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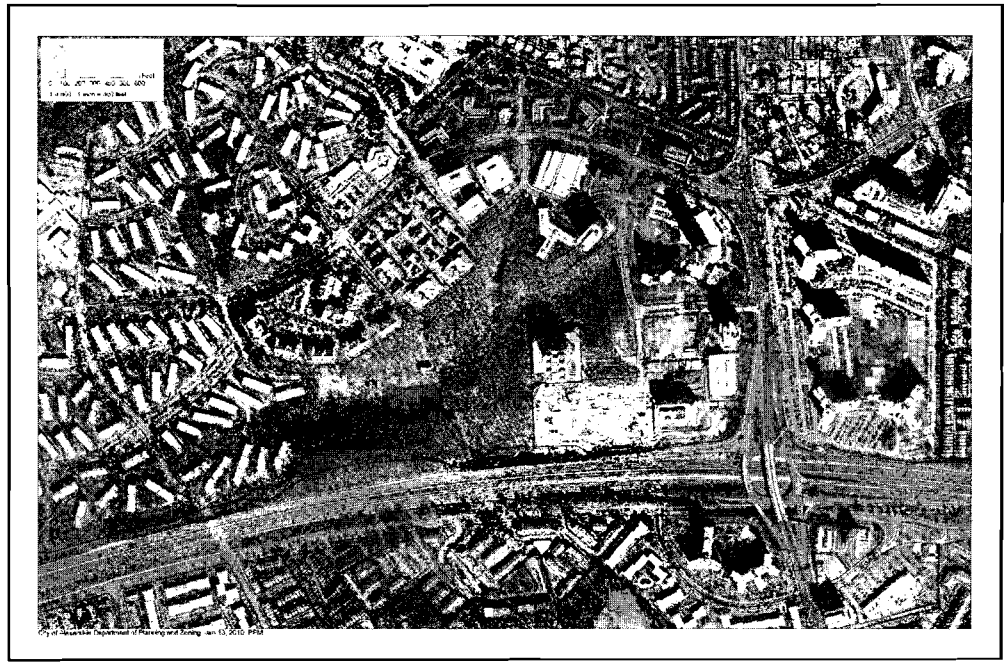
2-16-10

BRAC-133 ACCESS STUDY



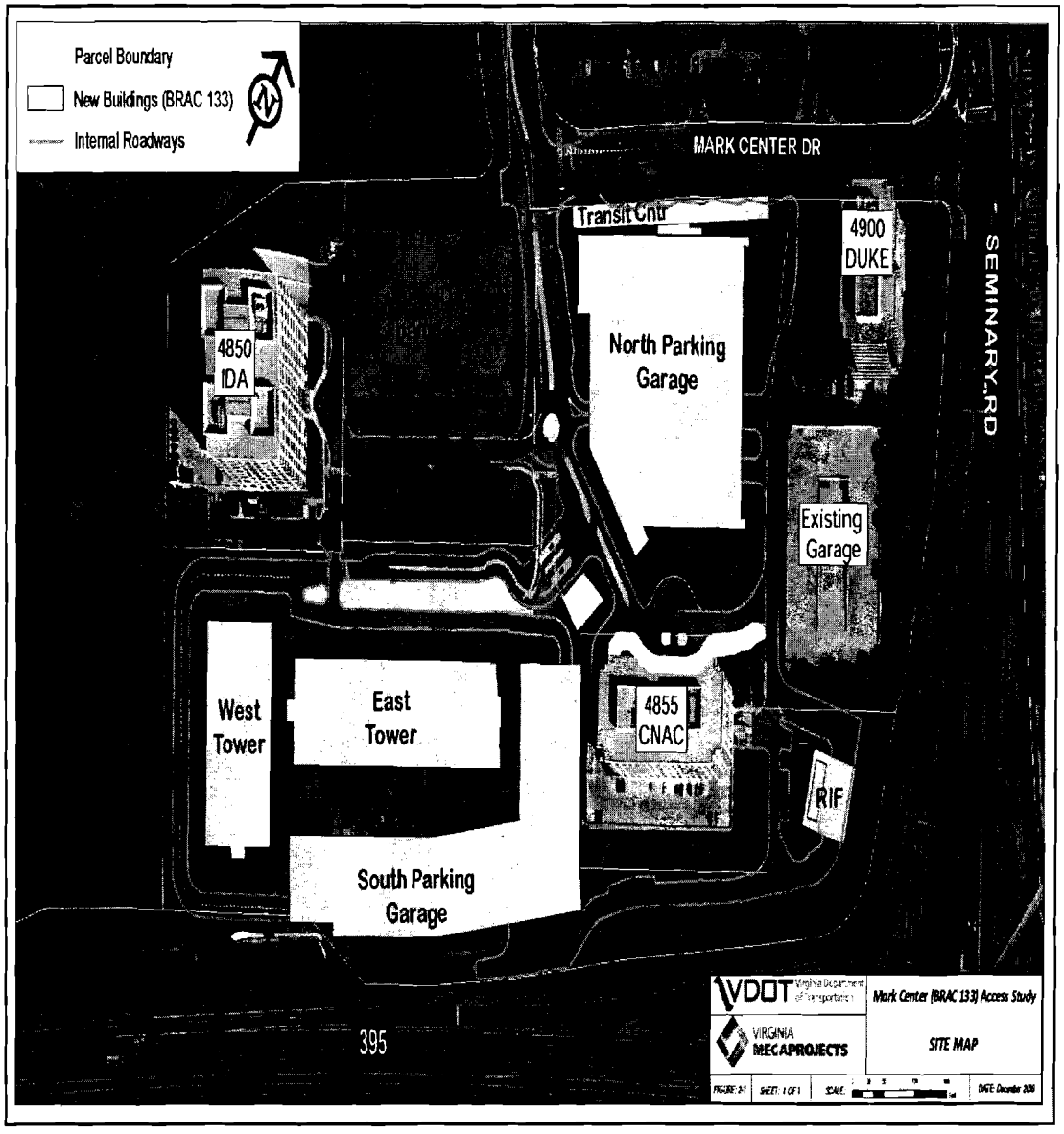
- **Schedule**
- **Purpose**
- **Background**
- **Analysis**
- **Preliminary Findings**
- **Process**

BRAC-133/BEAUREGARD ACCESS STUDY | **SCHEDULE**

- **Dec. 12: City Council public hearing on VDOT's BRAC-133 Access Alternatives**
- **Jan. 20: Joint Beauregard Corridor Plan/BRAC Advisory Group Public Meeting: Transportation Workshop**
- **Feb. 16: Mark Center (BRAC-133) Draft Access Study Report Published by VDOT**
- **Feb. 17: BRAC Advisory Group: IJR Alternatives Discussion**
- **Mar. 11: VDOT BRAC Public Information Meeting: Operational Analysis**
- **Final Interchange Justification Report and National Environmental Policy Act Evaluation**

Project Purpose

- **Enhance transportation access to Mark Center**
- **Meet existing and future travel demands of the BRAC-133 employees**
- **Provide opportunities for transit uses**


Parcel Boundary
New Buildings (BRAC 133)
Internal Roadways
MARK CENTER DR
Transit Cntr
4900
DUKE
SEMINARY RD
4850
IDA
North Parking
Garage
Existing
Garage
West
Tower
East
Tower
4855
CNAC
RIF
South Parking
Garage
395
VDOT
VIRGINIA
MEGAPROJECTS
Mark Center (BRAC 133) Access Study
SITE MAP

Project Background

- BRAC-133 Environmental Assessment in July 2008
- Finding of No Significant Impact in September 2008 recommended Mark Center site
- Long-Term minor traffic impacts
- 40% Reduction in BRAC related trips through travel demand management

Need for Additional Improvements

- Proffered intersection improvements
- Transportation Management Plan
- VDOT and City of Alexandria studies recommended additional improvements
- Gridlock forecasted for 2035 without additional improvements
- VDOT primary focus was on alternatives that provide direct access from I-395 to Mark Center

Alternatives Analysis

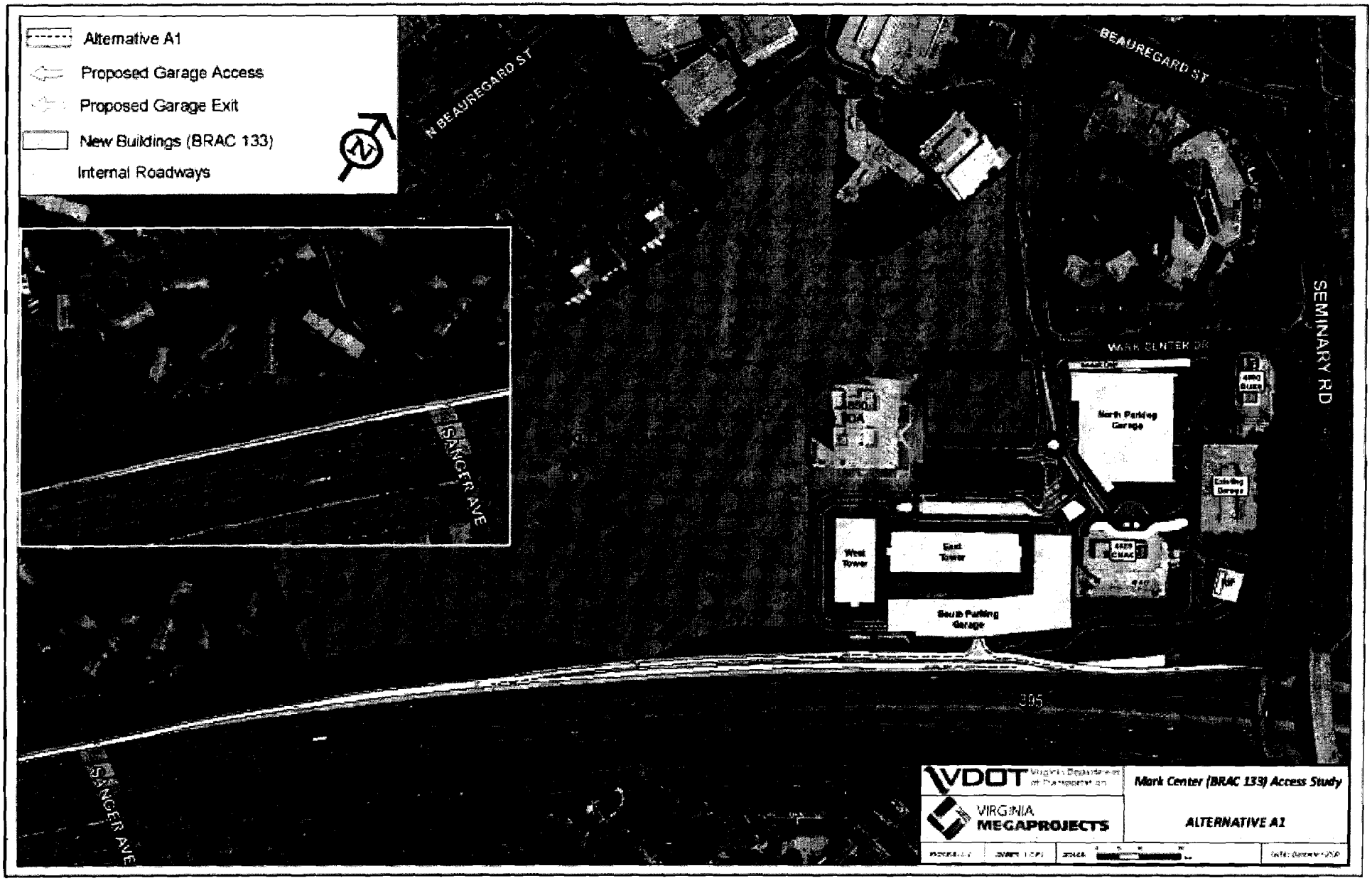
- VDOT primary focus was on alternatives that provide direct access from I-395 to Mark Center
- Alternatives A1 and A2: Provide direct access to south garage from I-395 SB on-ramp
- Alternatives B1 and B2 provides access to Mark Center from I-395 SB on-ramp
- Alternative C: Access to Army garage from I-395 SB on-ramp and the NB I-395 general purpose lanes

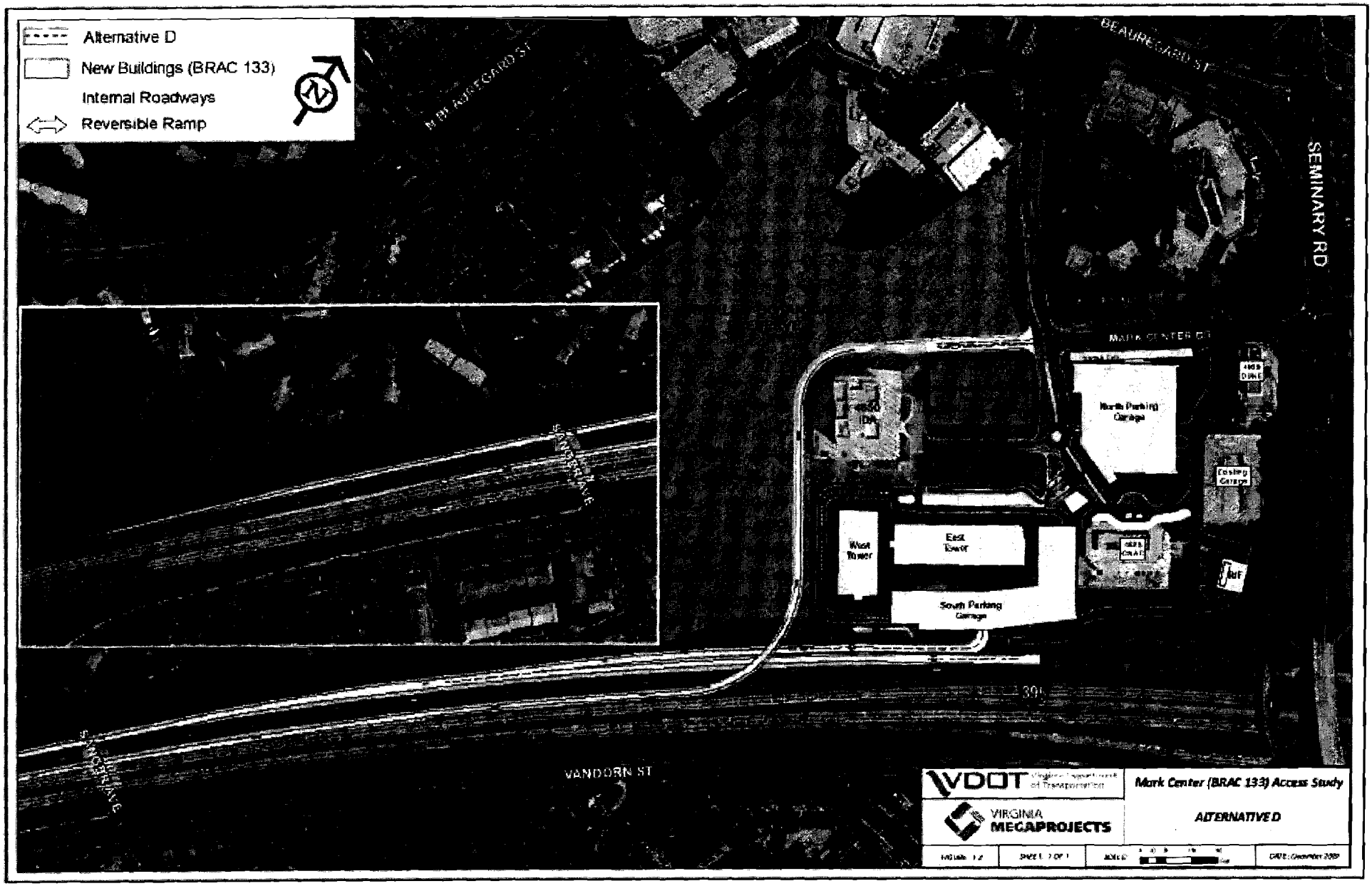
Alternatives Analysis (Continued)

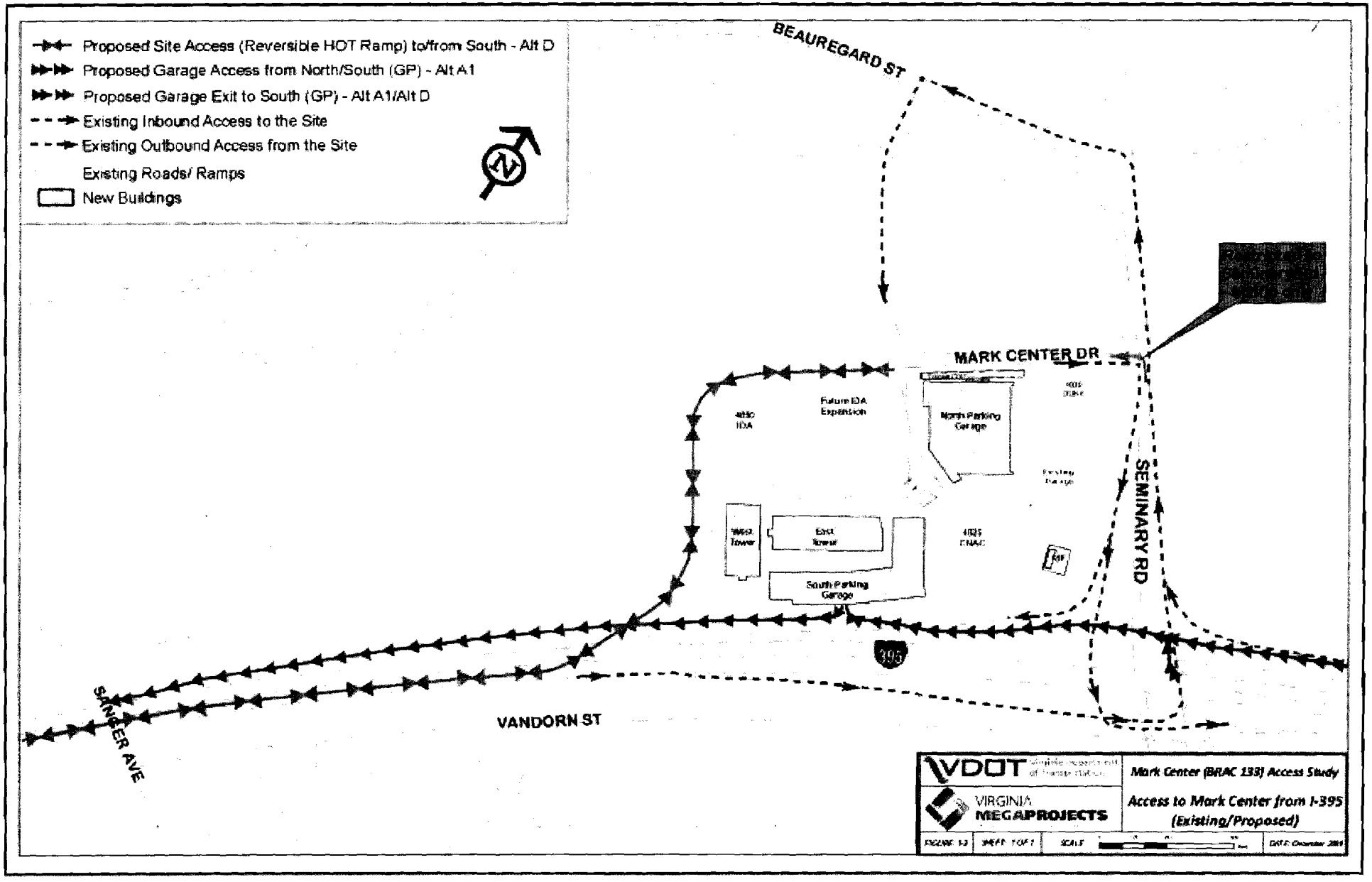
- **Alternative D: Provides access to Mark Center from I-395 HOT Lanes to and from the south. It also provides auto only SB exit movement from the army garage to I-395 SB GP lanes.**
- **Alternative E: Similar to D but also provides a direct connection between the Army garage and the HOT lanes. Provides connection to both the south and the north.**

Findings and Recommendations

- The study identified areas of operational deficiencies under 2035 No-Build Conditions
- Alternative A1 recommended to be advanced for increased study.
- Alternative D recommended to be advanced for increased study because it satisfies project purpose and need.


Alternative A1
Proposed Garage Access
Proposed Garage Exit
New Buildings (BRAC 133)
Internal Roadways
N BEAUREGARD ST
BEAUREGARD ST
SEMINARY RD
SANGER AVE
SANGER AVE
395
North Parking Garage
West Tower
East Tower
South Parking Garage
VDOT
VIRGINIA MEGAPROJECTS
Mark Center (BRAC 133) Access Study
ALTERNATIVE A1


Alternative D
New Buildings (BRAC 133)
Internal Roadways
Reversible Ramp
BEAUREGARD ST
SEMINARY RD
MARK CENTER DR
North Parking Garage
Existing Garage
West Tower
East Tower
South Parking Garage
395
VANDORN ST
VDOT
VIRGINIA MEGAPROJECTS
Mark Center (BRAC 133) Access Study
ALTERNATIVE D


Proposed Site Access (Reversible HOT Ramp) to/from South - Alt D
Proposed Garage Access from North/South (GP) - Alt A1
Proposed Garage Exit to South (GP) - Alt A1/Alt D
Existing Inbound Access to the Site
Existing Outbound Access from the Site
Existing Roads/ Ramps
New Buildings
BEAUREGARD ST
MARK CENTER DR
SEMINARY RD
VANDORN ST
SANGER AVE
Future IDA Expansion
North Parking Garage
South Parking Garage
395
VDOT
VIRGINIA MEGAPROJECTS
Mark Center (BRAC 133) Access Study
Access to Mark Center from I-395 (Existing/Proposed)

Findings and Recommendations (continued)

- Alternative D provides better level of service while A1 provides limited improvements
- Alternative D travels through the Winkler Preserve
- Alternative D significantly improves transit and HOV opportunities
- Alternative D improves traffic operations at adjacent HOT ramps (Turkeycock and Shirlington)
- Findings of report will be utilized in next stages: Interstate Justification Report and NEPA document

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2-16-10

MARK CENTER (BRAC 133) ACCESS STUDY

Commonwealth of Virginia

VIRGINIA MEGAPROJECTS

Operational Analysis Report
Volume 1 of 2 – Report

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:

Ronaldo T. Nicholson, PE Regional Transportation Program Director Virginia Department of Transportation	Date
Tom W. Fahrney Commonwealth BRAC Coordinator Virginia Department of Transportation	Date

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LIST OF EXHIBITS

LIST OF TABLES

SECTION 1

EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this Mark Center Access Operational Analysis is to enhance transportation access to Mark Center, meet the existing and future traffic demands of the projected 7,000 new employees which relieves anticipated congestion to the I-395/Seminary interchange and surrounding local roadway network and provides opportunities for planned transit uses. The findings of this report will be utilized during the next stages of project development that include the Final Interchange Justification Report and NEPA evaluation.

1.2 Project Background

The 2005 Defense Base Realignment and Closure (BRAC) Recommendation # 133 consists of relocating 6,409 Department of Defense (DoD) personnel to Fort Belvoir. Given other BRAC increases in Fort Belvoir employment, it was decided that these personnel would be located to a new site, not on Fort Belvoir proper. The U.S. Army Corps of Engineers, on behalf of the Department of Defense, conducted an Environmental Assessment (EA)[1] in July 2008 which evaluated three alternative sites in Northern Virginia for the proposed relocation. Following the EA, a Finding of No Significant Impact (FONSI)[2] was issued in September 2008 that recommended that the new site should be the Mark Center in the City of Alexandria, Virginia, as shown in Exhibit 1-1.

The traffic impact analysis in the EA for the proposed relocation at the Mark Center concluded that "long term minor, but not significant adverse affects" would be expected. The EA analysis assumed roadway improvements (addition/extension of turn lanes at three surrounding intersections, and addition of traffic signal/round-about inside the Mark Center facility) and a 40% reduction in BRAC related trips due to aggressive Travel Demand Management (TDM). Duke Realty Corporation ("Duke"), the developer for the ongoing BRAC 133 related development at the Mark Center site, will implement these roadway improvements as part of their proffers with the City of Alexandria.

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[1] U.S. Army Corps of Engineers, Mobile District, Final Environmental Assessment - Implementation of 2005 Base Realignment and Closure Recommendation 133, July 2008.

[2] U.S. Army, Finding of No Significant Impact (FONSI) - Implementation of 2005 Base Realignment and Closure Recommendation 133 (Washington Headquarter Services), Fort Belvoir, Virginia, September 25, 2008.

