FORT LEE EXPANSION
TRAFFIC STUDY

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1.0 EXISTING CONDITIONS

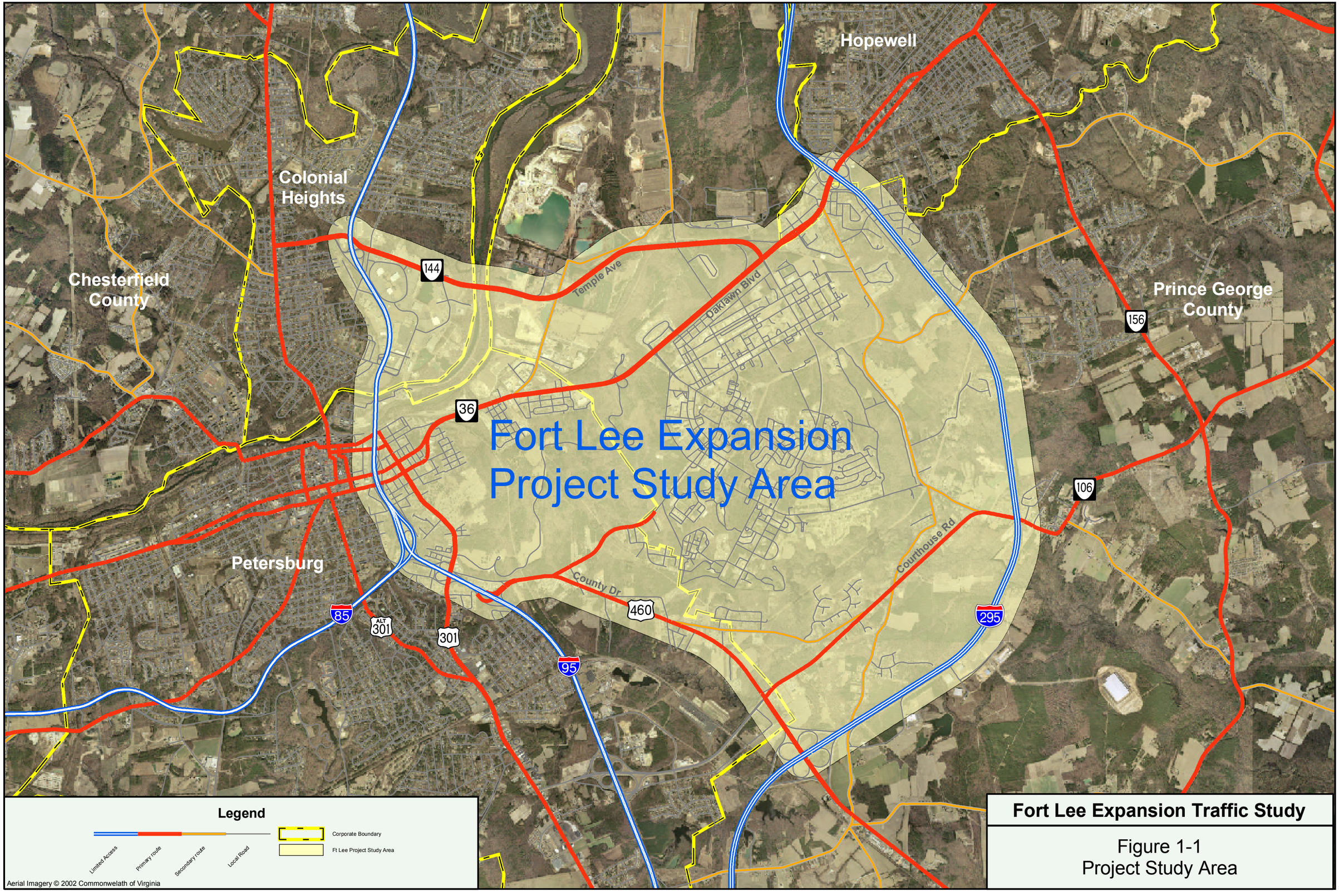
1.1 Introduction

Fort Lee, located in Prince George County, Virginia, is a focal point for Army logistics. It is home to the Combined Arms Support Command, U.S. Army Garrison, Army Logistics College, Quartermaster Center and School and is the headquarters for the Defense Commissary Agency. Due to the 2005 Base Realignment and Closure (BRAC) legislation, Fort Lee is undergoing significant expansion. The six recommendations made by the BRAC commission affecting Fort Lee include (1) establishing a Combat Service Support Center, (2) establishing a Joint Center for Consolidated Transportation Management Training, (3) establishing a Joint Center of Excellence for Culinary Training, (4) consolidation of Defense Commissary Agency Offices, (5) relocation of the Defense Contract Management Agency Headquarters, and (6) co-location of miscellaneous Department of Defense (DoD) functions. Based on these recommended realignments, the overall population at Fort Lee is expected to increase by 120 percent. Such considerable growth has the potential to create new or worsen existing traffic problems along major routes that provide access to the installation.

To understand the potential traffic impacts associated with the BRAC expansion at Fort Lee, the Virginia Department of Transportation (VDOT), in partnership with the Tri-Cities Metropolitan Planning Organization (MPO) and Fort Lee, has undertaken this study. This study will document existing and forecasted travel patterns and traffic conditions, identify existing and forecasted safety and capacity deficiencies on major routes and intersections, document planned land use and operational changes on Fort Lee and develop potential concepts for roadway improvements on the major roadways within the study area.

1.2 Study Area

Fort Lee is located in Prince George County, Virginia along Route 36 between Petersburg and Hopewell. West of the base is the main area of Petersburg National Battlefield and the City of Petersburg. South and southeast of the base are undeveloped or lightly developed areas of Prince George County, through which I-295 passes. Northeast of the base is the City of Hopewell which is largely developed. Just a few miles north and northwest of the base, across the Appomattox River, are Chesterfield County and Colonial Heights. The study area, shown in Figure 1-1, is generally bounded by I-95 on the west, I-295 to the east and south, US 460 to the west and south and Route 144 to the north.



Fort Lee Expansion Traffic Study

Figure 1-1
Project Study Area

The study area includes the following eleven roadways, which were analyzed as a part of this study.

- Route 36 (Oaklawn Boulevard / Washington Street) – a divided four-lane primary arterial highway with direct access to/from Fort Lee gates. Route 36 has interchanges at I-95 west of Fort Lee and I-295 east of Fort Lee.
- Route 106 (Courthouse Road) – a two-lane primary highway, southeast of Fort Lee.
- Route 109 (Mahone Avenue / Hickory Hill Road) – a two-lane primary highway entering/exiting at the Fort Lee Mahone Avenue Gate.
- Route 144 (Temple Avenue) – a divided four-lane primary arterial highway that ends at Fort Lee's Sisisky Gate.
- Route 460 (County Drive) – a four-lane primary arterial highway, south of Fort Lee.
- Route 603 (Baxter Road) – a two-lane secondary highway connecting Route 460 to Route 106.
- Route 630 (Jefferson Park Road) – a two-lane secondary highway (four-lane north of Middle Road – Route 646) running along the western Fort Lee boundary with direct access to the Adams Avenue Gate and Shop Road Gate.
- Route 634 (Allin Road) – a two-lane secondary highway connecting Route 106 to Route 630.
- Route 645 (Puddledock Road) – a two-lane secondary highway connecting Route 144 to Route 725.
- Route 646 (Middle Road) – a two-lane secondary highway branching off from Route 630.
- Route 725 (River Road) – a two-lane secondary highway intersecting Route 144 and ending at Route 36 south of the Fort Lee Sisisky Gate.

Fort Lee has four open gates and one planned gate for access into and out of the base. These gates include the following:

1. Lee Avenue. (Main) Gate (Access via Oaklawn Boulevard [Rte 36] on west side of base)
2. Sisisky Gate (Access via Oaklawn Boulevard [Rte 36] and Temple Avenue [Rte 144] at their intersection)
3. A Avenue (Golf Course) Gate (Access via Jefferson Park Road [Rte 630] and Allin Road [Rte 634])
4. Mahone Avenue Gate (Access via County Drive [US 460] and Hickory Hill Road [Rte 109])
5. River Road Gate (Planned future access via Oaklawn Boulevard [Rte 36] at River Road [Rte 725]).

Fort Lee has another gate at Shop Road and Jefferson Park Road (Rte 630) which was closed during the analysis period of this study. The Shop Road Gate was opened in October 2006 to

mitigate the temporary closure of Sisisky Gate, which is being reconstructed. Under current base plans, Sisisky Gate will reopen in twelve to eighteen months and Shop Gate will remain open indefinitely. The analysis in this report does not include Shop Gate remaining open. The impact of Shop Gate remaining open on the recommendations presented in this report is discussed in Chapter 4.

In addition to roadways, the following seventeen intersections were analyzed throughout the study area.

1. Temple Avenue (Rte 144) and Puddledock Road (Rte 645)
2. River Road (Rte 725) and Puddledock Road (Rte 645)
3. Temple Avenue (Rte 144) and River Road (Rte 725)
4. Oaklawn Boulevard (Rte 36) and Jefferson Park Road/Cousins Avenue (Rte 630)
5. Oaklawn Boulevard (Rte 36) and Temple Avenue (Rte 144)
6. Oaklawn Boulevard (Rte 36) and Lee Avenue (Main Gate)
7. Washington Street (Rte 36) and Puddledock Road/Court House Avenue (Rte 645)
8. Jefferson Park Road (Rte 630) and Middle Road (Rte 646)
9. Jefferson Park Road (Rte 630) and Adams Avenue (Gate)
10. Jefferson Park Road/Allin Road (Rte 630/634) and Bull Hill Road (Rte 630)
11. Courthouse Road (Rte 106) and Allin Road (Rte 634)
12. Courthouse Road (Rte 106) and Bull Hill Road (Rte 630)
13. Courthouse Road (Rte 106) and Baxter Road (Rte 603)
14. County Drive (US 460) and Courthouse Road (Rte 106)
15. County Drive (US 460) and Baxter Road (Rte 603)
16. County Drive (US 460) and Stedman Drive
17. County Drive (US 460) and Hickory Hill Road (Rte 109)

Figure 1-2 shows the location of these intersections in relation to the base as well as the location of the base gates.

1.3 Base Year Conditions

This section identifies existing deficiencies and presents traffic conditions on the eleven major roadways and seventeen major intersections analyzed. The existing lane configurations for intersections within the project area are shown in Figure 1-3.

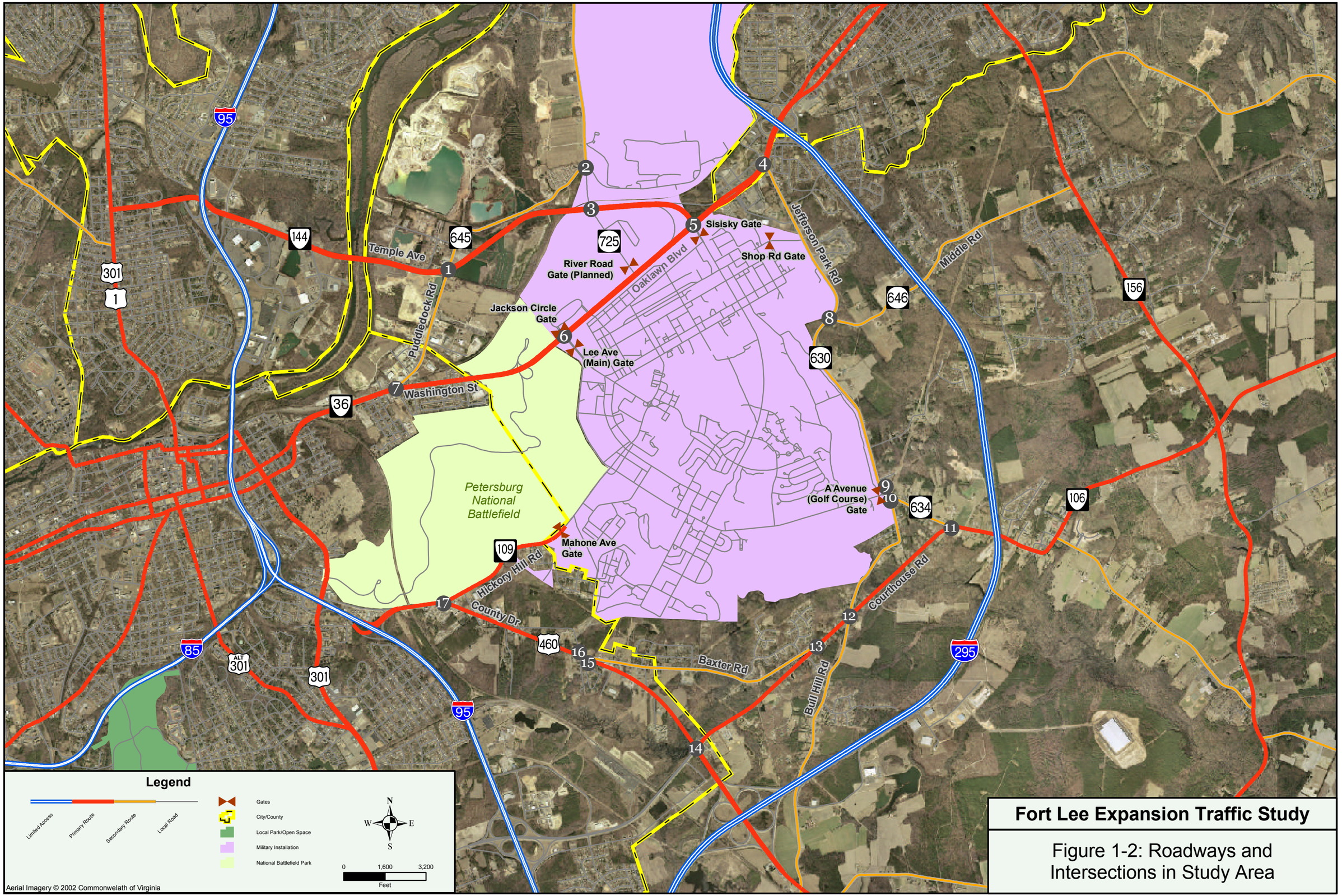


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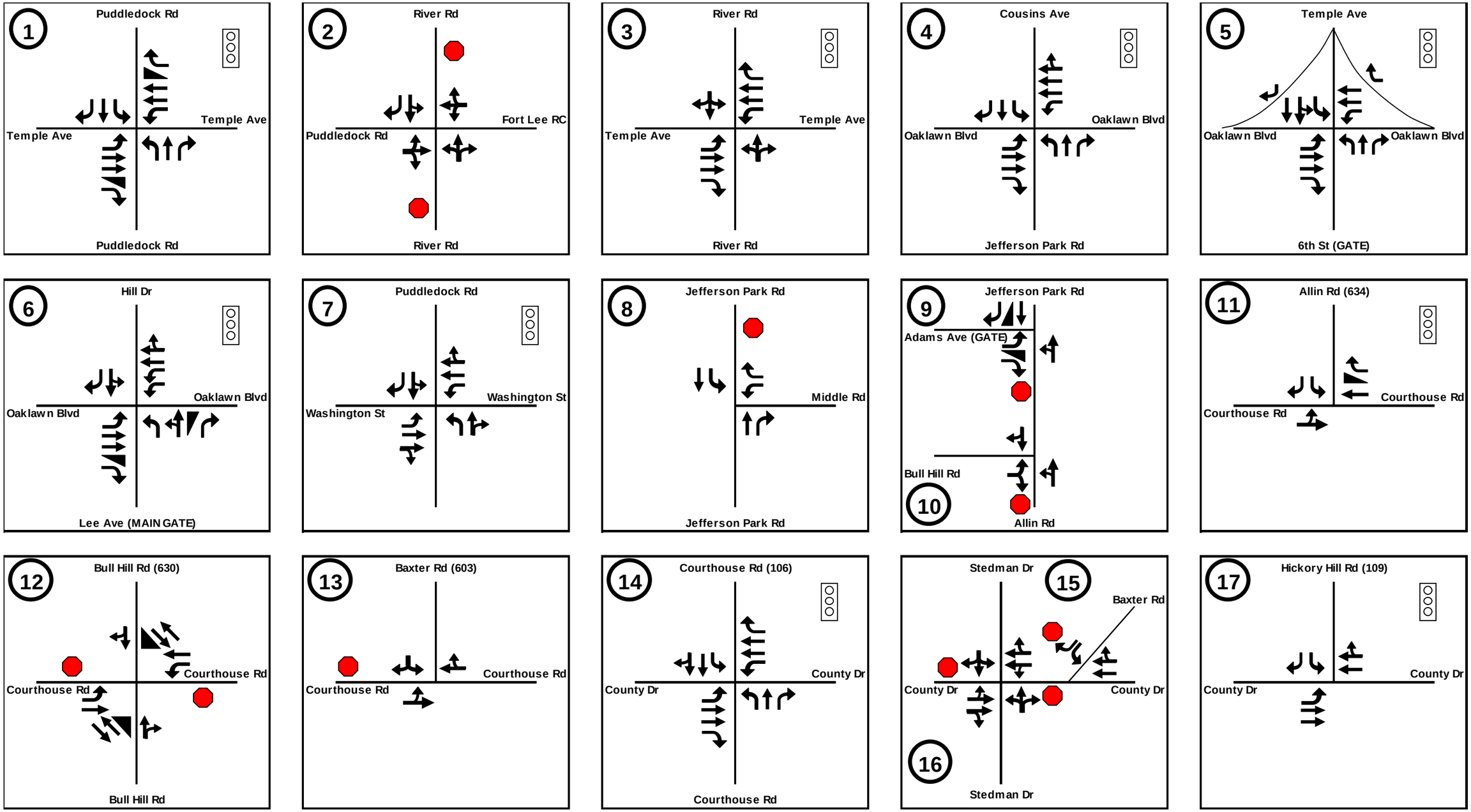
Figure 1-2: Roadways and Intersections in Study Area

Figure 1-3: Existing Intersection Geometry



To examine the base year (year 2006) conditions, average daily traffic volumes (ADTs) and truck percentages were obtained from the VDOT online count database. Turning movement counts were conducted in May 2006 at many key intersections in the study area. Average daily traffic volumes, peak hour volumes, and truck percentages are shown in Table 1-1.

Table 1-1: 2006 Link Volumes and Truck Percentages

Facility	From	To	2006 ADT	2006 AM Peak	2006 PM Peak	Truck Percentage
Washington Street / Oaklawn Blvd (Route 36)	Puddledock Rd (Route 645)	Lee Ave (Ft. Lee Gate)	17,800	1203	1294	6%
Oaklawn Blvd (Route 36)	Lee Ave (Ft. Lee Gate)	Temple Ave (Route 144)	18,700	1243	1385	6%
Oaklawn Blvd (Route 36)	Temple Ave (Route 144)	Jefferson Park Rd (Route 630)	36,100	2250	2840	6%
Hickory Hill Rd (Route 109)	County Dr (Route 460)	Mahone Ave (Ft. Lee Gate)	9,800	882	746	11%
Courthouse Rd (Route 106)	County Dr (Route 460)	Baxter Rd (Route 603)	7,900	669	656	11%
Courthouse Rd (Route 106)	Baxter Rd (Route 603)	Bull Hill Rd (Route 630)	9,900	882	765	11%
Courthouse Rd (Route 106)	Bull Hill Rd (Route 630)	Allin Rd (Route 634)	7,900	747	562	3%
Temple Ave (Route 144)	Puddledock Rd (Route 645)	River Rd (Route 725)	26,900	1523	2381	5%
Temple Ave (Route 144)	River Rd (Route 725)	Oaklawn Blvd (Route 36)	21,900	1202	1985	5%
Winfield Rd (Route 460)	Crater Rd (Route 301)	Hickory Hill Rd (Route 109)	20,500	1815	1636	11%
County Dr (Route 460)	Hickory Hill Rd (Route 109)	Baxter Rd (Route 603)	11,700	942	1027	11%
County Dr (Route 460)	Baxter Rd (Route 603)	Courthouse Rd (Route 106)	9,000	755	751	11%
Baxter Rd (Route 603)	County Dr (Route 460)	Courthouse Rd (Route 106)	3,300	307	232	11%
Jefferson Park Rd (Route 630)	Adams Ave (Ft. Lee Gate)	Middle Rd (Route 646)	9,900	809	851	3%
Jefferson Park Rd (Route 630)	Middle Rd (Route 646)	Oaklawn Blvd (Route 36)	12,100	869	1171	3%
Allin Rd (Route 634)	Bull Hill Rd (Route 630)	Courthouse Rd (Route 106)	6,200	538	488	3%
Puddledock Rd (Route 645)	Washington St (Route 36)	Temple Ave (Route 144)	6,200	337	560	6%
Puddledock Rd (Route 645)	Temple Ave (Route 144)	River Rd (Route 725)	2,900	178	221	5%
Middle Rd (Route 646)	Jefferson Park Rd (Route 630)	Takach Rd (Route 647)	8,300	604	794	3%
River Rd (Route 725)	Temple Ave (Route 144)	Puddledock Rd (Route 645)	5,600	406	356	5%

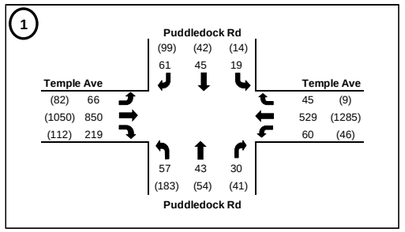
As shown in Table 1-1, the traffic volumes are highest along the four-lane roadways; Washington Street / Oaklawn Boulevard (Route 36), Temple Avenue (Route 144), and Winfield Road / County Drive (Route 460). These roadways operate as primary roadways around this area. Two-lane arterial roadways, including Jefferson Park Road (Route 630) and Courthouse Road (Route 106), carry a significant amount of traffic, but not as much as the four-lane roadways. Two-lane collector roadways, such as Puddledock Road and Baxter Road, carry the least amount of vehicles. Truck percentages are highest along the Route 460 and Route 106 corridors.

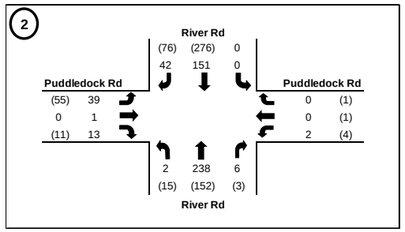
Base Year (2006) AM and PM peak hour turning movement counts are shown in Figure 1-4. The peak hours for each location were used instead of a standard peak hour for the entire corridor; therefore, inbound and outbound totals may differ slightly between adjacent intersections. These peak hour counts were taken between 7-9 AM and 4-6 PM in May 2006.

