


Shirley Gate Road Extended

CORRIDOR PLANNING STUDY

FINAL

Prepared for:

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Executive Summary

The purpose of the Shirley Gate Road Extended Corridor Planning Study was to take the guidance provided in the Comprehensive Plan and identify a preferred alignment for the Shirley Gate Road extension. In addition, the study also focused on identifying recommended interchange configurations at Fairfax County Parkway (FCP), with the goal of eliminating one of the two interchange locations identified in the Comprehensive Plan. This report documents the analysis of existing operational conditions within the project study area, the approach to identifying alternative alignments and interchange configurations, public and stakeholder input process, and recommendations for implementation of a preferred alternative.

Prior to identifying alignments for the extension of Shirley Gate Road, background information was compiled to guide project development. A review of previous studies and ongoing projects was completed at the onset of the study to identify any potential transportation impacts to the future alignment of the Shirley Gate Road extension and its interchange with FCP. Key findings from the review hinged around minimizing impacts to property and associated access, including the planned Patriot Park East, residences along Meath Court and other homes located off of Popes Head Road, and the Four Seasons Golf Center. In addition, future water storage tank construction by the Fairfax County Water Authority was a consideration in the selection of an alignment.

An operational assessment of existing traffic conditions was completed for study area intersections in the vicinity of the Popes Head Road intersection with FCP. Synchro analyses were completed for peripheral study area intersections while VISSIM analyses were completed for FCP study intersections. Significant queuing occurs during the morning and evening peak periods in both directions, with more substantial queues experienced in the northbound direction during the AM peak and in the southbound direction during the PM peak. In the northbound direction, the intersection of FCP and Burke Centre Parkway meters the volume of traffic that reaches the Popes Head Road intersection. Without this upstream constraint, operations at Popes Head Road could be expected to be much worse.

The primary indicator of the impact that the Popes Head Road intersection has on corridor operations can be observed in the corridor travel times. Average travel time between Burke Centre Parkway and Braddock Road, a distance of 2.5 miles, is more than 6 minutes in the peak direction during the AM and PM peak periods. This translates to an average travel speed of less than 25 mph, or half the posted speed limit. Thus, while the intersection delay indicates tolerable levels of operations, queuing associated with the Popes Head Road intersection contributes to the unfavorable driving conditions during peak periods.

A stakeholder engagement process was carried out between May and September of 2015 to garner input from potentially affected residents and business owners in the vicinity of the future alignment and interchange. Results of the analyses of existing and future conditions were shared at a series of five meetings during this timeframe, and alignments and interchange alternatives were reviewed and refined by the participants. The alignments were developed considering the northern and southern portions of the corridor. **Figure E.1** and **Figure E.2** illustrate the approximate alignment of these two sections of the corridor, with the southern alignments focusing on general connection options with FCP.

Figure E.1 – Northern Alignment Alternatives of Shirley Gate Road Extended

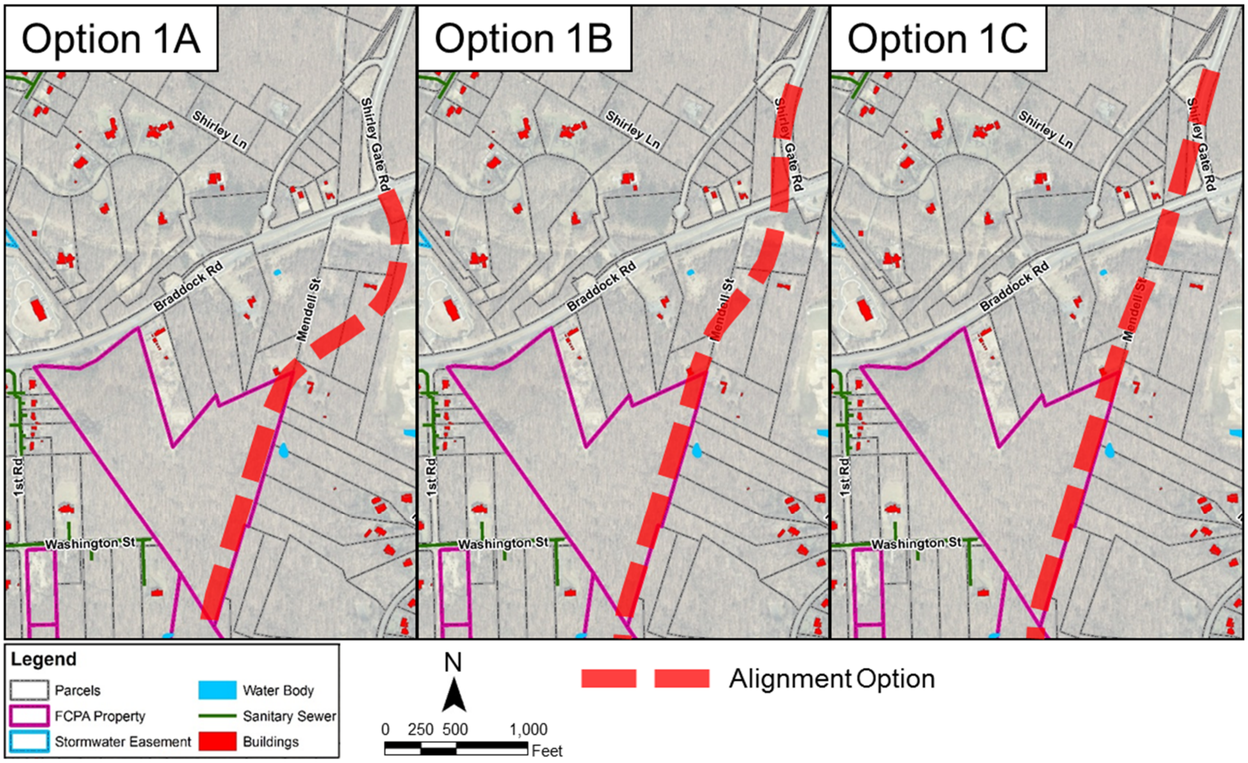
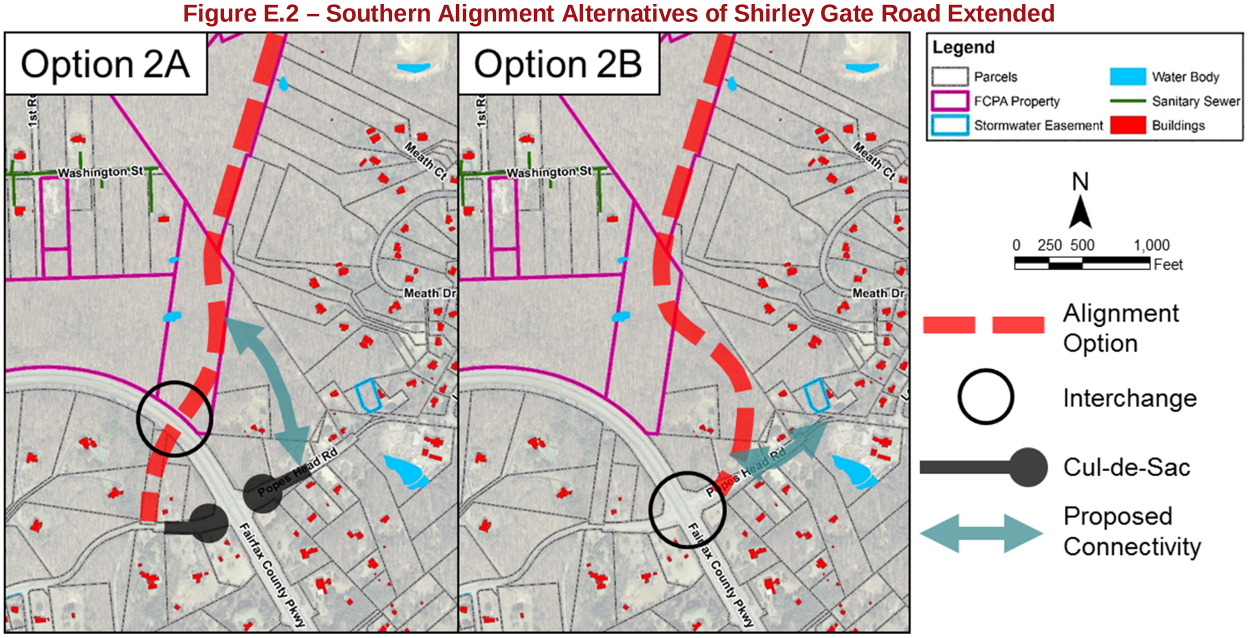


Figure E.2 – Southern Alignment Alternatives of Shirley Gate Road Extended



A list of measures of effectiveness (MOEs) were developed over the course of these meetings to help refine the alternatives and select a preferred roadway alignment and interchange configuration. **Table E.1** summarizes the list of MOEs that were developed to use in the screening of alternatives by the stakeholders.

Table E.1 – Final List of MOEs

MOEs		
I. Impacts to Adjacent Properties	**II. Impacts to Transportation System**	**III. Cost**
a. Property For Sale (posted)	a. Access	a. Construction Cost
b. Property Vacant	b. Traffic Operations and Levels of Service (delay/ travel time)	
c. Commercial Property	c. Safety	
d. Septic Field	d. Improvements to network (connectivity)	
e. Park Property	e. Construction Duration and Associated Traffic Disruption	
f. Land Grades	f. Change in volume on Popes Head Road	
g. Noise	g. Change in volume on Shirley Gate Road (north of Braddock)	
h. Lighting	h. Intersection skew at Braddock	
i. Property Value Degradation		
j. Property Value Degradation to Adjacent Properties		
k. Natural Environment		
l. Utility Crossings		

*vmt – vehicle miles traveled

Considering input from the stakeholders, the MOEs were used in the screening of a handful of alignments and interchange configurations, from which two recommended alternatives were identified. Graphical representations of the two alternatives are presented in **Figure E.3**. The northern alignment of the two alternatives are identical, with the Shirley Gate Road extension traversing south from a slightly relocated intersection with Braddock Road and passing along the easternmost border of an existing Fairfax County Park Authority (FCPA) property (Option 1B). Near the interchange at FCP, both alternative alignments meander east toward the easternmost border of another FCPA property that is adjacent to FCP. Alternative 2A(1) interchanges with FCP in a tight diamond configuration, with a continuation of the Shirley Gate Road extension to an intersection with Popes Head Road. Alternative 2A-2B consists of directional ramps to and from FCP providing access to Shirley Gate Road Extended. A new connector road provides access to Popes Head Road.

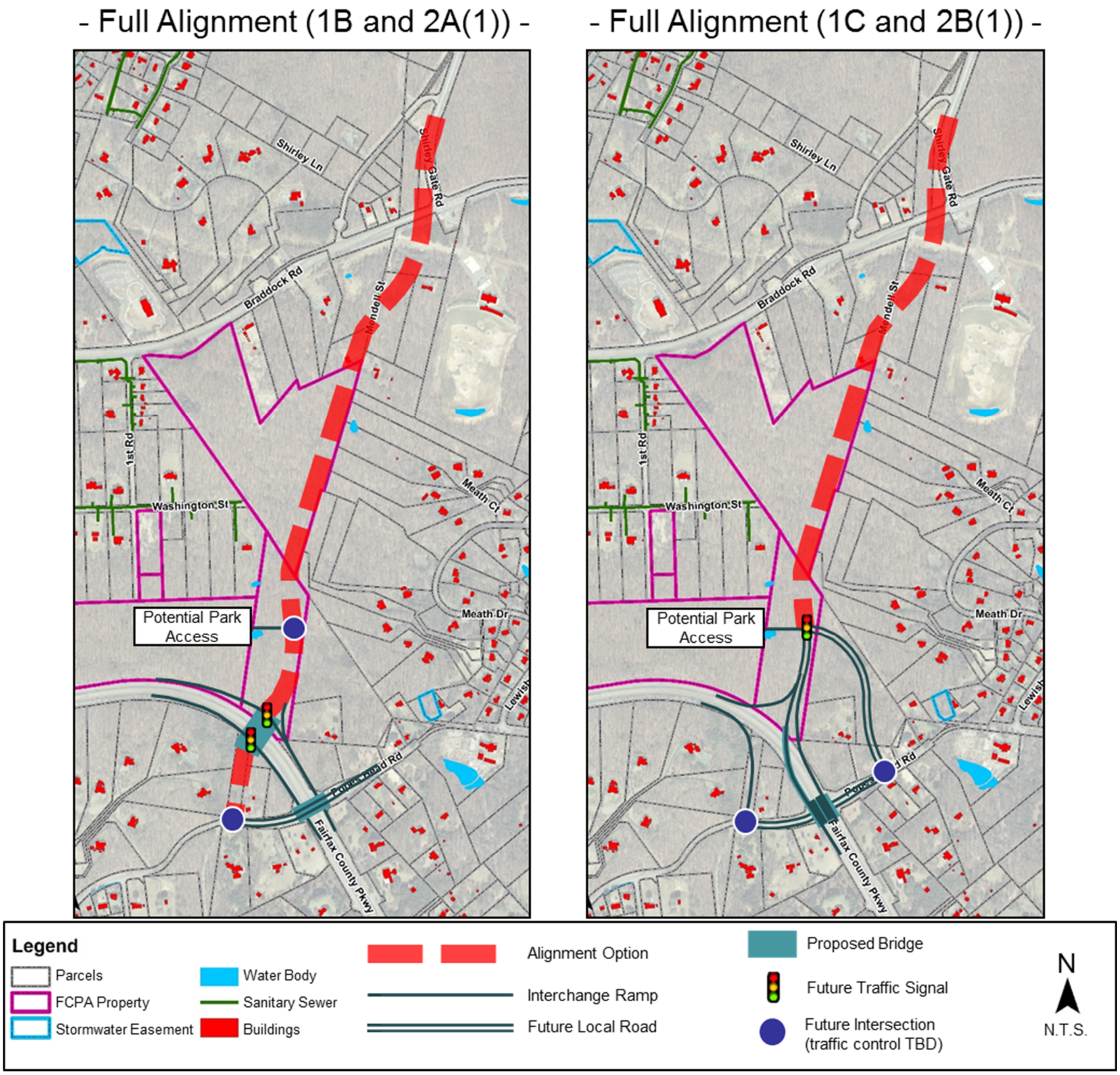
Property impacts were a major consideration in the identification of the alignment alternatives. While the two recommended alternatives minimize property impacts, a number of factors were discussed among stakeholders when scoring the alternatives based on the MOEs identified, including the following:

- **Direct impacts to properties with existing residential structures**: the northern alignment of the preferred alternative impacts one residential structure and the southern alignments both impact one residential structure.
- **Property Access**: the southern alignments, due to the proposed grade separation of Popes Head Road, will impact access to as many as nine residential properties located off of Popes Head Road near the existing intersection with FCP.
- **Noise and Lighting Impacts**: the alignments were evaluated based upon the cumulative offset distance of existing residential structures to the centerline of the alignment alternatives.

Figure E.3 – Alternatives Selected for Further Study

A. Northern Alignment 1B, Southern Alignment 2A(1)

B. Northern Alignment 1B, Southern Alignment 2A-2B



Both alternatives provide full access to and from FCP. However, alternative 2A-2B requires a more circuitous path for travelers to move between Popes Head Road and FCP. In addition, vehicles traveling southbound along FCP destined for Shirley Gate Road would have to navigate along Popes Head Road and the new connector road in order to access the Shirley Gate Road alignment. This ultimately resulted in longer anticipated travel times for trips that are redistributed by the interchange geometry. Combined with longer travel times, the relative construction cost and duration resulted in alternative 2A-2B receiving a lower score as compared to alternative 2A(1).

As such, the combination of northern alignment 1B and southern alignment 2A(1) was identified as the preferred alternative for the extension and future interchange configuration of Shirley Gate Road Extended. Additional information pertaining to the stakeholder engagement, development of MOEs, and selection of the preferred alternative can be found in **Chapter 4** and **Chapter 5** of this report.

Analysis of future conditions was performed using traffic forecasts from the County Travel Demand Model. The results of the analysis show that the Shirley Gate Road extension and associated interchange improvements will provide a number of benefits to the motoring public within the study area. These benefits include:

- Reduced traffic volumes along area roadways and intersections (Popes Head Road, Braddock Road, Route 123)
- Reduced travel times along FCP and Popes Head Road
- Increased safety at the juncture of FCP and Popes Head Road
- Enhanced access for residents along Popes Head Road to FCP
- Improved access to western portions of the City of Fairfax and the Fair Oaks area

As Fairfax County considers moving the project forward, a number of subsequent steps and considerations should be accounted for in order to realize the successful construction of the proposed roadway extension and interchange. In general, the following series of milestones should be accounted for through project construction:

1. Interchange Justification Report (IJR)
2. National Environmental Policy Act (NEPA) compliance
    a. Environmental Assessment (EA) could be required
       (documented existence of naturally occurring asbestos will influence this process)
    b. Phase I Environmental Site Assessment (ESA) for all property acquisition is recommended
    c. This process is influenced by the funding source for construction
    d. Public hearings can be expected
3. Preliminary engineering and design
4. Right-of-way acquisition
5. Construction

The timeframe over which these processes could occur can vary, especially due to the consecutive nature of these tasks. It is recommended that the County pursue funding for the IJR in the near term to initiate the project implementation sequence. However, this should be done concurrently with the identification of construction funding to build the improvements. Once the IJR is accepted by the reviewing agency, the County will have eight years to begin construction or an update to the document will be required, per Federal Highway Administration (FHWA) guidelines. Related to the extension, the County is planning to widen FCP from four to six lanes between US 29 and Route 123, with design efforts expected to begin during fiscal year 2017. It would be beneficial to initiate the project implementation process outlined above for the Shirley Gate Road extension to allow for construction of the two improvements to occur simultaneously.

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Chapter 1 – Introduction

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Fairfax County is the largest jurisdiction within the state of Virginia with a population of more than 1 million residents (2010 census). During the past several decades, the transportation network has evolved to accommodate population growth within the County. The 31-mile Fairfax County Parkway (FCP), initially envisioned to be an Outer Beltway around Washington, DC, began construction in 1987 and was completed in 2010. Although the Outer Beltway was never completed, Fairfax County Parkway still functions as a critical link through the county, linking several major regionally significant roadways, including Route 7, I-66, Route 123, and I-95.

One of the busiest segments of FCP is between I-66 and Route 123. This stretch of roadway carries nearly 70,000 vehicles per day and experiences significant congestion during the morning and evening peak commuting times. A major source of congestion is the signalized intersection at Popes Head Road. FCP operates as a limited access facility north of this intersection up to the Route 50 interchange, which operates with signalized ramp movements onto Fairfax County Parkway. As such, the at-grade intersection at Popes Head Road acts as a major bottleneck for travel to and from the north.

The Fairfax County Comprehensive Plan has identified this intersection to be replaced with a grade-separated interchange to alleviate congestion. Also, Shirley Gate Road is identified in the Comprehensive Plan to be extended between Braddock Road and FCP, connecting with FCP at a second grade-separated interchange. This roadway extension was identified to improve regional north-south travel in this area of the county and alleviate congestion along the parallel Route 123 to the east.

The purpose of the Shirley Gate Road Extended Corridor Planning Study was to take the guidance provided in the Comprehensive Plan and identify a preferred alignment for the Shirley Gate Road extension. In addition, the study also focused on identifying recommended interchange configurations at FCP, with the goal of eliminating one of the two interchange locations identified in the Comprehensive Plan. This report documents the analysis of existing operational conditions within the project study area, the approach to identifying alternative alignments and interchange configurations, public and stakeholder input process, and recommendations for implementation of a preferred alternative.

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Chapter 2 – Review of Previous Studied Ongoing Projects

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The extension of Shirley Gate Road to Fairfax County Parkway (FCP) from Braddock Road was initially added to the County Comprehensive Plan in 1991 as a means to reduce congestion along Braddock Road and Ox Road. In 2006, the Comprehensive Plan was amended to include grade-separated interchanges along FCP at the intersections of Shirley Gate Road Extended (future roadway) and Popes Head Road (existing roadway), thereby creating a 7.75 mile stretch of FCP that would be uninterrupted by traffic signal operations. The elimination of a traffic signal at the existing intersection at Popes Head Road would improve traffic operations along FCP as signal operations at this intersection have long been a source of congestion during peak periods. This study is aimed at identifying optimal geometric configurations for the intersection of these two roadways with FCP. Prior to the development of alternatives, various materials provided by the Fairfax County Department of Transportation (FCDOT) were reviewed that could impact the alignment of Shirley Gate Road Extended as well as the intersection with FCP. Specific resources that were reviewed consisted of the following (relevant location is shown in **Figure 2.1**):

- Fairfax County Comprehensive Plan, 2013 Edition
- Zoning Application Analysis for Garden World (March 20, 2014)
- Patriot Park East
- Four Seasons Golf Center
- Fairfax County Water Authority (FCWA) Water Storage Tank Options
- Route 123 and Braddock Road Interchange Study
- FCP Extended Southbound Auxiliary Lane
- Shirley Gate Road Extended Alternatives

Key findings and observations from these resources are summarized below.

FAIRFAX COUNTY COMPREHENSIVE PLAN, 2013 EDITION, POHICK PLANNING DISTRICT, AMENDED THROUGH OCTOBER 28, 2014

The Comprehensive Plan is required by state law to be used as a guide in decision-making about the built and natural environment by the County's Board of Supervisors and other agencies. It is also a guide for county staff and the public to use in the planning process. The project study area lies within the Pohick Planning District, located in the southwest portion of Fairfax County. Relevant plan elements are discussed briefly below and depicted in **Figure 2.2**:

- Construct grade separated interchanges at the following locations:
  - FCP and Shirley Gate Road Extended
  - FCP and Popes Head Road
  - Braddock Road and Ox Road
- FCP: widen to six lanes (total), including high occupancy vehicle (HOV) lanes (one lane in each direction).
- Shirley Gate Road Extended: construct a four-lane roadway between Braddock Road and FCP to provide an extension of Shirley Gate Road. The alignment should minimize impacts to the five acre lots and existing homes on Meath Court.
- Braddock Road Widening: widen to six lanes between FCP and Ox Road.
- Ox Road Widening: the widening of Ox Road from four to six lanes should be reevaluated given the construction of FCP, the extension of Burke Centre Parkway, the widening of Braddock Road west of Ox Road, and the planned extension of Shirley Gate Road. An independent study should be completed that evaluates alternative routes, transit service, and carpooling incentives.

Figure 2.1 – Fairfax County Comprehensive Plan Transportation Improvements

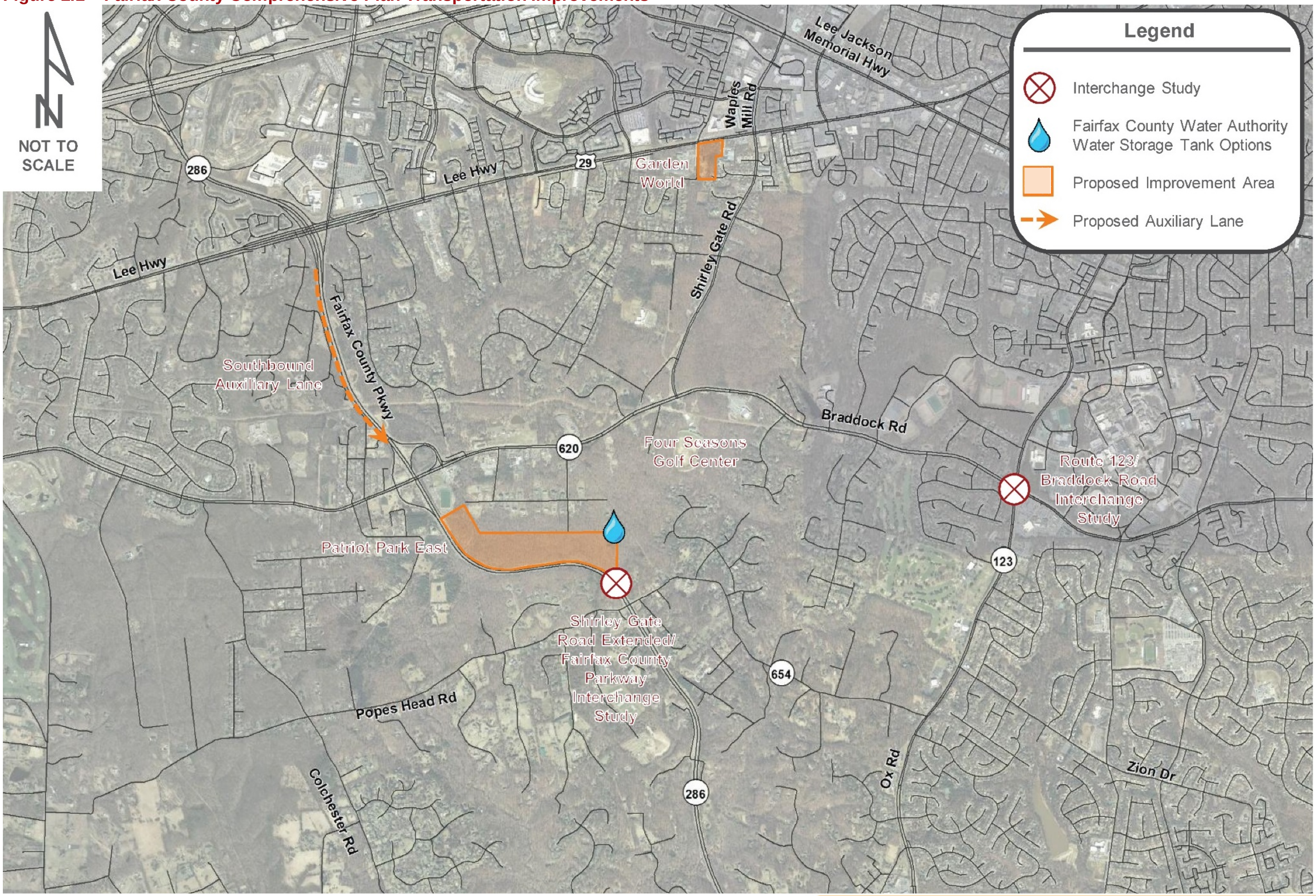
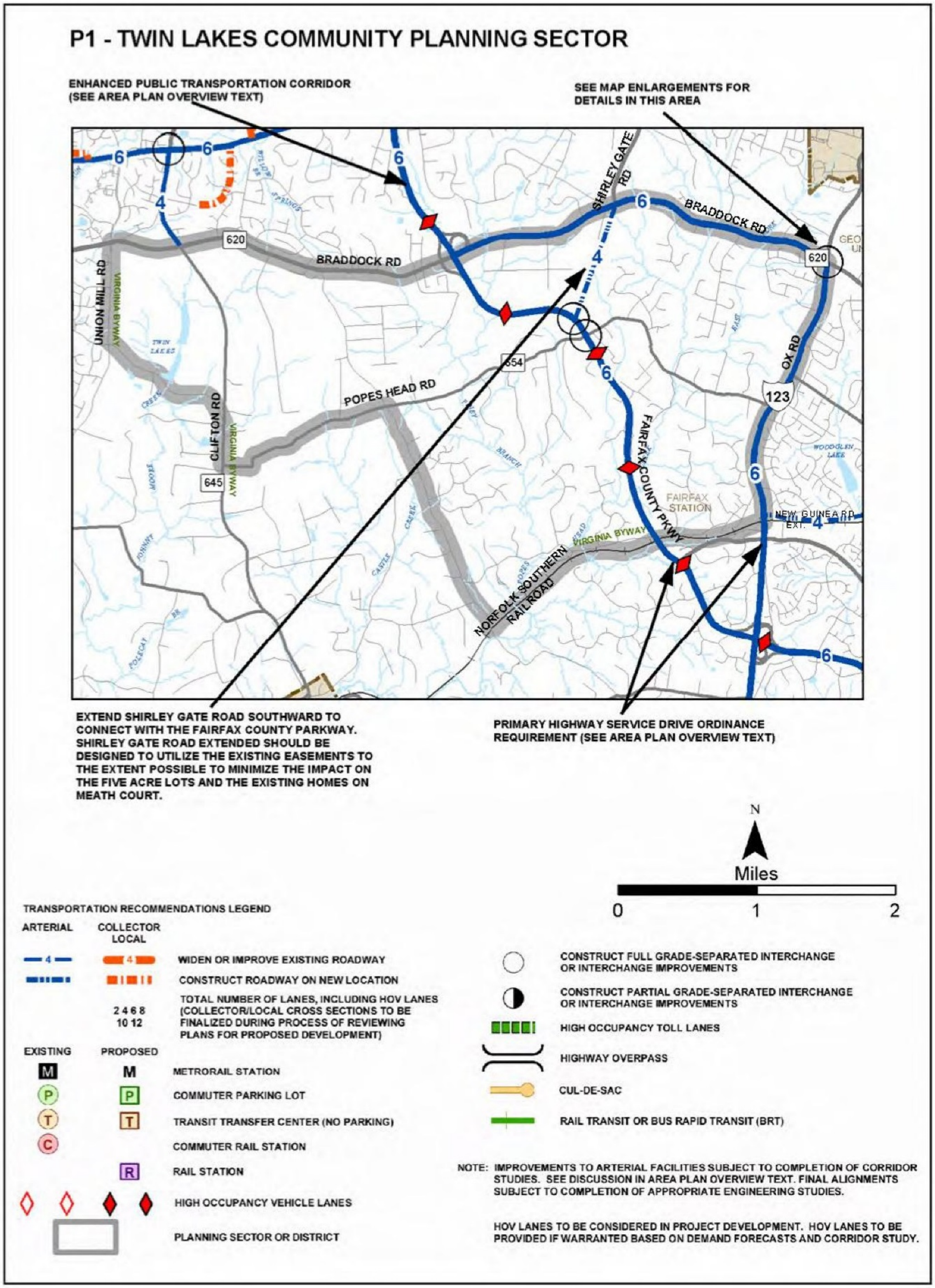


Figure 2.2 – Fairfax County Comprehensive Plan Transportation Improvements



ZONING APPLICATION ANALYSIS FOR GARDEN WORLD

A rezoning application was submitted to the county in July 2014 for the redevelopment of several parcels on the southeast corner of Lee Highway (Route 29) and Forest Hill Drive. Several of the parcels are currently vacant, with the larger of the parcels fronting Lee Highway functioning as a wholesale and retail nursery. The proposed development would include 41 single-family detached dwellings at a density of 2.95 dwelling units per acre. This density is less than the three dwelling units per acre maximum outlined in the Comprehensive Plan.

Since the density is within the limits outlined in the Comprehensive Plan, transportation improvements are not proposed. The proposed configuration of the residential development accounts for future widening of Lee Highway with a buffer space of approximately 60-70 feet allocated along the property frontage on Lee Highway. Access is limited to two entry points on Forest Hill Road with no direct access provided from Lee Highway. The terminus of the northernmost internal street is oriented to allow for a future connection to adjacent parcels. Given the relatively small size of this development and the distance away from the connection of Shirley Gate Road Extended with FCP, minimal impacts to the future FCP interchange can be expected from this development.

PATRIOT PARK EAST

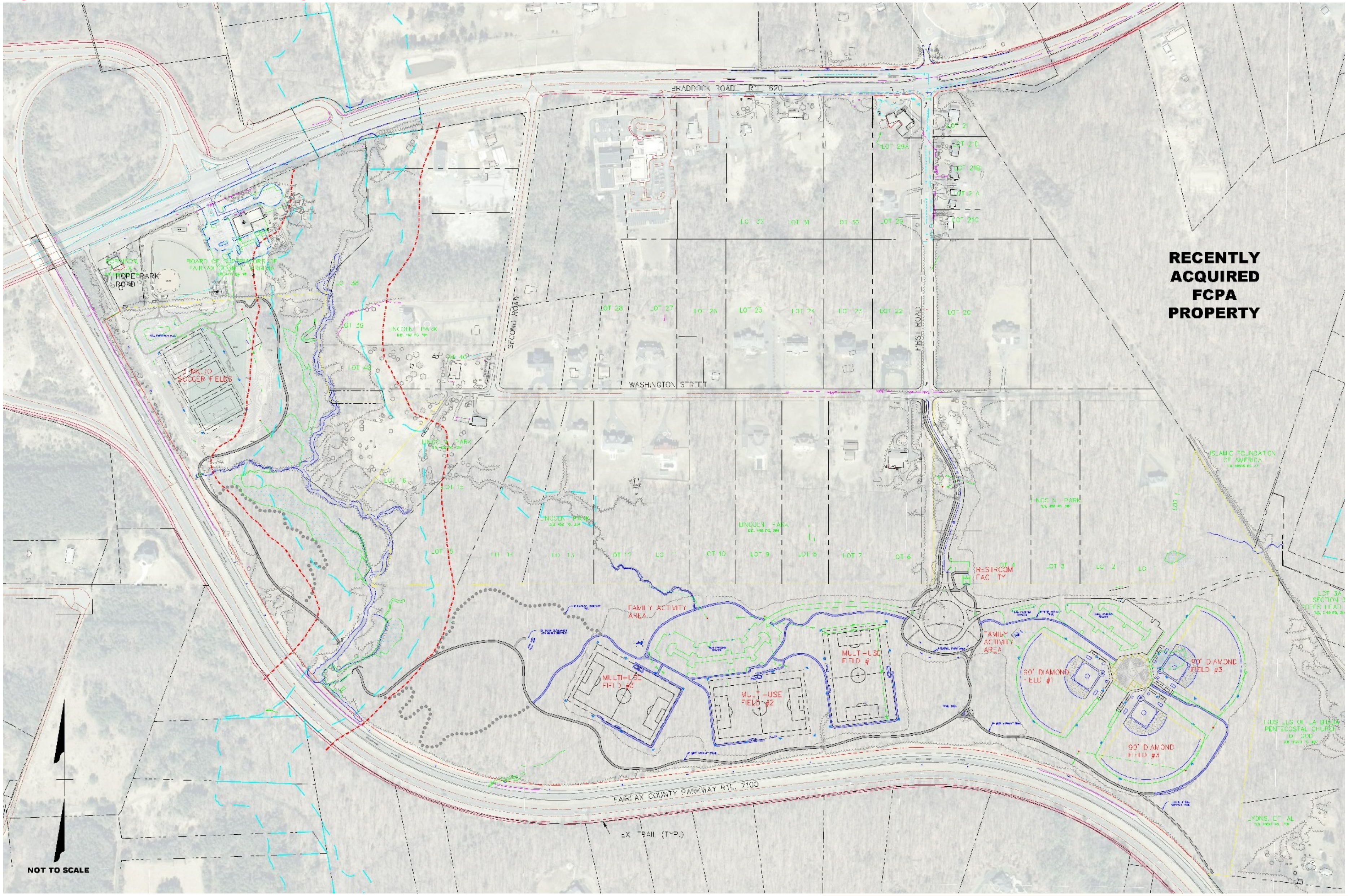
Patriot Park East is a planned park expansion east of the existing Patriot Park West, which is located at the intersection of Braddock Road and FCP. The master plan for the new park consists of three baseball diamonds and three soccer fields, with a trail linking the park to Patriot Park West. A project meeting was hosted on December 16, 2014, by staff from Fairfax County Park Authority (FCPA) to discuss the Shirley Gate Road Extended project as it relates to park development. A meeting summary is included in **Appendix A**. At the time of the meeting, park development had been suspended until the final alignment of the Shirley Gate Road extension is determined. FCPA staff indicated that the current park concept (see **Figure 2.2**) is not finalized, but that the clustering of the baseball diamonds and soccer fields is preferable. The primary objectives for the park related to the extension alignment are the provision for access from Shirley Gate Road Extended and limited impacts on park facilities. Access from Shirley Gate Road Extended is the preferred alternative of FCPA and would eliminate the need for access via First Road, which is a low volume, residential roadway.

Recently, FCPA acquired an approximately 34-acre parcel to the north of Patriot Park East. Located approximately 2,000 feet west of Shirley Gate Road with nearly 800 feet of frontage along Braddock Road, the parcel could provide an area along which the new alignment could travel. There are currently no plans for improvements to this parcel by FCPA nor any known restrictions in place that would preclude FCDOT from using the land for transportation improvements.

FOUR SEASONS GOLF CENTER

The Four Seasons Golf Center was considered for a special permit amendment in 2000 by the Board of Zoning Appeals. The amendment called for the construction of additional parking spaces, a storage structure, and the extension of operating hours. The special permit resolution of the Board included several limitations with the approval, including on-site lighting, hours of operation, and improvements to vegetation. In addition, the limitations indicate that ancillary easements deemed necessary for the future extension of Shirley Gate Road shall be provided along the full frontage of the property and the site entrance relocated at the time of roadway construction. The easements will allow for construction activities and installation of roadway support facilities (e.g. utilities, sidewalk, slope) on the property without acquisition of right-of-way (ROW). However, the easement cannot be utilized as ROW for the roadway alignment itself. An associated transportation impact memorandum corroborates the provision of the ancillary easement, noting an approximate offset of 15 feet from the property line is typically considered for these types of easements.

Figure 2.3 – Patriot Park East Concept



FAIRFAX COUNTY WATER AUTHORITY (FCWA) WATER STORAGE TANK OPTIONS

FCWA manages and maintains the water distribution system for the county and plans for expansions and improvements to the existing network. One such improvement that has been identified is the construction of a water storage tank on existing FCPA property. Two existing water mains that support two different water distribution networks pass through the project study area. One main follows a northwest-southeast path between the Popes Head Road Pumping Station and points north of Braddock Road, and the other follows a similar trajectory before turning north toward Shirley Gate Road, running along the back side of the parcels on Meath Court (see **Figure 2.3**). Two options have been identified for water storage tanks that will serve the two independent water distribution networks. The first option includes an elevated storage tank that would be located on high ground at the northern limits of the parcel recently acquired by FCPA. The second option includes a ground storage tank at the juncture of the two water mains. Both are recommended to include an area designation of approximately 1 acre (200 feet by 200 feet). Option two presents more challenges considering the planned improvements to Patriot Park East and various alignments of Shirley Gate Road Extended prepared by Virginia Department of Transportation (VDOT) in 1994. The location of these tanks is preliminary, and the proposed alignments will need to be coordinated with FCWA.

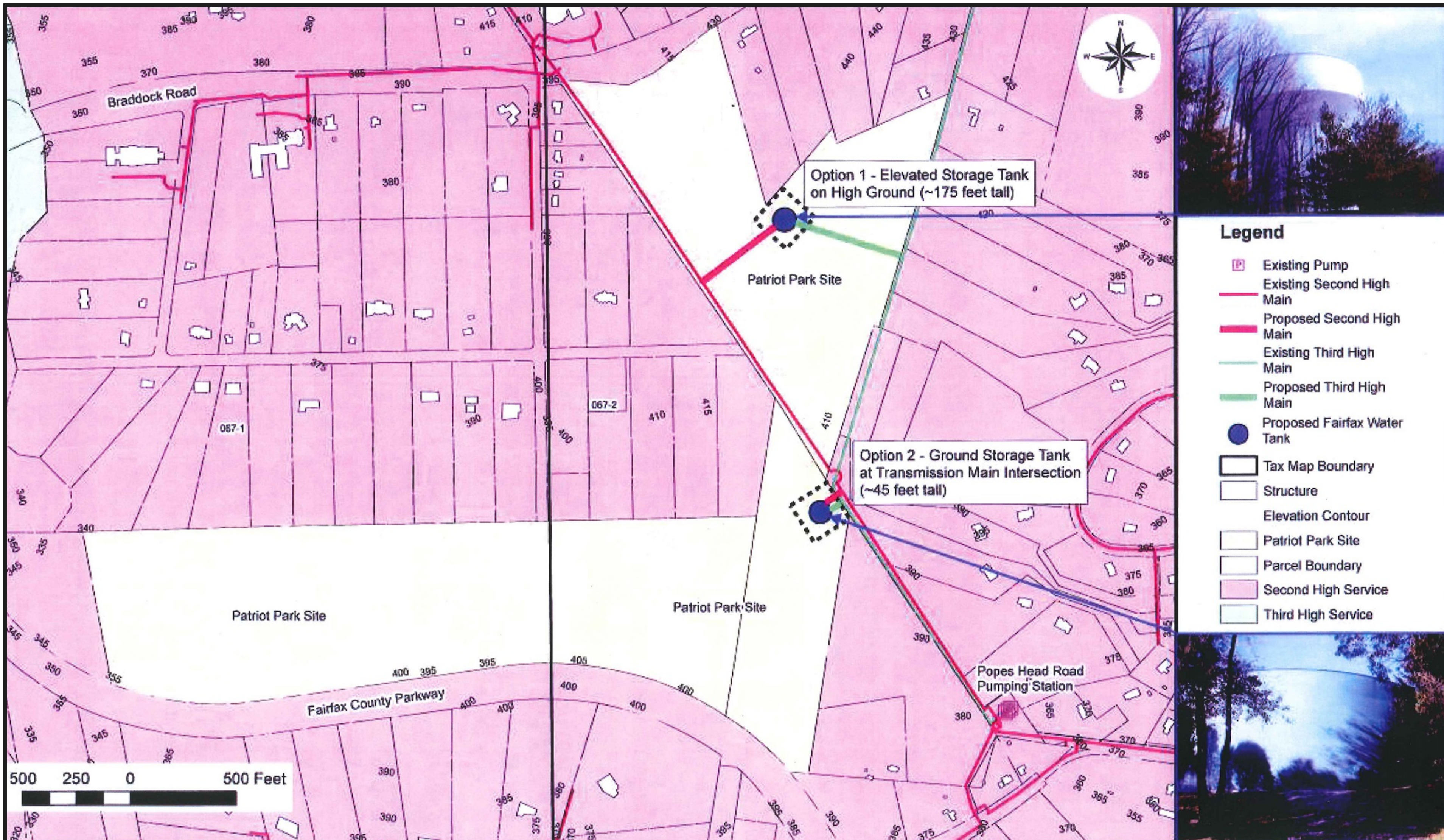
ROUTE 123 AND BRADDOCK ROAD INTERCHANGE STUDY, NOVEMBER 2009

A study of the Route 123 and Braddock Road intersection was completed in 2009 to evaluate potential interchange alternatives. The goal of the study was to evaluate the existing intersection under current and future year conditions and identify interchange alternatives that minimize impacts to the surrounding area, are cost effective solutions, and provide the greatest benefit to traffic operations. The analysis of existing conditions indicates that all movements operate at level of service (LOS) E or worse during the peak periods, with LOS F expected for all movements under future year conditions. At-grade intersection improvements were identified to alleviate intersection congestion, including roadway widening and signal modifications. However, future signal operations considering these improvements still indicate an overall intersection LOS F can be expected. Initially, twenty-one interchange alternatives were identified with only five being evaluated further against the study goals. The alternative recommended for further consideration was a tight single-point interchange, elevating Route 123 above Braddock Road and signalizing the ramp terminals at their intersection with Braddock Road. The estimated cost of construction and ROW acquisition is $84 million (2009 dollars).

FAIRFAX COUNTY PARKWAY EXTENDED SOUTHBOUND AUXILIARY LANE

FCP experiences heavy congestion during the weekday AM and PM peak periods. Recent improvements north of I-66 have improved operations by adding a lane in each direction (three total travel lanes) and eliminating at-grade intersections. South of I-66, FCP is two lanes in each direction. In the southbound direction, this creates congestion as traffic merges from three to two lanes. The congestion issue is further compounded by traffic merging at the on-ramp from Lee Highway. To alleviate congestion at this merge point, the County will be adding an auxiliary lane between the on-ramp from Lee Highway and the off-ramp to Braddock Road, a distance of approximately 2,450 feet. The third lane will increase the distance over which traffic entering FCP southbound from Lee Highway can travel before merging with mainline traffic. A similar benefit is expected for traffic exiting FCP to Braddock Road. This improvement will also mimic the current operations of the northbound segment, which consists of two mainline travel lanes and an outside auxiliary lane between the on-ramp from Braddock Road and the off-ramp to Lee Highway. FCDOT received final plans in August 2014, and construction is anticipated in 2016.

Figure 2.4 – Proposed Fairfax Water Storage Tank Options for Patriot Park Site



Preliminary recommendation is to set aside an area 200 feet by 200 feet (~1 acre) for either Storage Tank Option

SHIRLEY GATE ROAD EXTENDED ALTERNATIVES

In December 1994, VDOT developed several interchange alternatives of the Shirley Gate Road Extension and FCP. Altogether, six alternatives were identified, many of which include slight variations. **Appendix A** provides summaries and basic sketches for each alternative. Brief descriptions of each alternative are provided below.

