Manassas
HISTORIC HEART. MODERN BEAT.

City of Manassas

TRANSPORTATION MASTER PLAN

September 2019

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City of Manassas 2019 Transportation Master Plan

INTRODUCTION

The City of Manassas finds itself at a point in time when transportation issues are coming to the forefront both in citizen concerns as well as in the City's plans for the future. As the City moves forward, the "quality of life" aspects of transportation planning, developing an improved pedestrian and bike network, reducing traffic congestion from regional traffic passing through the City, and making all streets feel safer, are going to continue to take on increased relevance.

The City of Manassas undertook the Transportation Master Plan process in order to address the rising need to comprehensively address transportation planning issues at this critical juncture; including the following efforts:

- Documenting existing traffic volumes and travel patterns
- Travel demand forecasting for the target year of 2040
- Citywide traffic modelling and traffic analysis
- Evaluating complete street designs and policy needs
- Assessing pedestrian and bicycle connectivity, including bike share feasibility assessment
- Evaluating future transportation needs
- Engaging key stakeholders and the public in the process.

This report represents culmination of this effort representing a roadmap to guide future transportation planning and street design, and including a set of recommended traffic, pedestrian, and bicycle infrastructure investments.

EXISTING CONDITIONS

Existing conditions around the City of Manassas were documented through data collection, stakeholder interviews (see Appendix B), community input via the ongoing Community Conversations effort[1], and direction from City staff.

Transportation Context

Three major regional transportation planning processes are ongoing in the vicinity of Manassas. The ongoing Route 28 Feasibility Study has the most direct effect on the City's transportation landscape, as the alternative selected will determine the volume and path of traffic going to, through and around the City. For the purpose of this study, the City has assumed that Alternative 2B, which includes a bypass roadway running from the intersection of VA-28 and VA-658/Ordway Road to the intersection of Sudley Road and Godwin Drive, with Godwin Drive being widened as an extension of the bypass. The I-66 outside-the-beltway project will bring tolled express lanes to a 22-mile stretch of that corridor along with added bus transit service and 11 miles of pedestrian and bike trails. Lastly, Virginia Railway Express (VRE) is planning service improvements to the Manassas Line, the most impactful of which will be the planned expansion of the Broad Run Station. That station, which is located astride the City/County line near the Manassas Airport, will receive a third track, an extension of the existing platform, a significant parking expansion, and a pedestrian tunnel beneath the tracks linking the two sides of the station.

[1] The City's Community Conversations effort is the Community Engagement portion of the Comprehensive Plan Update. It has included two phases of Community Conversations meetings, pop-up events, HOA meetings, and an online engagement tool, Let's Talk Manassas. Findings from the Community Conversations process have been collated into twelve key priority areas, including four that bear directly on the Transportation Master Plan (Traffic & Access, Public Transportation, Non-Motorized Travel, and Safety & Police Services). More detail at https://www.manassascity.org/2325/Community-Conversations.

Meanwhile, new development projects in and near Manassas continue to increase the demand for mobility on the existing roadway network. Providing an adequate transportation network that safely accommodates all roadway users including vehicles, pedestrians, bicycles and transit is paramount to that objective.

Planned Transportation Investments in the City of Manassas

Capital Improvement Program

The Adopted Fiscal Year 2019 Five-Year Capital Improvement Program (CIP) includes nineteen transportation improvement projects, as summarized in Figure 1 and in Table 1. Additionally, there are two maintenance projects that are included in the FY19 CIP, as shown in Figure 1 and Table 2, that relate to the transportation network. Projects funded in the VDOT Six Year Program are marked with an asterisk in the following tables. Many of these projects will improve the capacity of roadways or intersections and others will improve the bicycle and pedestrian networks.

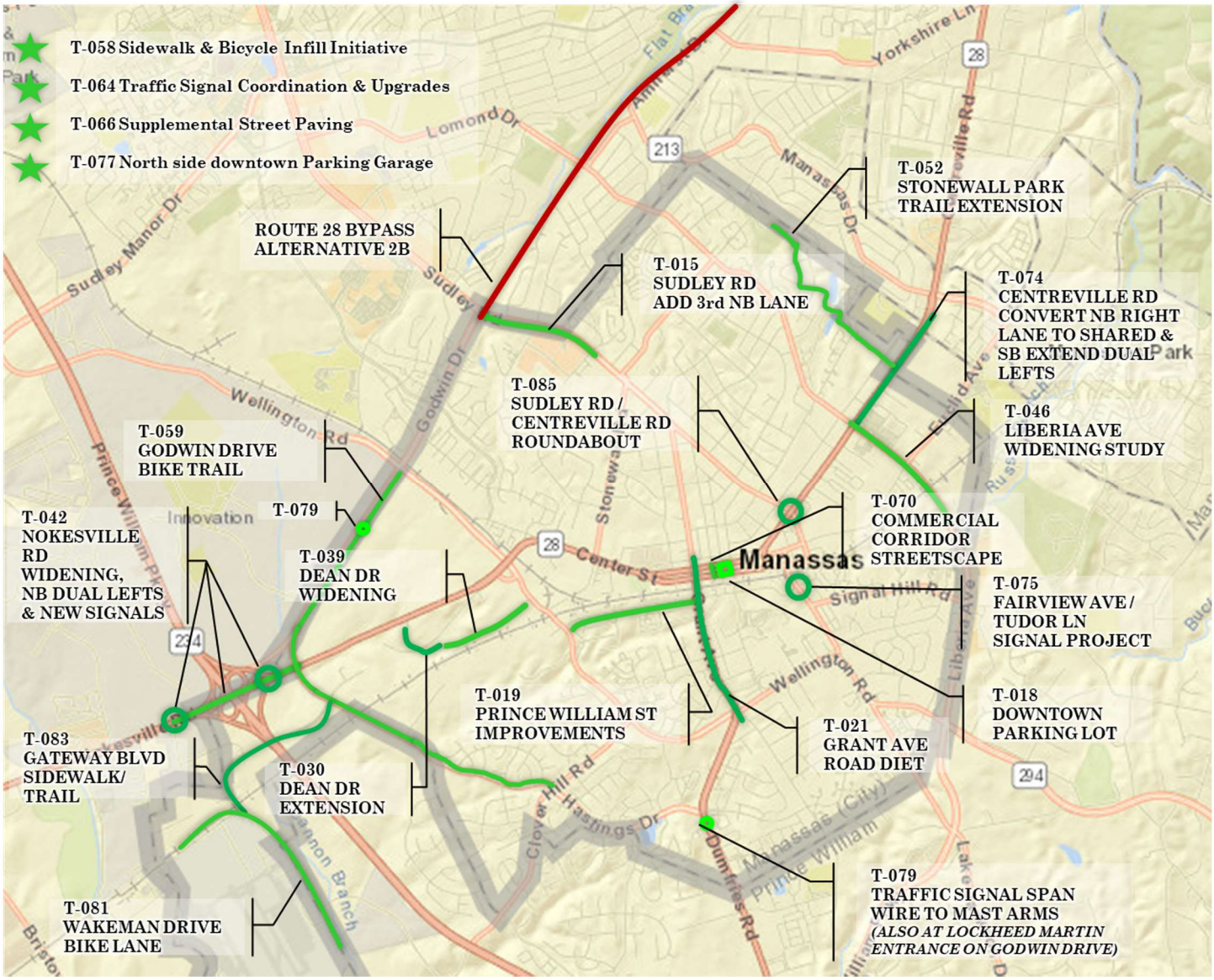


Figure 1: FY19 Adopted Capital Improvement Program Roadway Improvements + Route 28 Bypass

Table 1: Summary of Transportation Improvement Projects from FY19 CIP

** Projects funded in the VDOT Six Year Program*

ID	Name	Short Description	Extent
T-015*	Sudley Road Third Lane	Install northbound third lane on Sudley Road with curb, gutter, sidewalk, and drainage.	From Grant Avenue to Godwin Drive.
T-018	Land Acquisition (Downtown Parking Lot)	Purchase a privately-owned parking lot to increase public parking	North of Prince William Street between West Street and Battle Street
T-019*	Prince William Street	Widen and install curb, gutter, sidewalk, bike lanes, and storm drainage.	From Grant Avenue to Wellington Road
T-021	Grant Avenue	Reconstruct 4 lanes to 2 lanes with turn lanes, median, pedestrian improvements, bike path, and streetscaping.	From Lee Avenue to Wellington Road
T-030*	Dean Drive Extended	Extend and improve Dean Drive by installing curb, gutter, sidewalk, and drainage.	From existing cul-de-sac to animal shelter
T-039	Dean Drive	Widen Dean Drive and add curb, gutter, sidewalk, and a shared use trail.	From animal shelter to Wellington Road
T-042*	Route 28/Nokesville Road Widening	Widen Route 28 to six lanes southwest of Godwin Drive. Install northbound Route 28 dual left turn lanes. Install signal for northbound Route 234 off-ramp to turn left at Godwin Drive. Install street lights and shared use path.	From Pennsylvania Avenue to Godwin Drive
T-046*	Liberia Avenue Improvements	VDOT STARS Study analyzing Liberia Avenue for safety improvements and congestion relief: signal optimization, widening from four to six lanes (Quarry Rd to Route 28), and bridge improvement options.	From Wellington Road to Centreville Road
T-052*	Stonewall Park Trail Extension	Construct trail extension according to the Bikeway and Pedestrian Master Plan.	From Stonewall Road to Route 28
T-058	Sidewalk & Bicycle Infill Initiative	Citywide installation of trails, sidewalks, and bike facilities or other pedestrian / bicycle improvements.	Specific projects included and future projects to be planned.
T-059*	Godwin Drive Bike Trail	Install a shared use path along Godwin Drive.	From Wellington Road to Hastings Drive
T-070	Commercial Corridor Streetscapes	Plan, design, and construct streetscape enhancements within the Route 28, Mathis Avenue, and Sudley Road commercial corridors and the Historic District.	Route 28, Mathis Avenue, and Sudley Road commercial corridors and Historic District
T-074	Centreville Road Improvements	Extend southbound Route 28 dual left-turn lanes at Liberia Avenue. Restripe northbound Route 28 right-turn lane as shared north of Liberia Avenue. Install pedestrian improvements.	Intersection of Route 28 and Liberia Avenue and north on Route 28 to Manassas Drive

ID	Name	Short Description	Extent
T-075	Fairview Avenue / Tudor Lane Signal Project	Signalize the intersection when warranted. (The 2019 signal warrant study determined that a signal is not yet warranted. Estimated 2023 date.)	Intersection of Fairview Avenue and Tudor Lane
T-077	North Side Downtown Parking Garage	Conduct study to determine size and location of new parking garage.	North side of downtown
T-079*	Traffic Signal Span Wire to Mast Arms	Upgrade traffic signal equipment and replace span wire with mast arms.	Intersections of Dumfries Road at Milic Street / Donner Drive and Godwin Drive and Lockheed Martin entrance
T-081	Wakeman Drive Bike Lane	Construct bike lane along both sides of Wakeman Drive	From Harry J. Parrish Boulevard to the Gateway Business Park
T-083	Gateway Boulevard Sidewalk / Trail	Upgrade existing sidewalk and install shared use path along Gateway Boulevard and Carolina Drive.	From Wakeman Drive to Godwin Drive
T-085	Roundabout Sudley Rd / Centreville Rd	Evaluate replacing existing signal with two-lane roundabout.	Intersection of Sudley Road and Centreville Road

Table 2: Summary of Maintenance Projects from FY19 CIP

** Projects funded in the VDOT Six Year Program*

ID	Name	Short Description	Extent
T-064*	Traffic Signal Coordination & Upgrades	Upgrade traffic signal software and equipment and optimize timings	Citywide
T-066*	Supplemental Street Paving	Maintain streets	Citywide

Regional Projects

Various regional projects are located in or near the City of Manassas that may affect short-term and/or long-term transportation planning for the City and are summarized in Table 3.

Table 3: Summary of Regional Transportation Projects

Name	Short Description	Extent
Route 28	Construct a new roadway to relieve congestion along Route 28. The study is currently completing the NEPA phase.	The Bypass will connect Godwin Drive with Route 28 north of the City. Alternative 2B is the assumed selected option (see Figure 1).
I-66 Outside-the-Beltway	The project will bring tolled express lanes to a 22-mile stretch of I-66, along with added bus transit service and 11 miles of pedestrian and bike trails.	I-495 to Gainesville

Name	Short Description	Extent
Broad Run Station Expansion	Expansion will nearly double the footprint of the station. While existing station facilities are all on the south side of the tracks, a new parking facility will be added on the north side, along with a Pedestrian tunnel linking the two sides. A third track, additional train storage space, and new yard buildings will increase overall capacity at the station.	Immediately to the west of the City, adjacent to the airport.

Traffic Congestion and Safety

The following traffic and safety issues were summarized from public comments during the Community Conversations process.

- **Safety and Police Services.** Safety in general was a priority for many participants. They perceived Manassas to be safe generally, yet were concerned about some issues. These include police being lenient with parking violations, being more reactive and less proactive, and neighborhoods needing foot patrols. Poor lighting in garages and parking areas is a concern that was voiced.
- **Traffic and Access.** Concern is that getting in and out of Manassas is difficult due to traffic and congestion, with commercial corridors in particular becoming congested. Inadequate signal timing was cited as a major contributing factor to congestion. Drivers cutting through neighborhoods (on Oakenshaw, Richmond, Kirby, and Liberia) can be disrupting to neighborhood cohesiveness and is a safety issue. Also, the lack of traffic enforcement leads to a lot of speeding.
- **Schools.** Drivers park their cars too close to the bus stops blocking the stop and creating a dangerous situation for children.

Crash Data

A discussion was held with the City Police regarding road safety, and the 2017 Annual Police Report was consulted. Crash history shows the cause of most crashes in the City were due to failure to yield right of way (mostly red light running), failure to maintain proper control, and following too closely (which resulted in rear end crashes) according to the 2017 annual police report. The top ten intersections in the City that experienced the highest crashes are included in Table 1 along with the number of crashes, injuries, and fatalities during the most recent year of available data (2017). No fatalities occurred at these locations, but two were reported elsewhere in the City.

Table 4: 2017 Crashes in Manassas

Rank	Intersection	Total Crashes	Injuries
1	Centerville Road (Route 28) / Liberia Avenue	18	2
2	Euclid Avenue / Liberia Avenue	16	1
3	Godwin Road / Wellington Road	11	5
4	Grant Avenue / Prince William Street	9	4
5	Nokesville Road / Godwin Road	9	1
6	Centreville Road (Route 28) / Phoenix Drive	8	3
7	Mathis Avenue / Liberia Avenue	5	0

Rank	Intersection	Total Crashes	Injuries
8	Centreville Road / Sudley Road	4	0
9	Stonewall Road / Sudley Road	3	0
10	Sudley Road / Rolling Road	1	0

Source: Manassas City Police Department 2017 Annual Report
http://www.manassascity.org/DocumentCenter/View/31808/2017-Annual-Report?bidId

The Study team compiled all reported crashes from 2011 to 2017 in the City of Manassas, per VDOT. A reportable crash must have a fatality, an injury, or property damage of at least $1,500.00. Data gathered by state, local, and other law enforcement officials is sent to the Virginia Department of Motor Vehicles (DMV) for processing into the Traffic Records Electronic Data System (TREDS). Figure 2 summarizes the collision type and severity for this data set.

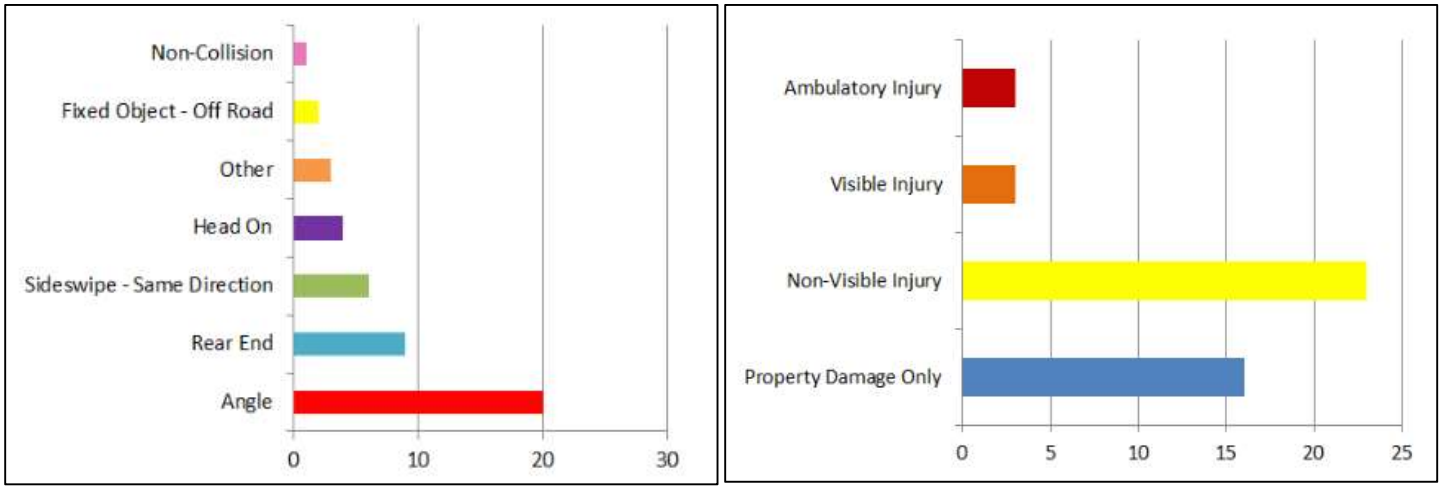


Figure 2: Type and Severity of Crashes from 2011 to 2017

Existing Traffic Volume and Data Collection

Historical traffic counts for signalized intersections were compiled from available sources, including the Route 28 and Liberia Avenue studies, developer traffic impact studies, and planning studies. Data more recent than 2015 was used to help build the traffic model. Locations with data recorded in 2014 or 2015 were validated by performing spot counts to compare volumes. Peak hour traffic counts were performed in October 2018 for locations without historical counts available.

Vehicular, bicycle, and pedestrian volumes were documented during the AM, midday, and PM peak periods. Counts were performed on a typical weekday when schools and Congress were in session. Detailed traffic count data is included in Appendix B.

Synchro Model Development

AM and PM peak hour models were created for this Transportation Management Plan using Synchro 10. The modeling effort focused on the intersections within Manassas as the most appropriate tool for analysis. Within an urban context, intersection delays will be reflected in the performance of adjacent roadway links and vice versa. Therefore, there is no need to conduct a link-level analysis to supplement the intersection analysis.[2]

Traffic volumes collected and recorded at the 61 signalized intersections were input into the Synchro traffic model along with City-provided traffic signal timings. The AM and PM peak hours for each intersection was used as opposed to the

[2] Only three roadway sections are recommended for widening, both in the 2040 recommendations set – Godwin Drive from Nokesville Road to Sudley Road, Liberia Avenue from Centreville Road to Euclid Avenue, and Liberia Avenue/Prince William Parkway from north of Wellington Road/ to south of Hastings Drive.

network peak hour to provide a conservative analysis. When appropriate, traffic volumes were balanced to account for discrepancies between adjacent intersections.

Summary of Existing Capacity Analysis

A capacity analysis was performed using Synchro 10 and Highway Capacity Manual (HCM) methodology for the signalized intersections. The measures of effectiveness evaluated in the study include average control delay, level of service (LOS), and volume-to-capacity (v/c) ratio. LOS, as defined by the HCM, is a "qualitative measure describing operational conditions within a traffic stream." LOS ranges from A to F, where a LOS A represents optimal conditions and a LOS F represents saturated or failing conditions (see Figure 3). The v/c ratio is the ratio of the current flow rate to capacity and is used to assess the sufficiency of a roadway facility such as an intersection. A v/c ratio of 1.0 indicates that the facility is operating at capacity, and a ratio greater than 1.0 indicates that the facility is failing as the number of vehicles exceeds the roadway capacity. The delay, volume-to-capacity ratio, and level of service are shown for the overall intersection.

