MARK CENTER (BRAC-133)
SHORT/MID-TERM IMPROVEMENTS

ALTERNATIVES
TECHNICAL MEMORANDUM

Commonwealth of Virginia

VIRGINIA MEGAPROJECTS

Submitted to:

United States Department of Transportation

Federal Highway Administration

Submitted by:

Virginia Department of Transportation

VDOT Virginia Department of Transportation

Prepared under the direction of:

2/3/11

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Date

2/3/11

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Date

This study was prepared under contracts with the Commonwealth of Virginia, with financial support from the Office of Economic Adjustment, Department of Defense and the City of Alexandria. The content reflects the views of the Commonwealth of Virginia and does not necessarily reflect the view of the Office of Economic Adjustment.

CONTENTS

1. Introduction 1
1.1 Purpose 1
1.2 Mark Center Development 1
1.3 Study Area 1
1.4 Relationship to Other Studies 2
1.4.1 Previous Mark Center Access Study 2
1.4.2 BRAC-133 Transportation Management Plan 2
1.4.3 Study of Long-Term Alternatives 2

2. Alternative Development 4
2.1 Spot/Operational Improvements 4
2.2 Alternative Combinations 5
2.3 Recommended Alternative 6
2.4 Utilities 6
2.5 Right-of-way 6
2.6 Alternative Costs 6
2.7 Geometric Review and Safety 7
2.8 Signing and Striping Plan 7
2.9 Coordination 7

3. Traffic Analysis Methodology 17
3.1 Traffic Forecasting Methodology 17
3.2 Traffic Operational Analysis Methodology 18
3.2.1 Scenario Years 19
3.2.2 Traffic Data Collection for Existing Year (2009) 19
3.2.3 Traffic Volume for Future Opening Year (2015) 19
3.2.4 Operational Analysis Parameters, Assumptions and MOE's 20
3.2.5 Signal Timing Optimization Using Synchro 21
3.2.6 VISSIM Model Calibration Procedure 21

4. Traffic Operational Analysis 24
4.1 2009 Existing Condition 24
4.2 2015 No–build Condition 24
4.3 2015 Build Condition 25

5. Preferred Alternative 44

Appendix A. Agency Coordination

Appendix B. VISSIM Model Calibration Results

Appendix C. VISSIM Operational Analysis Results

Appendix D. Alternative 'E' Conceptual Plans

List of Figures (except for Figure 3-1, figures are presented at the end of each section)

1-1 Study Area

2-1 Locations 1, 2, 3, 4, 5, 6, 7 & Pedestrian Bridge
2-2 Alt. A
2-3 Alt. B
2-4 Alt. C
2-5 Alt. D
2-6 Alt. E
2-7 Conceptual Signing and Striping Plan for Alternative 'E'

3-1 Traffic Operational Analysis Flow Chart

4-1 Existing Traffic Turning Movement Counts
4-2 Average Queues and Level of Service – AM Peak Hour, 2009 Condition
4-3 Average Queues and Level of Service – PM Peak Hour, 2009 Condition
4-4 2015 Forecasting Traffic Turning Movement Counts
4-5 Average Queues and Level of Service – AM Peak Hour, 2015 No-Build (Baseline)
4-6 Average Queues and Level of Service – PM Peak Hour, 2015 No-Build (Baseline)
4-7 Average Queues and Level of Service – AM Peak Hour, 2015 Alternative A vs. 2015 Baseline
4-8 Average Queues and Level of Service – AM Peak Hour, 2015 Alternative B vs. 2015 Baseline
4-9 Average Queues and Level of Service – AM Peak Hour, 2015 Alternative C vs. 2015 Baseline
4-10 Average Queues and Level of Service – AM Peak Hour, 2015 Alternative D vs. 2015 Baseline
4-11 Average Queues and Level of Service – AM Peak Hour, 2015 Alternative E vs. 2015 Baseline
4-12 Location Intersection Overall Performance – AM Peak
4-13 Rotary Intersection Overall Performance – AM Peak
4-14 Average Queues and Level of Service – PM Peak Hour, 2015 Alternative A vs. 2015 Baseline
4-15 Average Queues and Level of Service – PM Peak Hour, 2015 Alternative B vs. 2015 Baseline
4-16 Average Queues and Level of Service – PM Peak Hour, 2015 Alternative C vs. 2015 Baseline
4-17 Average Queues and Level of Service – PM Peak Hour, 2015 Alternative D vs. 2015 Baseline
4-18 Average Queues and Level of Service – PM Peak Hour, 2015 Alternative E vs. 2015 Baseline
4-19 Location Intersection Overall Performance – PM Peak
4-20 Rotary Intersection Performance – PM Peak

List of Tables

2-1 Alternative ‘E’ Costs
2-2 Design Parameters - Alternative 'E'

3-1 Site DOA – No-Build Alternative
3-2 Traffic Operations Analysis Parameters/Assumptions

1. Introduction

1.1 Purpose

The purpose of this Mark Center Short-/Mid-Term Improvements, Alternative Analysis is to investigate and recommend short/mid-term solutions on the arterial street network near the Mark Center in the City of Alexandria that will improve the traffic congestion that is expected as a result of the Base Realignment and Closure (BRAC) 133 facility scheduled to open in September 2011. The findings of this technical memorandum will be utilized during the next stages of project development that include environmental study, permits and approvals, engineering design, right-of-way acquisition, utility relocation, and construction.

1.2 Mark Center Development

The Mark Center is a mixed-use 24-acre site in western Alexandria, Virginia. The site is bounded by I-395 to the southeast, Seminary Road to the northeast, Beauregard Street to the northwest, and the Winkler Botanical Preserve to the southwest. The 2005 Department of Defense (DoD) BRAC Recommendation #133 consists of relocating 6,409 DoD personnel to a new location in northern Virginia. The U.S. Army Corps of Engineers, on behalf of DoD, conducted a study of various locations and ultimately recommended that the new facility be located at the Mark Center, as shown in Figure 1-1. These DoD employees would be in addition to current land uses at the Mark Center, including a hotel and other non-DoD office uses. The office construction associated with the BRAC-133 recommendation is underway and is planned for completion in September 2011. The inevitable growth in traffic volumes and resulting congestion is the motivation for this study.

1.3 Study Area

The study area evaluated for this report (Figure 1-1, all figures are located at the end of the section) is concentrated on the arterial street system immediately adjacent to the Mark Center. The following intersections are included:

- Beauregard Street / Mark Center Drive
- Seminary Road / Beauregard Street
- Seminary Road / Mark Center Drive
- Seminary Road / I-395 SB on-ramp
- Seminary Road / I-395 NB off-ramp
- Seminary Road / I-395 NB on-ramp
- Seminary Road / I-395 SB off-ramp

A larger study area will be investigated in a separate study of long-term transportation solutions (discussed in Section 1.4.3).

1.4 Relationship to Other Studies

1.4.1 Previous Mark Center Access Study

In February 2010, VDOT distributed the Mark Center (BRAC133) Access Study, Volumes 1 and 2. This document was prepared as a comprehensive investigation of potential **long-term** access improvements to the Mark Center site to accommodate the traffic growth described in Sections 1.1 and 1.2. The February 2010 study identified an alternative that was successful operationally but was eliminated due to lack of support from the local community and Alexandria City Council. A second study of long-term improvements, described in Section 1.4.3, is being undertaken to find an approvable long-term recommendation. Information developed for the February 2010 study was used to the extent possible in this short-/mid-term study.

1.4.2 BRAC-133 Transportation Management Plan

In July 2010, the Department of the Army Washington Headquarters Services released a Transportation Management Plan (TMP) for the BRAC-133 installation at the Mark Center. The objective of this document was to outline a plan to minimize impacts on the neighboring community and to facilitate tenant mobility to the site. The TMP focuses primarily on identifying and establishing a series of Travel Demand Management (TDM) strategies that will be employed to influence travel behavior and mode choice of employees, thereby reducing single occupancy vehicle (SOV) trips to the site. The TMP influences the VDOT study of short-/mid-term improvements in two basic ways. First, the short-/mid-term study assumed that the ride-sharing and vehicle reduction goals set forth in the TMP were successful. Second, the TMP contained useful information about Army employee direction of arrival patterns to the Mark Center site. This information was used to validate the travel forecast modeling conducted for the VDOT short-/mid-term study.

1.4.3 Study of Long-Term Alternatives

As mentioned in Section 1.4.1, a separate but related study is underway to identify long-term transportation access improvements to address the demands of the development described in Section 1.2. This long-term study will cover a larger study area and will forecast traffic conditions for the year 2035. Solutions identified in this VDOT long-term study are expected to be costly and may take several years to fund, design and construct. Most of the technical work, public outreach, and documentation of the long-term study will take place in 2011. Environmental study, design, and other phases of project development will follow as funding becomes available.

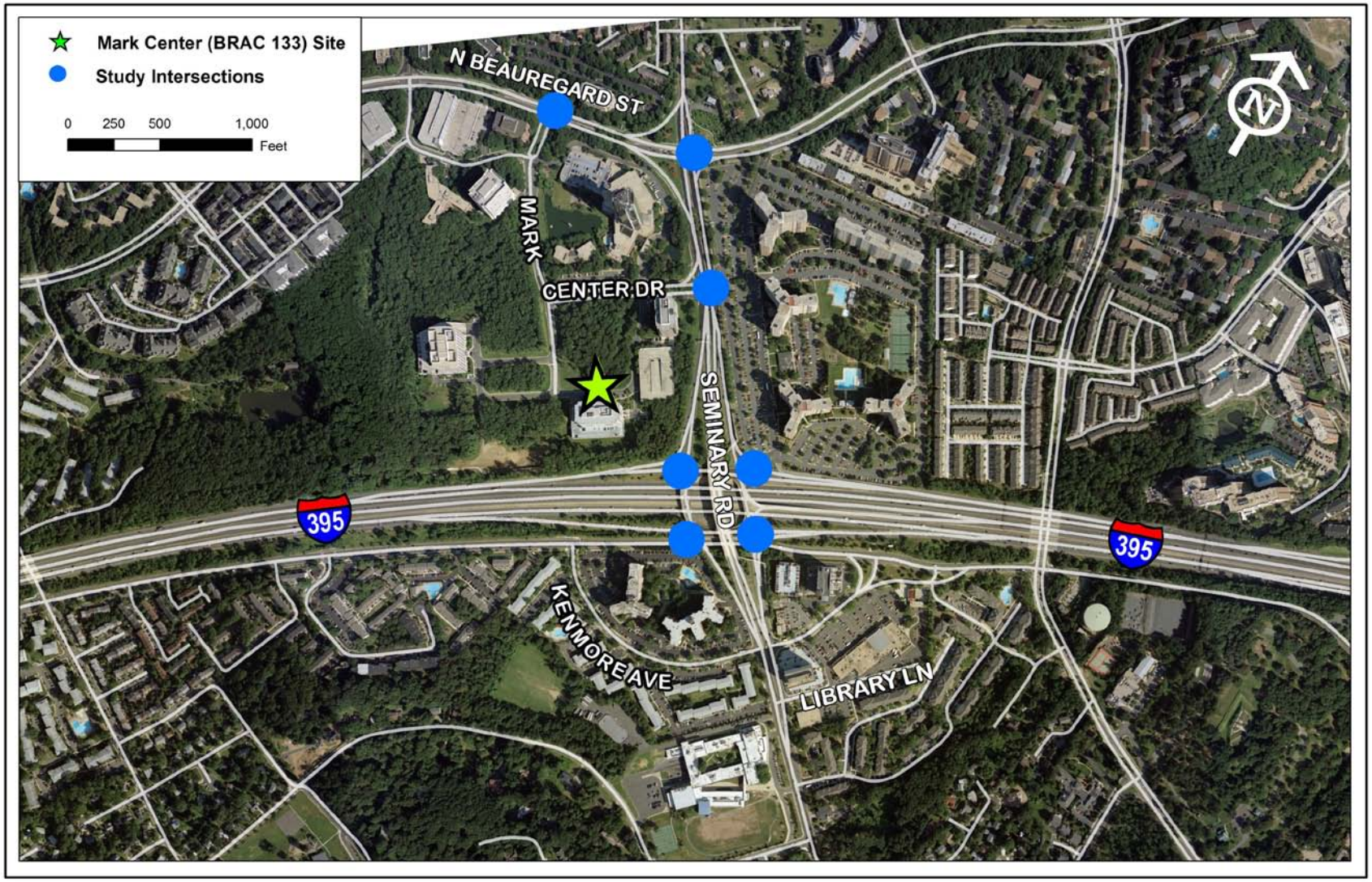


FIGURE 1-1
Study Area

2. Alternative Development

2.1 Spot/Operational Improvements

This study evaluated several locations in the study area where spot/operational improvements could upgrade traffic operations and mitigate the impacts associated with the opening of the Mark Center BRAC-133 site. Figure 2-1 (all figures are located at the end of the section) illustrates the spot/operational improvements developed for the study, and the following is a brief description of each improvement:

Location 1

Widen the northbound I-395 off-ramp from two to three lanes and provide two through lanes and one right-turn lane. Restripe the rotary (area encompassing the four intersections of the I-395 on and off ramps at the Seminary Road interchange) to provide dual lefts for the northbound–to- westbound movements and eastbound-to-northbound movements. Restripe the westbound approach at the I-395 southbound off-ramp intersection to provide two through lanes and one left-turn lane.

Location 2

Widen the Seminary Road westbound approach and gore area from the rotary to the Mark Center Drive intersection from one to two through lanes and provide a dedicated right-turn lane into Southern Towers. Restripe the westbound Seminary Road flyover to allow one through lane on Seminary Road and one left-turn lane into Mark Center Drive. Provide a physical separation between the two lanes from the rotary and the left-turn lane at Mark Center Drive.

Location 2a

Provide the same improvements as proposed in Location 2 above but remove the dedicated right-turn lane from westbound Seminary Road into Southern Towers. This improvement eliminates the need for additional right-of-way from Southern Towers.

Location 3

Widen westbound Seminary Road to provide a deceleration lane and widen northbound Beauregard Street to provide an acceleration lane for the westbound-to-northbound right-turn lane.

Location 4

Provide a physical separation between the two westbound lanes from the rotary and the two westbound lanes from the Seminary Road flyover at the approach to Mark Center Drive. Provide two separate signal phases at the westbound approach to Seminary Road and Mark Center Drive intersection that allows westbound traffic from the rotary turn left into Mark Center Drive and westbound Seminary Road flyover traffic turn right at Southern Towers. Preliminary traffic analysis showed a significant delay associated with the provision of two signal phases for the westbound approach. Therefore, this spot improvement was eliminated from further evaluation.

Location 5

Widen the eastbound Seminary Road approach to Mark Center Drive to allow three through lanes. Widen the northbound Mark Center Drive approach to four lanes to allow one left-turn lane, one shared through/right-turn lane, and two right-turn lanes. This improvement will provide triple rights for the northbound Mark Center to eastbound Seminary Road movement.

Location 6

Widen northbound Beauregard Street between Mark Center Drive and Seminary Road to provide a dedicated right-turn lane at the northbound approach to Seminary Road after the direct connect ramp from northbound Beauregard Street to eastbound Seminary Road. Reconfigure the intersection to allow the three-to two-through-lane drop at the new dedicated right-turn lane in lieu of one of the left-turn lanes and provide two dedicated left-turn lanes. The new dedicated right-turn lane will be signed for Seminary Road eastbound to allow eastbound Seminary Road traffic to avoid the weave condition between the direct connect ramp exit and Mark Center Drive.

Location 7

Widen eastbound Seminary Road and the southbound I-395 on-ramp by one lane from Mark Center Drive to the ramp meter signal to provide a continuous two-lane ramp from Seminary Road to the ramp meter. Restripe the southbound ramp connection from the rotary to provide a merge into the two-lane ramp from eastbound Seminary Road.

Pedestrian Bridge

A pedestrian bridge is proposed across Seminary Road just west of the Mark Center Drive intersection. This bridge eliminates crosswalk and pedestrian signals on the west leg of Seminary Road at Mark Center Drive and enables pedestrians to travel between the Mark Center and Southern Towers without crossing Seminary Road at grade.

2.2 Alternative Combinations

Improvement alternatives were developed by combining several different spot improvements. The following combinations were developed:

Alternative ‘A’ – Locations 1, 2, 3, 5, 6, and 7 (Figure 2-2)

This alternative includes all locations except the pedestrian bridge and provides pedestrian signal timing at all intersections.

Alternative ‘B’ – Locations 1, 2, 3, 5, and 7 (Figure 2-3)

This alternative is similar to Alternative ‘A’ but eliminates Location 6 improvements. This alternative allows us to identify the benefit of Location 6 improvements.

Alternative ‘C’ – Locations 1, and 2a (Figure 2-4)

This alternative was developed as a low-cost alternative and to evaluate the benefits if only AM peak movement improvements into the Mark Center Area are provided.

Alternative ‘D’ – Locations 1, 2a, 5, and 7 (Figure 2-5)

This alternative was developed as an alternative that did not require right-of-way and provide both AM and PM improvements.

Alternative 'E' – Locations 1, 2, 3, 5, 6, 7, and Pedestrian Bridge (Figure 2-6)

This alternative includes the same improvements identified for Alternative 'A' with the addition of the pedestrian bridge across Seminary Road. This alternative evaluates the benefits of all improvements without the pedestrian signal timing phase at the Seminary Road and Mark Center Drive intersection.

2.3 Recommended Alternative

The operational analysis in Section 4 of this memorandum has shown that each spot improvement provides a benefit to the traffic operations in the study area. In consultation with the City of Alexandria, it is recommended that Alternative 'E' be carried forward as the Preferred Alternative.

2.4 Utilities

The utility owners that may be affected are Dominion Virginia Power, Jones Cable, AT&T, Verizon, Alexandria Sanitation Authority, Virginia American Water Company, and Washington Gas. The utilities are generally located within the public right-of-way. A utility easement along the right-of-way at Location 6 will have to be replaced with the widening improvements proposed at that location.

The preliminary utility relocation costs have been estimated at $ 3,500,000. This estimate is based on all costs, regardless of responsibility and that all utilities within the project area will need to be relocated. Several of the utilities may be able to be avoided, so the associated cost may be reduced when the project gets into final design. In addition, most of the utilities are within the right-of-way, and the cost to relocate should be the responsibility of the utility owner unless they have prior rights. Thus, final costs may be reduced in the later phases of the project.

2.5 Right-of-way

Construction of improvement locations 2a, 3, and 6 will require right-of-way. Locations 2a and 3 will require right-of-way from Southern Towers, and Location 6 will require right-of-way from the Mark Center. The preliminary right-of-way acquisition cost for these locations is $1,610,000.

2.6 Alternative Costs

Based on the preliminary plans, the estimated construction cost for Alternative 'E' is $8,500,000. In order to expedite the implementation of these improvements, it is anticipated that this project will be delivered using the design-build process. As shown in Table 2-1, the total cost of implementation of the short- and mid-term improvements is estimated to be $17.76 million.

TABLE 2-1
Alternative 'E' Costs

Activity	Cost
Construction	$8,500,000
Right-of-way	$1,610,000
Utilities[1]	$3,500,000
Design	$1,020,000
QA/QC	$850,000
Design-Build Indirect (Bonds, Risk, Warranty, Field Office)	$1,275,000
Administration (Procurement, Preliminary Design, NEPA, oversight)	$1,000,000
	$ 17,755,000

[1]This estimate is based on the total utility relocation cost estimated at $ 3,500,000. It is anticipated that the majority of the relocations can be avoided or the cost to relocate will be the responsibility of the utility owner and these costs may be significantly reduced.

2.7 Geometric Review and Safety

The existing and proposed geometry was reviewed to determine if any non-standard conditions exist or need to be proposed that may impact the safety of the project. Storage lengths and taper widths were reviewed for the new turning lanes and turning radius was reviewed to accommodate the anticipated bus traffic in the corridor.

Table 2-2 Design Parameters – Alternative 'E' (at the end of this chapter) summarizes the results of this review. There are no anticipated design exceptions proposed with these improvements. There is one location on Mark Center Drive where the VDOT taper length for turning lanes is not met due to geometric constraints and a Design Waiver will be prepared during final design. In addition, all safety hardware within the project limits will be upgraded to meet the guidelines set forth in the VDOT IIM-LD-220.1.

2.8 Signing and Striping Plan

The Conceptual Signing and Striping Plan for Alternative 'E' is shown in Figure 2.7.