- **Alternative 1** – the existing signal is retained at Popes Head Road and a new at-grade signalized intersection is constructed 800 feet north of Popes Head Road at the terminus of Shirley Gate Road Extended.
  - **Alternative 1A** – truncate Popes Head Road on either side of FCP with cul-de-sacs and construct connector roadways to link Popes Head Road to Shirley Gate Road Extended. The intersection at Shirley Gate Road Extended would be an at-grade signalized intersection.
- **Alternative 2** – an urban diamond interchange 800 feet north of Popes Head Road that provides access to Shirley Gate Road Extended and Popes Head Road is truncated on either side of FCP with cul-de-sacs. Connector roadways would link Popes Head Road to Shirley Gate Road Extended.
  - **Alternative 2A** – a split urban diamond interchange is provided to retain the existing alignment of Popes Head Road.
- **Alternative 2B** – a modified split urban diamond interchange with directional ramps is provided for the major movements to/from Shirley Gate Road Extended. Shirley Gate Road Extended access to/from the south is provided by way of the ramps at Popes Head Road.
- **Alternative 2C** – similar to Alternative 2B; however, southbound Shirley Gate Road Extended connects directly to FCP. As a result, access to Popes Head Road is not provided from southbound Shirley Gate Road Extended.
- **Alternative 2D** – Popes Head Road is grade separated and directional ramps are provided to access Shirley Gate Road Extended. Access to Popes Head Road is provided by a combination of directional ramps, connector roadways, and spurs from the Shirley Gate Road Extended ramps to/from FCP. Access is not provided from Popes Head Road to FCP.
- **Alternative 3** – Popes Head Road is grade separated and a hybrid urban diamond interchange provides access to Shirley Gate Road Extended. Connector roadways would link Popes Head Road to Shirley Gate Road. Not all movements are accommodated by this alternative.
- **Alternative 4** – Popes Head Road is grade separated and directional ramps are provided to access Shirley Gate Road. A connector roadway would link Popes Head Road to Shirley Gate Road east of FCP. Not all movements are accommodated by this alternative.
- **Alternative 5** – Popes Head Road is grade separated and a trumpet interchange provides full access to Shirley Gate Road Extended. A connector roadway would link Popes Head Road to Shirley Gate Road east of FCP.
  - **Alternative 5A** – a hybrid of Alternative 3 and Alternative 5, the geometry east of FCP resembles Alternative 3, and on the west side, the trumpet interchange directional and cloverleaf ramps are retained. Connector roadways would link Popes Head Road to Shirley Gate Road. Not all movements are accommodated by this alternative.
- **Alternative 6** – Popes Head Road is grade separated and a partial cloverleaf interchange provides full access to Shirley Gate Road Extended. Connector roadways would link Popes Head Road to Shirley Gate Road Extended.

Table 2.1 provides a comparative summary of the alternatives. The assessment is based on the rough sketches of each alternative provided in **Appendix A**. The estimated number of parcels affected by each alternative does not include the two parcels that are owned by FCPA or the parcels affected north of Patriot Park East. It is estimated that eight parcels are affected north of the existing Patriot Park East parcel regardless of the alternative. Regarding interchange access, many provide exclusive access to and from Shirley Gate Road Extended, with indirect access provided to the existing Popes Head Road alignment (noted as "indirect" in **Table 2.1**). Where designated as "direct," the interchange alternative provides direct access along FCP to and from Shirley Gate Road Extended and Popes Head Road.

Table 2.1 – Comparative Summary of VDOT Interchange Alternatives

Alternative	Free Flow Operations on FCP (Y/N)	Estimated No. of Parcels Affected	Continuity of Popes Head Road (Y/N)	No. Traffic Signals	All Movements Permitted (Y/N)	FCP Access (Direct/ Indirect)	Access between Shirley Gate Road and Popes Head Road (Y/N)
1	N	1	Y	2	Y	Direct	N
1A	N	6	N	2	Y	Indirect	Y
2	Y	9	N	3	Y	Indirect	Y
2A	Y	15	N	4	Y	Direct	Y
2B	Y	11	Y	2	Y	Direct	Y
2C	Y	11	Y	2	N	Direct	N
2D	Y	14	Y	2	N	Direct	Y
3	Y	14	Y	2	N	Indirect	Y
4	Y	14	Y	1	N	Indirect	Y
5	Y	12	Y	2	Y	Indirect	Y
5A	Y	15	N	2	N	Indirect	Y
6	Y	15	N	2	Y	Indirect	Y

Table 2.1 indicates that Alternative 1 would have the least impact on surrounding parcels while Alternatives 2A, 5A, and 6 would each affect approximately 15 parcels near the connection of Shirley Gate Road Extended with FCP. However, Alternative 1 does not offer free flow operating conditions, an objective for this area of FCP. Although several alternatives do not permit all movements at the interchange, full access may not be warranted based on projected traffic volumes (to be discussed in **Chapter 4**). The development of alternatives will consider the work accomplished by VDOT and potentially build upon some of the ideas generated in the 1994 evaluation.

KEY FINDINGS AND CONSIDERATIONS

Based on the review of the information and materials provided by the FCDOT, the following elements will be considered in the development of alternatives as part of the Shirley Gate Road Extended Corridor Planning Study project:

Fairfax County Comprehensive Plan

- Six-lane cross section along FCP
- One grade separated interchange at either Shirley Gate Road Extended or at Popes Head Road

Property Impacts and Access

- Consider the current layout of the Patriot Park East master plan
- Provide direct access to the park from Shirley Gate Road Extended
- Limit impacts to the park facilities
- Align Shirley Gate Road Extended along the existing FCPA properties to minimize impacts to private properties
- Utilize the ancillary easement along the Four Seasons Golf Center

FCWA Water Storage Tank

- Consider space for the construction of a water storage tank

Build Upon Previous Alternatives

- Consider alternatives developed by VDOT
- Tailor geometry to match anticipated travel demand patterns

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Chapter 3 – Existing Conditions Assessment

Chapter 3 – Existing Conditions Assessment

An understanding of existing conditions is necessary to determine the potential benefits of the improvements associated with the future extension of Shirley Gate Road. Using traffic data and existing network operation parameters, a comprehensive analysis of existing conditions was completed within the immediate vicinity of the future roadway connection as well as the greater study area that extends north, east, and west of Fairfax County Parkway (FCP). **Figure 3.1** provides an overview of the limits of the study area and the intersections that were evaluated. It is anticipated that the new roadway will impact travel patterns along the study area arterials. Critical intersections along these arterials were included in the assessment of existing conditions to understand these impacts. However, the focus of this study is to identify improvements associated with the roadway extension at the key study area intersections (FCP/Popes Head Road and Braddock Road/Shirley Gate Road) and along FCP at the future intersection with Shirley Gate Road. This chapter summarizes the data collection and field observation efforts, the tools used and assumptions made during the analysis of existing conditions, and the results of the analyses.

DATA COLLECTION SUMMARY

Turning movement count (TMC) data were collected from various sources for use in the analysis of existing conditions at the 14 study area intersections (see **Figure 3.1**). Data was obtained from ongoing studies as well as specifically for this project. TMC data used as part of this study included the following:

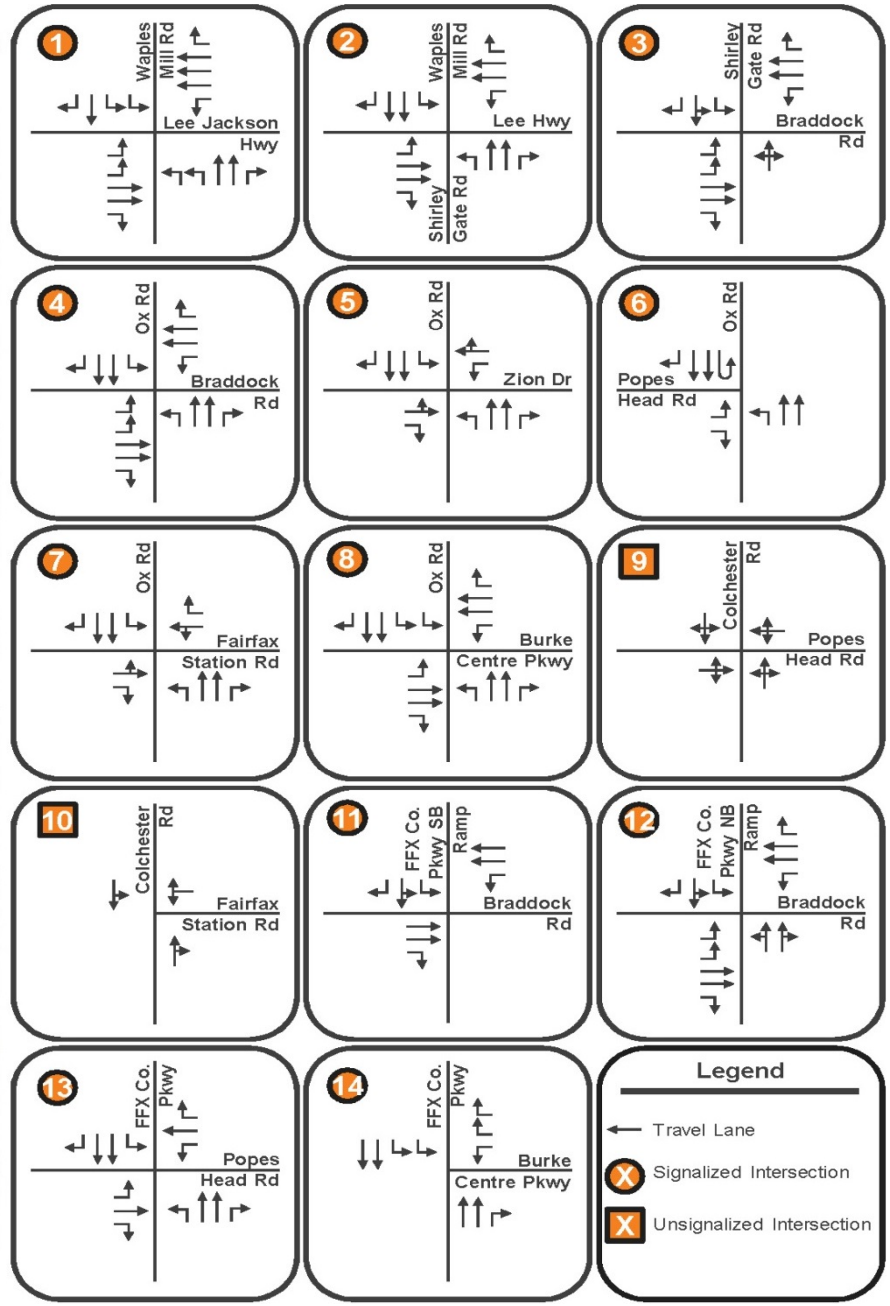
- FCP intersections (4 total): 6:00-9:00 a.m. and 3:30-6:30 p.m., collected on a Wednesday between May 28, 2014 and June 4, 2014.
- Non-Parkway intersections (excluding the intersection of Lee Jackson Highway and Waples Mill Road) (9 total): 5:00-9:00 a.m. and 3:00-7:00 p.m., collected on Wednesday, November 5, 2014 or Thursday, November 6, 2014.
- Intersection of Lee Jackson Highway and Waples Mill Road: 5:30-7:00 p.m. on Tuesday, June 3, 2014

In addition to TMC data, average daily traffic (ADT) count data was collected at three locations for 48 consecutive hours between Wednesday, November 5, 2014 and Thursday, November 6, 2014. ADT count locations included:

- FCP between Braddock Road and Popes Head Road
- Braddock Road between FCP and Shirley Gate Road
- Popes Head Road between FCP and Lewisham Road

Lastly, travel time data was collected along FCP between Braddock Road and Burke Centre Parkway on Wednesday, December 3, 2014 during the AM (7:00-9:00 a.m.), midday (11:00 a.m.-1:00 p.m.), and PM (4:00-6:00 p.m.) periods. Travel time data was collected to use in the calibration of the VISSIM models.

Figure 3.1 – Study Area Network and Existing Laneage



DATA SUMMARY AND FIELD OBSERVATIONS

Based on an evaluation of the TMC data, the AM peak hour was identified as 7:30-8:30 a.m. and the PM peak hour was identified as 5:00-6:00 p.m. TMC data for these peak hours was used in the analysis of existing conditions for non-FCP study area intersections using Synchro software. The peak periods, representing the highest network 15-minute interval volumes over a consecutive 2-hour period, were identified as 7:00-9:00 a.m. and 4:30-6:30 p.m. TMC data for these peak periods were balanced in 15-minute intervals for FCP study area intersections to be used in VISSIM modeling and simulation. A more detailed discussion of the two types of analyses is presented later in **Chapter 3**. Traffic data collected for this study can be found in **Appendix B**.

ADT data collected along FCP, Braddock Road, and Popes Head Road were reviewed to identify travel patterns along the study area roadways. FCP exhibits a sustained increase in traffic volumes in the southbound direction during the PM peak period, with a shorter interval during the AM peak period, and both periods processing similar mainline traffic volumes. In the northbound direction a discernable spike in volume is noted during the AM peak period, with a lesser increase in volume during the PM peak period. Braddock Road ADT data indicates a clear directional travel pattern, with the heaviest volumes noted in the eastbound direction during the AM peak period and the opposite holding true for the westbound direction during the PM peak period. Popes Head Road sustains a relatively low volume of traffic throughout the daytime hours, while the westbound direction exhibits a modest increase in traffic volumes during the AM and PM peak periods. Average 24-hour traffic volume data are summarized in **Figure 3.2** and **Figure 3.3** and are found in **Appendix B**. As shown in **Figure 3.3**, FCP carries significant volume during both peak periods in the northbound and southbound direction, unlike traditional arterial roadways that carry directional peak period volumes.

Field observations were performed during the AM and PM peak periods on December 3, 2014 to document operational conditions. Common themes are outlined in **Figure 3.2**, which include queuing (static or rolling), lane access issues, and other noted concerns. The intersections of Waples Mill Road at Lee Jackson Memorial Highway, Waples Mill at Lee Highway, and Ox Road at Braddock Road all experienced peak period directional queuing issues. At Ox Road and Braddock Road demand was typically high during both peak periods in the eastbound and westbound direction, while the northbound and southbound direction peaked separately during the AM and PM peak periods. Overall, there was competing demand for the available signalized intersection capacity, with several movements requiring multiple cycles to clear queued vehicles. A significant westbound queue was observed at Zion Drive during both peak periods, with the PM peak period queue extending nearly one-half mile to the east.

Along the Parkway, substantial queues were observed in the northbound direction during the AM peak period. While difficult to quantify the distance of static and rolling queues, periods of the AM peak displayed some form of queuing south of Popes Head Road along FCP beyond the intersection with Burke Centre Parkway. During the PM peak period the southbound direction experienced significant static and rolling queues complementary to the morning observations in the northbound direction, indicating a pattern of directional commuting through the study area.

The interchanges outside the study area to the north (Lee Highway and I-66) contributed to the queues, with peak queuing noted to points north of I-66. Travel time data that is summarized in **Figure 3.2** corroborates these issues with longer travel times in the northbound and southbound directions documented in the AM and PM peak periods. Due to heavy mainline volumes along FCP, the westbound right-turn at Popes Head Road is unable to make a right-turn on red, and even more so, the volume of traffic during the AM peak period results in queues of more than 20 vehicles, requiring multiple cycles to clear the intersection.

Excessive delays at the Popes Head Road intersection typically diminish patience among drivers attempting to execute turning maneuvers. As a result, drivers are more willing to assume greater risk in executing left-turn movements from FCP during the permissive window (green ball). Similar behaviors occur among drivers attempting to turn right on red from Popes Head Road. This observed behavior is corroborated by crash analyses being conducted as part of an ongoing study of FCP by the Virginia Department of Transportation (VDOT). A review of the most recent four years of crash data indicates that 13 right-angle collisions have occurred at this intersection, indicating that the permissive left-turn movement operations and risky driving behaviors have resulted in a number of crashes.

STUDY AREA NETWORK

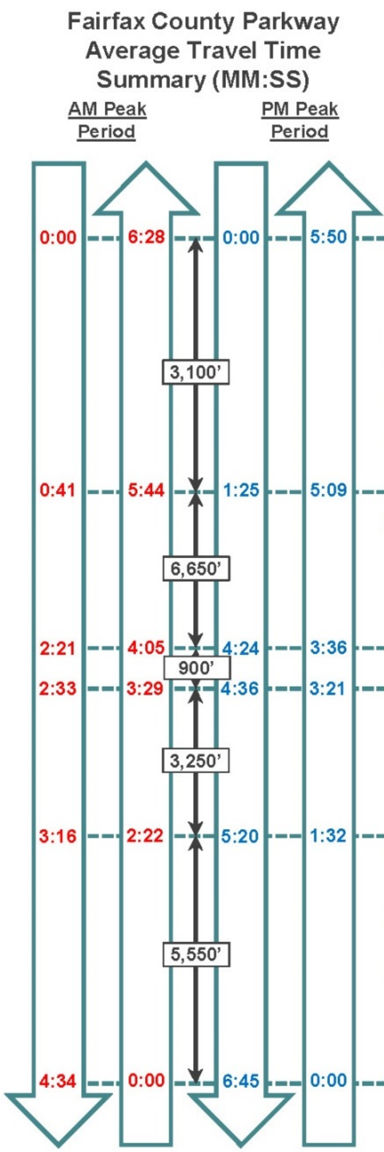
The study area network extends beyond FCP to include arterial and collector roadways. The following are key roadway facilities in the study area:

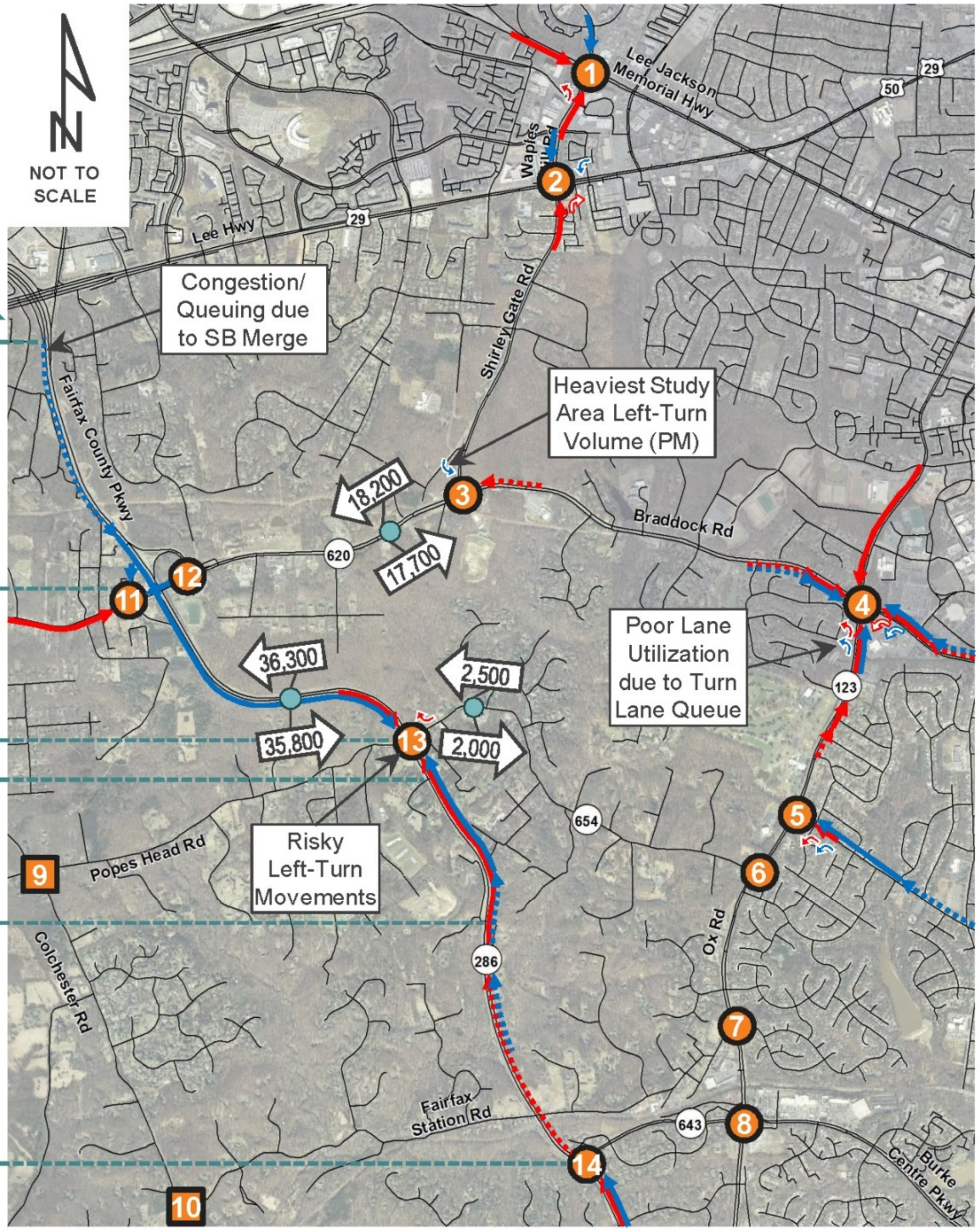
- **FCP (Route 286)**: FCP is classified as an urban principal arterial by the Federal Highway Administration (FHWA), with a posted speed limit of 50 miles per hour (mph). It is a four-lane divided roadway and is generally oriented in a north-south direction in the vicinity of the study area.
- **Waples Mill Road/Shirley Gate Road (Route 665)**: Waples Mill Road/Shirley Gate Road is classified as an urban minor arterial by the FHWA. The speed limit is 45 mph south of Lee Highway and 35 mph north of Lee Highway. It is generally oriented in a north-south direction in the vicinity of the study area. South of Lee Highway, it is a four-lane divided roadway and to the north a six-lane divided roadway.
- **Ox Road (Route 123)**: Ox Road is classified as an urban principal arterial by the FHWA, with a posted speed limit of 45 mph. It is a four-lane divided roadway and is generally oriented in a north-south direction in the vicinity of the study area.
- **Lee Jackson Memorial Highway (US 50)**: Lee Jackson Memorial Highway is classified as an urban principal arterial by the FHWA. The speed limit is 45 mph west of Waples Mill Road and 35 mph east of Waples Mill Road. It is predominantly a four-lane divided roadway, with limited stretches of five and six-lane segments, and is generally oriented in an east-west direction in the vicinity of the study area.
- **Lee Highway (US 29)**: Lee Highway is classified as an urban principal arterial by the FHWA, with a posted speed limit of 45 mph. It is a five-lane divided roadway and is generally oriented in an east-west direction in the vicinity of the study area.
- **Braddock Road (Route 620)**: Braddock Road is classified as an urban minor arterial by the FHWA. The speed limit is 45 mph west of Ox Road and 40 mph east of Ox Road. It is a four-lane divided roadway and is generally oriented in an east-west direction in the vicinity of the study area.
- **Popes Head Road (Route 654)**: Popes Head Road is classified as an urban collector by the FHWA, with a posted speed limit of 30 mph. It is a two-lane undivided roadway and is generally oriented in an east-west direction in the vicinity of the study area.
- **Burke Centre Parkway (Route 643)**: Burke Centre Parkway is classified as an urban minor arterial by the FHWA, with a posted speed limit of 40 mph. It is a four-lane divided roadway and is generally oriented in an east-west direction in the vicinity of the study area.

Analyses of existing conditions considered arterial geometry as well as intersection approach geometry and accounted for turn lanes, storage distances, and signal operations.

Figure 3.2 – Study Area Network ADT Data, Travel Time Data, and Field Observations

Field observations and travel time data collection completed on December 3, 2014





Study Area Intersections

1. Waples Mill Road & Lee Jackson Memorial Highway
2. Shirley Gate Road/Waples Mill Road & Lee Highway
3. Shirley Gate Road & Braddock Road
4. Ox Road & Braddock Road
5. Ox Road & Zion Drive
6. Ox Road & Popes Head Road
7. Ox Road & Fairfax Station Road
8. Ox Road & Burke Centre Parkway
9. Colchester Road & Popes Head Road
10. Colchester Road & Fairfax Station Road
11. Fairfax County Parkway SB Ramp & Braddock Road
12. Fairfax County Parkway NB Ramp & Braddock Road
13. Fairfax County Pkwy & Popes Head Road
14. Fairfax County Parkway & Burke Centre Parkway

Legend

AM PM

Turn lane queue blocks thru

Thru lane queue blocks turn

Solid queue

Rolling queue

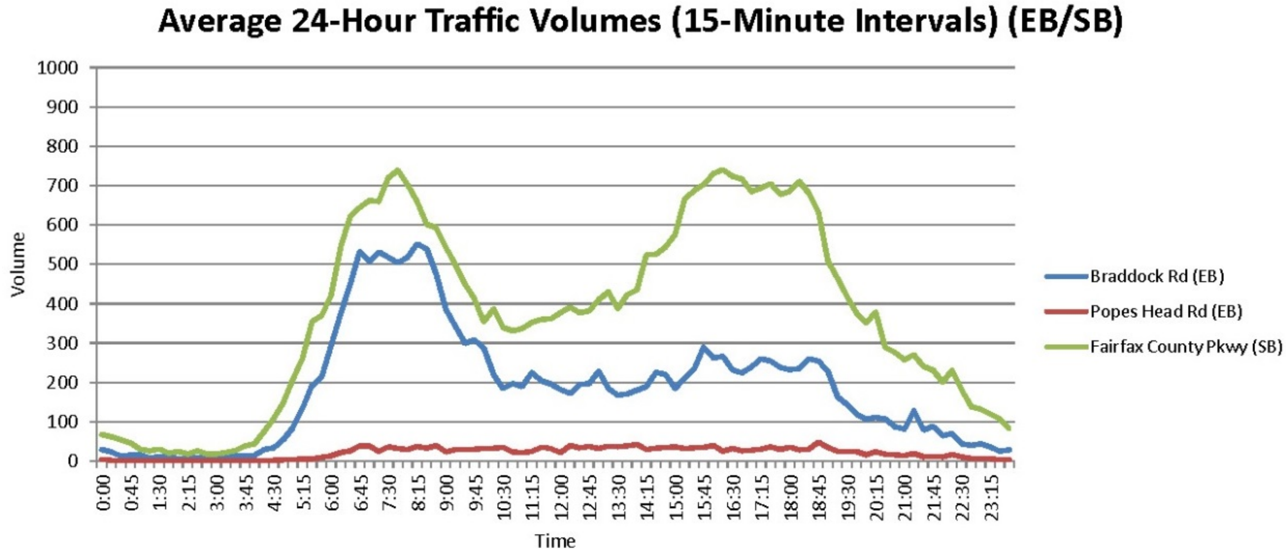
ADT Count Location

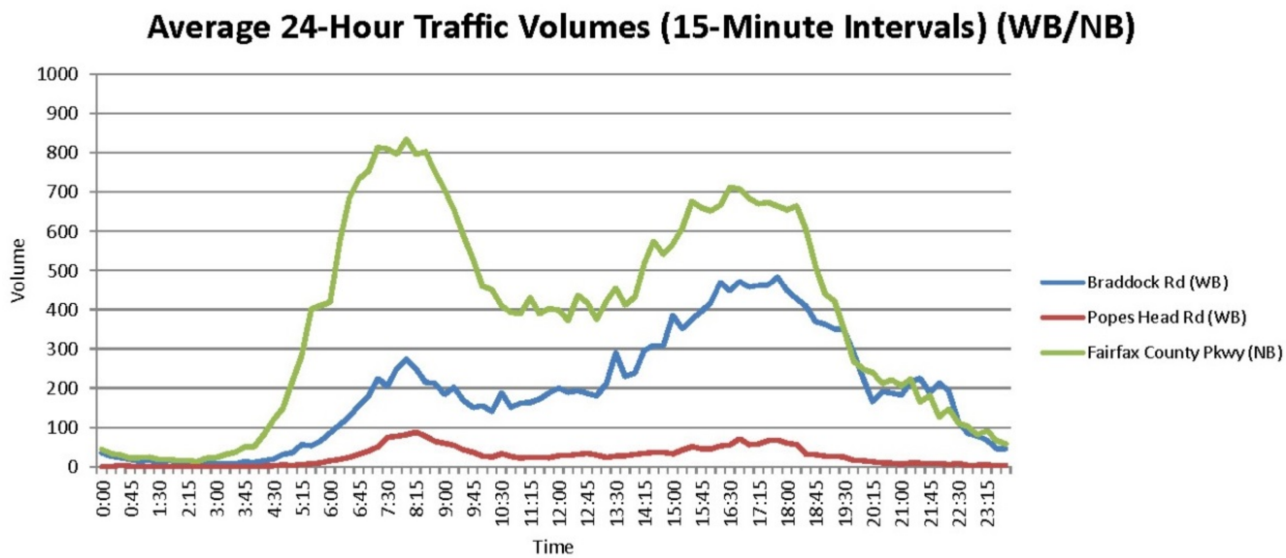
X,XXX Directional ADT Volume

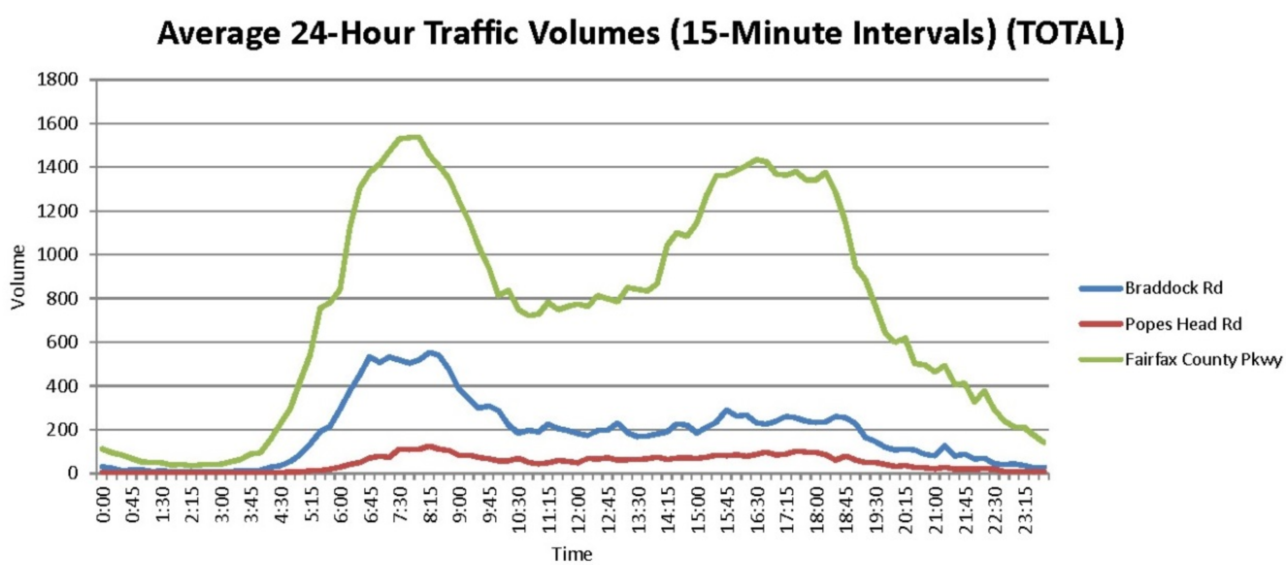
X Signalized Intersection

X Unsignalized Intersection

Figure 3.3 – Summary of Average 24-Hour Traffic Volumes







24-hour traffic volumes collected Wednesday, November 5, 2014 and Thursday, November 6, 2014

EXISTING CONDITIONS ANALYSIS

The analysis of existing conditions of the study area network was completed using two traffic analysis tools: Synchro and VISSIM. Synchro is a macroscopic modeling tool used to evaluate traffic flow and signal operations, while VISSIM is a microsimulation tool capable of analyzing the full range of roadway and public transportation systems. Analyses in Synchro are limited to a single peak hour and cannot evaluate the impacts of peak period congestion within a network. VISSIM allows for a larger range of data input and calibration, and the software can better simulate the effects of congestion upstream and downstream along a network. Several data analyses were completed to properly develop a VISSIM model and corresponding simulation, as described in the following sections.

Synchro Analysis – Non-Parkway Intersections

Peak hour analyses were completed using Synchro 8.0 software at the ten non-FCP study area intersections. Intersection turning movement counts were used along with information about the number of lanes and traffic control to determine existing levels of service. Level of service (LOS) describes traffic conditions—the amount of traffic congestion—at an intersection or on a roadway. LOS ranges from A to F—A indicating a condition of little or no congestion and F indicating a condition with severe congestion, unstable traffic flow, and stop-and-go conditions. For intersections, LOS is based on the average delay experienced by all traffic using the intersection during the busiest (peak) 15-minute period. LOS A through D are generally considered acceptable. **Table 3.1** shows the LOS and delay range for signalized and unsignalized intersections according to the *2010 Highway Capacity Manual* (HCM).

Table 3.1 —Levels of Service and Ranges of Delay

LOS	Delay per Vehicle (seconds per vehicle)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80	> 50

Figure 3.4 and **Figure 3.5** summarize the AM and PM peak hour volumes and associated intersection LOS, respectively. **Appendix C** provides a tabular summary of the LOS and delay by movement and the corresponding Synchro HCM reports.

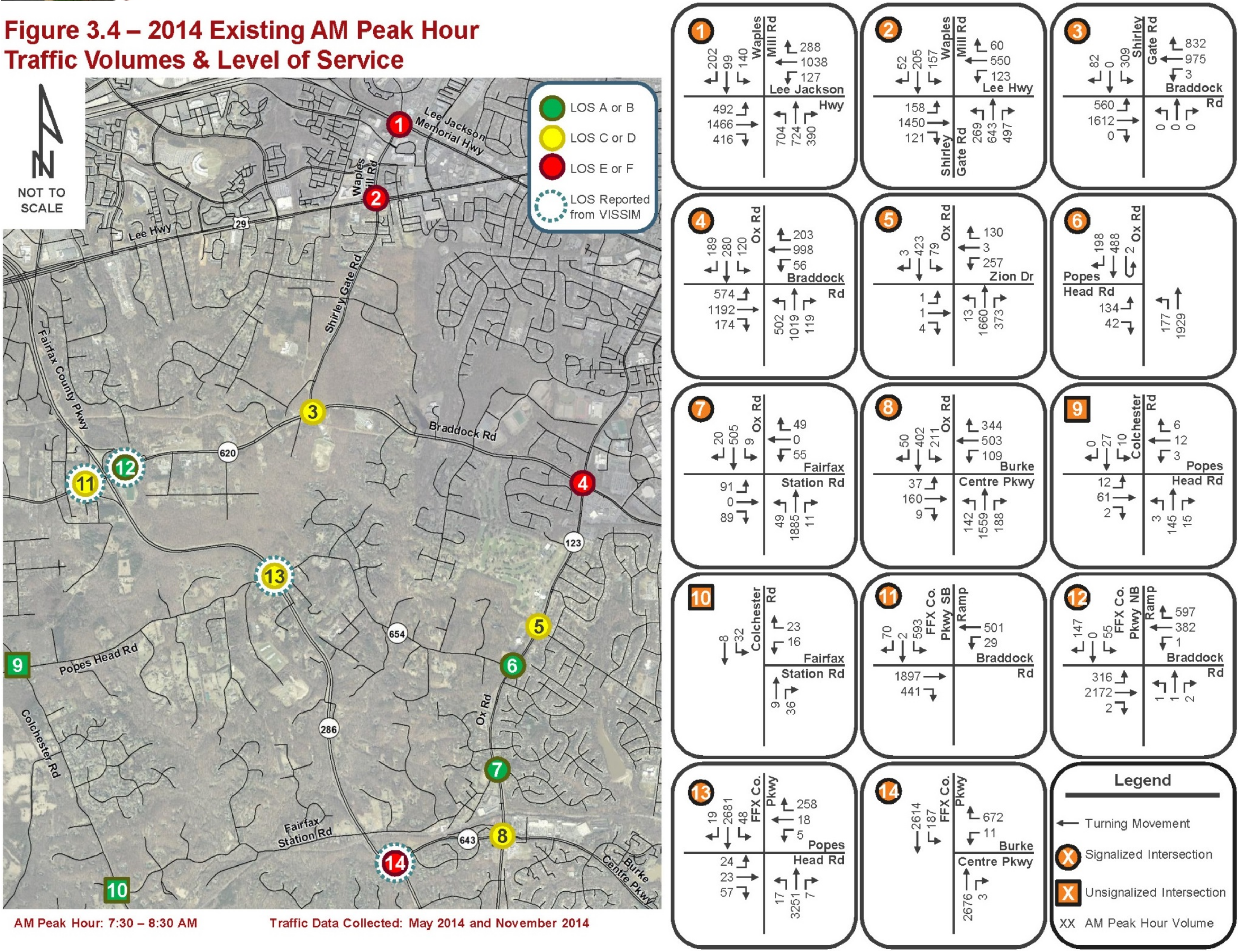
A key intersection associated with the extension of Shirley Gate Road, Braddock Road/Shirley Gate Road, operates at an average LOS C during the AM peak hour and LOS E during the PM peak hour. The greatest vehicular delays are associated with the southbound approach, particularly the southbound left-turn movement that experiences an average delay of more than 2.5 minutes during the PM peak hour. The heavy left-turn volume is likely associated with commuter traffic to George Mason University and Ox Road. This intersection does not operate in a coordinated system and provides green time for each movement based on the actual demand. The actuated cycle can run as long as 4 minutes, which contributes to the lengthy delay for several movements, despite carrying low volume (e.g. eastbound left-turn movement, northbound approach). Mainline movements experience average delays of less than 1 minute, with the exception of the eastbound left-turn movement that experiences nearly 2 minutes of average delay during the PM peak hour.

Six of the ten non-FCP study area intersections currently operate at an overall LOS D or better during the AM peak hour, as shown in **Figure 3.4**. The remaining three intersections experience greater delay as a result of heavy traffic volumes and insufficient intersection capacity:

- The intersection of Lee Jackson Memorial Highway and Waples Mill Road has an overall intersection delay of 79.9 seconds, which is at the threshold for LOS F. All left-turn movements operate at a LOS F, with all but the southbound left-turn movement experiencing an average delay of more than 100 seconds per vehicle. To the south at Lee Highway, the intersection with Waples Mill Road/Shirley Gate Road operates at a LOS E.
- Lee Highway carries the greatest volume of traffic, and as such, receives the largest proportion of green time. As a result, the side street approaches experience greater delay.
- The intersection of Ox Road and Braddock Road processes significant through volumes in the northbound, eastbound, and westbound directions, with competing demand from the eastbound and northbound left-turn movements, resulting in an overall intersection delay of 89.4 seconds (LOS F).

Figure 3.5 illustrates that similar operating conditions are expected during the PM peak hour at six of the ten non-FCP study area intersections. As with the AM peak hour, the remaining three intersections operate at a LOS E or worse, with similar operational deficiencies contributing to the lengthy delays. At Lee Jackson Memorial Highway, the mainline through volume in the westbound direction is nearly 1,900 vehicles per hour, demanding a higher allocation of green time than the side street approaches. The same is true at Lee Highway, where the westbound through volume is more than 1,400 vehicles per hour. Heavy through movement volumes at the intersection of Ox Road and Braddock Road in the southbound, eastbound, and westbound directions demand a greater proportion of green time.

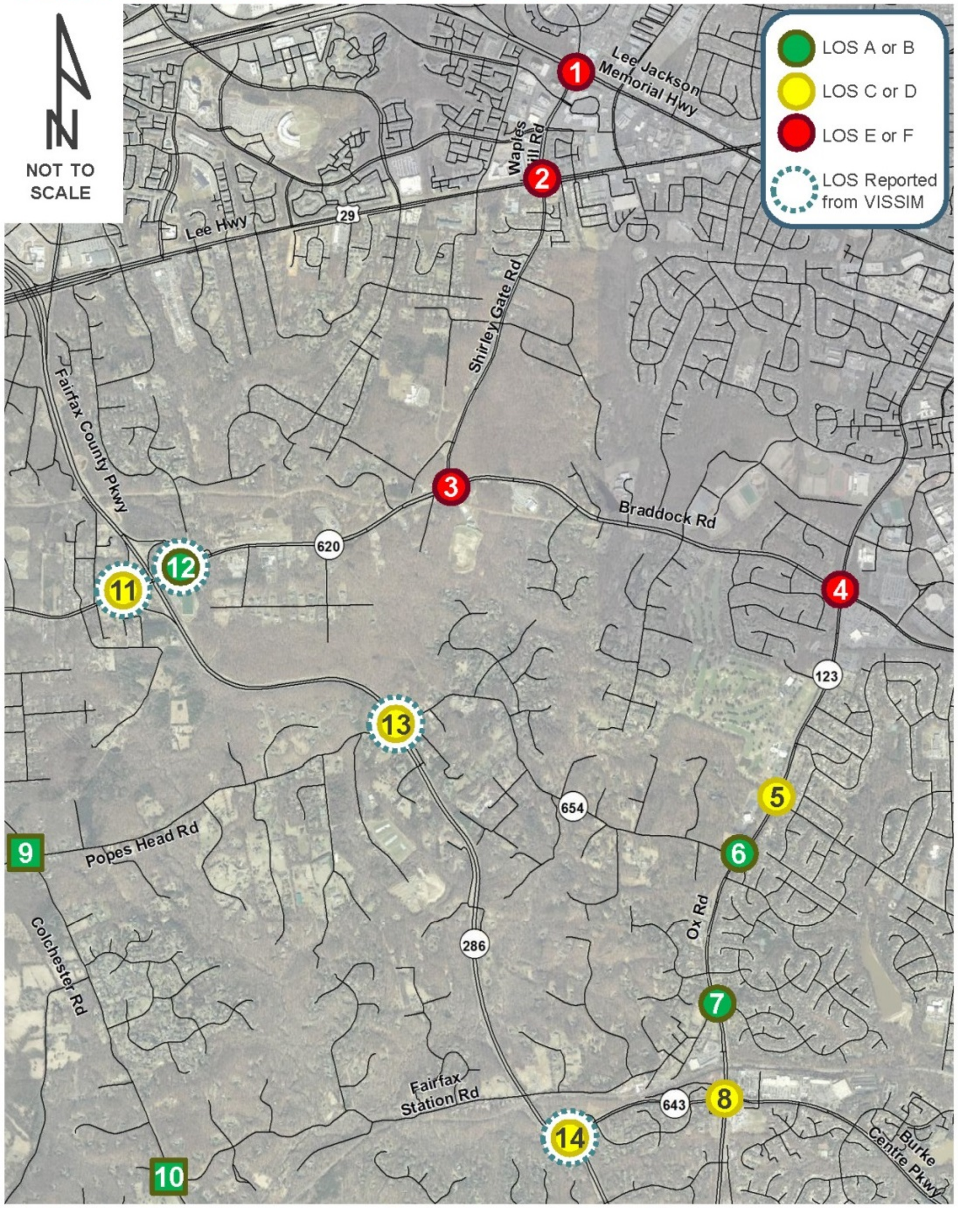
Figure 3.4 – 2014 Existing AM Peak Hour Traffic Volumes & Level of Service

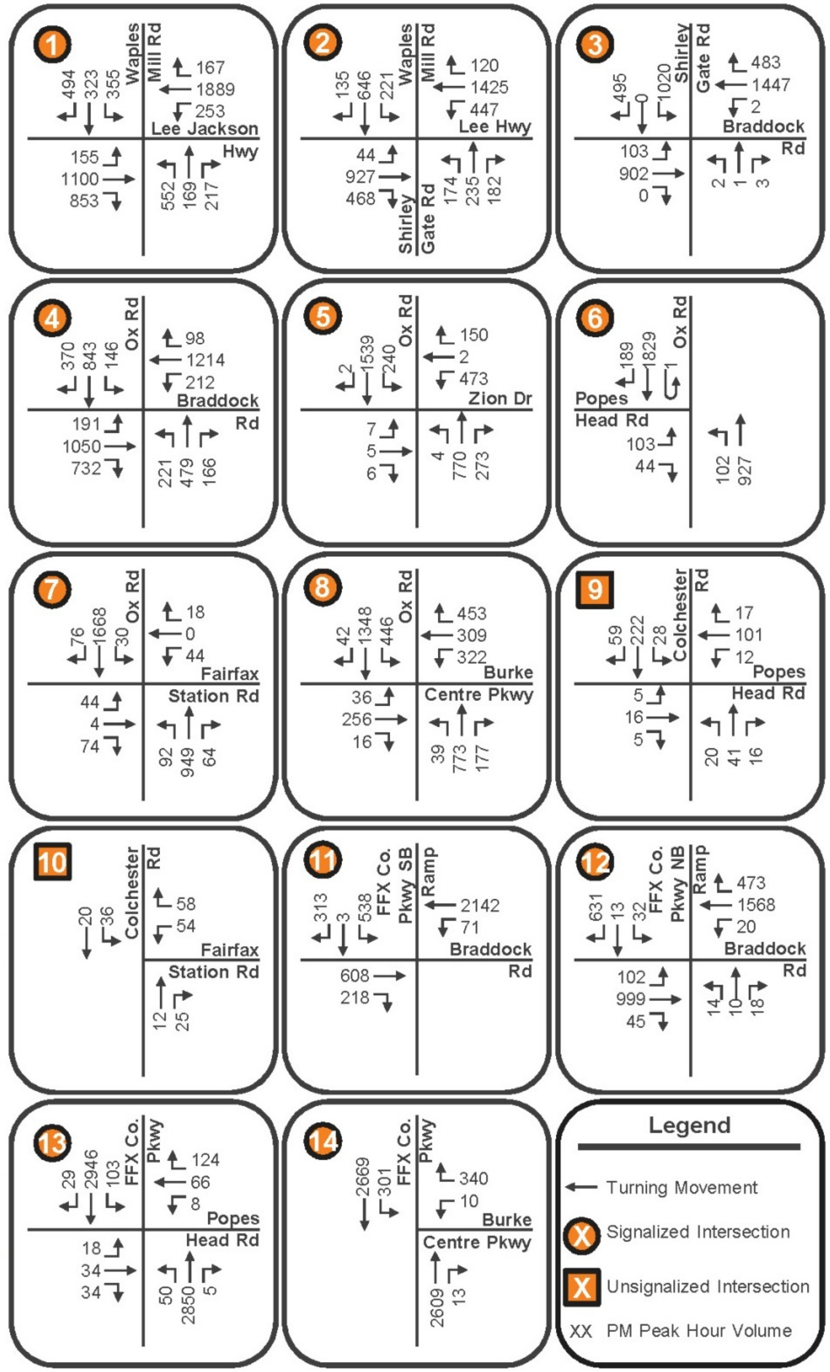


AM Peak Hour: 7:30 – 8:30 AM

Traffic Data Collected: May 2014 and November 2014

Figure 3.5 – 2014 Existing PM Peak Hour Traffic Volumes & Level of Service





PM Peak Hour: 5:00 – 6:00 PM

Traffic Data Collected: May 2014 and November 2014

SimTraffic Queue Analysis – Non-Parkway Intersections

SimTraffic (an extension of Synchro software) was used to evaluate vehicle queuing at the non-FCP study area intersections. SimTraffic is a microsimulation tool that animates traffic conditions based on the programmed inputs in Synchro. A good indication of anticipated vehicle queues generated by SimTraffic is the 95th percentile queue length. This metric represents the queue length assuming the 95th percentile traffic volumes occur during a 15-minute peak interval. The primary concern related to queuing is the incidence of queue spillback or vehicle queues blocking access to a storage lane. **Appendix C** provides a tabular summary of the 95th percentile queue lengths (rounded up to the nearest increment of 25 feet) as well as the outputs from SimTraffic. Queuing issues were noted at the following locations based on the results of the SimTraffic simulations:

- Lee Jackson Memorial Highway and Waples Mill Road
  - The northbound left-turn and through movements queue beyond the intersection with Random Hills Road to the south during the AM peak hour (95th percentile queue length of 775 feet). During the PM peak hour, the northbound left-turn queue extends the full length of the block at 525 feet.
  - The westbound through movement queue extends past the available storage for the westbound left-turn movement, potentially blocking access for turning vehicles.
- Lee Highway and Waples Mill Road/Shirley Gate Road
  - The eastbound through movement queue extends past the available storage for the eastbound left and right-turn movements, potentially blocking access for turning vehicles.
  - During the AM peak hour, the northbound through and right-turn movement queues both extend past the available storage for each movement, potentially blocking access for the adjacent movement. This was observed in the field during peak period observations.
  - During the PM peak hour, the westbound through movement queue extends past the available storage for the westbound left-turn movement, potentially blocking access for turning vehicles. This was observed in the field during peak period observations.
- Braddock Road and Shirley Gate Road
  - The westbound right-turn movement spills out of the available storage lane during the AM and PM peak hours, an issue that was observed intermittently during peak period observations.
- Ox Road and Braddock Road
  - The northbound through and left-turn movements experience significant queues during the AM peak hour. Field observations confirmed this level of congestion that affected operations for both movements.
  - Similarly, the eastbound through and left-turn movements experience significant queues during the AM peak hour. Queues in the through lanes can be attributed to spillback associated with the left-turn movement.
- Ox Road and Zion Drive
  - During the AM and PM peak hours, the westbound left-turn movement experiences significant queues that regularly block access to the shared through and right-turn lane. This was a common occurrence during peak period observations.
- Ox Road and Burke Centre Parkway
  - Although the queuing summary indicates that the westbound and northbound left-turn movement queues exceed the available storage, instances of vehicles being unable to clear the signal did not occur during peak period observations.