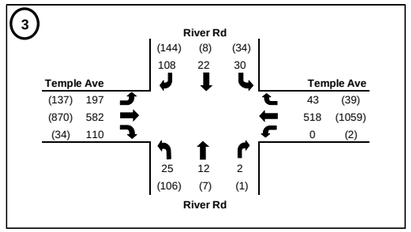
A set of level of service (LOS) guidelines was developed in previous VDOT planning studies to follow when conducting the capacity analysis for the roadway segments. Analysis methods varied depending on the roadway's functional classification. Look-up tables were established in these guidelines for the use in analyzing two-lane collectors, multi-lane highways, and two-lane highways. The LOS guidelines and look-up tables were based on theory presented in the Highway Capacity Manual.

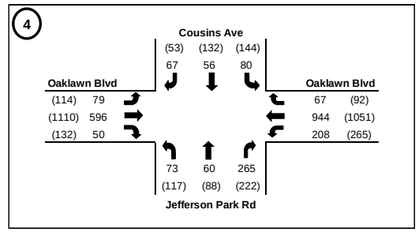
Levels of service analyses were performed for these roadway links and intersections throughout the Fort Lee study area. Level of Service (LOS) is a qualitative measure of the operating conditions of an intersection or other transportation facility. There are six LOS (LOS A-F) defined; LOS A represents the best operating conditions with no congestion and LOS F the worst with heavy congestion. The desirable LOS on roadway links for the Fort Lee study area is LOS C or better. For intersections, LOS E or F is considered unacceptable. The base year (2006) LOS for the roadway links can be seen in Table 1-2.

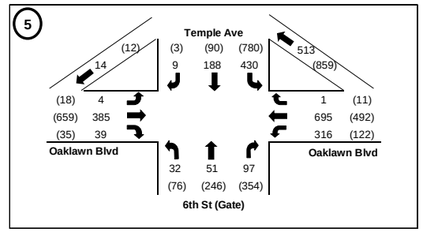
Figure 1-4: 2006 Base Year (AM / PM) Peak Hour Turning Movement Counts

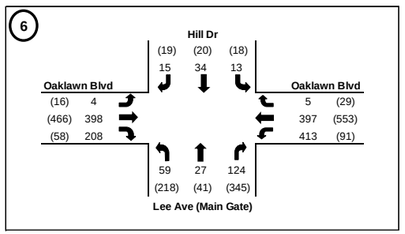


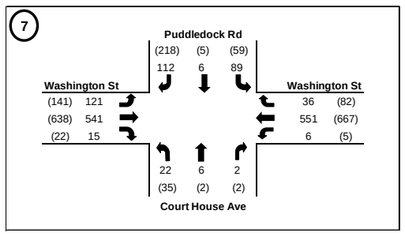


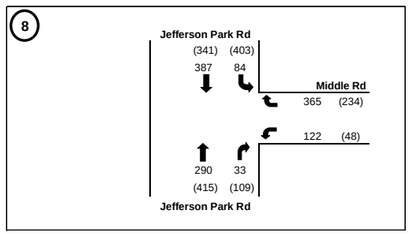


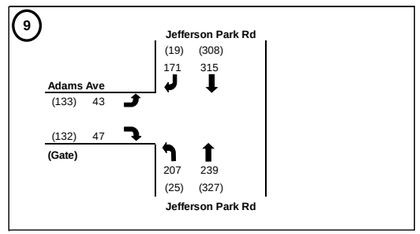


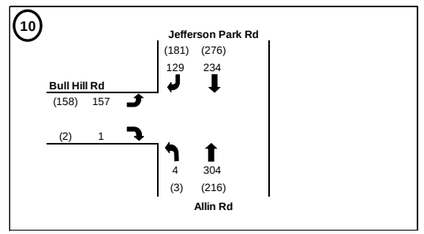


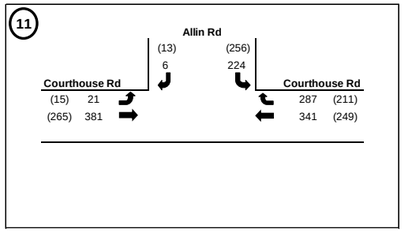


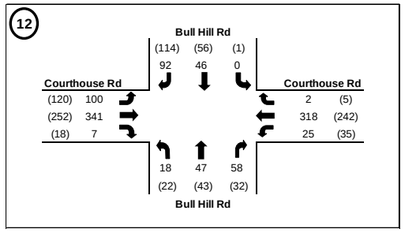


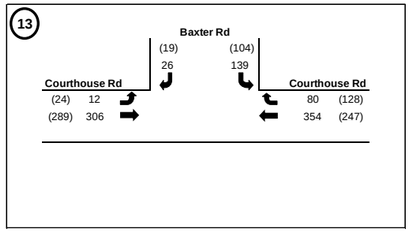


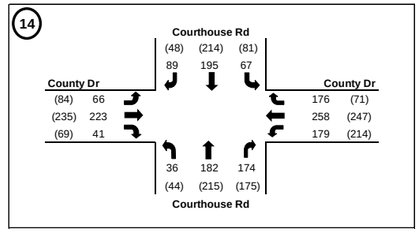


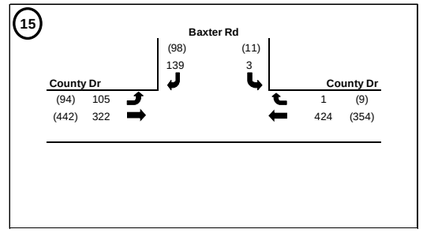


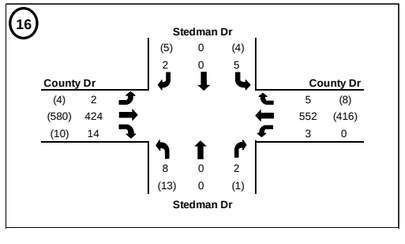


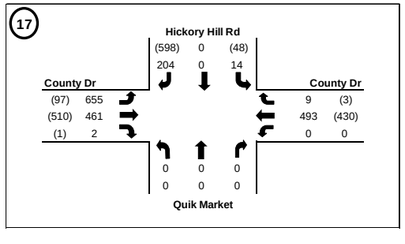












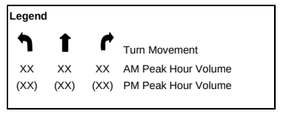


Table 1-2: 2006 Roadway Link ADT Volumes and LOS

Facility	From	To	Number of Lanes	2006 ADT	2006 AM Peak Hr	2006 PM Peak Hr	2006 Roadway LOS
Washington Street / Oaklawn Blvd (Route 36)	Puddledock Rd (Route 645)	Lee Ave (Ft. Lee Gate)	4	17,800	1203	1294	B
Oaklawn Blvd (Route 36)	Lee Ave (Ft. Lee Gate)	Temple Ave (Route 144)	4	18,700	1243	1385	A
Oaklawn Blvd (Route 36)	Temple Ave (Route 144)	Jefferson Park Rd (Route 630)	4	36,100	2250	2840	E
Hickory Hill Rd (Route 109)	County Dr (Route 460)	Mahone Ave (Ft. Lee Gate)	2	9,800	882	746	D
Courthouse Rd (Route 106)	County Dr (Route 460)	Baxter Rd (Route 603)	2	7,900	669	656	B
Courthouse Rd (Route 106)	Baxter Rd (Route 603)	Bull Hill Rd (Route 630)	2	9,900	882	765	C
Courthouse Rd (Route 106)	Bull Hill Rd (Route 630)	Allin Rd (Route 634)	2	7,900	747	562	B
Temple Ave (Route 144)	Puddledock Rd (Route 645)	River Rd (Route 725)	4	26,900	1523	2381	B
Temple Ave (Route 144)	River Rd (Route 725)	Oaklawn Blvd (Route 36)	4	21,900	1202	1985	B
Winfield Rd (Route 460)	Crater Rd (Route 301)	Hickory Hill Rd (Route 109)	4	20,500	1815	1636	B
County Dr (Route 460)	Hickory Hill Rd (Route 109)	Baxter Rd (Route 603)	4	11,700	942	1027	B
County Dr (Route 460)	Baxter Rd (Route 603)	Courthouse Rd (Route 106)	4	9,000	755	751	A
Baxter Rd (Route 603)	County Dr (Route 460)	Courthouse Rd (Route 106)	2	3,300	307	232	A
Jefferson Park Rd (Route 630)	Adams Ave (Ft. Lee Gate)	Middle Rd (Route 646)	2	9,900	809	851	C
Jefferson Park Rd (Route 630)	Middle Rd (Route 646)	Oaklawn Blvd (Route 36)	4	12,100	869	1171	B
Allin Rd (Route 634)	Bull Hill Rd (Route 630)	Courthouse Rd (Route 106)	2	6,200	538	488	B
Puddledock Rd (Route 645)	Washington St (Route 36)	Temple Ave (Route 144)	2	6,200	337	560	B
Puddledock Rd (Route 645)	Temple Ave (Route 144)	River Rd (Route 725)	2	2,900	178	221	A
Middle Rd (Route 646)	Jefferson Park Rd (Route 630)	Takach Rd (Route 647)	2	8,300	604	794	C
River Rd (Route 725)	Temple Ave (Route 144)	Puddledock Rd (Route 645)	2	5,600	406	356	A

As shown in Table 1-2, roadway conditions currently operate in a range from LOS A through LOS E. All of the two-lane facilities within the study area have an acceptable LOS for both the AM and PM peak hours. A majority of the roadways studied are currently operating at an acceptable LOS for both the AM and PM peak hour. The exceptions are the four-lane section of Oaklawn Boulevard (Route 36) between Temple Avenue (Route 144) and Jefferson Park Road (Route 630) and the two-lane section of Hickory Hill Road (Route 109) from County Drive (US 460) to the Mahone Gate. This section of Oaklawn Boulevard currently operates at LOS C (acceptable) in the AM peak hour, but worsens to LOS E in the PM peak hour. Hickory Hill Road operates at LOS D in the AM peak hour and LOS C (acceptable) in the PM peak hour. Roadway LOS and respective ADT volumes are shown in Figure 1-5.

Also shown in Figure 1-5 and its accompanying table are the levels of service for the analyzed intersections within the study area. Nine signalized intersections were investigated along with eight stop-controlled intersections. As shown in the Figure, all of the unsignalized intersections are currently operating with an acceptable LOS D or better for all movements. However, a number of signalized intersections within the study area operate with an overall LOS of E or F. These are listed below:

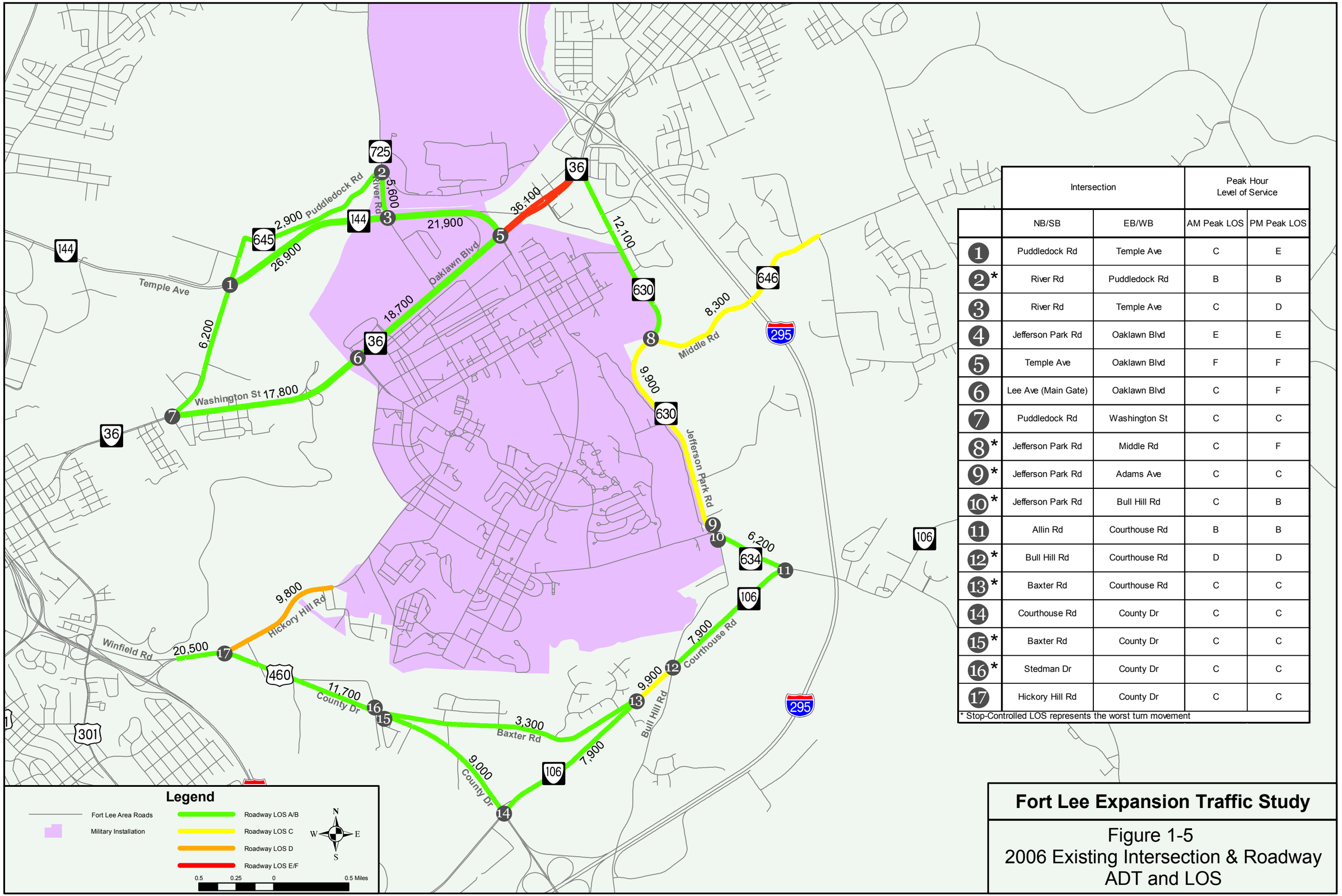
- Temple Avenue and Puddledock Road – LOS E for PM peak period
- Oaklawn Boulevard and Temple Avenue – LOS F for AM and PM peak period
- Oaklawn Boulevard and Jefferson Park Road – LOS E for AM and PM peak period
- Oaklawn Boulevard and Lee Avenue – LOS F for PM peak period

Other signalized intersections, although the overall delay for the entire intersection is acceptable, may have specific approaches, which operate with a failing LOS:

- Temple Avenue and Puddledock Road – The approaches from Puddledock Road are currently operating with a LOS E for the AM peak hour.
- Temple Avenue and River Road – The River Road approaches operate with a LOS F for both the AM and PM peak hour.
- Oaklawn Boulevard and Lee Avenue – The northbound approach (Lee Avenue Gate egress) currently operates with a LOS F for the AM and PM peak hours.

Detailed results of the intersection analyses can be found in the appendix.

Crash data from 2002 through 2005 was obtained from VDOT and accident analyses were conducted for the roadways and intersections throughout the Fort Lee study area. The VDOT database does not cover many of the area roads and intersections; therefore, only seven of the seventeen intersections were analyzed for their crash rates. The Institute of Transportation Engineers (ITE) recommends that improvements be evaluated for intersections with a crash rate of over two crashes per million entering vehicles (MEV). All of the intersections analyzed have crash rates below the ITE threshold. Table 1-3 summarizes the crash data for the analyzed intersections in the project study area.



	Intersection		Peak Hour Level of Service	
	NB/SB	EB/WB	AM Peak LOS	PM Peak LOS
1	Puddledock Rd	Temple Ave	C	E
2*	River Rd	Puddledock Rd	B	B
3	River Rd	Temple Ave	C	D
4	Jefferson Park Rd	Oaklawn Blvd	E	E
5	Temple Ave	Oaklawn Blvd	F	F
6	Lee Ave (Main Gate)	Oaklawn Blvd	C	F
7	Puddledock Rd	Washington St	C	C
8*	Jefferson Park Rd	Middle Rd	C	F
9*	Jefferson Park Rd	Adams Ave	C	C
10*	Jefferson Park Rd	Bull Hill Rd	C	B
11	Allin Rd	Courthouse Rd	B	B
12*	Bull Hill Rd	Courthouse Rd	D	D
13*	Baxter Rd	Courthouse Rd	C	C
14	Courthouse Rd	County Dr	C	C
15*	Baxter Rd	County Dr	C	C
16*	Stedman Dr	County Dr	C	C
17	Hickory Hill Rd	County Dr	C	C

* Stop-Controlled LOS represents the worst turn movement

Fort Lee Expansion Traffic Study

Figure 1-5
2006 Existing Intersection & Roadway ADT and LOS

Table 1-3: Fort Lee Study Area Crash Data

		Type of Accident									
Intersection	Year	Rear End	Angle	Head On	Sideswipe	Hit Fixed Object	T-Bone (Side Collision)	Hit Animal	Other	Total Accidents for Intersection	Crashes per Million Entering Vehicles
Jefferson Park Rd / Middle Rd	2002									0	0.13
	2003	1								1	
	2004									0	
	2005	1								1	
Oaklawn Blvd / Temple Ave	2002									0	0.32
	2003					1				1	
	2004		1		3					4	
	2005	3			1					4	
River Rd / Temple Ave	2002	1	1							2	0.19
	2003	1	1							2	
	2004	1	1							2	
	2005	1	1							2	
Puddledock Rd / Temple Ave	2002									0	0.39
	2003	2	2							4	
	2004	2	3							5	
	2005	3	2							5	
Jefferson Park Rd (Bull Hill Rd) / Allin Rd	2002									0	1.4
	2003		2							2	
	2004	2	3							5	
	2005		1							1	
Bull Hill Rd / Courthouse Rd	2002									0	0.66
	2003		1							1	
	2004	1			1					2	
	2005		3							3	
Allin Rd / Courthouse Rd	2002									0	0.72
	2003	1	1							2	
	2004	1	3							4	
	2005	1	1							2	

1.4 Land Use Analysis

As part of this analysis, existing and future land use were analyzed to determine exactly how the future expansion of the base and background traffic growth would impact the transportation demand on surrounding roadways. Comprehensive plans, capital improvement plans, zoning ordinances and subdivision ordinances from the five surrounding jurisdictions (Prince George County, Petersburg, Hopewell, Colonial Heights and Chesterfield) were obtained and reviewed. In addition, local planners in these jurisdictions were contacted to discuss land use trends in the area. These data indicate that large-scale residential development is expected in Prince George County near Fort Lee in the near future. Furthermore, significant growth is expected in southern Chesterfield County that will likely encourage new personnel from Fort Lee to reside there. In Hopewell, there are certain areas of undeveloped land where substantial residential development is likely to occur, especially on the western edge, near Fort Lee. New development in Petersburg is likely to occur in the southern parts of the city and there is significant opportunity for redevelopment of distressed historic areas of the city.

The Richmond Regional Travel Demand Model was used in this study to model existing and future travel demand. Updates to the model were made based on the above information gathered from planners and planning documents from the surrounding jurisdictions. Most of these changes were relatively minor and consisted of small corrections, which did not significantly alter forecast volumes. In addition, Fort Lee provided updated information about the existing population, households and employment on base at the Traffic Analysis Zone (TAZ) level. There are seven TAZ's that comprise the Fort Lee base, TAZ 206, 213, 214, 216, 217, 218 and 219 (See Appendix for map of Fort Lee TAZ's). Using the data provided, Baker updated the Richmond Regional Travel Demand Model with the new information regarding on-base population, households and employment for 2005. The original model data and the updated numbers can be seen in Table 1-4.