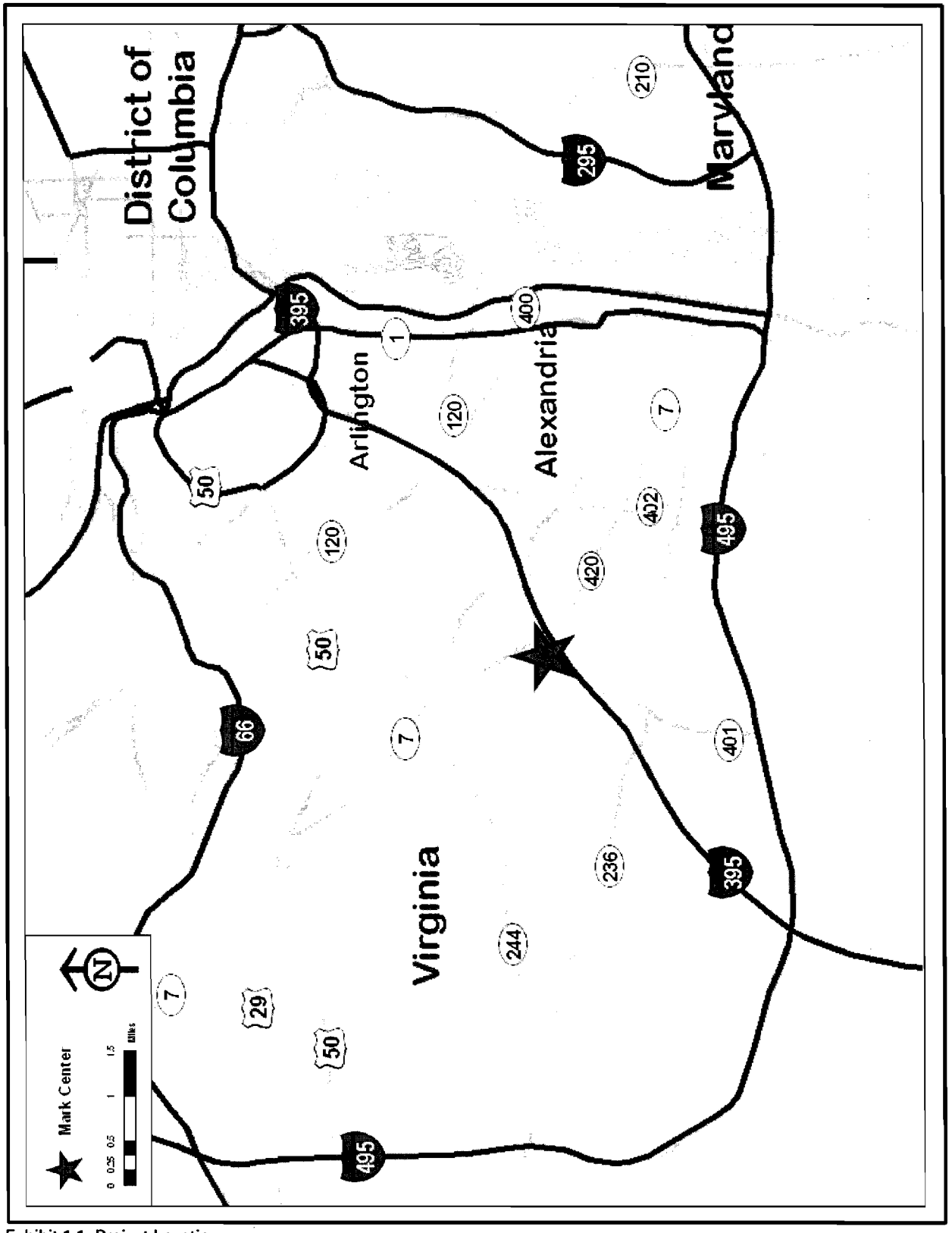

Exhibit 1-1: Project Location

1.3 Need for Additional Improvements

To meet the traffic demands of the 7,000 new employees, improvements to the intersections in the immediate vicinity have been proffered by Duke. In addition, the Department of Army is planning an ambitious Travel Demand Management plan (i.e. options such as carpooling, transit services, telecommuting, etc.). The Environmental Assessment also recommended improvements to the regional transportation system in the surrounding area including unspecified improvements to the I-395/Seminary Road interchange. Two other recently conducted transportation studies on Mark Center, one by the Virginia Department of Transportation[1] and the other by the City of Alexandria[2], recommended the need for a direct access to the Mark Center facility to maintain an acceptable level of service in the adjacent area.

In 2035, even with the improvements through the proffers and the planned High Occupancy Toll (HOT) lane project on I-395, the conditions at the adjacent freeway and arterial network are projected to degrade. Peak directions on I-395 between King Street and Duke Street interchanges are projected to operate at "severe" level of traffic congestion (See Table 8-1 in Section 8). Seminary Road at its intersection with Mark Center is projected to operate at LOS "F" (PM) and at Beauregard LOS "E" (AM). At all four traffic signals on the Seminary Road interchange rotary, critical approaches will operate at a failing level-of-service "F" (See Table 8-3 in Section 8). Microsimulation for 2035 No-Build PM peak scenario indicates complete gridlock conditions on Seminary Road and Beauregard Street in the vicinity of the Mark Center site as the outbound traffic tries to exit the facility. As a result of the well-documented concerns in the study area, and a detailed investigation of the traffic operations in the existing conditions as well as 2035 No-Build, a purpose and need statement was prepared for this effort. The detailed purpose and need can be found in Section 2.

1.4 Alternatives Analysis

This study included an alternatives analysis to determine what alternatives would best meet the project purpose and need while minimizing impacts and costs. The feasibility and effectiveness of potential Transportation System Management (TSM) solutions, Travel Demand Management (TDM) solutions, and improvements to the existing I-395 interchanges at King Street, Seminary Road, and Duke Street was considered. In addition to these ideas, seven unique build alternatives were developed that facilitate direct access from the I-395 corridor to the major employment destination of the Mark Center. These alternatives were shared with the project stakeholders, BRAC Citizens Advisory Committee, City Transportation Commission, and City Council. More information about the alternative development and vetting process can be found in Section 6 and Appendix H. The direct access build alternatives are summarized below:

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[1] Virginia Department of Transportation, Mark Center Transportation Study, April 2009.
[2] City of Alexandria, Mark Center Transportation Study, November 2009.

Alternative "A1" provides direct access to the Army south garage only from the I-395 SB on-ramp from Seminary Road and would be restricted to cars destined for the garage only. This ramp starts at the intersection of Seminary Road and the I-395 SB on ramp. The new access to the Army garage actually begins in the left lane of the on-ramp and then elevates up and over the existing I-395 on- ramp to connect to the Army garage on the P5 floor level. This ramp configuration will allow traffic to both enter and exit the garage. Exiting traffic can only travel southbound on I-395 general purpose lanes.

Alternative "A2" provides direct access to the Army south garage only from the I-395 SB on-ramp and would be restricted to cars destined for the garage. Unlike Alternative A1, this concept would involve at-grade construction to allow a new access point to the Army garage. This configuration will require the elimination of the free right turn from eastbound Seminary Road onto the I-395 SB on-ramp and would thus require right turns to be made by way of two lanes at the existing traffic signal. This ramp configuration would involve a weaving movement for traffic on this on-ramp and would allow traffic to both enter and exit the garage. Exiting traffic can only travel southbound on I-395 general purpose lanes.

Alternative "B1" provides access to Mark Center from the I-395 SB on-ramp and would be open to the public, not just the Army garage. This ramp configuration begins at grade from the I-395 SB on-ramp and then travels within and along the Winkler Preserve and touches down on the Mark Center private street network. This ramp will be one-way and will only allow traffic onto the site.

Alternative "B2" provides access to Mark Center from the I-395 SB on-ramp and would be open to the public, not just the Army garage. This ramp configuration begins at grade from the I-395 SB on-ramp and then travels within and along the Winkler Preserve and touches down at Mark Center Drive, a public road in Mark Center. This ramp will be one-way and only allow traffic onto the site.

Alternative "C" provides access to the Army garage only from the I-395 SB on-ramp and the NB I-395 general purpose lanes and would be restricted to cars destined for the garage only. This ramp configuration will allow traffic to both enter and exit the site. Exiting traffic can only travel southbound on I-395 general purpose lanes.

Alternative "D" provides access to Mark Center from the I-395 HOT lanes and would be open to the public, not just Army employees. This ramp configuration begins from the HOT lanes just south of the Seminary Road interchange and travels over the SB general purpose lanes and then travels within and along the edge of the Winkler Preserve and touches down at Mark Center Drive, a public road in Mark Center. This configuration will provide a reversible flow ramp which will allow traffic to enter the site in the morning and exit in the afternoon. Buses would be allowed in this configuration. In addition to the above, an auto-only southbound exit movement to get onto I-395 SB GP lanes would be allowed from the Army garage in this alternative.

Alternative "E" is similar to alternative "D" but also provides a direct connection between the Army garage and the HOT lanes. Unlike Alternative D, this configuration will provide a two-way ramp which allows a traffic connection to both the south and north on the HOV

lanes. The concept here is to allow for buses/carpools/vanpools/shuttles to make an interim stop at the Mark Center on their way to points north, such as the Pentagon.

Based on preliminary traffic analysis and level of costs and due to expressed support by the City Council of Alexandria, it was decided that Alternative "A1" (see Figure 1-1) would be advanced for increased study. Alternative "D" (see Figure 1-2) was also carried forward due to its ability to satisfy project purpose and need. Existing and proposed access to the Mark Center site from I-395 corridor are shown in Figure 1-3. Figures 1-1 to 1-3 can be found in Appendix A of this report.

1.5 Findings

The study has identified five areas of operational deficiencies in the study area under the 2035 No-Build peak traffic conditions. They are as follows:

1. NB I-395 General Purpose (GP) lanes between Little River Turnpike and Seminary Road during the AM peak hour
2. SB I-395 GP lanes between Seminary Road and Little River Turnpike during the PM peak hour
3. SB I-395 GP lanes between King Street and Seminary Road during AM/PM peak hour
4. Signalized "Rotary" at the second level of the I-395 and Seminary Road interchange
5. Local arterial intersections in the vicinity of the Mark Center development

The analysis demonstrates that alternative "D", direct connection into the Mark Center, provides better levels of service or reduced delays for each of the five areas identified above. It also demonstrates that alternative "A1", direct connection into the BRAC 133 garage, provides better levels of service for only the area identified in # 5 above and worse or similar levels of service in areas 1-4.

Other issues discussed in the report that warrant additional discussion is the fact that alternative "D" significantly improves transit and HOV opportunities in the Mark Center, and these improvements will enhance the DoD's (BRAC 133) very aggressive goal of 40% non-SOV mode split.

Alternative "D" also provides additional benefit to the I-95/395 HOT Lanes project by improving traffic operations at the Turkeycock and Shirlington HOT ramps.

In addition to the benefits associated with alternative "D", there is potential for other improvements in the study area to improve the deficiencies indentified in the study area. For example, auxiliary lanes between Little River Turnpike/Duke Street and Seminary Road in the NB and SB direction of I-395 may improve the deficiencies in that area.

The findings of this report will be utilized during the next stages of project development. To construct a new access point on I-395, an Interstate Justification Report (IJR) and National Environmental Policy Act (NEPA) document would be required to be approved by FHWA.

SECTION 2

PURPOSE AND NEED

2.1 Overview

The transportation challenge being investigated here involves the inability of the existing I-395/Seminary Road interchange and associated arterial streets to adequately handle the forecasted travel demand resulting from the adjacent development activity. The local jurisdiction is the City of Alexandria and the primary development activity in question is employment growth at the Mark Center in the southwest quadrant of the existing I-395/Seminary Road interchange.

Virginia Department of Transportation ("Department"), at the request and in coordination with the City of Alexandria[1] (See Appendix I) and U.S. Army, initiated this study to document the potential impact on the surrounding roadway network due to the relocation of 6,409 Department of Defense (DoD) personnel at the Mark Center by September 2011 and to provide transportation solutions to mitigate such impacts. The future No-Build condition for this study assumes all proffered roadway improvements associated with the proposed relocation and also Transportation Planning Board 2009 Constrained Long Range Plan (CLRP) for HOT lane proposal were in place. For the study horizon year of 2035, this HOT lane proposal was assumed to be in place as originally proposed.

2.2 Project Background

On November 9, 2005 the recommendations made by the BRAC (Base Realignment and Closure) commission regarding numerous realignment and closure actions for defense military installations became law. The BRAC Commission recommendation originally proposed to generate a net increase of 22,000 people in the workforce on Fort Belvoir. In an effort to distribute and minimize the impacts on the regional transportation network, it was further decided that 6,409 Washington Headquarter Services (WHS) personnel would be located to a new site, not on Fort Belvoir. The U.S. Army Corps of Engineers conducted an Environmental Assessment (EA)[2] in July 2008 which evaluated three alternative sites in Northern Virginia for the proposed relocation. Following the EA, a Finding of No

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[1] Letter from Mayor of Alexandria to VDOT District Administrator requesting that VDOT consider/study direct access/egress from I-395 to the Mark Center site to help mitigate traffic concerns resulting from BRAC 133 development, December 11, 2008.

[2] U.S. Army Corps of Engineers, Mobile District, Final Environmental Assessment - Implementation of 2005 Base Realignment and Closure Recommendation 133, July 2008.

Significant Impact (FONSI)[3] was issued in September 2008 that recommended Mark Center facility to house WHS (BRAC 133) employees to be relocated from various leased spaces in Northern Virginia.

BRAC 133 Mark Center is a 24-acre site located in the northwest corner of the City of Alexandria. The site was previously approved for up to 1.75 million sq-ft of office space by the City of Alexandria City Council in January, 2004. Duke Realty Corporation ("Duke"), the owner of this site, sold a 16-acre master-planned site to the U.S. Army and is currently building a 1.75 million gross sq-ft (GSF) headquarters campus and 1.3 million GSF of structured parking to accommodate the relocated DoD employees. The BRAC 133 site is part of a larger 350-acre mixed-use Mark Center development consisting of high-rise office and residential buildings, hotel, retail and the 44-acre Winkler Botanical Preserve.

The construction of the BRAC 133 complex includes two multi-story office towers, two parking garages and a public transportation center serving Mark Center and the surrounding community, as shown in Figure 2-1 in Appendix A. The construction is scheduled for completion by September 15, 2011, as mandated by the BRAC Act of 2005. The construction of this new complex would take into account Antiterrorism and Force Protection (AT/FP) requirements - one of the primary drivers for this realignment.

The current occupants of the Mark Center site will remain, and one of the occupants (IDA) has approved site plans for expansion. This expansion will add approximately 600 employees; as such the total growth of the site is 7,000 new employees. As per the ITE Trip Generation Manual, these new employees could generate as much as 23,000 workday trips.

The traffic impact analysis in the EA for the proposed relocation at the Mark Center concluded that "long term minor, but not significant adverse affects" would be expected. The EA analysis assumed roadway improvements (addition/extension of turn lanes at three surrounding intersections, and addition of traffic signal/round-about inside the Mark Center facility) and a 40% reduction in single occupant vehicle arrival due to aggressive Travel Demand Management (TDM). These roadway improvements are included as part of Duke's proffers for the ongoing development at the Mark Center.

Under the Virginia Public Private Transportation Act (PPTA), the Department received a proposal to build High Occupancy Toll Lanes (HOT) in the existing High Occupancy Vehicle / Express lanes located in the median of I-395. The proposal to build an additional lane in the current HOV / Express lanes and a south-facing bus-only ramp at the Seminary Road interchange is included in the 2009 CLRP for the National Capital Region. The HOT lanes proposal would allow for non-HOV toll-payers to access these lanes as long as capacity exists. The south-facing ramp would not be open to HOV or single occupancy vehicles. The current Seminary Road Interchange consists of a rotary with a grade separated

[3] U.S. Army, Finding of No Significant Impact (FONSI) - Implementation of 2005 Base Realignment and Closure Recommendation 133 (Washington Headquarter Services), Fort Belvoir, Virginia, September 25, 2008.

through movements. The HOT lanes proposal also calls for low-cost capacity improvements at this interchange.

Besides the proffered improvements, the EA recommended improvements to the regional transportation system in the surrounding area including non-specific improvements to the I-395/Seminary Road interchange. Two other recently conducted transportation studies on Mark Center, one by the Department [4] and the other by the City of Alexandria [5], recommended that a direct interstate access to the Mark Center facility, in addition to the proffered improvements, would be needed to maintain an acceptable level of service in the adjacent area. At the request of the City of Alexandria, the Department commissioned this report to develop alternatives to meet the challenging circumstances surrounding the Mark Center and the Seminary Road interchange. This section documents the purpose and need for the project.

2.3 Purpose

The purpose of this Mark Center Access Operational Analysis is to enhance transportation access to the Mark Center, meet the existing and future traffic demands of the projected 7,000 new employees which relieves anticipated congestion to the I-395/Seminary interchange and surrounding local roadway network and provides opportunities for planned transit uses. The findings of this report will be utilized during the next stages of project development that include the Final Interchange Justification Report and NEPA evaluation.

2.4 Need

1. **Reduce congestion on I-395.** The projected growth at the Mark Center is estimated to add 1,718 peak hour trips (AM inbound). It is estimated that 63% or 1,082 trips will originate from the I-95/I-395 corridor. In the vicinity of Mark Center, the northbound AM approach and the southbound PM egress on I-395 general purpose lanes are currently congested, as shown in the Traffic Quality Report on Metropolitan Washington Area Freeway System[6] (See Appendix E). By 2035 even with the planned HOT lane improvements, peak directions on I-395 between King Street and Duke Street interchanges are projected to operate at "severe" level of traffic congestion (See Table 8-1 in Section 8 and Figures 2-2 and 2-3 in Appendix A). During peak periods queues are expected to extend from the Seminary Road rotary onto the general purpose lanes. Without improved access to the Mark Center facility, the surrounding freeway network will not be able to handle this additional growth in traffic under 2035 traffic conditions.

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[4] Virginia Department of Transportation, Mark Center Transportation Study, April 2009.
[5] City of Alexandria, Mark Center Transportation Study, November 2009.
[6] Council of Government, Traffic Quality on the Metropolitan Washington Area Freeway System, Spring 2008 Report, May 20, 2009.

2. **Reduce congestion at local intersections and the Seminary Road Interchange.** In 2035, despite the proffered improvements at the arterial intersections, the conditions at the adjacent intersections are projected to degrade. Seminary Road at its intersection with Mark Center Drive is projected to operate at LOS "F" (PM) and at Beauregard LOS "E" (AM). At all four traffic signals on the Seminary Road interchange rotary, critical approaches will operate at a failing level-of-service "F" (See Table 8-3 in Section 8). Microsimulation for 2035 No-Build PM peak scenario indicates complete gridlock conditions on Seminary Road and Beauregard Street in the vicinity of the Mark Center site as the outbound traffic tries to exit the facility (See Figure 2-4 in Appendix A). The ultimate preferred alternative needs to offer relief to the nearby arterial intersections and Seminary Road interchange operations, thus improving intersection levels-of-service and mitigating the impact of the traffic growth.

3. **Promote use of transit and HOV**. Average transit use in the City of Alexandria is 18%[7]. To meet the high 40% single occupant vehicle (SOV) reduction goal as established within BRAC 133, conceptual alternatives need to be developed that allow for and promote ridesharing to the site. The Mark Center site is neither close to a Metro or VRE station, nor in the vicinity of an existing transit transfer area. The development plan includes an on-site transit center, and parking spaces will be limited to 60% of the total employees. The Mark Center transit center has been shown to be an important node for Bus Service using the HOT Lanes[8] and has a logical connection with Fort Belvoir, Fort Belvoir's Engineer Proving Ground and the Pentagon. By 2035 with over 40% of the new employees expected to originate from the south of the Mark Center facility, there will be good opportunities for carpools, vanpools and transit to use the HOT lanes.

[7] Census

[8] Virginia Department of Transportation, Draft I-95/I-395 Bus Rapid Transit Study, December 2009, page ES-2.

SECTION 3

BACKGROUND

3.1 Relationship to other Highway Improvement Plans and Programs

Under the Virginia Public Private Transportation Act (PPTA), the Department received a proposal to build High Occupancy Toll Lanes (HOT) in the existing High Occupancy Vehicle / Express lanes located in the median of I-95/I-395. The selected concessionaire, Fluor-Transurban, proposes to build an additional lane in the current HOV / Express lanes, extend HOT lanes 26 miles to the south, and add access points throughout the project. The proposed HOT lane improvements are included in the 2009 Constrained Long Range Transportation Plan for the National Capital Region.

Inside the beltway, the HOT Lanes proposal will add three access points:

- A flyover for northbound HOT traffic to northbound general purpose lanes. This flyover will be just south of the Duke Street (VA Route 236) interchange.
- A south-facing bus-only ramp at the Seminary Road interchange. This south-facing ramp would not be open to HOV or single occupancy vehicles. The plan also calls for low-cost capacity improvements at this interchange.
- A south-facing ramp at the Shirlington Road interchange. The plan also calls for the reconstruction of the Shirlington Road interchange.

There are four other highway projects in the Metro Washington Area Council of Governments Constrained Long Range Plan (CLRP)[1] that influence the I-395/Seminary Road interchange:

1. I-95 Fourth Lane from Route 123 to Newington, 2011. This improvement will add capacity to I-95 general purpose lanes approaching the Capital Beltway (I-495). This improvement is located eight miles to the south of Seminary Road.
2. I-95 Interchange at 7900, 2015. This project will improve connectivity for commuters from the south to destinations inside the beltway. This improvement is located over 6 miles from Seminary Road and is not expected to improve congestion inside the beltway.
3. I-95/I-495 Interchange improvements at Route 613 (S. Van Dorn Street), 2015. This project will improve access to S. Van Dorn Street. Van Dorn Street is a north-south roadway and N. Van Dorn Street crosses Seminary Road at I-395. This improvement

[1] Metro Washington Council of Governments, National Capital Region Transportation Planning Board, http://www.mwcog.org/clrp, Major Highway Improvements as of October 21, 2009.

is not projected to divert traffic from I-395 to or from Van Dorn Street, although if I-395 is heavily congested it will be one of several alternate routes to Seminary Road.

4. Capital Beltway (I-495) HOT Lanes, 2012. This improvement adds HOT Lanes and HOT access from the Springfield Interchange to the Dulles Toll Road. Seminary Road interchange concepts that encourage HOT lanes leverage this improvement.

In addition to the I-395 and I-495 HOT Lanes projects, there are three major transit projects included in the 2009 CLRP:

1. Potomac Yard Transitway, Arlington and Alexandria, 2013. This project will improve access and circulation in Crystal City and Potomac Yard. This project will not have an effect on traffic conditions at Seminary Road.
2. US-1 bus right turn lanes, 2025. This project will improve bus mobility on US-1 just outside of the beltway. US-1 serves as another north south commuter route.
3. VA 244 (Columbia Pike) Streetcar from Skyline to Pentagon City, 2016. This project will provide reliable transit service along Columbia Pike, which connects to Seminary Road at Bailey's Crossroads. The Mark Center is 1.6 miles from Columbia Pike, so it is unlikely that the Columbia Pike Streetcar will affect conditions on Seminary Road.

3.2 Communities and Activities Directly Served

I-95/I-395 serves the entire northern Virginia region, and connects communities over a broad area. At some locations the facility carries over 200,000 average daily trips. There are 5 closely-spaced interchanges on I-395 between the Capital Beltway and the Shirlington area, and each plays an important role in circulating traffic to and from I-395. The interchanges are interdependent; congestion at any one interchange will affect the others. The Seminary Road interchange and the Mark Center are in the City of Alexandria; Arlington County and Fairfax County are both in close proximity to the interchange.

The area is urbanized and any improvements support the land use plans of Alexandria, Arlington and Fairfax County. Although the area is developed, local jurisdictions do have redevelopment plans in the area. The City of Alexandria supports redevelopment for the Landmark/Van Dorn area, and Arlington County has plans for the Four Mile Run area. Neither area are directly accessed by Seminary Road, however both are approximately 2 miles away from the interchange and both areas will benefit from improved conditions on I-395.

The 2007 US Census Bureau[2] population estimate for the City of Alexandria is .14 million, Arlington County is .20 million and Fairfax County is 1.01 million.

The interchange at Seminary Road is within the District of Columbia Transportation Management Area (TMA).

[2] US Census Bureau, http://factfinder.census.gov, 2007 Population Estimates.

SECTION 4

STUDY AREA

The study area evaluated for this report is centered on the interchange at I-395 and Seminary Road in the City of Alexandria, Virginia. Also called the Henry G. Shirley Memorial Highway, I-395 is a 13-mile north-south route that runs between the south-eastern part of Fairfax County and Washington D.C. At its southern end, I-395 begins at its interchange with I-95 and I-495 in Springfield, Virginia; and at its northern end terminates in Washington, D.C. Seminary Road is a four-lane urban arterial that primarily runs east-west with its western end terminating in Fairfax County at Route 7 (Leesburg Pike) in Bailey's Crossroads. At the eastern end, Seminary Road continues as Janneys Lane and terminates on Route 7 (King Street) in City of Alexandria.

4.1 Study Area Boundaries

The study area evaluated for this report includes the adjacent interchanges upstream and downstream of the I-395/Seminary Road interchange. The study area also includes intersections on Little River Turnpike/Duke Street, Seminary Road, and King Street on both sides of I-395 corridor. The study area, as shown in Figure 4-1 in Appendix A, includes the following:

- I-395 between Little River Turnpike/Duke Street and King Street;
- Seminary Road between N. Beauregard Street and Library Lane, including the intersection at N. Beauregard Street and Mark Center Drive;
- Little River Turnpike/Duke Street between Beauregard Street and Walker Lane; and
- King Street between Park Center Drive and Menokin Drive, including the intersection at N. Van Dorn Street and Menokin Drive.

The study area is bounded by Duke Street to the south, King Street to the north, North Beauregard Street to the east, and Van Dorn Street to the west. The City of Alexandria, Shirlington, Bailey's Crossroads, Annandale, and Springfield are the core communities in the vicinity of the study area. The study area consists of a mix of commercial, office, and high-density residential land. Major activity centers include Inova Alexandria Hospital and Landmark Mall located on the east side of I-395 and the Mark Center on the south-west quadrant of the I-395/Seminary Road interchange.

4.2 Interchange Spacing

The interchange spacing along I-395 within the study area is non-uniform. The Seminary Road interchange is located much closer to the King Street interchange (0.9 mile) than it is to the Duke Street interchange (1.67 miles). Figure 4-2 in Appendix A indicates the spacing between the study interchanges.

4.3 Access to the Mark Center Site

As described in Section 2, BRAC 133 Mark Center is a 24-acre site located in the northwest corner of the City of Alexandria. Mark Center is bounded by I-395 to the east, Seminary Road to the north, Beauregard Street and Mark Center Drive to the west, and the Winkler Botanical Preserve to the south. The Mark Center site can currently be entered via two access points (1) Intersection of Seminary Road and Mark Center Drive and (2) Beauregard Street and Mark Center Drive. Exiting traffic from the site is also served by these two intersections. Presently, the traffic originating from the I-395 corridor has to exit at Seminary Road to enter the site through the intersection of Beauregard Street and Mark Center Drive. However, the motorists on a regular basis also access the site through the intersection of Seminary Road and Mark Center Drive. As part of the proffered improvements at the site, the westbound left-turn lane at this intersection will be accessible to the traffic approaching from the east side of Seminary Road only; traffic on I-395 exiting to Seminary Road will not be able to access the Mark Center facility through this intersection, as shown in Figure 1-3 of Appendix A. Such restriction will be accomplished through the placement of a physical barrier on Seminary Road.