VISSIM Analysis – Fairfax County Parkway Intersections

VISSIM 6.0-19 software was used to evaluate the operational performance of the following intersections along Fairfax County Parkway:

- Braddock Road and FCP SB Ramps
- Braddock Road and FCP NB Ramps
- FCP and Popes Head Road
- FCP and Burke Centre Parkway

VISSIM software was used for these intersections due to the heavy volumes FCP carries, the variable behavior of traffic at the Braddock Road interchange, and the documented levels of congestion along the corridor during peak periods that cannot be accounted for using Synchro. A benefit to using this software is the ability to calibrate the model based on field documented travel time data and count data, as well as report a comprehensive list of MOEs (e.g. travel time, delay, and queue length). The software also allows for a greater level of detail when coding modeling parameters to more accurately represent field conditions.

Seeding Hour, Peak Hour 1, and Peak Hour 2 Volume Development

The first step in developing a calibrated VISSIM model was the development of traffic volumes. Typical VISSIM analyses consist of a minimum of two intervals for simulation: a seeding interval and a peak period interval. The duration of these intervals depends on a number of factors including the size of the study area, traffic volumes, and travel patterns and characteristics. The two intervals are characterized by the following:

- **Seeding Interval** – intended to distribute traffic throughout the entire network, typically equal to the approximate travel time from one end of the corridor to the other during a peak hour. A 1-hour seeding interval was used for this study. Traffic volumes considered are only a portion of the peak period volumes. For this study the volumes represent 75 percent of the AM peak hour 1 data and 91 percent of the PM peak hour 1 data (see 15-mnute traffic volumes section for determination of proportion).
- **Peak Period Interval** – period during which the highest traffic volumes are observed (determined based on traffic data) and network congestion occurs. For this study 2 hours of data were evaluated, identified as peak hour 1 and peak hour 2. This is not the same as the network peak hour used for Synchro analyses.

The peak hour 1 and peak hour 2 data encompass the network peak hour that straddles the two. Traffic data was evaluated to determine the two peak hours of data, which were identified as shown in **Table 3.2**. The highest cumulative network volumes were observed over these two hour intervals, with the highest hourly volumes noted during the network peak hour.

Table 3.2 — Network Peak Periods and Peak Hours

	AM Peak Period	PM Peak Period
Seeding Hour	6:00 – 7:00 a.m.	3:30 – 4:30 p.m.
Peak Hour 1	7:00 – 8:00 a.m.	4:30 – 5:30 p.m.
Peak Hour 2	8:00 – 9:00 a.m.	5:30 – 6:30 p.m.
Network Peak Hour	7:30 – 8:30 a.m.	5:00 – 6:00 p.m.

Volume Balancing

The data collection effort for this portion of the study area was completed over a period of 2 weeks. Variations in traffic volumes between different days resulted in an imbalance between study intersections. While a natural outcome during data collection, the analysis software is sensitive to volume imbalances that can have a significant impact on the simulation outputs. For this study traffic volumes were balanced for each of the peak hours at the four FCP study area intersections. Unbalanced volumes were evaluated in Synchro, which has a tool that allows the user to quickly identify imbalances. To balance network volumes a proportional approach was taken to adjust volumes in the forward direction of travel, attempting to limit mainline adjustments to ±20 percent and mainline turning movements and side street approach volume adjustments to ±10 percent.

15-Minute Traffic Volumes

One of the benefits of using VISSIM is that it is a dynamic software tool capable of simulating traffic operations in shorter intervals than other traditional tools. This provides a better representation of variable traffic conditions over the course of an hour that can range from free-flow travel speeds and spare capacity to oversaturated travel conditions, reduced travel speeds, and inadequate capacity. Traffic volumes in 15-minute intervals allow VISSIM to replicate these conditions along with other calibration measures. Fifteen-minute traffic volumes were developed for use in the VISSIM peak period simulations based upon the balanced hourly volumes. Considering a larger sample of TMC data along FCP in the vicinity of the study area (obtained from another ongoing study), local intersection traffic volumes were evaluated to determine the proportion of each 15-minute volume to the total hourly volume. This was done for three consecutive hours of data for the AM and PM peak periods that allowed for a comparison of the seeding interval volumes to the two peak hours of data. TMC data was considered in lieu of tube count data because it represented a more comprehensive sample of the study area.

This evaluation was completed to develop 15-minute traffic volumes as well as identify an appropriate volume adjustment factor to generate seeding interval volumes. In doing so, volume balancing was limited to the two peak hours. **Table 3.3** summarizes the selected 15-minute volume distribution factors that were applied to the balanced peak hour volumes. In addition, the adjustment factor used to generate seeding interval volumes is indicated in the first column. Adjustment factors were applied to the first peak hour balanced volumes. **Appendix B** provides a summary of the 15-minute interval traffic volumes at the study area intersections that were evaluated using VISSIM.

Table 3.3 —15-Minute Volume Distribution Factors

AM Peak	Time	15-minute Distribution	PM Peak	Time	15-minute Distribution
Seeding Hour (75% of AM Peak Period Hour 1)	06:00 - 06:15	18.1%	**Seeding Hour (91% of PM Peak Period Hour 1)**	15:30 - 15:45	24.1%
	06:15 - 06:30	23.7%		15:45 - 16:00	24.6%
	06:30 - 06:45	27.9%		16:00 - 16:15	24.9%
	06:45 - 07:00	30.3%		16:15 - 16:30	26.4%
AM Peak Period Hour 1	07:00 - 07:15	23.6%	**PM Peak Period Hour 1**	16:30 - 16:45	24.4%
	07:15 - 07:30	24.9%		16:45 - 17:00	24.8%
	07:30 - 07:45	25.9%		17:00 - 17:15	24.9%
	07:45 - 08:00	25.6%		17:15 - 17:30	25.9%
AM Peak Period Hour 2	08:00 - 08:15	26.0%	**PM Peak Period Hour 2**	17:30 - 17:45	25.7%
	08:15 - 08:30	26.0%		17:45 - 18:00	25.2%
	08:30 - 08:45	24.6%		18:00 - 18:15	24.7%
	08:45 - 09:00	23.4%		18:15 - 18:30	24.4%

Heavy Vehicles

The average passenger vehicle is capable of accelerating and decelerating at high rates of speed and can maneuver through a traffic network with ease. Heavy vehicles, such as box trucks and tractor-trailers, operate differently than typical passenger vehicles and could have an impact on traffic operations if they were to constitute a significant portion of the network traffic volumes. An assessment of heavy vehicle percentages was completed for each study intersection of the heavy vehicle percentages that were documented during the data collection process for each movement. The data indicates an overall low percentage of heavy vehicles in the study area. Given the small size of the study area and the low percentage of heavy vehicles for the major network movements (e.g. FCP through movements) a value of 2 percent was used. A tabular summary of heavy vehicles by movement that were considered in this evaluation is provided in **Appendix B**.

Calibration Hour

VISSIM models (v.6.00-19) were developed for the study area including State Route 286 (FCP), State Route 620 (Braddock Road), State Route 654 (Popes Head Road), and State Route 643 (Burke Centre Parkway) during the AM and PM peak periods for 2014 existing conditions. A Bing aerial background from VISSIM 6 along with field notes was used to assist with the geometry coding. The VDOT Traffic Operations Analysis Tool Guidebook (TOATG) V1.1 was used as a guideline during the development of the VISSIM models.

The simulation period consisted of a 1-hour seeding interval and two peak period hours. The total simulation time was 10,800 seconds (3 hours). Volume, queue, and delay measurements were collected at each intersection during the network peak hours (time intervals 5,400 seconds to 9,000 seconds). Travel time measurements were collected during the two peak period hours (time intervals 3,600 seconds to 10,800 seconds) to collect a broad range of travel times from the model. This ensured that a true travel time average was captured. The time periods and calibration hour are summarized in **Table 3.4**.

Table 3.4 —Simulation Periods

Peak	Seeding Hour	Peak Period	Calibration Hour
AM	6:00 - 7:00	7:00 - 9:00	7:30 - 8:30
PM	3:30 - 4:30	4:30 - 6:30	5:00 - 6:00

Traffic Routing

The traffic routing in the models were predetermined to be static routes as a series of turning movement routes along the mainline, ramps, and at adjacent intersections. As a static route the percentage of volumes on each route is constant throughout the defined period. The routes were coded in a way that eliminated looping routes at an interchange, unless a substantial number of U-turns were observed. For example, turning movement routes were consolidated at the FCP and Braddock Road interchange to ensure that no looping vehicles were modeled. Looping vehicles included vehicles traveling northbound, exiting, and then reentering the highway in the southbound direction and vice versa for southbound vehicles.

Traffic Control

A ring barrier controller (RBC) was used to model traffic control at three of the four intersections in the study area. Existing signal timings were obtained from VDOT, modeled in Synchro, and exported as RBC files to be used in VISSIM. Field observations were completed on December 3, 2014 to verify left turn treatments and phasing. All RBC controllers were modeled using *PTV America's Ring Barrier Controller User Manual* as a guideline. At the intersection of Popes Head Road and the Parkway, vehicle-actuated programming (VAP) was used to develop a controller in replacement of RBC due to cycle length and split time limitations found in the RBC controller type.

VISSIM Model Calibration

The number of simulations was calculated following the guidelines in the TOATG and was determined to be 10 runs. The existing conditions model calibration criteria and targets followed what was adopted in the VDOT TOATG. **Table 3.5** lists the calibration criteria and targets. The calibration was performed during the network peak hours (7:30 – 8:30 a.m., 5:00 – 6:00 p.m.). Volume (throughput) was compared for the AM and PM network peak hours with the calibration targets listed in **Table 3.5**. Average travel time for the network peak hours was compared to average field travel time data collected in the same time periods. Although the most recent travel time data was collected during the traffic data collection effort in late 2014, the TMC data used in the analysis was collected in the spring of 2014. To be consistent with the traffic count data in the calibration process, the travel time data collected in the spring of 2014 was used for comparison. Speed profile was adjusted in the model to match field speed data and the VISSIM average hourly speeds along the corridor were compared to field speed data. Less emphasis was placed on the calibration of queue lengths on side streets that carried low volumes and more emphasis was placed on the mainline queues along FCP. Queues at selected locations were reviewed with queue data and field observations at the following intersections:

- Braddock Road Interchange (SB and NB Ramps)
- Popes Head Road
- Burke Centre Parkway

Table 3.5 —Calibration Targets

Criteria and Measures	Calibration Acceptance Targets
Modeled Capacity	Within 10% of field measurements
Modeled link volumes less than 700 vph	Within 100 vph of field measurements
Modeled link volumes from 700 to 2700 vph	Within 15% of field measurements
Modeled link volumes greater than 2700 vph	Within 400 vph of field measurements
Sum of modeled link flows	Within 5% of sum of all link counts
GEH Statistic < 5 for individual links*	>85% of cases
GEH Statistic for sum of all link flows	GEH < 4 for sum of all links counts
Modeled travel times	Within 15% of observed travel times
Modeled maximum queue lengths	Within 30% of observed queue lengths

*The GEH statistic is an empirical formula derived from the absolute and percentage differences used to compare observed and modeled traffic volumes.

The parameters that were adjusted in VISSIM include the route choices mentioned above, lane change distances for merge and intersection turning movements and lane change driving behavior parameters at merge areas and congested segments. Existing VISSIM models calibration has achieved the following targets:

1. Travel time percentage difference
   - Average simulated and observed travel time is within 15 percent for both AM and PM peak hours
2. Volume percentage difference
   - Simulated and measured link volumes are within 10 percent for more than 85 percent of links
   - Sum of simulated and measured link volumes within calibration area is within 2 percent for AM peak hour and within 4 percent for PM peak hour
3. GEH statistics
   - Simulated and measured link volumes GEH statistic values are lower than five for 95 percent of links in AM peak hour and for 100 percent of links in PM peak hour
   - Sum of simulated and measured link volumes GEH statistic values are two for AM peak hour and 4.7 for PM peak hour
4. Existing models were observed to represent field conditions in terms of the following aspects:
   - Signal operations
   - On- and off-ramp queuing
   - Locations of bottlenecks or critical movements
   - Patterns and extent of queue at intersection and congested links
   - Lane utilization/choice

In summary, the existing models have been calibrated to adequately reflect existing conditions and capture the corridor travel time, intersection throughputs, and extent of queues at selected locations. Detailed existing models calibration statistics are summarized in **Appendix C**. It is important to note that the calibration statistics indicate that the PM model does not satisfy the GEH statistic for the sum of all links. However, given the high level of compliance of the model with all other calibration statistics, the model can be considered well calibrated overall.

VISSIM Measures of Effectiveness and Simulation Results

As previously mentioned, a total of 10 simulation runs (per peak period) were completed to evaluate the AM and PM peak periods. Three MOEs were used to analyze existing operations based on the average of the simulation runs: average vehicular delay (seconds per vehicle), LOS, and the 95th percentile queue length (feet). **Table 3.6** and **Table 3.7** summarize the MOEs for each intersection analyzed. Movements and overall intersection delays that exceed the threshold for LOS E and LOS F are highlighted in orange and red. Queue lengths are reported to the nearest interval of 25 feet. The bold, underlined text indicates the queue length exceeds the available storage. Queue lengths of substantial distance also are delineated in red text, indicating significant volume for the associated movements.

The intersection of FCP and Popes Head Road is a major choke point along the corridor. Average vehicular delay at this intersection is approximately 30 seconds during the AM and PM peak hours (LOS C). The actuated cycle length of nearly 5 minutes results in significant delays for side street movements in an effort to process the heavy mainline volumes. Despite the long cycle, the northbound queue length reaches 3,450 feet, attributed to the heavy AM peak period directional volumes. Signal operations also contribute to lengthy delays for the westbound right-turn movement that carries a relatively low volume of 260 vehicles during the AM peak hour. The lack of gaps in mainline traffic does not allow for right-turns on red, and given the limited green time allocation this movement also experiences substantial queuing. This was noted during peak period observations in the field.

The northbound queue at Popes Head Road is comparable during the PM peak period at 3,575 feet. As noted in the field observations, similar static queues were observed during the AM and PM peak periods in the northbound direction, but the length of residual, rolling queues was far greater during the AM peak period. Southbound PM peak hour queues at this intersection increase nearly 2.5 times the AM equivalent, from 975 feet to 2,350 feet. Overall intersection delay increases slightly during the PM peak hour, attributed to the increased mainline left-turn volumes (northbound and southbound) and the southbound through volume. The drop in volume for the westbound right-turn movement results in a significant change in queue length.

A discernable travel pattern can be noted in the AM peak hour TMC data at the intersections of Ox Road/Popes Head Road and FCP/Popes Head Road. The northbound left-turn and southbound right-turn movement volumes at Ox Road are higher than would be expected for the land uses along Popes Head Road (low-density residential). At its intersection with FCP, the westbound right-turn movement volume is comparable to the turning movement volumes at Ox Road. It is plausible that there is a cut-through pattern along Popes Head Road, although the origins of these trips cannot be determined from the available traffic data. The evaluation of future year conditions should consider this pattern and not encourage the driver behavior; rather, reinforce the value of Burke Centre Parkway and the future connection of Shirley Gate Road.

Table 3.6: 2014 Existing AM Results

Int. Name	Direction	Movement	Delay (sec/veh)	LOS	95th Percentile Queue (ft)
Fairfax County Parkway SB Ramps and Braddock Road	EB	EBT	20.1	C	1,125
		EBR	12.1	B	50
	SB	SBL	71.9	E	550
		SBT	64.6	E	
		SBR	9.7	A	25
	WB	WBL	42.2	D	50
		WBT	6.6	A	125
	Intersection		25.5	C	-
Fairfax County Parkway NB Ramps and Braddock Road	NB	NBL	0.0	A	0
		NBT	0.0	A	
		NBR	0.0	A	
	EB	EBL	61.9	E	275
		EBT	3.7	A	250
		EBR	3.5	A	25
	SB	SBL	85.6	F	100
		SBT	81.3	F	
		SBR	5.6	A	0
	WB	WBL	0.0	A	0
		WBT	10.2	B	125
		WBR	11.7	B	325
	Intersection		12.0	B	-
Fairfax County Parkway and Popes Head Road	NB	NBL	63.8	E	25
		NBT	25.3	C	3,450
		NBR	22.1	C	25
	EB	EBL	141.1	F	125
		EBT	147.8	F	125
		EBR	4.7	A	75
	SB	SBL	119.4	F	125
		SBT	9.4	A	975
		SBR	7.0	A	25
	WB	WBL	327.5	F	75
		WBT	357.4	F	75
		WBR	341.7	F	2,425
	Intersection		30.7	C	-
Fairfax County Parkway and Burke Centre Parkway	NB	NBT	108.1	F	5,100
		NBR	89.0	F	0
	SB	SBL	131.5	F	225
		SBT	20.6	C	2,075
	WB	WBL	110.3	F	75
		WBR	107.1	F	600
	Intersection		70.8	E	-

Table 3.7: 2014 Existing PM Results

Int. Name	Direction	Movement	Delay (sec/veh)	LOS	95th Percentile Queue (ft)
Fairfax County Parkway SB Ramps and Braddock Road	EB	EBT	11.4	B	200
		EBR	2.6	A	0
	SB	SBL	149.0	F	525
		SBT	157.6	F	
		SBR	123.4	F	350
	WB	WBL	8.9	A	50
		WBT	7.9	A	500
	Intersection		35.1	D	-
Fairfax County Parkway NB Ramps and Braddock Road	NB	NBL	80.4	F	75
		NBT	77.1	E	
		NBR	14.7	B	
	EB	EBL	80.2	F	150
		EBT	5.0	A	175
		EBR	2.8	A	25
	SB	SBL	102.8	F	100
		SBT	95.6	F	
		SBR	22.5	C	0
	WB	WBL	91.1	F	100
		WBT	15.8	B	500
		WBR	7.1	A	50
	Intersection		17.3	B	-
Fairfax County Parkway and Popes Head Road	NB	NBL	114.8	F	75
		NBT	32.1	C	3,575
		NBR	30.9	C	25
	EB	EBL	121.9	F	125
		EBT	4.8	A	125
		EBR	136.9	F	75
	SB	SBL	131.5	F	575
		SBT	21.6	C	2,350
		SBR	21.1	C	25
	WB	WBL	125.8	F	75
		WBT	124.6	F	200
		WBR	66.2	E	175
	Intersection		32.2	C	-
Fairfax County Parkway and Burke Centre Parkway	NB	NBT	42.2	D	2,750
		NBR	29.3	C	0
	SB	SBL	152.9	F	500
		SBT	23.2	C	2,275
	WB	WBL	98.0	F	75
		WBR	88.4	F	325
	Intersection		41.6	D	-

FCP exhibits the greatest queue lengths within the network, which correlates to the heavy volumes that travel along this roadway. At Burke Centre Parkway the queue length indicated for the northbound through movement at 5,100 feet is likely overstated. The results of the model runs are based on the limited study area network between Braddock Road and Burke Centre Parkway. It is probable that the northbound through movement queue is metered upstream at signalized intersections along FCP, and the actual queue length is shorter. At 2,075 feet the southbound queue at this intersection is comparable to the level of congestion observed in the field. The other notable mainline through movement queue during the AM peak period is at the southbound ramp on Braddock Road. The 1,125-foot eastbound through movement queue can be attributed to the substantial traffic volumes originating from the west.

The results of the AM peak hour analyses indicate that three of the four FCP study intersections (including Popes Head Road) operate at an overall LOS C or better. The intersection of FCP and Burke Centre Parkway operates at an overall LOS E, with many of the movements failing at a LOS F. Signal operations at Burke Centre Parkway contribute to the lengthy delay for mainline turns and side street movements. The signal is programmed to favor the mainline through movements, allocating up to 204 seconds (approximately 3.5 minutes) of green time to the heavy movements. This in turn increases the average delay for mainline left-turn and side street movements. As shown in the summary, significant delay does not necessarily correlate to lengthy vehicle queues. The majority of these movements carry low volumes, and in turn, exhibit relatively short queues.

The significant movements that experience major queuing as a result of signal delay and volume are the southbound left-turn at the Braddock Road and the FCP southbound ramps and the westbound right-turn at Burke Centre Parkway. Another notable delay is the northbound right-turn movement at Burke Centre Parkway. The queue length for this movement is zero, but due to the lengthy queues of the adjacent through movement, access to the turn lane is blocked which increases the delay for this movement.

The PM peak hour exhibits similar operational issues as the AM peak hour. At Burke Centre Parkway, mainline queue lengths are nearly equivalent at 2,275 feet in the southbound direction and 2,750 feet in the northbound direction. As with the AM peak period, the northbound queue is slightly overstated as there isn't an upstream intersection metering vehicle arrivals within the VISSIM model network. Mainline queues along Braddock Road are minor, with the peak direction of travel (westbound) exhibiting the greatest queue length along Braddock Road at 500 feet.

All four study intersections operate at an overall intersection LOS D or better; however, there are more individual movements that operate at a LOS E or worse. The two intersections along Braddock Road that provide access to and from FCP experience increased delay as compared to the AM peak hour, with nearly half the allowable movements operating at LOS E or worse. However, as with the AM peak hour, nearly all these movements are relatively low volumes and the queue lengths are accommodated by existing storage capacity. Burke Centre Parkway exhibits improved operations, with a nearly 30 second drop in overall intersection delay. The northbound approach exhibits the greatest reduction in delay by movement, while the southbound left-turn increases in delay by approximately 20 seconds due to the increase in volume. The results of the simulation indicate that this movement exceeds the available storage capacity. The total storage capacity of the outermost left-turn lane is approximately 490 feet, with an additional 70 feet of taper. While the 95th percentile queue length of 500 feet exceeds the available storage, the duration of the condition is likely limited to only a portion of the peak hour and the impact to operations of the adjacent mainline through movement would be brief. Field observations indicate that the available storage capacity for this movement is sufficient during the PM peak hour.

CONCLUSION

The purpose of the existing conditions assessment was to establish a baseline of operational conditions at study area intersections to quantify the change in operations associated with the extension of Shirley Gate Road to FCP. As noted in the results of the VISSIM simulation, significant queuing and delay is associated with the two at-grade intersections of FCP with Popes Head Road and Burke Centre Parkway. At Popes Head Road in particular, major queuing issues were identified for the westbound right-turn movement, corresponding to significant delay during the AM peak hour. Other movements at this intersection experience significant delay, but due to low volume, do not generate substantial queues. The results of the Synchro analyses will serve as a basis for comparison of future intersection operations with the new roadway extension. While important to understand these impacts, the intent of the project is to identify a future roadway alignment for the Shirley Gate Road extension. Ultimately, the identification of improvements associated with the roadway extension should focus on alleviating mainline congestion (queuing) along FCP and enhance operations for side street movements to reduce delay and associated queuing.

Shirley Gate Road Extended

CORRIDOR PLANNING STUDY

FINAL

Chapter 4 – Alternatives Development

Chapter 4 – Alternatives Development

The primary objective of this study was to identify the alignment of the Shirley Gate Road extension from Braddock Road to Fairfax County Parkway (FCP) as a grade separated interchange. Before developing alternatives for the future alignment and interchange, measures of effectiveness (MOEs) were identified and traffic forecasting data was used to develop peak hour turning volumes. In addition to developing an understanding of previous studies and ongoing projects (Chapter 2), these efforts were targeted at better defining the ultimate alignment and ensuring it satisfied the goals of project stakeholders and the future demands of the transportation network. This chapter summarizes the process of identifying MOEs with project stakeholders to guide the development roadway alignment and interchange alternatives. A concurrent task included preparing traffic forecasting information using available traffic data and the County Travel Demand Model (TDM).

MEASURES OF EFFECTIVENESS

The development of MOEs was accomplished through a series of stakeholder meetings facilitated by County staff. Stakeholders were identified by Board of Supervisor (BOS) members Pat Herrity of the Springfield District and John Cook of the Braddock District. These stakeholders included the following:

- Property owners of the homes along Meath Court (specifically identified in the Comprehensive Plan)
- Residential community association leaders and board members of neighborhoods located on Popes Head Road and Shirley Gate Road
- Individual residential properties near the intersection of Popes Head Road with FCP
- Individual residential properties along Shirley Gate Road
- Businesses and other institutions located near the intersection of Braddock Road and Shirley Gate Road
- Fairfax County Park Authority (FCPA)

Although not listed above, George Mason University was contacted to be an involved stakeholder in this process, but did not send representatives to participate in any meetings. A total of five stakeholder meetings were hosted over a period of five months to review project information, with an emphasis on developing MOEs and recommending a preferred alignment based upon the chosen MOEs. Meetings were hosted at a location near the proposed alignment and generally covered the following topics:

1. May 13, 2015 – project background, data collection, traffic operations, and crash analyses
2. June 10, 2015 – preliminary traffic forecasting, Patriot Park master plan, preliminary MOEs
3. July 16, 2015 – refined MOEs, preliminary alignment review
4. August 3, 2015 – refined alignments, initial screening of refined alignments against MOEs
5. September 29, 2015 – final traffic forecasting, future traffic operations analysis, final evaluation of the refined alignments, and selection of a preferred alignment and interchange alternative

Initial MOEs

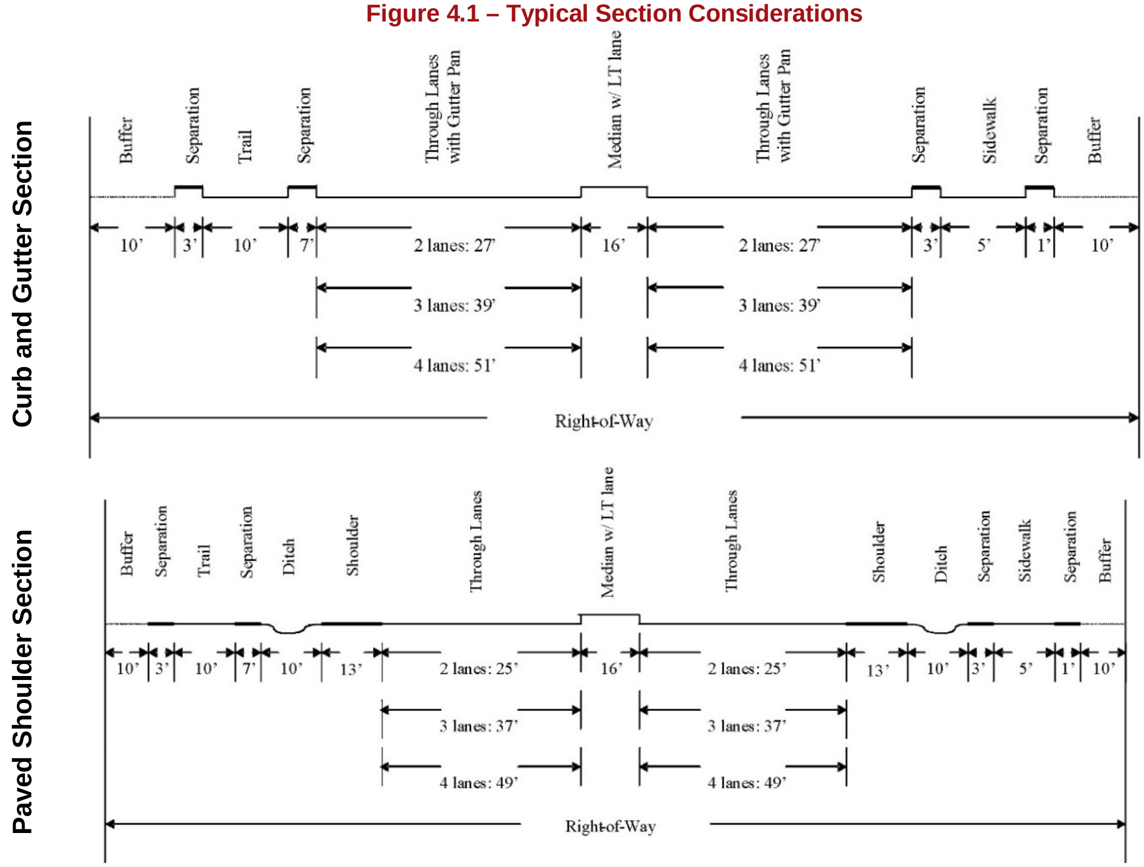
The County initiated discussion of MOEs at the second stakeholder meeting by presenting a list of potential MOEs to use in the screening of alignment alternatives. At the time of the meeting, alignment alternatives had not yet been identified, allowing for the unbiased development of MOEs. The initial list was subdivided into three categories and is presented in **Table 4.1**. The intent of the first category of MOEs (impacts to adjacent properties) was to allow stakeholders to screen the potential alignments and identify two preferred alignment alternatives. The two preferred alignments would then be refined to greater detail to allow for a more detailed evaluation of transportation impacts as well as the potential cost of design and construction.

Although alignments of the Shirley Gate Road extension had not yet been developed at the time of the first stakeholder meeting, the county shared with the stakeholders that the alignment would follow county standards for typical roadway sections, as outlined in the county Comprehensive Plan. Based on these standards, the alignment would require 119 feet of right-of-way (ROW) considering a curb and gutter typical section. A paved shoulder typical section would require a total of 161 feet of ROW. **Figure 4.1** summarizes the elements included in these respective typical roadway sections.

Table 4.1 – Initial List of MOEs

I. Impacts to Adjacent Properties
a. Residential and Commercial Property
b. Park Property
c. Noise
d. Aesthetics
II. Impacts to Transportation System
a. Access
b. Traffic Operations and Levels of Service (delay/ travel time)
c. Safety
d. Improvements to network (connectivity)
III. Cost
a. Construction Cost

Figure 4.1 – Typical Section Considerations



Source: FCDOT Comprehensive Plan

Refined MOEs

Based on feedback received at the second stakeholder meeting, the initial list of MOEs was refined and presented at the third stakeholder meeting. As part of the refined list of MOEs, metrics were identified to use as a basis to evaluate the alignments against the MOEs. Units of measurement and weighting values were also identified wherever possible. Weighting values were intended to prioritize MOEs based on the primary concerns of stakeholders. During the meeting, the county further refined the list of MOEs based on stakeholder feedback. The resultant list of MOEs is summarized in **Table 4.2** with the associated metrics, units of measurement, and weighting values. A dash indicates that a unit of measure or weighting value was not assigned during the stakeholder meeting.

Table 4.2 – Refined List of MOEs

MOEs	Metric	Unit of Measure	Weighting
I. Impacts to Adjacent Properties			
a. Property for Sale (posted)	Maximize use	each	2
b. Property Vacant	Maximize use	each	2
c. Commercial Property	Minimize impact to property access	-	-
d. Septic Field	Minimize impact	each	5
e. Park Property	Minimize impact on master plan	acre	5
f. Land Grades	Minimize grade changes to adjacent properties	acre	-
g. Noise	Maximize distance from residences	feet	5
h. Aesthetics	Minimize heights of structures	feet	2
i. Stormwater and Water Quality	Minimize impacts and impervious surface area (coordinate with DPWES)	-	5
j. Lighting	Minimize impact on residences	-	4
k. Property Value Degradation	Minimize land takings	-	2
l. Natural Environment	Minimize removal of plants and trees	acre	-
II. Impacts to Transportation System			
a. Access	Maintain access to properties	-	5
b. Traffic Operations and Levels of Service (delay/ travel time)	Reduce cumulative delay as compared to No Build option	sec/veh	10
c. Safety	Minimize major conflict points	-	5
d. Improvements to network (connectivity)	Reduce vehicle miles of travel	vmt*	10
e. Construction Duration and Associated Traffic Disruption	Minimize construction period and traffic disruption	-	5
f. Change in volume on Popes Head Road	Minimize traffic volume increase	veh/day	-
g. Change in volume on Shirley Gate Road (north of Braddock)	Minimize traffic volume increase	veh/day	-
III. Impacts to Transportation System			
a. Construction Cost	Minimize cost of construction	current $	25

*vmt – vehicle miles traveled

In addition to refining the list of MOEs, preliminary roadway alignments were developed for review by the stakeholders at the third meeting. It was determined that the first category of MOEs would each be applied separately to potential alignments for the northern and southern sections of the future alignment. The preliminary alignments were not developed using computer aided drafting software at this stage in the alternatives development process; however, centerline radii were approximated referencing a GIS basemap and considering Virginia Department of Transportation (VDOT) and County design standards. No specific action was taken regarding the preliminary alignments shared during the meeting.

Figure 4.2 depicts the two southern alignments that were identified at this stage of the project. The primary difference lies in the location of a future interchange with FCP. In Option 2A, the interchange would be along the Shirley Gate Road extension alignment. The existing Popes Head Road intersection would be eliminated and converted to a cul-de-sac on either side or grade separated from FCP (cul-de-sac would require alternative connectivity). This alignment maximizes the use of existing FCPA property. Option 2B aligns the roadway with the existing Popes Head Road to the east of FCP, introducing a more significant reverse curve in the alignment of the roadway. In addition, the alignment isolates the existing residential property between Popes Head Road and the FCPA property and would require a secondary intersection with Popes Head Road near the interchange.

Figure 4.3 depicts the three northern alignments that were identified at this stage of the project. The primary difference among the northern alignments lies in the degree of intersection skew that would be expected at the juncture with Braddock Road. Option 1A provides for perpendicular intersection approaches in all directions, which is preferable for visibility and safety but requires significant reverse curves to tie in with the middle portion of the future alignment. Option 1C provides for an alignment with very little curvature in the future roadway alignment but would create the largest intersection skew at Braddock Road. Option 1B represents a balance of the two on intersection skew and alignment curvature. Note that all three alignments are expected to avoid any direct impacts to the properties along Meath Court and maximize the use of the FCPA property. The alignment of Option 1A has the potential to impact operations of the existing Four Seasons Golf Center located in the southeast quadrant of the Braddock Road and Shirley Gate Road intersection.

Figure 4.2 – Illustrative Alignment Considerations (Southern Section)

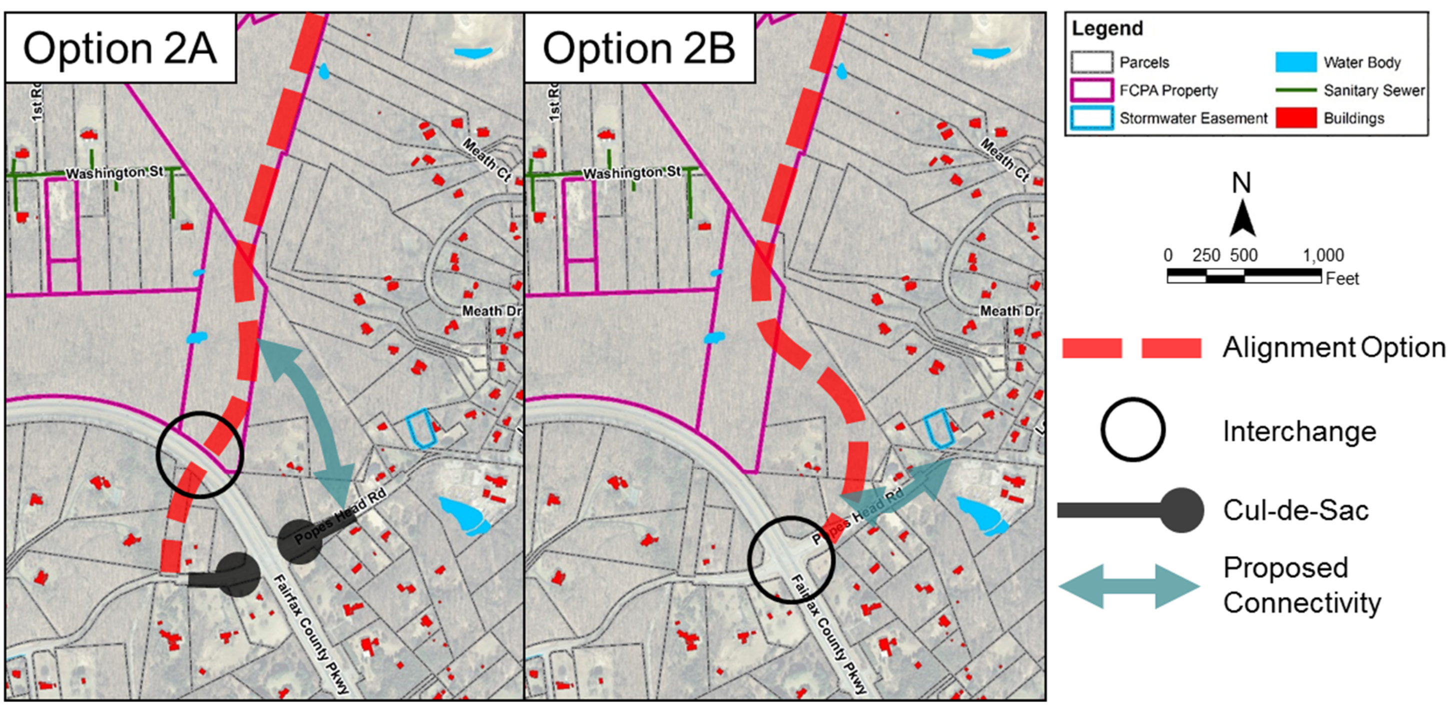
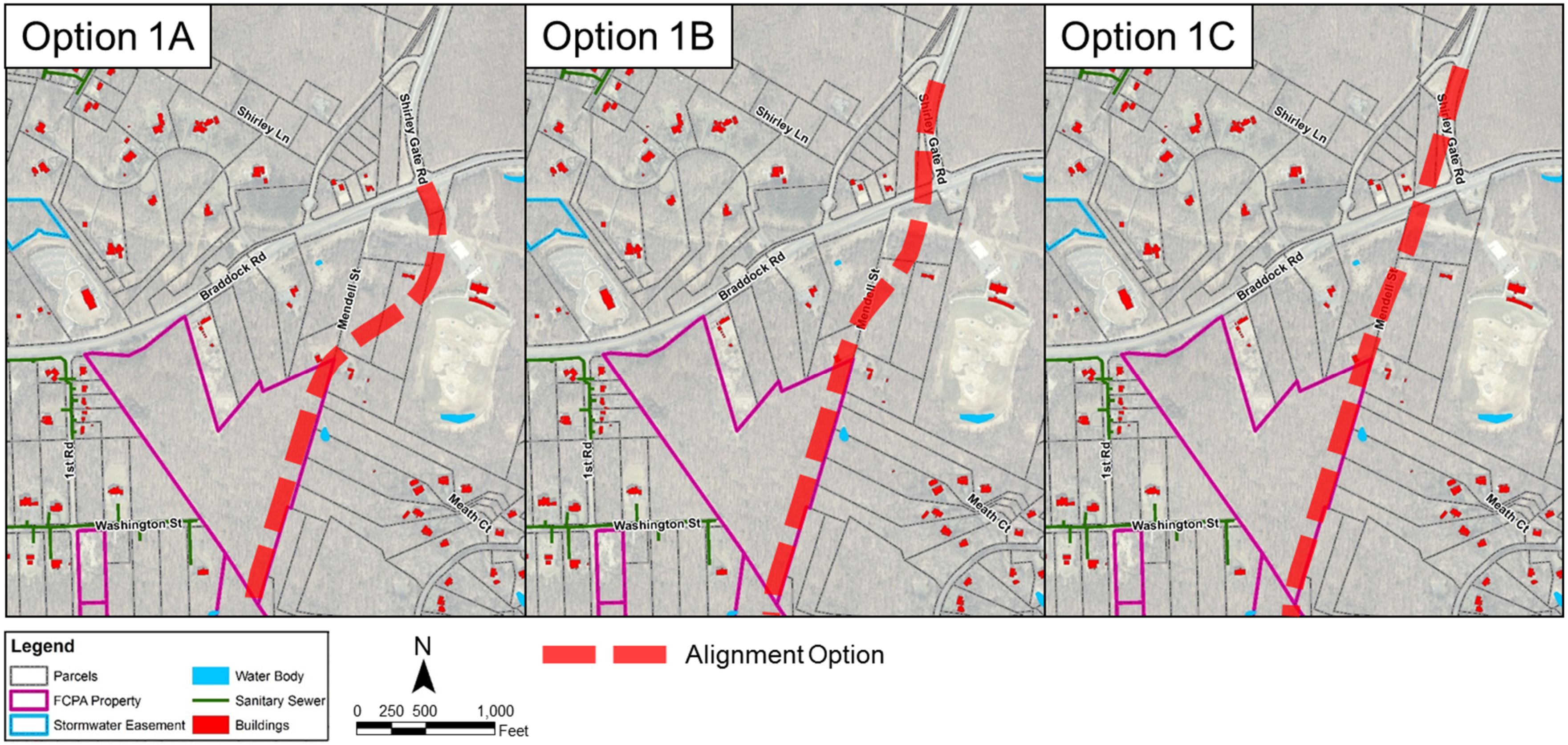


Figure 4.3 – Illustrative Alignment Considerations (Northern Section)



Final MOEs and Initial Stakeholder Screening

During the fourth stakeholder meeting, the county facilitated discussion among attendees to finalize the list of MOEs and associated metrics and weighting factors. The county introduced two new MOEs based upon new information gathered following the previous meeting and additional county and BOS feedback:

1. **Utility crossings** – two major utilities run east-west across the future alignment adjacent to the Braddock Road intersection: a gas main and high voltage transmission lines. It was recommended by the county that the alignment be perpendicular (or close to perpendicular) when crossing the gas main and avoid direct conflict with the support towers for the transmission lines.
2. **Intersection skew at Braddock Road** – to enhance the safety of operations, it was recommended by the county that the intersection of the Shirley Gate Road extension with Braddock Road be perpendicular (or close to perpendicular).