Table 1-4: Travel Demand Model Updates

	Original 2000 Model			Updated 2000 Model		
TAZ	Households	Group Quarters	Employment	Households	Group Quarters	Employment
206	2	0	0	0	0	8
213	975	0	26	174	0	5
214	0	0	0	0	0	3
216	0	1,000	500	0	1,605	283
217	0	930	2,030	0	0	2,944
218	0	0	812	0	0	1,255
219	4,071	400	315	1,150	5,142	1,213
Total	5,048	2,330	3,683	1,324	6,747	5,711

1.5 Future Traffic Projections

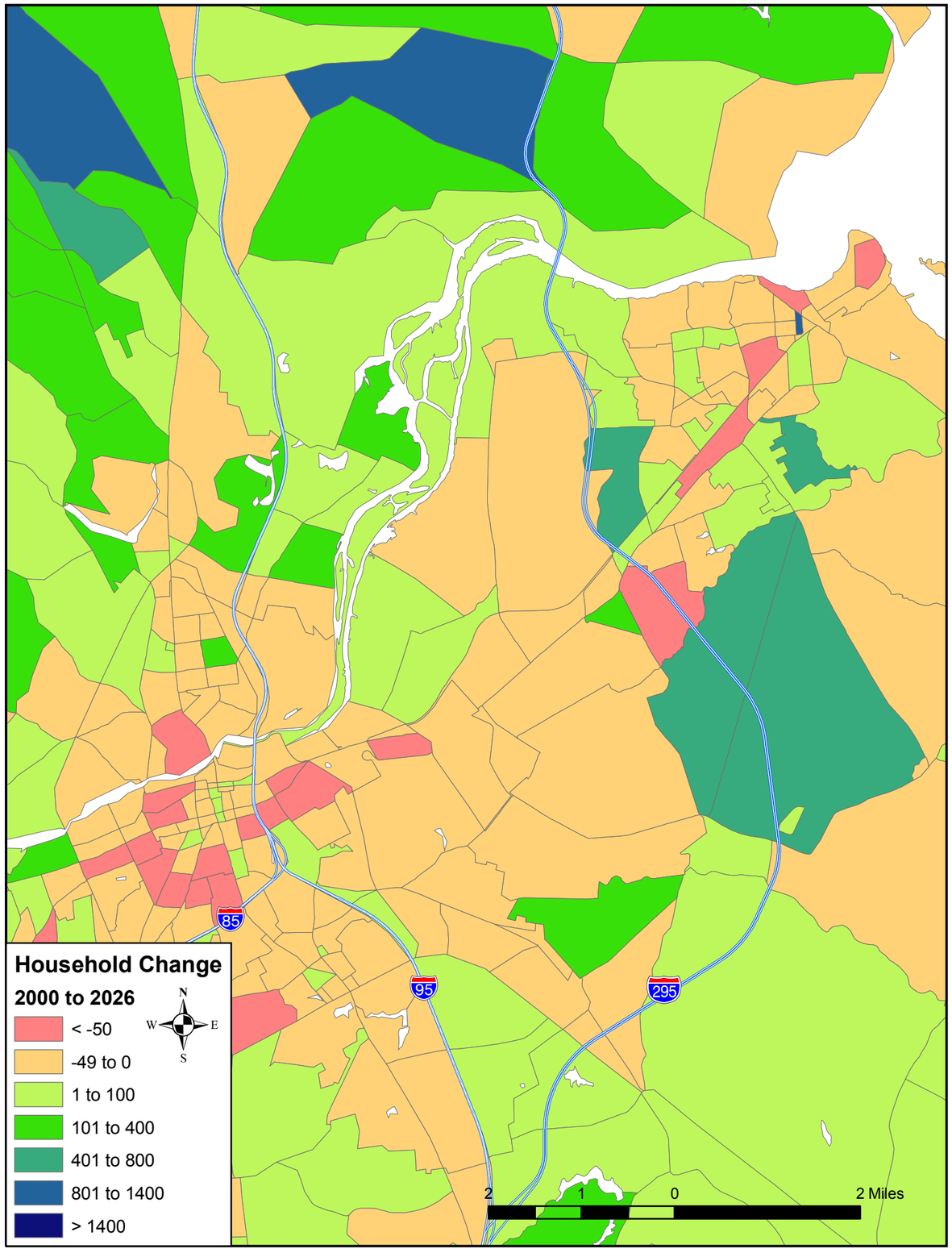
Projecting the future traffic level in the area of Fort Lee is a three-step process. First, background traffic growth is calculated using the Richmond Regional Travel Demand Model. Second, new trips generated by new facilities at Fort Lee must be calculated. Finally, these new trips must be distributed across the roadway network. To gauge the level of background traffic, Baker maintained the same population, household and employment assumptions for the seven on-base TAZ's in the 2026 Model. Figure 1-6 shows the model assumptions regarding household and employment changes between 2000 and 2026 by TAZ in the area surrounding Fort Lee.

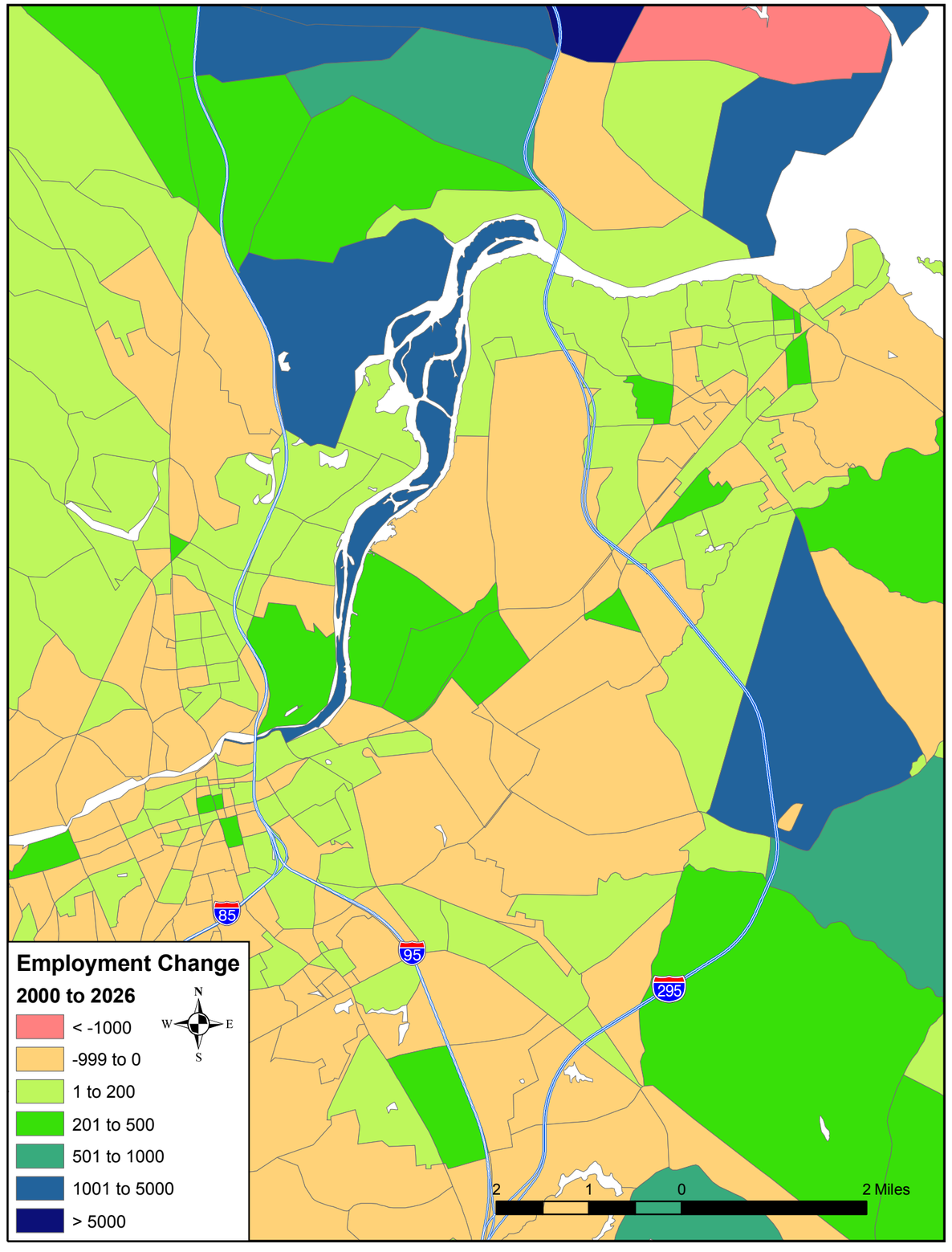
Data from the model informed the process of background traffic growth. By comparing the projected traffic volume for each road in the 2000 and 2026 models, Baker could determine the growth rate (without BRAC expansion) for each road surrounding Fort Lee. By applying the growth rates forecast by the model to the 2006 traffic counts, future background volumes on the surrounding roads were calculated. Table 1-5 details the projected growth rates for each analyzed roadway.

Table 1-5: Future Roadway Link Background Growth Rates

Facility	From	To	Avg. Annual Growth Rate
Washington Street / Oaklawn Blvd (Route 36)	Puddledock Rd (Route 645)	Lee Ave (Ft. Lee Gate)	1.5%
Oaklawn Blvd (Route 36)	Lee Ave (Ft. Lee Gate)	Temple Ave (Route 144)	2.0%
Oaklawn Blvd (Route 36)	Temple Ave (Route 144)	Jefferson Park Rd (Route 630)	1.5%
Hickory Hill Rd (Route 109)	County Dr (Route 460)	Mahone Ave (Ft. Lee Gate)	0.0%
Courthouse Rd (Route 106)	County Dr (Route 460)	Baxter Rd (Route 603)	1.0%
Courthouse Rd (Route 106)	Baxter Rd (Route 603)	Bull Hill Rd (Route 630)	1.0%
Courthouse Rd (Route 106)	Bull Hill Rd (Route 630)	Allin Rd (Route 634)	1.0%
Temple Ave (Route 144)	Puddledock Rd (Route 645)	River Rd (Route 725)	1.0%
Temple Ave (Route 144)	River Rd (Route 725)	Oaklawn Blvd (Route 36)	1.0%
Winfield Rd (Route 460)	Crater Rd (Route 301)	Hickory Hill Rd (Route 109)	1.0%
County Dr (Route 460)	Hickory Hill Rd (Route 109)	Baxter Rd (Route 603)	2.0%
County Dr (Route 460)	Baxter Rd (Route 603)	Courthouse Rd (Route 106)	2.0%
Baxter Rd (Route 603)	County Dr (Route 460)	Courthouse Rd (Route 106)	1.0%
Jefferson Park Rd (Route 630)	Adams Ave (Ft. Lee Gate)	Middle Rd (Route 646)	1.0%
Jefferson Park Rd (Route 630)	Middle Rd (Route 646)	Oaklawn Blvd (Route 36)	1.0%
Allin Rd (Route 634)	Bull Hill Rd (Route 630)	Courthouse Rd (Route 106)	1.0%
Puddledock Rd (Route 645)	Washington St (Route 36)	Temple Ave (Route 144)	1.5%
Puddledock Rd (Route 645)	Temple Ave (Route 144)	River Rd (Route 725)	5.0%
Middle Rd (Route 646)	Jefferson Park Rd (Route 630)	Takach Rd (Route 647)	2.0%
River Rd (Route 725)	Temple Ave (Route 144)	Puddledock Rd (Route 645)	1.0%

Figure 1-6: Fort Lee Area Household and Employment Change 2000 to 2026





1.6 Trip Generation

Fort Lee provided projections detailing the number of new personnel coming to the base as a result of BRAC expansion. Table 1-6 details the number of new personnel that Fort Lee projects will move to the area as a result of BRAC. Based on Fort Lee projections, there will be approximately 8,500 new personnel on base, which includes 4,600 new students on an average day. Of these students, about 2,800 will live on base and will not have vehicles. The remaining 1,800 will have vehicles and will most likely live off base until new housing is built on base. Thus, for the purposes of trip generation, these 1,800 students will be counted as part of the total new personnel while the other 2,800 students will be ignored since they will not have vehicles and their traffic impact would be negligible.

Table 1-6: Projected BRAC Personnel Growth

Personnel Type	Number of Personnel
Military	1,716
Civilian	1,832
Contractors	291
Students with cars	1,786
Subtotal: Personnel with cars	5,625
Students w/o cars	2,841
Total	8,466

To calculate the number of new trips generated by the new, 5,600 personnel with vehicles, Baker created a local trip generation rate specific to Fort Lee using gate traffic counts collected by VDOT in January 2006. According to these gate counts there are approximately 30,000 daily trips into and out of the base. During both the AM and PM peak hours, about 2,700 vehicles enter and exit the base. Using population data provided by Fort Lee, Baker calculated that the base generates about 3.48 trips per day and about 0.32 trips per peak hour per each employee and off-base student. These rates are similar to those found in the *Institute of Transportation Engineers Trip Generation Manual, 7th Edition*. According to ITE studies, military bases create about 1.78 trips per employee per day but the typical range can vary between 1 and 4.18 trips per employee. Furthermore, ITE studies indicate military bases generate, on average, 0.39 trips per employee during both peak hours. Thus, the locally calculated trip generation rate for Fort Lee falls well within the ITE daily range and is very similar to the ITE peak hour rates. Based on these generation rates, Baker calculates that BRAC expansion will add about 19,600 daily trips and about 1,800 new trips during each peak hour. Such an increase means 65% more trips into and out of the base during each peak hour and for the entire day.

1.7 Trip Distribution

To distribute trips into and out of the base requires a projection regarding the likely origin or destination of personnel entering and leaving the base. Baker assumed that most peak hour trips would be work related and thus relied on the likely home of Fort Lee employees as the

means for distributing these new trips through the surrounding road network. To determine the likely distribution of new personnel to the surrounding area, Baker used Census Table PHC-T-28, to estimate the number of households likely to settle in each surrounding jurisdiction. Table PHC-T-28 details the number of armed forces personnel in households by jurisdiction. With that data, Baker projects that the 3,153 new off-base households will distribute to the surrounding jurisdictions as seen in Table 1-7. The assumed number of households is equal to the number of permanent personnel expected to live off base, which includes all civilian employees, contractors and 60% of permanent military personnel.

Table 1-7: Distribution of Off-Base Households

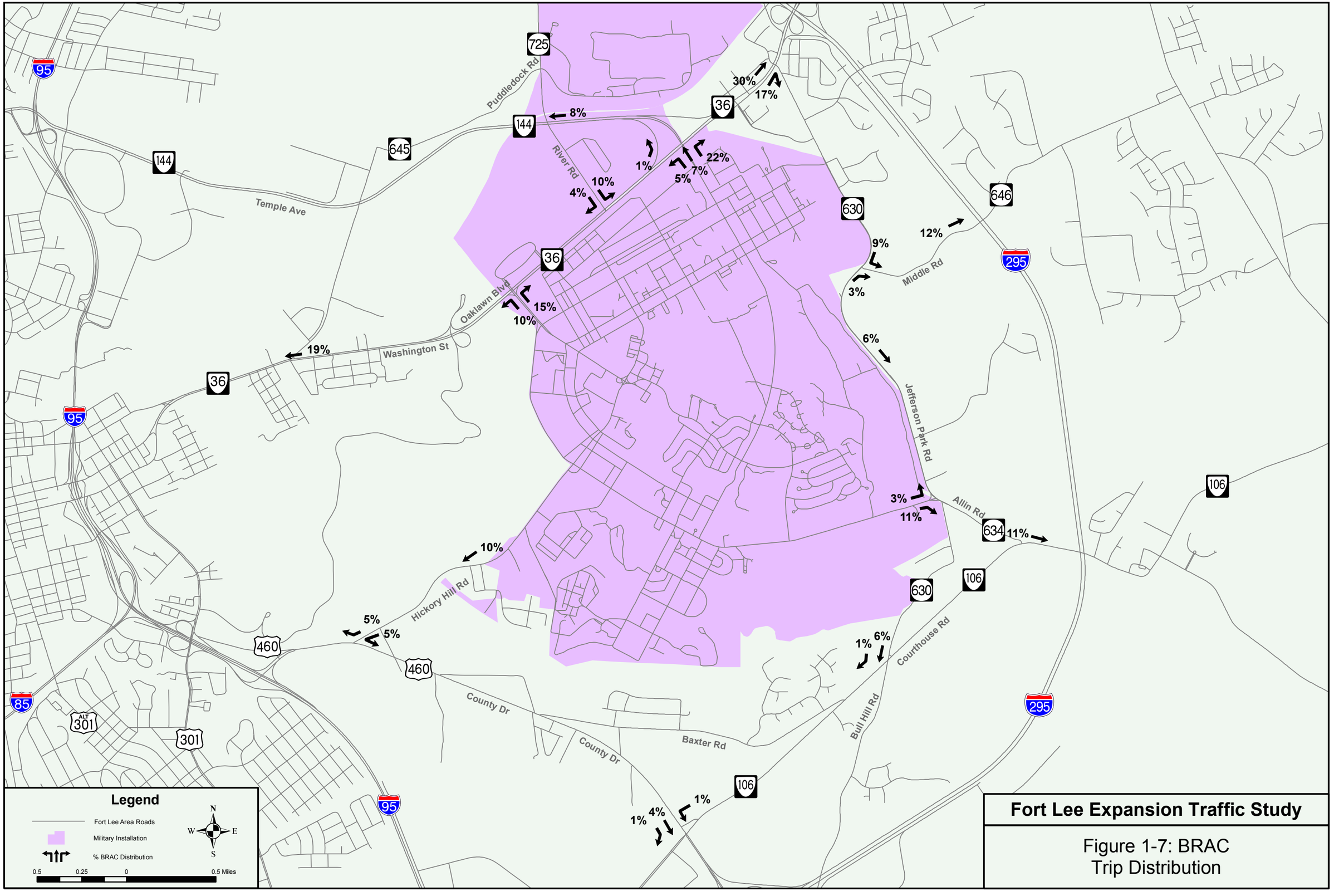
Jurisdiction	Distribution %	Off-Base Households
Chesterfield County	24.0%	756
Colonial Heights city	3.7%	116
Dinwiddie County	3.0%	93
Hopewell city	3.3%	105
Petersburg city	12.9%	407
Prince George County	53.1%	1,675
Total		3,153

Based on Census 2000 Table PHC-T-28

Based on this distribution of households to the surrounding jurisdictions, Baker then developed a distribution methodology to distribute the new BRAC trips to the surrounding roadways. Figure 1-9 summarizes the distribution of trips on the surrounding roads. Step one in the trip distribution process was to distribute these new trips to the appropriate gates. Based on information about the location of new installations and assumptions from Fort Lee about the likelihood or personnel using certain gates, Baker developed the distribution seen in Table 1-8. This distribution assumes that all trips into and out of the new River Road Gate would distribute to the surrounding jurisdictions in the proportions expected based on Table 1-7. As for the other gates, the trip distribution system assumes that all trips using the A Gate would be bound for or originating from Prince George County, trips using the Mahone Avenue Gate would be bound for or originate from all jurisdictions except Hopewell while the Main Gate and Sisisky Gate would handle trips from all surrounding jurisdictions. This gate distribution was further refined by applying a directional distribution in and out of each gate for each peak hour based on the direction ratios found in the VDOT gate counts.

Table 1-8: Distributions of New (BRAC) Trips to Fort Lee Gates

	Trips		
Gate	Daily	AM	PM
Lee	4,900	450	450
Sisisky	6,700	610	610
A Ave (Golf)	3,400	310	310
Mahone	2,000	180	180
River Rd	2,700	250	250


95
144
645
725
Puddledock Rd
8%
36
30%
17%
River Rd
1%
22%
7%
5%
10%
4%
Temple Ave
630
646
12%
9%
Middle Rd
295
3%
36
Oaklawn Blvd
15%
10%
19%
Washington St
6%
Jefferson Park Rd
95
3%
11%
Allin Rd
634
11%
106
10%
Hickory Hill Rd
630
106
5%
5%
460
460
1%
6%
Courthouse Rd
85
ALT
301
301
County Dr
Bull Hill Rd
295
Baxter Rd
County Dr
106
1%
1%
4%
95
Legend
Fort Lee Area Roads
Military Installation
% BRAC Distribution
N
W
E
S
0.5
0.25
0
0.5 Miles
Fort Lee Expansion Traffic Study
Figure 1-7: BRAC
Trip Distribution

2.0 FORECAST YEAR (2015 & 2026) CONDITIONS

Using the growth rates, as developed and described in Sections 1.4-1.7, future year volumes were forecasted for the years 2015 and 2026. The traffic volumes and traffic analysis in this chapter include background traffic based on the developed growth rates as well as the distributed traffic due to the BRAC expansion at Fort Lee.

2.1 2015 Forecast Year Volumes and LOS

The growth rate developed in Section 1.5 was used to calculate the background traffic for the year 2015. The trip distribution volumes for the new BRAC facilities were then added to the 2015 background traffic to develop the projected volumes for the study area. The computed average daily traffic, peak hour volumes, and resulting LOS for the studied roadway links are shown in Table 2-1. The average daily traffic for the year 2006 is shown for comparison. The 2015 LOS for each roadway is also presented in Figure 2-2.

Table 2-1: 2015 Roadway ADT and LOS (Including BRAC)

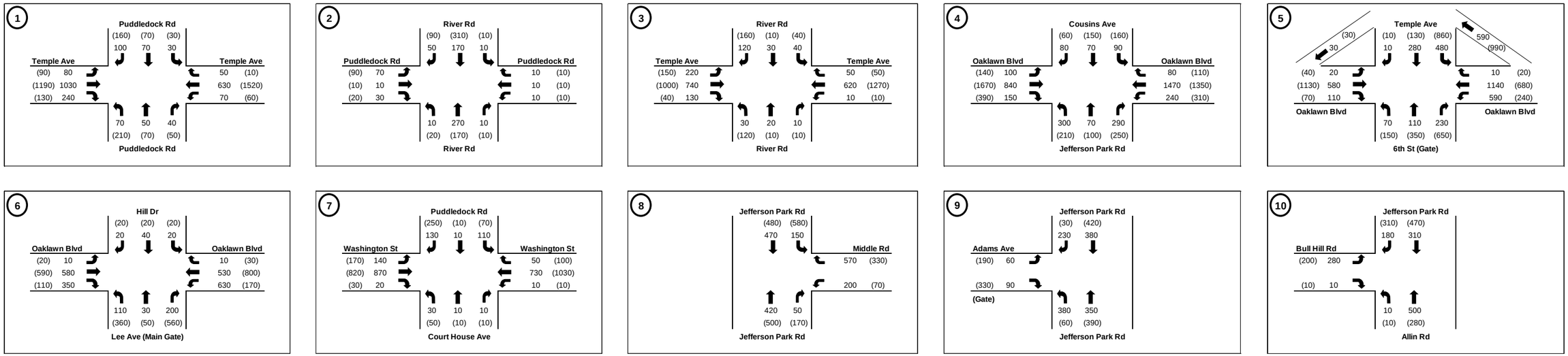
Facility	From	To	Number of Lanes	2006 ADT	Avg. Annual Growth Rate	2015 ADT	2015 AM Peak Hr	2015 PM Peak Hr	2015 LOS
Washington Street / Oaklawn Blvd (Route 36)	Puddledock Rd (Route 645)	Lee Ave (Ft. Lee Gate)	4	17,800	1.5%	23,900	1,700	1,800	C
Oaklawn Blvd (Route 36)	Lee Ave (Ft. Lee Gate)	Temple Ave (Route 144)	4	18,700	2.0%	27,300	1,900	2,100	B
Oaklawn Blvd (Route 36)	Temple Ave (Route 144)	Jefferson Park Rd (Route 630)	4	36,100	1.5%	50,100	3,200	4,000	E
Hickory Hill Rd (Route 109)	County Dr (Route 460)	Mahone Ave (Ft. Lee Gate)	2	9,800	0.0%	11,800	1,100	900	E
Courthouse Rd (Route 106)	County Dr (Route 460)	Baxter Rd (Route 603)	2	7,900	1.0%	8,700	800	800	B
Courthouse Rd (Route 106)	Baxter Rd (Route 603)	Bull Hill Rd (Route 630)	2	9,900	1.0%	10,900	1,000	900	C
Courthouse Rd (Route 106)	Bull Hill Rd (Route 630)	Allin Rd (Route 634)	2	7,900	1.0%	8,700	900	700	C
Temple Ave (Route 144)	Puddledock Rd (Route 645)	River Rd (Route 725)	4	26,900	1.0%	30,900	1,800	2,800	C
Temple Ave (Route 144)	River Rd (Route 725)	Oaklawn Blvd (Route 36)	4	21,900	1.0%	25,400	1,400	2,400	B
Winfield Rd (Route 460)	Crater Rd (Route 301)	Hickory Hill Rd (Route 109)	4	20,500	1.0%	23,500	2,100	1,900	B
County Dr (Route 460)	Hickory Hill Rd (Route 109)	Baxter Rd (Route 603)	4	11,700	2.0%	14,700	1,200	1,300	B
County Dr (Route 460)	Baxter Rd (Route 603)	Courthouse Rd (Route 106)	4	9,000	2.0%	11,600	1,000	1,000	B
Baxter Rd (Route 603)	County Dr (Route 460)	Courthouse Rd (Route 106)	2	3,300	1.0%	3,600	400	300	B
Jefferson Park Rd (Route 630)	Adams Ave (Ft. Lee Gate)	Middle Rd (Route 646)	2	9,900	1.0%	12,600	1,100	1,100	C
Jefferson Park Rd (Route 630)	Middle Rd (Route 646)	Oaklawn Blvd (Route 36)	4	12,100	1.0%	16,500	1,200	1,600	C
Allin Rd (Route 634)	Bull Hill Rd (Route 630)	Courthouse Rd (Route 106)	2	6,200	1.0%	9,100	800	800	C
Puddledock Rd (Route 645)	Washington St (Route 36)	Temple Ave (Route 144)	2	6,200	1.5%	7,100	400	700	C
Puddledock Rd (Route 645)	Temple Ave (Route 144)	River Rd (Route 725)	2	2,900	5.0%	4,300	300	400	B
Middle Rd (Route 646)	Jefferson Park Rd (Route 630)	Takach Rd (Route 647)	2	8,300	2.0%	12,000	900	1,200	C
River Rd (Route 725)	Temple Ave (Route 144)	Puddledock Rd (Route 645)	2	5,600	1.0%	6,200	500	400	A