SECTION 5

EXISTING CONDITIONS

5.1 Roadway Geometry

5.1.1 Interstate 395

I-395 is a 13-mile long urban freeway that runs in the north-south direction linking the Springfield area and Washington D.C. It consists of six-lane General Purpose facility with a barrier-separated two-lane HOV section in the median. In the peak hours of travel, the HOV facility is restricted to vehicles with 3 or more passengers and is reversible based on the peak direction of travel. The posted speed limit on the General Purpose lanes is 55 mph and that on the HOV lanes is 65 mph.

5.1.2 Seminary Road

Seminary Road (VA Route 420) is a four-lane urban arterial that runs in the east-west direction between Bailey's Crossroads in Fairfax County and the City of Alexandria. Seminary Road is surrounded by a mix of commercial, office, and residential land uses. The posted speed limit on Seminary Road is 35 mph.

5.1.3 Duke Street/Little River Turnpike

Duke Street (VA Route 236) is a four-lane urban arterial that runs in the east-west direction between Fairfax County and the City of Alexandria. West of I-395, Duke Street continues as Little River Turnpike in Fairfax County. East of I-395, Duke Street runs through the City of Alexandria and terminates in Old Town Alexandria. Within the study area, Little River Turnpike is posted at 40 mph and Duke Street is posted at 30 mph.

5.1.4 King Street

King Street (VA Route 7) continues as Leesburg Pike towards west in Fairfax County. East of I-395, King Street terminates in Old Town Alexandria. Within the study limits King Street is a four-lane urban arterial and posted at 35 mph.

5.2 Population Served

TheI-395 corridor serves as a major East Coast commuting route connecting Washington, D.C. with major activity centers in Arlington County, the city of Alexandria, and the greater Springfield area in Fairfax County. At the Springfield interchange, I-395 also connects with the Capital Beltway (I-495) which connects with major activity centers all around Washington D.C. According to the 2000 U.S. Census, Springfield, Virginia had approximately 30,000 residents, while the City of Alexandria had approximately 128, 000

residents, which per the 2008 U.S. Census' estimates represents an increase of 11 percent to approximately 143,000 residents.

According to the 2000 U.S. Census, the population density along I-395 between the Duke Street interchange and Holmes Run Parkway is reported to range between 15,300 and 25,500 persons/square mile, to both the east and west of I-395. The population density to the east of I-395 between Holmes Run Parkway and the Seminary Road interchange is reported to be 6,200 to 9,400 persons/square mile. To the west of I-395, the population density is reported to be between 15,400 and 25,500 persons/square mile between Richenbacher Avenue and the Seminary Road interchange, while the northwest quadrant of the I-395 and the Seminary Road interchange is reported to be densely populated, with a population density of 45,800 persons/square mile. The population density in the northeast quadrant of I-395 between the Seminary Road and King Street interchange is reported to range between 6,200 and 9,400 persons/square mile. In the future, the local and regional population will continue to grow in northern Virginia. The Round 7.1 Cooperative Forecast published by the Washington Metropolitan Council of Government (MWCOG) in January, 2008, *Growth Trends to 2030: Cooperative Forecasting in the Washington Region*, indicates a population growth of 26 percent, 22 percent, and 28 percent for the City of Alexandria, Arlington County, and Fairfax County, respectively between 2005 and 2030.

5.3 Topography and Physical Site Conditions

As cited in the "Overview and Physiography and Vegetation of Virginia", (Virginia Department of Conservation and Recreation)

The Mark Center property lies within the Atlantic Coastal Plain physiographic province which is characterized as a low-relief, terraced landscape that slopes gently toward the Atlantic Ocean from its highest elevation at the Fall Line (250 feet) to 60 feet elevation. The Fall Line is a zone of geologic transition that marks the boundary between the older resistant, metamorphic rocks of the Piedmont Plateau and the younger, softer mostly unconsolidated sediments of the Coastal Plain. The western or *inner* Coastal Plain (above 60 feet) is a broad upland, gently dissected by streams, and locally quite rugged where short, high gradient streams have incised steep ravine systems. The upland forests that originally covered much of the Coastal Plain have been extensively cleared or altered, so that it is difficult to determine which species and natural communities were prevalent.

The Seminary Road interchange study area is characterized by rolling terrain with areas of substantial grades concentrated adjacent to the roadway in cut and fill sections of I-395 mainline and ramps. To the southwest, I-395 slopes downward 0.5% from the Seminary Road interchange then after 0.25 miles, increases toward Holmes Run at a rate of 3.4% to 111 feet elevation. Between the Seminary Road interchange and Braddock Road, I-395 crests at 236 feet elevation upward at 1.5% then downward 1.0% to the northeast at the overpass at Braddock.

5.4 Land Use

The study area has a mix of commercial, office, residential, and woodland preserve land uses. The northwest quadrant of the I-395 and Seminary Road interchange is primarily occupied by the Southern Towers high-rise apartment complex. The northeast quadrant is occupied by two high-rise hotels, a high-rise office building, a strip shopping center, a bowling alley, and several restaurants. The southeast quadrant is occupied by the Seminary Towers high-rise and multi-level apartment complexes, as well as the Inova Alexandria Hospital. The southwest quadrant of the I-395 and Seminary Road interchange includes the 44-acre Winkler Botanical Preserve, a high-rise hotel and several high-rise office buildings. It is also home to the Mark Center, a 24-acre, privately owned facility and future home of the new BRAC 133 Washington Headquarter Services (WHS) by 2011. The proposed WHS facility will be developed on approximately 16 of the 24-acres within the Mark Center and will accommodate approximately 6,400 employees.

5.5 Environmental Conditions

Located within the Coastal Plain physiographic province, the area is typically underlain by unconsolidated sediments (gravel, sand, silt, and clay).[1] The study area is also located in the intensively developed Cameron Run watershed. Within that watershed, the study area lies within the Holmes Run subwatershed with three unnamed tributaries flowing through the area. These tributaries drain into the constructed stormwater and water quality management pond (a.k.a. Winkler Run Pond) on the Winkler Botanical Preserve property adjacent to the Mark Center. The stream along the southern boundary of the Mark Center and adjacent to I-395 has been channelized for stormwater management. It directs runoff from the eastern portion of the Mark Center site and I-395 through a series of constructed linear ponds with weirs to the pond on the Winkler Botanical Preserve.[2]

There is the potential for wetlands to be associated with these unnamed tributaries. There are no 100-year floodplains within the study area. There are no groundwater wells on the Mark Center property.

[1] U.S. Army Corps of Engineers, Mobile District, Final Environmental Assessment - Implementation of 2005 Base Realignment and Closure Recommendation 133, July 2008. Page 3-68.
[2] Ibid. Page 3-66.

SECTION 6

ALTERNATIVES CONSIDERED

This study included an analysis to determine which alternatives would best meet the project purpose and need while minimizing impacts and costs. See Section 2 for detailed project purpose and need. In summary, the purpose of the project is to provide improved, transit-friendly access to the large number of existing and planned jobs at the Mark Center in the City of Alexandria, thus reducing the significant forecasted traffic operations and safety problems on the surrounding interstate and arterial roadways. Project stakeholders and the BRAC Citizens Advisory Committee participated in developing and refining alternatives. More information about project outreach can be found in Appendix H.

In addition to the no-build scenario, a series of alternatives were developed and investigated for their ability to satisfy project purpose and need. Below are a summary of the alternatives considered and the results of the screening process. Ultimately two of these alternatives were identified for detailed study in this report.

6.1 No-Build Alternative

The No-Build Alternative (Figure 6-1 in Appendix A) represents no modifications to the interstate or arterial roadway system other than the planned and programmed improvements identified in the MPO (National Capital Region Transportation Planning Board) Fiscally Constrained Long Range Transportation Plan (CLRP), the proffered improvements to be constructed by Duke Realty Corporation, and the TDM and TSM improvements described in section 6.2 and 6.3 respectively. The most significant and relevant CLRP project is the assumed completion of the I-95/I-395 HOT lane project. This project includes the following modifications:

- A third reversible lane and the ability of non-HOV toll payers to access these lanes as long as capacity exists.
- A new bus-only ramp from the south will connect to the Seminary Road rotary. This south-facing ramp will serve the northbound bus traffic in AM and the southbound bus traffic in PM.
- The northbound general purpose off-ramp at Seminary Road will be widened from two to three lanes - two through lanes and a right turn lane.
- A 250-ft long second storage lane will be added on the existing HOT ramp on the north face of the rotary. The SB HOT ramp approach will also be controlled by a traffic signal during the PM peak.
- The Seminary Road rotary lanes will be revised by modifying islands and restriping to include a left turn, left-through and through lane on each side of the rotary.

The Proffered Improvements (see Figure 6-2 in Appendix A) at the local intersections in the vicinity of the Mark Center site include the following:

- Extension of the WB left-turn lane to 550 ft at the intersection of Seminary Road and Mark Center Drive. This left-turn lane will be accessible to the traffic approaching from the east side of Seminary Road only; Traffic on I-395 exiting to Seminary Road will not be able to access the Mark Center facility through this intersection.
- Addition of the third WB left-turn lane at the intersection of Seminary Road and Beauregard Street.
- Addition of the second SB left-turn lane at the intersection of Beauregard Street and Mark Center Drive.
- Signalization of Mark Center Dr and Mark Center Dr/WHS Circle intersection.

6.2 Transportation Demand Management (TDM)

Also included in the No-Build Alternative is Transportation Demand Management (TDM). TDM strategies are used to reduce the number of vehicles needing access to the site. The Department of Defense (DoD) TDM goal for the Mark Center site is for 40% non-single occupancy vehicle (SOV) travel. Since the Mark Center site is close to neither a Metro station nor an existing transit transfer area, this is an ambitious goal and will require a comprehensive plan and implementation.

The new BRAC 133 facility is required to submit a Transportation Management Plan (TMP) for approval by the National Capital Planning Commission (NCPC). The TMP is an action plan to implement TDM strategies. This TMP is being conducted by the Corps of Engineers (Baltimore District) and will be considered for approval by NCPC in June 2010.

The Transportation Management Plan Handbook suggests the following techniques and policies for the TMP[1]:

- Parking Management
- Carpooling
- Ride matching
- Vanpooling
- Transit Services
- Subsidies
- Travel Allowance
- Guaranteed Ride Home
- Bicycling/Walking
- Telecommuting
- Variable Work Hours
- Commuter Work Centers

The BRAC 133 Transportation Management Plan is expected to have most, if not all, of the techniques and policies in the list above. The traffic projections used in this report assume that the plan is successful and meets the goal of 40% travel by non-SOV. Reductions beyond the 40% goal would be unrealistic and a "TDM only Alternative" is not considered for detailed analysis.

[1] National Capital Planning Commission (NCPC), Implementing a Successful TMP, May 2008, page 6.

6.3 Transportation System Management (TSM)

TSM improvements were considered consisting of improved signal timing, addition of traffic signals, addition and extension of turn bays, channelization, improved signing and markings.

Improved signal timing and synchronization will incrementally improve operations and are included in the No-Build alternative. Additional turn bays and traffic signals, channelization, improved signing and marking will be included in the proffered improvements and the I-95/I-395 HOT lane project, as explained in section 6.1. The potential for additional TSM improvements to the existing Seminary interchange are limited and will be considered during the final design.

6.4 Preliminary Build Alternatives

A series of build alternatives were considered for their ability to meet project purpose & need. These include improvements to existing interchanges as well as construction of new interstate access. Each concept is described below.

Improvements to the existing Seminary Road Interchange with I-395 - As shown in the TSM discussion above, the existing interchange design at Seminary Road (diamond interchange with rotary connection to cross-street) provides limited opportunities for significant capacity enhancements without complete reconstruction. In order for the interchange to adequately satisfy the traffic demand forecasted for the study's horizon year of 2035, multi-lane directional ramps would be necessary for the heaviest left turn movements. The vertical engineering of such ramps would require the tie-down points to be well beyond the first signalized intersections along Seminary Road, thus prohibiting the heavy turns at these locations. The remaining intersections would be unable to accommodate the resulting traffic demand and this concept does not have the apparent ability to promote the use of transit. Therefore, it is determined that such an alternative does not meet the project purpose & need.

Improvements to adjacent interchanges (King Street & Duke Street) -Possible capacity enhancements were considered at the upstream and/or downstream interchange(s) along I-395. It was determined that even if these interchanges were reconstructed to provide additional capacity, the ultimate 'trip' to the Mark Center would be constrained by the existing and forecasted congestion on the arterial roadways and signalized intersections that would need to be traversed. Section 8 provides detail on the 2035 arterial traffic conditions in the study area. Further widening of these arterials and intersections is not practical without significant right-of-way impacts and commercial and residential relocations. Finally, this alternative does not have the apparent ability to promote the use of transit in the short term. Therefore, it was determined that this alternative does not meet project purpose and need.

New interchange at Sanger Avenue - During the coordination with the City of Alexandria, the City requested a review of an alternative that includes the construction of a new full

diamond interchange at Sanger Avenue and I-395. This location is currently a simple underpass with no interstate connection. The proposed concept would allow a connection between the I-395 general purpose lanes and Sanger Avenue. This concept is not being carried forward for further study for two basic reasons. 1) This location does not meet the AASHTO minimum interchange spacing of 1 mile. In order to develop access at Sanger Avenue it would be expected that a set of interstate collector-distributor (CD) roadways would need to be constructed. The CD roads would need to encompass the Turkeycock HOV interchange, the Duke Street interchange, New Sanger interchange, Seminary interchange, and the King Street interchange. The impact and access issue associated with this type of improvement is outside the scope of work intended for this project. 2) Even if this interchange was constructed to provide interstate access to Sanger, Sanger Avenue is not a major arterial and therefore access to the Mark Center facility would still be constrained by the existing and forecasted congestion on the local roadways and signalized intersections that would need to be traversed. Further widening of the above local roads and intersections is not practical without significant right-of-way impacts and commercial and residential relocations. Therefore, this proposal is not being carried forward for further study due to the sheer magnitude of impacts associated with the concept and inability of the local network to handle interchange traffic volumes.

As part of the City of Alexandria planning process, a BRAC Advisory Committee was established in early 2009 to provide advice regarding the impacts of BRAC initiatives within the City with specific focus on the BRAC 133 facility. The group's charge is to "make recommendations with respect to the proposed development with regards to traffic, transportation, architecture, landscape and site design."

During the fall of 2009, the BRAC Advisory Committee was provided information from VDOT about the potential alternatives that were being considered to provide improved transportation access to the Mark Center. Recognizing that each alternative had pros and cons, at their November 18, 2009 meeting the Advisory Committee developed 'Guiding Principles Relating to VDOT's BRAC Access Interchange Justification Report'. A copy of these principles can be found in Appendix I.

Seven preliminary build alternatives evolved from an iterative process involving engineering, traffic analysis, environmental analysis and review by stakeholders. Project planning and design criteria were developed in consultation with the Department of Defense Washington Headquarter Services (WHS), City of Alexandria, Fairfax County, FHWA, VDOT Central Office, the HOT Lanes project Concessionaire / Design-Build team, and adjacent property owners.

Sufficient preliminary design of the seven alternatives was developed to establish an understanding of the physical footprint, traffic operations, and impacts. These were presented to, evaluated, and reviewed by the project stakeholders in various meetings held between August and November 2009. Written review comments on the seven alternatives were received from public and private stakeholders affected by the project. More detail about project outreach can be found in Appendix H.

The preliminary build alternatives are described below:

Alternative "A1" (Figure 6-3 in Appendix A) provides access to the Army south garage only from the I-395 SB on-ramp and would be restricted to cars destined for the garage only. This ramp starts at the intersection of Seminary Road and the I-395 SB on ramp. The new access to the Army garage actually begins in the left lane of the on ramp and then elevates up and over the existing I-395 on ramp to connect to the Army garage on the P5 floor level. This ramp configuration will allow traffic to both enter and exit the garage. Exiting traffic can only travel southbound on I-395 general purpose lanes and no buses would be allowed.

This alternative has minimal benefits in traffic operations with minimal impacts on Winkler right-of-way. Transit use is provided by the I-95/395 HOT Lanes project south-facing HOT transit only ramp; however the buses will not be able to use the proposed ramps at the garage. With regard to local congestion, this alternative benefits arterial intersections in the vicinity of the Mark Center site; however it increases traffic circulation on the rotary. This alternative does not improve conditions on I-395, and complicates future ramp metering on the southbound ramp. Due to the fact that this alternative has the expressed support of the City and the Army, its minimum impact on the Winkler Preserve, and its benefit to the traffic operations at select arterial street intersections, it is being carried forward for further study.

Alternative "A2" (Figure 6-4 in Appendix A) provides access to the Army south garage only from the I-395 SB on-ramp and would be restricted to cars destined for the garage only. Unlike Alternative A1, this concept would involve at-grade construction to allow a new access point to the Army garage. This configuration will require the elimination of the free right turn from eastbound Seminary Road onto the I-395 SB on-ramp and would thus require right turns to be made by way of two lanes at the existing traffic signal. This ramp configuration would involve a weaving movement for traffic on this on-ramp and would allow traffic to both enter and exit the garage. Exiting traffic can only travel southbound on I-395 general purpose lanes and no buses would be allowed.

This alternative has similar impacts as "A1" with fewer benefits. Due to the required weave operations associated with this alternative, it is not being carried forward for further study.

Alternative "B1" (Figure 6-5 in Appendix A) provides access to Mark Center from the I-395 SB on-ramp and would be open to the public, not just the Army south garage. This ramp configuration begins at grade from the I-395 SB on-ramp and then travels within and along the Winkler Preserve and touches down on the Mark Center private street network. This ramp will be one-way and will only allow traffic onto the site.

This alternative has moderate impacts with slightly improved benefits. Transit use is provided by the I-95/395 HOT Lanes project south-facing HOT transit only ramp and buses will be able to access the site using the new access. This alternative does not improve conditions on I-395 and the benefits at the arterial intersections in the vicinity of the Mark Center site will be limited to AM peak conditions only. This alternative will also have a short weave section. As a result of these factors and the limited additional benefit when compared with the additional impacts on the Preserve, this alternative is not being carried forward for further study.

Alternative "B2" (Figure 6-6 in Appendix A) provides access to Mark Center from the I-395 SB on-ramp and would be open to the public, not just the Army south garage. This ramp configuration begins at grade from the I-395 SB on-ramp and then travels within and along the preserve and touches down at Mark Center Drive, a public road in Mark Center. This ramp will be one-way and only allow traffic onto the site.

Similar to B1, this alternative has moderate impact with slightly improved benefits. It will provide additional access to Mark Center Drive; however this benefit is minor when compared to the additional roadway required through the Winkler Preserve. For this reason, and the reasons B1 was eliminated for further study, this alternative is eliminated from further study.

Alternative "C" (Figure 6-7 in Appendix A) provides access to the Army south garage only from the I-395 SB on-ramp and the NB I-395 general purpose lanes and would be restricted to cars destined for the garage only. This ramp configuration will allow traffic to both enter and exit the site. Exiting traffic can only travel southbound on I-395 general purpose lanes.

This alternative does not support the need to promote transit use as the proposed long flyover ramp is from the general purpose lanes with no access to the HOT lanes. The additional traffic using the direct access will not benefit traffic conditions on I-395. For these reasons this alternative is not being carried forward for further study.

Alternative "D" (Figure 6-8 in Appendix A) provides access to Mark Center from the I-395 HOT lanes and would be open to the public, not just Army employees. This ramp configuration begins from the HOV lanes just south of the Seminary Road interchange and travels over the SB general purpose lanes and then travels within and along the edge of the Winkler Preserve and touches down at Mark Center Drive, a public road in Mark Center. This configuration will provide a reversible flow ramp which will allow traffic to enter the site in the morning and exit in the afternoon. Buses would be allowed in this configuration. In addition to the above, an auto-only southbound exit movement to get onto SB general purpose lanes would be allowed from the Army south garage in this alternative.

This alternative provides meaningful benefits with relatively high costs and impacts. It supports the need to promote transit and HOV use by providing direct access from the HOT lanes. This alternative improves conditions on I-395 as all site traffic originating from the south will not need to access the general purpose lanes. The direct access also improves traffic conditions at the local arterial intersections and also at the rotary. For these reasons this alternative is being carried forward for further study.

Alternative "E" (Figure 6-9 in Appendix A) is similar to alternative "D" but also provides a direct connection between the Army south garage and the HOV lanes. Unlike Alternative D, this configuration will provide a two-way flyover ramp which allows a traffic connection to both the south and north on the HOT lanes. The concept allows for buses/vanpools/shuttles to make an interim stop at the Mark Center in the morning on their way to points north, such as the Pentagon. It provides similar southbound operations in the afternoon.

This alternative provides marginally better HOT access than alternative "D". However, this benefit is outweighed by the challenges inherent in the elevated T intersections, friction caused by having closely spaced ramps, and significantly higher cost of construction. For these reasons, this alternative is not being carried forward for further study.

It is to be noted that only alternative "E" would result in "full interchanges". However, Alternative "D" provides for a direct connection from the reversible I-395 HOV/HOT facility to a public roadway within the Mark Center site and compliments the HOV/HOT lanes which would provide good opportunities for the transit vehicles, carpools, and vanpools to use the HOT lanes.

Table 6-1 summarizes the advantages and disadvantages of each of the Preliminary Build Alternatives based on the analysis and comments. Conceptual drawings of these alternatives are included in Appendix A. In addition, the alternatives were evaluated on their ability to satisfy the Guiding Principles established by the BRAC Advisory Committee and those results are shown in Table 6-2.

Table 6-1: Alternative Comparison Matrix

Evaluation Criteria	A1. Southbound Ramp on Flyover to South Parking Garage (SPG)	A2. Southbound Ramp to South Parking Garage	B1. Southbound Ramp to Private Road	B2. Southbound Ramp to Mark Center Drive	C. GP Lanes Flyover to South Parking Garage	D. HOT Lanes Flyover (One-Lane, Reversible Ramp) to Mark Center Drive	E. HOT Lanes Flyover (Two-Lane, Two-way Ramp) to Mark Center Drive
Pros	•Medium cost •Provides direct access to SB I-395 and indirect access to NB I-395 GP traffic in AM; Right-out from SPG provides exit option to SB GP lanes •Avoids significant impact to the Winkler Preserve •Separates BRAC-133 traffic from SB on-ramp traffic •Does not preclude south-facing HOT Lanes Bus-only ramp to Seminary Road Interchange ("Rotary"). •Reduces traffic on arterial intersections	•Low cost •Provides direct access to SB I-395 and indirect access to NB I-395 GP traffic in AM; Right-out from SPG provides exit option to SB GP lanes •Avoids significant impact to the Winkler Preserve •Uses Level P4 at SPG •Does not preclude south-facing HOT Lanes Bus-only ramp to Seminary Road Interchange ("Rotary") •Reduces traffic on arterial intersections	• Medium cost • Open to the public • Does not preclude south-facing HOT Lanes Bus-only ramp to Seminary Road Interchange ("Rotary") • Bus access available; easy access to Transit Center • Reduces traffic on arterial intersections	•Medium cost •Open to the public •Connects to a public roadway •Does not preclude south-facing HOT Lanes Bus-only ramp to Seminary Road Interchange ("Rotary") •Bus access available; easy access to Transit Center •Reduces traffic on arterial intersections	•Provides direct access to SB I-395 and NB I-395 GP traffic in AM; Right-out from SPG provides exit option to SB GP lanes •Avoids significant impact to the Winkler Preserve •Separates BRAC-133 traffic from SB on-ramp traffic •Does not preclude south-facing HOT Lanes Bus-only ramp to Seminary Road Interchange (Rotary") •Reduces traffic on arterial intersections	•Connects to a public roadway •Provides access to NB AM traffic and SB PM traffic to HOT Lanes: Right-out from SPG provides exit option to SB GP lanes • Open to the public •Promotes HOT/HOV/Transit use • Bus access available; easy access to Transit Center •Reduces significant traffic on the rotary and arterial intersections •Eliminates the need for the Bus-only ramp	•Connects to a public roadway •Provides access to NB AM traffic; SB PM traffic to HOT lanes • Open to the public • Exit from South parking Garage to SB HOT Lanes only (No exit in AM though) •Reduces significant traffic on the rotary and arterial intersections • Promotes HOT/HOV/Transit use. •Eliminates the need for the Bus-only ramp •Bus access available; easy access to Transit Center and travel beyond without entering the rotary or the adjacent arterials
Cons	•TMP required to manage queues at the South Parking Garage ("SPG") •Requires limited access design exception from FHWA •Worsens the traffic conditions on the rotary due to added circulation •Requires relocation of ramp metering due to the right-out option; Traffic exiting from the South Garage won't be metered in the refined design •Requires widening of Sanger Rd bridge • Connects to SPG only (secured entrance - possible backups at the rotary) •NB traffic must U-turn through Seminary Interchange to access SPG •Serves exiting traffic only in the SB direction •Requires shift of entry from Level P4 to P5 (Conflict with initial WHS garage construction plans) •No direct access to HOT Lanes (no incentives) •No bus access available •Does not serve the entire WHS employee population	•Eliminates Seminary to I-395 SB free-flow right turn •TMP required to manage queues at the South Parking Garage ("SPG") •Worsens the traffic conditions on the rotary due to added circulation •Requires limited access design exception from FHWA •Requires relocation of ramp metering due to the right-out option; Traffic exiting from the South Garage won't be metered in the refined design •Requires widening of Sanger Rd. bridge •Connects to SPG only (secured entrance - possible backups at the rotary) •NB traffic must U-turn through Seminary Interchange to access SPG •Serves exiting traffic in the SB direction only •No direct access to HOT Lanes (no incentives) •No bus access available Does not serve the entire WHS employee population	•Conflicts with the future IDA site plan •Connects to private roadway •NB traffic must U-turn through Seminary Interchange to access ramp •Potential impact on free-flowing right-turn from EB Seminary Rd •Weave with existing SB ramp is a concern •Impacts Winkler Preserve •No direct access to HOT Lanes (no incentives) •Provides entry to the site only, no exit onto freeway provided	•Conflicts with the future IDA site plan •Weave with existing SB ramp is a concern •NB traffic must U-turn through Seminary Interchange to access ramp •Impacts Winkler Preserve •Potential impact on free-flowing right-turn from EB Seminary Rd •No direct access to HOT Lanes. (no incentives) •Provides entry to the site only, no exit onto freeway provided	•High Cost •Connects to South Parking Garage (secured entrance - possible backups at the rotary) •TMP required to manage queues at the South Parking Garage ("SPG") •Requires limited access design exception from FHWA •Difficult traffic operations at South Parking Garage •NB traffic must U-turn through Seminary Interchange to access SPG •No direct access to HOT Lanes (no incentives) •No bus access available •Requires relocation of ramp metering due to the right-out option; Traffic exiting from the South Garage won't be metered in the refined design •Requires widening of Sanger Rd bridge •Serves exiting traffic in the SB direction only •Worsens the traffic conditions on the rotary due to added circulation	•High Cost •Conflicts with the future IDA site plan •Does not provide direct inbound access to the site from GP lanes • Impacts the Winkler Preserve •Requires relocation of ramp metering due to the right-out option; Traffic exiting from the South Garage won't be metered in the refined design •Requires widening of Sanger Rd bridge	•High Cost •Conflicts with the future IDA site plan •No access to exiting SB ramp traffic •Does not provide direct inbound access to the site from GP lanes •Difficult traffic operations at the T-intersections created by the proposed flyover •Precludes the south HOT Lanes Ramp to Seminary Road Interchange •Impacts the Winkler Preserve

Table 6-2: Alternative Comparison to BRAC Advisory Guiding Principle

BRAC Advisory Guiding Principle	Interchange Alternatives						
	A1	A2	B1	B2	C	D	E
	Southbound Ramp on Flyover to South Parking Garage	Southbound Ramp to South Parking Garage with Dual RT Lanes	Southbound Ramp to Private Road	Southbound Ramp to Mark Center Drive	GP Lanes Flyover and Southbound Ramp to South Parking Garage	HOT Lanes Flyover (One-Lane, Reversible Ramp) to Mark Center Drive	HOT Lanes Flyover (Two-Lane, Two-way Ramp) to Mark Center Drive
Be transit-oriented and accommodate HOV lanes	No	No	No	No	No		
Be consistent with the existing and proposed Transportation Management Plans and the City's Transportation Master Plan	No	No	No	No	No		
Provide for amenities/incentives to encourage alternate transit use	No	No	No	No	No		
Reduce the traffic impacts to the I-395 and Seminary Road Interchange	No	No	No	No			
Serve the entire Mark Center campus	No	No			No		
Protect the Winkler Botanical Preserve			No	No		No	No
Be designed/built for the long-term usage, being the most transit efficient alternative, **not** necessarily the least expensive or most expensive	No	No	No	No	No		
Consider/accommodate the potential future redevelopment of the surrounding areas (e.g. Mark Center & Beauregard Corridor)	No	No	No	No	No		
Be funded by the Federal Government through the design and construction phases	TBD	TBD	TBD	TBD	TBD	TBD	TBD

* "Maybe" in the context of this table means either that additional study is required for confirmation or the impact is slight relative to the more definitive 'Yes' or 'No' result.

