TRAFFIC TECHNICAL REPORT

for

Environmental Documentation for Route 28 Corridor

Prepared for:

Prince William County
Department of Transportation

May 22, 2019

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1. Introduction

1.1 Project Background

This technical report was prepared in support of the development of environmental documentation for improvements in the VA Route 28 Corridor between Sudley Road in Prince William County and Compton Road in Fairfax County. Specific efforts that are described in this document (both methodology and findings) include the following:

- Data collection: traffic counts (both roadway segments and intersections), peak period travel times, crash history, and Streetlight Data (anonymized data collected from smartphone apps and navigation GPS data).
- Travel demand forecasting for the year 2040 using the Prince William County Travel Demand Model 2016 Version 2.4 and Metropolitan Washington Council of Governments (MWCOG) Round 8.4 Cooperative Forecasts for regional population and employment.
- Traffic operations analysis for existing conditions (2018) and the analysis year (2040) for No Build conditions as well as three build alternatives -- Alternatives 2A, 2B, and 4 from the December 2017 *Route 28 Corridor Feasibility Study*.

Alternatives 2A, 2B, and 4, were the three highest ranked alternatives in the Feasibility Study based on criteria that included planning level costs, project benefits, and environmental and right of way impacts.

- Alternative 2A would extend Godwin Drive north from the existing Godwin Drive/Sudley Road intersection, then turn east along the south side of Bull Run until joining existing Centreville Road. Centreville Road would be widened from this point north to tie into widening of Centreville Road planned by Fairfax County.
- Alternative 2B would follow the same alignment as Alternative 2A until reaching a point near Old Centreville Road, where it would turn northward and cross Bull Run at the existing crossing of Old Centreville Road, and tie into existing Centreville Road north of Bull Run where it would meet the Centreville Road widening planned by Fairfax County.
- Alternative 4, would widen existing Centreville Road on the existing alignment between Liberia Avenue and the Fairfax County/Prince William County Line.

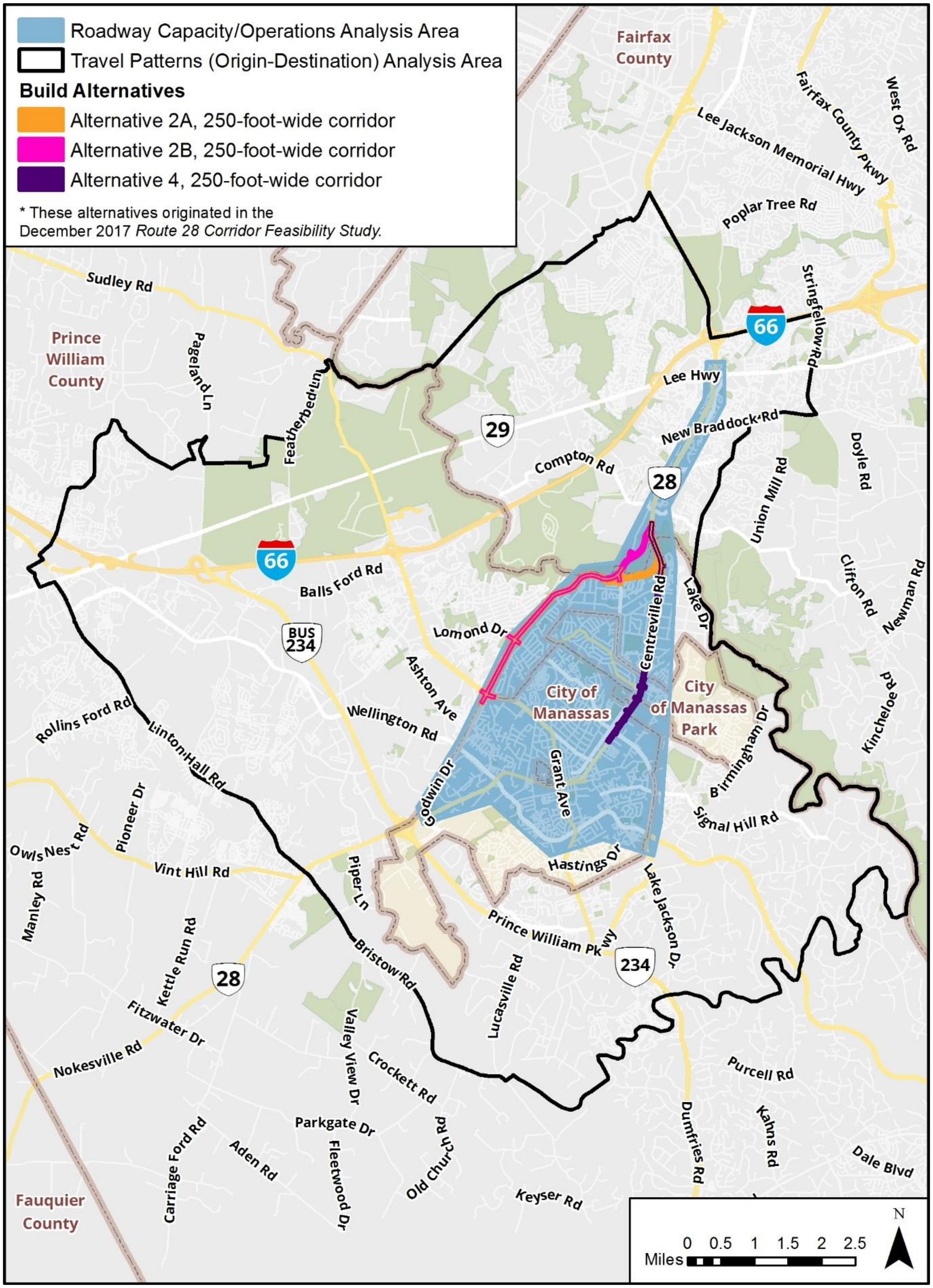
The analysis described in this report builds on previous studies of the Route 28 corridor, including the December 2017 *Route 28 Corridor Feasibility Study* and the September 2015 *Route 28 Corridor Safety and Operations Study*.

1.2 Study Area

The analysis described in the report covers two geographic scales. **Figure 1.2-1** shows the boundaries for both of these analysis scales.

- Roadway Capacity/Operations Analysis Area: The effects of changes in traffic patterns between the No Build Alternative and the three build alternatives is covered by this geographic area that encompasses the major roadways where traffic volumes are most affected by the proposed project; these include Route 28, Godwin Drive, Old Centreville Road, Liberia Avenue, Wellington Road, and Mathis Avenue.
- Travel Patterns (Origin-Destination [OD]) Analysis Area: This report also provides a summary of travel patterns (trip origins and destinations) at a larger scale than was used for the traffic analyses. This larger analysis area encompasses portions of Prince William County, the City of Manassas, the City of Manassas Park, and Fairfax County.

Figure 1.2-1. Map of Study Areas



2. Existing Conditions

2.1 Traffic Data Collection

Traffic data to support the analysis described in this report was compiled from previous studies of the Route 28 corridor (including the December 2017 *Route 28 Corridor Feasibility Study* and the September 2015 *Route 28 Corridor Safety and Operations Study*) as well as counts available from various land development traffic impact analysis (TIA) studies and counts performed specifically for this study. These count sets include roadway segment machine counts (covering 48-hour periods) as well as peak period intersection turning movements counts.

2.1.1 Roadway Segment Machine Counts

Table 2.1-1 provides a list of the seven roadway segment machine counts performed for this study along with the locations of fourteen machine counts from the December 2017 *Route 28 Corridor Feasibility Study*. These locations are shown graphically in **Figure 2.1-1**.

Table 2.1-1. Machine Count Locations

Roadway Segment	Source (Year Collected)
Godwin Drive south of Route 234	2018 counts
Route 28 south of Ordway Road	2018 counts
Route 28 south of New Braddock Road	2018 counts
Prince William Parkway east of Liberia Ave	2018 counts
Route 234 Business	2018 counts
Route 28 (Center Street) west of Grant Avenue	2018 counts
Route 28 (Church Street) east of Grant Avenue	2018 counts
Albemarle Drive north of Yorkshire Lane	*Route 28 Corridor Feasibility Study* (2016)
Alleghany Road south of Agate Court	*Route 28 Corridor Feasibility Study* (2016)
Amherst Drive between Lomond Drive and Allegheny Road	*Route 28 Corridor Feasibility Study* (2016)
Boundary Avenue north of June Street	*Route 28 Corridor Feasibility Study* (2016)
Bull Run Road north of Yorkshire Lane	*Route 28 Corridor Feasibility Study* (2016)
Compton Road north of Upper Occoquan Water Treatment	*Route 28 Corridor Feasibility Study* (2016)
Garrison Road between June Street and Boundary Avenue	*Route 28 Corridor Feasibility Study* (2016)
Godwin Drive at Sudley Road	*Route 28 Corridor Feasibility Study* (2016)
Godwin Drive at Route 28	*Route 28 Corridor Feasibility Study* (2016)
I-66 near Compton Road Crossing	*Route 28 Corridor Feasibility Study* (2016)

Table 2.1-1. Machine Count Locations

Roadway Segment	Source (Year Collected)
June Street between Garrison Road and Bull Run Road	*Route 28 Corridor Feasibility Study* (2016)
Lomond Drive between Victoria Street and Manassas Drive	*Route 28 Corridor Feasibility Study* (2016)
Parkland Street west of Old Centreville Road	*Route 28 Corridor Feasibility Study* (2016)
Yorkshire Lane west of Old Centreville Road	*Route 28 Corridor Feasibility Study* (2016)

2.1.2 Intersection Turning Movement Counts

Intersection turning movement counts were performed at 19 locations in May 2018; this data was supplemented by four intersection turning movement counts from the September 2015 *Route 28 Corridor Safety and Operations Study* and three turning movement counts from the December 2017 *Route 28 Corridor Feasibility Study*. The locations of these turning movement counts are listed in **Table 2.1-2** and pinpointed graphically in **Figure 2.1-1**. As noted previously, the full traffic data set for this analysis effort also included counts from various land development TIA studies from Prince William County and the City of Manassas.

Table 2.1-2. Intersection Turning Movement Count Locations

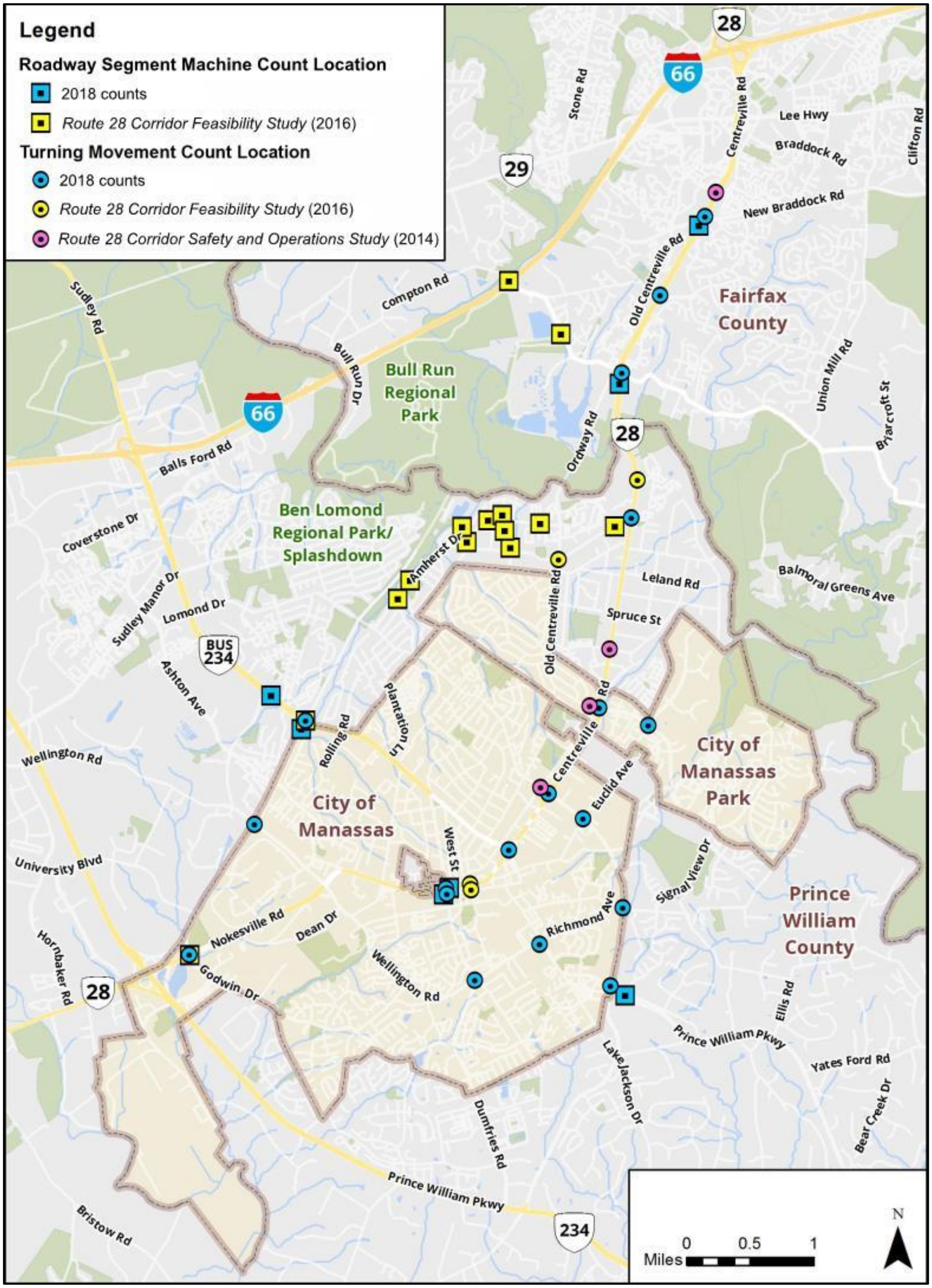
Intersection	Source (Year Collected)
Route 28 and Machen Road	*Route 28 Corridor Safety and Operations Study* (2014)
Route 28 and New Braddock Road	2018 counts
Route 28 and Green Trails Boulevard / Old Mill Road	2018 counts
Route 28 and Compton Road / Ordway Road	2018 counts
Route 28 and Orchard Bridge Drive	*Route 28 Corridor Feasibility Study* (2016)
Route 28 and Yorkshire Lane	2018 counts
Old Centreville Road and Yorkshire Lane	2018 counts
Route 28 and Maplewood Drive	*Route 28 Corridor Safety and Operations Study* (2014)
Route 28 and Manassas Drive	2018 counts
Mathis Avenue and Manassas Drive	*Route 28 Corridor Safety and Operations Study* (2014)
Euclid Avenue and Manassas Drive	2018 counts
Route 28 and Liberia Avenue	2018 counts
Mathis Avenue and Liberia Avenue	*Route 28 Corridor Safety and Operations Study* (2014)
Euclid Avenue and Liberia Avenue	2018 counts

Table 2.1-2. Intersection Turning Movement Count Locations

Intersection	Source (Year Collected)
Route 28 and Sudley Road / Prescott Avenue	2018 counts
Route 28 (Center Street) and Main Street	*Route 28 Corridor Feasibility Study* (2016)
Route 28 (Church Street) and Main Street	*Route 28 Corridor Feasibility Study* (2016)
Route 28 (Center Street) and Grant Avenue	2018 counts
Route 28 (Church Street) and Grant Avenue	2018 counts
Route 28 and Godwin Drive	2018 counts
Wellington Road and Godwin Drive	2018 counts
Sudley Road and Godwin Drive	2018 counts
Liberia Avenue and Signal Hill Road	2018 counts
Wellington Road and Grant Avenue	2018 counts
Wellington Road and Fairview Avenue	2018 counts
Wellington Road and Prince William Parkway and Liberia Avenue	2018 counts

The full range of traffic counts from the various sources allowed for the development of a data set that supported traffic operations analysis over a wide area. Counts collected prior to 2018 were adjusted to reflect a common analysis year of 2018 based on analysis of traffic changes at locations were traffic was collected for both a prior year and 2018 as well as annual VDOT count data sets. The analysis results described in **Section 2.2** reflect this common analysis year of 2018 (the adjustment to reflect 2018 traffic volumes is also described in **Section 2.2**). For reference purposes, the full set of traffic counts compiled and utilized for this study is listed and included in **Attachment A**.

Figure 2.1-1. Machine Count and Intersection Turning Movement Count Locations



2.1.3 Travel Time Runs

In addition to traffic counts, travel time runs were conducted along six routes in the Roadway Capacity/Operations Analysis area. For the travel time runs, prevailing travel times and speeds were collected on major roadway corridors using the floating car technique whereby the vehicle collecting the time and speed data travels at the prevailing speed of surrounding traffic. Three runs were conducted in each direction along the six travel time routes described below.

- Travel Time Route 1 is along Route 28 (Nokesville Road, Center Street, Church Street, Zebedee Street, Centreville Road) from Hornbaker Road to the south and Route 29 to the north.
- Travel Time Route 2 is along Godwin Drive from Route 28 (Nokesville Road) to the south and Route 234 (Sudley Road) to the north.
- Travel Time Route 3 is Mathis Avenue from Route 234 (Sudley Road) to the south and Manassas Drive to the north.
- Travel Time Route 4 is along Old Centreville Road from the intersection with Route 28 (Centreville Road) to the south and the Compton Road intersection to the north.
- Travel Time Route 5 is along Prince William Parkway from Moore Drive to the south up to Wellington Road and then continues along Liberia Avenue to Route 28 (Centreville Road) to the north.
- Travel Time Route 6 is along Prince William Parkway from Moore Drive to the south up to Liberia Avenue and then continues along Wellington Road to Route 28 (Nokesville Road) to the north.

For a map of the six travel time routes and maps of the average speeds along the routes in the AM and PM peaks, see **Attachment B**. The maps of the average speeds along routes are compared with the posted speed limit in the segments to designate each segment as having an average speed that is: greater than 75% of the speed limit, between 50% and 75% of the speed limit, and less than 50% of the speed limit.

2.1.4 Crash Analysis Data

Crash data was obtained from the Virginia Department of Motor Vehicles Commonwealth of Virginia Traffic Records Electronic Data System (TREDS). Data from January 1, 2014 to December 31, 2017 (covering four full years) was obtained from TREDS for Route 28 in Prince William County, Manassas City, Manassas Park City, and Fairfax County.

2.2 Operations Analysis

2.2.1 Level of Service Results

The existing AM and PM peak hour volumes at the 26 intersections within the study area, as listed in Section 2.1.2, were developed using the turning movement counts that were conducted as a part of this study and the 2014 and 2016 studies. The peak hour approach volumes at each study intersection, as well as the associated turning movement volumes, are contained in **Attachment C**.

For existing conditions, results are based on 2018 (or factored 2014/2016) count data. Seven of the 26 intersections were counted in 2014 or 2016. The counts for these locations were projected to the year 2018 by using a 1% yearly growth rate. This growth rate was developed using a process of calculating the growth rates for each intersection with count data from varying years. A comprehensive review of the full data set (comprised of counts performed for this study in 2018 as well as data from the 2017 *Route 28 Corridor Feasibility Study*, 2015 *Route 28 Corridor Safety and Operations Study,* and data from various land development TIA studies) indicated generally positive, but also relatively low, year-on-year growth rates between 2015 and 2018. Based on this analysis, a 1% yearly growth rate was assumed. The turning movement volumes were projected to the year 2018 using a Fratar-based methodology[1].

