193

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LEGEND

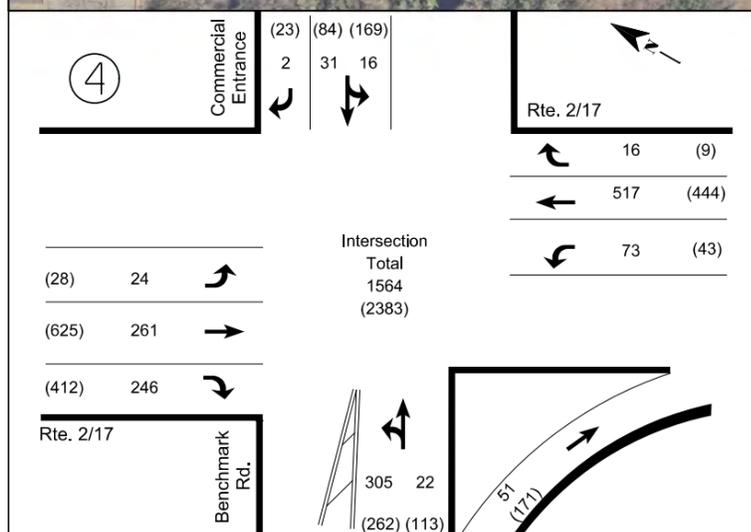
xxxx AM Peak Hour Volume

(xxxx) PM Peak Hour Volume

↔ Traffic Movement

↔↔ Two - Way Left - Turn Lane

⊗ Intersection Number



Sheet Locator



10/18/2018 9:39:49 AM



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MAF

2035 NO BUILD PEAK HOUR VOLUMES

SCALE:

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DATE:

09/21/2018

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KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

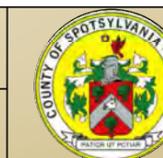
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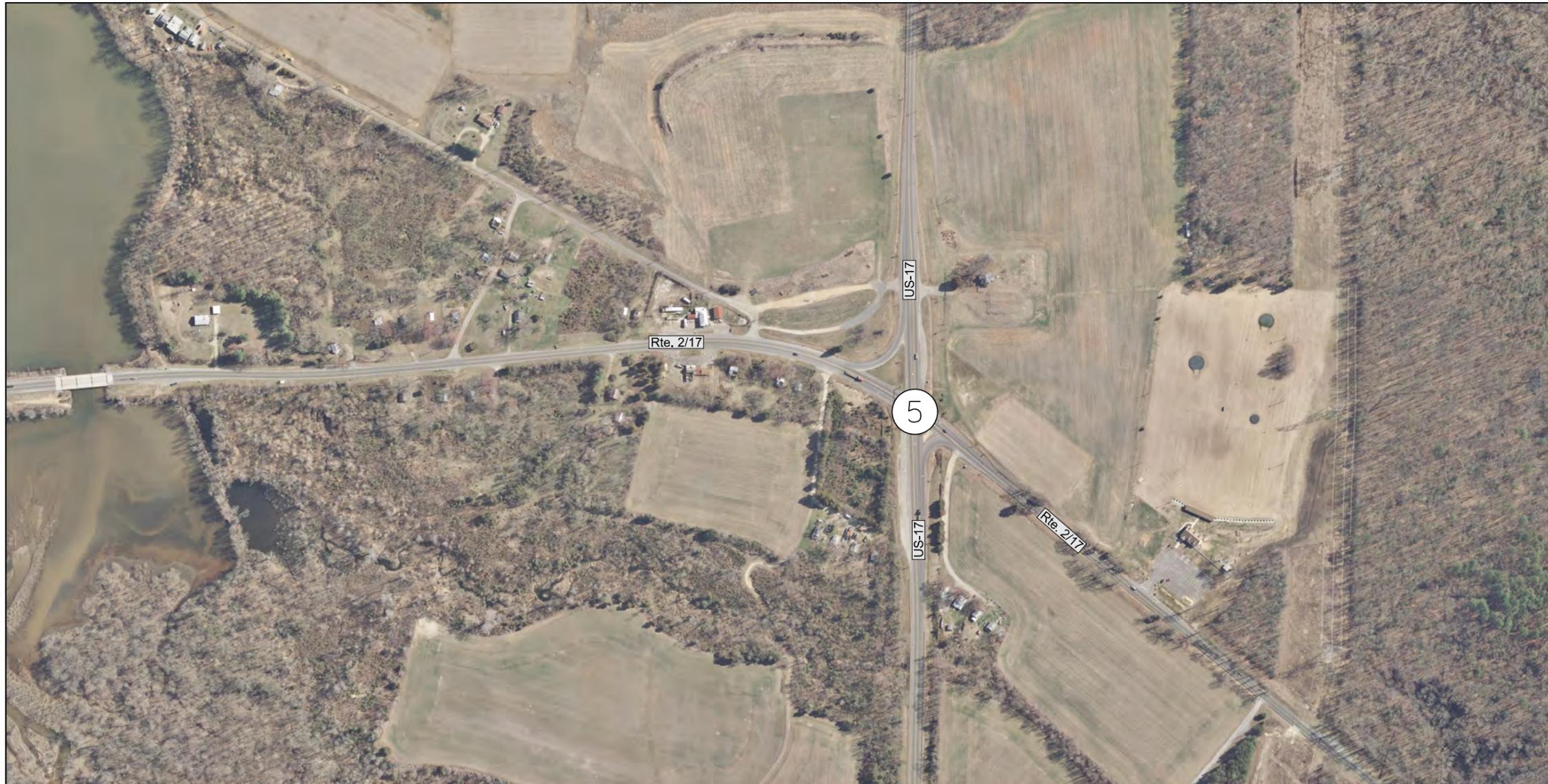
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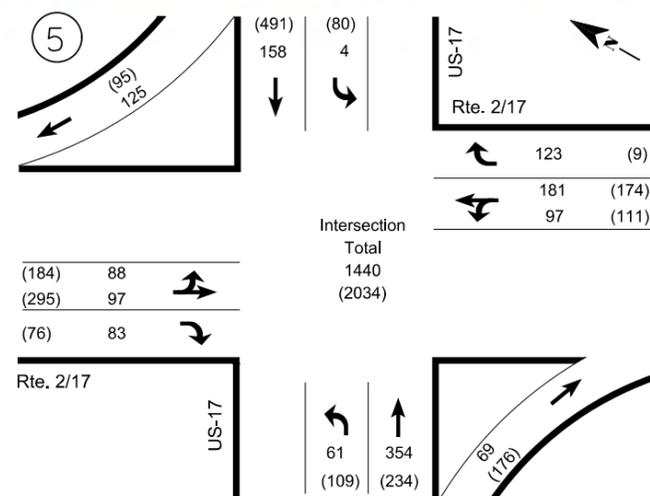
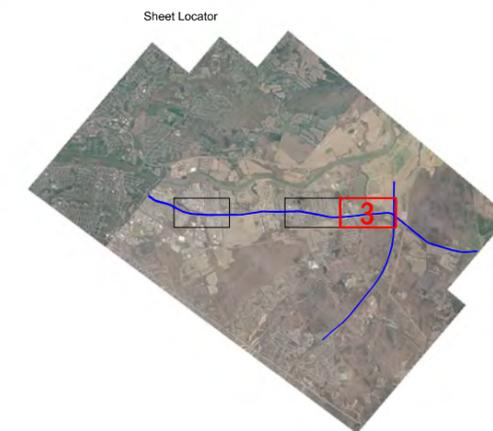


LEGEND

xxxx AM Peak Hour Volume

(xxxx) PM Peak Hour Volume

-  Traffic Movement
-  Two - Way Left - Turn Lane
-  Intersection Number



DRAWN BY:

MAF

2035 NO BUILD PEAK HOUR VOLUMES

SCALE:

1:400

DATE:

09/21/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

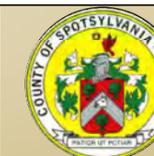
VDOT UPC PROJECT NO.: 107193

SHEET NO.:

3

OF

3



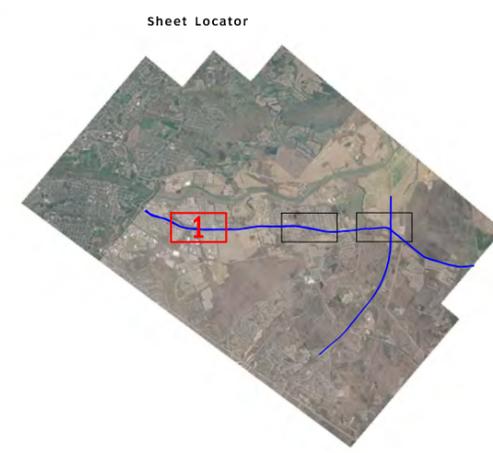
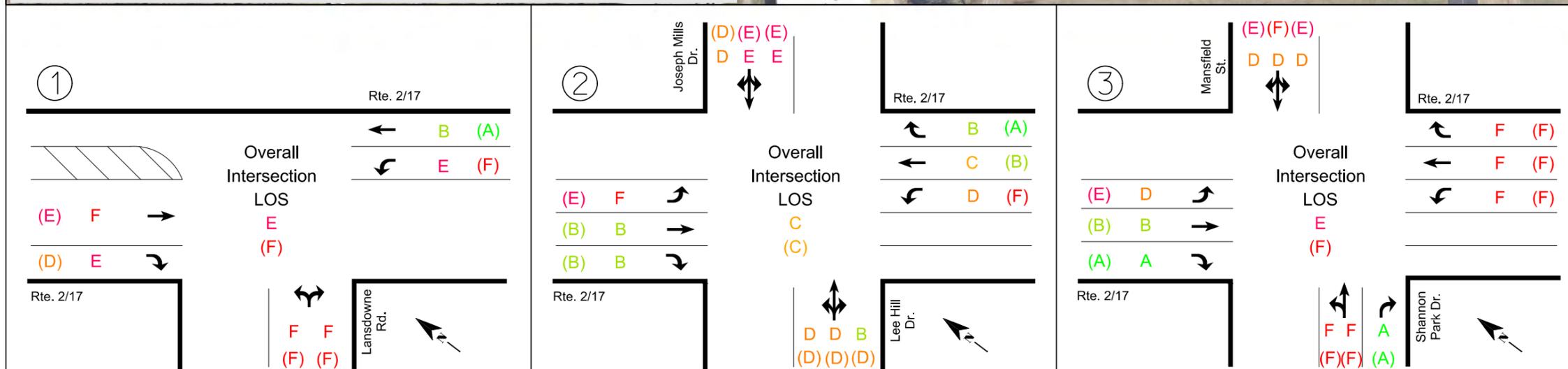


LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F

 LOS COLOR RAMP

Operational capacity of the corridor for the future year (2035) no-build scenario was analyzed in VISSIM for the AM and PM peak hours. Delays were used to determine the operating Level of Service for individual movements and intersections.

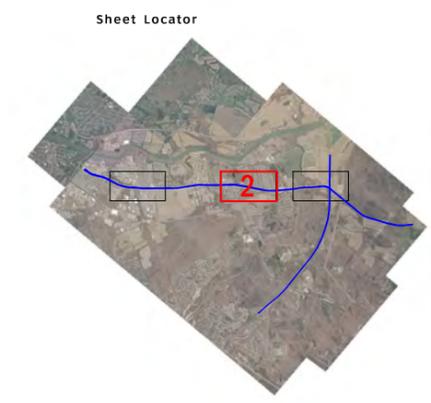
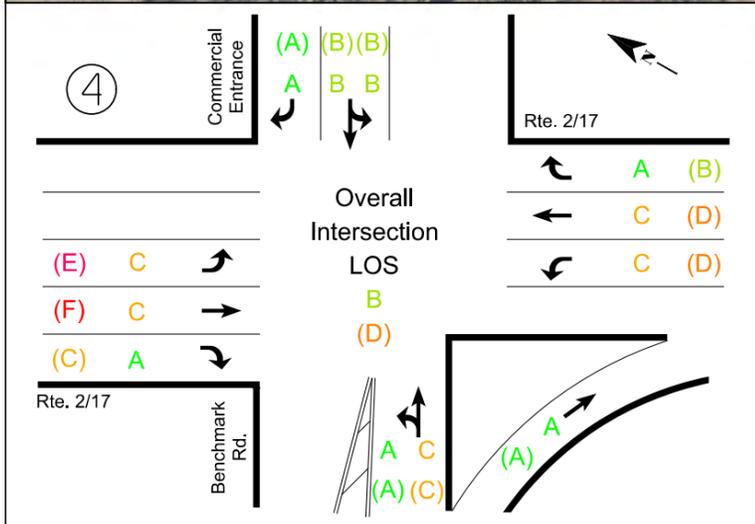


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	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	VDOT UPC PROJECT NO.: 107193	SHEET NO.:	1 OF 3	

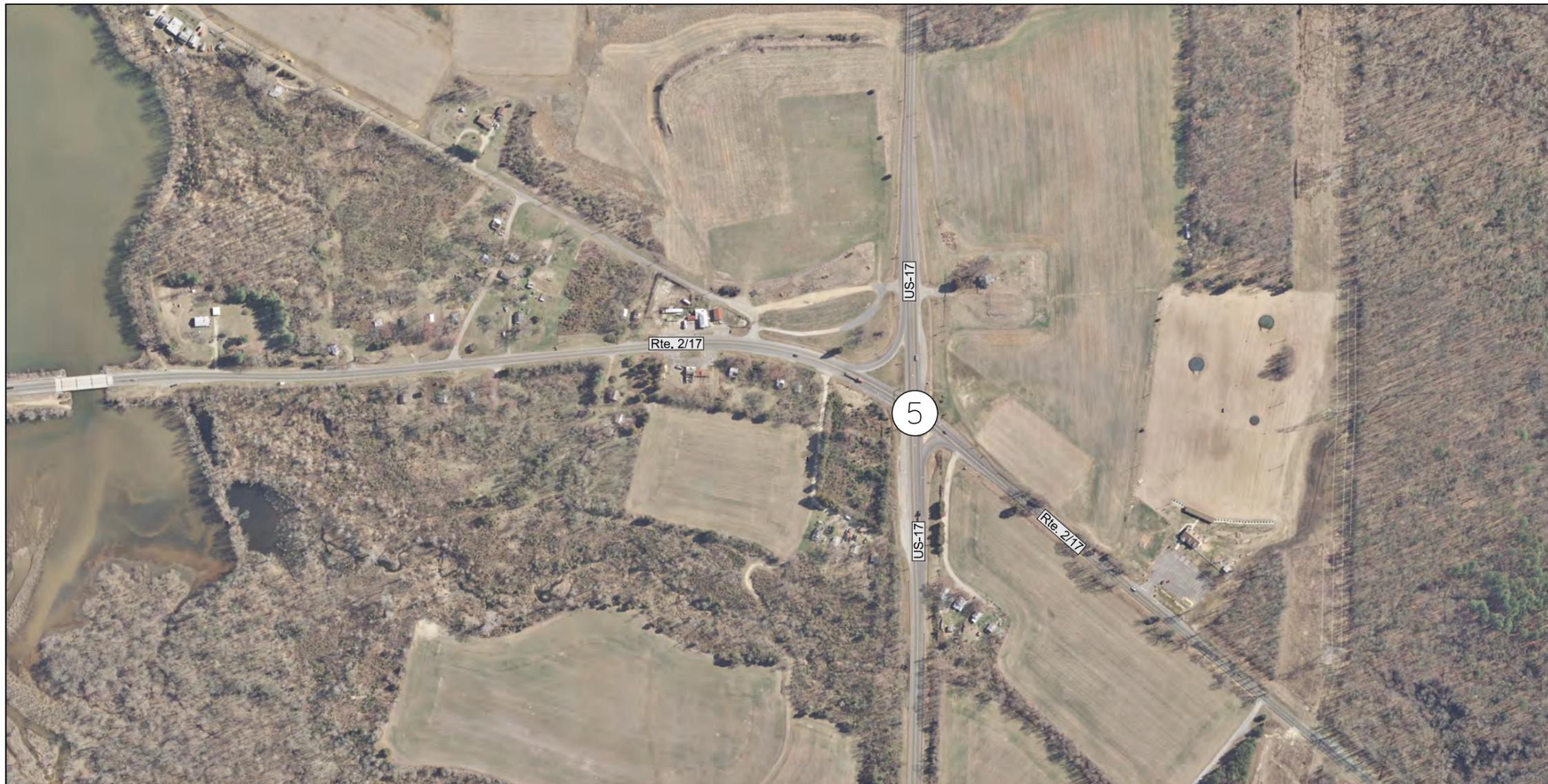


LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP



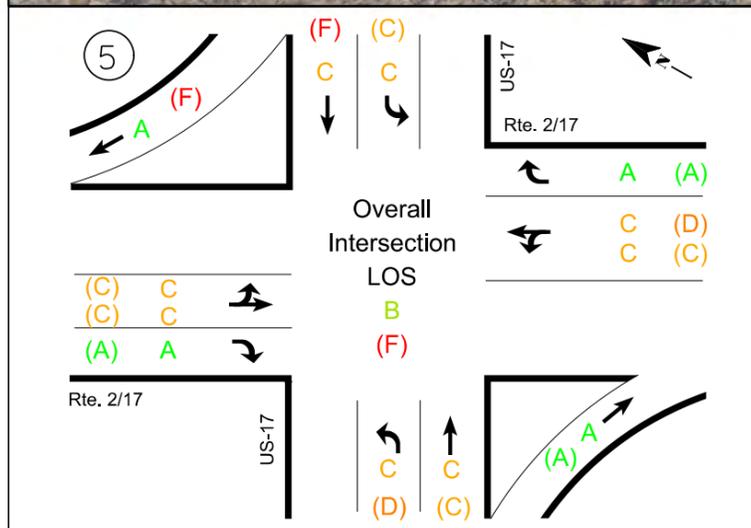
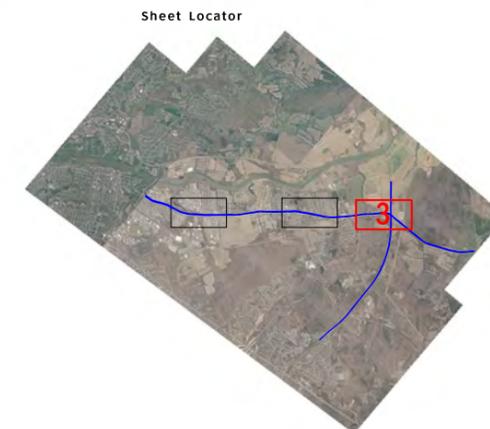
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	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	2	OF	



LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F

 LOS COLOR RAMP



	DRAWN BY:	MAF	2035 NO BUILD LEVELS OF SERVICE RTE. 2/17 CORRIDOR STUDY	SCALE:	1:400	DATE:	09/21/2018	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	3	OF	

Alternative 1

Alternative 1 was based on the County's plan to widen Rte. 2/17 to a four 12'-lane divided roadway from the Fredericksburg City Line to the intersection of Rte. 2/17 at US-17. Alternative 1 also includes intersection improvements, in terms of adding capacity and/or lane configurations, and optimized signals to achieve the best possible LOS at each intersection. The proposed improvements were developed to address the deficiencies identified from the future no-build scenario. This alternative includes a 10' wide shared use path on one side of the roadway and includes four bus pullouts at the current bus stops to minimize the impact of public transit on through traffic. Between major intersections, Rte. 2/17 will have a raised median that will restrict full movements from side streets and entrances. U-turns will be permitted at the major intersections to accommodate the restricted movements. The section south of the US-17 intersection to the Caroline County Line will remain as existing due to relatively lower traffic. The no-build VISSIM model was updated to reflect the proposed corridor improvements in this alternative and run for 12 iterations. The overall intersection LOS for both AM and PM peak hours are shown in Table F 2 and the single movements LOS details are shown on individual sheets. The following can be concluded from the capacity analysis results of Alternative 1:

1. All the intersections performed at LOS B during the AM and PM peak hours, except the intersection of Rte. 2/17 at US-17 which performed at an acceptable LOS C during the PM peak hour.

Table F 2: Alternative 1 Intersection LOS

#	Intersection of Rte. 2/17 at	Peak Hour	
		AM 7:15 - 8:15	PM 4:30 - 5:30
1	Lansdowne Road	B	B
2	Lee Hill Drive/Joseph Mills Drive	B	B
3	Shannon Park Drive/Mansfield Street	B	B
4	Benchmark Road/Commercial Entrance	B	B
5	US-17	B	C

Alternative 1 Cost:

A high-level cost estimate was completed for Alternative 1. The cost estimate was broken down into three main categories; (1) structural, (2) construction, and (3) environmental. The cost estimates of the three categories utilized the typical cross-section proposed for this alternative, shown in Figure F 4.

The proposed shared use path continues along the entire corridor from the Fredericksburg City Line to the intersection of Rte. 2/17 at US-17. Additionally, the cost estimate, shown in Table F 3, includes the proposed improvements at the five study intersections based on the capacity analysis results for both AM and PM peak hours. The structural cost includes four proposed bus pullouts with shelters located at the existing bus stops along the corridor, five culvert replacements, and a new 150' long bridge over Ruffin's Pond.

VDOT provided unit costs from the Transportation and Mobility Planning Division (TMPD), inflated to year 2018, was used to determine the planning level cost estimates for this alternative, which includes low and high ranges. Cost estimates provided herein are not for construction purposes. Detailed engineering design and cost estimates are required to identify the budget needed for implementing Alternative 1. In general, the cost estimate of this alternative is impacted by the following:

- a. Requires a bridge and multiple culvert replacements with the widening, and a new 150' long bridge over Ruffin's Pond.
- b. Anticipated high cost for ROW acquisition (~36% of the construction cost).



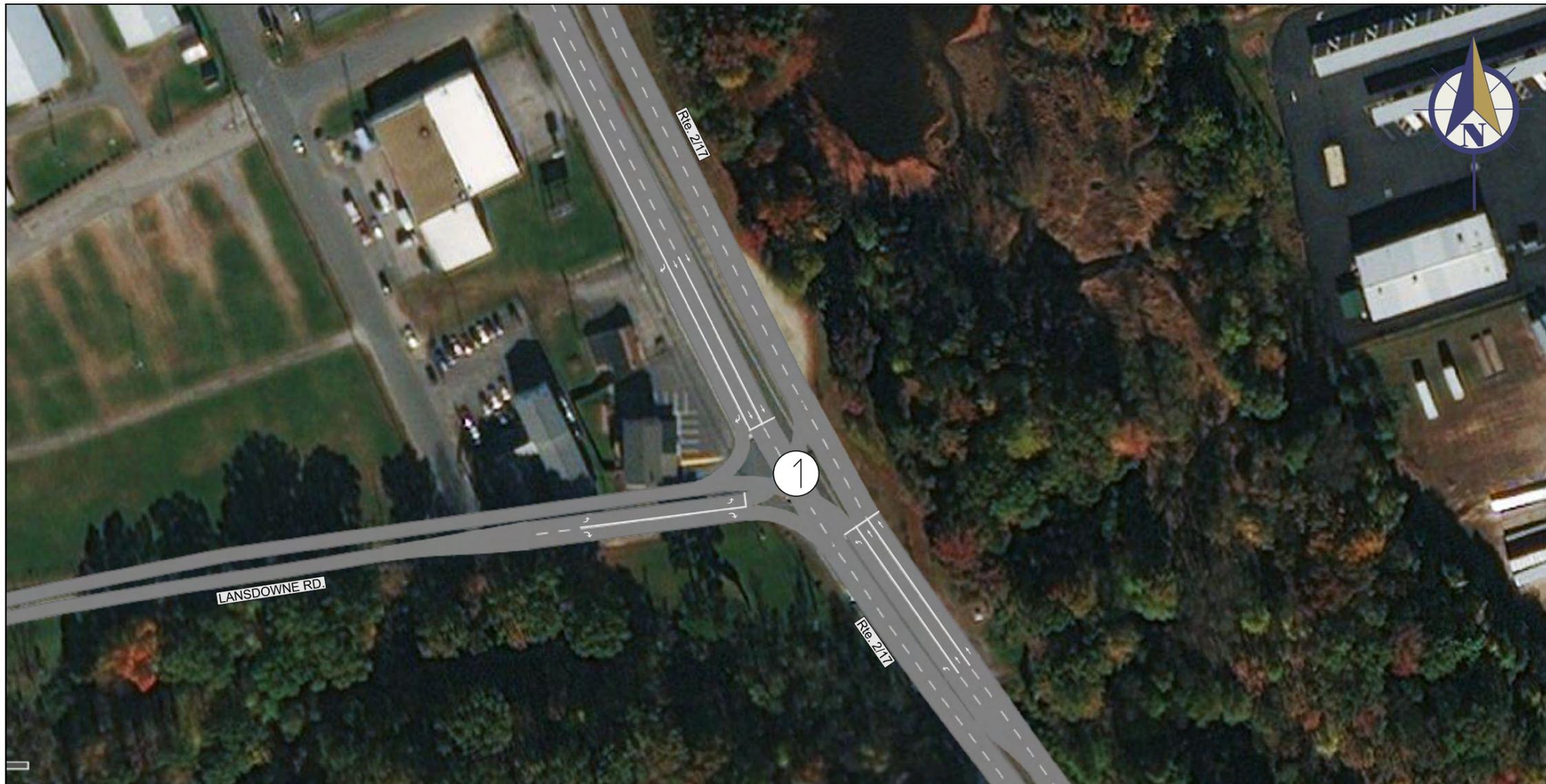
Figure F 4: Alternative 1 Proposed Lane Configurations (VISSIM)

Table F 3: Alternative 1 Planning Level Construction Cost Estimate

Item	Quantity	Unit Cost		Unit	Costs	
		Low	High		Low	High
Structural Cost						
Bus Pullout/Shelter	4.00	\$30,000		Each	\$120,000	
Culvert - 300' South of Lansdowne Rd.	1.00	\$63,000		Each	\$63,000	
Culvert for Deep Run Creek (replace existing bridge)	1.00	\$500,000		Each	\$500,000	
Culvert - 500' S of Pierson Dr./N. Club Dr.	1.00	\$50,000		Each	\$50,000	
Culvert - 500' N of Benchmark Rd.	1.00	\$93,000		Each	\$93,000	
Culvert - 75' N of Ruffin Dr.	1.00	\$156,000		Each	\$156,000	
Bridge over Ruffin's Pond	1.00	\$1,720,000		Each	\$1,720,000	
Structural Subtotal					\$2,702,000	
Construction Cost						
Signal						
Modify Existing Signal	5.00	\$142,000	\$306,000	Per Intersection	\$710,000	\$1,530,000
Pavement						
Right turn lane	4.00	\$66,000	\$144,000	Per 100'	\$264,000	\$576,000
Right turn Taper	2.00	\$44,000	\$96,000	Per 100'	\$88,000	\$192,000
Left turn lane	4.00	\$126,000	\$156,000	Per 200'	\$504,000	\$624,000
Left turn taper	1.50	\$84,000	\$104,000	Per 200'	\$126,000	\$156,000
2 lanes**	0.21	\$4,698,000	\$7,047,000	CPM*	\$986,580	\$1,479,870
4 lanes**	4.23	\$8,217,000	\$11,394,000	CPM	\$34,757,910	\$48,196,620
Pavement around bridge area	0.06	\$5,167,800	\$7,751,700	CPM	\$310,068	\$465,102
10' Shared use path off road	4.44	\$940,000	\$940,000	CPM	\$4,173,600	\$4,173,600
16' raised median	3.78	\$343,200	\$422,400	CPM	\$1,297,296	\$1,596,672
6-8' raised median (U-turn)	0.16	\$257,400	\$316,800	CPM	\$41,184	\$50,688
Construction Subtotal					\$43,259,000	\$59,041,000
Structural & Construction Subtotal					\$45,961,000	\$61,743,000
Right-of-Way (36% of ST & CN)					\$16,545,960	\$22,227,480
Subtotal (Structural & Construction)					\$62,510,000	\$83,980,000
Environmental Cost						
Wetland/Stream Mitigation Estimate	1.00	\$423,000		Each	\$423,000	
NEPA Environmental Documentation	1.00	\$40,000		Each	\$40,000	
Phase 1 Environmental Site Assessment	1.00	\$6,000		Each	\$6,000	
Phase 1 Cultural Resource Survey	1.00	\$8,000		Each	\$8,000	
Permitting	1.00	\$25,000		Each	\$25,000	
Air/Noise Studies	1.00	\$50,000		Each	\$50,000	
Subtotal					\$560,000	
Grand Total (rounded)					\$63,500,000	\$85,000,000

*CPM: Cost Per Mile

**Cost considered the use of existing pavement

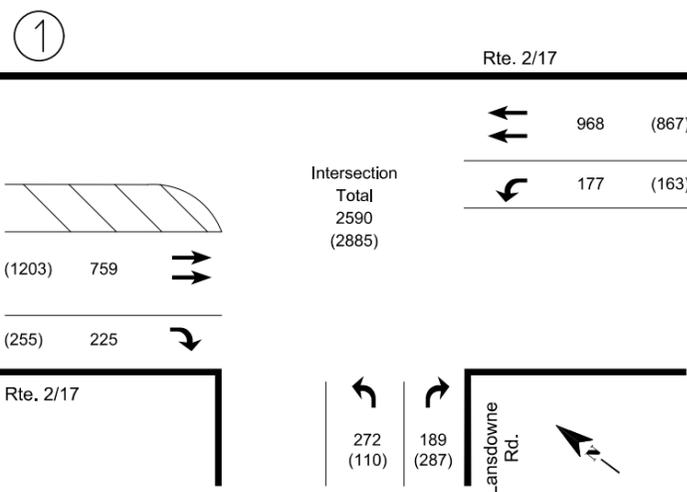


LEGEND

xxxx AM PHV

(xxxx) PM PHV

- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number



Proposed Improvements*:

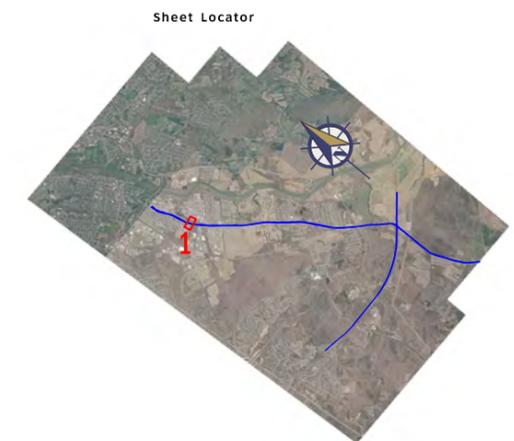
Southbound Approach:

- extend existing right-turn lane to be ~400'

Eastbound Approach:

- add right-turn lane to be ~200'
- convert shared left/right-turn lane to be exclusive left-turn lane

*In addition to signal optimization and coordination, as applicable



PHV: PEAK HOUR VOLUME

10/18/2018 9:52:12 AM



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HLR

ALTERNATIVE 1 - PHV + PROPOSED IMPROVEMENTS

SCALE:

NOT TO SCALE

DATE:

09/21/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

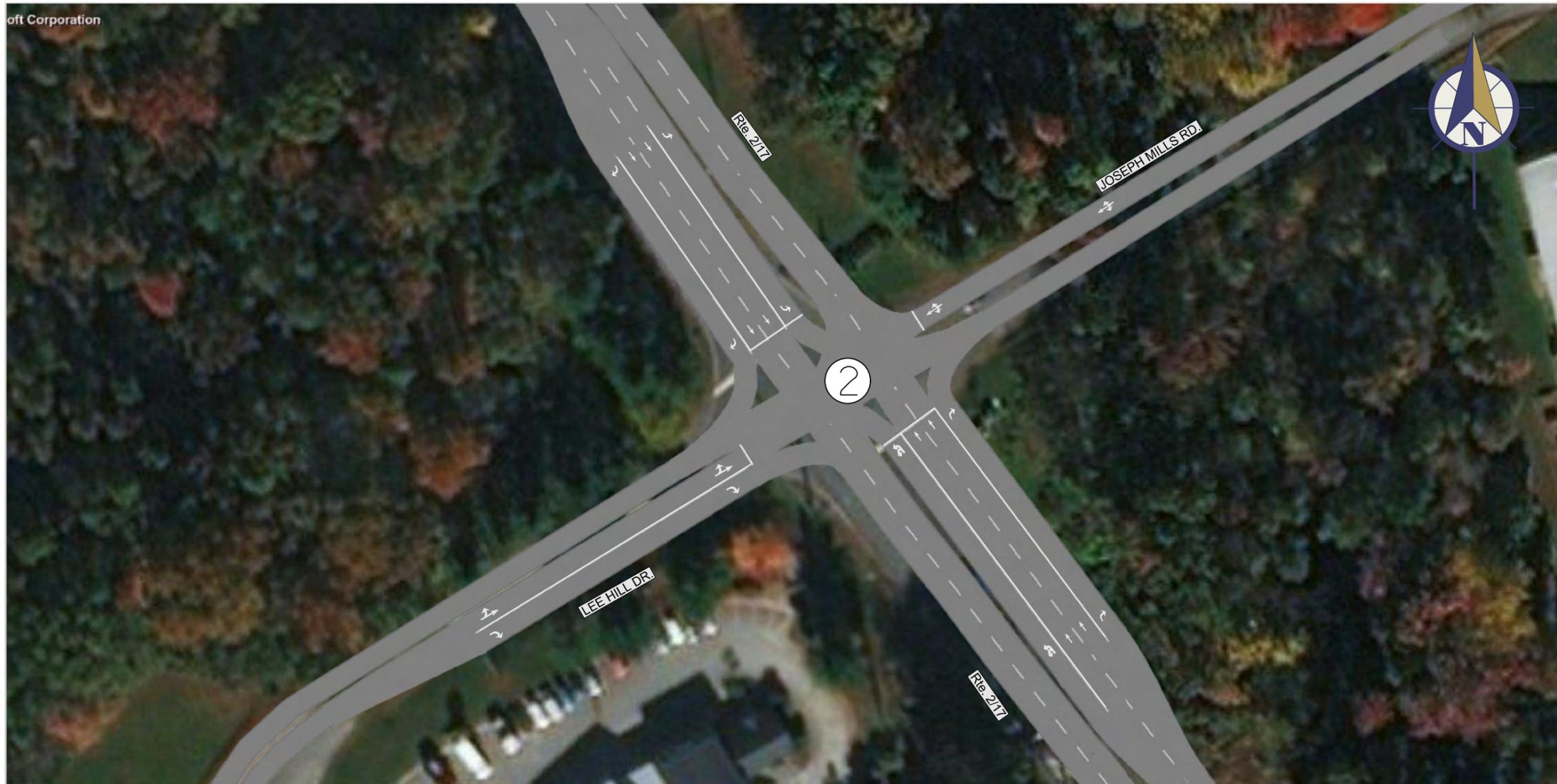
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OF

5





LEGEND

- xxxx AM Peak Hour Volume (PHV)
- (xxxx) PM PHV
- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number

②	Joseph Mills Dr.	(144) (31) (46)	↕	Rte. 2/17	63 (48)
		118 22 30			1011 (811)
		Intersection Total 2237 (2706)			10 (1)
(46)	193				
(1424)	681				
(21)	74				
Rte. 2/17				Lee Hill Dr.	
		16 (75)	3 (30)	16 (29)	

Proposed Improvements*:

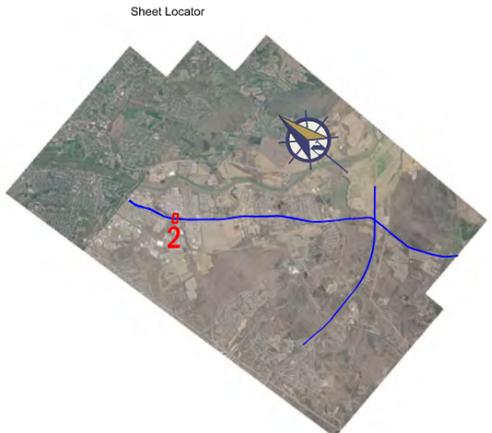
Northbound Approach:

- allow U-turns due to adding median and restricting full movements from side streets and driveways

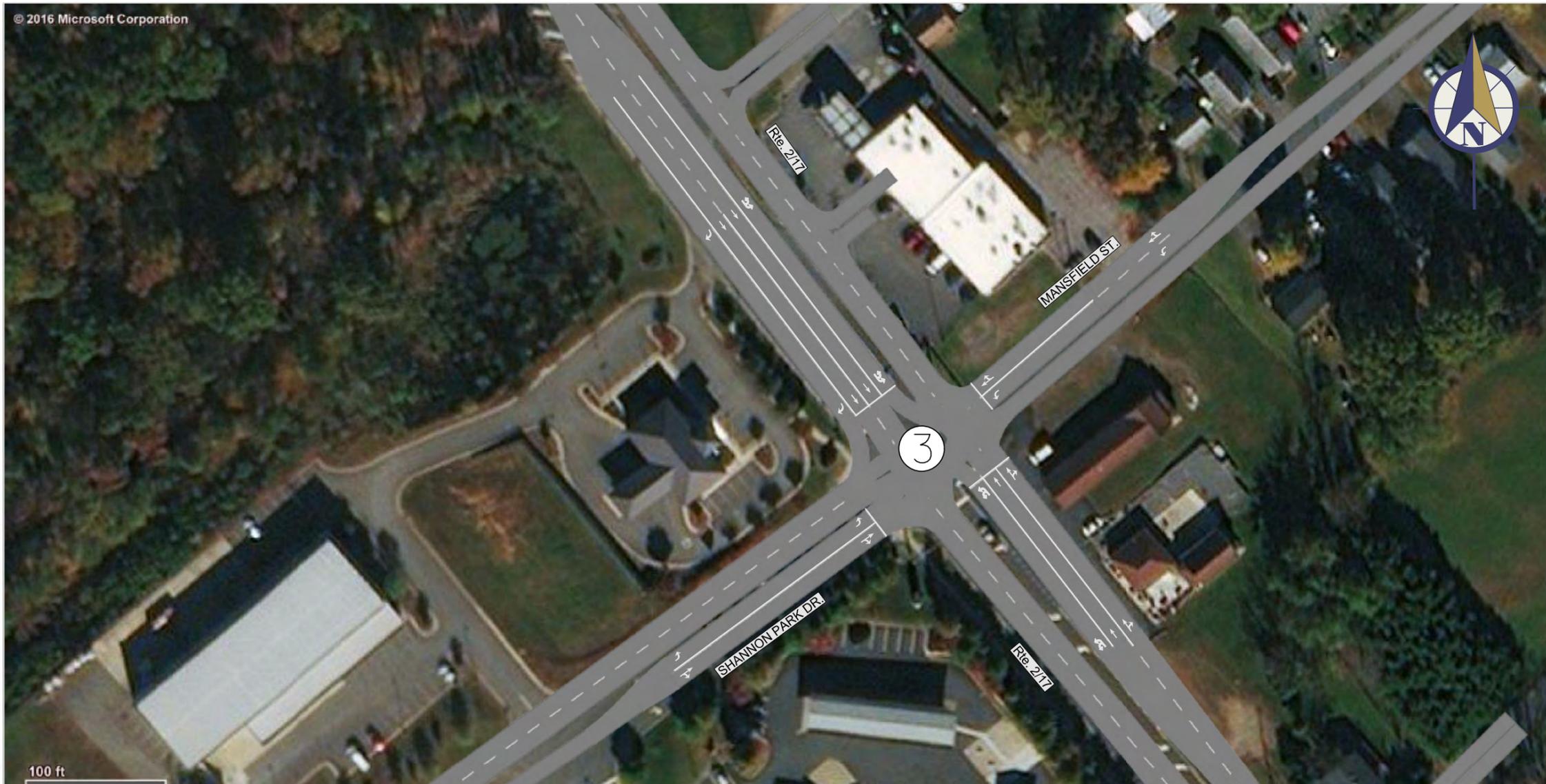
Eastbound Approach:

- add right-turn lane to be ~200'
- convert shared left/through/right-turn lane to be shared through/left-turn lane

*In addition to signal optimization and coordination, as applicable



	DRAWN BY:	HLR	ALTERNATIVE 1 - PHV + PROPOSED IMPROVEMENTS	SCALE:	NOT TO SCALE			DATE:	09/21/2018			
	CHECKED BY:	KHB		RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002	SHEET NO.:	2	OF	5			
				VDOT UPC PROJECT NO.: 107193								



LEGEND

- xxxx AM Peak Hour Volume (PHV)
- (xxxx) PM PHV
- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number

	Mansfield St.	(25) (10) (15) 48 11 23		Rte. 2/17
		Intersection Total 2078 (2564)		
(134) 52				2 (4) 722 (591) 252 (151)
(1106) 502				
(259) 173				
Rte. 2/17			279 (176) 5 (15) 9 (78)	Shannon Park Dr.