6.5 Final Alternatives

As described above, Alternatives "A1" and "D" are carried forward for additional study.

These alternatives provide very different benefits, impacts and costs.

Level of Service and other indicators of traffic conditions for I-395 and adjacent intersections are compared for the No-Build Alternative, Alternative "A1" and Alternative "D" in Section 8. Safety considerations are documented in Section 9.

Below is additional detail on the two final alternatives:

6.5.1 Alternative A1 – WHS Access via Braided Flyover from the Existing Southbound Ramp to the South Parking Garage

A preliminary design of this proposed access ramp is shown in Figure 6-3 in Appendix A. Southbound I-395 traffic can access the ramp by the existing general purpose exit and interchange "rotary." Northbound I-395 exiting traffic must make a "U-turn" through the existing Seminary Road interchange rotary through four traffic signals. A conceptual signing plan for this alternative can be found in Appendix G. The proposed ramp can be constructed between the existing southbound on-ramp and the I-395 mainline. Due to space limitations, some relocation of the existing on-ramp will be required. The flyover will begin as a one lane tapered exit, then widen to two lanes approximately two hundred feet from the South Parking Garage entrance. A 300-foot, four-span bridge will carry the flyover above the on-ramp. Due to the vertical clearance required on the existing entrance ramp, the access to the South Parking Garage will be at level P5, instead of P4 as proposed by the WHS. This modification will require structural changes to the parking garage. Additional foundations for future support structures at the garage entrance have been included in the current construction schedule. A short 10- to 20-foot span to the parking garage is anticipated.

The construction of the garage is currently under way. Based on the garage construction plans, it is anticipated that only one lane from the proposed flyover will be processed through the identification checkpoint or Access Control Point (ACP) as ENTER ONLY lanes. Errant drivers will be turned away at the checkpoint and can leave via the exit ramp to I-395 southbound. The existing ramp meter signal and STOP line on SB on-ramp will need to be relocated in this alternative. The existing raised median between the on-ramp and the I-395 mainline will be extended further south. The SB on-ramp and the exit ramp from the garage will merge into a single entering lane that terminates south of the existing Sanger Road overpass on I-395 general purpose lanes. This will require widening of the Sanger Road overpass.

The South Parking Garage will contain approximately 1,715 spaces. The total traffic entering the garage through the proposed braided ramp is limited by the presence of one security booth inside the garage which has a capacity of 360 vehicles/hr (based on 10 sec/vehicle security processing time as provided by WHS). This is consistent with the 350 vehicles/hr

processing rate as recommended in the Traffic and Safety Engineering for a Better Entry Control Facilities, 2009, SDDCTEA Pamphlet 55-15, page 2-16.

From a constructability standpoint, Alternative "A1" would require reconstruction of the existing interstate on-ramp to avoid conflict with the new flyover and extend the ramp terminal to receive the WHS ramp. The construction of the retaining walls and bridge for the flyover can be accomplished while maintaining two lanes of ramp traffic except during beam setting operations. The construction of the WHS ramp should be scheduled prior to reconstructing the existing on-ramp since the maximum construction space is available at that time. The I-395 HOT Lanes project could proceed at any time since the flyover and WHS ramp are not in conflict with any HOT lanes facilities.

From an environmental perspective, the proposed alignment would require strips of property along the on-ramp for paving, drainage and grading. The ramp foot print is expected to require approximately 3.7 acres of urban forest removal, the majority along the I-395 right of way. Both the existing I-395 roadway near Seminary Road and the Mark Center drain to the ravine and pond in the Winkler Botanical Preserve. Since the amount of new pavement will be 3.3 acres, storm water management will be required. Given the sensitivity of the preserve and its watercourses, special emphasis on sediment and erosion control will be implemented as part of the design. More detail about environmental considerations can be found in Section 11 of this report.

6.5.2 Alternative D – HOT Lanes Flyover (One-Lane, Reversible Ramp) to Mark Center Drive

A preliminary design of this proposed flyover access ramp and South Parking Garage exit ramp is shown in Figure 6-8 in Appendix A. While this flyover will be an entrance ramp for the northbound I-395 HOT/HOV/Bus lane traffic to enter the Mark Center site in the morning, this will serve as an exit ramp for the southbound HOT traffic in the afternoon. This ramp will be designed as a left-side exit for the NB motorists, which in turn will serve as a right-side merge for the SB motorists. The HOT lane ramps at the Turkeycock Run will provide an opportunity for the general purpose (GP) traffic from the south (inside the beltway) to use this flyover ramp. Traffic heading from the north of Seminary Road interchange will not have access to this ramp. Since the flyover ramp will be open to the general public, it will not only serve all buildings within the Mark Center facility, but also allow "cut-through" traffic from Seminary Road and Beauregard Street direct access to and from the HOT lanes on I-395. A conceptual signing plan for this alternative can be found in Appendix G.

The flyover ramp can be constructed between the proposed HOT Lanes and the northbound I-395 mainline. Due to space limitations, shifting of the existing northbound I-395 mainline and exit ramp to Seminary Road will be required. The flyover will begin as one lane parallel lane exit, and then be carried on a bridge over the southbound I-395 general purpose lanes. A 600-foot multi-span bridge will cross the I-395 southbound general purpose lanes, southbound on-ramp and the existing 40-foot deep ravine, before touching down near the WHS site. The ramp continues through the Winkler Botanical Preserve closely following the Washington Headquarter Services and Institute for Defense Analyses property boundaries.

The ramp terminates at the intersection of Mark Center Drive. At the termini, separate storage lanes for left-turn and right-turn movements will be provided.

An EXIT ONLY ramp from the South Parking Garage is included in this alternative as well. This exit ramp will be very similar to Alternative "A1" exit except that level P4 as proposed by the WHS can be utilized. This feature will not require structural changes to the parking garage. Additional foundations for future support structures at the garage entrance have been included in the 2009 construction schedule. A short 10- to 20-foot span to the parking garage is anticipated.

There will be two lanes at the South Parking Garage ramp. These will operate as EXIT ONLY lanes. Downstream of the garage access, the ramp will be reduced to one lane. The existing ramp meter signal and STOP line on SB on-ramp will need to be relocated due to this exit ramp. The existing raised median between the SB on-ramp and the I-395 mainline will be extended further south. The SB on-ramp and the exit ramp from the garage will merge into a single entering lane that terminates in the vicinity of the existing Sanger Road overpass on I-395 general purpose lanes. It is to be noted that the HOT lane flyover ramp in this alternative will begin at a point south of the Sanger Road overpass. Therefore, alternative "D" will require widening of the Sanger Road overpass.

From an environmental perspective, the proposed alignment would require property along the ramp alignment for bridges, retaining walls, paving, drainage and grading. The ramp foot print is expected to require approximately 9.0 acres of urban forest removal, with over 6.0 acres cleared on the I-395 right of way. Both the existing I-395 roadway near Seminary Road and the Mark Center drain to the ravine and pond in the Winkler Botanical Preserve. Since the amount of new pavement will be 5.9 acres, storm water management will be required. Given the sensitivity of the preserve and its watercourses, special emphasis on sediment and erosion control will be implemented as part of the design. More detail about environmental considerations can be found in Section 11 of this report.

6.6 Utilities

The utilities in the project area include Dominion Virginia Power, Washington Gas, Verizon (telephone), Comcast (cable television), Virginia American Water and City of Alexandria (sewers). The utilities are generally located along public right of ways including I-395, Seminary Road, and Mark Center Drive. City of Alexandria sewers flow to the southwest in easement through the Winkler Botanical Preserve. Alternative "A1" will require protection or relocation of utilities along the southbound on-ramp in the vicinity of the proposed bridge and retaining walls for the proposed ramp connection to the South Parking Garage. Alternative "D" will require similar protections or relocations, but only those south of the ramp connection to the South Parking Garage. Within the Winkler Botanical Preserve, there are few utilities to relocate until the proposed alignment approaches Mark Center Drive. Here electric, gas, water mains and sanitary sewer lines and appurtenances will need to be protected or relocated.

6.7 Alternative Costs

Based on the 15% Plans developed for Alternatives "A1" and "D", planning level construction quantities were estimated. Using unit costs associated with the I-395 HOT Lanes proposal, conceptual construction costs were prepared for both of the proposed alternatives. The estimated total cost of alternative "A1" is $34,500,000 and includes the braided flyover and retaining walls to access level P5 of the South Parking Garage. The estimated right of way cost for alternative "A1" is $4,300,000. Alternative "D" includes significant bridge and retaining walls to cross I-395 southbound lanes and access to the lower level P4 of the South Parking Garage, and thus raising the estimated total cost to $87,900,000. The estimated right of way cost in alternative "D" is $19,500,000.

SECTION 7

SUBSTANDARD FEATURES

It is to be noted that the results of the substandard features analysis reported in this section are based on the complete set of 15% plans and profiles for the two refined alternatives, as presented in Appendix F of this report.

This report proposes to improve accessibility, convenience, safety and relieve traffic congestion in the transportation network surrounding the WHS Mark Center site. A second access point is being requested to provide direct general purpose and or HOT/HOV/Bus access to the WHS site and to deliver traffic to the interstate in safer and more efficient manner than via the ramps at the existing interchanges. Based on the projected traffic demand and the limited capacity provided by the surrounding roadway network, the proposed connections warrant consideration. The proposed access points avoid adversely impacting the I-395 mainline, take advantage of additional capacity to be added by the I-395 HOT Lanes project, and serve to improve safety on Seminary Road and its interchange with I-395.

A comparison of project requirements, existing and proposed conditions is depicted in Table 7-1 below.

Table 7-1: Review of Existing Design Elements for Proposed Ramps

Design Criteria	Project Requirement	Existing Condition*	Proposed Condition
I-395 SB Ramp/WHS South Parking Garage Access Ramp			
Design Speed of Highway	65 MPH	Posted 55 MPH	No Change
Ramp Design Speed	35 MPH	N/A	35 MPH
Minimum Radius	350'	1800'	350'
Ramp Gradient	6%	5.80%	6.06%
Superelevation Rates	8%	2%	3.7%
Design Width of Pavement	16'	24' to 16'	No Change
Acceleration Lane Length	846'	1020'	>1020'
Stopping Sight Distance	250'	>250'	No Change
I-395 HOT Lanes Access Ramp to Mark Center Drive			
Design Speed of Highway	65 MPH	Posted 55 MPH	No Change
Ramp Design Speed	35 MPH	N/A	35 MPH
Minimum Radius	314'	6500'	314'
Ramp Gradient	6%	4.2%	6.9%
Superelevation Rates	8%	2.1%	8%
Design Width of Pavement	16'	16' to 24'	16'
Deceleration Lane Length	252'	490'	505'
Stopping Sight Distance	250'	320'	250'

*North Bus-Only HOT Lanes Ramp at Seminary Road used as Existing for HOT Lanes Access

Design elements were reviewed for the I-395 southbound entrance ramp and the WHS South Parking Garage access ramp (Alternative "A1"). A review of the 15% plans finds five (5) design exceptions and or design waivers for the ramps, as shown in Figure 7-1 in Appendix A. All other project improvements will conform to VDOT/FHWA design criteria and standards.

Design elements were reviewed for the I-395 HOT Lanes access ramp to Mark Center Drive and the exit-only ramp from the South Parking Garage (Alternative "D"). A review of the 15% plans indicates seven (7) design exceptions and or design waivers for this alternative, as shown in Figure 7-2 in Appendix A. All other project improvements will conform to VDOT/FHWA design criteria and standards.

A complete list of potential design exceptions (DE) and design waivers (DW) associated with the two Build alternatives are summarized in Table 7-2.

Table 7-2: Summary of Potential Design Exceptions and Waivers

	Location	Station From	Station To	Side	Design Feature	Proposed Design	Standard Required	DE or DW	Reason for DE/DW	Required for Standard to be Fully Met
Design Alternative A1	Seminary/Mark Center RAMP MCSR				Access Control	Break in access control.	No break in access control within 100ft of ramp terminal	DE-A1-1	Providing an access to South Parking Garage.	N/A
	Seminary/Mark Center RAMP MCSR	203+71	213+60	RT	Shoulder Width	2ft RT	6ft RT	*DE-A1-2*	1. Minimize the impact to BRAC 133 R/W and possible security zone. 2. Limited available space between existing ramp and I-395.	1. Re-alignment of existing ramp from Seminary Road onto SB I-395. *Realignment of I-395.* 2. Additional R/W & wider bridge structure.
		200+91	217+50	LT		2ft LT	4ft LT			
	Seminary RAMP SMSR	1649+15	1651+50	RT	Shoulder Width	2ft RT	6ft RT	DE-A1-3	1. Minimize the impact to BRAC 133 R/W and possible security zone. 2. Match existing ramp geometry. 3. Minimize the impact to the existing I-395. 4. Limited available space between I-395 and South Parking Garage.	1. Re-alignment of existing ramp from Seminary Road onto SB I-395. And/or, realignment of I-395. 2. Additional R/W. 3. Seminary Road Interchange improvement.
		(Station based on I-395 HOT Lane Baseline)		LT		2ft LT	4ft LT			
	I-395 SB General Purpose Lanes	1629+62	1649+17	RT	Shoulder Width	10ft RT	12ft RT	DW-A1-1	1. Minimize the impact to BRAC 133 R/W and possible security zone. 2. Minimize the impact to Sanger Road Bridge.	1. Additional R/W; 2.Widening or reconstruction of Sanger Bridge.
	I-395 SB General Purpose Lanes	Bridge over Sanger Ave			Vertical Cleanance	< 14.5ft	16.5ft	DW-A1-2	1. The minimum vertical cleanance at existing Sange Ave Bridge is 14.5ft. 2. Existing Sanger Bridge is to be widened.	1. Reconstruction of Sanger Bridge. 2. I-395 Mainlane connecting to the bridge and/or Sanger Ave under the bridge has to be re-graded. 3. Additional R/W.
Design Alternative D	Seminary/Mark Center RAMP MCSR				Access Control	Break in access control.	No break in access control within 100ft of *ramp terminal*	DE-D-1	Providing an exit to South Parking Garage.	N/A
	Seminary/Mark Center RAMP MCSR	1000+00	1004+71	RT	Shoulder Width	2ft RT	6ft RT	DE-D-2	1. Minimize the impact to BRAC 133 R/W and possible security zone. 2. Limited available space between existing ramp and I-395.	1. Re-alignment of existing ramp from Seminary Road onto SB I-395. Re-alignment of I-395. 2. Additional R/W & wider bridge structure.
		1000+00	1008+67	LT		2ft LT	4ft LT			
	Seminary RAMP SMSR	1649+15	1651+50	RT	Shoulder Width	2ft RT	6ft RT	DE-D-3	1. Minimize the impact to BRAC 133 R/W and possible security zone. 2. Match existing ramp geometry. 3. Minimize the impact to the existing I-395. 4. Limited available space between I-395 and South Parking Garage.	1. Re-alignment of existing ramp from Seminary Road onto SB I-395. And/or, realignment of I-395. 2. Additional R/W. 3. Seminary Road Interchange improvement.
		(Station based on I-395 HOT Lane Baseline)		LT		2ft LT	4ft LT			
	Pavement shoulder under Mark Center Reversible HOT Ramp MCHR	Bridge Pier Locations			Shoulder Width	Various	Various	DE-D-4	Pier structures for Bridge.	1. Re-alignment of existing ramp from Seminary Road onto SB I-395. Re-alignment of I-395. 2. Additional R/W and widening of existing Sanger Bridge.
	I-395 SB General Purpose Lanes	1629+62	1649+17	RT	Shoulder Width	10ft RT	12ft RT	DW-D-1	1. Minimize the impact to BRAC 133 R/W and possible security zone. 2. Minimize the impact to Sanger Road Bridge.	1. Additional R/W; 2.Widening or reconstruction of Sanger Bridge.
	HOT Lanes Mark Center Ramp MCHR	Entire Ramp		RT/LT	Shoulder Width	6 ft (both LT/RT)	8 ft (both LT/RT)	DW-D-2	1. Minimize the impact to BRAC 133 R/W and possible security zone. 2. Minimize the impact to existing Winkler Preserved Area, I-395 and Sanger Road Bridge. 3. Realignment of HOT Lanes is restricted by the location of the existing Seminary Road Rotary bridge piers.	More area taken from Winkler Preserved Area and Mark Center. Additional R/W. Wider/higher structures. Realignment of I-395 and widening/reconstruction of existing Sanger Road Bridge.
	I-395 SB General Purpose Lanes	Bridge over Sanger Ave			Vertical Cleanance	< 14.5ft	16.5ft	DW-D-3	1. The minimum vertical cleanance at existing Sange Ave Bridge is 14.5ft. 2. Existing Sanger Bridge is to be widened.	1. Reconstruction of Sanger Bridge. 2. I-395 Mainlane connecting to the bridge and/or Sanger Ave under the bridge has to be re-graded. 3. Additional R/W.

SECTION 8

TRAFFIC OPERATIONAL ANALYSIS

The operational performance of the I-395 study corridor and the parallel arterials were evaluated for three analysis years: existing conditions (2009), opening year (2015), and design year (2035).

8.1 Traffic Operations Analysis Assumptions and Methods

It is to be noted that the results of the traffic operations analysis reported in this section are based on the originally proposed Build alternatives as explained in details in Section 6.5. (See **Figures 6-3 and 6-8** in Appendix A.) Following the traffic analysis, the proposed alternatives were further refined to improve design deficiencies. A complete set of 15% plans and profiles for the refined alternatives can be found in Appendix F. The key changes made in the refined alternatives include:

- Longer acceleration lane (from 750 ft to 1380 ft) on the southbound on-ramp from Seminary Road (R-6) in both "A1" and "D"; and
- Longer acceleration/deceleration lane (from 805 ft to 905 ft) on the new merge/diverge segment (R7-B) on the HOT lanes created due to the proposed flyover in alternative "D".

Since these geometric changes will only improve overall traffic operations, traffic models and all of the other analyses presented in this section were not revised to reflect the final refined alternatives. Therefore, some discrepancies would be found between the 15% plans (refined) and the traffic models. These discrepancies, however, will not cause major fluctuations in the results presented in this section and would not alter the conclusion of this report.

All figures in this section can be found in Appendix A of **Volume II** that serves a companion document to this report. Details regarding the traffic operational analysis methods and assumptions are presented in Appendix B. The analysis for this study was conducted for the AM and PM peak hour traffic conditions for the following **scenarios**:

- 2009 Existing
- 2015 No-Build
- 2015 Build - Alternative 1 (Alt "A1")
- 2015 Build - Alternative 2 (Alt "D")
- 2035 No-Build
- 2035 Build - Alternative 1 (Alt "A1")
- 2035 Build - Alternative 2 (Alt "D")

The existing conditions analysis, for most part, was conducted by collecting 2009 traffic volumes. Design hour volumes for 2015 and 2035 traffic conditions were developed in a manner consistent with the Federal and State requirements and processes to be utilized in the development traffic for an IJR. Travel forecast for this study was developed by using Transportation Planning Board (TPB) Regional Travel Model (Version 2.2) and through a close coordination with VDOT District Transportation Planning section. **Traffic volumes** for the study network as used in this operational analysis for Existing, No-Build and Build scenarios are shown in Figures **8-1 to 8-8**. Travel demand forecasting methodology is presented in Appendix C.

Future No-Build conditions assume improvements associated with the I-395 HOT lanes project including the capacity enhancement on the HOT lanes, proposed bus-only ramp and other geometric improvements at the Seminary Road interchange; and BRAC 133 related roadway improvements along the arterial network surrounding the Mark Center facility. Future Build Conditions include No-Build configurations plus the proposed direct connection to the Mark Center site as identified in two (2) design alternatives. **Lane geometry** and the operational features for the I-395 study corridor are shown in Figures **8-9 to 8-12** for Existing, No-Build and Build scenarios.

Traffic analysis of the study corridor was performed utilizing both Highway Capacity Manual (HCM) methods as well as traffic operational micro-simulation **models**. Capacity analysis for the basic freeway segments, ramp merges and diverges, and weaving segments within the study area was conducted using the Highway Capacity Software (HCS). In some cases the HCS analysis does not accurately portray the actual field operation under congested conditions because the HCM methodologies do not take into consideration upstream or downstream effects. Therefore, consistent with VDOT approved processes, VISSIM micro-simulation modeling was used to supplement the HCS capacity analysis. While the HCS analysis evaluates roadway segments as isolated conditions, VISSIM analysis can assess system-wide operations by evaluating the upstream and downstream impacts. Since these two tools are based on different methodologies, discrepancy between the HCS and VISSIM results are expected. All study intersections were analyzed using the Synchro software due to its ability to optimize traffic signal timing and also report HCM output. VISSIM models also included these study intersections to estimate travel time and queue-length information.

8.1.1 VISSIM Analysis

VISSIM models were run for two hours, which include one hour of initialization period followed by one hour of data collection (for a total of 120 minutes of micro-simulation modeling). To account for the stochastic nature of the simulation a total of 5 simulation runs were carried out to evaluate the travel times, queue-lengths, density, and volumes for each traffic condition. The VISSIM levels-of-service for basic freeway segments, ramp merges and diverges and weave movements were calculated comparing the VISSIM outputs for link densities to the densities associated with each level-of-service in the Highway Capacity Manual. Four categories were developed for the VISSIM levels-of-service to represent the comparison with that of the HCM and were also color coded for the accompanying exhibits:

- Light to Moderate Traffic (green): LOS A - C

- Heavy Traffic (yellow): LOS D
- High Congestion (orange): LOS E
- Severe Congestion (red): LOS F

VISSIM outputs were also used to develop other measures of effectiveness (MOE) such as average travel speeds by link for the freeway facilities. Four categories were developed for the speeds and were also color coded for the exhibits:

- Speeds of 20 mph or lower: red
- Speeds from 20 mph to 35 mph: orange
- Speeds from 35 mph to 55 mph: yellow
- Speeds of 55 mph or greater: green

These exhibits demonstrate at a greater detail on how the capacity constraints along the freeway segments affect the speeds and the effects of congestion on each lane along the weaving segments. These exhibits also complement the findings of the peak hour levels of service calculated using VISSIM.

Calibration process used to fine-tune the VISSIM models was a rigorous task and explained in Section VII of Appendix B.

Table 8-1 summarizes the VISSIM results for the freeway segments and Figures **8-13 to 8-16, 8-21 and 8-22** illustrate the **HCM** LOS and **VISSIM** traffic congestion results, Figures **8-27 to 8-30, 8-35 and 8-36** show VISSIM average travel speed results, and Figures **8-41, 8-42 and 8-45** show HCM LOS/delay results at the critical intersections for the **Existing and No-Build** conditions. Similar results are shown for two **Build** alternatives in figures **8-17 to 8-20, 8-23 to 8-26, 8-31 to 8-34, 8-37 to 8-40, 8-43, 8-44, 8-46 and 8-47**.