Existing year traffic operations were analyzed using Synchro (Version 10.1) and reflected 2018 traffic data and roadway geometrics. After importing the volumes to Synchro, the signals were optimized. There are three signal networks (A, B, and Z) to which various intersections are grouped in. The cycle lengths for those networks were optimized together, while the cycle lengths and splits for the stand-alone intersections were optimized separately. See **Attachment D** for the Synchro Reports for existing AM and PM level of service (LOS). LOS provides a "grading" of the operations of roadway segments and junctions (intersection and interchanges) using a scale from A to F, with A representing excellent traffic flow with minimal delays and F representing high level of delay. **Table 2.2-1** below summarizes the ranges of delay associated with each level of service grade.

Table 2.2-1. Level of Service (LOS) Criteria

Level of Service (LOS)	Signalized Intersections (sec/veh)
A	<= 10
B	> 10 – 20
C	> 20 – 35
D	> 35 – 55
E	> 55 – 80
F	> 80

The maps in **Figure 2.2-1 and 2.2-2** on the following pages show the LOS for each study intersection in the existing AM and PM peak.

[1] Using a four-zone trip table (each zone representing a leg of a conventional four-leg intersection), the Fratar technique proportions future trips to/from each leg of the intersection as a function of the growth in trips entering and exiting the intersection for each leg. The growth entering and exiting the intersection is the ratio between existing volumes and those calculated using the 1% annual growth rate.

Figure 2.2-1. Existing AM Peak LOS Results

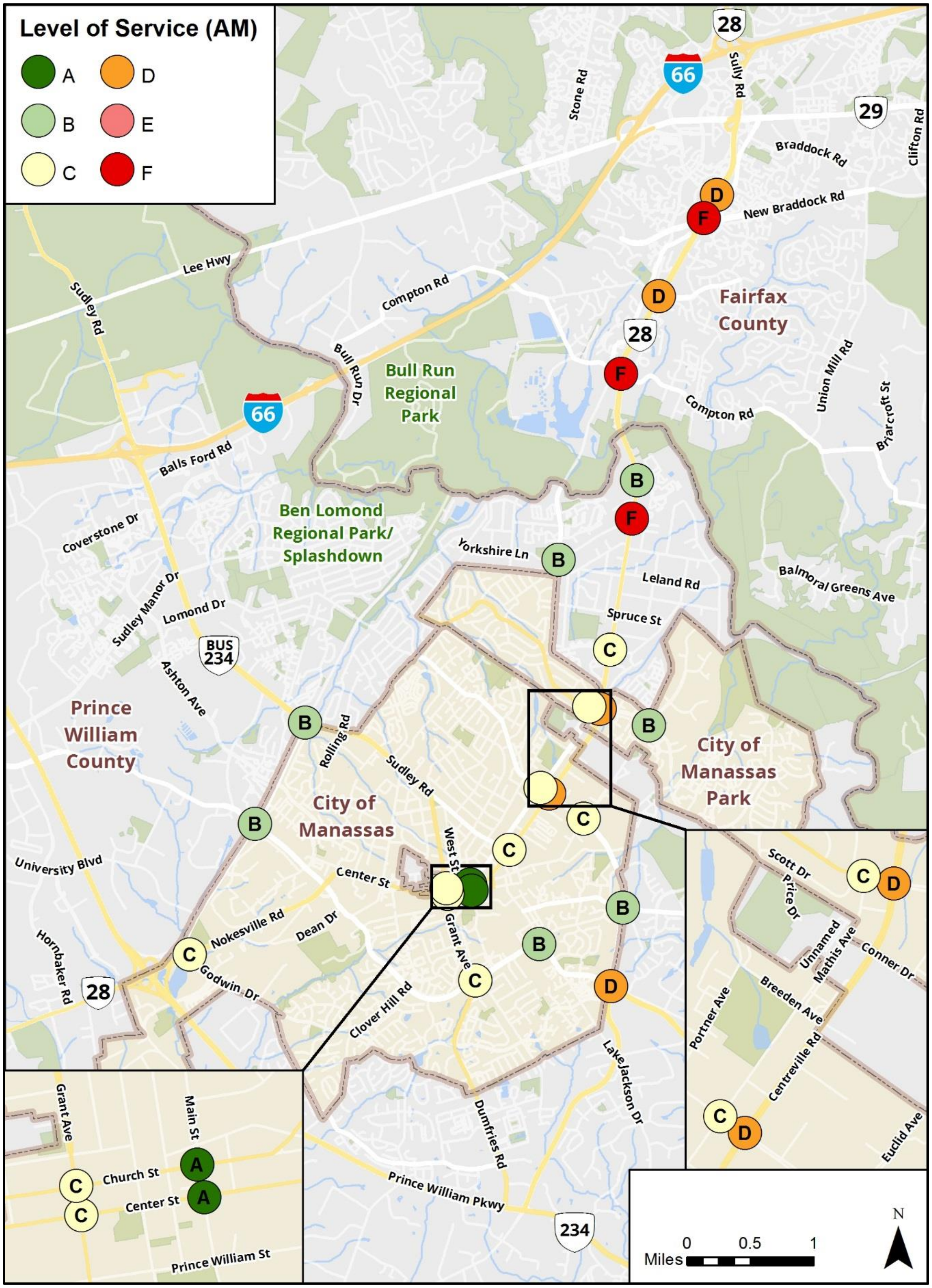
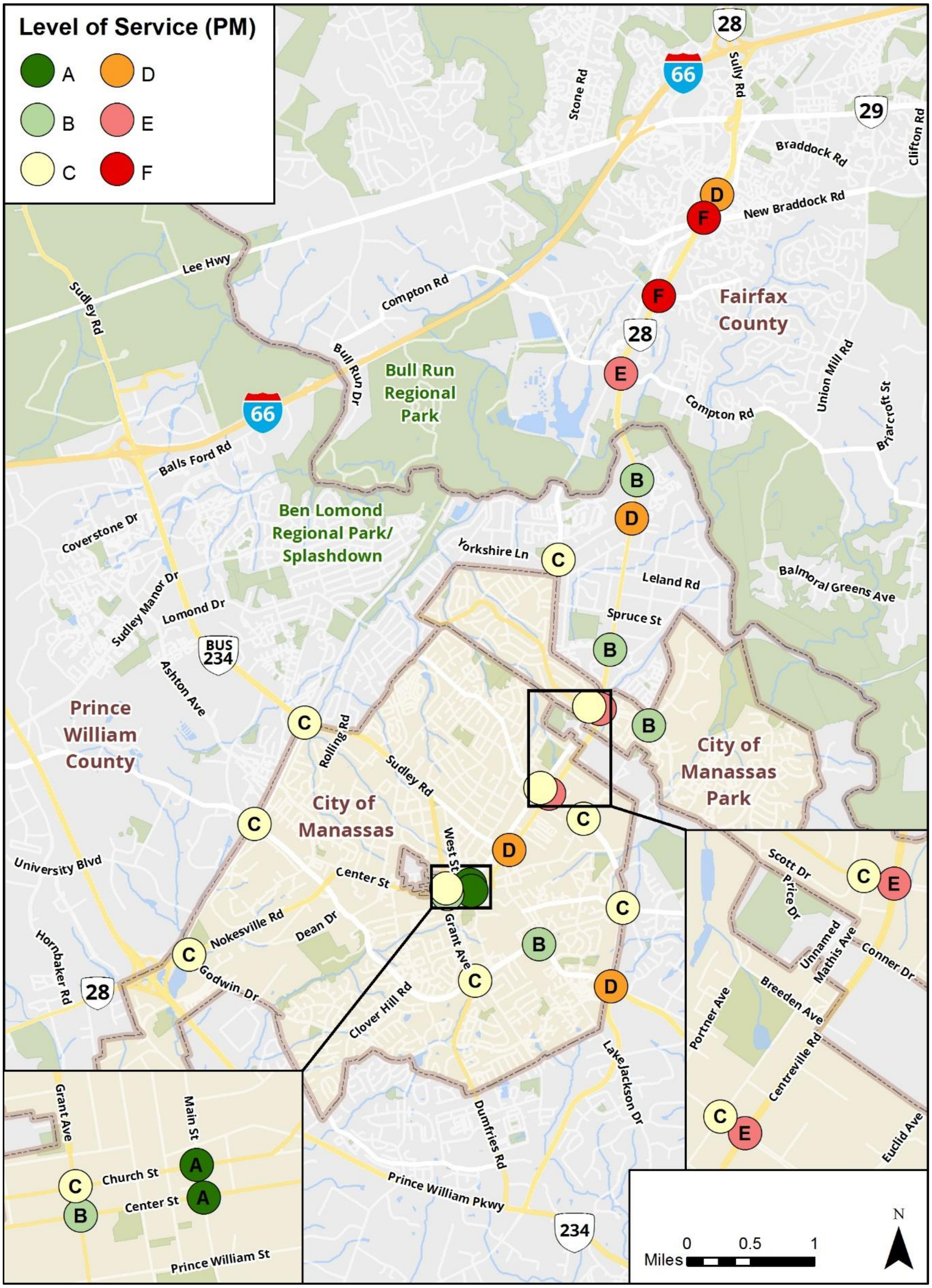


Figure 2.2-2. Existing PM Peak LOS Results



2.2.2 Travel Time Results

For Travel Time Route 1 (Route 28), the majority of the segments with speeds that are less than 50% of the speed limit in the peak travel periods occur in the northbound direction in the AM and in the southbound direction in the PM, representing the peak direction of traffic. General observations relative to the travel time data include:

- For Travel Time Route 2 (Godwin Drive), the speeds are less than 50% of the speed limit between Wellington Road and Ashton Avenue in both the AM and PM peaks in both directions.
- For Travel Time Route 3 (Mathis Avenue), the speeds are less than 50% of the speed limit near the Sudley Road intersection in the AM northbound direction and near the Liberia Avenue intersection in the PM southbound direction.
- For Travel Time Route 4 (Old Centreville Road), the speeds are less than 50% of the speed limit north of Spruce Street in both directions in the AM while in the PM peak, the speeds are less than 50% of the speed limit in the southbound direction north of Spruce Street.
- For Travel Time Route 5 (Liberia Avenue), the speeds are less than 50% of the speed limit at the intersection with Prince William Parkway and Wellington Road in the AM peak while the speeds are less than 50% of the speed limit at the intersection with Route 28 for the PM peak.
- For Travel Time Route 6 (Wellington Road), the speeds are less than 50% of the speed limit at the Grant Avenue and Prince William Parkway/Liberia Avenue intersections in the southbound direction in the AM peak. The speeds are less than 50% of the speed limit in the PM peak at the Grant Avenue intersection in the southbound direction and at the Prince William Parkway/Liberia Avenue intersection in both directions.

See **Attachment B** for graphical representations of these findings.

2.2.3 Crash Analysis Data Results

For the four-year period from January 1, 2014 to December 31, 2017, there were a total of 1,217 crashes, 1,035 injuries, and 2 fatalities on Route 28 between the Prince William Parkway (Prince William County) and Lee Highway (Fairfax County). As **Table 2.2-2** below shows, the number of crashes increased from 2014 to 2015/2016 and then decreased in 2017.

Table 2.2-2. Crash Data Summary

	Property Damage	Injury	*# of Injuries*	Fatal	*# of Fatalities*	Total Crashes
2014	143	151	*238*	0	*0*	**294**
2015	162	163	*255*	0	*0*	**325**
2016	140	184	*316*	0	*0*	**324**
2017	147	125	*226*	2	*2*	**274**
Total	**592**	**623**	*1035*	**2**	*2*	**1217**

Source: TREDS, Commonwealth of Virginia - DMV

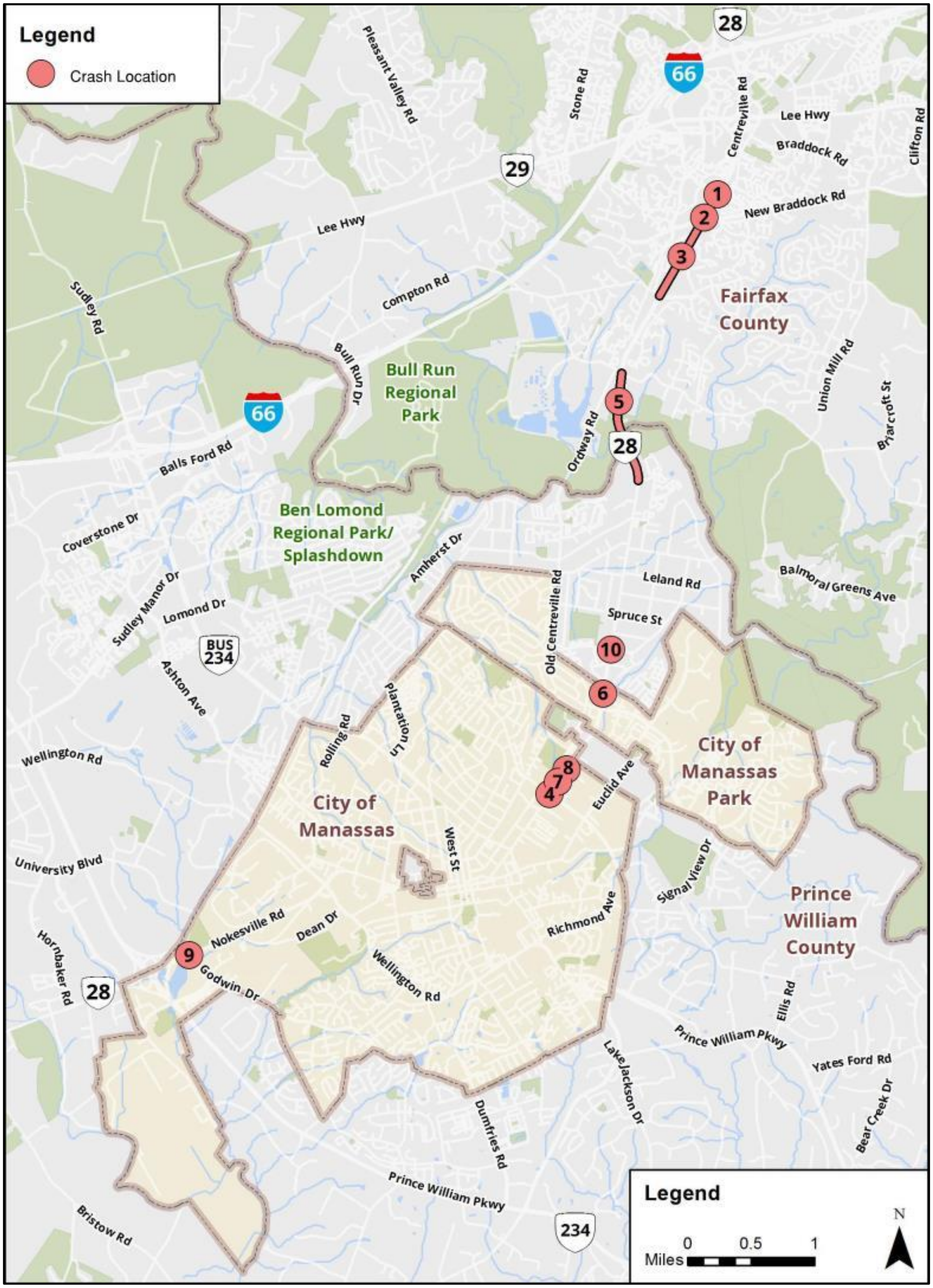
The Route 28 intersections with the highest number of crashes from 2014 to 2017 are at Machen Road, New Braddock Road, Liberia Avenue, and Old Centreville Road/Blooms Quarry Lane. In addition to these intersections, the following stretches of Route 28 between intersections experienced a relatively high number of crashes: between New Braddock and Green Trails Boulevard/Old Mill Road; and between Ordway Road/Compton Road and Orchard Bridge Drive. **Table 2.2-3** below highlights the top 10 locations and lists them in order from highest to lowest number of crashes. Note that the table below does not include every intersection or roadway segment along Route 28 and only shows the locations with the highest number of crashes. See **Figure 2.2-3** for a map of these locations.

Table 2.2-3. Key Location Crash Data

Location	*Key Map # (Figure 2.2-3)*	Number of Crashes 2014 to 2017	Crash Rate	Crash Severity
Route 28 and Machen Road	***1***	66	2.94	5.78
Route 28 and New Braddock Road	***2***	62	2.19	72.47
Route 28 between Braddock Road and Green Trails Boulevard	***3***	57	2.85	8.44
Route 28 and Liberia Avenue	***4***	45	2.42	72.90
Route 28 between Ordway/Compton Road and Orchard Bridge Road	***5***	44	2.54	67.86
Route 28 and Old Centreville Road / Blooms Quarry Lane	***6***	40	2.00	40.25
Route 28 and Kincheloe Drive	***7***	36	3.42	63.60
Route 28 and Phoenix Drive	***8***	35	3.44	71.29
Route 28 and Godwin Drive	***9***	33	2.35	49.88
Route 28 and Maplewood Drive	***10***	31	1.60	22.68

Sources: TREDS, Commonwealth of Virginia – DMV; 2017 VDOT Traffic Data Publications; Turning Movement Counts from 2014 VDOT Study

Figure 2.2-3. Map of Key Locations – Crash Data



2.3 OD Data Analysis

Advances in technology provide transportation planners with new data sets that can be used to better understand travel patterns. For the analysis described below, data sets from StreetLight Data were obtained and analyzed to develop a generalized picture of travel patterns in the vicinity of the proposed project. StreetLight Data provides anonymized data collected from smartphone apps and navigation GPS data to support this analysis. The data used for the analysis described below covered a full year from April 2017 to March 2018, excluding summer months[2]. The area covered by the analysis is shown in **Figure 1.2-1**; this area is bordered by Linton Hall Road to the west, Featherbed Lane to the north, Stringfellow Road to the east, and Lee Jackson Drive to the south. Within this area, geographic zones and external points where both major and minor roadways cross the analysis area boundaries were defined, thereby allowing for a tabulation of where trips start and end both within the area and beyond.

The geographic zones are shown in **Figure 2.3-1** and described below.

- G1 – West: Area bounded I-66 to the north, VA 619 (Litton Hall Road) to the west, Wellington Road to the east, and Route 28 (Nokesville Road) to the south.
- G2 – Mid-Central: Area east of Wellington Road and south of I-66, north of City of Manassas.
- G3 – Manassas/Southeast: includes City of Manassas south of the railroad line and Prince William County down to Broad Run. Bounded to the west by Route 234.
- G4 – Southwest: includes area bounded by VA 619 (Bristow Road) and Broad Run to the west and south, Route 28 (Nokesville Road) to the north, and Route 234 to the east.
- G5 – Central: Includes the City of Manassas north of the railroad line and Prince William County areas immediately to the north, generally bounded to the north by Rixlew Lane and Lomond Drive and Bull Run.
- G6 – Fairfax County Route 28 and I-66: Includes the area bounded by I-66, Stone Road and Westfields Boulevard to the north, Route 28 (Sudley Road) and VA 645 (Stringfellow Road) to the east, and VA 620 (New Braddock Road) and Little Rocky Run to the south/east.
- G7 – North of I-66: Includes the area bounded by I-66 to the south, Stone Road to the east, Catharpin Road to the west, and, to the north, a line generally running from Catharpin Road where it crosses Catharpin Creek extending to Route 28 (Sully Road) where it crosses Flatlick Branch in Fairfax County.