The City's signalized intersections operate at an overall acceptable level of service (LOS D or better) during the peak hours, with the exception of two locations along Liberia Avenue: Route 28/Centreville Road and Prince William Parkway. Six intersections operate at an overall LOS D during one or both peak hours. The map shown in Figure 4 depicts the level of service for each signalized intersection in the City. Green and yellow indicate acceptable levels of service while red shows locations with failing levels of service during the morning and/or the afternoon peak hour. Table 5 provides a summary of the delay, level of service, and volume-to-capacity ratio for all 61 signalized intersections in the City.

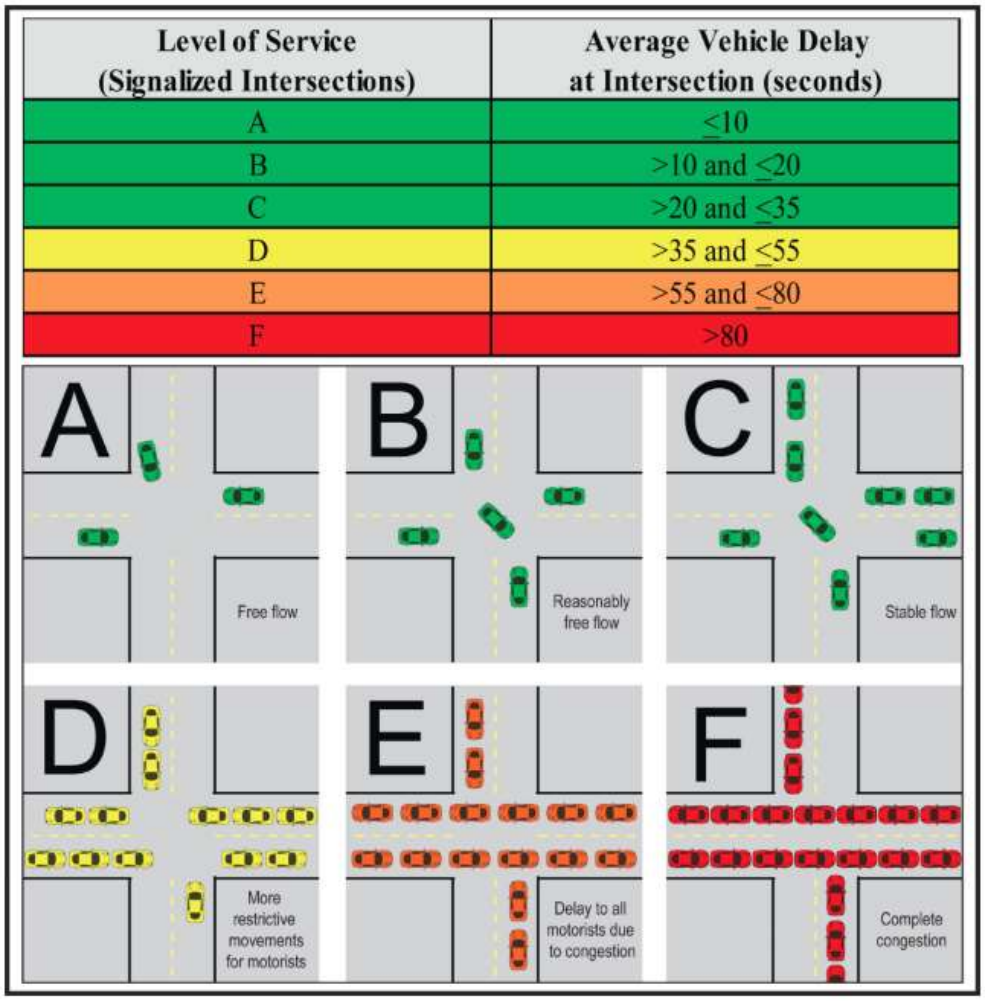


Figure 3: Level of Service (LOS) Definitions

City of Manassas Master Plan

Intersection Level of Service

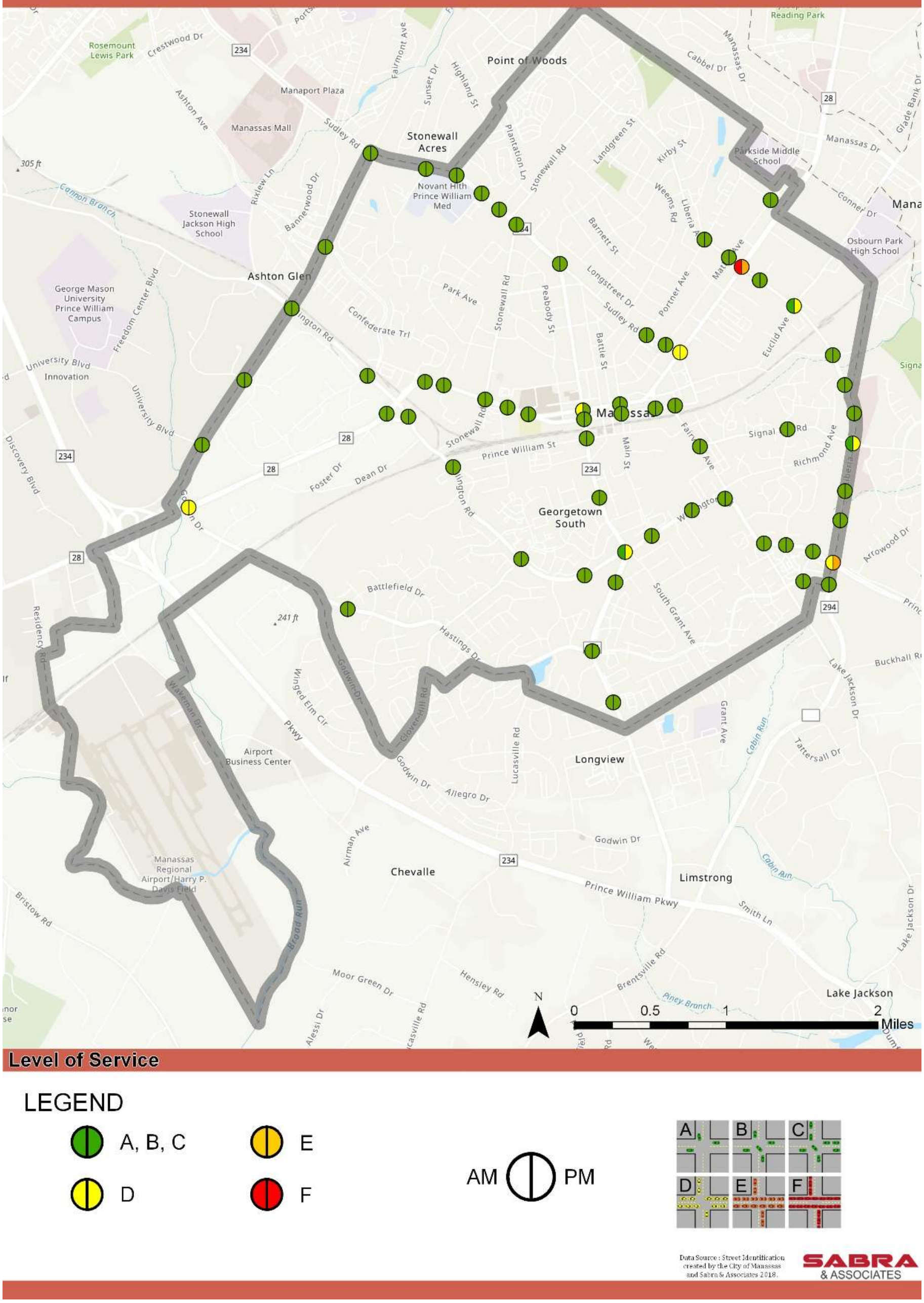


Figure 4: Existing Conditions Intersection Level of Service

Table 5: Summary of Existing Capacity Analysis by Overall Intersection – Without Improvements

Intersection	Synchro 10 (HCM 6th) Results					
	Delay (sec/veh)		v/c Ratio		Level of Service	
	AM	PM	AM	PM	AM	PM
Godwin Dr & Sudley Road	18.3	26.9	0.45	0.70	B	C
Rolling Rd & Sudley Road	18.8	21.3	0.40	0.57	B	C
Digges Rd & Sudley Road	12.8	17.9	0.39	0.53	B	B
Sudley Rd & Plantation Ln	12.3	15.1	0.35	0.53	B	B
Stonewall Rd & Sudley Rd	15.7	20.5	0.40	0.56	B	C
Grant Ave & Sudley Rd	19.3	31.4	0.43	0.58	B	C
Route 28 (Church St) & Grant Ave	38.8	29.9	0.66	0.68	D	C
Grant Ave & Route 28 (Center St)	27.7	21.7	0.77	0.58	C	C
Grant Ave & Prince William St	22.8	22.9	0.49	0.70	C	C
Grant Ave & Byrd Dr / Bartow St	7.2	4.1	0.35	0.31	A	A
Rte 234 (Dumfries Rd / Grant Ave) & Wellington Rd	32.9	49.8	0.57	0.73	C	D
Route 234 (Dumfries Rd) & Hastings Dr	24.6	26.3	0.63	0.61	C	C
Route 234 (Dumfries Rd) & Donner Dr / Milic St	13.6	13.4	0.27	0.32	B	B
Portner Ave & Sudley Rd	13.6	15.8	0.33	0.45	B	B
Mathis Ave & Sudley Rd	11.9	16.5	0.32	0.54	B	B
Route 28 (Centreville Rd) & Sudley Rd / Prescott Ave	36.2	42.7	0.71	0.76	D	D
Portner Ave & Liberia Ave	27.6	31.7	0.54	0.55	C	C
Liberia Ave & Mathis Ave	23.7	34.0	0.42	0.61	C	C
Route 28 (Centreville Rd) & Liberia Ave	91.0	67.9	1.01	0.92	F	E
Sheehy / Manassas Junction Driveways & Liberia Ave	7.8	22.8	0.39	0.60	A	C
Euclid Ave & Liberia Ave	22.1	38.9	0.59	0.74	C	D
Liberia Ave & Quarry Rd	6.6	6.4	0.57	0.67	A	A
Liberia Ave & Richmond Ave	11.2	12.3	0.49	0.58	B	B
Liberia Ave & Signal Hill Rd	34.9	45.3	0.73	0.78	C	D
Prince William Pkwy / Liberia Ave & Wellington Rd / Prince William Pkwy	51.4	78.2	0.86	0.96	D	E
Prince William Pkwy & Hastings Dr	17.1	11.3	0.63	0.65	B	B
Liberia Ave & Chick-fi-A Driveway / Walmart Driveway	6.3	28.6	0.43	0.59	A	C
Wellington Rd & Fairview Ave	11.5	13.5	0.42	0.53	B	B
Main St & Route 28 (Church St)	8.1	8.8	0.46	0.52	A	A
Main St & Route 28 (Center St)	10.3	8.7	0.58	0.49	B	A
Fairview Ave & Center St	15.0	24.7	0.46	0.73	B	C
Mathis Ave & Breeden Ave	15.4	14.9	0.50	0.53	B	B
Godwin Dr & Ashton Ave	23.2	32.6	0.47	0.61	C	C
Godwin Dr & Wellington Rd	29.2	34.0	0.55	0.62	C	C
Godwin Dr & Lockheed Martin Access	4.5	9.5	0.23	0.34	A	A
Godwin Dr & University Blvd	19.8	23.0	0.43	0.47	B	C

Intersection	Synchro 10 (HCM 6th) Results					
	Delay (sec/veh)		v/c Ratio		Level of Service	
	AM	PM	AM	PM	AM	PM
Godwin Dr & Route 28 (Nokesville Rd)	38.7	49.3	0.67	0.78	D	D
Stonewall Rd & Route 28 (Center St)	16.2	10.1	0.41	0.37	B	B
Prince William St & Wellington Rd	12.4	19.0	0.38	0.56	B	B
Clover Hill Rd & Wellington Rd	29.2	26.4	0.33	0.42	C	C
Wellington Rd & Hampton Rd	11.9	16.7	0.29	0.41	B	B
Hastings Dr & Battlefield Dr	9.9	9.4	0.14	0.21	A	A
Route 234 Dumfries Rd & Orchard Ln	6.2	3.8	0.29	0.29	A	A
Wellington Rd & S Main St	10.2	13.5	0.39	0.52	B	B
Lake Jackson Dr / Dutchman Ct & Wellington Rd	15.2	12.6	0.42	0.46	B	B
Hospital / Dorsey Cir & Sudley Rd	10.3	10.1	0.37	0.52	A	B
Liberia Ave & Davis Ford Crossing	4.9	6.8	0.38	0.55	A	A
Liberia Ave & TD Bank Driveway / Patient First Driveway	5.9	15.3	0.43	0.56	A	B
Fairview Ave & Manassas PD / Signal Hill Rd	19.9	20.0	0.47	0.49	B	C
Oakenshaw Dr / Mayfield Ct & Signal Hill Rd	13.4	8.6	0.36	0.32	B	A
OHS & Wellington Rd	9.6	8.1	0.43	0.46	A	A
Market St & Wellington Rd	17.6	29.9	0.35	0.59	B	C
Hastings Dr & Market St	3.9	9.2	0.15	0.19	A	A
Libeau Dr / Oakenshaw Dr & Wellington Rd	9.3	10.6	0.33	0.39	A	B
Route 28 (Nokesvile Rd / Center St) & Brinkley Ln	11.6	12.1	0.40	0.49	B	B
Ashton Ave & Wellington Rd	21.2	23.9	0.29	0.40	C	C
Wellington Rd Connector & Wellington Rd	12.7	13.9	0.23	0.41	B	B
Route 28 (Center St) & Rescue Squad	2.3	2.4	0.29	0.30	A	A
Wellington Rd Connector & Route 28 (Nokesville Rd)	14.1	15.0	0.46	0.36	B	B
Lee Ave / W Courthouse & Route 28 (Center St)	9.6	11.0	0.32	0.35	A	B
Cockrell Rd & Route 28 (Nokesville Rd)	15.9	27.8	0.47	0.55	B	C
Route 28 (Center St) & Route 28 (Zebedee St)	8.0	5.3	0.40	0.35	A	A

Bicycle and Pedestrian Network Needs

Bicycle Network

The existing bicycle network in the City of Manassas includes a number of bike lane and shared use path sections throughout the City that are not well connected. In some cases, infrastructure has been implemented as a target of opportunity, such as the bike lanes on sections of Clover Hill Road and Euclid Avenue that were installed in 2018 when those roadways were repaved. A system of signed bicycle routes has been implemented in an attempt to connect the dispersed pieces of bicycle infrastructure.

The City has taken measures, through the CIP process, to address the gaps in the bicycle network. Shared use paths are planned and funded for sections of Godwin Drive, Gateway Boulevard, Grant Avenue and Dumfries Road, while bike lanes have been planned or are under construction on portions of Prince William Street, Wakeman Drive, and Dean Drive. Combined, these investments will significantly improve the connectivity of the Manassas bicycling network and provide safe cycling connections between sections of the City where previously none existed (see Figure 5).

Even accounting for those new connections, there are major gaps in the overall bicycle network, including:

- **North-south imbalance**. The number of cycling connections in the southern half of the City (south of Norfolk Southern/VRE tracks) greatly outweighs those in the northern half. While the southern portion of Manassas is not well-connected, it has far more infrastructure than neighborhoods to the north.
- **Lack of north-south routes**. The City possesses one strong east-west route comprised of the Wellington Road shared use path and the Winters Branch Trail, which will become even more complete when additional sections of shared use path are constructed on Wellington Road and Godwin Drive. No comparable north-south connection exists, and public comments received in the September, 2018 town hall specifically highlighted the lack of connection between residential areas north of downtown and Jennie Dean Park.
- **Lack of penetration into neighborhoods**. The City's bicycle network generally does not extend into residential neighborhoods, and those routes that do serve residential areas are almost entirely simple, signed bike routes.

Feedback on the City's bicycle network received during the Community Conversations process focused on the need for more bike racks throughout the City and the need to connect the existing sections of the Wellington Road shared use path.

Pedestrian Network

The City's pedestrian network is highly comprehensive on the one hand, with ADA-compliant sidewalks on the vast majority of streets, while at the same time actual connectivity and walkability are not what they should be for a City with such a high percentage of sidewalk coverage, due to the following issues:

- **North-of-downtown sidewalk "hole."** While most residential neighborhoods in Manassas have comprehensive sidewalks, there are two notable exceptions. The neighborhood directly north of downtown, between Stonewall Road and Sudley Road, for the most part lacks sidewalks. The neighborhood directly across Sudley Road from this area has, at best, 50% sidewalk coverage. Combined, these two areas create a glaring "hole" in the City's overall pedestrian network that limits connectivity between sections of Manassas. Even Sudley Road and Grant Avenue, arterials that bisect this area, have substantial sidewalk coverage gaps.
- **Isolated neighborhoods**. Several neighborhoods within Manassas were developed according to the common practice of the late 20th century, characterized by a trunk and branch arrangements of streets ending in cul-de-sacs, with few outlets onto arterial streets. Long, roundabout walking routes to cover short distances are the norm in such neighborhoods. The southwestern part of Manassas between Wellington Road and Godwin Drive is a prime example of this development pattern.

- **Lack of pedestrian accommodation at major intersections**. At many of the City's intersections on its busiest roadways, pedestrian accommodations seem to have been an afterthought in their design. Public comments gathered through Community Conversations, at town hall meetings, and in stakeholder interviews point to five corridors and ten individual intersections in need of improvements (see additional details in Recommendations section). While crosswalks exist at these locations, high-radius slip ramps, wide crossing distances, and inadequate pedestrian signal phases all too often make negotiating these intersections on foot a harrowing experience.

Feedback on the City's pedestrian network received during the Community Conversations process focused on the need to continue the pace of sidewalk improvements in neighborhoods and to improve pedestrian access to transit.