During the meeting, it was determined that the “aesthetics” and “stormwater and water quality” MOEs could not be qualitatively measured to a reasonable degree that would distinguish one alignment from the other. As such, these two were eliminated from further consideration. The final adjustment to MOEs considered as part of the initial screening of the alternatives by stakeholders was related to property value degradation. It was recommended that the category is separated into two: one for the actual degradation of land due to partial property acquisition and one for the secondary degradation of land due to the presence of an arterial roadway to an adjacent residential property.

Before completing the initial screening of the northern and southern alignments, the stakeholders provided input on the recommended weighting factors for the remaining MOEs. As a group, it was determined that a higher weighting value should be assigned to impacts on residential properties as well as the natural environment. Weighting values were also assigned to MOEs included under the category of impacts on the transportation system, with minor adjustments to values previously identified. The final list of MOEs, metrics, units of measure, final weighting values, and initial stakeholder screening recommendations is summarized in **Table 4.3**.

The initial screening values are what was recommended by the panel of stakeholders based on the preliminary alignment alternatives shown in **Figure 4.2** and **Figure 4.3**. Since the screening was not based on detailed geometry or operational analyses, the majority of MOEs included under the impacts on the transportation system and cost was left incomplete. These values were assigned later in the stakeholder engagement process based on the results of traffic forecasting, subsequent operational analyses, and CAD drawings prepared for the two preferred alternatives. The initial screening of the preliminary alignment alternatives indicated that alignment 1B was the preferred alternative to the north. This northern alignment was considered with variations of southern alignments 2A and 2B under subsequent tasks.

Table 4.3 – Final List of MOEs and Initial Stakeholder Screening of Preliminary Alternatives

MOEs	Metric	Unit of Measure	Weighting	Initial Stakeholder Screening				
				1A	1B	1C	2A	2B
I. Impacts to Adjacent Properties								
a. Property for Sale (posted)	Maximize use	each	2	1	1	1	2	2
b. Property Vacant	Maximize use	each	2	2	0	0	0	0
c. Commercial Property	Minimize impact to property access	-	2	0	2	2	2	2
d. Septic Field	Minimize impact	each	5	0	1	1	5	1
e. Park Property	Minimize impact on master plan	acre	2	2	2	2	0	0
f. Land Grades	Minimize grade changes to adjacent properties	acre	2	2	1	1	2	2
g. Noise	Maximize distance from residences	feet	8	0	0	0	1	0
h. Lighting	Minimize impact on residences	-	6	1	2	2	1	0
i. Property Value Degradation	Minimize land takings	-	2	0	1	1	1	2
j. Property Value Degradation to Adjacent Properties	-	-	8	0	0	0	0	0
k. Natural Environment	Minimize removal of plants and trees	acre	6	0	0	0	4	6
l. Utility Crossings	Minimize Impacts	-	2	2	1	0		
II. Impacts to Transportation System								
a. Access	Maintain access to properties	-	3	0	1	1	3	3
b. Traffic Operations and Levels of Service (delay/ travel time)	Reduce cumulative delay as compared to No Build option	sec/veh	8					
c. Safety	Minimize major conflict points	-	3					
d. Improvements to network (connectivity)	Reduce vehicle miles of travel	vmt*	8					
e. Construction Duration and Associated Traffic Disruption	Minimize construction period and traffic disruption	-	3					
f. Change in volume on Popes Head Road	Minimize traffic volume increase	veh/day	5					
g. Change in volume on Shirley Gate Road (north of Braddock)	Minimize traffic volume increase	veh/day	5					
h. Intersection skew at Braddock	-	-	4					
III. Cost								
a. Construction Cost	Minimize cost of construction	current $	25					
			TOTAL	**10**	**12**	**11**	**21**	**18**

*vmt – vehicle miles traveled

TRAFFIC FORECASTING

To quantify the volume of traffic to be served by the Shirley Gate Road extension and determine intersection/interchange level geometry needs, existing traffic data was used in combination with the county TDM to forecast daily and peak period traffic volumes throughout the study area network. The County TDM is based on the regional Metropolitan Washington Council of Governments (MWCOG) TDM and consists of a network of roadway link segments that have associated characteristics, including the number of travel lanes, link speeds, and roadway classification. The assignment of traffic through the network for a given future year condition is impacted by roadway geometry and the socioeconomic data coded to the various traffic analysis zones (TAZs). The TDM functions as a gravity model whereby trips are assigned through the network based on the attraction of the destination and the shortest path of least resistance.

Future year traffic volumes were developed for the 2040 no build and build conditions. Both future year models reflected the following geometry within the study area network considering identical TAZ socioeconomic data:

- No capacity improvements to I-66 associated with the Transform I-66 Outside the Beltway project
- At-grade intersections at US 50 and Waples Mill Road, US 29 at Shirley Gate Road, and Route 123 at Braddock Road (all identified in the county Comprehensive Plan as grade separated interchanges)
- Six-lane section along Braddock Road east of FCP
- Six-lane section along FCP through the study area

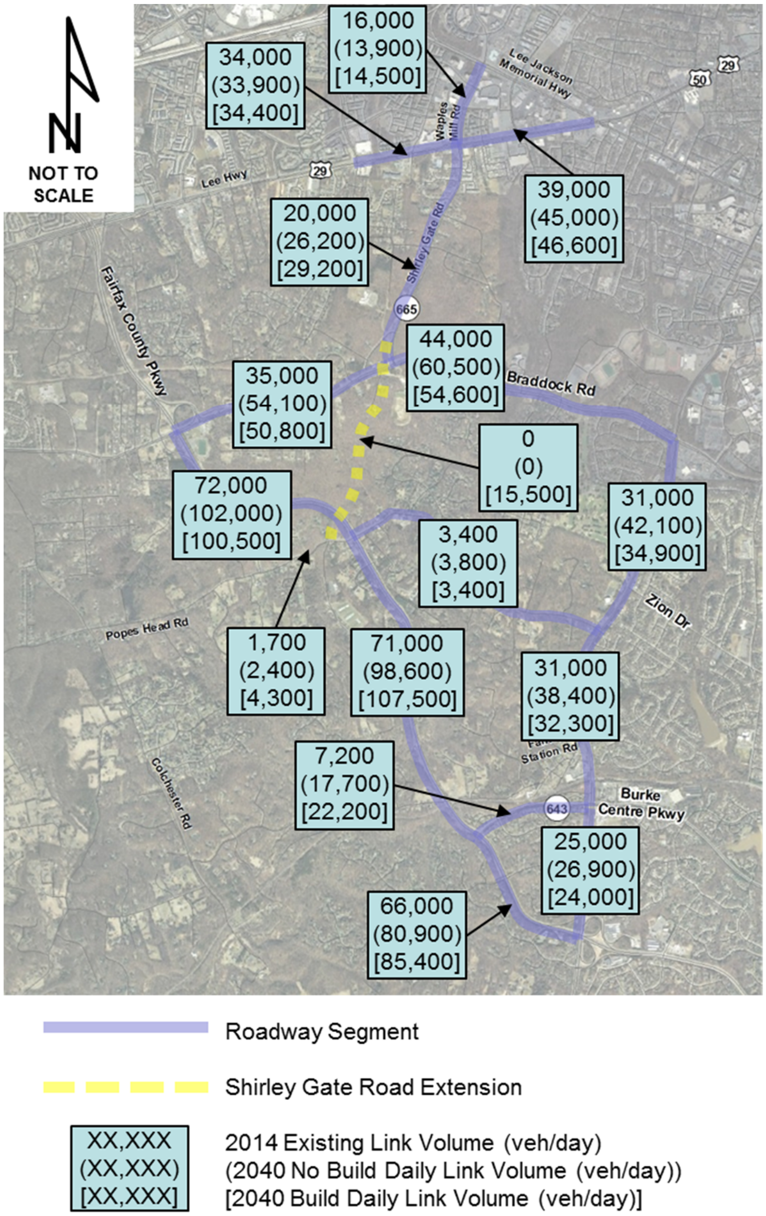
The build condition model included the Shirley Gate Road extension between Braddock Road and FCP in addition to the background conditions listed above. The build model reflects a four-lane section of roadway along the extension and an interchange at the juncture of Shirley Gate Road Extended with FCP. The interchange configuration reflected in the model evaluated is a basic diamond interchange configuration that allows access in all directions. While this doesn’t necessarily reflect the final configuration of the interchange, it allowed for the evaluation of changes in travel patterns given the access provided by the extension and interchange. The resultant daily traffic volumes along study area roadways in the 2040 no build and build condition are summarized graphically in **Figure 4.4** along with 2014 existing daily traffic volumes obtained from VDOT.

The traffic forecasting information indicates that the Shirley Gate Road extension will carry approximately 15,500 vehicles per day (vpd), which is comparable to the volume of traffic traveling along the southern section of Waples Mill Road just north of US 29. In general, traffic volumes along Route 123 and Braddock Road are reduced with the introduction of the Shirley Gate Road extension. As compared to no build, traffic volumes along these roadways decrease by more than five percent. Conversely, traffic volumes along Burke Centre Parkway, FCP south of Popes Head Road, and Shirley Gate Road itself increase by five percent. Daily traffic volumes along Popes Head Road maintain 2014 conditions in the build condition east of FCP but are more than double 2014 conditions to the west. Although this represents a significant increase, the relative increase in traffic volumes is in the range of 200 to 300 vehicles over the course of an hour.

Development of Peak Hour Intersection Turning Volumes

The National Cooperative Highway Research Program (*NCHRP) Report 255: Highway Traffic Data for Urbanized Area Project Planning and Design* contains methodologies that can be applied to forecast link volumes to generate future year turning movement volumes. Based on this methodology, given base year (existing conditions) seed volumes, base year (existing conditions) directional link volumes, and future year directional link volumes, future year turning movement forecasts can be estimated by comparing relative differences between the base year counts and applying those relationships to future turning movements. The goal for this iterative process is to generate future turning movements that are within 10 percent of the forecast link volumes. This approach was used in the development of future year turning movement volumes.

Figure 4.4 – Existing, 2040 No Build, and 2040 Build Daily Traffic Volumes



This methodology was applied to future year no build and build conditions. The TDM assignment generates daily traffic volumes (shown in **Figure 4.4**) as well as peak period traffic volumes for the AM, midday, PM, and overnight periods. The AM peak period represents a period of three hours in the morning and the PM peak period represents a period of four hours in the afternoon. Considering the link volumes in the base year model (2010) and future year models (2040), peak period growth factors were determined for the AM and PM peak periods over the 30-year interval for each study area intersection approach and departure link segments. Using the peak period growth factors, future year (2040) peak hour link volumes (approach and departure) were generated by applying the respective peak period growth factors to the actual link volumes (2014 data). Based on these future year link volumes and existing turning volumes, the NCHRP 255 methodology was applied to the data to generate future year turning volumes for the AM and PM peak hour. All future year turning volumes were rounded to the nearest increment of five.

In the case of the future interchange alternatives, the juncture of Shirley Gate Road Extended with FCP was treated as a single intersection similar to the intersection of Popes Head Road in the no build condition. Turning volumes were redistributed based on the allowable movements and access provided by the alternatives developed. As for the intersection of Popes Head Road with Shirley Gate Road, which does not exist today, seed volumes were equal values of 1 vehicle per hour for all allowable movements. The iterative process then adjusted these seed values in a similar manner to generate turning volumes and corresponding link volumes that were within 10 percent of the forecast link volumes. **Figure 4.5** provides an example of the iterative process for the future interchange.

During the review of the hourly turning volumes generated by this process, it was determined that some post-processing of the traffic volumes was necessary. This need was identified to better match available throughput (or capacity) of certain movements that are already over capacity and to match shifts in traffic patterns through consecutive intersections in the build alternative. In the AM peak hour (no build and build), the westbound right-turn volume at Burke Centre Parkway and FCP was too heavy, and drivers would likely seek an alternate route to reach FCP. An initial adjustment was made to the no build and build alternatives to reassign 10 percent of the right-turn volume to the northbound through movement on FCP, approximately 150 vehicles.

In addition to this specific adjustment, the following adjustments were made to traffic volumes in the build alternative and are summarized graphically in **Figure 4.6** and **Figure 4.7**:

AM Peak Hour

- Reduce the westbound right-turn volume at Shirley Gate Road and Braddock Road to be comparable to the reduction in the northbound left-turn movement at Braddock Road and Route 123. In addition, reduce both turning movement volumes an additional amount to a volume that is comparable to the available capacity of the northbound left-turn movement at Route 123. This additional reduction is recommended under the notion that the limited capacity of this movement will cause drivers to seek an alternative route to the north.
- Reduce the southbound left-turn volume at the future interchange with Shirley Gate Road to be comparable to existing conditions; the new link would not generate significantly more trips than are processed today.
- Reduce the westbound right-turn volume at Burke Centre Parkway and FCP to better match the available capacity of the movement, rerouting trips by way of Route 123 and other arterials that provide access to FCP; these trips would be repurposed to the northbound through movement at Burke Centre Parkway

PM Peak Hour

- Reduce the southbound left-turn volume at Shirley Gate Road and Braddock Road to be comparable to the reduction in the eastbound right-turn movement at Braddock Road and Route 123.
- Reduce the volume along Popes Head Road in the eastbound direction and reassign the volume to eastbound Burke Centre Parkway by way of southbound FCP (comparable to the reverse movement during the AM peak). Traffic bypassing FCP to use Popes Head Road and Route 123 to reach eastbound Burke Centre Parkway is not considered to be a reasonable route given the lower speed on Popes Head Road and the congestion along southbound Route 123.

Figure 4.5 – Sample Future Year Traffic Volume Development Shirley Gate Road Extended and Fairfax County Parkway

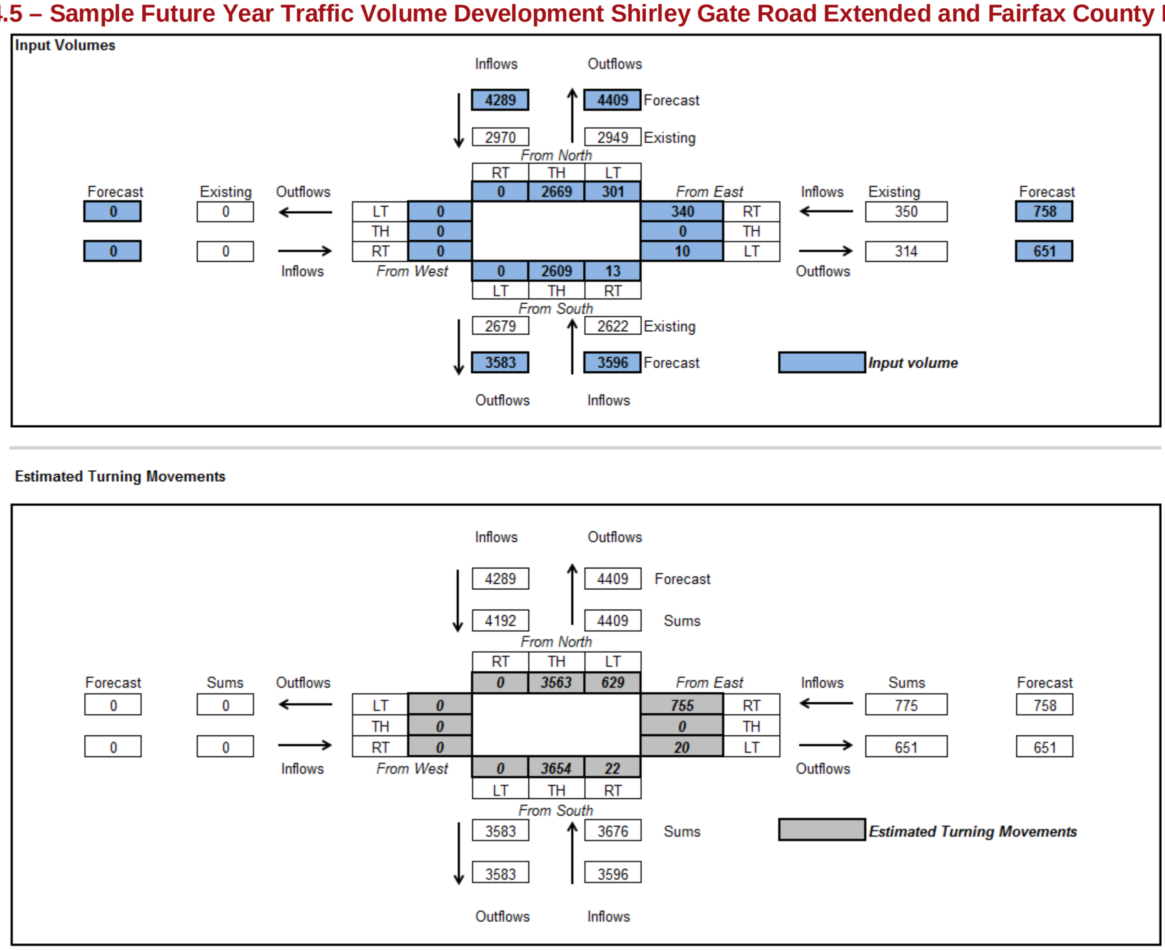
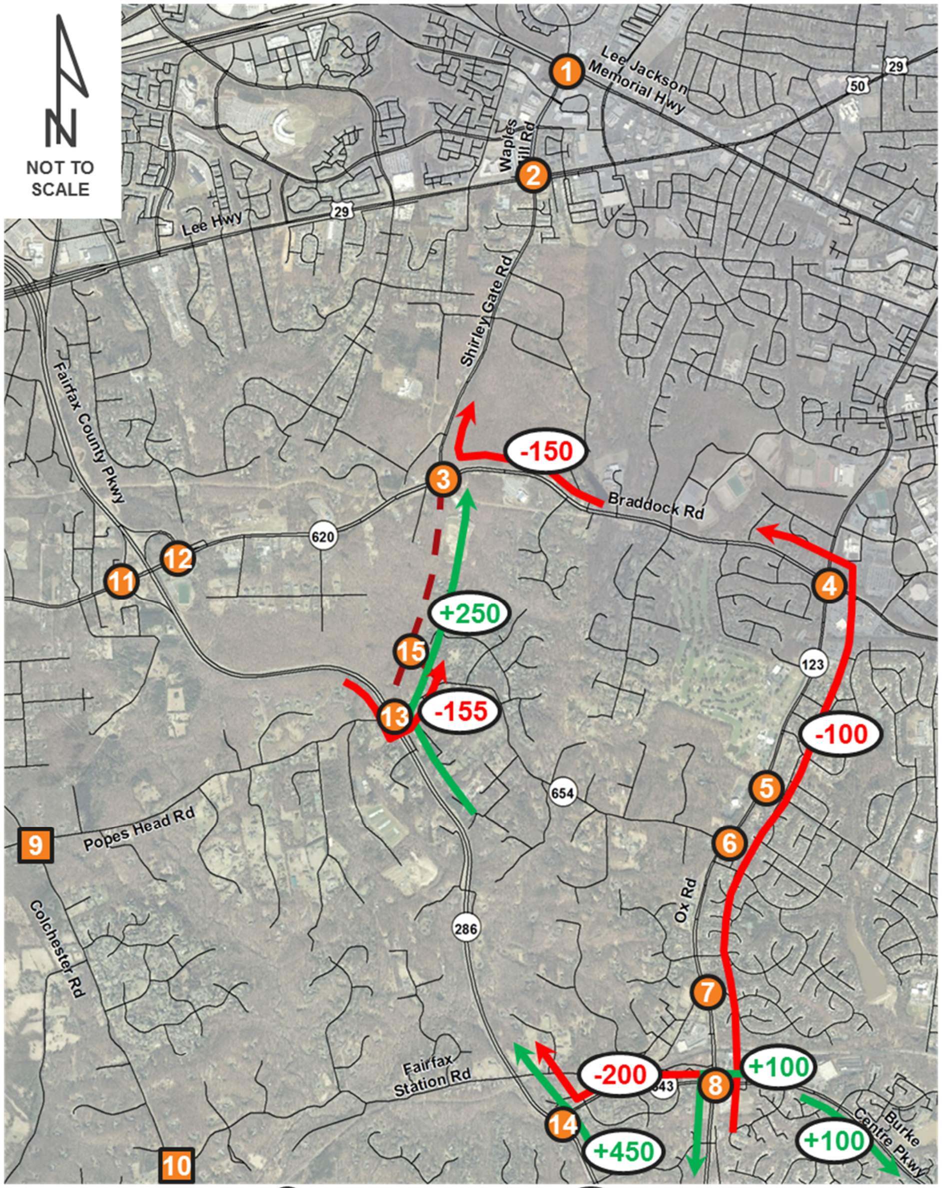
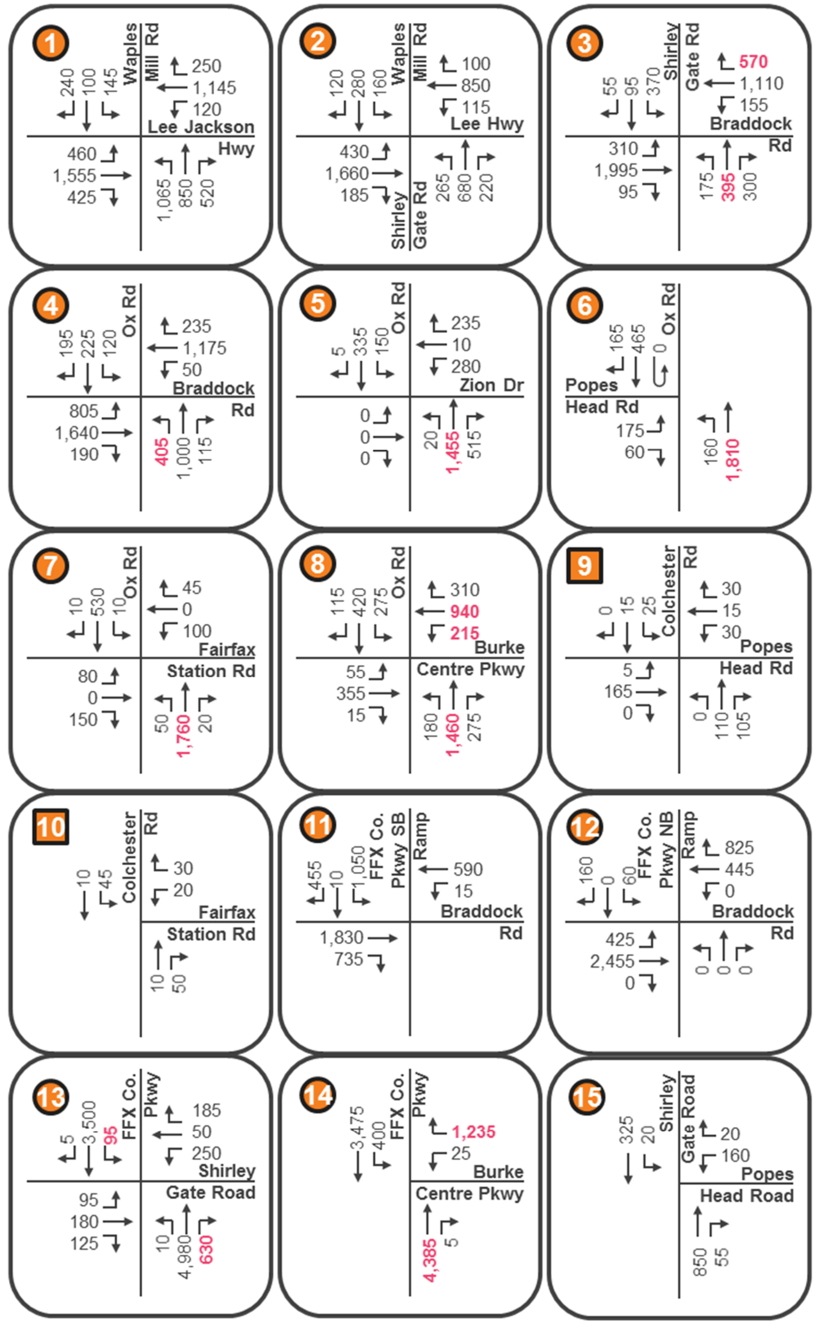


Figure 4.6 – Study Area Network Volume Adjustments
2040 AM Peak Hour – Build Scenario



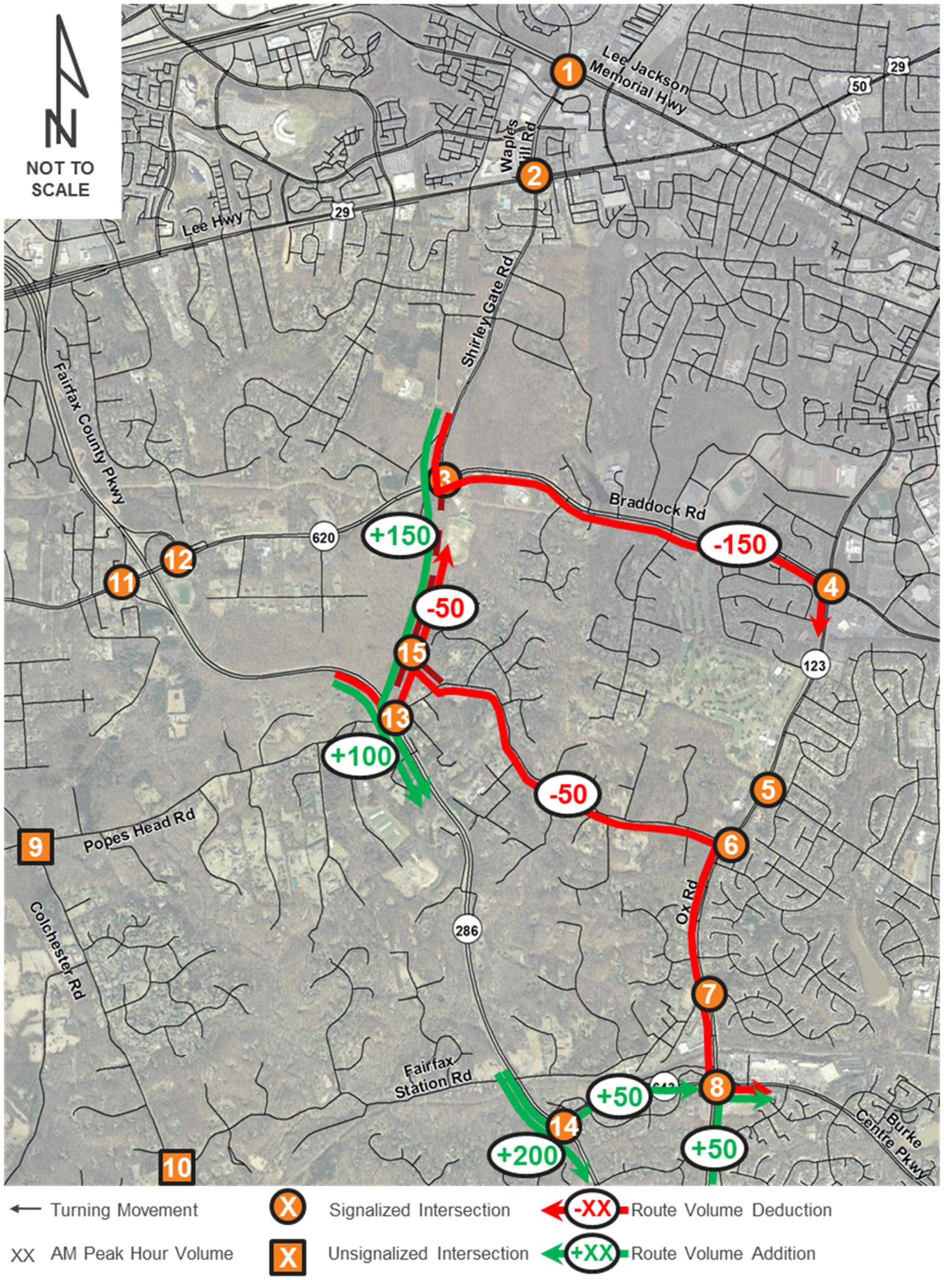
← Turning Movement
XX AM Peak Hour Volume
X Signalized Intersection
X Unsignalized Intersection
-XX Route Volume Deduction
+XX Route Volume Addition

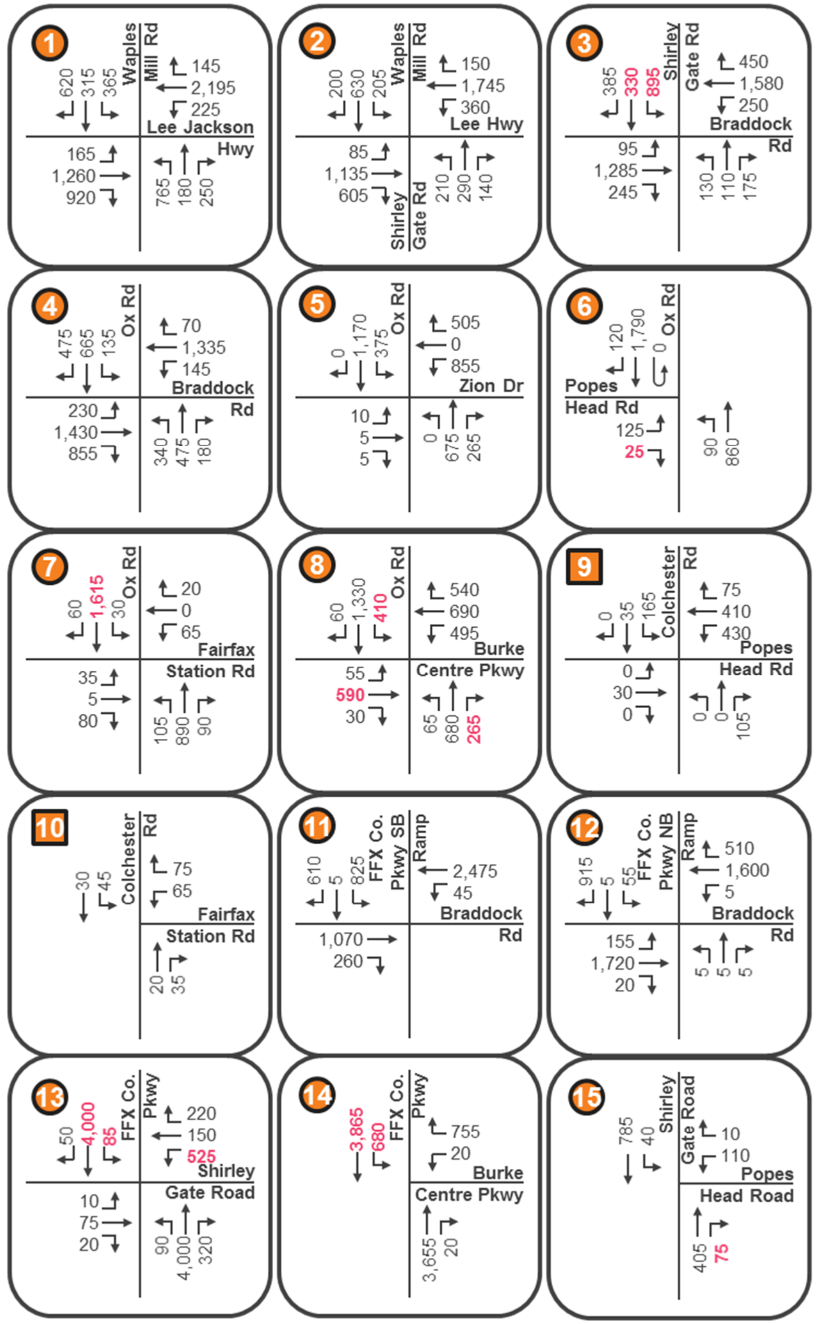


Volumes in **red** manually adjusted from the initial turning movement volume forecast (NCHRP 255)

Shirley Gate Road Extended
CORRIDOR PLANNING STUDY

Figure 4.7 – Study Area Network Volume Adjustments 2040 PM Peak Hour – Build Scenario





Volumes in **red** manually adjusted from the initial turning movement volume forecast (NCHRP 255)

INTERCHANGE ALTERNATIVES DEVELOPMENT

The initial stakeholder screening of the alignments identified Option 1B as the preferred northern alignment, but did not specify the exact configuration of the southern alignment of Option 2A and Option 2B. Given the desire of the stakeholders to maintain similar access to FCP from Popes Head Road, one of the objectives in the development of interchange alternatives was not to eliminate any movements to or from Popes Head Road without providing alternate access. In addition, traffic volumes were considered when determining intersection control and the number of lanes to provide for each movement. From the traffic volumes (see **Figure 4.6** and **Figure 4.7**), the following were the predominant movements through the future interchange with the Shirley Gate Road extension:

- FCP through movements (free-flow in the build condition)
- Shirley Gate Road Extended westbound left-turn movement
- FCP northbound right-turn movement

All other turning movement volumes at the interchange are expected to be less than approximately 200 vehicles per hour during 2040 AM or PM peak hour.

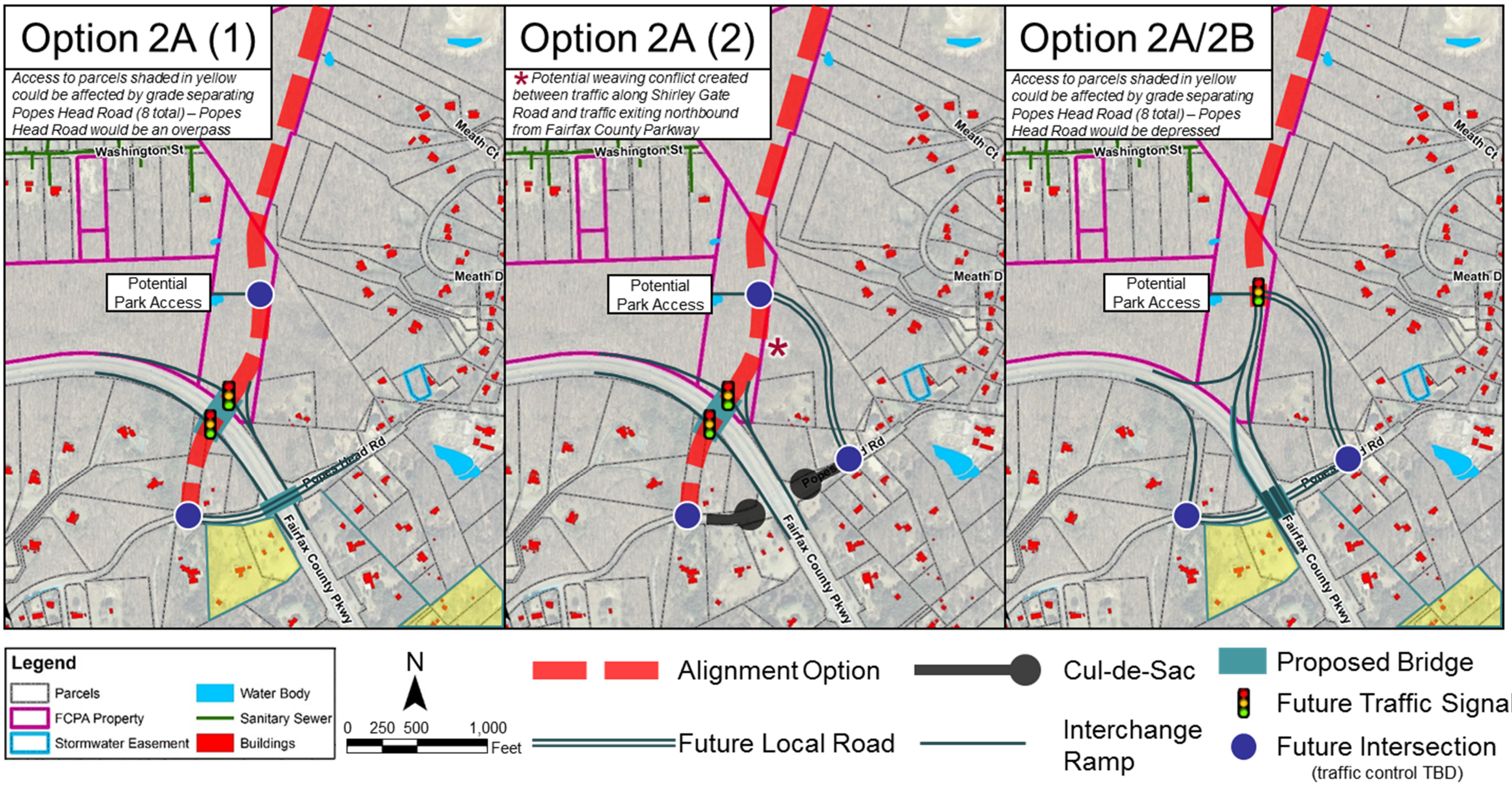
Considering the alignment Option 2A in **Figure 4.2**, the most compact configuration that could accommodate all turning movements was determined to be a tight urban diamond interchange. Although this configuration would introduce two closely spaced signalized intersections along the new alignment, strategic signal operations and sequencing would help minimize queuing at the interchange and progress the heaviest turning volumes. The northbound right-turn movement was assumed to be a free-flow movement given the significant volume expected. Two variations of Option 2A were initially considered:

1. **Option 2A (1)** – grade separate Popes Head Road and require all interchange traffic to travel through the intersection at the southern terminus of Shirley Gate Road Extended to access FCP.
2. **Option 2A (2)** – terminate Popes Head Road at FCP (cul-de-sac) and construct a connector road between Shirley Gate Road Extended and Popes Head Road to maintain access.

Option 2A (1) would require the provision of alternative access to eight homes located near the existing intersection of FCP and Popes Head Road due to the grade separation of Popes Head Road. Option 2A (2) would impact a larger number of properties to construct the connector road and introduce a short weaving segment along Shirley Gate Road Extended between FCP and the connector road (northbound direction). One of the objectives the County tries to employ when introducing a new roadway network is not to segment or truncate an existing one. Option 2A (2) would ultimately create a segmented Popes Head Road and hinder mobility through the area. For these reasons, Option 2A (1) was one of the preferred interchange alternatives. **Figure 4.8** summarizes both alternatives.

Alignment Option 2B created challenges to providing access to FCP. As shown in **Figure 4.2**, the alignment would create the need for an intersection with the realigned Popes Head Road to the east within proximity of the interchange. In addition, this configuration would carry the forecast Shirley Gate Road Extended traffic, estimated to be 15,500 vpd, in greater proximity to residential properties than the Option 2A alignment. Thus, a combination Option 2A/2B alternative was developed to reduce the volume of traffic bisecting these properties. The alternative retains the connector road between the new alignment and Popes Head Road and provides free-flow access between Shirley Gate Road Extended and FCP for three of the four movements oriented to the north. All movements to and from Popes Head Road would be required to use the connector road except for the southbound FCP off-ramp traffic. The interchange configuration would require that Popes Head Road be grade separated. As with Option 2A, the grade separation has the potential to require alternative access to homes near the existing intersection.

Figure 4.8 – Illustrative Interchange Alternatives[1]



[1]The preliminary interchange alternatives were not developed using computer aided drafting software; however, centerline radii were approximated referencing a GIS basemap and considering VDOT and County design standards.

SUMMARY

Given the interchange alternatives and the need to generate scoring values under the MOEs for impacts to the transportation system and cost (see **Table 4.3**), further analyses were necessary. Option 2A (1) and Option 2A/2B were carried forward with detailed analyses to make a recommendation for a preferred alternative. As outlined in Chapter 5, detailed analyses of the no build and build alternatives were completed along with a planning level cost estimate of these two alternatives.


Shirley Gate Road Extended

CORRIDOR PLANNING STUDY

FINAL

Chapter 5 – Alternatives Analysis

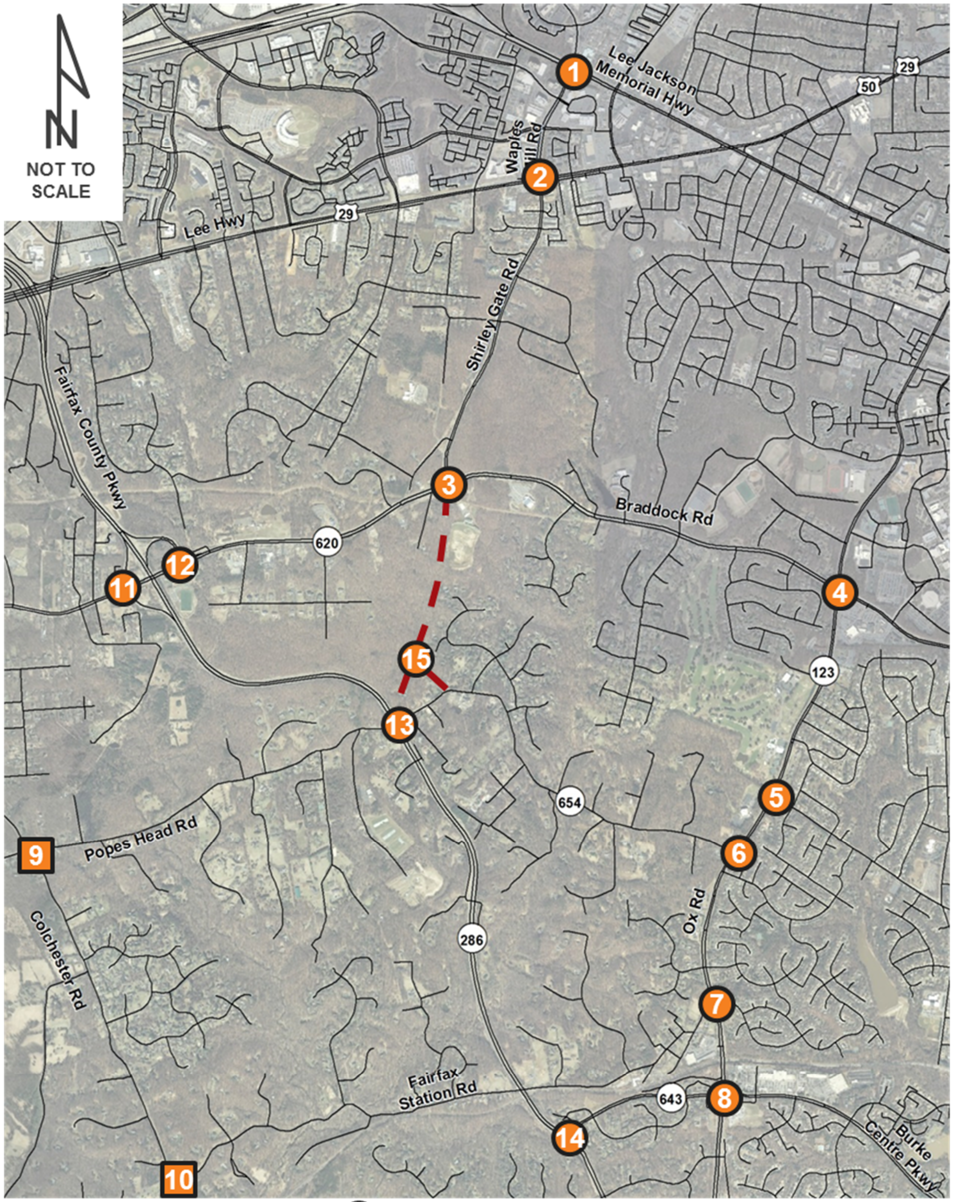

Chapter 5 – Alternatives Analysis

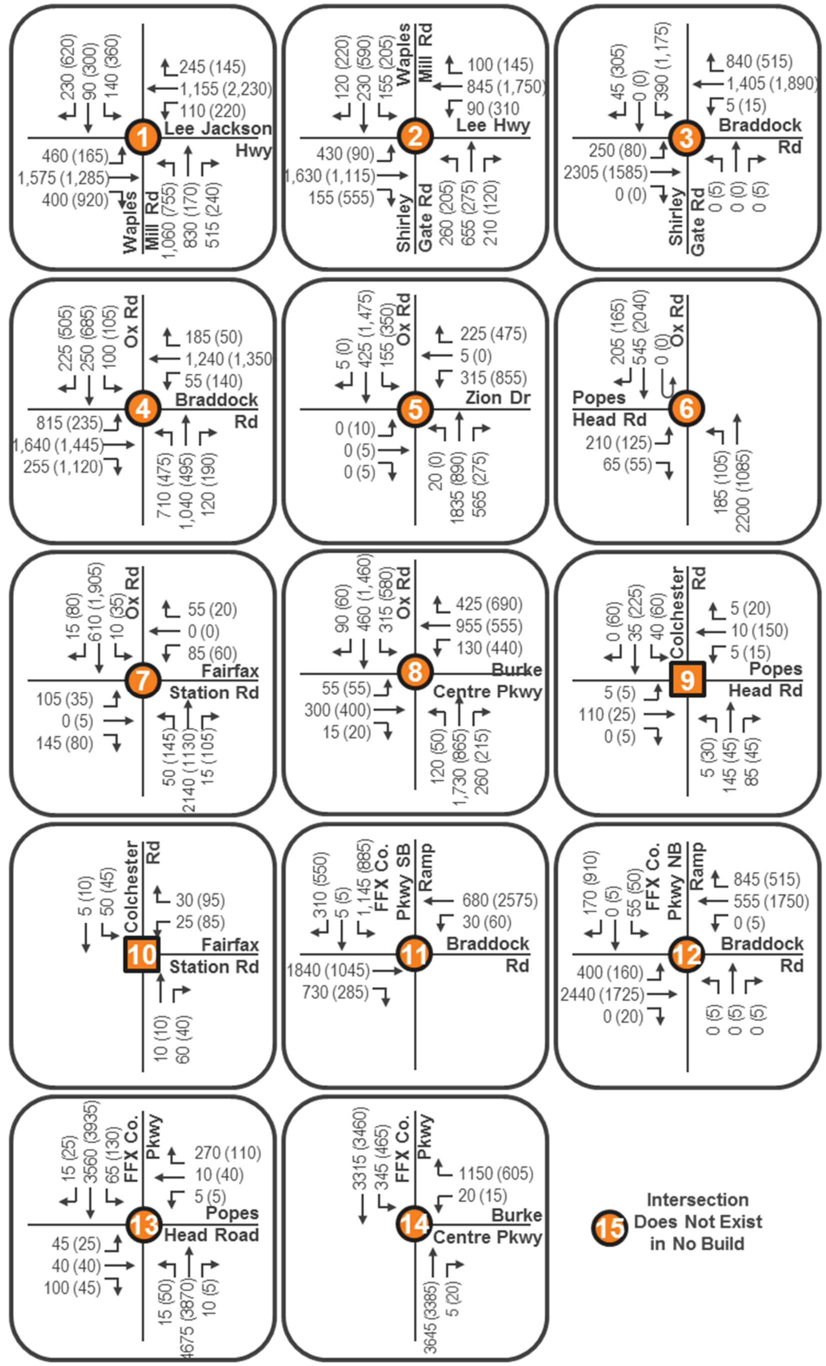
A detailed operational analysis of the two recommended alternatives developed for the alignment of the Shirley Gate Road extension was completed to assess the changes in network operations provided by the new network connectivity. The assessment compared future operations of no build and build alternatives with 2040 traffic volumes in the immediate vicinity of the future roadway connection as well as the greater study area. The focus of this analysis included key intersections along Fairfax County Parkway (FCP) and future intersections with Shirley Gate Road. The traffic forecasting methodology used to develop future year peak hour turning volumes is described in Chapter 4. The alternatives analysis was completed as an extension of the existing conditions analysis described in Chapter 3. The analysis of future conditions of the study area network was completed using two traffic analysis tools, Synchro and VISSIM, consistent with the methodologies employed for the analysis of existing conditions. This chapter summarizes and compares the operational results of no build and build alternatives under future conditions as well as the qualitative cost assessments prepared for the two alternatives and the final measures of effectiveness (MOE) evaluation.