External points are also shown in **Figure 2.3-1** and listed below:

X1 Bristow Road (VA 619)
X2 Valley View Drive
X3 Nokesville Road (VA 28)
X4 Braemar Parkway
X5 Sudley Manor Drive
X6 Worthington Drive
X7 Rollins Ford Road
X8 Glenkirk Road

[2] Months covered include April 2017, May 2017, September 2017, October 2017, November 2017, December 2017, January 2018, February 2018, and March 2018.

X9	Whitney Road
X10	Lee Highway (US 29)
X11	John Marshall Highway (VA 55)
X12	I-66 West
X13	Heathcote Boulevard
X14	Catharpin Road
X15	Artemus Road
X16	Pageland Lane
X17	Sudley Road North
X18	Bull Run Post Office Road
X19	Pleasant Valley Road
X20	Braddock Road
X21	Stonecroft Boulevard
X22	Westfields Boulevard
X23	Walney Road
X24	I-66 East
X25	Lee Highway (US 29)
X26	Braddock Road East
X27	Compton Road
X28	Yates Ford Road
X29	Davis Ford Road (VA 663)
X30	Prince William Parkway (VA 294)
X31	Dumfries Road (VA 234)

For tabulation purposes, external points have also been grouped as follows:

- External points 3 through 12 are grouped as the West Externals
- External points 21 through 27 are grouped as the East Externals
- External points 28 through 31 as well as 1 and 2 are grouped as the South Externals
- External points 13 through 20 are grouped as North Externals

Tables 2.3-1 through 2.3-3 show the distribution of trips from each of the geographic zones and external points to all of the others for the AM, Mid-Day, and PM peak hours. The tables are color-coded so that low levels of interaction from one to another are shown in blue while high levels of interaction are shown in red. The gradient color-coding is used to facilitate comprehension and give perspective of the lower values, middle values, and higher values[3]. It is important to note that the data does not represent just commuting trips; it represents all trips that take place during the three time periods that are reported. It is also important to recognize that the tables summarize the percentages of total traffic from one location to another.

[3] Values in the cells with no color in Tables 2.3-1 to 2.3-3 represent the midpoints (or 50th percentile) between the lowest and highest values in the table as a whole. The gradient from no color to the deepest value of the color indicates how far the value in each cell diverges from this midpoint with the deepest blue representing the lowest value in the table and the deepest red the highest value.

Figure 2.3-1. Map of Geographic Zones and External Points for OD Analysis

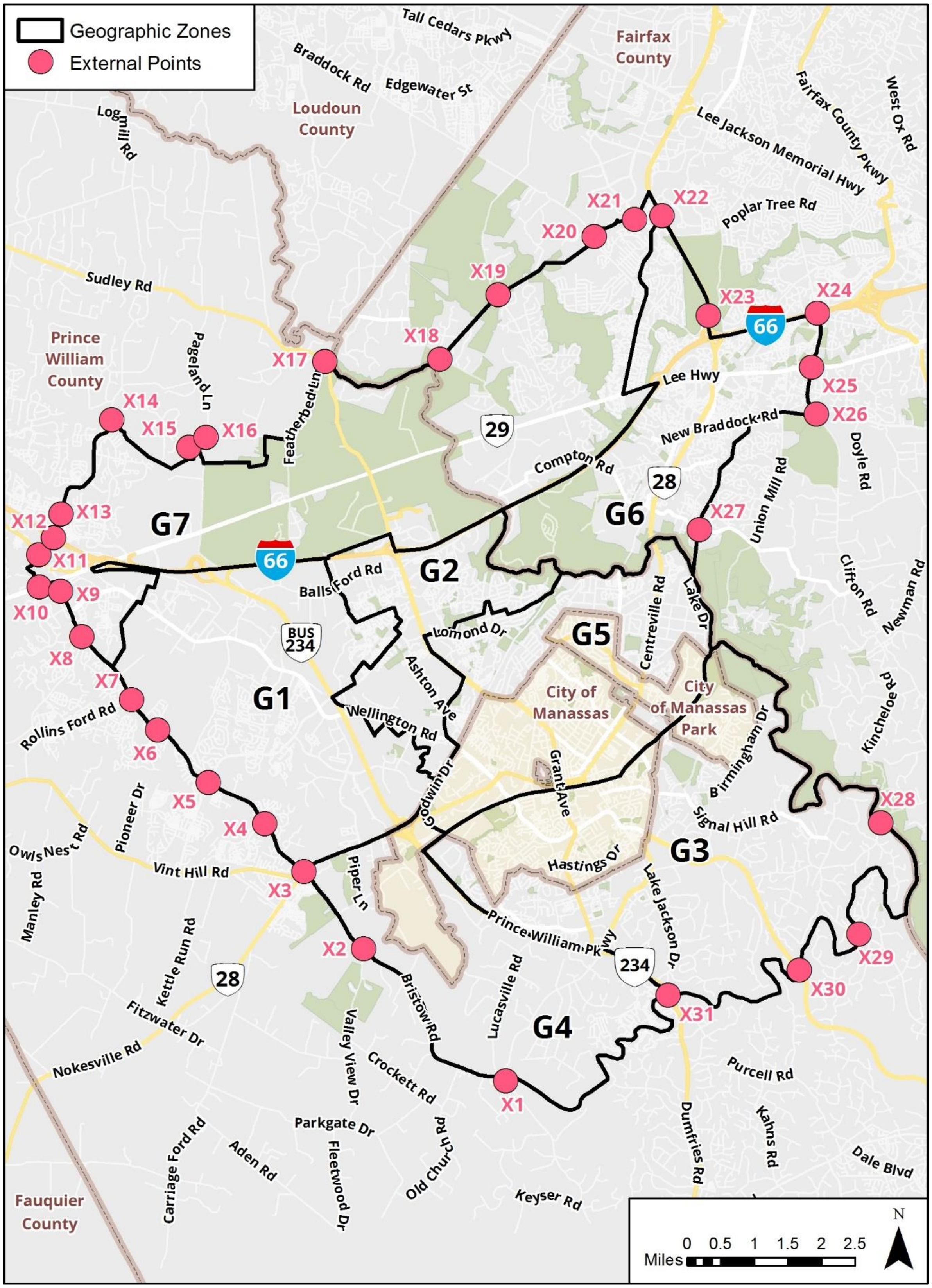


Table 2.3-1. Distribution of Trips in the AM Peak Period (6:00 to 9:00 AM)

		TO										
		G1	G2	G3	G4	G5	G6	G7	East Exts	South Exts	West Exts	North Exts
FROM	G1		24.5%	2.9%	2.5%	14.7%	1.6%	8.9%	14.4%	5.4%	20.3%	4.9%
	G2	16.9%		5.0%	1.1%	26.7%	5.0%	7.2%	21.3%	4.7%	9.1%	3.0%
	G3	6.1%	7.6%		2.0%	36.1%	5.7%	1.5%	10.4%	12.6%	4.5%	13.5%
	G4	10.5%	6.7%	13.8%		23.5%	1.0%	1.1%	5.2%	19.2%	11.2%	7.6%
	G5	7.3%	20.0%	19.3%	1.3%		10.8%	3.3%	16.8%	8.9%	5.9%	6.5%
	G6	1.0%	2.0%	1.2%	0.0%	5.3%		9.5%	72.3%	1.3%	1.9%	5.5%
	G7	5.3%	4.2%	0.5%	0.6%	4.5%	14.4%		39.6%	1.3%	12.4%	17.3%
	East Exts	8.3%	7.5%	2.6%	0.8%	12.7%	28.4%	15.8%		1.8%	17.6%	4.5%
	South Exts	6.5%	6.3%	12.3%	5.0%	26.6%	3.9%	2.2%	7.8%		5.8%	23.7%
	West Exts	14.8%	9.0%	2.1%	3.9%	11.7%	1.3%	19.5%	23.8%	3.4%		10.4%
	North Exts	8.0%	4.4%	2.6%	2.3%	10.2%	8.2%	16.5%	31.5%	2.5%	13.7%	

Table 2.3-2. Distribution of Trips in the PM Peak Period (4:00 to 7:00 PM)

		TO										
		G1	G2	G3	G4	G5	G6	G7	East Exts	South Exts	West Exts	North Exts
FROM	G1		21.4%	8.7%	2.0%	15.5%	1.7%	9.7%	4.4%	4.2%	28.3%	4.1%
	G2	17.1%		12.1%	0.7%	38.3%	2.8%	6.5%	4.7%	3.5%	11.6%	2.7%
	G3	4.3%	12.4%		3.9%	49.8%	3.3%	1.8%	3.1%	14.3%	4.1%	3.0%
	G4	9.0%	5.8%	21.1%		15.9%	0.8%	1.7%	1.7%	15.1%	24.2%	4.6%
	G5	7.2%	25.3%	32.7%	2.3%		4.9%	3.1%	5.7%	8.3%	7.6%	2.7%
	G6	1.3%	3.3%	8.8%	0.2%	16.5%		20.9%	36.3%	2.5%	3.0%	7.2%
	G7	6.3%	5.9%	2.3%	0.3%	4.8%	16.9%		11.1%	1.3%	37.1%	13.9%
	East Exts	3.4%	4.5%	4.5%	0.2%	8.6%	41.9%	16.5%		1.7%	12.9%	5.7%
	South Exts	7.1%	8.9%	32.8%	5.1%	25.6%	3.3%	2.1%	2.2%		6.1%	6.8%
	West Exts	17.1%	9.2%	4.3%	2.6%	9.1%	2.7%	33.1%	10.0%	2.7%		9.2%
	North Exts	4.1%	3.8%	16.5%	1.5%	11.4%	10.8%	19.0%	5.1%	14.5%	13.3%	

Table 2.3-3. Distribution of Trips in the Mid-Day Peak Period (9:00 AM to 4:00 PM)

		TO										
		G1	G2	G3	G4	G5	G6	G7	East Exts	South Exts	West Exts	North Exts
FROM	G1		24.1%	6.0%	3.3%	13.7%	1.2%	10.1%	9.1%	4.8%	23.8%	3.8%
	G2	16.8%		9.5%	1.5%	36.1%	2.3%	6.8%	8.6%	3.6%	11.3%	3.5%
	G3	5.3%	11.2%		3.0%	48.1%	2.9%	1.8%	6.5%	12.5%	4.3%	4.3%
	G4	13.6%	7.1%	16.1%		19.9%	0.7%	2.3%	4.9%	11.8%	18.6%	5.0%
	G5	7.2%	25.9%	27.3%	2.6%		4.7%	3.1%	9.6%	9.2%	7.5%	3.0%
	G6	1.0%	2.9%	3.6%	0.2%	9.4%		14.6%	56.6%	1.8%	3.5%	6.5%
	G7	7.0%	6.7%	1.5%	0.3%	4.1%	13.8%		17.4%	1.2%	35.5%	12.5%
	East Exts	4.5%	6.9%	3.9%	0.6%	10.4%	33.0%	13.9%		1.7%	19.4%	5.8%
	South Exts	7.0%	8.7%	22.9%	4.3%	27.6%	3.5%	3.1%	4.9%		8.2%	9.9%
	West Exts	13.7%	10.3%	3.1%	2.4%	9.2%	2.1%	30.1%	18.5%	3.1%		7.6%
	North Exts	5.2%	5.9%	7.4%	1.5%	8.2%	11.4%	22.7%	12.9%	8.4%	16.5%	

The summary tables show high percentages of trips taking place between adjacent geographic zones, particularly trips going from G1, G2, G3 and G4 to/from G5 – Central during all three time periods. High percentages of traffic from the South Externals are also destined to G5 in all three time periods. Other key observations include the following:

- The East Externals, including I-66 and US 29, represent the destination of over 70 percent of traffic from G6 in the AM peak (as well as over half in the mid-day, and over one-third in the PM peak); this highlights the high levels of interaction between this area and destinations in Fairfax County and points east.
- For the zones to the south and west of the central areas of Manassas (G1, G2, G3, and G4), travel to that central area (G5) represents the highest percentage of travel from these zones (in the range of 15% to 36% in the AM, 14% to 48% in the mid-day, and 16% to 50% in the PM). Travel from these same four zones to all external zones represents the next highest percentage (ranging from 38% to 45% in the AM, 27% to 42% in the mid-day, and 23% to 46% in the PM). In general, percentages of travel to the East Externals is higher in the AM, while higher percentages of travel are to the West Externals in the mid-day and PM.
- Traffic from G7 leans towards the East Externals in the AM peak (almost 40 percent) while during the mid-day and PM peak, more traffic from this zone is destined to the West Externals.
- For traffic coming from the West Externals, about one-third goes through to the East Externals in the morning peak. In the mid-day and PM periods, the highest percentage of traffic from the West Externals is destined for G7 (north of I-66), with substantial percentages also going to G1, the area just south of I-66.
- For travel from the South Externals, the highest percentage in the AM goes to G5 (Central) and G3 (Manassas/Southeast); a total of 39% of traffic from the South Externals goes to these two zones. Another 24% of traffic from the south goes to the North Externals. Travel from the South Externals to G5 (Central) and G3 (Manassas/Southeast) represents an even higher percentage of the total traffic from the South Externals in the mid-day and PM: 51% in the mid-day and 58% in the PM.
- For travel from the West Externals, 43% of this traffic in the AM is destined to the zones adjacent to I-66 (G1 West, G2 Mid-Central, and G7 North of I-66) while 24% travels through to the East Externals and 10% travels to North Externals. For the mid-day period, 54% of traffic from the West Externals is destined to the zones adjacent to I-66 (G1 West, G2 Mid-Central, and G7 North of I-66) with 19% going to the East Externals and 8% percent to North Externals. For the PM period, these same values are 59% to I-66 adjacent zones, 10% to the East Externals, and 9% to Other Externals.

3. No Build / Build Conditions and Travel Demand Forecasting

3.1 Base Model (PWC Model)

The travel demand forecasts described in this report were developed using the Prince William County Travel Demand Model 2016 Version 2.4. This model represents the latest in a number of updates to the Prince William County model dating back to 1999. Since 2008, the Prince William County model has covered not only Prince William County but also the entire metropolitan Washington region; the geography covered by the model matches that of the MWCOG travel demand model. The 2016 update to the Prince William County model incorporated enhancements from Loudoun County's travel demand model and the MWCOG regional model as well as the following:

- Conflating the highway network to more accurately reflect the actual roadway system;
- Expanding the time of day model from three to four time periods (AM, midday, PM, night) and associated changes to the assignment step;
- Adding a simplified transit model for intra-county transit trips;
- Updating the auto occupancy model and calibrating it using the Washington region's most recent survey data from 2007-08;
- Expanding the traffic analysis zone system in the County to provide greater detail; and
- Updating base inputs to 2015 and re-validating the model to 2015 conditions.

Documentation developed in support of the Prince William County Travel Demand Model 2016 Version 2.4[4] provides information on the validation of model assignments with respect to County, VDOT, and FHWA modeling standards. This documentation is included as **Attachment E** to this technical report.

Table 3.1-1 below shows the annual average daily traffic (AADT) volumes from the model for segments along Route 28, Godwin Drive, Old Centreville Road, Mathis Avenue, Liberia Avenue, and Wellington Road in the following conditions: 2040 No Build, 2040 Build 2A, 2040 Build 2B, and 2040 Build 4. The table also includes the change in volume between the No Build condition and each of the Build conditions. Note that the 2018 Existing AADT was developed using the 2017 VDOT Jurisdiction Report and growing the volume to 2018 using a 1% growth rate. These volumes were used because daily counts were not available at all locations.

[4] Prince William County Travel Model Update 2016. Prepared for Prince William County Department of Transportation by William G. Allen, Jr., PE, October 21, 2016.

Table 3.1-1. Existing and Future Average Daily Volumes (from Model)

Segment	Key Map #	2018 Existing AADT[1]	2040 No Build			2040 Build 2A			2040 Build 2B			2040 Build 4		
			AADT	Change from Existing	% Change	AADT	Change from No Build	% Change	AADT	Change from No Build	% Change	AADT	Change from No Build	% Change
Route 28 - Figure 3.1-1														
Route 234 to Godwin Drive	1	32320	45260	+12940	40.0%	56309	+11049	24.4%	58685	+13425	29.7%	45700	+440	1.0%
Godwin Drive to Wellington Road	2	22220	35708	+13488	60.7%	29582	-6125	-17.2%	29732	-5976	-16.7%	36171	+463	1.3%
Wellington Road to Cockrell Road	3	22220	30964	+8744	39.4%	24574	-6390	-20.6%	24641	-6323	-20.4%	31403	+439	1.4%
Cockrell Road to Brinkley Lane	4	22220	37782	+15562	70.0%	30447	-7335	-19.4%	30514	-7268	-19.2%	38242	+460	1.2%
Brinkley Lane to Stonewall Road	5	22220	37782	+15562	70.0%	30447	-7335	-19.4%	30514	-7268	-19.2%	38242	+460	1.2%
Stonewall Road to W Court House Road	6	22220	35670	+13450	60.5%	28697	-6973	-19.5%	28759	-6911	-19.4%	36211	+541	1.5%
W Court House Road to Grant Avenue (Center Street)	7	21210	36490	+15280	72.0%	29656	-6835	-18.7%	29712	-6778	-18.6%	37011	+521	1.4%
Grant Avenue (Center Street) to Main Street (Center Street)	8	23230	37594	+14364	61.8%	28494	-9101	-24.2%	28485	-9110	-24.2%	35052	-2543	-6.8%
Main Street (Center Street) to Zebedee Street (Center Street)	9	23230	42958	+19728	84.9%	35525	-7433	-17.3%	35332	-7626	-17.8%	42111	-847	-2.0%
Zebedee Street (Center Street) to Sudley/Prescott Road	10	27270	34430	+7160	26.3%	27241	-7189	-20.9%	26908	-7522	-21.8%	33337	-1093	-3.2%
Sudley Prescott Road to Liberia Avenue	11	27270	42064	+14794	54.3%	29779	-12285	-29.2%	29221	-12843	-30.5%	38428	-3636	-8.6%
Liberia Avenue to Manassas Drive	12	43430	66071	+22641	52.1%	58124	-7947	-12.0%	56797	-9274	-14.0%	74589	+8518	12.9%
Manassas Drive to Browns Lane	13	50500	83925	+33425	66.2%	77841	-6084	-7.2%	75255	-8670	-10.3%	96412	+12487	14.9%
Browns Lane to Maplewood Drive	14	50500	76853	+26353	52.2%	65140	-11713	-15.2%	63167	-13686	-17.8%	87195	+10342	13.5%
Maplewood Drive to Leland Road	15	50500	72757	+22257	44.1%	61537	-11221	-15.4%	59183	-13575	-18.7%	83630	+10873	14.9%
Leland Road to Yorkshire Lane	16	50500	73124	+22624	44.8%	61574	-11550	-15.8%	59263	-13861	-19.0%	83878	+10754	14.7%
Yorkshire Lane to Orchard Bridge Drive	17	50500	76848	+26348	52.2%	61854	-14994	-19.5%	59942	-16906	-22.0%	85973	+9125	11.9%
Orchard Bridge Drive to Compton/Ordway Road	18	58580	76488	+17908	30.6%	104581	+28093	36.7%	76484	-4	0.0%	85578	+9090	11.9%
Compton/Ordway Road to Green Trails/Old Mill	19	58580	93012	+34432	58.8%	113885	+20873	22.4%	117489	+24477	26.3%	95219	+2207	2.4%
Green Trails/Old Mill to New Braddock Road	20	58580	114909	+56329	96.2%	134985	+20076	17.5%	138511	+23602	20.5%	117042	+2133	1.9%
New Braddock Road to Machen Road	21	58580	107780	+49200	84.0%	121759	+13979	13.0%	125313	+17533	16.3%	109153	+1373	1.3%
Machen Road to Upperridge/Old Cent	22	58580	107780	+49200	84.0%	121759	+13979	13.0%	125313	+17533	16.3%	109153	+1373	1.3%
Godwin Drive - Figure 3.1-2														
Battlefield Drive to Route 28	1	12120	21964	+9844	81.2%	20969	-995	-4.5%	20897	-1067	-4.9%	22022	+59	0.3%
Route 28 to University Boulevard	2	15150	29107	+13957	92.1%	44224	+15117	51.9%	46455	+17348	59.6%	29112	+6	0.0%