City of Manassas Transportation Master Plan

Bicycle Facilities - Existing and Funded

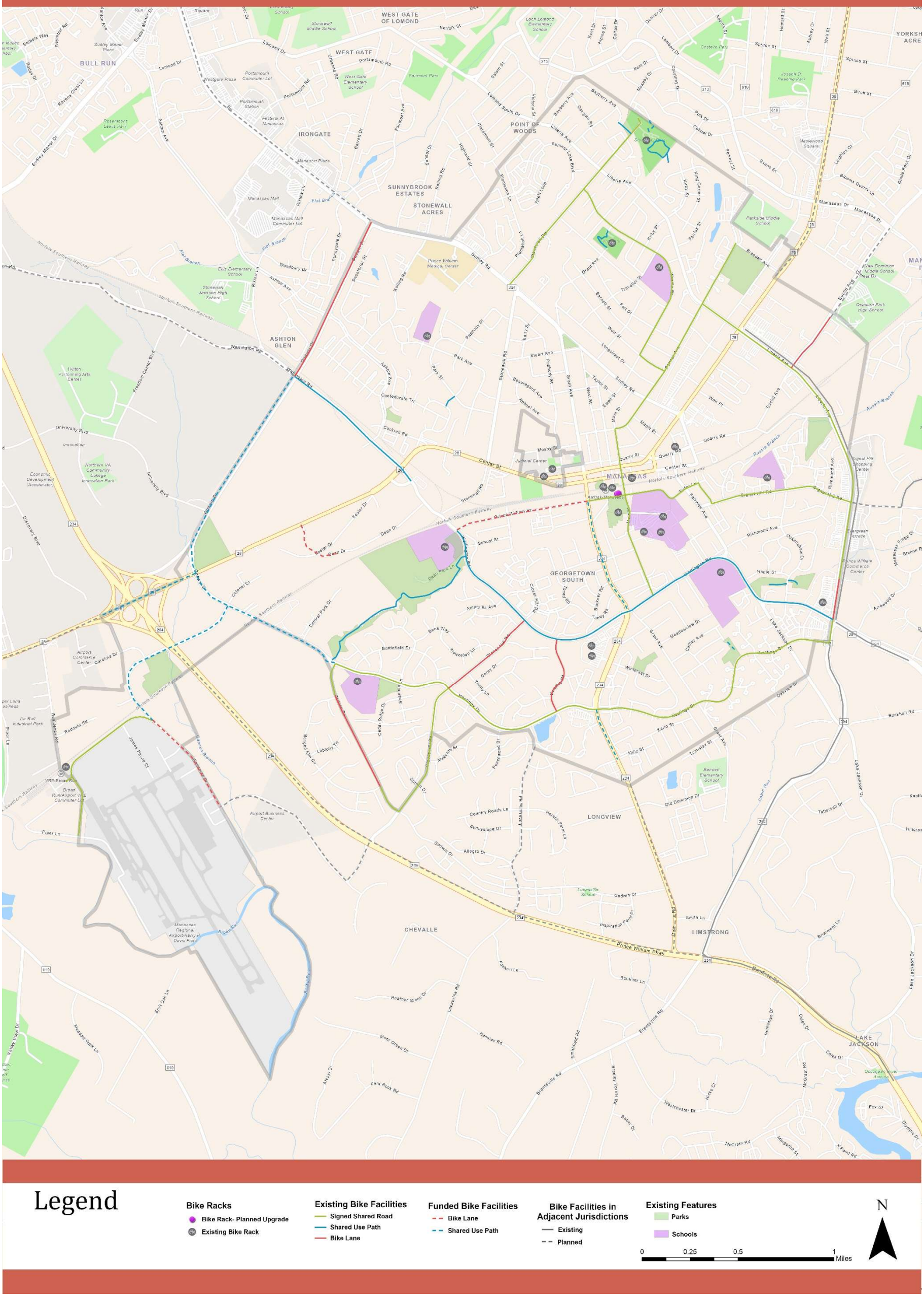


Figure 5: Existing and Funded Bicycle Infrastructure in Manassas

Transit Service

Feedback on the City's transit service received during the Community Conversations process focused on the need for more frequent, weekend, and reverse-commute service, the need for more and better options for disabled passengers, and the desire to have a transit hub within the City.

PRTC / OmniRide

The Potomac and Rappahannock Transportation Commission (PRTC) is a multi-jurisdictional transit agency that includes the City of Manassas, Manassas Park and Fredericksburg and Prince William, Stafford, and Spotsylvania Counties. This bus service provides commuter (OmniRide Express) and local (OmniRide Local) bus services. As of FY2017, two OmniRide Express routes serving Manassas averaged 245 daily boardings and 288 daily alightings in the City. Three OmniRide Local routes averaged 391 daily boardings and 358 daily alightings in the City in 2017.

- Manassas Metro Direct connects commuters from Manassas Junction to the Tysons Corner Metro with a number of stops near Manassas before entering I-66. The bus runs in the morning and evening for commuters traveling east from Manassas.
- The Cross County Connector connects eastern Prince William County and Manassas. The service starts in Dale City and the Potomac Mills area to City of Manassas and Manassas Park. Both eastbound and westbound buses run all day.
- Two routes connect Manassas and the downtown area. One bus is for commuters traveling to the Pentagon in Arlington, Virginia and the other travels to several stops in Downtown Washington D.C. These buses depart from the Portsmouth Commuter Lot near the City of Manassas and travel to the east in the morning and travel west in the evening.
- Several local Manassas routes serve the immediate area to the City of Manassas Area. Manassas OmniRide Local North travels between Manassas Mall and NOVA while Manassas OmniRide Local-South travels to and from Manassas Mall and Oaks of Wellington connecting south of the City to the western side of Manassas.
- A new route structure for OmniRide service has been proposed to improve the operating efficiency of both services. In Manassas this new plan will result in the number of routes increasing from four to five, with additional service brought to Liberia Avenue, Wellington Road, and Hastings Drive. In addition, the new PRTC operating plan will include a new transit hub near downtown Manassas on Mosby Street and W. Courthouse Road, replacing the Manassas Mall as the primary transfer point between Manassas-area routes.

VRE

The Virginia Railway Express (VRE) has three stations in the vicinity of Manassas. From west to east these are Broad Run Airport Station (located partially within the City), Manassas Station (located within the City) and Manassas Park Station. The Manassas Station is located in the urban downtown of the City of Manassas. The Manassas Line, which travels from Broad Run to Union Station averages midweek ridership for northbound trains (running in the morning) of 88% at its peak load point entering the Alexandria Station. Southbound trains (running in the evening) current midweek average ridership is slightly less than 90%. The total number of seats on Manassas Line trains is either 780 or 1040 seats, based on trains of six or eight cars at 130 passengers per car.

The VRE FY2020 – FY2025 Transit Development Plan reports ridership profiles per station. Broad Run Station in 2017 averaged 1,138 daily boardings and 1,125 daily alightings, and AM trains exiting Broad Run Station averaged 21 percent occupancy. Manassas Station averaged 865 daily boardings and 772 daily alightings, with an average of 36.9 percent occupancy leaving the station. The Manassas Park Station averaged 711 daily boardings and 752 daily alightings, with an

average outgoing occupancy of 50.2 percent. Both Manassas and Manassas Park stations had fully utilized parking in 2017, while utilization at Broad run was well over 90 percent.

In 2017 VRE Operations Board adopted Broad Run Expansion as the preferred means of expanding Manassas Line capacity and alternative to the Gainsville-Haymarket Extension. Additionally, I-66 Outside the Beltway Concessionaire Payment grant awarded for the Manassas Line Capacity Expansion. The VRE System Plan 2040 outlines actions through 2040 to sustain and grow service to meet regional travel needs. Phase II which is from 2021 to 2030, looks at potential service expansion plans for the Manassas area, and major investments that could relieve key capacity bottlenecks on the VRE system. The Manassas Line Capacity Improvements include acquisition of 10 new passenger coaches, end-of-the-line station and equipment storage expansion at Broad Run, lengthening the platforms at the Downtown Manassas station, a new parking garage at the Manassas Park station, and collection and dissemination of real-time information including how many parking spaces are available at stations and how many seats are available on each train.

FUTURE TRANSPORTATION LANDSCAPE

The TMP analysis timeframe extends out to the year 2040. The following section details the expected changes to the City's transportation landscape out to that target year, focusing on three primary areas: traffic forecast, bicycle network, and overarching future trends in the field of transportation.

Outputs from traffic model (2040)

The City modeled travel demand for the target year of 2040 using a customized CUBE model based on the Prince William County Traffic Model version 2.4, updated in October 2016. Assumptions regarding changes to the City and County roadway networks were based on:

a. the MWCOG Visualize 2045 CLRP (adopted in October 2018) projects and associated coded networks included in the MWCOG V2.3.75 travel forecasting networks

b. the Manassas 2019 CIP Project (as of 12/10/2018) and incorporated the changes into a new PWC Traffic Model Network. These are discussed further below:

c. the Prince William County Comprehensive Plan adopted on 2 February 2010, updated as of 20 April 2016

Land use assumptions were based on 2040 MWCOG Round 9.1 land use and demographics data for the City of Manassas, Prince William County and the City of Manassas Park. Additionally, the City of Manassas is expecting the Micron plant located in PWC TAZ 2595A to expand its industrial/manufacturing employment by 1100 employees by 2040. We added this additional employment to PWC TAZ 2595A (900 industrial workers and 200 office/research workers).

Using the regional travel demand model output, growth factors were calculated to input into the Synchro model to determine future 2040 peak hour traffic volumes. The developed growth factors shown in Figure 6, represent the change in overall traffic volumes on each roadway link from 2018 to 2040. Growth factors above 1 indicate an increase in traffic volumes, while those below 1 indicate a reduction in traffic volumes. For example, a growth factor of 1.2% would indicate that the traffic on that roadway segment is expected to be 20% higher in 2040 than in 2018, while a growth factor of 0.85 would indicate a 15% reduction in traffic.

Improvements recommended under existing conditions were assumed to be in place by 2040. In addition, signal timing adjustments and planned projects were included in the base 2040 Synchro model. Assumed background improvements affecting the roadway network for the City are described in the following paragraphs.

- At Godwin Drive and Sudley Road, Alternative 2B of the Route 28 Bypass study was assumed. The southbound bypass approach is assumed to have a left-turn lane, two through lanes, and a right-turn lane. An exclusive right-turn lane on westbound Sudley Road and two northbound through lanes on Godwin Drive are assumed.

- The eastbound approach of Signal Hill Road at Liberia Avenue was restriped during fiscal year 2029 to have a 150-foot left-turn lane, a shared through/left-turn lane, and a 200-foot right-turn lane.
- Route 28 will be widened to six lanes southwest of Godwin Drive to Pennsylvania Road per CIP project T-042. A second left-turn lane will be added for traffic turning from northeast Route 28 onto northbound Godwin Drive. Additionally, the off-ramp from northbound Route 234 (Prince William Parkway) will be modified to allow a free flow right and a signalized right turn for drivers making the next left onto northbound Godwin Drive. The new signal for the off-ramp will have a two-lane approach with right turns on red prohibited.
- Following the CIP project T-015, a third northbound lane will be constructed on Sudley Road between Grant Avenue and Godwin Drive. This widening will match the roadway in the County, too. Right-turn lane in the northbound direction will be converted to shared through/right-turn lanes.
- Following the CIP project T-019, westbound Prince William Street will have a right-turn lane and a shared through/left-turn lane at its approach to Wellington Road.
- Following CIP project T-021, Grant Avenue will be reduced from four lanes to two lanes from Prince William Street to Wellington Road with turn lanes and a median.
- Liberia Avenue maintains the current four-lane configuration from Centreville Road to Quarry Road.
- At the intersection of Centreville Road and Liberia Avenue, CIP Project T-074 will extend the southbound left turn lanes on Centreville Road and restripe the existing right-turn only lane on northbound Centreville Road as a shared through/right-turn lane. Pedestrian improvements will be made to reduce the crossing distance by installing channelized right-turn islands, which will also allow the signal timings to be adjusted.

Summary of 2040 Future Capacity Analysis

A capacity analysis was performed for the AM and PM peak hours for Future 2040 conditions. Figure 7 depicts the future LOS for each signalized intersection graphically, and Table 6 summarizes the results of the analysis for those signalized intersections that are expected to operate overall at level of service D, E or F in 2040 during the morning and/or afternoon peak hour.

City of Manassas Master Plan

Growth Factors

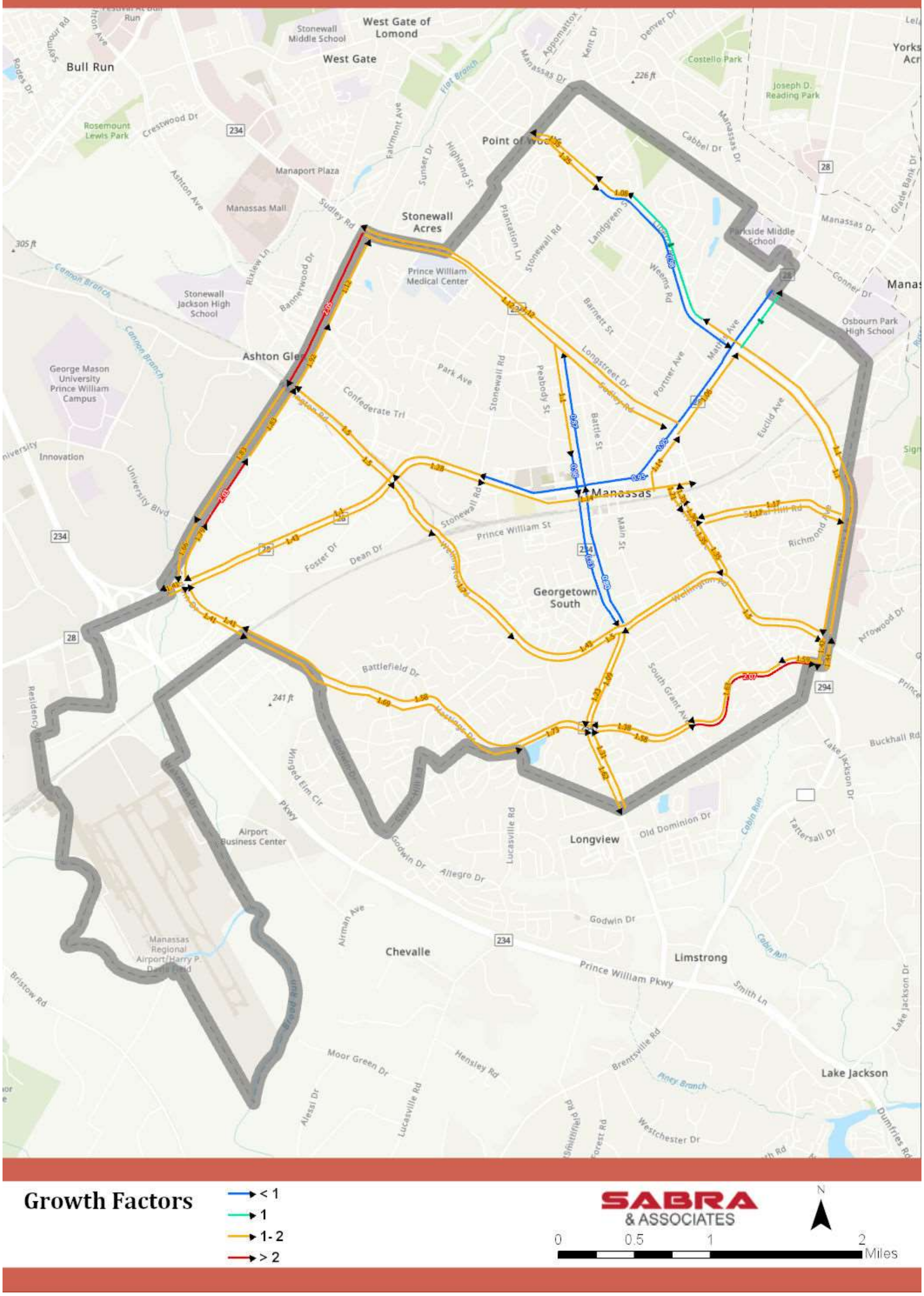


Figure 6: Map of Citywide Growth Factors

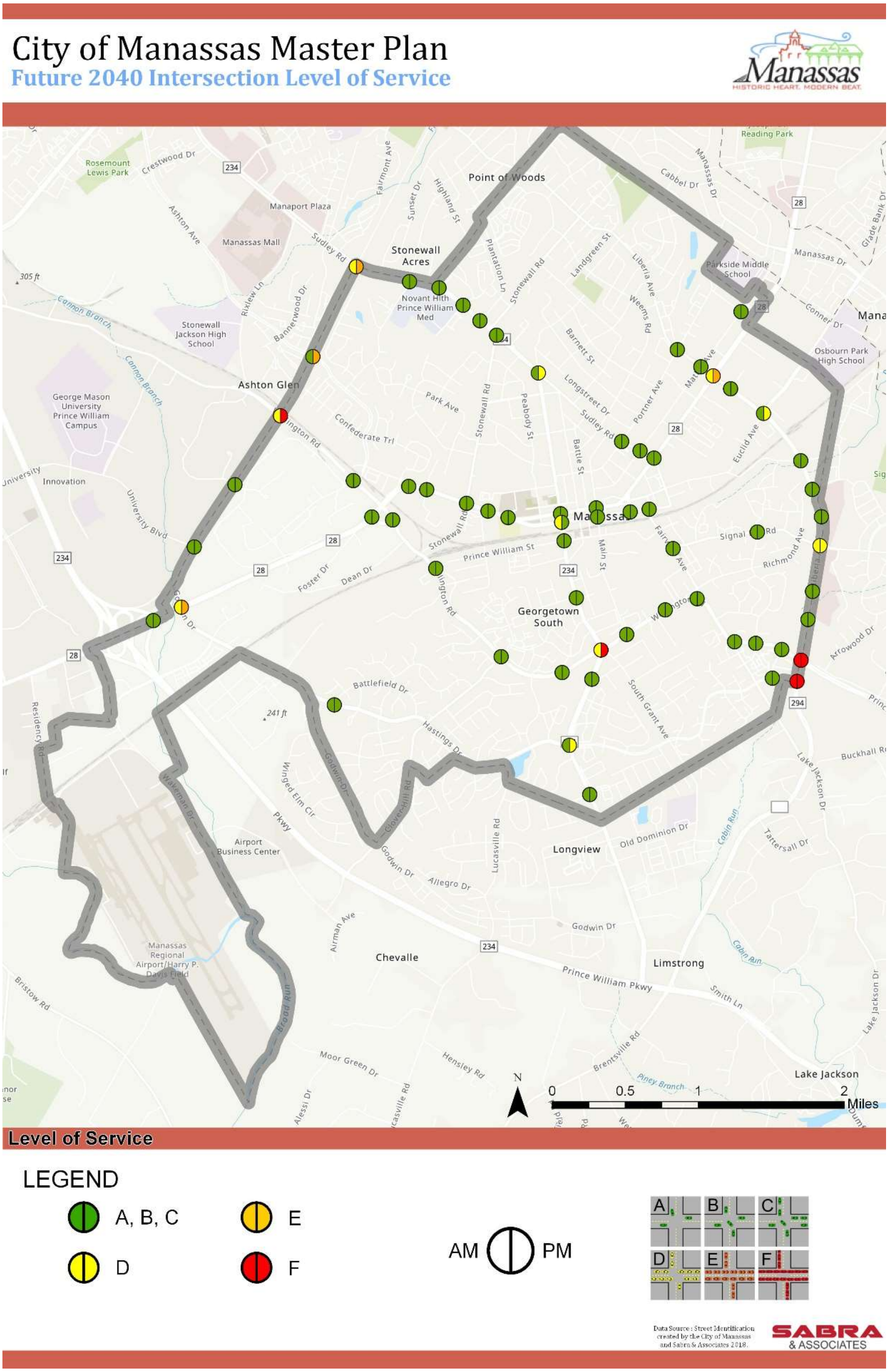


Figure 7: 2040 Future Levels of Service

Table 6: Summary of 2040 Future Capacity Analysis by Overall Intersection – Without Improvements

Intersection	Synchro 10 (HCM 6th) Results					
	Delay (sec/veh)		v/c Ratio		Level of Service	
	AM	PM	AM	PM	AM	PM
Godwin Dr & Sudley Road	48.3	68.8	0.75	0.99	D	E
Grant Ave & Sudley Rd	17.2	35.1	0.45	0.63	B	D
Grant Ave & Route 28 (Center St)	44.9	25.7	0.75	0.57	D	C
Rte 234 (Dumfries Rd / Grant Ave) & Wellington Rd	42.7	106.8	0.68	1.05	D	F
Route 234 (Dumfries Rd) & Hastings Dr	31.2	35.6	0.88	0.86	C	D
Route 28 (Centreville Rd) & Liberia Ave	47.9	60.1	0.92	0.93	D	E
Euclid Ave & Liberia Ave	25.6	41.4	0.67	0.81	C	D
Liberia Ave & Signal Hill Rd	41.1	42.6	0.78	0.84	D	D
Prince William Pkwy / Liberia Ave & Wellington Rd / Prince William Pkwy	113.3	103.6	1.24	1.15	F	F
Prince William Pkwy & Hastings Dr	137.1	91.1	1.08	1.08	F	F
Godwin Dr & Ashton Ave	35.0	68.1	0.70	0.99	C	E
Godwin Dr & Wellington Rd	50.8	83.2	0.98	1.11	D	F
Godwin Dr & Route 28 (Nokesville Rd)	44.0	76.9	0.79	1.06	D	E

The results of the analysis show that four locations operate at LOS F during one or both peak periods. Four additional intersections operate with LOS E during the PM peak hour.