Proposed Improvements*:

Northbound Approach:

- right-turn lane to be shared with through lane
- allow U-turns due to adding median and restricting full movements from side streets and driveways

Westbound Approach:

- add left-turn lane to be ~200'
- convert shared through/left-/right-turn lane to be shared through/right-turn lane

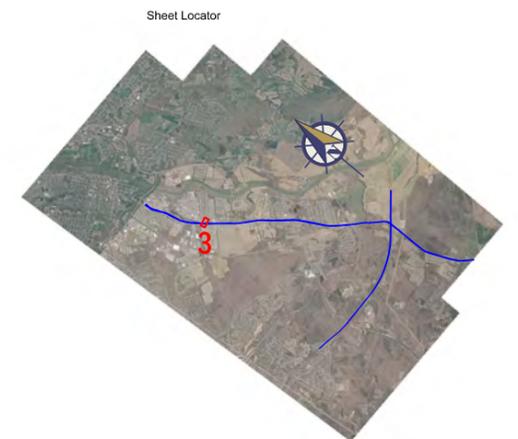
Southbound Approach:

- allow U-turns due to adding median and restricting full movements from side streets and driveways

Eastbound Approach:

- change lane configurations to be exclusive left-turn lane and a shared through/right-turn lane

*In addition to signal optimization and coordination, as applicable



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ALTERNATIVE 1 - PHV + PROPOSED IMPROVEMENTS

SCALE:

NOT TO SCALE

DATE:

09/21/2018

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RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

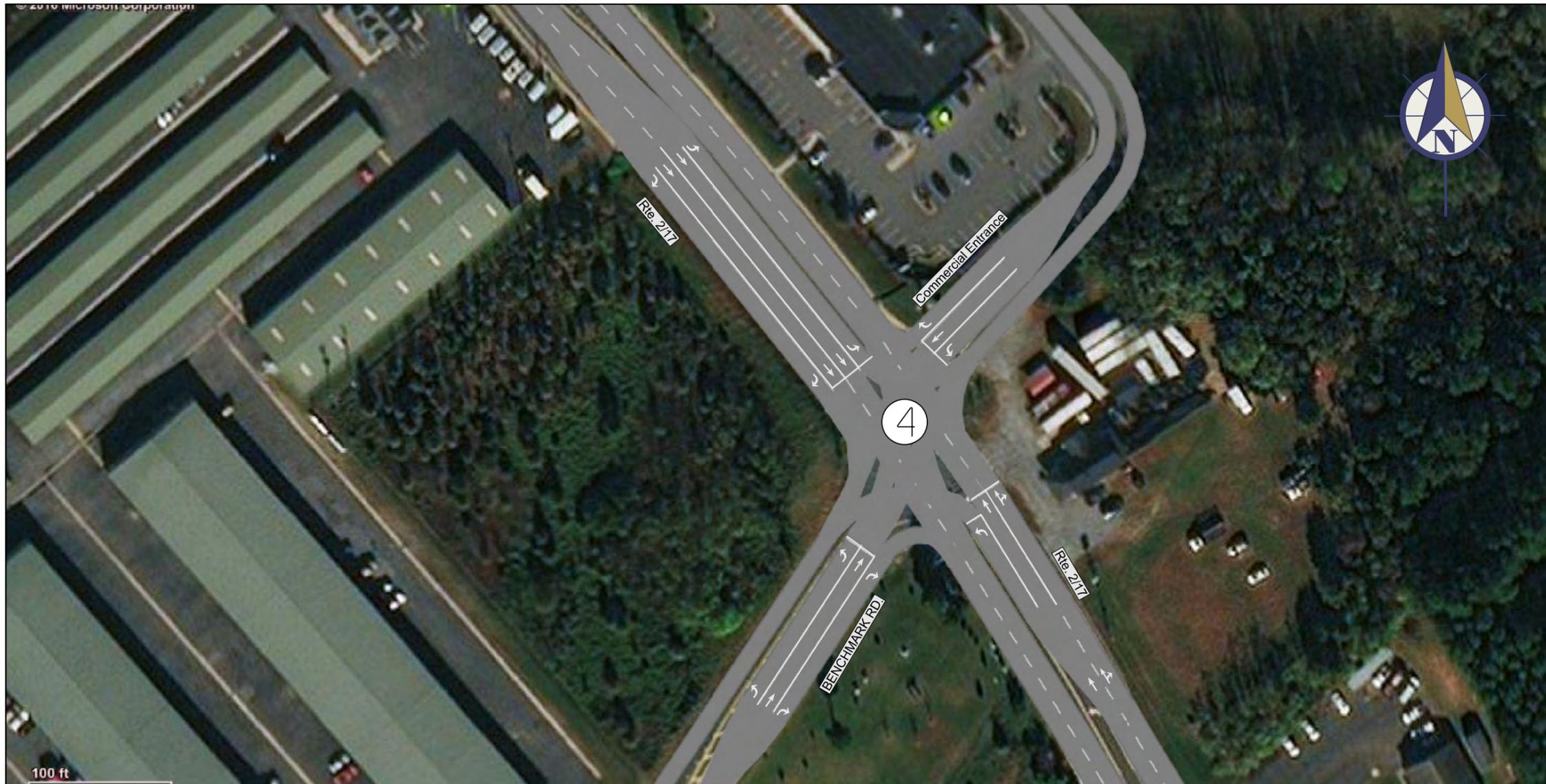
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OF

5





LEGEND

xxxx AM Peak Hour Volume (PHV)

(xxxx) PM PHV

Traffic Movement

Two - Way Left - Turn Lane

Intersection Number

④	Commercial Entrance	(23)	(84)	(169)
		2	31	16
Rte. 2/17				
		16	(9)	
		517	(444)	
		73	(43)	
Intersection Total 1564 (2383)				
(28)	24			
(625)	261			
(412)	246			
Rte. 2/17				
		305	22	
		(262)	(113)	

Proposed Improvements*:

Northbound Approach:

- right-turn lane to be shared with through lane

Westbound Approach:

- add left-turn lane to be ~150'
- convert shared through/left-turn lane to be exclusive through lane

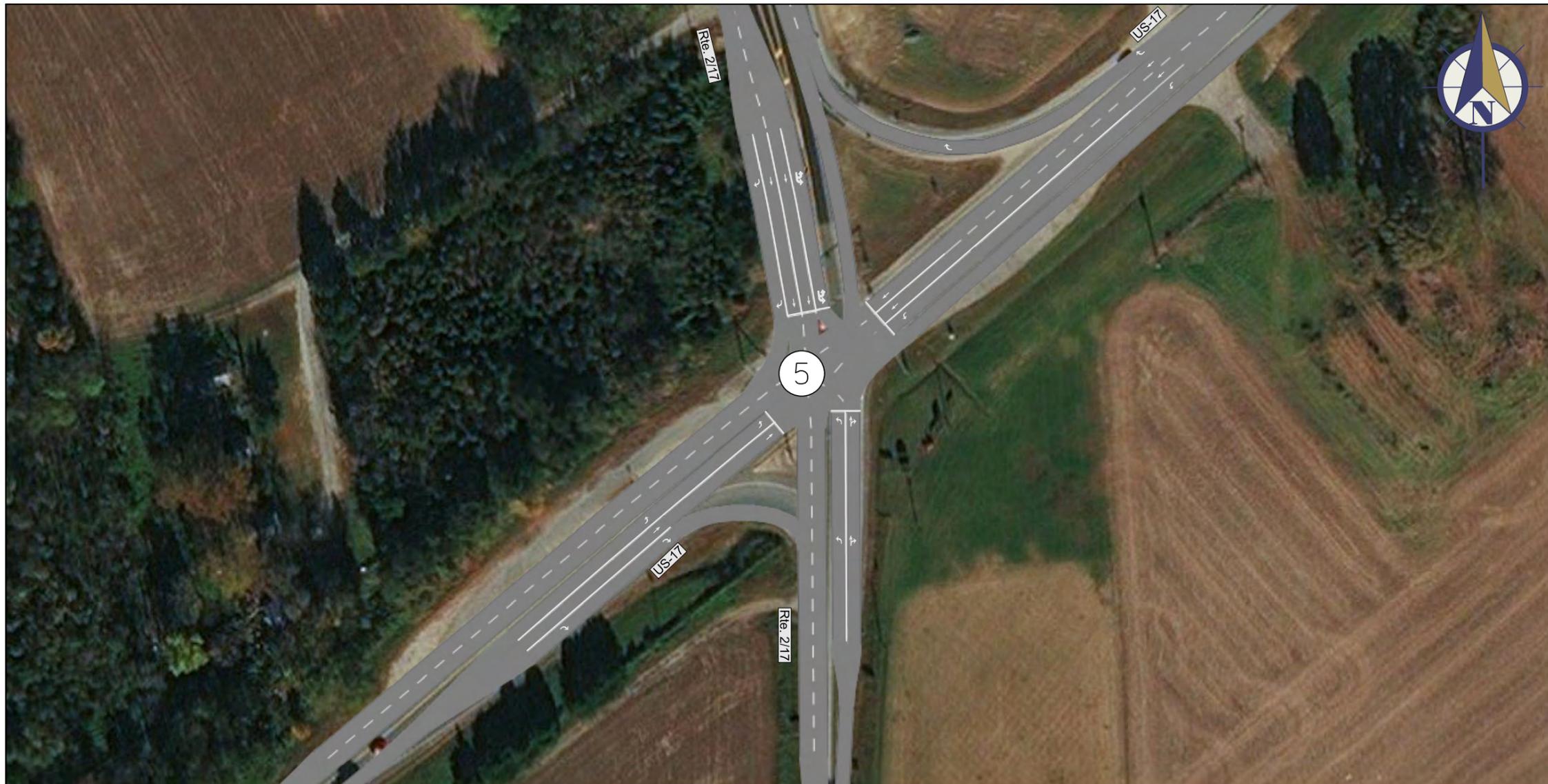
Eastbound Approach:

- add left turn lane to be ~300'
- convert shared through/left-turn lane to be exclusive through lane

*In addition to signal optimization and coordination, as applicable



	DRAWN BY:	HLR	ALTERNATIVE 1 - PHV + PROPOSED IMPROVEMENTS	SCALE:	NOT TO SCALE	DATE:	09/21/2018	
	CHECKED BY:	KHB	RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	4	OF 5	



LEGEND

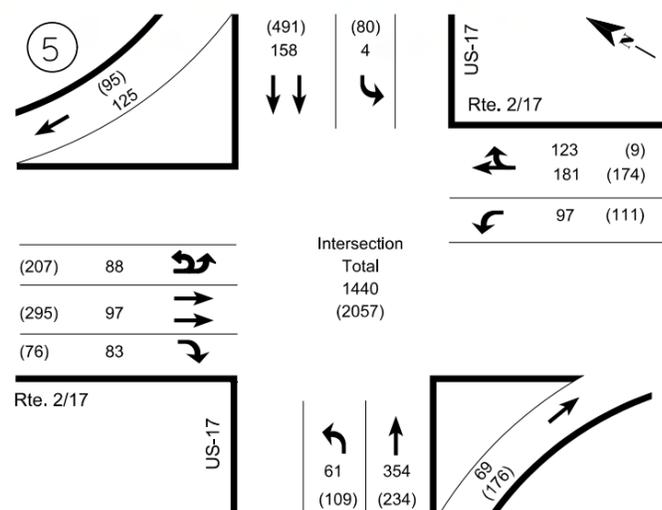
xxxx AM Peak Hour Volume (PHV)

(xxxx) PM PHV

Traffic Movement

Two - Way Left - Turn Lane

Intersection Number



Proposed Improvements*:

Northbound Approach:

- change lane configurations to be shared through/right-turn lane and exclusive left-turn lane to be ~450'

Westbound Approach:

- add second through lane to be ~950'

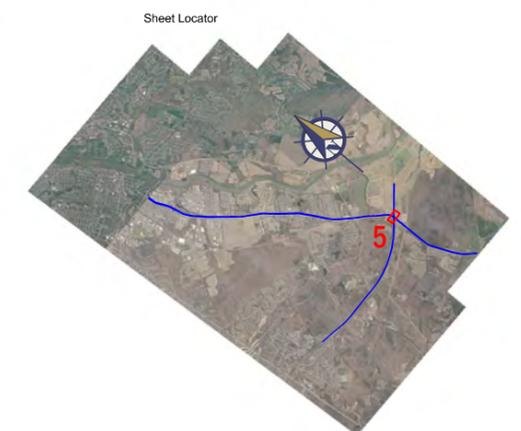
Southbound Approach:

- extend existing right-turn lane to be ~400'
- allow U-turns due to adding median and restricting full movements from side streets and driveways

Eastbound Receiving:

- add a second receiving lane to be ~550'

*In addition to signal optimization and coordination, as applicable



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ALTERNATIVE 1 - PHV + PROPOSED IMPROVEMENTS

SCALE:

NOT TO SCALE

DATE:

09/21/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

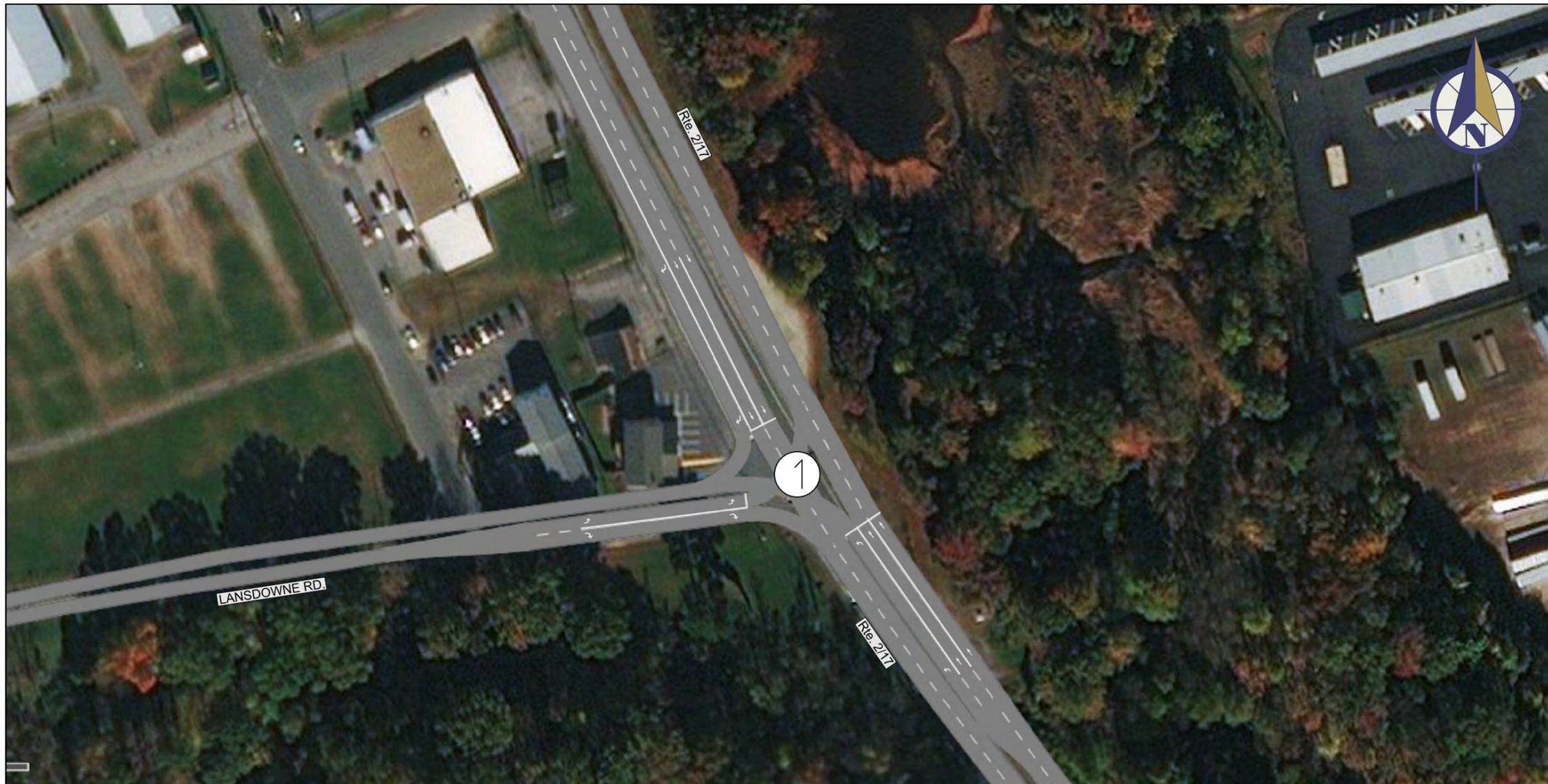
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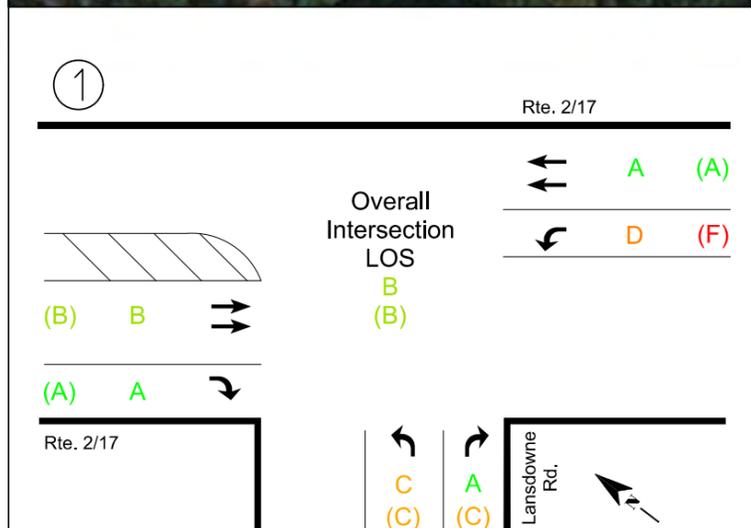
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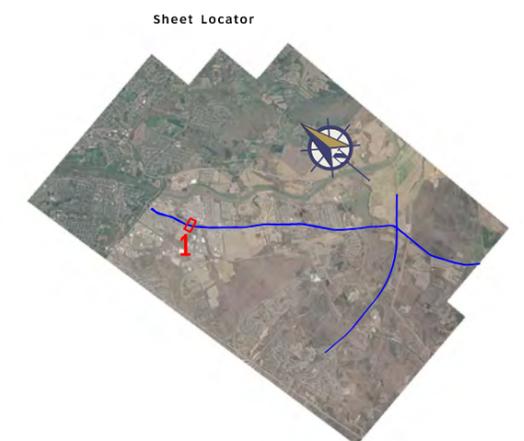


LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP



Operational capacity of the corridor for the Alternative 1 scenario was analyzed in VISSIM for the AM and PM peak hours. Delays were used to determine the operating Level of Service for individual movements and intersections.



10/18/2018 9:54:41 AM



DRAWN BY:

HLR

2035 ALTERNATIVE 1 LEVELS OF SERVICE

SCALE:

NOT TO SCALE

DATE:

09/21/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

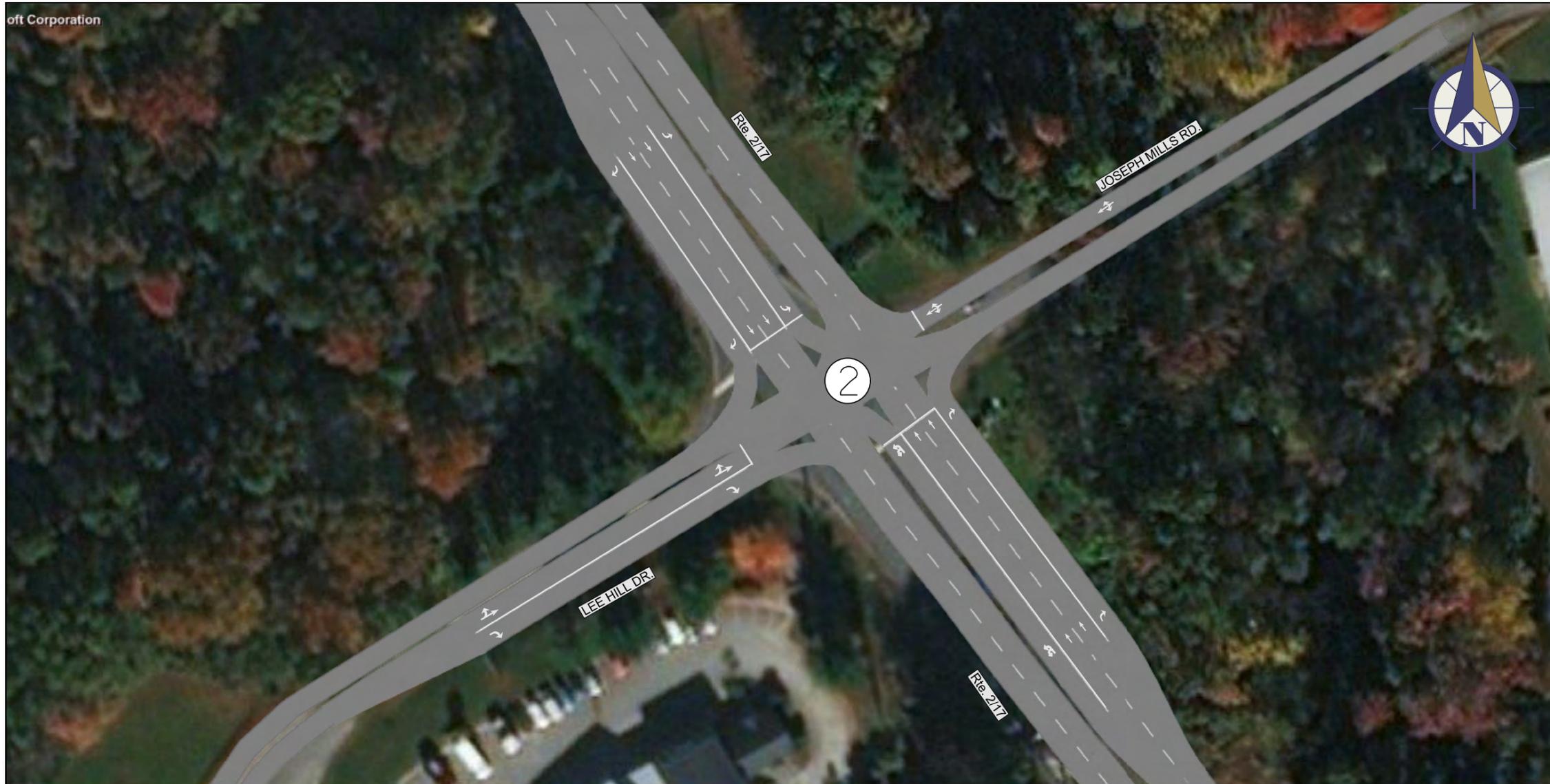
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OF

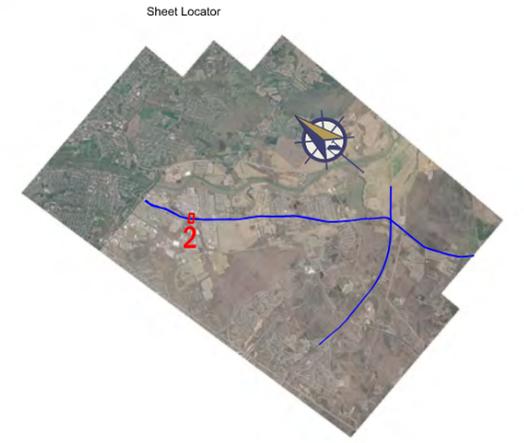
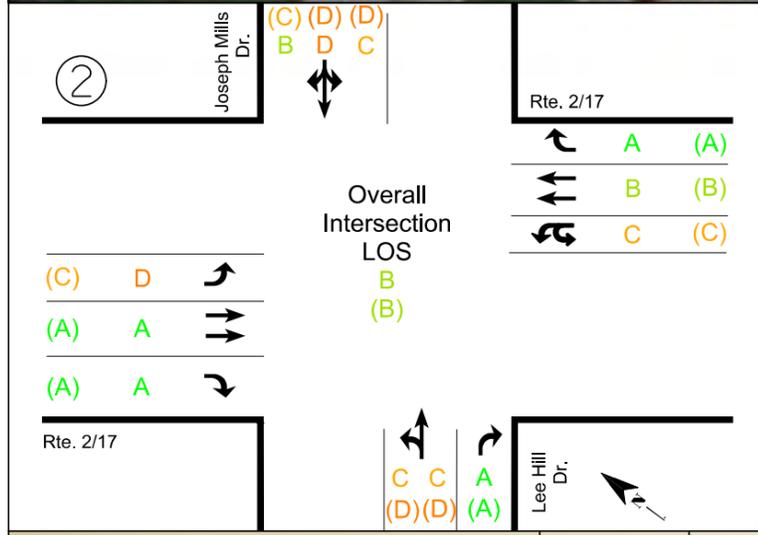
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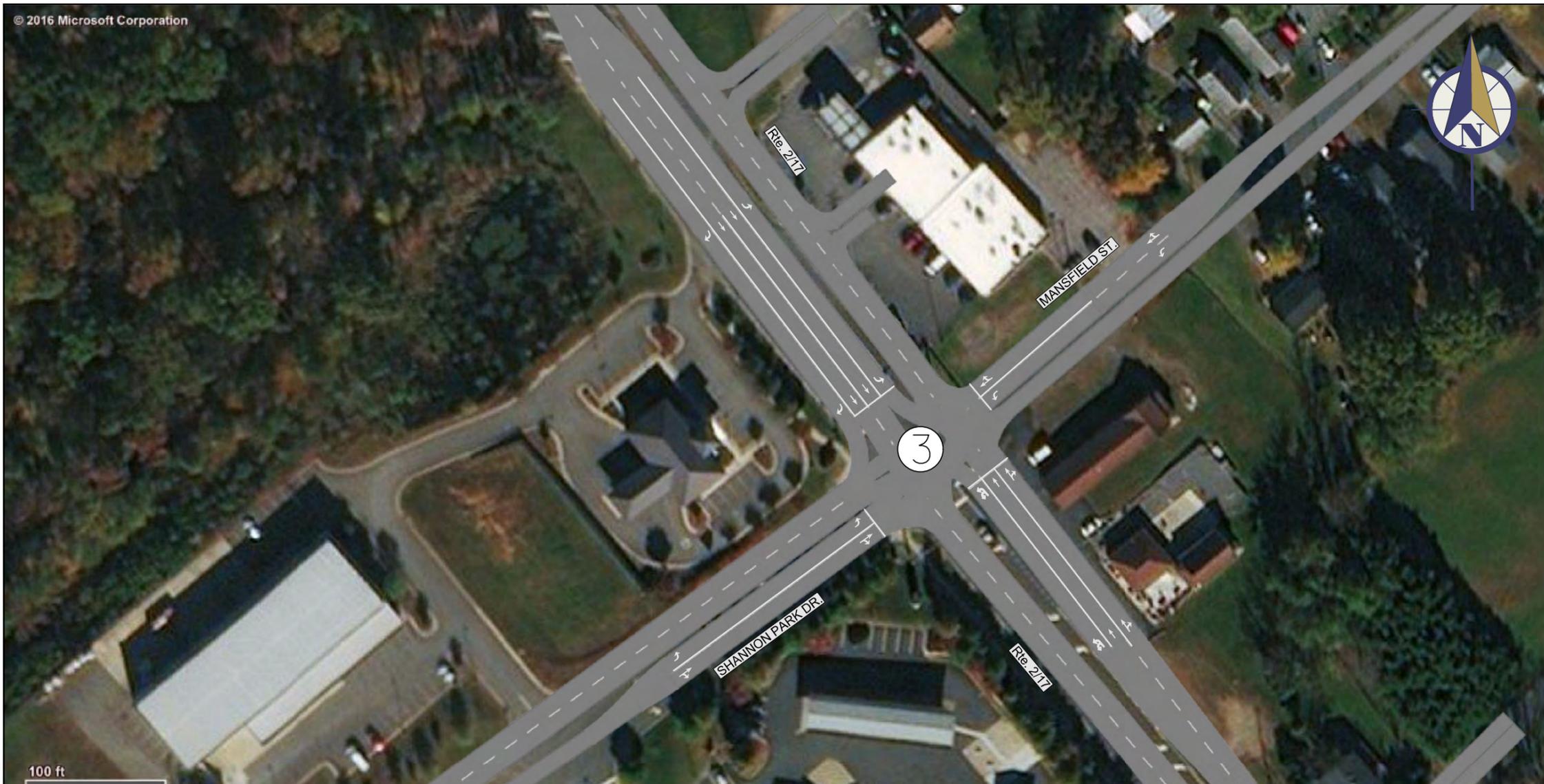


LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP

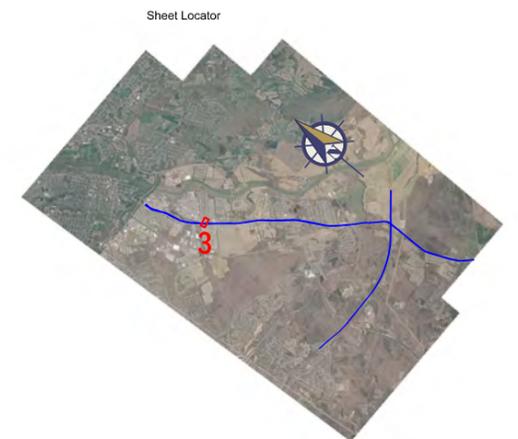
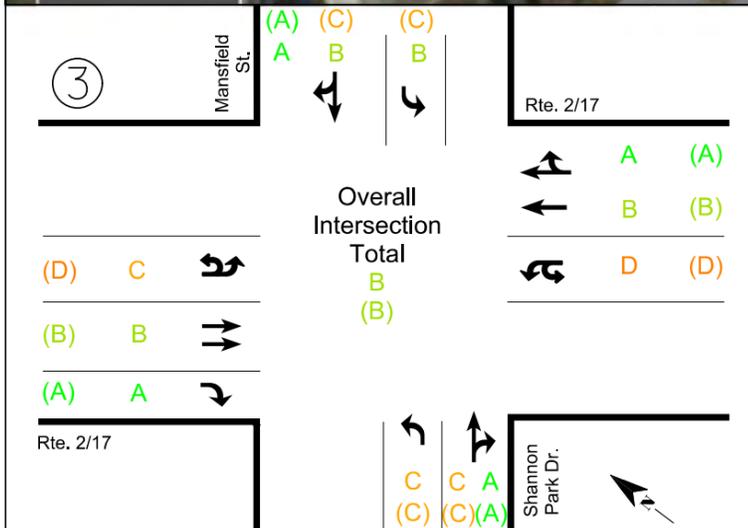


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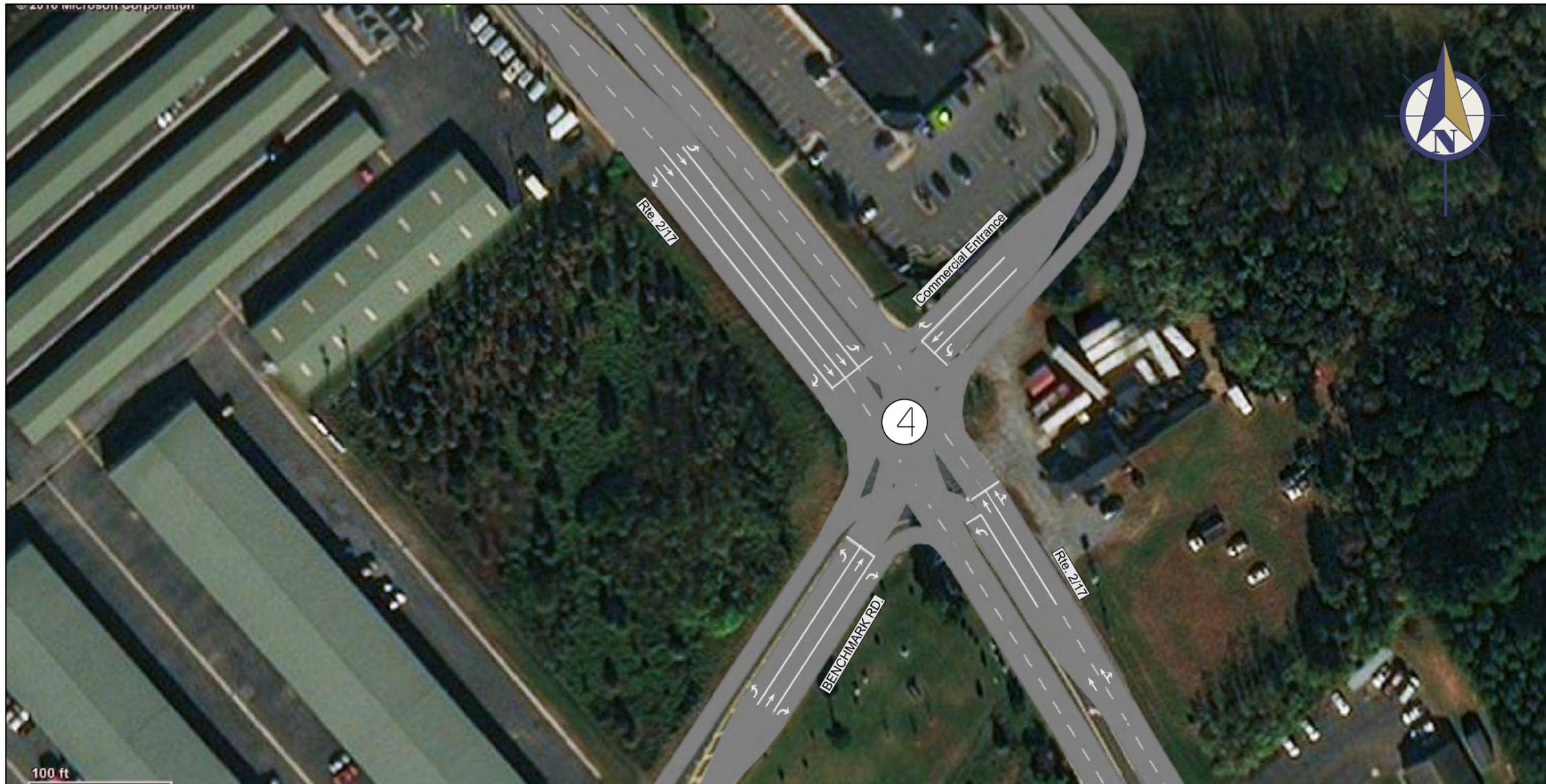
LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP



AM

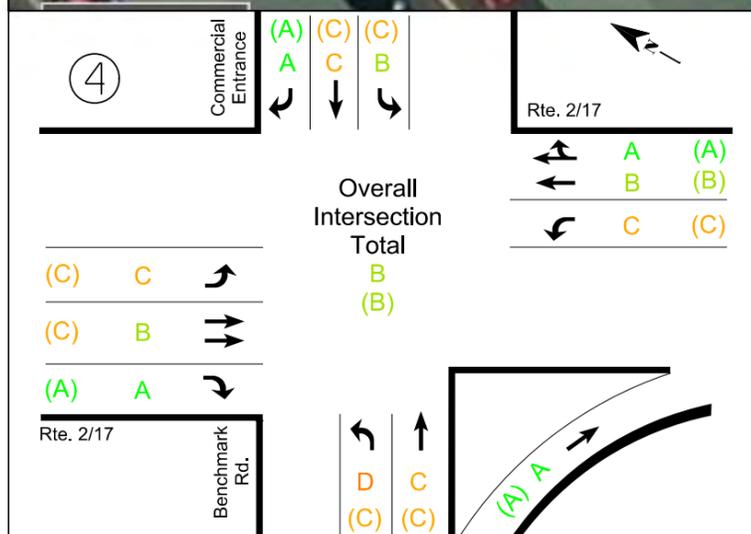
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				VDOT UPC PROJECT NO.: 107193						



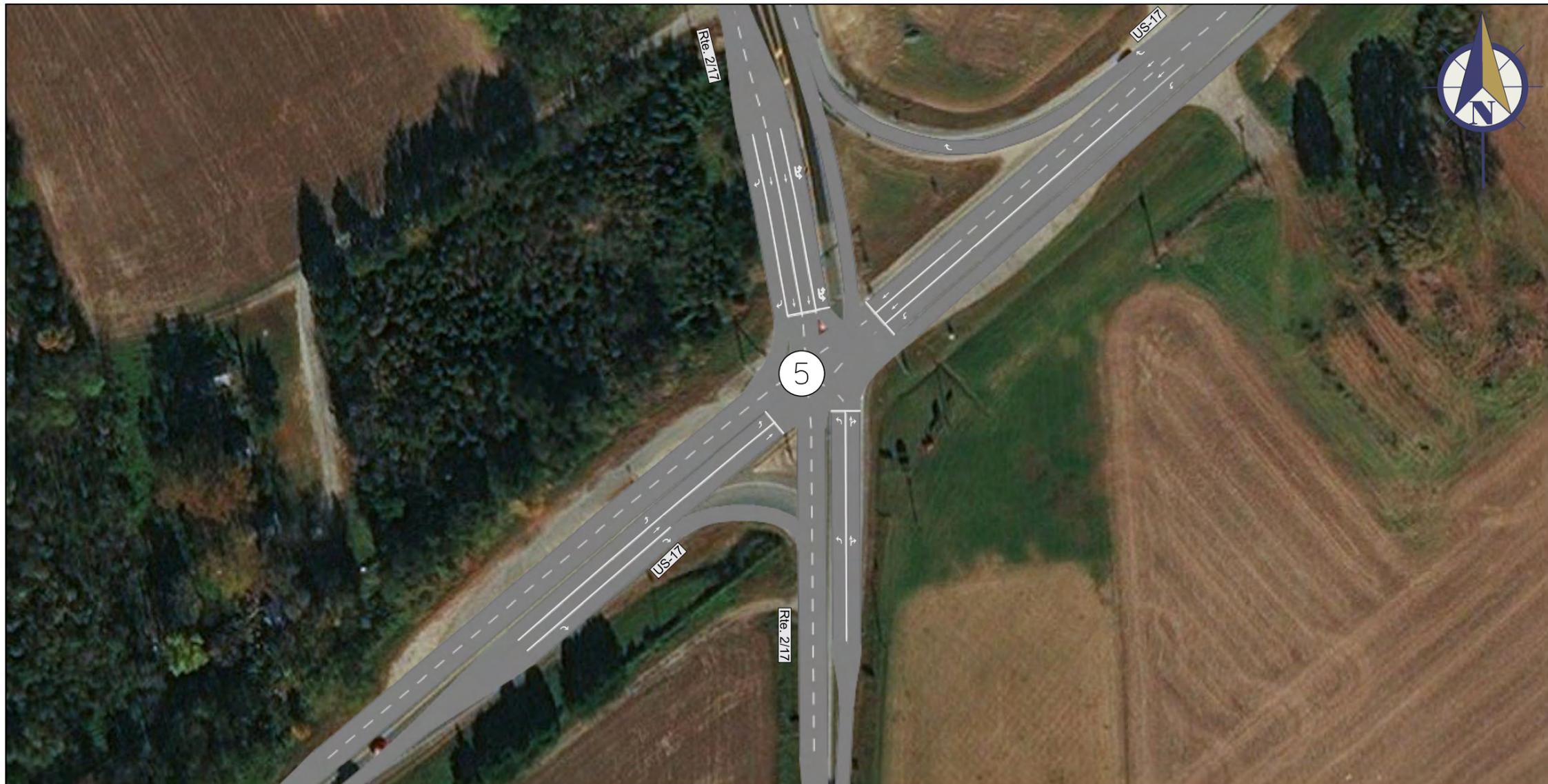
LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F

 LOS COLOR RAMP

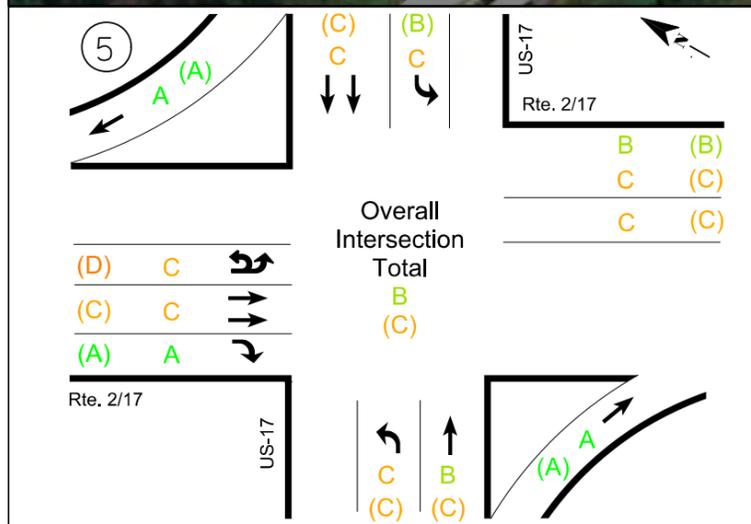


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				VDOT UPC PROJECT NO.: 107193						



LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
-
- LOS COLOR RAMP



	DRAWN BY:	HLR	2035 ALTERNATIVE 1 LEVELS OF SERVICE	SCALE:	NOT TO SCALE	DATE:	09/21/2018	
	CHECKED BY:	KHB	RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002	SHEET NO.:	5	OF	
				VDOT UPC PROJECT NO.: 107193				

Alternative 2

Alternative 2 was derived from the deficiencies identified in the future no-build scenario. This alternative proposed widening the southbound direction to two lanes, from the Fredericksburg City Line to Shannon Airport Circle, keeping the northbound direction as one lane. Additionally, improvements were proposed at the five study intersections to achieve acceptable LOS. Bus pullouts with shelters at the existing bus stops and a shared use path on one side are also included in this Alternative. Evaluation of the access points throughout the corridor was compared to VDOT Access Management Standards. This evaluation can be used by the County as a guide for consolidating existing entrances, and for approval of new access points, if future developments occurred along the corridor.