Table 3.1-1. Existing and Future Average Daily Volumes (from Model)

Segment	Key Map #	2018 Existing AADT [1]	2040 No Build			2040 Build 2A			2040 Build 2B			2040 Build 4		
			AADT	Change from Existing	% Change	AADT	Change from No Build	% Change	AADT	Change from No Build	% Change	AADT	Change from No Build	% Change
University Boulevard to Lockheed Martin Access	3	15150	19319	+4169	27.5%	35709	+16390	84.8%	37914	+18595	96.3%	19441	+122	0.6%
Lockheed Martin Access to Wellington Road	4	15150	21138	+5988	39.5%	38625	+17487	82.7%	40849	+19711	93.2%	21264	+126	0.6%
Wellington Road to Ashton Avenue	5	15150	25649	+10499	69.3%	45406	+19757	77.0%	48016	+22367	87.2%	25735	+86	0.3%
Ashton Avenue to Sudley Road	6	15150	23304	+8154	53.8%	47983	+24679	105.9%	50783	+27479	117.9%	23358	+54	0.2%
Sudley Road to Lomond Drive/Liberia Avenue	7	--	--	--	--	51300	--	--	56317	--	--	--	--	--
Lomond Drive/Liberia Avenue to Old Centreville Road to Southern [2,3]	8	--	--	--	--	55428	--	--	61233	--	--	--	--	--
Old Centreville Road Southern to Old Centreville Road Northern [3]	9	--	--	--	--	--	--	--	72383	--	--	--	--	--
Old Centreville Road to Northern to Route 28 [3]	10	--	--	--	--	--	--	--	61425	--	--	--	--	--
Old Centreville Road to Route 28 [2]	11	--	--	--	--	44458	--	--	--	--	--	--	--	--
Old Centreville Road - Figure 3.1-3														
Route 28 to Yorkshire Lane	1	10100	23312	+13212	130.8%	11937	-11375	-48.8%	11940	-11372	-48.8%	17096	-6216	-26.7%
Yorkshire Lane to Route 28	2	14140	25745	+11605	82.1%	--	--	--	--	--	--	20515	-5230	-20.3%
Yorkshire Lane to Godwin Drive Extension-Southern [2,3]	3	--	--	--	--	15613	--	--	14729	--	--	--	--	--
Godwin Drive Extension-Southern to Godwin Drive Extension-Northern [3]	4	--	--	--	--	--	--	--	72383	--	--	--	--	--
Godwin Drive Extension-Northern to Route 28 [3]	5	--	--	--	--	--	--	--	39038	--	--	--	--	--
Godwin Drive Extension to Route 28 [2]	6	--	--	--	--	22734	--	--	--	--	--	--	--	--
Mathis Avenue - Figure 3.1-4														
Maple Street to Sudley Road	1	9797	2344	-7453	-76.1%	2140	-204	-8.7%	1907	-437	-18.6%	2767	+423	18.0%
Sudley Road to Liberia Avenue	2	9797	8839	-958	-9.8%	8049	-790	-8.9%	7816	-1023	-11.6%	11700	+2861	32.4%
Liberia Avenue to Breeden Avenue	3	9797	11435	+1638	16.7%	15056	+3621	31.7%	14855	+3420	29.9%	18906	+7471	65.3%
Breeden Avenue to Manassas Drive	4	9797	18310	+8513	86.9%	11609	-6701	-36.6%	11420	-6890	-37.6%	15608	-2702	-14.8%
Liberia Avenue – Figure 3.1-5														
Wellington Road to Shopping Center 1	1	36360	41643	+5283	14.5%	41820	+177	0.4%	41478	-165	-0.4%	42665	+1022	2.5%
Shopping Center 1 to Car Wash	2	36360	41643	+5283	14.5%	41820	+177	0.4%	41478	-165	-0.4%	42665	+1022	2.5%
Car Wash to Signal Hill Road	3	36360	41643	+5283	14.5%	41820	+177	0.4%	41478	-165	-0.4%	42665	+1022	2.5%

Table 3.1-1. Existing and Future Average Daily Volumes (from Model)

Segment	Key Map #	2018 Existing AADT[1]	2040 No Build			2040 Build 2A			2040 Build 2B			2040 Build 4		
			AADT	Change from Existing	% Change	AADT	Change from No Build	% Change	AADT	Change from No Build	% Change	AADT	Change from No Build	% Change
Signal Hill Road to Panera Bread	4	36360	40994	+4634	12.7%	41388	+394	1.0%	41093	+99	0.2%	42111	+1117	2.7%
Panera Bread to Richmond Avenue	5	36360	40994	+4634	12.7%	41388	+394	1.0%	41093	+99	0.2%	42111	+1117	2.7%
Richmond Avenue to Quarry Road	6	36360	52750	+16390	45.1%	52897	+147	0.3%	52546	-204	-0.4%	54637	+1887	3.6%
Quarry Road to Euclid Avenue	7	36360	48869	+12509	34.4%	48895	+26	0.1%	48486	-383	-0.8%	50820	+1951	4.0%
Euclid Avenue to Shopping Center 2	8	36360	48803	+12443	34.2%	50957	+2154	4.4%	50626	+1823	3.7%	53872	+5069	10.4%
Shopping Center 2 to Route 28	9	36360	51422	+15062	41.4%	53689	+2267	4.4%	53335	+1913	3.7%	56083	+4661	9.1%
Wellington Road - Figure 3.1-6														
Moore Drive to Liberia Avenue/Prince William Parkway	1	37370	94844	+57474	153.8%	92921	-1923	-2.0%	92622	-2222	-2.3%	47506	-47338	-49.9%
Liberia Avenue/ Prince William Parkway to Fairview Avenue	2	17170	32862	+15692	91.4%	32200	-662	-2.0%	32304	-558	-1.7%	32896	+34	0.1%
Fairview Avenue to Grant Avenue	3	16160	31986	+15826	97.9%	29453	-2533	-7.9%	29128	-2858	-8.9%	32628	+642	2.0%
Grant Avenue to Buckner Road	4	15150	31433	+16283	107.5%	28955	-2478	-7.9%	28571	-2862	-9.1%	31522	+89	0.3%

[1] 2017 Existing AADT is from the 2017 VDOT Jurisdiction Report. All 2040 data is from the County model. [2] Segment is part of Build Alternative 2A. [3] Segment is part of Alternative 2B.

Figure 3.1-1. Route 28 - Key Map of Segments for Existing / Future Daily Volumes (from Model) and Existing / Future Speeds (from ARTPLAN)

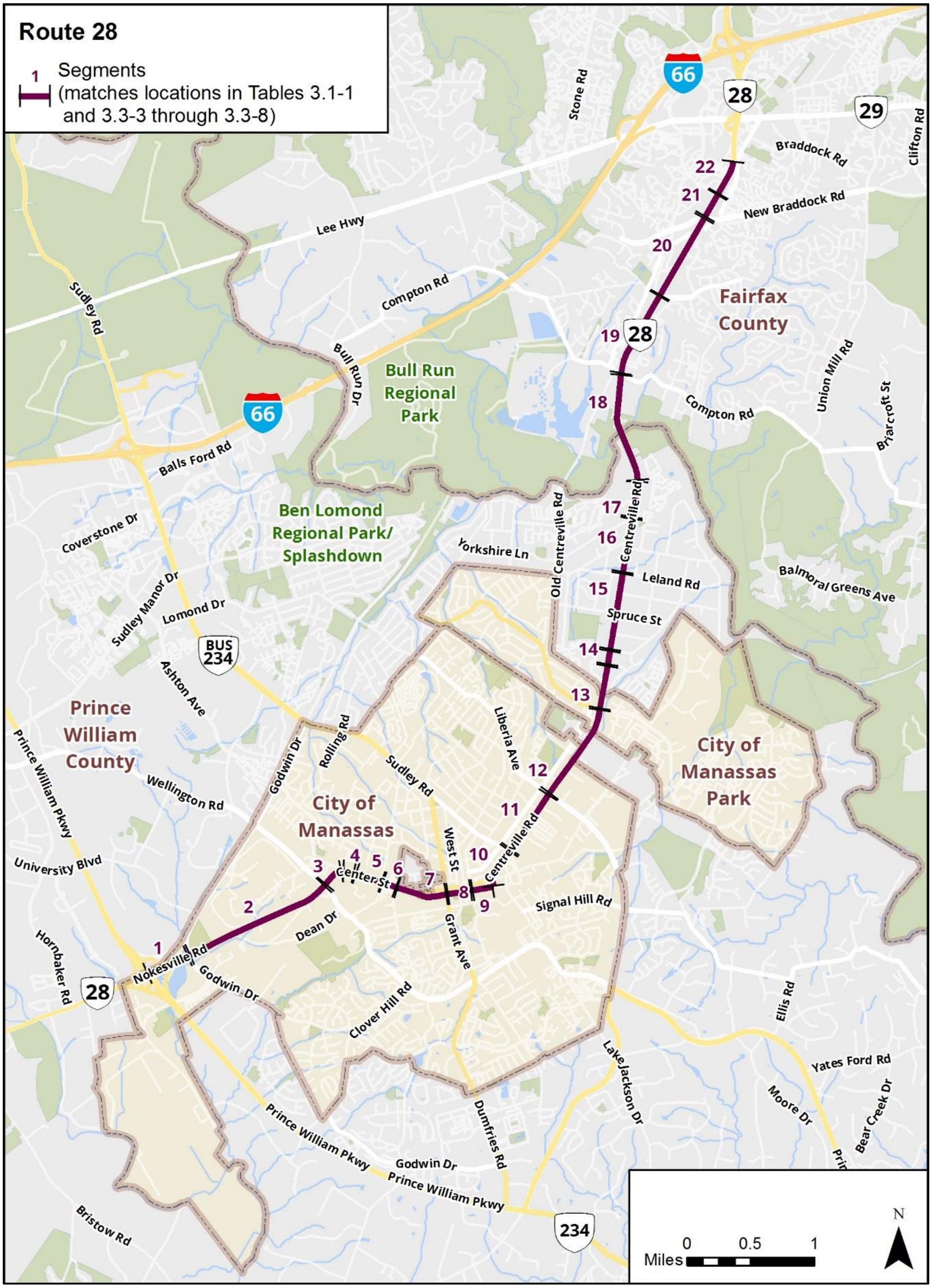


Figure 3.1-2. Godwin Drive - Key Map of Segments for Existing / Future Daily Volumes (from Model) and Existing / Future Speeds (from ARTPLAN)

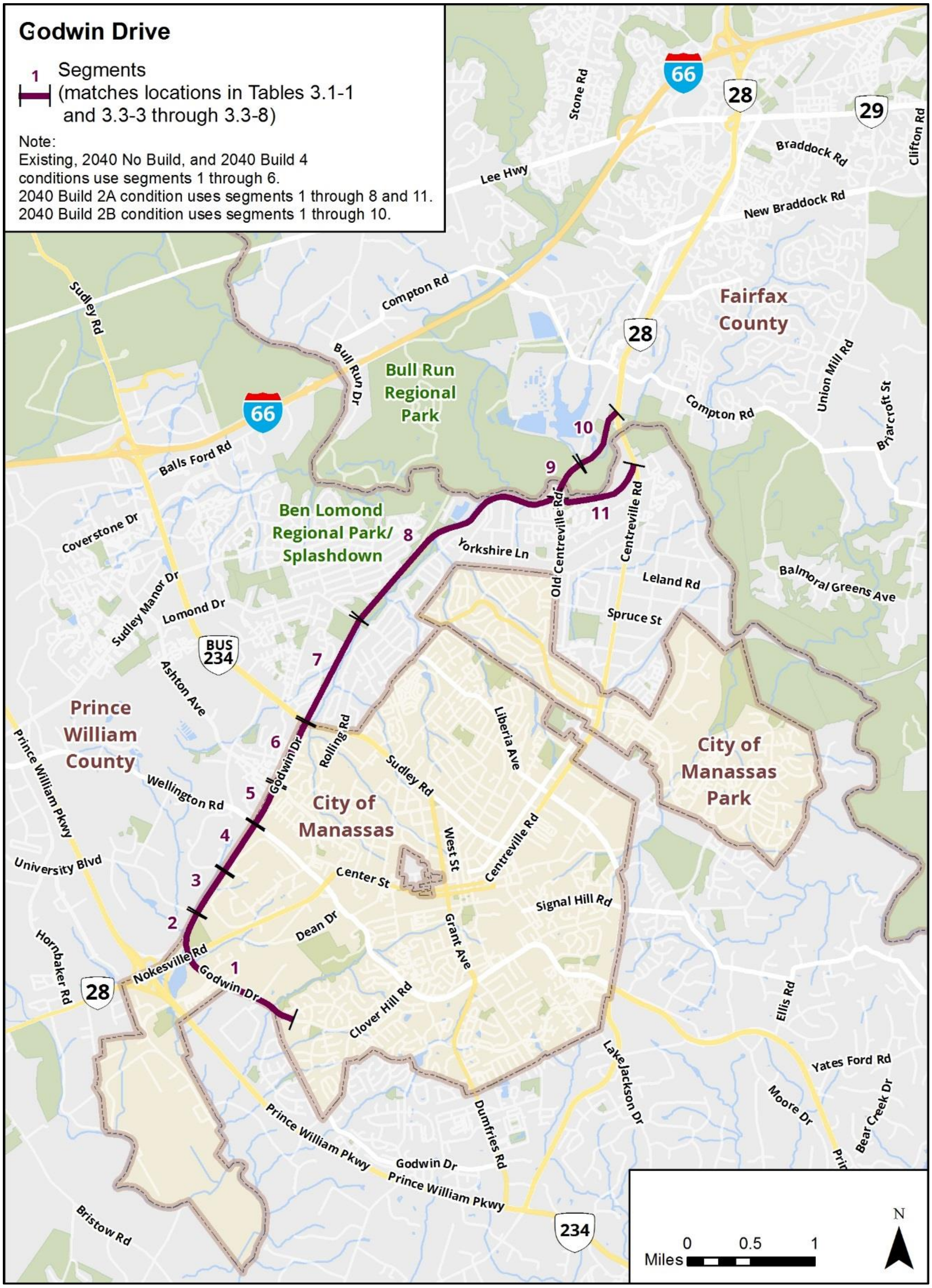


Figure 3.1-3. Old Centreville Road - Key Map of Segments for Existing / Future Daily Volumes (from Model) and Existing / Future Speeds (from ARTPLAN)

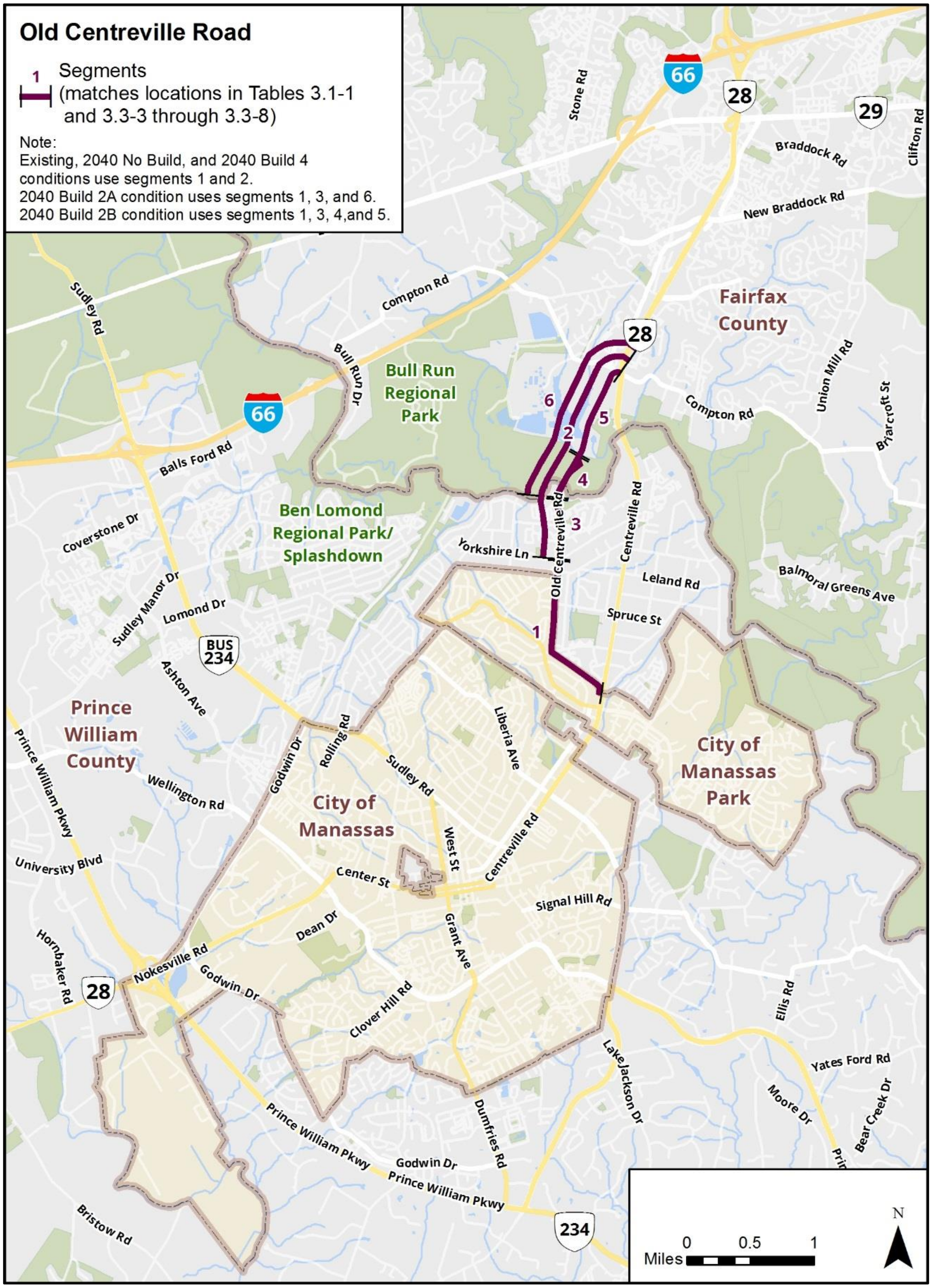


Figure 3.1-4. Mathis Avenue - Key Map of Segments for Existing / Future Daily Volumes (from Model) and Existing / Future Speeds (from ARTPLAN)