FUTURE CONDITIONS ANALYSIS

Synchro analyses were completed for ten non-Parkway study area intersections. Since the roadway geometry of these intersections and the future year traffic volume forecasting is independent of the two FCP and Popes Head Road interchange alternatives in the build condition, one analysis scenario was evaluated for the build condition in addition to the no build condition. **Figure 5.1** and **Figure 5.2** summarize the AM and PM peak hour turning volumes for the 2040 no build and build conditions for all study area intersections. MOEs obtained from Synchro include intersection level of service (LOS), delay, as well as queuing results from the SimTraffic simulations. The VISSIM analysis focused on key interchanges and intersections along FCP (similar to existing conditions). Two build condition VISSIM models for the interchange alternatives included the northern alignment 1B (both models) and the southern alignments 2A (1) and 2A/2B, as described in Chapter 4. In addition to the two build models, a no build condition model was also evaluated using VISSIM software. The intersection of Braddock Road and Shirley Gate Road was also modeled in the build scenarios given its importance to the extension of Shirley Gate Road. MOEs obtained from VISSIM include intersection LOS, delay, queue length, and travel time. Note that in the no build and build condition, FCP was assumed to be a six-lane facility and Braddock Road was assumed to be a six-lane facility between the signalized southbound off-ramp from FCP and Ox Road, per the County Comprehensive Transportation Plan.

Figure 5.1 – 2040 No Build
AM and PM Peak Hour Turning Volumes





Turning Movement

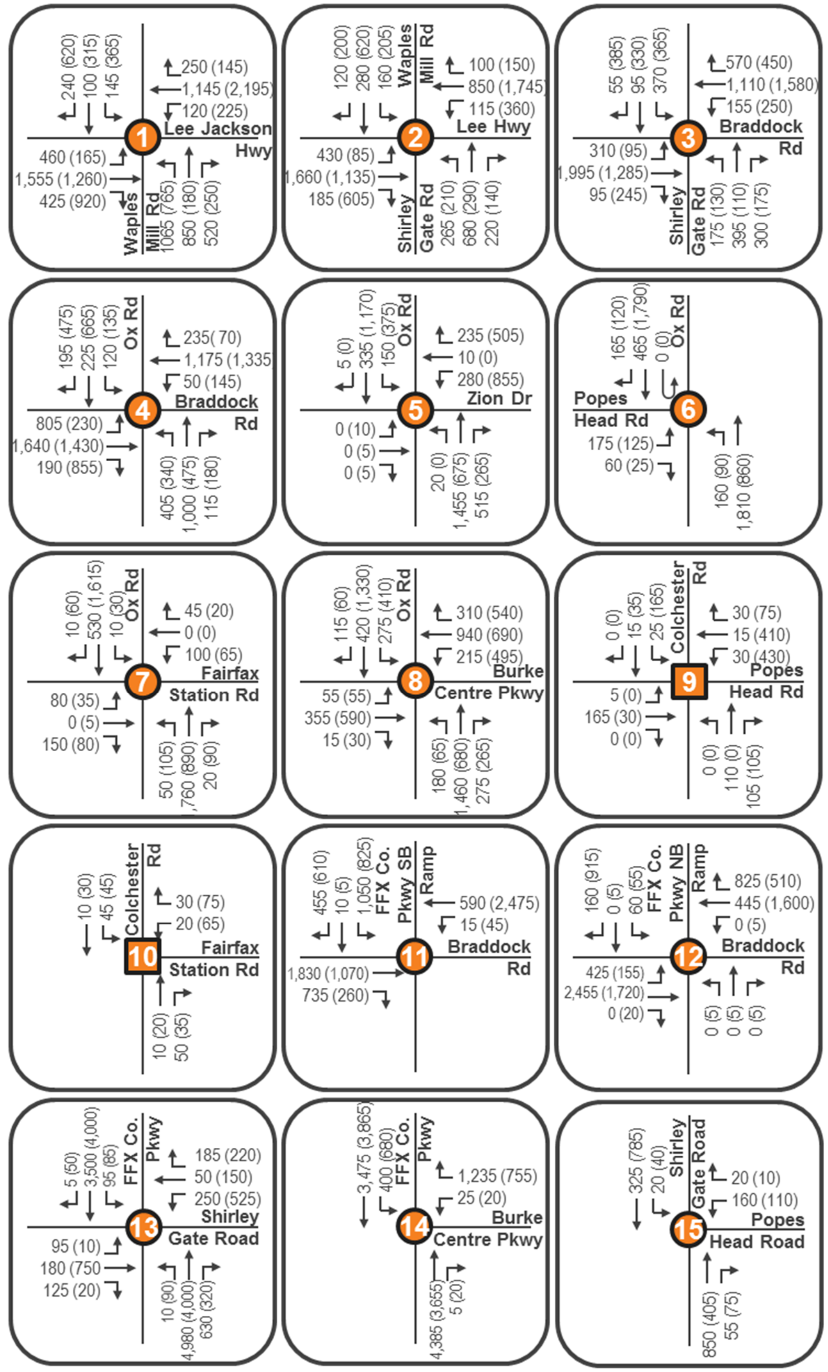
XX (XX) AM (PM) Peak Hour Volume

X Signalized Intersection

X Unsignalized Intersection

Shirley Gate Road Extended (Build Scenario)

Figure 5.2 – 2040 Build
AM and PM Peak Hour Turning Volumes



Synchro Analysis – Non-Parkway Intersections

Peak hour future conditions analyses were completed using Synchro 8.0 software at the ten non-Parkway study area intersections. Refer to Chapter 3 for a description of LOS and delay thresholds for signalized and unsignalized intersections. **Figure 5.3** and **Figure 5.4** summarize the no build and build intersection LOS for the AM and PM peak hours, respectively. **Appendix D** provides a tabular summary of the LOS and delay by movement, approach, and overall intersection, along with the corresponding HCM reports from Synchro. As shown in **Figure 5.3**, six of the ten non-Parkway study area intersections operate at an overall LOS D or better during the AM peak hour under no build conditions. The remaining four intersections experience a greater delay because of heavy traffic volumes and insufficient intersection capacity. Under build conditions, similar levels of service are observed for these ten intersections as in no build, though the actual delay differs as shown in **Table 5.1**.

Summary of AM Peak Hour Operations

The intersection of Lee Jackson Memorial Highway and Waples Mill Road has an overall intersection delay of approximately 96 seconds under both no build and build conditions. All left-turn movements operate at a LOS F, with all but the southbound left-turn movement experiencing an average delay of more than 100 seconds per vehicle. This level of delay is also observed under existing conditions. The intersection of Lee Highway and Waples Mill Road/Shirley Gate Road operates at a LOS E under both no build and build conditions, with a slightly greater overall delay under build conditions. Build volumes are slightly greater on the northbound and southbound approaches, which can be attributed to increased demand from the Shirley Gate Road extension. These approaches are allocated a lower proportion of green time than the mainline Lee Highway given the lower demand along these approaches.

All the intersections along Ox Road experience less delay under build conditions due to the lower mainline volumes as compared to no build. Because of the Shirley Gate Road extension, a notable shift in traffic occurs from the Ox Road corridor to the new roadway alignment.

The intersection of Shirley Gate Road and Braddock Road operates at LOS C in the no build condition, but with the roadway extension, intersection operations diminish to LOS D in the build condition. The increase in delay can be attributed to the northbound approach volume in the build condition, which is zero in no build. The intersection effectively operates with three phase sequences in the no build given the lack of demand on this approach (i.e. mainline left-turns, mainline through movements, and southbound). Given the added demand, a fourth phase sequence is introduced, reducing the allocation of green time to the heavy Braddock Road mainline through movements. This intersection is evaluated in the build condition and is discussed in greater detail in the VISSIM Analysis section on page 10.

Table 5.1: Summary of AM Peak Hour Intersection Levels of Service and Delay (seconds) from Synchro

Intersection	Delay (seconds per vehicle)		
	No Build	Build	Delta
1 - Lee Jackson Memorial Highway and Waples Mill Road	F (95.7)	F (96.2)	+0.5
2 - Lee Highway and Waples Mill Road/Shirley Gate Road	E (67.8)	E (74.2)	+6.4
3 - Braddock Road and Shirley Gate Road	C (21.1)	D (51.1)	+30.0
4 - Ox Road and Braddock Road	F (170.4)	F (137.5)	-33.0
5 - Ox Road and Zion Drive	D (50.1)	C (30.9)	-19.2
6 - Ox Road and Popes Head Road	B (18.5)	B (12.9)	-5.6
7 - Ox Road and Fairfax Station Road/Adare Road	B (16.0)	B (15.2)	-0.8
8 - Ox Road and Burke Centre Parkway	F (108.0)	F (82.5)	-25.5
9 - Colchester Road and Popes Head Road	A (8.8)	A (9.1)	+0.3
10 - Colchester Road and Fairfax Station Road	A (5.0)	A (4.9)	-0.1

Summary of PM Peak Hour Operations

Figure 5.4 and **Table 5.2** illustrate that similar operating conditions are expected during the PM peak hour, with several additional intersections transitioning into the LOS E and F thresholds as compared to existing conditions. As with the AM peak hour, left-turn movements contribute to the increased delay at the intersection of Lee Jackson Memorial Highway and Waples Mill Road under build conditions (overall increase in delay of approximately 24 seconds). Lee Highway and Waples Mill Road/Shirley Gate Road also experiences a slight increase in delay under build conditions resulting from the increase in westbound left-turn and southbound through volume, which compete with the heavy through movements along the mainline.

Similar to the AM peak hour, the intersections along Ox Road experience less delay under build conditions due to the lower volumes compared to no build. The exception to this is the intersection of Ox Road and Burke Centre Parkway. The eastbound approach at the intersection carries greater volume than the no build scenario, which can be attributed to vehicles using FCP in the build scenario to travel south and east with the elimination of the congestion point at Popes Head Road. In the no build scenario, these trips likely diverted at Popes Head Road, Braddock Road, or points further north. In the build scenario, the eastbound approach competes with the heavy southbound through movement for green time allocation.

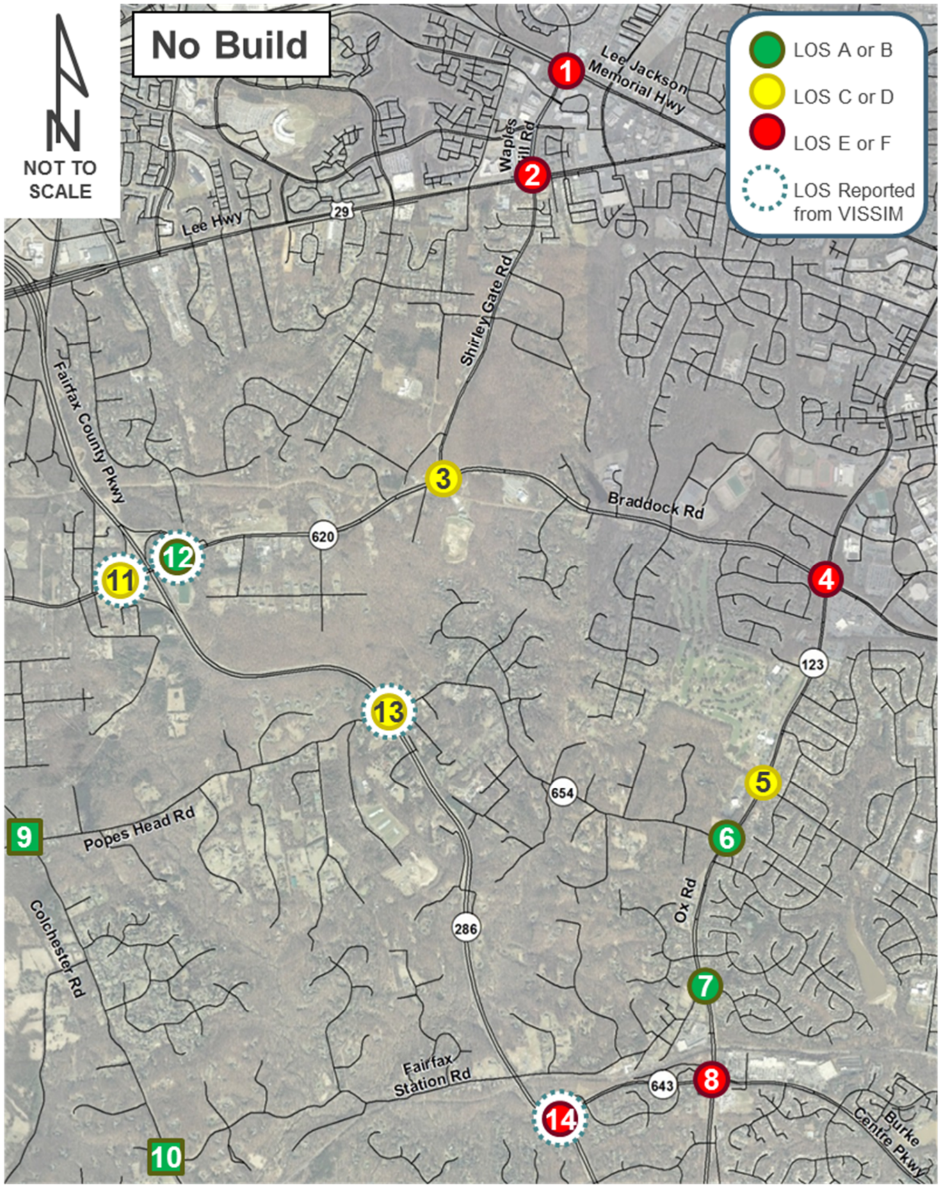
Operations of the stop-controlled intersection of Colchester Road and Popes Head Road degrade as a result of the large increase in westbound Popes Head Road volume. This increase in volume could represent trips diverting from FCP to reach points west and south of the study area, albeit less than 400 trips during the peak hour. While the unsignalized intersection deteriorates to LOS F, it is likely that these diversion trips will revert to FCP if the stop control delay proves to be too great. Aside from the westbound approach, all other movements at the intersection operate at LOS B or better.

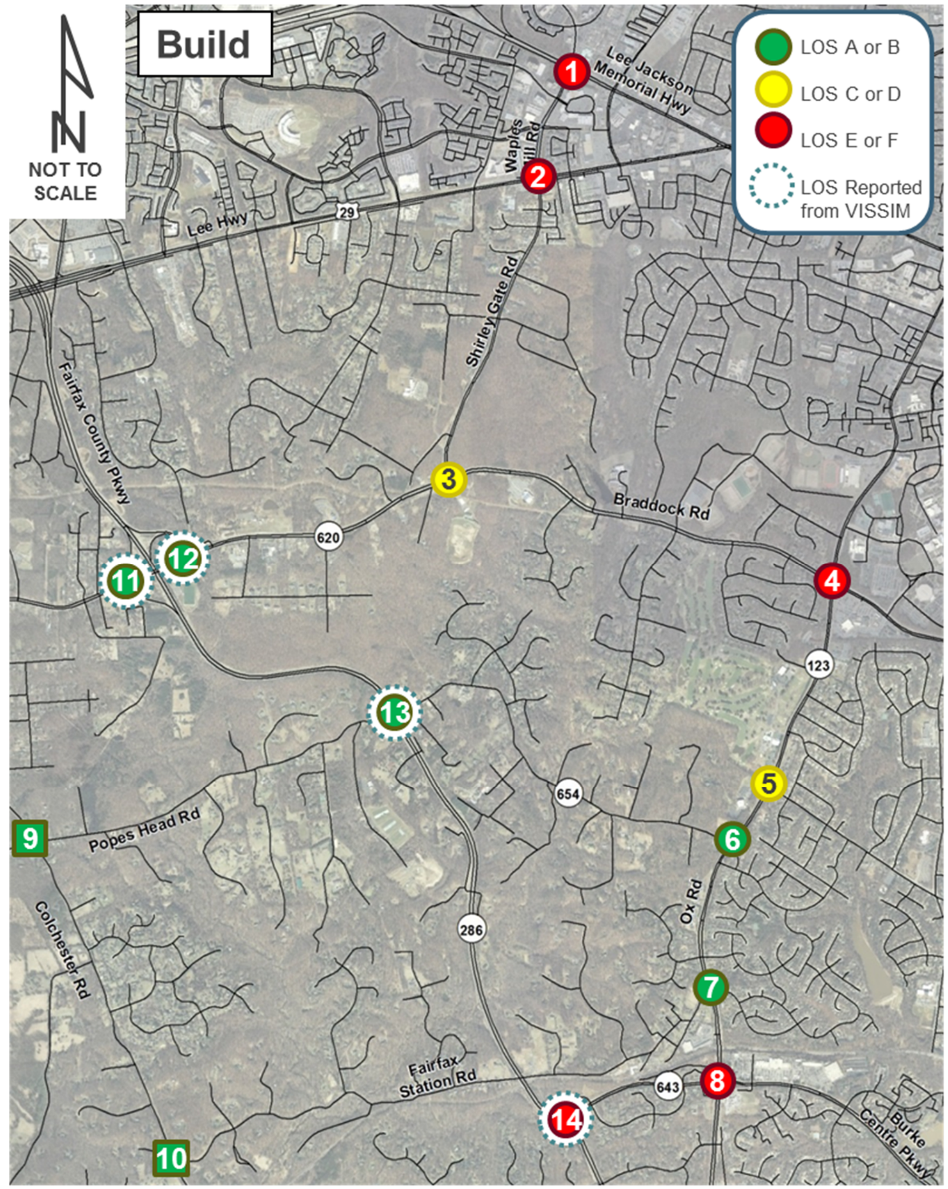
The intersection of Shirley Gate Road and Braddock Road operates at LOS F under no build conditions and improves to LOS E under build conditions, with a decrease in average delay of 23.5 seconds per vehicle overall, or nearly 30 percent. The heavy southbound left-turn movement in the no build alternative experiences average delays of approximately 4 minutes per vehicle. In addition, the high demand along this approach negatively impacts the heavy mainline Braddock Road, competing for green time. The extension of Shirley Gate Road to the south alleviates this issue with a more efficient use of the southbound approach green time allocation. Operations of this intersection are further discussed in the VISSIM Analysis section on page 10.

Table 5.2: Summary of PM Peak Hour Intersection Levels of Service and Delay (seconds) from Synchro

Intersection	Delay (seconds per vehicle)		
	No Build	Build	Delta
1 - Lee Jackson Memorial Highway and Waples Mill Road	F (121.4)	F (145.3)	+24.0
2 - Lee Highway and Waples Mill Road/Shirley Gate Road	E (68.0)	E (80.1)	+12.1
3 - Braddock Road and Shirley Gate Road	F (81.9)	E (58.4)	-23.5
4 - Ox Road and Braddock Road	F (132.1)	F (110.8)	-22.0
5 - Ox Road and Zion Drive	F (120.1)	F (117.5)	-3.0
6 - Ox Road and Popes Head Road	B (16.1)	B (15.6)	-0.5
7 - Ox Road and Fairfax Station Road/Adare Road	B (11.2)	A (9.5)	-1.7
8 - Ox Road and Burke Centre Parkway	E (69.1)	F (89.0)	+19.9
9 - Colchester Road and Popes Head Road	A (10.7)	F (45.6)	+34.9
10 - Colchester Road and Fairfax Station Road	A (7.5)	A (6.4)	-1.1

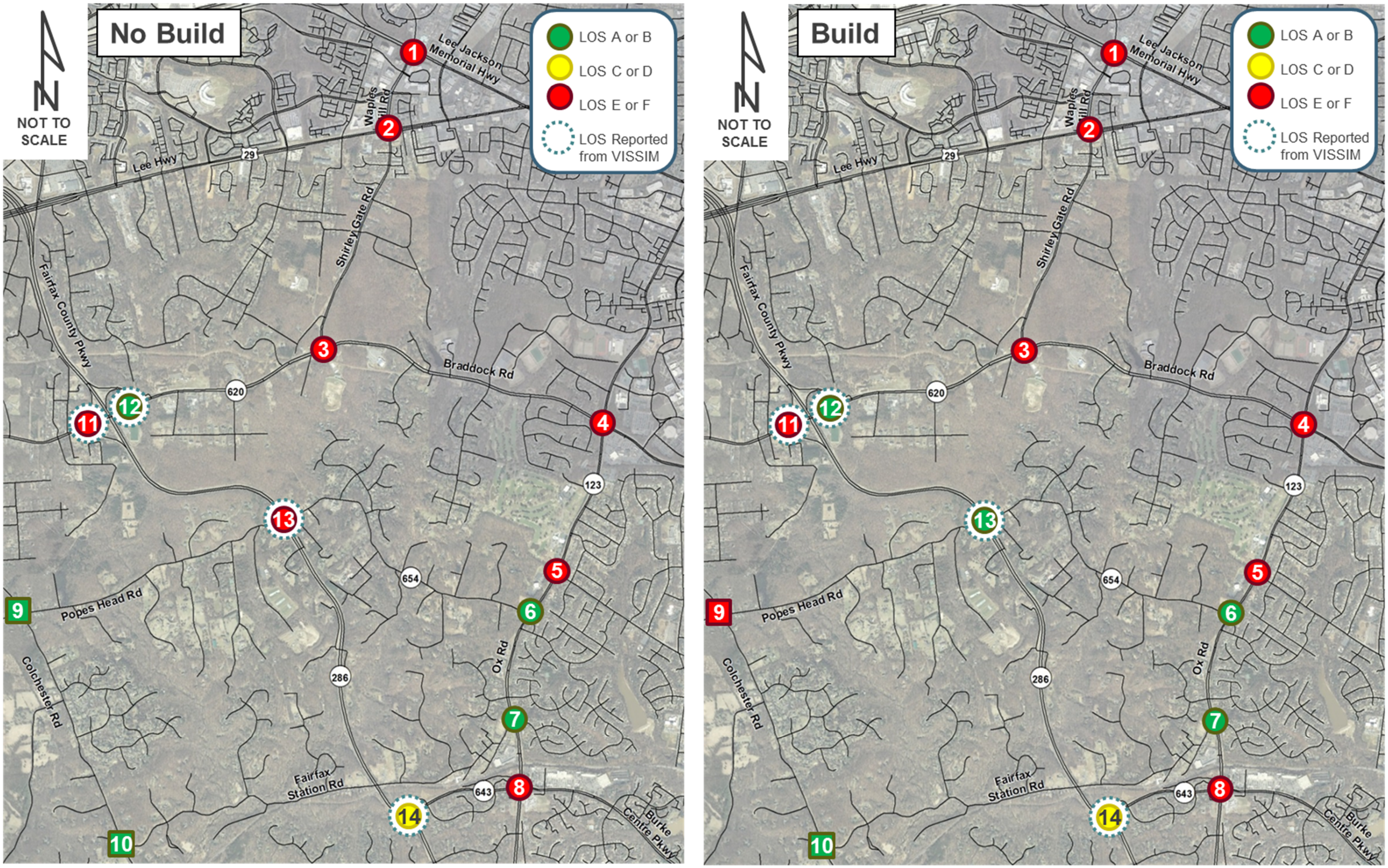
Figure 5.3 – 2040 AM Peak Hour Level of Service





AM Peak Hour: 7:30 – 8:30 AM

Figure 5.4 – 2040 PM Peak Hour Level of Service



PM Peak Hour: 5:00 – 6:00 PM

SimTraffic Queue Analysis – Non-Parkway Intersections

SimTraffic was used to evaluate vehicle queuing at the non-FCP study area intersections under 2040 conditions. **Appendix D** provides a tabular summary of the 95th percentile queue lengths (rounded up to the nearest increment of 25 feet) as well as the outputs from SimTraffic. Queuing issues were noted at the following locations based on the results of the SimTraffic simulations (issues noted with an asterisk (*) represent further degradation as compared to existing conditions):

- Lee Jackson Memorial Highway and Waples Mill Road
  - The northbound left-turn movement queues beyond the intersection with Random Hills Road to the south during the AM and PM peak hours in both no build and build conditions.
  - The southbound left-turn movement queue extends past the available storage during the PM peak hour for both no build and build scenarios.*
  - Significant eastbound queuing is observed in all scenarios, with through movement queues occasionally blocking access for left-turning vehicles.*
  - The westbound through movement queue extends past the available storage for the westbound left-turn movement in all scenarios, potentially blocking access for turning vehicles.
- Lee Highway and Waples Mill Road/Shirley Gate Road
  - During the AM peak hour, the northbound through and right-turn movement queues both extend past the available storage for each movement under build conditions, potentially blocking access for the adjacent movement. This is observed to a lesser degree in the no build scenario.
  - The southbound left-turn movement spills out of the available storage in all scenarios. Under build conditions, the through movements also exceeds the storage length of the left-turn movement, potentially blocking access.*
  - The eastbound through movement queue extends past the available storage for the left and right-turn movements in all scenarios, potentially blocking access for turning vehicles.
  - During the PM peak hour, the westbound through movement queue extends past the available storage for the left-turn movement, potentially blocking access for turning vehicles. This was observed in both no build and build scenarios.
- Braddock Road and Shirley Gate Road
  - During the PM peak hour, the southbound left-turn movement queue exceeds the existing storage length and the southbound through movement queue also extends past this storage length, potentially blocking left-turning vehicles. This is predominantly an issue under no build conditions. The reconfiguration of the intersection in the build scenario combined with travel pattern shifts associated with the Shirley Gate Road extension results in significant reductions in queuing as compared to no build.
  - Significant queues are observed on the eastbound approach during the AM peak hour under no build conditions. This is a result of the queue spillback from the downstream left-movement at the Ox Road and Braddock Road intersection. Greater demand at this downstream intersection limits the throughput of the intersection, which has an impact on operations at the Shirley Gate Road intersection.
- Ox Road and Braddock Road
  - The northbound through and left-turn movements experience significant queues during the AM peak hour. The through movement queue decreases significantly under build conditions which results in less frequent turn-bay blocking.
  - Significant southbound queues are observed in all scenarios except for AM build conditions. In the build condition, the volume of the opposing northbound left-turn movement is diminished, allowing for the reallocation of green time to this and other movements.*

- The eastbound through and left-turn movements experience significant queues during the AM peak hour in both no build and build scenarios. Queues in the through lanes can be attributed to spillback associated with the left-turn movement. Significant queues are observed in the PM scenarios as well; however, spill back does not occur from the left-turn movement.

- Ox Road and Zion Drive
  - During the AM peak hour under no build conditions, the northbound through movement extends past the available storage for the left- and right-turn movements, potentially blocking access for turning vehicles.*
  - During the PM peak hour under both no build and build conditions, the southbound left-turn movement spills out of the available storage.
  - During the AM and PM peak hours, the westbound left-turn movement experiences significant queues, which regularly blocks access to the shared through and right-turn lane. This queue decreases under build conditions but still impacts the shared lane.
- Ox Road and Popes Head Road
  - During the AM peak hour under no build conditions, the northbound left-turn movement spills out of the available storage.*
- Ox Road and Burke Centre Parkway
  - During the AM peak hour in both the no build and build scenarios, the northbound left-turn movement exceeds the available storage. The through movement queue also exceeds the turn bay storage lengths, potentially blocking vehicle access.*
  - The eastbound through movement exceeds the turn bay storage lengths in the build scenario during the PM peak hour, potentially blocking vehicle access; however, the volume of the volume of the eastbound left-turn movement is relatively low and the impact of access being blocked should be minimal.
  - Similarly, the westbound through movement exceeds the left-turn movement storage length in all scenarios. The length of the westbound through movement queue is partially attributed to the westbound left-turn queue extending beyond the available turn bay storage.

VISSIM Analysis – Fairfax County Parkway Intersections

VISSIM 6.0-19 software was used to evaluate the operational performance of the intersections along FCP under no build conditions as well as two build alternatives. As discussed in **Chapter 4**, interchange alternatives Option 2A (1) and Option 2A/2B were selected for further VISSIM analysis. Both interchange alternatives utilize the northern alignment Option 1B. Therefore, the alternative VISSIM scenarios are denoted as (refer to **Chapter 4** for graphical representations of these alignments or **Figure 5.6** and **Figure 5.7** for conceptual representations of these alignments):

- No Build
- Build 1B-2A
- Build 1B-2A/2B

The operational performance is evaluated for the following intersections along FCP and Shirley Gate Road:

- Braddock Road and FCP SB Ramps
- Braddock Road and FCP NB Ramps
- FCP and Popes Head Road
- FCP and Burke Centre Parkway
- Braddock Road and Shirley Gate Road (Build 1B-2A and 1B-2A/2B only)
- Shirley Gate Road and Popes Head Road (Build 1B-2A only)
- Shirley Gate Road and Connector Road (Build 1B-2A/2B only)
- Connector Road and Popes Head Road (Build 1B-2A/2B only)

The methodology used in the future conditions VISSIM analysis was consistent with what is presented in Chapter 3 for existing conditions VISSIM analysis and Chapter 4 for traffic volume forecasting. Balanced 2040 traffic volumes for no build and build conditions (summarized in **Figure 5.1** and **Figure 5.2**) were used to obtain VISSIM traffic volumes for a seeding hour and two peak hours. 15-minute distribution factors consistent with existing conditions (shown in **Table 3.3**) were applied to the post-processed peak hour turning volumes. Traffic routing in the models primarily consists of static routes as a series of turning movement routes at each intersection. One exception to this was made at the future interchange of FCP and Shirley Gate Road in the build scenarios. Routing at this location was consolidated into longer routes through multiple adjacent intersections (e.g. the ramp and Connector Road intersections in Build 1B-2A/2B) to avoid unrealistic looping routes. Throughput, delay, queue, and travel time measurements were collected at each intersection listed above during the network peak hours (7:30 – 8:30 a.m. and 5:00 – 6:00 p.m.). A total of 10 simulation runs per peak period and scenario were completed.

The results presented below highlight the differences between no build and the two build interchange alternatives (existing conditions provided for reference from **Chapter 3**). **Table 5.4** and **Table 5.5** summarize the MOEs for each intersection analyzed for the AM and PM peak hours. Movements and overall intersection delays that exceed the thresholds for LOS E and LOS F are highlighted in orange and red, respectively. A comparison of the travel time between the no build and build alternatives is also discussed below for northbound/southbound FCP and eastbound/westbound Popes Head Road.

AM Peak Results

No Build

Intersection analyses of the AM peak hour indicate that significant delays and queuing are expected under no build conditions at the intersection of FCP and Popes Head Road, as shown in **Table 5.5**. The side street movements and mainline left-turns from FCP experience delays greater than 140 seconds per vehicle. Increased delay of the left-turn movements can be partially attributed to the change from protected-permissive to protected only operations. This change in operations was assumed given the peak hour intersection volume and widening of FCP to six lanes. Overall vehicular delay during the AM peak hour is approximately 39 seconds (LOS D) at this intersection. The high cycle length of more than 5 minutes (similar to existing conditions) is intended to maintain an extended green interval and process the heavy mainline through traffic; however, northbound queues reach 4,425 feet, and southbound queues reach 1,385 feet at their maximum. The westbound right turn movement experiences substantial delay and queuing due to the lack of gaps in mainline traffic and limited green time allocation.

Build Alternatives

Delays and queues are reduced or eliminated in the build alternatives. Delay and congestion along FCP at Popes Head Road in the build condition are eliminated with the proposed removal of the traffic signal and grade separation. The signalized intersections associated with the tight diamond interchange considered in the Build 1B-2A scenario operate with an average delay of about 14 seconds per vehicle, or LOS B, with maximum queues around 225 feet. The intersection of Shirley Gate Road and Popes Head Road southwest of the interchange operates with minimal delay and queuing. This intersection was modeled as stop-controlled on the Shirley Gate Road approach based on the anticipated hourly volume. Due to the sufficient number of gaps along Popes Head Road, an average overall delay of less than 5 seconds per vehicle is expected. While this intersection configuration functions operationally, further assessment of design and sight distance are necessary, which may yield a recommendation for all-way stop control or signal control. The free-flow ramps of Build 1B-2A/2B also provide reduced delay and queues in this area compared to no build. The southbound off-ramp and the Connector Road intersections with Popes Head Road operate with minimal delay and queuing. Similar to the previous build alternative, sufficient gaps along Popes Head Road allow these intersections to operate at LOS A with the approaches to Popes Head Road operating as stop-controlled. The signalized intersection of Shirley Gate Road and the Connector Road (and future park access) has an average delay of approximately 14 seconds per vehicle (LOS B).

The intersection of Braddock Road with Shirley Gate Road was modeled in VISSIM only for the build alternatives; Synchro and SimTraffic results for the no build condition are included for comparison. This intersection operates at an average LOS C during the AM peak hour under no build conditions. The greatest delays are associated with the southbound and eastbound left-turn movements, each with an average delay of more than 40 seconds per vehicle. The heaviest movement, the eastbound through movement, operates at a LOS B but has a maximum queue of 3,500 feet. Overall intersection delays increase in the build alternatives with the added southern leg and increased volume. Both build alternatives operate very similarly at this location. Average delay is approximately 37 seconds per vehicle, or LOS D. The left turn movements experience the greatest delays, approximately one minute. Queuing decreases compared to no build due to a shorter 150 second cycle length, especially on the heavy eastbound approach. The reduction in cycle length was made to better match cycle length with demand and intersection capacity based on guidance provided in Synchro.

Other intersections included in the VISSIM models include the FCP ramps at Braddock Road as well as FCP and Burke Centre Parkway. The ramp intersections with Braddock Road operations are improved slightly in the build alternatives. The southbound off-ramp intersection overall delays decrease from approximately 24 seconds (LOS C) under no build to 19 seconds (LOS B) under build conditions. Maximum queues on the ramp approach do not reach the mainline of FCP in any of the AM peak scenarios. The intersection of Braddock Road with the northbound FCP ramps also has decreased delay in the build alternatives. Overall delay remains at LOS B; however, the eastbound and southbound left-turn movements experience delays of more than one minute across all scenarios. The primary cause for the reduction in delay at these intersections is associated with a reduction in traffic volumes along Braddock Road in the build condition.

Operations at the intersection of FCP and Burke Centre Parkway degrade under the build alternatives compared to no build, although overall LOS F is maintained in all scenarios. The two build alternatives operate with minor differences at this location despite identical demand and operations, which can be attributed to the variability in microsimulation. The increase in northbound volume under build conditions results in greater delays and queues for this approach compared to no build. The through movement delay increases by approximately 82 seconds per vehicle compared to no build and maximum queues exceed 4,600 feet compared to 2,325 feet in no build. The southbound left-turn volume also increases slightly in the build condition which contributes to the northbound approach delays. The westbound Burke Centre Parkway demand increases in the build scenarios resulting in significant delays and queues for the over-capacity right turn movement.

It is important to note that delays and queues at Burke Centre Parkway intersection may be overstated as there isn't upstream intersection metering captured in the VISSIM model for the northbound approach. In addition, while demand in the build condition is much greater as compared to the no build, the capacity of the intersection limits the actual throughput. As shown in **Table 5.5**, the total throughput at the intersection is approximately 800 vehicles less than the actual demand. This is ultimately what contributes to the increased delay and queuing. In actuality, what this represents in the field is a peak hour that spans a period of time greater than 60 minutes to process the intersection demand during the peak hour.

Travel time measurements obtained from the models show improvement in the build alternatives. Again, both build alternatives showed similar travel times. **Figure 5.5** shows no build directional travel times and the travel time reductions with the build alternatives. Northbound travel time along FCP has an approximately 40 second reduction under the build alternatives from the 4.5 minutes in no build. The southbound direction has a marginal travel time reduction of about 15 seconds. The interchange alternatives greatly reduce travel times along Popes Head Road crossing FCP to the extents shown in the figure. Westbound travel time reduces by about 6.5 minutes while the eastbound direction has a 3.2 minute reduction.