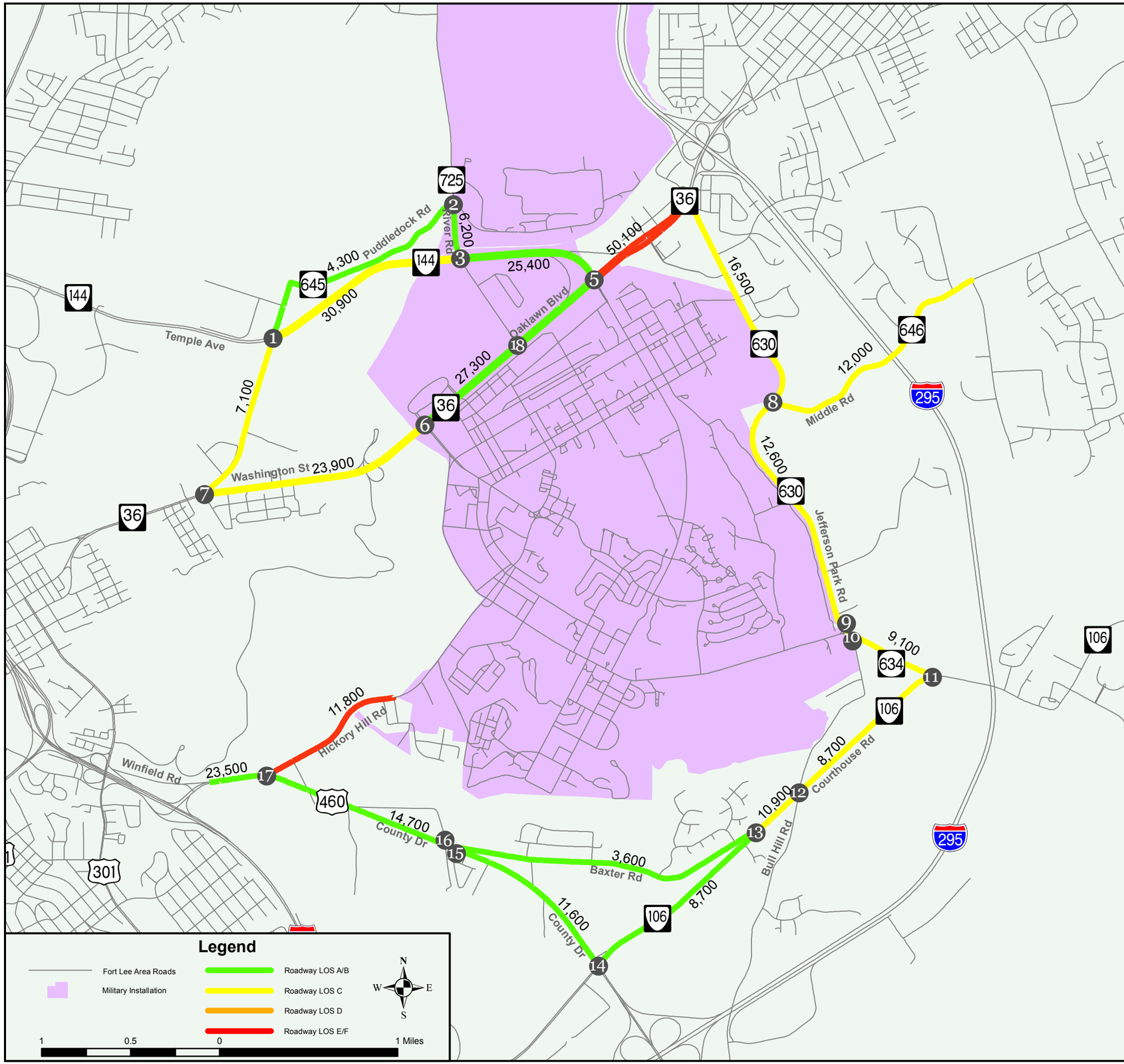
As shown in Table 2-1, the Average Daily Traffic for each of the roadways is expected to increase throughout the study area; many of the roadway links have increases in daily traffic of over 40 percent. As a result, the Levels of Service for the studied facilities are expected to degrade. The following roadway links are expected to operate with an unacceptable LOS for the year 2015:

- Oaklawn Boulevard from Temple Avenue to Jefferson Park Road – LOS E for AM Peak Hour and LOS F for PM Peak hour
- Hickory Hill Road from County Drive to Mahone Avenue – LOS E for AM Peak Hour and LOS D for the PM Peak Hour

In addition to the roadway link analyses, the growth rates and BRAC development volumes were added to the existing intersection counts to develop volumes and LOS for the year 2015. Intersection turning movements are shown in Figure 2-1. The overall LOS for each intersection and for each roadway segment is shown in Figure 2-2.

Figure 2-1: 2015 Forecast Year (AM / PM) Peak Hour Turning Movement Counts (Includes BRAC expansion)





	Intersection		Peak Hour Level of Service	
	NB/SB	EB/WB	AM Peak LOS	PM Peak LOS
1	Puddledock Rd	Temple Ave	C	E
2*	River Rd	Puddledock Rd	B	C
3	River Rd	Temple Ave	D	E
4	Jefferson Park Rd	Oaklawn Blvd	F	F
5	Temple Ave	Oaklawn Blvd	F	F
6	Lee Ave (Main Gate)	Oaklawn Blvd	E	F
7	Puddledock Rd	Washington St	C	D
8*	Jefferson Park Rd	Middle Rd	F	F
9*	Jefferson Park Rd	Adams Ave	F	E
10*	Jefferson Park Rd	Bull Hill Rd	F	F
11	Allin Rd	Courthouse Rd	B	C
12*	Bull Hill Rd	Courthouse Rd	F	F
13*	Baxter Rd	Courthouse Rd	C	C
14	Courthouse Rd	County Dr	C	D
15*	Baxter Rd	County Dr	D	C
16*	Stedman Dr	County Dr	C	D
17	Hickory Hill Rd	County Dr	E	C
18*	River Rd	Oaklawn Blvd	F	F

* Stop-Controlled LOS represents the worst turn movement

Fort Lee Expansion Traffic Study

Figure 2-2
2015 Intersection & Roadway
ADT & LOS (Including BRAC)

As shown in Figure 2-2, most of the intersections LOS have degraded considerably. Six of the nine signalized intersections studied are expected to operate with an overall LOS of E or F during peak hours. All of the currently signalized intersections are expected to have certain approaches with unacceptable delay during one or both of the peak hours. In addition to the intersections that have a LOS E or F in the year 2006, the following signalized intersections are expected to have an overall failing LOS in the year 2015:

- Temple Avenue and River Road – LOS E for PM peak period
- Oaklawn Boulevard and Lee Avenue – LOS E and LOS F for AM and PM peak periods
- County Drive and Hickory Hill Road – LOS E for AM peak period

Besides the above mentioned intersections, multiple signalized locations are expected to have a failing LOS for individual approaches. In addition to failing approaches in 2006, the following approaches of intersections are anticipated to have an unacceptable LOS:

- Washington Street and Puddledock Road – The approaches from Puddledock Road have degraded to LOS E for both the AM and PM peak hours.
- Courthouse Road and Allin Road – the southbound approach from Allin Road will degrade to LOS D for the PM peak hour.
- County Drive and Courthouse Road – the westbound approach from County Drive is expected to degrade to a LOS E for the PM peak hour.

Unsignalized intersections are also expected to have considerably more delay in 2015. The following intersections have a LOS E or F for the minor movements controlled by stop signs:

- Jefferson Park Road and Middle Road
- Jefferson Park Road and Adams Avenue
- Jefferson Park Road and Bull Hill Road
- Courthouse Road and Bull Hill Road
- Oaklawn Boulevard and River Road

Based on a preliminary signal warrant analysis, all five of these stop-controlled intersections would meet the criteria for signals under MUTCD warrants 1 and 3. Furthermore, the intersections of Courthouse Road and Baxter Road and County Drive and Baxter Road would also meet the same warrants. Detailed signal warrant analyses would still need to be completed in the future to justify signalization of these intersections.

The intersection of Oaklawn Boulevard and River Road was analyzed due to the significant increase in traffic volumes due to BRAC. This intersection is listed as intersection #18.

Detailed results of the intersection analyses can be found in the appendix.

2.2 2026 Forecast Year Volumes and LOS

Traffic volumes for the year 2026 were calculated using the growth rate developed in Section 1.5 as well as the projected volumes for the BRAC expansion. It is important to note that the volumes used for the BRAC expansion are the same as in the year 2015 due to the fact that there is no planned development after the year 2015. The computed average daily traffic, peak hour volumes, and resulting LOS for the studied roadway links are shown in Table 2-2. The average daily traffic for the years 2006 and 2015 are shown for comparison. The 2026 LOS for each roadway is also presented in Figure 2-4.

Table 2-2: 2026 Roadway ADT and LOS (Including BRAC)

Facility	From	To	Number of Lanes	2006 ADT	Avg. Annual Growth Rate	2015 ADT	2026 ADT	2026 AM Peak Hr	2026 PM Peak Hr	2026 LOS
Washington Street / Oaklawn Blvd (Route 36)	Puddledock Rd (Route 645)	Lee Ave (Ft. Lee Gate)	4	17,800	1.5%	23,900	26,900	1,900	2,000	C
Oaklawn Blvd (Route 36)	Lee Ave (Ft. Lee Gate)	Temple Ave (Route 144)	4	18,700	2.0%	27,300	31,400	2,100	2,300	B
Oaklawn Blvd (Route 36)	Temple Ave (Route 144)	Jefferson Park Rd (Route 630)	4	36,100	1.5%	50,100	56,100	3,500	4,300	F
Hickory Hill Rd (Route 109)	County Dr (Route 460)	Mahone Ave (Ft. Lee Gate)	2	9,800	0.0%	11,800	11,800	1,100	900	E
Courthouse Rd (Route 106)	County Dr (Route 460)	Baxter Rd (Route 603)	2	7,900	1.0%	8,700	9,500	900	800	C
Courthouse Rd (Route 106)	Baxter Rd (Route 603)	Bull Hill Rd (Route 630)	2	9,900	1.0%	10,900	12,000	1,100	1,000	C
Courthouse Rd (Route 106)	Bull Hill Rd (Route 630)	Allin Rd (Route 634)	2	7,900	1.0%	8,700	9,500	900	700	C
Temple Ave (Route 144)	Puddledock Rd (Route 645)	River Rd (Route 725)	4	26,900	1.0%	30,900	33,900	2,000	3,000	C
Temple Ave (Route 144)	River Rd (Route 725)	Oaklawn Blvd (Route 36)	4	21,900	1.0%	25,400	27,900	1,600	2,500	B
Winfield Rd (Route 460)	Crater Rd (Route 301)	Hickory Hill Rd (Route 109)	4	20,500	1.0%	23,500	25,700	2,300	2,100	B
County Dr (Route 460)	Hickory Hill Rd (Route 109)	Baxter Rd (Route 603)	4	11,700	2.0%	14,700	17,300	1,400	1,600	B
County Dr (Route 460)	Baxter Rd (Route 603)	Courthouse Rd (Route 106)	4	9,000	2.0%	11,600	13,500	1,200	1,200	B
Baxter Rd (Route 603)	County Dr (Route 460)	Courthouse Rd (Route 106)	2	3,300	1.0%	3,600	4,000	400	300	B
Jefferson Park Rd (Route 630)	Adams Ave (Ft. Lee Gate)	Middle Rd (Route 646)	2	9,900	1.0%	12,600	13,700	1,200	1,200	D
Jefferson Park Rd (Route 630)	Middle Rd (Route 646)	Oaklawn Blvd (Route 36)	4	12,100	1.0%	16,500	17,800	1,300	1,700	C
Allin Rd (Route 634)	Bull Hill Rd (Route 630)	Courthouse Rd (Route 106)	2	6,200	1.0%	9,100	9,800	900	800	C
Puddledock Rd (Route 645)	Washington St (Route 36)	Temple Ave (Route 144)	2	6,200	1.5%	7,100	8,100	500	800	C
Puddledock Rd (Route 645)	Temple Ave (Route 144)	River Rd (Route 725)	2	2,900	5.0%	4,300	5,800	400	500	B
Middle Rd (Route 646)	Jefferson Park Rd (Route 630)	Takach Rd (Route 647)	2	8,300	2.0%	12,000	13,800	1,100	1,300	D
River Rd (Route 725)	Temple Ave (Route 144)	Puddledock Rd (Route 645)	2	5,600	1.0%	6,200	6,800	500	500	A

As shown in Table 2-2, the Average Daily Traffic for each of the roadways is expected to increase throughout the study area from 2015 to 2026. Many of the facilities studied have increases in ADT of over 50 percent from 2006, while the increase in traffic from 2015 to 2026 varies from eight percent to 35 percent. As a result of these traffic increases, the LOS for the studied facilities are expected to degrade. The following roadway links are expected to operate with an unacceptable LOS for the year 2026:

- Oaklawn Boulevard from Temple Avenue to Jefferson Park Road – LOS E for AM Peak Hour and LOS F for PM Peak hour

- Hickory Hill Road from County Drive to Mahone Avenue – LOS E for AM Peak Hour and LOS D for the PM Peak Hour

- Jefferson Park Road from Adams Avenue to Middle Road – LOS D for AM and PM Peak Hour

- Middle Road from Jefferson Park Road to Takach Road – LOS D for the PM Peak Hour

In addition to the roadway link analyses, the growth rates and BRAC development volumes were added to the existing intersection counts to develop volumes and LOS for the year 2026. Intersection turning movements are shown in Figure 2-3. The overall LOS for each intersection and for each roadway segment is shown in Figure 2-4.

As shown in Figure 2-4, the following signalized intersections are expected to operate with an overall LOS E or F in 2026:

- Temple Avenue and Puddledock Road – LOS F for the PM peak period
- Temple Avenue and River Road – LOS F for the PM Peak period
- Oaklawn Boulevard and Temple Avenue – LOS F for the AM and PM peak periods
- Oaklawn Boulevard and Jefferson Park Road – LOS F for the AM and PM peak periods
- Oaklawn Boulevard and Lee Avenue – LOS F for the PM peak hour
- County Drive and Courthouse Road – LOS E for the PM peak hour
- County Drive and Hickory Hill Road – LOS F for the AM peak hour

In addition to the above mentioned locations, the following signalized intersections are expected to have at least one approach operating with an unacceptable LOS:

- Courthouse Road and Allin Road – The southbound approach from Allin Road is expected to operate with a LOS F for the PM peak hour.
- County Drive and Courthouse Road – The westbound approach from County Drive is expected to operate with a LOS E for the AM peak hour and LOS F for the PM peak hour.

Also shown in Figure 2-4 are the LOS results for the stop-controlled intersections within the study area. Below are stop-controlled intersections, which are expected to have a LOS E or LOS F in 2026 for a minor turn movement controlled by a stop sign:

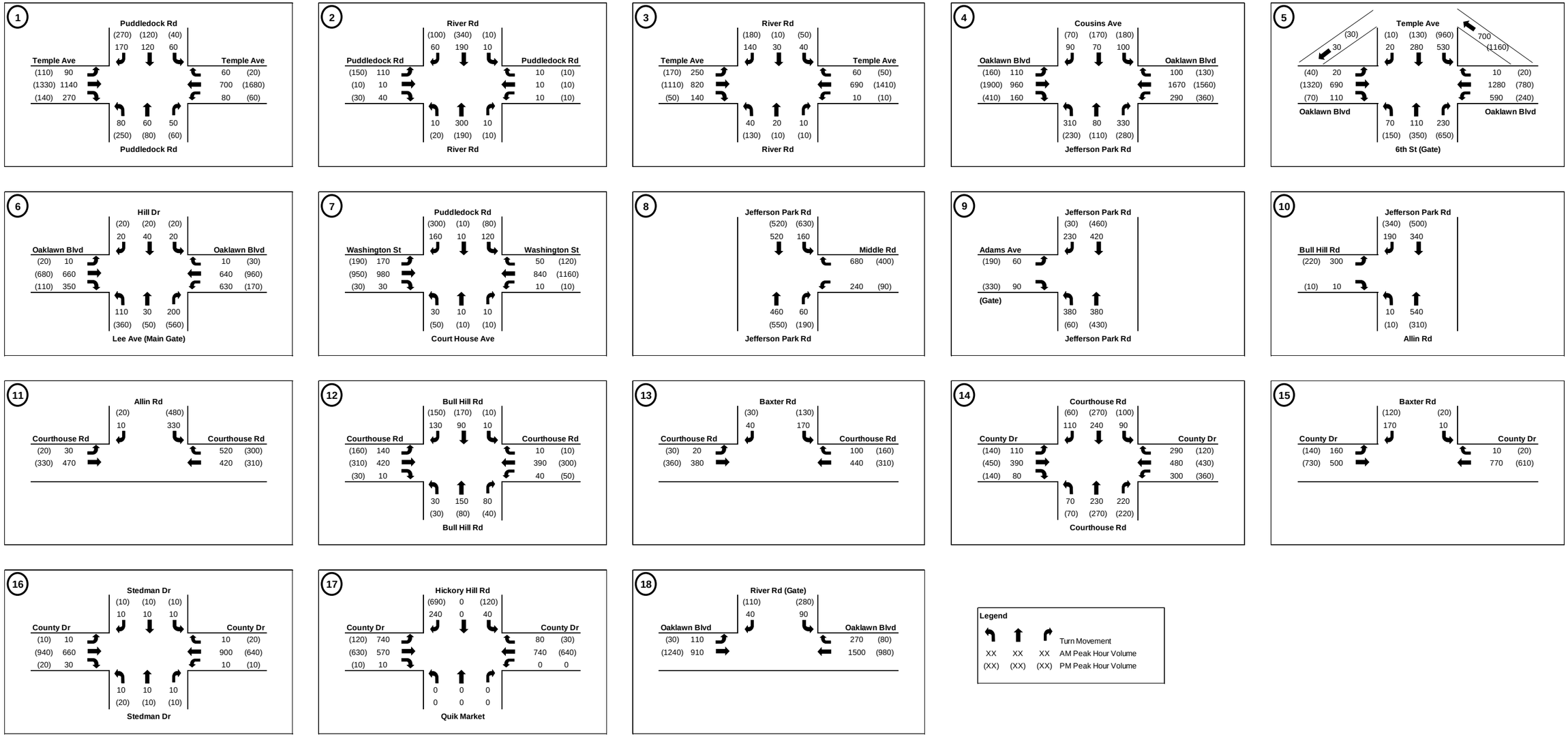
- Jefferson Park Road and Middle Road
- Jefferson Park Road and Adams Avenue
- Jefferson Park Road and Bull Hill Road
- Courthouse Road and Bull Hill Road
- County Drive and Baxter Road
- County Drive and Stedman Drive
- Oaklawn Boulevard and River Road

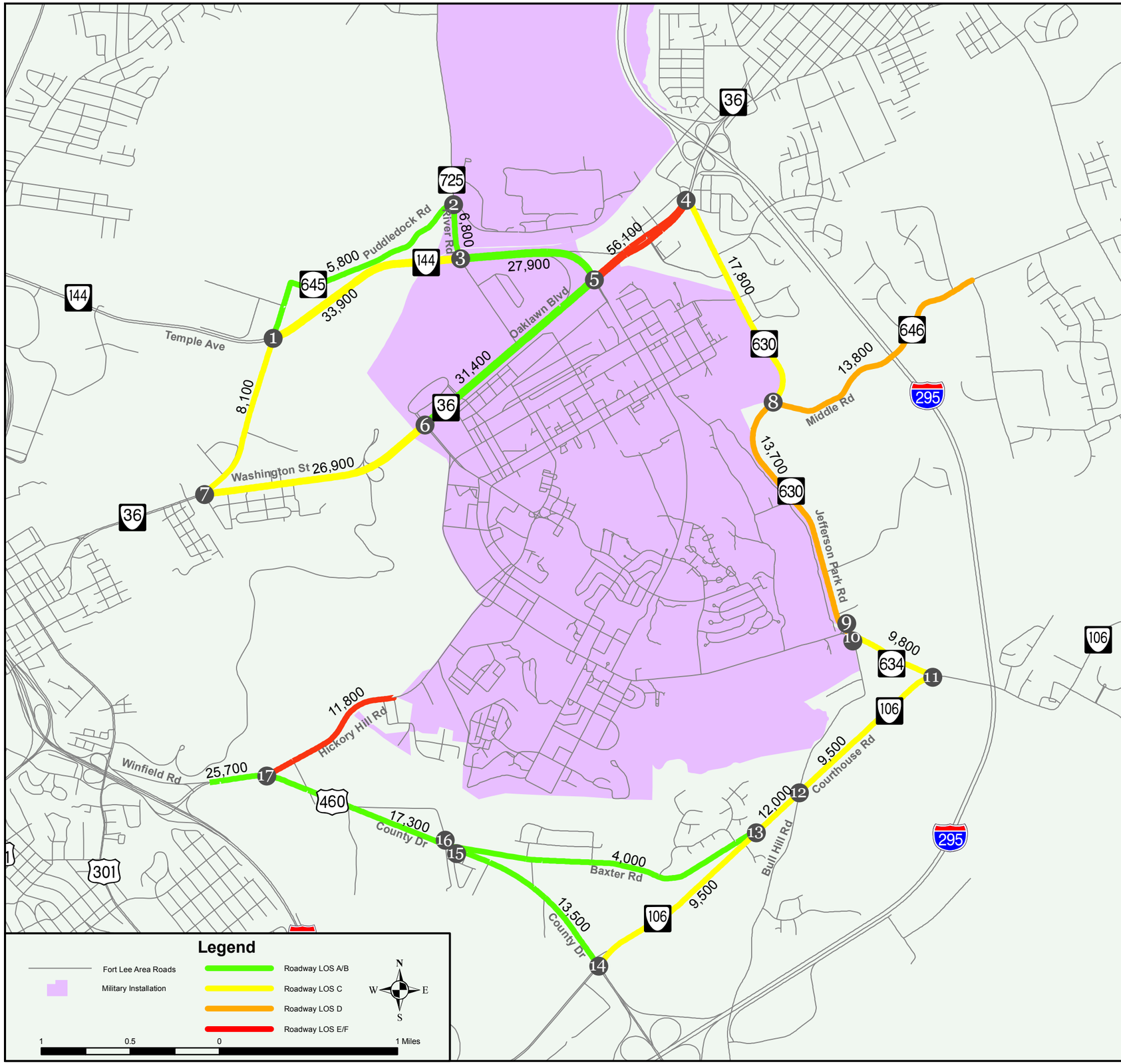
Based on a preliminary signal warrant analysis, the following stop-controlled intersections would meet the criteria for signals under MUTCD warrants 1 and 3.