2.9 Coordination

The development of the spot improvements and alternative combinations was coordinated with the City of Alexandria staff. The operational analysis was presented to the City of Alexandria BRAC Advisory Committee on October 20, 2010, and the recommended alternative, project costs and project schedule were presented on November 17, 2010. The City of Alexandria BRAC Advisory Committee approved a resolution at the November 17, 2010 meeting endorsing

Table 2-2 - Design Parameters - Alternative 'E'

Functional Classification:	I-395: **Urban Freeway**. Seminary Road and Beauregard Street: **Urban Minor Arterial**. Mark Center Drive: **Urban Local Street**

Improvement Location #1	**I-395 NB & Seminary Rd Rotary Ramps**		Additional RT lane on exist ramp & pavement restripping with new traffic pattern.		
	Design Value	**Design Standard**	**VDOT/AASHTO**	**Meet Design Standards?**	**Will potential DE/DW be Needed?**
Design Speed	30 mph				
Taper for Additional RT Lane	100 ft.	min 100 ft.	VDOT Roadway Design Manual (RDM)DM App F Fig 3-1	Yes	No
Lane width	12 ft.	12 ft.	AASHTO Exhibit 10-67	Yes and Match existing	No
Turning Radius@ Additional RT Lane	91 ft.	45 ft.	VDOT RDM App F Section 4	Yes	No

Improvement Location #2	**Seminary Rd WB Prior to Mark Center Dr**		Additional RT lane and pavement restripping with new traffic pattern and lane configuration.		
	Design Value	**Design Standard**	**VDOT/AASHTO**	**Meet Design Standards?**	**Will potential DE/DW be Needed?**
Design Speed (Posted Speed Limit)	40 mph (35 mph)				
Taper for Additional RT Lane	100 ft.	min 200 ft.	VDOT RDM App F Fig 3-1	No - in order to increase the storage length	**DW is needed.**
Length of Storage for Additional RT Lane	220 ft.	min 200 ft.	VDOT RDM App F Fig 3-2	Yes	No
RT turn Lane width	12 ft.	min 11 ft.	VDOT RDM App A GS-6	Yes	No
Turning Radius@ Entrance	25 ft.	min 25 ft.	VDOT RDM App F Section 4	Yes	No

Improvement Location #3	**Seminary Rd WB onto North Beauregard St NB**		Additional RT lane.		
	Design Value	**Design Standard**	**VDOT/AASHTO**	**Meet Design Standards?**	**Will potential DE/DW be Needed?**
Design Speed (Posted Speed Limit)	40 mph (35 mph)				
Additional RT Lane Width	12 ft.	min 11 ft.	VDOT RDM App A GS-6		No
Taper for Additional RT Lane	50 ft.	min 200 ft.	VDOT RDM App F Fig 3-1	No - in order to increase the storage length	**DW is needed.**
Acceleration Lane Length @ Beauregard	550 ft.	220 ft. (from 15 to 35mph)	AASHTO Exhibit 10-70	Yes - Existing condition for lane merging.	No
Curve Radius@ RT Lane Center Line	92 ft.	45 ft.	VDOT RDM App F Section 4	Yes	**DW may be needed.**

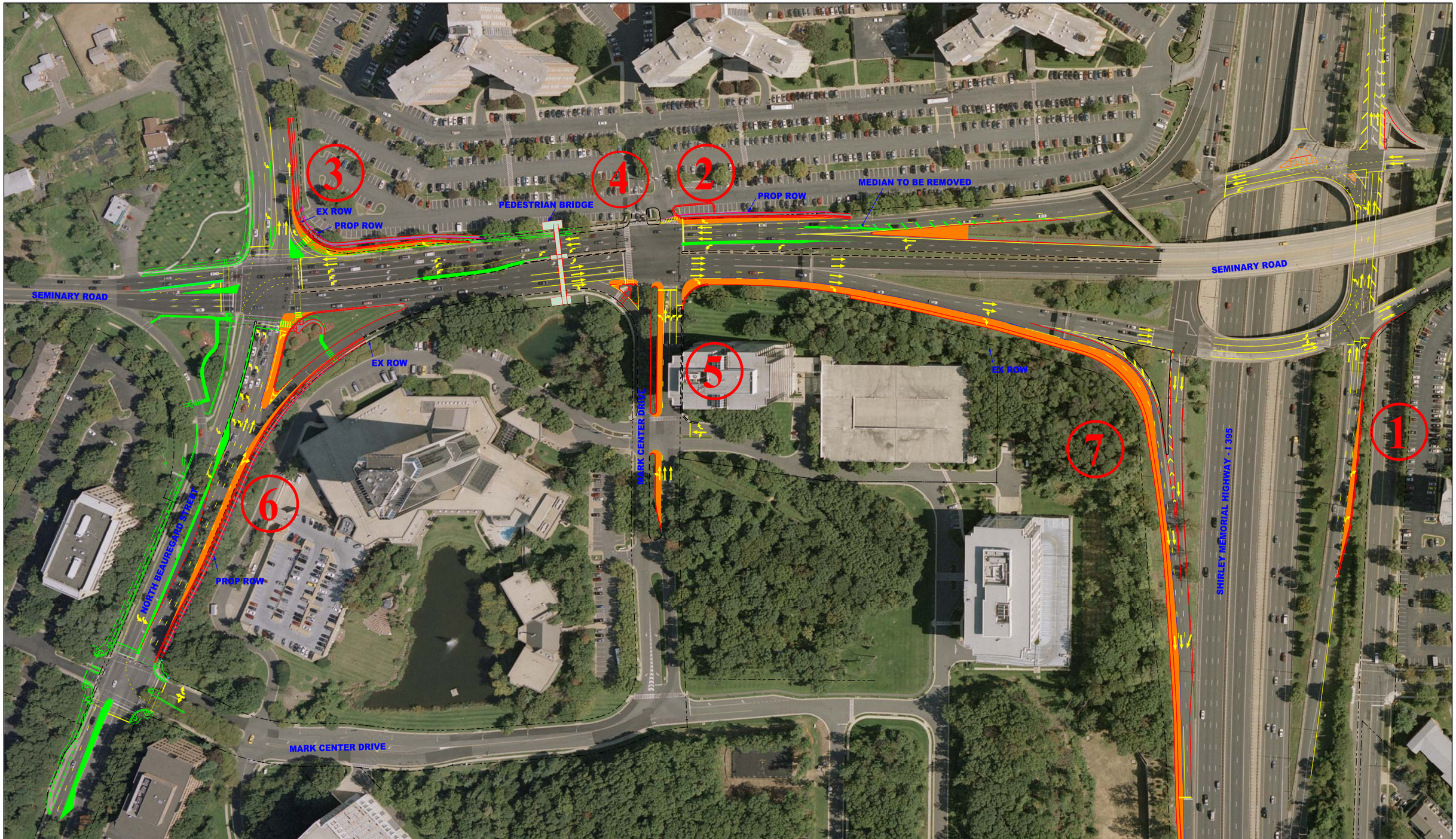
Improvement Location #5	**Mark Center Drive**		Additional LT and RT lanes.		
	Design Value	**Design Standard**	**VDOT/AASHTO**	**Meet Design Standards?**	**Will potential DE/DW be Needed?**
Design Speed (Posted Speed Limit)	30 mph (25 mph)				
Lane Width	12 ft.	min 10 ft.	VDOT RDM App A GS-8	Match existing.	No
Taper for Additional LT Lane	75 ft.	min 100 ft.	VDOT RDM App F Fig 3-1	No - in order to increase the storage length	**DW is needed.**
Turning Radius@ Additional RT Lane	48 ft.	45 ft.	VDOT RDM App F Section 4	Yes	No

Improvement Location #6	**North Beauregard St West of Seminary Rd**		Lane shift to provide additional storage for duel left turn lanes and add additional RT lane with new traffic pattern.		
	Design Value	**Design Standard**	**VDOT/AASHTO**	**Meet Design Standards?**	**Will potential DE/DW be Needed?**
Design Speed (Posted Speed Limit)	40 mph (35 mph)				
Lane Width	12 ft.	min 11 ft.	VDOT RDM App A GS-6	Match existing.	No
Taper for 1st Left Turn Lane	100 ft	min 200 ft.	VDOT RDM App F Fig 3-1	No - in order to increase the storage length	**DW is needed.**
Turning Radius @ Intersection RT Lane	75 ft.	45 ft.	VDOT RDM App F Section 4	Yes	No

Improvement Location #7	**Seminary Rd EB onto I-395 SB Ramps**		Add additional auxiliary lane on ramp; Extend concrete median to channel merging traffic.		
	Design Value	**Design Standard**	**VDOT/AASHTO**	**Meet Design Standards?**	**Will potential DE/DW be Needed?**
Design Speed	25 mph				
Lane Width	12 ft.	12 ft.	AASHTO Exhibit 10-67	Yes	No
Shoulder Width	6 ft.	6 ft.	AASHTO Exhibit 10-67	Yes	No
Accel Ln Length prior to Ramp Meter	250 ft. (2 LT Lns Merge into one Ln) 150 ft.+100 ft.Taper (LT Ln Merges into Two RT Lns)		Merge Condition and Speeds of Merging traffic are equal.	Yes	No
Curve Radius	185 ft.	min 171 ft.	VDOT RDM GS - R	Yes	No

Alternative 'E'. The City of Alexandria BRAC Advisory Committee resolution is in Appendix A.

The recommendation to proceed with Alternative 'E' was presented to and approved by the City of Alexandria on December 14, 2010. City Council endorsed implementing the recommended short- and mid-term improvements. The City Council resolution is in Appendix A.



LEGEND

- ASPHALT PAVEMENT WIDENING
- CONCRETE PAVEMENT (MEDIAN/SIDEWALK)
- AREAS CURRENTLY UNDER CONSTRUCTION
- PROP.R/W
- EX.R/W
- EX MEDIAN REMOVAL

VDOT Virginia Department of Transportation

VIRGINIA MEGAPROJECTS

VDOT NORTHERN VIRGINIA DISTRICT

MARK CENTER
SHORT/MID-TERM IMPROVEMENT
LOCATIONS 1, 2, 3, 4, 5, 6, 7
& PEDESTRIAN BRIDGE

SCALE: N.T.S.	SHEET:	DATE: OCTOBER 16, 2010

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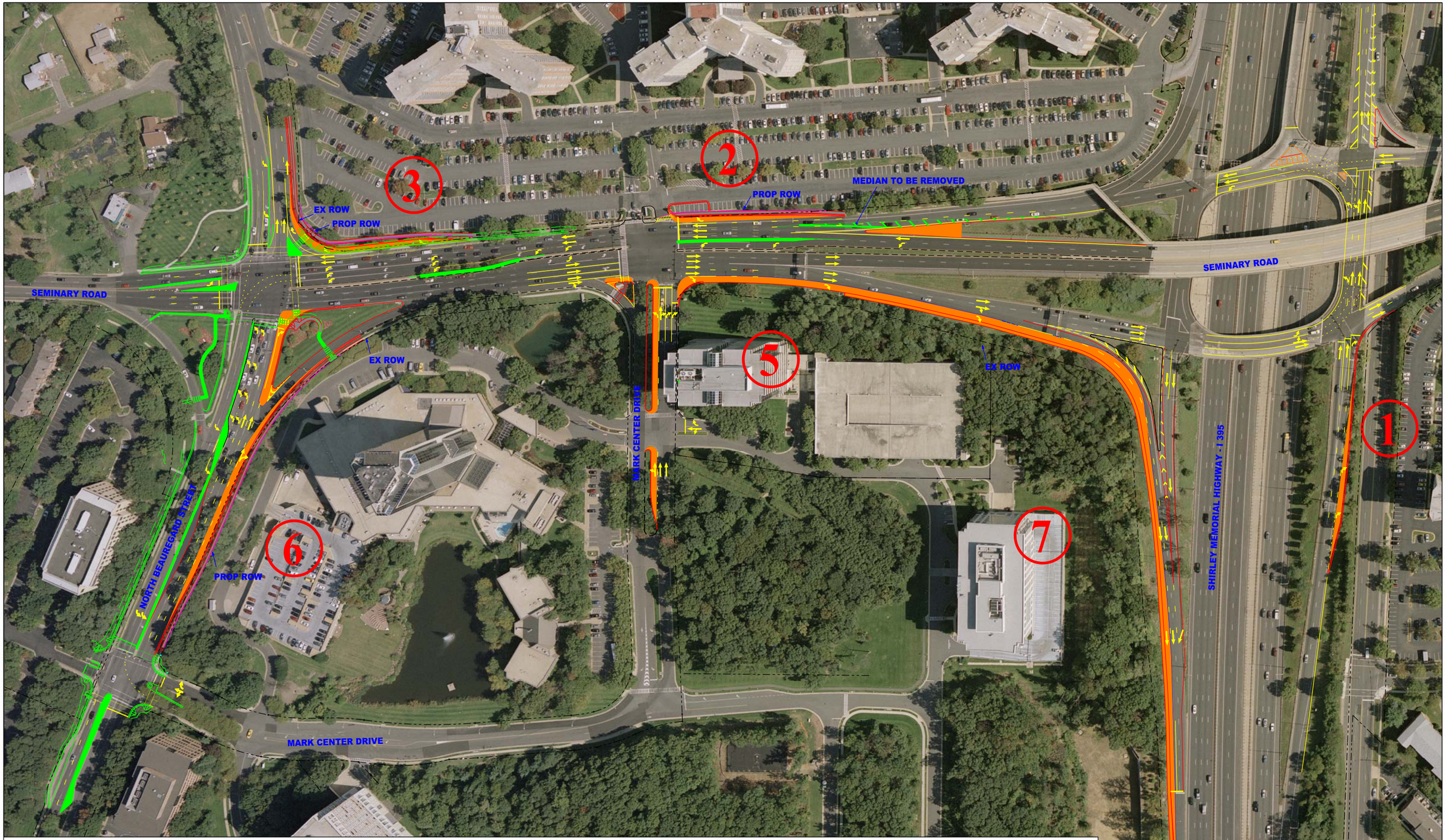
FIGURE 2-1



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VIRGINIA MEGAPROJECTS

VDOT NORTHERN VIRGINIA DISTRICT

MARK CENTER
SHORT/MID-TERM IMPROVEMENT
ALT. A

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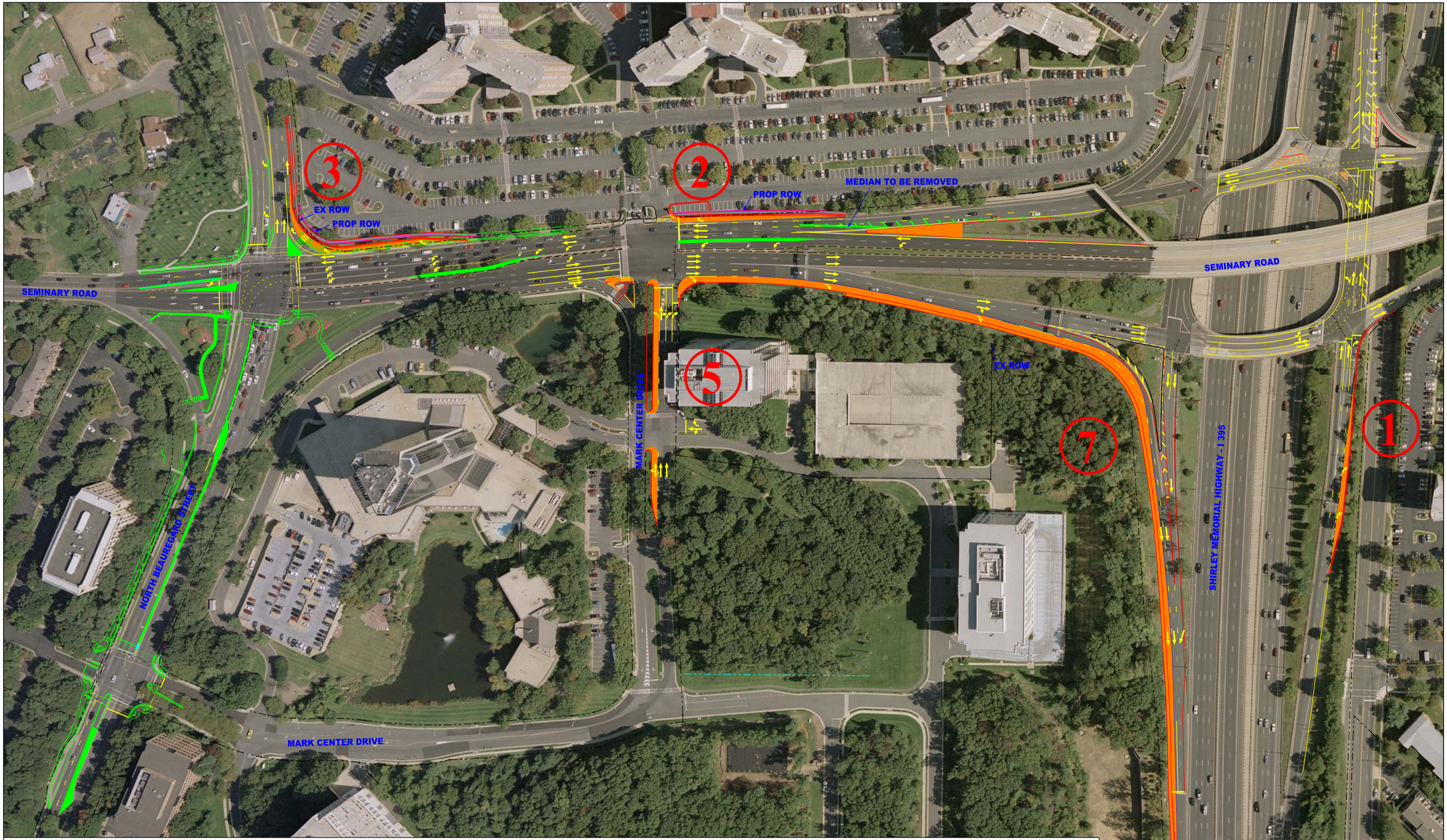
FIGURE 2-2



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VIRGINIA MEGAPROJECTS

VDOT NORTHERN VIRGINIA DISTRICT

MARK CENTER

SHORT/MID-TERM IMPROVEMENT

ALT. B

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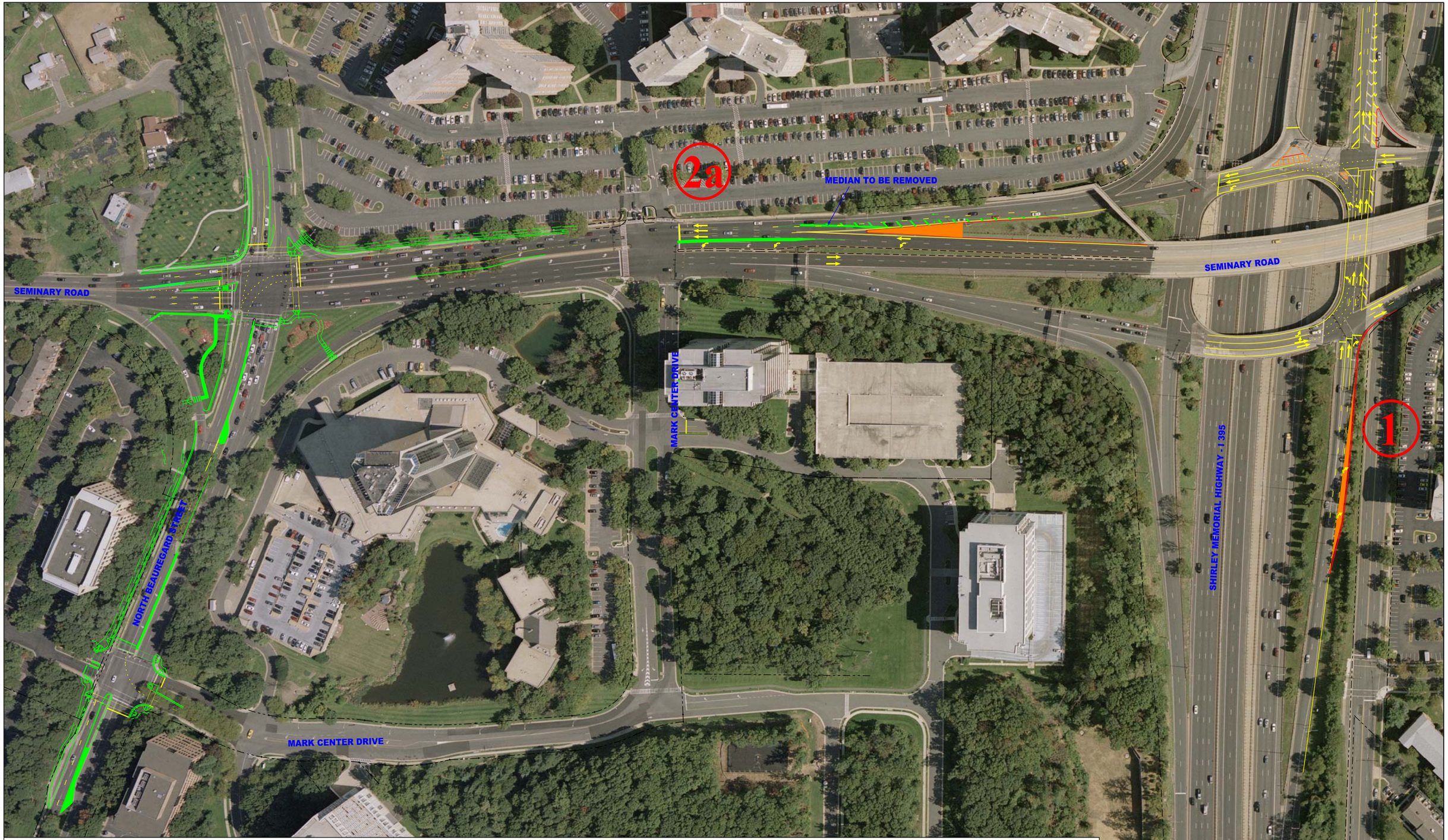
FIGURE 2-3



LEGEND

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- EX.R/W
- EX MEDIAN REMOVAL

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VIRGINIA MEGAPROJECTS

VDOT NORTHERN VIRGINIA DISTRICT

MARK CENTER
SHORT/MID-TERM IMPROVEMENT
ALT. C

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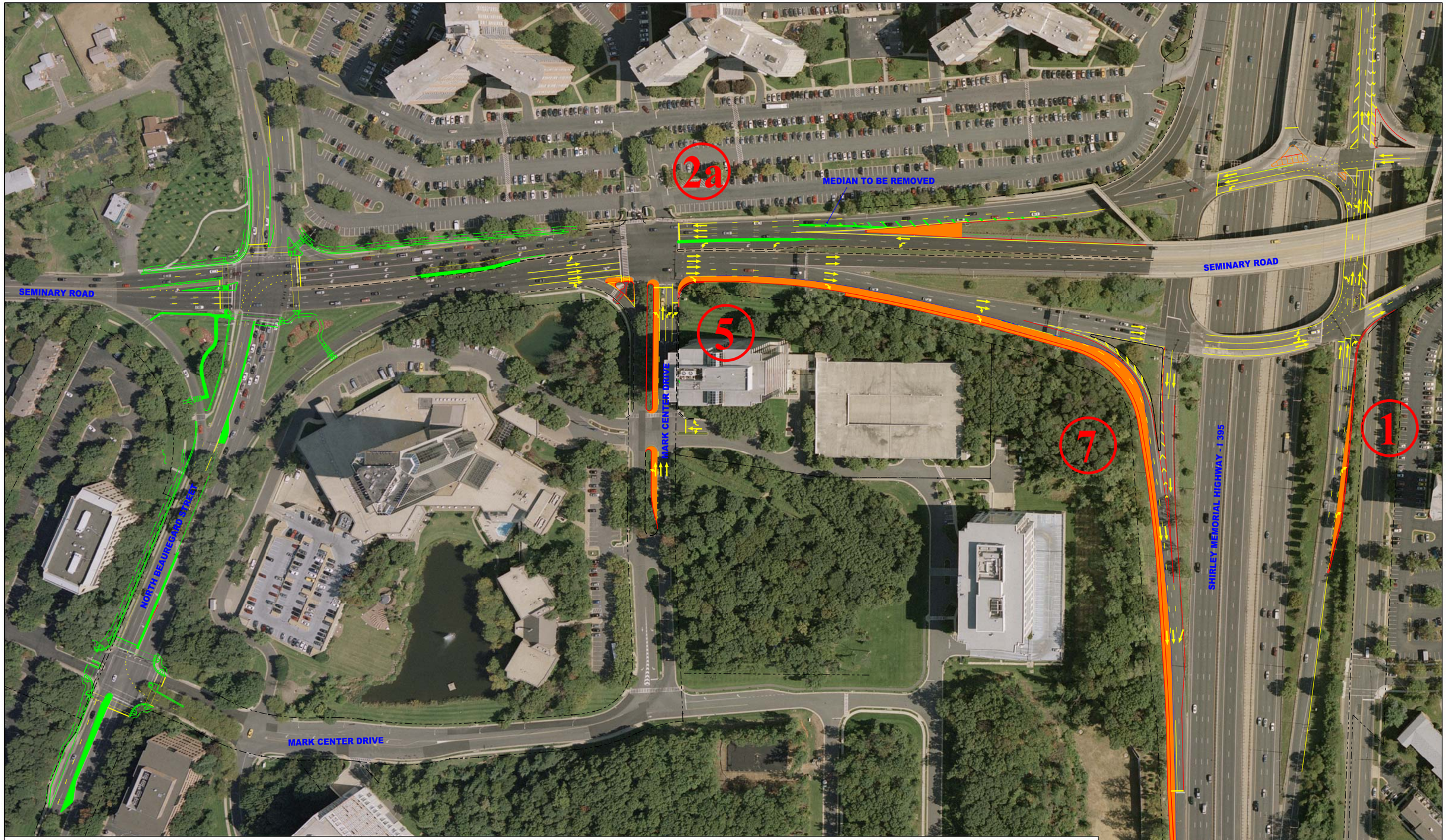
FIGURE 2-4