8.1.2 HCS Analysis

The HCS analysis methodology for the basic freeway segments, ramps and ramp junctions, and weaving sections used the following global input values for existing and future conditions:

- Peak Hour Factor (PHF) - 0.96(AM)/0.94 (PM)
- Terrain Type - Varies
- Percent Heavy Vehicles - 4% on GP, 1% on HOV/HOT
- Base free-flow speed: 70 mph
- Lane Widths - Varies
- Right Shoulder Lateral Clearance - Varies
- Interchange Density (per mile) - 0.83 on GP, ≤ 0.5 on HOV/HOT
- Driver Population Factor: 1.00

All other input values were used based on the facility type, location, time of the day, and analysis year. The list of all input values as used in the HCS analysis is shown in Table B-1 of Appendix B. The HCS output included average travel speed, density and level-of-service (LOS) for each link.

Table 8-2 summarizes the HCS results for the freeway segments (basic, diverge/merge, and weaving) and Table 8-3 summarizes the HCS LOC/delay results for the study intersections under the existing, no-build, and build scenarios.

Table 8-1: VISSIM Model MOE Summary -Freeway Segments

Section ID	Facility Type	Description	2009 Existing AM		2015 No Build AM		2015 Build Alt A1 AM		2015 Build Alt D AM		2035 No Build AM		2035 Build Alt A1 AM		2035 Build Alt D AM		2009 Existing PM		2015 No Build PM		2015 Build Alt A1 PM		2015 Build Alt D PM		2035 No Build PM		2035 Build Alt A1 PM		2035 Build Alt D PM	
			Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln
I-495 General Purpose Lanes NB																														
F-1	Basic	From EB Duke St off-ramp to WB LRT off-ramp	26.57		21.89		25.02		24.17		21.80		15.87		44.60		51.42	29.49	51.49	29.36	51.74	29.42	51.84	29.18	51.96	28.67	52.25	28.38	41.67	22.80
R-1	Diverge	Off-ramp to WB LRT	23.84		20.16		21.88		21.35		19.84		14.86		39.09	34.62	44.04	26.27	43.00	26.81	43.95	26.36	45.41	25.38	44.80	25.33	46.96	24.84	37.22	19.52
F-2	Basic	From WB LRT off-ramp to EB LRT/WB Duke on-ramp	19.12		17.60		19.79		19.34		17.65		13.53		21.00		53.46	25.67	53.44	25.48	53.48	25.42	53.45	25.47	53.49	25.30	53.48	25.14	42.78	20.19
R-2	Merge	On-ramp from EB LRT/WB Duke	18.73		16.87		23.21		22.80		17.13		13.20		16.78		43.44	31.27	42.94	31.88	45.39	29.76	45.80	29.78	39.92	34.14	47.53	29.14	33.20	27.00
F-3	Basic	From EB LRT/WB Duke on-ramp to Seminary Rd off-ramp	54.50	31.40	46.60	34.03	51.34	30.61	54.57	32.18	54.29	27.20	17.65		51.89	30.69	51.57	28.61	51.77	28.45	52.09	34.91	52.03	29.15	51.57	29.17	51.52	29.15	41.52	28.87
R-3	Diverge	Off-ramp to Seminary Rd	52.65	28.68	33.79	43.71	42.24	29.14	53.24	28.62	52.96	28.10	12.95		47.50	34.18	50.15	27.24	51.27	26.34	51.90	25.82	51.69	26.04	50.82	27.06	42.64	34.81	41.47	21.28
F-4	Basic	From Seminary Rd off-ramp to Seminary Rd on-ramp	56.42	31.43	55.62	29.48	56.10	30.61	56.37	32.18	56.56	28.00	54.40	26.20	56.29	30.69	53.26	28.61	53.25	28.45	53.36	28.26	53.26	28.35	53.12	29.17	53.02	29.15	42.55	23.38
W-1	Weave	From Seminary Rd on-ramp to King St off-ramp	49.84	33.06	50.86	29.97	51.53	30.03	46.73	28.51	51.79	27.79	51.79	20.17	49.17	26.01	46.89	29.02	52.10	25.46	52.23	28.34	52.19	28.43	36.34	32.62	52.13	29.30	42.14	16.77
F-5	Basic	From King St off-ramp to EB King St on-ramp	52.23	31.53	53.22	31.99	53.40	32.39	43.15	33.23	53.48	29.65	53.62	26.77	52.04	33.92	53.05	26.35	53.60	24.94	53.55	25.09	53.31	25.28	53.49	25.05	53.33	24.84	42.59	20.15
R-4	Merge	On-ramp from EB King St	41.17	37.80	46.67	30.46	49.11	29.10	32.75	30.49	48.92	27.21	50.14	24.23	41.30	35.82	51.23	23.29	51.11	22.84	51.91	22.54	51.68	22.74	50.86	22.63	51.84	22.85	43.22	18.36
F-6	Basic	From EB King St on-ramp to WB King St on-ramp	52.39	38.71	52.64	36.05	52.66	36.75	52.03	39.85	52.91	33.66	52.98	30.63	52.49	37.42	52.97	30.16	52.90	29.56	53.14	29.48	52.92	29.74	52.98	21.82	53.02	21.45	42.29	17.95
I-395 General Purpose Lanes SB																														
F-13	Basic	From EB Duke St off-ramp to EB LRT on-ramp	55.62	20.01	55.64	21.40	55.99	17.85	55.83	21.18	55.36	23.30	55.89	20.47	55.17	28.24	15.05		15.03		14.47		14.58		16.62		15.00		12.94	
W-3	Weave	From WB Duke St on-ramp to EB Duke St off-ramp	46.17	20.78	46.28	22.35	48.94	17.67	48.15	21.56	43.46	26.64	47.80	21.43	41.62	28.94	14.87		14.69		14.42		15.15		20.27		16.24		16.12	
F-12	Basic	From WB LRT off-ramp to WB Duke St on-ramp (3-lane section)	56.07	20.24	55.87	22.30	56.38	17.99	55.95	22.41	54.89	26.08	55.56	22.66	54.36	27.43	17.99		17.94		17.27		19.29		26.98		21.12		20.72	
F-11	Basic	From WB LRT off-ramp to WB Duke St on-ramp (4-lane section)	56.45	14.84	56.30	16.32	56.74	13.50	56.30	16.44	55.94	18.90	56.11	16.56	55.71	19.77	12.00		10.74		11.77		13.42		10.84		11.99		10.60	
R-7	Diverge	Off-ramp to WB LRT	52.49	14.35	50.81	16.51	52.97	12.75	50.61	16.50	50.40	18.38	50.39	15.97	48.40	19.75	15.51		13.52		13.09		15.22		23.24		13.43		11.28	
F-10	Basic	From Seminary Rd on-ramp to WB LRT off-ramp	56.78	16.93	56.68	18.90	56.77	15.26	56.67	18.02	56.66	20.89	56.47	18.27	56.53	21.74	19.66		14.67		11.97		15.04		12.76		12.11		9.73	
R-6	Merge	On-ramp from Seminary Rd	55.42	13.69	55.30	15.29	52.65	13.13	52.81	16.08	55.61	16.79	51.99	15.71	51.40	18.77	29.74		15.35		11.13		15.20		12.96		11.66		8.98	
F-9	Basic	From Seminary Rd off-ramp to Seminary Rd on-ramp	57.16	14.00	57.06	15.82	56.82	12.63	57.13	15.84	56.90	17.20	57.06	14.64	56.98	17.22	53.69	23.19	40.66	22.40	53.55	25.02	53.53	25.68	53.37	21.44	47.17	25.97	42.72	20.11
W-2	Weave	From EB King St on-ramp to Seminary Rd off-ramp	56.11	13.71	49.03	20.17	5.70		55.76	16.55	15.66		8.16		54.74	18.18	52.99	22.40	52.73	24.53	47.79	27.88	51.35	25.74	8.80		9.19		14.87	
F-8	Basic	From WB King St on-ramp to EB King St on-ramp	57.04	15.34	56.94	18.55	8.09		56.93	18.58	36.19	34.59	16.85		56.86	20.08	53.00	25.84	52.90	27.91	51.36	28.73	52.93	28.57	12.12		13.31		21.35	
R-5	Merge	On-ramp from WB King St	56.34	17.46	56.21	15.07	6.96		56.21	15.09	37.91	26.90	19.30		56.07	16.13	51.65	21.06	51.40	22.81	50.35	23.29	51.58	23.28	9.61		10.23		18.89	
F-7	Basic	From WB King St off-ramp to WB King St on-ramp	57.26	14.14	57.24	17.36	15.65		57.22	17.36	44.43	25.85	24.16		57.19	18.76	53.46	24.40	53.22	26.52	53.28	26.45	53.11	27.25	12.96		13.65		21.86	18.14

* The traffic congestion level on this section can be reduced to light to moderate by improving the westbound merge condition on Seminary Road, as noted in section 8.2.1.

Table 8-1: VISSIM Model MOE Summary - Freeway Segments (Continued)

Section ID	Facility Type	Description	2009 Existing AM		2015 No Build AM		2015 Build Alt A1 AM		2015 Build Alt D AM		2035 No Build AM		2035 Build Alt A1 AM		2035 Build Alt D AM		2009 Existing PM		2015 No Build PM		2015 Build Alt A1 PM		2015 Build Alt D PM		2035 No Build PM		2035 Build Alt A1 PM		2035 Build Alt D PM	
			Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln
I-395 HOV NB (AM)																														
F-14	Basic	From Duke St to Seminary Rd	54.31	30.96	56.50	20.33	56.48	20.36	56.34	21.30	55.86	28.26	55.86	28.26	54.29	33.39														
R-7B	Diverge	Off-ramp to Mark Center Dr							55.57	17.56					50.70	26.50														
R-7A	Diverge	Bus only off-ramp to Seminary Rd			56.52	15.22	56.53	15.29			50.36	23.61	50.36	23.61																
F-14B	Basic	From Mark Center Dr off-ramp to Seminary Rd on-ramp							57.00	18.51					56.84	25.00														
F-14A	Basic	From Seminary Rd BUS only off-ramp to Seminary Rd on-ramp			56.52	20.00	57.11	16.77			57.04	22.84	57.14	19.48																
R-8	Merge	On-ramp from Seminary Rd	41.37	28.44	49.34	19.34	48.70	19.57	48.42	18.36	44.99	28.19	44.49	28.54	47.15	24.77														
F-15	Basic	From Seminary Rd on-ramp to North of King St Interchange	54.55	32.60	56.36	22.77	56.29	22.75	56.40	21.19	55.82	30.54	55.73	30.65	56.08	27.99														
I-395 HOV SB (PM)																														
F-14	Basic	From Seminary Rd to Duke St															51.75	29.70	53.36	21.86	53.34	21.88	53.30	20.46	53.11	30.47	53.17	30.36	42.47	22.82
R-7B	Merge	On-ramp from Mark Center Dr																					46.08	21.77					37.60	22.71
R-7A	Merge	BUS only on-ramp from Seminary Rd																	52.97	16.19	52.32	16.39			52.32	22.81	51.06	23.85		
F-14B	Basic	From Seminary Rd off-ramp to Mark Center Dr on-ramp																					53.59	20.09					42.80	22.41
F-14A	Basic	From Seminary Rd off-ramp to Seminary Rd (Bus only) on-ramp																	53.56	21.46	53.56	21.48			53.40	29.89	49.44	33.00		
R-8	Diverge	Off-ramp to Seminary Rd															49.92	21.53	53.18	19.17	53.16	19.02	53.15	17.36	44.07	24.18	36.33	42.15	20.18	41.65
F-15	Basic	From North of King St Interchange to Seminary Rd off-ramp															52.42	31.11	53.01	25.61	53.01	25.62	52.99	24.23	50.98	37.63	48.39	38.86	30.44	39.32

Legend

- Severe congestion
- High congestion
- Heavy traffic
- Light to moderate traffic

Table 8-2: HCS Analysis MOE Summary – Freeway Segments

Section ID	Facility Type	Description	Existing AM			2015 No Build AM			2015 Build Alt A1 AM			2015 Build Alt D AM			2035 No Build AM			2035 Build Alt A1 AM			2035 Build Alt D AM			Existing PM			2015 No Build PM			2015 Build Alt A1 PM			2015 Build Alt D PM			2035 No Build PM			2035 Build Alt A1 PM			2035 Build Alt D PM		
			Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS
I-395 General Purpose Lanes NB																																												
F-1	Basic	From EB Duke St off-ramp to WB LRT off-ramp	62.70	30.80	D	60.10	34.70	D	60.10	34.70	D	62.00	31.90	D	60.70	33.90	D	60.70	33.90	D	64.00	28.50	D	65.00	25.60	C	65.00	25.50	C	65.00	25.50	C	65.00	25.50	C	65.10	25.00	C	65.10	25.00	C	65.10	25.00	C
R-1	Diverge	Off-ramp to WB LRT	51.40	28.20	D	51.30	30.00	D	51.30	30.00	D	51.30	28.80	D	51.40	29.60	D	51.40	29.60	D	51.40	26.90	C	51.20	25.00	C	51.00	25.10	C	51.00	25.10	C	51.00	25.10	C	51.10	24.60	C	51.10	24.60	C	51.10	24.60	C
F-2	Basic	From WB LRT off-ramp to EB LRT/WB Duke on ramp	64.20	27.90	D	62.80	30.60	D	62.80	30.60	D	64.00	28.40	D	63.00	30.40	D	63.00	30.40	D	64.90	25.90	C	65.30	22.70	C	65.30	22.30	C	65.30	22.30	C	65.30	22.30	C	65.30	22.00	C	65.30	22.00	C	65.30	22.00	C
R-2	Merge	On-ramp from EB LRT/WB Duke	51.00	35.40	E	46.00	39.40	F	46.00	39.40	F	49.00	37.10	E	38.00	42.60	F	38.00	42.60	F	45.00	39.40	E	53.00	32.80	D	52.00	33.90	D	52.00	33.90	D	52.00	33.90	D	50.00	36.10	E	50.00	36.10	E	50.00	36.10	E
F-3	Basic	From EB LRT/WB Duke on-ramp to Seminary Rd off-ramp	54.40	42.10	E	-	-	F	-	-	F	-	-	F	-	-	F	-	-	F	-	-	F	60.80	33.70	D	60.00	34.80	D	60.00	34.80	D	60.00	34.80	D	57.80	37.70	E	57.80	37.70	E	57.80	37.70	E
R-3	Diverge	Off-ramp to Seminary Rd	53.60	33.90	D	52.70	38.50	F	52.70	38.50	F	53.60	36.00	F	51.90	45.00	F	51.90	45.00	F	53.30	40.50	F	53.30	33.20	D	53.10	34.80	D	53.10	34.80	D	53.10	34.80	D	53.10	37.70	E	53.10	37.70	E	53.10	37.70	E
F-4	Basic	From Seminary Rd off-ramp to Seminary Rd on-ramp	61.50	32.60	D	60.70	33.90	D	60.70	33.90	D	59.90	35.00	D	59.40	35.60	E	59.40	35.60	E	59.40	35.60	E	64.80	26.30	D	64.70	26.50	D	64.70	26.50	D	64.70	26.50	D	64.10	28.10	D	64.10	28.10	D	64.10	28.10	D
W-1	Weave	From Seminary Rd on-ramp to King St off-ramp	48.80	36.93	E	47.71	39.19	E	47.70	39.20	E	47.67	39.83	E	47.05	40.76	E	47.07	40.73	E	47.03	40.76	E	49.53	29.87	D	47.34	33.11	D	47.30	33.14	D	47.34	33.11	D	45.68	36.81	E	45.68	36.81	E	45.63	36.85	E
F-5	Basic	From King St off-ramp to EB King St on-ramp	60.90	33.50	D	59.60	35.30	E	59.60	35.30	E	58.70	36.50	E	59.20	35.90	E	59.20	35.90	E	59.20	35.90	E	65.30	23.20	C	65.20	24.20	C	65.20	24.20	C	65.20	24.20	C	65.00	25.70	C	65.00	25.70	C	65.00	25.70	C
R-4	Merge	On-ramp from EB King St	53.00	32.10	D	51.00	33.50	D	51.00	33.50	D	51.00	34.00	D	51.00	33.90	D	51.00	33.90	D	51.00	33.90	D	56.00	25.60	C	56.00	27.10	C	56.00	27.10	C	56.00	27.10	C	55.00	29.30	D	55.00	29.30	D	55.00	29.30	D
F-6	Basic	From EB King St on-ramp to WB King St on ramp	56.70	39.10	E	54.10	42.50	E	54.10	42.50	E	52.70	44.40	E	53.20	43.70	E	53.20	43.70	E	53.20	43.70	E	64.60	26.80	D	63.90	28.60	D	63.90	28.60	D	63.90	28.60	D	62.40	31.40	D	62.40	31.40	D	62.40	31.40	D
I-395 General Purpose Lanes SB																																												
F-13	Basic	From EB Duke St off-ramp to EB LRT on-ramp	63.40	19.80	C	63.40	20.80	C	63.40	20.80	C	63.40	20.80	C	63.40	24.70	C	63.40	24.70	C	63.40	24.70	C	58.30	36.10	E	55.30	40.30	E	55.30	40.30	E	57.70	37.10	E	-	-	F	-	-	F	-	-	F
W-3	Weave	From WB Duke St on-ramp to EB Duke St off-ramp	44.69	24.35	C	43.92	26.12	C	43.92	26.12	C	43.92	26.12	C	39.42	35.44	E	39.42	35.44	E	39.42	35.44	E	37.08	51.54	F	39.80	48.31	F	36.92	52.08	F	37.12	49.99	F	33.73	65.29	F	33.73	65.29	F	33.94	62.00	F
F-12	Basic	From WB LRT off-ramp to WB Duke St on-ramp (3-lane section)	63.40	20.40	C	63.40	21.60	C	63.40	21.60	C	63.40	21.60	C	63.30	26.00	C	63.30	26.00	C	63.30	26.00	C	56.30	38.90	E	-	-	F	-	-	F	54.70	41.00	E	-	-	F	-	-	F	-	-	F
F-11	Basic	From WB LRT off-ramp to WB Duke St on-ramp (4-lane section)	64.70	15.00	B	64.70	15.80	B	64.70	15.80	B	64.70	15.80	B	64.70	19.10	C	64.70	19.10	C	64.70	19.10	C	64.50	25.50	C	64.00	27.40	D	64.00	27.40	D	64.40	26.20	D	61.40	32.40	D	61.40	32.40	D	62.80	30.20	D
R-7	Diverge	Off-ramp to WB LRT	53.90	15.80	B	53.70	17.50	B	53.70	17.50	B	53.70	17.50	B	54.00	19.60	B	54.00	19.60	B	54.00	19.60	B	53.50	27.90	C	53.20	30.60	D	53.20	30.60	D	53.20	29.60	D	53.30	33.90	D	53.30	33.90	D	53.30	32.50	D
F-10	Basic	From Seminary Rd on-ramp to WB LRT off-ramp	64.70	17.00	B	63.90	18.40	C	63.90	18.40	C	64.70	18.20	C	64.70	20.90	C	64.70	20.90	C	64.70	20.90	C	63.40	28.80	D	61.70	31.90	D	61.70	31.90	D	62.70	30.40	D	56.90	38.70	E	56.90	38.70	E	59.30	35.50	E
R-6	Merge	On-ramp from Seminary Rd	58.00	15.90	B	58.00	17.30	B	58.00	19.00	B	58.00	19.00	B	57.00	21.00	C	57.00	22.70	C	57.00	22.70	C	55.00	28.20	D	52.00	32.00	D	52.00	33.70	D	54.00	31.10	D	46.00	37.00	E	45.00	38.70	E	50.00	35.80	E
F-9	Basic	From Seminary Rd off-ramp to Seminary Rd on-ramp	64.70	14.20	B	64.70	14.90	B	64.70	14.90	B	64.70	14.90	B	64.70	16.30	B	64.70	16.30	B	64.70	16.30	B	64.70	22.50	C	64.70	22.80	C	64.70	22.80	C	64.70	23.40	C	64.60	24.40	C	64.60	24.40	C	64.60	24.40	C
W-2	Weave	From EB King St on-ramp to Seminary Rd off-ramp	59.38	15.30	B	56.15	18.28	B	55.84	18.38	B	56.17	18.27	B	55.74	19.92	B	55.76	19.91	B	55.74	19.92	B	55.47	25.84	C	54.18	27.13	C	54.13	27.16	C	54.17	27.72	C	51.53	31.46	D	51.53	31.46	D	51.53	31.46	D
F-8	Basic	From WB King St on-ramp to EB King St on-ramp	64.70	16.10	B	64.70	18.20	C	64.70	18.20	C	64.70	18.20	C	64.70	19.70	C	64.70	19.70	C	64.70	19.70	C	64.50	25.70	C	64.40	26.00	C	64.40	26.00	C	64.20	26.60	D	63.50	28.70	D	63.50	28.70	D	63.50	28.70	D
R-5	Merge	On-ramp from WB King St	58.00	14.70	B	58.00	16.40	B	58.00	16.40	B	58.00	16.40	B	57.00	17.70	B	57.00	17.70	B	57.00	17.70	B	57.00	22.30	C	57.00	22.50	C	57.00	22.50	C	57.00	23.00	C	56.00	24.60	C	56.00	24.60	C	56.00	24.60	C
F-7	Basic	From WB King St off-ramp to WB King St on ramp	64.70	14.80	B	64.70	17.00	B	64.70	17.00	B	64.70	17.00	B	64.70	18.40	C	64.70	18.40	C	64.70	18.40	C	64.60	24.50	C	64.60	24.70	C	64.60	24.70	C	64.50	25.30	C	64.10	27.00	D	64.10	27.00	D	64.10	27.00	D

Table 8-2: HCS Analysis MOE Summary – Freeway Segments (Continued)

Section ID	Facility Type	Description	Existing AM			2015 No Build AM			2015 Build Alt A1 AM			2015 Build Alt D AM			2035 No Build AM			2035 Build Alt A1 AM			2035 Build Alt D AM			Existing PM			2015 No Build PM			2015 Build Alt A1 PM			2015 Build Alt D PM			2035 No Build PM			2035 Build Alt A1 PM			2035 Build Alt D PM		
			Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS	Speed mph	Density pc/m/ln	LOS
I-395 HOV NB (AM)																																											
F-14	Basic	From Duke St to Seminary Rd	64.70	27.00	D	65.10	18.50	C	65.10	18.50	C	65.10	20.70	C	64.80	25.60	C	64.80	25.60	C	63.10	30.00	D																				
R-7B	Diverge	Off-ramp to Mark Center Dr										52.30	22.70	C							52.40	30.90	D																				
R-7A	Diverge	Bus only off-ramp to Seminary Rd				55.10	16.30	B	55.10	16.30	B				55.00	22.80	C	55.00	22.80	C																								
F-14B	Basic	From Mark Center Dr off-ramp to Seminary Rd on-ramp										65.10	16.50	B							65.10	22.90	C																				
F-14A	Basic	From Seminary Rd BUS only off-ramp to Seminary Rd on-				65.10	18.30	C	65.10	18.30	C				64.90	25.20	C	64.90	25.20	C																								
R-8	Merge	On-ramp from Seminary Rd	56.00	28.60	D	58.00	20.30	C	58.00	20.30	C	58.00	18.60	B	56.00	27.30	C	56.00	27.30	C	57.00	25.90	C																				
F-15	Basic	From Seminary Rd on ramp to North of King St Interchange	63.90	28.90	D	65.10	20.80	C	65.10	20.80	C	65.10	19.10	C	63.70	28.50	D	63.70	28.80	D	64.70	26.10	D																				
I-395 HOV SB (PM)																																											
F-14	Basic	From Seminary Rd to Duke St																						65.30	25.00	C	64.70	19.40	C	64.70	19.40	C	64.70	22.60	C	63.90	27.50	D	63.90	27.50	D	62.20	31.10	D
R-7B	Merge	On-ramp from Mark Center Dr																															57.00	23.40	C							55.00	29.90	D
R-7A	Merge	BUS only on-ramp from Seminary Rd																									57.00	19.30	B	57.00	19.30	B				55.00	27.40	C	55.00	27.40	C			
F-14B	Basic	From Seminary Rd off ramp to Mark Center Dr on-ramp																																		63.90	18.10	C				63.70	25.80	C
F-14A	Basic	From Seminary Rd off ramp to Seminary Rd (Bus only) on-ramp																									63.90	19.40	C	63.90	19.40	C				63.40	27.30	D	63.40	27.30	D			
R-8	Diverge	Off-ramp to Seminary Rd																						55.00	26.00	C	53.30	22.60	C	53.30	22.60	C	53.30	71.40	C	52.70	31.10	D	52.70	31.10	D	52.70	30.10	D
F-15	Basic	From North of King St Interchange to Seminary Rd off-																						64.80	26.70	D	63.90	22.50	C	63.90	22.50	C	63.90	21.30	C	59.90	34.20	D	59.90	34.20	D	61.30	32.00	D