- Jefferson Park Road and Middle Road
- Jefferson Park Road and Adams Avenue
- Jefferson Park Road and Bull Hill Road
- Courthouse Road and Bull Hill Road
- Courthouse Road and Baxter Road
- County Drive and Baxter Road
- Oaklawn Boulevard and River Road

Detailed signal warrant analyses would still need to be completed in the future to justify signalization of these intersections. Detailed results of the intersection analyses can be found in the appendix.

Figure 2-3: 2026 Forecast Year (AM / PM) Peak Hour Turning Movement Counts (Includes BRAC expansion)





	Intersection		Peak Hour Level of Service	
	NB/SB	EB/WB	AM Peak LOS	PM Peak LOS
1	Puddledock Rd	Temple Ave	D	F
2 *	River Rd	Puddledock Rd	C	C
3	River Rd	Temple Ave	D	F
4	Jefferson Park Rd	Oaklawn Blvd	F	F
5	Temple Ave	Oaklawn Blvd	F	F
6	Lee Ave (Main Gate)	Oaklawn Blvd	E	F
7	Puddledock Rd	Washington St	C	D
8 *	Jefferson Park Rd	Middle Rd	F	F
9 *	Jefferson Park Rd	Adams Ave	E	F
10 *	Jefferson Park Rd	Bull Hill Rd	F	F
11	Allin Rd	Courthouse Rd	B	D
12 *	Bull Hill Rd	Courthouse Rd	F	F
13 *	Baxter Rd	Courthouse Rd	C	C
14	Courthouse Rd	County Dr	D	E
15 *	Baxter Rd	County Dr	E	C
16 *	Stedman Dr	County Dr	E	E
17	Hickory Hill Rd	County Dr	F	D
18 *	River Rd	Oaklawn Blvd	F	F

* Stop-Controlled LOS represents the worst turn movement

Fort Lee Expansion Traffic Study

Figure 2-4
2026 Intersection & Roadway
ADT & LOS (Including BRAC)

3.0 ALTERNATIVES ANALYSIS

The expansion of Fort Lee due to BRAC is expected to increase traffic in the study area. As shown in the previous chapter, many capacity deficiencies are expected on roadways and intersections surrounding Fort Lee due to the increased traffic volumes. The majority of these deficiencies are expected prior to 2015, once the changes at Fort Lee are implemented. Additional deficiencies are expected by 2026 as the study area continues to grow in population and employment.

This chapter will analyze and evaluate possible solutions to these capacity deficiencies. These solutions include improvements suggested by VDOT and Fort Lee. In developing and analyzing potential improvements, it became apparent that each improvement to intersections or roadway segments generally had limited impact on adjacent intersections or roadway sections other than removing a bottleneck. Therefore, improvements were identified for individual roadway segments and intersections and not combined into alternatives. The few instances where impacts to other intersections occur are clearly identified. Section 3.1 will focus on improvements for roadway sections while Section 3.2 focuses on intersection improvements including potential interchanges. A brief description, planning level cost estimates and the resulting levels of service (LOS) are provided for each potential roadway or intersection improvement. Graphics or lane configuration diagrams are provided to help describe some of the improvements. For a few locations, multiple improvement options were developed. Each option is discussed and evaluated and an improvement is recommended based on traffic benefits, fatal flaws, cost, and environmental constraints.

At the request of Fort Lee, this study also evaluated options that would create better connectivity between the north and south sections of the base. Section 3.3 analyzes and evaluates the change in traffic circulation and impact to area roadways associated with these options. The two options suggested by VDOT and Fort Lee include 1) an overpass over Route 36 and 2) the rerouting of Route 36 from Oaklawn Boulevard to Temple Avenue. Section 3.4 discusses analysis of the five Fort Lee gates.

Chapter 4 prioritizes the recommendations for transportation improvements within the study area and discusses the next steps required to implement them.

3.1 Roadway Section Improvements

Roadway improvements were developed for those roadway sections operating at LOS D or worse. Based on roadway capacity analyses, the following four roadway sections meet this criterion. The resulting LOS for 2026 conditions with the recommended improvements are

shown in Table 3-1. Planning level cost estimates for roadway improvements are shown in Table 3-2.

Oaklawn Boulevard (Route 36) – from Temple Avenue to Jefferson Park Road. This section of Oaklawn Boulevard operates at LOS E during the PM Peak Hour in 2006 and is expected to worsen to LOS F by 2015. Currently there are two eastbound lanes and three westbound lanes. Adding a third EB through lane improves the LOS to LOS C in 2015 and 2026.

Middle Road (Rte 646) - from Jefferson Park Road (Rte 630) to Takach Road (Rte 647). In 2026, Middle Road is expected to operate at LOS D in the AM and PM peak hours. By adding left and right turn lanes at all intersecting roads and major developments, the level of service can be improved to LOS C.

Jefferson Park Road (Rte 630) - from Middle Road (Rte 646) to Adams Avenue (Gate). In 2026, Jefferson Park Road is expected to operate at LOS D in the PM peak hour. By adding left and right turn lanes at all intersecting roads and major developments, the level of service can be improved to LOS C.

Hickory Hill Road (Rte 109) - from County Drive (US 460) to Mahone Avenue (Gate). In 2015, Hickory Hill Road is expected to operate at LOS E and D in the AM and PM peak hours, respectively. Since Hickory Hill Road provides a direct entrance to Fort Lee, increasing capacity to and from the gate would give Fort Lee flexibility in gate operations during periods of higher Force Protection. Two options were considered. Option 1 is to widen Hickory Hill Road to four lanes (two lanes in each direction). Option 2 is to widen Hickory Hill Road to a three-lane cross-section. The center lane could serve as a reversible lane whose direction is set based on peak traffic flow or Fort activities. Overhead electronic lane control signs would be required for the reversible lane option. Both options would require improvements to the Mahone Gate.

Either option would operate at LOS B in 2015 and 2026 and solve the capacity deficiency. There is not a large difference in cost between the two options, therefore Option 1 would appear superior as it is safer than a reversible lane and provides more capacity. If required right-of-way encroaches on the Petersburg National Battlefield Park then a three-lane cross-section with a reversible center lane or dedicated turn lanes should be explored during the design phase of the project.

Table 3-1: Proposed Roadway Levels of Service

2026 Level of Service for Roadway Improvements						
Roadway	**From**	**To**	**No-Build AM Peak LOS**	**No-Build PM Peak LOS**	**AM Peak LOS**	**PM Peak LOS**
Oaklawn Blvd	Temple Ave	Jefferson Park Rd	E	F	C	C
Middle Rd	Jefferson Park Rd	Takach Rd	C	D	C	C
Hickory Hill Rd - Option 1	County Dr	Ft Lee Mahone Gate	E	E	B	B
Hickory Hill Rd - Option 2	County Dr	Ft Lee Mahone Gate	E	E	B	B
Jefferson Park Rd	Middle Rd	Adams Ave	D	D	C	C

Planning level cost estimates for each potential improvement are listed in

Table 3-2. These cost estimates were obtained using the methodology from VDOT Transportation and Mobility Planning (TMPD) Division's "Statewide Plan Cost Estimates" updated in June 2006. Some of the projects costs were also reviewed and altered by VDOT Location and Design staff. Cost are in 2006 dollars and do not represent future construction costs accounting for inflation. Costs for obtaining right-of-way were calculated based on VDOT right-of-way and utility cost estimates as a percentage of construction cost as follows:

- Residential/Suburban Low Density = 50% of construction cost
- Business/Suburban Low Density = 60% of construction cost
- New Signal Locations = 5% of construction cost

Table 3-2: Planning Level Cost Estimates for Roadway Improvements

ROADWAY IMPROVEMENTS			
Improvement Identifier	**Location / Intersection**	**Improvement Description**	**Total Cost (in 2006 $)**
Roadway - Oaklawn Blvd	From Temple Ave to Jefferson Park Rd	Widen EB Oaklawn Blvd from 2 to 3 lanes	1,900,000*
Roadway - Middle Rd	From Jefferson Park Rd to Takach Rd	Widen Middle Rd - 1 lane used for turn lanes	1,550,000*
Roadway - Hickory Hill Option 1	From Ft. Lee Mahone Gate to County Dr	Add 1 lane to both NB/SB directions	2,000,000
Roadway - Hickory Hill Option 2	From Ft. Lee Mahone Gate to County Dr	Add 1 lane as an alternating NB/SB lane during AM/PM peaks	1,500,000
Roadway - Jefferson Park Rd	From Middle Rd to Adams Ave	Widen Jefferson Park Rd - 1 lane used for turn lanes	1,990,000*

Cost Estimates were developed using 2006 VDOT Planning Level Cost Estimates for Richmond, Fredericksburg, Culpeper, Salem, Staunton
All construction costs are in 2006 dollars and do not represent future construction costs accounting for inflation.
* Estimates by VDOT Location and Design staff

3.2 Intersection Improvements

Intersection improvements were developed for those intersections that operate at LOS E or worse. Based on the intersection capacity and signal warrant analyses, all intersections except #2 (River Road and Puddledock Road) and #7 (Washington St and Puddledock Road) would require improvements by 2026. Improvements considered included additional turn lanes, installation of signals, signal timing modifications and the complete redesign and realignment of an intersection or an interchange. For some of the intersections, multiple options were developed to solve the traffic deficiencies at the intersection. Each option is presented including its pros and cons and then one option is recommended. The resulting Levels of Service for 2026 conditions with the recommended improvements are shown in Table 3-3. Stop-controlled intersections meeting traffic signal warrants were analyzed as signalized intersections. Planning level cost estimates for intersection improvements are shown in Table 3-4. It is important to note when addressing signal needs that VDOT does not install a traffic signal until it meets warrants for eight hours and is approved by the District Traffic Engineer.

Intersection #1 (Temple Avenue and Puddledock Road): This intersection currently operates at LOS C in the AM Peak Hour and LOS E in the PM Peak Hour. By 2026, the intersection is expected to worsen to LOS D and LOS F for the AM and PM Peak Hours, respectively. Improvements to the intersection including additional thru lanes, one each southbound, eastbound and westbound, plus an additional northbound left turn lane help the intersection to achieve LOS B in the AM Peak Hour and LOS C in the PM Peak Hour in 2026.

Intersection #2 (River Road and Puddledock Road): Minor approach movements at this stop-controlled intersection currently operate at LOS B in both peak hours. In 2026, these movements are expected to operate at LOS C in both peak hours. No improvements are necessary to achieve acceptable LOS levels.

Intersection #3 (Temple Avenue and River Road): This intersection operates at LOS C in the AM Peak Hour and LOS D in the PM Peak Hour in 2006. This intersection is expected to worsen to LOS D in the AM Peak Hour and LOS F in the PM Peak Hour by 2026. The intersection would require separate left and right turn lanes for the northbound and southbound approaches. With these turn lane improvements the intersection will operate at LOS C for both peak hours in 2026. If Fort Lee closes River Road as planned, then the improvements mentioned above will not be required.

Intersection #4 (Oaklawn Boulevard and Jefferson Park Road/Cousins Avenue): This intersection currently operates at LOS E for both peak hours and is expected to worsen to LOS F for both peak hours in 2026. The addition of a second northbound left turn lane from northbound Jefferson Park Road to westbound Oaklawn Boulevard and improved traffic signal phasing will improve the intersection operation to LOS D in both peak periods in 2026.

Intersection #5 (Oaklawn Boulevard and Temple Avenue): This intersection currently operates at LOS F for both the AM and PM Peak Hours. The vehicle delay is expected to worsen in 2026 and remain at LOS F for both peak hours. This intersection would require major improvements to achieve an acceptable LOS. Three options were developed and tested for this intersection.

Option 1: The intersection would require three southbound left turn lanes. The southbound approach would also require two thru lanes. Both the eastbound and westbound approaches would require one additional thru lane while the westbound approach would also require an additional left turn lane. The northbound approach would require a channelized, free-flow right turn, and one additional lane for both the thru and left turn movements. Even with the improvements, the intersection of Oaklawn Boulevard and Temple Avenue would operate at LOS D in the PM peak hour in 2026.

Option 2: The intersection would be replaced by a single point urban interchange (SPUI). To fit an interchange at this location requires shifting the intersection location to the north causing a realignment of Oaklawn Boulevard. Shifting the location also would help with maintaining traffic during construction. Oaklawn Boulevard through traffic would be carried over Temple Avenue since it has the higher traffic volume. Ramps would descend from Oaklawn Boulevard down to Temple Avenue providing access to Fort Lee. The underneath intersection would have dual left turn lanes, two through lanes and a channelized right turn lane for the northbound and southbound approaches. At the ramp termini, two left turn lanes and a channelized right turn lane would be provided. With an interchange, the intersection would operate at LOS A. See Figure 3-1 for a conceptual diagram.

Option 3: The intersection of Oaklawn Boulevard and Temple Avenue is split into two separate signalized and coordinated intersections. The northbound Sisisky Gate traffic and the northbound departing traffic along Temple Avenue would intersect Oaklawn Boulevard at the existing intersection. Westbound left turns into Fort Lee would also occur at the existing intersection. Southbound Temple Avenue traffic, however, would be realigned approximately 700 feet southwest of the existing intersection creating a new intersection on Oaklawn Boulevard. The splitting of Intersection #5 decreases the number of conflicting movements at the resulting two intersections and thus requires fewer total turn lanes. The original intersection would still require an additional westbound left, eastbound thru and free flow right turn lane, northbound left, northbound thru and a northbound, channelized, free-flow right. The new intersection would require only two southbound lefts and one additional eastbound thru. With the improvements suggested both intersections would operate at LOS C or better in 2026. See Figure 3-2 for a conceptual diagram.

Option 2 provides the greatest improvement in traffic operations at the intersection of Oaklawn Boulevard and Temple Avenue; constructing an interchange, however, is very expensive at approximately $22.5 million. Since significantly cheaper alternatives exist that will achieve acceptable LOS for future traffic volumes, an interchange is not recommended for this location. Both Options 1 and 3 will solve the expected problems at the intersection. Although Option 3 is more expensive than Option 1 and introduces a new access point along Oaklawn Boulevard, it provides a better level of service than Option 1 and would better accommodate pedestrians at the intersection. Option 1 requires an unusual triple left turn causing the intersection to become extremely wide. Therefore, Option 3 is recommended to solve the expected traffic option problems at this intersection.

Figure 3-1: Proposed Layout of SPUI

Figure 3-2: Proposed Layout of Split Intersections

Intersection #6 (Oaklawn Boulevard and Lee Avenue): This intersection operates at LOS C in the AM Peak Hour and LOS F in the PM Peak Hour in 2006 and is expected to worsen to LOS D in the AM Peak Hour and LOS F with increased vehicle delay in the PM Peak Hour by 2026. This intersection is able to achieve an acceptable LOS C for the AM and PM Peak Hours in 2026 by improving the traffic signal phasing and timing. No other improvements are necessary.

Intersection #7 (Washington Street and Puddledock Road): This intersection operates at LOS C in the AM and PM Peak Hours in 2006 and is expected to worsen to LOS D in the PM Peak Hour by 2026. This intersection is able to achieve an acceptable LOS C for the AM and PM Peak Hours in 2026 by improving the traffic signal phasing and timing. No other improvements are necessary.

Intersection #8 (Jefferson Park Road and Middle Road): Minor approach movements (westbound left turns) at this stop-controlled intersection currently operate at LOS C in the AM Peak Hour and LOS F in the PM Peak Hour. By 2026, these movements are expected to operate at LOS F in both peak hours. This stop-controlled intersection meets signal warrants in 2015. An additional northbound through lane on Jefferson Park Road is needed to improve intersection operations. With a traffic signal and the extra northbound through lane, the intersection will operate at LOS B or better for both peaks.

Intersections #9 and #10 (Jefferson Park Road and Adams Avenue; Jefferson Park Road/Allin Road and Bull Hill Road): Both of these stop-controlled intersections currently have minor approaches operating at LOS C for AM Peak Hour and LOS B for the PM Peak Hour. These intersections are expected to worsen to LOS E and LOS F by 2026. Both of these intersections meet signal warrants in 2015 and have operational problems. Given the proximity of these two intersections, less than 250 feet apart, any improvements and signalization would need to be coordinated between the two intersections or the intersections would need to be realigned into one intersection. There are three options for improving these intersections so that they meet acceptable LOS levels.

Option 1: Add signals to both intersections and left turn lanes to northbound Allin Road at Bull Hill and to northbound Jefferson Park at Adams Avenue. The two signals would be coordinated to operate at an acceptable LOS and prevent queuing into the upstream signal. The two signalized intersections would operate at LOS B or better for both peak periods in 2026.

Option 2: Realign Bull Hill Road, Allin Road and Jefferson Park Road to intersect at a four-way intersection just west of the existing Jefferson Park Road/Adams Avenue intersection. Add signal and provide one thru, left and right lane at each approach. The right turn movements from Bull Hill to Allin and from Allin to Jefferson Park could be channelized and use existing pavement. As a single signalized intersection, LOS B can be obtained for both peak periods. See Figure 3-3 for a conceptual diagram.

Option 3: Realign Bull Hill Road, Allin Road and Jefferson Park Road to intersect at a four way, two-lane roundabout just west of the existing Jefferson Park Road/Adams Avenue intersection. The right turn movements from Bull Hill to Allin and from Allin to Jefferson Park could be channelized and use existing pavement. The roundabout is expected to operate at LOS B for both peak hours. See Figure 3-4 for a conceptual diagram.

Any of the three options would provide an acceptable solution to the expected traffic problems. Option 1 is recommended since it is the least expensive option and requires the least amount of construction.

Intersection #11 (Courthouse Road and Allin Road): This intersection operates at LOS B in the AM and PM Peak Hours in 2006 and is expected to worsen to LOS B in the AM Peak Hour and LOS D in the PM Peak Hour by 2026. This intersection is able to achieve an acceptable LOS C or better for the AM and PM Peak Hours in 2026 by improving the traffic signal phasing and timing. No other improvements are necessary.

Intersection #12 (Courthouse Road and Bull Hill Road): This stop-controlled intersection currently has minor approach movements operating at LOS D in the AM and PM peak hours, and is expected to worsen to LOS E and F in the AM and PM peak hours, respectively, by 2026. The intersection meets signal warrants in 2015. Courthouse Road and Bull Hill Road meet at a severe skew creating very acute left turn movements. Currently, the intersection has a unique layout with very little storage for left turning vehicles. Signalizing the intersection will compound any problems. The intersection will need to be reconfigured prior to signalization. Two

Figure 3-3: Signalized Realignment of Intersections 9 & 10

Figure 3-4: Roundabout Realignment of Intersections 9 & 10

options were developed.

Option 1: This option realigns Bull Hill Road to intersect Courthouse Road at two separate locations (Figure 3-5). This will eliminate the skew problem at the existing intersection and provide for full turn access at the two new intersections, 12a and 12b. Both intersections will need to be signalized and provide left and right turn lanes to and from Courthouse Road. Intersection 12a is expected to operate at LOS A for both peak periods, while intersection 12b is expected to operate at LOS B for both peak hours.

Option 2: This option reconfigures the intersection to a four-way intersection (on the existing skew), relocates left turn lanes on Courthouse Road and adds left turn lanes to Bull Hill Road. Because of the skew, the intersection would be about 260 feet in width in both directions (See Figure 3-6). The intersection will operate at LOS C or better during both peak periods.

Figure 3-5: Courthouse/Bull Hill Intersection Realignment

Figure 3-6: Courthouse/Bull Hill Intersection with Signal

Although Option 1 is more expensive than Option 2, it is the recommended improvement at this intersection. Existing problems at the intersection due to the severe skew between intersecting roadways will only be compounded with adding turn lanes and widening out of the intersection. Separating the intersections will eliminate these problems. An additional benefit of Option 1 is the reduction in traffic in front of many residential houses due to the relocation of Bull Hill Road.

Intersection #13 (Courthouse Road and Baxter Road): Currently, this stop-controlled intersection has minor approach movements at LOS C for both the AM and PM Peak Hours and is expected to remain at LOS C in 2026. However, the intersection meets signal warrants in 2026. As a signalized intersection, the intersection is expected to operate at LOS B or better during both peak periods. No other improvements are needed.