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VIRGINIA MEGAPROJECTS

VDOT NORTHERN VIRGINIA DISTRICT

MARK CENTER
SHORT/MID-TERM IMPROVEMENT
ALT. D

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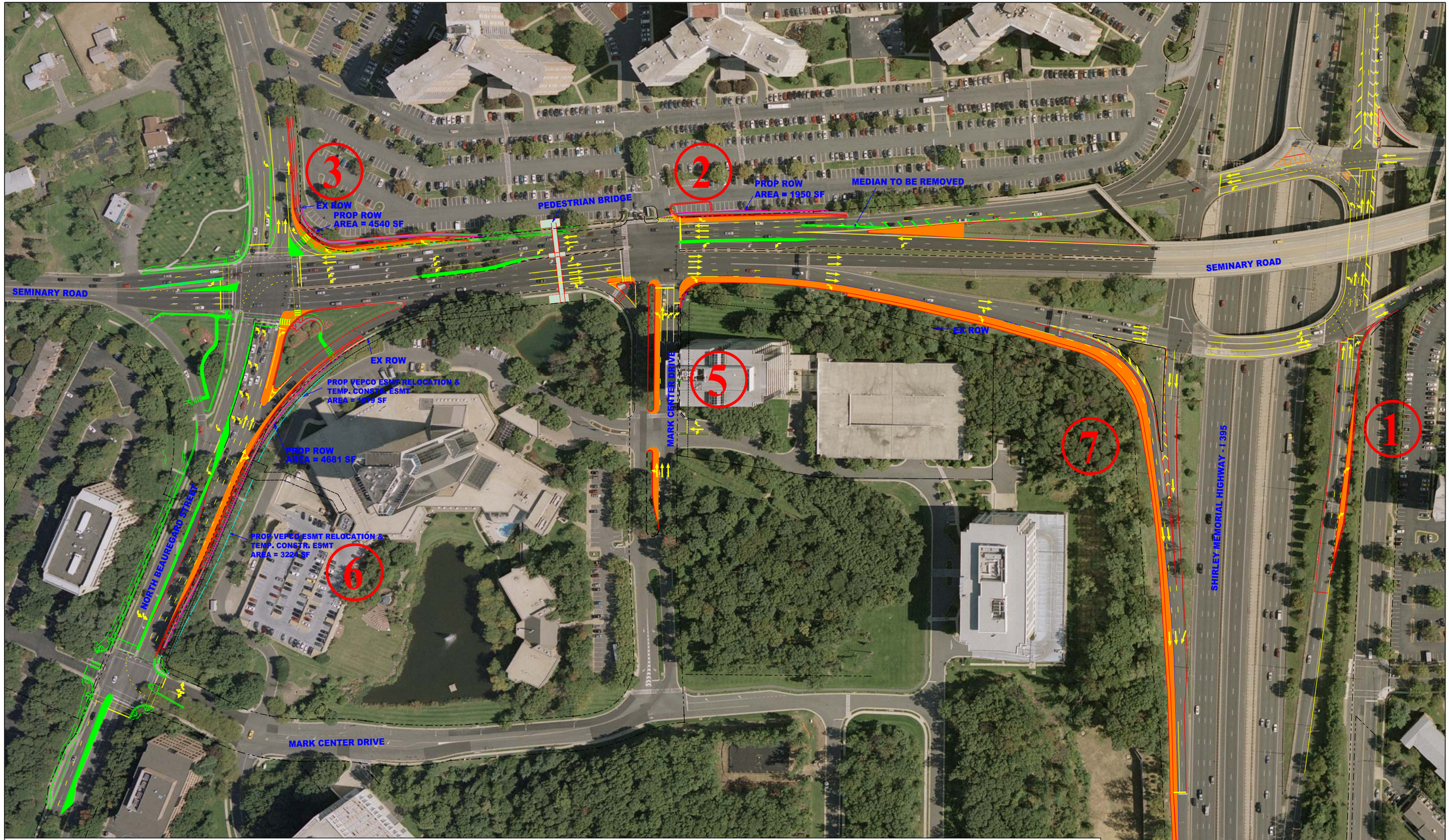
FIGURE 2-5



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- AREAS CURRENTLY UNDER CONSTRUCTION
- PROP.R/W
- EX.R/W
- PROP.RELOC. ESMT
- EXIST.UTIL.ESMT
- EX MEDIAN REMOVAL

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VIRGINIA MEGAPROJECTS

VDOT NORTHERN VIRGINIA DISTRICT

MARK CENTER

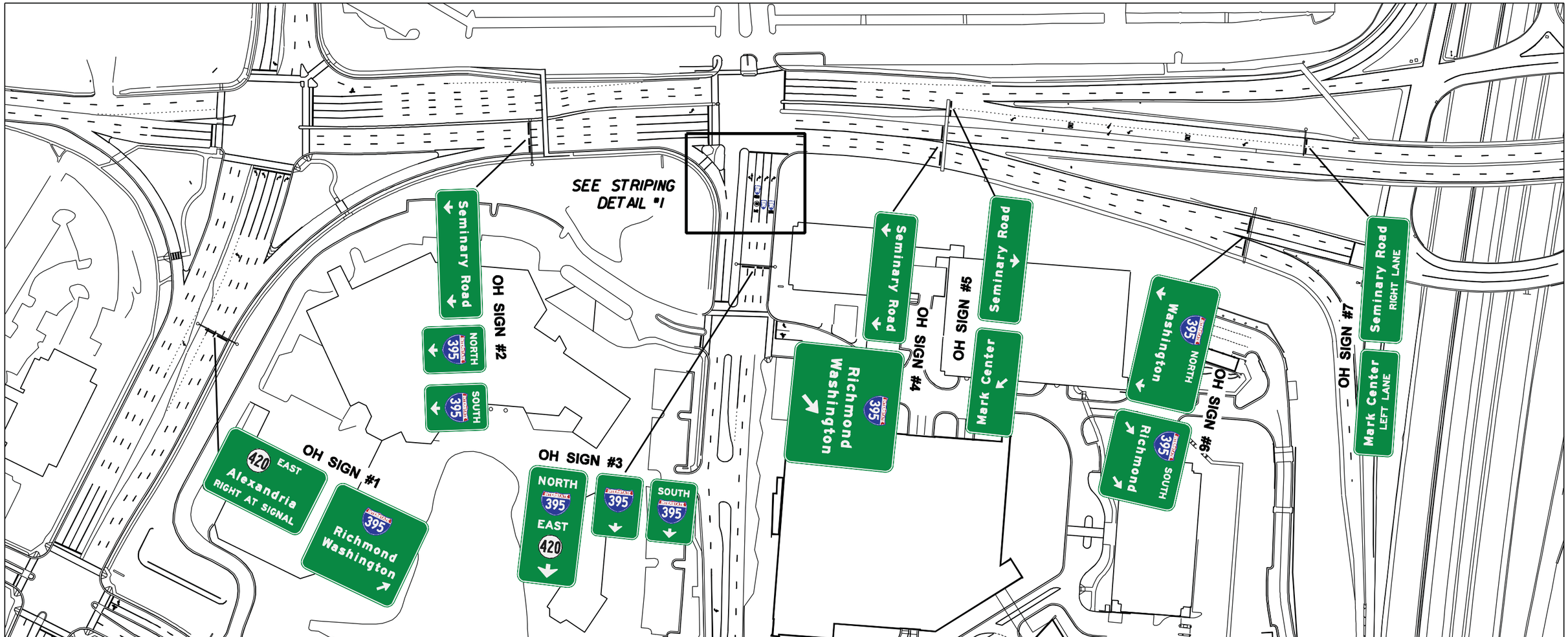
SHORT/MID-TERM IMPROVEMENT
ALT E

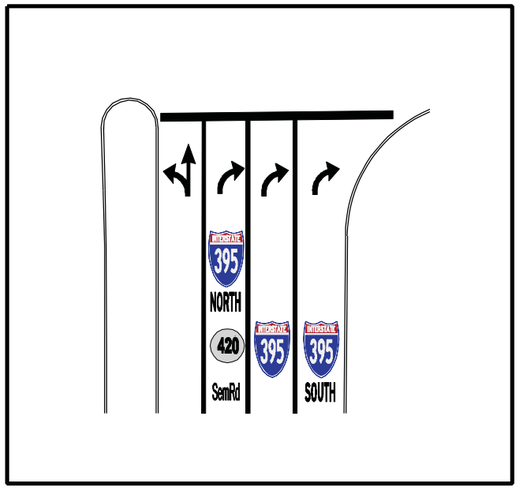
SCALE: N.T.S.

SHEET:

DATE: OCTOBER 16, 2010

FIGURE 2-6





STRIPING DETAIL #1

Figure 2-7

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VIRGINIA MEGAPROJECTS

VDOT NORTHERN VIRGINIA DISTRICT

Conceptual Signing and Striping Plan for Alternative `E'

SCALE: 1" = 75'	SHEET: 1 OF 1	DATE: FEBRUARY, 2011

3. Traffic Analysis Methodology

3.1 Traffic Forecasting Methodology

No-build traffic forecasts for this analysis were developed based on the data and analysis performed for the previous Mark Center Access Study as well as new information available from the TMP for BRAC-133 at the Mark Center[1] completed in July 2010. The travel demand model used in this analysis is the Transportation Planning Board (TPB) FY-2008 Regional Travel Model (version 2.2), along with the Metropolitan Washington Council of Governments Round 7.2 land use forecasts. Forecasts comprise two components: 1) background traffic; and 2) traffic generated from activity associated with the BRAC-133 site – referred to in this document as site traffic. No-build forecasts were developed for AM and PM peak hours.

The TPB model provided an estimate of background traffic growth. This growth was applied to observed traffic volumes[2], yielding background traffic forecasts. In estimating background growth, the travel model was modified to account for roadway accessibility to the site and the Mark Center in general. Also, land use activity associated with the site was not considered by the travel model as a part of background growth.[3] Traffic estimates implied by the travel model were used to estimate average annual growth between 2010 and 2020. This growth was applied appropriately to observed traffic volumes to yield turning movement forecasts reflecting background traffic for the year 2015.[4]

The site-related component of forecasted traffic was based on forecasts from the Mark Center Access Study for year 2013. The Mark Center Access Study assumed that the magnitude of site traffic remains at the magnitude forecasted for year 2015. For this analysis, however, 2015 forecasts were developed based on the direction of approach (DOA) associated with the site traffic that was derived from the BRAC-133 TMP using Washington Headquarters Service employee commute survey data collected in the fall of 2009. Table 3-1 compares the new DOA patterns for 2015 against the DOA patterns used for the Access Study.

Generally, the new DOA shows a larger demand from/to the south on I-395, while a decrease in demand is observed on the Seminary Road approach routes. Despite these changes in DOA, overall changes in the No-build traffic forecasts for 2015 were modest.

Year 2015 background traffic forecasts were used in conjunction with the 2015 No-build (background + site) forecasts in order to support the request for federal Defense Access Road funding. A BRAC-133 Traffic Impact Technical Memorandum will be prepared separately to document the results of the impact BRAC133 has on the surrounding road network.

[1] Transportation Management Plan for BRAC-133 at Mark Center, Washington Headquarters Services/US Army Corps of Engineers/The Benham Companies, LCC/SAIC, July 2010.
[2] Turning movement counts collected in 2009
[3] Employment associated with the BRAC-133 migration (6,400 employees) was removed from Year 2020 Round 7.2 land use forecasts
[4] Application of growth in accordance with NCHRP 255 methods; resulting turning movements were balanced using a fratar technique to match link level forecasts.

TABLE 3-1
Site DOA - No-Build Alternative

Origin/Destination	Previous Access Study - Year 2015 (%)	Current BRAC-133 TMP - Year 2015 (%)
North on I-395	20	19
South on I-395	23	29
East on Seminary	20	15
West on Seminary	15	12
North on Beauregard	5	8
South on Beauregard	15	16
Southern Towers	2	1

3.2 Traffic Operational Analysis Methodology

This section discusses the framework for the traffic operational analysis for the development and evaluation of the various alternatives evaluated in this study. It identifies the analysis years, traffic data collection, operational analysis parameters, signal optimizations and VISSIM model calibrations. Figure 3-1 illustrates the flow chart of the traffic operational analysis procedure used for this study.

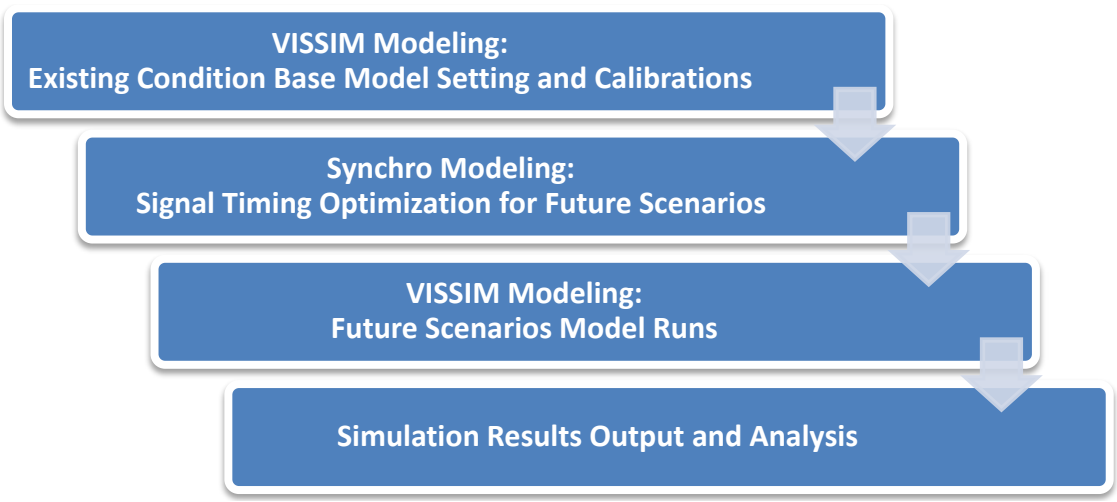

FIGURE 3-1
Traffic Operational Analysis Flow Chart

The study area is a typical urban arterial setting with near or over-saturated traffic conditions. The freeway section near the study area is also highly congested during peak hours. According to the FHWA's Interstate System Access Informational Guide[5], "simulation analysis is the recommended analysis approach for system-wide analysis". Moreover, the roadway geometries in the study area are complicated, especially on the rotary interchange. Therefore, a microsimulation package, VISSIM, is selected as the main tool in this study for its flexibility in

[5] Table 4 (p.65), Interstate System Access Informational Guide, U.S. DOT, FHWA, Office of Interstate, August, 2010.

geometry coding and comprehensive capability in modeling both under and over-saturated traffic flow conditions.

3.2.1 Scenario Years

The traffic operational performance was analyzed for the following years:

- Existing Year - 2009
- Future Opening Year - 2015[6]

3.2.2 Traffic Data Collection for Existing Year (2009)

Turning Movement Counts

Turning movement counts at the study intersections were collected either in the field between June 2, 2009 and June 16, 2009 or from recently conducted studies[7].

Traffic Volumes on Freeway/Ramps

Traffic volume data for the basic freeway segments on I-395 were obtained from the Archived Data Management System (ADMS) Virginia website. The ADMS archives traffic volume, speed, and occupancy data obtained from the permanent counters located along the freeways in Northern Virginia in different time aggregates throughout the year. Twenty-four-hour traffic volume data on I-395 was downloaded for June 2 to June 4, 2009, and for June 9 to June 11, 2009. Twenty-four-hour traffic volume data obtained for 6 week days from each count station were averaged for the respective time periods.

Traffic volume data for the interchange ramps at King Street and at Duke Street were collected using automated traffic recorders between June 9 and June 11, 2009. Ramp volumes at the Seminary Road interchange was collected from the Washington Headquarters Service Transportation Improvement and Management Plan study.

Signal Timing Data

Signal timing, phasing, and coordination data for the study intersections were obtained from VDOT and the City of Alexandria. Signal phasing for each study intersection was verified based on field observations.

Roadway Geometry Data

Roadway geometry data for the study intersections, including lane configuration, storage and taper lengths, and the pedestrian/transit facilities, were collected during field observations. Speed limit information for each facility was obtained from the Statewide Planning System database. Aerial maps and the geographic information system database provided by VDOT were used to obtain lane configurations on freeway and ramp segments, lengths for acceleration/deceleration lanes, and weaving sections.

3.2.3 Traffic Volume for Future Opening Year (2015)

Refer to Section 3.1.

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[6] While the BRAC facility is expected to open in 2011, the analysis of traffic operations was performed for a year 2015 scenario.

[7] Washington Headquarters Service at Mark Center Alexandria, VA BRAC-133 Build to Suit Transportation Improvement and Management Plan, Wells + Associates, Inc., July, 2008.

3.2.4 Operational Analysis Parameters, Assumptions and MOE's

The analysis for this study was built on the traffic and transportation analysis work that was for the I-95/I-395 HOV/Bus/HOT lanes IJR (Referred to as "I-395 HOT Lanes IJR" hereafter) and Mark Center Access Study. Table 3-2 lists the freeway and arterial analysis assumptions and parameters.

This study mainly focused on the impacts of the Mark Center (BRAC-133) on local arterial and interchange rotary in terms of level of congestions. Three key arterial/intersection measures of effectiveness (MOEs) were selected to evaluate the traffic operational performance: (1) delay, (2) volume (throughput serviced), and (3) queue lengths for critical movements.

TABLE 3-2
Traffic Operations Analysis Parameters / Assumptions

Freeway Operations Parameters	**Scenarios**		
	Existing	**2015 No-Build**	**2015 Build**
Peak Hour Volumes – Freeway	AM/PM Peak (2009 volumes – automated traffic recorder counts on-ramps/ADMS database for Freeway sections; Other previous Studies)	Travel Demand Forecasting	
Peak Hour Volumes - Arterial	2009 turning movement counts	Travel Demand Modeling	
Percent Heavy Vehicles - Freeway	NB/SB GP – 4% HOV – 1%[8]		
Percent Heavy Vehicles - Arterial	1% (Except for 2-intersections as calculated from turning movement counts		
Lane Width - Freeway	NB 12 feet; SB 11 feet; HOV 12 feet	NB 12 feet; SB 11 feet; HOT 11 feet	
Lane Width - Arterial	Field Observations	Per design plans	
Signal Timing, Phasing and Coordination	City of Alexandria/VDOT	Re-Optimization based on future demand	
Simulation – Seeding Time	0-1800 sec		
Simulation – Recording Time	1800-5400 sec		
Simulation - # of Rep	5		
Simulation - Resolution	5-8		
Simulation – Intersection Measures of Effectiveness	Delay, Volume (throughput serviced), Queue Lengths for Critical/Identified Movements		

[8] Source: 2008 VDOT Daily Traffic Volume/Vehicle Classification Estimate

3.2.5 Signal Timing Optimization Using Synchro

The Synchro software package was used for signal timing re-optimizations for all future scenarios. In accordance with instructions from the City of Alexandria Department of Transportation, the following signal timing assumptions were included in all future scenarios:

- The cycle lengths on all local street intersections in future scenarios should not be shorter than the existing City cycle lengths.
- The considerations of pedestrian timing should be included in the traffic operational analysis. Specifically,
    - For the intersection of Seminary / Mark Center Drive, it was assumed a pedestrian needs to cross Seminary (immediately west of the signal box) during every cycle of the signal. Pedestrian timing was eliminated in Alternative 'E' since a pedestrian bridge is assumed.
    - For the intersection of Seminary / Beauregard, it was assumed a pedestrian needs service every third cycle of the signal.
    - Flash Don't Walk time should be recalculated based on the proposed crosswalk in all future scenarios. A walking speed of 3.5 feet/second was used in this study based on the City of Alexandria Department of Transportation's standard.
- The ramp metering signal on the I-395 SB on-ramp should be kept the same as the existing condition, which is running at 2-second green and 2-second red in the PM peak hour.

3.2.6 VISSIM Model Calibration Procedure

As a part of traffic operational analysis, the study used VISSIM (version 5.20) to investigate the impacts of the proposed Mark Center (BRAC-133) on traffic conditions of adjacent local street and freeway ramps and the effectiveness of each alternative in mitigating congestion from an integrated system perspective. Traffic simulations were conducted for: existing conditions (2009) , future No-Build, and five Build Alternatives (A – E) for year 2015 traffic conditions. All analyses reviewed both AM and PM peak hour traffic operations, resulting in a total of 14 VISSIM models that were built during this study.

VISSIM is a stochastic microscopic simulation package intended to provide detailed models of traffic behavior across a road network. However, without calibration, its internal algorithms cannot assure that the simulation model will predict traffic performance accurately. Calibration therefore improves the ability of the model to accurately reproduce local driver behavior and roadway system performance characteristics. This section briefly documents the VISSIM model calibration procedure used for this study.

Modeling Limits

The study area was, shown in Figure 1-1, was described in Section 1.3. In the traffic operation analysis, the micro-simulation models used in this study were built on the previous VISSIM models that had been completed for the Mark Center Access Study. The actual modeling area in VISSIM is larger than the study area, which included I-395 corridor between Duke Street and King Street interchanges, Seminary Road between Library Lane and Beauregard Street, and intersections along King Street and Duke Street. However, the modeling efforts were focused primarily on the study area, including the three local intersections around the Mark Center and

the four intersections at the Seminary Road interchange. However, close attention was also paid to the freeway ramps and mainline sections near the Seminary Road interchange to ensure a replication of the real field conditions in VISSIM models.

VDOT and the City of Alexandria defined the traffic study area sufficiently large to include those roadways, intersections and interstate ramps most impacted by the anticipated 2015 traffic congestion associated with access into and out of the BRAC -133 facility. The study area limits were described in the study scope of work approved in August 2010.