Traffic data was based on the future conditions of the travel demand model which accounted for the expected growth regionally and within the limits of the study corridor. The VISSIM model was updated with these traffic volumes, the proposed improvements to the northern portion of the corridor and at the major intersections, in terms of adding capacity and/or lane configurations, in addition to optimizing signals to achieve the best possible LOS at each intersection. The overall intersection LOS for weekday AM and PM peak hours are shown in Table F 4 and the single movements LOS details are shown on individual sheets. The following can be concluded from the capacity analysis results of Alternative 2:

1. All the intersections perform at acceptable LOS C or better during the AM and PM peak hours, and provide significant operational improvements when compared to the no-build conditions.

Table F 4: Alternative 2 Intersection LOS results

#	Intersection of Rte. 2/17 at	Peak Hour	
		AM 7:15 - 8:15	PM 4:30 - 5:30
1	Lansdowne Road	B	B
2	Lee Hill Drive/Joseph Mills Drive	C	C
3	Shannon Park Drive/Mansfield Street	C	C
4	Benchmark Road/Commercial Entrance	C	C
5	US-17	B	C

Alternative 2 Cost:

Similar to Alternative 1, a cost estimate for this alternative was completed. The cost estimate was broken down into three main categories; (1) structural, (2) construction, and (3) environmental. The cost estimate for this alternative was derived based on the no-build scenario results, therefore, only the most problematic areas of the corridor were improved to reach acceptable LOS. The cost estimates of the three categories, shown in Table F 5, were based on the typical cross section proposed for the northern portion of the corridor from the Fredericksburg City Line to Shannon Airport Circle, shown in Figure F 5. The cost estimate includes the proposed improvements at each of the five study intersections in terms of adding capacity and/or changing lane configurations. Also, the structural cost includes four proposed bus pullouts with shelters located at the existing bus stops along the corridor. VDOT provided unit costs from TMPD, inflated to year 2018, was used to determine the planning level cost estimates for this alternative, which includes low and high ranges. Cost estimates provided herein are *not* for construction purposes. Detailed engineering design and cost estimates are required to identify the budget needed for implementing Alternative 2. In general, the cost estimate of this alternative is impacted by the following:

- Low overall ROW cost when compared to Alternative 1.
- Does not include a new bridge over Ruffins Pond.
- Relatively, low impact on the environment due to less road widening over culverts and bridges.
- The corridor's cross section remains the same from Shannon Airport Circle to the Caroline County line, except for intersection improvements.



Figure F 5: Alternative 2 Lane Configurations (Looking North) – (VISSIM)

Table F 5: Alternative 2 Planning Level Construction Cost Estimate

Item	Quantity	Unit Cost		Unit	Costs	
		Low	High		Low	High
Structural Cost						
Bus Pullout/Shelter	4.00	\$30,000		Each	\$120,000	
Culvert - 300' S of Lansdowne Rd.	1.00	\$63,000		Each	\$63,000	
Culvert for Deep Run Creek (replace existing bridge)	1.00	\$500,000		Each	\$500,000	
Culvert - 500' S of Pierson Dr./N. Club Dr.	1.00	\$32,000		Each	\$32,000	
Culvert - 500' N of Benchmark Rd.	1.00	\$73,000		Each	\$73,000	
Culvert - 75' N of Ruffin Dr.	1.00	\$120,000		Each	\$120,000	
Bridge over Ruffin's Pond	1.00	\$20,000		Each	\$20,000	
Structural Subtotal					\$928,000	
Construction Cost						
Signal						
Modify Existing Signal	5.00	\$142,000	\$306,000	Per Intersection	\$710,000	\$1,530,000
Pavement						
Right turn lane	6.00	\$66,000	\$144,000	Per 100'	\$396,000	\$864,000
Right turn Taper	3.00	\$44,000	\$96,000	Per 100'	\$132,000	\$288,000
Left turn lane	4.00	\$126,000	\$156,000	Per 200'	\$504,000	\$624,000
Left turn taper	1.50	\$84,000	\$104,000	Per 200'	\$126,000	\$156,000
1 Lane	0.07	\$2,349,000	\$3,523,500	CPM*	\$164,430	\$246,645
2 lanes**	1.09	\$4,698,000	\$7,047,000	CPM	\$5,120,820	\$7,681,230
10' Shared use path off road	4.44	\$940,000	\$940,000	CPM	\$4,173,600	\$4,173,600
16' raised median	0.47	\$343,200	\$422,400	CPM	\$161,304	\$198,528
6-8' raised median (U-turn)	0.47	\$257,400	\$316,800	CPM	\$120,978	\$148,896
Construction Subtotal					\$11,610,000	\$15,911,000
Structural & Construction Subtotal					\$12,538,000	\$16,839,000
Right-of-Way (36% of ST & CN)					\$4,513,680	\$6,062,040
Subtotal (Structural & Construction)					\$17,060,000	\$22,910,000
Environmental Cost						
Wetland/Stream Mitigation Estimate	1.00	\$188,000		Each	\$188,000	
NEPA Environmental Documentation	1.00	\$40,000		Each	\$40,000	
Phase 1 Environmental Site Assessment	1.00	\$6,000		Each	\$6,000	
Phase 1 Cultural Resource Survey	1.00	\$8,000		Each	\$8,000	
Permitting	1.00	\$25,000		Each	\$25,000	
Air/Noise Studies	1.00	\$50,000		Each	\$50,000	
Subtotal					\$320,000	
Grand Total (rounded)					\$17,500,000	\$23,500,000
*CPM: Cost Per Mile						
**Cost considered the use of existing pavement						



LEGEND

xxxx AM PHV

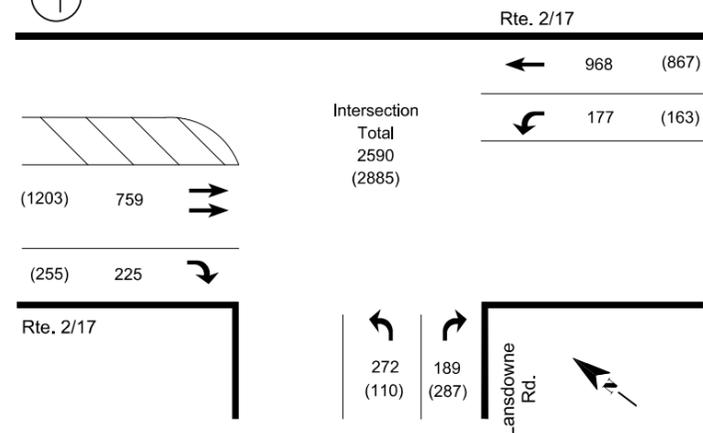
(xxxx) PM PHV

Traffic Movement

Two - Way Left - Turn Lane

Intersection Number

①



Proposed Improvements*:

Southbound Approach:

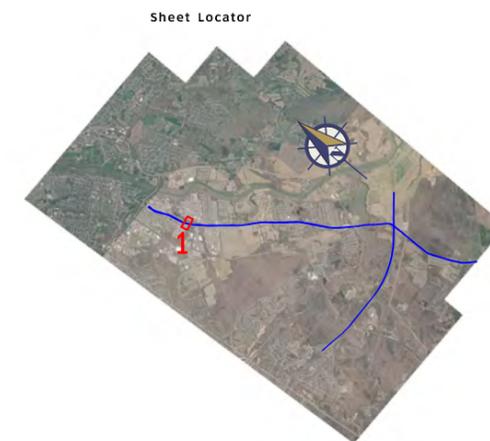
- extend existing right-turn lane to be ~400'

Eastbound Approach:

- add right-turn lane to be ~200'
- convert shared left/right-turn lane to be exclusive left-turn lane

*In addition to signal optimization and coordination, as applicable

PHV: PEAK HOUR VOLUME



DRAWN BY:

HLR

ALTERNATIVE 2 - PHV + PROPOSED IMPROVEMENTS

SCALE:

NOT TO SCALE

DATE:

09/21/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

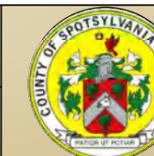
VDOT UPC PROJECT NO.: 107193

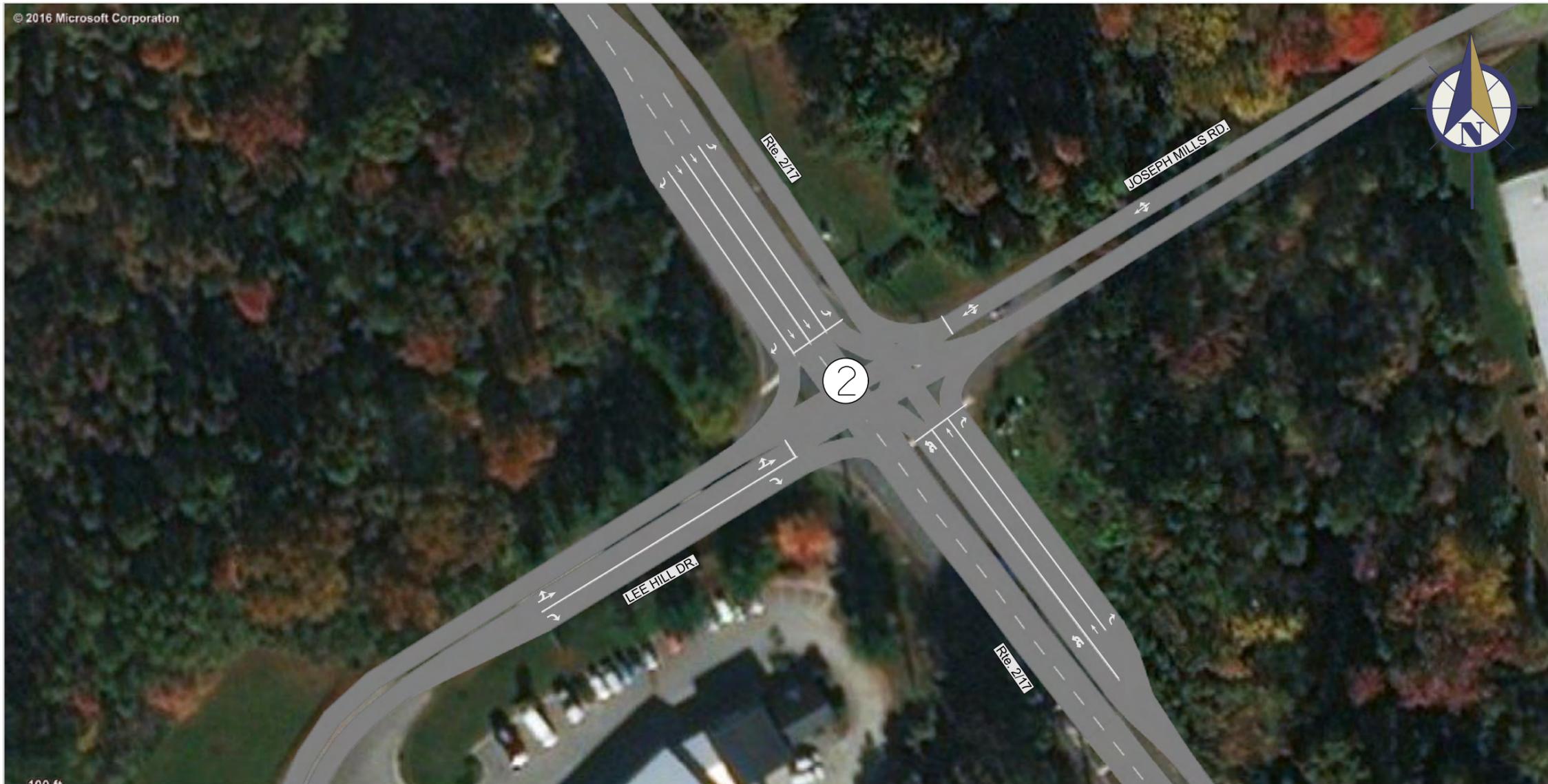
SHEET NO.:

1

OF

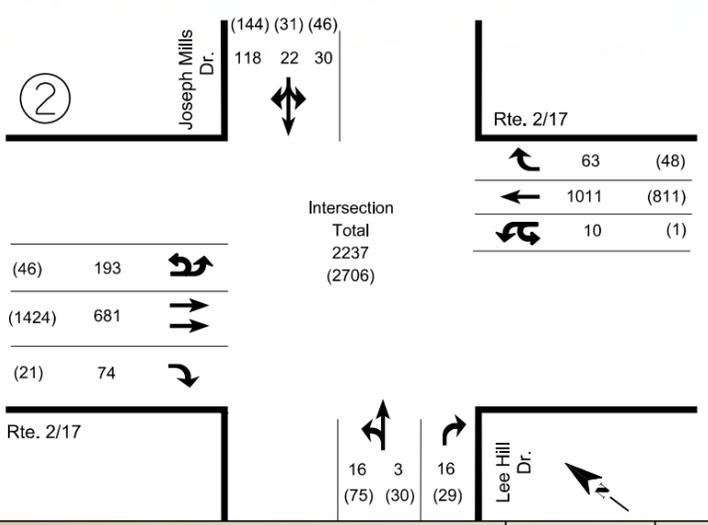
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LEGEND

- xxxx AM Peak Hour Volume (PHV)
- (xxxx) PM PHV
- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number



Proposed Improvements*:

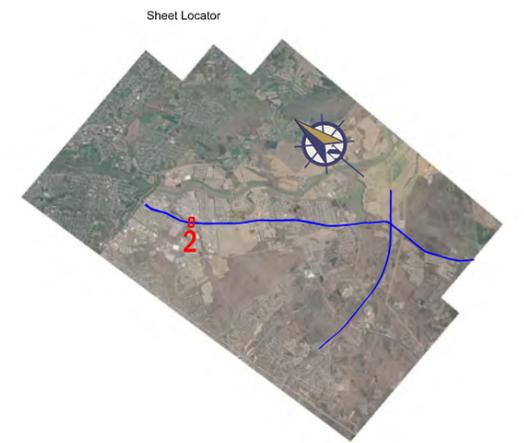
Northbound & Southbound Approaches:

- allow U-turns due to adding median and restricting full movements from side streets and driveways

Eastbound Approach:

- add right-turn lane to be ~200'
- convert shared through/left-/right-turn lane to be shared through/left-turn lane

*In addition to signal optimization and coordination, as applicable



DRAWN BY:	HLR	ALTERNATIVE 2 - PHV + PROPOSED IMPROVEMENTS	SCALE:	NOT TO SCALE	DATE:	09/21/2018
	CHECKED BY:		KHB	JMT PROJECT NO.: 15-0038-002	SHEET NO.:	2
RTE. 2/17 CORRIDOR STUDY			VDOT UPC PROJECT NO.: 107193			





LEGEND

- xxxx AM Peak Hour Volume (PHV)
- (xxxx) PM PHV
- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number

③	Mansfield St.	(25) (10)	(15)	Rte. 2/17
		48 11	23	
(134)	52			
(1106)	502			
(259)	173			
				Shannon Park Dr.
		279	5 9	
		(176)	(15) (78)	
Intersection Total		2078 (2564)		

Proposed Improvements*:

Northbound Approach:

- right-turn lane to be shared with through lane
- allow U-turns due to adding median and restricting full movements from side streets and driveways

Westbound Approach:

- Add left-turn lane to be ~200'
- convert shared through/left-/right-turn lane to be shared through/right-turn lane

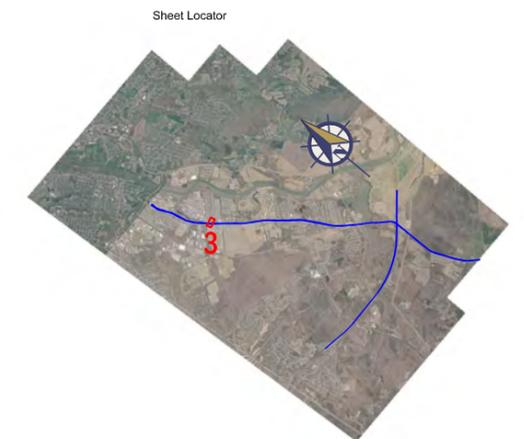
Southbound Approach:

- allow U-turns due to adding median and restricting full movements from side streets and driveways

Eastbound Approach:

- change lane configurations to be exclusive left-turn lane and a shared through/right-turn lane

*In addition to signal optimization and coordination, as applicable



DRAWN BY:

HLR

ALTERNATIVE 2 - PHV + PROPOSED IMPROVEMENTS

SCALE:

NOT TO SCALE

DATE:

09/21/2018

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KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

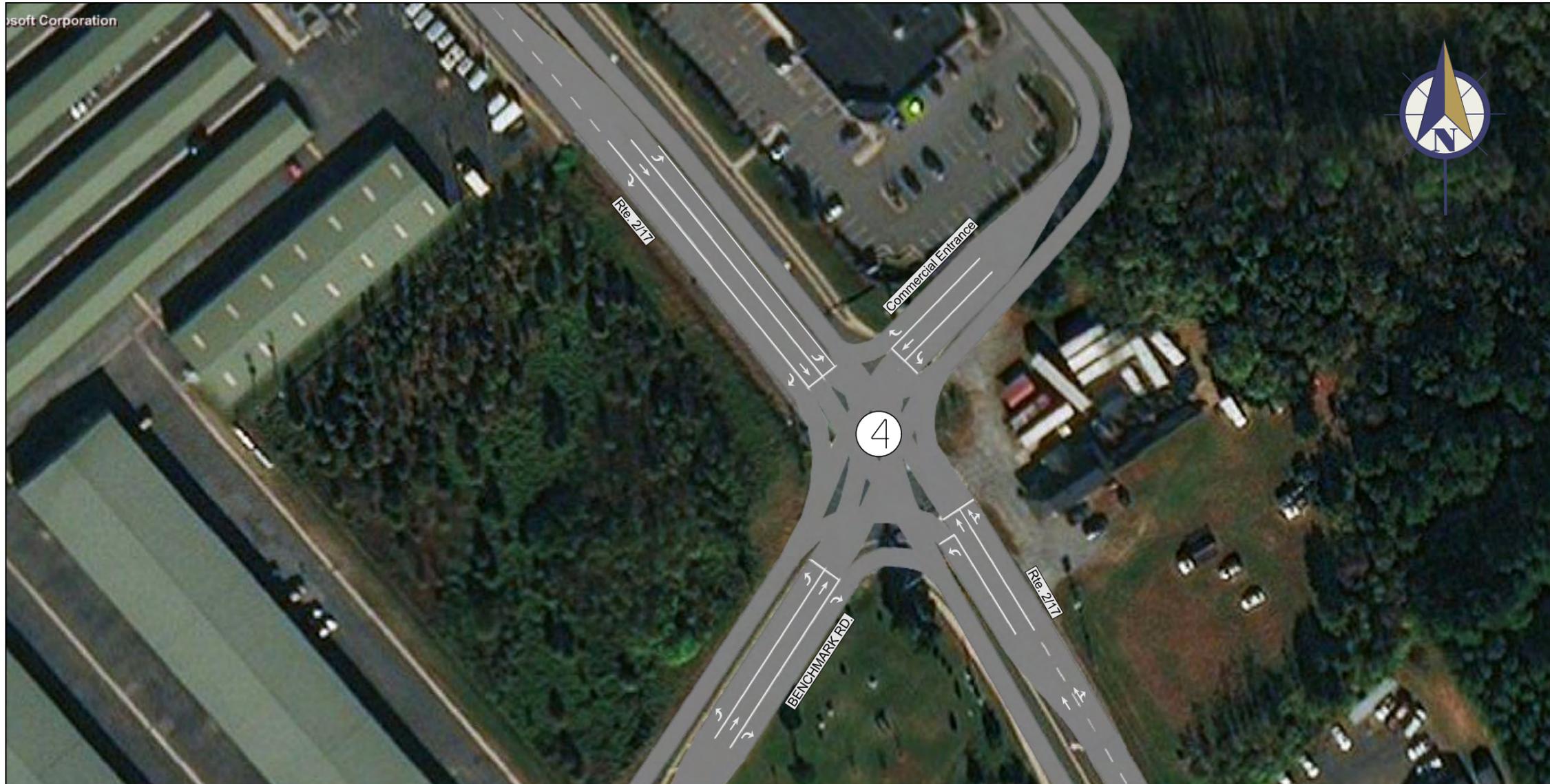
SHEET NO.:

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OF

5





LEGEND

- xxxx AM Peak Hour Volume (PHV)
- (xxxx) PM PHV
- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number

④	Commercial Entrance	(23)	(84)	(169)
		2	31	16
Rte. 2/17				
		16	(9)	
		517	(444)	
		73	(43)	
Intersection Total 1564 (2383)				
(28)	24			
(625)	261			
(412)	246			
Rte. 2/17	Benchmark Rd.			
		305	22	
		(262)	(113)	

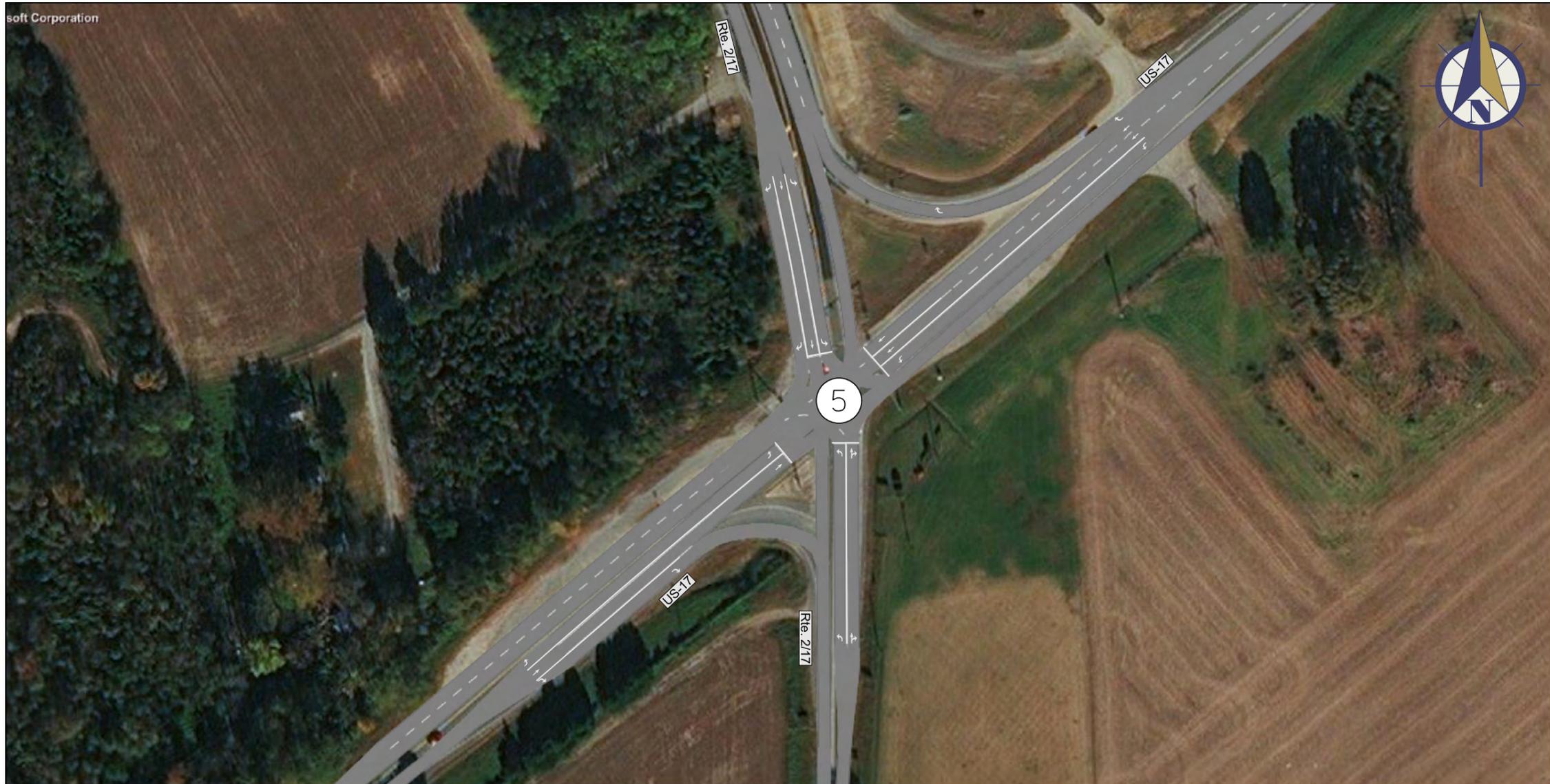
Proposed Improvements*:

- Westbound Approach:**
- add left-turn lane to be ~150'
 - convert shared through/left-turn lane to be exclusive through lane
- Eastbound Approach:**
- add left-turn lane to be ~300'
 - convert shared through/left-turn lane to be exclusive through lane

*In addition to signal optimization and coordination, as applicable

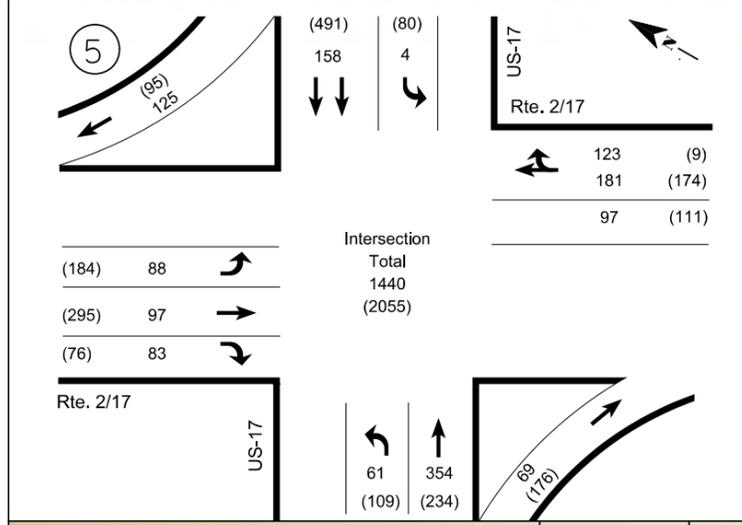


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	CHECKED BY:	KHB	RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	4	OF 5	



LEGEND

- xxxx AM Peak Hour Volume (PHV)
- (xxxx) PM PHV
- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number



Proposed Improvements*:

Northbound Approach:

- change lane configurations to be shared through/right-turn lane and exclusive left-turn lane to be ~450'

Westbound Approach:

- add second through lane to be ~950'

Southbound Approach:

- extend existing right-turn lane to be ~400'

Eastbound Receiving:

- add a second receiving lane to be ~550'

*In addition to signal optimization and coordination, as applicable

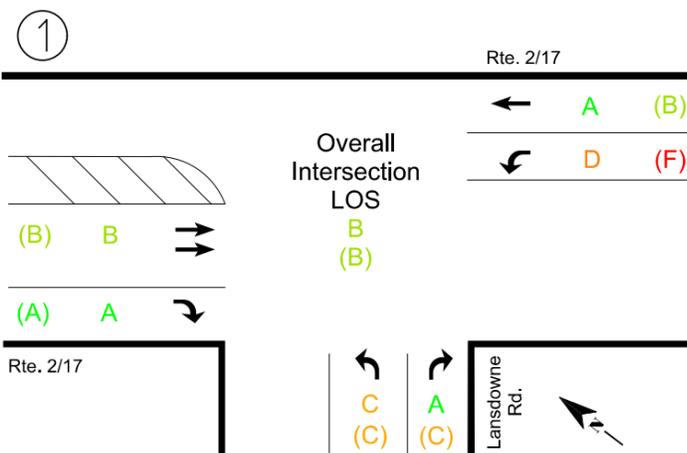


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				VDOT UPC PROJECT NO.:	107193				



LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP



Operational capacity of the corridor for the Alternative 2 scenario was analyzed in VISSIM for the AM and PM peak hours. Delays were used to determine the operating Level of Service for individual movements and intersections.

Sheet Locator



DRAWN BY:

HLR

2035 ALTERNATIVE 2 LEVELS OF SERVICE

SCALE:

NOT TO SCALE

DATE:

09/21/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

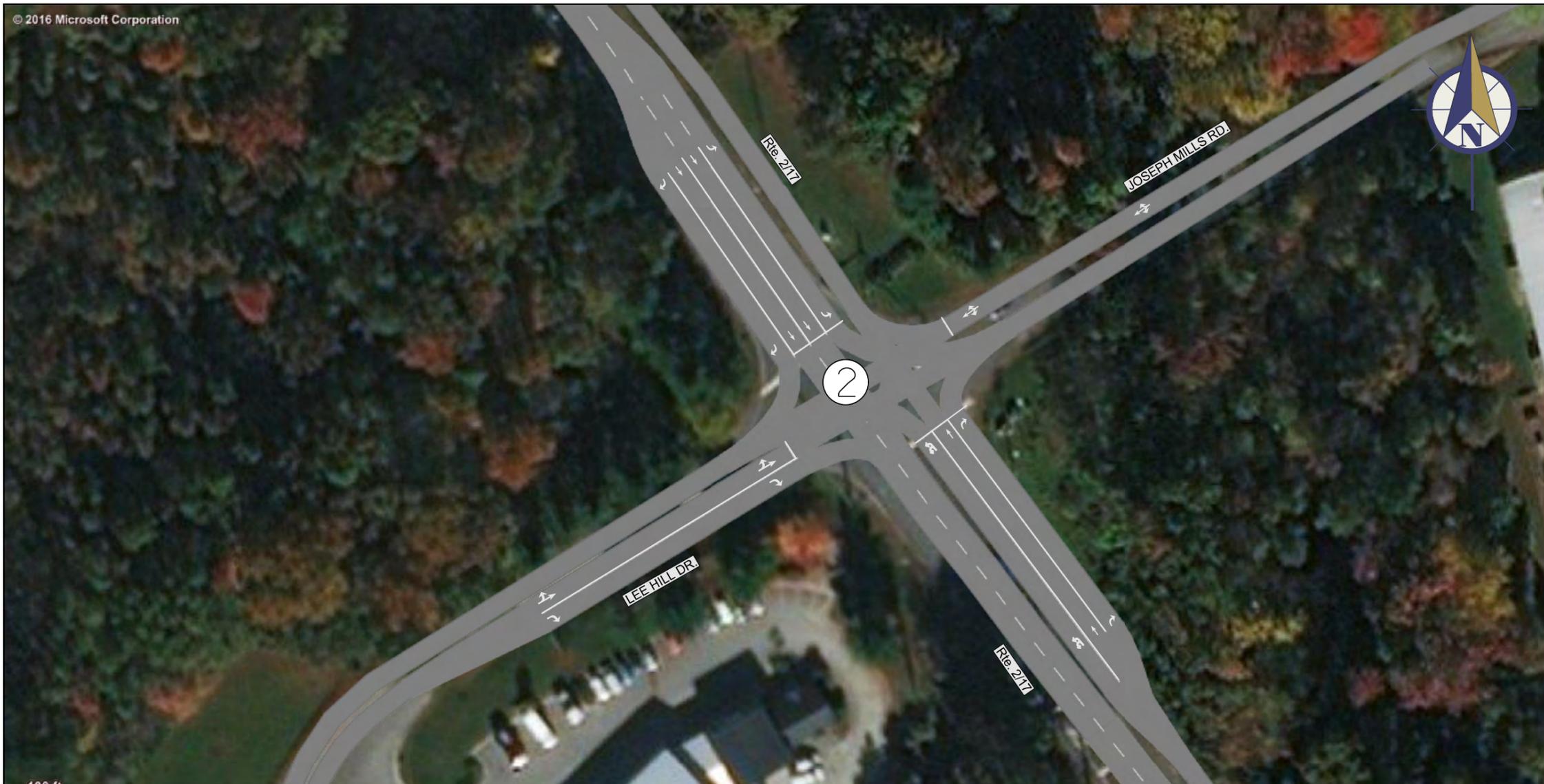
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OF

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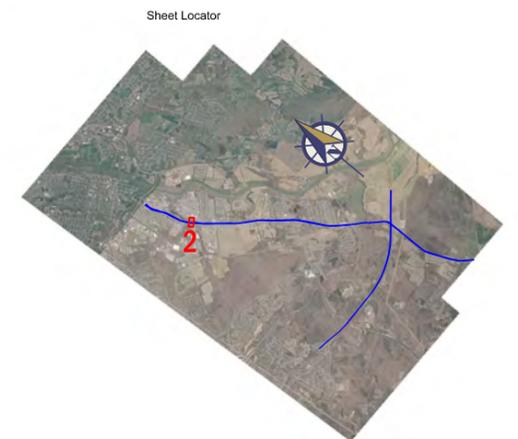
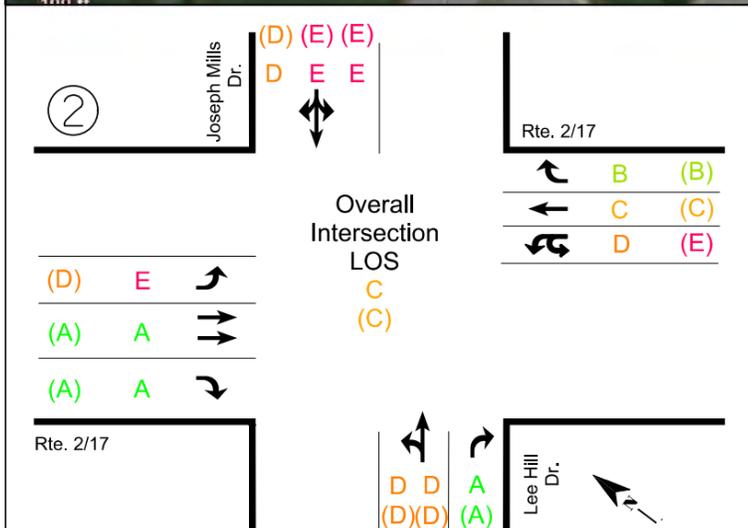




LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F

 LOS COLOR RAMP



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	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	SHEET NO.:	2	OF	5		
				VDOT UPC PROJECT NO.: 107193						

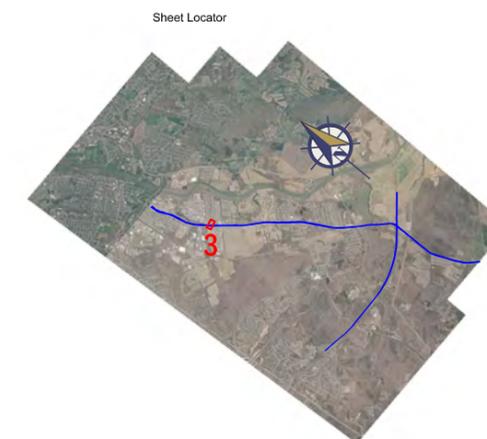
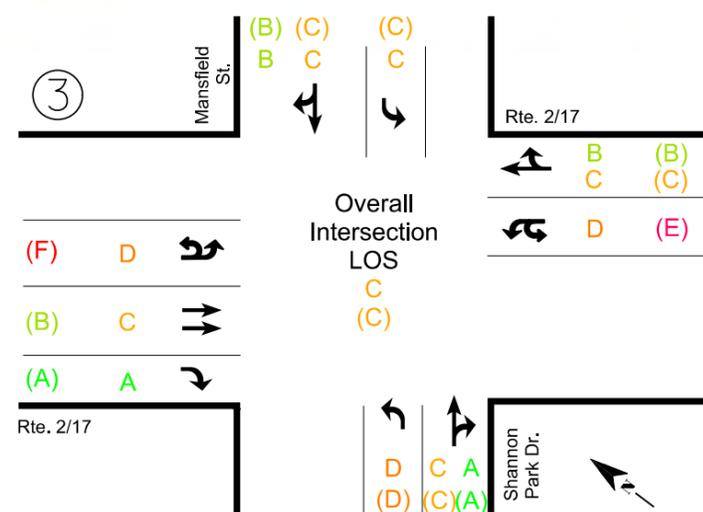
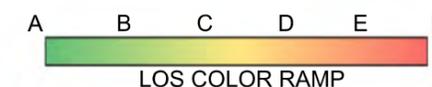