Intersection #14 (County Drive and Courthouse Road): This intersection operates at LOS C in the AM and PM Peak Hours in 2006 and is expected to worsen to LOS D in the AM Peak Hour and LOS E in the PM Peak Hour by 2026. The signal will need to be retimed to provide additional time for critical westbound left-turn movement. Timing changes result in the intersection operating at LOS D or better for both peak periods.

Intersection #15 (County Drive and Baxter Road): This stop-controlled intersection currently has minor approach movements at LOS B or better for both the AM and PM Peak Hours and is expected to worsen to LOS E in the AM Peak Hour in 2026. The intersection meets signal warrants in 2026. As a signalized intersection, the intersection is expected to operate at LOS B or better during both peak periods. No other improvements are needed.

Intersection #16 (County Drive and Stedman Drive): This stop-controlled intersection currently has minor approach movements at LOS C or better for both the AM and PM Peak Hours. This intersection is expected to have operational problems in 2026 with left turn movements from Stedman Drive experiencing significant delay and operating at LOS E. The intersecting volumes do not meet any of the signal warrants. If a signal is installed at Intersection #15, County Drive and Baxter Road, sufficient gaps will be created on County Drive to accommodate the left turning vehicles from Stedman Drive. The minor approach movements are expected to operate at LOS C in the AM Peak Hour and LOS D in the PM Peak Hour in 2026. Consideration should be given to installing a signal in the future should safety or queuing become a problem at this intersection.

Intersection #17 (County Drive and Hickory Hill Road): This intersection currently operates at LOS C for both peak hours and is expected to worsen to LOS F for the AM Peak Hour and

LOS D for the PM Peak Hour in 2026. The addition of a second eastbound left turn lane on County Drive at the intersection and improvements to the traffic signal timings will improve the operation to LOS B in both peak periods.

Intersection #18 (Oaklawn Boulevard and River Road): The minor approach movements at this stop-controlled intersection operate at LOS F for both peak hours in 2026. The addition of a southbound right turn lane is required for the intersection to operate with an acceptable LOS. The intersection meets signal warrants in 2026. As a signalized intersection, the intersection is expected to operate at LOS B during both peak periods.

Table 3-3: Proposed Intersection Levels of Service

2026 Proposed Intersection Improvements						
Intersection #	**NB/SB**	**EB/WB**	**No-Build AM Peak LOS**	**No-Build PM Peak LOS**	**Improvements AM Peak LOS**	**Improvements PM Peak LOS**
1	Temple Ave	Puddledock Rd	D	F	B	C
2	River Rd	Puddledock Rd	C	C	C	C
3	Temple Ave	River Rd	D	F	C	C
4	Jefferson Park Rd	Oaklawn Blvd	F	F	D	D
5 Option 1	Oaklawn Blvd	Temple Ave	F	F	C	D
5 Option 2	Oaklawn Blvd	Temple Ave	F	F	A	A
5c Option 3	Oaklawn Blvd	Temple Ave	F	F	B	C
5d Option 3	Oaklawn Blvd	Temple Ave	F	F	B	C
6	Oaklawn Blvd	Lee Ave	D	F	C	C
7	Washington St	Puddledock Rd	C	D	C	C
8	Jefferson Park Rd	Middle Rd	F	F	A	B
9 Option 1	Jefferson Park Rd	Adams Ave	E	F	A	B
10 Option 1	Bull Hill Rd	Allin Rd	F	F	B	B
9-10 Option 2	Jefferson Park Rd	Adams Ave	N/A	N/A	B	B
9-10 Option 3	Jefferson Park Rd	Adams Ave	N/A	N/A	B	B
11	Courthouse Rd	Allin Rd	B	D	B	C
12a Option 1	S. Bull Hill Rd	Courthouse Rd	N/A	N/A	A	A
12b Option 1	N. Bull Hill Rd	Courthouse Rd	N/A	N/A	B	B
12 Option 2	Bull Hill Rd	Courthouse Rd	F	F	C	B
13	Baxter Rd	Courthouse Rd	C	C	B	A
14	Courthouse Rd	County Dr	D	E	D	D
15	Baxter Rd	County Dr	E	C	B	B
16	County Dr	Stedman Dr	E	E	C	D
17	Hickory Hill Rd	County Dr	F	D	B	B
18	River Rd	Oaklawn Blvd	F	F	B	B

Planning level cost estimates for each potential intersection improvement is listed in Table 3-4. These cost estimates were obtained from VDOT Transportation and Mobility Planning (TMPD) Division's "Statewide Plan Cost Estimates" updated in June 2006. Costs for

obtaining right-of-way were calculated based on VDOT right-of-way and utility cost estimates as a percentage of construction cost as follows:

- Residential/Suburban Low Density = 50% of construction cost
- Business/Suburban Low Density = 60% of construction cost
- New Signal Locations = 5% of construction cost

Table 3-4: Planning Level Cost Estimates for Potential Improvements

INTERSECTION IMPROVEMENTS			
Improvement Identifier	**Location / Intersection**	**Improvement Description**	**Total Cost (in 2006 $)**
Intersection - 1	Temple Ave / Puddledock Rd	Provide turn lanes, optimize signal phasing/timings at intersection	1,210,000
Intersection - 3	Temple Ave / River Rd	Provide turn lanes, optimize signal phasing/timings at intersection	870,000
Intersection - 4	Oaklawn Blvd / Jefferson Park Rd	Add turn lane at intersections	340,000
Intersection - 5 Option 1	Temple Ave / Oaklawn Blvd	Provide additional turn lanes, improve traffic signal phasing and timing	1,680,000
Intersection - 5 Option 2	Temple Ave / Oaklawn Blvd	Construct Single Point Urban Interchange	22,500,000
Intersection - 5 Option 3	Temple Ave / Oaklawn Blvd	Provide new split intersection with signal, additional turn lanes, new roadway alignment,	2,230,000
Intersection - 6	Oaklawn Blvd / Hill Dr / Lee Ave	Improve phasing or system, signalized intersections	10,000
Intersection - 7	Washington St / Puddledock Rd	Improve phasing or system, signalized intersections	10,000
Intersection - 8	Jefferson Park Rd / Middle Rd	Provide signal at unsignalized intersection and provide additional NB thru lane	510,000

INTERSECTION IMPROVEMENTS			
Improvement Identifier	**Location / Intersection**	**Improvement Description**	**Total Cost (in 2006 $)**
Intersection - 9-10 Option 1	Jefferson Park Rd / Allin Rd / Adams Ave / Bull Hill Rd	Provide two coordinated traffic signals, turn lanes at intersection	920,000
Intersection - 9-10 Option 2	Jefferson Park Rd / Allin Rd / Adams Ave / Bull Hill Rd	Realign roadways and provide single intersection with traffic signal and additional turn lanes	2,070,000
Intersection - 9-10 Option 3	Jefferson Park Rd / Allin Rd / Adams Ave / Bull Hill Rd	Realign roadways and provide roundabout at intersection	1,470,000
Intersection - 11	Courthouse Rd / Bull Hill Rd	Improve phasing or system, signalized intersections	10,000
Intersection - 12 Option 1	Courthouse Rd / Bull Hill Rd	Realign roadway to create split intersection with new traffic signals, add turn lanes, close existing intersection	2,760,000
Intersection - 12 Option 2	Courthouse Rd / Bull Hill Rd	Provide new traffic signal, additional turn lanes, new median	860,000
Intersection - 13	Courthouse Rd / Baxter Rd	Provide signal at unsignalized intersection	280,000
Intersection - 14	County Dr / Courthouse Rd	Improve phasing or system, signalized intersections	10,000
Intersection - 15	County Dr / Baxter Rd	Provide signal at unsignalized intersection	280,000
Intersection - 17	County Dr / Hickory Hill Rd	Provide additional left turn lane from EB County Dr to Hickory Hill Rd	1,470,000
Intersection - 18	Oaklawn Blvd / River Rd	Provide additional turn lane from SB River Rd to Oaklawn Blvd, Provide traffic signal	450,000

Cost Estimates were developed using 2006 VDOT Planning Level Cost Estimates for Richmond, Fredericksburg, Culpeper, Salem, Staunton

All construction costs are in 2006 dollars and do not represent future construction costs accounting for inflation.

3.3 Options for Connecting the Two Sections of Fort Lee

At the request of Fort Lee, Baker considered options to connect the two currently separated potions of the base. Since major parts of the BRAC growth at Fort Lee are expected to be built north of Oaklawn Boulevard (Rte 36), there are concerns that the division of the base will negatively impact its operation. Therefore, two options were considered to connect the two halves of the base. In Option 1, an overpass is built carrying River Road over Oaklawn Boulevard (Rte 36) providing a secure connection between the two halves of the base. In Option 2, Oaklawn Boulevard through the base is closed to thru traffic and Route 36 is rerouted via Puddledock Road to Temple Avenue north of the base. This option would remove thru traffic from Oaklawn Boulevard and allow Fort Lee to use it as an internal base road. The options are shown graphically in Figure 3-7.

Option 1: 2026 Forecast Year Volumes and LOS

In Option 1, a two-lane overpass is built carrying River Road over Oaklawn Boulevard, connecting the northern and southern sections of the base. Under this option, there would be no need for a gate at River Road and Oaklawn Boulevard, since traffic between the two sections of the base could pass unobstructed using the overpass. Instead, the River Road Gate would be moved to the north, where River Road intersects Route 144 (Temple Avenue). With the River Road Gate moved north, the distribution of traffic would shift somewhat, since most traffic entering the northern section of the base would now use Temple Avenue to access the relocated River Road Gate.

Option 1 would alter the volume of traffic on Oaklawn Boulevard between the Lee Gate and Sisisky Gate intersections, on all of Temple Avenue in the study area and would change the volume of traffic passing through intersections #1, #3, #5, #6 and #7, though not significantly. All affected intersections would still require the same improvements as recommended in Section 3.2. Therefore, the decision of whether to construct an overpass is not driven by its impact on adjacent intersections or roadways but on its affect on base activities and operation. As seen in Table 3-5, the estimated cost for an overpass is approximately $4.92 million.

The exact location of the overpass would depend on the layout of facilities and roadways associated with the BRAC expansion. The gate at River Road and possible realignment of internal base roads to accommodate the overpass could add to the total cost of this option.

Table 3-5: Planning Level Cost Estimates for Option 1 Improvements

OPTION 1 (Overpass) IMPROVEMENTS			
Improvement Identifier	**Location / Intersection**	**Improvement Description**	**Total Cost (in 2006 $)**
Bridge Deck	River Rd / Oaklawn Blvd	Construct Overpass from River Rd over Oaklawn Blvd and tie into internal Fort Lee roadway network	2,430,000
Roadway - River Rd	River Rd north and south of Oaklawn Blvd	Construct roadway from bridge deck to grade level	740,000
Roadway - River Rd	River Rd north and south of Oaklawn Blvd	Realign new roadway to existing roadway network	320,000
Roadway - River Rd	River Rd north and south of Oaklawn Blvd	Provide earthwork (borrow excavation) from bridge deck to at grade	1,410,000
Roadway - River Rd	River Rd north and south of Oaklawn Blvd	Provide earthwork (cut excavation) from bridge deck to at grade	20,000
		Total Cost (Option 1)	4,920,000

Cost Estimates were developed using 2006 VDOT Planning Level Cost Estimates for Richmond, Fredericksburg, Culpeper, Salem, Staunton
All construction costs are in 2006 dollars and do not represent future construction costs accounting for inflation.

Option 2: 2026 Forecast Year Volumes and LOS

In Option 2, the Lee Gate (Main Gate) is moved to the old Route 36 where it crosses base property. With all of the old Route 36 now within base boundaries, there is no need for a gate at Jackson Circle and thus Intersection #6 is no longer analyzed since it would fall within gate boundaries and thru traffic volumes would drop significantly. Furthermore, the Temple/Oaklawn/Sisisky Gate intersection is realigned. Old Route 36 no longer extends all the way to 6th Street and the Sisisky Gate intersection is simplified to a three-point intersection with the realigned Route 36 (Intersection #5A). Also, with no disconnect between the northern and southern halves of the base, there is no need for a gate at River Road and the old Route 36. This gate is thus moved to the north, where River Road intersects the realigned Route 36. There is a new intersection (Intersection #7A) where the old Route 36 meets the realigned 36 to the west of the base. From this point, only base and Battlefield Park traffic would use the old Route 36. All other traffic would be diverted around the base on the realigned segment.

Separating the thru traffic from the base traffic was completed by subtracting the traffic turning into the two gates from Oaklawn Boulevard from the total traffic approaching from each side of the base. All traffic that turned left from Oaklawn Boulevard into the Sisisky or

Lee Gates was assumed to be coming from the east and thus would enter at the new Sisisky Gate intersection. All traffic turning right from Oaklawn Boulevard into the Lee or Sisisky Gates was assumed to be coming from the west and thus would now enter via the relocated Main Gate. Furthermore, with the River Road Gate moved to the north, traffic coming to the northern section of the base now has two options for entering the base, the River Road Gate and the Main Gate. Depending on how Fort Lee would address the connections between the two halves of the base if Route 36 is realigned, some traffic bound for the northern section of the base may be able to use the Sisisky Gate, but for purposes of this study it is assumed the all traffic bound for this section of the base would use either the River Road Gate or the Main Gate.

Implementation of Option 2 would remove Intersection #6, move and alter the alignment of Intersections #5 and #7 (now Intersections #5A and #7A) and change and volumes at intersections #1 and #3, requiring different improvements than those recommended in Section 3.2. Furthermore, the realignment would significantly change the volume of traffic on Temple Avenue between Puddledock Road (now part of the realigned Route 36) and the Sisisky Gate intersection (Intersection #5A). All through traffic from Route 36 would now follow the realignment via Puddledock to its intersection with Temple Avenue (Intersection #1). No other intersection or roadway segment volumes would change under this option.

With this realignment, traffic volumes on Puddledock Road and Temple Ave would increase dramatically. Puddledock Road from where the realignment meets it to Temple Avenue would see volume in 2026 increase from 8,100 to 21,700. In its current two-lane configuration, it would operate at LOS F in 2015 and 2026. Therefore, Puddledock Road would require widening from two to four lanes in this section. Temple Avenue from Puddledock Road to the new intersection 5A would also see a significant increase in volume over the No-Build. The western segment, from Puddledock Road to River Road would increase from 33,700 vehicles per day (vpd) in the 2026 No-Build to 53,400 vpd under Option 2 in 2026. The eastern segment from River Road to the new intersection 5A would increase from 27,700 vpd in the 2026 No-Build to 47,700 vpd under Option 2 in 2026. Thus, the roadway LOS would decrease to almost LOS E. Therefore, it would be advisable to widen Temple Avenue in this area to six thru lanes, 3 in each direction if Option 2 were implemented. Oaklawn Boulevard would be slightly realigned and widened to six lanes between the Sisisky Gate and Jefferson Park Road. Three thru lanes are necessary at Intersections #1, #3 and #5A along Temple so widening the whole roadway would provide lane continuity. Under these circumstances, no segment of the road would fall below LOS C in 2026.

Major intersection changes would also be required. Intersections #1, #3, #5A and #7A would require the lane configurations seen in Figure 3-8 to achieve acceptable LOS levels. Since Puddledock Road would no longer connect at its current location, Intersection #7 would become a three point, stop-controlled intersection. A new signalized intersection, #7A, would exist to serve traffic entering and exiting Fort Lee from the Main Gate and to and from Petersburg National Battlefield Park. With the suggested improvements, all intersections would operate at LOS C or better in 2026.

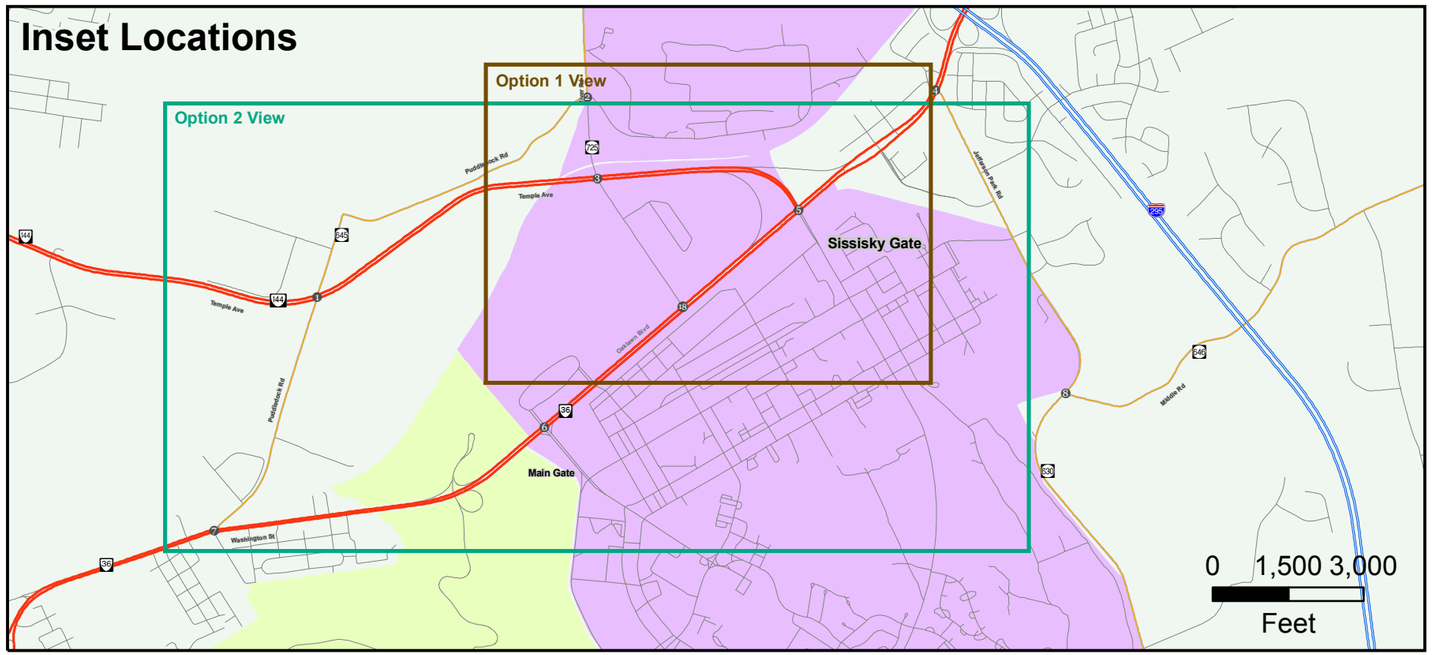
Planning level cost estimates for Option 2 are listed in Table 3-6. These cost estimates include necessary roadway (Temple Avenue, Oaklawn Boulevard, and Puddledock Road) improvements and intersection improvements required to achieve acceptable LOS levels.

Table 3-6: Planning Level Cost Estimates for Option 2 Improvements

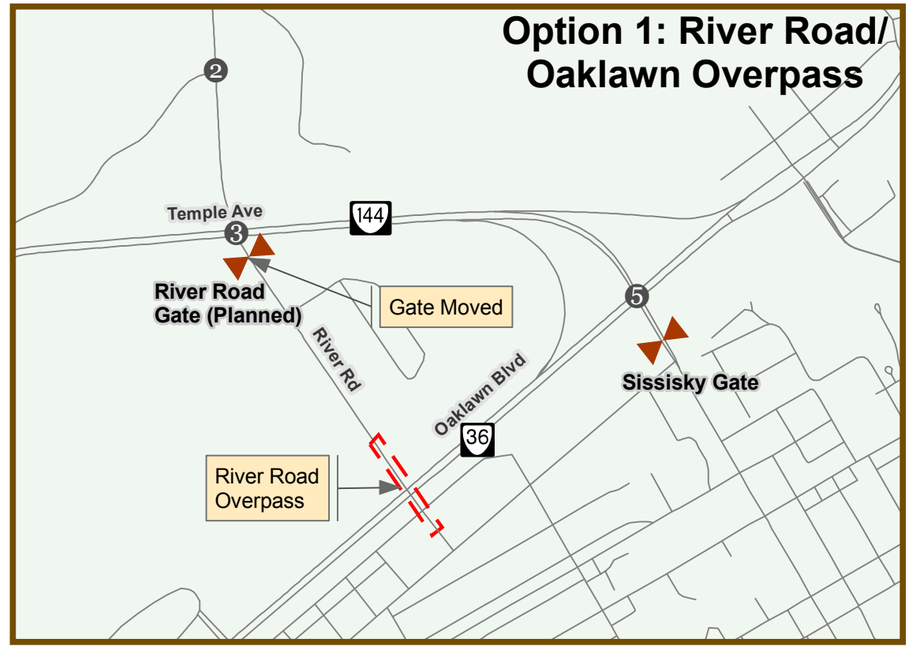
OPTION 2 (RT 36 Realignment) IMPROVEMENTS			
Improvement Identifier	**Location / Intersection**	**Improvement Description**	**Total Cost (in 2006 $)**
Roadway - Temple Ave	From Puddledock Rd to Temple Ave to Oaklawn Blvd Ramp	Widen from 4 lane divided to 6 lane divided	14,580,000
Roadway - Temple Ave	From Temple Ave to Oaklawn Blvd Ramp to Existing Oaklawn Blvd	Create new 6 lane rural roadway	5,330,000
Roadway - Puddledock Rd	From new alignment to Temple Ave	Widen Puddledock Rd from 2 lane to 4 lane	1,350,000
Roadway - Puddledock Rd	From Washington St to Existing Puddledock Rd	Create new 4 lane rural roadway on high fill	9,440,000
Roadway - Oaklawn Blvd	From new alignment intersection (7a) to existing Oaklawn Blvd	Realign Oaklawn Blvd to tie into new intersection (7a) by creating new 4 lane rural roadway	950,000
Roadway - 6th St Extension	Temple Ave to Existing 6th St	Create new 4 lane rural roadway to tie existing 6th St into Temple Ave	3,310,000
Bridge Deck	Temple at Railroad Bridges	Widen bridge deck on 4 bridges on Temple Ave	2,700,000
Bridge Deck	New Puddledock Rd over RR	Construct bridge over Railroad as part of new Puddledock Rd	3,240,000
Intersection - 1	Temple Ave / Puddledock Rd	Provide turn lanes, restripe lanes, optimize signal phasing/timings	570,000
Intersection - 3	Temple Ave / River Rd	Provide additional turn lanes, add receiving lane, restripe lanes, optimize signal phasing/timings	1,460,000
Intersection - 5a	Temple Ave / 6th Street Ext	Provide traffic signal, additional turn lanes to intersection	870,000
Intersection - 6	Oaklawn Blvd / Hill Dr / Lee Ave	Improve phasing or system, signalized intersections	10,000
Intersection - 7a	Puddledock Rd / Oaklawn Blvd (new)	Provide traffic signal, additional turn lanes, restripe lanes at intersection	660,000
		Total Cost (Option 2)	44,470,000
		Minus cost of improvements to Intersections 1, 3, 5, 6 & 7	3,780,000
		Total Marginal Cost (Option 2)	40,690,000

Cost Estimates were developed using 2006 VDOT Planning Level Cost Estimates for Richmond, Fredericksburg, Culpeper, Salem, Staunton
All construction costs are in 2006 dollars and do not represent future construction costs accounting for inflation.