Base Model Calibration Approach

The previously calibrated models developed for the Mark Center Access Study were used. These models had been calibrated based on travel time and throughputs on I-395 freeway sections. However, that study focused primarily on the freeway operations, and the models were calibrated primarily on freeway throughputs and travel time. In this study, the local arterial system is the principal focus. Therefore, further calibrations and fine tuning were performed for the local street traffic. Two field measurements were used as the key targets in the base model (existing conditions model) calibration procedure for this study. Throughput volumes at the study intersections were used as the primary capacity target, and queuing formation conditions at key intersection approaches were used as the system performance target.

In general, the model calibration in this study followed the two-step procedure described in FHWA's *Guidelines for Applying Traffic Microsimulation Modeling Software*:

1. **Capacity calibration**: VISSIM model parameters were adjusted to meet the calibration criteria of the throughput volume target. These candidate parameters include driving behavior parameters (car-following parameters and lane-changing parameters), and lane change distance for different intersections.

2. **System performance calibration**: Traffic performance predicted by VISSIM simulation results were then compared to the field measurements, in this case, queuing conditions. Link free-flow speed and capacity related parameters were further refined to better match the field conditions.

The model parameters were adjusted to reflect actual network performance and driving conditions in an iterative process. The model was run with these adjusted parameters, and the outputs were examined against field measurements. If the criteria were not met, further adjustments were made, and the model was re-run, and so forth. Based on FHWA's *Guidelines for Applying Traffic Microsimulation Modeling Software*, this study used simulation results greater than 85 percent of field measurements as the calibration acceptance criteria.

Summary of Base Model Calibration Parameters

The following adjustments were made to reach the calibration criteria:

1. Two types of arterials were set for regular driving behaviors and aggressive arterial merging/lane-changing driving behavior. The latter type was particularly coded for short-distance lane changing on arterials, such as the rotary at the Seminary Road interchange.

2. Three freeway link types were set: (1) basic freeway, (2) merging/diverging section, and (3) weaving/lane drop section to reflect driver behavior along different types of freeway segments. These segments also account for aggressive driver behavior; parameters were

most aggressive for the weaving/lane drop sections, and least aggressive for the basic freeway segments.

3. The desired speed distributions on local arterials were set as speed limits ±5 mph.
4. Considering that the speed limit on I-395 near the study area is 55 mph, and that this speed is observed in the field, the desired speed distribution on freeway mainline segments in the VISSIM models was set as 50-60 mph.
5. Freeway link splits were made to accurately reflect the locations of merging/diverging points.
6. Reasonable lane change distances were set based on different types of roadways. For local streets, the lane change distances were set case-by-case based on intersection spacing and local driving experience. For most cases on freeway ramps, the lane change distances were set as 2,000 to 5,000 feet.
7. The entire study area of Seminary Road near Mark Center site as well as I-395 corridor section between Little River Turnpike/Duke Street and King Street was coded in the VISSIM model. Speed reduction zones were set at the north end on I-395 NB and the south end on I-395 SB to reflect upstream/downstream congestion. Based on the I-95/I-395 HOT Lanes Interchange Justification Report, the traffic conditions at these downstream bottlenecks are at LOS E-F. The desired speed at these reduction zones was set as 25-35 mph.

Base Model Calibration Results

The calibration results were obtained from averaging five VISSIM model runs with different random seeds. Each model run was conducted for 3,600 seconds to collect data with 1,800-second initial time periods.

In all intersections, the total throughputs in VISSIM models were more than 90 percent of the actual field data. The field queuing conditions were measured based on surveillance aerial photos taken in peak hours of 2008 and 2009 by SkyComp for VDOT and the Virginia MegaProjects program as part of the yearly traffic condition monitoring reports. The average queue lengths from simulation model outputs at key intersections were in reasonable ranges compared with field observations. Calibration results are included in Appendix B.

Based on these efforts and subsequent results, it was concluded that the base models were suitably calibrated to reflect traffic conditions in the study area. The base models were further modified to predict traffic performance in the 12 future No-build and Build scenarios.

Future No-Build and Build Models

To maintain a consistent base for traffic operational analyses of all the scenarios, parameters in the calibrated base models were retained in the future No-build and Build models. New roadway geometry, lane configurations, future traffic volumes, new traffic signal timing and routing decisions were updated in the future No-build and Build models. Test runs were conducted and simulation outputs were reviewed to validate these future models.

4. Traffic Operational Analysis

The operational performance of the study area was evaluated for the existing condition (2009) and future No-Build and Build conditions (2015). As previously mentioned, VISSIM was used as the primary analysis tool because of its flexibility in coding complex roadway geometries as well as its comprehensive capability in modeling saturated traffic flow conditions. Three key arterial/intersection measures of effectiveness (MOEs) were selected to evaluate the traffic operational performance: (1) delay, (2) volume (throughput serviced), and (3) queue lengths for critical movements. Because VISSIM does not provide direct HCM delay and Level of Service in its output, the VISSIM delay results were not translated into HCM delay and LOS in this study. Instead, we used the VISSIM outputs directly for comparison across all the scenarios

4.1 2009 Existing Condition

The existing condition (2009) is based on traffic counts and represents a scenario where the BRAC-133 development is not in place. The 2009 traffic volumes are shown in Figure 4-1 (all figures are located at the end of the section). These volumes were analyzed for the study area intersections as described in Section 3.2. Overall intersection delay and average queue lengths were calculated and are shown for the AM peak hour and PM peak hour in Figures 4-2 and 4-3, respectively. More detailed operational information, such as delay by movement and throughput can be found in Appendix C of this report.

4.2 2015 No–build Condition

The 2015 condition represents the scenario where the BRAC-133 development is in place at the Mark Center and all other planned land use changes in the local area and region are in place. This scenario also assumes that all regional transportation improvements identified in the Metropolitan Washington Council of Governments Constrained Long Range Transportation Plan are in place. A key example of this is the I-95/I-395 HOT lanes project which included a new bus only access ramp to Seminary Road to and from the HOT lanes from the south. The Seminary Road and Beauregard Street turn lane improvements that are currently under construction near the Mark Center are also considered part of this 2015 baseline condition. The term 'no-build' pertains to any **additional** improvements not part of an existing, planned, or programmed list. These 'additional improvements' were the subject of the short-/mid-term study.

The 2015 traffic volumes are shown in Figure 4-4. These volumes were analyzed for the study area intersections described in Section 3.2. Overall intersection delay and average queue lengths were calculated and are shown for the AM peak hour and PM peak hour in Figures 4-5 and 4-6, respectively. For the purposes of the operational analysis, pedestrians are assumed to be present and needing accommodation at the study area intersections as described in Section 3.2.5. For the 2015 No-build condition, most of the study area intersections are showing significant delay resulting in recurring congestion. Queue spill-back from many of the intersections extend to and interfere with upstream intersections or freeway gore areas. More-detailed operational information, such as delay by movement and throughput can be found in Appendix C of this report.

4.3 2015 Build Condition

The 2015 Build condition represents everything described for the 2015 No-build scenario, with the only change being the various alternatives described in Section 2 of this report. Each unique alternative (combination of spot improvements) was modeled to evaluate its ability to address the transportation deficiencies identified in the No-build condition. The VISSIM Measures of Effectiveness (MOE) evaluated for each alternative included throughput, average delay, and average queue length. A detailed table of the MOE results is included in Appendix C.

The AM peak hour delay and queue spill-back results for each alternative was compared to the no-build condition for the various alternatives and is shown on Figures 4-7 thru 4-11. In order to identify the benefits of each alternative since some of the proposed spot/operational improvements were minor, a cumulative delay verses throughput graph was prepared to illustrate the benefits of each alternative. The average delay and throughput values for the three local intersections were combined on one chart and the four rotary intersections on the second chart. The combined average delay and throughput for each alternative including the no-build is shown on Figures 4-12 and 4-13. The same information was prepared for the PM peak hour and the queue spill-back is shown on Figures 4-14 thru 4-18 and the combined average delay and throughput is shown on Figures 4-19 and 4-20.

Below are the key findings from a review of the 2015 Build traffic analysis results:

- Many alternatives show significant improvements in 2015 queuing and delay when compared to the No-build condition with the exception of the local intersection delay and throughput provided in Alternative C in the PM peak hour.
- The I-395 Northbound off-ramp operations are expected to improve significantly due to the proposed changes at location #1. The additional left turn lane will greatly reduce the queue that is anticipated to reach the mainline lanes under the 2015 peak conditions.
- The I-395 Southbound on-ramp merge point with the mainlanes is anticipated to operate with no-change due to no change to the ramp metering device that regulates vehicles entering the mainlanes during the peak period.
- None of the alternatives is successful at resolving the internal queue problem for traffic attempting to exit the Mark Center site in the PM peak hour however Alternative 'E' does provide some benefit.
- The pedestrian bridge crossing Seminary Road at Mark Center Drive provided with Alternative 'E' improves the intersection and rotary operations.
- While much improved, the intersection of Seminary Road and Mark Center Drive will still operate with significant delay and recurring congestion in the PM peak hour, even with the most significant improvements tested in this study.
- Alternative 'E' provides the least delay, highest throughput and best overall operations of the proposed alternatives.

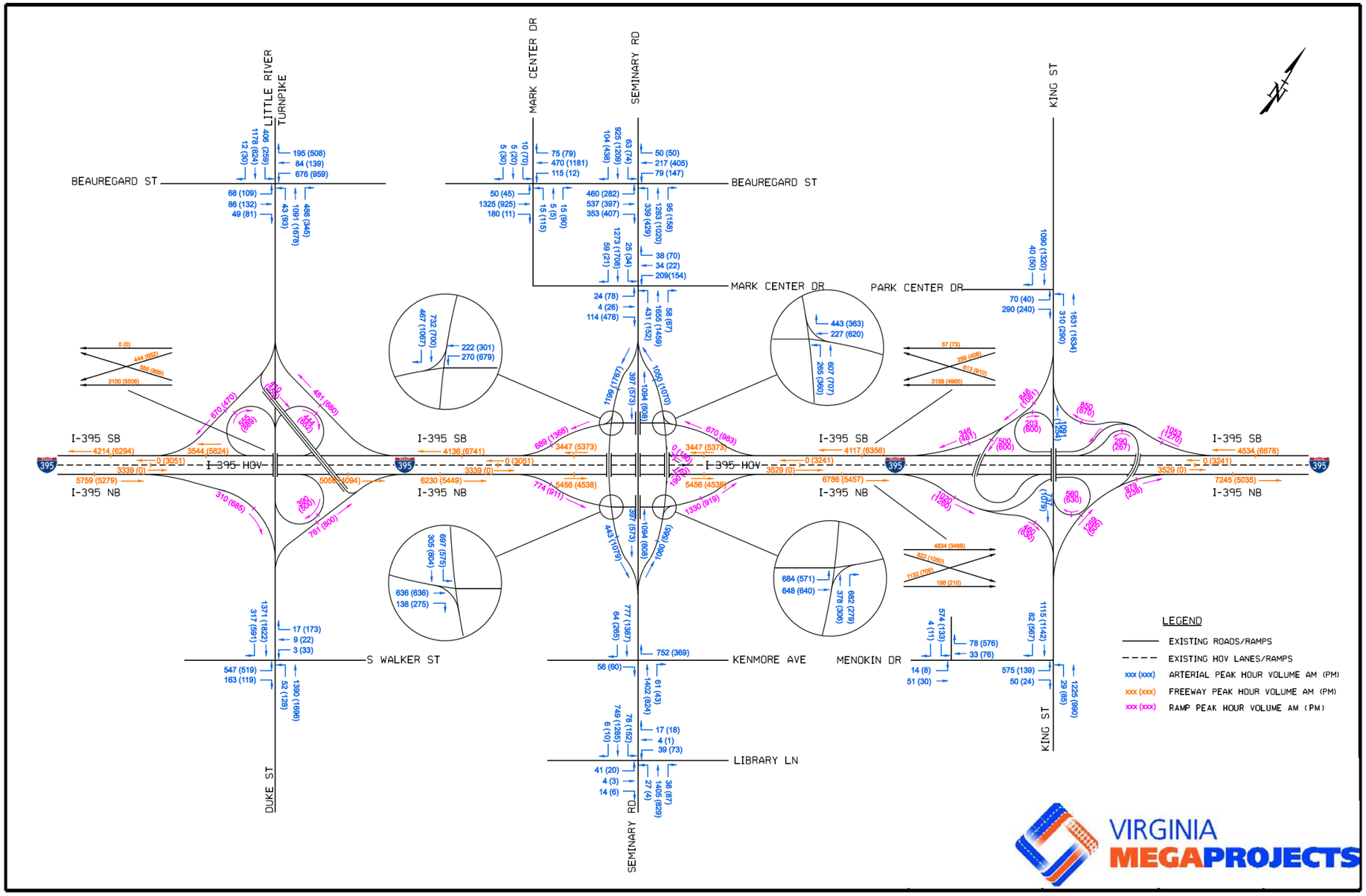


FIGURE 4-1
2009 Existing Traffic Turning Movement Counts

FIGURE 4-2

Average Intersection Delays and Average Queue Lengths of Critical Movements – AM Peak Hour, 2009 Condition

FIGURE 4-3

Average Intersection Delays and Average Queue Lengths of Critical Movements – PM Peak Hour, 2009 Condition

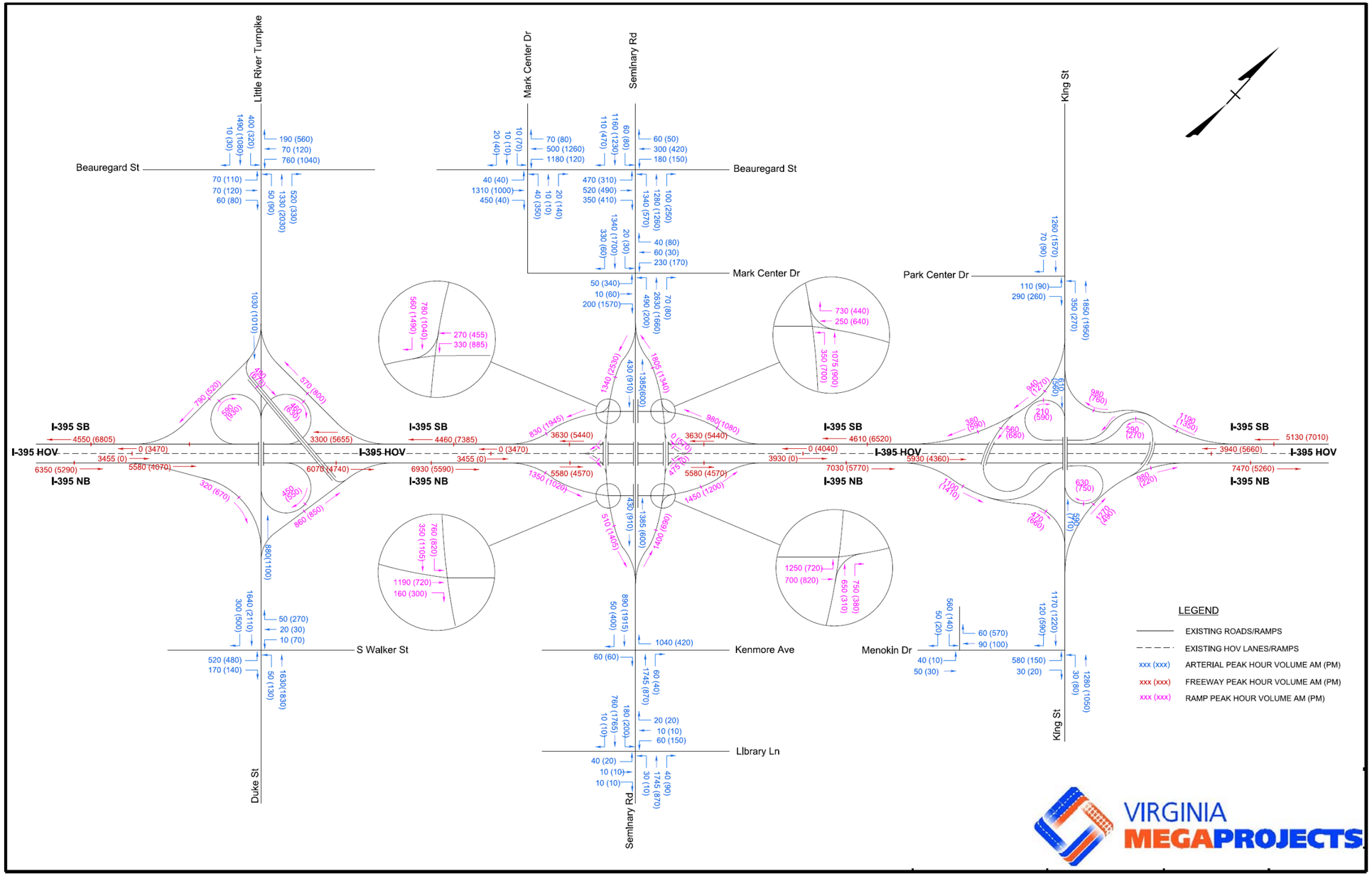


FIGURE 4-4
2015 Forecasting Traffic Turning Movement Counts

FIGURE 4-5

Average Intersection Delays and Average Queue Lengths of Critical Movements – AM Peak Hour, 2015 No-Build (Baseline)

FIGURE 4-6

Average Intersection Delays and Average Queue Lengths of Critical Movements – PM Peak Hour, 2015 No-Build (Baseline)

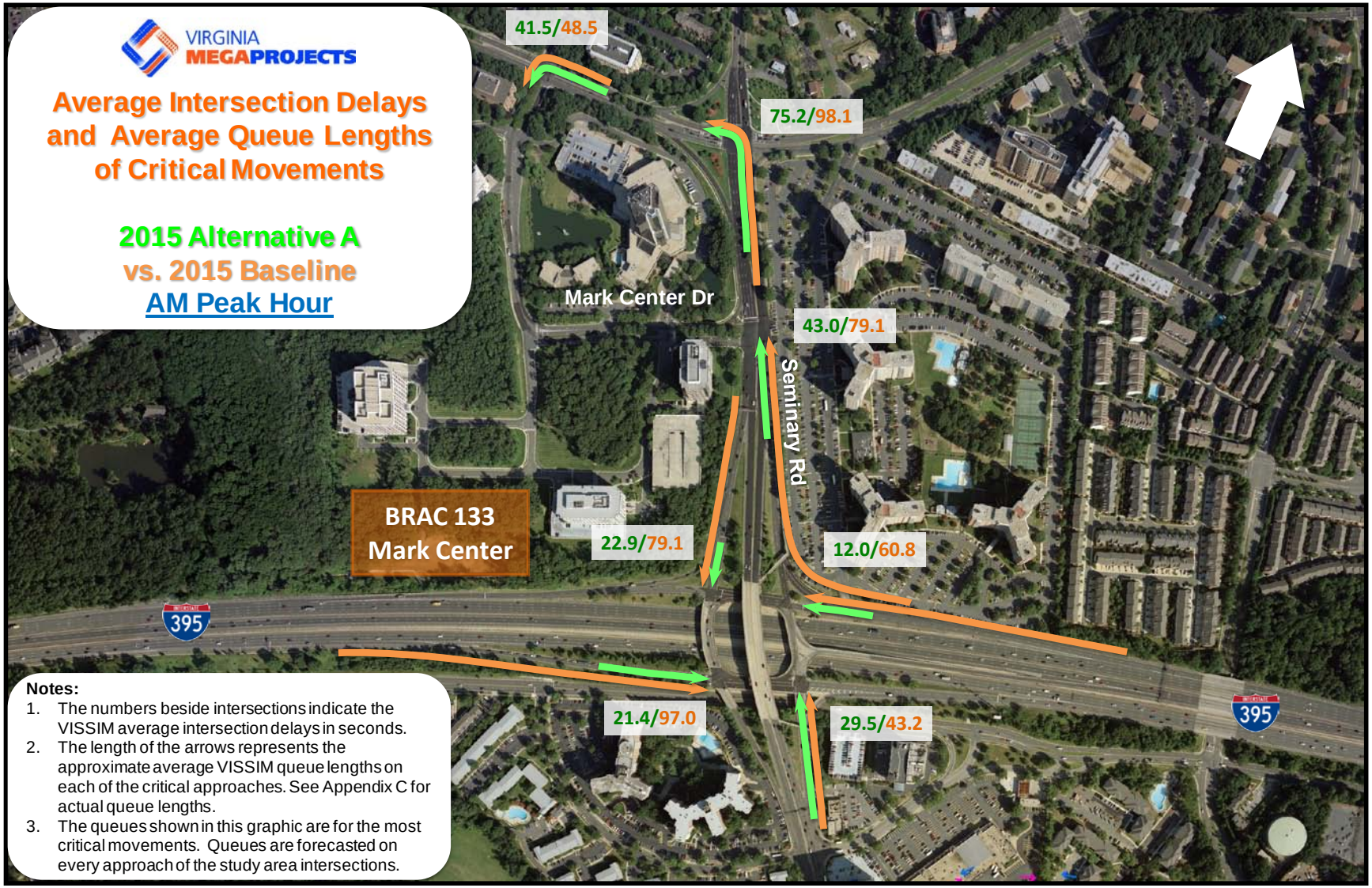


FIGURE 4-7

Average Intersection Delays and Average Queue Lengths of Critical Movements – AM, 2015 Alternative A vs. 2015 Baseline

FIGURE 4-8

Average Intersection Delays and Average Queue Lengths of Critical Movements – AM, 2015 Alternative B vs. 2015 Baseline