LEGEND

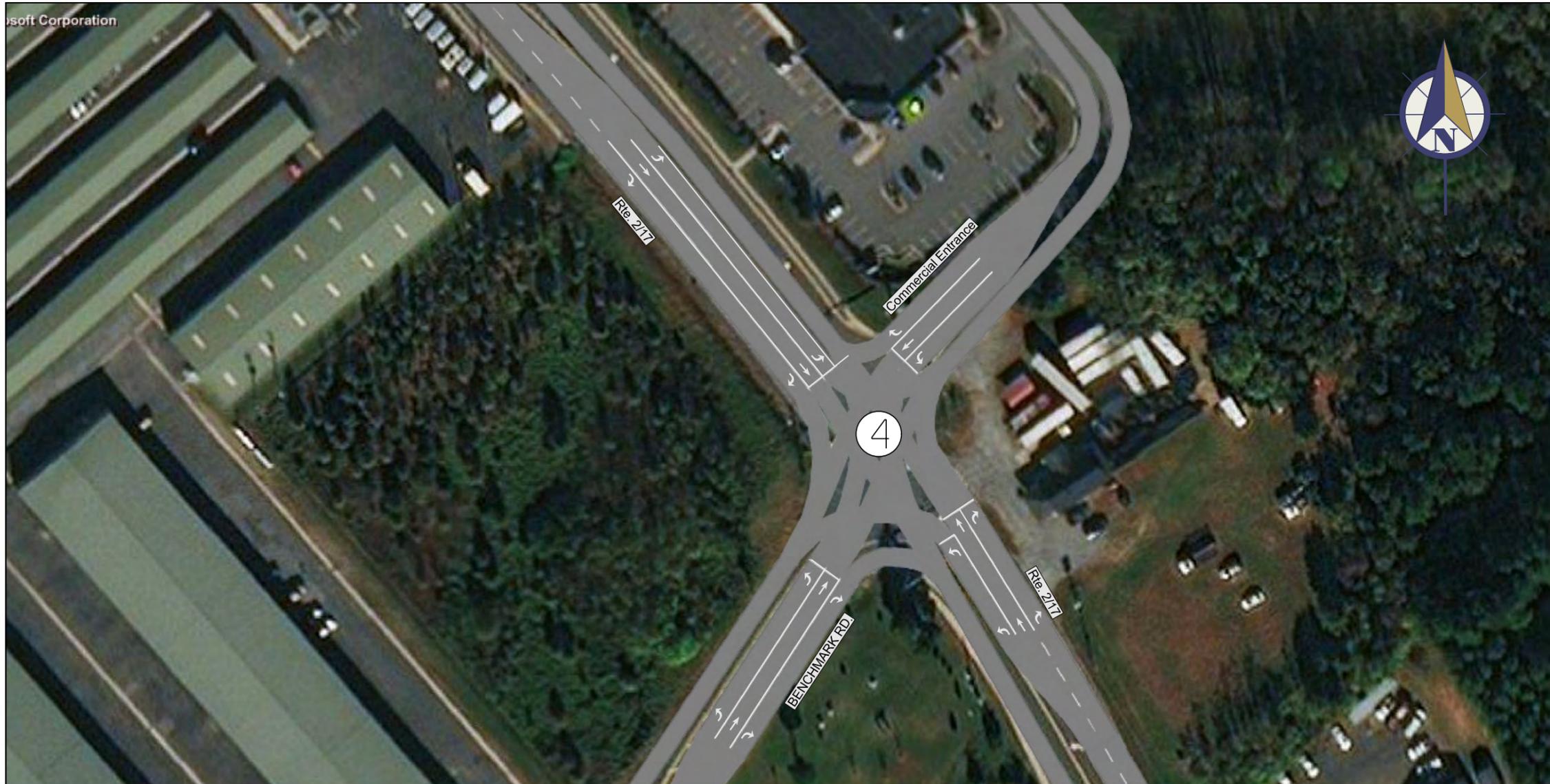
X (X) AM (PM) Level of Service (LOS)

↔ Traffic Movement

⊗ Intersection Number



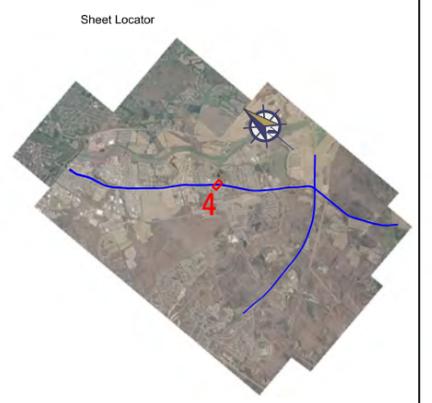
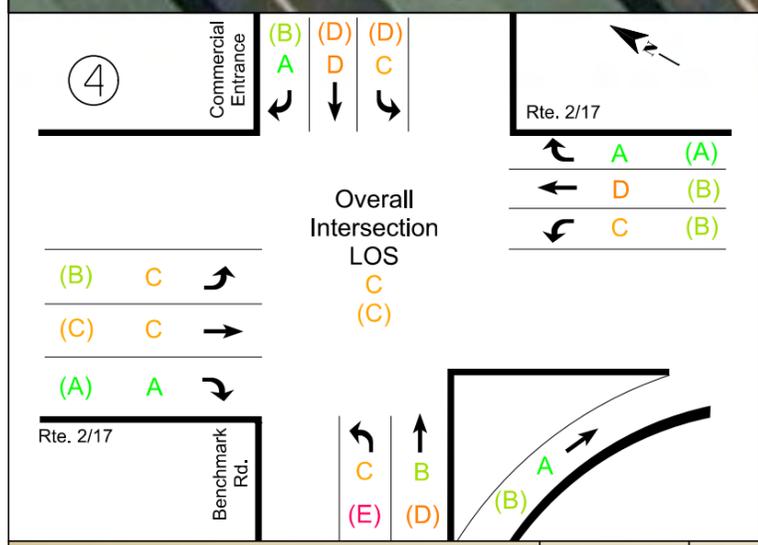
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				VDOT UPC PROJECT NO.: 107193						



LEGEND

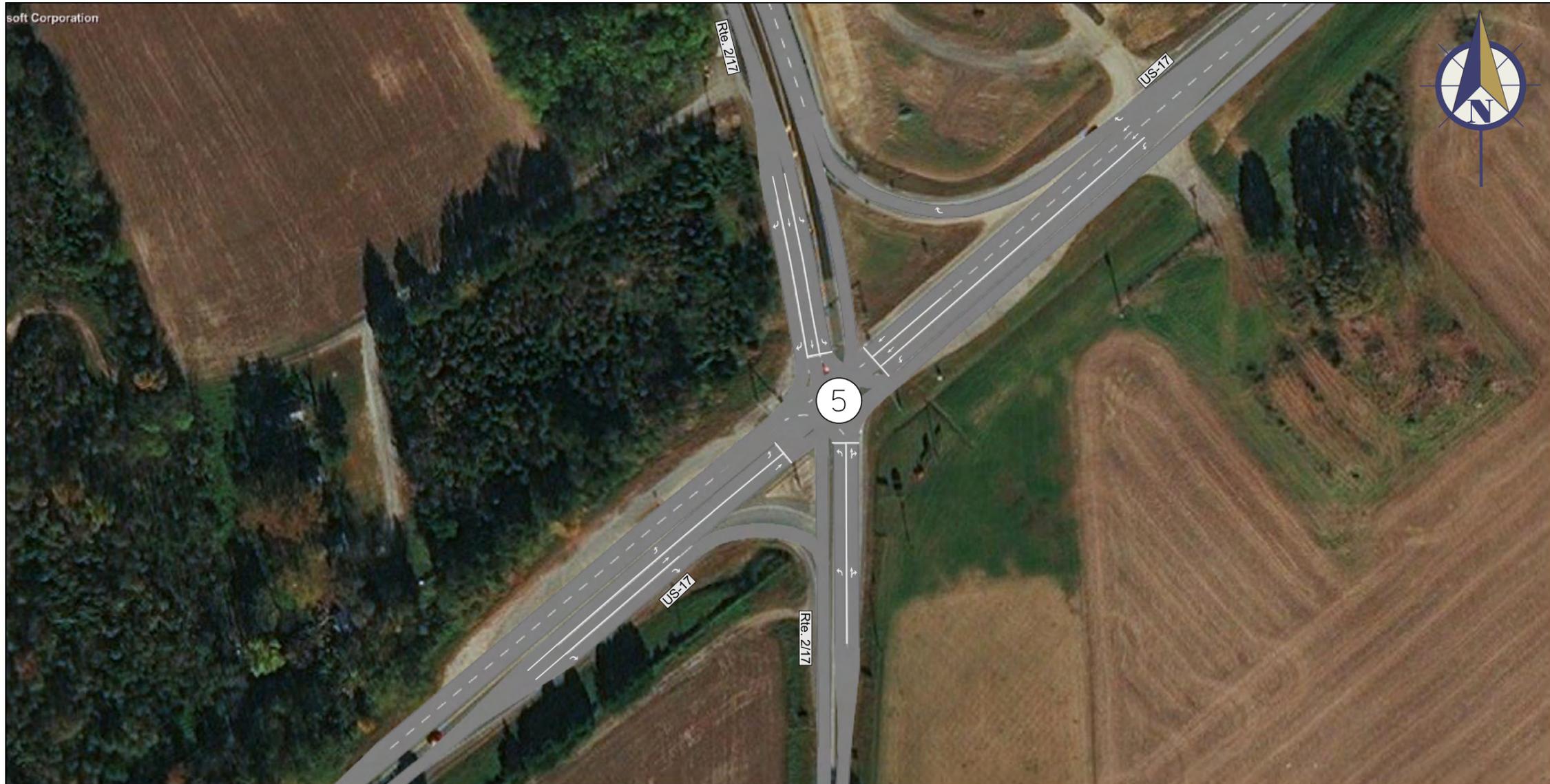
- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F

 LOS COLOR RAMP



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	CHECKED BY:	KHB		JMT PROJECT NO.:	15-0038-002	VDOT UPC PROJECT NO.:	107193	SHEET NO.:	4	

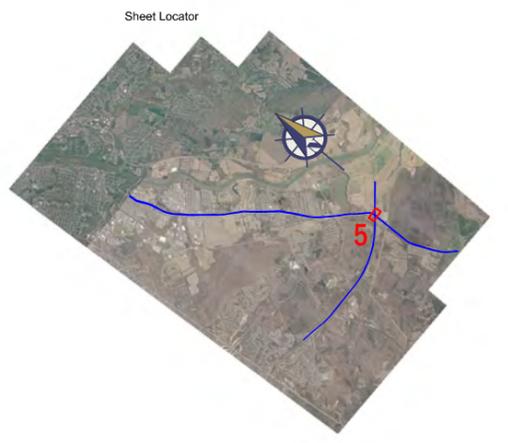
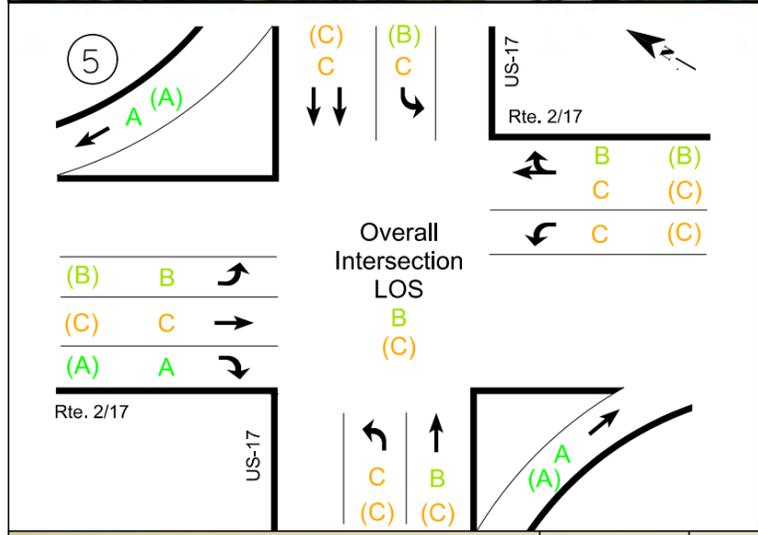
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LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F

 LOS COLOR RAMP



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	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	5	OF	



Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	35 to 45	1,050	660	470	250

FUTURE RECOMMENDATIONS:

This portion of Rte. 2/17 is mostly built out. If new developments are to be built between entrance E5 and E6 (continues to sheet 2), then it is recommended to add no more than one right-in/right-out only entrance with a minimum of 250' spacing with adjacent entrances. No new access points are recommended at any other location on this sheet. If new access points are considered, they should be based on the required spacing shown in Table 1.

ENTRANCE CONSOLIDATION:

There are multiple businesses with two or more access points on Rte. 2/17. There is potential of consolidating some of these entrances by removing one or more access point and keeping one entrance to each business. This will improve the corridor efficiency as well as safety. There are also instances where a business has an access point on a side road in addition to one on Rte. 2/17. The following entrances are recommended for consolidation:

- E2 can be removed because the business can be accessed from Beulah Salisbury Dr.
- W5 can be removed and W4 be the only access point at this location.
- W9 can be removed and W8 be the only access point at this location.



INTRODUCTION

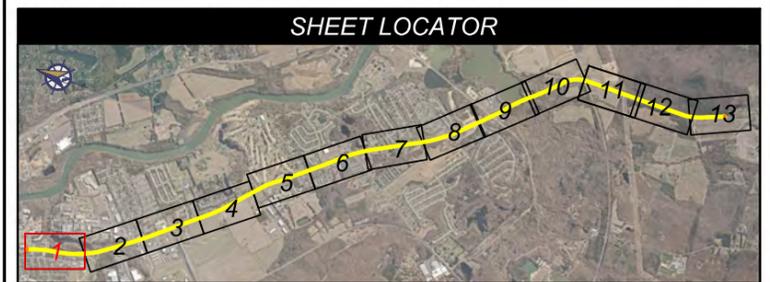
All the existing access points within the vicinity of the Rte. 2/17 corridor (classified as Minor Arterial) were re-evaluated based on the Alternative 2 design. The northern portion of Rte. 2/17 from the Fredericksburg City Line to Shannon Airport Circle is proposed to be a divided roadway, making most of the existing full access entrances and side roads to be Right-in/Right-out only entrances. The access points were evaluated based on the VDOT's "Access Management Design Standards for Entrances and Intersections", effective July 1, 2008. The objectives of the standards are to reduce congestion, improve safety and support economic development due to efficient movement of people and goods.

Based on the types of the entrances, intersections and median openings, the roadway classification, and speed; the spacing was compared to the required spacing to evaluate the compliance with the standards. If an entrance or intersection meets the required spacing on one side only, it is considered as Partially Meets Standards. The Alternative 2 Access Management Evaluation sheets show the compliance of the entrances and the intersections within the corridor, and the recommendations for future access control. Detailed Access Management Evaluation tables shown in Appendix C.

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



12/27/2018 9:35:36 AM



DRAWN BY:	MAF	ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION	SCALE:	1:150	DATE:	10/1/2018
CHECKED BY:	KHB		RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002	SHEET NO.:	1 OF 13
			VDOT UPC PROJECT NO.: 107193			





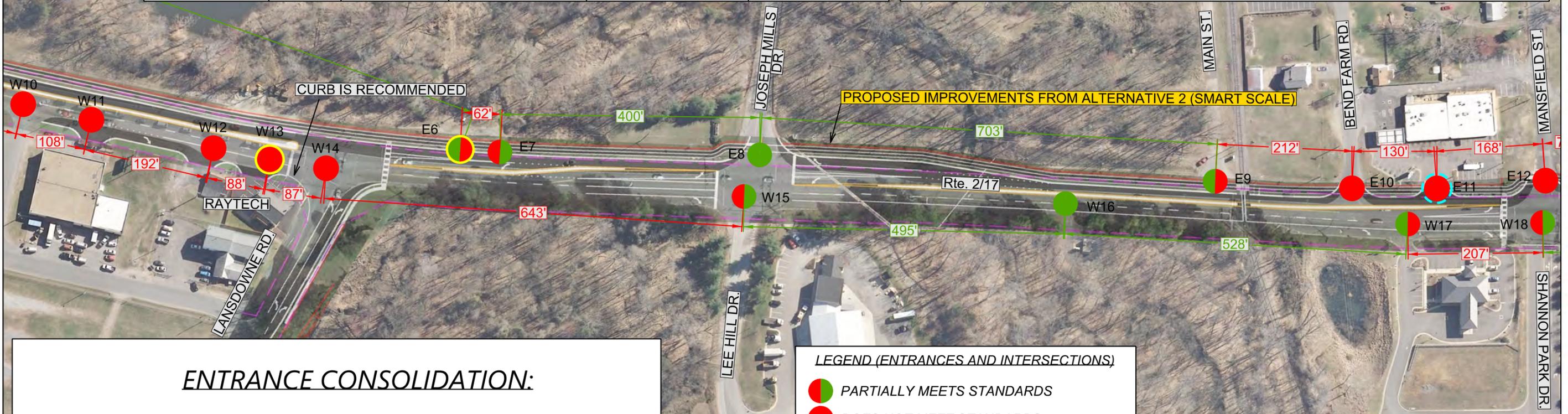
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Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
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Minor Arterial	35 to 45	1,050	660	470	250

FUTURE RECOMMENDATIONS:

There is potential for development along this portion of Rte. 2/17 between entrances E6-E8, E8-E9, W14-W15, W15-W16. If the land between these entrances is developed then it should have no more than the following recommended number of access points:

- E6-E8: one right-in/right-out only entrance consolidated with E7.
- E8-E9: one right-in/right-out only entrance with a minimum of 250' of spacing with adjacent entrances.
- W14-W15: one right-in/right-out only entrance with a minimum of 250' of spacing with adjacent entrances. Note: It is unlikely that this land is developed due to environmental factors (stream crossing).
- W15-W16: no new access points between these entrances due to spacing requirements.
- W16-W17: one right-in/right-out only entrance with a minimum of 250' of spacing with adjacent entrances, however, caution is required due to proximity to the railroad.



ENTRANCE CONSOLIDATION:

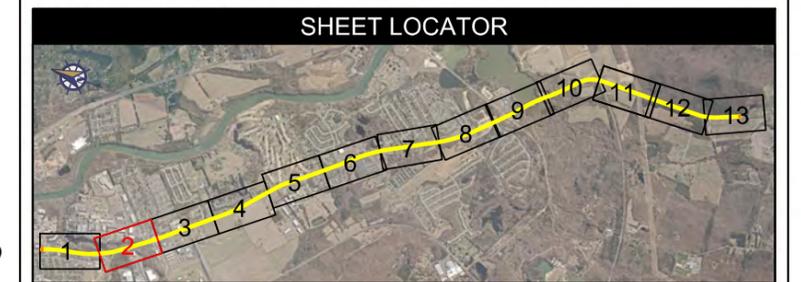
The following entrances are recommended for consolidation:

- W12 and W13 currently can be accessed along the entire Rte. 2/17 right turn lane onto Lansdowne Rd. These two entrances can be consolidated at the northern most part of the W13 Business (Raytech), and roadway curb be placed past the entrance and along the curve of the right turn to restrict access to the business from the Rte. 2/17 & Lansdowne Rd. intersection (northwest quadrant).
- E6 can be removed and E7 be the only access point at this location.
- E11 can be removed because it can be accessed from Bend Farm Rd. and Mansfield St.

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



12/27/2018 9:40:32 AM



DRAWN BY:

MAF

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION

SCALE:

1:150

DATE:

10/1/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

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OF

13





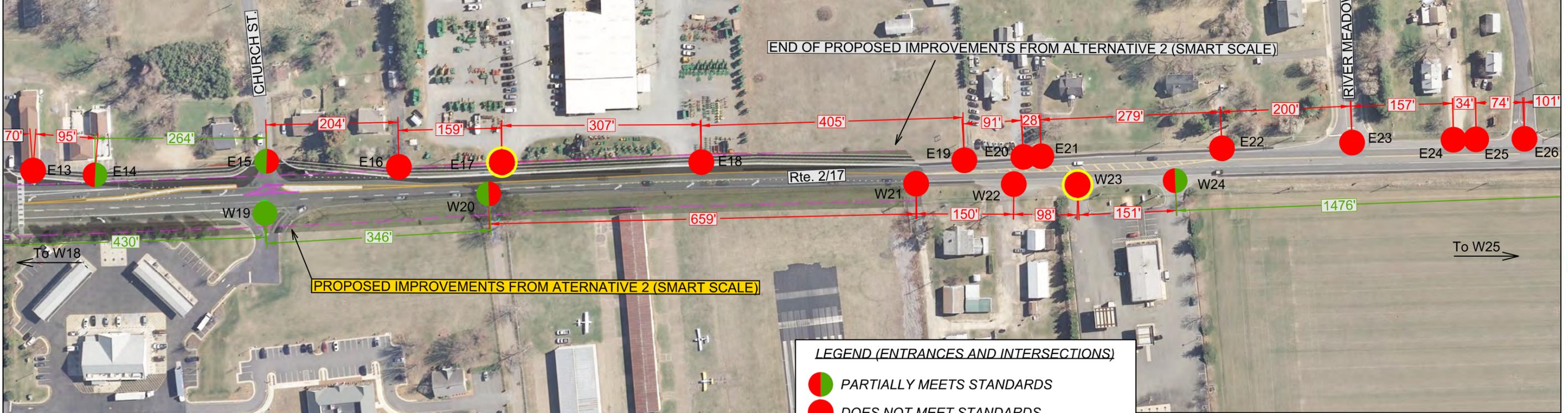
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Minor Arterial	35 to 45	1,050	660	470	250

FUTURE RECOMMENDATIONS:

This portion of Rte. 2/17 is mostly built out. However, there is potential for development between entrances E18-E19 and W24-W25 (continues to sheet 4). If the property between these entrances is developed then it should have no more than the following recommended number of access points:

- E18-E19: no new access points between these entrances due to spacing requirements. Considering a shared entrance is preferred.
- W24-25: two full access entrances with a minimum of 470' of spacing with adjacent entrances, or four right-in/right-out only entrances with a minimum of 250' of spacing with adjacent entrances.



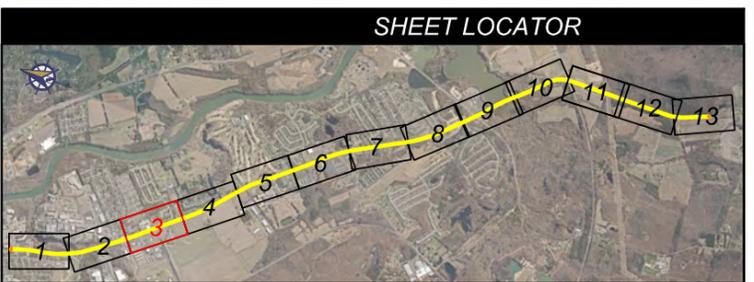
ENTRANCE CONSOLIDATION:

- The following entrances are recommended for consolidation:
- E17 can be removed and E18 be the only access point at this location.
 - W23 can be removed and W24 be the only access point at this location.

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



10/27/2018
8:47:45 AM



DRAWN BY:	MAF	ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION	SCALE:	1:150	DATE:	10/1/2018
CHECKED BY:	KHB		RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002	SHEET NO.:	3
			VDOT UPC PROJECT NO.: 107193			





FUTURE RECOMMENDATIONS:

There is potential for development along this portion of Rte. 2/17 between entrances E35-E36, W24-W25 (discussed on sheet 3), and W25-W26. If the property between these entrances is developed then it should have no more than the following recommended number of access points:

- E35-E36: no new access points between these entrances due to spacing requirements. Considering a shared entrance is preferred.
- W24-W25: discussed on sheet 3.
- W25-W26: two full access entrances with a minimum of 470' of spacing with adjacent entrances, or four right-in/right-out only entrances with a minimum of 250' of spacing with adjacent entrances.

ENTRANCE CONSOLIDATION:

There are no recommendations for entrance consolidations along this portion of Rte. 2/17. Most access points on this sheet are for individual houses and cannot be consolidated.

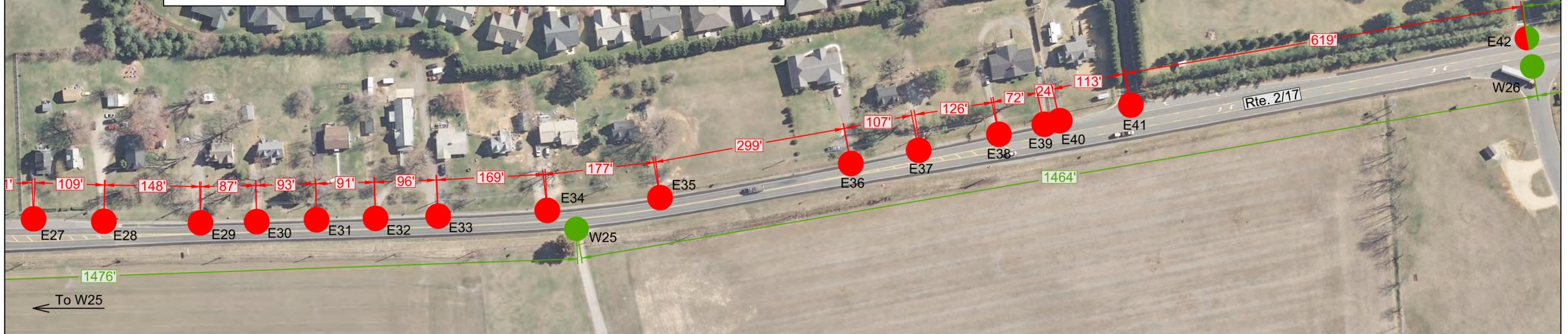


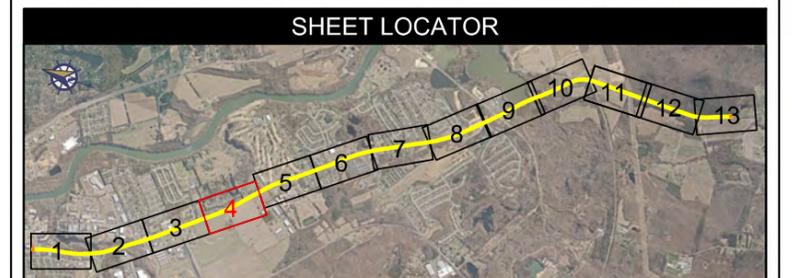
Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	35 to 45	1,050	660	470	250

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



10/2/2018 8:55:39 AM



DRAWN BY:

MAF

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION

SCALE:

1:150

DATE:

10/ 1 /2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

4

OF

13





Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	35 to 45	1,050	660	470	250

FUTURE RECOMMENDATIONS:

There is potential for development between entrances W26 (sheet 4)-W27 along this portion of Rte. 2/17.

- If the property between these two entrances is developed then it should have no more than one right-in/right-out only entrance with a minimum of 250' of spacing with adjacent entrances.*



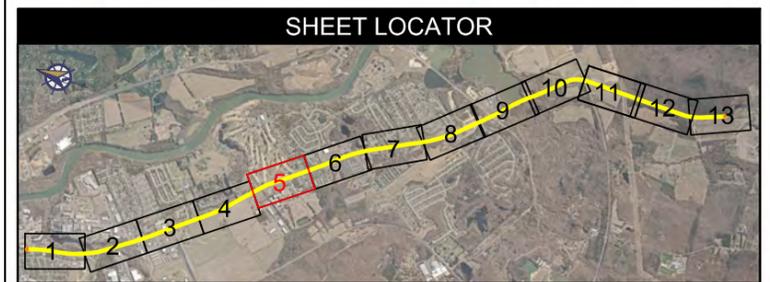
ENTRANCE CONSOLIDATION:

There are no recommendations for entrance consolidations along this portion of Rte. 2/17. The access points W29 through W34 are for individual houses and cannot be consolidated.

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



10/27/2018 10:47:57 AM



DRAWN BY: MAF
CHECKED BY: KHB

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION
RTE. 2/17 CORRIDOR STUDY

SCALE: 1:150
DATE: 10/1/2018
JMT PROJECT NO.: 15-0038-002
VDOT UPC PROJECT NO.: 107193
SHEET NO.: 5 OF 13



FUTURE RECOMMENDATIONS:

This portion of Rte. 2/17 is mostly built out. There is potential for development between entrances W46-W47 at the corner of the Rte. 2/17 and Benchmark Rd. intersection.

- If this property is developed then no new access points along Rte. 2/17 are recommended, instead, it is recommended to provide access along Benchmark Rd. and as close to the southwest corner of the property as possible.

ENTRANCE CONSOLIDATION:

The following entrances are recommended for consolidation:

- The Tire Center currently has two entrances located along Rte. 2/17 (E48 and E49) and one entrance on The Shops At River Club side entrance. It is recommended that the two entrances, E48 and E49, along Rte. 2/17 be removed due to their close proximity to the intersection at Benchmark Rd. The only recommended accessible entrance is the side entrance along The Shops at River Club.
- W44 can be removed and W45 be the only access point at this location.

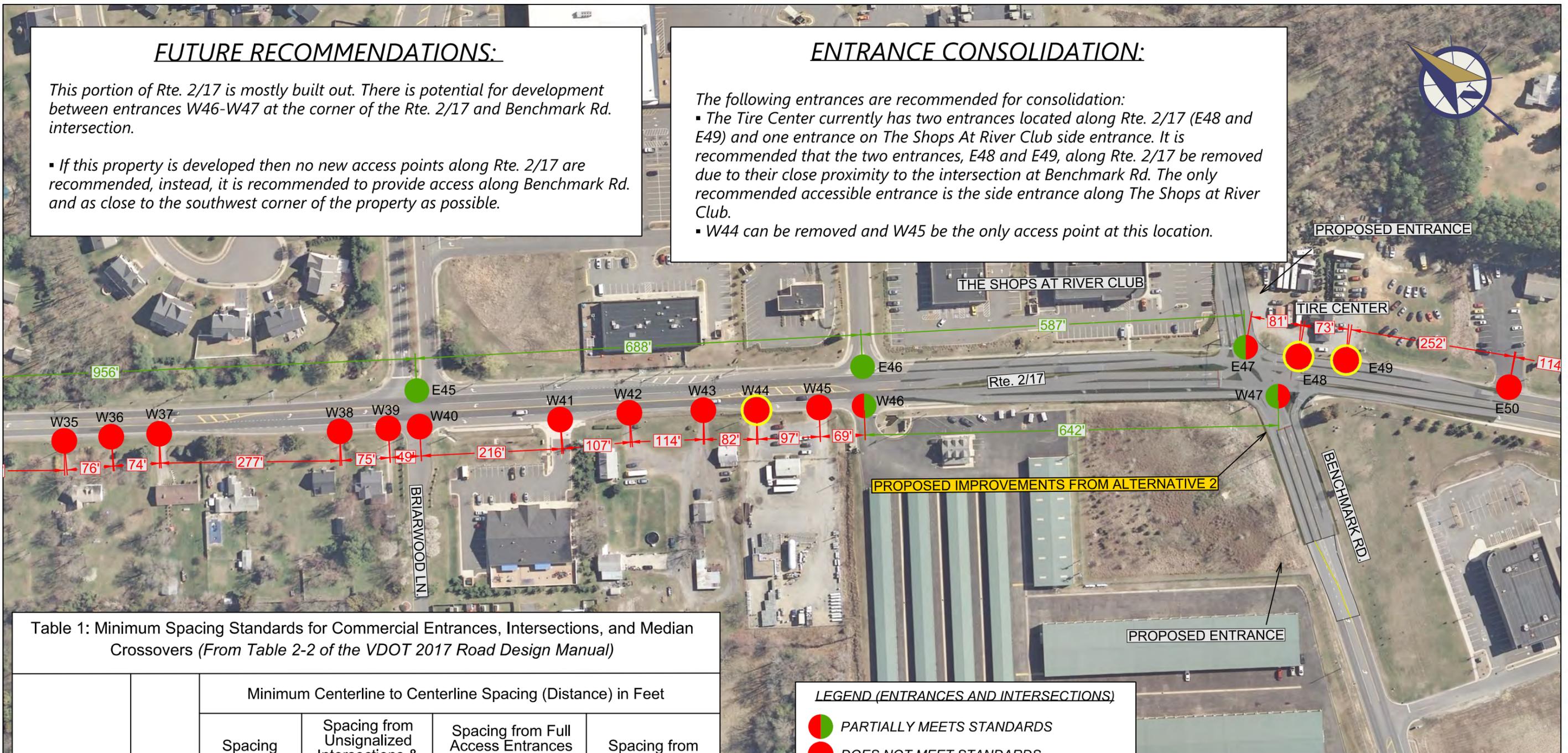


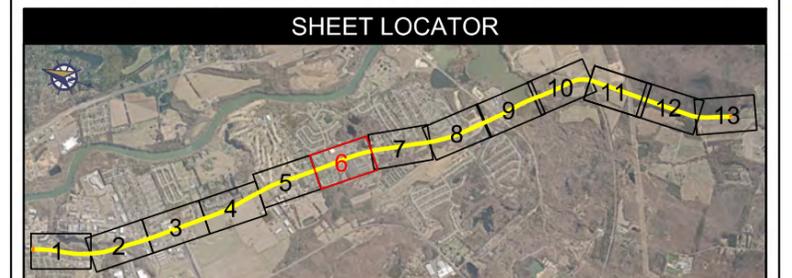
Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	35 to 45	1,050	660	470	250

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



10/27/2018 10:51:36 AM



DRAWN BY:

MAF

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION

SCALE:

1:150

DATE:

10/1/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

6

OF

13





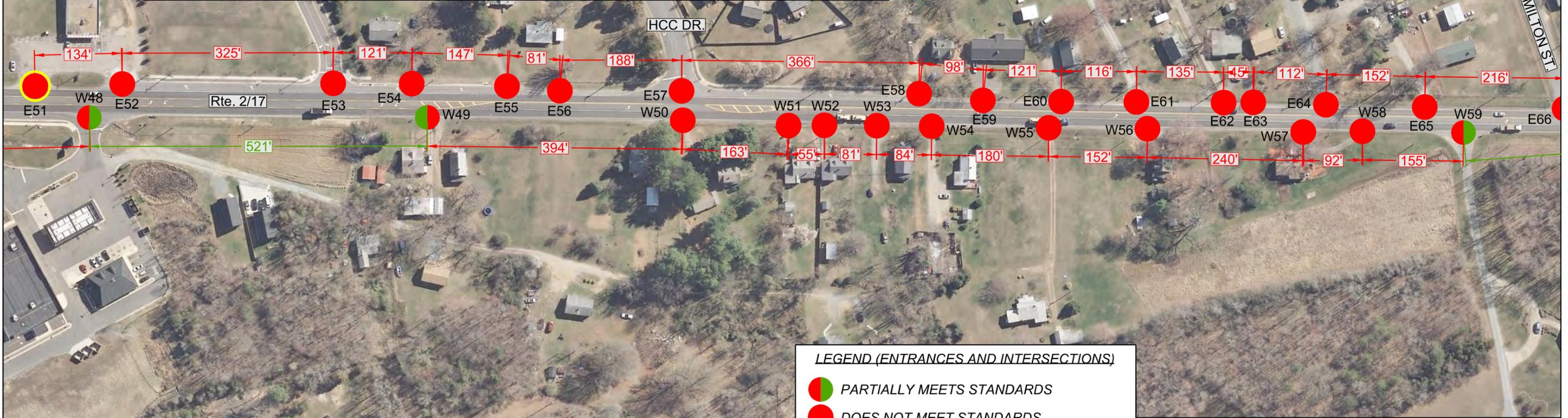
Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	35 to 45	1,050	660	470	250

FUTURE RECOMMENDATIONS:

This portion of Rte. 2/17 is mostly built out. However, there is potential for development between entrances E52-E53, W48-W49, W49-W50, W54-W55, W55-W56, and W56-W57. If the property between these entrances is developed then it should have no more than the following recommended number of access points:

- W48-W49: one right-in/right-out only entrance with a minimum of 250' of spacing with adjacent entrances.*
- E52-E53, W49-W50, W54-W55, W55-W56, W56-W57: no new access points between these entrances due to spacing requirements. Considering a shared entrance between adjacent properties is preferred.*



ENTRANCE CONSOLIDATION:

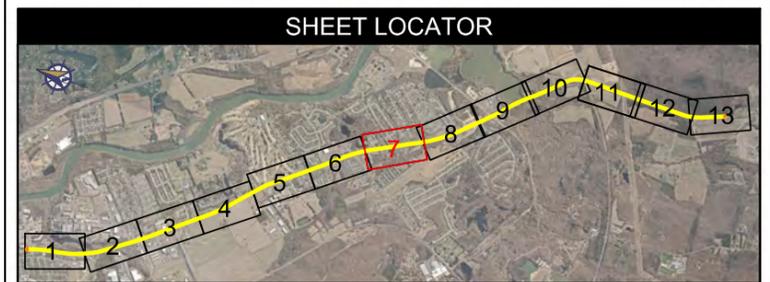
The following entrances are recommended for consolidation:

- E51 can be removed and E52 be the only access point at this location.*

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



10/27/2018 10:54:31 AM



DRAWN BY:	MAF	ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION	SCALE:	1:150	DATE:	10/1/2018
CHECKED BY:	KHB		RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	7 OF 13





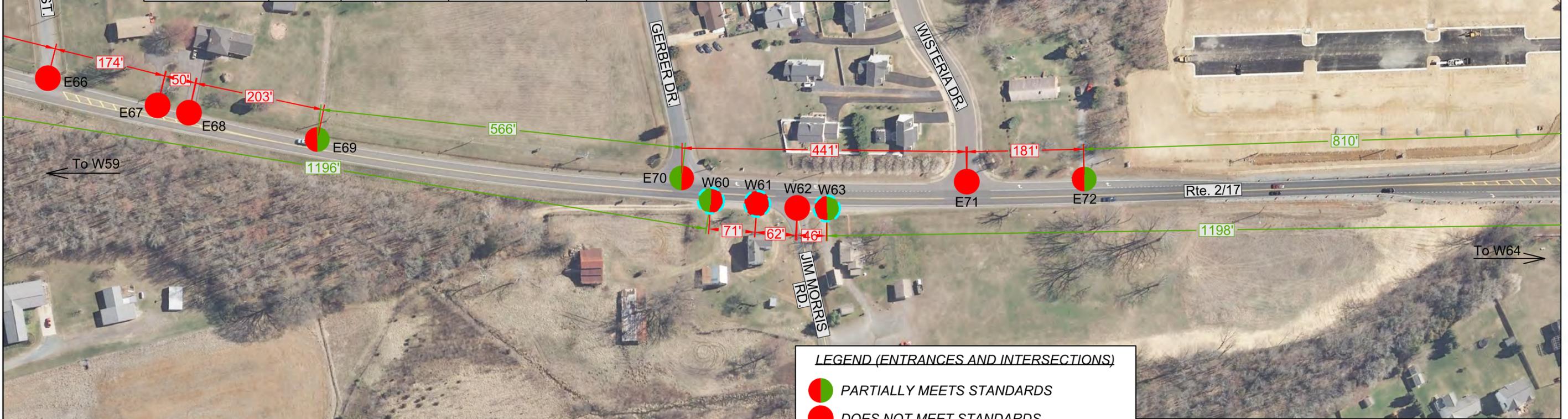
Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	35 to 45	1,050	660	470	250

FUTURE RECOMMENDATIONS:

There is potential for development between entrances E69-E70, W59 (from sheet 7)-W60, and W63-W64 (continues to sheet 9). If the property between these entrances is developed then it should have no more than the following recommended number of access points:

- E69-E70: one right-in/right-out only entrance with a minimum of 250' of spacing with adjacent entrances.
- W59-W60: one full access entrances with a minimum of 470' of spacing with adjacent entrances, or three right-in/right-out only entrances with a minimum of 250' of spacing with adjacent entrances.
- W63-W64: one full access entrances with a minimum of 470' of spacing with adjacent entrances, or three right-in/right-out only entrances with a minimum of 250' of spacing with adjacent entrances.



ENTRANCE CONSOLIDATION:

The following entrances are recommended for consolidation:

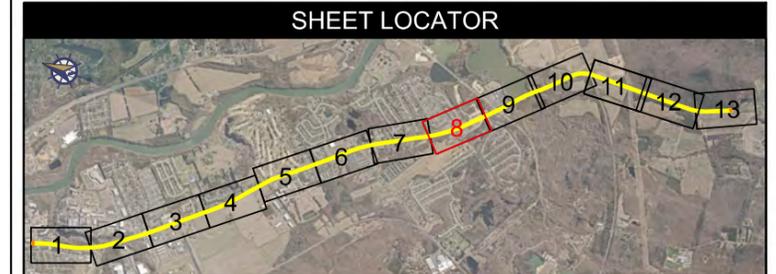
- W60, W61, and W63 can be removed with access from Jim Morris Rd.

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.

SHEET LOCATOR



DRAWN BY:

MAF

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION

SCALE:

1:150

DATE:

10/ 1 /2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

8

OF

13





ENTRANCE CONSOLIDATION:

The following entrances are recommended for consolidation:

- The Culpepper Wood Reserves has one entrance, E75, along Rte. 2/17 and one entrance along Billy Days Rd (E74). It is recommended that entrance E75 be removed because it does not meet spacing requirements with E74, and entrance E74 should be the only access point for Culpepper Wood Reserves.

FUTURE RECOMMENDATIONS:

This portion of Rte. 2/17 is mostly built out. However, there is potential for development between entrances W64-W65. It is unlikely that the area between E75-E76 and W69-W70 (continues to sheet 10) on this sheet will be developed due to Ruffins Pond. If the land between entrances W64-W65 is developed then it should have no more than the following recommended number of access points:

- W64-W65: one right-in/right-out only entrance with a minimum of 250' of spacing with adjacent entrances.