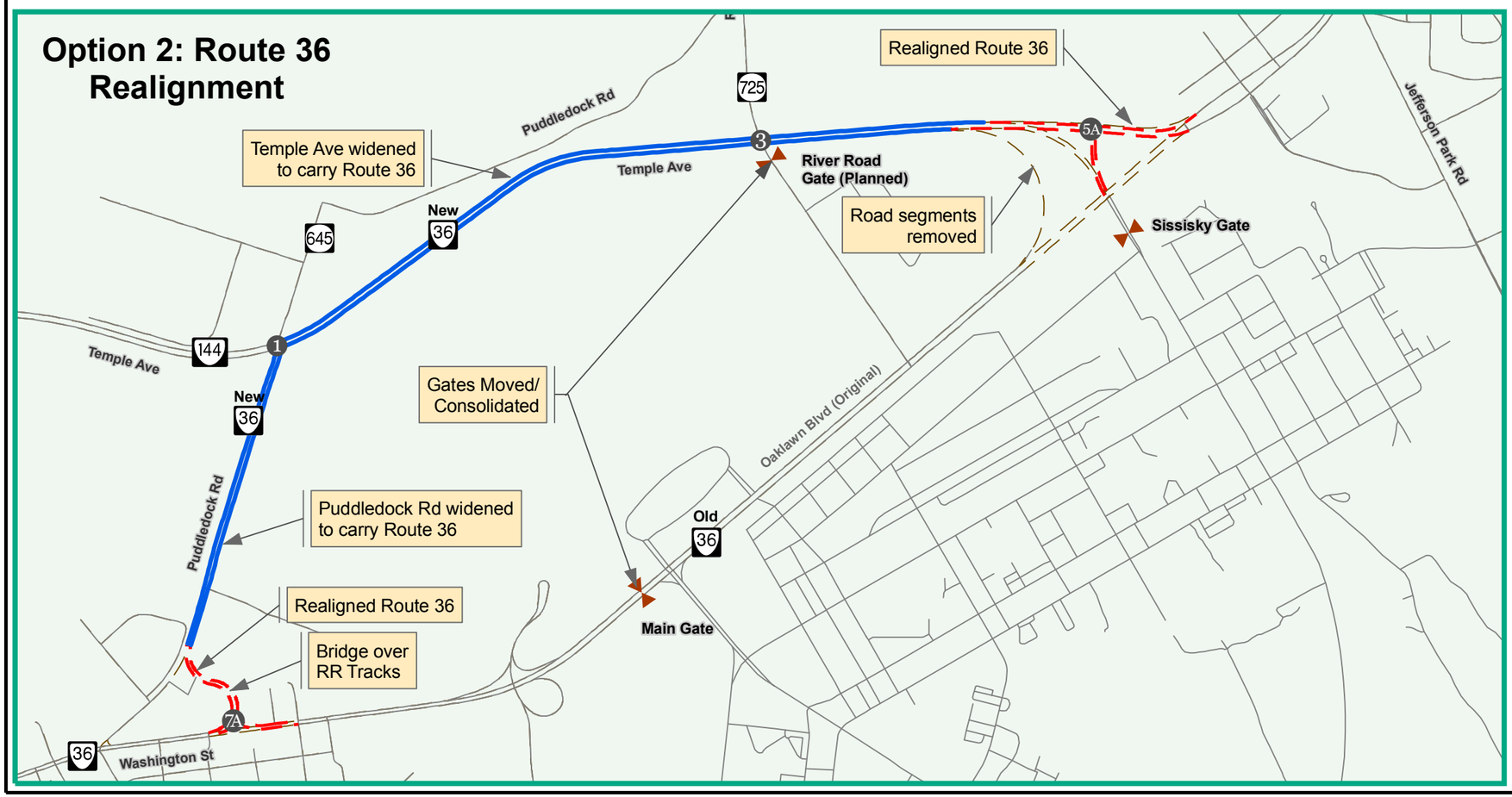
Inset Locations



Option 1: River Road/ Oaklawn Overpass



Option 2: Route 36 Realignment



Road Improvements

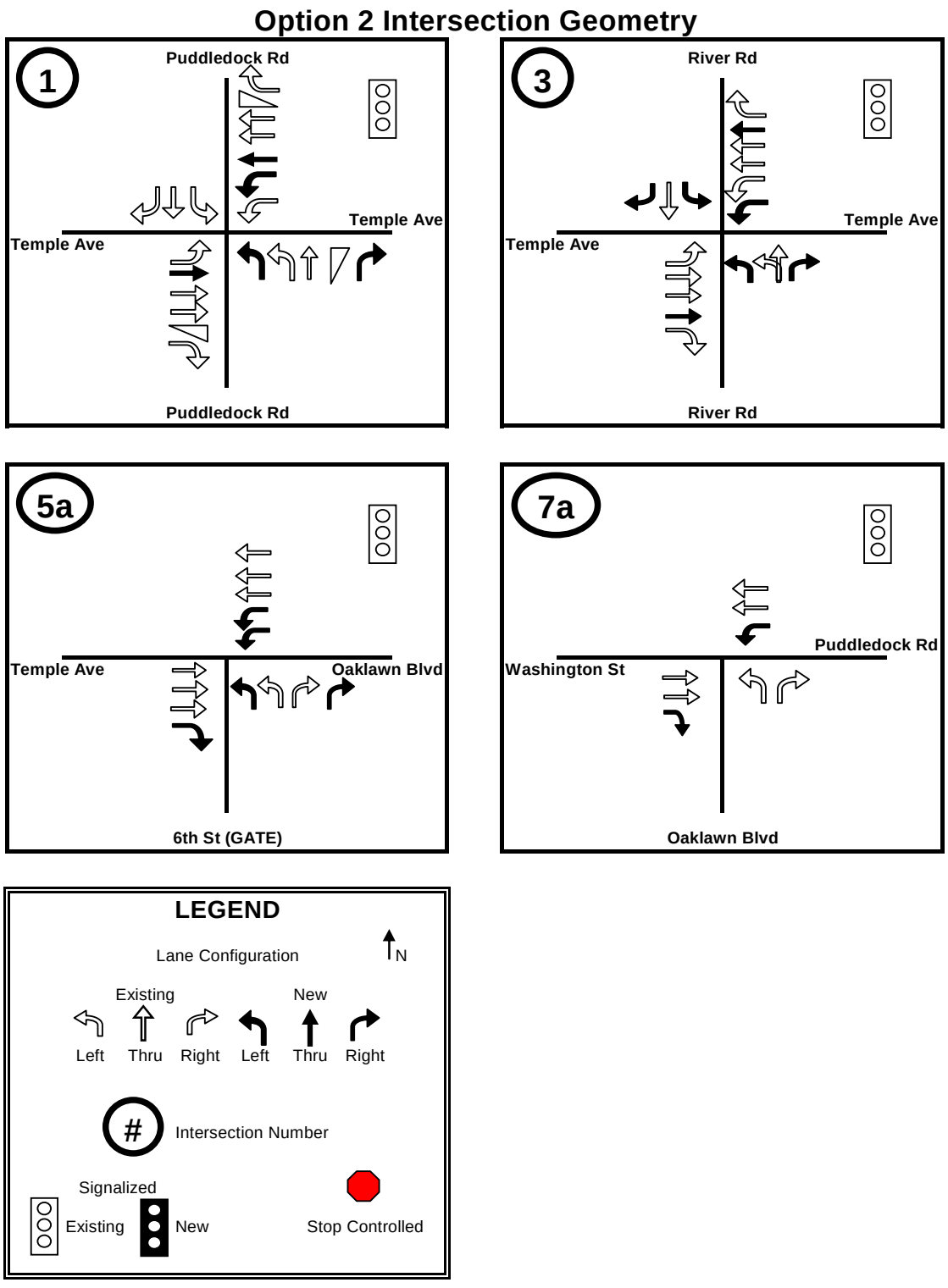
- Widen
- Realignment/Addition
- Unchanged Roads
- Roads Removed
- # Intersection #
- Gates

0 750 1,500
Feet

Fort Lee Expansion Traffic Study

Figure 3-7: Options 1 & 2 Alignment

Figure 3-8: Option 2 Intersection Geometry



The two options take vastly different approaches to solving the connectivity problem for Fort Lee. Option 1 is rather inexpensive and has no significant impacts, negative or positive, on surrounding roadways or intersections. While this option provides secure access between the two halves of the base, the existing barrier between the two halves remains. Also, this option would require realignment of some base roads to accommodate the overpass where it would descend into the southern half of the base.

Option 2 is much more expensive but does completely remove the major barrier between the two halves of the base. Furthermore, under Option 2, the major traffic issues associated with Intersection 5 disappear. By merging and diverging the Oaklawn Boulevard and Temple Avenue traffic at Intersection 1 instead, the critical turn movements no longer conflict with traffic entering and exiting Fort Lee. Nevertheless, implementation of the option could be challenging, requiring major coordination and approval from multiple jurisdictions and agencies. Impacts to interchanges on I-95 were not analyzed as part of this study; however, it is likely that traffic would shift away from the Washington Street (Route 36) interchange with I-95 to the Temple Avenue (Route 144) interchange, which is currently at or over capacity.

Table 3-7: Comparison of Intersection LOS: No-Build, Improvements, Options 1 & 2

	Intersection		2026 No Build Peak Hour Level of Service		2026 Improvements Peak Hour Level of Service*		Option 1 Peak Hour Level of Service		Option 2 Peak Hour Level of Service	
	NB/SB	EB/WB	AM Peak LOS	PM Peak LOS	AM Peak LOS	PM Peak LOS	AM Peak LOS	PM Peak LOS	AM Peak LOS	PM Peak LOS
1	Puddledock Rd	Temple Ave	D	F	B	C	B	C	C	C
3	River Rd	Temple Ave	D	F	C	C	C	C	C	C
5	Temple Ave	Oaklawn Blvd	F	F	C	C	N/A	N/A	N/A	N/A
5a	Temple Ave	Oaklawn Blvd	N/A	N/A	N/A	N/A	C	C	N/A	N/A
5b	Temple Ave	Oaklawn Blvd	N/A	N/A	N/A	N/A	N/A	N/A	C	C
6	Lee Ave (Main Gate)	Oaklawn Blvd	E	F	C	C	C	C	Internal Base Intersection	
7	Puddledock Rd	Washington St	C	D	C	C	C	C	B	C

* Improvements as recommended in Section 3.2

In conclusion, rerouting Route 36 alone will not solve the traffic problems associated with BRAC expansion. Actually, the rerouting of traffic will create additional traffic problems along Puddledock Road and Temple Avenue. The estimated cost of providing acceptable levels of service on study area roadways with the rerouting of Route 36 is approximately $41 million more than leaving Route 36 on Oaklawn Boulevard through the base. As Table 3-7 shows,

despite its high cost, Option 2 does not vastly improve intersection LOS in the study area. Only one intersection, #7, would show any improvement in LOS under Option 2 while intersection #1 would actually drop from LOS B to LOS C in the AM peak hour. Furthermore, as seen in Table 3-8, Option 2 would significantly improve LOS on Oaklawn Avenue between Puddledock Road and Lee Gate, but at the expense of Temple Avenue and Puddledock Road. Thus, there is no clear operational improvement gained over the whole network from the implementation of Option 2.

Table 3-8: Comparison of Roadway LOS: No-Build, Improvements, Options 1 & 2

Facility	From	To	2026 No Build		2026 Improvements*		Option 1		Option 2	
			AM Peak LOS	PM Peak LOS	AM Peak LOS	PM Peak LOS	AM Peak LOS	PM Peak LOS	AM Peak LOS	PM Peak LOS
Washington Street / Oaklawn Blvd (Route 36)	Puddledock Rd (Route 645)	Lee Ave (Ft. Lee Gate)	C	C	C	C	C	C	C	C
Oaklawn Blvd (Route 36)	Lee Ave (Ft. Lee Gate)	Temple Ave (Route 144)	B	B	B	B	B	B	A	A
Oaklawn Blvd (Route 36)	Temple Ave (Route 144)	Jefferson Park Rd (Route 630)	E	F	C	C	C	C	C	C
Oaklawn Blvd (Route 36)	Lee Ave (Ft. Lee Gate)	Temple Ave (Route 144)	B	B	B	B	B	B	A	A
Temple Ave (Route 144)	Puddledock Rd (Route 645)	River Rd (Route 725)	B	C	B	C	B	C	C	C
Temple Ave (Route 144)	River Rd (Route 725)	Oaklawn Blvd (Route 36)	A	B	A	B	A	B	C	C
Puddledock Rd (Route 645)	Washington St (Route 36)	Temple Ave (Route 144)	B	C	B	C	B	C	C	C

* Improvements as recommended in Section 3.1

Based on the costs required to implement options to better connect sections of Fort Lee and their associated traffic impacts, it appears adding an overpass is the best option. The analysis shows that adding an overpass is an independent decision for Fort Lee and has little impact upon the traveling public and local jurisdictions.

3.4 Gate Improvements

In addition to analyzing the impact that increased traffic will have on the intersections just outside of the Fort Lee gates, this study evaluated the impact the traffic would have on the gate entrances and exits. Based on previous studies done for Navy installations in Hampton Roads, Virginia it was discovered that approximately 250 vehicles could be ID checked by a single personnel in an hour during high security levels. Other Military Traffic Management Command studies show that up to 400 vehicles can be checked during average levels of security. With multiple ID checkers per lane during peak periods, the throughput of an entrance lane could be between 500 and 800 vehicles per hour. It is estimated that a single exit lane could handle 720 to 900 vehicles per hour (4-5 second headways) with the presence of serpentine barriers. Fort Lee has four open gates and one planned gate for access into and

out of the base. Results of each gate's ability to handle projected 2026 peak hour flows are presented below.

1. Lee Avenue (Main) Gate (Access via Oaklawn Boulevard [Rte 36] on west side of base). The gate has two inbound and two outbound lanes. There is enough capacity with dual ID checkers in each lane to handle the expected 2026 peak hour demand of 1,020 ingress vehicles per hour. Two outbound lanes can handle the 970 egress vehicles per hour.

2. Sisisky Gate (Access via the intersection of Oaklawn Boulevard [Rte 36] and Temple Avenue [Rte 144]). The gate has two inbound and two outbound lanes. There is enough capacity with dual ID checkers in each lane to handle the expected 2026 peak hour demand of 980 ingress vehicles per hour. Two outbound lanes can handle the 1,150 egress vehicles per hour.

3. Adams Avenue (Golf Course) Gate (Access via Jefferson Park Road [Rte 630] and Allin Road [Rte 634]). The gate has one inbound and one outbound lane. There is enough capacity with dual ID checkers to handle the expected 2026 peak hour demand of 610 ingress vehicles per hour. A single outbound lane can handle the 520 egress vehicles per hour.

4. Mahone Avenue Gate (Access via County Drive [US 460] and Hickory Hill Road [Rte 109]). The gate has one inbound and one outbound lane. The expected 2026 peak hour demand of 820 ingress vehicles per hour and 810 egress vehicles per hour is approaching or slightly exceeding the capacity of single entrance and exit lanes at this gate. In addition, Hickory Hill Road is recommended to be widened to a four-lane cross section. The gate should be widened to handle the additional lanes.

5. River Road Gate (Planned future access via Oaklawn Boulevard [Rte 36] at River Road [Rte 725]). One inbound and one outbound lane should accommodate the projected 2026 peak hour demand of 380 ingress vehicles per hour and 390 egress vehicles per hour.

Fort Lee has another gate at Shop Road and Jefferson Park Road (Rte 630) which was opened in October 2006 when Sisisky Gate was closed for reconstruction. Under current base plans, this gate will remain open after Sisisky Gate is reopened. One inbound and one outbound lane should accommodate the projected peak hour demand of ingress and egress vehicles.

4.0 RECOMMENDATIONS

The expansion of Fort Lee's operations due to BRAC will bring additional traffic to the study area and have a negative impact on the operation of area roadways and intersections. Transportation improvements were developed and analyzed to address existing and future capacity deficiencies. The improvements were developed for short, intermediate-, and long-term planning horizons as follows:

- Short-term improvements consist of those improvements that are relatively low in cost, do not require right-of-way and are needed to correct an existing deficiency. These improvements can often be implemented quickly with available pools of funds.
- Intermediate-term improvements consist of recommendations that are needed to address existing deficiencies. These improvements are generally significantly higher in cost than short-term improvements and, in many cases, require right-of-way. These recommendations also include improvements to address projected deficiencies for 2015.
- Long-term improvements are mostly recommendations to address projected deficiencies for 2026.

This chapter of the report provides a list of recommended transportation improvements for the study area. These recommended improvements were chosen from a larger list of potential improvements evaluated in Chapter 3.0 as those that best economically solve the existing and projected capacity and safety deficiencies. Collectively, these projects will address the traffic impacts created by operational changes at Fort Lee. Within each category of improvements, the improvements were prioritized. Priority was based on level of congestion, when the improvement is needed, and cost. Generally, improvements that addressed the most severe congestion should be implemented first and received the highest priority. Those that address an existing problem or could be done for a lower cost also received higher priority. Utilizing these prioritized lists, VDOT and the local jurisdictions must work toward a system determining when and how these improvements should be advanced through the project development process. That process will incorporate input from the public and elected officials. This prioritized list of projects should be flexible to accommodate opportunities that result from the dedication of right-of-way, proffers or construction funds offered by private sources.

The forecast traffic volumes and analysis conducted for this study were based on the Fort Lee Shop Road Gate being closed. Currently, the gate is open while Sisisky Gate is being reconstructed. The latest plans from Fort Lee include leaving the Shop Road Gate open long-term. It is not anticipated that Shop Gate will have a significant effect on the travel patterns or traffic volumes analyzed in this report. The majority of the traffic diverted to Shop Gate will come from Sisisky Gate. Since the congestion problems along Oaklawn Boulevard near Sisisky

Gate are existing and only worsen with BRAC expansion, it is expected that the improvements recommended below will still be required regardless of whether or not Shop Gate is open.

A standard process was used to determine planning level cost estimates for each of the recommended short- intermediate- and long-term improvements. Planning level unit costs for various improvements were developed using methodology from VDOT Transportation and Mobility Planning (TMPD) Division's "Statewide Plan Cost Estimates" updated in June 2006. VDOT Location and Design staff completed more detailed cost estimates for some of the projects. Cost are in 2006 dollars and do not represent future construction costs accounting for inflation. Costs for obtaining right-of-way were calculated based on VDOT right-of-way and utility cost estimates as a percentage of construction cost as follows:

- Residential/Suburban Low Density = 50% of construction cost
- Business/Suburban Low Density = 60% of construction cost
- New Signal Locations = 5% of construction cost

4.1 Short-Term Improvements

Short-term improvements consist of actions that are needed to correct existing deficiencies, are relatively low in cost and require minimal right-of-way. The following recommended permanent improvements fall within the category of short-term improvements:

Shop Road / Jefferson Park Road (Rte 630): One improvement that would be considered short-term is the placement of a new traffic signal at Shop Road and Jefferson Park Road to assist traffic accessing the Shop Road Gate. Fort Lee has opened the gate at Shop Road and Jefferson Park Road beginning in October 2006 due to the reconstruction of Sisisky Gate. Under current base plans, this gate will remain open as a permanent gate. VDOT is in process of evaluating the need for the signal based on current and project traffic volumes. Since Shop Gate is designated as the gate for construction vehicles to enter the base, traffic will increase at the gate as construction activities associated with BRAC expansion begin.

Hickory Hill Road (Rte 109): Capacity improvements to Hickory Hill Road between County Drive (US 460) and Mahone Avenue (Gate). The capacity improvements would include some roadway widening and the addition of turn lanes. This improve will require the acquisition of right of way.

Intersection #17, County Drive and Hickory Hill Road: Add a second westbound left turn lane on County Drive at the intersection. This improvement may require the acquisition of right-of-way.

Table 4-1 lists the short-term improvement recommendations and their associated estimated costs.

Table 4-1: Short-Term Roadway & Intersection Improvements

SHORT-TERM ROADWAY & INTERSECTION IMPROVEMENTS				
Prioritization	**Improvement Identifier**	**Location / Intersection**	**Improvement Description**	**Total Cost (in 2006 $)**
1	Intersection - Shop Road Gate	Jefferson Park Rd / Shop Rd Gate	Provide traffic signal for gate access during Sisisky Gate construction	270,000
2	Intersection - 17	County Dr / Hickory Hill Rd	Provide additional left turn lane from EB County Dr to Hickory Hill Rd	1,500,000*
3	Roadway - Hickory Hill	From Ft. Lee Mahone Gate to County Dr	Capacity improvements including widening and adding turn lanes	1,500,000*
Total Cost ($)				**3,260,000**

Cost Estimates were developed using 2006 VDOT Planning Level Cost Estimates for Richmond, Fredericksburg, Culpeper, Salem, Staunton
All construction costs are in 2006 dollars and do not represent future construction costs accounting for inflation.
* Estimates by VDOT Location and Design staff

4.2 Intermediate-Term Improvements

These projects or investments are needed to improve the existing level of efficiency and safety. These recommended improvements generally are significantly higher in cost than short-term improvements and in many cases, require right-of-way. The intermediate–term improvements are listed below and in Table 4-2 in priority based on the factors previously described. Projects also received higher priority that would better accommodate the temporary increase in construction vehicles expected accessing Fort Lee to construct infrastructure associated with BRAC.