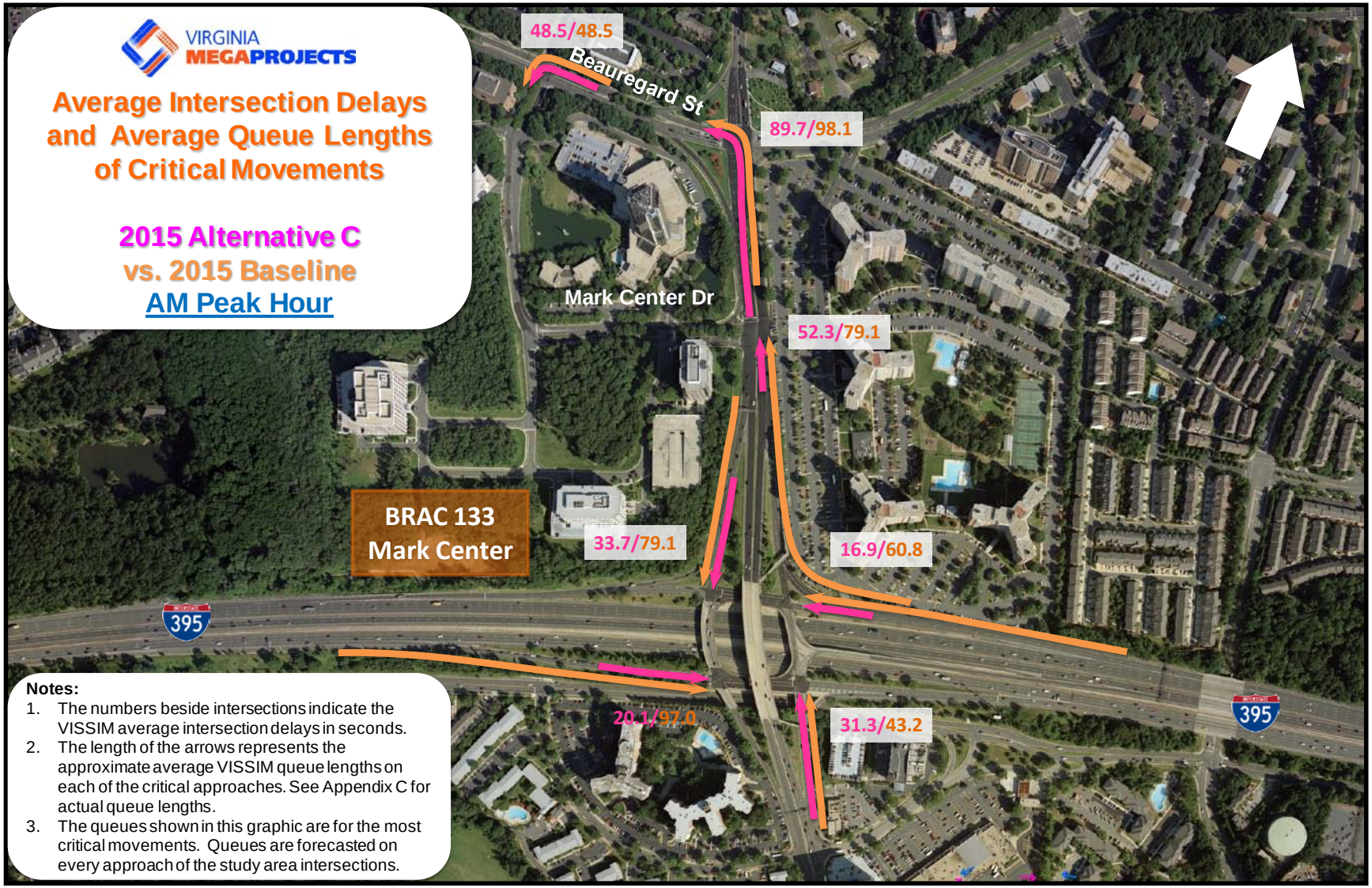


FIGURE 4-9

Average Intersection Delays and Average Queue Lengths of Critical Movements – AM, 2015 Alternative C vs. 2015 Baseline

FIGURE 4-10

Average Intersection Delays and Average Queue Lengths of Critical Movements – AM, 2015 Alternative D vs. 2015 Baseline

FIGURE 4-11

Average Intersection Delays and Average Queue Lengths of Critical Movements – AM, 2015 Alternative E vs. 2015 Baseline

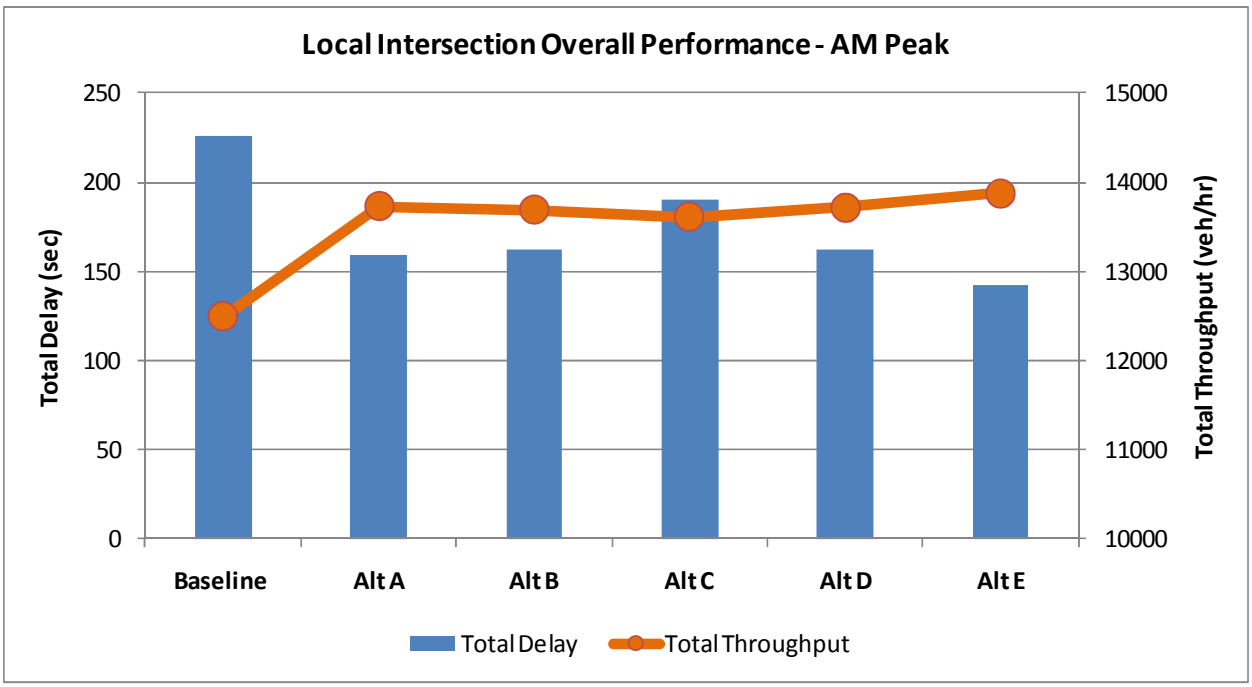


FIGURE 4-12
Location Intersection Overall Performance – AM Peak

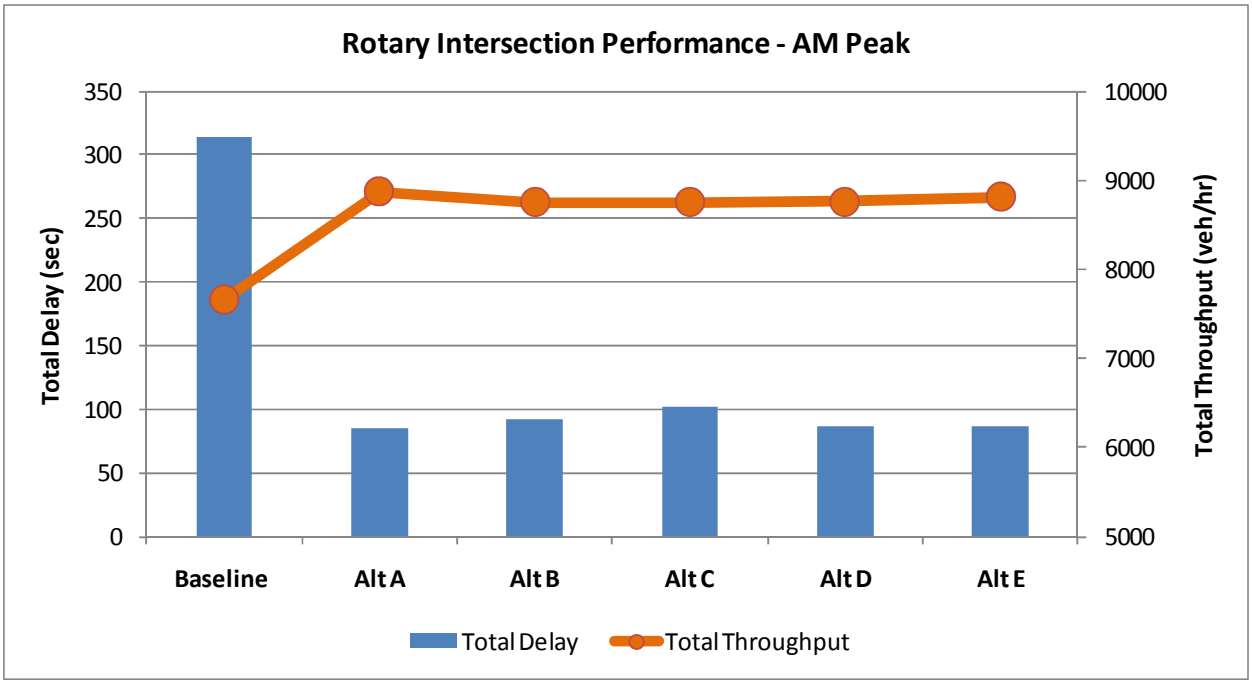


FIGURE 4-13
Rotary Intersection Performance – AM Peak

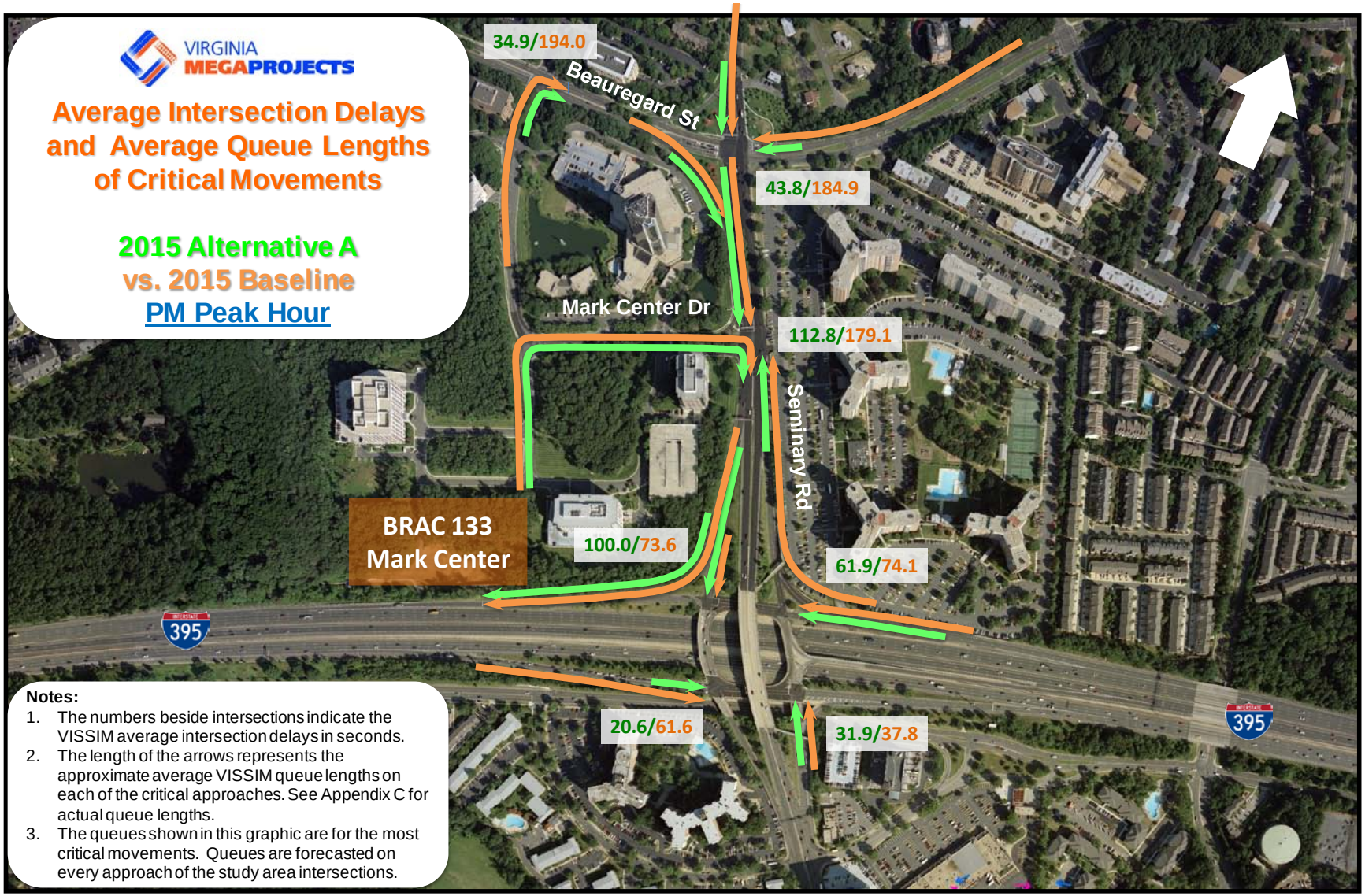


FIGURE 4-14

Average Intersection Delays and Average Queue Lengths of Critical Movements – PM, 2015 Alternative A vs. 2015 Baseline

FIGURE 4-15

Average Intersection Delays and Average Queue Lengths of Critical Movements – PM, 2015 Alternative B vs. 2015 Baseline

FIGURE 4-16

Average Intersection Delays and Average Queue Lengths of Critical Movements – PM, 2015 Alternative C vs. 2015 Baseline

FIGURE 4-17

Average Intersection Delays and Average Queue Lengths of Critical Movements – PM, 2015 Alternative D vs. 2015 Baseline

FIGURE 4-18

Average Intersection Delays and Average Queue Lengths of Critical Movements – PM, 2015 Alternative E vs. 2015 Baseline

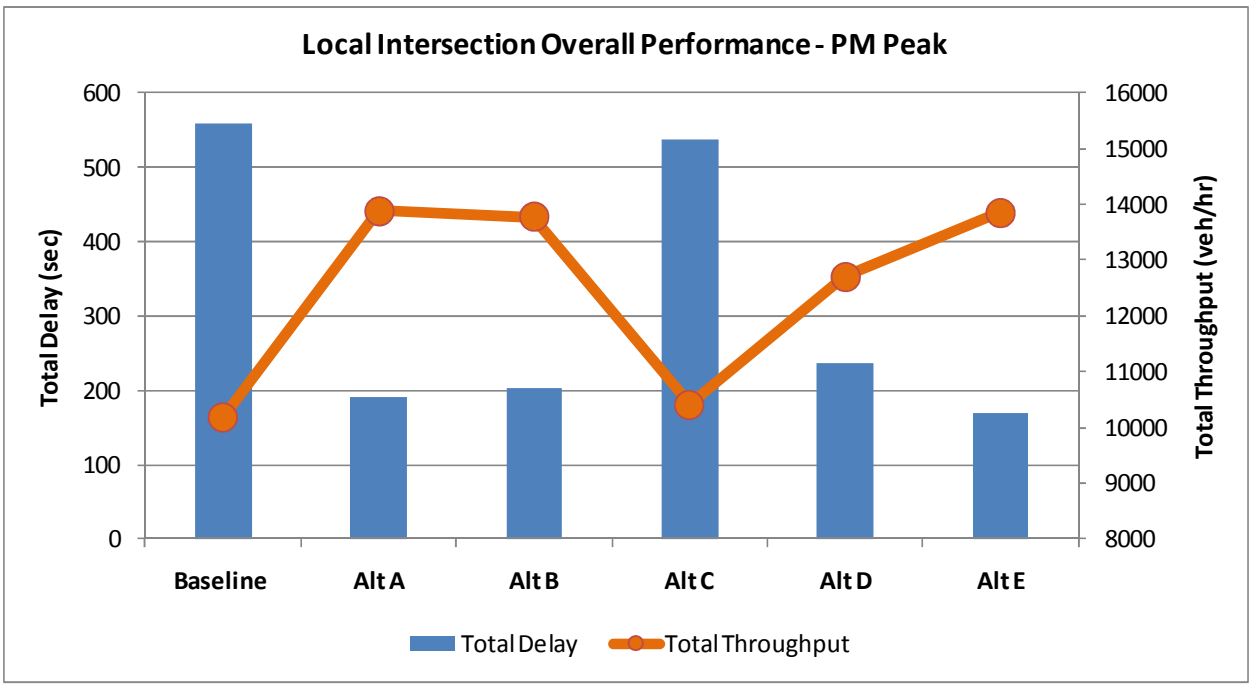


FIGURE 4-19
Intersection Overall Performance – PM Peak

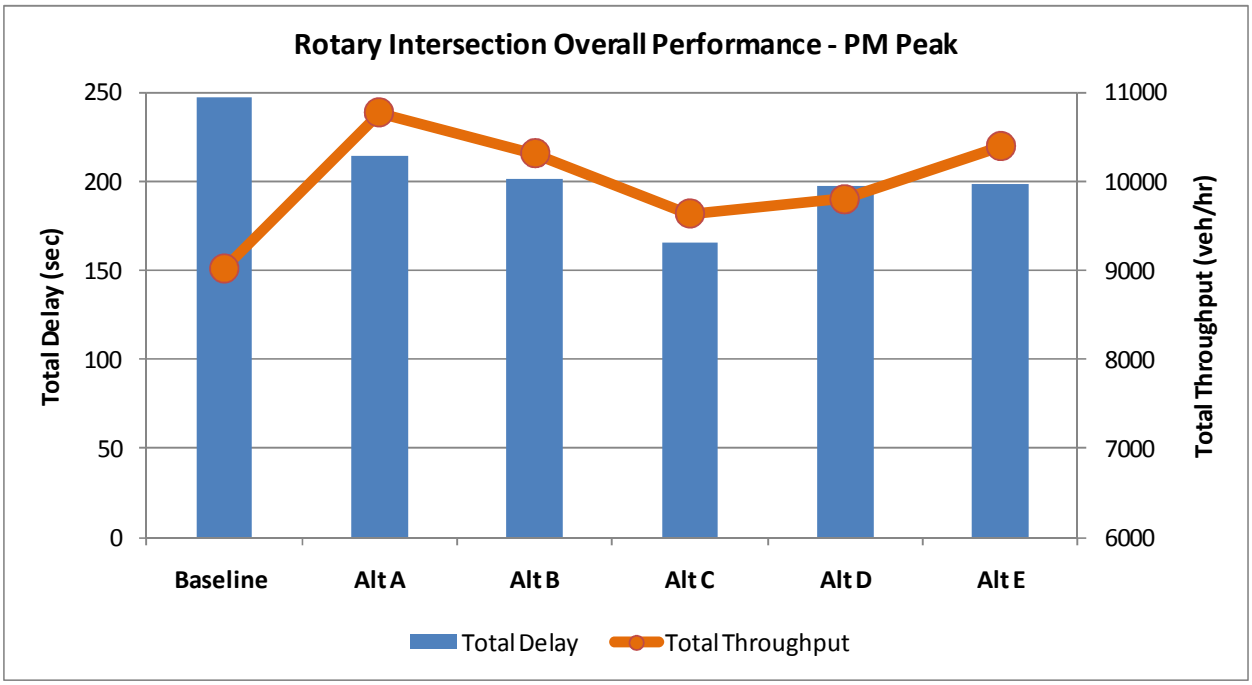


FIGURE 4-20
Rotary Intersection Overall Performance – PM Peak

5. Preferred Alternative

The study has shown that seven of the eight proposed improvements, as identified in Alternative 'E', provide a benefit to the operations of the study area. Therefore, it is recommended that Alternative 'E' proceed as the preferred alternative.

The conceptual plans for Alternative 'E' are included in Appendix D.

Appendix A
Agency Coordination

RESOLUTION

WHEREAS, the City Council established the BRAC-133 Advisory Group in February 2009 to create a forum for adjacent neighborhoods to provide input, ideas and recommendations to the City, the Army and to Duke Realty, as well as serve as a communication forum among all parties; and,

WHEREAS, the City and VDOT engaged a consultant to conduct an analysis of Short and Mid-term road improvements to address the anticipated traffic problems generated by the BRAC-133 facility located at the Mark Center; and,

WHEREAS, the consultant conducted such an analysis, prepared cost estimates and presented their recommendations to the BRAC-133 Advisory Group on November 17, 2010; and,

WHEREAS, the cost of these additional analyses generate a financial burden on the City of Alexandria as it seeks to mitigate the impacts of the BRAC-133 facility on transportation and other services; and,

WHEREAS, the BRAC-133 Advisory Group has carefully considered the recommendations of the consultant with regard to alternatives for short and mid-term transportation improvements in the immediate vicinity of the BRAC-133 facility.

NOW, THEREFORE BE IT RESOLVED BY THE BRAC-133 ADVISORY GROUP

1. That a recommendation be forwarded to the Alexandria City Council in support of the recommendations put forward by the consultant to implement Short and Mid-term traffic improvements as outlined herein, and identified as Alternative E Phased.
2. That Alternative E Phased shall include two phases.
3. That Phase I shall include Alternative D (Improvement areas 1,2a, 5 and 7)
4. That Phase II shall include Alternative E (Improvement areas 2b, 3, 6, and Pedestrian Bridge)
5. That the preferred procurement method is design-build and that projects from either Phase I or Phase II should be completed as soon as circumstances permit.

AND BE IT FURTHER RESOLVED BY THE BRAC-133 ADVISORY GROUP

That City Council request the Federal Government and/or Duke Realty and/or other comparable alternative sources bear the full cost of these analyses and the full cost of implementing the improvements.

ADOPTED: November 17, 2010

David T. Dexter

David Dexter, Chair
BRAC-133 Advisory Group

Geoffrey M. Goodale

Geoffrey Goodale, Vice Chair
BRAC-133 Advisory Group

RESOLUTION NO. 2427

WHEREAS, The United States Department of Defense (DoD) has selected and purchased a building site at the Mark Center as the location to construct a major office building and associated facilities (BRAC-133 facility) for occupancy by the Washington Headquarters Service and other DoD agencies; and

WHEREAS, this BRAC-133 facility will entail approximately 1,750,000 square feet of office space and house approximately 6,400 employees; and

WHEREAS, transportation improvements proffered with the 2004 approval of the 2004 Mark Winkler office development are now under construction; and

WHEREAS, City Council created the BRAC-133 Advisory Group to create a forum for developing ideas and recommendations relating to the transportation improvements and other issues associated with the BRAC-133 facility, as well as to serve as a communications forum among all parties; and

WHEREAS, those proffered improvements alone will not mitigate the impacts on traffic around the Mark Center once the BRAC-133 facility opens in September 2011; and

WHEREAS, the City in cooperation with the Office of Economic Adjustment (OEA) contracted with the VDOT General Engineering Contractor (GEC) to analyze and make recommendations for short- and mid–term road improvements to further mitigate traffic impacts from the BRAC-133 facility; and

WHEREAS, GEC made a recommendation to the BRAC-133 Advisory Group with respect to such Short- and Mid-term Road Improvements; and

WHEREAS, the Short- and Mid-term Road Improvements encompass GEC Improvement Areas Phase I (Improvement Areas 1, 2a, 5 and 7) and Phase II (Improvement Areas 2b, 3, 6 and the pedestrian bridge); and

WHEREAS, the BRAC-133 Advisory Group adopted a resolution on November 17, 2010 to recommend that the City Council implement the GEC recommended Short- and Mid-term Road Improvements.