Bike Network and Infrastructure

In early 2018, the City of Manassas was approached by a bike share system operator about the possibility of bringing service to the City in early 2018 prompting the City to seek more information about bike share and its potential benefits. The intent of this section is to explain bike share—and assess existing and future conditions so that the City of Manassas can make an informed decision whether to move forward with a bike share system in the City.

Bike share systems are designed to provide a cost-effective, environmentally-friendly and convenient travel option for many short trips and for a short period of time. Bike share systems are typically structured to operate like automated bike rental for short periods (typically 30 minutes or less) and either returned to any station in the system or informally parked at the final destination.

The three primary technology types for bike share programs are 1) dock-based equipment, 2) dockless smart-bike equipment and 3) lock-to smart-bike equipment. All three types of bike share equipment locking technology described above have strengths and weaknesses. These system technologies represent a fleet of shared bikes for use by members (hourly, daily, monthly or annually) within a designated service area of a city or region.

The City of Manassas has some of the characteristics traditionally thought to support bike share, including: an amenable policy environment, with support for bicycling and implementation of new facilities and programs; a walkable downtown comprised of shops, galleries, restaurants, cafés and bars; a population that includes many people who are outdoor enthusiasts; a relatively flat topography; a developing shared use path and on-street bikeway network; a bus network gaps that could potentially be filled with bike share; high numbers of visitors and tourists; and relatively comfortable weather allows for a system to operate much of the year.

There are also several challenges to implementing bike share in Manassas. Many of these can be overcome by a logical strategy. Lack of a comprehensive on-street bicycle and shared use path network can be mitigated by ensuring continued funding recommendations included in the Transportation Master Plan. Ease of automobile access and parking can be mitigated by ongoing redevelopment policies and public outreach to encourage transit, biking and walking trips among commuters and residents. Bike share can be leveraged to better connect workers who travel by car from their homes to transit trunk lines that connect to regional employment centers.

Some challenges Manassas faces in establishing bike share are more difficult to mitigate such as separation of land-uses in some parts of the city, low barriers to personal bicycle ownership and use, and low barriers to automobile ownership and use. The fact that driving is such a convenient mode of transportation for many residents in Manassas tends to work against the viability of a bike share system. However, it is notable that bike share has not only launched but is functioning quite well in other auto-oriented cities in including, Charlotte, Atlanta, Greenville and Norfolk. Several Virginia jurisdictions are also actively planning or have already launched bike share programs.

Bike share, especially dockless, mobility continues to rapidly evolve with mergers and even more vehicle types, such as motorized scooters with rapidly changing usage trends, company mergers and amenity fleets.

In Virginia, operation of low speed mobility devices is governed under State Code § 46.2-904. The following rules related to bike share include:

- **Sidewalk/Trail use**: Current state law allows bicycles, electric bicycles and electric scooters to be ridden on sidewalks unless prohibited by local ordinance.
- **Helmets**: There is no current enabling legislation to require helmets for electric scooters. The enabling legislation for helmets only applies to riders of bicycles and electric bicycles who are 14 years of age or younger.

To proactively prepare for a bike and/or scooter share, the City of Manassas should consider two main elements:

ELEMENT 1: Improve Bicycle Infrastructure and Network. Like other transportation modes, bike share works best with supportive infrastructure and programs. Thinking ahead to policies, plans and project delivery will help avoid missed opportunities. With Complete Streets, communities are redesigning streets to support multiple modes, including walk, bike, transit and automobiles. Planning for bike share requires consideration of competing uses of streets, sidewalks, curbs and station areas as well as funding and financing strategies. The recommendations section includes a detailed list of improvements to the City's bicycle and pedestrian networks.

ELEMENT 2: Develop Pilot Framework. Like any innovation, new mobility comes with the potential for both benefits and challenges. Manassas and its surrounding jurisdictions need not reinvent new processes for developing a bike share system. The pilot framework for Manassas should represent a context-sensitive approach to meet the needs of City residents, employees, businesses, and visitors. To achieve a balanced and reliable shared mobility option, there are critical steps to ensuring a successful program that effectively scales and integrates into the overall mobility system.

Recommendation

Given the fast-moving pace of change in the personal shared mobility arena, the lack of an imminent need to negotiate with a bike share vendor and the anticipated adoption of the Transportation Master Plan, **it is recommended that the City does not move forward with a bike share program *at this time.*** As the City's bicycle network is being expanded and improved, the City should undertake a thoughtful process to make Manassas welcoming to bike share companies while protecting the safety of users, residents and visitors:

- Develop a regulatory framework for bike share services
- Set shared mobility performance standards
- Conduct outreach for partnerships
- Consider project expenses and revenues

Future Transportation Trends

According to the National Academies/Transportation Research Board Forum on Preparing for Automated Vehicles and Shared Mobility, "the deployment of automated vehicles, shared mobility services, and other transformational technologies has the potential to dramatically increase safety, reduce congestion, improve access, enhance sustainability, and spur economic development. However, success in meeting these goals is not assured, and there are significant risks that these deployments could cause negative results."

As the transportation technology landscape is advancing rapidly, new data will continuously become available and regulatory and network needs are likely to change over time. Therefore, mid- and long-term actions needed to ensure successful implementation of some of the newest technologies and programs currently cannot be tightly defined at this time and until data becomes available. For the City of Manassas, monitoring of and harmonization with Federal and State fact-based research will be needed to deploy these technologies in a manner and timeframe that informs policy to meet the beneficial long-term goals for the residents, commuters and visitors to the City.

The following is a discussion of future trends, actions the City of Manassas may take to prepare for new technologies and services, and an overview of potential impacts on the City of Manassas' transportation network, traffic conditions, and complete streets plan and, as applicable, recommended next steps to ensure the City is prepared to address the quickly advancing transportation landscape.

Connected and Automated Driving Systems

Connected and Automated Driving System equipped vehicles are likely to transform mobility around the globe. Residents of Manassas have an average one-way commute time of 32.8 minutes; self-driving cars could address this problem, increasing safety on the roads as well as increasing passenger comfort and productivity.

Already, semi-autonomous functions in some newer car models are improving highway safety by automatically braking when approaching an obstacle, for example. Self-driving cars will maintain more constant speeds and more predictable stops and starts, preventing many traffic jams. Self-driving cars could also help tackle other problems, from enabling senior citizens to retain their independence, to helping smaller communities provide mass transit. In order to prepare for the rapid advancements of autonomous vehicles, preparedness on the Federal, state, and local levels is required.

In 2017, the Department of Transportation National Highway Traffic Safety Administration (NHTSA) issued Automated Driving Systems 2.0: A Vision for Safety, which outlined vehicle performance standards guidance for automated vehicles and delineated State's roles for implementing regulatory requirements.

On Oct. 4, 2018, the Department of Transportation released new Federal guidance – Automated Vehicles 3.0: Preparing for the Future of Transportation. This builds upon Automated Driving Systems 2.0 and provides guidance for states to consider for the training and licensing of test drivers. It also offers guidance for testing entities to consider driver engagement methods. Additionally, NHTSA announced the development of a national pilot research program to help safely test and deploy automated driving system-equipped vehicles. This collaboration could help aid the research and development of standards for advanced vehicle safety technologies.

Many states and local jurisdictions are beginning to develop statutes, regulations, and policies regarding the integration of these vehicles into the existing transportation network. States continue to retain their traditional responsibilities for vehicle licensing; registration; traffic laws and enforcement; and motor vehicle insurance and liability, and across the country states are utilizing a variety of different approaches for automated vehicles, from highly regulated to somewhat deregulated. Some local jurisdictions are also introducing policies, zoning restrictions, and ordinances both for and against level 3+ automated driving system-equipped vehicles

In the Fall of 2017 the Virginia Department of Transportation (VDOT) issued its Connected and Automated Vehicle Program Plan which provides a roadmap to guide in the development of new policies, programs and partnerships; address rapidly

changing technologies and the need to deploy and maintain those technologies; manage and analyze new data from a variety of new sources; and address the funding needs associated with both the implementation of new roadside and backend technologies and the impacts these new vehicles may have on funding. While VDOT does not detail mid and long-term goals and objectives, three key actions to support mid-term and long-term planning efforts are identified and include the future development of Mid and Long-Term Implementation Plans, establishing deployment guidance for stakeholders and developing connected and automated vehicle standards and specifications. The goals and objectives of VDOT's participation in the connected and automated vehicles program are focused on four key areas:

- Reduce crashes and fatalities on Virginia roadways by improving safety measures.
- Improve mobility to reduce delay, increase system reliability and provide more efficient use of physical infrastructure.
- Reduce infrastructure investments through efficiencies enabled by the conversion of vehicles that are connected and automated.
- Enhance traveler information.

VDOT and the Department of Motor Vehicles have since entered into a new partnership with Virginia Technical Institute and Nokia to develop the Virginia Automated Corridors program. These corridors cover more than 70 miles of interstates and arterials in the Northern Virginia region and will provide car companies and suppliers of automated vehicles the real-world environments they need prior to putting their vehicles on roadways. The corridors integrate access to dedicated high-occupancy toll lanes and real-time traffic and incidents, among other data acquisition and communication systems. The City of Manassas can in turn incorporate State research and data into municipal policies and regulations regarding connected and automated vehicles.

By working with VDOT, the City can minimize redundant or conflicting standards, and reduce potential barriers or accelerate deployment of connected and automated vehicles within the City limits. This would include setting or modifying local controls over roadways and who can operate on them, the rules of the road, and considering issues of State level preemption.

Another consideration for the eventual deployment of automated vehicles on a wide scale is communication between the City's signals infrastructure and vehicles. Broadcasting of real time signal phasing and timing data can enable maximization of the efficiency gains to be had from AVs, as vehicles will be able to speed up or slow down based on signal phasing information, or could possibly "call" for extended green signals in much the same way as existing Transit Signal Priority (TSP) technology. As the City established a comprehensive signals plan for the future, the benefits and the marginal cost of enabling the broadcast of phasing and timing data should be assessed.

Electric Vehicles

According to a Fall 2018 report from the United Nations' scientific panel, the Intergovernmental Panel on Climate Change (IPCC), humanity has about 12 years to avoid the most dire consequences of climate change. The report states emissions must be reduced by 45 percent from 2010 levels, and by 100 percent by 2050, and the global transportation sector will need a major overhaul. In the US, the world's second-largest producer of greenhouse gases, transportation makes up the largest share of emissions.

In 2017, only 1.15 percent out of 17,340,700 cars sold in 2017 were electric vehicles, including both plug-in hybrid electric vehicles like the Chevy Volt and the Toyota Prius Prime and battery-electric vehicles like the Nissan Leaf and Tesla Model S. However, those purchases represent a 26 percent increase over electric vehicle purchases in 2016, and the trend is expected to continue, according to environmental advocates and electric vehicle industry experts. As such, cities around the country are currently undertaking a range of initiatives, regulations, and incentives to embrace this future-critical technology and move from fuel-burning vehicles to electric technology.

For example, in 2017 Atlanta passed an ordinance that requires all new residential homes and public parking facilities to accommodate electric vehicles and 20 percent of the spaces in all new commercial and multi-family parking structures to

be plug-in ready. Similarly, Vermont's energy building code requires commercial and residential projects over a certain size to include a percentage of electric vehicle supply equipment or electric vehicle-ready parking spaces.

In Ohio, Smart Columbus, a public-private partnership, aims to reinvent local mobility systems with a goal of increasing electric vehicle market penetration in the city by 500 percent by early 2020. To help the city meet this goal, the nonprofit group Drive Electric Ohio offers a program where residents and local businesses can meet up to learn about and test drive electric vehicles as an effective tactic for overcoming people's misconceptions about electric vehicles and opening them up to the possibility of buying one. Several cities are also rapidly working to transition municipally-owned vehicles into electric and installing charging stations throughout the cities. The City of Manassas may consider exploring similar initiatives to encourage electric vehicle use.

The City has already installed three public charging stations, at City Hall, the Manassas Museum, and at the Public Works building. Additional stations are available at the VRE Manassas Station garage, Sheehy Nissan, and at Bull Run Harley-Davidson. The City should consider programs aimed at expanding the deployment of charging stations and the conversion of existing stations to fast-charge technology, including potential incentives for private businesses to provide stations on their property.

Stationless Car Sharing

Car sharing services provide a flexible option alongside traditional modes of public transport such as the bus, and a key factor to the success of car sharing is the ease of use that comes from being able to pick up and return a vehicle around the clock. Demand for carsharing services tends to be the strongest on the weekend. Prices are based on time and distance traveled. Members typically pay around $7/month fee with hourly rates of approximately $9 including up to 180 miles per day.

Users of most car sharing services in the region currently must pick up and drop off their vehicle at the same location, which is typically a limited curbside area with parking for 3-5 vehicles within the public right-of-way. With the introduction of free floating or stationless car sharing programs, drivers will be able to drop off their vehicle at any parking space within designated areas in the municipality, such as downtown. Customers can also unlock and lock their car with a smartphone app without having to book in advance or specify a drop-off time. The "stationless" car-sharing system is significantly less expensive for cities because no dedicated parking or amenities are required. To prepare for stationless car sharing programs, the City of Manassas may consider where the pickup/return locations may be located within the City limits. The City may also consider incentives to encourage car sharing vendors to partner with the City, such as free parking in downtown locations.

Dockless Bike and Scooter Sharing

Dockless bikes and scooters provide the most flexibility of these bicycle share programs as users may generally retrieve or park anywhere within the designated service area. The dockless systems offer a lower cost alternative to docking stations, and less infrastructure within the right of way. Some systems include a "lock-to" technology where a bike must be locked to a fixed object which can vary per municipal requirements.

If there is a common lesson among other cities with bike share systems, it is that a core network of bicycle facilities is a condition precedent to program success. The City of Manassas should continue working to build out the bicycle facilities network to accommodate bicyclists of all ages and riding abilities, As the bicycle network is being designed and built out, it is recommended the City take the following steps to prepare for a dockless or other bike/scooter share program:

- Develop a regulatory framework in the form of a City ordinance for bike share services such as limitation on the number of bikes and/or scooters that can be placed in the public right-of-way; and rules for the use and placement of bikes or scooters in the public right of way, including parking, sidewalk use (allowed under State law in the

absence of a local ordinance), maximum speed for motor-assisted vehicles, etc. The City's regulatory framework must be in place by December 31, 2019 under the provisions of Virginia HB 2752, signed into law in March of 2019.

- Set performance standards that would take the place of rigid specifications and allow vendors to deliver the program in best alignment with consumer demand and their own business model. Performance standards might relate to minimum equipment safety specifications; maximum duration for removal of damaged equipment; equitable distribution of equipment throughout the City.
- Conduct outreach for partnerships and strongly consider joining with other jurisdictions such as the National Park Service, Prince William County and George Mason University in providing a unified dockless program.
- Consider project financing and revenues. As bike share programs operate at a very thin profit margin in suburban environments, the City should be prepared to subsidize either the start-up capital or ongoing operational cost of a bike share program to attract vendor(s) to a suburban environment.

Ride Hailing and Microtransit Services

Uber, Lyft and other transportation network companies, or TNCs, transported 2.61 billion passengers in 2017, potentially creating a drop in the use of taxis, bus and subway ridership. A 2018 study finds that up to 60 percent of those riding with Uber and Lyft-like services in large cities would have taken transit, biked, walked or would not have made the trip at all, if not for the availability of the ride-hailing services. According to the study, these services are increasing congestion in large cities because unlike taxis, there is no limit to the number of private cars operating in city limits. Among other reasons cited, the study contends that Ubers and Lyfts drive 2.8 new miles for every one mile saved by passengers not using their own car, in part because drivers also spend part of their time behind the wheel without riders as they drive to pick someone up. However TNC companies and some new mobility experts dispute these findings, and because the use of these services has exploded only within the last few years, it is not yet clear how these services may impact traffic congestion and operations in larger cities or cities the size of Manassas.

Microtransit is the middle ground between a taxi service and public transit, and it can be broken down into two main categories:

- Services like UberPool that let you split a ride with people nearby who have a similar destination.
- Transport services that operate by commuting shuttles based on user demand.

UberPool is already available to riders in Manassas, and while some data suggests that ride hailing services in general increase the number of vehicles on the road, representatives from services such as Lyft have stated that a significant number of customers in larger urban area have given up their cars given the freedom ride hailing services offer. Microtransit on-demand shuttle services generally operate in larger cities with multiple transit options and it remains to be seen how well this model works outside of its current locations. A service model that is effective for certain routes in Downtown Boston or San Francisco could be difficult to apply in more suburban areas such as Manassas, where land use and geometry factors are more difficult to overcome.

Curbside management is rapidly becoming one of the most difficult transportation planning challenges in downtown locations with the addition of rideshare services and the changing face of last-mile freight delivery. Cities increasingly must consider a finer-grain mix of uses, flexible use zones, and changing use regulations by time of day. On streets that conform to the City's Urban Street and Mixed-Use street types, flexible pick-up and drop-off zones should be a standard feature, trading a few parking spaces for a much more high intensity of use.

Drones and Door to Door Delivery Service

Delivery drones may become widespread over the next five to ten years, particularly for what is known as the "last-mile" logistics of small, light items. Companies like Amazon, Google, the United Parcel Service (UPS), DHL, and Alibaba have been running high-profile experiments testing drone delivery systems. In the future, drones could augment, or in some

situations even replace, truck fleets and could have important implications for energy consumption, public safety, personal privacy, air pollution, city noise, air traffic management, road congestion and urban planning.

However, in the short term, trucks will be primarily gas-powered and drones are more likely to be electric-powered, potentially using renewable sources, In addition, the energy per drone delivered package can be significantly reduced by having many drone centers distributed throughout a city or region instead of using one centralized center. Providing many distributed drone centers also decreases the number of drones required to service a city. An increased number of drone centers decreases the time per flight, thus allowing for more deliveries with fewer drones.

Drone delivery will require changes to the built environment in order to successfully and efficiently deliver via drones. However, the exact changes needed are not yet clear. Different stakeholders seem to envision varied methods, leaving consumers and business to navigate a quickly changing technology and business model landscape. Businesses, including developers, are unlikely to bet on different drone delivery business models that require them to make capital investments without some assurance of the continuity of those methods. Accordingly, a standard for delivery including the physical attributes of the landing site is recommended. Currently, different companies are experimenting and competing to find a successful business model. However, without either cooperation or a monopoly on drone delivery, a common and successful model may not emerge in the near term.

CONCLUSION

The transportation landscape is advancing at an extremely rapid pace, and technologies and services such as automated vehicles, shared mobility, and drones have the potential to dramatically increase safety, reduce congestion, improve access, enhance sustainability, and spur economic development.

While several of the technologies and services described above do not individually result in significant impacts to the City's traffic operations and network, the implementation of such technologies cumulatively allows for more choices for residents, visitors and commuters, and complements the work towards building out a Complete Streets that the City is currently undertaking. Services such as ride hailing are currently available within the City of Manassas, and stationless car sharing may be integrated into the existing network when it becomes available in the region at the City's discretion.

Some technologies – such as drone deliveries and connected and automated vehicles – are currently under development and testing and not enough data is currently available to fully know what effects these technologies will have on the City of Manassas. In the mid to long-term the City can track trends and data and work with VDOT and other jurisdictions to identify network needs and develop fact-based and harmonized policies to meet the beneficial long-term goals of new transportation technologies.