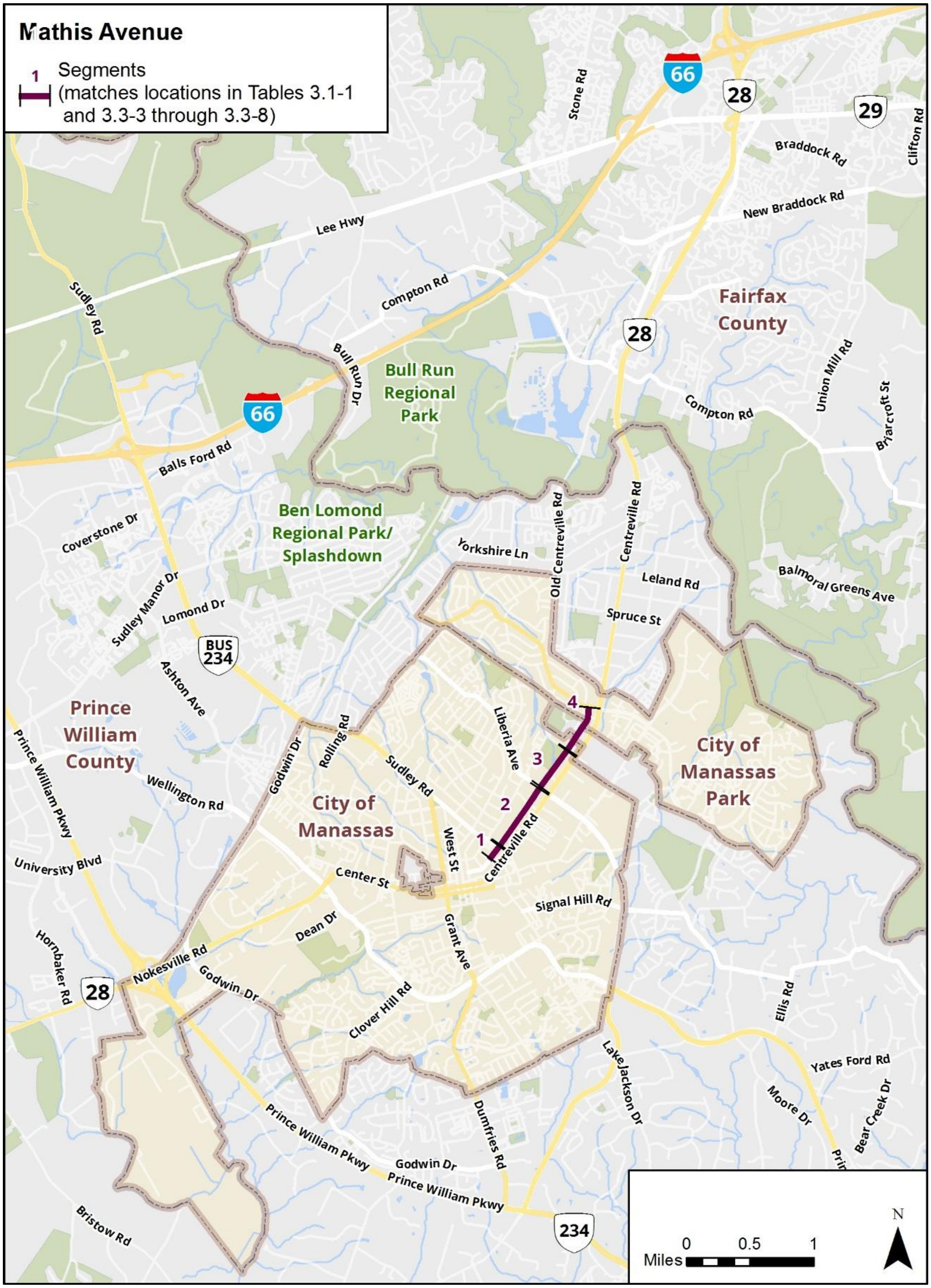


Figure 3.1-5. Liberia Avenue- Key Map of Segments for Existing / Future Daily Volumes (from Model) and Existing / Future Speeds (from ARTPLAN)

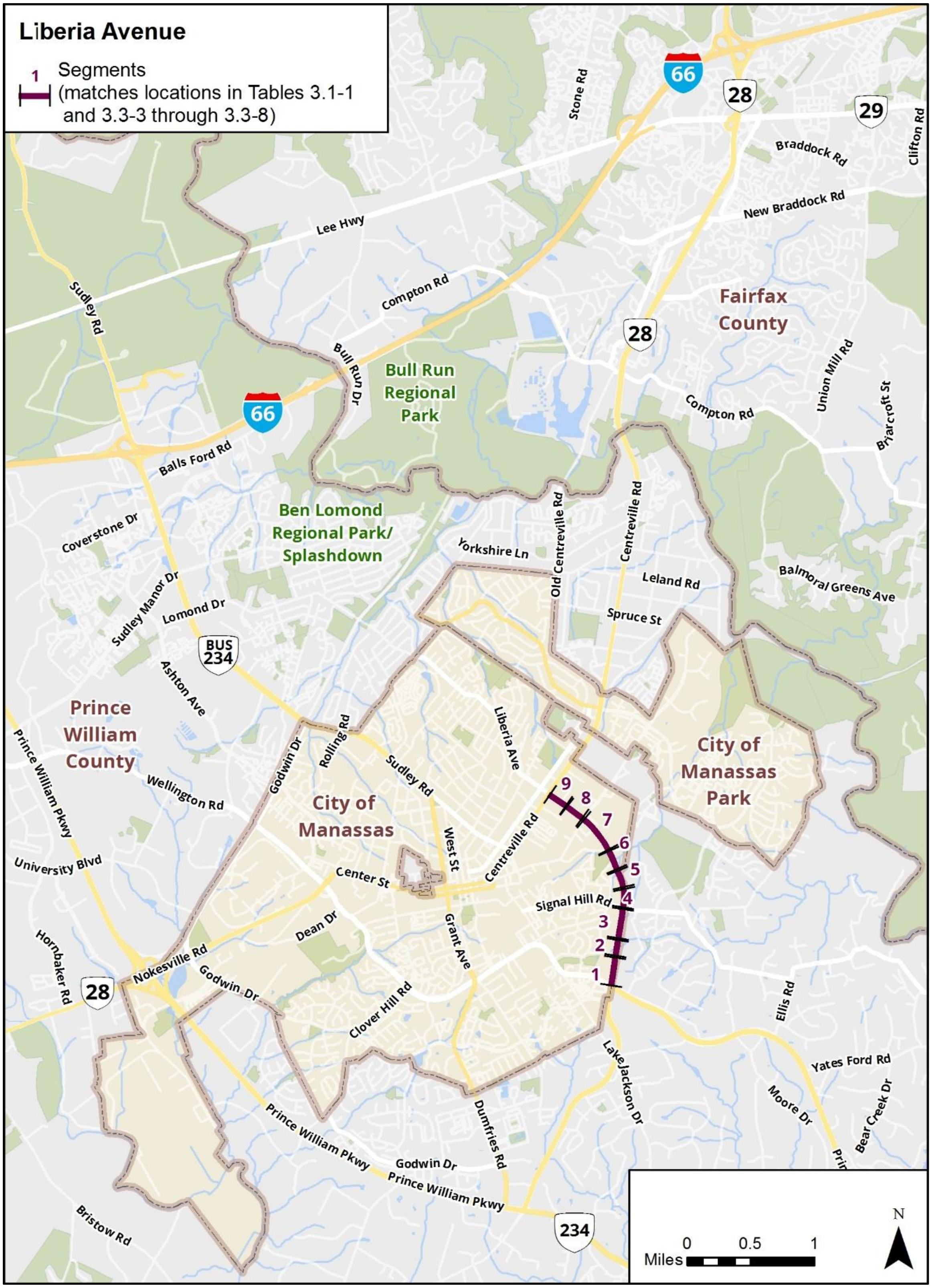
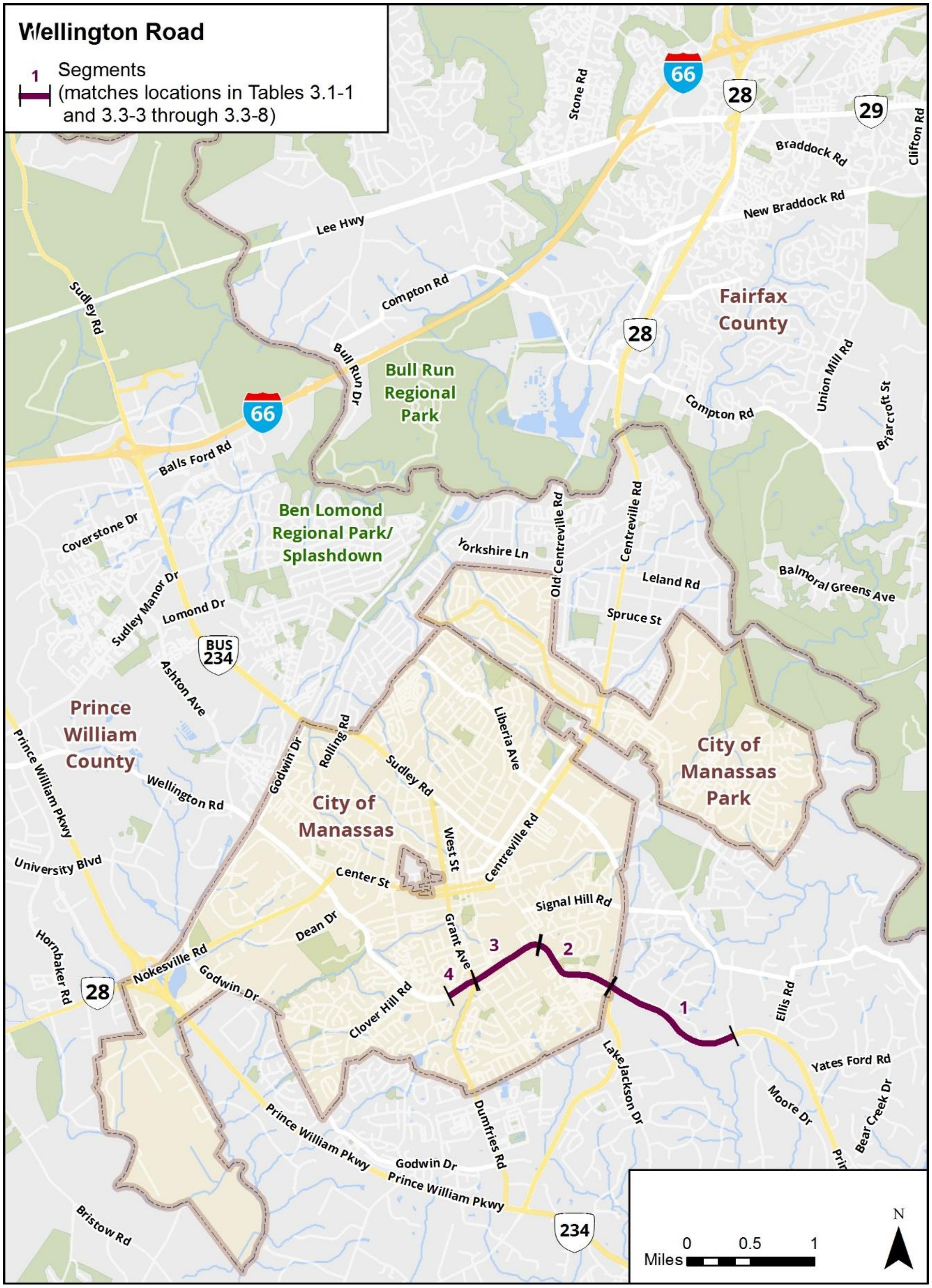


Figure 3.1-6. Wellington Road - Key Map of Segments for Existing / Future Daily Volumes (from Model) and Existing / Future Speeds (from ARTPLAN)



The following is a roadway-by-roadway summary of the results from **Table 3.1-1**. These summaries compare the three Build conditions to the No Build condition.

Route 28 (**Figure 3.1-1**)

For Alternatives 2A and 2B, the AADT volumes entering the system on Route 28 from the south near the intersection of Route 28 and Godwin Drive increase from the No Build condition and since the extension of Godwin Drive diverts cars from continuing on Route 28, the volumes on Route 28 decrease after Godwin Drive to Orchard Bridge Drive. For Alternative 4, vehicles are added to the system north of Liberia Avenue since additional capacity is available with the widening.

Godwin Drive (**Figure 3.1-2**)

For Alternatives 2A and 2B, the number of vehicles traveling on Godwin Drive increases due to the extension of Godwin Drive north towards Route 28 near Bull Run. For Alternative 4, however, the volumes increase to a lesser degree.

Old Centreville Road (**Figure 3.1-3**)

Volumes decrease along Old Centreville Road under all three build alternatives compared to the No Build condition.

Mathis Avenue (**Figure 3.1-4**)

For Alternatives 2A and 2B, volumes decrease along Mathis Avenue except near the Liberia Avenue intersection. For Alternative 4, volumes increase at Sudley Road and Liberia Avenue and decrease at the other intersections.

Liberia Avenue (**Figure 3.1-5**)

For Alternative 2A, volumes increase along Liberia Avenue from Wellington Road / Prince William Parkway to Route 28. For Alternative 2B, volumes increase along Liberia Avenue from Richmond Avenue to Signal Hill Road and from Route 28 to Euclid Avenue, but volumes decrease from Euclid Avenue to Richmond Avenue and from Signal Hill Road to Wellington Road / Prince William Parkway. For Alternative 4, volumes increase along Liberia Avenue from Wellington Road / Prince William Parkway to Route 28.

Wellington Road (**Figure 3.1-6**)

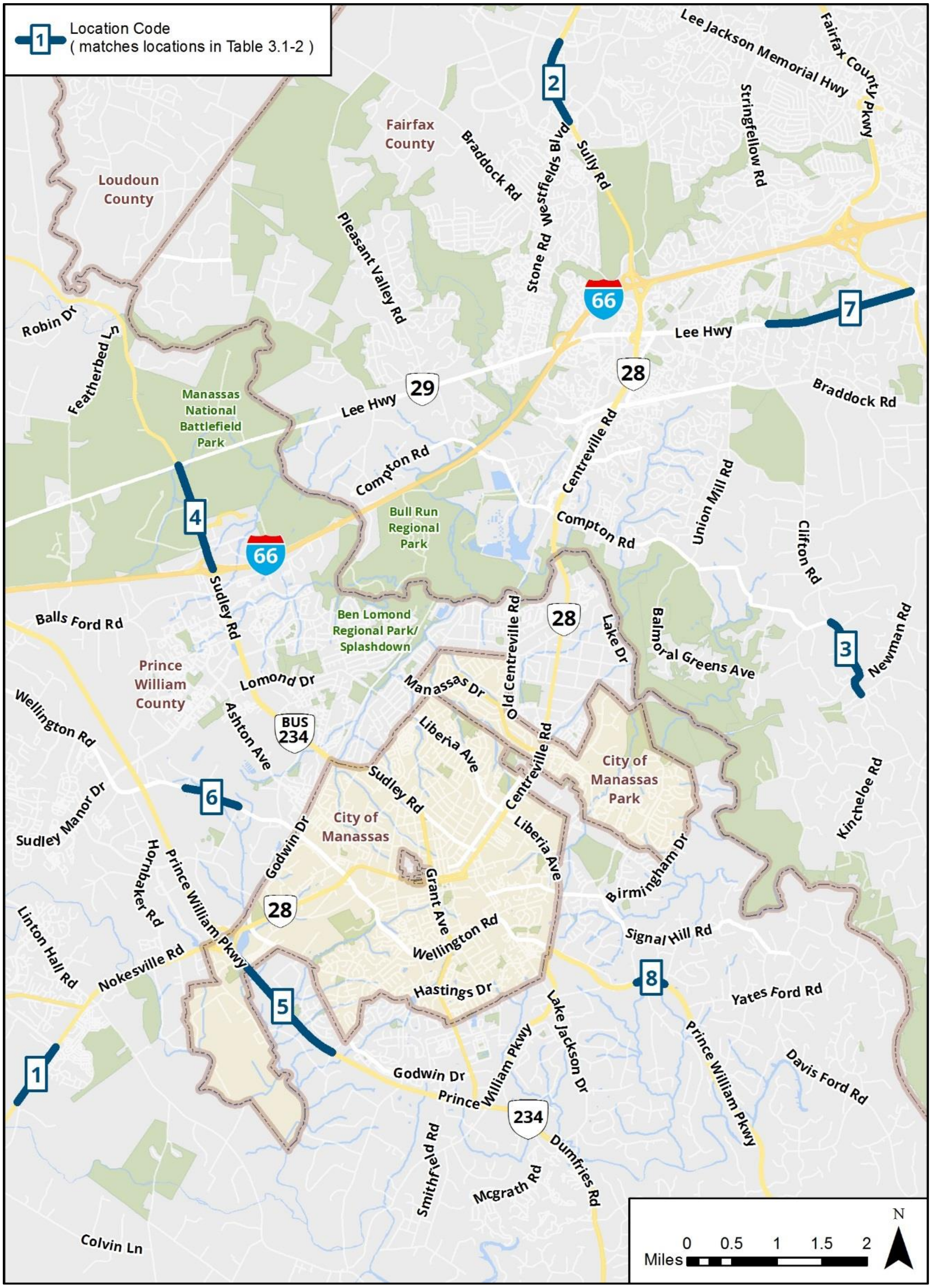
The volumes along Wellington Road decrease in Alternatives 2A and 2B while the volumes under Alternative 4 stay roughly the same, excluding the segment from Moore Drive to Liberia Avenue/Prince William Parkway. This segment experiences an increase in volume under all three build alternatives.

In addition to affecting volumes inside the Roadway Capacity/Operations Analysis Area, the build alternatives affect roadways outside of this analysis area. **Table 3.1-2** below shows a sampling of locations outside of this analysis area and how they are affected in each build alternative. This table highlights that the model shows traffic changes outside of the immediate analysis area, thereby indicating the wider extent of the project impact. See **Figure 3.1-7** for a map of the locations in the table below.