Table 8-3: Intersection Analysis – HCM Delay and LOS Summary

Intersection	Movement Approach	Existing AM		2015 No Build AM		2015 Build Alt A1 AM		2015 Build Alt D AM		2035 No Build AM		2035 Build Alt A1 AM		2035 Build Alt D AM		Existing PM		2015 No Build PM		2015 Build Alt A1 PM		2015 Build Alt D PM		2035 No Build PM		2035 Build Alt A1 PM		2035 Build Alt D PM	
		Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS
Llittle River Tpke & Beauregard St	NBL	89.6	F	90.5	F	90.5	F	90.5	F	94.9	F	94.9	F	94.9	F	99.9	F	102.2	F	102.2	F	102.2	F	130	F	130	F	130	F
	NBT	92.6	F	90	F	90	F	90	F	88.9	F	88.9	F	88.9	F	111.8	F	104.4	F	104.4	F	104.4	F	97.4	F	97.4	F	97.4	F
	NBR	75.7	E	75	E	75	E	75	E	74.7	E	74.7	E	74.7	E	71.3	E	71.7	E	71.7	E	71.7	E	71.8	E	71.8	E	71.8	E
	NB Approach	87.5	F	85.7	F	85.7	F	85.7	F	86.4	F	86.4	F	86.4	F	97.6	F	95.1	F	95.1	F	95.1	F	101.5	F	101.5	F	101.5	F
	SBL	99.6	F	113.8	F	113.8	F	113.8	F	85.5	F	85.5	F	85.5	F	215.6	F	240.5	F	240.5	F	240.5	F	102.2	F	102.2	F	102.2	F
	SBT	98.7	F	118	F	118	F	118	F	84.5	F	84.5	F	84.5	F	211.7	F	247	F	247	F	247	F	103.8	F	103.8	F	103.8	F
	SBR	60.6	E	60.2	E	60.2	E	60.2	E	63	E	63	E	63	E	97.9	F	133.6	F	133.6	F	133.6	F	64.3	E	64.3	E	64.3	E
	SB Approach	91.3	F	105.6	F	105.6	F	105.6	F	81.7	F	81.7	F	81.7	F	177.1	F	207.9	F	207.9	F	207.9	F	91.9	F	91.9	F	91.9	F
	EBL	84.3	F	84.2	F	84.2	F	84.2	F	86.7	F	86.7	F	86.7	F	86.5	F	88.3	F	88.3	F	88.3	F	86.7	F	86.7	F	86.7	F
	EBTR	32.6	C	41.5	D	41.5	D	41.5	D	38.2	D	38.2	D	38.2	D	33.3	C	37.2	D	37.2	D	37.2	D	40.7	D	40.7	D	40.7	D
	EB Approach	45.8	D	50.5	D	50.5	D	50.5	D	43.6	D	43.6	D	43.6	D	45.7	D	48.6	D	48.6	D	48.6	D	47.3	D	47.3	D	47.3	D
	WBL	91.7	F	90.1	F	90.1	F	90.1	F	97.6	F	97.6	F	97.6	F	93	F	92.2	F	92.2	F	92.2	F	118.4	F	118.4	F	118.4	F
	WBT	47.9	D	57	E	57	E	57	E	37.7	D	37.7	D	37.7	D	79.2	E	174.1	F	174.1	F	174.1	F	173.9	F	173.9	F	173.9	F
	WBR	13.4	B	13.4	B	13.4	B	13.4	B	7.5	A	7.5	A	7.5	A	9.2	A	9.7	A	9.7	A	9.7	A	7.7	A	7.7	A	7.7	A
	WB Approach	38.7	D	45.9	D	45.9	D	45.9	D	35	C	35	C	35	C	68.4	E	149	F	149	F	149	F	152.2	F	152.2	F	152.2	F
	Intersection	55	E	61.4	E	61.4	E	61.4	E	48.3	D	48.3	D	48.3	D	99.2	F	139	F	139	F	139	F	109.5	F	109.5	F	109.5	F
Duke St & Walker St	NBL	54.8	D	55.1	E	55.1	E	55.1	E	54.2	D	54.2	D	54.2	D	59.8	E	60.5	E	60.5	E	60.5	E	64.4	E	64.4	E	64.4	E
	NBR	43.6	D	44.4	D	44.4	D	44.4	D	41.4	D	41.4	D	41.4	D	47.4	D	49	D	49	D	49	D	50.5	D	50.5	D	50.5	D
	NB Approach	52.2	D	52.5	D	52.5	D	52.5	D	52.5	D	52.2	D	52.2	D	57.5	E	57.9	E	57.9	E	57.9	E	61.3	E	61.3	E	61.3	E
	SBL	64.3	E	63.1	E	63.1	E	63.1	E	62.2	E	62.4	E	62.4	E	62.9	E	63.7	E	63.7	E	63.7	E	152.5	F	152.5	F	152.5	F
	SBT	64.9	E	64.1	E	64.1	E	64.1	E	69	E	69	E	69	E	62.8	E	63.6	E	63.6	E	63.6	E	138.1	F	138.1	F	138.1	F
	SBR	60.8	E	57.1	E	57.1	E	57.1	E	65.1	E	65.1	E	65.1	E	60.1	E	63.8	E	63.8	E	63.8	E	257	F	257	F	257	F
	SB Approach	62.4	E	59.6	E	59.6	E	59.6	E	65.6	E	65.6	E	65.6	E	60.7	E	63.8	E	63.8	E	63.8	E	228.9	F	228.9	F	228.9	F
	EBT	20.6	C	23.5	C	23.5	C	23.5	C	34.9	D	37.9	D	37.9	D	39.2	D	52	D	52	D	52	D	101	F	101	F	101	F
	EBR	16.3	B	16.5	B	16.5	B	16.5	B	20.7	C	20.7	C	20.7	C	29.6	C	27.8	C	27.8	C	27.8	C	25.4	C	25.4	C	25.4	C
	EB Approach	19.8	B	22.4	C	22.4	C	22.4	C	35.4	D	35.4	D	35.4	D	36.8	D	47.4	D	47.4	D	47.4	D	88.3	F	88.3	F	88.3	F
	WBL	66.1	E	65.8	E	65.8	E	65.8	E	65.8	E	65.8	E	65.8	E	76	E	76	E	76	E	76	C	94.8	F	94.8	F	94.8	F
	WBT	16.6	B	19.9	B	19.9	B	19.9	B	32.9	C	32.3	C	32.2	C	25.9	C	27.5	C	27.5	C	27.5	C	45.5	D	45.5	D	45.5	D
	WB Approach	18.4	B	21.3	C	21.3	C	21.3	C	33	C	33	C	33	C	29.4	C	30.7	C	30.7	C	30.7	C	48.3	D	48.3	D	48.3	D
	Intersection	25.6	C	27.4	C	27.4	C	27.4	C	38.7	D	38.7	D	38.7	D	37.8	D	43.8	D	43.8	D	43.8	D	101.8	F	101.8	F	101.8	F
Mark Center Dr & Beauregard St	NBL	54.7	D	75.5	E	65.2	E	65.2	E	80.7	F	65.2	E	70.3	E	54.9	D	64.9	E	65.2	E	64.9	E	64.9	E	65.2	E	60	E
	NBTR	8	A	37.8	D	27.5	C	29	C	46.9	D	32.7	C	24.9	C	7.3	A	20.2	C	18.3	B	16.6	B	16.8	B	14.6	B	15.7	B
	NB Approach	9.5	A	38.7	D	28.3	C	29.9	C	47.7	D	33.5	C	26	C	9.5	A	21.8	C	20	C	18.4	B	18.4	B	16.3	B	17.2	B
	SBL	62	E	39	D	30.7	C	23.4	C	41	D	28.1	C	27.6	C	75	E	72.1	E	72.6	E	70.3	E	68.8	E	71.3	E	57.1	E
	SBTR	6.2	A	5.4	A	9.4	A	11.3	B	2.9	A	9.7	A	14.6	B	4.3	A	14.2	B	13.6	B	9.6	A	13	B	11.5	B	7.8	A
	SB Approach	15.9	B	27.9	C	22	C	18.5	B	27.5	C	20.3	C	20.9	C	5	A	18.6	B	16.1	B	20.8	C	17.4	B	13.3	B	18.9	B
	EBLT	51.1	D	66	E	56.1	E	53.4	D	70.9	E	56.1	E	59.2	E	49	D	39.5	D	39.5	D	47.6	D	44.9	D	44.9	D	50.4	D
	EBR	50.2	D	64.7	E	55.1	E	52.5	D	69.5	E	55.1	E	58.2	E	40.5	D	33.3	C	33.3	C	43.7	D	38.2	D	38.2	D	44.6	D
	EB Approach	50.9	D	65.4	E	55.6	E	53	D	70.2	E	55.6	E	58.7	E	46.9	D	37.4	D	37.4	D	46.3	D	42.9	D	42.9	D	48.7	D
	WBLT	51.4	D	84.1	F	67.8	E	27.1	C	84.4	F	64.4	E	41.3	D	62.4	E	150.7	F	147.1	F	73.8	E	78.7	E	71.8	E	71.8	E
	WBR	50.2	D	115.2	F	87.9	F	9	A	106.9	F	78.1	E	62	E	40.9	D	59	E	52.1	D	54.5	D	55.3	E	47.1	D	55.7	E
	WB Approach	50.9	D	92.8	F	73.4	E	15.1	B	90.7	F	68.2	E	58.2	E	52.6	D	127.3	F	122.8	F	65.9	E	73.6	E	66.5	E	66.5	E
	Intersection	12.4	B	34.9	C	26.9	C	24.6	C	37.9	D	28	C	27.3	C	12.5	B	36.8	D	34.7	C	25.1	C	23.9	C	20.7	C	22.2	C

Table 8-3: Intersection Analysis - HCM Delay and LOS Summary (Continued)

Intersection	Movement Approach	Existing AM		2015 No Build AM		2015 Build Alt A1 AM		2015 Build Alt D AM		2035 No Build AM		2035 Build Alt A1 AM		2035 Build Alt D AM		Existing PM		2015 No Build PM		2015 Build Alt A1 PM		2015 Build Alt D PM		2035 No Build PM		2035 Build Alt A1 PM		2035 Build Alt D PM	
		Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS
Seminary Rd & Beauregard St	NBL	52.1	D	60.9	E	61.8	E	71.7	E	62.1	E	75.1	E	81.6	F	62.6	E	86.3	F	87.7	F	56.5	E	87.7	F	84.9	F	82.6	F
	NBT	35.1	D	28.1	C	24	C	31.9	C	39.2	D	22.3	C	46	D	54.3	D	45.9	D	42.1	D	62.2	E	48.4	D	45.7	D	49.1	D
	NBR	0.3	A	0.2	A	0.2	A	0.2	A	0.2	A	0.2	A	0.2	A	0.4	A	0.4	A	0.4	A	0.3	A	0.4	A	0.4	A	0.4	A
	NB Approach	31.8	C	32.3	C	31.1	C	38.1	D	38.5	D	36.6	D	49.3	D	36.3	D	40.7	D	39.6	D	41.1	D	41.7	D	39.9	D	42	D
	SBL	55.6	E	86.7	F	67.1	E	71.5	E	93.2	F	72	E	87.7	F	67	E	87.8	F	87.8	F	63.8	E	80.6	F	88.5	F	76.8	E
	SBTR	40.1	D	64.5	E	52.4	D	52.4	D	90.5	F	59.8	E	68.3	E	46.3	D	55.5	E	55.5	E	66.7	E	54.2	D	54.6	D	53.6	D
	SB Approach	43.6	D	71	E	56.7	E	58	E	91.2	F	62.6	E	72.8	E	51.3	D	63.3	E	63.3	E	66.3	E	60.5	E	62.8	E	57.8	E
	EBL	54.1	D	80.3	F	66.2	E	70.8	E	81.7	F	70.1	E	73.5	E	54.6	D	68.1	E	68.1	E	68.1	E	70.9	E	68.1	E	72.3	E
	EBT	35.2	D	68.2	E	52.6	D	49.8	D	79.7	E	68.5	E	51.1	D	31.3	C	35.7	D	34.2	C	37.3	D	37.6	D	34.6	C	40.3	D
	EBR	28.2	C	45.1	D	36.6	D	35.4	D	49.5	D	40.2	D	37.1	D	29.5	C	34.7	C	33.1	C	37.1	D	36.9	D	34	C	48.8	D
	EB Approach	35.6	D	66.7	E	51.8	D	49.5	D	76.7	E	65.7	E	50.7	D	31.8	C	36.9	D	35.5	D	38.5	D	39	D	36	D	44.2	D
	WBL	66.4	E	63.9	E	66.8	E	70.3	E	76.3	E	65.2	E	67.6	E	78.7	E	79.4	E	75.6	E	69.3	E	81.5	F	77	E	68.3	E
	WBTR	57.9	E	20.7	C	25.5	C	38.1	D	23.9	C	30	C	45.1	D	18.3	B	21.6	C	25.5	C	27	C	22.1	C	23.3	C	33.9	C
	WB Approach	59.6	E	41.8	D	42.9	D	50.1	D	51.1	D	46	D	53.1	D	34.4	C	37	D	38	D	39	D	39.5	D	37.7	D	44.8	D
	Intersection	44.2	D	47.9	D	43.4	D	47.5	D	58.4	E	50.5	D	53.6	D	36	D	40.6	D	40.3	D	42.3	D	41.9	D	40.2	D	45.5	D
Seminary Rd & Mark Center Dr/Southern Towers	NBLT	52	D	80.3	F	66.2	E	90.6	F	64.6	E	65.2	E	112.8	F	49.1	D	54.7	D	83.5	F	178.9	F	51.8	D	59.9	E	102.5	F
	NBR	29.1	C	41.7	D	30.9	C	17.5	B	61.3	E	33	C	9.4	A	35.1	D	180.6	F	150.3	F	69.5	E	220.2	F	164.7	F	101.1	F
	NB Approach	33.5	C	50.7	D	39.8	D	52.2	D	61.9	E	40.3	D	54	D	37.6	D	153.5	F	134.6	F	99.3	F	188.7	F	142.7	F	101.4	F
	SBL	51.9	D	82.7	F	68.6	E	68.6	E	86.9	F	71.6	E	78.4	E	50.1	D	65.2	E	61.9	E	62.3	E	69.8	E	62.2	E	56.3	E
	SBT	51.5	D	81.8	F	67.7	E	67.7	E	85.5	F	70.4	E	77.1	E	50.1	D	65.8	E	62.3	E	62.3	E	69.4	E	62.1	E	56	E
	SBR	45.8	D	62.2	E	53.5	D	53.5	D	64.5	E	52.8	D	56.9	E	46.9	D	56.8	E	55.8	E	55.9	E	57.8	E	55.9	F	51.4	D
	SB Approach	50.9	D	79.9	E	66.4	E	66.4	E	84.3	F	69.4	E	76	E	49.2	D	63.3	E	60.5	E	60.6	E	65.7	E	60.1	E	54.6	D
	EBL	76.5	E	60.1	E	57.2	E	61.8	E	64.3	E	57.3	E	65.8	E	69.7	E	83.1	F	83.8	F	95	F	101.3	F	98	F	108.1	F
	EBT	5.7	A	22.3	C	20.4	C	32.2	C	20.7	C	17.7	B	30.4	C	12.5	B	50.8	D	32.5	C	18.8	B	66.4	E	43.3	D	20.2	C
	EBR	0	A	0.2	A	0.2	A	0.2	A	0.1	A	0.1	A	0.2	A	0	A	0	A	0	A	0.1	A	0	A	0	A	0.1	A
	EB Approach	6.7	A	18.3	B	16.8	B	26.2	C	17.6	B	15.1	B	25.7	C	13.5	B	49.8	D	32.6	C	18.5	B	65.7	E	43.9	D	21.9	C
	WBL	213.1	F	64.1	E	73	E	95.2	F	72.1	E	72.6	E	77.8	E	61.9	E	195	F	125.6	F	71.3	E	103.3	F	112.7	F	132.1	F
	WBTR	14.9	B	18.6	B	17.9	B	26.9	C	23.9	C	19.8	B	24	C	17.8	B	42.3	D	33.1	C	26.8	C	50.6	D	42.1	D	34.7	C
	WB Approach	54.7	D	25.9	C	27	C	39.4	D	30.4	C	27.5	C	33	C	21.8	C	58.9	E	43	D	31.9	C	55.9	E	49.3	D	45.3	D
	Intersection	37.1	D	28.1	C	26.9	C	38.1	D	31.4	C	26.8	C	35.6	D	22.1	C	87.9	F	69.6	E	47.8	D	104.9	F	78.5	E	55	E
EB Seminary Rd & I-395 NB Off Ramp	NBT	242.5	F	57.4	E	57.4	E	48.5	D	86.1	F	99.3	F	60.5	E	257.8	F	104.5	F	104.5	F	104.5	F	207.7	F	207.7	F	128.5	F
	NBR	57.6	E	35.4	D	35.4	D	38.9	D	36.5	D	39.9	D	44.7	D	65.2	E	71.7	E	71.7	E	71.7	E	110.1	F	110.1	F	110.1	F
	NB Approach	209.5	F	54.4	D	54.4	D	46.7	D	80.6	F	92.7	F	57.5	E	199.7	F	94.4	F	94.4	F	94.4	F	178.4	F	178.4	F	178.4	F
	EBL	8.8	A	6.8	A	5.5	A	5.9	A	9	A	8.9	A	6.4	A	21.2	C	25.2	C	25.1	C	25.7	C	24.7	C	24.6	C	26.5	C
	EBT	4.9	A	12.7	B	12.7	B	8.2	A	19.4	B	19.3	B	7.7	A	4.9	A	5.9	A	5.9	A	5.9	A	4.6	A	4.6	A	4.6	A
	EB Approach	6.3	A	10.7	B	10.2	B	7.4	A	15.7	B	15.6	B	7.2	A	10.2	B	12.2	B	12.1	B	12.3	B	11.1	B	11	B	11.7	B
	Intersection	94.8	F	32.9	C	32.7	C	23.3	C	51.5	D	58.2	E	28.1	C	85.6	F	39.6	D	39.6	D	39.7	D	61.6	E	61.6	E	62.1	E
WB Seminary Rd & I-395 NB On Ramp	NBL	11	B	5.1	A	5	A	5.9	A	7.6	A	8.6	A	6.3	A	12.3	B	11.5	B	11.5	B	11.5	B	16.7	B	16.7	B	16.7	B
	NBT	3	A	10.2	B	9.2	A	8.6	A	26.2	C	27.4	C	12.9	B	3.7	A	4.2	A	4.2	A	4.2	A	2.2	A	2.2	A	2.2	A
	NB Approach	7.1	A	8.6	A	7.8	A	7.7	A	19.9	B	21	C	10.8	B	7.8	A	6.6	A	6.6	A	6.6	A	6.9	A	6.9	A	6.9	A
	WBT	70.5	E	64.8	E	83.1	F	55.3	E	147.5	F	135.9	F	76.2	E	69	E	87	F	88.3	F	87	F	269.6	F	279.9	F	269.6	F
	WBR	0.9	A	1.1	A	1.1	A	1.1	A	1.2	A	1.2	A	1.2	A	0.3	A	0.4	A	0.4	A	0.4	A	0.5	A	0.5	A	0.5	A
	WB Approach	25.8	C	30.7	C	40.4	D	26.3	C	81.6	F	75.9	E	42.4	D	36.2	D	39.3	D	40.3	D	39.3	D	107.4	F	112.7	F	107.4	F
	Intersection	15.4	B	18.1	B	22.1	C	16.8	B	46.4	D	44.8	D	27.1	C	17	B	16.8	B	17.2	B	16.8	B	39.4	D	41.3	D	39.4	D

Table 8-3: Intersection Analysis – HCM Delay and LOS Summary (Continued)

Intersection	Movement Approach	Existing AM		2015 No Build AM		2015 Build Alt A1 AM		2015 Build Alt D AM		2035 No Build AM		2035 Build Alt A1 AM		2035 Build Alt D AM		Existing PM		2015 No Build PM		2015 Build Alt A1 PM		2015 Build Alt D PM		2035 No Build PM		2035 Build Alt A1 PM		2035 Build Alt D PM	
		Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS
WB Seminary Rd & I-395 SB Off Ramp	SBT	67.5	E	66.7	E	79.7	E	60.3	E	89.4	F	121.5	F	66.7	E	88.1	F	114.2	F	126	F	114.2	F	140.9	F	150.5	F	140.9	F
	SBR	0.5	A	1.2	A	0.8	A	1.2	A	1.3	A	1	A	1.3	A	0.4	A	0.5	A	0.4	A	0.5	A	0.5	A	0.5	A	0.5	A
	SB Approach	23.2	C	17.2	B	31.7	C	15.7	B	22.2	C	41.1	D	16.9	B	55.7	E	67.9	E	77.7	E	67.9	E	92.7	F	101.2	F	92.7	F
	WBL	1.6	A	3.4	A	4.4	A	1.9	A	3.6	A	4.5	A	2.1	A	2.2	A	9.6	A	9.5	A	9.5	A	15.7	B	15.7	B	15.6	B
	WBT	1.5	A	3.7	A	4.2	A	1.8	A	3.7	A	4.2	A	2	A	2	A	9.1	A	9.1	A	9.1	A	14.9	B	14.9	B	14.9	B
	WB Approach	1.5	A	3.6	A	4.2	A	1.8	A	3.7	A	4.3	A	2	A	2.1	A	9.3	A	9.3	A	9.3	A	15.1	B	15.1	B	15.1	B
	Intersection	10.9	B	9.6	A	16.1	B	9.1	A	10.3	B	17.3	B	8.8	A	27.8	C	33.3	C	37.2	D	33.2	C	47.7	D	51.2	D	47.7	D
EB Seminary Rd & I-395 SB On Ramp	SBL	2.1	A	2.4	A	11.9	B	2.2	A	7.6	A	13.5	B	6.1	A	4	A	4.3	A	4.9	A	4.3	A	7.7	A	8.4	A	7.6	A
	SBT	15.3	B	6.8	A	6.4	A	9.1	A	4.9	A	5.2	A	8.4	A	15.2	B	15.3	B	14.9	B	14.2	B	25.6	C	24.8	C	17.6	B
	SB Approach	11	B	5.4	A	8.1	A	6.9	A	5.8	A	7.2	A	7.7	A	11.4	B	11.5	B	11.6	B	10.8	B	19.4	B	19.4	B	14.2	B
	EBT	68.2	E	60.1	E	61.9	E	50.2	D	103.6	F	124.8	F	58.4	E	69.8	E	77.2	E	77.2	E	77.2	E	129.1	F	129.1	F	129.1	F
	EBR	0.5	A	0.6	A	0.6	A	0.6	A	0.7	A	0.7	A	0.7	A	2.7	A	12	B	5	A	1.5	A	170.5	F	20.5	C	3.6	A
	EB Approach	41.8	D	36.2	D	37.8	D	30.9	C	61.2	E	75.7	E	35.8	D	29.3	C	40.1	D	38.4	D	43.6	D	154.2	F	67.1	E	65.5	E
	Intersection	32.9	C	26.6	C	25.2	C	23.6	C	40.4	D	43.7	D	25.6	C	22.9	C	30.1	C	28.3	C	30.4	C	101.5	F	46.9	D	43.2	D
I-395 HOT Ramp & WB Seminary Rd	SBR							0	A			0	A	0	A			46.3	D	46.3	D	46.3	D	37.9	D	37.9	D	37.9	D
	SB Approach							0	A			0	A	0	A			46.3	D	46.3	D	46.3	D	37.9	D	37.9	D	37.9	D
	WBT																	5.1	A	5.1	A	5.1	A	12.5	B	12.5	B	12.5	B
	WBTR			0.3	A	0.3	A	0.2	A	0.5	A	0.5	A	0.3	A														
	WBR			0.4	A	0.3	A	0.4	A	0.2	A	0.3	A	0.4	A														
	WB Approach			0.3	A	0.3	A	0.3	A	0.4	A	0.4	A	0.3	A			5.1	A	5.1	A	5.1	A	12.5	B	12.5	B	12.5	B
	Intersection			0.3	A	0.3	A	0.3	A	0.4	A	0.4	A	0.3	A			20.2	C	20.1	C	20.2	C	24.3	C	24.3	C	24.3	C
Seminary Rd & Library Ln	NBT	43.3	D	53.1	D	53.1	D	53.1	D	53.1	D	53.1	D	53.1	D	41	D	41.5	D	41.5	D	41.5	D	41.5	D	41.5	D	41.5	D
	NB Approach	43.3	D	53.1	D	53.1	D	53.1	D	53.1	D	53.1	D	53.1	D	41	D	41.5	D	41.5	D	41.5	D	41.5	D	41.5	D	41.5	D
	SBT	43.1	D	57.6	E	57.6	E	57.6	E	57.6	E	57.6	E	57.6	E	46.9	D	65.3	E	65.3	E	65.3	E	65.3	E	65.3	E	65.3	E
	SB Approach	43.1	D	57.6	E	57.6	E	57.6	E	57.6	E	57.6	E	57.6	E	46.9	D	65.3	E	65.3	E	65.3	E	65.3	E	65.3	E	65.3	E
	EBL	9.8	A	29.1	C	29.1	C	29.1	C	29.2	C	29.2	C	29.2	C	8.5	A	9.4	A	9.4	A	9.4	A	9.5	A	9.5	A	9.5	A
	EBT	7	A	5.2	A	5.2	A	5.2	A	5.2	A	5.2	A	5.2	A	8.8	A	13.3	B	13.3	B	13.3	B	13.6	B	13.6	B	13.6	B
	EBR	5.4	A	3.8	A	3.8	A	3.8	A	3.9	A	3.9	A	3.9	A	5.4	A	5.4	A	5.4	A	5.4	A	5.4	A	5.4	A	5.4	A
	EB Approach	7.2	A	9.5	A	9.5	A	9.5	A	9.5	A	9.5	A	9.5	A	8.7	A	12.8	B	12.8	B	12.8	B	13.1	B	13.1	B	13.1	B
	WBL	12.9	B	10.7	B	10.7	B	10.7	B	10.7	B	10.7	B	10.7	B	13.3	B	17.9	B	17.9	B	17.9	B	18.1	B	18.1	B	18.1	B
	WBTR	18.2	B	17.4	B	17.4	B	17.4	B	17.9	B	17.9	B	17.9	B	16.7	B	17	B	17	B	17	B	17.1	B	17.1	B	17.1	B
	WB Approach	18.1	B	17.3	B	17.3	B	17.3	B	17.7	B	17.7	B	17.7	B	16.6	B	17	B	17	B	17	B	17.2	B	17.2	B	17.2	B
	Intersection	15.6	B	16.7	B	16.7	B	16.7	B	16.9	B	16.9	B	16.9	B	13.4	B	17.5	B	17.5	B	17.5	B	17.6	B	17.6	B	17.6	B
King St & Park Center Dr	NBL	36	D	37	D	37	D	37	D	40.9	D	40.9	D	40.9	D	38.7	D	38.8	D	38.8	D	38.8	D	39.6	D	39.6	D	39.6	D
	NBR	55.7	E	55.7	E	55.7	E	55.7	E	54	D	54	D	54	D	52.2	D	52.5	D	52.5	D	52.5	D	53.6	D	53.6	D	53.6	D
	NB Approach	51.9	D	50.6	D	50.6	D	50.6	D	48.4	D	48.4	D	48.4	D	50.3	D	49	D	49	D	49	D	48.5	D	48.5	D	48.5	D
	EBTR	19.2	B	20.5	C	20.5	C	20.5	C	21.4	C	21.4	C	21.4	C	17.2	B	20	C	20	C	20	C	24.4	C	24.4	C	24.4	C
	EB Approach	19.2	B	20.5	C	20.5	C	20.5	C	21.4	C	21.4	C	21.4	C	17.2	B	20	C	20	C	20	C	24.4	C	24.4	C	24.4	C
	WBL	28.8	C	90.9	F	90.9	F	90.9	F	157.5	F	157.5	F	157.5	F	24.5	C	43.9	D	43.9	D	43.9	D	64.4	E	64.4	E	64.4	E
	WBT	9.3	A	10.1	B	10.1	B	10.1	B	10.4	B	10.4	B	10.4	B	7.1	A	8.5	A	8.5	A	8.5	A	10.1	B	10.1	B	10.1	B
	WB Approach	12.4	B	23	C	23	C	23	C	32.8	C	32.8	C	32.8	C	9.7	A	12.8	B	12.8	B	12.8	B	16.2	B	16.2	B	16.2	B
	Intersection	18.8	B	25	C	25	C	25	C	30.5	C	30.5	C	30.5	C	15.7	B	18.6	B	18.6	B	18.6	B	22.4	C	22.4	C	22.4	C