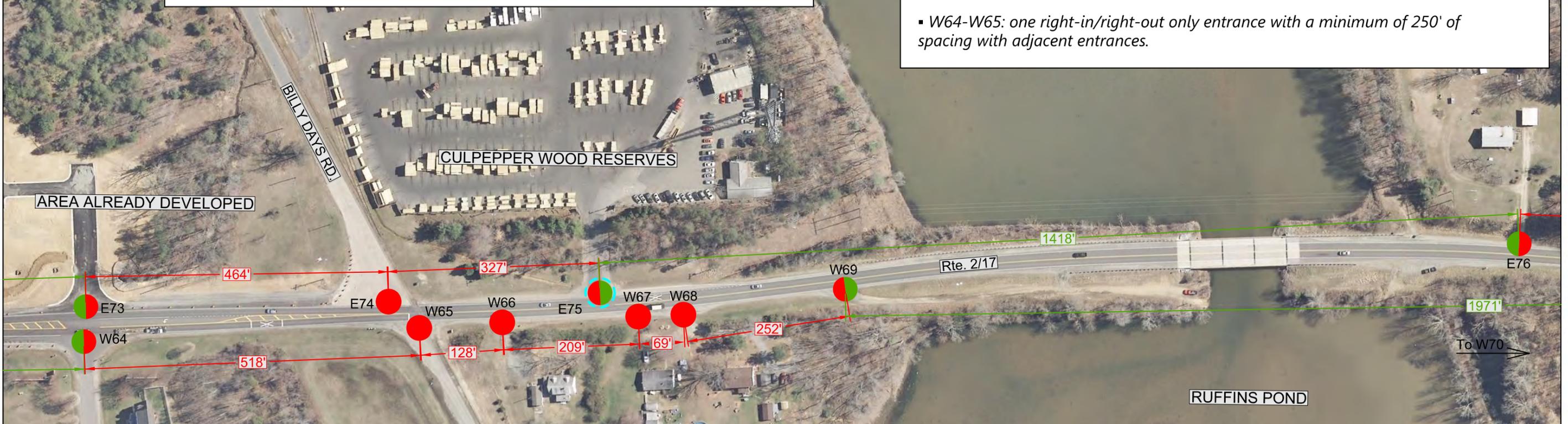


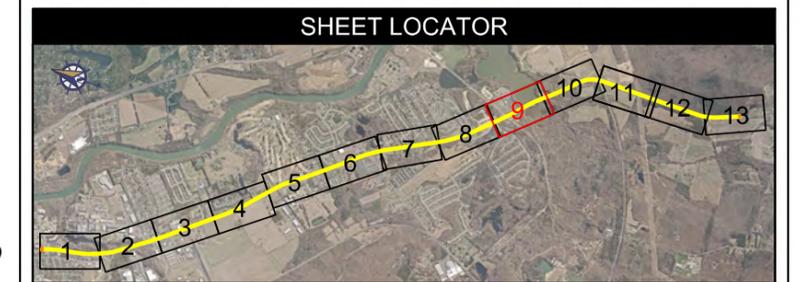
Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
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Minor Arterial	35 to 45	1,050	660	470	250

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



10/27/2018 11:02:41 AM



DRAWN BY: MAF
CHECKED BY: KHB

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION
RTE. 2/17 CORRIDOR STUDY

SCALE: 1:150
DATE: 10/1/2018
JMT PROJECT NO.: 15-0038-002
VDOT UPC PROJECT NO.: 107193
SHEET NO.: 9 OF 13





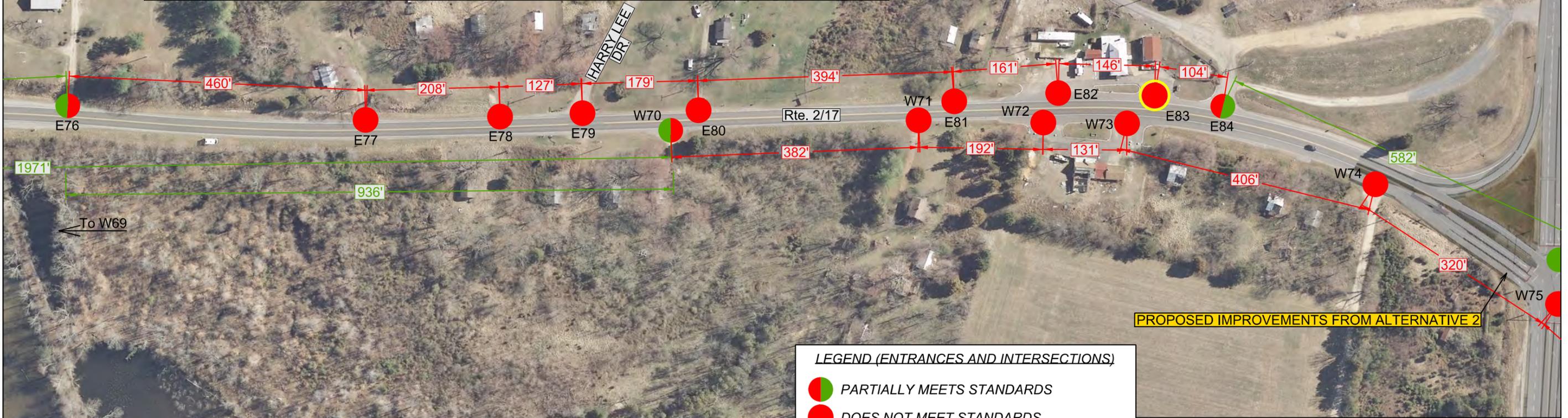
Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	35 to 45	1,050	660	470	250

FUTURE RECOMMENDATIONS:

This portion of Rte. 2/17 is mostly built out. However, there is potential for development between entrances W69 (from sheet 9) and W70 on this sheet, but only for the 936' after Ruffins Pond (from sheet 9). There is also potential for development between entrances W74 and W75. It should be noted that the New Post development (E84) is built out and is a right-in/right-out/left-in only entrance. If the land between entrances W69-W70 on this sheet and W74-W75 is developed then it should have no more than the following number of recommended access points:

- *W69-W70: two right-in/right-out only entrances with minimum of 250' of spacing between adjacent entrances.*
- *W74-W75: no new access points are recommended due to spacing requirements and proximity to the intersection.*



ENTRANCE CONSOLIDATION:

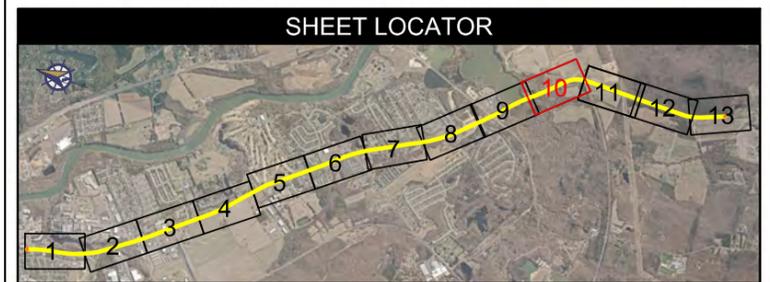
The following entrances are recommended for consolidation:

- *E83 can be removed and E82 be the only access point at this location.*

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.



10/27/2018 11:06:15 AM



DRAWN BY: MAF
CHECKED BY: KHB

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION
RTE. 2/17 CORRIDOR STUDY

SCALE: 1:150
DATE: 10/1/2018
JMT PROJECT NO.: 15-0038-002
VDOT UPC PROJECT NO.: 107193
SHEET NO.: 10 OF 13





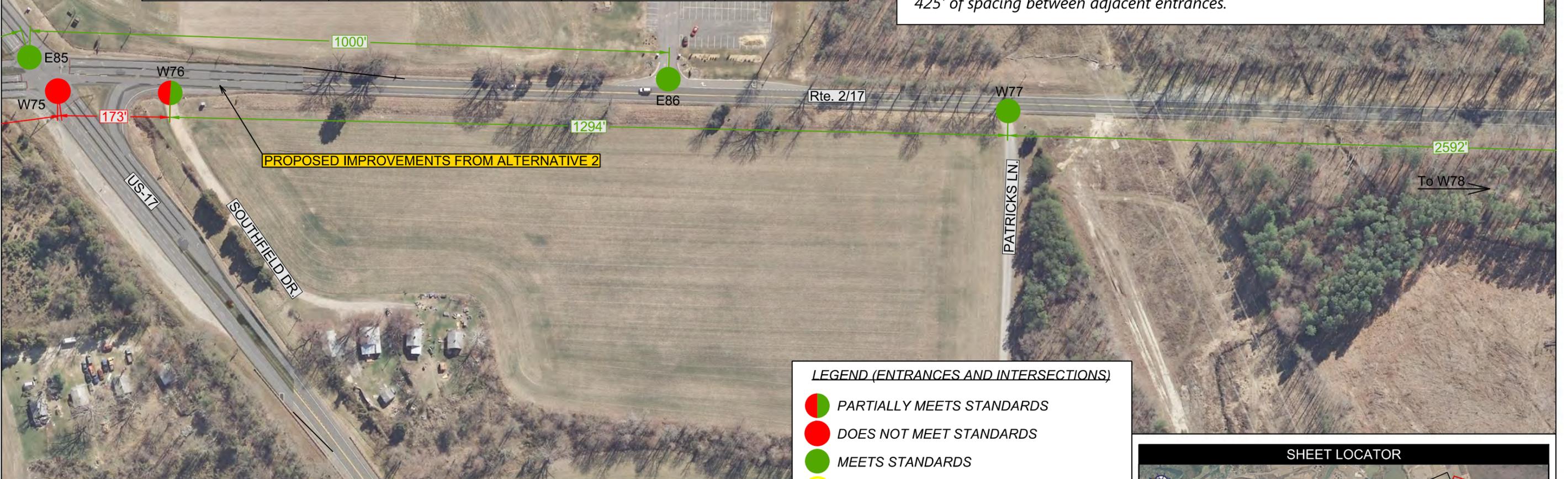
Table 2: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
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Minor Arterial	≥ 50	1,320	1,050	555	425

FUTURE RECOMMENDATIONS:

There is potential for development between entrances E85-E86, E86-End of Project (shown on sheet 13), W76-W77, and W77-W78 (continues to sheet 12). If the property between these entrances is developed then it should have no more than the following recommended number of access points:

- E85-E86: one right-in/right-out only entrance with a minimum of 425' of spacing between adjacent entrances.
- E86-End of Project: any proposed access points should follow Table 2 provided for spacing requirements for ≥ 50 mph on Minor Arterial roadways.
- W76-W77: one full access entrance with a minimum of 555' of spacing between adjacent entrances, or three right-in/right-out only entrances with a minimum of 425' of spacing between adjacent entrances.
- W77-W78: three full access entrances with a minimum of 555' of spacing between adjacent entrances, or five right-in/right-out only entrances with a minimum of 425' of spacing between adjacent entrances.



ENTRANCE CONSOLIDATION:

There are no recommendations for entrance consolidations for this portion of Rte. 2/17.

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.

SHEET LOCATOR



10/27/2018 11:09:42 AM



DRAWN BY:

MAF

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION

SCALE:

1:150

DATE:

10/ 1 /2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

11

OF

13





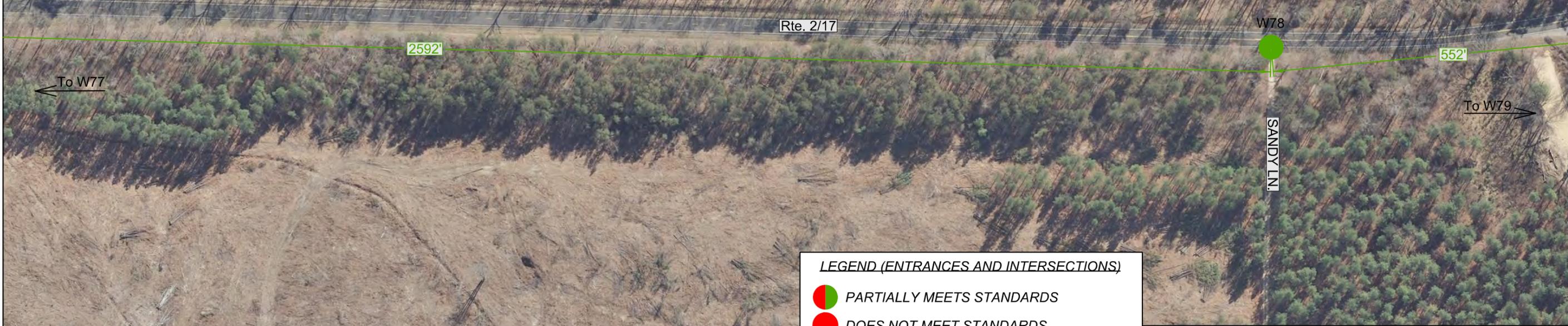
Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

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		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	≥ 50	1,320	1,050	555	425

FUTURE RECOMMENDATIONS:

There is potential for development on all of the properties on the east side of Rte. 2/17, between entrances W77-W78, and W78-W79. If these properties are developed then it should have no more than the following recommended number of access points.

- Properties east of Rte. 2/17, W77-W78: discussed on Sheet 11.
- W78-W79: no new access points between these entrances due to spacing requirements.



ENTRANCE CONSOLIDATION:

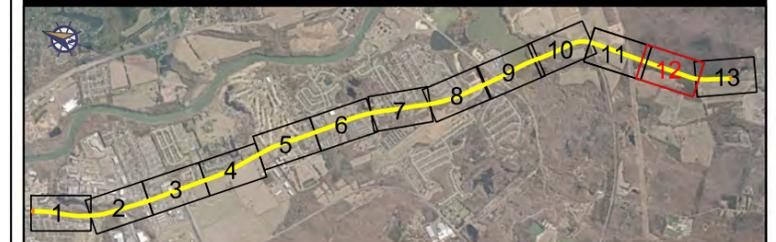
There are no recommendations for entrance consolidations for this portion of Rte. 2/17.

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.

SHEET LOCATOR



10/27/2018 11:23:38 AM



DRAWN BY:

MAF

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATION

SCALE:

1:150

DATE:

10/ 1 /2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

12

OF

13





Table 1: Minimum Spacing Standards for Commercial Entrances, Intersections, and Median Crossovers (From Table 2-2 of the VDOT 2017 Road Design Manual)

Highway Functional Classification	Legal Speed Limit (mph)	Minimum Centerline to Centerline Spacing (Distance) in Feet			
		Spacing from Signalized Intersections to Other Signalized Intersections	Spacing from Unsignalized Intersections & Full Median Crossovers to Signalized or Unsignalized Intersections & Full Median Crossovers	Spacing from Full Access Entrances or Directional Median to Other Full Access Entrances and Any Intersection or Median Crossover	Spacing from Partial Access One or Two Way Entrances to Any Type of Entrance, Intersection or Median Crossover
Minor Arterial	≥ 50	1,320	1,050	555	425

FUTURE RECOMMENDATIONS:

There is potential for development on all of the properties on the east side of Rte. 2/17 and between entrance W79 and the End of Project. If the property between these entrances is developed then it should have no more than the following recommended number of access points:

- Properties east of Rte. 2/17: discussed on Sheet 11
- W79-End of Project: one full access entrance with a minimum spacing of 555' with adjacent entrances, or one right-in/right-out entrance with a minimum spacing of 425' with adjacent entrances.



ENTRANCE CONSOLIDATION:

There are no recommendations for entrance consolidations for this portion of Rte. 2/17.

LEGEND (ENTRANCES AND INTERSECTIONS)

- PARTIALLY MEETS STANDARDS
- DOES NOT MEET STANDARDS
- MEETS STANDARDS
- ENTRANCE RECOMMENDED TO BE REMOVED
- ENTRANCE RECOMMENDED TO BE REMOVED. BUSINESS HAS ACCESS ON SIDE STREETS

NOTE: ACCESS MANAGEMENT WAS EVALUATED BASED ON TABLE 1.

SHEET LOCATOR



10/14/2018 9:02:54 AM



DRAWN BY:

MAF

ALTERNATIVE 2 ACCESS MANAGEMENT EVALUATIONS

SCALE:

1:150

DATE:

10/ 1 /2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

SHEET NO.:

13

OF

13



Alternative 3

Alternative 3 included all the improvements from Alternative 2 and the proposed widening of Benchmark Rd. into a four-lane undivided roadway. A 10'-wide shared use path on one side of the roadway and four bus pullouts with shelters at existing bus stops are also included in this Alternative. Evaluation of the access points throughout the corridor conducted for Alternative 2 will be applicable for this Alternative as well.

Similar to the previous Alternatives, traffic data was based on the future conditions of the travel demand model which accounted for the expected growth regionally and within the limits of the study corridor. The VISSIM model was updated with these traffic volumes and new traffic patterns for the two intersections along Rte. 2/17, at Benchmark Rd. and US-17 due to the improvement of Benchmark Rd. The VISSIM model was also updated with the proposed improvements to the northern portion of the corridor and at the intersections, in terms of adding capacity and/or lane configurations and optimizing signals to achieve the best possible LOS at each intersection. The overall intersection LOS for weekday AM and PM peak hours are shown in Table F 6 and the single movements LOS details are shown on individual sheets. The following can be concluded from the capacity analysis results of Alternative 3:

1. All the intersections performed at acceptable LOS C or better during the AM and PM peak hours, and provide significant operational improvement when compared with the no-build condition.

Table F 6: Alternative 3 Intersection LOS results

#	Intersection of Rte. 2/17 at	Peak Hour	
		AM 7:15 - 8:15	PM 4:30 - 5:30
1	Lansdowne Road	B	B
2	Lee Hill Drive/Joseph Mills Drive	C	B
3	Shannon Park Drive/Mansfield Street	C	C
4	Benchmark Road/Commercial Entrance	C	C
5	US-17	B	C

Alternative 3 Cost:

Similar to the previous alternatives, a cost estimate for this alternative was completed. The cost estimate was broken down into three main categories; (1) structural, (2) construction, and (3) environment. The cost estimates of the three categories, shown in Table F 7, were based on the Alternative 2 improvements and the proposed Benchmark Rd. improvements shown in Figure F 6. The cost estimate includes proposed improvements at the five study intersections in terms of adding capacity and four bus pullouts located at the existing bus stops along the corridor. VDOT provided unit costs from TMPD, inflated to year 2018, was used to determine the planning level cost estimates for this alternative, which includes low and high ranges. Cost estimates provided herein are not for construction purposes. Detailed engineering design and cost estimates are required to identify the budget needed for implementing Alternative 3. In general, the cost estimate of this alternative is impacted by the following:

- a) Includes an additional culvert replacement along Benchmark Rd.
- b) Relatively, high impact on the environment due to Benchmark Rd. widening.
- c) Does not include new bridge over Ruffins Pond.

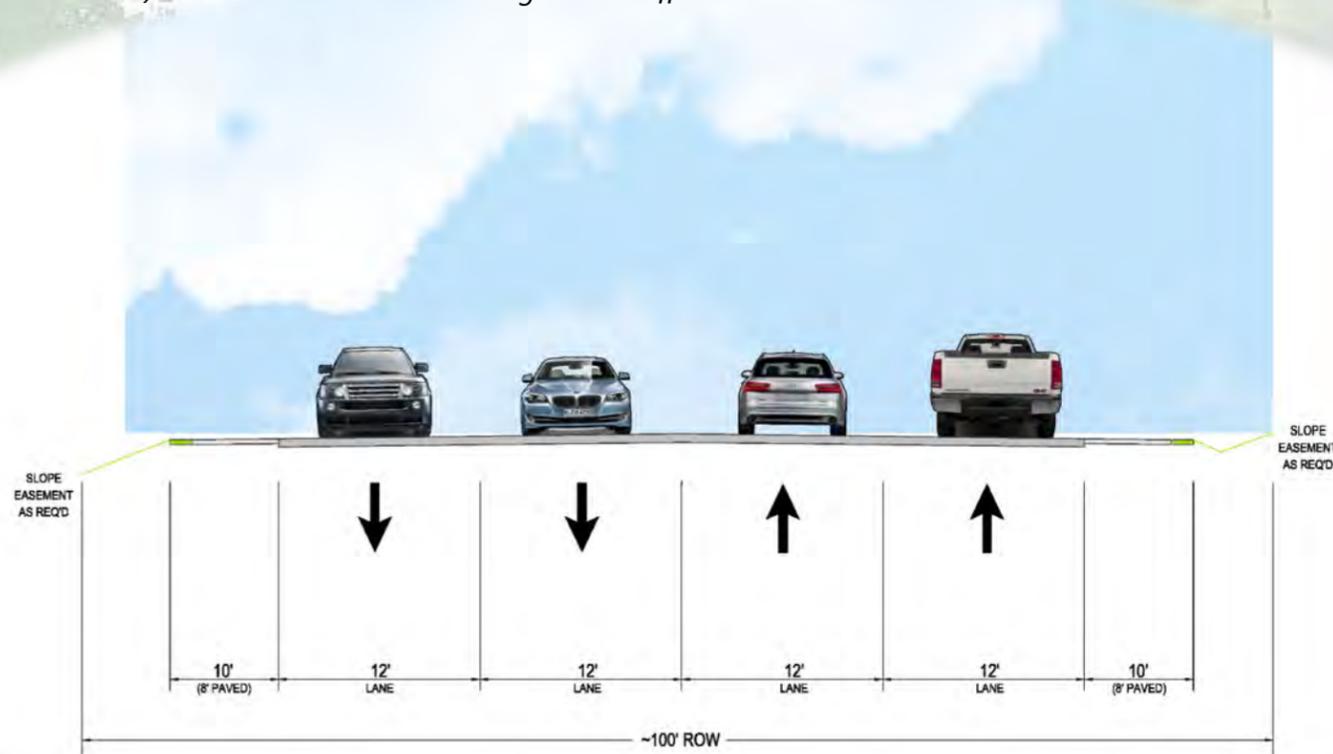


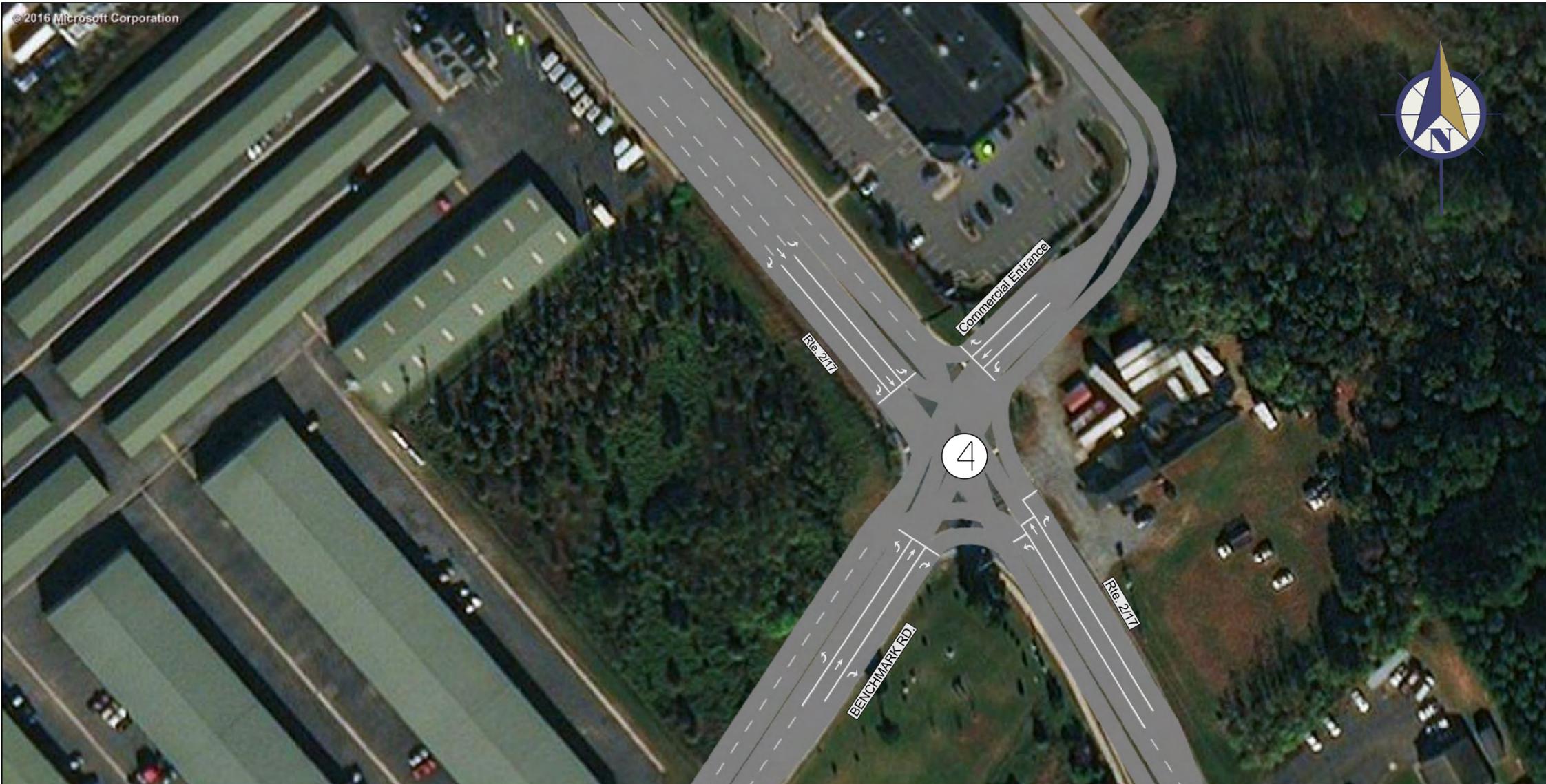
Figure F 6: Alternative 3 Benchmark Road Cross Section

Table F 7: Alternative 3 Planning Level Construction Cost Estimate

Item	Quantity	Unit Cost		Unit	Costs	
		Low	High		Low	High
Structural Cost						
Bus Pullout/Shelter	4.00	\$30,000		Each	\$120,000	
Culvert - 300' S of Lansdowne Rd.	1.00	\$63,000		Each	\$63,000	
Culvert for Deep Run Creek (replace existing bridge)	1.00	\$500,000		Each	\$500,000	
Culvert - 500' S of Pierson Dr./N. Club Dr.	1.00	\$32,000		Each	\$32,000	
Culvert - 500' N of Benchmark Rd.	1.00	\$93,000		Each	\$93,000	
Culvert - 75' N of Ruffin Dr.	1.00	\$120,000		Each	\$120,000	
Bridge over Ruffin's Pond	1.00	\$20,000		Each	\$20,000	
Culvert for Shirley Stream	1.00	\$136,000		Each	\$136,000	
Structural & Subtotal					\$1,084,000	
Construction Cost						
Signal						
Modify Existing Signal	5.00	\$142,000	\$306,000	Per Intersection	\$710,000	\$1,530,000
Pavement						
Right turn lane	6.00	\$66,000	\$144,000	Per 100'	\$396,000	\$864,000
Right turn Taper	3.00	\$44,000	\$96,000	Per 100'	\$132,000	\$288,000
Left turn lane	2.50	\$126,000	\$156,000	Per 200'	\$315,000	\$390,000
Left turn taper	1.00	\$84,000	\$104,000	Per 200'	\$84,000	\$104,000
1 Lane	0.07	\$2,349,000	\$3,523,500	CPM*	\$164,430	\$246,645
2 lanes**	3.75	\$4,698,000	\$7,047,000	CPM	\$17,617,500	\$26,426,250
10' Shared use path off road	4.44	\$940,000	\$940,000	CPM	\$4,173,600	\$4,173,600
16' raised median	0.47	\$343,200	\$422,400	CPM	\$161,304	\$198,528
6-8' raised median (U-turn)	0.47	\$257,400	\$316,800	CPM	\$120,978	\$148,896
Construction Subtotal					\$23,875,000	\$34,370,000
Structural & Construction Subtotal					\$24,959,000	\$35,454,000
Right-of-Way (36% of ST & CN)					\$8,985,240	\$12,763,440
Subtotal (Structural & Construction)					\$33,950,000	\$48,220,000
Environmental Cost						
Wetland/Stream Mitigation Estimate	1.00	\$458,000		Each	\$458,000	
NEPA Environmental Documentation	1.00	\$45,000		Each	\$45,000	
Phase 1 Environmental Site Assessment	1.00	\$6,500		Each	\$6,500	
Phase 1 Cultural Resource Survey	1.00	\$10,000		Each	\$10,000	
Permitting	1.00	\$40,000		Each	\$40,000	
Air/Noise Studies	1.00	\$55,000		Each	\$55,000	
Subtotal					\$620,000	
Grand Total (rounded)					\$35,000,000	\$49,000,000

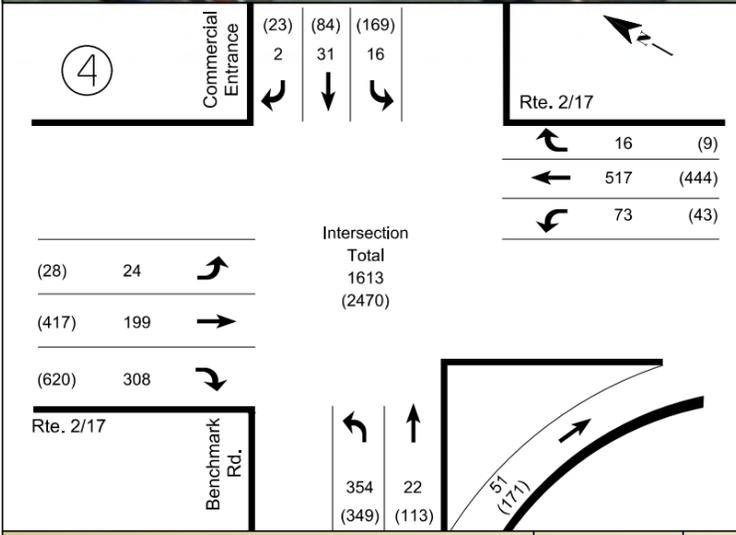
*CPM: Cost Per Mile

**Cost considered the use of existing pavement



LEGEND

- xxxx AM PHV
- (xxxx) PM PHV
- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number



Proposed Improvements*:

Westbound Approach:
 ▪ add through lane to be ~150'

Eastbound Approach:
 ▪ add through lane (Benchmark Rd. widened to a four-lane undivided roadway)

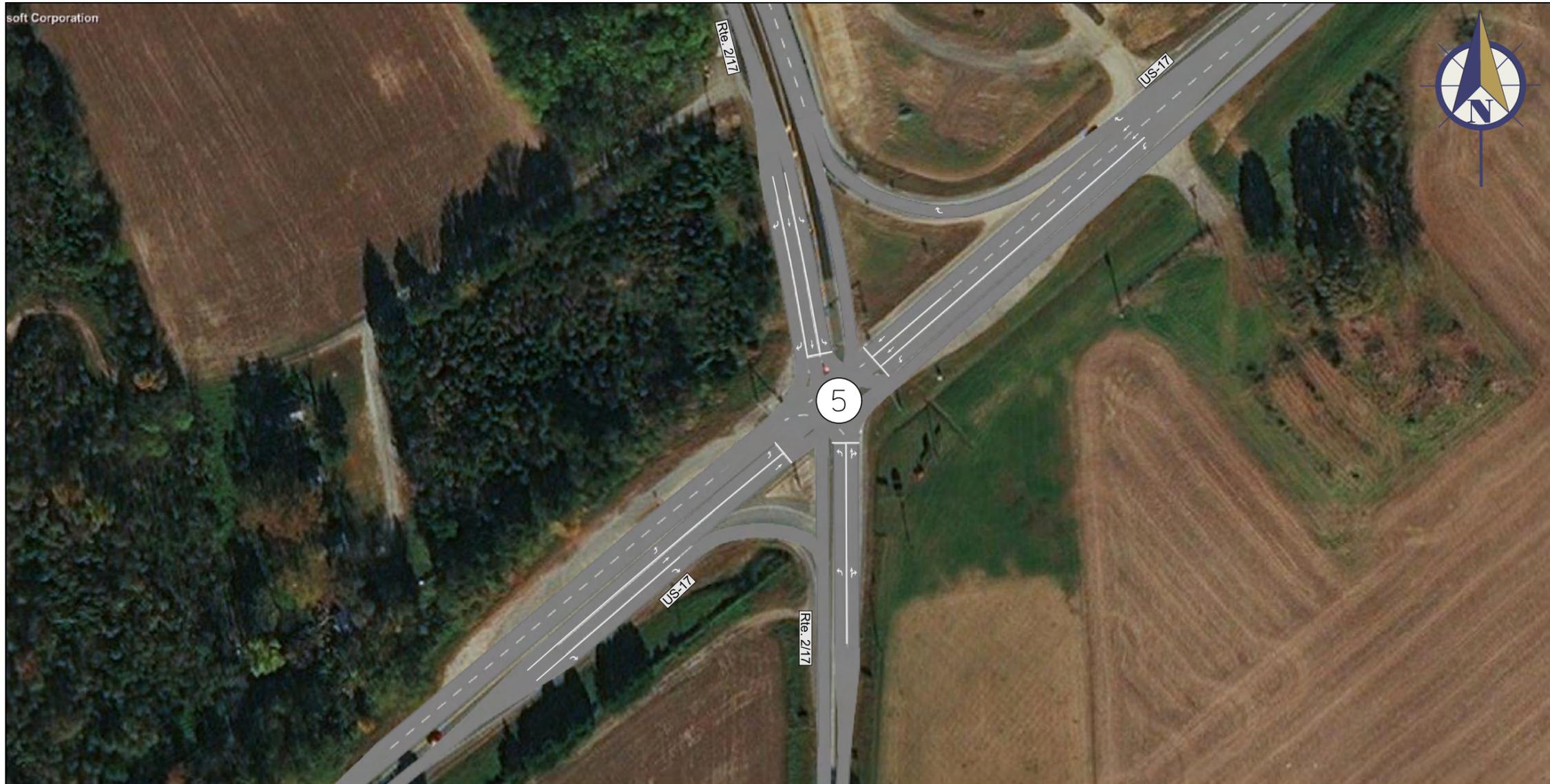
*In addition to signal optimization and coordination, as applicable

NOTE: Alternative 3 peak hour volumes at intersections 1, 2, and 3 are same as Alternative 2.

PHV: PEAK HOUR VOLUME

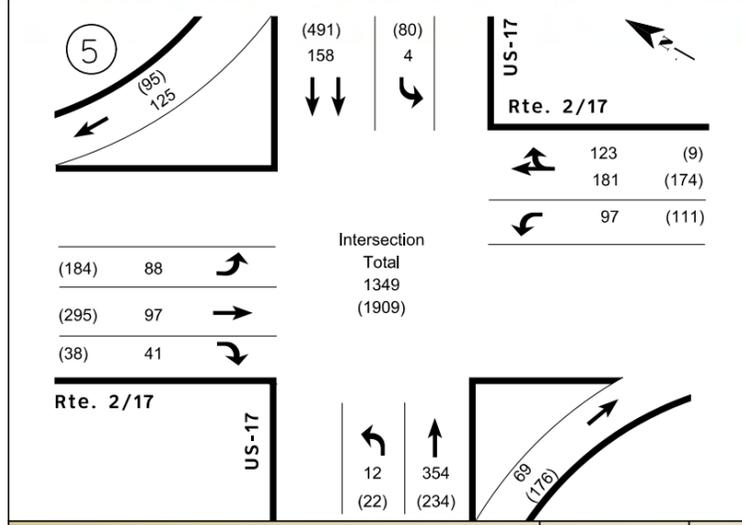


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	CHECKED BY:		KHB	RTE. 2/17 CORRIDOR STUDY		JMT PROJECT NO.: 15-0038-002	SHEET NO.:	1	
				VDOT UPC PROJECT NO.: 107193					



LEGEND

- xxxx AM Peak Hour Volume (PHV)
- (xxxx) PM PHV
- Traffic Movement
- Two - Way Left - Turn Lane
- Intersection Number



Proposed Improvements*:

Northbound Approach:

- change lane configurations to be shared through/right-turn lane and exclusive left-turn lane to be ~450'

Westbound Approach:

- add second through lane to be ~950'

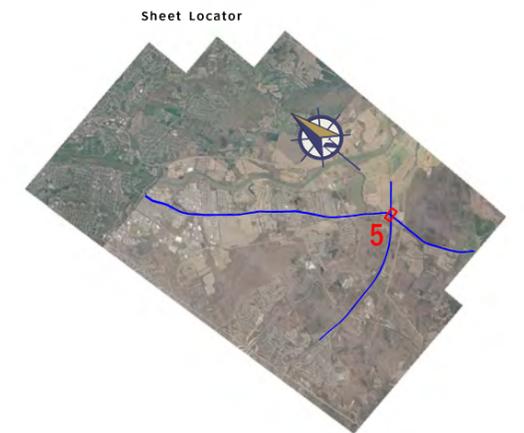
Southbound Approach:

- extend existing right-turn lane to be ~400'

Eastbound Receiving:

- add a second receiving lane to be ~550'

*In addition to signal optimization and coordination, as applicable

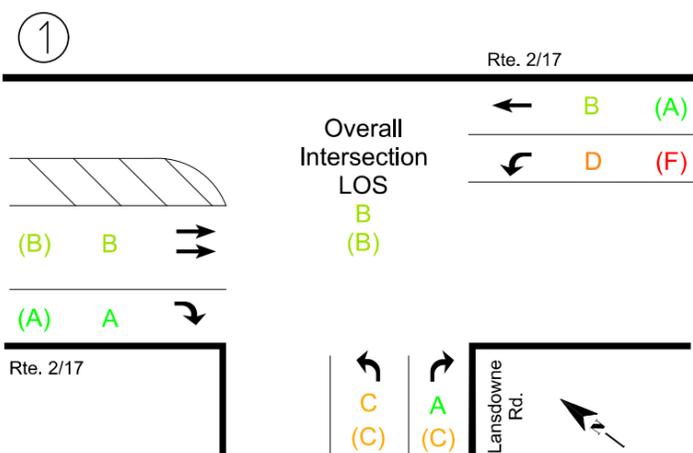


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	CHECKED BY:		KHB	RTE. 2/17 CORRIDOR STUDY		JMT PROJECT NO.: 15-0038-002	
			VDOT UPC PROJECT NO.: 107193				



LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP



Operational capacity of the corridor of the Alternative 3 scenario was analyzed in VISSIM for the AM and PM peak hours. Delays were used to determine the operating Level of Service for individual movements and intersections.