Table 3.1-2. Changes in AADT Outside of Roadway Capacity/Operations Analysis Area

Mainline	Segment	*Key Map # (Figure 3.1-7)*	2040 No Build	2040 Build 2A			2040 Build 2B			2040 Build 4		
				Volume (AADT)	Change in Volume	% Change	Volume (AADT)	Change in Volume	% Change	Volume (AADT)	Change in Volume	% Change
Route 28 (Nokesville Road)	Aden Road to Vint Hill Road	*1*	35887	38285	+2398	6.7%	39013	+3126	8.7%	36535	+648	1.8%
Route 28 (Sully Road)	Westfields Boulevard to Willard Road	*2*	96699	96700	+1	0.0%	96336	-363	-0.4%	97833	+1134	1.2%
Clifton Road	Compton Road to Chapel Road	*3*	31102	32141	+1039	3.3%	32736	+1634	5.3%	30762	-340	-1.1%
Sudley Road	Route 29 to I-66	*4*	18313	18425	+112	0.6%	18663	+350	1.9%	17977	-336	-1.8%
Prince William Parkway	Gateway Boulevard to Clover Hill Road	*5*	94309	93535	-774	-0.8%	92635	-1674	-1.8%	94309	0	0.0%
Wellington Road	Vulcan Lane to Freedom Center Boulevard	*6*	26432	28807	+2375	9.0%	28975	+2543	9.6%	26647	+215	0.8%
Route 29	Stringfellow Road to Fairfax County Parkway	*7*	52461	52991	+530	1.0%	53402	+941	1.8%	52465	+4	0.0%
Prince William Parkway	Moore Drive to Ellis Road	*8*	100161	97649	-2512	-2.5%	97354	-2807	-2.8%	100083	-78	-0.1%

Figure 3.1-7. Location Map – Change in Volume (AADT) Outside of Roadway Capacity/Operations Analysis Area



3.2 Methodology for Development of Future No Build and Build Turning Movement Volumes

The daily forecast outputs from the travel demand model were used directly to develop estimated future year peak hour turning movement volumes; use of the direct model output allowed for assessments of the potential impacts of traffic diversion across competing routes as predicted by the model. Turning movement values used for analysis of intersection operations (levels of service) were developed using the methodologies described in Section 6.2 "Factoring Procedure – Ratio Method" in *NCHRP Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design*.

The process of developing the future year turning movement volumes began with the calculation of roadway segment volumes, which involved extracting the future year model output for the roadway segments; developing the peak hour two-way volumes (by applying a K-factor); and developing the directional peak hour volumes (by applying a D-factor). The directional peak hour volumes for the roadway segments served as inputs into the Fratar process for developing estimated turning movement volumes at each intersection.

3.2.1 Traffic Factors

The factors used to develop peak hour roadway segment volumes are K and D-factors. The K-factor is the ratio of the traffic volume in the study hour to the ADT, while the D-factor is the directional distribution factor and is defined as the proportion of the total, two-way design hour traffic travelling in the peak direction.

The K-factor was calculated from the 2018 machine counts and turning movement counts. The AM K-factors ranged from 3.6% to 6.1% while the PM K-factors ranged from 5.9% to 8.8%. A K-factor of 5.3% was used in the AM peak and 7.3% was used in the PM peak. The D-factors were calculated based on the existing turning movement counts.

3.2.2 Development of Future AADT Volumes (Two-Way)

The model outputs were used for all roadway segments represented in the model. For any segment not in the model, the two-way AADT from the existing turning movement counts were grown to the future year using the growth rates of similar segments or intersections.

3.2.3 Development of Future Turning Movement Volumes

The AM and PM design hour volumes (DHV) were calculated using the 5.3% and 7.3% K-factors (for AM and PM peaks, respectively) applied to the two-way AADT volumes. Directionality was then assigned to the AM and PM DHVs using the D-factor based on the existing turning movement counts. The future year calculated directional design hour volumes (DDHV) were used with the 2018 turning movement data as inputs to the Fratar process described previously.

3.2.4 Supplemental Methodology for Build Alternatives

It was necessary to supplement the above methodology in order to develop turning movements reflective of new travel patterns on Godwin Drive resulting from the new intersections that would be created as part of Build Alternatives 2A and 2B.

Alternative 2A has three new intersections and one modified existing intersection. The intersection of Godwin Drive and Sudley Road, originally a three-way intersection, is modified to include a northern leg that connects to Liberia Avenue/Lomond Drive. In lieu of using the existing turning movements at this intersection and the new intersection at Liberia Avenue/Lomond Drive, daily turns were predicted using the percentages for the existing turning movements at Godwin Drive and Wellington Road, which is a similar intersection. For the two new intersections, Godwin Drive/Old Centreville Road and Godwin Drive/Route 28 near Orchard Bridge Drive, daily turns were predicted using the travel demand model instead of existing turning movements.

Alternative 2B has four new intersections and one modified existing intersection. When developing the turning movements, as done for Alternative 2A, the existing intersection of Godwin Drive and Sudley Road and the new intersection of Godwin Drive and Liberia Avenue/Lomond Drive were developed using the percentages for the existing turning movements at Godwin Drive and Wellington Road. For the three new intersections, Godwin Drive/Old Centreville Road (southern connection), Godwin Drive/Old Centreville Road (northern connection), and Godwin Drive/Route 28 near Orchard Bridge Drive, daily turns were predicted using the travel demand model instead of existing turning movements.

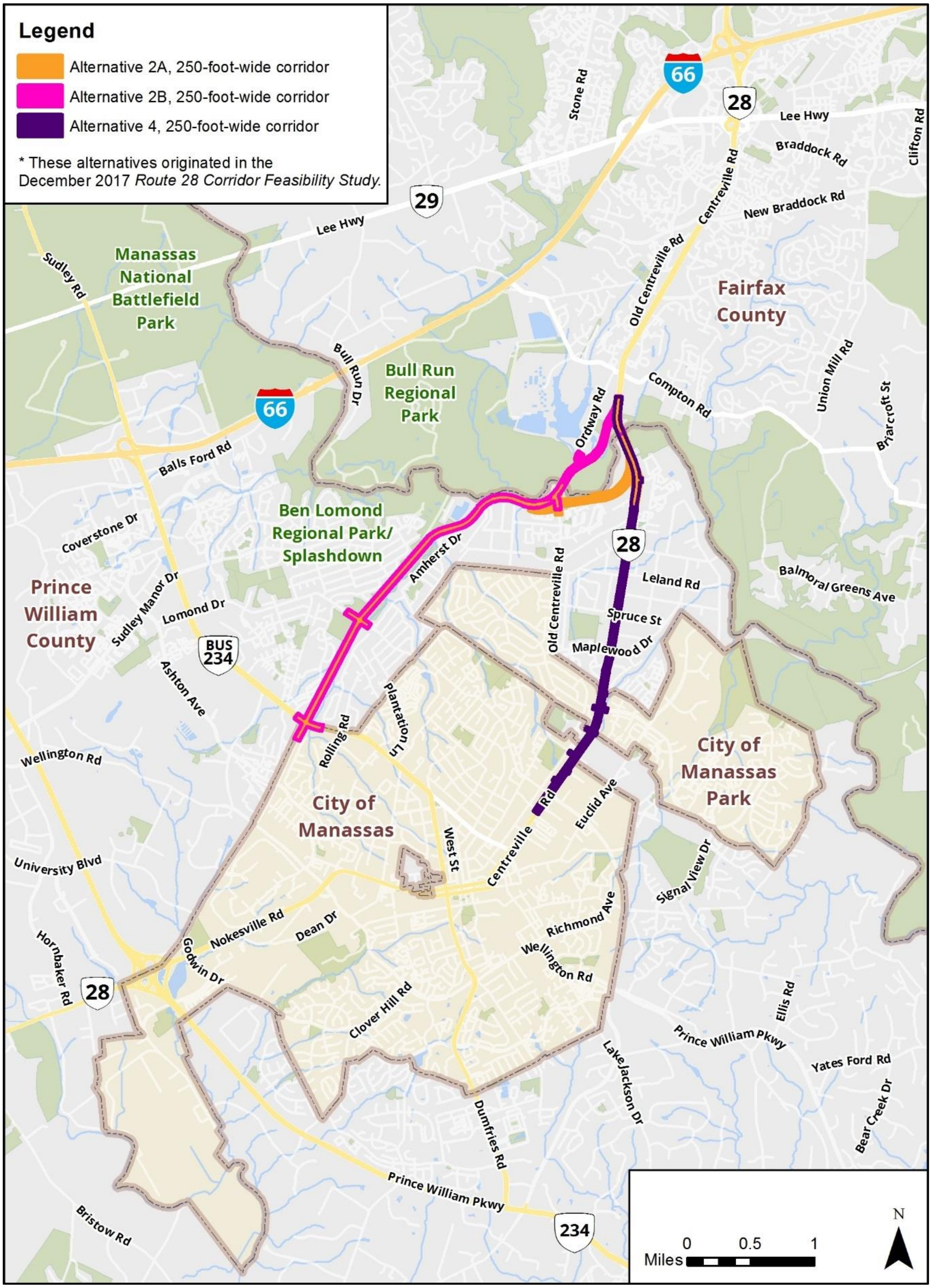
After developing the predicted turns for the new or modified intersections, they were then used with the future year calculated directional design hour volumes (from the model) to calculate peak period turning movement volumes.

3.3 Future No Build and Build Conditions and Build Alternatives Analysis

3.3.1 Build Alternatives Description

Alternatives 2A, 2B, and 4 were described in Section 1.1 and they are shown again in **Figure 3.3-1** below.

Figure 3.3-1. Map of Alternatives 2A, 2B, and 4



3.3.2 Peak Period Operations Analysis

Peak period traffic operations at key intersections in the project area are a key tool for measuring the effectiveness of study alternatives. Detailed operations analysis performed for the Route 28 corridor for this study as well as the previous study efforts documented in the December 2017 *Route 28 Corridor Feasibility Study* and the September 2015 *Route 28 Corridor Safety and Operations Study* used the Synchro analysis tool. This software implements the methodologies of the Highway Capacity Manual and requires, as input, details regarding roadway geometries as well as individual traffic signal and signal system characteristics.

As with many major commuting corridors in Northern Virginia, traffic signal timing, phasing, and the interconnectedness of signals in the corridor are critical factors in overall operations; they also reflect decisions such as the amount of signal timing allocated to the major commuter roadway versus side streets. Signal timing settings on these roadways is constantly monitored and adjustments to timing, phasing, etc. are made to maximize traffic flow and reduce overall congestion levels. The high level of detail in the analysis, while entirely appropriate for maximizing traffic operations for a roadway corridor, is less useful when analyzing future year conditions for multiple alternatives at a planning level. At the planning level and preliminary engineering stages, key questions to be answered relate to the general capacity improvements that are provided through geometric improvements such as added travel and/or turn lanes and the general capacity effects of either increases or decreases in traffic volumes. It is important to note that, for purposes of environmental studies, refinements to signal timing, phasing, and other operational improvements have often been categorized as Transportation System Management (TSM) improvements that are either an improvement option unto themselves (i.e., the implementation of a region-wide interconnected traffic signal system) or, as an existing feature of the roadway system would be included and optimized as part of any alternative.

In order to support decision-making at the planning and preliminary engineering levels, this study separates the effects of changes to roadway geometry from the myriad of decisions that are made on an ongoing basis within the Route 28 corridor (such as allocation of signal green time to the main road versus side road, the length of peak period signal timing plans versus non-peak period timing plans, coordination of signals to support particular travel speeds, etc.). To assess the relative effectiveness of each alternative in providing additional capacity independent of these other considerations, two planning level analysis tools were used. These are the Critical Lane Volume (CLV) methodology and ARTPLAN (an arterial planning-level analysis tool that is a component of the Highway Capacity Software HCS 2010 Ver 6.60). These two tools are described below.

- Critical Lane Volume (CLV) analysis methods, originally developed in 1971 and continually refined since then, provide planning level results without focusing on details (such as signal timing specifics and peak-hour factors) that are more uncertain when analyzing operations 20 or more years in the future. The CLV method is focused on assessing the differences in operations based on different levels of traffic demand and/or roadway lane geometries rather than assessing operations against a standard, and it is therefore very useful for planning applications where decisions reflect a long planning horizon which results in less detail and certainty.

  In simplified terms, CLV analysis focuses on the total critical volume that passes through an intersection on each road at an intersection. The critical volume for each road is the higher of the left plus through-right traffic (per lane) for each approach; these lane-volumes for each of the two roadways at the intersection are them summed to calculate the total CLV. The CLV is then correlated with research-validated values for LOS and volume/capacity (v/c) ratios to provide estimated LOS and v/c ratios. Care should be taken in comparing LOS and v/c ratios generated by the CLV analysis with those generated by Highway Capacity Manual methodologies; the CLV LOS and v/c ratios do, however, provide a tool for comparison of the effects of changes to roadway capacity across multiple alternatives at a planning/ preliminary engineering level.

- ARTPLAN, like CLV methodologies, provides a tool to support planning/preliminary engineering decisions related to a project's design concept and its scope. ARTPLAN, originally developed by the Florida Department of Transportation, includes the following as key inputs: roadway geometrics (number of lanes by movement type, turn lane storage lengths, etc.), traffic signal data such as cycle lengths, and vehicle arrival type information. As noted above, ARTPLAN is also a component of the Highway Capacity Software HCS 2010 Ver 6.60.

In the continuum of analysis tools from generalized planning (often based on standardized lookup tables) to detailed simulation tools such as VISSIM to support detailed design, CLV and ARTPLAN are both tools to support planning and preliminary engineering.

3.3.3 Critical Lane Volume (CLV) Analysis and Results

The locations where CLV analyses were performed are shown in **Figure 3.3-2** and the CLV results by intersection and by analysis time period (year, alternative, and peak period) are shown in **Table 3.3-1**.

Table 3.3-1. Intersection Summary from CLV Analysis

Mainline	Intersection	Key Map # (Figure 3.3-2)	Existing				2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
			AM		PM		AM		PM		AM		PM		AM		PM		AM		PM	
			LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV
Route 28	Route 28 and Godwin Drive	1	A	814	B	1002	A	958	C	1220	D	1375	F	1737	D	1448	F	1830	A	967	C	1227
	Route 28 (Center St) and Grant Avenue	2	A	767	A	837	A	933	B	1136	A	862	B	1007	A	861	B	1020	A	934	B	1132
	Route 28 (Church St) and Grant Avenue	3	A	580	A	833	A	841	C	1185	A	731	B	1042	A	727	B	1036	A	847	C	1190
	Route 28 (Center St) and Main Street	4	A	616	A	564	A	899	C	1211	A	807	B	1107	A	801	B	1090	A	873	C	1189
	Route 28 (Church St) and Main Street	5	A	459	A	558	A	648	A	891	A	543	A	743	A	535	A	733	A	640	A	877
	Route 28 and Sudley Road / Prescott Avenue	6	A	662	B	1008	A	996	D	1425	A	828	C	1248	A	824	C	1244	B	1033	E	1456
	Route 28 and Liberia Avenue	7	B	1048	C	1202	E	1490	F	1770	D	1400	E	1590	D	1365	E	1565	F	1620	F	1827
	Route 28 and Manassas Drive	8	A	872	C	1272	D	1421	F	1953	C	1220	F	1700	C	1180	F	1655	C	1208	F	1710
	Route 28 and Maplewood Drive	9	B	1104	D	1438	D	1343	F	2032	C	1162	F	1762	B	1139	F	1738	B	1107	F	1682
	Route 28 and Yorkshire Lane	10	D	1331	D	1433	E	1509	F	1994	C	1158	E	1535	B	1144	E	1515	C	1199	E	1558
	Route 28 and Orchard Bridge Drive	11	B	1132	C	1206	D	1370	F	1729	C	1207	E	1467	B	1081	D	1356	B	1078	D	1356
	Route 28 and Compton/Ordway Road	12	D	1364	E	1462	E	1510	F	1942	F	1689	F	2130	F	1911	F	2655	F	1707	F	1912
	Route 28 and Green Trails Boulevard / Old Mill Road	13	B	1146	D	1449	B	1048	C	1278	C	1167	D	1439	C	1236	F	1609	B	1066	C	1277
	Route 28 and New Braddock Road	14	D	1423	C	1294	F	1886	F	1894	F	2023	F	2039	F	2059	F	2073	E	1462	F	1749
	Route 28 and Machen Road	15	D	1423	B	1093	A	835	D	1404	A	937	E	1544	A	961	E	1580	A	845	D	1416
Godwin Dr	Godwin Drive and Wellington Road	16	A	634	A	757	B	1004	C	1207	D	1435	F	1687	E	1491	F	1752	B	1007	C	1209
	Godwin Drive and Sudley Road	17	A	607	B	1090	A	825	C	1225	D	1313	F	1696	D	1312	F	1693	A	825	C	1223
	Godwin Drive Extension and Liberia Avenue / Lomond Drive[1]	18	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	E	1523	F	1980	D	1346	F	1817	*n/a*	*n/a*	*n/a*	*n/a*
	Godwin Drive Extension and Old Centreville Road - S[1]	19	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	D	1437	F	1609	D	1350	F	1808	*n/a*	*n/a*	*n/a*	*n/a*
	Godwin Drive Extension-S and Old Centreville Road - N[1]	20	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	F	1888	F	2257	*n/a*	*n/a*	*n/a*	*n/a*
	Godwin Drive Extension-N and Route 28[1]	21	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	D	1376	F	1832	*n/a*	*n/a*	*n/a*	*n/a*
	Godwin Drive Extension-S and Route 28[1]	22	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	B	1025	F	2081	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
Old Centreville Road	Old Centreville Road and Yorkshire Lane	23	A	794	C	1249	D	1331	F	1887	A	691	B	1027	A	703	B	1036	B	1055	E	1520
Wellington Road	Wellington Road and Grant Avenue	24	A	544	C	1272	A	688	C	1234	A	646	C	1167	A	640	C	1152	A	687	C	1246
	Wellington Road and Fairview Avenue	25	A	450	A	717	A	601	A	842	A	562	A	793	A	554	A	787	A	624	A	866
	Wellington Road and Liberia Avenue and Prince William Parkway	26	B	1030	C	1261	F	1957	F	2275	F	1904	F	2228	F	1896	F	2219	F	1959	F	2286
Liberia Avenue	Liberia Avenue and Euclid Avenue	27	A	894	B	1134	B	1021	C	1226	B	1005	C	1205	A	998	C	1193	B	1056	C	1261
	Liberia Avenue and Signal Hill	28	A	870	C	1241	A	892	C	1195	A	887	C	1187	A	882	C	1181	A	902	C	1205
Mathis Avenue	Mathis Avenue and Liberia Avenue	29	A	724	B	1015	A	875	B	1046	A	714	A	880	A	709	A	874	A	916	B	1087
	Mathis Avenue and Manassas Drive	30	B	1102	A	799	A	806	A	789	A	802	A	771	A	808	A	774	A	779	A	773
Manassas Drive	Manassas Drive and Euclid Avenue	31	A	412	A	598	A	490	A	656	A	417	A	574	A	410	A	565	A	417	A	582

[1] Intersection is part of Build Alternative 2A or 2B. Intersection numbers 18, 19, 22 are part of 2A while numbers 18, 19, 20, 21 are part of 2B.