NOW, THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF ALEXANDRIA, VIRGINIA THAT
City Council endorses the Short- and Mid-term Road Improvements and hereby authorizes the City Manager to pursue by all reasonable means the securing of funding from the Department of Defense or any other appropriate Federal Government entity for the environmental analyses, engineering design, and construction and related costs of the Short- and Mid-term Road Improvements recommended by the GEC, as well as to seek right-of-way donations from the adjacent and benefited property owners.

Adopted: December 14, 2010

WILLIAM D. EUILLE MAYOR

ATTEST:

Jacqueline M. Henderson, MMC City Clerk

Appendix B
VISSIM Model Calibration Results

Table B-1
Throughput Calibration Results at Local Intersections

Intersection		Beauregard Street & Mark Center Drive												
Movement		EBL	EBT	EBR	SBL	SBT	SBR	WBL	WBT	WBR	NBL	NBT	NBR	Overall
2009 Existing AM	Field Data	10	5	5	115	470	75	15	5	15	50	1325	180	**2270**
	VISSIM Throughput	10	4	7	117	453	72	14	5	17	51	1321	179	**2250**
	Thruput Percent	98%	88%	132%	102%	96%	97%	96%	100%	112%	103%	100%	99%	**99%**
2009 Existing Demand	Field Data	70	20	30	12	1181	79	115	5	90	45	925	11	**2583**
	VISSIM Throughput	69	9	28	112	1200	74	322	9	116	43	940	40	**2963**
	Thruput Percent	98%	92%	71%	94%	95%	93%	92%	92%	83%	107%	94%	99%	**94%**

Intersection		Seminary Road & Beauregard Street												
Movement		EBL	EBT	EBR	SBL	SBT	SBR	WBL	WBT	WBR	NBL	NBT	NBR	Overall
2009 Existing AM	Field Data	63	925	104	79	217	50	339	1283	95	460	537	353	**4505**
	VISSIM Throughput	63	933	101	86	230	56	309	1213	78	452	535	358	**4414**
	Thruput Percent	99%	101%	97%	109%	106%	113%	91%	95%	82%	98%	100%	101%	**98%**
2009 Existing Demand	Field Data	74	1209	438	147	405	50	429	1020	158	282	397	407	**5016**
	VISSIM Throughput	77	1194	454	152	425	52	510	1159	225	292	438	352	**5330**
	Thruput Percent	96%	97%	97%	101%	101%	104%	90%	92%	90%	94%	89%	86%	**94%**

Intersection		Seminary Road & Mark Center Drive												
Movement		EBL	EBT	EBR	SBL	SBT	SBR	WBL	WBT	WBR	NBL	NBT	NBR	Overall
2009 Existing AM	Field Data	25	1273	59	209	34	38	431	1655	58	24	4	114	**3924**
	VISSIM Throughput	27	1287	58	213	35	31	349	1546	50	25	5	109	**3736**
	Thruput Percent	107%	101%	98%	102%	104%	82%	81%	93%	87%	103%	125%	96%	**95%**
2009 Existing Demand	Field Data	34	1708	21	154	22	70	152	1459	67	78	26	478	**4269**
	VISSIM Throughput	29	1649	57	165	26	81	185	1647	82	251	33	1276	**5482**
	Thruput Percent	97%	97%	95%	97%	87%	101%	93%	99%	102%	74%	55%	81%	**92%**

Table B-2
Throughput Calibration Results at Rotary Interchange Intersections

Intersection		Seminary Road & I-395 SB On-Ramp					Seminary Road & I-395 SB Off-Ramp					Seminary Road & I-395 NB On-Ramp					Seminary Road & I-395 NB Off-Ramp				
Movement		EBT	EBR	SBL	SBT	Overall	SBT	SBR	WBL	WBT	Overall	EBL	EBT	NBT	NBR	Overall	WBT	WBR	NBL	NBT	Overall
2009 Existing AM	Field Data	732	467	270	222	**1691**	227	443	265	607	**1542**	697	305	636	138	**1776**	378	682	684	648	**2392**
	VISSIM Throughput	731	463	229	219	**1642**	229	419	218	546	**1412**	693	263	570	126	**1652**	217	659	544	648	**2068**
	Thruput Percent	100%	99%	85%	99%	**97%**	101%	95%	82%	90%	**92%**	99%	86%	90%	92%	**93%**	57%	97%	80%	100%	**86%**
2009 Existing Demand	Field Data	700	1067	679	301	**2747**	620	363	360	707	**2050**	575	804	636	275	**2290**	306	279	571	640	**1796**
	VISSIM Throughput	829	1144	800	447	**3220**	559	405	713	836	**2514**	670	953	668	272	**2563**	312	368	659	670	**2009**
	Thruput Percent	80%	77%	90%	98%	**83%**	87%	92%	102%	93%	**94%**	82%	86%	93%	91%	**87%**	101%	97%	92%	82%	**90%**

Table B-3
Throughput Calibration Results on Freeway Sections

Segment	2009 Existing AM Peak Hour			2009 Existing PM Peak Hour		
	VISSIM Outputs (vph)	Field Measurements (vhp)	Difference	VISSIM Outputs (vph)	Field Measurements (vhp)	Difference
I-395 GP Northbound						
I-395 NB Before NB Off Ramp to Duke Street EB	5303	5279	0%	5303	5279	0%
I-395 NB Off Ramp to Duke Street EB	671	685	-2%	671	685	-2%
I-395 NB Off Ramp to Duke Street WB	487	500	-3%	487	500	-3%
I-395 NB On Ramp from Duke Street Both Bounds	1317	1452	-9%	1317	1452	-9%
I-395 NB Between Duke Street and Seminary Road	5464	5449	0%	5464	5449	0%
I-395 NB Between NB On and Off Ramp at Seminary Road	4564	4538	1%	4564	4538	1%
I-395 NB Between Seminary Road and King Street	5442	5457	0%	5442	5457	0%
I-395 NB Off Ramp to King Street	1251	1260	-1%	1251	1260	-1%
I-395 NB After NB On Ramp from King Street	5036	5035	0%	5036	5035	0%
I-395 HOV Southbound						
I-395 HOV SB Before Seminary Road	3267	3241	1%	3267	3241	1%
I-395 HOV SB After Seminary Road	3074	3051	1%	3074	3051	1%
I-395 GP Southbound						
I-395 SB Before SB Off Ramp to King Street	6415	6878	-7%	6415	6878	-7%
I-395 SB Off Ramp to King Street	1177	1270	-7%	1177	1270	-7%
I-395 SB Between King Street and Seminary Road	5935	6356	-7%	5935	6356	-7%
I-395 SB Between SB On and Off Ramp at Seminary Road	4997	5373	-7%	4997	5373	-7%
I-395 SB Between Seminary Road and Duke Street	6066	6471	-6%	6066	6471	-6%
I-395 SB Off Ramp to Duke Street WB	620	680	-9%	620	680	-9%
I-395 SB Off Ramp to Duke Street EB	780	889	-12%	780	889	-12%
I-395 SB On Ramp from Duke Street WB	451	470	-4%	451	470	-4%
I-395 SB After NB On Ramp from Duke Street	5547	6294	-12%	5547	6294	-12%

Table B-4
Travel Time Calibration Results on Freeway Sections

Time Period	Segment	VISSIM Outputs (sec)	Field Measurements (sec)	Difference
AM Peak	395 NB from Duke St to King St	352.62	367	-3.92%
	395 SB from King St to Duke St	222.3	207	7.39%
PM Peak	395 NB from Duke St to King St	244.78	217	12.80%
	395 SB from King St to Duke St	446.52	494	-9.61%

Appendix C
VISSIM Operational Analysis Results

TABLE C-1

VISSIM Operational Analysis Results - Key Signalized Intersections MOEs (AM Peak Hours)

Intersection	Movement	2009 Existing Demand	2009 Existing AM						2015 Future Demand	2015 Baseline AM						2015 Alternative A AM					
			Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)		Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)	Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)
Beauregard Street & Mark Center Drive	EBL	10	10	0	98%	37.7	3	69	10	9	-1	94%	77.3	12	117	9	-1	94%	51.6	7	87
	EBT	5	4	-1	88%	31.2	3	69	10	12	2	116%	73.4	12	117	11	1	114%	60.8	7	87
	EBR	5	7	2	132%	8.1	4	72	20	21	1	103%	24	10	124	21	1	103%	12	5	94
	SBL	115	117	2	102%	21.9	10	142	1180	920	-260	78%	42	202	805	1071	-109	91%	37	208	770
	SBT	470	453	-17	96%	2.9	3	127	500	398	-102	80%	12	29	756	452	-48	90%	11	29	614
	SBR	75	72	-3	97%	2.5	3	129	70	56	-14	80%	12	30	759	66	-4	94%	10	29	617
	WBL	15	14	-1	96%	49.2	11	104	40	34	-6	85%	76.9	19	104	38	-2	95%	56.8	15	117
	WBT	5	5	0	100%	36.0	11	104	10	9	-1	90%	67.4	19	104	8	-2	84%	59.8	15	117
	WBR	15	17	2	112%	49.5	11	104	20	19	-1	96%	15.1	20	106	21	1	106%	12.3	16	119
	NBL	50	51	1	103%	4.3	0	24	40	41	1	103%	108	19	116	41	1	102%	104	13	110
	NBT	1325	1321	-4	100%	3.6	8	173	1310	1292	-18	99%	61.3	313	941	1285	-25	98%	50.9	224	746
	NBR	180	179	-1	99%	3.3	8	174	450	454	4	101%	55.8	312	942	446	-4	99%	57.1	225	747
	Overall	**2270**	**2250**	**-20**	**99%**	**5.3**			**3660**	**3265**	**-395**	**89%**	**48.5**			**3469**	**-191**	**95%**	**41.5**		
Seminary Road & Beauregard Street	EBL	63	63	0	99%	62.9	20	127	60	58	-2	97%	136.6	70	979	59	-1	98%	143	64	712
	EBT	925	933	8	101%	30.8	64	344	1160	1114	-46	96%	129.8	442	1322	1157	-3	100%	83	332	910
	EBR	104	101	-3	97%	3.9	0	4	110	108	-2	98%	37	0	32	111	1	101%	32	0	35
	SBL	79	86	7	109%	59.7	27	151	180	134	-46	74%	359	456	1146	176	-4	98%	119	125	435
	SBT	217	230	13	106%	44.5	40	184	300	290	-10	97%	110	293	986	311	11	104%	56	60	249
	SBR	50	56	6	113%	42.3	40	184	60	59	-1	98%	108.9	293	986	64	4	106%	53.9	60	249
	WBL	339	309	-30	91%	52.5	66	502	1340	988	-352	74%	95	181	542	1157	-183	86%	85	185	730
	WBT	1283	1213	-70	95%	38.2	155	660	1280	897	-383	70%	34	100	473	1049	-231	82%	42	136	566
	WBR	95	78	-17	82%	25.1	120	605	100	66	-34	66%	18	69	414	78	-22	78%	16	101	506
	NBL	460	452	-8	98%	60.9	95	414	470	435	-35	93%	169.8	389	775	442	-28	94%	196	451	799
	NBT	537	535	-2	100%	39.5	65	371	520	501	-19	96%	71.7	258	777	494	-26	95%	47	61	316
	NBR 1	353	358	5	101%	1.3	1	75	350	351	1	100%	35	122	430	276	0	100%	16	57	273
	NBR 2															74			14	61	316
	Overall	**4505**	**4414**	**-91**	**98%**	**37.2**			**5930**	**5001**	**-929**	**84%**	**98.1**			**5447**	**-483**	**92%**	**75.2**		
Seminary Road & Mark Center Drive	EBL	25	27	2	107%	90.5	13	79	20	19	-1	93%	140	14	73	22	2	109%	103	11	70
	EBT	1273	1287	14	101%	19.8	62	349	1340	1207	-133	90%	87.4	419	836	1335	-5	100%	46.5	207	597
	EBR	59	58	-1	98%	3.3	53	348	330	297	-33	90%	52.9	419	838	318	-12	96%	49.5	207	598
	SBL	209	213	4	102%	67.6	88	260	230	183	-47	80%	334.8	329	486	234	4	102%	61.0	91	277
	SBT	34	35	1	104%	82.5	88	260	60	42	-18	70%	317.2	329	486	62	2	104%	68.4	91	277
	SBR	38	31	-7	82%	9.0	91	264	40	33	-7	82%	332.2	332	489	37	-3	92%	51.3	91	277
	WBL	431	349	-82	81%	109.7	422	1065	490	285	-205	58%	80	133	491	316	-174	64%	64	137	505
	WBT	1655	1546	-109	93%	21.6	116	884	2630	1871	-759	71%	41.6	1518	1678	2195	-435	83%	34	279	1225
	WBR	58	50	-8	87%	18.4	116	884	70	48	-22	69%	36.9	1518	1678	53	-17	76%	33	279	1225
	NBL	24	25	1	103%	56.8	12	82	50	47	-3	93%	126.2	57	196	46	-4	91%	86.4	33	107
	NBT	4	5	1	125%	56.7	12	82	10	8	-2	84%	123.9	57	196	8	-2	78%	102.4	33	107
	NBR	114	109	-5	96%	15.9	12	82	200	186	-14	93%	83.8	57	196	190	-10	95%	30.1	33	107
	Overall	**3924**	**3736**	**-188**	**95%**	**32.6**			**5470**	**4224**	**-1246**	**77%**	**79.1**			**4815**	**-655**	**88%**	**43.0**		
Seminary Road & I-395 SB On Ramp	EBT	732	731	-1	100%	46.0	103	535	780	667	-113	86%	95	840	1070	765	-15	98%	52	83	465
	EBR	467	463	-4	99%	2	0	0	560	497	-63	89%	62	435	658	561	1	100%	2	2	88
	SBL	270	229	-41	85%	1.7	0	19	330	192	-138	58%	2	0	51	248	-82	75%	1.9	0	33
	SBT	222	219	-3	99%	0.2	0	19	270	197	-73	73%	0	0	51	227	-43	84%	0	0	33
	Overall	**1691**	**1642**	**-49**	**97%**	**21.2**			**1940**	**1553**	**-387**	**80%**	**60.8**			**1801**	**-139**	**93%**	**22.9**		
Seminary Road & I-395 SB Off Ramp	SBT	227	229	2	101%	51.7	41	169	250	192	-58	77%	212	1216	1676	249	-1	100%	73	61	199
	SBR	443	419	-24	95%	8.8	2	33	730	559	-171	77%	222	1151	1674	712	-18	97%	10	0	0
	WBL	265	218	-47	82%	1.1	0	53	350	197	-153	56%	1	3	118	225	-125	64%	0.8	0	76
	WBT	607	546	-61	90%	5.9	0	53	1075	996	-79	93%	24	3	118	1129	54	105%	1.7	0	76
	Overall	**1542**	**1412**	**-130**	**92%**	**13.5**			**2405**	**1944**	**-461**	**81%**	**97.0**			**2315**	**-90**	**96%**	**12.0**		
Seminary Road & I-395 NB Off Ramp	EBL	697	693	-4	99%	22.7	1	77	760	648	-112	85%	3.3	3	96	746	-14	98%	3.0	1	87
	EBT	305	263	-42	86%	21.5	1	77	350	210	-140	60%	3.4	3	96	268	-82	77%	1.7	1	87
	NBT	636	570	-66	90%	65.9	505	1008	1190	926	-264	78%	211	1361	1678	1040	-150	87%	42	135	541
	NBR	138	126	-12	92%	3.6	0	48	160	127	-33	79%	131	1	67	143	-17	89%	6	0	66
	Overall	**1776**	**1652**	**-124**	**93%**	**36.0**			**2460**	**1911**	**-549**	**78%**	**112.6**			**2196**	**-264**	**89%**	**21.4**		
Seminary Road & I-395 NB On Ramp	WBT	378	217	-161	57%	54.8	64	252	650	364	-286	56%	175.4	616	769	418	-232	64%	122.6	544	765
	WBR	682	659	-23	97%	1.4	0	31	750	453	-297	60%	53.2	375	526	511	-239	68%	39.9	313	522
	NBL	684	544	-140	80%	2.9	0	22	1250	830	-420	66%	4.5	5	170	936	-314	75%	1.7	7	145
	NBT	648	648	0	100%	0.7	1	40	700	605	-95	86%	9	16	217	690	-10	99%	3.2	7	145
	Overall	**2392**	**2068**	**-324**	**86%**	**7.2**			**3350**	**2252**	**-1098**	**67%**	**43.2**			**2555**	**-795**	**76%**	**29.5**		

Intersection	Movement	2015 Alternative B AM						2015 Alternative C AM						2015 Alternative D AM						2015 Alternative E AM					
		Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)	Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)	Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)	Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)
Beauregard Street & Mark Center Drive	EBL	9	-2	85%	56.3	7	88	9	-1	88%	59.9	14	129	9	-1	94%	69.5	16	128	9	-1	94%	58.1	8	90
	EBT	12	2	118%	58.8	7	88	12	2	118%	52.2	7	91	11	1	114%	60.3	8	90	11	1	114%	63.3	8	90
	EBR	21	1	103%	13	6	95	21	1	103%	9	4	96	21	1	103%	11	5	95	21	1	103%	12	6	97
	SBL	1066	-114	90%	34	185	761	1062	-118	90%	34	179	756	1067	-113	90%	35	182	741	1068	-112	91%	33	180	750
	SBT	449	-51	90%	12	34	687	453	-47	91%	15	42	649	451	-49	90%	11	28	622	448	-52	90%	10	26	617
	SBR	62	-8	89%	11	35	690	62	-9	88%	14	43	652	64	-6	91%	11	27	621	65	-5	93%	9	26	620
	WBL	35	-5	87%	53.1	14	92	35	-5	88%	52.8	13	93	36	-4	91%	59.9	15	99	39	-1	97%	60.5	17	117
	WBT	10	0	100%	63.2	14	92	11	1	105%	43.1	13	93	9	-1	92%	51.3	15	99	9	-1	86%	61.3	17	117
	WBR	21	1	103%	16.3	15	94	19	-1	95%	15.9	14	95	20	0	99%	14.8	15	99	20	0	101%	10.4	17	119
	NBL	42	2	105%	77	14	99	41	1	103%	83	13	99	42	2	104%	100	13	103	41	1	103%	98	13	108
	NBT	1290	-21	98%	52.1	218	776	1283	-28	98%	65.6	303	921	1284	-26	98%	52.1	261	810	1288	-22	98%	50.6	502	970
	NBR	457	7	102%	54.8	219	777	449	-1	100%	73.0	304	922	456	6	101%	61.8	262	811	448	-2	100%	59.9	502	971
	Overall	**3472**	**-189**	**95%**	**41.0**			**3455**	**-205**	**94%**	**48.5**			**3471**	**-189**	**95%**	**42.3**			**3467**	**-193**	**95%**	**40.7**		
Seminary Road & Beauregard Street	EBL	57	-3	95%	151	276	996	56	-4	93%	177	374	1390	58	-2	96%	164	259	995	62	2	103%	162	77	716
	EBT	1146	-14	99%	104.2	671	1323	1117	-43	96%	146.1	874	1567	1138	-22	98%	101	592	1263	1161	1	100%	72	298	899
	EBR	108	-3	98%	51	0	34	106	-4	96%	61	0	5	108	-2	98%	48	0	25	113	3	103%	28	0	20
	SBL	185	5	103%	91	93	355	168	-12	93%	251	304	754	180	0	100%	84	82	318	181	1	100%	79	82	318
	SBT	315	15	105%	52	63	246	304	4	101%	65	60	239	311	11	104%	53	61	247	310	10	103%	53	63	247
	SBR	66	6	109%	53.9	63	246	63	3	105%	63.2	60	239	64	4	106%	52.9	61	247	64	4	106%	52.9	63	247
	WBL	1142	-198	85%	74	165	690	1157	-183	86%	76	171	668	1151	-189	86%	75	166	593	1148	-192	86%	81	178	610
	WBT	1036	-244	81%	50	180	735	1059	-222	83%	45	166	689	1048	-232	82%	45	164	693	1043	-237	81%	38	127	610
	WBR	77	-23	77%	23	142	673	78	-22	78%	29	128	630	79	-21	79%	31	128	634	78	-22	78%	12	93	550
	NBL	436	-34	93%	159.1	348	782	433	-37	92%	161.2	342	783	440	-30	94%	172	395	780	444	-26	95%	187	431	801
	NBT	511	-9	98%	47	170	766	505	-15	97%	48	92	550	508	-12	98%	50	237	688	495	-25	95%	41	56	294
	NBR 1	355	5	101%	27.0	81	436	346	-5	99%	20	76	439	353	3	101%	11	109	438	274	-2	99%	5	44	275
	NBR 2																			74			11	56	294
	Overall	**5433**	**-497**	**92%**	**75.6**			**5391**	**-539**	**91%**	**89.7**			**5438**	**-492**	**92%**	**74.3**			**5447**	**-483**	**92%**	**68.0**		
Seminary Road & Mark Center Drive	EBL	21	1	103%	105	11	67	20	0	100%	103	10	79	22	2	108%	112	13	72	22	2	109%	103	12	73
	EBT	1337	-3	100%	44.4	240	662	1257	-84	94%	76.5	355	750	1321	-19	99%	48.1	164	544	1334	-6	100%	43.1	95	460
	EBR	330	-1	100%	47.5	244	669	312	-19	94%	69.3	354	751	327	-3	99%	46.9	171	552	331	1	100%	38.5	94	462
	SBL	233	3	101%	60.5	91	273	235	5	102%	51.8	76	261	234	4	102%	62.4	73	273	240	10	104%	65.8	95	298
	SBT	63	3	104%	66.9	91	273	62	2	104%	56.4	76	261	63	3	105%	64.6	73	273	58	-2	96%	68.5	95	298
	SBR	37	-3	92%	53.7	91	273	36	-5	89%	17.9	79	264	37	-3	93%	15.9	74	276	38	-2	94%	54.9	95	298
	WBL	291	-199	59%	65	121	513	330	-160	67%	64	137	526	314	-176	64%	68	136	563	385	-105	78%	61	112	479
	WBT	2174	-456	83%	42	543	1517	2209	-421	84%	37	420	1339	2192	-438	83%	38	259	1262	2256	-374	86%	17	102	709
	WBR	55	-16	78%	34	543	1517	56	-14	80%	32	420	1339	55	-15	79%	36	279	1262	54	-16	78%	18	102	709
	NBL	46	-5	91%	87.2	32	106	45	-5	90%	88.6	30	117	50	0	99%	88.8	37	137	45	-5	91%	84.1	33	110
	NBT	9	-1	90%	82.3	32	106	9	-1	90%	76.8	30	117	9	-1	90%	102	37	137	8	-2	80%	101.6	33	110
	NBR	192	-9	96%	29.4	32	106	192	-9	96%	19.7	30	117	187	-13	93%	39.7	37	137	190	-10	95%	29.5	33	110
	Overall	**4785**	**-685**	**87%**	**45.7**			**4761**	**-709**	**87%**	**52.3**			**4810**	**-660**	**88%**	**46.0**			**4960**	**-510**	**91%**	**33.7**		
Seminary Road & I-395 SB On Ramp	EBT	774	-6	99%	54	130	478	740	-40	95%	75	187	723	753	-27	96%	49	75	445	766	-14	98%	54	88	445
	EBR	553	-8	99%	2	2	90	525	-36	94%	5	13	323	557	-3	99%	2	0	46	557	-3	99%	2	2	71
	SBL	246	-85	74%	1.9	0	42	247	-83	75%	1.9	0	59	250	-80	76%	1.7	0	9	246	-84	75%	1.7	0	34
	SBT	205	-65	76%	1	0	42	224	-46	83%	0	0	59	219	-51	81%	0	0	9	222	-48	82%	0	0	34
	Overall	**1777**	**-163**	**92%**	**24.6**			**1736**	**-205**	**89%**	**33.7**			**1779**	**-161**	**92%**	**21.7**			**1792**	**-148**	**92%**	**23.8**		
Seminary Road & I-395 SB Off Ramp	SBT	248	-2	99%	71	72	539	247	-3	99%	80	71	334	250	0	100%	81	67	206	246	-4	98%	79	66	220
	SBR	731	1	100%	31	1	54	729	-2	100%	20	0	24	719	-11	98%	10	0	0	713	-17	98%	6	0	0
	WBL	206	-144	59%	0.8	0	143	223	-128	64%	0.8	4	155	218	-132	62%	0.8	0	43	223	-127	64%	0.8	0	30
	WBT	1113	38	104%	3.2	0	143	1127	52	105%	4.0	4	155	1109	34	103%	1.3	0	43	1122	47	104%	0.4	0	30
	Overall	**2297**	**-108**	**96%**	**19.2**			**2325**	**-80**	**97%**	**16.9**			**2296**	**-109**	**95%**	**12.6**			**2304**	**-101**	**96%**	**10.6**		
Seminary Road & I-395 NB Off Ramp	EBL	755	-6	99%	3.1	2	94	717	-44	94%	3.2	1	73	737	-23	97%	3.0	1	83	740	-20	97%	2.9	1	89
	EBT	267	-83	76%	2.7	2	94	268	-83	76%	1.7	1	73	270	-80	77%	1.6	1	83	271	-79	77%	1.8	1	89
	NBT	1037	-153	87%	40	135	600	1039	-152	87%	38	121	570	1028	-162	86%	41	132	525	1037	-153	87%	41	130	522
	NBR	140	-20	87%	6	0	61	139	-22	87%	6	0	47	142	-18	89%	6	0	52	143	-17	89%	6	0	46
	Overall	**2198**	**-262**	**89%**	**20.9**			**2161**	**-299**	**88%**	**20.5**			**2177**	**-283**	**89%**	**21.0**			**2191**	**-269**	**89%**	**20.8**		
Seminary Road & I-395 NB On Ramp	WBT	386	-264	59%	121.2	592	764	417	-234	64%	121.3	539	758	407	-243	63%	131.6	566	770	412	-238	63%	131.8	576	761
	WBR	465	-285	62%	41.1	359	521	521	-230	69%	39.9	310	515	494	-256	66%	45.8	334	527	493	-257	66%	45.4	342	518
	NBL	933	-317	75%	1.5	7	163	932	-318	75%	2.1	17	179	922	-328	74%	1.5	6	112	934	-316	75%	1.6	6	125
	NBT	693	-7	99%	3.1	7	163	661	-40	94%	8.2	17	179	685	-15	98%	3.2	6	112	685	-15	98%	3.2	6	125
	Overall	**2477**	**-873**	**74%**	**28.0**			**2530**	**-820**	**76%**	**31.1**			**2509**	**-841**	**75%**	**31.8**			**2524**	**-826**	**75%**	**31.9**		