Sheet Locator



DRAWN BY:

HLR

2035 ALTERNATIVE 3 LEVELS OF SERVICE

SCALE:

NOT TO SCALE

DATE:

09/21/2018

CHECKED BY:

KHB

RTE. 2/17 CORRIDOR STUDY

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

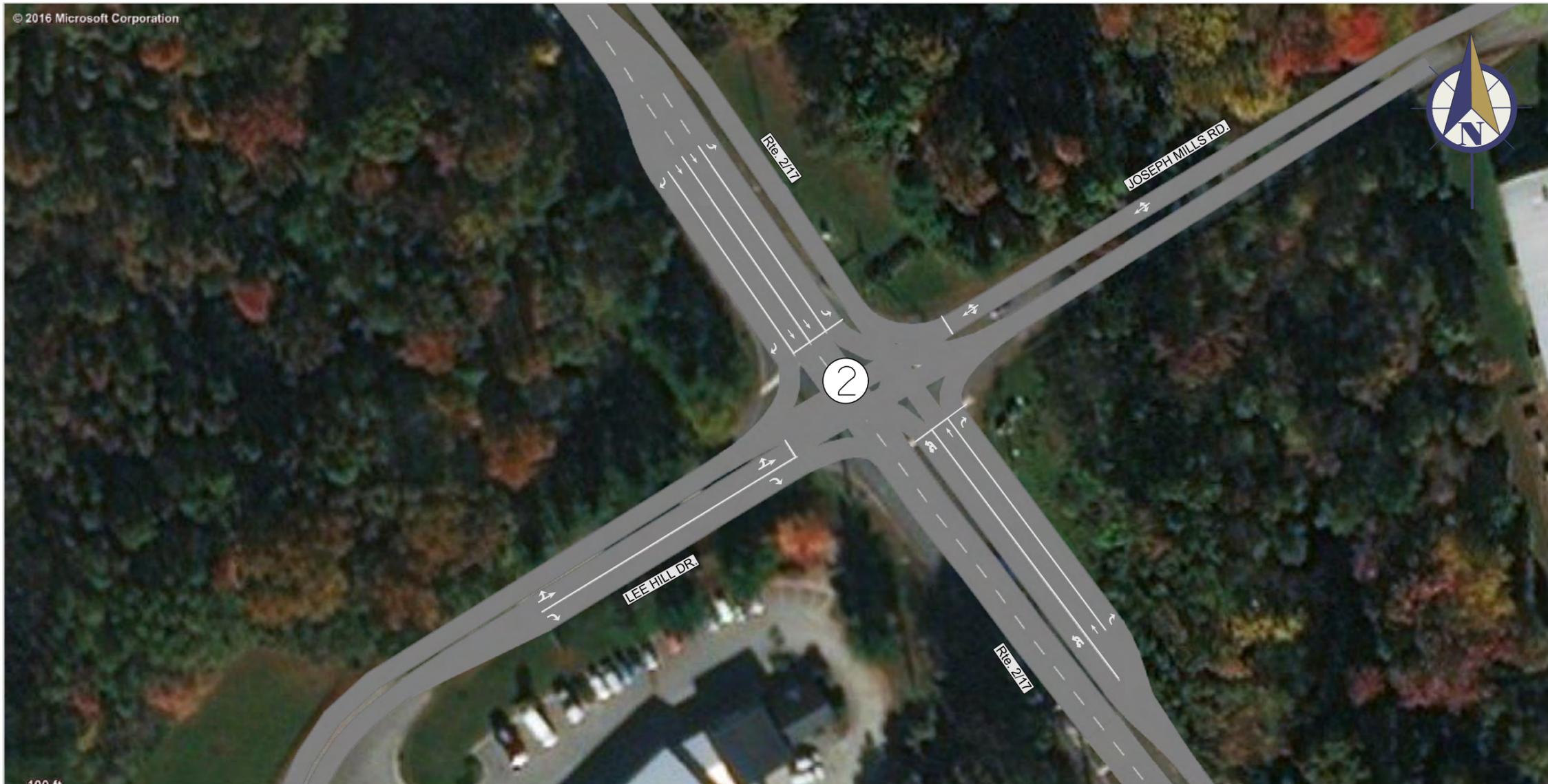
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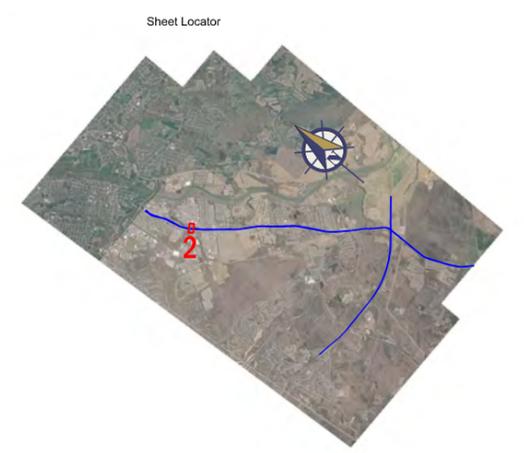
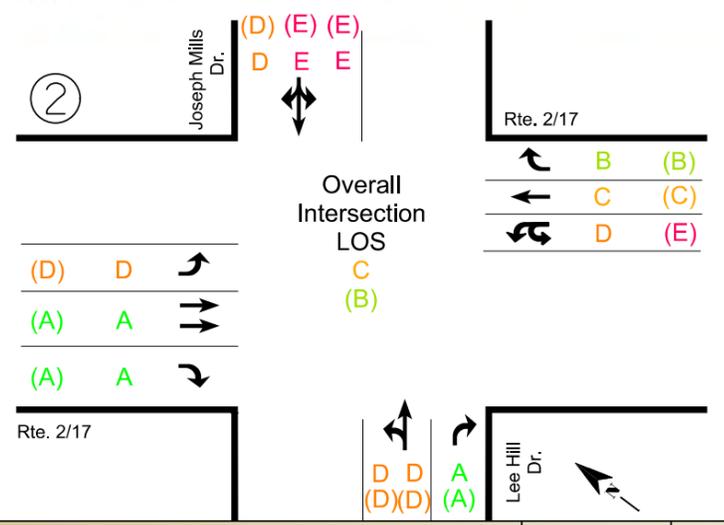
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LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP

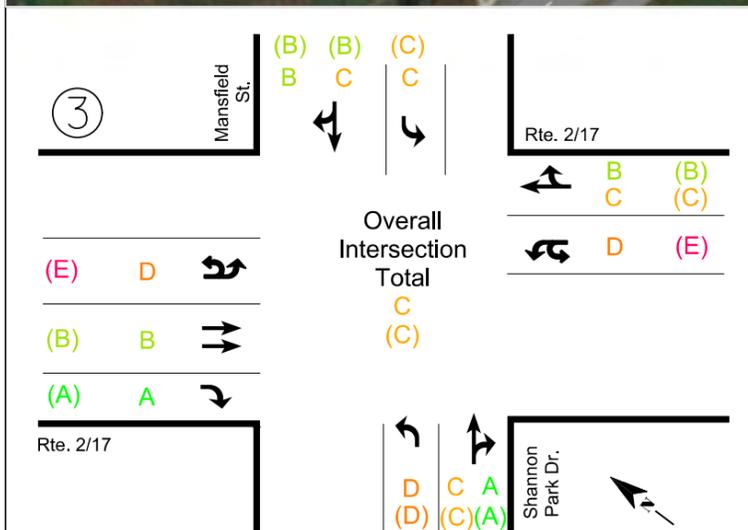


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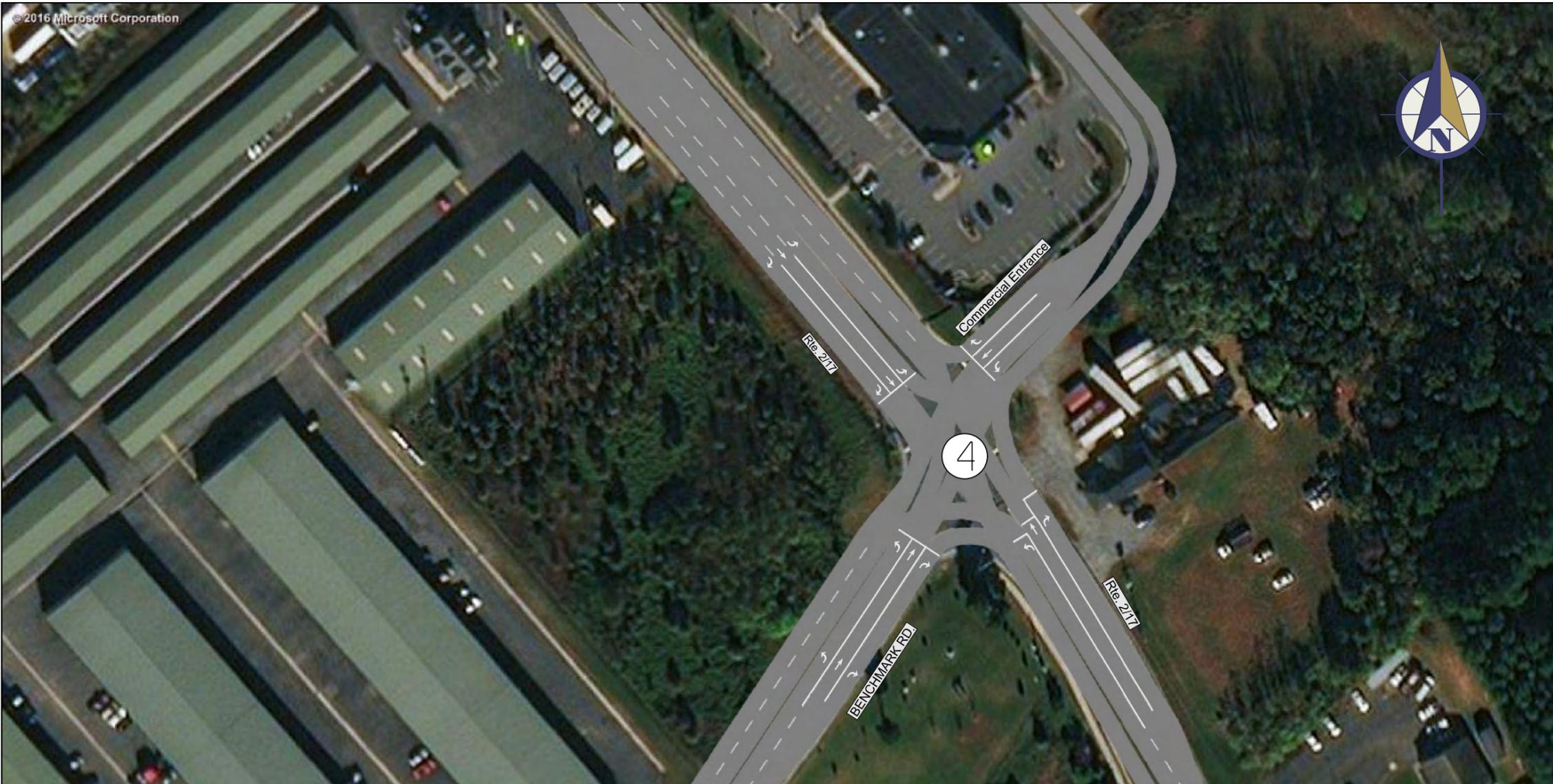


LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP

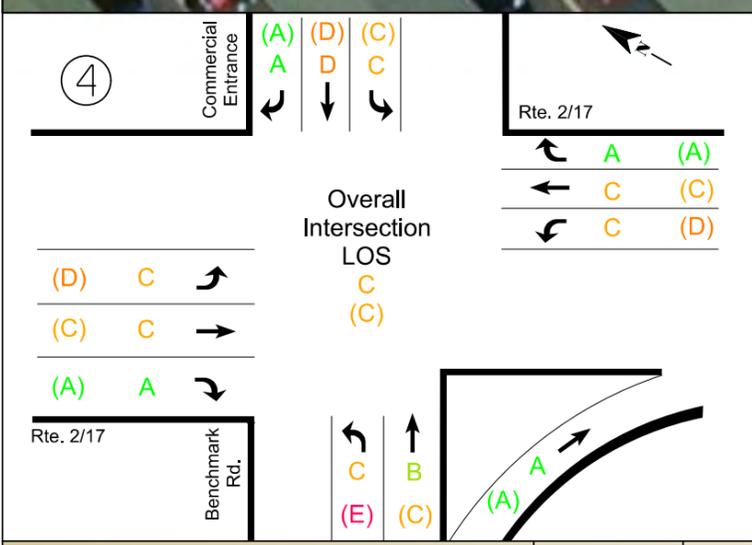


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				VDOT UPC PROJECT NO.: 107193						



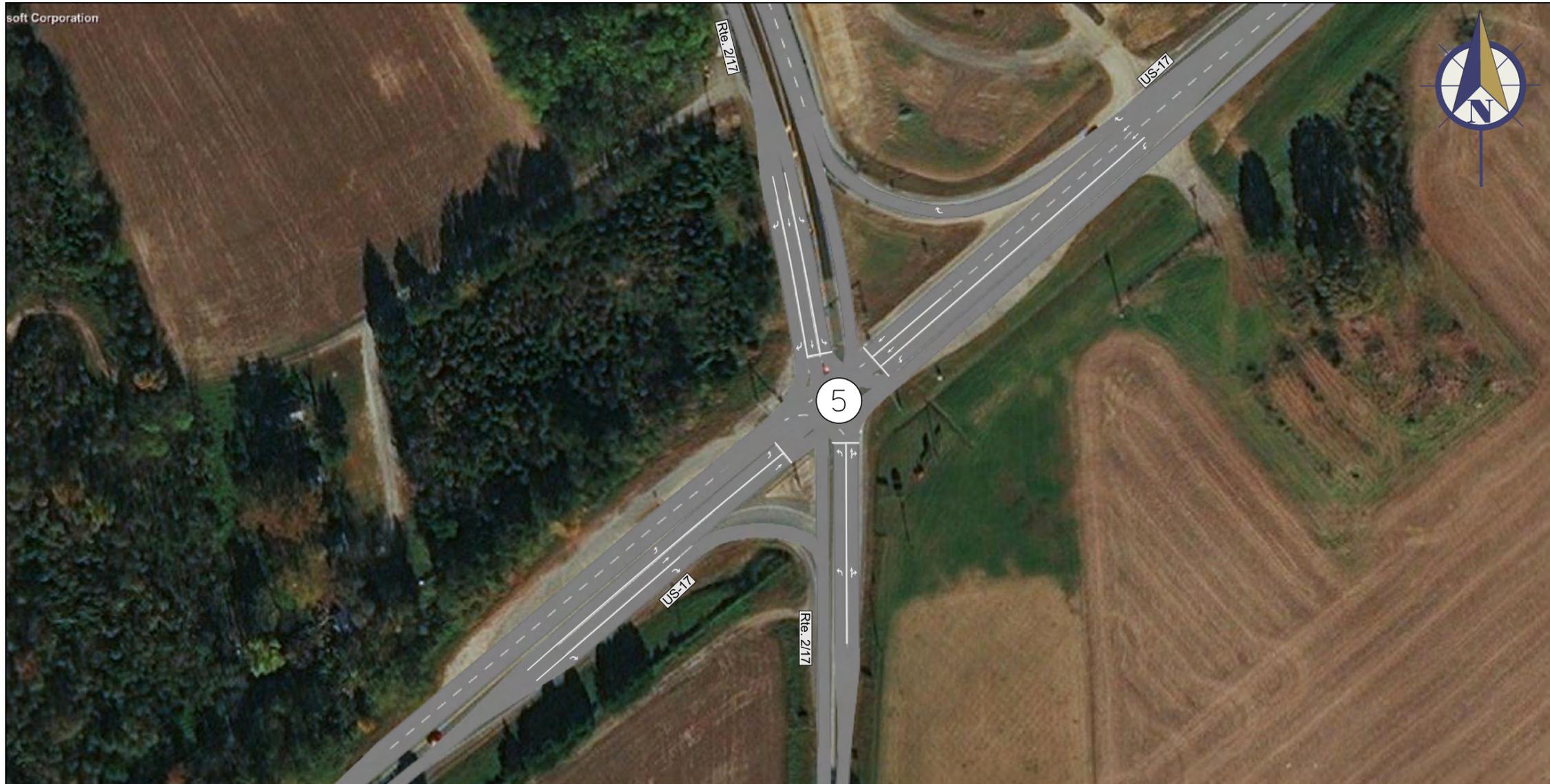
LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F
LOS COLOR RAMP



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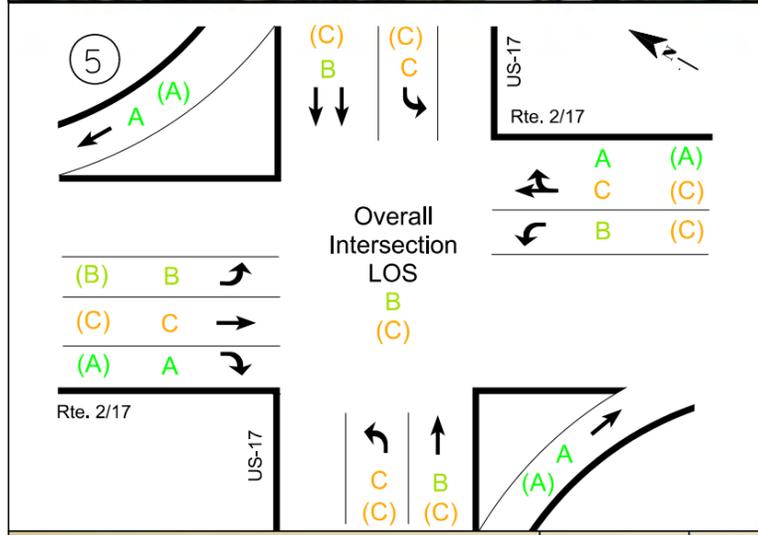
10/18/2018 10:21:00 AM



LEGEND

- X (X) AM (PM) Level of Service (LOS)
 - ↔ Traffic Movement
 - ⊗ Intersection Number
- A B C D E F

 LOS COLOR RAMP



	DRAWN BY:	HLR	2035 ALTERNATIVE 3 LEVELS OF SERVICE RTE. 2/17 CORRIDOR STUDY	SCALE:	NOT TO SCALE	DATE:	09/21/2018			
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	SHEET NO.:	5	OF	5		
				VDOT UPC PROJECT NO.: 107193						

APPROVED PROJECTS FOR 2018 SMART SCALE APPLICATION

This study evaluated the capacity of three alternatives to address the future traffic issues within the study corridor. Alternative 1 consists of widening the corridor to a four 12'-lane divided roadway with improvements at the five study intersections. Alternative 2 consists of improving the five intersections and widening the southbound direction into two lanes, from the City of Fredericksburg line to Shannon Airport Circle, keeping the northbound as one lane. Alternative 3 consists of all the proposed improvements from Alternative 2 with proposed widening of Benchmark Rd. into a four-lane undivided roadway. The three alternatives with detailed capacity analysis and approximate costs were presented to Spotsylvania County on May 10, 2018. The County's Transportation Committee, Planning Department, and Board of Supervisors approved and submitted one Smart Scale application based on this corridor study. The Smart Scale application was based on Alternative 2 of this study, with few modifications due to cost constraints. As of October 1, 2018, the application is under review by VDOT.

SMART SCALE PROJECT:

The Smart Scale application was based on the improvements proposed in Alternative 2 of this study. The application considered only the improvements proposed from Fredericksburg City line to Shannon Airport Circle without the proposed improvements at the intersections of Rte. 2/17 at Joseph Mills Dr./Lee Hill Dr., Rte. 2/17 at Shannon Park Dr./Mansfield St., Rte. 2/17 at Benchmark Rd., and Rte. 2/17 at US-17 due to the cost constraints. The submitted draft plan (prepared by VDOT for the application and provided by the County) is shown in Figure F 7 which includes the proposed widening of the southbound lanes to two 12'-lanes and the proposed improvements for the intersection of Rte. 2/17 at Lansdowne Rd. by adding exclusive right-turn lane onto Rte. 2/17 and keeping the existing lane as exclusive left-turn lane. The submitted draft plan also includes the 10'-wide shared use path proposed in Alternative 2 of this study.

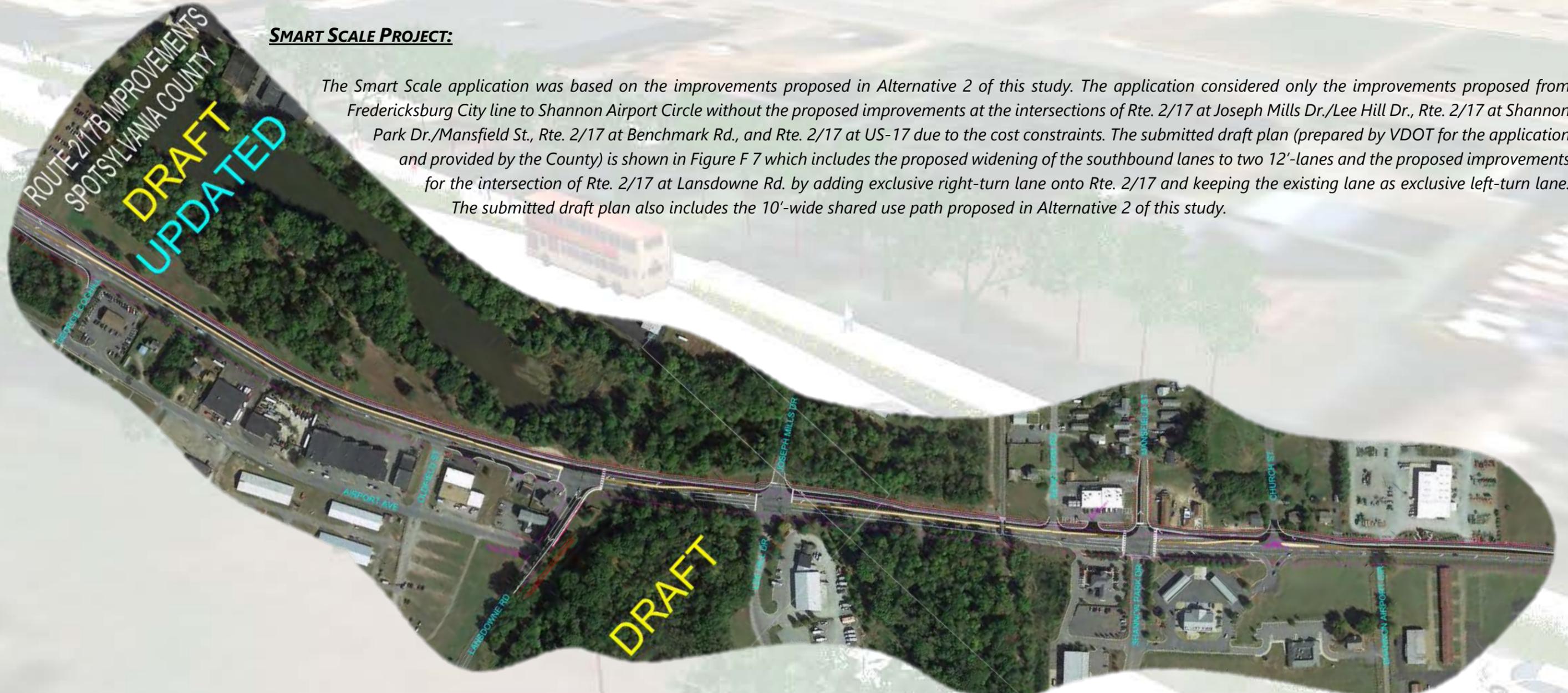


Figure F 7: Smart Scale Draft Plan (Source: VDOT/County)

APPENDICES

Appendix **A**

Existing Access Management Evaluation

Table 1: Assessment of Existing Access Points within the Study Area

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
Northbound						
E-1	236+80	Sideroad (Beulah Salisbury Dr)	FM	Project Start		
					177	470
E-2	235+03	Quarles Fleet Fuel	FM	N/N		
					170	470
E-3	233+33	Shopping Center	FM	N/N		
					133	470
E-4	232+00	Shopping Center	FM	N/N		
					153	470
E-5	230+47	Sideroad (Bowman Dr.)	FM	N/Y		
					2329	470
E-6	207+18	Access Road	FM	Y/N		
					62	470
E-7	206+56	Access Road	FM	N/N		
					400	470
E-8	202+56	Sideroad (Joseph Mills Dr)	FM	N/Y		
					703	660
E-9	195+53	Sideroad (Main St)	FM	Y/N		
					212	660
E-10	193+41	Sideroad (Bend Farm Rd)	FM	N/N		
					130	470
E-11	192+11	Velero/Fast Mart	FM	N/N		
					168	470
E-12	190+43	Sideroad (Mansfield St.)	FM	N/N		
					70	470
E-13	189+71	Business Entrance	FM	N/N		
					95	470

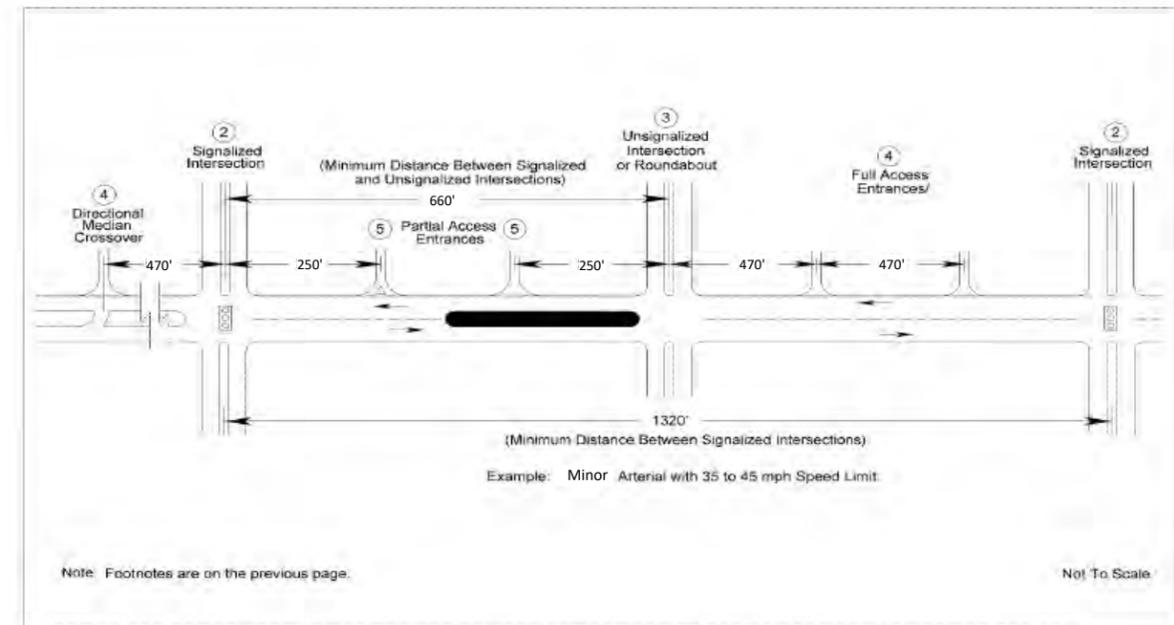


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
E-14	188+76	Business Entrance	FM	N/N	264	470
E-15	186+12	Sideroad (Church St)	FM	N/N	205	470
E-16	184+07	Residence Driveway	FM	N/N	158	470
E-17	182+49	Greenline Service Corp. Entrance	FM	N/N	309	470
E-18	179+40	Greenline Service Corp. Entrance	FM	N/N	403	470
E-19	175+37	Residence Driveway	FM	N/N	91	470
E-20	174+46	Xpress Car8 Entrance	FM	N/N	28	470
E-21	174+18	Residence Driveway	FM	N/N	279	470
E-22	171+39	Residence Driveway	FM	N/N	200	470
E-23	169+39	Sideroad (River Meadows Way)	FM	N/N	157	470
E-24	167+82	Residence Driveway	FM	N/N	34	470
E-25	167+48	Residence Driveway	FM	N/N	74	470
E-26	166+74	Elks Lodge Entrance	FM	N/N	101	470
E27	165+73	Residence Driveway	FM	N/N		

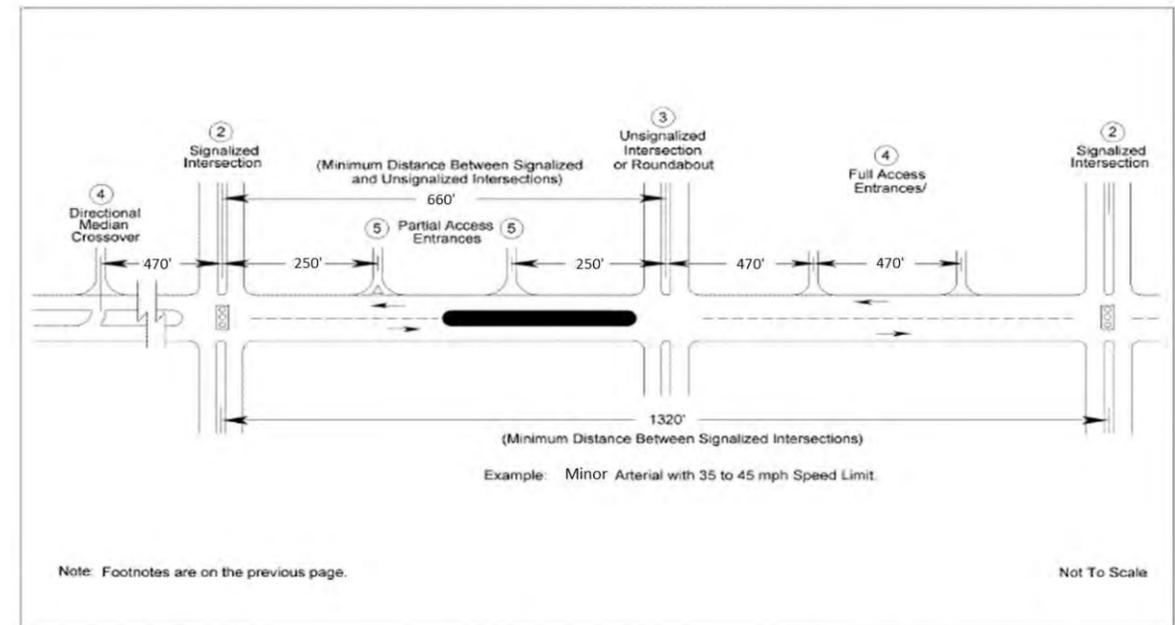


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					109	470
E-28	164+64	Residence Driveway	FM	N/N		
					148	470
E-29	163+16	Residence Driveway	FM	N/N		
					87	470
E-30	162+29	Residence Driveway	FM	N/N		
					93	470
E-31	161+36	Residence Driveway	FM	N/N		
					91	470
E-32	160+45	Residence Driveway	FM	N/N		
					96	470
E-33	159+49	Residence Driveway	FM	N/N		
					169	470
E-34	157+80	Residence Driveway	FM	N/N		
					177	470
E-35	156+03	Residence Driveway	FM	N/N		
					299	470
E-36	153+04	Residence Driveway	FM	N/N		
					107	470
E-37	151+97	Residence Driveway	FM	N/N		
					126	470
E-38	150+71	Residence Driveway	FM	N/N		
					72	470
E-39	149+99	Residence Driveway	FM	N/N		
					24	470
E-40	149+75	Residence Driveway	FM	N/N		
					113	470

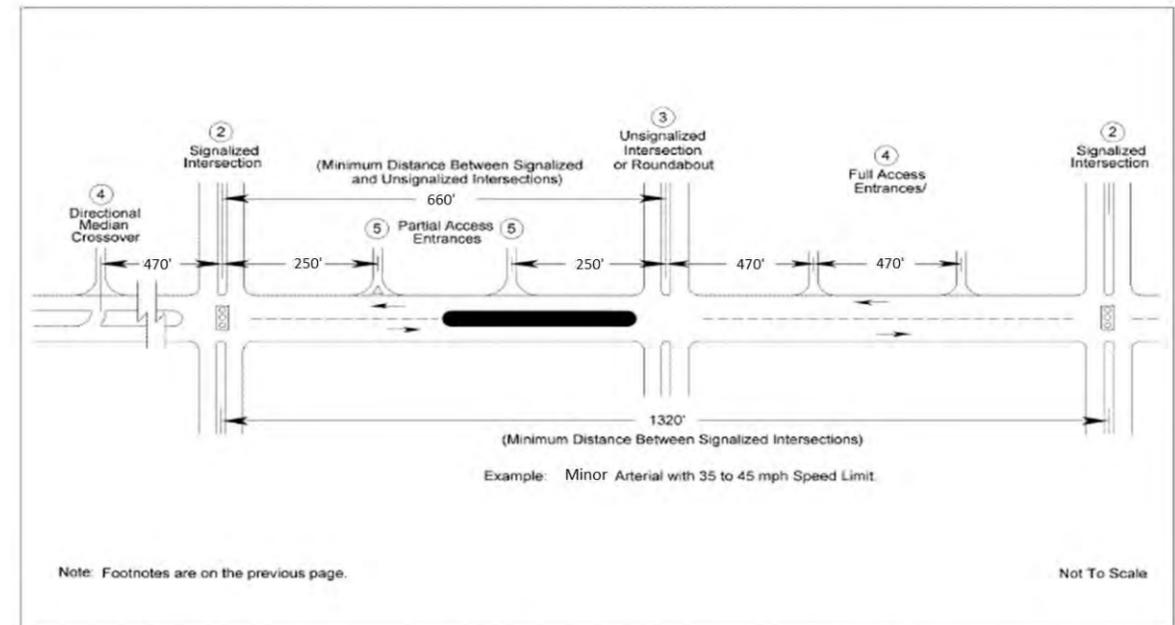


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
E-41	148+62	Sideroad (Mansfield Club Dr)	FM	N/N		
					619	660
E-42	142+43	Sideroad (N Club Dr)	FM	N/Y		
					999	660
E-43	132+44	Fredericksburg Country Club Entrance	FM	Y/Y		
					1141	660
E-44	121+03	Sideroad (Brooke Dr/Vance Dr)	FM	Y/Y		
					956	660
E-45	111+47	Sideroad (Glendas Way)	FM	Y/Y		
					688	250
E-46	104+59	The Shops At River Club Entrance	RI/RO	Y/Y		
					587	250
E-47	098+72	The Shops At River Club Side Entrance	FM	Y/N		
					81	470
E-48	097+91	Tidewater Tire Center Entrance	FM	N/N		
					73	470
E-49	097+18	Tidewater Tire Center Entrance	FM	N/N		
					252	470
E-50	094+66	Home Paramount Pest Control Entrance	FM	N/N		
					114	470
E-51	093+52	Vacant Lot Entrance	FM	N/N		
					134	470
E-52	092+18	Vacant Lot Entrance	FM	N/N		
					325	470
E-53	088+93	Sideroad (Dewitt Dr)	FM	N/N		
					121	470
E-54	087+72	Residence Driveway	FM	N/N		

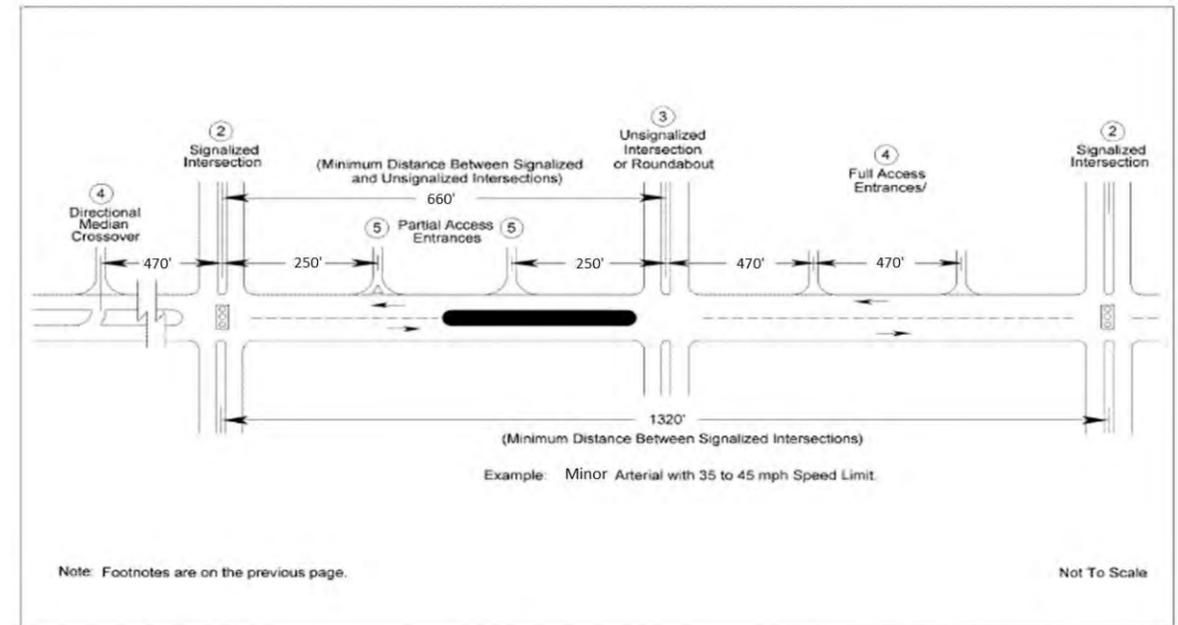


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					147	470
E-55	086+25	Residence Driveway	FM	N/N		
					81	470
E-56	085+44	Residence Driveway	FM	N/N		
					188	470
E-57	083+56	Sideroad (Cosner Dr)	FM	N/N		
					366	470
E-58	079+90	Residence Driveway	FM	N/N		
					98	470
E-59	078+92	Residence Driveway	FM	N/N		
					121	470
E-60	077+71	Residence Driveway	FM	N/N		
					116	470
E-61	076+55	Sideroad (24th St)	FM	N/N		
					135	660
E-62	075+20	Sideroad (RBS Rd)	FM	N/N		
					45	470
E-63	074+75	Residence Driveway	FM	N/N		
					112	470
E-64	073+63	Sideroad (Powell St)	FM	N/N		
					152	470
E-65	072+11	Residence Driveway	FM	N/N		
					216	470
E-66	069+95	Sideroad (Hamilton St.)	FM	N/N		
					174	470
E-67	068+21	Residence Driveway	FM	N/N		
					50	470
E-68	067+71	Residence Driveway	FM	N/N		
					203	470

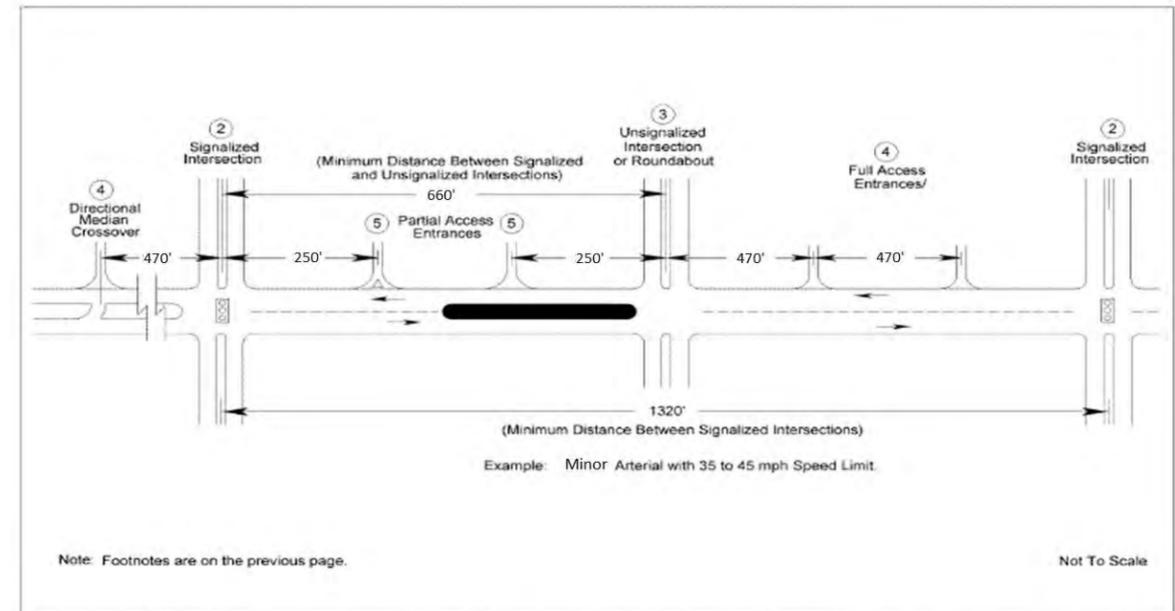


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
E-69	065+68	Residence Driveway	FM	N/Y		
					566	470
E-70	060+02	Sideroad (Gerber Dr)	FM	Y/N		
					441	660
E-71	055+61	Sideroad (Wisteria Dr)	FM	N/N		
					181	470
E-72	053+80	Residence Driveway	FM	N/Y		
					810	470
E73	045+70	Sideroad (Mallard Landing Dr)	FM	Y/N		
					464	660
E-74	041+06	Sideroad (Billy Days Rd)	FM	N/N		
					327	470
E-75	037+79	Culpeper Wood Reserves Entrance	FM	N/Y		
					1418	470
E-76	023+61	Residence Driveway	FM	Y/N		
					460	470
E-77	019+01	Residence Driveway	FM	N/N		
					208	470
E-78	016+93	Residence Driveway	FM	N/N		
					127	470
E-79	015+66	Harry Lee Dr	FM	N/N		
					179	470
E-80	013+87	Residence Driveway	FM	N/N		
					394	470
E-81	009+93	Residence Driveway	FM	N/N		
					161	470
E-82	008+32	Business Entrance	FM	N/N		
					146	470