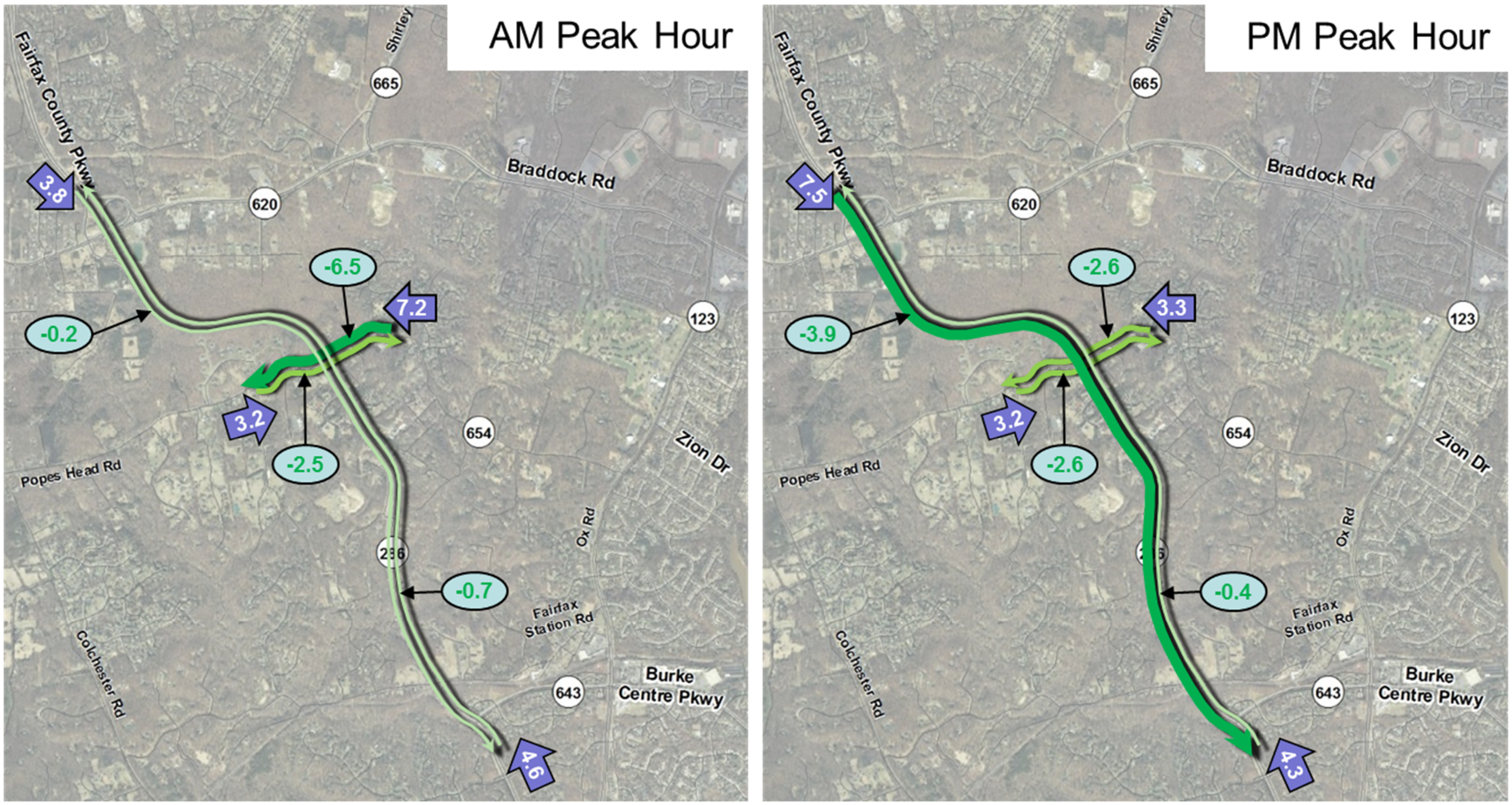
Table 5.5 —AM Peak Hour Intersection MOEs from VISSIM

AM Peak Hour Intersection Results			2014 Existing					2040 No Build					2040 Build 1B 2A					2040 Build 1B 2A/2B				
Intersection	Approach	Movement	Throughput (vph)	Demand (vph)	Delay (LOS)	Average Queue (ft)	Maximum Queue (ft)	Throughput (vph)	Demand (vph)	Delay (LOS)	Average Queue (ft)	Maximum Queue (ft)	Throughput (vph)	Demand (vph)	Delay (LOS)	Average Queue (ft)	Maximum Queue (ft)	Throughput (vph)	Demand (vph)	Delay (LOS)	Average Queue (ft)	Maximum Queue (ft)
Fairfax County Pkwy SB Ramp and Braddock Rd	SB	LT	582	593	71.9 (E)	150	550	1169	1145	37.2 (D)	115	470	1072	1050	31.8 (C)	95	425	1072	1050	31.9 (C)	95	420
		TH	5	2	64.6 (E)	150	550	0	5	0.0 (A)	115	470	0	10	0.0 (A)	95	425	0	10	0.0 (A)	95	420
		RT	104	70	9.7 (A)	25	25	310	310	12.8 (B)	5	125	460	455	9.4 (A)	5	135	460	455	9.3 (A)	5	150
	EB	TH	1906	1897	20.1 (C)	175	1125	1869	1840	26.9 (C)	100	460	1863	1830	20.2 (C)	70	375	1862	1830	20.6 (C)	75	375
		RT	450	441	12.1 (B)	25	50	748	730	9.6 (A)	0	0	750	735	7.7 (A)	5	60	751	735	7.1 (A)	5	20
	WB	LT	32	29	42.2 (D)	25	50	31	30	47.4 (D)	10	80	15	15	21.6 (C)	5	40	15	15	17.6 (B)	5	45
		TH	600	501	6.6 (A)	25	125	711	695	14.6 (B)	25	205	583	590	12.9 (B)	20	165	586	590	15.8 (B)	25	195
	Intersection		**3679**	**3533**	**25.5 (C)**		**1125**	**4838**	**4755**	**24.1 (C)**		**470**	**4743**	**4685**	**18.9 (B)**		**425**	**4746**	**4685**	**19.3 (B)**		**420**
Fairfax County Pkwy NB Ramps and Braddock Rd	NB	LT	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0
		TH	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0
		RT	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0
	SB	LT	70	55	61.9 (E)	50	100	53	55	98.2 (F)	25	95	54	60	87.2 (F)	25	90	54	60	86.8 (F)	25	95
		TH	8	0	3.7 (A)	50	100	0	0	0.0 (A)	25	95	0	0	0.0 (A)	25	90	0	0	0.0 (A)	25	95
		RT	244	147	3.5 (A)	0	0	164	170	13.9 (B)	0	0	143	160	3.3 (A)	0	0	143	160	3.8 (A)	0	0
	EB	LT	326	316	85.6 (F)	75	275	426	420	64.7 (E)	90	380	430	425	68.2 (E)	95	415	430	425	76.6 (E)	100	405
		TH	2176	2172	81.3 (F)	25	250	2649	2565	5.0 (A)	10	330	2538	2455	4.2 (A)	10	245	2537	2455	4.3 (A)	10	245
		RT	18	2	5.6 (A)	25	25	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0
	WB	LT	0	1	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0	0	0	0.0 (A)	0	0
		TH	390	382	B (10.2)	25	125	574	555	17.0 (B)	20	165	453	445	11.6 (B)	15	140	453	445	13.6 (B)	20	145
		RT	593	597	B (11.7)	25	325	874	845	37.7 (D)	215	950	832	825	15.9 (B)	50	690	831	825	6.1 (A)	0	0
	Intersection		**3825**	**3672**	**B (12.0)**		**325**	**4740**	**4610**	**18.3 (B)**		**950**	**4450**	**4370**	**14.3 (B)**		**690**	**4448**	**4370**	**12.7 (B)**		**405**
Fairfax County Pkwy and Popes Head Rd*	NB	LT	15	17	63.8 (E)	25	25	16	15	191.3 (F)	15	80	41	48	43.4 (D)	10	100					
		TH	3191	3251	25.3 (C)	625	3450	4620	4770	38.1 (D)	945	4425										
		RT	12	7	22.1 (C)	25	25	10	10	37.8 (D)	5	30	529	592	2.8 (A)	5	110					
	SB	LT	60	48	141.1 (F)	25	125	66	65	177.2 (F)	70	230	94	89	39.3 (D)	25	145					
		TH	2724	2681	147.8 (F)	100	975	3685	3560	11.4 (B)	115	1385										
		RT	21	19	4.7 (A)	25	25	17	15	9.7 (A)	5	25	12	11	6.6 (A)	30	160					
	EB	LT	28	24	119.4 (F)	25	125	46	45	144.6 (F)	45	190	158	156	21.5 (C)	30	225					
		TH	31	23	9.4 (A)	50	125	43	40	149.5 (F)	40	165	199	189	18.7 (B)	30	225					
		RT	60	57	7.0 (A)	25	75	102	100	5.8 (A)	5	60	219	207	11.2 (B)	30	225					
	WB	LT	17	5	327.5 (F)	25	75	6	5	390.2 (F)	10	45	167	168	29.4 (C)	10	135					
		TH	12	18	357.4 (F)	25	75	9	10	392.5 (F)	15	60	54	54	12.4 (B)	10	135					
		RT	177	258	341.7 (F)	825	2425	255	270	351.0 (F)	815	1615	132	124	5.9 (A)	10	140					
	Intersection		**6348**	**6408**	**30.7 (C)**		**3450**	**8875**	**8905**	**38.6 (D)**		**4425**	**1605**	**1638**	**14.3 (B)**		**225**					
Fairfax County Pkwy and Burke Centre Pkwy	NB	TH	2617	2676	108.1 (F)	2625	5100	3709	3645	35.2 (D)	510	2325	3834	4385	117.2 (F)	3165	4615	3860	4385	116.4 (F)	3165	4615
		RT	13	3	89.0 (F)	0	0	6	5	26.5 (C)	0	0	4	5	111.3 (F)	0	0	4	5	104.2 (F)	0	0
	SB	LT	178	187	131.5 (F)	100	225	350	345	100.0 (F)	110	355	410	400	88.8 (F)	130	405	413	400	97.3 (F)	130	415
		TH	2635	2614	20.6 (C)	300	2075	3474	3320	14.4 (B)	40	1095	3584	3475	5.4 (A)	25	645	3589	3475	9.3 (A)	25	645
	WB	LT	19	11	110.3 (F)	25	75	16	20	591.3 (F)	20	80	18	25	773.8 (F)	20	80	17	25	780.7 (F)	20	85
		RT	570	672	107.1 (F)	250	600	948	1150	525.4 (F)	2735	3365	875	1235	715.7 (F)	3280	3390	875	1235	724.5 (F)	3305	3415
	Intersection		**6032**	**6163**	**70.8 (E)**		**5100**	**8503**	**8485**	**85.0 (F)**		**3365**	**8725**	**9525**	**131.3 (F)**		**4615**	**8758**	**9525**	**133.6 (F)**		**4615**
Braddock Rd and Shirley Gate Rd**	NB	LT											167	175	54.3 (D)	60	275	167	175	57.3 (E)	60	295
		TH											378	395	51.8 (D)	70	260	377	395	52.2 (D)	65	255
		RT											278	300	19.4 (B)	30	235	278	300	20.2 (C)	35	260
	SB	LT	Not Reported from Synchro Analyses	309	47.5 (D)	110	195	Not Reported from Synchro Analyses	390	43.6 (D)	185	560	374	370	52.0 (D)	70	255	373	370	51.5 (D)	70	260
		TH		0	-	-	-		0	-	-	-	98	95	43.6 (D)	20	90	97	95	43.8 (D)	20	100
		RT		82	23.2 (C)	10	25		45	25.2 (C)	20	70	56	55	6.5 (A)	5	65	56	55	6.0 (A)	5	70
	EB	LT		560	51.7 (D)	195	320		250	47.8 (D)	190	625	312	310	59.6 (E)	65	245	315	310	59.9 (E)	65	240
		TH		1612	16.0 (B)	295	840		2305	18.2 (B)	1040	4940	2028	1995	37.7 (D)	190	920	2040	1995	38.5 (D)	200	945
		RT		0	-	-	-		0	-	-	-	98	95	10.9 (B)	5	55	99	95	11.0 (B)	5	50
	WB	LT		3	18.8 (B)	10	10		5	16.9 (B)	10	20	158	155	61.4 (E)	40	145	157	155	64.0 (E)	45	150
		TH		975	28.5 (C)	325	680		1405	22.0 (C)	170	370	1137	1110	31.7 (C)	85	335	1142	1110	32.2 (C)	85	345
		RT		832	14.8 (B)	185	445		840	8.6 (A)	150	370	601	570	12.5 (B)	30	305	602	570	12.0 (B)	25	310
	Intersection			**4373**	**47.5 (D)**		**840**		**5240**	**21.0 (C)**		**4940**	**5685**	**5625**	**36.5 (D)**		**920**	**5703**	**5625**	**37.0 (D)**		**945**
Shirley Gate Rd and Popes Head Rd	SB	LT											60	64	16.1 (C)	5	85					
		RT											47	49	6.0 (A)	5	85					
	EB	LT											404	389	4.1 (A)	5	140					
		TH											12	11	0.3 (A)	0	0					
	WB	TH											17	16	1.0 (A)	0	0					
		RT											172	163	1.4 (A)	0	0					
	Intersection												**712**	**692**	**4.5 (A)**		**140**					
Fairfax County Pkwy SB Ramp and Popes Head Rd	SB	LT																101	95	13.4 (B)	5	95
		RT																5	5	6.9 (A)	5	50
	EB	TH																414	400	0.1 (A)	0	0
	WB	TH																58	50	0.0 (A)	0	0
	Intersection																	**578**	**550**	**2.5 (A)**		**95**
Connector Rd and Popes Head Rd	SB	LT																53	58	11.7 (B)	5	70
		RT																42	44	6.0 (A)	5	75
	EB	LT																499	478	6.9 (A)	10	215
		TH																19	17	0.8 (A)	5	15
	WB	TH																17	16	0.7 (A)	0	0
		RT																172	164	1.3 (A)	0	0
	Intersection																	**802**	**777**	**5.7 (A)**		**215**
Shirley Gate Rd and Connector Rd	NB	TH																529	592	16.8 (B)	25	185
		RT																41	48	6.0 (A)	5	60
	SB	LT																54	54	14.6 (B)	5	95
		TH																298	292	9.3 (A)	10	120
	WB	LT																378	363	20.6 (C)	45	415
		RT																292	278	8.3 (A)	10	130
	Intersection																	**1592**	**1627**	**14.4 (B)**		**415**

**No Build results for this intersection are obtained from Synchro (LOS) and SimTraffic (Queuing)

*This is the intersection of the directional Fairfax County Parkway ramps and Shirley Gate Road extension in Build 1B-2A (tight diamond interchange)

Figure 5.5 – 2040 Travel Time
No Build vs. Build



X.X
No Build Directional Travel Time (Minutes)

-X.X
Travel Time Reduction (Minutes)

Directional Travel Time Reduction Less Than 1 Minute (Build)

Directional Travel Time Reduction 1 to 3 Minutes (Build)

Directional Travel Time Reduction More Than 3 Minutes (Build)

PM Peak Results

No Build

The PM peak hour exhibits similar operational patterns as the AM scenarios. At FCP and Popes Head Road, many of the movements operate at LOS F in the no build scenario, resulting in an overall intersection delay of 120 seconds per vehicle (see **Table 5.6**). Lengthy queues are anticipated along FCP, particularly in the southbound direction, which has a maximum queue length of nearly 5,000 feet. This queue also meters upstream traffic destined for Braddock Road. Southbound left turn queues frequently spill out of the turn bay, further reducing through movement capacity to two lanes. Several cycles are required for vehicles to make the left-turn movement, resulting in average delays in excess of 14 minutes. Northbound delays and queues are much less; however, a maximum queue length of 2,420 feet can be expected. The northbound left-turn movement experiences an average delay of 183 seconds due to the long cycle length, but the low volume of the movement allows the available storage lane to accommodate the maximum queue.

Build Alternatives

Similar to AM, the two build alternatives offer substantial operational improvements at this location. The significant queuing noted above along FCP near Popes Head Road is eliminated with the construction of grade separation improvements. The signalized intersections associated with the tight diamond interchange considered in the Build 1B-2A scenario (see **Figure 5.7**) operate with an average delay of about 20 seconds per vehicle, the threshold for LOS B and LOS C, with maximum queues under 300 feet. The eastbound left-turn movement experiences the greatest delay of approximately 40 seconds, while the highest volume movement, the westbound left-turn, has a delay of approximately 24 seconds. The intersection of Shirley Gate Road and Popes Head Road also operates without any operational deficiencies at LOS A. The free-flow ramps of the Build 1B-2A/2B alternative and the associated intersections with this interchange alternative operate at LOS A. The signalized intersection of Shirley Gate Road and the Connector Road has an average delay of approximately 10 seconds, with the highest delay movement being the westbound left-turn at 23 seconds.

The intersection of Shirley Gate Road and Braddock Road shows operational improvements with the build alternatives compared to no build. The Synchro analysis of this intersection under no build conditions indicates an overall average intersection delay of approximately 82 seconds, or LOS F. Similar to AM, the high volume southbound left-turn movement experiences significant delay in the no build condition, approximately 4 minutes. The southbound right-turn queue frequently exceeds the storage length due to limited gaps in the westbound direction for right turn on red. Overall intersection delay decreases with the two build alternatives at this location. The intersection operates similarly in both build alternatives, with an overall delay of approximately 45 seconds, or LOS D. The left-turn movements from Braddock Road experience the greatest delays; however, these movements carry relatively low volumes and the queues do not affect mainline operations. The added northbound approach with the Shirley Gate Road extension experiences the next highest delays, approximately 85 seconds for the through and left-turn movements. The southbound left-turn movement carries a large volume, nearly 900 vehicles per hour. The largest queues at this intersection are seen for this movement, ranging from 850 to nearly 1,000 feet at their maximum in the build scenarios.

The improvements at FCP and Popes Head Road alleviate the extensive queuing and metering of traffic in the southbound direction. Thus, the ramp intersection at Braddock Road and the intersection with Burke Centre Parkway experience greater overall delays compared to no build from the additional volume that reaches these locations. The overall intersection delay for the southbound ramp intersection with Braddock Road increases from 70 seconds in no build (LOS E) to approximately 90 seconds in the build alternatives. In all scenarios, the southbound approach (off-ramp from FCP) experiences the greatest delays, with maximum queues over one mile spilling back onto FCP. The eliminated downstream bottleneck at Popes Head Road in the build scenarios puts additional strain on this ramp; average delay increases from about 4.5 minutes in no build to 6 minutes for the southbound approach. The northbound ramps intersection with Braddock Road has similar operations between no build and the build scenarios. It operates at LOS B in all scenarios. The movements that operate at LOS E or worse, all carry very low volumes—the sum of which constitute less than 5 percent of the total intersection volume.

Operations at the intersection of FCP and Burke Centre Parkway degrade slightly with the additional demand in the build alternatives. In no build, the greatest delays are seen for the southbound left-turn and westbound turning movements. The maximum queues for the southbound left-turn are contained within the storage length of the turn bay, and maximum queues on the westbound approach reach about 500 feet. Overall, the intersection operates with an average delay of 28 seconds (LOS C). In the build scenarios, demand increases among all movements, particularly for the same movements that operate poorly in the no build condition. This results in an increased delay of for the southbound left-turn movement, increasing from approximately 95 seconds to nearly 135 seconds. Unlike no build, maximum queues are not contained within the turn bay for this movement. Delays and queues also increase for the westbound approach compared to no build, with a maximum queue length ranging from 745 to 760 feet. The intersection operates at LOS D in both build scenarios with an average delay of 41 seconds and 45 seconds for Build 1B-2A and Build 1B-2A/2B, respectively. While delay increases at the intersection, overall throughput is higher in the build condition by approximately 1,300 vehicles during the peak hour as compared to no build, indicating that the intersection has available capacity during the PM peak hour. Although operating at a higher overall delay, the intersection can serve the unmet demand in the no build condition (constrained at the upstream intersection with Popes Head Road) as well as the added demand created by the travel pattern shift with the extension of Shirley Gate Road.

Travel time measurements obtained from the models show improvement in the build alternatives similar to the AM peak. Again, both build alternatives showed similar travel times. **Figure 5.5** shows no build directional travel times and the travel time reductions with the build alternatives. Northbound travel time along FCP has a marginal reduction of approximately 25 seconds compared to no build. Southbound has a more substantial improvement, nearly 4 minutes. The interchange alternatives also reduce travel times along Popes Head Road crossing FCP. The eastbound and westbound directions see a travel time reduction of approximately 2.6 minutes.

Table 5.6 —PM Peak Hour Intersection MOEs from VISSIM

PM Peak Hour Intersection Results			2014 Existing					2040 No Build					2040 Build 1B 2A					2040 Build 1B 2A/2B				
Intersection	Approach	Movement	Throughput (vph)	Demand (vph)	Delay (LOS)	Average Queue (ft)	Maximum Queue (ft)	Throughput (vph)	Demand (vph)	Delay (LOS)	Average Queue (ft)	Maximum Queue (ft)	Throughput (vph)	Demand (vph)	Delay (LOS)	Average Queue (ft)	Maximum Queue (ft)	Throughput (vph)	Demand (vph)	Delay (LOS)	Average Queue (ft)	Maximum Queue (ft)
Fairfax County Pkwy SB Ramp and Braddock Rd	SB	LT	480	538	149.0 (F)	150	525	667	885	257.7 (F)	3575	5325	673	825	369.0 (F)	4180	5300	675	825	350.4 (F)	4360	5325
		TH	8	3	157.6 (F)	150	525	0	5	0.0 (A)	3575	5325	0	5	0.0 (A)	4180	5300	0	5	0.0 (A)	4360	5325
		RT	283	313	123.4 (F)	100	350	410	550	276.8 (F)	3550	5325	492	610	380.2 (F)	4695	5320	497	610	356.8 (F)	4595	5320
	EB	TH	620	608	11.4 (B)	25	200	1052	1045	24.1 (C)	60	350	1082	1070	15.3 (B)	40	310	1082	1070	16.0 (B)	40	335
		RT	220	218	2.6 (A)	0	0	289	285	2.8 (A)	0	0	263	260	2.4 (A)	5	5	264	260	2.2 (A)	5	5
	WB	LT	68	71	8.9 (A)	25	50	61	60	95.1 (F)	40	175	44	45	18.8 (B)	5	50	45	45	7.3 (A)	5	55
		TH	2064	2142	7.9 (A)	50	500	2644	2605	15.2 (B)	170	1305	2517	2475	12.9 (B)	110	1085	2529	2475	13.3 (B)	120	1245
	Intersection		**3743**	**3893**	**35.1 (D)**		**525**	**5123**	**5435**	**69.8 (E)**		**5325**	**5071**	**5290**	**95.8 (F)**		**5320**	**5092**	**5290**	**91.5 (F)**		**5325**
Fairfax County Pkwy NB Ramps and Braddock Rd	NB	LT	18	14	80.4 (F)	25	75	5	5	84.1 (F)	5	45	4	5	106.6 (F)	5	40	4	5	106.9 (F)	5	40
		TH	13	10	77.1 (E)	25	75	5	5	94.9 (F)	5	45	5	5	84.5 (F)	5	40	5	5	86.7 (F)	5	40
		RT	20	18	14.7 (B)	25	75	5	5	8.2 (A)	5	50	4	5	7.0 (A)	5	40	4	5	6.7 (A)	5	40
	SB	LT	34	32	80.2 (F)	25	100	50	50	107.6 (F)	25	95	56	55	96.5 (F)	25	95	56	55	98.3 (F)	25	100
		TH	28	13	5.0 (A)	25	100	5	5	108.8 (F)	25	95	5	5	91.6 (F)	25	95	5	5	98.1 (F)	25	100
		RT	637	631	2.8 (A)	0	0	912	910	30.9 (C)	5	320	931	915	19.0 (B)	5	100	931	915	18.6 (B)	5	140
	EB	LT	108	102	102.8 (F)	50	150	161	160	53.6 (D)	35	170	157	155	62.8 (E)	40	175	157	155	64.4 (E)	40	180
		TH	1001	999	95.6 (F)	25	175	1663	1750	2.2 (A)	5	250	1659	1720	3.0 (A)	10	260	1667	1720	3.0 (A)	10	255
		RT	43	45	22.5 (C)	25	25	17	20	2.1 (A)	5	15	16	20	2.3 (A)	5	25	16	20	2.1 (A)	5	20
	WB	LT	35	20	91.1 (F)	25	100	6	5	89.6 (F)	5	40	5	5	83.5 (F)	5	40	5	5	85.3 (F)	5	40
		TH	1453	1568	15.8 (B)	75	500	1772	1750	16.5 (B)	45	425	1627	1600	14.0 (B)	40	360	1629	1600	14.0 (B)	40	345
		RT	450	473	7.1 (A)	25	50	527	515	6.9 (A)	5	185	512	540	6.0 (A)	5	185	512	540	4.8 (A)	0	0
	Intersection		**3840**	**3925**	**17.3 (B)**		**500**	**5128**	**5180**	**14.8 (B)**		**425**	**4981**	**5030**	**13.2 (B)**		**360**	**4991**	**5030**	**12.1 (B)**		**345**
Fairfax County Pkwy and Popes Head Rd*	NB	LT	52	50	114.8 (F)	25	75	52	50	183.0 (F)	55	210	133	140	57.1 (E)	40	225					
		TH	2904	2850	32.1 (C)	800	3575	4010	3935	21.4 (C)	305	2420										
		RT	18	5	30.9 (C)	25	25	6	5	19.6 (B)	5	10	275	270	2.6 (A)	20	230					
	SB	LT	106	103	121.9 (F)	150	575	106	130	864.6 (F)	4000	4980	74	72	37.1 (D)	15	125					
		TH	2844	2946	4.8 (A)	350	2350	3385	3935	214.6 (F)	3915	4980										
		RT	42	29	136.9 (F)	25	25	21	25	201.5 (F)	5	30	57	63	8.0 (A)	25	140					
	EB	LT	25	18	131.5 (F)	25	125	23	25	159.1 (F)	25	105	41	37	39.8 (D)	15	110					
		TH	32	34	21.6 (C)	25	125	34	40	148.0 (F)	35	165	71	73	27.8 (C)	15	110					
		RT	36	34	21.1 (C)	25	75	46	45	5.4 (A)	5	50	81	85	10.8 (B)	15	115					
	WB	LT	15	8	125.8 (F)	25	75	6	5	141.6 (F)	5	50	468	460	23.8 (C)	30	285					
		TH	65	66	124.6 (F)	50	200	41	40	159.3 (F)	45	165	181	172	17.0 (B)	30	285					
		RT	112	124	66.2 (E)	50	175	110	110	39.6 (D)	30	190	196	193	11.3 (B)	30	290					
	Intersection		**6251**	**6267**	**32.2 (C)**		**3575**	**7840**	**8345**	**119.7 (F)**		**4980**	**1577**	**1565**	**20.6 (C)**		**290**					
Fairfax County Pkwy and Burke Centre Pkwy	NB	TH	2562	2609	42.2 (D)	750	2750	3398	3385	34.5 (C)	415	1950	3680	3655	49.3 (D)	810	3060	3641	3655	52.0 (D)	855	3105
		RT	19	13	29.3 (C)	325	0	19	20	20.7 (C)	0	0	19	20	37.4 (D)	0	0	19	20	37.2 (D)	0	0
	SB	LT	269	301	152.9 (F)	225	500	400	470	93.1 (F)	130	515	641	680	124.2 (F)	385	1830	663	680	134.3 (F)	495	2100
		TH	2635	2669	23.2 (C)	350	2275	3017	3515	4.1 (A)	10	355	3640	3865	9.2 (A)	30	845	3681	3865	13.5 (B)	50	1215
	WB	LT	15	13	98.0 (F)	25	75	15	15	110.8 (F)	10	80	18	20	134.4 (F)	15	90	19	20	139.6 (F)	15	90
		RT	354	340	88.4 (F)	100	325	620	605	66.2 (E)	150	490	766	755	78.1 (E)	220	745	774	755	78.3 (E)	220	760
	Intersection		**5854**	**5945**	**41.6 (D)**		**2750**	**7469**	**8010**	**28.1 (C)**		**1950**	**8764**	**8995**	**40.8 (D)**		**3060**	**8797**	**8995**	**44.6 (D)**		**3105**
Braddock Rd and Shirley Gate Rd**	NB	LT	Not Reported from Synchro Analyses	2	108.2 (F)	-	-	Not Reported from Synchro Analyses	5	108.2 (F)	10	40	127	130	83.7 (F)	70	295	127	130	86.3 (F)	70	305
		TH		1	-	10	30		0	-	-	-	116	110	85.5 (F)	40	145	115	110	88.6 (F)	40	140
		RT		3	108.2 (F)	-	-		5	108.2 (F)	10	40	176	175	13.0 (B)	15	165	176	175	13.0 (B)	15	145
	SB	LT		1020	167.7 (F)	925	1350		1175	239.5 (F)	1970	2940	889	895	64.3 (E)	205	850	888	895	67.1 (E)	220	985
		TH		0	-	-	-		0	-	-	-	339	330	57.1 (E)	70	300	339	330	57.5 (E)	70	290
		RT		495	77.5	525	770		305	58.4 (F)	1090	2550	392	385	20.8 (C)	50	360	393	385	19.2 (B)	45	340
	EB	LT		103	107.3 (F)	80	130		80	106.0 (F)	50	110	97	95	89.8 (F)	40	150	97	95	91.2 (F)	40	145
		TH		902	29.2 (C)	375	580		1585	35.4 (D)	270	510	1304	1285	42.2 (D)	135	570	1306	1285	42.7 (D)	135	570
		RT		0	-	-	-		0	-	-	-	250	245	9.5 (A)	10	125	253	245	45.2 (D)	70	400
	WB	LT		2	26.6 (C)	10	10		15	39.4 (C)	10	40	253	250	103.7 (F)	95	285	253	250	115.2 (F)	105	305
		TH		1447	52.1 (D)	980	1280		1890	46.0 (D)	350	570	1604	1580	40.4 (D)	160	765	1608	1580	41.2 (D)	165	840
		RT		486	5.8 (A)	10	15		515	6.0 (A)	100	485	455	450	7.4 (A)	5	135	455	450	7.5 (A)	5	140
	Intersection			**4461**	**73.3 (E)**		**1350**		**5575**	**81.9 (F)**		**2940**	**6002**	**5930**	**44.7 (D)**		**850**	**6010**	**5930**	**47.4 (D)**		**985**
Shirley Gate Rd and Popes Head Rd	SB	LT											100	103	8.4 (A)	5	75					
		RT											271	272	11.9 (B)	20	235					
	EB	LT											93	93	1.6 (A)	5	50					
		TH											14	12	0.1 (A)	0	0					
	WB	TH											21	18	0.6 (A)	0	0					
		RT											101	102	1.0 (A)	0	0					
	Intersection												**600**	**600**	**7.2 (A)**		**235**					
Fairfax County Pkwy SB Ramp and Popes Head Rd	SB	LT																86	85	10.3 (B)	5	70
		RT																47	50	8.6 (A)	5	75
	EB	TH																106	105	0.1 (A)	0	0
	WB	TH																246	240	0.1 (A)	0	0
	Intersection																	**485**	**480**	**2.7 (A)**		**75**
Connector Rd and Popes Head Rd	SB	LT																90	90	7.9 (A)	5	70
		RT																226	222	9.1 (A)	15	120
	EB	LT																167	165	2.5 (A)	5	55
		TH																25	25	0.1 (A)	0	0
	WB	TH																20	18	0.4 (A)	0	0
		RT																101	102	1.0 (A)	0	0
	Intersection																	**629**	**622**	**5.2 (A)**		**120**
Shirley Gate Rd and Connector Rd	NB	TH																275	270	12.4 (B)	10	100
		RT																132	140	3.3 (A)	0	0
	SB	LT																183	172	16.1 (B)	15	165
		TH																669	653	6.8 (A)	10	210
	WB	LT																122	122	22.8 (C)	20	140
		RT																146	145	4.9 (A)	5	75
	Intersection																	**1527**	**1502**	**9.7 (A)**		**210**

**No Build results for this intersection are obtained from Synchro (LOS) and SimTraffic (Queuing)

*This is the intersection of the directional Fairfax County Parkway ramps and Shirley Gate Road extension in Build 1B-2A (tight diamond interchange)

Summary of Analyses

The purpose of the alternatives analysis was to assess the future operational performance of no build and build alternatives and quantify the changes in travel delays associated with the extension of Shirley Gate Road to FCP. The Synchro analyses show a general reduction in delays and queuing at the Ox Road intersections with the addition of the new parallel route of the Shirley Gate Road extension. While important to understand these impacts to surrounding intersections, the intent of the project is to identify a future roadway alignment for the Shirley Gate Road extension.

Therefore, the primary focus of the alternatives analysis was on future intersections with Shirley Gate Road and locations along FCP within the project study area. At Popes Head Road, the analysis shows a significant reduction in mainline queuing and delay as well as side street delay in the build alternatives compared to the no build. This translates to travel time improvements along both directions of FCP and Popes Head Road, especially the southbound direction of FCP during the PM peak period and the westbound direction of Popes Head Road during the AM peak period. The new intersections associated with the two interchange alternatives operate at LOS B or better in the AM peak hour and LOS C or better in the PM peak hour. The intersection of Braddock Road and Shirley Gate Road experiences a slight increase in overall intersection delay during the AM peak hour with the addition of the northbound Shirley Gate Road approach in the build alternatives; however, queues along eastbound Braddock Road decrease significantly as demand patterns are better distributed around the intersection. In the PM peak hour, this intersection operates with significantly less delay and with reduced queues in the build alternatives compared to no build. Overall, the two build alternatives perform similarly with few operational differences at key study area intersections.

ASSESSMENT OF RELATIVE COST

Conceptual level sketches for the two recommended alternatives (1B-2A and 1B-2A/2B) were developed based on aerial mapping and available GIS data. Survey was not conducted as part of this study as it is a planning level effort. The conceptual sketches were used to develop a qualitative assessment of the magnitude of the relative cost to construct the two alternatives. A conceptual sketch for alternative 1B is presented in **Figure 5.6** and conceptual sketches for alternative 2A and alternative 2A/2B is presented in **Figure 5.7**. These sketches were prepared assuming specific design speeds along the ramps and study area roadways, each with associated minimum centerline radii. Based on standards outlined in the *Virginia Department of Transportation (VDOT) Road Design Manual*, the study area roadways were designed to the following VDOT Geometric Design Standards (abbreviated below as "GDS"):

- Ramps – GDS for Interchange Ramps (*Road Design Manual GS-R*)
- Shirley Gate Road extension – GDS for Minor Arterial Streets (*Road Design Manual GS-6*)
- Popes Head Road and the Future Connector Road – GDS for Urban Collector Streets (GS-7)

The sketches reflect the assumed design parameters listed in **Table 5.7** to the greatest extent possible given the available data used to prepare the sketches.

Table 5.7 – Conceptual Sketch Design Parameters

Facility (VDOT GDS)	Design Speed (mph)	Posted Speed (mph)	Min. Radii (ft)
Fairfax County Parkway Ramps (GS-R)	40*	35*	446
Shirley Gate Road Extended (GS-6)	50	45	929
Popes Head Road (GS-7)	35	30	373
Future Connector Road (GS-7)	30	25	251

*due to right-of-way limitations, the SB off-ramp to Popes Head Road in alternative 2A/2B was designed to 30 mph, with a posted advisory speed of 25 mph and minimum radii of 215 feet

No.	REVISIONS	DATE	BY

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KHA PROJECT 110213026
DATE 2/12/2016
SCALE AS SHOWN
DESIGNED BY SB
DRAWN BY DM
CHECKED BY DCM

Shirley Gate Road Extended
Corridor Planning Study
Fairfax County Department of Transportation

Figure 5.6
Alternative 1B

No.	REVISIONS	DATE	BY

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Shirley Gate Road Extended
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Figure 5.7
Alternative 2A(1) and Alternative 2A-2B

There are many variables that influence the cost to construct a new interchange along an existing roadway alignment. Upfront pre-construction activities of survey and design for the two interchange alternatives would likely fall in the same approximate range of costs relative to the overall cost of the project. Differences in cost between the alternatives are expected beyond the design phase. A qualitative assessment of cost was completed considering the following major elements of construction that follow the preparation of engineering design plans:

- Right-of-Way
- Stormwater Management
- Construction Phasing
- Structures and Earthwork

Right-of-Way (ROW)

Acquisition of ROW to construct new roadway facilities can be a time consuming and expensive process. Government agencies (i.e. Fairfax County, VDOT) must negotiate with affected property owners an agreeable purchase price, at which point funds must be secured to purchase the property. The conceptual sketches illustrate the approximate footprint of each alternative and areas where ROW may need to be acquired. Alternative 2A is expected to have modest encroachments on adjacent properties to allow construction of the proposed interchange. Alternative 2A/2B has a similar interchange footprint; however, due to the connector road required to maintain access to Popes Head Road, additional ROW will be required. The connector road bisects multiple parcels and isolates one residence from the rest of Popes Head Road. For this reason, Alternative 2A/2B was assigned a higher ROW cost.

- Alternative 2A – moderate ROW cost
- Alternative 2A/2B – high ROW cost

Stormwater Management

Stormwater runoff within the study area roadway network is currently managed by an existing network of roadside ditches. During the stakeholder engagement process, several residents expressed concerns that existing stormwater management is poor and flooding occurs along Popes Head Road during significant rain events. It was noted during this process that the interchange and associated roadway improvements would be implemented such that stormwater runoff would be managed in compliance with current standards.

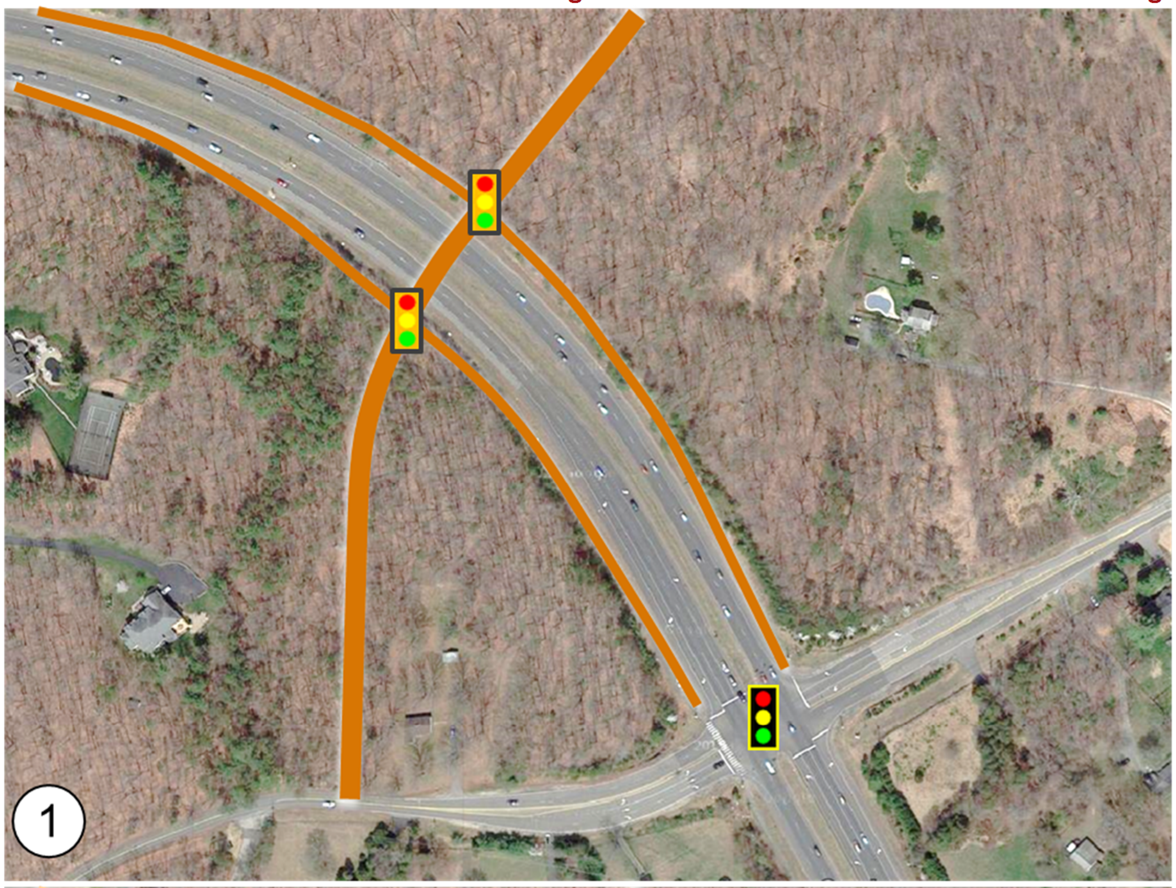
Management practices are driven by the amount of impervious area and associated runoff that could be generated during a storm. Thus, there is a direct correlation between infrastructure requirements (and costs) to the total amount of roadway, sidewalk, and other impervious areas constructed. The footprints of the two interchange alternatives are similar except for the connector road in Alternative 2A/2B. Additional infrastructure costs could be expected to manage runoff along the connector road in Alternative 2A/2B; therefore, it was assigned a higher cost with respect to stormwater management.

- Alternative 2A – moderate stormwater management cost
- Alternative 2A/2B – high stormwater management cost

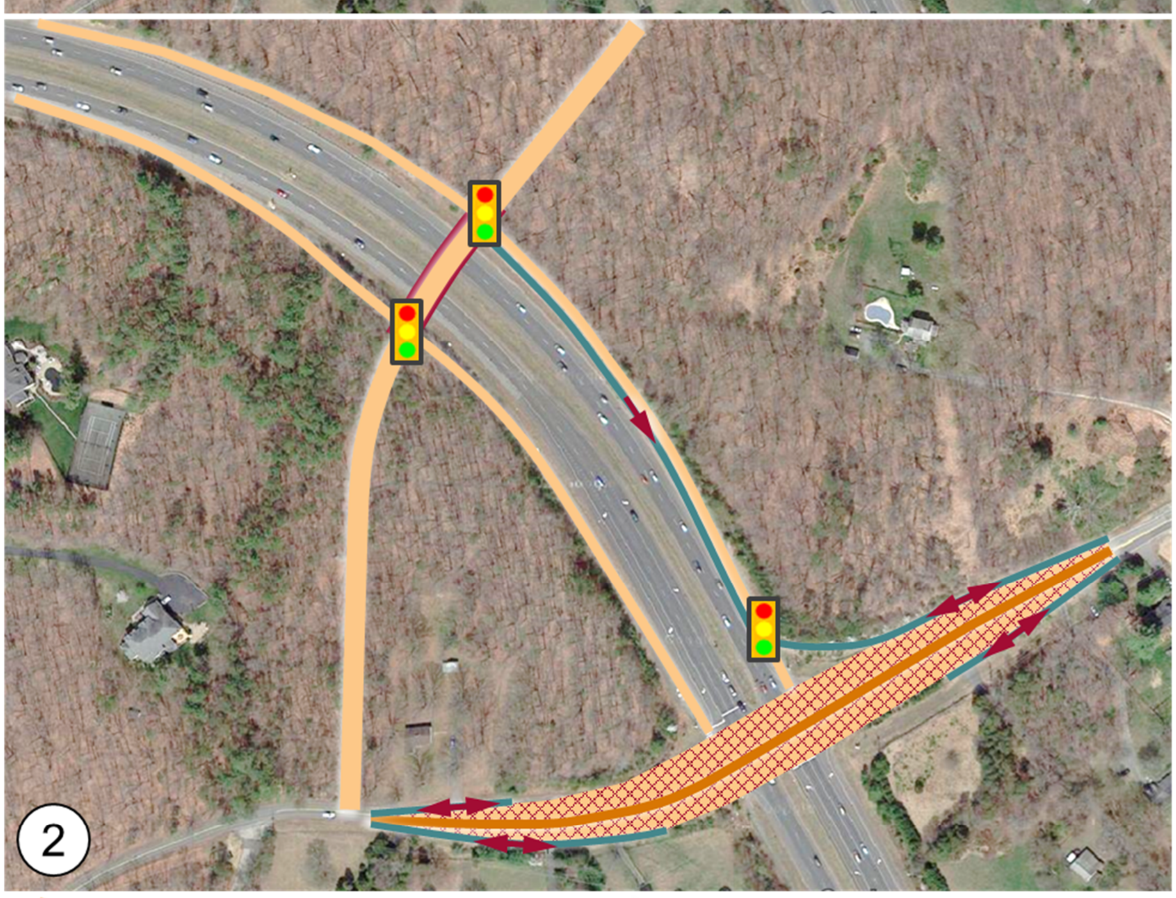
Construction Phasing

An important component of constructing interchange improvements will be minimizing impacts to current traffic operations, especially given the potential duration of construction. **Figure 5.8** and **Figure 5.9** illustrate the anticipated construction phases for Alternative 2A and Alternative 2A/2B, respectively.

Figure 5.8 – Alternative 2A Construction Phasing



- Shirley Gate Road extension to new interchange should be constructed simultaneously (not shown in graphic)
- Maintain signalized operations at the Fairfax County Parkway and Popes Head Road intersection
- Construct Shirley Gate Road bridge over Fairfax County Parkway and connect to Popes Head Road
- Construct on and off-ramps to Fairfax County Parkway
- Install traffic signals at the ramp terminals with Shirley Gate Road



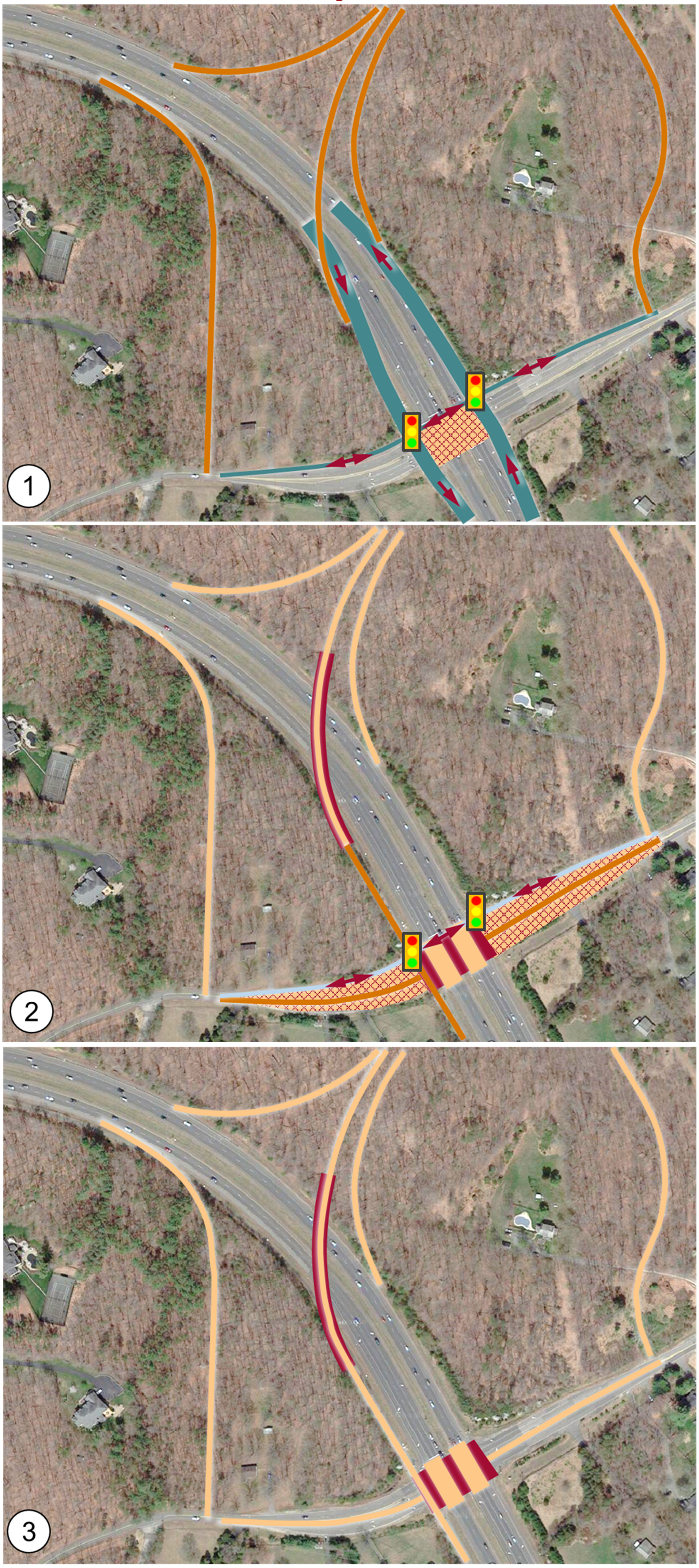
- Construct temporary pavement along Popes Head Road to maintain access to residential properties during construction of the overpass
- Temporarily allow two-way traffic along the NB off-ramp to provide access to the eastern portion of Popes Head Road (SB traffic would have to travel to Shirley Gate Road and use the SB on-ramp)
- Allow traffic to use all ramps to and from Shirley Gate Road as well as the extension between Braddock Road and Popes Head Road
- Construct Popes Head Road overpass
- NOTE: temporary signal may be necessary to provide safer access to Popes Head Road on the NB off-ramp.