TABLE C-2
VISSIM Operational Analysis Results - Key Signalized Intersections MOEs (PM Peak Hours)

Intersection	Movement	2009 Existing Demand	2009 Existing PM						2015 Future Demand	2015 Baseline PM					
			Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)		Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)
Beauregard Street & Mark Center Drive	EBL	70	71	1	101%	45.5	27	192	70	69	-1	99%	82.5	22	191
	EBT	20	17	-3	86%	44.5	27	192	10	9	-1	92%	32.5	22	191
	EBR	30	29	-1	98%	21.8	29	194	40	28	-12	71%	25.9	23	193
	SBL	12	10	-2	80%	36.8	1	28	120	93	-27	78%	127	41	127
	SBT	1181	1220	39	103%	4.0	13	204	1260	967	-293	77%	11	37	484
	SBR	79	75	-4	95%	3.3	13	205	80	60	-20	75%	14	38	486
	WBL	115	91	-24	79%	151.1	248	529	350	181	-169	52%	182.6	712	789
	WBT	5	0	-5	0%	0.0	248	529	10	6	-4	58%	217.0	712	789
	WBR	90	79	-11	87%	171.2	248	529	140	33	-107	24%	1288.3	712	789
	NBL	45	47	2	104%	24.4	1	48	40	26	-14	66%	251	20	91
	NBT	925	863	-62	93%	47.9	155	512	1000	594	-406	59%	465.9	1084	1189
	NBR	11	10	-1	87%	101.1	156	513	40	20	-20	49%	738.4	1085	1190
	Overall	**2583**	**2512**	**-71**	**97%**	**28.8**			**3160**	**2087**	**-1073**	**66%**	**194.0**		
Seminary Road & Beauregard Street	EBL	74	69	-5	94%	63.8	23	256	80	51	-29	64%	182.2	1424	1678
	EBT	1209	1222	13	101%	49.5	106	536	1230	796	-434	65%	353.2	1566	1678
	EBR	438	451	13	103%	7.8	1	109	470	317	-153	67%	111	542	725
	SBL	147	155	8	105%	99.8	82	294	150	92	-58	62%	1112	1183	1676
	SBT	405	418	13	103%	44.3	63	258	420	329	-91	78%	164	1117	1676
	SBR	50	53	3	106%	42.8	63	258	50	40	-10	80%	146.6	1117	1676
	WBL	429	435	6	101%	98.0	167	531	570	478	-92	84%	134	141	289
	WBT	1020	1057	37	104%	16.5	52	432	1260	1076	-184	85%	7	21	227
	WBR	158	163	5	103%	6.3	22	377	250	216	-34	86%	3	8	253
	NBL	282	255	-27	91%	80.5	54	199	310	179	-131	58%	123.7	457	817
	NBT	397	352	-45	89%	93.2	158	330	490	257	-233	52%	149.6	572	828
	NBR 1	407	345	-62	85%	209.4	139	192	410	146	-264	36%	780.8	408	476
	NBR 2														
	Overall	**5016**	**4975**	**-41**	**99%**	**53.6**			**5690**	**3977**	**-1713**	**70%**	**184.9**		
Seminary Road & Mark Center Drive	EBL	34	31	-3	92%	66.6	11	95	30	16	-14	53%	155	12	67
	EBT	1708	1632	-76	96%	53.3	381	528	1700	892	-808	52%	204.4	947	974
	EBR	21	23	2	111%	89.8	376	526	60	35	-25	59%	309.9	950	976
	SBL	154	64	-90	42%	118.9	101	250	170	160	-10	94%	262.0	216	356
	SBT	22	111	89	505%	142.8	101	250	30	27	-3	91%	375.0	216	356
	SBR	70	73	3	104%	24.7	102	252	80	83	3	103%	133.8	216	356
	WBL	152	150	-2	99%	80.0	65	285	200	139	-61	70%	546.6	499	711
	WBT	1459	1518	59	104%	18.3	52	361	1660	1478	-182	89%	92.6	1291	1669
	WBR	67	75	8	112%	17.8	52	361	80	76	-4	95%	83.8	1291	1669
	NBL	78	69	-9	89%	115.2	114	269	340	214	-126	63%	287.1	1609	1678
	NBT	26	23	-3	88%	127.8	114	269	60	37	-23	62%	289.6	1609	1678
	NBR	478	465	-13	97%	52.7	114	269	1570	969	-601	62%	194.9	1625	1678
	Overall	**4269**	**4235**	**-34**	**99%**	**43.6**			**5980**	**4127**	**-1853**	**69%**	**179.1**		
Seminary Road & I-395 SB On Ramp	EBT	700	701	1	100%	68.1	109	395	1040	592	-448	57%	106	185	786
	EBR	1067	997	-70	93%	30	112	363	1490	875	-615	59%	139	488	621
	SBL	679	686	7	101%	5.1	4	187	885	778	-107	88%	6.9	18	303
	SBT	301	301	0	100%	2.4	4	187	455	371	-84	81%	8	18	303
	Overall	**2747**	**2684**	**-63**	**98%**	**30.1**			**3870**	**2615**	**-1255**	**68%**	**73.6**		
Seminary Road & I-395 SB Off Ramp	SBT	620	629	9	101%	65.7	128	421	640	611	-29	95%	211	645	1283
	SBR	363	371	8	102%	0.8	2	124	440	396	-44	90%	64	101	525
	WBL	360	360	0	100%	4.4	7	178	700	537	-163	77%	18.8	177	333
	WBT	707	686	-21	97%	2.6	7	178	900	790	-110	88%	10.8	177	333
	Overall	**2050**	**2047**	**-3**	**100%**	**22.0**			**2680**	**2334**	**-346**	**87%**	**74.1**		
Seminary Road & I-395 NB Off Ramp	EBL	575	602	27	105%	3.4	39	345	820	473	-347	58%	3	111	370
	EBT	804	772	-32	96%	14.7	39	345	1105	880	-225	80%	23.2	111	370
	NBT	636	615	-21	97%	109.9	726	1494	720	647	-73	90%	161	855	1638
	NBR	275	274	-1	100%	11.1	462	1266	300	267	-33	89%	50	0	94
	Overall	**2290**	**2263**	**-27**	**99%**	**36.9**			**2945**	**2266**	**-679**	**77%**	**61.6**		
Seminary Road & I-395 NB On Ramp	WBT	306	242	-64	79%	71.1	86	265	310	312	2	101%	188	254	407
	WBR	279	265	-14	95%	1.0	0	22	380	367	-13	97%	3	32	164
	NBL	571	616	45	108%	3.0	0	0	720	650	-70	90%	12	16	325
	NBT	640	603	-37	94%	0.3	0	0	820	471	-349	57%	1	10	321
	Overall	**1796**	**1726**	**-70**	**96%**	**11.3**			**2230**	**1801**	**-429**	**81%**	**37.8**		

Intersection	Movement	2015 Alternative A PM						2015 Alternative B PM					
		Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)	Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)
Beauregard Street & Mark Center Drive	EBL	71	1	101%	42.1	19	152	69	-1	98%	55.4	18	162
	EBT	9	-1	92%	35.0	19	152	9	-1	92%	39.1	18	162
	EBR	28	-12	71%	18	20	155	28	-12	71%	20	20	165
	SBL	117	-3	98%	91	37	134	112	-8	94%	95	38	184
	SBT	1228	-32	97%	13	49	396	1200	-60	95%	14	58	438
	SBR	75	-5	94%	13	50	398	74	-6	93%	14	59	441
	WBL	339	-11	97%	54.8	175	599	322	-28	92%	60.1	252	644
	WBT	10	0	100%	48.1	175	599	9	-1	92%	59.1	252	644
	WBR	123	-17	88%	127.4	175	599	116	-24	83%	178.8	252	644
	NBL	44	4	111%	119	26	110	43	3	107%	98	19	110
	NBT	973	-27	97%	34.4	61	314	940	-60	94%	77.8	189	695
	NBR	42	2	104%	45.5	62	315	40	0	99%	79.9	190	696
	Overall	**3060**	**-100**	**97%**	**34.9**			**2963**	**-197**	**94%**	**51.9**		
Seminary Road & Beauregard Street	EBL	76	-4	95%	85	97	600	77	-3	96%	81	34	224
	EBT	1243	13	101%	44.9	172	943	1194	-36	97%	43.8	163	796
	EBR	476	6	101%	10	1	75	454	-16	97%	11	2	129
	SBL	156	6	104%	71	53	232	152	2	101%	73	54	229
	SBT	431	11	103%	44	64	241	425	5	101%	44	65	242
	SBR	53	3	106%	44.8	64	241	52	2	104%	46.8	65	242
	WBL	516	-54	91%	86	96	218	510	-60	90%	87	98	233
	WBT	1192	-68	95%	11	32	213	1159	-101	92%	14	41	332
	WBR	232	-18	93%	4	5	166	225	-25	90%	4	13	333
	NBL	302	-8	97%	62	66	264	292	-18	94%	68.2	110	578
	NBT	465	-25	95%	58	294	811	438	-52	89%	66	241	597
	NBR 1	248	-52	87%	132	55	273	352	-58	86%	152.5	133	390
	NBR 2	110			112	294	811						
	Overall	**5389**	**-301**	**95%**	**43.8**			**5330**	**-360**	**94%**	**48.8**		
Seminary Road & Mark Center Drive	EBL	28	-2	93%	69	11	88	29	-1	97%	77	11	74
	EBT	1652	-48	97%	73.9	718	1150	1649	-51	97%	63.5	668	954
	EBR	63	3	106%	95.3	724	1156	57	-3	95%	83.6	675	962
	SBL	174	4	102%	41.3	48	231	165	-5	97%	48.4	48	213
	SBT	27	-3	91%	45.7	48	231	26	-4	87%	30.3	48	213
	SBR	83	3	104%	10.9	50	234	81	1	101%	11.4	50	216
	WBL	190	-10	95%	304	439	755	185	-15	93%	327	487	872
	WBT	1601	-59	96%	40	368	772	1647	-13	99%	42	426	982
	WBR	82	2	103%	44	368	772	82	2	102%	43	426	982
	NBL	252	-88	74%	249	1494	1678	251	-89	74%	226	1570	1678
	NBT	43	-17	71%	401	1541	1678	33	-27	55%	339	1608	1678
	NBR	1236	-334	79%	216	1541	1678	1276	-294	81%	184	1608	1678
	Overall	**5433**	**-547**	**91%**	**112.8**			**5482**	**-498**	**92%**	**101.7**		
Seminary Road & I-395 SB On Ramp	EBT	897	-143	86%	116	573	1049	829	-211	80%	73	180	821
	EBR	1287	-203	86%	161	257	594	1144	-346	77%	156	159	569
	SBL	833	-52	94%	9.7	86	303	800	-85	90%	10.3	74	307
	SBT	463	8	102%	63	86	303	447	-8	98%	54	74	307
	Overall	**3480**	**-390**	**90%**	**100.0**			**3220**	**-650**	**83%**	**84.1**		
Seminary Road & I-395 SB Off Ramp	SBT	601	-39	94%	207	540	1247	559	-81	87%	237	674	1384
	SBR	426	-14	97%	44	118	585	405	-35	92%	53	256	984
	WBL	700	0	100%	16.1	110	310	713	13	102%	17.6	92	322
	WBT	834	-66	93%	4.8	110	310	836	-64	93%	5.4	92	322
	Overall	**2562**	**-118**	**96%**	**61.9**			**2514**	**-166**	**94%**	**68.0**		
Seminary Road & I-395 NB Off Ramp	EBL	722	-98	88%	4.0	98	372	670	-150	82%	3.6	91	368
	EBT	994	-111	90%	19.5	98	372	953	-152	86%	18.3	91	368
	NBT	669	-51	93%	45	92	373	668	-52	93%	45	89	356
	NBR	274	-26	91%	8	0	0	272	-28	91%	8	0	6
	Overall	**2660**	**-285**	**90%**	**20.6**			**2563**	**-382**	**87%**	**20.2**		
Seminary Road & I-395 NB On Ramp	WBT	315	5	101%	184.9	230	410	312	2	101%	163.3	232	387
	WBR	367	-13	97%	3.2	19	167	368	-12	97%	2.3	19	144
	NBL	663	-57	92%	8.9	3	121	659	-61	92%	9.8	4	192
	NBT	722	-98	88%	1.0	3	121	670	-150	82%	0.7	4	192
	Overall	**2067**	**-163**	**93%**	**31.9**			**2009**	**-221**	**90%**	**29.2**		

Intersection	Movement	2015 Alternative C PM						2015 Alternative D PM					
		Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)	Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)
Beauregard Street & Mark Center Drive	EBL	75	5	107%	68.3	13	137	76	6	109%	47	22	177
	EBT	9	-1	94%	29.9	13	137	9	-1	92%	42	22	177
	EBR	31	-9	77%	12	14	139	31	-9	77%	18	23	180
	SBL	102	-18	85%	113	39	162	110	-10	92%	62	24	114
	SBT	1031	-229	82%	21	73	560	1149	-111	91%	24	96	481
	SBR	63	-17	79%	23	74	562	72	-8	90%	20	96	482
	WBL	171	-179	49%	178.7	723	789	347	-3	99%	43.9	115	436
	WBT	4	-6	44%	145.6	723	789	11	1	106%	46.2	115	436
	WBR	30	-110	21%	1570.5	723	789	128	-12	91%	55.3	115	436
	NBL	29	-11	74%	214	15	95	45	5	112%	105	26	114
	NBT	651	-349	65%	452.7	1422	1671	945	-55	95%	27.8	59	416
	NBR	19	-21	48%	878.8	1423	1672	39	-1	98%	20.7	60	417
	Overall	**2215**	**-945**	**70%**	**196.6**			**2962**	**-198**	**94%**	**31.9**		
Seminary Road & Beauregard Street	EBL	40	-40	50%	198	489	729	70	-10	87%	91	32	233
	EBT	643	-587	52%	347.1	1622	1678	1122	-108	91%	59.5	291	1427
	EBR	260	-210	55%	138	0	75	434	-36	92%	20	2	135
	SBL	153	3	102%	196	112	358	151	1	101%	92	68	268
	SBT	425	5	101%	43	61	249	428	8	102%	44	64	237
	SBR	52	2	104%	44.0	61	249	52	2	105%	44.6	64	237
	WBL	495	-75	87%	86	92	216	467	-103	82%	83	88	219
	WBT	1139	-121	90%	9	26	210	1064	-196	84%	12	34	249
	WBR	222	-28	89%	3	7	197	208	-42	83%	3	11	279
	NBL	187	-123	60%	97.3	112	302	300	-10	97%	84	97	391
	NBT	272	-218	56%	117	500	821	454	-36	93%	33	59	396
	NBR 1	165	-245	40%	690.9	418	477	359	-51	88%	47	45	345
	NBR 2												
	Overall	**4054**	**-1636**	**71%**	**132.0**			**5109**	**-581**	**90%**	**44.2**		
Seminary Road & Mark Center Drive	EBL	15	-15	49%	82	6	57	28	-2	93%	90	13	76
	EBT	824	-876	48%	161.4	943	970	1515	-185	89%	52.0	274	823
	EBR	35	-25	58%	279.7	946	973	58	-2	97%	67.8	280	831
	SBL	169	-1	100%	39.0	37	204	174	4	102%	37.9	36	208
	SBT	27	-3	91%	41.3	37	204	28	-2	93%	36.3	36	208
	SBR	82	2	102%	7.7	39	207	83	3	104%	8.2	38	211
	WBL	147	-53	74%	524	1020	1553	141	-59	71%	552	1113	1585
	WBT	1574	-86	95%	54	1011	1553	1464	-196	88%	60	1236	1677
	WBR	80	0	100%	61	1011	1553	76	-4	95%	58	1236	1677
	NBL	206	-134	61%	567	1537	1612	184	-156	54%	486	1472	1616
	NBT	36	-24	59%	574	1537	1612	26	-34	43%	547	1546	1610
	NBR	951	-619	61%	432	1550	1612	861	-709	55%	432	1546	1610
	Overall	**4145**	**-1835**	**69%**	**209.5**			**4639**	**-1341**	**78%**	**159.4**		
Seminary Road & I-395 SB On Ramp	EBT	569	-471	55%	55	56	223	741	-299	71%	50	128	445
	EBR	833	-657	56%	142	431	637	994	-496	67%	173	211	634
	SBL	889	4	100%	7.0	42	299	718	-167	81%	11.2	90	311
	SBT	488	33	107%	17	42	299	463	8	102%	53	90	311
	Overall	**2779**	**-1091**	**72%**	**58.9**			**2916**	**-954**	**75%**	**82.8**		
Seminary Road & I-395 SB Off Ramp	SBT	634	-6	99%	209	543	1201	575	-65	90%	217	1409	1676
	SBR	443	3	101%	40	110	582	408	-32	93%	42	1098	1676
	WBL	742	42	106%	15.1	76	318	725	25	104%	16.8	85	318
	WBT	855	-45	95%	4.9	76	318	846	-54	94%	5.6	85	318
	Overall	**2674**	**-6**	**100%**	**61.9**			**2554**	**-126**	**95%**	**62.2**		
Seminary Road & I-395 NB Off Ramp	EBL	450	-370	55%	2.8	76	366	590	-230	72%	3.2	74	370
	EBT	999	-106	90%	15.5	76	366	861	-244	78%	16.9	74	370
	NBT	665	-55	92%	40	79	327	672	-48	93%	41	82	324
	NBR	272	-28	91%	8	0	7	272	-28	91%	8	0	0
	Overall	**2385**	**-560**	**81%**	**19.1**			**2396**	**-549**	**81%**	**19.3**		
Seminary Road & I-395 NB On Ramp	WBT	312	2	101%	132.0	199	371	312	2	101%	181.2	248	427
	WBR	367	-13	97%	1.7	11	127	365	-15	96%	3.0	29	184
	NBL	666	-54	93%	5.8	1	93	671	-49	93%	8.4	2	120
	NBT	449	-371	55%	0.3	1	93	591	-229	72%	0.7	2	120
	Overall	**1794**	**-436**	**80%**	**25.5**			**1939**	**-291**	**87%**	**32.9**		