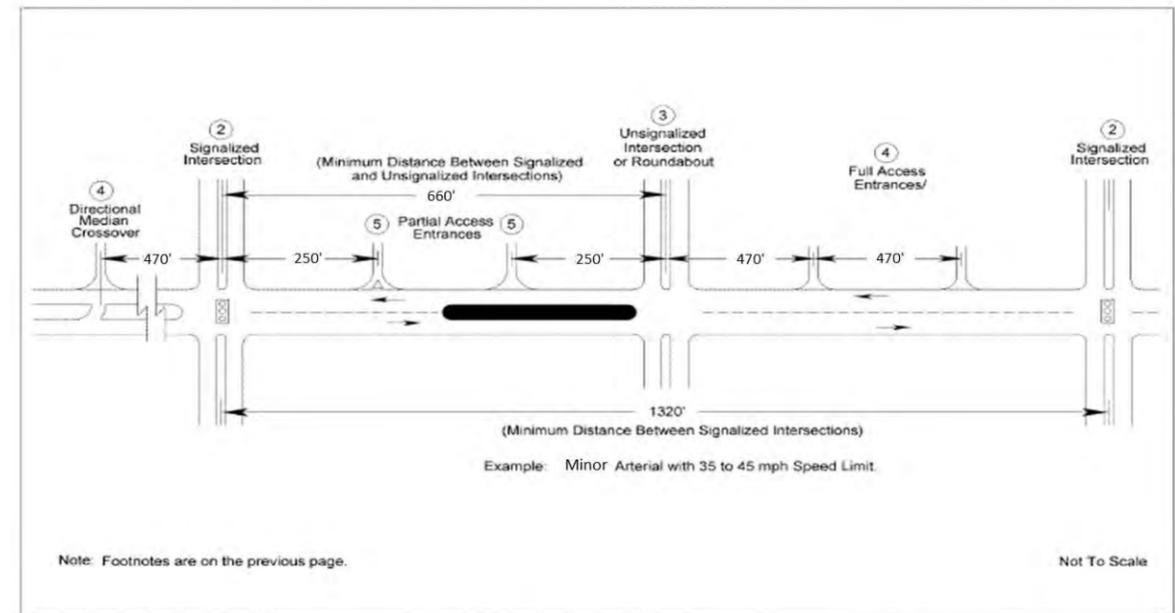


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
E-83	006+86	Business Entrance	FM	N/N	104	250
E-84	005+82	Sideroad (Bartlett Ln)	LI/RI/RO	N/Y	582	250
E-85	000+00	US-17	FM	Y/Y	1000	555
E-86	049+12	New Post Golf Entrance	FM	Y/Y		
Southbound						
W-1	236+18	Car Wash	FM	Project Start	187	470
W-2	234+31	Charlotte International Inc Car Lot	FM	N/N	114	470
W-3	233+17	Charlotte International Inc Car Lot	FM	N/N	209	470
W-4	231+08	7-11	FM	N/N	55	470
W-5	230+53	7-11	FM	N/N	412	470
W-6	226+41	Sideroad (Geo. Coghill St.)	FM	N/Y	672	470
W-7	219+69	Time to Ride	FM	Y/N	433	470
W-8	215+36	Business Entrance	FM	N/N	63	470
W-9	214+73	Vikhen Motors Inc.	FM	N/N	78	470

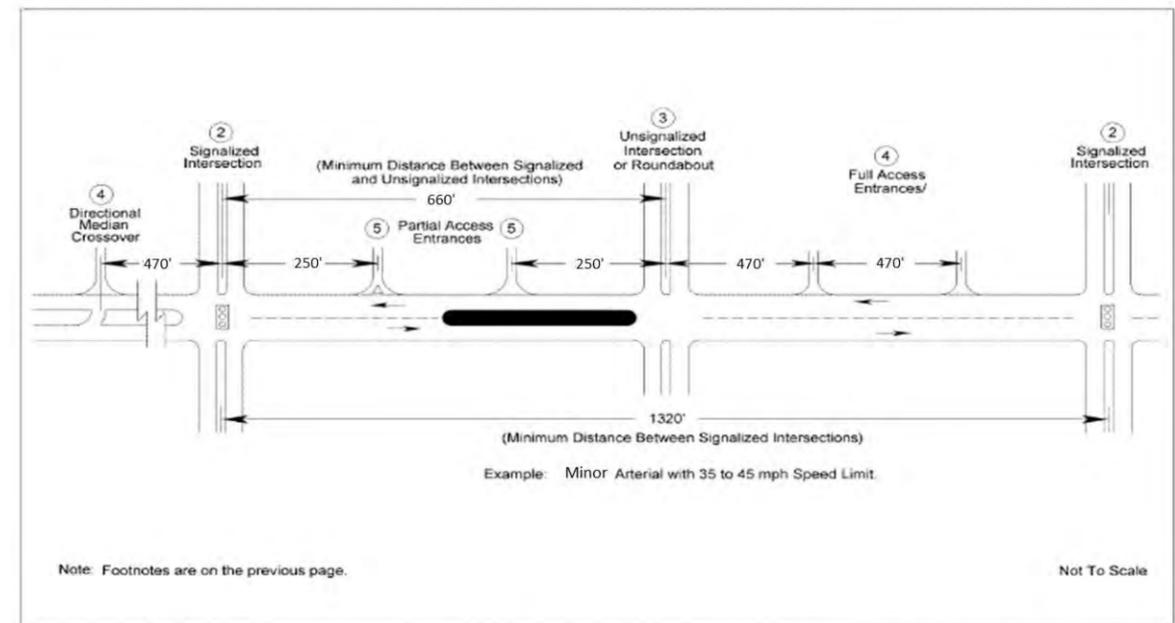


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
W-10	213+95	Sideroad (Old Field St)	FM	N/N	108	470
W-11	212+87	Gold Monkey Tattoo	FM	N/N	192	470
W-12	210+95	D & T Treasures	FM	N/N	88	470
W-13	210+07	Business Entrance	FM	N/N	87	470
W-14	209+20	Sideroad (Lansdowne Rd)	FM	N/N	643	1050
W-15	202+77	Sideroad (Lee Hill Dr)	FM	N/Y	495	470
W-16	197+82	Residence Driveway	FM	Y/Y	528	470
W-17	192+54	Business Entrance	FM	Y/N	207	470
W-18	190+47	Sideroad (Shannon Park Dr)	FM	N/Y	430	250
W-19	186+17	Sideroad (WaWa Entrance)	RI/RO	Y/Y	346	250
W-20	182+71	Sideroad (Shannon Airport Cir)	FM	Y/N	659	660
W-21	176+12	Sideroad (Imboden St)	FM	N/N	150	470
W-22	174+62	Residence Driveway	FM	N/N	98	470
W-23	173+64	Southern States	FM	N/N		

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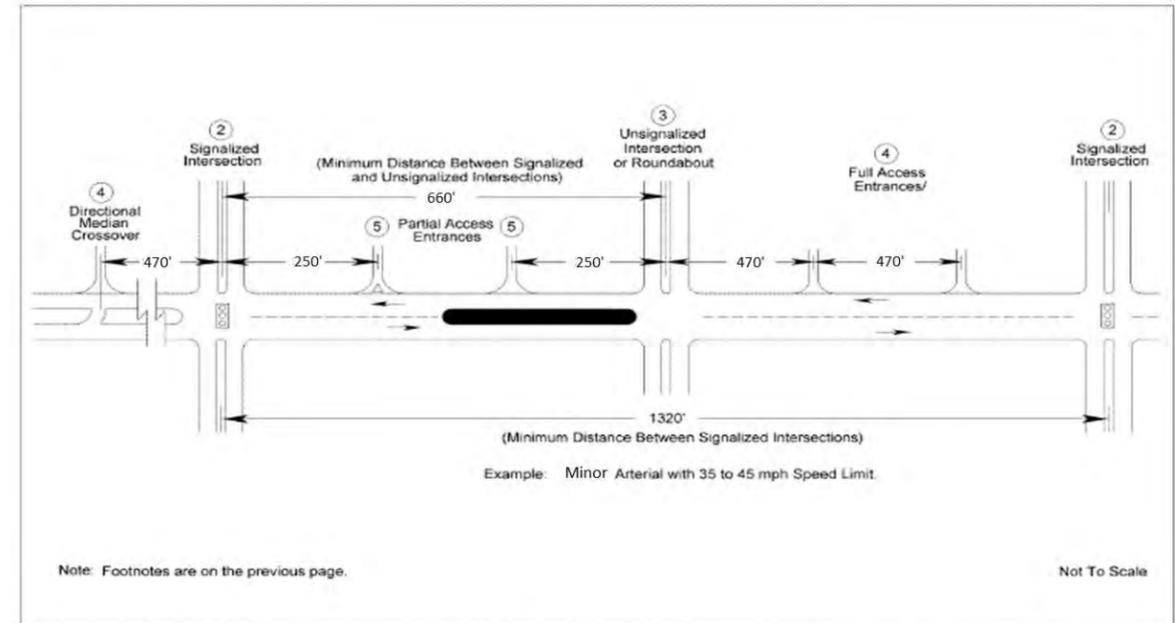


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					151	470
W-24	172+13	Southern States	FM	N/Y		
					1476	470
W-25	157+37	Residence Driveway	FM	Y/Y		
					1464	470
W-26	142+73	Sideroad (Pierson Dr)	FM	Y/Y		
					541	470
W-27	137+32	Business Entrance	FM	Y/Y		
					1161	470
W-28	125+71	Business Entrance	FM	Y/N		
					284	470
W-29	122+87	Residence Driveway	FM	N/N		
					49	470
W-30	122+38	Residence Driveway	FM	N/N		
					23	470
W-31	122+15	Residence Driveway	FM	N/N		
					100	470
W-32	121+15	Residence Driveway	FM	N/N		
					97	470
W-33	120+18	Residence Driveway	FM	N/N		
					98	470
W-34	119+20	Residence Driveway	FM	N/N		
					224	470
W-35	116+96	Residence Driveway	FM	N/N		
					76	470
W-36	116+20	Residence Driveway	FM	N/N		
					74	470

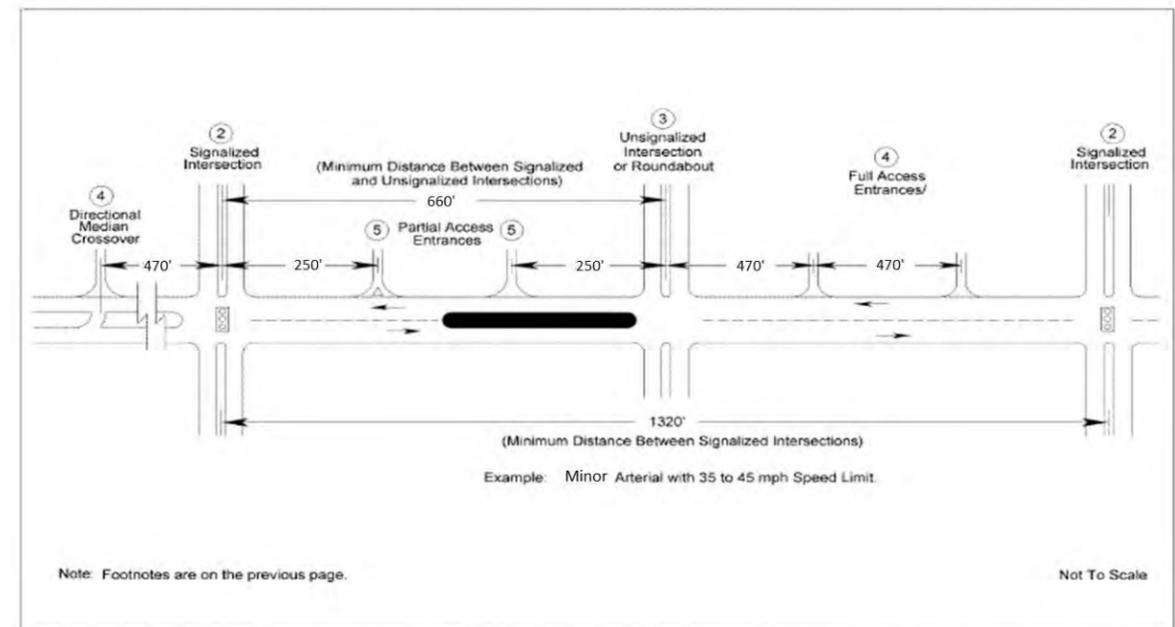


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
W-37	115+46	Residence Driveway	FM	N/N	277	470
W-38	112+69	Residence Driveway	FM	N/N	75	470
W-39	111+94	Residence Driveway	FM	N/N	49	470
W-40	111+45	Sideroad (Briarwood Ln)	FM	N/N	216	470
W-41	109+29	Business Entrance	FM	N/N	107	470
W-42	108+22	Residence Driveway	FM	N/N	114	470
W-43	107+08	Residence Driveway	FM	N/N	82	470
W-44	106+26	Ferrellgas	FM	N/N	97	470
W-45	105+29	Ferrellgas	FM	N/N	69	470
W-46	104+60	2&17 Self Storage	FM	N/Y	642	470
W-47	098+18	Sideroad (Benchmark Rd)	FM	Y/N	550	470
W-48	092+68	Coles Ln	FM	N/Y	521	470
W-49	087+47	Residence Driveway	FM	Y/N	394	470
W-50	083+53	Residence Driveway	FM	N/N		470

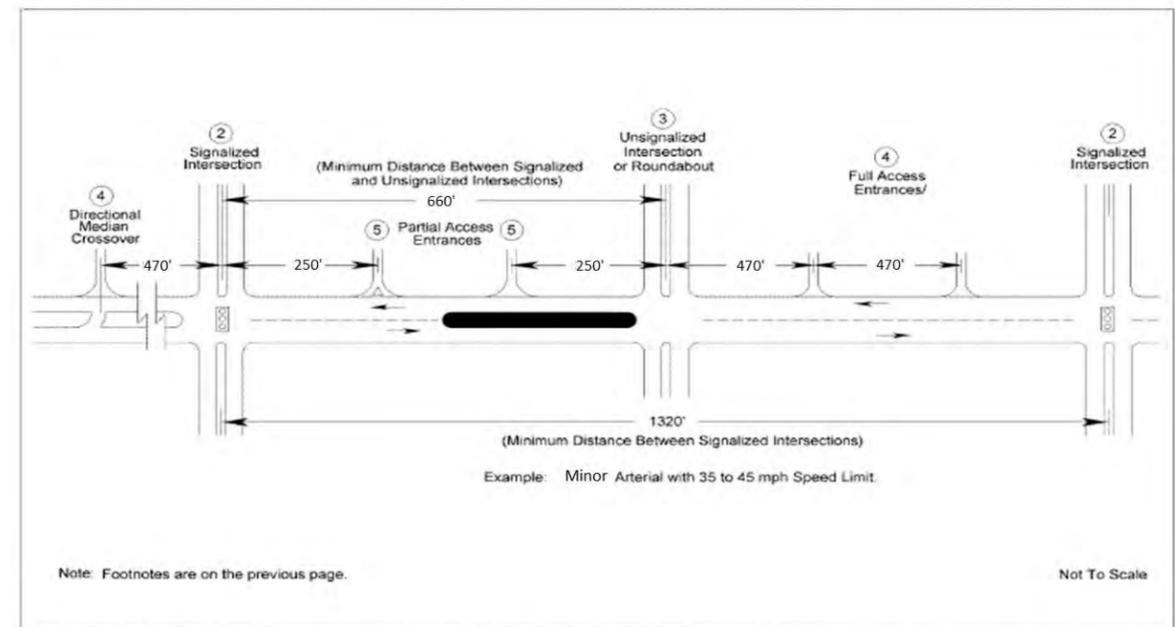


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					163	470
W-51	081+90	Residence Driveway	FM	N/N		
					55	470
W-52	081+35	Residence Driveway	FM	N/N		
					81	470
W-53	080+54	Residence Driveway	FM	N/N		
					84	470
W-54	079+70	Residence Driveway	FM	N/N		
					180	470
W-55	077+90	Residence Driveway	FM	N/N		
					152	470
W-56	076+38	Residence Driveway	FM	N/N		
					240	470
W-57	073+98	Residence Driveway	FM	N/N		
					92	470
W-58	073+06	Residence Driveway	FM	N/N		
					155	470
W-59	071+51	Residence Driveway	FM	N/Y		
					1196	470
W-60	059+55	Residence Driveway	FM	Y/N		
					71	470
W-61	058+84	Residence Driveway	FM	N/N		
					62	470
W-62	058+22	Sideroad (Jim Morris Rd)	FM	N/N		
					46	470
W-63	057+76	Residence Driveway	FM	N/Y		
					1198	470
W-64	045+78	Sideroad (Ruffin Dr)	FM	Y/N		

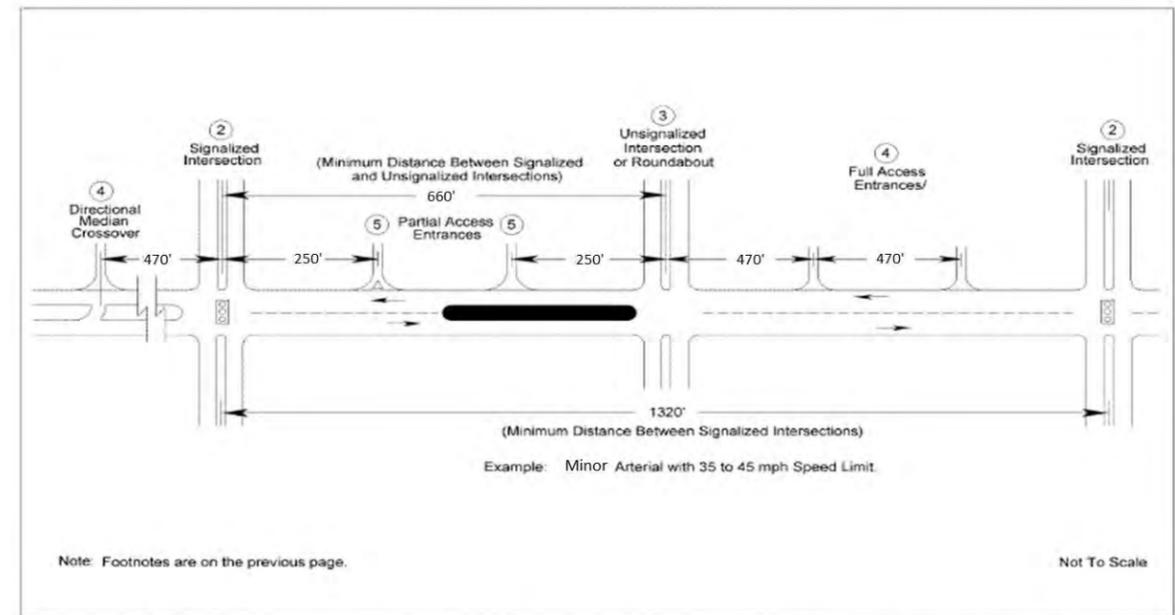


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					518	660
W-65	040+60	Sideroad (Billy Days Rd)	FM	N/N		
					128	470
W-66	039+32	Residence Driveway	FM	N/N		
					209	470
W-67	037+23	Residence Driveway	FM	N/N		
					69	470
W-68	036+54	Residence Driveway	FM	N/N		
					252	470
W-69	034+02	River Access	FM	N/Y		
					1971	470
W-70	014+31	Residence Driveway	FM	Y/N		
					382	470
W-71	010+49	Residence Driveway	FM	N/N		
					192	470
W-72	008+57	Business Entrance	FM	N/N		
					131	470
W-73	007+26	Business Entrance	FM	N/N		
					406	470
W-74	003+20	Sideroad (Middlefield Rd)	FM	N/N		
					320	660
W-75	000+00	US-17	FM	N/N		
					173	660
W-76	056+80	Sideroad (Southfield Dr)	FM	N/Y		
					1294	660
W-77	043+86	Sideroad (Patricks Ln)	FM	Y/Y		
					2592	1050
W-78	017+94	Sideroad (Sandy Ln)	FM	Y/N		

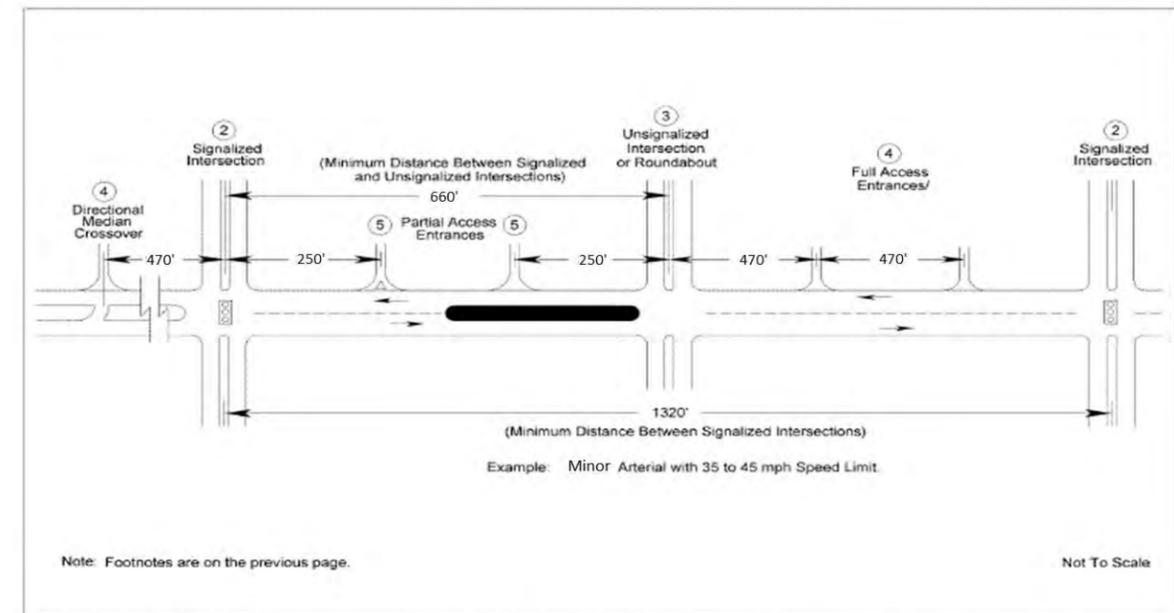


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					552	555
W-79	012+42	Farm Entrance	FM	N/-		

*RI/RO = Right In/Right Out
RI Only = Right In Only
RO Only = Right Out Only
LI/RI/RO = Left In/Right In/Right Out
FM = Full Movement

 Sideroad

Appendix **B**

Existing Traffic Control Devices

Rte. 2/17 Traffic Control Device Replacement List

To Be Replaced Immediately

Sheet #	Description of the Sign	Reason for Non-Compliance	No. of Signs On Post	Photo
11	AMTRAK	Faded and Illegible	1	
Subtotal: number of signs to be replaced immediately			1	

To Be Replaced with Roadway Improvement

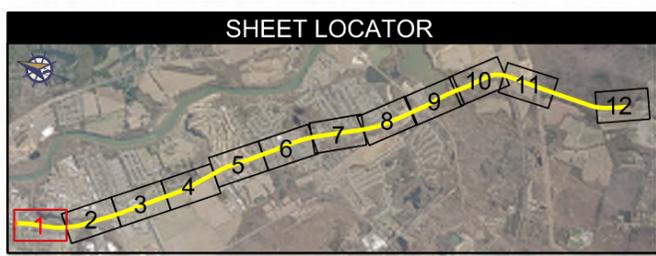
Sheet #	Description of the Sign	Reason for Non-Compliance	No. of Signs On Post	Photo
1	LANSDOWNNE RD NEXT SIGNAL	Text shall be a mix of upper and lower case letters	1	
2	DIXON ST/OLDFIELD ST	Text shall be a mix of upper and lower case letters	2	
2	SHANNON AIRPORT →	Text shall be a mix of upper and lower case letters	1	
2	← JOSEPH MILLS DR. LEE HILL DR. → NEXT SIGNAL	Text shall be a mix of upper and lower case letters	1	
2	LANSDOWNNE RD NEXT SIGNAL	Text shall be a mix of upper and lower case letters	1	

Sheet #	Description of the Sign	Reason for Non-Compliance	No. of Signs On Post	Photo
2	LEE HILL DR	Text shall be a mix of upper and lower case letters	1	
2	← JOSEPH MILLS DR. LEE HILL DR. → NEXT SIGNAL	Text shall be a mix of upper and lower case letters	1	
3	IMBODEN ST	Text shall be a mix of upper and lower case letters	1	
3	RIVER MEADOWS WAY/ TIDEWATER TRAIL	Text shall be a mix of upper and lower case letters	2	
4	MANSFIELD CLUB DR/ TIDEWATER TRAIL	Text shall be a mix of upper and lower case letters	2	
4	NORTH CLUB DR/ TIDEWATER TRAIL	Text shall be a mix of upper and lower case letters	2	
4	PIERSON DR	Text shall be a mix of upper and lower case letters	1	
5	TIDEWATER TR/ BROOKE DR	Text shall be a mix of upper and lower case letters	2	

Sheet #	Description of the Sign	Reason for Non-Compliance	No. of Signs On Post	Photo
5	ROSSER ST	Text shall be a mix of upper and lower case letters	1	
6	BRIANWOOD LN	Text shall be a mix of upper and lower case letters	1	
6	TIDEWATER TR/ GLENDAWAY	Text shall be a mix of upper and lower case letters	2	
7	DEWITT DR	Text shall be a mix of upper and lower case letters	1	
7	24TH ST	Text shall be a mix of upper and lower case letters	1	
7	RBS RD	Text shall be a mix of upper and lower case letters	1	
7	POWELL ST	Text shall be a mix of upper and lower case letters	1	
8	GERBER DR.	Text shall be a mix of upper and lower case letters	1	

Sheet #	Description of the Sign	Reason for Non-Compliance	No. of Signs On Post	Photo
8	JIM MORRIS RD	Text shall be a mix of upper and lower case letters	1	
8	TIDEWATER TRAIL/ WISTERIA DR	Text shall be a mix of upper and lower case letters	2	
9	TIDEWATER TRAIL/ RUFFIN DR	Text shall be a mix of upper and lower case letters	2	
9	MALLARD LANDING DR TIDEWATER TRAIL	Text shall be a mix of upper and lower case letters	2	
9	BILLY DAYS RD	Text shall be a mix of upper and lower case letters	1	
9	RUFFIN'S POND	Text shall be a mix of upper and lower case letters	1	
9	RUFFIN'S POND	Text shall be a mix of upper and lower case letters	1	
10	HARRY LEE DR	Text shall be a mix of upper and lower case letters	1	

Sheet #	Description of the Sign	Reason for Non-Compliance	No. of Signs On Post	Photo
10	FREDERICKSBURG 6 WARRENTON 44 WINCHESTER 88	Text shall be a mix of upper and lower case letters	1	
11	SOUTHFIELD DR	Text shall be a mix of upper and lower case letters	1	
11	PATRICKS LN	Text shall be a mix of upper and lower case letters	1	
Subtotal: number of signs to be replaced with roadway improvements			41	
Total: Overall number of signs to be replaced			42	
<p>Note: 1. Sign panels to be replaced are assumed to remain on the existing sign post. 2. Sign inventory created from publicly available domains (Google Earth & Bing Maps). The deficient signs verified from videos and photos collected during field visits from 2016 and Dec. 2017</p>				



NOTES

TO BE REPLACED WITH ROADWAY IMPROVEMENTS:

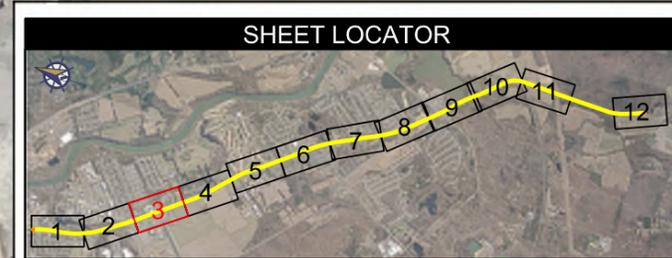
1. The text shall be a mix of upper and lower case letters as shown on page D3-2 of the 2012 Supplement to the 2004 Edition of the Standard Highway Signs Book. Quantity - 1

	DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT RTE. 2/17 CORRIDOR STUDY	SCALE:	1:150	DATE:	12/07/2017			
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	VDOT UPC PROJECT NO.: 107193	SHEET NO.:	1	OF	12	

NOTES

TO BE REPLACED WITH ROADWAY IMPROVEMENTS:

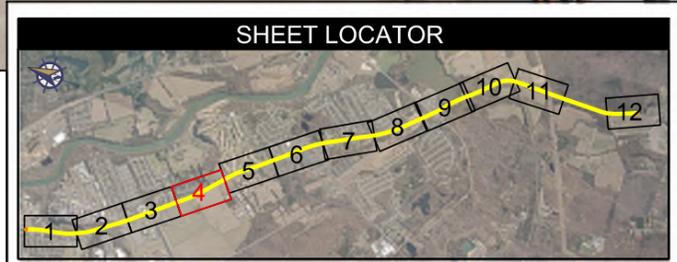
1. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 3



	DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT RTE. 2/17 CORRIDOR STUDY	SCALE:	1:150	DATE:	12/07/2017	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	3	OF	



NOTES
 TO BE REPLACED WITH ROADWAY IMPROVEMENTS:
 1. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 5



	DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT	SCALE:	1:150	DATE:	12/07/2017	
	CHECKED BY:	KHB	RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002	SHEET NO.:	4	OF	
				VDOT UPC PROJECT NO.: 107193				

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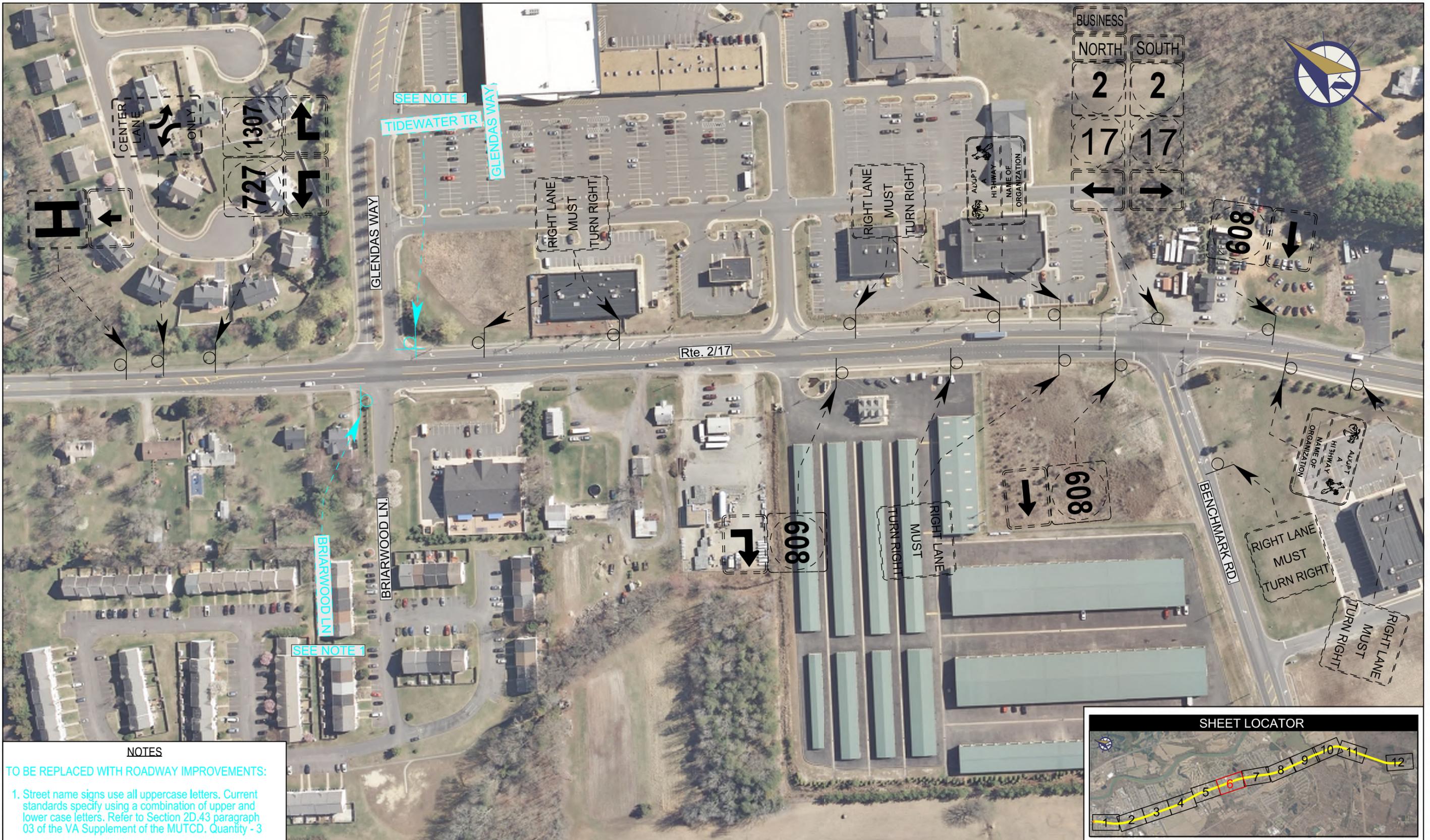
NOTES

TO BE REPLACED WITH ROADWAY IMPROVEMENTS:

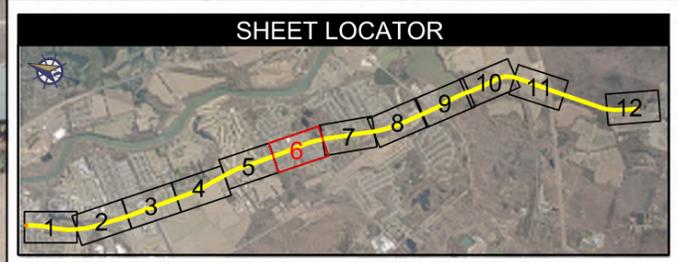
1. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 3



DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT	SCALE:	1:150	DATE:	12/07/2017	
	CHECKED BY:		KHB	JMT PROJECT NO.: 15-0038-002	SHEET NO.:	5	
RTE. 2/17 CORRIDOR STUDY			VDOT UPC PROJECT NO.:	107193			



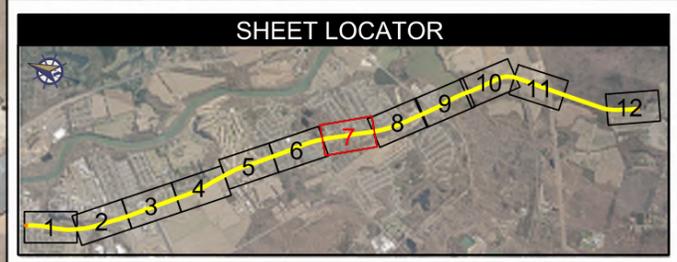
NOTES
 TO BE REPLACED WITH ROADWAY IMPROVEMENTS:
 1. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 3



	DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT RTE. 2/17 CORRIDOR STUDY	SCALE:	1:150	DATE:	12/07/2017	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	6	OF	



NOTES
 TO BE REPLACED WITH ROADWAY IMPROVEMENTS:
 1. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 4



	DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT RTE. 2/17 CORRIDOR STUDY	SCALE:	1:150	DATE:	12/07/2017	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	7	OF	

12/8/2017
9:51:59 AM



NOTES

TO BE REPLACED WITH ROADWAY IMPROVEMENTS:

1. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 4



DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT	SCALE:	1:150	DATE:	12/07/2017			
	CHECKED BY:			KHB		RTE. 2/17 CORRIDOR STUDY		JMT PROJECT NO.: 15-0038-002	
				VDOT UPC PROJECT NO.: 107193					



NOTES

TO BE REPLACED WITH ROADWAY IMPROVEMENTS:

1. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 5
2. Named waterway signs shall be a mix of upper and lower case letters as shown on page I-V9 of the Virginia Standard Highway Signs Book, Revision 1. Quantity - 2



DRAWN BY: BNG

CHECKED BY: KHB

TRAFFIC CONTROL DEVICES ASSESSMENT

RTE. 2/17 CORRIDOR STUDY

SCALE:

1:150

DATE:

12/07/2017

JMT PROJECT NO.: 15-0038-002

VDOT UPC PROJECT NO.: 107193

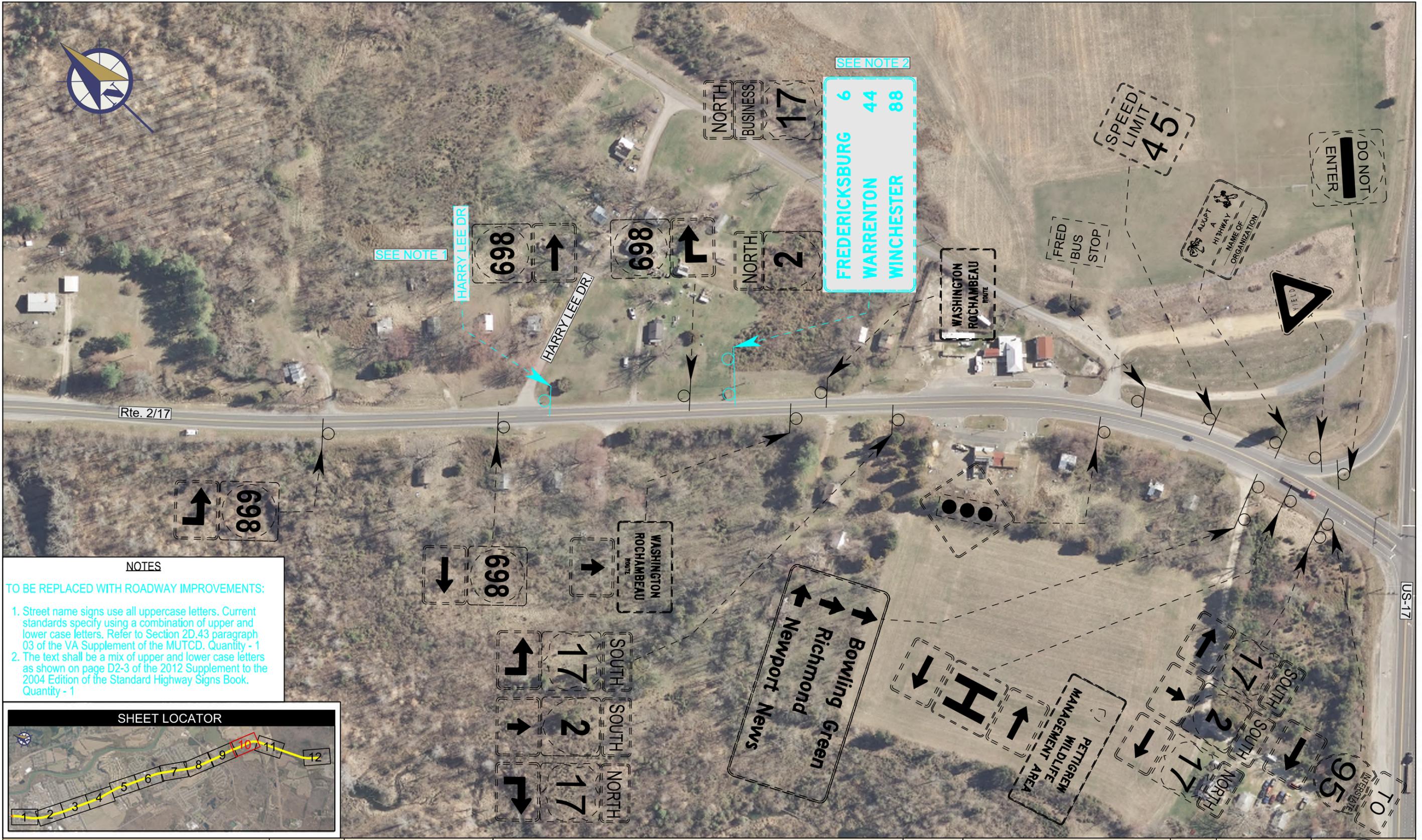
SHEET NO.:

9

OF

12

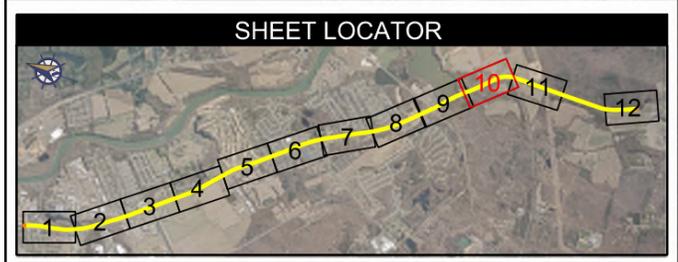




NOTES

TO BE REPLACED WITH ROADWAY IMPROVEMENTS:

1. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 1
2. The text shall be a mix of upper and lower case letters as shown on page D2-3 of the 2012 Supplement to the 2004 Edition of the Standard Highway Signs Book. Quantity - 1



	DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT	SCALE:	1:150	DATE:	12/07/2017	
	CHECKED BY:	KHB	RTE. 2/17 CORRIDOR STUDY	JMT PROJECT NO.: 15-0038-002	VDOT UPC PROJECT NO.: 107193	SHEET NO.:	10 OF 12	

12/8/2017 9:56:24 AM



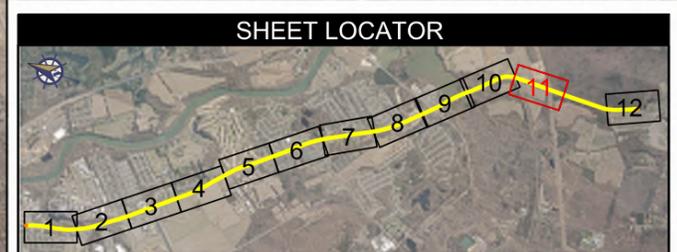
NOTES

TO BE REPLACED IMMEDIATELY:

1. The sign panel is faded and illegible. Quantity - 1

TO BE REPLACED WITH ROADWAY IMPROVEMENTS:

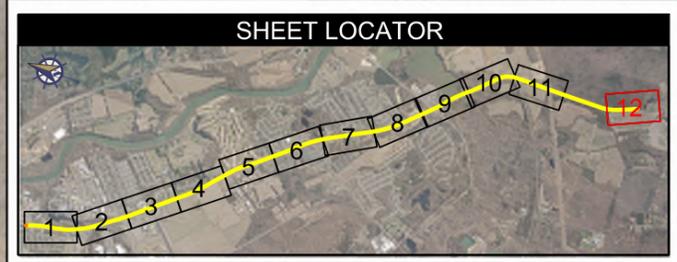
2. Street name signs use all uppercase letters. Current standards specify using a combination of upper and lower case letters. Refer to Section 2D.43 paragraph 03 of the VA Supplement of the MUTCD. Quantity - 2



	DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT RTE. 2/17 CORRIDOR STUDY	SCALE:	1:150	DATE:	12/07/2017	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002	SHEET NO.:	11	OF	
				VDOT UPC PROJECT NO.:	107193			



NOTES
All signs meet current MUTCD and VA Standards.