- Shift Popes Head Road traffic to the new overpass
- Remove the temporary pavement
- NOTE: some temporary pavement may need to be constructed and retained as permanent pavement to provide access to residential properties

Not to Scale

Legend
- Existing Signalized Intersection
- Temporary Signalized Intersection
- Temporary Pavement Direction(s) of Travel
- # - Construction Phase
- Overpass Construction
- Completed Bridge
- Phase Under Construction
- Construction Phase Completed
- Temporary Pavement Construction
- Temporary Pavement In-Place

Figure 5.9 – Alternative 2A/2B Construction Phase



- Shirley Gate Road extension to new interchange should be constructed simultaneously (not shown in graphic)
- Construct temporary pavement along Popes Head Road and Fairfax County Parkway to maintain access
- Install temporary signals to control offset intersection locations (2 total, operating as a cluster)
- Construct new Connector Road, the NB and SB off-ramps, the NB on-ramp, and the bridge portion of the SB on-ramp
- Construct the center portion of the underpass and the new bridges for Fairfax County Parkway over Popes Head Road
- Alternatively, shift Fairfax County Parkway to the east, construct the western overpass, then shift to the west to construct the eastern overpass

- Shift Fairfax County Parkway traffic to the new bridges over Popes Head Road
- Continue operations of the 2 signalized intersections to maintain access to Popes Head Road
- Open the SB off-ramp to Popes Head Road and restrict left-turn access to Popes Head Road from Fairfax County Parkway (this movement would be diverted to the SB off-ramp)
- Remove the temporary pavement for Fairfax County Parkway
- Construct southern portion of the SB on-ramp to Fairfax County Parkway
- Construct the western and eastern portions of the Popes Head Road underpass
- All other ramps to/from Shirley Gate Road should remain closed

- Shift Popes Head Road traffic to the new underpass
- Remove the temporary traffic signals and temporary pavement
- Allow traffic to use all ramps to and from Shirley Gate Road/Popes Head Road, providing full access to/from Popes Head Road

Not to Scale

Legend

- Temporary Signalized Intersection
- Temporary Pavement Direction of Travel
- Construction Phase
- Underpass Construction
- Completed Bridge
- Phase Under Construction
- Construction Phase Completed
- Temporary Pavement Construction
- Temporary Pavement In-Place

Construction of Alternative 2A is expected to be straightforward:

1. Construct Shirley Gate Road extension and interchange along new alignment
   - Minimal impact to existing operations
2. Divert Popes Head Road traffic to the new interchange along temporary roadways to construct the Popes Head Road overpass
   - Moderate impact to Popes Head Road traffic
   - Intermittent delays for FCP to install bridge structure; however, the signal at Popes Head Road is eliminated

For Alternative 2A/2B, constructing the Popes Head Road underpass requires temporary roadway construction and signals to maintain similar access as noted below:

1. Construct Shirley Gate Road extension and associated ramps to FCP
   - Shift FCP and Popes Head Road to temporary roadways to create the construction space for the underpass (requires two temporary signals)
   - On-ramp to southbound FCP would be incomplete during the first phase
2. Continue operations of Popes Head Road temporary roadway while construction of the underpass and remaining sections of the southbound on-ramp are completed
   - Continued signal operations along FCP

The shift in traffic required as part of Alternative 2A/2B construction combined with continued signal operations along FCP during construction are expected to result in a greater impact on traffic as compared to Alternative 2A. For that reason, Alternative 2A/2B was assigned a higher cost.

- Alternative 2A – low construction impact cost
- Alternative 2A/2B – high construction impact cost

Structures and Earthwork

Roadway structures (e.g. bridges, mechanically stabilized earth (MSE) walls) generally have a higher cost than at grade roadway elements (e.g. asphalt, sidewalk, traffic signals) due to the materials, earthwork, and maintenance of traffic requirements during installation. Both interchange alternatives require the installation of bridges and MSE walls. Based on the conceptual sketches, Alternative 2A/2B requires nearly twice as much bridge deck as Alternative 2A. While this represents a considerable cost, the higher structures cost can be expected with the installation of MSE walls for the roadway abutments on either side of the bridge. The only elements of Alternative 2A/2B that require MSE wall are the on-ramp to southbound FCP and the Popes Head Road underpass. Conversely, Alternative 2A requires MSE wall construction for all ramps along with the Popes Head Road overpass. Thus, Alternative 2A is expected to have higher costs associated with roadway structures.

- Alternative 2A – high structures and earthwork cost
- Alternative 2A/2B – moderate structures and earthwork cost

A qualitative rating of the two interchange alternatives was completed assigning values of 1, 3, and 5 to low, moderate, and high construction costs, respectively. Considering the overview of the four major construction elements listed above, Alternative 2A is assigned a lower cumulative construction cost score compared to Alternative 2A/2B. This can be attributed to lower ROW, stormwater management, and construction phasing costs. **Table 5.8** summarizes the qualitative scoring of the alternatives.

Table 5.8 – Qualitative Construction Cost Assessment

	Alternative 2A	Alternative 2A/2B
ROW	3	5
Stormwater Management	3	5
Construction Phasing	1	5
Structures and Earthwork	5	3
TOTAL	**12**	**18**

CONCLUSION

The operational analyses indicated that the extension of Shirley Gate Road to FCP has a net positive impact on network operations. The benefits of the extension and interchange with FCP include:

- Reduced demand along Ox Road that translates to less delay and improved intersection operations
- Balanced demand at the intersection of Braddock Road and Shirley Gate Road, generally reducing delay and queuing for heavy movements
- Reduced travel times along FCP and Popes Head Road
- Increased throughput along FCP with the elimination of the signalized intersection at Popes Head Road

There are a few intersections that will experience greater delays because of the extension due to shifts in travel patterns through the network. The intersection of FCP and Burke Centre Parkway will experience the greatest level of degradation, particularly during the AM peak hour. This is due in part to increased demand through the intersection, but geometric and signal operations limit the capacity of the intersection, so there is a notable volume of unserved demand during the peak hour. This intersection should be considered for further analyses and alternatives development to mitigate the anticipated increase in delays. Note that the intersection will operate poorly during the AM peak hour regardless of the extension of Shirley Gate Road.

Given the findings of the operational analyses and qualitative cost assessment, the final list of MOEs developed by the project stakeholders was populated with screening values for the MOEs listed under the *Impacts to Transportation System* and *Cost*. Detailed analyses of operations were completed for the northern alignment 1B only; however, no discernable difference is expected relative to the impacts to the transportation system and the cost of construction would likely fall within a similar range. Thus, the northern alignments were assigned identical screening values. With respect to the southern alignments 2A and 2B, the latter considered to be alternative 2A/2B, specific MOEs were evaluated as follows per the metrics identified:

- **Traffic Operations and Levels of Service**: a cumulative assessment of delay for allowable movements at the existing Popes Head Road intersection with FCP was completed considering the trip rerouting imposed by the interchange alternatives 2A and 2A/2B. For each movement, total peak hour delay was evaluated by movement against the demand. For example, the westbound left-turn movement from Popes Head Road is rerouted as follows:
    - Alternative 2A – right-turn onto Shirley Gate Road, right-turn at the signalized on-ramp to FCP
    - Alternative 2A/2B – right-turn onto the Connector Road, left-turn onto Shirley Gate Road, free-flow ramp onto southbound FCP

Considering these rerouting patterns for all movements (except through movements on FCP), the cumulative delay was compared for each interchange alternative. **Table 5.9** summarizes the cumulative delay for the no build and build conditions (considering link travel time and intersection delay), with the delta indicated in parentheses. Throughput is also summarized to reflect the total volume of demand served at the intersection (no build) or interchange (build). *As shown, alternative 2A provides for the greatest reduction in network travel time, primarily attributed to the reductions in delay during the AM peak; thus, it was assigned a better screening value. The difference in throughput is negligible when comparing the two alternatives, but illustrates the additional capacity of the interchange as compared to the existing at-grade intersection*.

Table 5.9 – Cumulative Network Delay (No Build vs. Build)

	AM Peak		PM Peak		Total
	Cumulative Delay (min)	Throughput Volume*	Cumulative Delay (min)	Throughput Volume*	Cumulative Delay (min)
No Build	2086	8,875	2098	7,840	3936
Alternative 2A	589 (-1497)	11,129	555 (-1543)	10,569	1144 (-3040)
Alternative 2A/2B	947 (-1139)	11,126	501 (-1597)	10,574	1448 (-2736)

*throughput volume includes mainline traffic along Fairfax County Parkway

- **Safety**: the evaluation of safety for the two alternatives considered the number of conflict points relative to the no build condition. Both alternatives eliminate all angle conflicts for movements to and from FCP. However, alternative 2A still retains the potential for angle conflicts at the signalized intersections directly off FCP. Alternative 2A/2B still retains turning movements, but the heaviest movements to and from FCP are through movements and do not cross through high turning volume intersections. *Thus, alternative 2A/2B was assigned a better screening value*.
- **Construction Duration**: as demonstrated in **Figure 5.8** and **Figure 5.9**, three primary phases of construction are anticipated for the two interchange alternatives. However, alternative 2A/2B requires major construction activities to build the Popes Head Road underpass, shifting the major through-volume movements along FCP. *For this reason, alternative 2A was assigned a better screening value*.
- **Cost**: as shown in **Table 5.8**, the relative cost of construction is higher for Alternative 2A/2B due to the magnitude of major construction activities compared to Alternative 2A. *Given the higher relative cost of construction for Alternative 2A/2B, Alternative 2A was assigned a better screening value*.

The two interchange alternatives were assigned identical screening values for the remaining MOEs since there was no discernable difference between the two. There is no significant change expected in the total vehicle miles traveled (vmt). While the total network vmt increases, the increase in network volume is proportional to the increase in vmt; thus the ratio of vmt to volume remains constant. Similarly, along Popes Head Road, the daily traffic volume is diminished compared to the no build condition, but identical to existing conditions. For these two metrics, a mid-range screening value was assigned. However, an increase in daily traffic volumes along Shirley Gate Road is expected with the extension of Shirley Gate Road north of Braddock Road. For this reason, a low screening value was assigned for this MOE.

The completed MOE table is summarized in **Table 5.10**. Taking an average of the 1B alignment with the 2A and 2A/2B alignments, a final evaluation is noted in the rightmost columns for the two alternatives. As shown, alternative 1B-2A received a higher score than alternative 1B-2A/2B. The primary factors contributing to the higher score were delay reduction, construction duration, and relative cost. The findings of the analyses and completed MOE table were shared with project stakeholders during the final stakeholder meeting on September 29, 2015 and again at the public information meeting on December 7, 2015. These results will help inform any future interchange justification report (IJR) work required when the project is carried forward by Fairfax County Department of Transportation (FCDOT) into a design state.

Table 5.10 – Final List of MOEs and Final Screening of Preliminary Alternatives

MOEs	Metric	Unit of Measure	Weighting	Initial Stakeholder Screening					Final Evaluation (average of two segments)	
				1A	1B	1C	2A	2B	1B-2A	1B-2A/2B
I. Impacts to Adjacent Properties										
a. Property for Sale (posted)	Maximize use	each	2	1	1	1	2	2	1.5	1.5
b. Property Vacant	Maximize use	each	2	2	0	0	0	0	0	0
c. Commercial Property	Minimize impact to property access	-	2	0	2	2	2	2	2	2
d. Septic Field	Minimize impact	each	5	0	1	1	5	1	3	1
e. Park Property	Minimize impact on master plan	acre	2	2	2	2	0	0	1	1
f. Land Grades	Minimize grade changes to adjacent properties	acre	2	2	1	1	2	2	1.5	1.5
g. Noise	Maximize distance from residences	feet	8	0	0	0	1	0	0.5	0
h. Lighting	Minimize impact on residences	-	6	1	2	2	1	0	1.5	1
i. Property Value Degradation	Minimize land takings	-	2	0	1	1	1	2	1	1.5
j. Property Value Degradation to Adjacent Properties	-	-	8	0	0	0	0	0	0	0
k. Natural Environment	Minimize removal of plants and trees	acre	6	0	0	0	4	6	2	3
l. Utility Crossings	Minimize Impacts	-	2	2	1	0			0.5	0.5
II. Impacts to Transportation System										
a. Access	Maintain access to properties	-	3	0	1	1	3	3	2	2
b. Traffic Operations and Levels of Service (delay/ travel time)	Reduce cumulative delay as compared to No Build option	sec/veh	8	8	8	8	8	6	8	7
c. Safety	Minimize major conflict points	-	3	3	3	3	2	3	2.5	3
d. Improvements to network (connectivity)	Reduce vehicle miles of travel	vmt*	8	4	4	4	4	4	4	4
e. Construction Duration and Associated Traffic Disruption	Minimize construction period and traffic disruption	-	3	2	2	2	2	1	2	1.5
f. Change in volume on Popes Head Road	Minimize traffic volume increase	veh/day	5	3	3	3	3	3	3	3
g. Change in volume on Shirley Gate Road (north of Braddock)	Minimize traffic volume increase	veh/day	5	1	1	1	1	1	1	1
h. Intersection skew at Braddock	-	-	4	4	2	0			1	1
III. Cost										
a. Construction Cost	Minimize cost of construction	current $	25	20	20	20	20	15	20	17.5
		TOTAL	**118**	**53**	**55**	**52**	**61**	**51**	**58**	**53**

*vmt – vehicle miles traveled

Shirley Gate Road Extended

CORRIDOR PLANNING STUDY

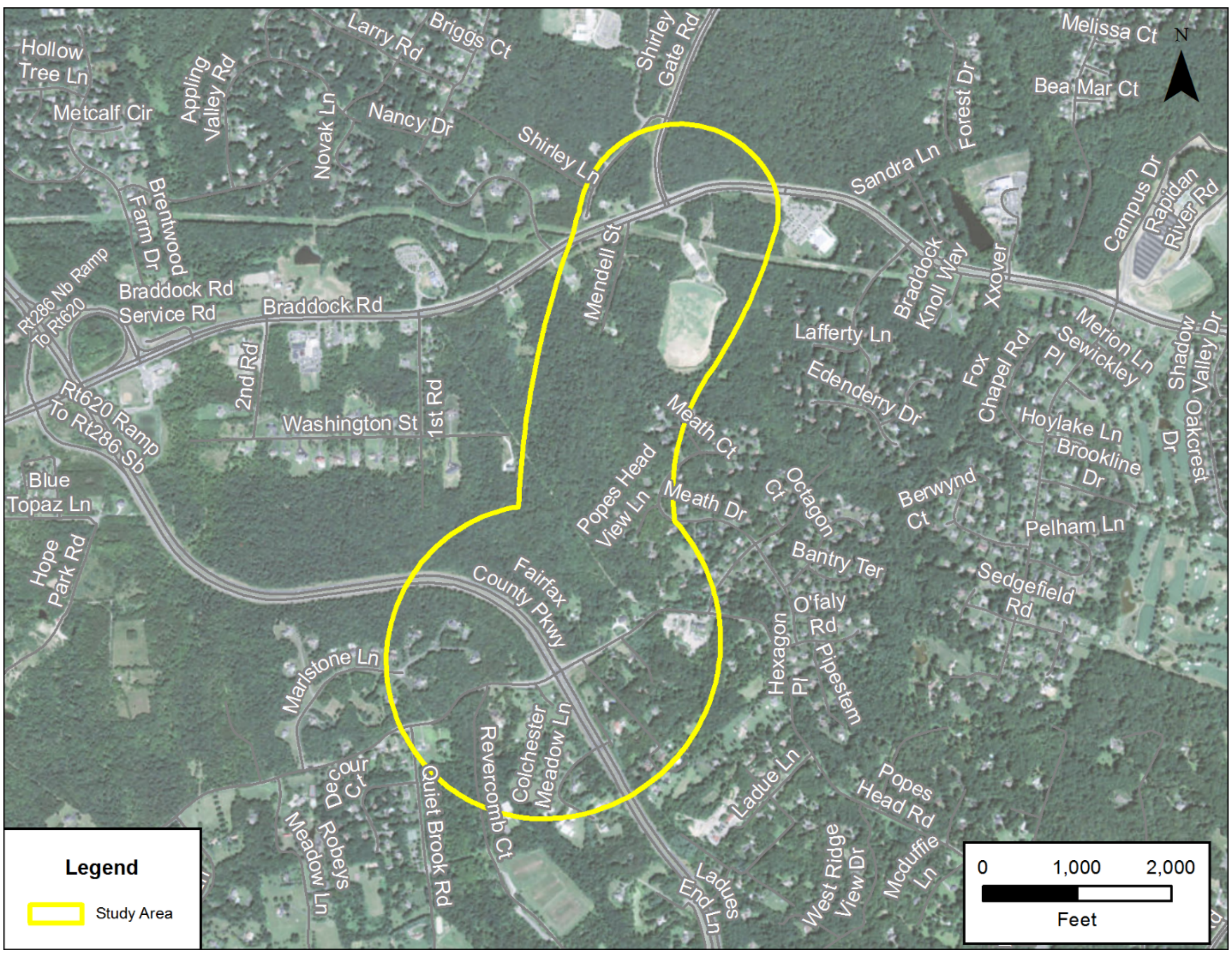
FINAL

Chapter 6 – Preliminary Environmental Evaluation

Chapter 6 – Preliminary Environmental Evaluation

The extension of Shirley Gate Road to Fairfax County Parkway (FCP) from Braddock Road was initially added to the County Comprehensive Plan in 1991 as a means to reduce congestion along Braddock Road and Ox Road (Route 123). In 2006, the Comprehensive Plan was amended to include grade separated interchanges along FCP at the intersections of Shirley Gate Extended (future roadway) and Popes Head Road (existing roadway), thereby creating a 7.75-mile stretch of FCP that would be uninterrupted by traffic signal operations. The purpose of this evaluation is to identify environmental constraints that may affect the design and construction of Shirley Gate Road Extended or require additional studies in the future. This evaluation is preliminary and based on readily available local, state, and federal databases; Geographic Information System (GIS) data; and a visual inspection limited to public thoroughfares and the county parks: Patriot Park and Popes Head Park. As the exact alignment has not yet been determined, a study area encompassing many alternatives is used as the area evaluated for this study. When preferred alignments are identified, an Interchange Justification Report (IJR) will be completed and environmental constraints for each alignment will be evaluated. This study is limited to a broad overview of potential environmental constraints for numerous potential alignments. This area is called the “study area” for the remainder of this chapter and can be seen in **Figure 6.1** below.

Figure 6.1: Study Area



RIGHT-OF-WAY AND RELOCATIONS

The Shirley Gate Road extension is proposed along a new alignment and some property acquisition would be required. At least one residential relocation is anticipated. The project proposes to minimize right-of-way (ROW) impacts to adjacent property owners by routing the alignment adjacent to the planned Patriot Park expansion. This was determined in a December 1994 Virginia Department of Transportation (VDOT) interchange alternatives analysis. Potential impacts to Patriot Park, including Section 4(f), are discussed later but should be minimized to the maximum extent practicable.

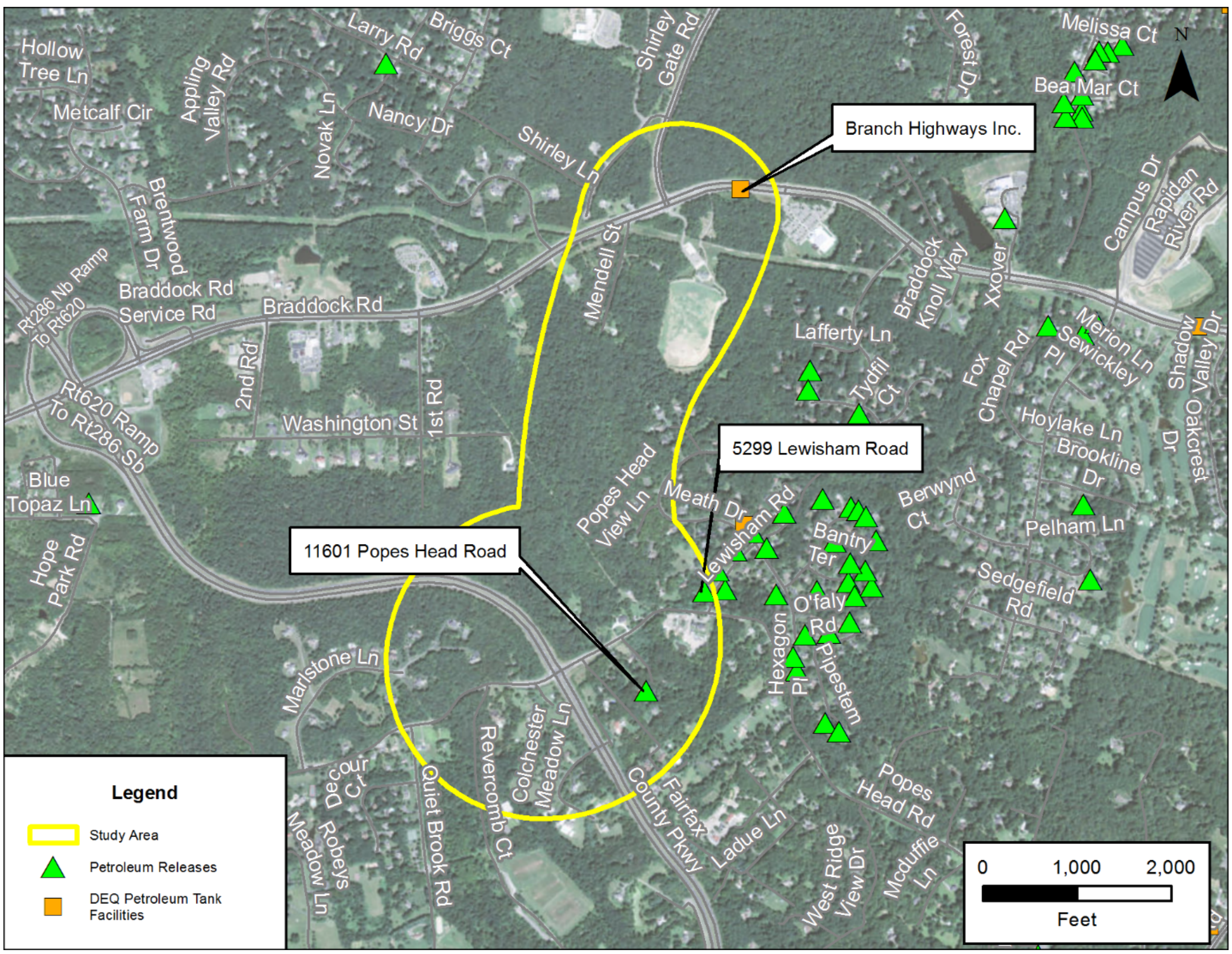
Hazardous Materials

A desktop review of available GIS databases from the Virginia Department of Environmental Quality (DEQ) and Fairfax County was conducted to identify known hazardous materials concerns within the study area.

DEQ records indicate two recorded petroleum releases and one registered petroleum facility within the study area:

- Petroleum Release: 5299 Lewisham Road (PC#: 20023224-closed)
- Petroleum Release: 11601 Popes Head Road (PC#: 20023032-closed)
- Petroleum Tank Facility: Branch Highways Inc.

Figure 6.2: Hazardous Materials



Depending on the alternative selected, additional studies relating to the identification and management of contaminated soil and groundwater may be required. In addition, a Phase I Environmental Site Assessment (ESA) for all property acquisition is recommended.

Air Quality

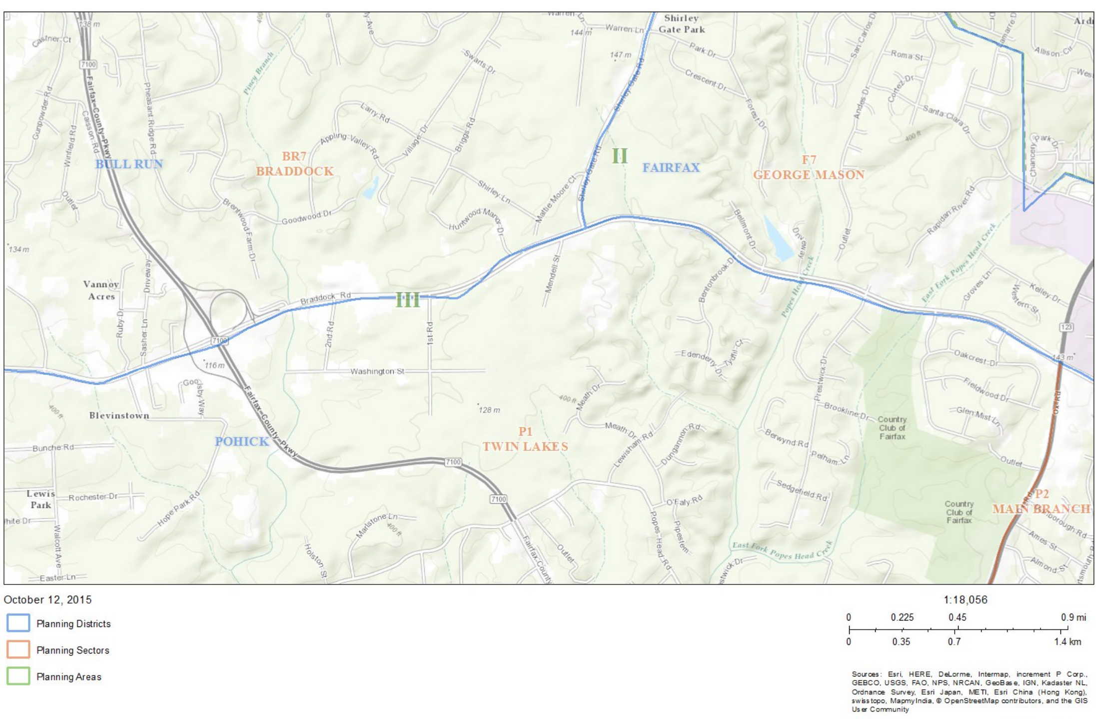
In areas designated as nonattainment or maintenance areas for air quality in accordance with the Clean Air Act, as amended, the Metropolitan Washington Air Quality Committee (MWAQC) that is part of the Metropolitan Washington Council of Governments (MWCOG), is responsible for coordinating transportation and air quality planning in northern Virginia. Fairfax County is within the Northern VA/DC/MD PM2.5 and Ozone Nonattainment Area and is therefore under the jurisdiction of MWAQC. Version 18 of the “Consultant Guide: Air Quality Project-Level Analysis” (rev. 5/09) from VDOT was consulted in regards to air quality requirements for the project. The project is considered to be regionally significant for conformity. However, this project is not programmed or modeled in the currently conforming MWAQC Regional Transportation Plan and Transportation Improvement Program (TIP). An amendment or administrative modification as appropriate will need to be made to the Transportation Plan and TIP to include this project before it can proceed.

Land Use

The study area can be seen in **Figure 6.1** above and is primarily forested. A golf facility, park land, and residential houses can be found within the study area. According to Fairfax County’s online GIS mapping system, the study area is zoned entirely residential.

The study area is mainly within the Pohick Planning District, although the Fairfax and Bull Run planning districts are just north of Braddock Road. The study area is mainly within Planning Area III but the northeast quadrant of Braddock Road and Shirley Gate Road is designated as Planning Area II. **Figure 6.3** is shown below and provides an overview of the planning areas. The proposed project is included in the County’s Transportation Plan.

Figure 6.3: Fairfax County Planning Districts, Sectors, and Areas

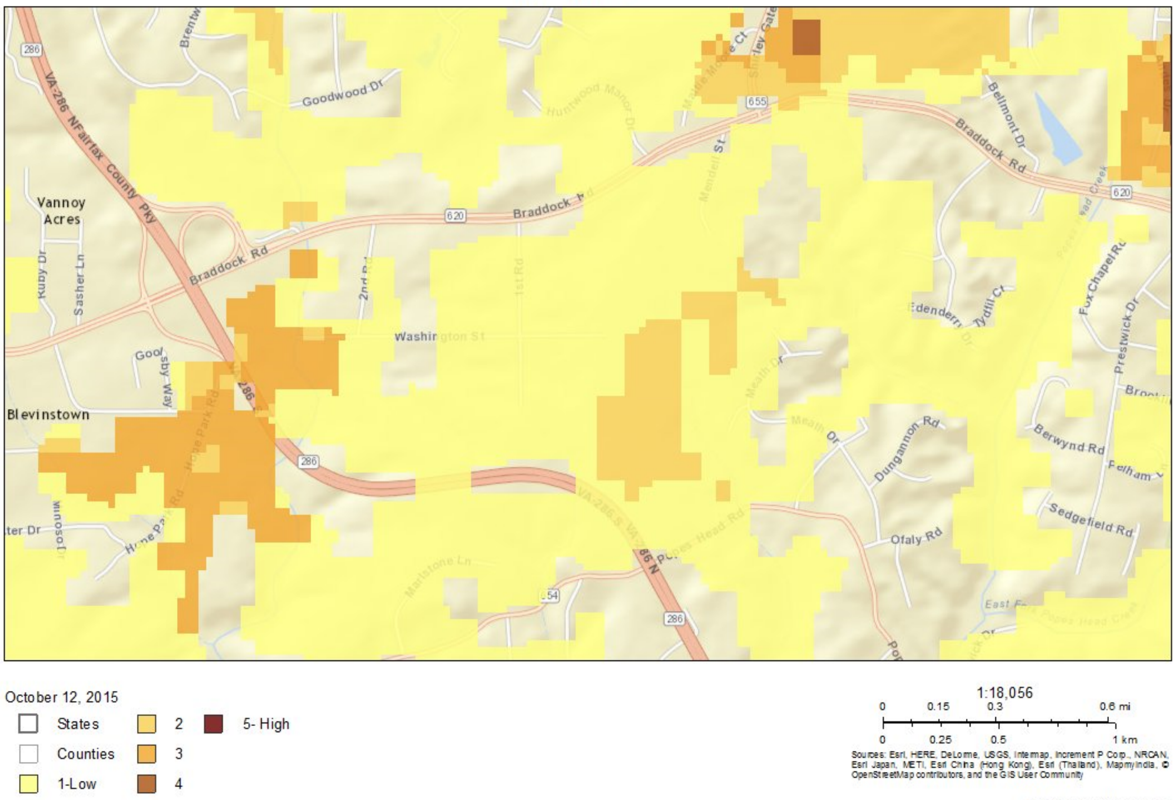


AGRICULTURAL/FORESTAL DISTRICTS, FARMLAND, AND FORESTLAND

The Natural Resources Conservation Service (NRCS) Web Soil Survey online application was consulted to identify prime farmland, unique farmland, and farmland of statewide or local importance within the study area. None of these farmland types were identified. **Figure 6.4** provides an overview of forested land located within the project study area.

The majority of the study area is identified as low conservation priority forestland by the Virginia Department of Forestry (DOF) GIS online mapper. No conservation lands were identified by the Department of Recreation and Conservation's (DCR) Natural Heritage Data Explorer (NHDE). Although no forestal districts were identified through online and GIS research, Fairfax County has a tree conservation ordinance specification that should be followed during development.

Figure 6.4: Forested Land



OPEN SPACE EASEMENTS

No open space easements were found within the study area based on a search of available GIS data and DCR NHDE.

FEDERAL LANDS

No federal lands were identified within the study area based on a review of available GIS data and DCR NHDE.

Community Facilities

Based on a review of the available data from GIS and field reconnaissance, the following community facilities were identified within the study area:

Recreational Facilities: Two tennis courts were identified within the project area

1. A neighborhood facility along Meath Drive that is owned by the Popes Head View Homeowners Association
2. A residential facility located on private property off Maristone Lane

School Districts: The project area is within the Fairfax Villa and Oak View elementary school districts, the Frost Middle School district, and the W.T. Woodson High School district. Other schools located within the vicinity of the study area are the Little Flock Christian School, Gesher Jewish Day School, and Trinity Christian School. As none of these schools will be directly impacted by the road extension, no additional coordination is anticipated.

Public Service Facilities: The closest fire and rescue station is Fire Station 32, located at 5600 Burke Center Parkway in Fairfax Station, Virginia. The closest police station is located at 4900 Stonecroft Boulevard in Chantilly. No stations are located within the project area.

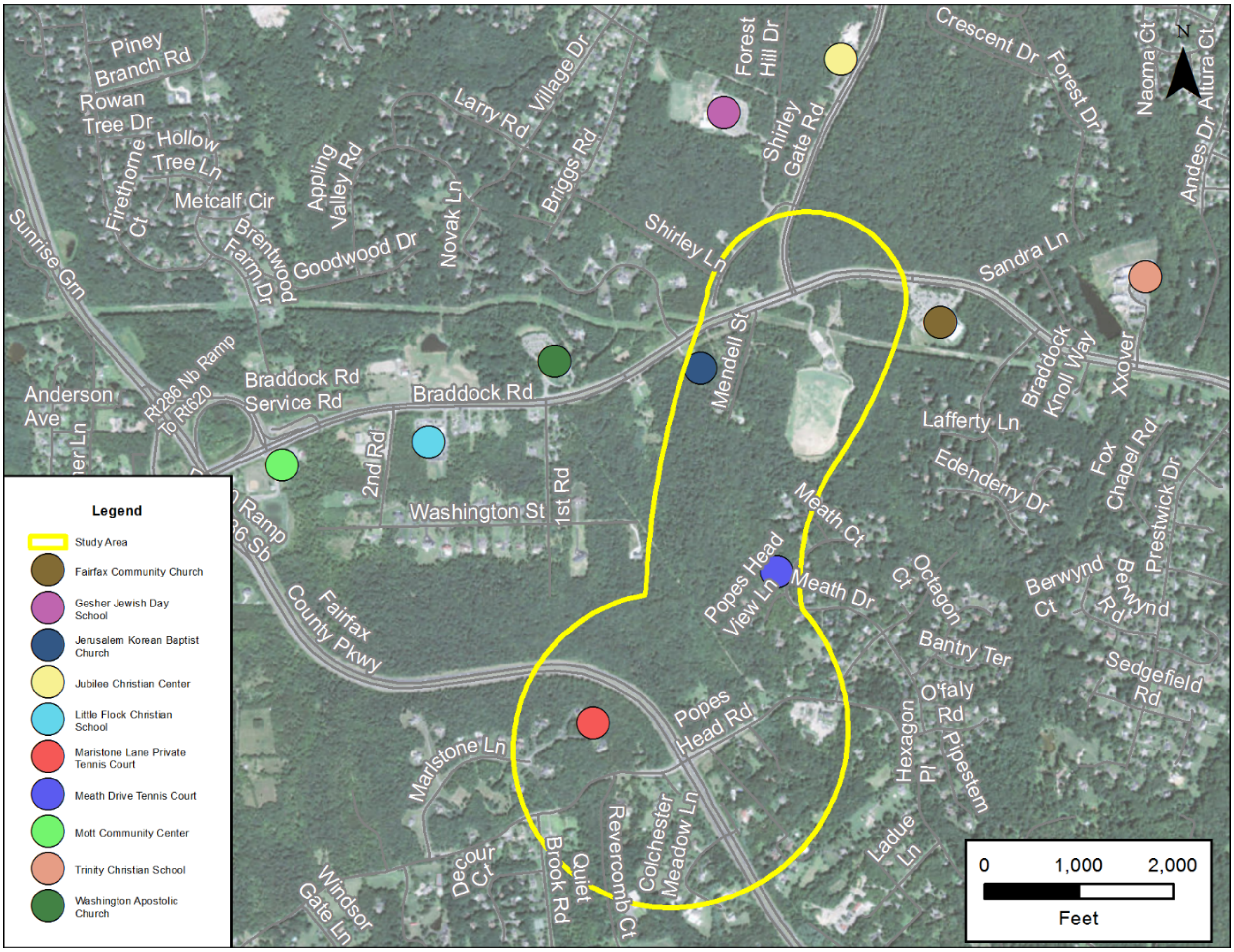
Places of Worship: Two places of worship were located within or adjacent to the project area, including:

- Jerusalem Korean Baptist Church, 11615 Braddock Road, within project area to the west
- Fairfax Community Church, 11451 Braddock Road, adjacent to project area to the east
- Jubilee Christian Center, 4650 Shirley Gate Road, north of the project area
- Washington Apostolic Church, 11800 Braddock Road, west of the project area

Although the Jerusalem Korean Baptist Church is within the study area, this facility is not anticipated to be affected by the road extension.

No libraries, schools, hospitals, or other community facilities were identified during a visual inspection of the study area. All of the above mentioned facilities can be seen on **Figure 6.5**.

Figure 6.5: Community Facilities



Section 6(f)

Section 6(f) of the Land and Water Conservation Act requires that the conversion of lands or facilities acquired with the Land and Water Conservation Funds (LWCF) be coordinated with the Department of Conservation and Recreation (DCR), and replacement in-kind is usually required. The National Park Service's detailed list of grants was consulted to identify lands within or adjacent to the study area that were established under the LWCF, and therefore protected under Section 6(f). No resources were identified on the list at this time. A copy of this list is included in **Appendix E**.

Section 4(f) /Parks and Recreational Facilities

In the event that federal funding or approval is necessary, the proposed project would be subject to Section 4(f) of the Department of Transportation Act of 1966. Section 4(f) stipulates that federal agencies cannot approve the use of land from existing or planned publically owned parks, recreation areas, wildlife and waterfowl refuges, or historic sites unless there is no feasible and prudent alternative to use of a Section 4(f) property and that all possible planning to minimize harm to the property has been incorporated into the project. A "use" of a Section 4(f) property may include acquisition of ROW or a permanent easement, temporary occupancy, or constructive use. Historic resources are further discussed later in the document.

The following park/recreational properties were identified within the project area and are likely to qualify for protection under Section 4(f):

- **Patriot Park Expansion** — Approximately 41 acres of the county-owned Patriot Park expansion property is located within the project area north of FCP and west of Mendell Street. Phase I of the park is complete and includes a soccer field complex, a 120-space parking lot, three lighted synthetic turf micro-soccer fields, trails, site lighting, and landscaping. The county is currently planning Phase II of the park. No plans have been finalized, but preliminary schematic drawings show three baseball diamonds approximately 1,000 feet north of the FCP and Popes Head Road intersection and within the study area.
- **Popes Head Park** — Approximately 7 acres of the county-owned Popes Head Park is located within the study area. The park is adjacent to Popes Head Road at Revercomb Court, which is west of FCP. The overall park includes athletic fields, tennis courts, natural areas, and some hiking trails. The portion of the park within the project area is forested.
- **Trails** — The Braddock Road Trail is a 10-foot wide mixed-use trail located along eastbound Braddock Road. The FCP Trail also is 10 feet wide and runs along southbound FCP. These trails are standalone facilities designated for recreational use.

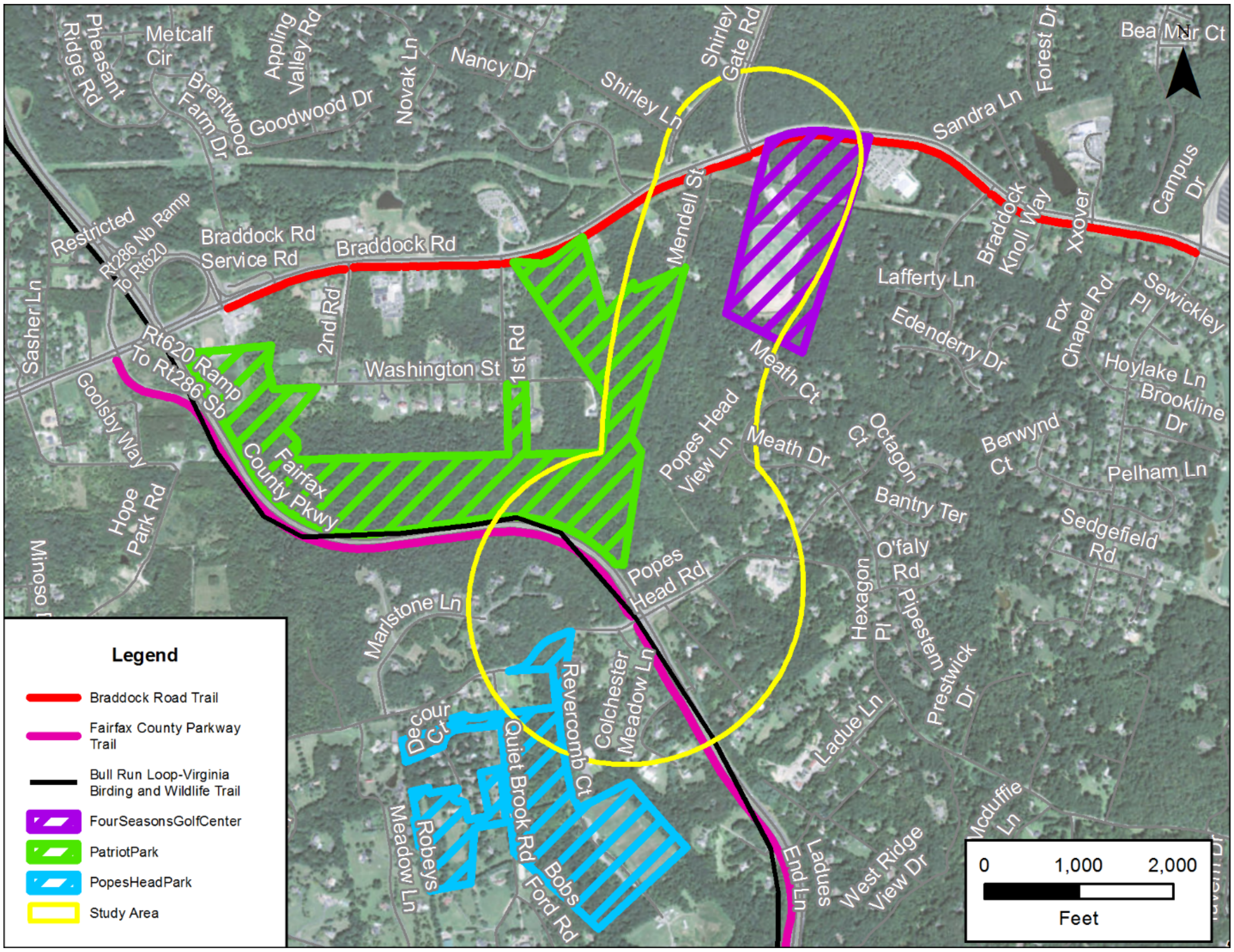
Should federal funds be utilized or federal approval be required, coordination on Section 4(f) resources would be necessary. An alignment that avoids or minimizes impacts to Section 4(f) properties in accordance with section 4(f) regulations should be selected. If local funds are used on the portions of the project that require the use of park property, the interagency ROW agreement between the county and the park, rather than Section 4(f), would apply.

Two other recreational properties/sites were identified within the project corridor. However, based on the nature of these sites it is not anticipated that that they would qualify for protection under Section 4(f):

- **The Bull Run Loop of the Virginia Birding and Wildlife Trail** — A driving trail leading to wildlife viewing sites throughout Virginia, it is mapped along FCP. Approximately 6.5 miles of the trail is within the study area. The trail occupies existing road ROW and is therefore unlikely to qualify for protection under Section 4(f).
- **The Four Seasons Golf Center** — The golf center is located entirely within the northeast portion of the study area. The entrance to the golf center is located on Braddock Road directly across from the existing southern terminus of Shirley Gate Road. The golf center is a private recreation facility and is therefore unlikely to qualify for protection under Section 4(f).

Upon selection of an alignment alternative, further coordination regarding the applicability of Section 4(f) should be conducted. **Figure 6.6** provides an overview of Section 4(f) properties located within or in close proximity of the project area.

Figure 6.6: Section 4(f) Properties



Cultural Resources

ARCHITECTURAL AND ARCHAEOLOGICAL RESOURCES/SECTION 106

The Virginia Department of Historic Resources (VDHR) serves as the State Historic Preservation Officer (SHPO) in Virginia. Under Section 106 of the National Historic Preservation Act, a historic property is any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places (NRHP). To be eligible for listing sites must meet at least one of the National Register Criteria for Evaluation, which involves examining the age, integrity, and significance of the site. Historic sites that are eligible for listing on the NRHP and/or are recommended for preservation in place by VDHR also are protected under Section 4(f) as previously mentioned.

The VDHR Virginia Cultural Resource Information System (VCRIS) database was reviewed to identify existing records of structures, districts, and archaeological sites within the study area that are listed on or eligible for the NRHP. A total of 12 archaeological records were identified and can be seen in **Table 6.1** below, and in **Appendix F**. Locations of archaeological sites are shown below in **Figure 6.7**. No historic districts or architectural resources were identified. The exact alignment of the road extension will need to be determined to evaluate impacts to these archaeological sites.