Table 7: Future Trends and Potential Impacts on City of Manassas' Traffic Operations

Trend	Potential Mid- and Long-Term Impacts	Notes
Connected and Automated Driving Systems	Future Traffic Conditions: High Transportation Network/ Complete Streets Plan: Moderate to High	• Semi-autonomous functions in some newer car models are improving highway safety by automatically braking when approaching an obstacle. • Self-driving cars could address congestion and increasing safety on the roads, maintain more constant speeds and more predictable stops and starts. They could help suburban communities like Manassas provide more mass transit. • In order to prepare for the rapid advancements of autonomous vehicles, preparedness on the local level and coordination with VDOT is required. • Incorporate broadcast of signal phasing and trimming data in the City's long-term comprehensive signals plan. • Virginia DRPT has identified Manassas as a potential location for a future first/last mile AV shuttle deployment to connect passengers to VRE.
Electric Vehicles	Future Traffic Conditions: Low Transportation Network/ Complete Streets Plan: Low	• City of Manassas may consider initiatives, regulations, and incentives to embrace electric technology. • Ordinance that new residential, commercial and public parking facilities require to accommodations for electric vehicles. • Public-private partnerships to increase electric vehicle use. • Transitioning municipally-owned vehicles into electric and installing charging stations within the City. • Incentives to encourage private commercial property owners to install charging stations • Deploy additional public charging stations and convert existing stations to fast-charging technology

Trend	Potential Mid- and Long-Term Impacts	Notes
Stationless Car Sharing	Future Traffic Conditions: Low Transportation Network/ Complete Streets Plan: Low	• Car sharing services provide a flexible option alongside traditional modes of public transport. • Stationless car-sharing system is significantly less expensive than traditional services because no dedicated parking or amenities are required. • To prepare for this service, the City may consider where the pickup/return locations may be permitted within the City limits, or encourage car sharing vendors to partner with the City by providing incentives such as free parking in downtown locations.
Dockless Bike and Scooter Sharing	Future Traffic Conditions: Low Transportation Network/ Complete Streets Plan: Moderate	• Dockless bikes and scooters provide the most flexibility as users may generally retrieve or park anywhere within the designated service area. • The dockless systems offer a lower cost alternative to docking stations. • The City of Manassas should continue working to build out the bicycle facilities network to accommodate bicyclists of all ages and riding abilities to prepare for the introduction of bicycle and scooter sharing. • City ordinance regulating dockless bikeshare must be in place by December 31, 2019.
Ride Hailing and Microtransit Services	Future Traffic Conditions: Unknown Transportation Network/ Complete Streets Plan: Low	• Uber, Lyft and UberPool are already operating in the City of Manassas • It is not yet clear how these services may impact traffic congestion and operations. • Microtransit on-demand shuttle services generally operate in larger cities with multiple transit options and it remains to be seen how well this model works in more suburban areas. • Incorporate pick-up/drop-off zones into guidelines for Urban Street and Mixed-Use Street in the City's Complete Streets Typology.

Trend	Potential Mid- and Long-Term Impacts	Notes
Drones and Door to Door Delivery Service	Future Traffic Conditions: Low Transportation Network/ Complete Streets Plan: Low	• Delivery drones may become widespread over the next five to ten years, particularly for what is known as the "last-mile" logistics of small, light items. • Drones could augment, or in some situations even replace, truck fleets and could have important implications • For energy consumption, public safety, personal privacy, air pollution, city noise, air traffic management, road congestion and urban planning. • Drone delivery will require changes to the built environment however, the exact changes are not yet clear. • A common and successful model may not emerge in the near term.

RECOMMENDATIONS

Traffic Recommendations

Two sets of traffic recommendations were developed;

- The first set is based on **existing (2018) conditions** with all funded CIP improvements assumed. Recommendations were developed for any locations with failing conditions not fully addressed by those improvements.
- The second set of recommendations is based on **2040 conditions**. Again, all funded CIP improvements are assumed, as are the first set of recommendations.

Near-Term Recommendations Based on Existing Conditions

Improvements are recommended for the two intersections that currently operate at LOS E or worse, namely Centreville Road/Liberia Avenue and Liberia Avenue/Wellington Road/Prince William Parkway. Additionally, a roundabout is approved for study at the Centreville Road/Sudley Road/Prescott Avenue intersection, and SAI evaluated the functioning of the intersection as a roundabout as part of the existing conditions evaluation. Capacity analysis was performed using HCS 6th Edition as part of the Synchro software program. The results are summarized in Table 8. Figure 8 through Figure 11 depict the improvement concept diagrams for these intersections.

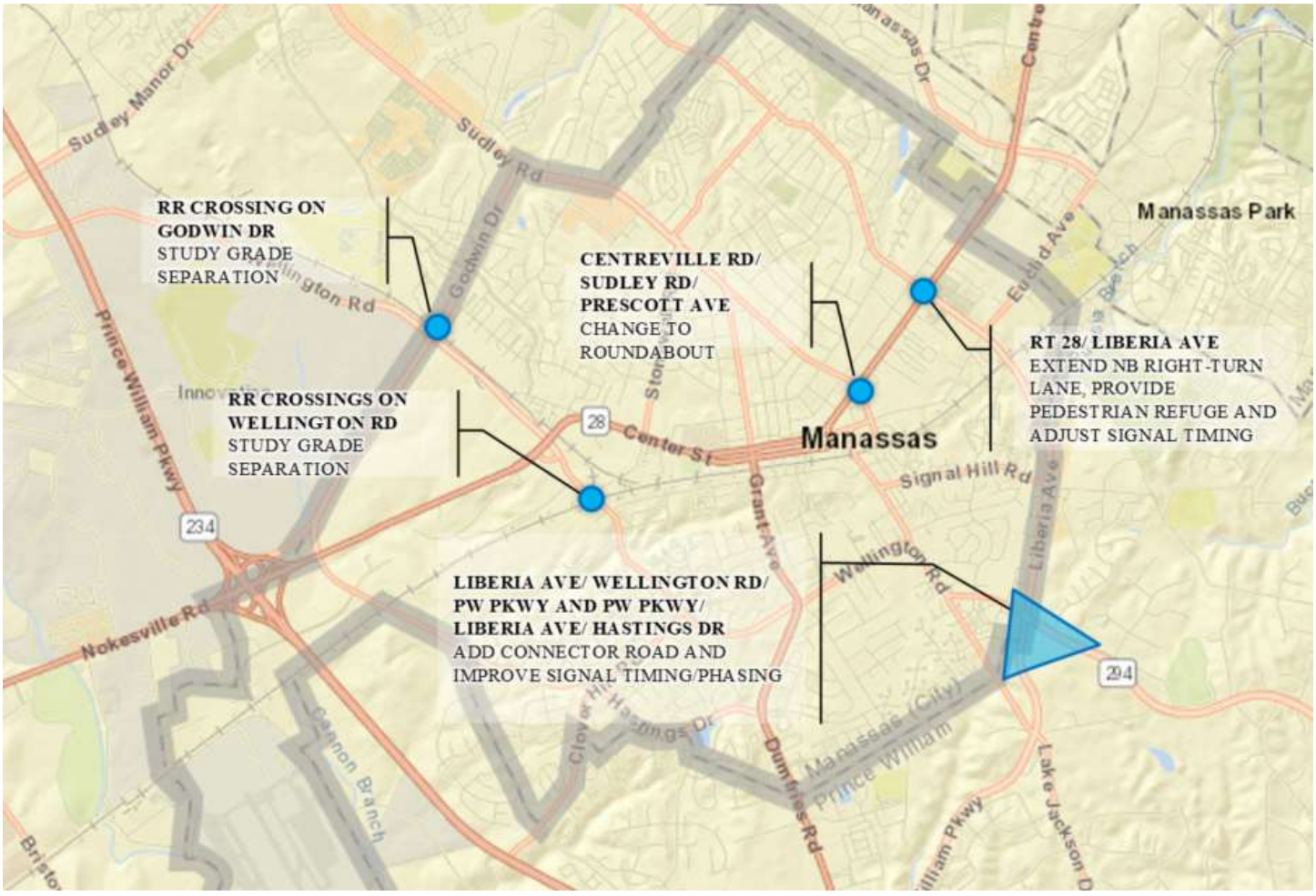


Figure 8: Traffic Recommendations Based on Existing Conditions

In addition to the recommendations for physical improvements at the four locations detailed below, it is also recommended that two locations be thoroughly studied to analyze the potential benefits of implementing grade separation over existing railroad tracks:

- The section of Wellington Road between Nokesville Road and Prince William Street includes at-grade crossings of no fewer than five tracks. This corridor has been identified as a critical pedestrian and bicycle link to provide city-wide connectivity, and the TMP traffic modeling indicates that Wellington will experience a greater than 50% increase in traffic volume by 2040. Grade separation may be a viable long-term solution
- The Route 28 bypass will increase the width, capacity, and traffic volume of Godwin Drive north of Nokesville Road. As such, the existing at-grade crossing on Godwin Drive immediately to the north of Wellington Road should be analyzed for the potential benefits associated with a possible grade separation.

All recommendations based on existing conditions are shown in Figure 8.

Route 28 (Centreville Road) and Liberia Avenue

At Route 28 (Centreville Road) and Liberia Avenue, the recommended improvements (partly addressed by T-074, which is in design) include:

- Update signage for Liberia Avenue free northwest right turn onto Route 28
- Provide pedestrian refuge on east and south corners and restripe crosswalk to shorten crossing distance
- Adjust pedestrian and vehicle signal timings
- Widen northbound Route 28 to extend left-turn lane

Figure 9: Concept Diagram for Route 28 and Liberia Avenue Existing Conditions with Improvements

Liberia Avenue/Wellington Road/Prince William Parkway

At the two Liberia Avenue intersections with Prince William Parkway, Hastings Drive, and Wellington Road, the following improvements are recommended:

- Construct new connector roadway(s) between Hastings Drive and Prince William Parkway. Note that the proposed Kline Property development from a 2017 study is shown in the image but not assumed, and that this recommendation is the same with or without the unapproved Kline development.
  - The analysis assumes 25% of traffic uses the proposed roadway in the southeast quadrant for northbound right turns and for westbound left turns.
- Install a continuous green T-intersection on Prince William Parkway at the new connector road when a signal is warranted.
- Install a free northbound right-turn with an add lane from northbound Prince William Parkway onto eastbound Prince William Parkway. The add lane may drop at the proposed new roadway or further east.

Figure 10: Concept Diagram for Liberia Avenue Existing Conditions with Improvements

- Install a southbound right-turn lane on Liberia Avenue onto westbound Wellington Road.
- Install a northbound right-turn lane from Prince William Parkway onto Hastings Road Extended.
- Restripe the eastbound approach of Hastings Road as left/through/right, and stripe the westbound approach the same.
- Adjust signal timing and phasing.
- Consider innovative intersections such as quadrant roadway, median U-turn, or displaced lefts to improve traffic flow.

CENTREVILLE ROAD/SUDLEY ROAD/PRESCOTT AVENUE

At the intersection of Route 28 and Sudley Road/Prescott Avenue, the following improvements are recommended:

- Replace existing signal with two-lane roundabout. The concept is shown in Figure 11.
  - There will be two approach lanes in each direction
    - Prescott Avenue will have a shared left-turn/through lane and an exclusive right-turn lane.
    - Sudley Avenue will have an exclusive left-turn lane and a shared through/right-turn lane.
    - Route 28 will have shared left-turn/through and through/right-turn lanes in both directions.
  - There will be two receiving lanes in both directions on Route 28.
  - There will be one receiving lane on Sudley Road and on Prescott Avenue.

Figure 11: Sudley Roundabout Concept

Source: RK&K May 2018 Roundabout Feasibility Report

Table 8: Existing Conditions with Recommended Improvements Capacity Analysis Summary

Intersection Existing Conditions & *with Improvements*		Synchro 10 (HCM 6th) Results					
		Delay (sec/veh)		v/c Ratio		Level of Service	
		AM	PM	AM	PM	AM	PM
Liberia Avenue & Route 28 (Centreville Road)	*existing*	91.0	67.9	1.01	0.92	F	E
	with Improvements	45.5	59.1	0.89	0.92	D	E
Prince William Parkway/Liberia Avenue & Wellington Road/ Prince William Parkway	*existing*	51.4	78.2	0.86	0.96	D	E
	with Improvements	39.5	54.6	0.82	0.88	D	D
Prince William Parkway/Liberia Avenue & Hastings Drive	*existing*	17.1	11.3	0.63	0.65	B	B
	with Improvements	23.0	25.7	0.68	0.76	C	C
Route 28 and Sudley Road/Prescott Avenue	*existing*	36.2	42.7	0.71	0.76	D	D
	with Improvements (Roundabout)	13.7	15.7	0.77	0.76	B	C

The results of the analysis show that the intersection of Route 28 and Liberia Avenue will operate at acceptable LOS D in the morning instead of LOS F, and in the PM peak, the delay will drop almost ten seconds. Improvements to the Prince William Parkway/Liberia Avenue/Wellington Road/Hastings Drive cluster will decrease delay at the northern intersection to operate acceptably at LOS D but cause a slight increase in delay at the southern section while still operating at acceptable LOS C during both peak periods. The roundabout at Sudley Road will reduce average delay per vehicle by over twenty seconds in the morning and nearly thirty seconds in the afternoon.

Recommendations based on 2040 Conditions with Near-Term Improvements

All funded CIP projects are assumed as are the improvements based on existing (2018) conditions. Improvements are recommended for the eight intersections that are expected to operate at LOS E or LOS F in 2040 (see Figure 20). A capacity analysis was performed for AM and PM peak hours for Future 2040 conditions with improvements. The results of the analysis are summarized for existing and future conditions in Table 9.

ROUTE 234 (DUMFRIES ROAD/GRANT AVENUE) AND WELLINGTON ROAD
At Route 234 (Dumfries Road/Grant Avenue) and Wellington Road, the following improvements are recommended:

- Remove split phasing and adjust signal timings.
- Restripe the eastbound approach with one exclusive left-turn lane, two through lanes, and an exclusive right-turn lane.
- Restripe the westbound approach with exclusive dual left-turn lanes, one through lane, and an exclusive right-turn lane.
- CIP Project #T-021 narrows the north leg to only one southbound through lane and one northbound lane north of the shopping center.

Figure 12 shows a graphical representation of the recommended improvements.

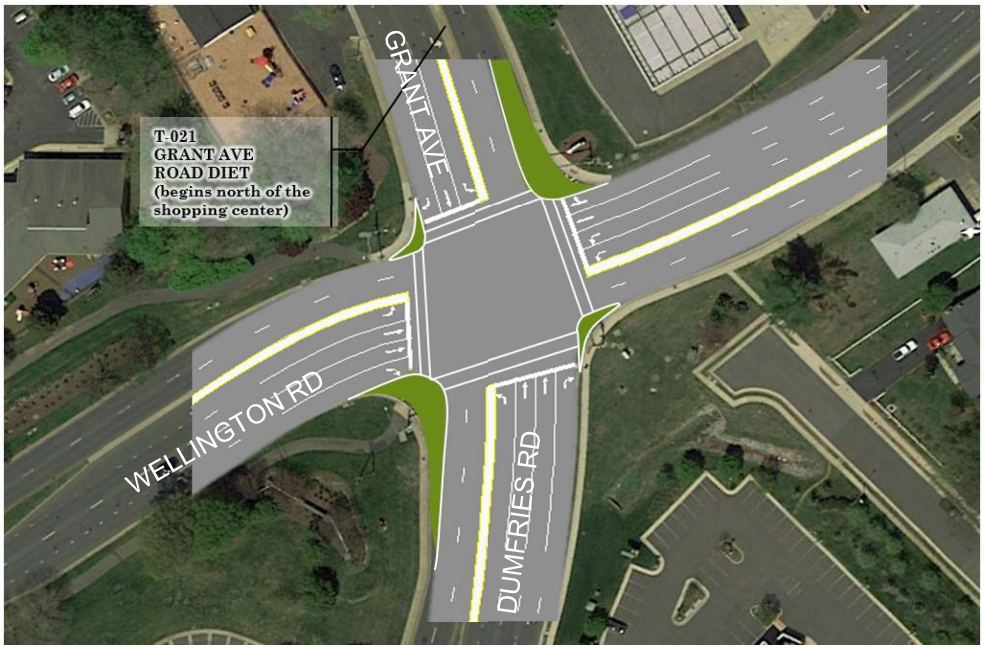


Figure 12: Future Improvements at Route 234 and Wellington Road

PRINCE WILLIAM PKWY/LIBERIA AVE AND WELLINGTON RD/PRINCE WILLIAM PKWY & PRINCE WILLIAM PKWY AND HASTINGS DR
Due to their proximity, improvements for the two intersections of Prince William Parkway/Liberia Avenue and Wellington Road/Prince William Parkway and Prince William Parkway and Hastings Drive were considered together. Both intersections are expected to operate at LOS F during the AM and PM peak periods in 2040 without additional improvements. Various options were considered, including widening, innovative intersection types (displaced left turns, compressed diamond interchange, quadrant roadways), and/or providing new connections. These five improvement options will be discussed briefly here. Ultimately, a more detailed study should be performed to determine the preferred alternative in the future.

The analysis results in Table 9 show the expected results of Option A (widening), whereas the innovative intersection design options (B, C, and D) were not modeled as part of this study. Those options are recommended for further study. Under Option A, the PM peak hour is expected to improve from LOS F to LOS E at Wellington Road. As part of its ongoing transportation planning process, the City should consider standardizing LOS E as acceptable for specific highly-congested areas.

<u>Improvement Option A: Widening</u>
Option A is perhaps the most traditional approach; it widens the northbound and southbound approaches to three through lanes. Also provided at the Wellington Road intersection are a southbound right turn lane, making the westbound right turn free flow, and providing an add lane to make the northbound right turn lane free flow. At Hastings Drive, the southbound left-turn lane would be eliminated. Southbound left turn, U-turns, and the westbound pedestrian phase would be prohibited.

A northbound right turn lane and two westbound approach lanes would be added. Hastings Road would continue east across Prince William Parkway to connect with Prince William Parkway in Prince William County. This new intersection should be signalized after verifying that the signal warrant is met and could be designed as a Continuous Green T-intersection. Signal head locations would have to be updated as well as signal timings.

Figure 13 shows Hastings Extended, the 2040 AM and PM peak hour volumes, and proposed lanes for this scenario. Figure 14 shows an example of a Continuous Green T-intersection.