Intersection	Movement	2015 Alternative E PM					
		Thruput (veh/hr)	Difference	Thruput Percent	Average Delay (sec)	Average Queue (ft)	Max Queue (ft)
Beauregard Street & Mark Center Drive	EBL	71	1	101%	41.9	19	158
	EBT	9	-1	92%	35.7	19	158
	EBR	29	-11	72%	19	20	161
	SBL	117	-3	97%	86	36	123
	SBT	1263	3	100%	12	50	469
	SBR	75	-5	94%	12	51	471
	WBL	343	-7	98%	46.7	146	501
	WBT	12	2	118%	42.2	146	501
	WBR	129	-11	92%	69.9	146	501
	NBL	44	4	111%	102	25	110
	NBT	1000	0	100%	25.2	52	266
	NBR	42	2	104%	29.1	53	267
	Overall	**3134**	**-26**	**99%**	**27.5**		
Seminary Road & Beauregard Street	EBL	76	-4	95%	79	36	282
	EBT	1238	8	101%	39.1	104	589
	EBR	477	7	102%	8	1	128
	SBL	155	5	103%	65	52	239
	SBT	433	13	103%	44	64	249
	SBR	53	3	106%	44.9	64	249
	WBL	508	-62	89%	74	86	217
	WBT	1179	-81	94%	22	78	507
	WBR	231	-19	92%	6	41	448
	NBL	305	-5	98%	62	65	251
	NBT	475	-15	97%	58	290	766
	NBR 1	242	-58	86%	118	44	232
	NBR 2	110			99	290	766
	Overall	**5371**	**-319**	**94%**	**42.8**		
Seminary Road & Mark Center Drive	EBL	28	-2	95%	76	12	89
	EBT	1661	-39	98%	64.9	721	1150
	EBR	57	-3	94%	96.0	757	1191
	SBL	28	-142	17%	81.7	37	198
	SBT	167	137	556%	35.7	37	198
	SBR	83	3	104%	9.0	38	200
	WBL	182	-18	91%	312	485	812
	WBT	1575	-85	95%	23	298	777
	WBR	83	3	103%	23	298	777
	NBL	259	-81	76%	126	1071	1678
	NBT	39	-21	65%	313	1265	1678
	NBR	1191	-379	76%	221	1265	1678
	Overall	**5353**	**-627**	**90%**	**98.5**		
Seminary Road & I-395 SB On Ramp	EBT	844	-196	81%	122	454	1056
	EBR	1204	-286	81%	159	230	596
	SBL	799	-86	90%	10.9	77	299
	SBT	437	-18	96%	58	77	299
	Overall	**3284**	**-586**	**85%**	**99.8**		
Seminary Road & I-395 SB Off Ramp	SBT	569	-71	89%	157	372	1139
	SBR	414	-26	94%	38	187	843
	WBL	694	-6	99%	17.6	114	315
	WBT	828	-72	92%	5.0	114	315
	Overall	**2504**	**-176**	**93%**	**48.6**		
Seminary Road & I-395 NB Off Ramp	EBL	681	-139	83%	3.8	107	374
	EBT	953	-152	86%	18.9	107	374
	NBT	671	-49	93%	45	91	341
	NBR	273	-27	91%	8	0	0
	Overall	**2578**	**-367**	**88%**	**20.7**		
Seminary Road & I-395 NB On Ramp	WBT	316	6	102%	165.4	233	427
	WBR	368	-12	97%	2.7	22	184
	NBL	660	-60	92%	8.6	2	139
	NBT	683	-137	83%	0.9	2	139
	Overall	**2027**	**-203**	**91%**	**29.4**		

Appendix D
Alternative ‘E’ Conceptual Plans

LIMITED ACCESS HIGHWAY

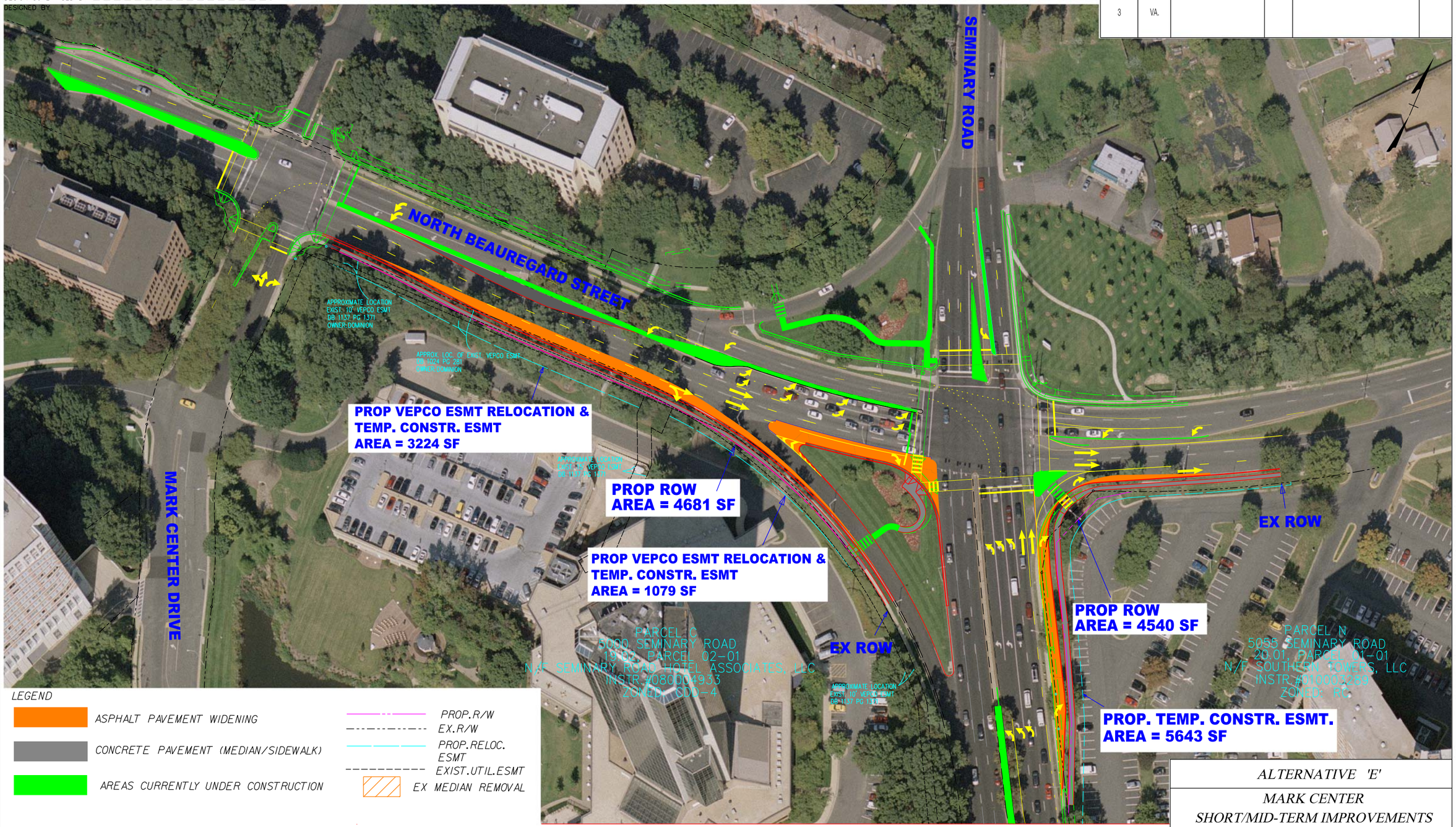
By Resolution of Commonwealth Transportation Board dated January 18, 2001

FHWA REGION	STATE	FEDERAL AID PROJECT	STATE ROUTE	STATE PROJECT	SHEET NO.
3	VA.				

PROJECT MANAGER
SURVEYED BY
DESIGN SUPERVISED BY
DESIGNED BY

Not for Construction
1-12-11

Mark Center (BRAC 133)
Short/Mid Term Improvements



LEGEND

- ASPHALT PAVEMENT WIDENING
- CONCRETE PAVEMENT (MEDIAN/SIDEWALK)
- AREAS CURRENTLY UNDER CONSTRUCTION
- PROP.R/W
- EX.R/W
- PROP.RELOC. ESMT
- EXIST.UTIL.ESMT
- EX MEDIAN REMOVAL

SCALE
0 50' 100'

Rev.	Date	Description

ALTERNATIVE 'E'

MARK CENTER
SHORT/MID-TERM IMPROVEMENTS

Scale 1" = 100'-0"	Date JAN - 2011	Sheet 1 of 4	
PLAN NO. A	PROJECT	FILE NO.	SHEET NO. XXX-X

$FILE$
$DATE$ $TIME$
Pen Table = IP_PEN_TABLE

LIMITED ACCESS HIGHWAY By Resolution of Commonwealth Transportation Board dated January 18, 2001

FHWA REGION	STATE	FEDERAL AID PROJECT	STATE ROUTE	STATE PROJECT	SHEET NO.
3	VA.				

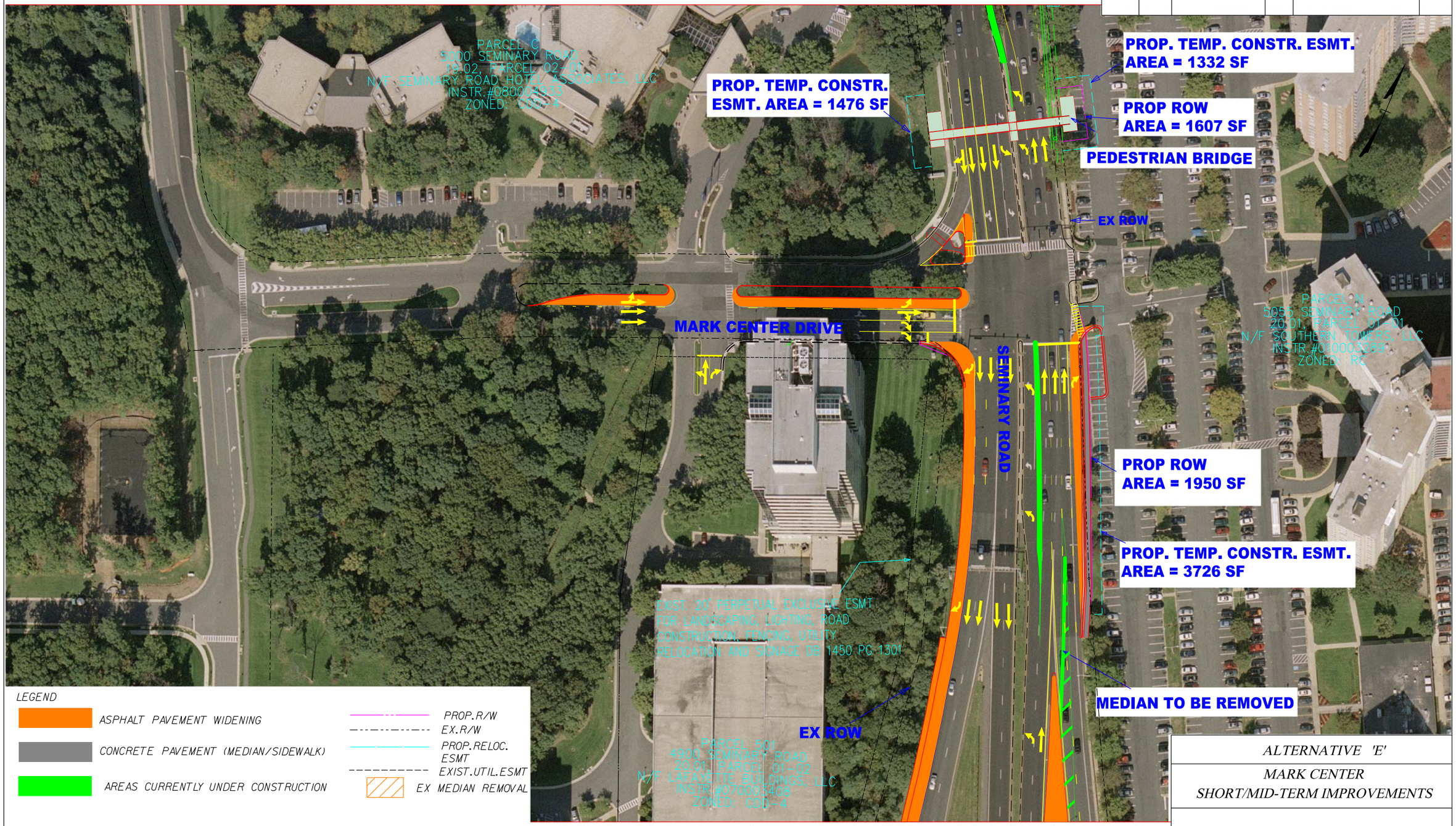
PROJECT MANAGER
SURVEYED BY
DESIGN SUPERVISED BY
DESIGNED BY

Not for Construction
1-12-11

Mark Center (BRAC 133)
Short/Mid Term Improvements

Rev.	Date	Description

MATCH LINE, SEE SHEET 1 OF 4



LEGEND

- ASPHALT PAVEMENT WIDENING
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- AREAS CURRENTLY UNDER CONSTRUCTION
- PROP.R/W
- EX.R/W
- PROP.RELOC. ESMT
- EXIST.UTIL.ESMT
- EX MEDIAN REMOVAL

MATCH LINE, SEE SHEET 3 OF 4

SCALE 0 50' 100'

ALTERNATIVE 'E'

MARK CENTER
SHORT/MID-TERM IMPROVEMENTS

Scale 1" = 100'-0"	Date JAN - 2011	Sheet 2 of 4	
PLAN NO. A	PROJECT	FILE NO.	SHEET NO. XXX-X

$FILE$
$DATE$ $TIME$
Pen Table • IP_PEN_TABLE

LIMITED ACCESS HIGHWAY By Resolution of Commonwealth Transportation Board dated January 18, 2001

FHWA REGION	STATE	FEDERAL AID PROJECT	ROUTE	STATE PROJECT	SHEET NO.
3	VA.				

PROJECT MANAGER
SURVEYED BY
DESIGN SUPERVISED BY
DESIGNED BY

Not for Construction
1-12-11

Mark Center (BRAC 133)
Short/Mid Term Improvements

LEGEND

- ASPHALT PAVEMENT WIDENING
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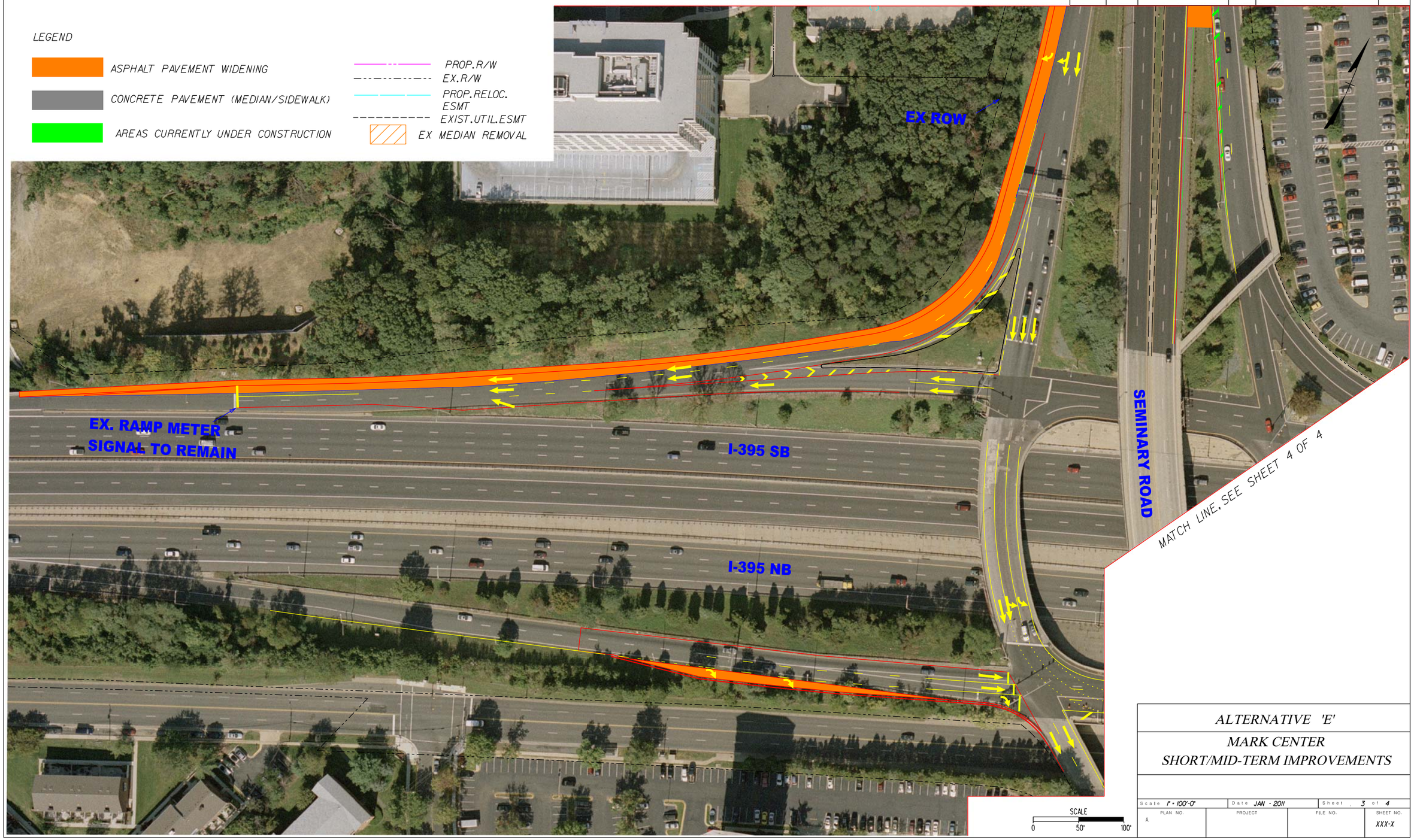
- EX.R/W
- PROP.RELOC. ESMT
- EXIST.UTIL.ESMT
- EX MEDIAN REMOVAL

MATCH LINE, SEE SHEET 2 OF 4



Rev.	Date	Description

ALTERNATIVE 'E'

MARK CENTER
SHORT/MID-TERM IMPROVEMENTS

Scale 1" = 100'-0"	Date JAN - 2011	Sheet 3 of 4	
PLAN NO. A	PROJECT	FILE NO.	SHEET NO. XXX-X

$FILE$
$DATE$ $TIME$
Pen Table = IP_PEN_TABLE

LIMITED ACCESS HIGHWAY By Resolution of Commonwealth Transportation Board dated January 18, 2001

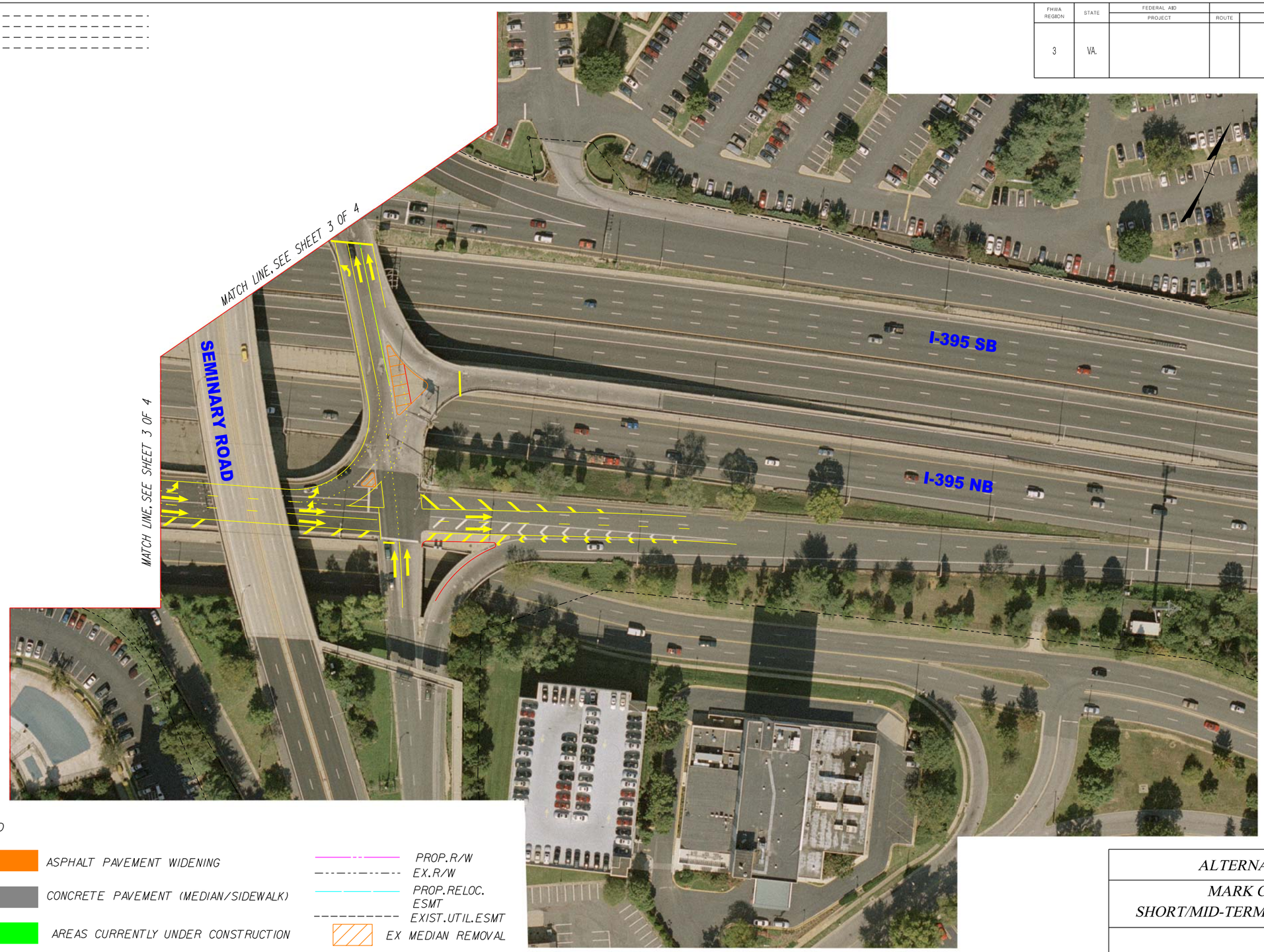
FHWA REGION	STATE	FEDERAL AID PROJECT	STATE ROUTE	STATE PROJECT	SHEET NO.
3	VA.				

PROJECT MANAGER
SURVEYED BY
DESIGN SUPERVISED BY
DESIGNED BY

Not for Construction
1-12-11

Mark Center (BRAC 133)
Short/Mid Term Improvements

Rev.	Date	Description



LEGEND

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- CONCRETE PAVEMENT (MEDIAN/SIDEWALK)
- AREAS CURRENTLY UNDER CONSTRUCTION
- PROP.R/W
- EX.R/W
- PROP.RELOC. ESMT
- EXIST.UTIL.ESMT
- EX MEDIAN REMOVAL

SCALE
0 50' 100'

ALTERNATIVE 'E'

MARK CENTER
SHORT/MID-TERM IMPROVEMENTS

Scale 1" = 100'-0"	Date JAN - 2011	Sheet 4 of 4	
PLAN NO. A	PROJECT	FILE NO.	SHEET NO. XXX-X

$FILE$
$DATE$ $TIME$
Pen Table = IP_PEN_TABLE