Roadway Improvements

Oaklawn Boulevard (Rte 36): The road segment of Oaklawn Boulevard between Temple Avenue and Jefferson Park Road is currently a 5-lane roadway, 3 lanes westbound and 2 lanes eastbound. It is recommended to improve the eastbound direction by widening the roadway to three lanes. This improvement could use the center median in some places, but may require acquisition of right-of-way on the outside of the roadway.

Intersection Improvements

Although, installing traffic signals are recommended at some intersections below based on preliminary analysis from this study, VDOT does not install a traffic signal until it meets warrants for eight hours and is approved by the District Traffic Engineer. Recommended lane configurations for each intersection are shown in Figure 4-1.

Intersection #1, Temple Avenue and Puddledock Road: Add a second northbound left turn lane from northbound Puddledock Road to westbound Temple Avenue. Additional thru lanes should be added to the southbound, eastbound, and westbound approaches. It is suggested that these additional thru lanes have 500 feet of storage and 700 foot tapers both entering and exiting the intersection. Acquisition of right of way and replacement of existing signal are required for this project. Signal phasing and timing should be updated.

Intersection #4, Oaklawn Boulevard and Jefferson Park Road / Cousins Avenue: Add a second northbound left turn lane from northbound Jefferson Park Road to westbound Oaklawn Boulevard. Acquisition of right of way is required for this project. Signal modification will also be required.

Intersection #5, Oaklawn Boulevard and Temple Avenue: Split intersection into two separate signalized and coordinated intersections (5c & 5d). The northbound Sisisky Gate traffic and the northbound departing traffic along Temple Avenue would intersect Oaklawn Boulevard at the existing intersection. Westbound left turns into Fort Lee would also occur at the existing intersection. Southbound Temple Avenue traffic, however, would be realigned approximately 700 feet southwest of the existing intersection creating a new intersection on Oaklawn Boulevard. The original intersection would still require an additional westbound left, eastbound thru and free flow right turn lane, northbound left, northbound thru and a northbound, channelized, free-flow right. The new intersection would require only two southbound lefts and one additional eastbound thru. This improvement will require the acquisition of right-of-way. (See Figure 3-1)

Intersection #6, Oaklawn Boulevard and Lee Avenue / Hill Drive: Signal timing changes are recommended at this intersection. No other improvements are necessary.

Intersection #8, Jefferson Park Road and Middle Road: Install a traffic signal and add an additional northbound through lane on Jefferson Park Road. This improvement will require the acquisition of right-of-way.

Intersections #9 & #10, Jefferson Park Road / Allin Road / Adams Avenue / Bull Hill Road: These roadways should be realigned and tie into a single intersection where a roundabout will be constructed. The roadway realignment will require the acquisition of right-of-way.

Intersection #12, Option 1 of this intersection improvement requires roadway realignment for the creation of two separate intersections. Exclusive turn lanes are added to the eastbound and westbound approaches of each intersection. Separate left and right turn lanes are necessary for the northbound and southbound minor approaches. This improvement will require the acquisition of right-of-way and possibly a single residence. Additional study will be required to locate the best location for the two intersections to minimize impacts to residences and the environment.

Intersection #14, County Drive and Courthouse Road: Retime the traffic signal to provide additional time for critical westbound left-turn movement.

Intersection #18, Oaklawn Boulevard and River Road: Add a second turn lane from southbound River Road to Oaklawn Boulevard. Add a traffic signal at this intersection. This improvement may require the acquisition of right-of-way.

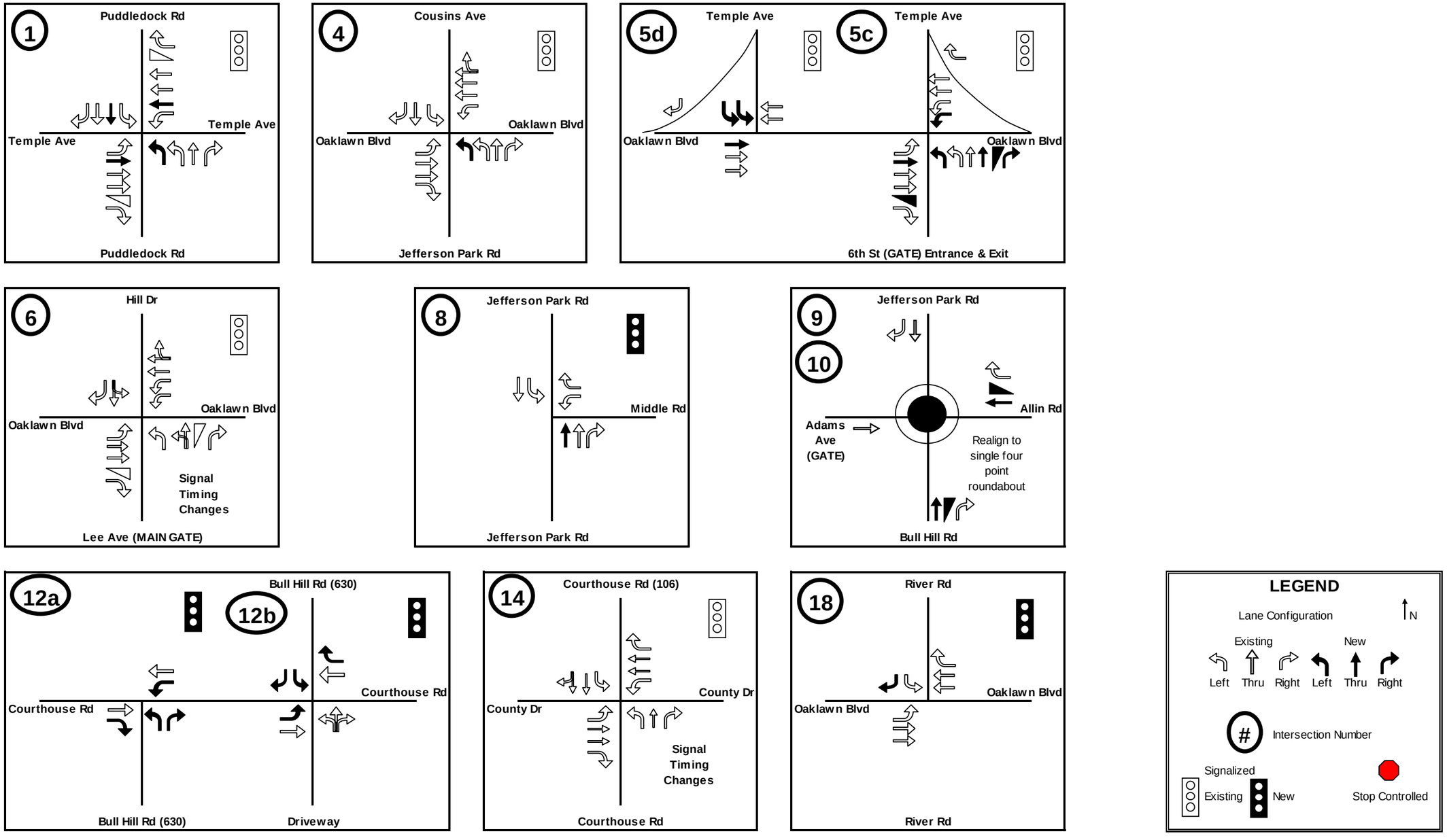
Most of these recommendations can be implemented individually. Recommendations 1, 2 and 3 from Table 4-2, however, would best be implemented as a package of improvements to this entire segment of Oaklawn Boulevard. Given the recommended design of Intersections 5C and 5D, it would be advisable to widen Oaklawn Boulevard from Temple Avenue to Jefferson Park Road at the same time. Furthermore, while widening Oaklawn Boulevard in this area it would also be advisable to improve Intersection #4 concurrently.

Table 4-2: Intermediate Roadway & Intersection Improvements

INTERMEDIATE ROADWAY & INTERSECTION IMPROVEMENTS				
Prioritization	**Improvement Identifier**	**Location / Intersection**	**Improvement Description**	**Total Cost (in 2006 $)**
1	Intersection - 5c & 5d	Temple Ave / Oaklawn Blvd	Provide new split intersection with signal, additional turn lanes, new roadway alignment,	3,500,000*
2	Roadway - Oaklawn Blvd	From Temple Ave to Jefferson Park Rd	Widen EB Oaklawn Blvd from 2 to 3 lanes	1,900,000*
3	Intersection - 4	Oaklawn Blvd / Jefferson Park Rd	Add turn lane at intersections and modify traffic signal	360,000*
4	Intersection - 1	Temple Ave / Puddledock Rd	Provide turn lanes, optimize signal phasing/timings at intersection	1,210,000
5	Intersection - 6	Oaklawn Blvd / Hill Dr / Lee Ave	Improve phasing or system, signalized intersections	10,000
6	Intersection - 18	Oaklawn Blvd / River Rd	Provide additional turn lane from SB River Rd to Oaklawn Blvd, Provide traffic signal	440,000
7	Intersection - 14	County Dr / Courthouse Rd	Improve phasing or system, signalized intersections	10,000
8	Intersection - 9-10 Option 3	Jefferson Park Rd / Allin Rd / Adams Ave / Bull Hill Rd	Realign roadways and provide roundabout at 4-leg intersection	1,470,000
9	Intersection - 8	Jefferson Park Rd / Middle Rd	Provide signal at unsignalized intersection and provide additional NB thru lane	510,000
10	Intersection - 12 Option 1	Courthouse Rd / Bull Hill Rd	Realign roadway to create split intersection with new traffic signals, add turn lanes, close existing intersection	2,760,000
Total Cost ($)				**12,170,000**

Cost Estimates were developed using 2006 VDOT Planning Level Cost Estimates for Richmond, Fredericksburg, Culpeper, Salem, Staunton
All construction costs are in 2006 dollars and do not represent future construction costs accounting for inflation.
* Estimates by VDOT Location and Design staff

Figure 4-1: Intermediate-Term Recommended Improvements



4.3 Long-Term Improvements

The following recommended long-term improvements include improvements aimed at addressing projected deficiencies for 2026. The long–term improvements are listed below and in Table 4-3 in priority based on the factors previously described.

Roadway Improvements

Middle Road (Rte 646): Add left and right turn lanes at all intersecting roads and major developments (existing and future) along Middle Road between Jefferson Park Road (Rte 630) and Takach Road (Rte 647). This improvement will require the acquisition of right-of-way.

Jefferson Park Road (Rte 630): Add left and right turn lanes at all intersecting roads and major developments (existing and future) along Jefferson Park Road from Middle Road (Rte 646) to Adams Avenue (Gate). This improvement will require the acquisition of right-of-way.

Intersection Improvements

Although, installing traffic signals are recommended at some intersections below based on preliminary analysis from this study, VDOT does not install a traffic signal until it meets warrants for eight hours and is approved by the District Traffic Engineer. Recommended lane configurations for each intersection are shown in Figure 4-2.

Intersection #7, Washington Street and Puddledock Road: Signal timing changes are recommended at this intersection. No other improvements are necessary.

Intersection #11, Courthouse Road and Allin Road: Signal timing changes are recommended at this intersection. No other improvements are necessary.

Intersection #13, Courthouse Road and Baxter Road: Install a traffic signal. No other improvements are needed. Minimal right of way may be required.

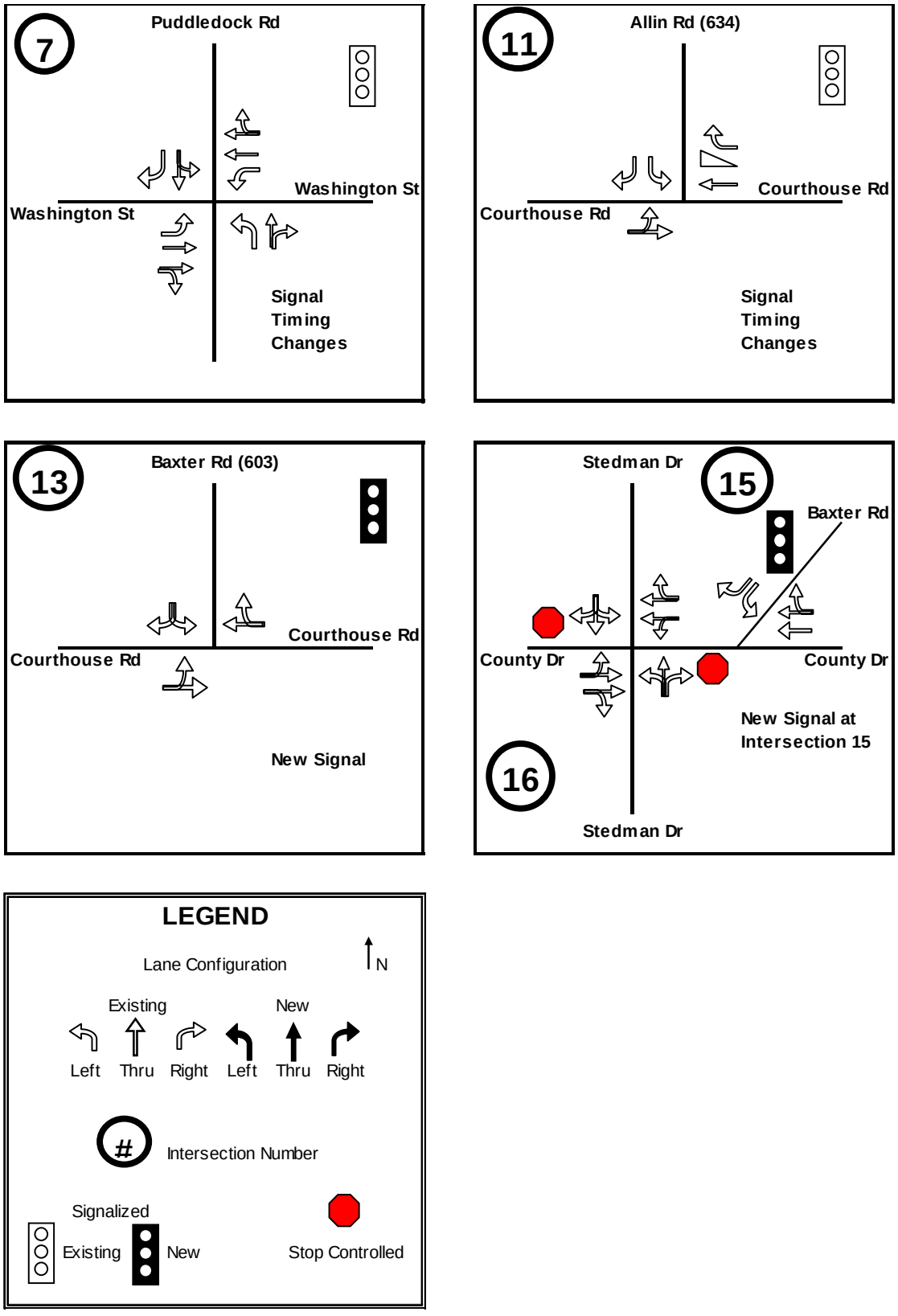
Intersection #15, County Drive and Baxter Road: Install a traffic signal. No other improvements are needed. Minimal right of way may be required.

Table 4-3: Long-Term Roadway and Intersection Improvements

LONG-TERM ROADWAY & INTERSECTION IMPROVEMENTS				
Prioritization	**Improvement Identifier**	**Location / Intersection**	**Improvement Description**	**Total Cost (in 2006 $)**
1	Intersection - 7	Washington St / Puddledock Rd	Improve phasing or system, signalized intersections	10,000
2	Intersection - 11	Courthouse Rd / Bull Hill Rd	Improve phasing or system, signalized intersections	10,000
3	Intersection - 15	County Dr / Baxter Rd	Provide signal at unsignalized intersection	270,000
4	Intersection - 13	Courthouse Rd / Baxter Rd	Provide signal at unsignalized intersection	270,000
5	Roadway - Jefferson Park Rd	From Middle Rd to Adams Ave	Widen Jefferson Park Rd - 1 lane used for turn lanes	1,990,000*
6	Roadway - Middle Rd	From Jefferson Park Rd to Takach Rd	Widen Middle Rd - 1 lane used for turn lanes	1,550,000*
Total Cost ($)				**4,100,000**

Cost Estimates were developed using 2006 VDOT Planning Level Cost Estimates for Richmond, Fredericksburg, Culpeper, Salem, Staunton
All construction costs are in 2006 dollars and do not represent future construction costs accounting for inflation.
* Estimates by VDOT Location and Design staff

Figure 4-2: Long-Term Roadway and Intersection Improvements



4.4 Funding Possibilities

In addition to the normal VDOT and MPO funding sources, two new funding possibilities exist for the projects recommended in this report. These include the Defense Access Road (DAR) Program and grant funding from the Virginia National Defense Industrial Authority. The following text describing the DAR program was taken from the Federal Highway Administration Website.

> The Defense Access Road (DAR) Program provides a means for the military to pay their fair share of the cost of public highway improvements necessary to mitigate an unusual impact of a defense activity. An unusual impact could be a significant increase in personnel at a military installation, relocation of an access gate, or the deployment of an oversized or overweight military vehicle or transporter unit.
>
> To initiate a DAR project, the local military base identifies the access or mobility needs and brings these deficiencies to the attention of the Military Surface Deployment and Distribution Command (SDDC). The Military Traffic Management Command (MTMC) will either prepare a needs evaluation or request the FHWA to make an evaluation, in accordance with 23 CFR, Part 660E, of improvements that are necessary, develop a cost estimate, and determine the scope of work. The FHWA will forward the needs evaluation to the MTMC for their review and the review of the appropriate military service. The MTMC will determine if the proposed work/project/improvements are eligible for DAR funds and certify the road as important to the national defense. Then the military service requests funding for the project through their normal budgeting process. Once the funds are provided by Congress, they are transferred to FHWA and allocated to the agency administering the project. Title 23 Federal-aid procedures are followed in the design and construction of the project.

Fort Lee has begun the process to request DAR funding for many of the recommended projects.

The Virginia National Defense Industrial Authority (VNDIA) was created during the 2005 Session of the Virginia General Assembly with the goal to support the mission and transformation of Virginia-based, U.S. Military and National Defense activities, collaborating with Virginia communities to identify and maximize opportunities that meet the current and future needs of the military, local partners and related industries. One way the VNDIA supports

its mission is through the Military Strategic Response Fund. Below is a description of the fund from the VNDIA website:

> Established during the 2006 Session of the Virginia General assembly to… *"Assist impacted Virginia localities in funding needs associated with the implementation and response to the recommendations of the 2005 Base Realignment and Closure Commission (BRAC) which were subsequently agreed to by the President and the United States Congress."* -Virginia Budget Bill 2006
>
> Grant funds will be made available on a reimbursement basis to eligible organizations through a competitive application process. Projects must be fully supported by local governing bodies. Qualified activities include planning and implementation efforts in the areas of transportation, housing, public infrastructure, environmental issues, encroachment, workforce transition, and historic preservation.

The Crater Planning District Commission applied for grant funds in November of 2006 for $1.5 million to be used for the capacity improvements to Hickory Hill Road and the improvements to the Hickory Hill/County Drive intersection. Only $750,000 of the requested money was granted to the Crater PDC. Additional grant funds will be requested in the next cycle of grant applications due Spring of 2007.

4.5 Other Recommendations

In addition to the identified intermediate and long-term recommendations, there are several other measures that VDOT and the local jurisdictions can implement. Some of these measures are standard practice for VDOT and the local jurisdictions and should continue on an ongoing basis. Additional measures recommended include:

- Focus on the management of access to developed land to ensure efficient traffic flow and minimize hazards. As redevelopment occurs, VDOT and the localities should look for opportunities to eliminate access points, consolidate driveways and provide inter-parcel connections. The capacity and safety of study area roadways can be preserved with good access management.
- Turn lanes should be provided at all intersecting roadways and entrances to large developments.
- Traffic impact studies should also be required for new developments and rezonings.
- Preserve right-of-way for planned improvements.
- Encourage Fort Lee and other employees to develop and expand travel demand management practices such as carpooling, flextime, and telecommuting.

- Improve and promote transit service in the region and to Fort Lee. Educate the public and particularly federal employees on the federal Transportation Incentive Program, which reimburses federal employees for using transit.
- Look for opportunities for park and ride lots.

4.6 Conclusion

This study provides VDOT, the local jurisdictions in the study area, and Fort Lee with a tool to help advance projects in VDOT's Six-Year Construction Plan and to obtain needed right-of-way and roadway improvements when properties within the study area develop or redevelop.
The analysis conducted for this study indicates that the major roadway and intersection improvements are needed to handle the increased traffic volumes associated with changes to Fort Lee operations outlined by BRAC. A total of $3.3 million in short-term improvements, $12.2 million in intermediate-term improvements, and an additional $4.1 million in long-term improvements is needed. These construction costs are in 2006 dollars and do not represent future construction costs accounting for inflation.

The next step in the planning process is for local jurisdiction and State officials to determine which projects warrant inclusion into VDOT's Six-Year Plan, and which can be funded locally or by other means. Once the projects are advanced, they will require environmental clearance, and in some cases additional traffic analysis. In the meantime, as development continues to occur, VDOT and the local jurisdictions should take steps to ensure that the appropriate right-of-way be preserved or donated in order to accommodate future planned improvements. The successful implementation of these projects will require political support and in-depth planning and design due to the need for the acquisition of right-of-way and anticipated construction costs.

This study also looked at options to improve connectivity between the north and south sections of Fort Lee currently separated by Route 36. The analysis indicates that rerouting Route 36 alone will not solve the traffic problems associated with BRAC expansion. Actually, the rerouting of traffic will create additional traffic problems along Puddledock Road and Temple Avenue. The estimated cost of providing acceptable levels of service on study area roadways with the rerouting of Route 36 is almost $41 million more than leaving Route 36 on Oaklawn Boulevard through the base.

An overpass over Route 36 would be a better means of providing connectivity between sections of Fort Lee without the adverse traffic impacts and high construction costs. The analysis shows that adding an overpass is an independent decision for Fort Lee and has little

impact upon the traveling public and local jurisdictions. Adding an overpass would cost approximately $4.92 million. The decision by Fort Lee of whether to pursue the rerouting of Route 36 or an overpass should incorporate issues and considerations other than solving the study area's traffic problems. Any pursuit of these options should explore the use of Defense Access Road Program funds.

APPENDIX