Table 8-3: Intersection Analysis – HCM Delay and LOS Summary (Continued)

Intersection	Movement Approach	Existing AM		2015 No Build AM		2015 Build Alt A1 AM		2015 Build Alt D AM		2035 No Build AM		2035 Build Alt A1 AM		2035 Build Alt D AM		Existing PM		2015 No Build PM		2015 Build Alt A1 PM		2015 Build Alt D PM		2035 No Build PM		2035 Build Alt A1 PM		2035 Build Alt D PM	
		Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS	Delay (veh/sec)	LOS
King St & Menokin Dr	NBLR	39.1	D	38.8	D	38.8	D	38.8	D	39.6	D	39.6	D	39.6	D	40	D	40	D	40	D	40	D	39.4	D	39.4	D	39.4	D
	NB Approach	39.1	D	38.8	D	38.8	D	38.8	D	39.6	D	39.6	D	39.6	D	40	D	40	D	40	D	40	D	39.4	D	39.4	D	39.4	D
	EBTR	16	B	16.4	B	16.4	B	16.4	B	18	B	18	B	18	B	11	B	11.6	B	11.6	B	11.6	B	13.7	B	13.7	B	13.7	B
	EB Approach	16	B	16.4	B	16.4	B	16.4	B	18	B	18	B	18	B	11	B	11.6	B	11.6	B	11.6	B	13.7	B	13.7	B	13.7	B
	WBL	8.4	A	8.6	A	8.6	A	8.6	A	9.6	A	9.6	A	9.6	A	6.6	A	7.5	A	7.5	A	7.5	A	9.7	A	9.7	A	9.7	A
	WBT	9.4	A	9.7	A	9.7	A	9.7	A	10.7	B	10.7	B	10.7	B	3.6	A	3.8	A	3.8	A	3.8	A	4.6	A	4.6	A	4.6	A
	WB Approach	9.4	A	9.6	A	9.6	A	9.6	A	10.7	B	10.7	B	10.7	B	3.9	A	4	A	4	A	4	A	4.9	A	4.9	A	4.9	A
	Intersection	18	B	17.9	B	17.9	B	17.9	B	19.1	B	19.1	B	19.1	B	10	B	10.4	B	10.4	B	10.4	B	12.5	B	12.5	B	12.5	B
Mark Center Dr & Mark Center Dr/WHS Circle	NBL							45.4	D					38.1	D														
	NBT							63.3	E					58.8	E														
	NBR							43.1	D					40	D														
	NB Approach							53.7	D					48.7	D														
	SBL			86.5	F	74.5	E	72.5	E	136.4	F	48.9	D	65.5	E			3.4	A	4.7	A			2.2	A	4.2	A		
	SBR			25.7	C	18.9	B	69.5	F	45.2	D	19.9	B	37.6	D			19.7	B	30.5	C			0.3	A	16.6	B		
	SBLTR																					13.1	B					32.4	C
	SB Approach			79.3	E	67.6	E	72.1	E	124.2	F	44.9	D	61.8	E			17.2	B	26.9	C	13.1	B	0.7	A	14.3	B	32.4	C
	EBL			9.4	A	6.2	A	15.6	B	7.8	A	7.2	A	17.4	B			9	A	9.2	A	13	B	8.3	A	8.5	A	3.6	A
	EBT			9.5	A	6.9	A	15.8	B	8.4	A	8	A	22.9	C			6.6	A	7.5	A	9.9	A	5.9	A	7.4	A	3.1	A
	EBR																	N/A				3.5	A					0.3	A
	EB Approach			9.5	A	6.7	A	15.8	B	8.2	A	7.7	A	21.8	C			8.2	A	8.5	A	9	A	7.4	A	8.1	A	2.2	A
	WBL																	N/A				8.3	A					6.7	B
	WBT			20.4	C	15.7	B	42.4	D	19.6	B	15.8	B	43.8	D			15.8	B	15.8	B	18.1	B	15	B	14.9	B	11.7	B
	WBR			20.6	C	15.8	B	42.6	D	19.8	B	15.9	B	44	D			20.1	C	19.1	B	17.8	B	21.5	C	19.8	B	15.1	B
	WB Approach			20.5	C	15.8	B	42.5	D	19.7	B	15.9	B	43.9	D			18.8	B	18	B	16	B	20.1	C	18.7	B	13	B
	Intersection			24.3	C	21.4	C	38.3	D	29.2	C	15.8	B	40.1	D			16.3	B	17.8	B	13.4	B	14.7	B	15.9	B	15	B

8.2 Highlights of Traffic Operations Analysis

Traffic operational analyses, *primarily the VISSIM results,* confirm that the No-Build conditions, even with the proffered improvements at the local intersections and the planned HOT lanes improvements in I-395 corridor, will produce significant operational deficiencies within the study area by 2035. Most of these operational deficiencies are focused at the following locations:

- NB I-395 General Purpose (GP) lanes between Little River Turnpike and Seminary Road during the AM peak hour
- SB I-395 GP lanes between Seminary Road and Little River Turnpike during the PM peak hour
- SB I-395 GP lanes between King Street and Seminary Road during AM/PM peak hour
- Signalized "Rotary" at the second level of the I-395 and Seminary Road interchange
- Local arterial intersections in the vicinity of the Mark Center development

The analyses of **Alternative "D"** demonstrate the effectiveness of the proposed direct ramp connections to the Mark Center site. While Alternative "D" makes significant operational improvements within both freeway and local networks, **Alternative "A1"** was only able to improve traffic conditions at the local intersections in the vicinity of the Mark Center site.

8.2.1 Key Findings of the Traffic Operations Analyses

- *Northbound (NB) GP lanes on I-395 between Little River Turnpike (LRT) and Seminary Road interchanges* currently experience bumper-to-bumper traffic during the AM peak hour conditions, as shown in the 2008 Council of Government (COG) Aerial Survey in Appendix E. Due to the increase in new trips generated by the Mark Center site, AM peak hour traffic on the NB off-ramp to Seminary Road is projected to double by 2035 (from existing 774 vehicles per hour [vph] to 1540 vph in 2035), which under the No-Build conditions would result in **severe** traffic congestion along NB I-395. In 2035 Build Alternative "D", NB AM traffic conditions between Little River Turnpike and Seminary Road would significantly improve (as shown in VISSIM MOE comparison in Table 8-4) due to a noticeable diversion of GP traffic onto the HOT lanes with the proposed direct flyover connection to the Mark Center site. Under Alternative "D", 2035 AM peak queues formed at the NB off-ramp to the rotary would be reduced by half compared to the No-Build conditions, as shown in Figure 8-51. Alternative "A1" does not provide relief to this queuing problem.

Table 8-4: VISSIM MOE Comparison – NB I-395 GP lanes between LRT and Seminary (AM Peak)

ID	Facility Type	Description	2035 No Build		2035 Build Alt "D"	
			Speed mph	Density pc/m/ln	Speed mph	Density pc/m/ln
F-1	Basic	From EB Duke St off-ramp to WB LRT off-ramp	8.06	132.75	44.60	39.41
R-1	Diverge	Off-ramp to WB LRT	7.58	106.28	39.09	34.62
F-2	Basic	From WB LRT off-ramp to EB LRT/WB Duke on-ramp	6.55	148.49	21.00	80.14
R-2	Merge	On-ramp from EB LRT/WB Duke	5.08	161.78	16.78	88.74
F-3	Basic	From EB LRT/WB Duke on-ramp to Seminary Rd off-ramp	6.40	161.00	51.89	38.79
R-3	Diverge	Off-ramp to Seminary Rd	4.50	163.43	47.50	34.18

- *Southbound (SB) GP lanes on I-395 between Seminary Road and Little River Turnpike interchanges* currently (2009) experience heavy traffic congestion during the PM peak and will continue to get worse under the 2035 operating conditions, with the heaviest segment on this stretch carrying over 8,000 vph. This is largely due to the addition of heavy SB on-ramp traffic (2290 vph in 2035 No-Build scenario) that originates from the Seminary Road corridor and a reduction in SB through lane at Little River Turnpike. VISSIM analyses confirm the demand exceeds the capacity of this stretch of freeway. Average speed of travel on this stretch by 2035 is projected to be lower than 20 mph, as illustrated in Figure 8-36. While Alternative "D" will not be able to eliminate such **severe** congestion, it would provide some relief to the SB GP traffic by diverting some outbound trips from the Mark Center onto the HOT lanes. Alternative "A1" does not provide relief to this operational problem.

- *Southbound GP lanes on I-395 between King Street and Seminary Road interchanges* would experience **severe** traffic congestion by 2035 during both AM and PM peak conditions. This is primarily due to the friction caused by the heavy weaving volumes (e.g., 1824 vph in 2035 PM traffic conditions) between the two interchanges and long queues on the SB off-ramp at the rotary (Figure 8-51) as confirmed by the VISSIM analyses. Since Alternative "D" will significantly reduce traffic congestion along the rotary and also on Seminary Road, SB off-ramp traffic would get onto Seminary Road with much lesser friction, which in turn would eliminate the operational problems on the SB GP lanes in AM and significantly reduce in PM. It is to be noted that such conditions, especially during the AM peak, would get worse under Build Alternative "A1" due to the additional turning maneuvers on the rotary and also delays caused by the vehicles trying to access the South Parking Garage through the secured Access Control Point (ACP). Additional traffic analysis was conducted to reduce the queuing on SB off-ramp traffic by improving the westbound merge condition on Seminary Road. On the westbound approach at the intersection of Seminary Road and Mark Center Drive, two out of three lanes were designated to carry the traffic originating from the rotary and the SB off-ramp. Such changes in lane configuration would eliminate the AM peak SB congestion in the No-Build

condition. However, the operational problems in PM peak will remain as the PM congestion is primarily due to the heavy weaving volumes on SB I-395 between the King Street and Seminary Road interchanges.

- *Signalized "Rotary" at the second level of the I-395 and Seminary Road Interchange* - The existing traffic operation at the rotary is complex as it tries to serve the traffic demand from four signalized approaches (two off-ramps from I-395 and the other two from Seminary Road corridor). Under the 2035 No-Build conditions, critical movements from all four approaches on the rotary will operate at a failing level-of-service "F" during at least one of the peak hours, as shown in Table 8-3. With the reduced traffic on the rotary under Alternative "D", traffic conditions will improve at all four of these intersections, with intersection LOS values getting "D" or better. Alternative "A1", on the other hand, would not address the operational problems on the rotary due to the additional delays associated with the South Parking Garage as the motorists entering the garage will be processed through a secured Access Control Point.

- *Local arterial intersections in the vicinity of the Mark Center* – Most of the operational deficiencies center around the three following intersections:
    1. Beauregard Street and Mark Center Drive
    2. Seminary Road and Beauregard Street
    3. Seminary Road and Mark Center Drive

  With only two access points currently available to serve the entire Mark Center site, four critical turn movements at the above intersections end up carrying most of the load to service the site-generated traffic. Proffered improvements include addition of left-turn lanes at the first two intersections above and westbound left-turn prohibition at Seminary Road and Mark Center Drive for any traffic approaching from the I-395 corridor. These improvements, along with traffic signal optimization, will improve operational conditions at these intersections under the future No-Build scenarios. However, as shown in Table 8-3, multiple movements at these intersections will continue to operate at LOS "E" or "F" in 2035 No-Build scenario while serving approximately 10,000 total future employees at the Mark Center site. Either of the two proposed alternatives will reduce projected delays and queuing problems at these intersections. With the improved access to the Mark Center site, these intersections would operate at LOS "D" or better in 2035 Build conditions, except for the intersection of Seminary Road and Mark Center in PM peak. However, this intersection will improve to operate at LOS "E" under the Build conditions compared to LOS "F" under the No-Build scenario.

  In addition to the Synchro analyses, the VISSIM model was also run to observe the overall traffic performance at these intersections. Microsimulation indicated severe traffic congestion along Seminary Road and also along Beauregard Street, particularly under 2035 PM peak traffic conditions. Seminary Road/SB Off-ramp at the rotary and Seminary Road/Mark Center Drive intersections are projected to operate at level-of-service "F" in 2035 No-Build PM peak. Due to the heavy right-turn traffic (1780 vph) exiting onto Seminary Road from the Mark Center facility and

also the severe PM peak traffic congestion on SB I-395 as described earlier, eastbound queues formed at the rotary would spill over onto Beauregard Street and extend upstream beyond the intersection at Mark Center Drive. The proposed alternatives, particularly "D", would alleviate such gridlock conditions in traffic from the local arterials.

8.2.2 Other Notable Findings of the Traffic Operations Analyses

- The new merge/diverge segment (R-7B) on the HOT lanes, created due to the proposed flyover connection in Alternative "D", is projected to operate at LOS "D" in 2035 as per the HCS analysis. However, HCS average speed on this segment would be higher than 52 mph, which would be adequate to comply with the minimum operational conditions to be maintained on the future HOT lane facility. VISSIM density results, on the other hand, indicate that this segment would operate under light to moderate congestion level (LOS "C").

- With the planned HOT lane improvements incorporated into the No-Build scenario as described in Section 6.1, HOV/HOT segments between King Street and Little River Turnpike under the 2035 No-Build/Build scenarios are projected to operate under adequate conditions.

- A supplemental HCS traffic analysis was conducted to evaluate the traffic conditions at the Turkeycock and Shirlington HOT lane ramps. Under the I-95/I-395 HOT lane proposal, a new flyover off-ramp from northbound HOT lanes to NB general-purpose (GP) lanes and a south-facing HOT ramp at the Shirlington rotary would be added. HCS analysis considers these ramps under both No-Build and Build scenarios. A detailed traffic analysis is presented in Appendix J of Volume 2.

  Traffic conditions remain unchanged in Alternative "A1" compared to the No-Build scenario. However, traffic volumes on the HOT lanes change in alternative "D" due to the proposed flyover to/from Mark Center Drive. At the Turkeycock interchange, traffic volumes exiting the HOT lanes in AM and that entering the HOT lanes in PM would be lighter compared to the No-Build scenario. Similarly, there would be a higher traffic demand from the GP to HOT lanes in AM and the pattern would be reversed in PM. Consequently, these volume changes would result in marginal improvement/degradation at the corresponding ramps.

  HOT traffic, north of the Seminary Road interchange, reduces in alternative "D" due to the proposed flyover at Mark Center Drive. A portion of the HOT traffic from the Shirlington interchange would be diverted to use the direct flyover ramp. Such condition in alternative "D", for most part, would improve traffic operations at the Shirlington HOT ramps during both AM and PM peak conditions.

- Since the I-395 GP lanes between Little River Turnpike and Seminary Road was an area of severe congestion, a supplemental traffic analysis was conducted to evaluate the benefits of adding an auxiliary lane in both directions on I-395 between Seminary Road and Little River Turnpike/Duke Street under both No-Build and Build

scenarios, as presented in Appendix J of Volume 2. Results of the HCS analysis indicate that the addition of an auxiliary lane between these two interchanges would yield significant improvements in traffic operations in both No-Build and Build conditions to alleviate traffic congestion during NB AM peak and SB PM peak periods.

- VISSIM results indicate that the southbound Merge from Seminary Road (R-6) to I-395 SB general purpose lanes will slightly degrade under the future Build conditions compared to the No-Build scenarios. This is primarily due to the fact that the original design of the proposed alternatives reduced the existing merge length from 1020 ft to 750 ft. Alternative "A1" will produce worse results than alternative "D" as the merge volume in "D" will be lower due to the diversion of traffic onto the HOT lanes. HCS results even indicate slightly better results for alternative "D" compared to the No-Build conditions as it does not take into account the upstream or downstream impacts associated with a particular segment. Nevertheless, due to the future degradation as noted in the VISSIM results, further design refinements were conducted which resulted in a much longer merge length of 1380 ft. New HCS analyses were conducted to confirm better results for both the Build alternatives compared to the No-Build conditions and are presented in Appendix J of Volume 2. However, as noted earlier in this Section, the VISSIM analyses were not modified to reflect these geometric refinements due to the fact that longer acceleration lanes will only improve traffic performance.

- In Alternative "D", the proposed flyover from the HOT lanes will touch down at the intersection of Mark Center Drive and Mark Center Drive/WHS Circle. This T-intersection, which is currently unsignalized, will be brought under signal control as part of the proffered improvements at the Mark Center site. In alternative "D", this intersection will operate as a four-legged signalized intersection with the proposed (reversible) northbound leg serving as the new access to the site from the HOT lanes. The northbound approach is projected to carry 784 vph in 2015 AM peak and 1157 vph in 2035 AM peak. As a result, this intersection would operate at LOS "D" under 2015/2035 AM peak traffic conditions in alternative "D" compared to LOS "C" in future No-Build scenarios. Alternative "A1", on the other hand, is projected to reduce delays at this intersection as a portion of the site traffic would access the Mark Center facility through the South Parking Garage.

8.3 Travel Time Results

This analysis was conducted primarily to evaluate the travel time results for the traffic entering and exiting the Mark Center facility during the AM and PM peak conditions respectively. The VISSIM models were used to estimate the AM peak hour travel times for twelve travel segments within the study area for the existing and future scenarios. The origin and destination points of these segments are shown in Figure **8-48**. The travel times as listed in Table 8-5 below were calculated by averaging the results from multiple runs made for the Traffic Analyses.

AM peak hour travel times to access the Mark Center facility either from I-395 or Seminary Road corridor will improve under Alternative "D" compared to No-Build conditions. However, this is not true for all routes under Alternative "A1". In fact, anticipated delays at the South Parking Garage are reflected in the relatively long travel times, as shown in Table 8-5.

Table 8-5: VISSIM Model Travel Time (minutes) Summary - AM Peak Hour

Description	Existing	2015 NB	2015 Alt A1	2015 Alt D	2035 NB	2035 Alt A1	2035 Alt D
I-395 NB - Seminary & Mark Cntr	9						
I-395 NB - Beauregard & Mark Cntr	9	12	10	8	14	10	12
I-395 NB - South Garage			19			20	
I-395 NB HOT - Mark Cntr Dr (Flyover)				3			3
I-395 SB - Seminary & Mark Cntr	11						
I-395 SB - Beauregard & Mark Cntr	6	9	27	5	13	16	6
I-395 SB - South Garage			31			25	
Seminary EB - Seminary & Mark Cntr	3	6	11	6	9	13	5
Seminary EB - Beauregard & Mark Cntr	1	2	2	2	6	3	2
Seminary WB - Seminary & Mark Cntr	4	3	3	2	3	3	3
Seminary WB - Beauregard & Mark Cntr	4	5	4	4	8	5	5
Seminary WB - South Garage			15			12	

The VISSIM models were also set-up to collect PM peak hour travel times for three travel segments within the study area to analyze the traffic exiting the Mark Center, as shown in Table 8-6. The origin and destination points of these segments are shown in Figure **8-49**. PM peak hour travel times to exit the Mark Center facility would reduce in alternative "D" and slightly increase in alternative "A1".

Table 8-6: VISSIM Model Travel Time (minutes) Summary - PM Peak Hour

Description	Existing	2015 NB	2015 Alt A1	2015 Alt D	2035 NB	2035 Alt A1	2035 Alt D
Seminary & Mark Cntr – I-395 SB	7	12	14	11	15	17	12
South Garage – I-395 SB			10	9		11	9
Mark Cntr Dr (Flyover) – I-395 SB HOT				3			3

8.4 Queuing Analysis – Future Conditions

The VISSIM models were also used to estimate the queue-lengths for the critical intersection movements within the study area network, as shown in Figures **8-50** and **8-51**. Average queue-lengths on all critical movements under 2035 traffic conditions, as tabulated in Tables 8-7 and 8-8 below, will be reduced in Alternative "D" compared to the No-Build scenario. While Alternative "A1" would also reduce queues at most local intersections, it

will either make minor improvements or in some cases worsen the queuing conditions at the intersections on the rotary.

Table 8-7: VISSIM Model Average Queue-Length (ft) Summary – AM Peak Hour

Intersection	Movement	2035 NB AM	2035 Alt A1 AM	2035 Alt D AM
Beauregard Street/Mark Center Drive	SBL on Beauregard Street	187	137	104
Seminary Road/Beauregard Street	WBL on Seminary Road	1148	361	224
Seminary Road/Mark Center Drive	WBL on Seminary Road	142	148	139
Seminary Road/I-395 SB on-ramp	EBT on Seminary Road	934	921	749
Seminary Road/I-395 NB off-ramp	NBT on I-395 NB Off Ramp	1554	1423	761
Seminary Road/I-395 NB on-ramp	WBT on Seminary Road	624	378	269
Seminary Road/I-395 SB off-ramp	SBR on I-395 SB Off Ramp	1204	1607	401

Table 8-8: VISSIM Model Average Queue-Length (ft) Summary – PM Peak Hour

Intersection	Movement	2035 NB PM	2035 Alt A1 PM	2035 Alt D PM
Seminary Road/Mark Center Drive	Mark Center Drive NBLTR	1048	941	781
Seminary Road/I-395 SB on-ramp	Seminary Road EBTR	1632	1166	989

SECTION 9

SAFETY ANALYSIS

This section presents the results of the safety analysis for existing conditions and the proposed designs under future Build conditions. It relies on the most recently available crash data for the portion of I-395 within the study limits for the three-year period from 2005 to 2007. Based on the estimated crash rates, high crash frequency locations and associated contributing factors were identified along the study corridor. A brief qualitative analysis identifying potential safety impacts is presented for the future Build conditions.

9.1 Data Collection and Methodology

Three years of crash data (from January 1, 2005 to December 31, 2007) were obtained for the I-395 corridor within the study area from the Virginia Department of Transportation (VDOT). The data contained crash information by location, date, time, type, severity, and major factors associated with the crashes, as well as the direction and the facility information for the crashes, (i.e., whether the crashes happened in the northbound or southbound direction and in the general purpose lanes or in the HOV lanes). Location information was provided by the route milepost information.

GIS maps were created for a 3.65 mile section of I-395, beginning 0.65 miles south of Duke Street and ending at 0.45 miles north of King Street. Within this area, crashes were located on the I-395 corridor in the northbound and southbound general purpose lanes, the on/off ramps of the study interchanges, and the HOV lanes. The maps were also created to identify crashes by different types. The crashes on the study corridor were aggregated by 0.1-mile roadway segments. GIS maps were used to identify the high frequency crash locations along the study corridor, and a detailed investigation of the crash type and pattern was then conducted to identify major contributing factors.

A qualitative approach was used to evaluate the potential safety impacts of the proposed alternatives for the Build condition. It was determined whether the high frequency crash locations were directly or indirectly influenced by the design alternatives.

9.2 Existing Safety Condition

Figure 9-1 in Appendix A presents a map of overall crash locations and types. The total number of crashes between 2005 and 2007 within the study corridor is shown in Exhibit 9-1. As shown, on I-395 northbound general purpose (GP) lanes, the total number of crashes slightly increased from 114 in 2005 to 122 in 2007. On I-395 southbound direction, the annual number of crashes shows a decline on the GP lanes between 2005 and 2007, from 153 to 122 crashes per year. Nevertheless, the number of crashes on the southbound direction

remained higher than the total number on the northbound direction during the three-year study period. On the reversible HOV lanes, the annual number of crashes in this 3-year period ranged between 12 and 17. Overall, there were no significant changes on the total yearly number of crashes on I-395 within the study area over the recent 3 years.

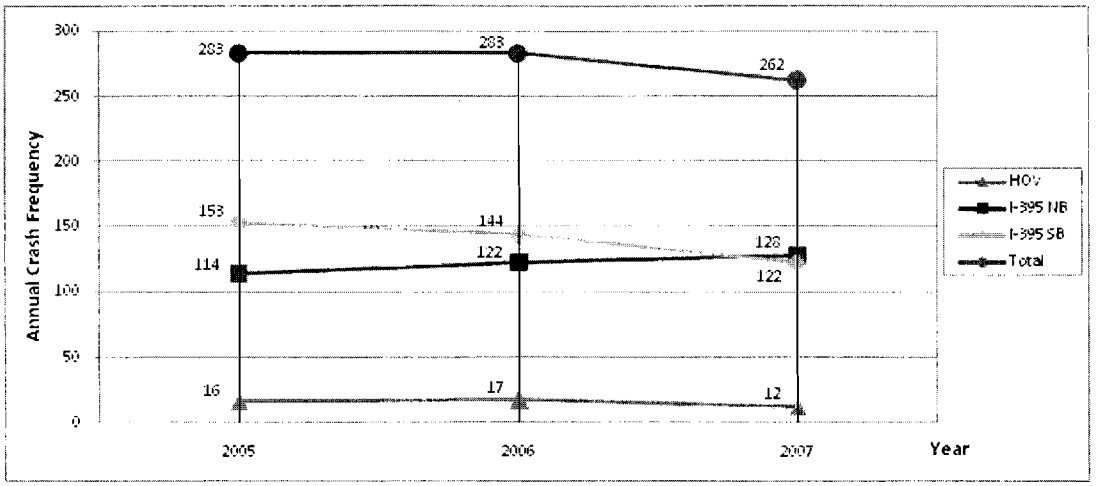

Exhibit 9-1: Annual Crash Frequencies on I-395 between the Duke Street and King Street (2005 - 2007)

Based on the crash frequencies and the Annual Average Daily Traffic (AADT) published by VDOT, crash rates were calculated for the study corridor. Rates were then estimated for the northbound and southbound I-395 GP and HOV lanes for the three-year study period. Table 9-1 compares the study segments crash rates and the Virginia statewide average crash rates for the corresponding roadway classification. In the northbound direction on I-395 between Duke Street and Seminary Road the crash rates for all three years are significantly higher than the statewide crash rates. The crash rates between Seminary Road and King Street on I-395 NB are slightly higher than the statewide crash rates for 2005 and 2006; the rate is lower than the statewide rate for the year 2007. On I-395 SB, the estimated crash rates for the entire study corridor are significantly higher than the statewide crash rates for all three years of the study period. As one of the busiest freeway sections in Virginia, the high crash rates on I-395 in the study area are not unexpected for such a congested segment.