Figure 6.7: VCRIS Mapping

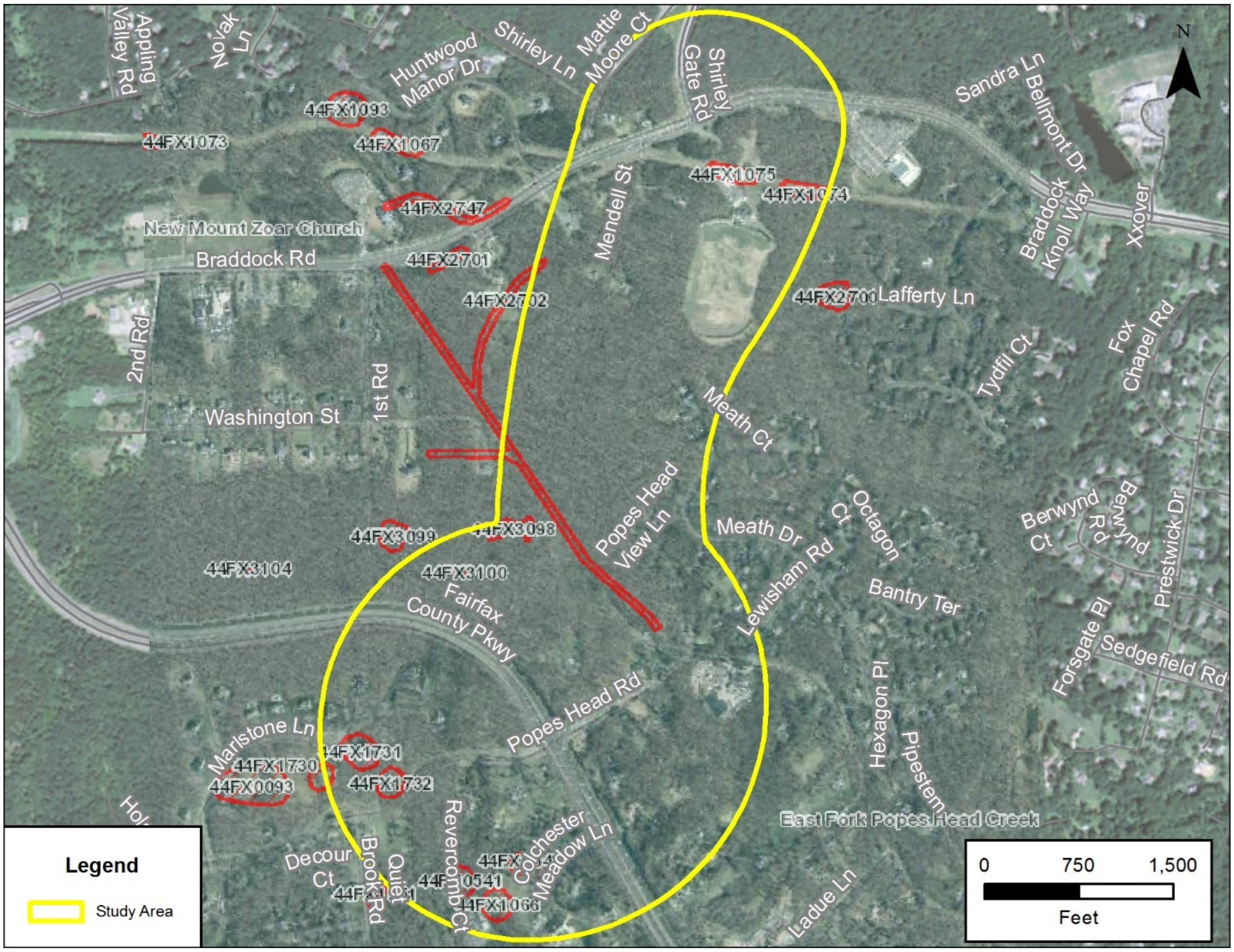


Table 6.1: VCRIS Identified Cultural Resources

DHR ID	Site Name	Site Types	Evaluation Status
44FX0541	null	Camp	null
44FX0542	null	null	null
44FX1066	null	null	null
44FX1074	null	null	null
44FX1075	null	null	null
44FX1730	null	null	DHR Staff: Not Eligible
44FX1731	null	null	DHR Staff: Not Eligible
44FX1732	null	null	DHR Staff: Not Eligible
44FX2702	Road trace	Road	null
44FX3098	null	Lithic scatter	null
44FX3100	null	Lithic scatter	null
44FX3101	null	Lithic scatter	null

A Fairfax County Historical Marker Database search revealed one historical marker associated with the Fairfax Nike Missile Site located along FCP NB, approximately 1,600 feet south of Popes Head Road. This is not anticipated to affect the construction of the alignment of Shirley Gate Road Extended.

Further coordination with VDHR may be necessary to identify, confirm, and/or determine the eligibility of previously recorded or unlisted resources. In addition, if federal funds are approved or permitting is required, additional architectural and archaeological studies may be required to identify historic resources. Impacts to eligible resources should be minimized to the maximum extent practicable in accordance with Section 106 and Section 4(f). In the event that impacts are proposed, additional coordination with VDHR and Federal Highway Administration (FHWA) will be required.

SCENIC RESOURCES

The DCR Virginia Outdoors Plan Mapper and NHDE were reviewed to identify scenic rivers and byways in the vicinity of the project area. Popes Head Road is designated as a Virginia Scenic Byway along its entire length, from Clifton Road (Route 645) to Ox Road (Route 123). Patriot Park is identified as a local public access land. No National scenic byways, National scenic rivers, or Virginia scenic rivers were identified; therefore, no scenic resources are anticipated to be impacted as a result of the proposed project.

Natural Resources

GEOLOGY

To summarize the area geology, a review of the digital representation of the 1993 Geologic Map of Virginia from the United States Geologic Service (USGS) was conducted. Most of the proposed project area lies within an area underlain by the Western Piedmont's Piney Branch Complex from the Proterozoic Z-Cambrian era. This area is comprised of metamorphosed mafic and ultramafic rock. Only the southeastern portion of the proposed project area is found in an area underlain by the Mather George Formation from the Proterozoic Z-Cambrian era. This area is comprised of schist. Supporting documentation is included in **Appendix G.**

SURFACE WATERS

The study area is within the Popes Head Creek Watershed, which is subdivided into the Upper Popes Head and Popes Head 2 Subwatersheds.

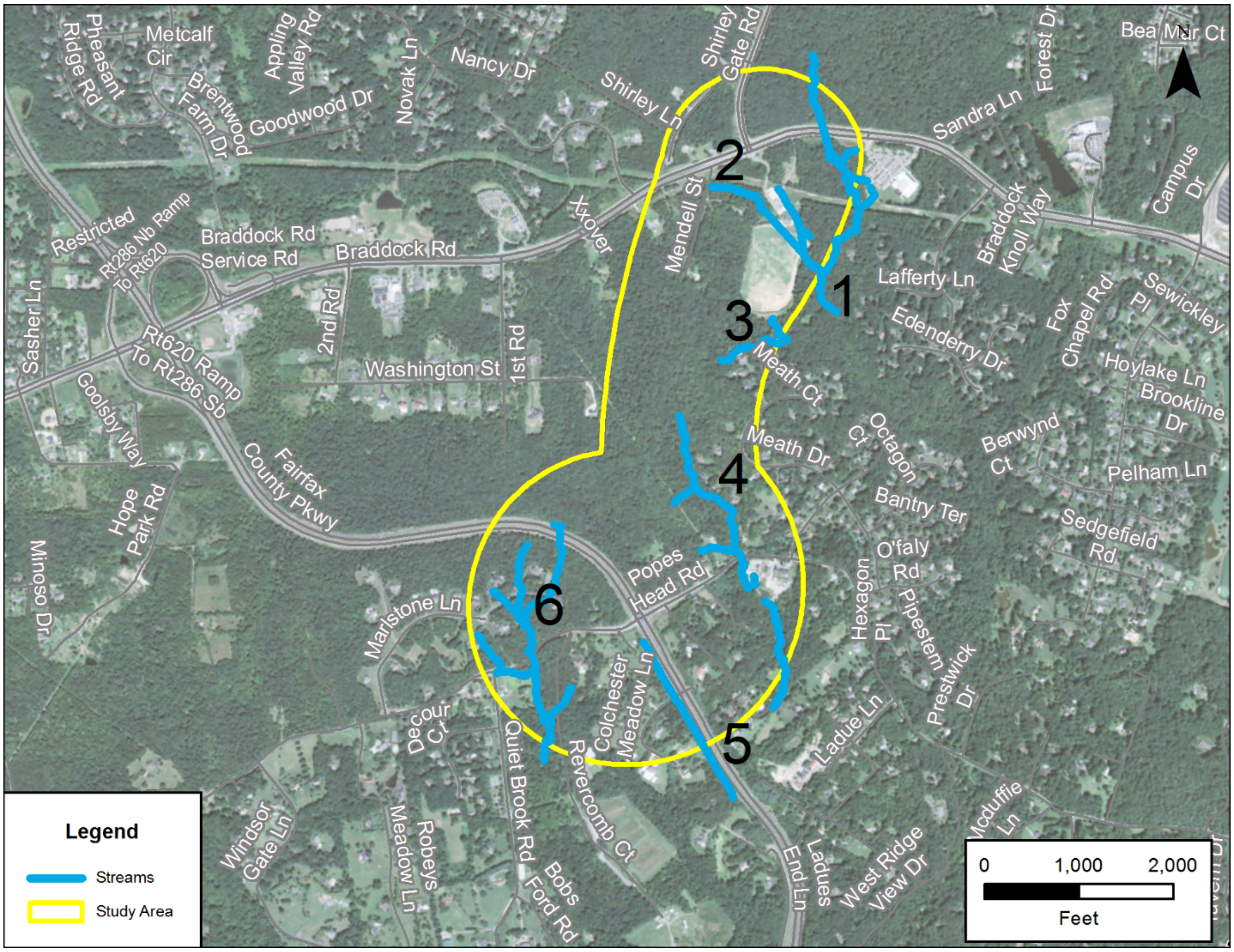
No wetlands are shown on the United States Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI). NWI mapping is included in **Appendix G.** A complex stream network can be found within the study area as identified on the county's water feature lines GIS data. This data mirrors data on the UGSG National Hydrography Dataset (NHD). The county data can be seen on **Figure 6.8** and is described below.

- **Stream 1**—an unnamed tributary to Popes Head Creek is located at the northern end of the study area and crosses under Braddock Road via a culvert approximately 800 feet east of the existing Shirley Gate Road.
- **Stream 2**—flows east from Mendell Street, passes underground through the Four Seasons Golf Center, and drains into Stream 1.
- **Stream 3**—consists of two branches that ultimately flow into Stream 1. One branch flows from a stormwater management pond on the Four Seasons Golf Center property. The second branch originates behind the residences on Meath Court.
- **Stream 4**—originates in the center of the study area and flows south behind the residences on Meath Drive, under a private driveway and Popes Head Road, through an instream stormwater management pond, and subsequently into Popes Head Creek.
- **Stream 5**—a roadside ditch along the FCP Trail starting at Popes Head Road and draining into Popes Head Creek.

- **Stream 6**—this system is a network of tributaries south of FCP that eventually drains into Piney Branch.

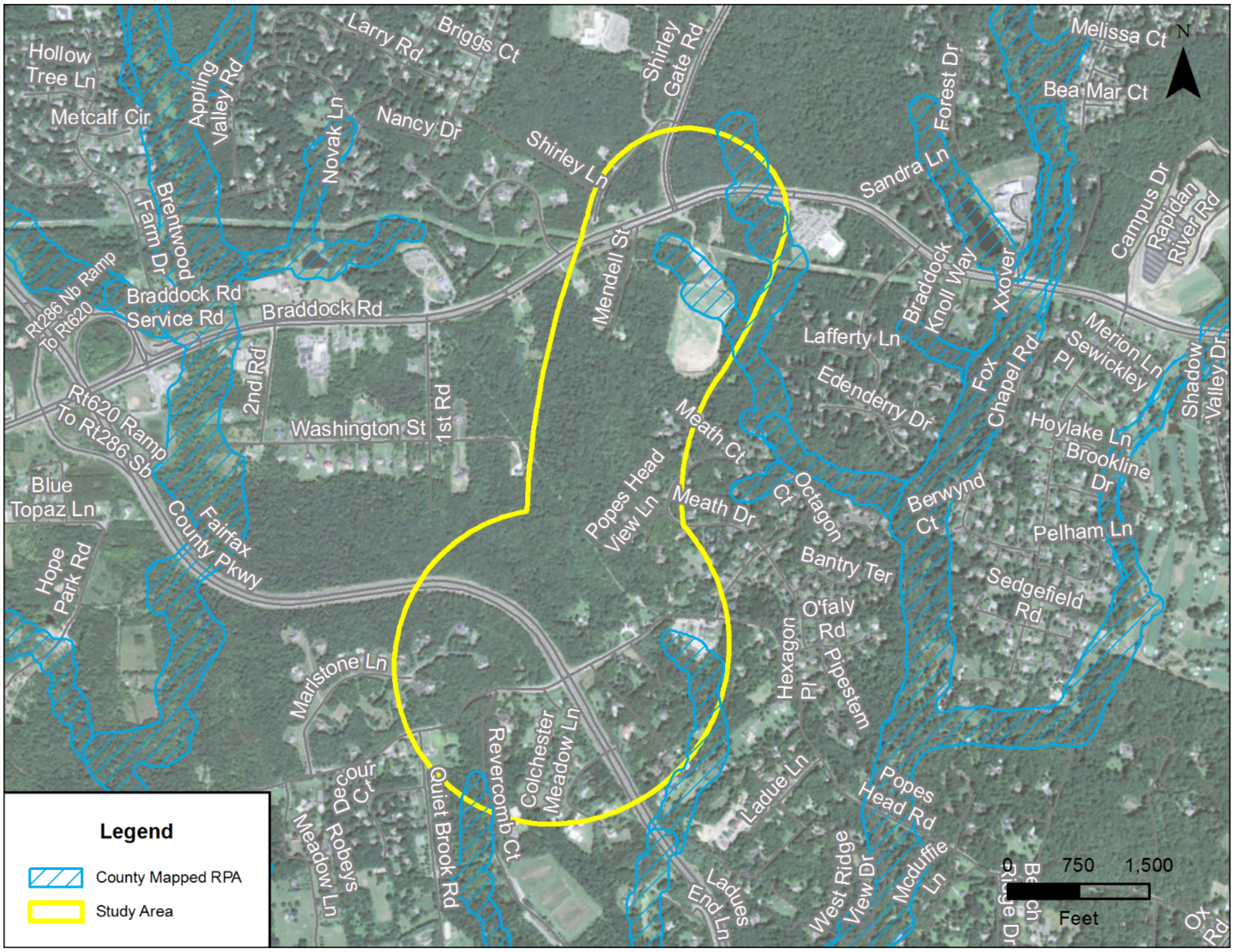
Although wetlands were not identified on the NWI mapping, wetlands may be associated with these streams.

Figure 6.8: Streams within Study Area



Fairfax County's Code of Ordinances specifies a Resource Protection Area (RPA) as a stream with perennial flow and a 100-foot buffer from these streams. The RPA is mapped by the county, but is subject to changes by a site-specific RPA determination in accordance with the methodologies and requirements outlined in Section 6-1700 of *Fairfax County's 2011 Public Facilities Manual* (PFM). According to Fairfax County Mapping, all or parts of streams1, 2, 4, and 6 are within an RPA. Construction of a road in or across an RPA requires optimization of the alignment and design of the roadway to minimize encroachment and the approval of a Water Quality Impact Assessment (WQIA). Coordination with the county will be required if encroachment within the RPA is anticipated due to the proposed road extension. These RPA areas are shown in **Figure 6.9** below. It is worth noting that if VDOT constructs the FCP Improvements project, the county's RPA ordinance, and the PFM will not apply to this project because local ordinances do not apply to state agencies. However, any portion of the project that will be constructed by the county will need to follow all local ordinances and land development procedures.

Figure 6.9: RPA within Study Area



303(D) IMPAIRED WATERS

Although no 303(d) Impaired Waters are found within the study area, in the DEQ's Draft 2014 305(b)/303(d) Water Quality Assessment Integrated Report these streams drain to Pope's Head Run that drains to Bull Run and has a limitation on fish consumption due to PCBs in fish tissue. The water eventually drains to the Occoquan River, which has limited recreation due to E. coli and aquatic life because of estuarine bioassessments. An excerpt of this report is included in **Appendix G**.

WATER SUPPLY PROTECTION

According to the official zoning map and Fairfax County Code of Ordinances, the proposed project site lies within a Water Supply Protection Overlay District (WSPOD). This WSPOD was been developed to prevent further water quality degradation of the Occoquan Reservoir by developing requirements to reduce projected phosphorus runoff within the Occoquan Watershed. The WSPOD's requirements should be considered during design of the proposed roadway extension.

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOODPLAINS

The study area is shown on Flood Insurance Rate Map panel 51059C0255E. The entire study area lies within "unshaded Zone X" which is an area determined to be outside of the 0.2 percent annual chance floodplain. The FEMA mapping is included in **Appendix G.**

THREATENED AND ENDANGERED SPECIES/NATURAL HERITAGE RESOURCES

The USFWS Information, Planning and Conservation (IPaC) system; Virginia Department of Game and Inland Fisheries (DGIF) Virginia Fish and Wildlife Information Service (VaFWIS) database; and the DCR NHDE interactive map and database were queried to identify species that are federally or state listed as threatened or endangered. USFWS IPaC identified the northern long-eared bat (*Myotis septentrionalis*), which is federally listed as threatened. This species has specific guidance for construction; therefore, coordination with the USFWS will be necessary prior to construction.

No confirmed occurrences of listed species were identified within the study area on VDGIF VaFWIS and DCR NHDE databases. Database and interactive map results can be viewed in **Appendix G.**

Streams 4 and 6 are listed by DGIF and DCR as a predicted habitat for the wood turtle (*Glyptemis insculpta*). This species is state listed as threatened. If these streams will be impacted by the potential roadway construction, further coordination (that potentially include field surveys) with DGIF and DCR may be required to determine the impact to this species.

DGIF and DCR did not identify anadromous fish waters or trout waters within the study area. The DCR NHDE interactive map and database did identify Popes Head Park and Patriot Park as managed conservation lands.

NOISE

This project would be considered a Type I project under 23 CFR 772.5 and therefore require a noise assessment per VDOT and FHWA requirements.

ENVIRONMENTAL JUSTICE

Population demographics were obtained from the U.S. Census Bureau for Fairfax County from 2010 and 2013 census data, as this was the most recent data available at the time of the analysis. The environmental justice (EJ) study area traverses census tracts 492000 (block group 1 and 2), 490500 (block group 4), and 440600 (block group 1). The census tracts are shown on **Figure 6.10** and the data is summarized in **Table 6.2** below. The minority or low-income population of the EJ study area does not exceed 50 percent; however, the percentage of the minority population is above the EJ evaluator factor in tract 490500 (block group 4) and tract 440600 (block group 1). Upon selection of an alternative and determination of ROW requirements, impacts to minority populations, if any, would need to be determined. The project should be designed so impacts to minority or low-income populations are minimized as much as possible.

The census tracts exceed the 2013 Health and Human Services Guidelines. The 2015 guidelines state that a family of four is considered at poverty level if the median household income is $24,550 or below. All census blocks exceed that number; therefore, no-low income population is considered present.

Figure 6.10: Block Groups

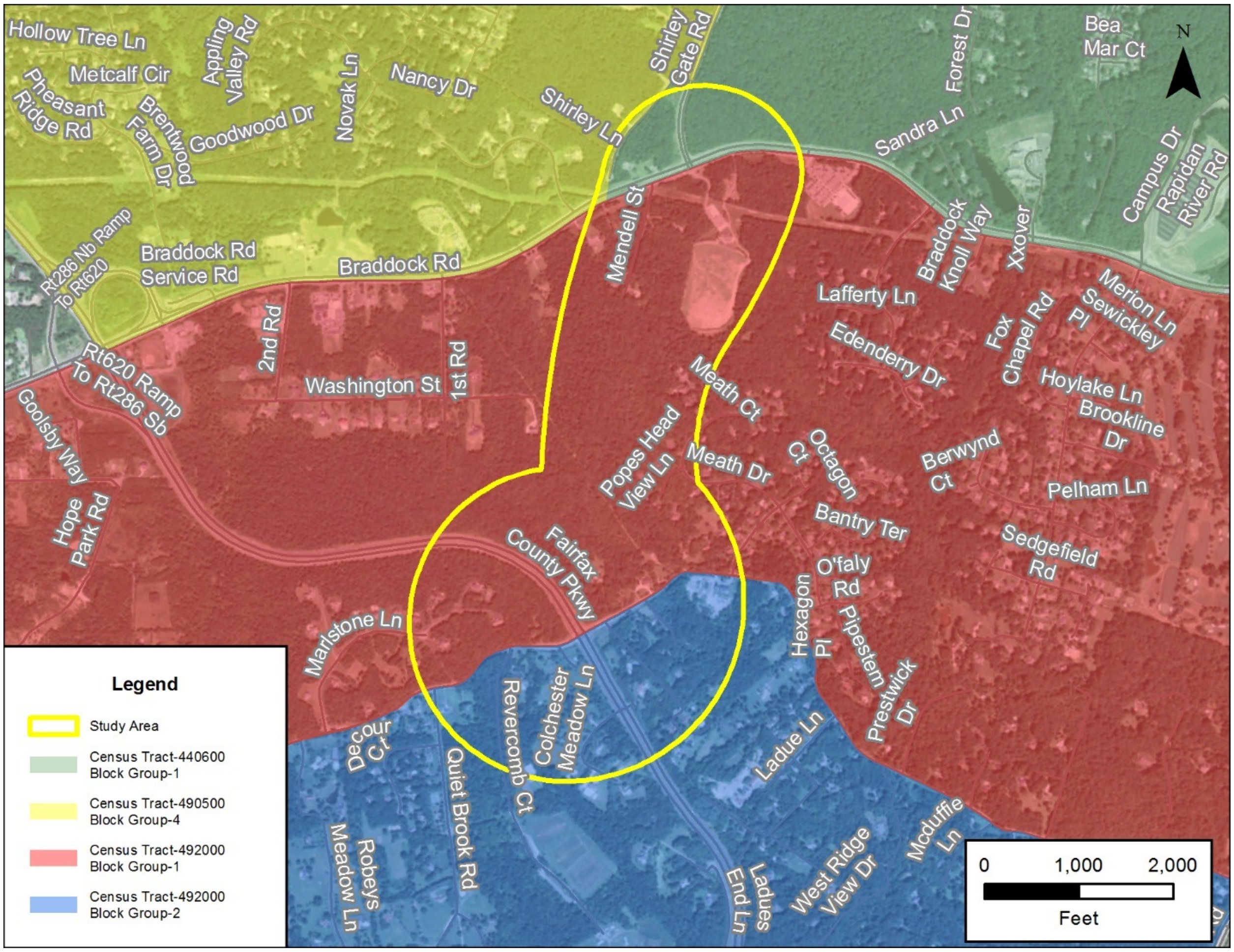


Table 6.2: 2010 Census Data Summary for Environmental Justice

Census Block Groups Per 2010 Census Data

STATE FIPs Code	COUNTY FIPs CODE	TRACTCE	BLOCK GRPCE	FIPS	**Total Population**	**Minority Population**	**Minority Percentage**
51	059	492000	1	510594920001	2221	564	25.39%
51	059	492000	2	510594920002	2157	380	17.62%
51	059	490500	4	510594905004	1439	524	36.41%
51	059	440600	1	510594406001	2846	1256	44.13%
Totals					8663	2724	31.44%
EJ evaluator factor equals 1.1 x greater than lowest							27.93%

2013 Census Tract Median Household Income

Fairfax County Median Household Income	
United States	***53,046 USD***
Virginia	***63,907 USD***
Fairfax County	***110,292 USD***
Census Tract 059492000	***172,440 USD***
Block Group 1	***153,482 USD***
Block Group 2	***165,278 USD***
Census Tract 059490500	***171,538 USD***
Block Group 4	***172,292 USD***
Census Tract 059440600	***90,781 USD***
Block Group 1	***90,781 USD***

Conclusion

Based on the findings of the environmental due diligence efforts, the following are considerations for the county as further action is taken to carry the Shirley Gate Road Extended project through design and construction:

- Depending on the alternative selected, additional studies relating to the identification and management of contaminated soil and groundwater relating to hazardous materials may be required. In addition, a Phase I Environmental Site Assessment (ESA) for all property acquisition is recommended.
- For air quality considerations this project is not programmed or modeled in the currently conforming MWAQC Regional Transportation Plan and Transportation Improvement Program (TIP). An amendment or administrative modification as appropriate will need to be made to the transportation plan and TIP to include this project before it can proceed.
- No libraries, schools, hospitals, or other community facilities were identified during a visual inspection of the study area. Although the Jerusalem Korean Baptist Church is within the study area, this facility is not anticipated to be affected by the road extension. Coordination will be required if impacts to this facility are anticipated.
- Should federal funds be utilized or federal approval be required, coordination on Section 4(f) resources would be necessary. An alignment that avoids or minimizes impacts to Section 4(f) properties in accordance with Section 4(f) regulations should be selected. Further coordination with VDHR may be necessary to identify, confirm, and/or determine the eligibility of previously recorded or unlisted resources. In addition, if federal funds are approved or permitting is required, additional architectural and archaeological studies may be required to identify historic

resources. Impacts to eligible resources should be minimized to the maximum extent possible in accordance with Section 106 and Section 4(f). In the event that impacts are proposed, additional coordination with VDHR and FHWA will be required.

- Six streams were identified within the study area, and although wetlands were not identified on the NWI mapping, wetlands may be associated with these streams. Fairfax County's Code of Ordinances specifies a RPA as a stream with perennial flow and a 100-foot buffer from these streams. The RPA is mapped by the county, but is subject to change by a site-specific RPA determination in accordance with the methodologies and requirements outlined in Section 6-1700 of Fairfax County's 2011 PFM. According to Fairfax County Mapping, four streams are within an RPA. Construction of a road in or across an RPA requires optimization of the alignment and design of the roadway to minimize encroachment and the approval of a WQIA. Coordination with the county will be required if encroachment within the RPA is anticipated due to the proposed road extension.
- According to the Official Zoning Map and Fairfax County Code of Ordinances, the proposed project site lies within a WSPOD. This WSPOD has been developed to prevent further water quality degradation of the Occoquan Reservoir by developing requirements to reduce projected phosphorus runoff within the Occoquan Watershed. The WSPOD's requirements should be considered during design of the proposed roadway extension.
- No confirmed occurrences of listed species were identified within the study area on VDGIF, VaFWIS, and DCR NHDE databases, but two streams are listed by DGIF and DCR as a predicted habitat for the wood turtle (Glyptemis insculpta). This species is state listed as threatened. If these streams will be impacted by the potential roadway construction, further coordination (potentially to include field surveys) with DGIF and DCR may be required to determine the impact to this species. USFWS IPaC identified the northern long-eared bat (Myotis septentrionalis) that is federally listed as threatened. This species has specific guidance for construction; therefore, coordination with the USFWS will be necessary prior to construction.
- This project would be considered a Type I project under 23 CFR 772.5 and would therefore require a noise assessment per VDOT and FHWA requirements.
- The minority or low-income population of the EJ study area does not exceed 50 percent; however, the percentage of the minority population is above the EJ evaluator factor in tract 490500 (block group 4) and tract 440600 (block group 1). Upon selection of an alternative and determination of ROW requirements, impacts to minority populations, if any, would need to be determined. The project should be designed so impacts to minority or low-income populations are minimized as much as possible.

Shirley Gate Road Extended

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Chapter 7 – Continued Public Engagement

Chapter 7 – Continued Public Engagement

As previously outlined in **Chapter 4**, a series of stakeholder meetings were hosted between May and September of 2015to solicit input on the development of measures of effectiveness (MOEs), alternative concepts, and the ultimate selection of a preferred alignment. The stakeholder engagement process concluded with the selection of a preferred alignment and interchange alternative that was presented at a public information meeting on December 7, 2015, along with pertinent information and results prepared over the life of the corridor planning study.

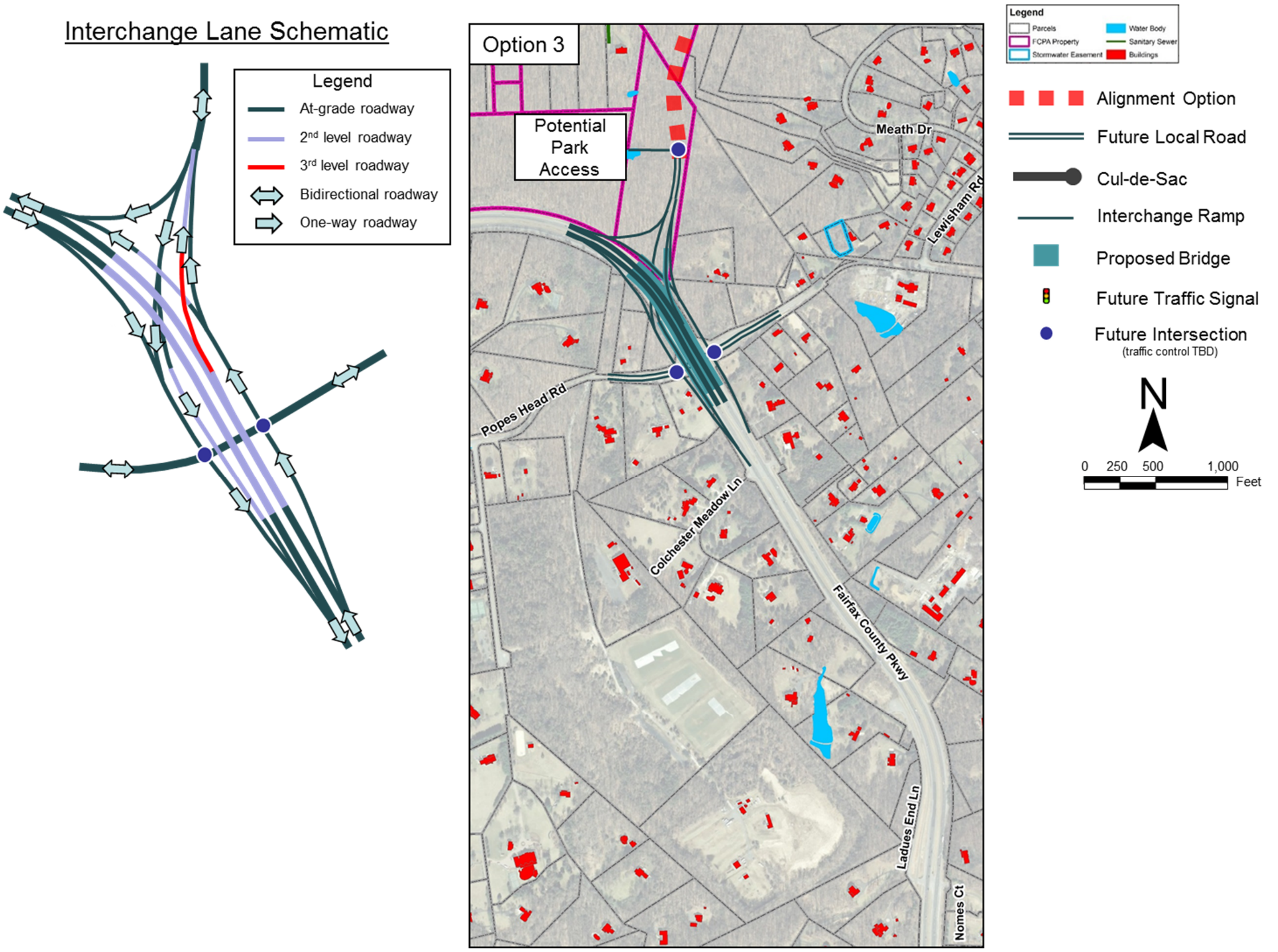
In February 2016, the board of supervisors authorized a Comprehensive Plan amendment to consider showing the refined alignment for the Shirley Gate Road extension and the preferred interchange alternative on the Plan. On June 6, 2016, the proposed comprehensive plan amendment for the Shirley Gate Road extension was presented by the Fairfax County Department of Transportation (FCDOT) at a Springfield Land Use Committee Information Meeting. Similar information presented at the public information meeting in December 2015 was shared with attendees. Several residents at the meeting that lived in the vicinity of the proposed extension voiced concerns regarding the recommended interchange alternative and the alignment of the Shirley Gate Road extension. One of the main issues identified was the termination of the Shirley Gate Road extension at Popes Head Road to the west of Fairfax County Parkway (FCP), which based on forecast traffic volumes is expected to increase the volume of traffic through Clifton along Popes Head Road. Also, many people at the meeting indicated that they were not aware of the previous stakeholder meetings that occurred between May and September of 2015.

To ensure that all interested residents had complete information about the study, Springfield Supervisor, Pat Herrity, and Planning Commissioner, Pete Murphy, hosted another community meeting on July 19, 2016, to discuss the process leading up to the selection of a preferred alternative, impacts to the west side of Popes Head Road, and opportunities to address concerns of residents. FCDOT staff presented the study background and results, and Virginia Department of Transportation (VDOT) staff also attended the community meeting to hear input that may be relevant to a future widening project of FCP between Route 29 and Route 123. In response to the citizen feedback received, with support from a group of engaged citizens, a new interchange alternative was presented that eliminates the terminus of the Shirley Gate Road extension at Popes Head Road while maintaining full access to and from Popes Head Road and the Shirley Gate Road extension. The proposed alternative is illustrated in **Figure 7.1** and is herein referred to as Alignment Option 3 (or Option 3). The interchange lane schematic demonstrates how the various movements to and from the study roadways would be accommodated. A tight urban diamond interchange would allow full access to and from FCP. Directional ramps would provide free-flow access to and from Shirley Gate Road while bypassing the interchange at Popes Head Road. One-way roadways integrated with ramps from Popes Head Road and Shirley Gate Road would allow for movement between these two roadways. While full access is provided to the Shirley Gate Road extension, an indirect route would be required for southbound trips from FCP destined for northbound Shirley Gate Road. Although indirect, this movement carries a relatively low volume of traffic.

A comprehensive evaluation of Alignment Option 3 against the project MOEs would allow for a direct comparison to the alternatives identified as part of this project. This would require operational analyses of the interchange, evaluation of property impacts, and a qualitative assessment of cost which are just a few of the MOEs identified. Depending on the final configuration of FCP in Option 3, whether at-grade or elevated as a 2nd level roadway as shown in **Figure 7.1**, construction costs could vary significantly. At this stage of the planning process it is difficult to make a certain determination on which of the three interchange alternatives is the most feasible.

Since new stakeholders were involved near the end of the process and new concerns were identified about the previous preferred alternative, it is necessary to explore additional interchange alternatives. VDOT will be carrying this interchange configuration selection process forward as part of the preliminary design for the FCP widening project between Route 29 and Route 123 that includes design of the interchange. The preliminary design process was initiated in the fall of 2016.

Figure 7.1 – Shirley Gate Road Extended Alignment and Interchange Option 3



Based on feedback received during the community meeting in response to the project and the alternative presented above, the following are issues of concern to the community for VDOT and FCDOT to consider as the project moves forward into future design and construction phases:

- Maintain access to Colchester Meadow Lane and Ladues End Lane/Nomes Court south of Popes Head Road (see **Figure 7.1**)
- Maintain the rural character of Popes Head Road
- Avoid a direct connection of the Shirley Gate Road extension to Popes Head Road
- Consider interim mitigation opportunities to address safety concerns at the existing signalized intersection of FCP and Popes Head Road
- Increase the scope of community outreach as part of future public engagement processes, specifically including residents to the west of FCP
- Provide access to the Patriot Park east site from the Shirley Gate Road extension

Shirley Gate Road Extended

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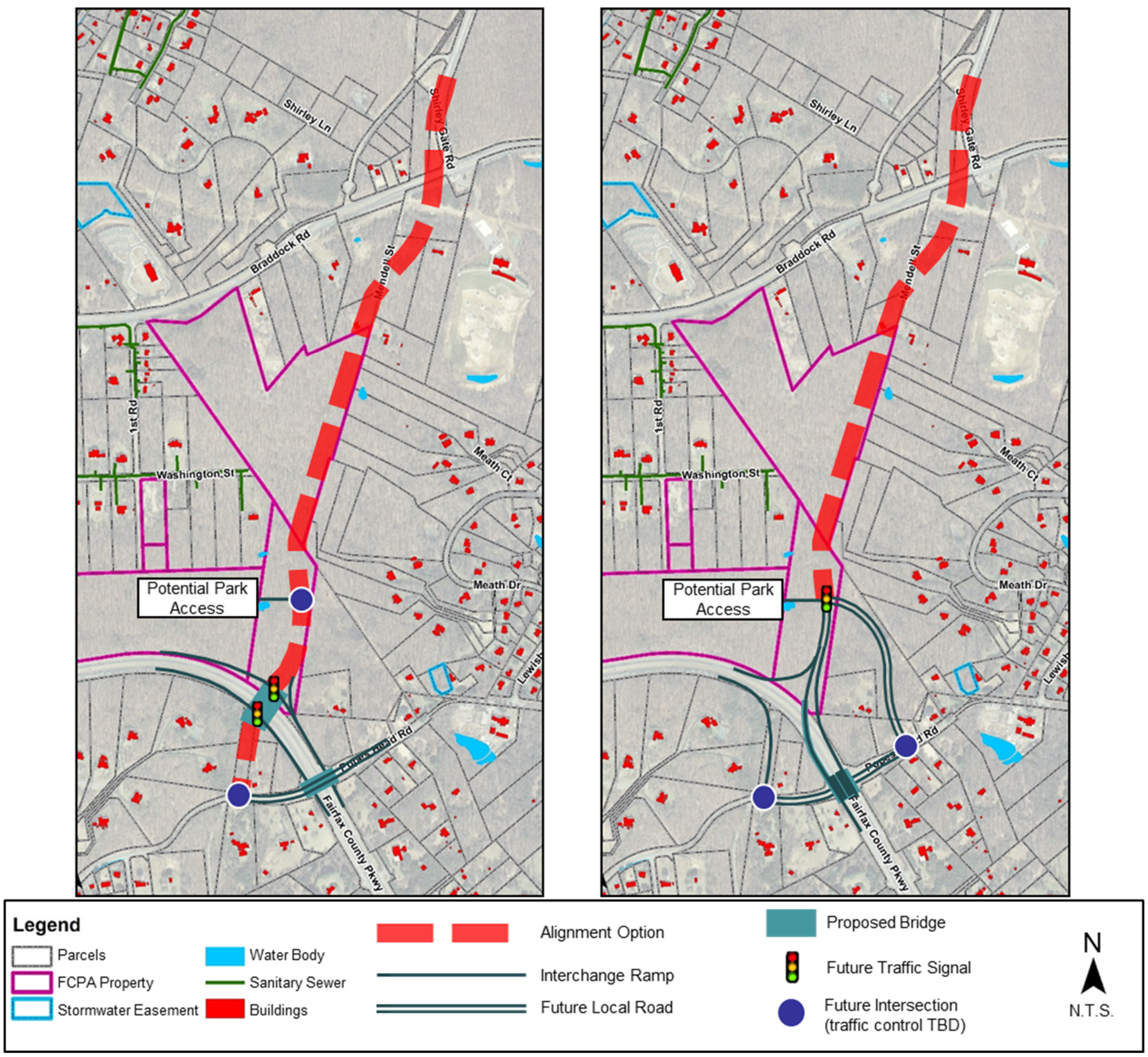
Chapter 8 – Conclusions and Recommendations

Chapter 8 – Conclusions and Recommendations

The development of alignment alternatives for the Shirley Gate Road extension and interchange with Fairfax County Parkway (FCP) was accomplished through a combination of stakeholder involvement activities and detailed operational analyses. Based upon information gathered during a review of previous studies and ongoing projects (**Chapter 2**) and input at stakeholder meetings, northern and southern alignment alternatives were developed for the future roadway. The stakeholder engagement supported the identification of measures of effectiveness (MOEs) to use in the evaluation of alignment alternatives. The initial stakeholder screening of preliminary alignment alternatives using these MOEs (see **Table 4.3**) allowed for the identification of two alternatives for further evaluation. The screening was based on qualitative feedback during the stakeholder engagement process and did not account for quantified assessments of each alignment. Graphical representations of the two alternatives are presented in **Figure 8.1**.

Figure 8.1 – Recommended Alternatives

A. Northern Alignment Option 1B, Southern Alignment Option 2A(1) | **B. Northern Alignment Option 1B, Southern Alignment Option 2A-2B**



VISSIM microsimulation software was used to perform operational analyses of the two alternatives to assess the impact to traffic operations as compared to the no build condition. The results indicate that a significant reduction in travel times and delays can be expected with the grade separation of the existing Popes Head Road intersection. Access between Popes Head Road and FCP also is enhanced, with an expected travel time savings of more than two minutes. Comparable operational benefits are expected based on the microsimulation of the two alternatives. Considering the quantitative MOEs identified by the stakeholders related to transportation impacts and cost, Alignment Option 1B-2A (**Figure 8.1A**) was scored higher than Alignment Option 1B-2A/2B (**Figure 8.1B**) for the following reasons:

- **Travel time savings**—the interchange configuration of the southern Alignment 2A provides more efficient access through the interchange, particularly for side street left-turn movements from Popes Head Road
- **Construction Duration**— the need to provide an underpass of Popes Head Road in Alignment 2A/2B would be expected to require a longer construction schedule and impact travel patterns to a much larger degree than Alignment 2A
- **Construction Cost**— the relative cost of Alignment 2A/2B is expected to be more costly than Alignment 2A, primarily associated with the added construction phasing requirements to build the Popes Head Road underpass and right-of-way (ROW) acquisition

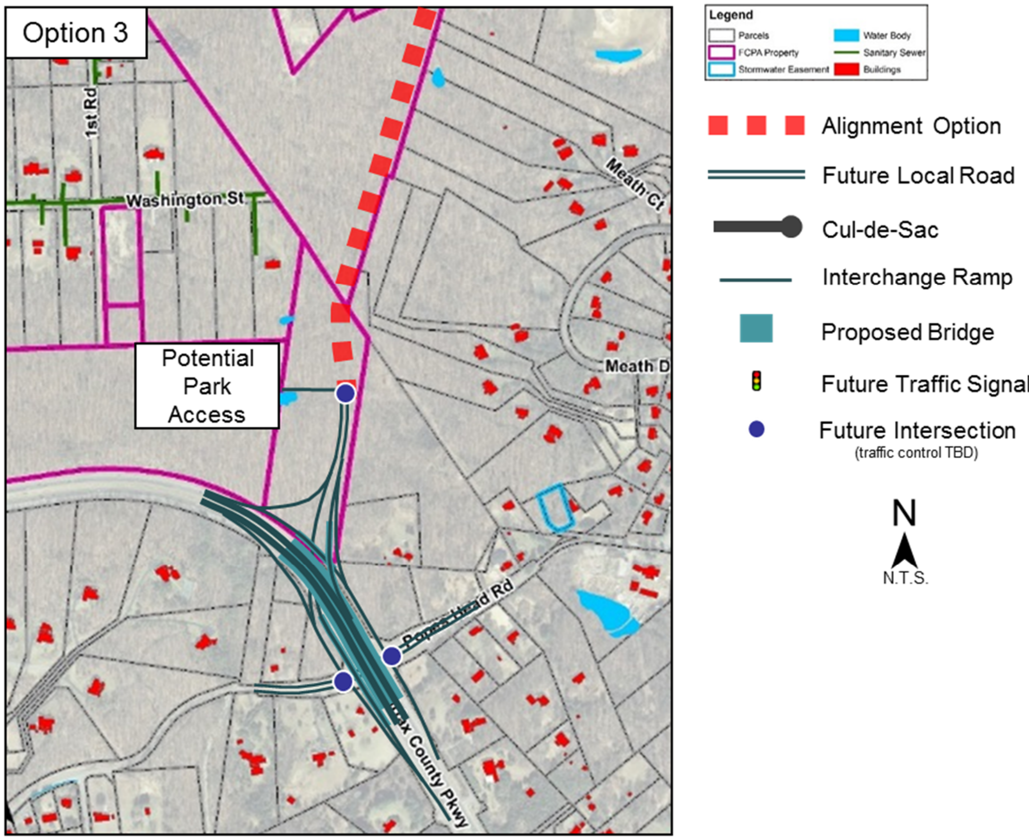
The completed assessment of the two alternatives is summarized in **Table 5.10**. The results of the future conditions analyses show that the Shirley Gate Road extension and associated interchange improvements will provide several benefits to the motoring public within the study area. These benefits include:

- Reduced traffic volumes along area roadways and intersections (Popes Head Road east of FCP, Braddock Road, Route 123)
- Reduced travel times along FCP and Popes Head Road
- Increased safety at the juncture of FCP and Popes Head Road
- Enhanced access for residents along Popes Head Road to FCP
- Improved access to western portions of the City of Fairfax and the Fair Oaks area

As documented in **Chapter 8** a continued public engagement occurred after the initial identification of the highest scoring alternative. Through this process a third alignment option for the southern portion of the extension was identified (illustrated in **Figure 8.2**). Although it satisfies many of the qualitative criteria met by the other two options, a quantitative assessment of traffic operations, cost, and other MOEs has not been completed. Further development and refinement of these and other alignment options along with continued public engagement, will occur by VDOT as part of the FCP widening project between Route 29 and Route 123.

All three alternatives appear to be reasonable, constructible, and provide a measurable benefit to operations compared to no build conditions (not yet confirmed for the third alternative). These are three of the eight policy points outlined in the guidelines required for Federal Highway Administration (FHWA) approval of an interchange justification report (IJR). As part of the aforementioned widening project, an IJR will be completed to further evaluate two alternatives (minimum number required) against the no build condition in order to select a single alternative to carry forward to design and construction. Given that the IJR is for a new interchange facility, the review and approval process can take longer than an interchange modification report (IMR), upwards of two years.

Figure 8.2 – Southern Alignment Option 3



It is estimated that the complete project cycle could span a period of 6 to 8 years, which will include the following:

1. IJR
2. National Environmental Policy Act (NEPA) compliance
   a. Environmental Assessment (EA) could be required (documented existence of naturally occurring asbestos will influence this process)
   b. Phase I Environmental Site Assessment (ESA) for all property acquisition is recommended
   c. This process is influenced by the funding source for construction
   d. Public hearings can be expected
3. Preliminary engineering and design
4. ROW acquisition
5. Construction

At the time of this study, funding for the construction of the Shirley Gate Road extension and interchange had not been identified. FHWA guidelines pertaining to IJRs require that a project move to construction within 8 years of formal acceptance of the IJR by the reviewing agency. So as not to jeopardize the outcome of the approval of a future IJR, it is recommended that the county have a reasonable level of confidence in a funding source to implement the improvements.