	DRAWN BY:	BNG	TRAFFIC CONTROL DEVICES ASSESSMENT RTE. 2/17 CORRIDOR STUDY	SCALE:	1:150	DATE:	12/07/2017	
	CHECKED BY:	KHB		JMT PROJECT NO.: 15-0038-002 VDOT UPC PROJECT NO.: 107193	SHEET NO.:	12	OF	

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Appendix C

Alternative 2 Access Management Evaluation

Table 1: Assessment of New Alternative 2 Access Points within the Study Area

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
Northbound						
E-1	236+80	Sideroad (Beulah Salisbury Dr)	FM	Project Start	177	470
E-2	235+03	Quarles Fleet Fuel	FM	N/N	170	470
E-3	233+33	Shopping Center	FM	N/N	133	470
E-4	232+00	Shopping Center	FM	N/N	153	470
E-5	230+47	Sideroad (South St.)	FM	N/Y	2329	250
E-6	207+18	Access Road	RI/RO	Y/N	62	250
E-7	206+56	Access Road	RI/RO	N/Y	400	250
E-8	202+56	Sideroad (Joseph Mills Dr)	FM	Y/Y	703	250
E-9	195+53	Sideroad (Main St)	RI/RO	Y/N	212	250
E-10	193+41	Sideroad (Bend Farm Rd)	RI/RO	N/N	130	250
E-11	192+11	Velero/Fast Mart	RI/RO	N/N	168	250
E-12	190+43	Sideroad (Mansfield St.)	FM	N/N	72	250
E-13	189+71	Business Entrance	RI/RO	N/N	95	250

F-26

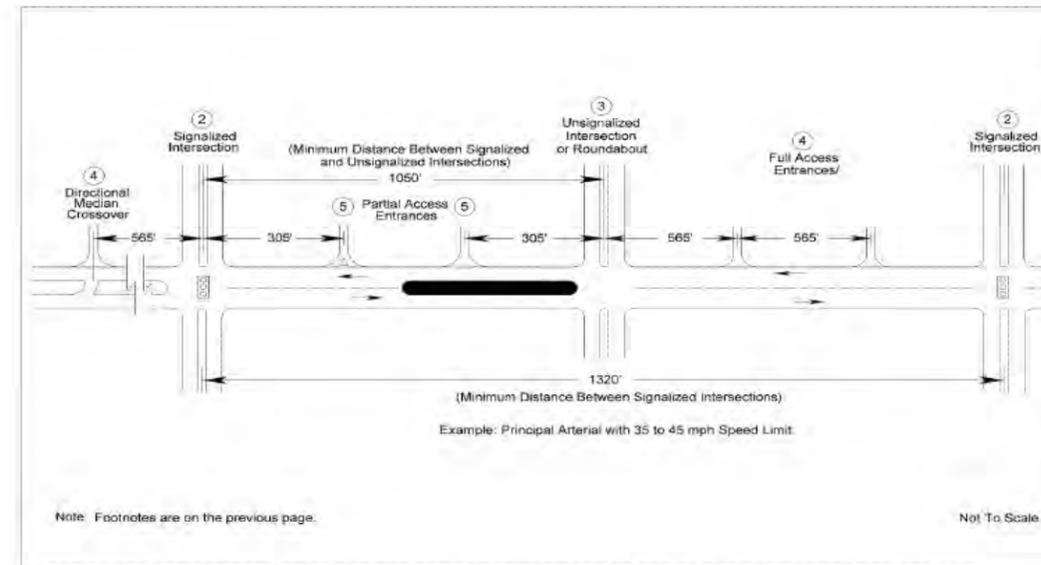


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
E-14	188+76	Business Entrance	RI/RO	N/Y	264	250
E-15	186+12	Sideroad (Church St)	RI/RO	Y/N	205	250
E-16	184+07	Residence Driveway	RI/RO	N/N	158	250
E-17	182+49	Greenline Service Corp. Entrance	FM	N/N	309	470
E-18	179+40	Greenline Service Corp. Entrance	FM	N/N	403	470
E-19	175+37	Residence Driveway	FM	N/N	91	470
E-20	174+46	Xpress Car8 Entrance	FM	N/N	28	470
E-21	174+18	Residence Driveway	FM	N/N	279	470
E-22	171+39	Residence Driveway	FM	N/N	200	660
E-23	169+39	Sideroad (River Meadows Way)	FM	N/N	157	660
E-24	167+82	Residence Driveway	FM	N/N	34	470
E-25	167+48	Residence Driveway	FM	N/N	74	470
E-26	166+74	Elks Lodge Entrance	FM	N/N		

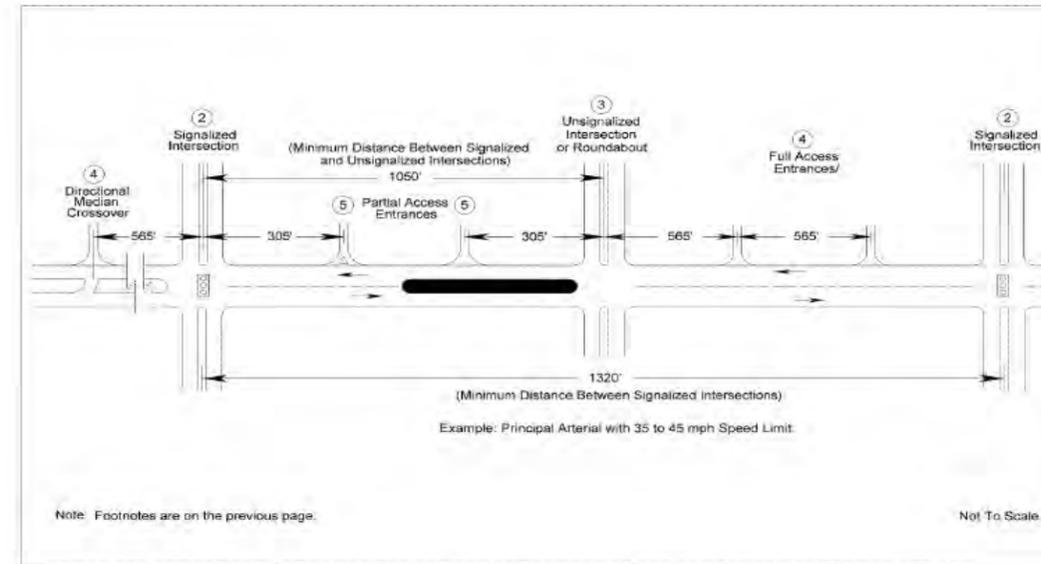


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					101	470
E-27	165+73	Residence Driveway	FM	N/N		
					109	470
E-28	164+64	Residence Driveway	FM	N/N		
					148	470
E-29	163+16	Residence Driveway	FM	N/N		
					87	470
E-30	162+29	Residence Driveway	FM	N/N		
					93	470
E-31	161+36	Residence Driveway	FM	N/N		
					91	470
E-32	160+45	Residence Driveway	FM	N/N		
					96	470
E-33	159+49	Residence Driveway	FM	N/N		
					169	470
E-34	157+80	Residence Driveway	FM	N/N		
					177	470
E-35	156+03	Residence Driveway	FM	N/N		
					299	470
E-36	153+04	Residence Driveway	FM	N/N		
					107	470
E-37	151+97	Residence Driveway	FM	N/N		
					126	470
E-38	150+71	Residence Driveway	FM	N/N		
					72	470
E-39	149+99	Residence Driveway	FM	N/N		
					24	470
E-40	149+75	Residence Driveway	FM	N/N		
					113	660

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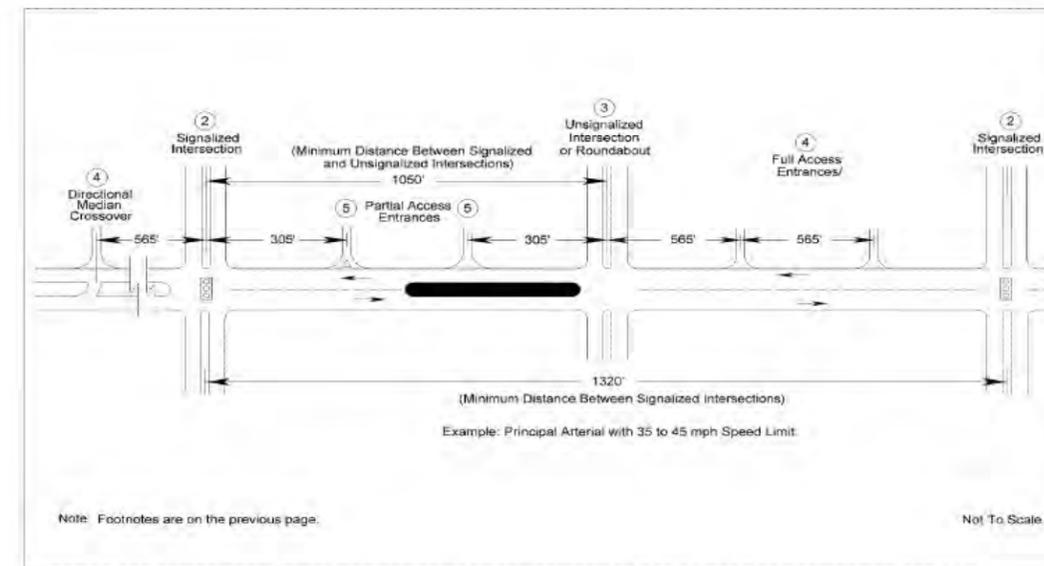


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
E-41	148+62	Sideroad (Mansfield Club Dr)	FM	N/N	619	660
E-42	142+43	Sideroad (N Club Dr)	FM	N/N	999	660
E-43	132+44	Fredericksburg Country Club Entrance	FM	N/Y	1141	660
E-44	121+03	Sideroad (Brooke Dr/Vance Dr)	FM	Y/N	956	660
E-45	111+47	Sideroad (Glendas Way)	FM	N/N	688	250
E-46	104+59	The Shops At River Club Entrance	RI/RO	N/N	587	250
E-47	098+72	The Shops At River Club Side Entrance	FM	N/N	81	470
E-48	097+91	Tidewater Tire Center Entrance	FM	N/N	73	470
E-49	097+18	Tidewater Tire Center Entrance	FM	N/N	252	470
E-50	094+66	Home Paramount Pest Control Entrance	FM	N/N	114	470
E-51	093+52	Vacant Lot Entrance	FM	N/N	134	470
E-52	092+18	Vacant Lot Entrance	FM	N/N	325	660
E-53	088+93	Sideroad (Dewitt Dr)	FM	N/N	121	660
E-54	087+72	Residence Driveway	FM	N/N		

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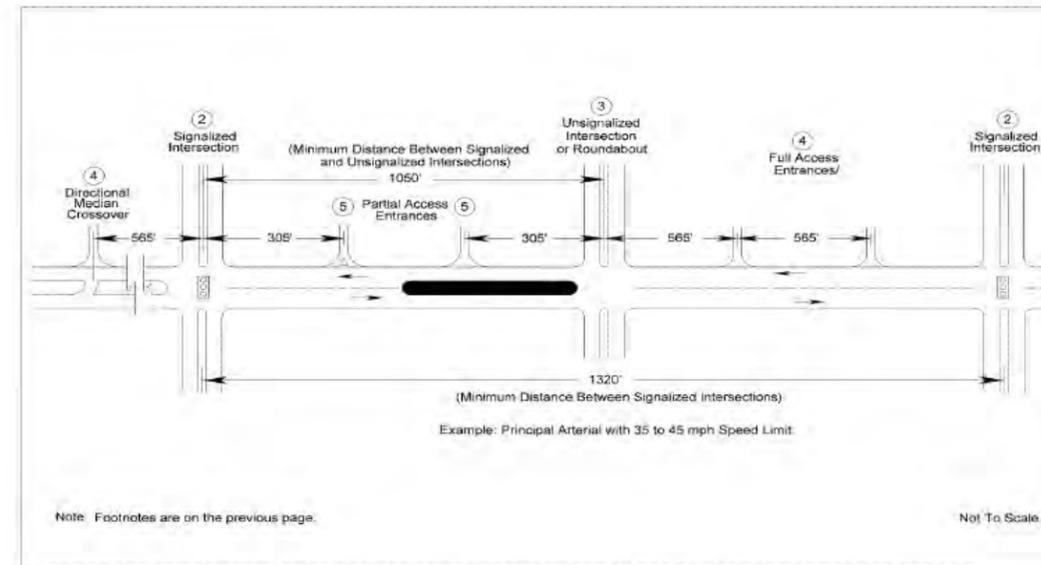


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					147	470
E-55	086+25	Residence Driveway	FM	N/N		
					81	470
E-56	085+44	Residence Driveway	FM	N/N		
					188	660
E-57	083+56	Sideroad (Cosner Dr)	FM	N/N		
					366	660
E-58	079+90	Residence Driveway	FM	N/N		
					98	470
E-59	078+92	Residence Driveway	FM	N/N		
					121	470
E-60	077+71	Residence Driveway	FM	N/N		
					116	660
E-61	076+55	Sideroad (24th St)	FM	N/N		
					135	660
E-62	075+20	Sideroad (RBS Rd)	FM	N/N		
					45	660
E-63	074+75	Residence Driveway	FM	N/N		
					112	660
E-64	073+63	Sideroad (Powell St)	FM	N/N		
					152	660
E-65	072+11	Residence Driveway	FM	N/N		
					216	660
E-66	069+95	Sideroad (Hamilton St.)	FM	N/N		
					174	660
E-67	068+21	Residence Driveway	FM	N/N		
					50	470
E-68	067+71	Residence Driveway	FM	N/N		

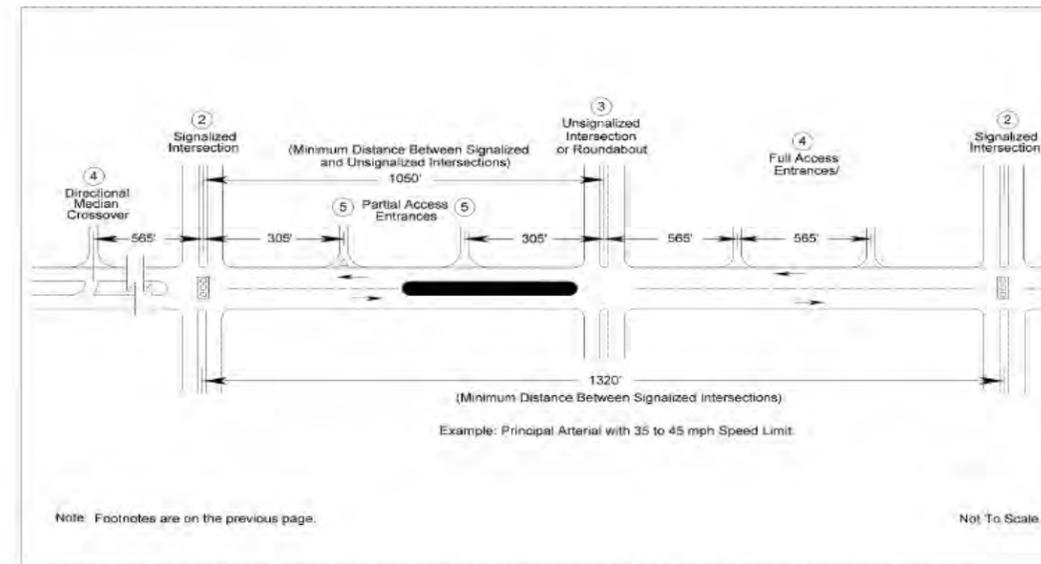


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					203	470
E-69	065+68	Residence Driveway	FM	N/N		
					566	660
E-70	060+02	Sideroad (Gerber Dr)	FM	N/N		
					441	660
E-71	055+61	Sideroad (Wisteria Dr)	FM	N/N		
					181	660
E-72	053+80	Residence Driveway	FM	N/N		
					810	470
E73	045+70	Sideroad (Mallard Landing Dr)	FM	N/N		
					464	660
E-74	041+06	Sideroad (Billy Days Rd)	FM	N/N		
					327	660
E-75	037+79	Culpeper Wood Reserves Entrance	FM	N/Y		
					1418	470
E-76	023+61	Residence Driveway	FM	Y/N		
					460	470
E-77	019+01	Residence Driveway	FM	N/N		
					208	470
E-78	016+93	Residence Driveway	FM	N/N		
					127	660
E-79	015+66	Harry Lee Dr	FM	N/N		
					179	660
E-80	013+87	Residence Driveway	FM	N/N		
					394	470
E-81	009+93	Residence Driveway	FM	N/N		
					161	470
E-82	008+32	Business Entrance	FM	N/N		

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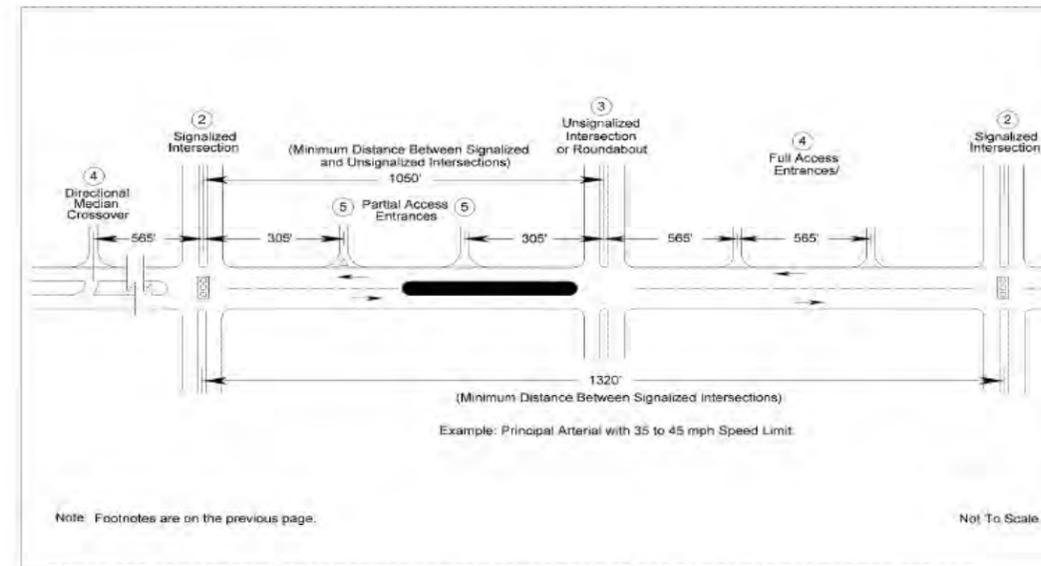


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
E-83	006+86	Business Entrance	FM	N/N	104	660
E-84	005+82	Sideroad (Bartlett Ln)	FM	N/N	582	660
E-85	000+00	US-17	FM	N/Y	1000	555
E-86	049+12	New Post Golf Entrance	FM	Y/Y		
Southbound						
W-1	236+18	Car Wash	FM	Project Start	187	470
W-2	234+31	Charlotte International Inc Car Lot	FM	N/N	114	470
W-3	233+17	Charlotte International Inc Car Lot	FM	N/N	209	470
W-4	231+08	7-11	FM	N/N	55	470
W-5	230+53	7-11	FM	N/Y	412	250
W-6	226+41	Sideroad (Geo. Coghill St.)	RI/RO	Y/Y	672	250
W-7	219+69	Time to Ride	RI/RO	Y/Y	433	250
W-8	215+36	Business Entrance	RI/RO	Y/N	63	250
W-9	214+73	Vikhen Motors Inc.	RI/RO	N/N	78	250

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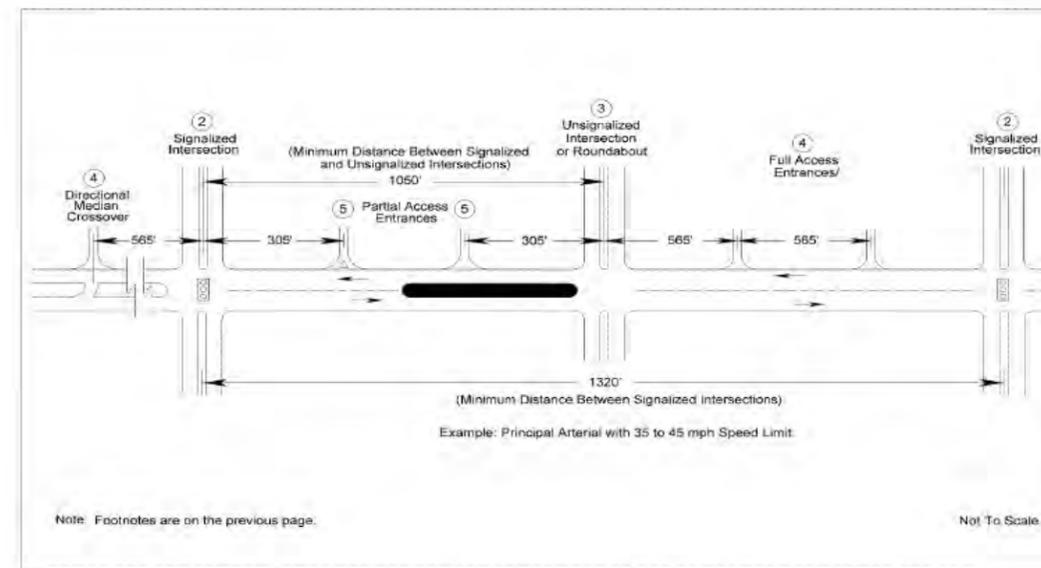


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
W-10	213+95	Sideroad (Old Field St)	RI/RO	N/N	108	250
W-11	212+87	Gold Monkey Tattoo	RI/RO	N/N	192	250
W-12	210+95	D & T Treasures	RI/RO	N/N	88	250
W-13	210+07	Business Entrance	RI/RO	N/N	87	250
W-14	209+20	Sideroad (Lansdowne Rd)	FM	N/N	643	1050
W-15	202+77	Sideroad (Lee Hill Dr)	FM	N/Y	495	250
W-16	197+82	Residence Driveway	RI/RO	Y/Y	528	250
W-17	192+54	Business Entrance	RI/RO	Y/N	207	250
W-18	190+47	Sideroad (Shannon Park Dr)	FM	N/Y	430	250
W-19	186+17	Sideroad (Church St)	RI/RO	Y/Y	346	250
W-20	182+71	Sideroad (Shannon Airport Cir)	FM	Y/N	659	660
W-21	176+12	Sideroad (Imboden St)	FM	N/N	150	660
W-22	174+62	Residence Driveway	FM	N/N	98	470
W-23	173+64	Southern States	FM	N/N	151	470

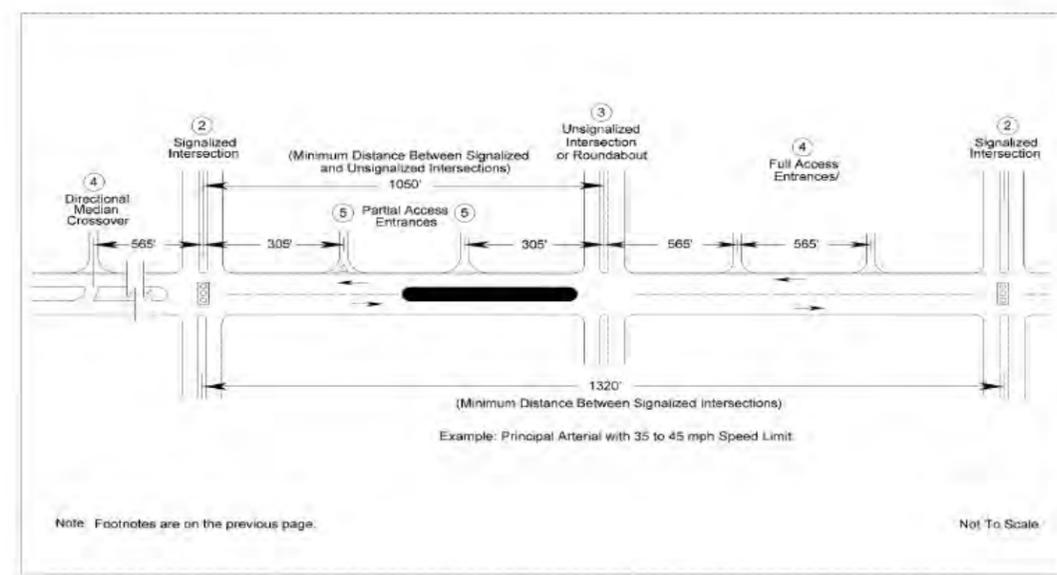


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
W-24	172+13	Southern States	FM	N/Y		
					1476	470
W-25	157+37	Residence Driveway	FM	Y/Y		
					1464	660
W-26	142+73	Sideroad (Pierson Dr)	FM	Y/N		
					541	660
W-27	137+32	Business Entrance	FM	N/Y		
					1161	470
W-28	125+71	Business Entrance	FM	Y/N		
					284	470
W-29	122+87	Residence Driveway	FM	N/N		
					49	470
W-30	122+38	Residence Driveway	FM	N/N		
					23	470
W-31	122+15	Residence Driveway	FM	N/N		
					100	470
W-32	121+15	Residence Driveway	FM	N/N		
					97	470
W-33	120+18	Residence Driveway	FM	N/N		
					98	470
W-34	119+20	Residence Driveway	FM	N/N		
					224	470
W-35	116+96	Residence Driveway	FM	N/N		
					76	470
W-36	116+20	Residence Driveway	FM	N/N		
					74	470

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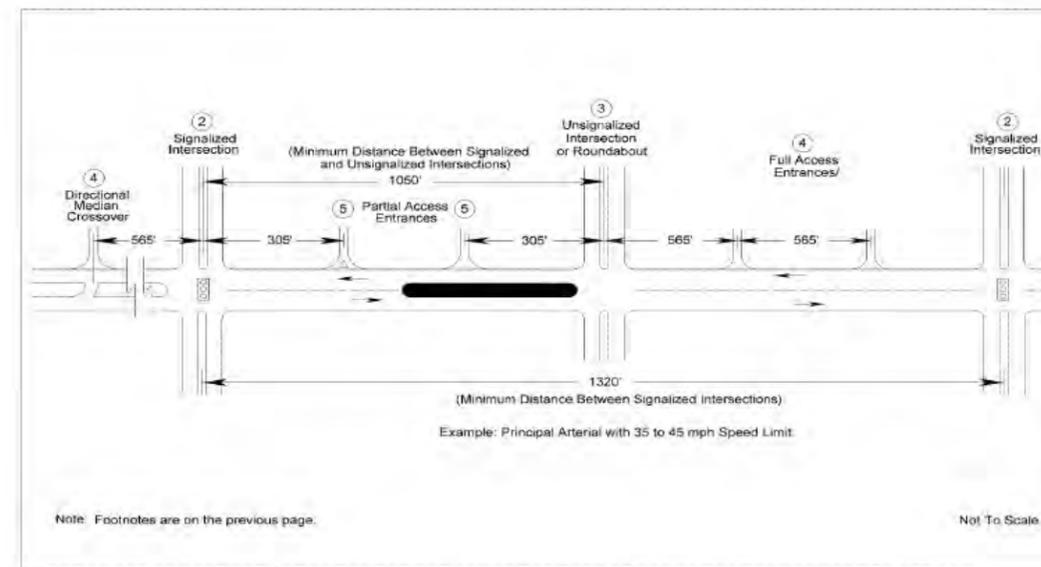


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
W-37	115+46	Residence Driveway	FM	N/N		
					277	470
W-38	112+69	Residence Driveway	FM	N/N		
					75	470
W-39	111+94	Residence Driveway	FM	N/N		
					49	660
W-40	111+45	Sideroad (Briarwood Ln)	FM	N/N		
					216	660
W-41	109+29	Business Entrance	FM	N/N		
					107	470
W-42	108+22	Residence Driveway	FM	N/N		
					114	470
W-43	107+08	Residence Driveway	FM	N/N		
					82	470
W-44	106+26	Ferrellgas	FM	N/N		
					97	470
W-45	105+29	Ferrellgas	FM	N/N		
					69	470
W-46	104+60	2&17 Self Storage	FM	N/N		
					642	660
W-47	098+18	Sideroad (Benchmark Rd)	FM	N/N		
					550	660
W-48	092+68	Sideroad (Coles Ln)	FM	N/N		
					521	660
W-49	087+47	Residence Driveway	FM	N/N		
					394	470
W-50	083+53	Residence Driveway	FM	N/N		

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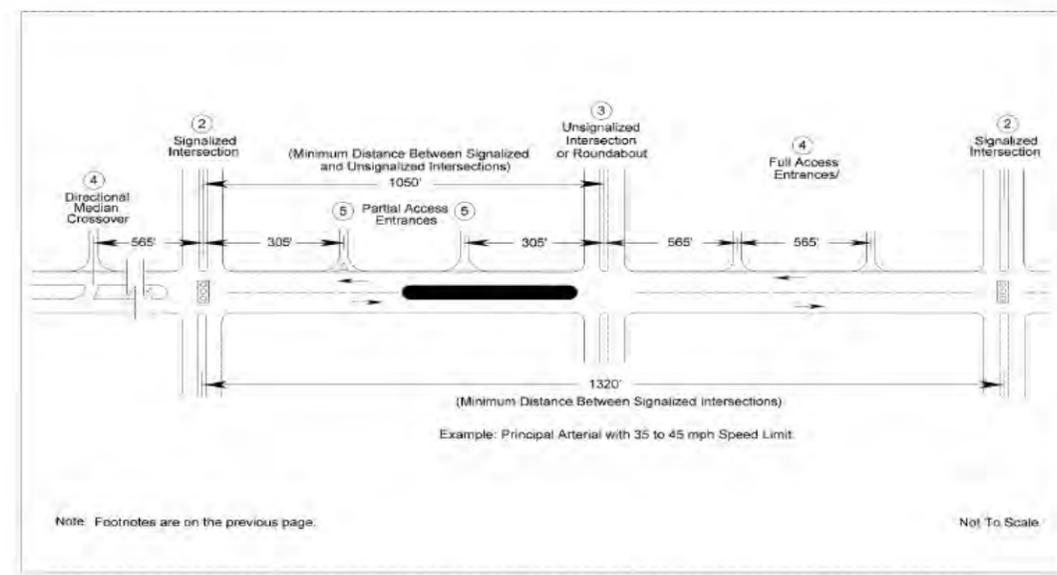


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					163	470
W-51	081+90	Residence Driveway	FM	N/N		
					55	470
W-52	081+35	Residence Driveway	FM	N/N		
					81	470
W-53	080+54	Residence Driveway	FM	N/N		
					84	470
W-54	079+70	Residence Driveway	FM	N/N		
					180	470
W-55	077+90	Residence Driveway	FM	N/N		
					152	470
W-56	076+38	Residence Driveway	FM	N/N		
					240	470
W-57	073+98	Residence Driveway	FM	N/N		
					92	470
W-58	073+06	Residence Driveway	FM	N/N		
					155	470
W-59	071+51	Residence Driveway	FM	N/Y		
					1196	470
W-60	059+55	Residence Driveway	FM	Y/N		
					71	470
W-61	058+84	Residence Driveway	FM	N/N		
					62	660
W-62	058+22	Sideroad (Jim Morris Rd)	FM	N/N		
					46	660
W-63	057+76	Residence Driveway	FM	N/Y		
					1198	660
W-64	045+78	Sideroad (Ruffin Dr)	FM	Y/N		
					518	660
W-65	040+60	Sideroad (Billy Days Rd)	FM	N/N		

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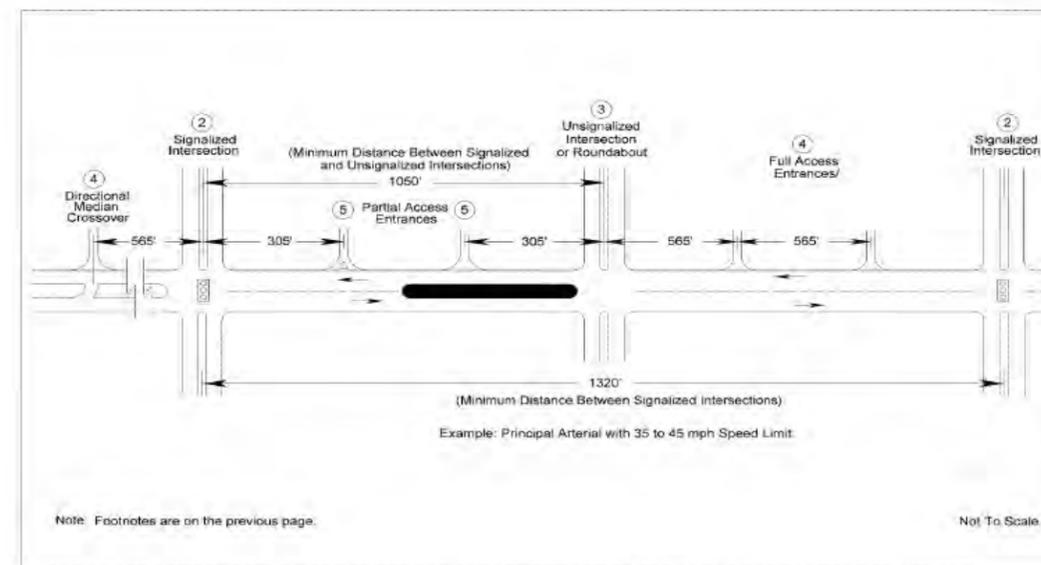


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14

Entrance #	Existing Station	Access to	Entrance Type*	Meets VDOT Acc. Mgmt. Spacing STD (Y/N) (To South/ To North)	Existing Spacing (Ft.)	Required Spacing Standards (Ft.)
					128	660
W-66	039+32	Residence Driveway	FM	N/N		
					209	470
W-67	037+23	Residence Driveway	FM	N/N		
					69	470
W-68	036+54	Residence Driveway	FM	N/N		
					252	470
W-69	034+02	River Access	FM	Y/N		
					1971	470
W-70	014+31	Residence Driveway	FM	Y/N		
					382	470
W-71	010+49	Residence Driveway	FM	N/N		
					192	470
W-72	008+57	Business Entrance	FM	N/N		
					131	470
W-73	007+26	Business Entrance	FM	N/N		
					406	660
W-74	003+20	Sideroad (Middlefield Rd)	FM	N/N		
					320	660
W-75	000+00	US-17	FM	N/Y		
					173	660
W-76	056+80	Sideroad (Southfield Dr)	FM	Y/Y		
					1294	660
W-77	043+86	Sideroad (Patricks Ln)	FM	Y/Y		
					2592	660
W-78	017+94	Sideroad (Sandy Ln)	FM	Y/N		
					552	660
W-79	012+42	Farm Entrance	FM	N/-		

*RI/RO = Right In/Right Out
RI Only = Right In Only
RO Only = Right Out Only
LI/RI/RO = Left In/Right In/Right Out
FM = Full Movement
Sideroad

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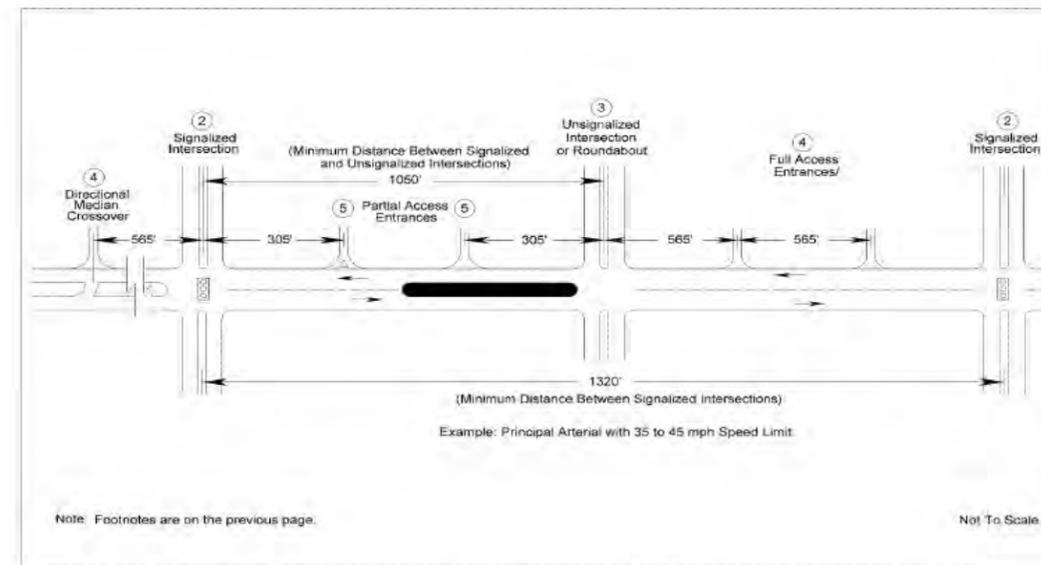


FIGURE 2-8.1 ILLUSTRATION OF THE RELATIONSHIP BETWEEN SPACING STANDARDS*

* Rev. 7/14