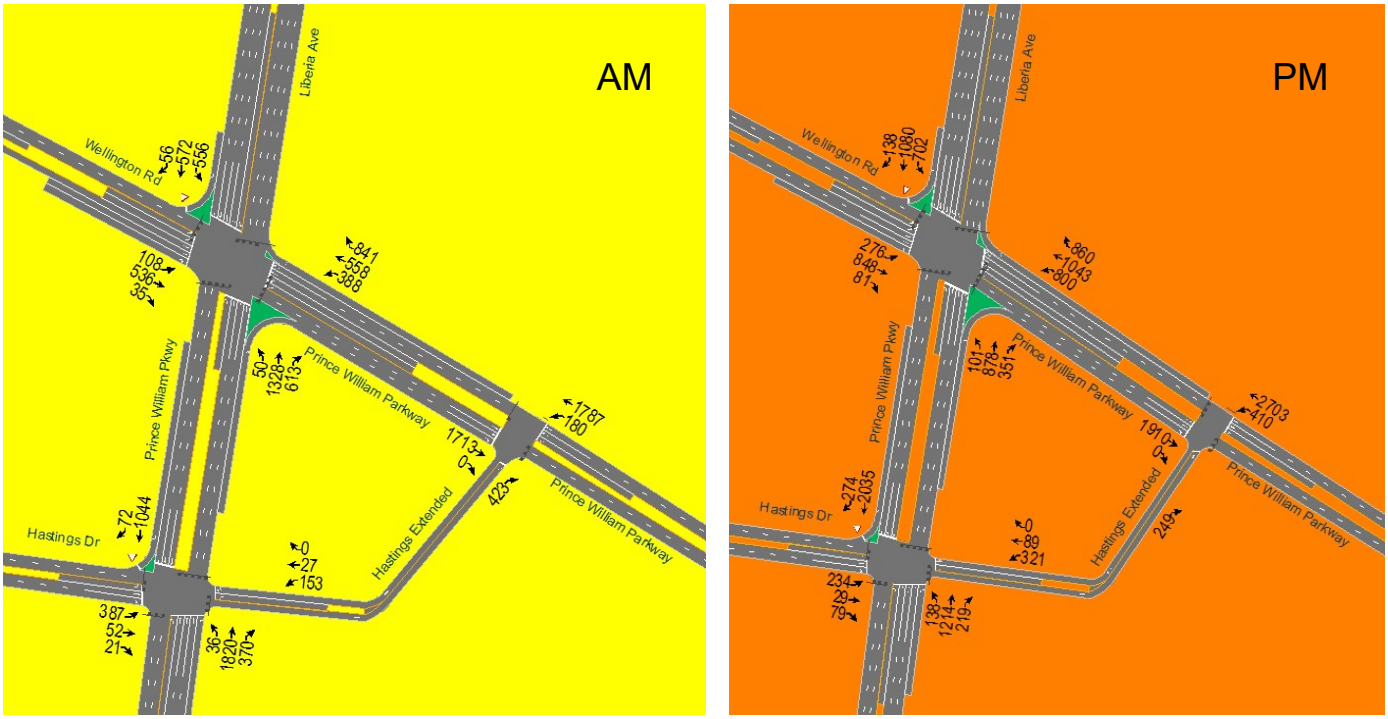


Figure 13: AM and PM Peak Hour Volumes for 2040 Improvement Option A

Figure 14: Example of a Continuous Green T-Intersection

Source: http://www.virginiadot.org/info/innovative_intersections_and_interchanges/cgt.asp

Innovative Intersection Alternatives

Improvement Option B: Displaced Left Turns

A displaced left turn (DLT) design forces left-turn vehicles to cross to the other side of the opposing through-traffic in advance of the main intersection. Left turns and opposing through movements may then occur simultaneously at the main intersection. An intersection can be designed as a partial DLT, with crossovers for left turns only on the major street, or a full DLT, with crossovers for left turns on both the major and side streets. The main intersection and the crossovers are signalized and timed to work together to minimize stops. This design should be considered at intersections with moderate to heavy traffic volumes in all directions, where opposing legs have similar through volumes, with heavy left-turn traffic, and/or with a limited number of driveways or access points near the intersection. Among the benefits are improved safety by reducing and spreading the number of conflict points, increased efficiency by moving left tuns and through movements simultaneously, and better synchronization by eliminating the left-turn phase and allowing drivers at the crossover and the main intersection to spend less time stopped. Two examples of displaced left turns are provided in Figure 15.

Improvement Option C: Compressed Diamond Interchange

A compressed diamond interchange grade separates two major roadways in an urban environment. In this scenario, the intersection of Liberia Avenue and Wellington Road would be reconstructed to provide grade separation. The through traffic on one street would no longer be forced to stop. The turning traffic would still be signalized at the end of the ramps. Two examples of compressed diamond interchanges are provided in Figure 16.

SR 741 & Austin Boulevard, Miamisburg, Ohio

3500 S & Bangerter Highway, Salt Lake City, UT

Figure 15: Examples of Displaced Left Turns in Ohio and Utah

New York Ave & North Capitol St, Washington, DC

Rio Road in Charlottesville, VA

Figure 16: Examples of Compressed Diamond Interchanges in the District of Columbia and in Virginia

Improvement Option D: Quadrant Roadway

A quadrant roadway connects one main intersection and two secondary intersections by linking a connector road in any quadrant of the intersection. Left-turn vehicles from all four legs of the main intersection use the secondary intersections and connector road, instead of the main intersection, to complete left-turn movements. Secondary intersections are typically signalized but can also be unsignalized. When all three intersections are signalized, traffic signals are timed to operate together. A quadrant roadway design should be considered at locations with an existing roadway that can be used as the connector roadway and/or at four-legged intersections with heavy through and left-turn traffic volumes on the major and side streets. Among the benefits are improved safety by reducing and spreading the number of conflict points, increased efficiency by reducing the number of signal phases by removing left turns from the main intersection, and better synchronization by coordinating the major and side streets.

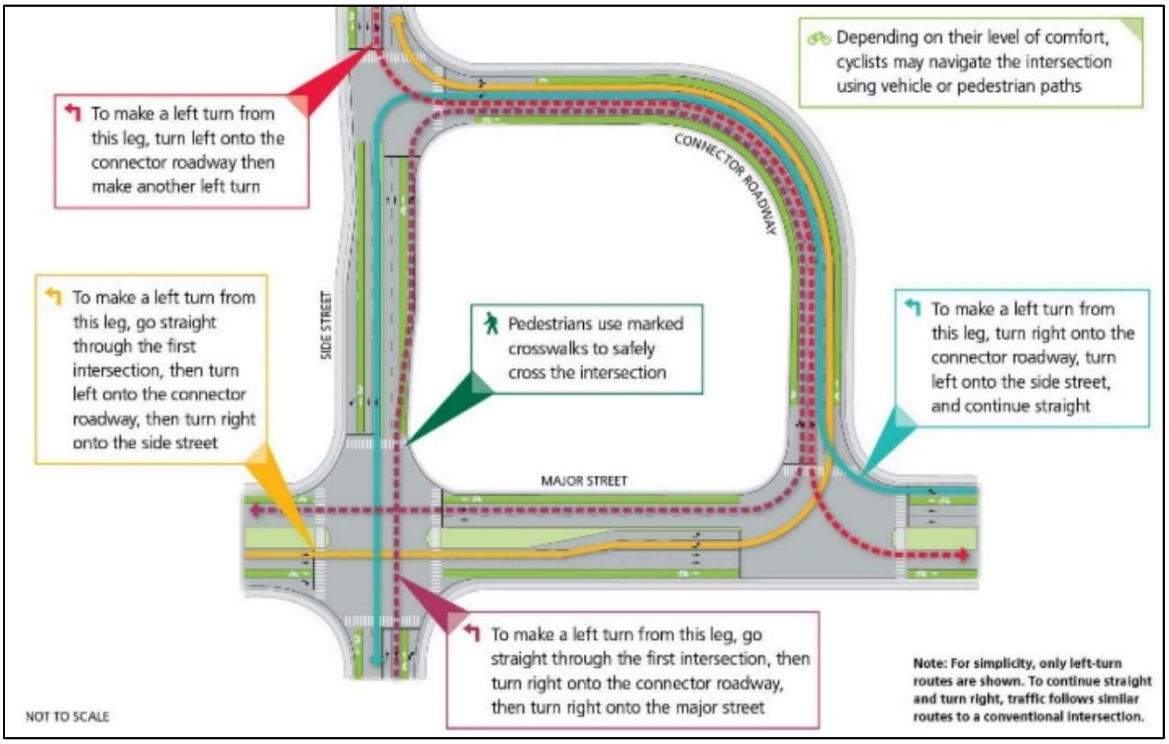


Figure 17: Graphical Explanation of How to Use a Quadrant Intersection

Source: http://www.virginiadot.org/info/innovative_intersections_and_interchanges/qr.asp

Improvement Option E: New Connections

In addition to the previously mentioned Hastings Drive Extension, a second new roadway to the south is suggested connecting the south and east legs of Prince William Parkway. Additional street connections would reduce the amount of traffic traveling through the two study intersections, thus improving operations. The Prince William Parkway route could be re-designated as following Buckhall Road instead of continuing to Liberia Avenue. Though there may be perceived negative impacts to economic development due to removing traffic from the City's corridors, this alternative provides a way to improve intersection operations within the City while being designed to only remove drivers that intend to travel north-to-east or west-to-south on Prince William Parkway with no intention of using the Liberia Avenue commercial corridor.

GODWIN DRIVE AT WELLINGTON RD, SUDLEY ROAD, ASHTON AVENUE, AND NOKESVILLE ROAD (ROUTE 28)

The recommendation is to widen Godwin Drive from Sudley Road to Nokesville Road (Route 28) as part of the Route 28 Bypass. Each signalized intersection along Godwin Drive will all be affected, including four that are expected to operate at LOS E or F in 2040: Wellington Road (LOS F) and Sudley Road, Ashton Avenue, and Nokesville Road (LOS E). As a result, signal timings should be adjusted. Figure 18 depicts an example before and after typical section.

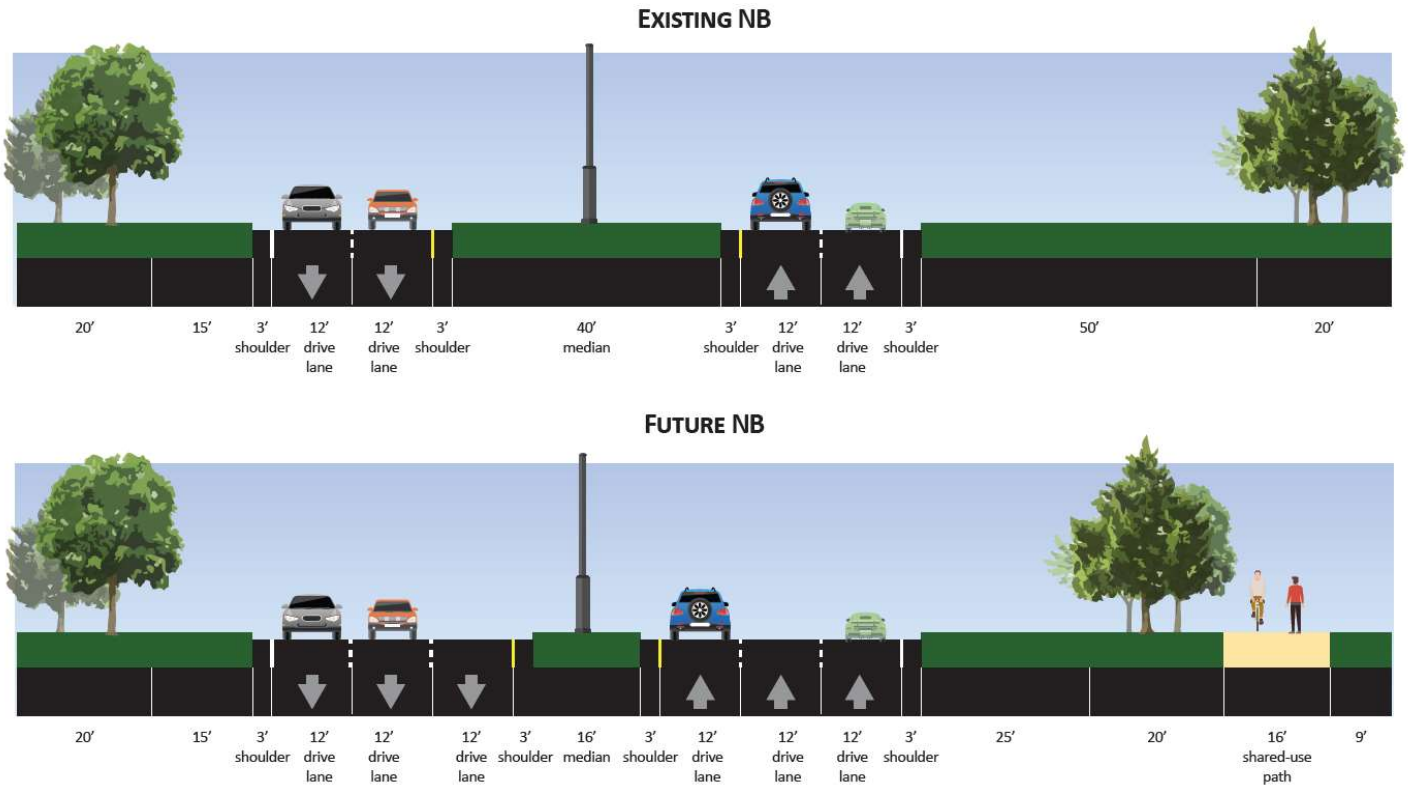


Figure 18: Example Typical Section of Godwin Drive South of Wellington Road before and after Widening

Route 28 (Centreville Road) and Liberia Avenue

Improvements to the intersection of Route 28 and Liberia Avenue include converting the northeast right-turn from Route 28 into a free right with an add lane that drops at Sheehy Driveway. Signal timings should be adjusted as well. Figure 19 shows the proposed added lane.

Route 28 (Nokesville Road) & Dean Drive

Additionally, consideration should be given to installing a traffic signal at the intersection of Nokesville Road and Dean Drive. Dean Drive is a major entrance to Micron, whose expansion will lead to additional traffic. Under existing conditions, truck drivers report difficultly turning. Sight distance should be examined in addition to the MUTCD signal warrants.

Figure 19: Proposed improvements at Route 28 and Liberia Avenue

Other Intersections

Intersections expected to operate at LOS D during one or both peak periods include:

- Grant Avenue and Sudley Road
- Grant Avenue and Route 28 (Center Street)
- Route 234 (Dumfries Road) and Hastings Road
- Route 28 (Centreville Rd) & Sudley Rd / Prescott Ave
- Liberia Avenue and Euclid Avenue
- Liberia Avenue and Signal Hill Road

Note that signal timing adjustments were only considered for LOS E or F locations. Citywide signal timing optimization, which should be performed periodically, may improve capacity at other locations not specifically discussed here.

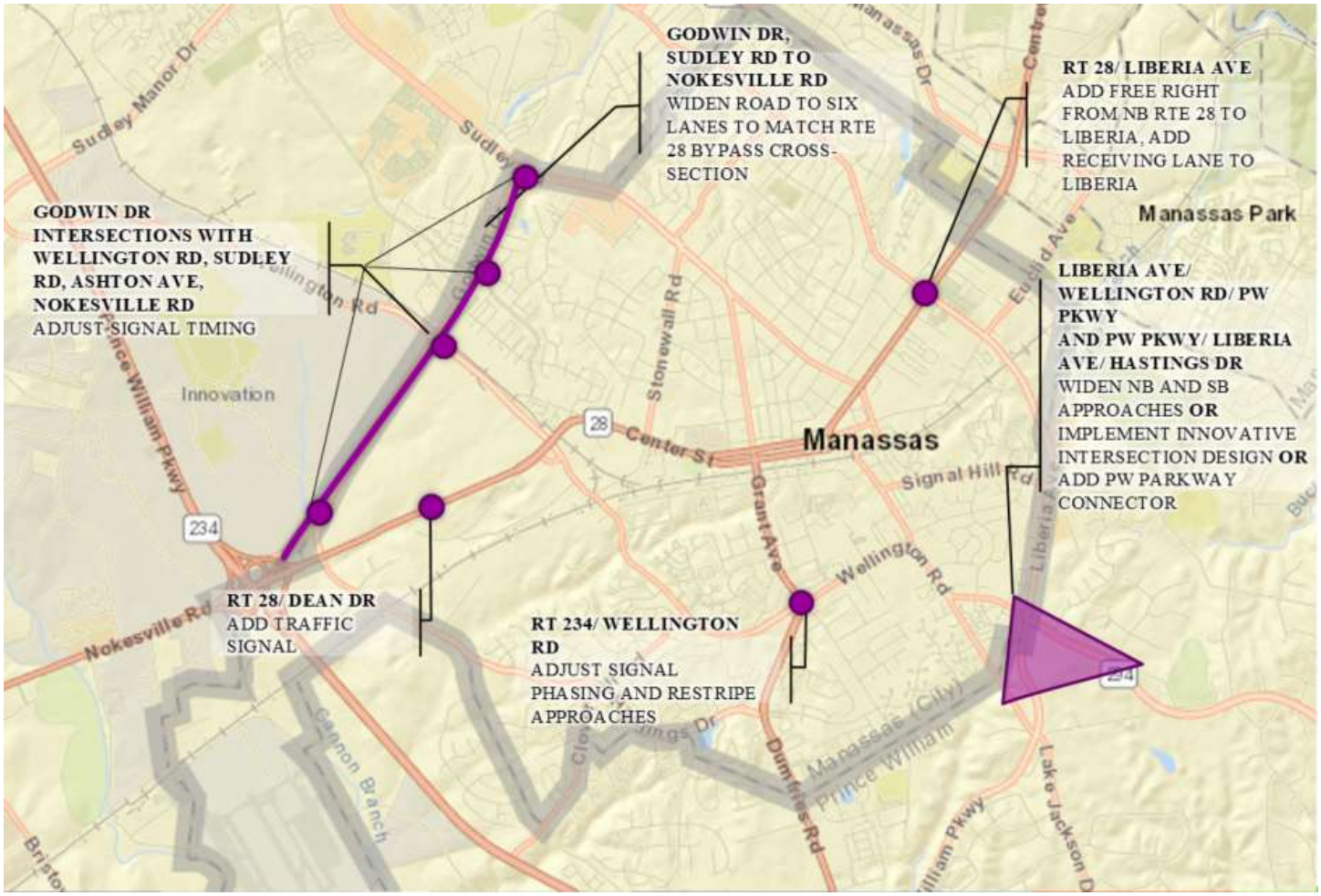


Figure 20: Recommendations based on 2040 Conditions with Near-Term Improvements

Table 9: Summary of 2040 Future Capacity Analysis – with Improvements

Intersection 2040 Future Conditions & *with Improvements*		Synchro 10 (HCM 6th) Results					
		Delay (sec/veh)		v/c Ratio		Level of Service	
		AM	PM	AM	PM	AM	PM
Rte 234 (Dumfries Rd / Grant Ave) & Wellington Rd	*2040 Conditions (from model)*	42.7	106.8	0.68	1.05	D	F
	with Improvements	30.9	45.7	0.65	0.81	C	D
Prince William Pkwy / Liberia Ave & Wellington Rd / Prince William Pkwy	*2040 Conditions (from model)*	113.3	103.6	1.24	1.15	F	F
	with Improvements	32.5	73.1	0.90	1.08	C	E
Prince William Pkwy & Hastings Dr	*2040 Conditions (from model)*	137.1	91.1	1.08	1.08	F	F
	with Improvements	36.4	39.0	0.85	0.96	D	D
Prince William Pkwy & Hastings Dr Extended (new)		36.8	38.5	0.91	0.97	D	D
Godwin Dr & Wellington Rd	*2040 Conditions (from model)*	50.8	83.2	0.98	1.11	D	F
	with Improvements	42.6	54.0	0.85	1.04	D	D
Godwin Dr & Sudley Road	*2040 Conditions (from model)*	48.3	68.8	0.75	0.99	D	E
	with Improvements	44.3	51.1	0.78	0.91	D	D
Godwin Dr & Ashton Avenue	*2040 Conditions (from model)*	35.0	68.1	0.70	0.99	C	E
	with Improvements	27.2	43.3	0.58	0.84	C	D
Godwin Dr & Route 28 (Nokesville Road)	*2040 Conditions (from model)*	44.0	76.9	0.79	1.06	D	E
	with Improvements	43.5	53.0	0.71	0.72	D	D
Route 28 (Centreville Road) & Liberia Avenue	*2040 Conditions (from model)*	47.9	60.1	0.92	0.93	D	E
	with Improvements	45.7	54.8	0.91	0.92	D	D

The results of the analysis show that the intersection of Route 234 (Dumfries Road/Grant Avenue) and Wellington Road would improve to an acceptable overall LOS D or better by adjusting the signal phasing and timing as well as restriping the existing pavement. The pair of intersections at Prince William Parkway/Liberia Avenue/Wellington Road/Hastings Drive will operate at LOS E or better depending on the improvements chosen. Widening Godwin Drive will provide additional capacity to reduce delays to an average of less than one minute per vehicle at Wellington Road. The other three Godwin Drive intersections (Sudley Road, Ashton Avenue, and Route 28) are expected to operate at LOS D or better during both peak periods.

Complete Streets Typology

Traditionally, streets have been classified into one of several *functional street classifications*, as defined by the Federal Highway Administration (FHWA) and American Association of State Highway and Transportation Officials (AASHTO). In the case of Manassas, roadway functional class stems from the Virginia Department of Transportation's (VDOT) Functional Classification Comprehensive Guide. The traditional functional street classification system defines street types based on vehicle mobility versus property access. Traffic volumes, travel speeds, and other design characteristics are often based on the assigned classifications. These categories are meant almost exclusively for vehicular circulation rather than a multimodal perspective.