A summary of crash types is presented in Table 9-2. Rear-end collisions had the highest frequency, accounting for approximately 58.5 percent of the total crashes. The second highest frequency was for fixed object crashes, which accounted for 21.1 percent of total crashes, followed by sideswipe crashes at 15.3 percent. All other types of crashes experienced along the corridor accounted for only 5.1 percent of accidents. A majority of the crashes occurred during the morning and evening peak hours. For instance, the crash analysis results indicate that approximately 55 percent of the rear-end crashes occurred during the AM and PM peak periods. Rear-end crashes usually occur during congested traffic flow conditions typified by long queues and continuous stop and go conditions. The crash analysis results also show that a majority of the rear end crashes within the study area occurred on the basic freeway segments of I-395 between Duke Street and Seminary Road interchanges.

Table 9-1: Annual Crash Rates on I-395 between Duke Street and King Street (2005 - 2007)

Year	I-395 NB GP					I-395 SB GP					I-395 HOV				Virginia Statewide Interstate Highway Average*
	Duke St to Seminary Rd		Seminary Rd to King St		SB GP Average	Duke St to Seminary Rd		Seminary Rd to King St		NB GP Average	Duke St to Seminary Rd		Seminary Rd to King St		
	AADT	Crash Rate	AADT	Crash Rate		AADT	Crash Rate	AADT	Crash Rate		AADT	Crash Rate	AADT	Crash Rate	
2005	70,000	107	72,000	94	103	75,000	138	63,000	149	108	29,000	29	32,000	58	86
2006	69,000	143	72,000	94	112	74,000	150	63,000	88	102	29,000	67	31,000	7	81
2007	70,000	138	73,000	64	88	74,000	111	62,000	129	76	29,000	37	31,000	20	77

AADT - Annual Average Daily Traffic (veh/day)
Crash Rate per HMVMT = (# of crashes per year X 100,000,000)/(AADT X 365 X Segment Length)
*Source: 2005, 2006, and 2007 Virginia Crash Data Summary Reports, Virginia Department of Transportation, http://virginiadot.org/business/ted_app_pro.asp

Table 9-2: Summary of Crash Types on I-395 between Duke Street and King Street (2005 - 2007)

Facility	Rear End	Side Swipe	Fixed Object	Others	Total
HOV	27	1	15	2	45
I-395 NB (GP lanes and Ramps)	224	51	74	14	363
I-395 SB (GP lanes and Ramps)	234	74	86	26	420
Total	**485 (58.5%)**	**126 (15.3)**	**175 (21.1%)**	**42 (5.1%)**	**828**

A summary of the crash frequency by time of the day is illustrated in Exhibit 9-2. The histogram shows a dual-peak pattern of crashes over a 24-hour period. On I-395 NB, the crash peak period is between 6:00 AM - 9:00 AM and that on I-395 SB is between 3:00 PM - 7:00 PM. Such pattern in crash frequency matches with the peak directions and peak periods of traffic flow within the study area.

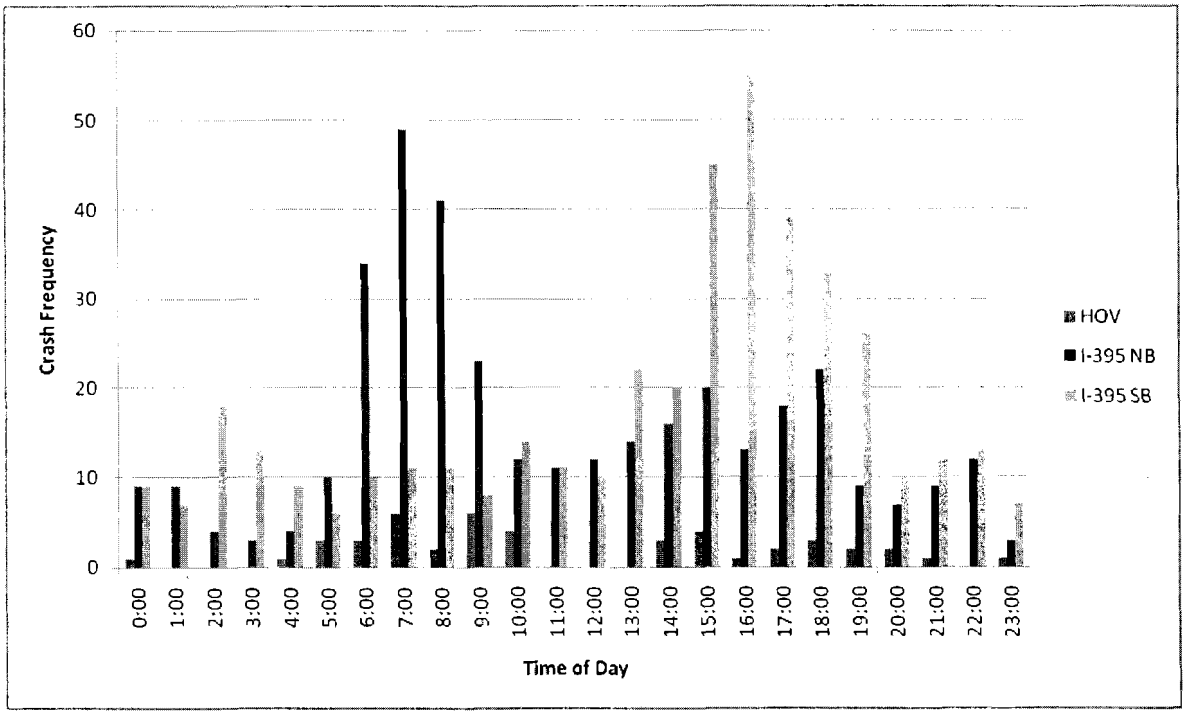

Exhibit 9-2: Crash Frequency by Time of the Day (2005 - 2007)

The crash data were aggregated at 0.1-mile intervals to identify high crash locations along the study corridor. Exhibits 9-3 and 9-4 represent the crash frequency histograms by type and severity respectively, aggregated at 0.1-mile intervals. Figure 9-2 in Appendix A displays the 0.1-mile crash frequency map.

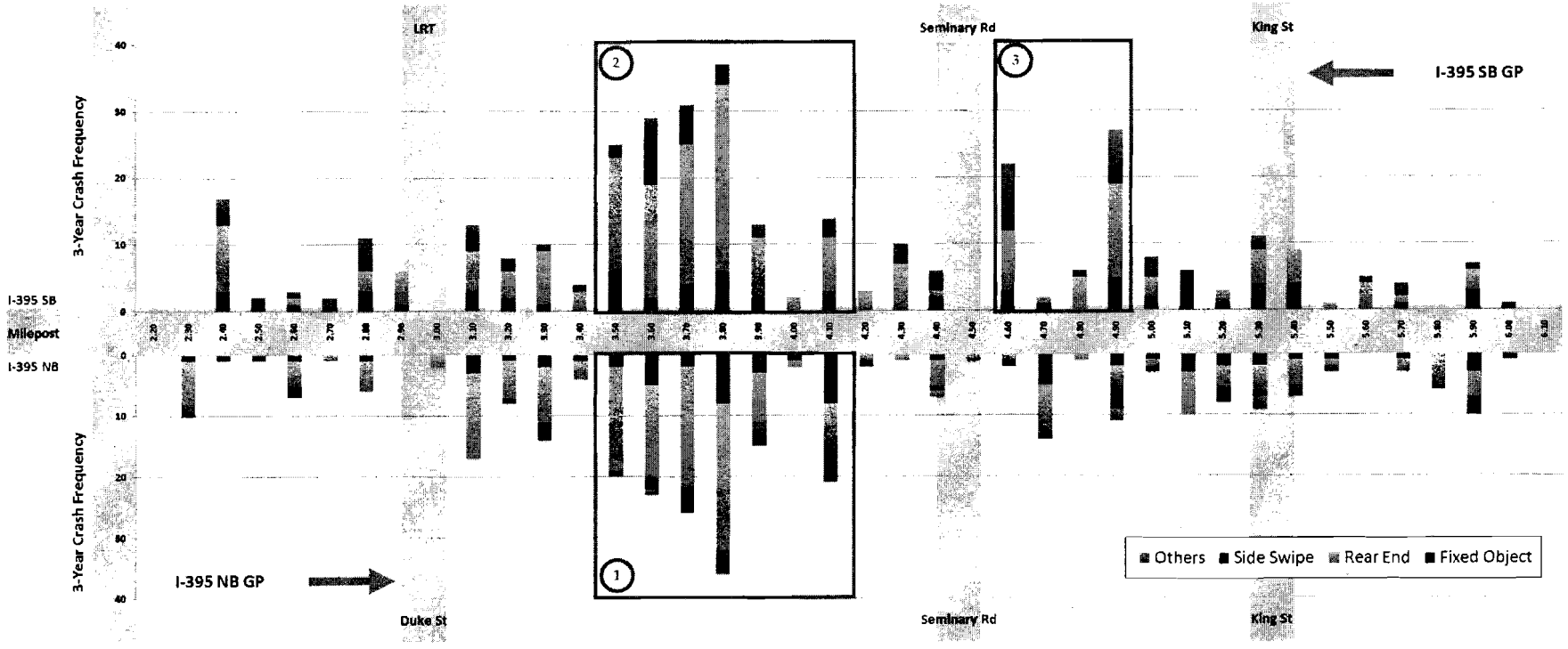

Exhibit 9-3: Crash Frequency by Type at 0.1-Mile Interval (2005 – 2007)

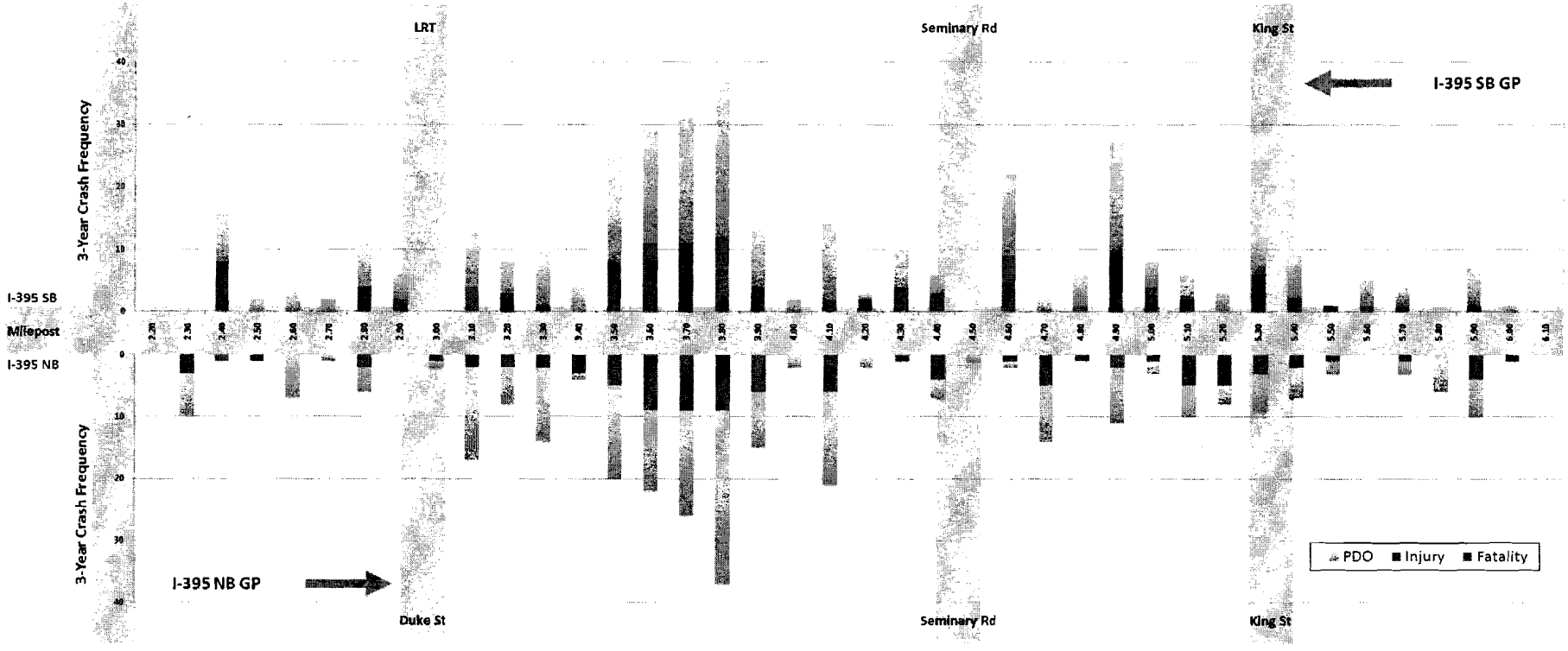

Exhibit 9-4: Crash Frequency by Severity at 0.1-Mile Interval (2005 – 2007)

Exhibits 9-3 and 9-4 also show the high crash locations along the I-395 corridor including a correlation between the crash frequency and the level of severity. The statistics for the crash frequency by severity for the general purpose lanes within the limits of the study area include 214 injury-related crashes (approximately 32%), 456 crashes (approximately 68%) resulting in property damage only, and one fatality. Specifically, 55 percent (117 crashes) of the injury-related crashes occurred in the southbound direction as compared to 45 percent (97 crashes) in the northbound direction. Similarly, 53 percent (241 crashes) of the property damage-related crashes occurred in the southbound direction while 47 percent (215 crashes) occurred in the northbound direction. The only fatality crash occurred in the northbound direction.

Based on an evaluation of the crash statistics, the following three high crash locations were identified:

1. I-395 NB between milepost 3.5 and milepost 4.1
2. I-395 SB between milepost 3.5 and milepost 4.1
3. I-395 SB between milepost 4.6 and milepost 4.9

The highest crash frequency along the I-395 corridor occurred near milepost 3.8, which lies within the band of high frequency crashes (i.e. between milepost 3.5 and 4.1 of the I-395 corridor). This location is approximately 0.85 miles north of the Little River Turnpike / Duke Street (SR 236) interchange or 0.65-mile south of the Seminary Road interchange. Crashes that occurred within this segment of roadway may be attributed to the following factors: heavy traffic volumes and unexpected queue build-up.

The southbound freeway segment between King Street (Route 7) and Seminary Road interchanges (from milepost 4.6 to 4.9) displayed the second highest crash frequency.

High crash frequency locations, in general, experienced a predominance of rear-end collisions, which resulted in mostly property damages but fewer injuries.

For each of the identified high crash locations within the study corridor a number of potential contributing factors influencing the high crash frequency were evaluated. These contributing factors, including the corresponding crash type/pattern and geometric features, are shown in Table 9-3.

Table 9-3: Identified High Crash Frequency Locations and Major Contributing Factors

Location	Crash Type/ Pattern	Geometric Features	Major Contributing Factors
(1) NB I-395 between Duke St and Seminary Rd (between milepost 3.5 and 4.1)	Predominantly rear-end collisions	Three-lane basic freeway segment, Sag curve	High traffic volume, congested traffic flow, and unexpected queue build-up
(2) SB I-395 between Seminary Rd and Duke St (between milepost 3.5 and 4.1)	Predominantly rear-end collisions	Four-lane basic freeway segment, Sag curve	High traffic volume, congested traffic flow, and unexpected queue build-up
(3) SB I-395 between King St and Seminary Rd (between milepost 4.6 and 4.9)	Mixed crash types	Five-lane weaving segment	High traffic volume and weaving maneuvers

9.3 Safety Impacts under Future No-Build Conditions

The roadway improvements to the freeway sections within the study area under the future No-Build condition include the following:

- Addition of a third HOT/HOV/Bus lane
- Addition of a new bus-only HOT lane ramp (single lane) on the south-face of the rotary at the Seminary Road interchange

These major improvements will be limited to the HOT/HOV facility only. Exhibit 9-1 shows that majority of the crashes (95%) over the three-year study period takes place on the general purpose lanes. GP lanes, especially between Duke Street and Seminary Road interchanges, will experience a significant increase in traffic in future No-Build conditions with the opening of the BRAC 133 development at the Mark Center. The high crash locations within the study area happen to lie within this section of freeway as well, with high traffic volume and congested traffic flow being the leading causes of such crashes. Therefore, without any geometric improvements to the GP lanes, No-Build conditions in the study area will most likely result in an increase in overall number of crashes.

9.4 Safety Impacts under Future Build Conditions

In addition to the proposed HOT lane improvements in the No-Build scenario, Alternative "A1" provides an access to the South Parking Garage at the Mark Center via a braided flyover from the existing southbound on-ramp from Seminary Road interchange. Under this alternative, an exit ramp (right-out) from the garage also connects with the SB on-ramp prior to its merge with SB I-395.

At the Seminary Road interchange, Alternative "A1" will result in an increased turning maneuvers on the rotary, which is projected to function inadequately with multiple signalized approaches served in a sequential fashion. The proposed access to the secured

garage will most likely introduce additional delays on the rotary as well, consequently creating additional congestion and possibly influencing aggressive driver behaviors.

Alternative "D" will provide a reversible fly-over ramp from the HOT lanes to connect with Mark Center Drive, a public roadway inside the Mark Center facility. This ramp will be designed as a left-side exit for the northbound motorists, which in turn will serve as a right-side merge for the southbound motorists. In addition, a right-out egress ramp similar to Alternative "A1" will be provided in Alternative "D" to facilitate the exiting traffic from the South Parking Garage to access SB I-395 general purpose lanes directly.

In Alternative "D", a significant portion of the inbound site-generated traffic originating from the south is expected to be diverted onto the proposed fly-over ramp. Thus, this design would reduce traffic congestion on NB I-395 GP lanes between Duke St and Seminary Road interchanges, the segment which has the highest crash frequencies in the study area. Compared to No-Build and Alternative "A1" scenarios, Alternative "D" therefore would not worsen the safety condition at this location by reducing the volume of diverge maneuvers from the NB off-ramp to Seminary Road.

Though the provision of a left-side exit is not optimal, left exits are not uncommon in the Northern Virginia area, where daily commuters are familiar with such traffic patterns especially on a reversible HOV facility. It is further expected that with proper advance signing for the left exit, there will not be any adverse impact on the drivers' comfort level or safety.

SECTION 10

LAND USE COMPATIBILITY

10.1 Land Use

The Mark Center is located in the southwest quadrant of the I-395/Seminary Road interchange. Land uses within that quadrant include the Mark Center office park complex with retail and hotel development, along with the 44-acre Winkler Botanical Preserve. The northwest quadrant of the interchange is fully built out with high-rise, high density residential development. Land use in the northeast quadrant of the interchange is built out with a mix of commercial office space and retail development adjacent to I-395 and Seminary Road and multi-family and single-family housing to the east of the commercial buildings. Land use in the southeastern quadrant is fully built out with high density residential and multi-family development and a middle school. Figure 10-1 in Appendix A illustrates the land uses within the project area.

10.2 Land Use Plans and Future Land Use

As part of the Base Realignment and Closure (BRAC) Commission's Recommendation #133, approximately 6,400 Department of Defense (DoD) personnel will be relocated to new office facilities at the Mark Center by 2011. The *Final Environmental Assessment* for implementation of BRAC 133[1] describes the Mark Center and surrounding area as follows:

> The Mark Center site is a 24-acre, privately owned facility located in the northwest portion of Alexandria, Virginia, at the intersection of Seminary Road and I-395. The site currently consists of forested land and two existing office buildings at 4825 and 4850 Mark Center Drive. The buildings currently house the Center for Naval Analysis Corporation (CNAC) and the Institute for Defense Analyses (IDA). The CNAC building is an 8-story, 214,000 ft^2 building, and the IDA building is a 10-story, 270,000 ft^2 building. Up to five additional office buildings totaling approximately 1.35 million ft^2 are planned to be constructed by the Mark Center developer (Duke Realty Corporation) and have been approved by the City of Alexandria, as well as 1.3 million ft^2 of structured parking. The site is currently zoned for office space and is part of a larger 350-acre mixed use Mark Center development consisting of residential, hotel, retail, office, and open space. Access to the site is from Mark Center Drive, which connects to Seminary Road to the northeast and North Beauregard Street to the northwest. The site is surrounded by mixed use

[1] U.S. Army Corps of Engineers, Mobile District, Final Environmental Assessment - Implementation of 2005 Base Realignment and Closure Recommendation 133, July 2008.

development to the north, high-rise office and residential buildings to the northeast, I-395 to the southeast, and the 44-acre Winkler Botanical Preserve to the west.

The development noted above includes a new DoD complex at the Mark Center to accommodate the new personnel. Two buildings (west and east tower), two parking garages (north and south), and a public transportation center attached to the north parking garage have been built or are currently under construction. Figure 2-1 in Appendix A illustrates facilities planned at the Mark Center (BRAC 133).

City-approved land use plans for the Mark Center call for substantial development of commercial space over time while maintaining its park-like setting. The Institute for Defense Analysis (IDA) owns its headquarters at the Mark Center and purchased an adjacent parcel for its expansion. The new building and site plans were approved by the City of Alexandria in June of 2009 and are consistent with maintaining the park-like setting of the Mark Center.

Land uses at the Winkler Botanical Preserve (Preserve) are to remain unchanged. The 44-acre Preserve is directly adjacent to the southwest perimeter of the Mark Center Property. The Preserve was established in 1979 by the Mark Winkler family and operates as a non-stock corporation that is qualified as a 501(c)(3) nonprofit entity. The Preserve contains indigenous plants and trees which contains a network of trails, creeks/stormwater management pond, lodge, native plant propagation area and a ropes course. Since 1999, the Preserve has partnered with the Alexandria City Public Schools to provide elementary and middle school students with learning experiences outside of the classroom within nature. It is estimated that annually 12,000 students visit the Preserve as part of this program from 13 elementary and two middle schools. FHWA has not made a determination on the status of this Preserve as a Section 4(f) resource.

10.3 Right-of-Way

Between Seminary Road and Sanger Avenue, the existing VDOT right-of-way width for I-395 ranges from 290 to 420 feet along the length of the northern side of the interstate. Other property owners from whom right-of-way may need to be acquired include the 44-acre Winkler Botanical Preserve (a non-profit organization) and, within the Mark Center, the U.S. Department of the Army for BRAC 133 and the IDA. Table 10-1 provides a preliminary estimate of the ROW needed by the Build alternatives. The ROW estimates do not include potential ROW needed to accommodate storm water management facilities. Figures 1-1 and 1-2 in Appendix A illustrate the property boundary constraints for each alternative, respectively.

Table 10-1: Preliminary Estimate of ROW Needs

PROPERTY OWNERSHIP	ALTERNATIVES		
	No-Build *sq. ft.*	A1 *sq. ft.*	D *sq. ft.*
Winkler Botanical Preserve	N/A	1,935	96,297
Institute for Defense Analysis (IDA)	N/A	0	30,772
US Army (BRAC 133)	N/A	12,476	8,805
VDOT	N/A	0	0
Other	N/A	0	0
TOTAL	N/A	14,411	135,874

10.4 Land Use Impacts

To date, the proposed project is not included in the City of Alexandria's Comprehensive Plan or Transportation Plan, nor is it included in VDOT's Six-Year Improvement Program, VDOT's 2025 State Highway Plan, the Northern Virginia Transportation Authority's Northern Virginia 2030 Transportation Plan, the TPB (MWCOG) Constrained Long Range Transportation Plan, or the Statewide TIP. Prior to FHWA's final approval of the project, it would need to be included in all of these documents.

The Winkler Botanical Preserve is open to the public and functions as a nature preserve. The conversion of any portion of the Preserve would be inconsistent with its current and future land use.

Of the Alternatives carried forward the No-Build Alternative would be consistent with existing and future land uses. Alternative "D", the acquisition of lands will be required from the Preserve and from the IDA. Alternative "A1" would require the acquisition of land from the Preserve.

10.5 Coordination with the Local Jurisdictions

At the City of Alexandria's Transportation Commission Meeting on December 2, 2009, the City Staff recommended support of only those alternatives that avoided the Preserve (i.e., Alternative "A1" and "A2"). At the meeting, there was considerable public support for the Commission's recommendation, citing the importance of the Preserve to the local community. At the same meeting, a representative for the IDA spoke and stated that construction of Alternative "D" would make the construction of their previously approved building plan impossible due to the proposed access ramp's location on the IDA's parcel. The Commission's recommendation was forwarded to the City Council for the December 12, 2009 City Council Public Hearing. At the hearing, the Council formally approved the Commission's recommendations with minor amendments and the Mayor summarized the recommendations of the City Council in a letter dated January 15, 2010[2]. Fairfax County

[2] Letter from Major of Alexandria recommending Alternatives "A1"and "A2"

Board of Supervisors submitted a letter dated January 12, 2010[3] recommending support of alternative "D" with some ramp modifications from the south parking garage.

Copies of these letters of recommendation are included in Appendix I.

[3] Letter from Chairman Bulova of Fairfax County Board of Supervisors recommending Alternative "D".