Figure 3.3-2. Key Map of Intersections for CLV Analysis Results

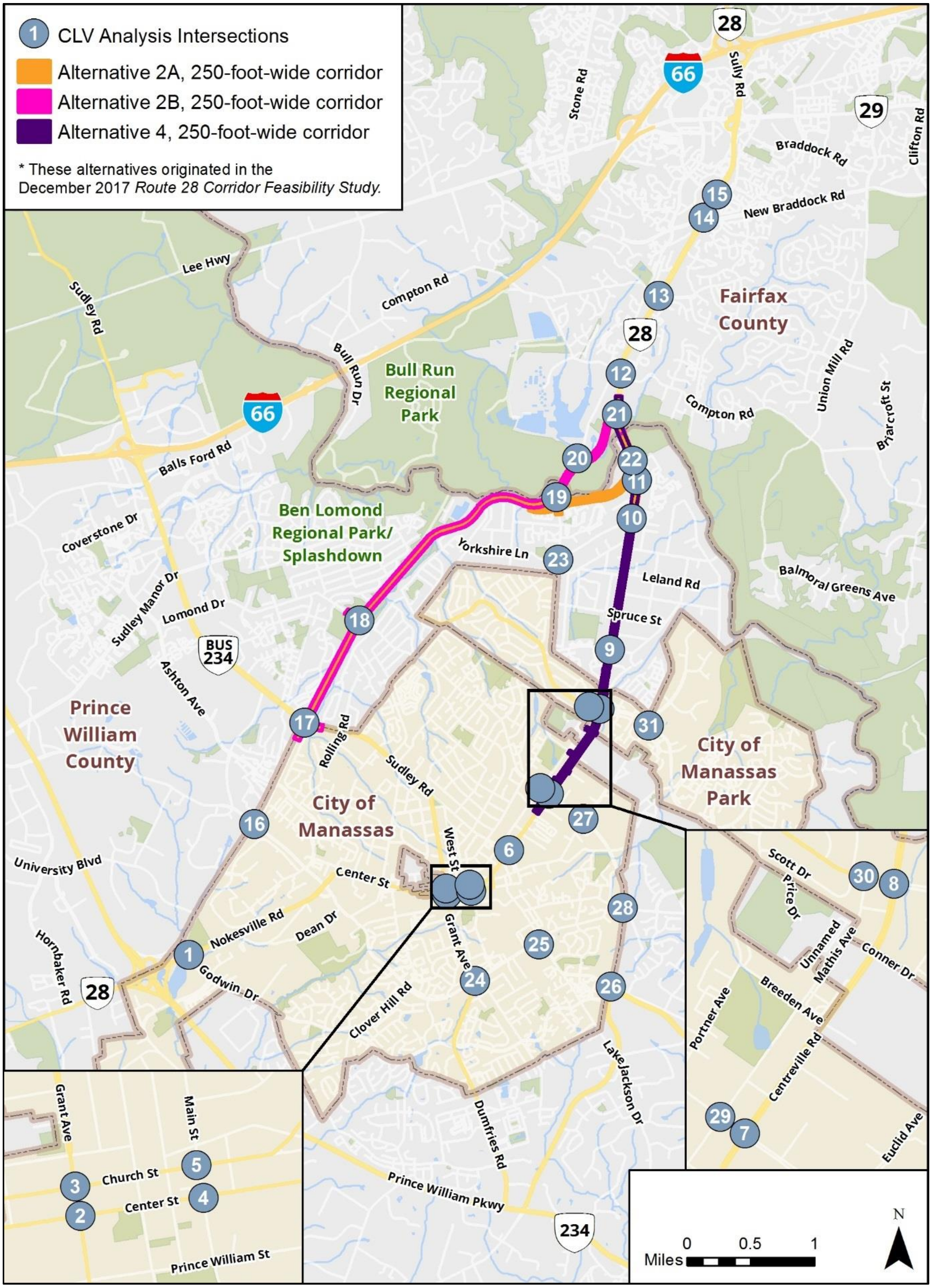


Table 3.3-2. Summary of Intersection Performance - Level of Service

Intersection Location	Existing						2040 No Build						2040 Build 2A						2040 Build 2B						2040 Build 4					
	AM			PM			AM			PM			AM			PM			AM			PM			AM			PM		
	A/B	C/D	E/F	A/B	C/D	E/F	A/B	C/D	E/F	A/B	C/D	E/F	A/B	C/D	E/F	A/B	C/D	E/F	A/B	C/D	E/F	A/B	C/D	E/F	A/B	C/D	E/F	A/B	C/D	E/F
Along Route 28	11	4	0	7	7	1	8	3	4	2	6	7	6	7	2	4	2	9	9	4	2	4	2	9	10	2	3	2	6	7
Along Godwin Drive	2	0	0	2	0	0	2	0	0	0	2	0	1	3	1	0	0	5	0	4	2	0	0	6	2	0	0	0	2	0
Along Old Centreville Road	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	1
Along Mathis Avenue	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0	2	0	0
Along Liberia Avenue	2	0	0	1	1	0	2	0	0	0	2	0	2	0	0	0	2	0	2	0	0	0	2	0	2	0	0	0	2	0
Along Wellington Road	3	0	0	1	2	0	2	0	1	1	1	1	2	0	1	1	1	1	2	0	1	1	1	1	2	0	1	1	1	1
Total	**21**	**4**	**0**	**13**	**11**	**1**	**16**	**4**	**5**	**5**	**11**	**9**	**14**	**10**	**4**	**8**	**5**	**15**	**16**	**8**	**5**	**8**	**5**	**16**	**19**	**2**	**4**	**5**	**11**	**9**

Note: Intersection of Manassas Drive and Mathis Road has been excluded from this table. It does not fall along one of the main routes focused on in the report and it performs at LOS A in all scenarios.

Table 3.3-2 summarizes the performance of intersections along each major roadway for each condition.

Compared to the 2040 No Build condition, the number of intersections that would perform at LOS E or F remains about the same in the AM peak for Alternatives 2A and 2B and would increase by 5 to 6 intersections in the PM peak. Most of the intersections that would perform at LOS E or F in Alternatives 2A and 2B occur along Godwin Drive due to the new roadway connection from Sudley Road to Route 28 near Bull Run. The anticipated increases in traffic volumes on Godwin Drive would result in more congestion and more vehicles passing through the intersections. For Alternative 4, the number of intersections that would perform at LOS E or F decreases in both the AM and PM peaks. The widening of Route 28 in Alternative 4 would provide more lanes for vehicles passing through each intersection, which increases performance.

The following is an intersection by intersection summary of the results from **Table 3.3-1**. These summaries compare the three Build conditions to the No Build condition.

<u>Route 28 and Godwin Drive:</u>

Performance levels worsen at Route 28 and Godwin Drive with Alternatives 2A and 2B. CLV values increase in both peaks, and LOS would worsen from A to a D (both alternatives) in the AM peak and from a C to F (both alternatives) in the PM peaks. This is due to the increase in vehicles turning onto Godwin Drive from Route 28 due to the extension. For Alternative 4, there is no change in CLV or LOS.

<u>Route 28 (Center Street) and Grant Avenue:</u>

Performance levels improve for Alternatives 2A and 2B. CLV values are lower in both peaks and LOS remains the same in the both peaks for both alternatives. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, there is no change in CLV or LOS.

<u>Route 28 (Church Street) and Grant Avenue:</u>

Performance levels improve for Alternatives 2A and 2B. CLV values are lower in both peaks and LOS remains the same in the AM peak and improves from C to B in PM peak for both alternatives. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, there is no change in CLV or LOS.

<u>Route 28 (Center Street) and Main Street:</u>

Performance levels improve for Alternatives 2A and 2B. CLV values are lower in both peaks and LOS remains the same in the AM peak and improves from C to B in PM peak for both alternatives. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, there is no change in CLV or LOS.

<u>Route 28 (Church Street) and Main Street:</u>

Performance levels improve for Alternatives 2A and 2B. CLV values are lower in both peaks and LOS remains the same both peaks. This improvement in CLV is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, there is no change in CLV or LOS.

Route 28 and Sudley Road / Prescott Avenue:

Performance levels improve for Alternatives 2A and 2B. CLV values are lower in both peaks and LOS remains the same in the AM peak and improves from D to C in PM peak for both alternatives. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, performance degrades slightly. CLV values are higher in both peaks and LOS would worsen from A to B in the AM peak and from D to E in the PM peak. The widening of Route 28 begins one intersection north of Sudley Road / Prescott Avenue; therefore, since there is an increase in volume due to added capacity, this intersection performs slightly worse than the No Build.

Route 28 and Liberia Avenue:

Performance levels improve for Alternatives 2A and 2B. CLV values are lower in both peaks and LOS improves from E to D in the AM peak and improves from F to E in PM peak. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, performance levels worsen slightly. CLV values are higher in both peaks and LOS would worsen from E to F in the AM peak and remains the same in the PM peak. The widening of Route 28 begins just north of this intersection; therefore, since there is a small increase in volume due to added capacity, this intersection performs slightly worse than the No Build.

Route 28 and Manassas Drive:

Performance levels improve for Alternatives 2A and 2B. CLV values are lower in both peaks and LOS improves from D to C in the AM peak and remains the same in PM peak for both alternatives. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, performance increases. CLV values decrease in both peaks, and LOS improves from D to C in the AM peak and remains the same in the PM peak. This is due to the increased number of lanes on Route 28.

Route 28 and Maplewood Drive:

Performance levels improve for Alternatives 2A and 2B. CLV values decrease in both peaks and LOS improves from D to C and B (2A and 2B, respectively) in the AM peak and remains the same in PM peak for both alternatives. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, performance levels improve and CLV values decrease in both peaks, and LOS improves from D to B in the AM peak and remains the same in the PM peak. This is due to the increased number of lanes on Route 28.

Route 28 and Yorkshire Lane:

Performance levels improve for Alternatives 2A and 2B. CLV values decrease in both peaks and LOS improves from E to C and B (2A and 2B, respectively) in the AM peak and from F to E in PM peak for both alternatives. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, performance levels improve. CLV values decrease in both peaks, and LOS improves from E to C in the AM peak and from F to E in the PM peak. This is due to the increased number of lanes on Route 28.

Route 28 and Orchard Bridge Drive:

Performance levels improve for Alternatives 2A and 2B. For Alternative 2A, CLV values decrease in both peaks and LOS improves from D to C in the AM peak and from F to E in PM peak. For Alternative 2B, CLV values decrease in both peaks and LOS improves from D to B in the AM peak and from F to D in the PM peak. This improvement is due to the reduced number of vehicles using Route 28 as opposed to the Godwin Drive extension. For Alternative 4, performance levels improve. CLV values decrease in both peaks, and LOS improves from D to B in the AM peak and from F to D in the PM peak. This is due to the increased capacity on Route 28.

Route 28 and Compton / Ordway Road:

Performance levels worsen for Alternatives 2A and 2B. CLV values increase in both peaks and LOS would worsen from E to F in the AM peak and remains the same in the PM peak. This is due to changes in traffic flow based on the new intersection configuration. For both alternatives, the Godwin Drive extension intersects with Route 28 just south of this intersection and therefore, the added volume to that new roadway merges with the Route 28 volume. For Alternative 4, CLV values increase in the AM peak and remain about the same in the PM peak. LOS would worsen from E to F in the AM peak and would remain the same in the PM peak. Overall, this intersection does not experience much change from the No Build condition.

Route 28 and Green Trails Boulevard / Old Mill Road:

Performance levels decrease for Alternatives 2A and 2B. For Alternative 2A, CLV values increase in both peaks and LOS would worsen from B to C in the AM peak and from C to D in PM peak. For Alternative 2B, CLV values increase in both peaks and LOS would worsen from B to C in the AM peak and from C to F in the PM peak. This is due to the increase in traffic volumes at this location. For Alternative 4, performance remains the same in both peaks.

Route 28 and New Braddock Road:

Performance levels worsen for Alternatives 2A and 2B. CLV values increase in both peaks but LOS remains the same. The increase in CLV values is due to the increase in volume in this part of the network with Alternatives 2A and 2B. For Alternative 4, performance levels improve. CLV values decrease in both peaks and LOS improves from F to E in the AM peak and remains the same in the PM peak.

Route 28 and Machen Road:

Performance levels worsen for Alternatives 2A and 2B. CLV values increase in both peaks and LOS remains the same in the AM peak and would worsen from D to E in both alternatives in the PM peak. This is due to the increase in volume in this part of the network. For Alternative 4, performance remains the same.

Godwin Drive and Wellington Road:

Performance levels worsen for Alternatives 2A and 2B. For Alternative 2A, CLV values increase in both peaks and LOS would worsen from B to D in the AM peak and from C to F in the PM peak. For Alternative 2B, CLV values increase in both peaks and LOS would worsen from B to E in the AM peak and from C to F in the PM peak. This is due to the increase in volume using Godwin Drive and the extension instead of

Route 28. For Alternative 4, performance levels remain the same. The widening of Route 28 does not affect the performance of Godwin Drive.

Godwin Drive and Sudley Road:

Performance levels worsen for Alternatives 2A and 2B. CLV values increase in both peaks and LOS would worsen from A to D in the AM peak and from C to F in the PM peak for both alternatives. This is due to the increase in volume using Godwin Drive and the extension instead of Route 28. For Alternative 4, performance levels remain the same. The widening of Route 28 does not affect the performance of Godwin Drive.

Godwin Drive Extension and Liberia Avenue / Lomond Drive:

This is a new intersection in Alternatives 2A and 2B. In Alternative 2A, this intersection performs at LOS E in the AM peak and LOS F in the PM peak. In Alternative 2B, this intersection performs at LOS D in the AM peak and F in the PM peak.

Godwin Drive Extension and Old Centreville Road (Southern Intersection):

This is a new intersection in Alternatives 2A and 2B. In Alternative 2A, this intersection performs at LOS D in the AM peak and LOS F in the PM peak. In Alternative 2B, this intersection performs at LOS D in the AM peak and F in the PM peak.

Godwin Drive Extension and Old Centreville Road (Northern Intersection):

This is a new intersection in Alternative 2B. It performs at LOS F in both peaks.

Godwin Drive Extension and Route 28 (Alternative 2B):

This is a new intersection in Alternative 2B. It performs at LOS D in the AM peak and F in the PM peak.

Godwin Drive Extension and Route 28 (Alternative 2A):

This is a new intersection in Alternative 2A. It performs at LOS B in the AM peak and F in the PM peak.

Old Centreville Road and Yorkshire Lane:

Performance levels improve in Alternatives 2A and 2B. CLV values decrease in both peaks and LOS improves from D to A in the AM peak and from F to B in the PM peak. This improvement is due to the reduction of vehicles using Old Centreville Road as a bypass for Route 28 since Godwin Drive has been extended. For Alternative 4, performance levels improve. CLV values decrease in both peaks and LOS improves from D to B in the AM peak and from F to E in the PM peak. This improvement is due to the reduction of vehicles using Old Centreville Road as a bypass for Route 28 since the widening adds capacity.

Wellington Road and Grant Avenue:

Performance levels improve for both Alternatives 2A and 2B. CLV values decrease in both peaks and LOS remains the same in both peaks. For Alternative 4, performance remains the same.

For the following intersections, performance remains essentially the same for all three Build alternatives when compared to the No Build:

- Wellington Road and Fairview Avenue
- Wellington Road and Liberia Avenue and Prince William Parkway
- Liberia Avenue and Euclid Avenue
- Liberia Avenue and Signal Hill Road
- Mathis Avenue and Liberia Avenue
- Mathis Avenue and Manassas Drive
- Manassas Drive and Euclid Avenue

3.3.4 ARTPLAN Analysis and Results

As described earlier, ARTPLAN analysis was also performed to provide information about the relative performance of the roadway network within the Roadway Capacity/Operations Analysis area for each of the alternatives. ARTPLAN 2012 was used for the analysis; this software provides as an output the estimated travel speeds for segments of each arterial roadway. See **Tables 3.3-3 to 3.3-8** for a summary of the results from the ARTPLAN analysis. For the full result sheets, see **Attachment F**.

Table 3.3-3. Route 28 – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-1)	Existing Speed (mph)		2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
				Speed (mph)		Change from Existing		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Godwin Drive to Wellington Road	2	43	42	41	39	-2	-3	42	38	+1	-1	42	38	+1	-1	41	40	0	+1
Wellington Road to Cockrell Road	3	30	28	28	18	-2	-10	28	41	0	+23	29	41	+1	+23	28	26	0	+8
Cockrell Road to Brinkley Lane	4	18	16	16	2	-2	-14	17	18	+1	+16	17	18	+1	+16	15	3	-1	+1
Brinkley Lane to Stonewall Road	5	28	26	27	3	-1	-23	28	14	+1	+11	28	14	+1	+11	27	10	0	+7
Stonewall Road to W Court House Road	6	20	19	18	15	-2	-4	19	26	+1	+11	19	26	+1	+11	18	8	0	-7
W Court House Road to Grant Ave (Center Street)	7	23	24	12	23	-11	-1	20	20	+8	-3	20	21	+8	-2	12	22	0	-1
Grant Ave (Center Street) to Main St (Center Street)	8	18	19	8	19	-10	0	17	24	+9	+5	17	24	+9	+5	11	16	+3	-3
Liberia Avenue to Manassas Drive	12	31	33	14	32	-17	-1	22	21	+8	-11	23	22	+9	-10	29	31	+15	-1
Manassas Drive to Browns Lane	13	18	30	4	9	-14	-21	5	15	+1	+6	5	18	+1	+9	4	25	0	+16
Browns Lane to Maplewood Drive	14	8	3	2	1	-6	-2	6	3	+4	+2	1	3	-1	+2	3	2	+1	+1
Maplewood Drive to Leland Road	15	23	9	8	4	-15	-5	8	1	0	-3	11	1	+3	-3	15	7	+7	+3
Leland Road to Yorkshire Lane	16	21	7	6	3	-15	-4	7	6	+1	+3	9	6	+3	+3	12	5	+6	+2
Yorkshire Lane to Orchard Bridge Drive	17	15	5	4	2	-11	-3	4	4	0	+2	6	5	+2	+3	8	4	+4	+2

Table 3.3-3. Route 28 – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-1)	Existing Speed (mph)		2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
				Speed (mph)		Change from Existing		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Compton/Ordway Road to Green Trails/Old Mill Road	**19**	16	8	34	10	+18	+2	33	17	-1	+7	31	17	-3	+7	35	7	+1	-3
Green Trails/Old Mill Road to New Braddock Road	**20**	16	7	33	13	+17	+6	34	13	+1	0	34	13	+1	0	33	13	0	0
New Braddock Road to Machen Road	**21**	6	4	16	4	+10	0	16	4	0	0	16	4	0	0	16	4	0	0
Machen Road to Upperridge Drive /Old Centreville Road	**22**	8	4	22	10	+14	+6	22	10	0	0	22	10	0	0	22	10	0	0

Note: Results for some arterial segments were not calculated by ARTPLAN based on high input volumes and/or geometrics that are outside of the analysis range of the software. These segments are not included in the table.

Summary: For Alternatives 2A and 2B, speeds generally increase along **Route 28** between Godwin Drive and Ordway Road / Compton Road. Diverting vehicles from Route 28 to the Godwin Drive extension reduces congestion along Route 28 and therefore increases speeds. For Alternative 4, speeds decrease between Godwin Drive and Manassas Drive, and increase between Liberia Avenue and Ordway Road / Compton Road. Widening Route 28 provides some reduction in congestion between Liberia Avenue and Ordway Road / Compton Road, but the volume of vehicles using Route 28 increases.