The City of Manassas has developed the following Complete Streets Typology in order to incorporate more considerations into the thought process of street design and planning. Complete streets are healthy streets that balance the needs of pedestrians, bicyclists and transit users in addition to vehicle traffic. The City's expectation is not to include facilities for every mode in every street segment, but rather that each mode is thoroughly accommodated city-wide as part of the overall network. For example, two parallel streets do not necessarily need to each feature the same bicycle accommodations if one is inherently better suited to bicycle traffic. While the functional classification of each street in Manassas will continue to have relevance with regard to integration with the street networks of neighboring jurisdictions and the application of state and federal transportation funding resources, the City's Complete Streets Typology will serve as the primary design guidelines for Manassas streets going forward.

These guidelines provide a classification system that helps guide future street improvements and road design projects. It is critical to organize the street design of the City of Manassas as a part of reaching the objectives of the Citywide Transportation and Mobility Master Plan. The street typology will address the needs of all modes of travel and ensure safe accommodations for all users. The street types described in this plan are shown in the optimal condition. It should be noted that available right-of-way, land use, grade, utilities and existing roadway geometry will ultimately impact design, and the layout shown for each street type will not be achievable in every instance. The objective is to strive to meet as many of the typology elements described as possible.

The typology defines road geometry, pedestrian and bicycle amenities, speed limit guidelines and crosswalk guidelines for each street type. There are eight types included in the typology:

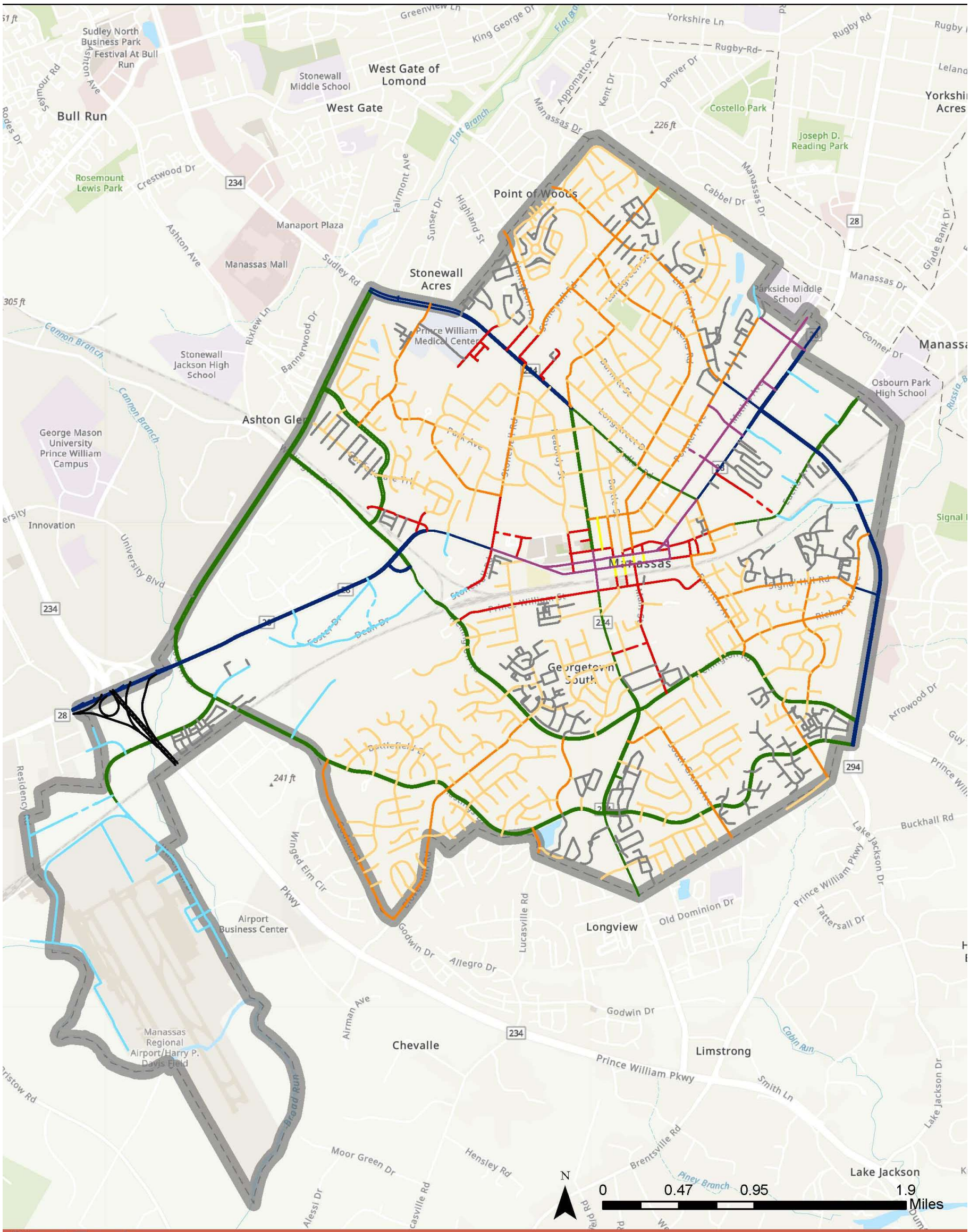
- Urban Street
- Mixed-Use Street
- Collector-Connector
- Commercial Corridor
- Industrial/Suburban Business Road
- Neighborhood Connector
- Neighborhood Street
- Shared Street

Figure 21 depicts the City of Manassas and the designation of each street within the typology.

The preferred street layout for each street type is defined in the sections below, which will serve as the City's design goals for new or re-designed streets in the future. It should be noted that these cross-sections and descriptions represent an optimal condition. In many cases, right-of-way constraints may make it impossible or impractical to include all prescribed elements. In those instances, a thorough roadway design effort incorporating local conditions should determine which amenities are prioritized. The guidelines shown in Table 10 should inform which elements should be prioritized in such a design process.

Table 10: Street Design Element Prioritization Guidelines

Condition	Prioritized Elements
All Urban Streets and Mixed-Use Streets	Maximize pedestrian zone within existing physical constraints up to the desired width shown in the type definitions (12' on Urban Streets, 8' on Mixed-Use Streets).
Street is a bike route	Prioritize bike infrastructure in accordance with what is recommended in the citywide bike infrastructure plan (see Appendix E).
Street is a bus route	• Prioritize transit amenities, including ADA-compliant alighting areas curbside. • Prioritize pull-out space of at least 8 feet or curb bulb-outs, with parallel parking configured to accommodate bus movements.
Street is within the ½-mile walkshed of a school	Prioritize pedestrian amenities.
Street is a designated truck route	Prioritize minimum lane widths of 11 feet.



Street Typology

Collector/ Connector
The "get around town" streets that form the primary routes for traffic between one part of the City and another. These streets generally have two lanes in either direction and often have landscaped medians. They have fewer commercial uses, and therefore fewer turning vehicles, than the Commercial Corridor streets.

Mixed Use Street
Smaller Streets in areas with street grids. Primarily commercial, office or multi family residential uses.

Proposed Mixed Use Road

Shared Street
Also called a woonerf, this type has both the vehicle & pedestrian amenities at the same level. "Sidewalks"may be marked but pedestrians have equal access to the entire street.

Neighborhood Street
Quiet, narrow neighborhood streets with houses set back from the roadway. Primarily residential or institutional (school, house of worship) uses. Naturally bicycle- and pedestrian-friendly by virtue of their low speeds and low traffic volumes.

Proposed Neighborhood Street

Neighborhood Connector
These are the more heavily-trafficked streets within neighborhoods, which provide important connections to major streets. These streets typically are wider than neighborhood streets, with a marked center line. While speeds are relatively low, they require some additional protections for cyclists (bike lanes or sharrows).

Urban Street
Main axes of downtown & areas with street grids. Commerical streets with lots of pedestrian activity.

Proposed Urban Street

Commercial Corridor
The biggest, busiest commercial streets. Lots of entrances.

Industrial/ Suburban Business Road
Roads serving industrial and low - density commercial land uses. In many cases these are dead-end streets. Freight access is prioritized to a higher degree than other street types.

Proposed Industrial/ Suburban Business Road

Highway/ Ramps

Private

Figure 21: Manassas Complete Streets Typology

Street Type Descriptions

URBAN STREET

These are the main axes of downtown and areas with street grids. Commercial streets that have a lot of pedestrian activity are in this category as well. These streets are destinations with small and medium sized businesses and restaurants. A significant amount of pedestrian and bicycle activity occurs on these streets. On-street parallel parking with enhanced streetscaping serve as a buffer for cyclists in this street typology. Additionally, on-street parking zones should be used for Pick-Up Drop-Off (PUDO) zones. These will serve emergency vehicles when necessary. Planters should be placed further apart in these zones.

Note that any future implementation of 10ft travel lanes on Urban Streets will require a review of the City's snow removal plan.

TWO-WAY URBAN STREET

- Key Features:
  - 12 ft pedestrian zones on both sides of the street
  - 6 ft bike lanes protected with flex posts or planters and striping and green pavement markings at intersection approaches
  - 8 ft parking lanes / PUDO zones
  - 10 ft travel lanes
- Example Street: Center Street from Stonewall Road to the Courthouse Complex

ONE-WAY URBAN STREET

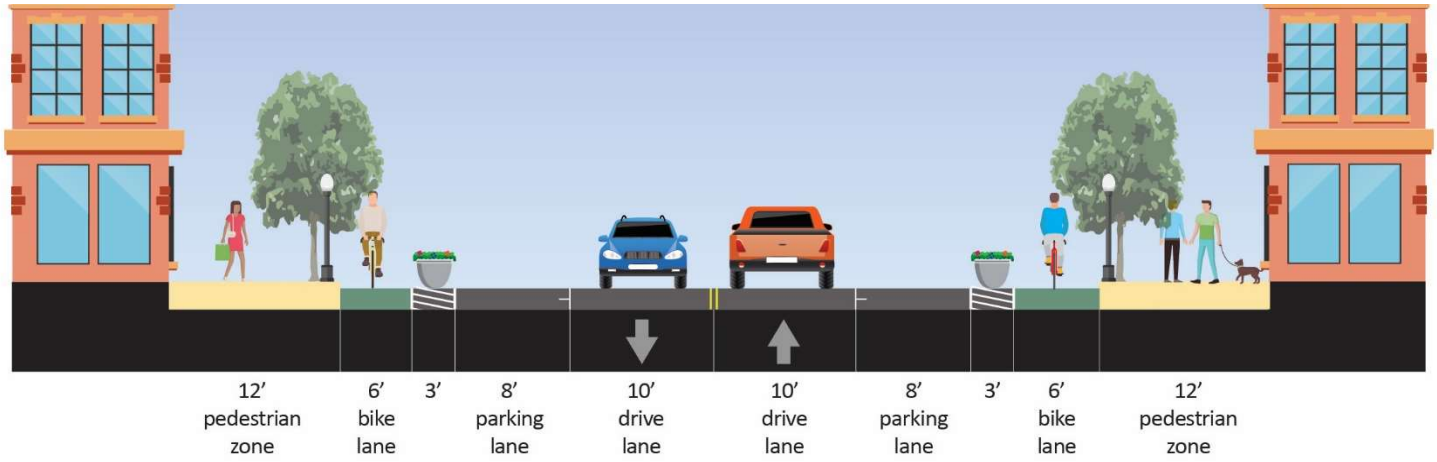


Figure 22: Two-Way Urban Street Intended Cross-Section

Exactly like the two-way Urban Street, one-way Urban Streets are the main axes of downtown and areas with street grids. They serve the same need as the two-way streets in this typology with the exception of bidirectional vehicle and bike traffic.

- Key Features:
  - 12 ft pedestrian zones on both sides of the street
  - 6 ft bike lane adjacent to left side curb, protected with flex posts or planters and striping and green pavement markings at intersection approaches. Posts/planters should be placed at a greater distance apart in PUDO zones.
  - 8 ft parking lane / PUDO zones adjacent to right side curb
  - 10 ft travel lanes

- Example Streets: One-way Urban Street: Center Street and Church Street.

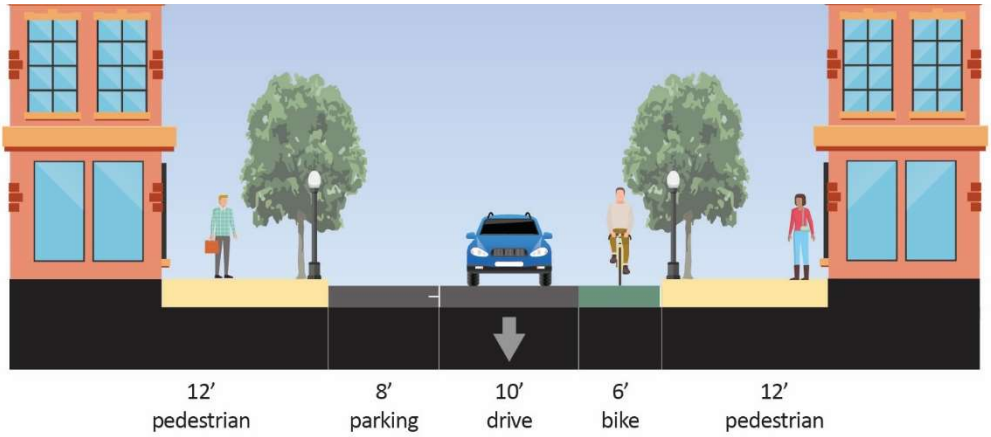


Figure 23: One-Way Urban Street Intended Cross-Section

Mixed Use Street

This typology is best described as smaller streets in the areas with street grids. Primarily commercial, office or multifamily residential uses are located adjacent to this street type. Parallel parking in this street typology should have designated PUDO zones. These will serve emergency vehicles when necessary. Planters should be placed further apart in these zones.

Note that any future implementation of 10ft travel lanes on Mixed-Use Streets will require a review of the City's snow removal plan.

- Key Features:
  - 8 ft pedestrian zones on both sides of the street
  - 6 ft wide bike lanes protected with flex posts or planters and striping and green pavement markings at intersection approaches. Posts/planters should be placed at a greater distance apart in PUDO zones.
  - 8 ft parking lanes / PUDO zones
  - 10 ft travel lanes
- Example Streets: Prince William Street, Lee Avenue and Cockrell Road.

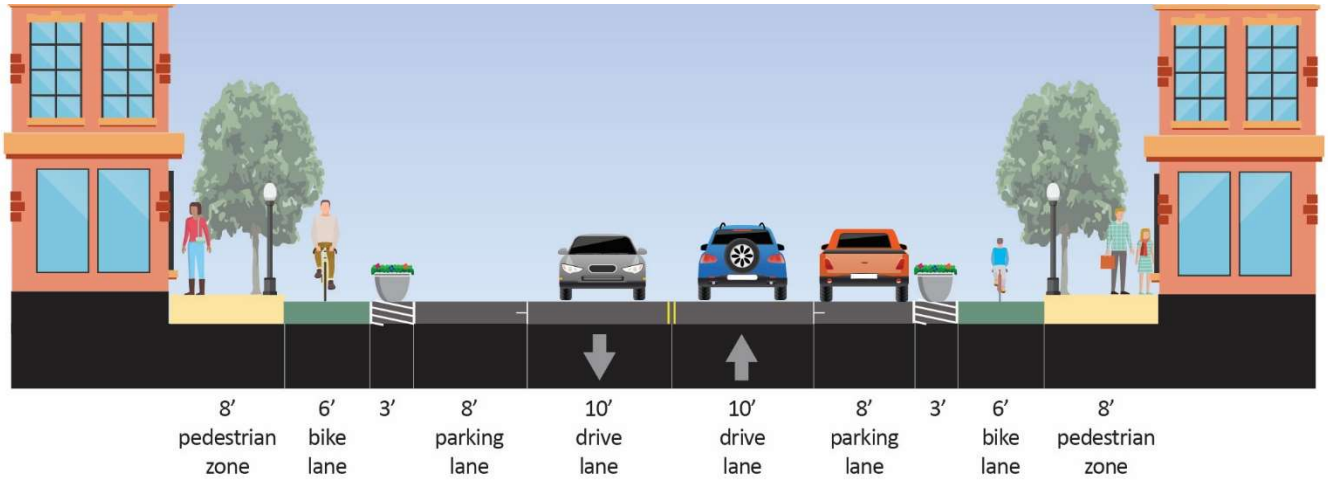


Figure 24: Mixed-Use Street Intended Cross-Section

Collector / Connector

Collector / Connector Streets are the "get around town" streets that form the primary routes for traffic between one part of the city and another. These streets generally have two lanes in either direction and often have landscaped medians. They have fewer commercial uses, and therefore fewer turning vehicles, than the Commercial Corridor Streets. Due to the nature of the roadway, bicycle and pedestrian activity is off-road on a side path.

- Key Features:
  - 10 ft shared use path for pedestrians and cyclists separated from street by 6 ft landscape buffer

- 5 ft minimum sidewalks on opposite side separated from street by 6 ft landscape buffer
- 11 ft travel lanes
- 10 ft planted median

- Example Streets: Wellington Road, Dumfries Road and Hastings Drive

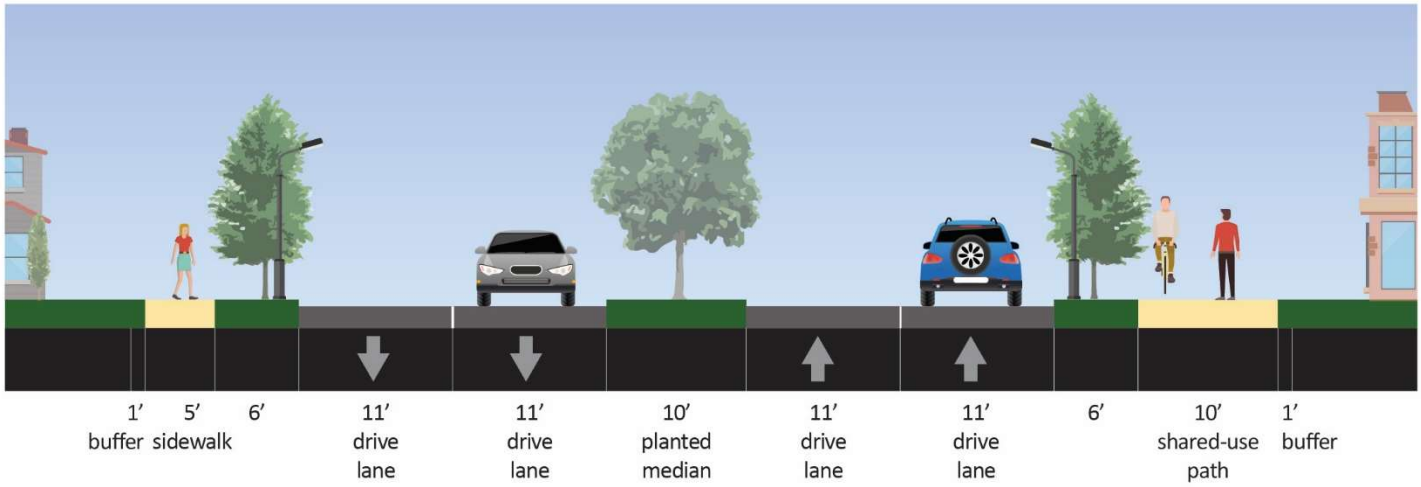


Figure 25: Collector/Connector Intended Cross-Section

COMMERCIAL CORRIDOR

Commercial corridors are the busiest, biggest commercial streets in the City of Manassas. Many access points and driveways are on the road. These roads typically serve the employment centers, commercial and civic centers in town. Safe bike lanes are key for these wider, busy streets.

- Key Features:
  - 5 ft minimum sidewalks on both sides of the road
  - 6 ft buffered bike lanes with striped buffer and green pavement markings at intersection approaches. A 10 ft shared use path could be implemented as a substitute where sufficient right-of-way exists.
  - 11 ft travel lanes
  - 10 ft planted median
  - 5 ft minimum sidewalks with 3 ft landscaping buffer
- Example Streets: Centreville Road, Liberia Avenue and Nokesville Road.