Table 3.3-4. Godwin Drive – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-2)	Existing Speed (mph)		2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
				Speed (mph)		Change from Existing		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
University Boulevard to Lockheed Martin Access	**3**	35	35	35	34	0	-1	32	28	-3	-6	31	21	-4	-13	35	34	0	0
Lockheed Martin Access to Wellington Road	**4**	36	36	36	34	0	-2	34	16	-2	-18	34	12	-2	-22	36	34	0	0
Wellington Road to Ashton Avenue	**5**	34	34	33	32	-1	-2	24	14	-9	-18	21	11	-12	-21	33	31	0	-1
Ashton Avenue to Sudley Road	**6**	39	38	38	37	-1	-1	34	30	-4	-7	36	31	-2	-6	38	37	0	0
Sudley Road to Lomond Drive /Liberia Avenue [1]	**7**	--	--	--	--	--	--	39	16	--	--	40	38	--	--	--	--	--	--

Note: Results for some arterial segments were not calculated by ARTPLAN based on high input volumes and/or geometrics that are outside of the analysis range of the software. These segments are not included in the table. [1] Segment is part of Build Alternative 2A or 2B.

Summary: For Alternatives 2A and 2B, speeds generally decrease along **Godwin Drive**. Diverting vehicles from Route 28 to the Godwin Drive extension increases congestion along Godwin Drive and therefore reduces speeds. For Alternative 4, speeds remain the same along Godwin Drive. Widening Route 28 does not affect the volume of vehicles using Godwin Drive; therefore, the speeds do not change.

Table 3.3-5. Old Centreville Road – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-3)	Existing Speed (mph)		2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
				Speed (mph)		Change from Existing		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Route 28 to Yorkshire Lane	**1**	27	27	13	20	-14	-7	26	26	+13	+7	26	26	+13	+7	23	25	+10	+6
Yorkshire Lane to Route 28	**2**	36	26	34	13	-1	-13	--	--	--	--	--	--	--	--	32	19	-3	+7
Yorkshire Lane to Godwin Drive Extension-Southern [1]	**3**	--	--	--	--	--	--	22	8	--	--	24	11	--	--	--	--	--	--
Godwin Drive Extension-Northern to Route 28 [1]	**5**	--	--	--	--	--	--	--	--	--	--	37	30	--	--	--	--	--	--
Godwin Drive Extension-Southern to Route 28 [1]	**6**	--	--	--	--	--	--	41	18	--	--	--	--	--	--	--	--	--	--

Note: Results for some arterial segments were not calculated by ARTPLAN based on high input volumes and/or geometrics that are outside of the analysis range of the software. These segments are not included in the table. [1] Segment is part of Build Alternative 2A or 2B.

Summary: For Alternatives 2A and 2B, speeds generally increase on **Old Centreville Road**. The extension of Godwin Drive reduces the diversion of vehicles from Route 28 to Old Centreville Road, which increases the speed from Route 28 to Yorkshire Lane. For Alternative 4, speeds increase along Old Centreville Road. Widening Route 28 reduces the volume of vehicles using Old Centreville Road as a bypass or alternate route.

Table 3.3-6. Mathis Avenue – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-4)	Existing Speed (mph)		2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
				Speed (mph)		Change from Existing		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Sudley Road to Liberia Avenue	**2**	25	24	25	22	0	-2	25	23	0	+1	25	23	0	+1	24	23	-1	+1
Liberia Avenue to Breeden Avenue	**3**	23	23	23	22	0	-1	23	20	0	-2	23	20	0	-2	23	17	-1	-5
Breeden Avenue to Manassas Drive	**4**	24	24	23	25	-1	+1	23	25	0	0	23	25	0	0	23	24	0	-1

Note: Results for some arterial segments were not calculated by ARTPLAN based on high input volumes and/or geometrics that are outside of the analysis range of the software. These segments are not included in the table.

Summary: **Mathis Road** does not experience much change in either of the three build alternatives. Speeds change by 5 mph at most.

Table 3.3-7. Liberia Avenue – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-5)	Existing Speed (mph)		2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
				Speed (mph)		Change from Existing		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Wellington Road to Shopping Center	**1**	24	24	23	24	-1	0	23	24	0	0	23	24	0	0	23	24	0	0
Shopping Center to Carwash	**2**	20	19	20	17	0	-2	20	17	0	0	20	17	0	0	20	17	0	0
Carwash to Signal Hill Road	**3**	25	23	24	22	-1	-1	24	22	0	0	24	22	0	0	24	22	0	0
Signal Hill Road to Panera Bread	**4**	21	19	20	19	0	0	20	19	0	0	20	19	0	0	20	19	0	0
Panera Bread to Richmond Avenue	**5**	20	19	19	18	-1	-1	19	18	0	0	19	18	0	0	19	18	0	0
Richmond Avenue to Quarry Road	**6**	18	20	5	9	-13	-11	5	9	0	0	5	9	0	0	5	7	0	-2
Quarry Road to Euclid Avenue	**7**	25	11	18	5	-7	-6	18	5	0	0	19	5	+1	0	18	4	0	-1
Shopping Center to Route 28	**9**	16	6	12	2	-4	-4	10	2	-2	0	10	2	-2	0	12	2	0	0

Note: Results for some arterial segments were not calculated by ARTPLAN based on high input volumes and/or geometrics that are outside of the analysis range of the software. These segments are not included in the table.

Summary: **Liberia Avenue** does not experience much change in either of the three build alternatives. Speeds change by 3 mph at most.

Table 3.3-8. Wellington Road – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-6)	Existing Speed (mph)		2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
				Speed (mph)		Change from Existing		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Fairview Avenue to Grant Avenue	**3**	25	24	24	19	-1	-5	24	21	0	+2	24	21	0	+2	24	17	0	-2

Note: Results for some arterial segments were not calculated by ARTPLAN based on high input volumes and/or geometrics that are outside of the analysis range of the software. These segments are not included in the table.

Summary: **Wellington Road** does not experience much change in either of the three build alternatives. Speeds change by 2 mph at most.

4. Conclusion

Focusing on intersections and roadway segments in the Route 28 corridor, this section provides a comparison of year 2040 intersection and corridor operations between the No Build Alternative and the Build Alternatives. Based on year 2040 intersection operations derived from the CLV analysis and the year 2040 estimated travel speeds derived from the ARTPLAN analysis, the Build Alternatives provide benefits as compared to the No-Build.

Figure 4.0-1 below shows a graphical representation of the change in volume between the No Build Alternative and each of the Build Alternatives (which were provided earlier in Table 3.1-1). As would be expected with the provision of an additional north-south route, the volumes along Route 28 decrease with Alternatives 2A and 2B.

Tables 4.0-1 through 4.0-3 summarize the effects that the three Build alternatives have on intersection operations on Route 28. These tables provide information regarding intersection operations for each intersection individually (Table 4.0-1), summaries across all intersections on Route 28 regarding changes in LOS letter grade (Table 4.0-2), and comparisons of the overall CLV total values across all 15 intersections.

As shown in Table 4.0-1, each of the Build Alternatives would result in a reduction of intersections operating at LOS E or F in at least one of the peak periods (AM or PM). Alternatives 2A and 2B would provide the highest benefit by this measure during the AM peak; reducing the number of intersections operating at LOS E or F from four intersections to two while Alternative 4 would reduce LOS E/F intersections from four to three. During the PM peak, Alternatives 2A and 2B would increase the number of intersections operating at LOS E or F from 7 to 9, while Alternative 4 would keep the number of intersections operating at LOS E or F the same as the No Build.

As shown in Table 4.0-2, seven and six of the 15 intersections on Route 28 during the AM and PM peaks, respectively, would experience no change in LOS grade for Alternatives 2A and 2B while three intersections would experience a degradation in LOS of at least one letter grade with these two alternatives. When comparing the number of intersections where LOS degrades, more intersections (5 and 6 in the AM and PM peaks, respectively) would experience LOS improvements of between 1 and 4 letter grades. For Alternative 4, more intersections would maintain the same LOS grades as the No-Build, with fewer intersections experiencing both reduced and improved LOS.

A comparison of total CLV values across all 15 intersections is shown in Table 4.0-3. While care should be used in reviewing and interpreting these totals because differences between intersections are masked when the values are totaled, the totals provide a proxy planning measure representing overall operations in the corridor. As the table shows, Alternative 4 provides the highest level of reduction in total CLV, when compared to the No Build, across all 15 intersections.

Figure 4.0-1. Change in AADT from No Build Condition to Build Conditions

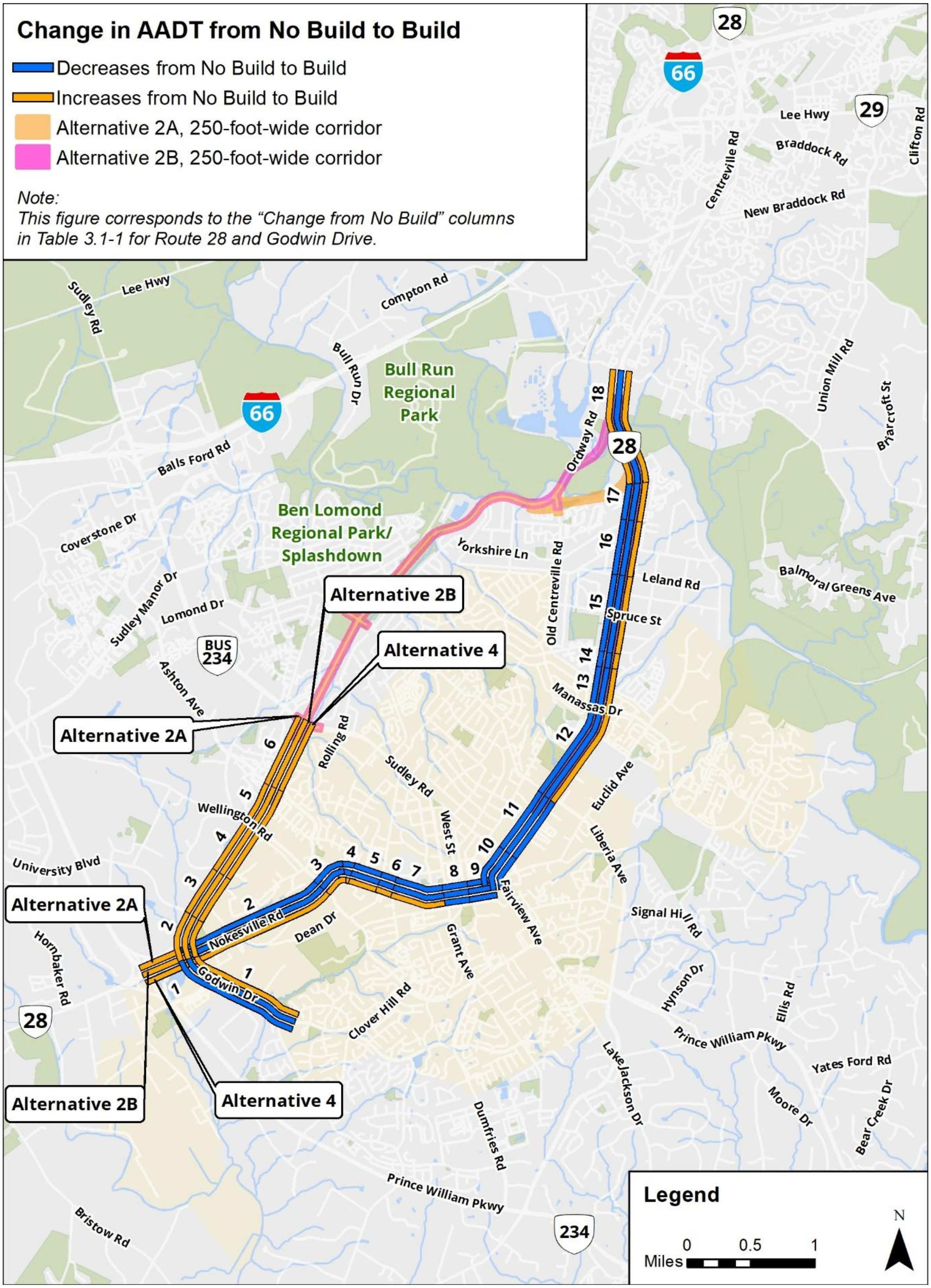


Table 4.0-1. Route 28 - Intersection Summary from CLV Analysis

Intersection	Key Map # (Figure 3.3-2)	2040 No Build				2040 Build 2A				2040 Build 2B				2040 Build 4			
		AM		PM		AM		PM		AM		PM		AM		PM	
		LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV	LOS	CLV
Route 28 and Godwin Drive	1	A	958	C	1220	D	1375	F	1737	D	1448	F	1830	A	967	C	1227
Route 28 (Center St) and Grant Avenue	2	A	933	B	1136	A	862	B	1007	A	861	B	1020	A	934	B	1132
Route 28 (Church St) and Grant Avenue	3	A	841	C	1185	A	731	B	1042	A	727	B	1036	A	847	C	1190
Route 28 (Center St) and Main Street	4	A	899	C	1211	A	807	B	1107	A	801	B	1090	A	873	C	1189
Route 28 (Church St) and Main Street	5	A	648	A	891	A	543	A	743	A	535	A	733	A	640	A	877
Route 28 and Sudley Road / Prescott Avenue	6	A	996	D	1425	A	828	C	1248	A	824	C	1244	B	1033	E	1456
Route 28 and Liberia Avenue	7	E	1490	F	1770	D	1400	E	1590	D	1365	E	1565	F	1620	F	1827
Route 28 and Manassas Drive	8	D	1421	F	1953	C	1220	F	1700	C	1180	F	1655	C	1208	F	1710
Route 28 and Maplewood Drive	9	D	1343	F	2032	C	1162	F	1762	B	1139	F	1738	B	1107	F	1682
Route 28 and Yorkshire Lane	10	E	1509	F	1994	C	1158	E	1535	B	1144	E	1515	C	1199	E	1558
Route 28 and Orchard Bridge Drive	11	D	1370	F	1729	C	1207	E	1467	B	1081	D	1356	B	1078	D	1356
Route 28 and Compton/Ordway Road	12	E	1510	F	1942	F	1689	F	2130	F	1911	F	2655	F	1707	F	1912
Route 28 and Green Trails Boulevard / Old Mill Road	13	B	1048	C	1278	C	1167	D	1439	C	1236	F	1609	B	1066	C	1277
Route 28 and New Braddock Road	14	F	1886	F	1894	F	2023	F	2039	F	2059	F	2073	E	1462	F	1749
Route 28 and Machen Road	15	A	835	D	1404	A	937	E	1544	A	961	E	1580	A	845	D	1416
TOTAL E/F:	--	4	--	7	--	2	--	9	--	2	--	9	--	3	--	7	--

Table 4.0-2. Route 28 – Change in Intersection LOS Letter Grade from No Build to Build Based on CLV Analysis

Change in LOS Letter Grade from No-Build to Build	2040 Build 2A		2040 Build 2B		2040 Build 4	
	AM	PM	AM	PM	AM	PM
1 to 3 letter grade degradation	3	3	3	3	3	1
No change in letter grade	7	6	7	6	7	12
1 to 4 letter grade improvement	5	6	5	6	5	2

Table 4.0-3. Route 28 – Change in Total CLV from No Build to Build

2040 No Build		2040 Build 2A				2040 Build 2B				2040 Build 4			
AM	PM	AM		PM		AM		PM		AM		PM	
Total CLV	Total CLV	Total CLV	Change from No Build	Total CLV	Change from No Build	Total CLV	Change from No Build	Total CLV	Change from No Build	Total CLV	Change from No Build	Total CLV	Change from No Build
17689	23064	17108	-580	22091	-973	17273	-416	22699	-365	16586	-1103	21557	-1507

As described previously, the ARTPLAN analysis provides a planning-level tool for estimating travel speeds on arterial corridors. Table 4.0-4 summarizes existing and future speeds (as estimated by ARTPLAN) along Route 28 (these values for the Route 28 intersections are extracted from the tables in Section 3.3.4 that include the wider analysis area). The diversion of traffic from Route 28 that results from Alternatives 2A and 2B results in large increases in travel speed in the southern portion of the corridor from Godwin Drive to Manassas Drive as compared to the No Build Alternative. North of Manassas Drive, the widening of Route 28 as part of Alternative 4 has a larger effect on travel times than the diversion aspect of Alternatives 2A and 2B.

Table 4.0-4. Route 28 – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-1)	2040 No Build		2040 Build 2A				2040 Build 2B				2040 Build 4			
		Speed (mph)		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Godwin Drive to Wellington Road	2	41	39	42	38	+1	-1	42	38	+1	-1	41	40	0	+1
Wellington Road to Cockrell Road	3	28	18	28	41	0	+23	29	41	+1	+23	28	26	0	+8
Cockrell Road to Brinkley Lane	4	16	2	17	18	+1	+16	17	18	+1	+16	15	3	-1	+1
Brinkley Lane to Stonewall Road	5	27	3	28	14	+1	+11	28	14	+1	+11	27	10	0	+7
Stonewall Road to W Court House Road	6	18	15	19	26	+1	+11	19	26	+1	+11	18	8	0	-7
W Court House Road to Grant Ave (Center Street)	7	12	23	20	20	+8	-3	20	21	+8	-2	12	22	0	-1
Grant Ave (Center Street) to Main St (Center Street)	8	8	19	17	24	+9	+5	17	24	+9	+5	11	16	+3	-3
Liberia Avenue to Manassas Drive	12	14	32	22	21	+8	-11	23	22	+9	-10	29	31	+15	-1

Table 4.0-4. Route 28 – Existing and Future Speeds (ARTPLAN)

Segment	Key Map # (Figure 3.1-1)	2040 No Build		2040 Build 2A				2040 Build 2B				2040 Build 4			
		Speed (mph)		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build		Speed (mph)		Change from No Build	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Manassas Drive to Browns Lane	**13**	4	9	5	15	+1	+6	5	18	+1	+9	4	25	0	+16
Browns Lane to Maplewood Drive	**14**	2	1	6	3	+4	+2	1	3	-1	+2	3	2	+1	+1
Maplewood Drive to Leland Road	**15**	8	4	8	1	0	-3	11	1	+3	-3	15	7	+7	+3
Leland Road to Yorkshire Lane	**16**	6	3	7	6	+1	+3	9	6	+3	+3	12	5	+6	+2
Yorkshire Lane to Orchard Bridge Drive	**17**	4	2	4	4	0	+2	6	5	+2	+3	8	4	+4	+2
Compton/Ordway Road to Green Trails/Old Mill Road	**19**	34	10	33	17	-1	+7	31	17	-3	+7	35	7	+1	-3
Green Trails/Old Mill Road to New Braddock Road	**20**	33	13	34	13	+1	0	34	13	+1	0	33	13	0	0
New Braddock Road to Machen Road	**21**	16	4	16	4	0	0	16	4	0	0	16	4	0	0
Machen Road to Upperridge Drive /Old Centreville Road	**22**	22	10	22	10	0	0	22	10	0	0	22	10	0	0

Note: Results for some arterial segments were not calculated by ARTPLAN based on high input volumes and/or geometrics that are outside of the analysis range of the software. These segments are not included in the table.

The analysis on Route 28 described in this section highlights that the alternatives under study would provide different levels of benefit on different sections of Route 28. By providing an additional option for north-south travel, the analysis described above demonstrates that, from a traffic operations standpoint, Alternatives 2A and 2B provide benefits over a larger section of Route 28.