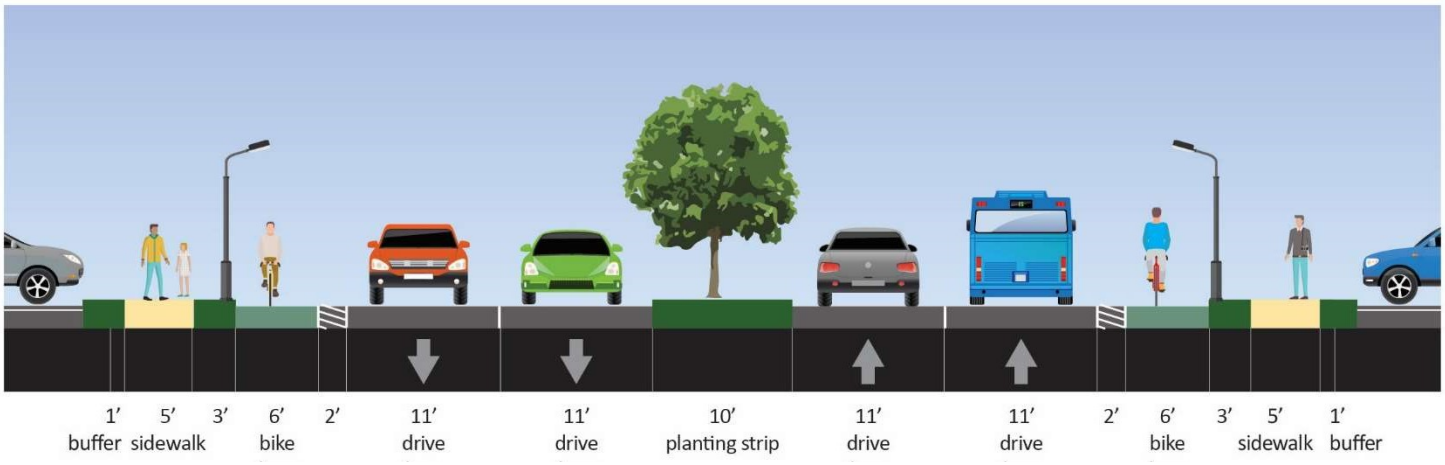


Figure 26: Commercial Corridor Intended Cross-Section

NEIGHBORHOOD CONNECTOR

These are the more heavily-trafficked streets within neighborhoods, which provide important connections to major streets. These streets typically are wider than neighborhood streets, with a marked center line. Due to the volume of vehicle traffic, there is a strong need to accommodate and encourage pedestrian and bicycle activity. While speeds are relatively low, they require some additional protection for cyclists (bike lanes or sharrows if bike lanes are not feasible).

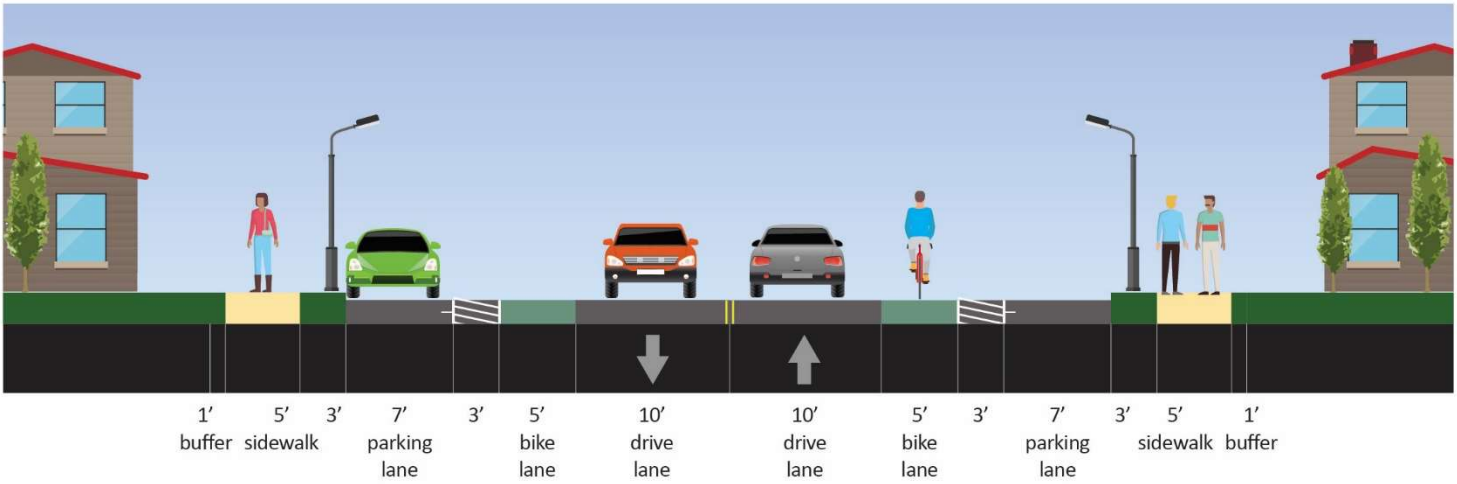


Figure 28: Neighborhood Connector Intended Cross-Section

- Key Features:
  - 5 ft minimum sidewalks on both sides of the road
  - 7 ft parking lanes on both sides of the road
  - 5 ft bike lanes in both directions with green pavement markings at intersection approaches. A 10 ft shared use path could be implemented as a substitute where sufficient right-of-way exists. Sharrows if neither bike lanes nor shared use path are feasible.
  - 10 ft travel lanes
- Example Streets: Stonewall Road, Cloverhill Road.

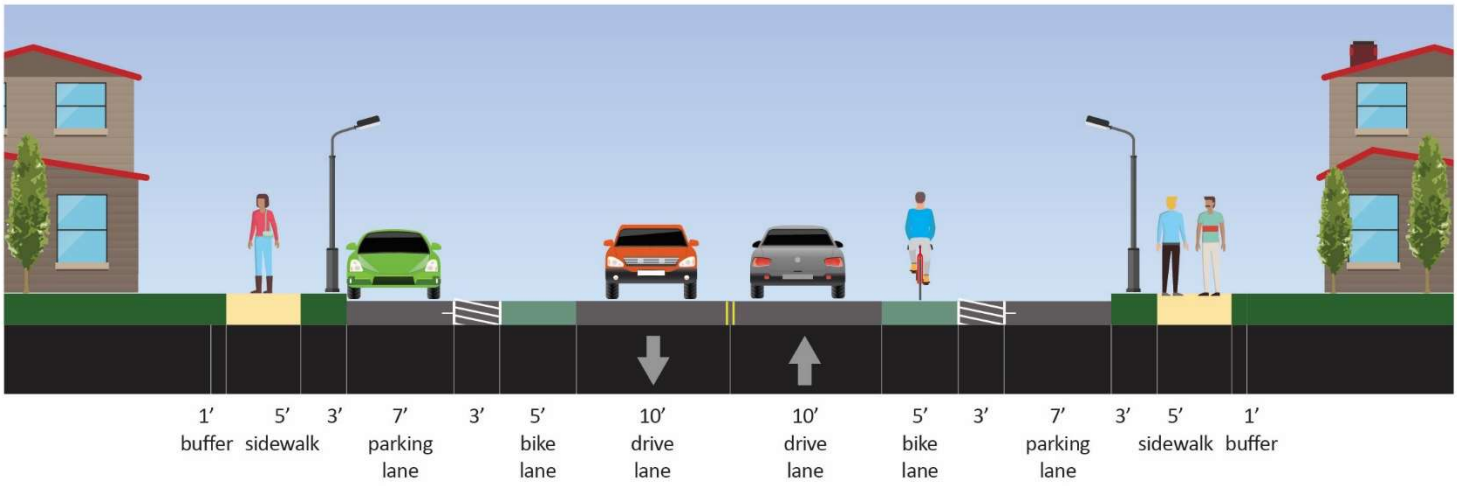


Figure 28: Neighborhood Connector Intended Cross-Section

NEIGHBORHOOD STREET

These streets are quiet, narrow neighborhood streets with houses set back from the roadway. Primary land uses along the street are residential or institutional (school, house of worship). Neighborhood streets are bicycle- and pedestrian-friendly by virtue of their low speeds and low traffic volumes.

Note that any future implementation of 10ft travel lanes on Neighborhood Connectors will require a review of the City's snow removal plan.

- Key Features:
  - 5 ft minimum sidewalks on both sides of the road
  - 7 ft parking lanes on both sides of the road
  - 10 ft travel lanes
- Example Streets: Meadowview Drive, Battlefield Drive and Landgreen Street

SHARED STREET

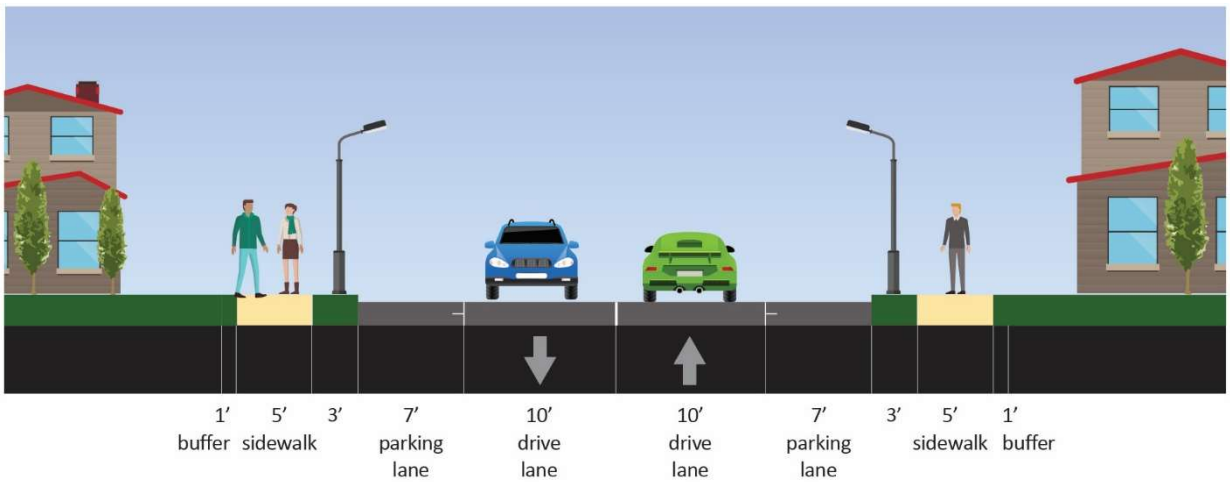


Figure 29: Neighborhood Street Intended Cross-Section

Also called a woonerf, this type of street has both the vehicle and pedestrian amenities at the same level. Pedestrians have equal access to the entire street. Vehicles travel on these streets at very low speeds and there are usually curbless with the sidewalk blending with the travel way. Typically, shared streets are abutted by small businesses and restaurants.

- Key Features: 35 ft. of shared space for pedestrians, cyclists and vehicles.
- Example Streets: Portions of East Street, Main Street, Battle Street and West Street.

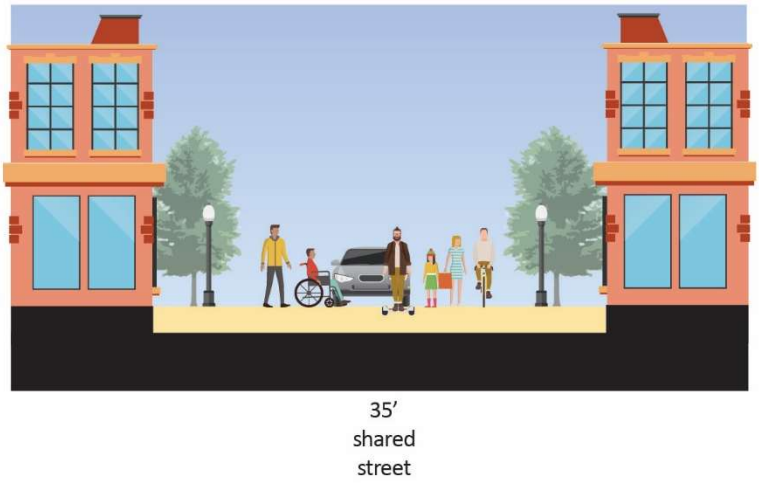


Figure 30: Shared Street Intended Cross-Section

Speed Limit Guidelines

Speed limits should be uniform and reasonable to expect driver compliance and set with an expectation of protecting and enhancing the safety of all road users. Generally, the posted speed limit should be the same in both directions on a two-way road. Table 11 provides the recommended maximum posted speed limit by street type, as well as for school zones and private streets. Example roadways are provided for each category. These values are subject to an engineering study that determines the appropriate speed based on the specific physical conditions of a specific roadway, and speed limits for individual streets within a type may be higher or lower depending on localized conditions. A speed study, in which the instance of speeding is quantified, should be conducted prior to changing speed limits in the City.

Table 11: Guidelines for Determining Posted Speed Limit

Recommended Posted Speed Limit*	Street Type (or other condition)	Examples
5 mph	Shared Street	Battle Street between Church Street and Center Street
15 mph (when children are present, during school arrival and dismissal times, or when flashing)	Designated school zone	Hastings Drive near George Carr Round Elementary School
20 mph	Neighborhood Street	Beauregard Avenue, Cedar Ridge Drive, Traveller Street
	Private Street	Gooseberry Drive, Buttress Lane
25 mph	Urban Street	Mathis Avenue, Breeden Avenue
	Mixed Use Street	Prince William Street, Main Street
25-30 mph	Industrial / Suburban Business Road	Aviation Lane, Dean Drive, Quarry Road
	Neighborhood Connector	Stonewall Road, Oakenshaw Drive, Weems Road, Clover Hill Road
35 mph	Commercial Corridor	Liberia Avenue, Sudley Road west of Grant Avenue
	Collector / Connector	Hastings Drive, Grant Avenue, Godwin Drive

**The posted speed limit may be higher or lower depending on site characteristics and engineering judgement.*

Intersection/Crosswalk Guidelines

These guidelines are intended to be recommendations for the City, notwithstanding site-specific conditions that may require different treatment. An engineering study should be performed and engineering judgement used when determining crosswalk design and placement, including which approaches of an intersection warrant crosswalks (Urban Streets and

Mixed-Use Streets should have crosswalks on all legs of every intersection). All crosswalks should be compliant with the latest version of the Manual on Uniform Traffic Control Devices.

Table 12 provides guidance for crosswalk implementation for each street type in the Complete Streets Typology, as well as certain special conditions, specifically designated school zones, locations where a shared use path crosses a roadway, or mid-block crossings. At intersections where different street types intersect, the higher-level prescribed crosswalk type between the two street types should be utilized. When a special condition exists, the higher-level prescribed crosswalk type between the street type and the special condition should be utilized.

The three crosswalk types prescribed in these guidelines are:

- **Standard Crosswalk –** 10' wide, marked with standard parallel lines. With or without diagonal hatching.
- **Wide Crosswalk –** Over 10' wide, marked with standard parallel lines. With or without diagonal hatching.
- **High Visibility Crosswalk –** Includes features longitudinal markings (e.g. diagonally hatched) and increased width of markings. May include contrasting pavement markings. High-visibility crosswalks should be used on the approaches to roundabouts.

Table 12: Crosswalk Guidelines by Street Type/Special Condition

Street Type (or other condition)	2 Lanes	3 Lanes	4+ Lanes	Notes
Shared Street	S			Consider contrasting pavement color and/or textured pavement (e.g. stamped concrete)
Designated school zone	HV	HV	HV	Implement text markings to warn of school crossing.
Neighborhood Street Private Street	S	S		
Industrial / Suburban Business Road Neighborhood Connector	S	S		
Urban Street Mixed Use Street	W	W	W	Implement contrasting pavement color and/or textured pavement (e.g. stamped concrete)
Collector / Connector	S	S	W	Consider removal of slip ramps/reduced curb radii
Commercial Corridor			HV	Consider removal of slip ramps/reduced curb radii
Shared Use Path Crossing (any street type)	W	W	W	
Mid-Block Crossing (any street type)	HV	HV	HV	• Distance to an adjacent designated crossing is more than 500 feet. • Implement passive warning, consider active warning device. • Consider curb extensions where practical (i.e. not a truck route, will not impede a bike lane) • Consider text markings to warn of pedestrian crossing.

Crosswalks at a midblock location should be striped with high-visibility pavement markings. All midblock crosswalks should be signed with passive warning signage (pedestrian warning signs and downward facing arrow plaques) Engineering judgement should be used to determine the necessity of advance warning signs and/or active warning or traffic control devices such as HAWK signals or flashing beacons.

Per the MUTCD, stop lines should be placed a minimum of four feet in advance of a crosswalk. The width of the crosswalk should be a minimum of ten feet and encompass the ramp. Parking should be restricted within twenty feet of a crosswalk in order to ensure visibility of crossing pedestrians, unless curb extensions are employed.

Other design choices should be considered to improve intersection safety, reduce vehicle speeds, and avoid or mitigate conflicts between modes at intersections, specifically the following:

- **Remove Slip-Ramps** – Slip ramps are in some cases necessary for traffic flow, but in many cases are remnants of a default approach to prioritize maintaining vehicle speed over safety considerations. Their removal will reduce intersection complexity and remove an unimpeded vehicle movement that creates high vehicle turning speeds. Consider at any intersection with slip ramps, particularly on Commercial Corridors and Collector/Connecters.
- **Reduce Curb Radii** – Shorter turning radii can facilitate lower turning speeds, shorten the overall crossing distance for pedestrians, and improve sight distance between pedestrians and motorists at intersections. Consider during all intersection re-design processes, particularly for Commercial Corridors and Collector/Connecters.
- **Green Pavement for Bike Lanes** – All bike lanes should include green pavement markings in the final 100'-200' of approach to an intersection, with the specific extent and type of markings to be determined by an engineering design process. Colored pavement can serve as a warning to both drivers and cyclists to an upcoming conflict area, and help to reinforce the bike lane's "claim" to a portion of the roadway.
- **Refuge Medians** – Should be implemented at all intersections on any roadway which has raised center medians of at least 6', unless impractical due to other engineering design considerations.

Functional Classification

While the Complete Streets Typology will serve as the primary set of design guidelines moving forward within the City of Manassas, functional street classifications will continue to be relevant in order to classify roadways for the use of state and federal funding. The VDOT Functional Classification Comprehensive Guide (2014) identifies seven classifications, ranging from Interstate to Local. Of these, all but Interstate are represented in Manassas (see Figure 31):

- **Other Freeways and Expressways** – These roads are very similar to Interstates. There is a physical barrier between directional travel lanes and their access and egress points are limited to on- and off-ramp locations or a very limited number of at-grade intersections. Only 0.5 mile of Freeways and Expressways are in the City of Manassas.
- **Other Principal Arterial** – Other: These roads provide a high degree of mobility and include some access to driveways of specific parcels and at-grade intersections with other roadways. There are 6 miles of Other Principal Arterials in the City of Manassas.
- **Minor Arterial** – These roads provide service for moderate length trips, and interconnect the higher arterial system, providing intra-community continuity in the city. There are 24 miles of Minor Arterials in the City of Manassas.
- **Major and Minor Collector** – Collectors are a critical part of the roadway network and gather traffic from local roads funneling them through the arterial network. Collectors are broken down into two categories, Major Collectors and Minor Collectors. Major Collector routes are generally longer in lengths with fewer connecting driveways, higher annual average traffic volumes and higher speed limits than their Minor Collector counterparts. The City of Manassas has 7 miles of Major Collectors and 7 miles of Minor Collectors.
- **Local Roads** – Locally classified roads are not intended for use in long distance travel, except at the origin or destination end of the trips, as they provide direct access to abutting land. Local Roads are the largest percentage of all roadways in terms of mileage, covering 167 miles in the City of Manassas.

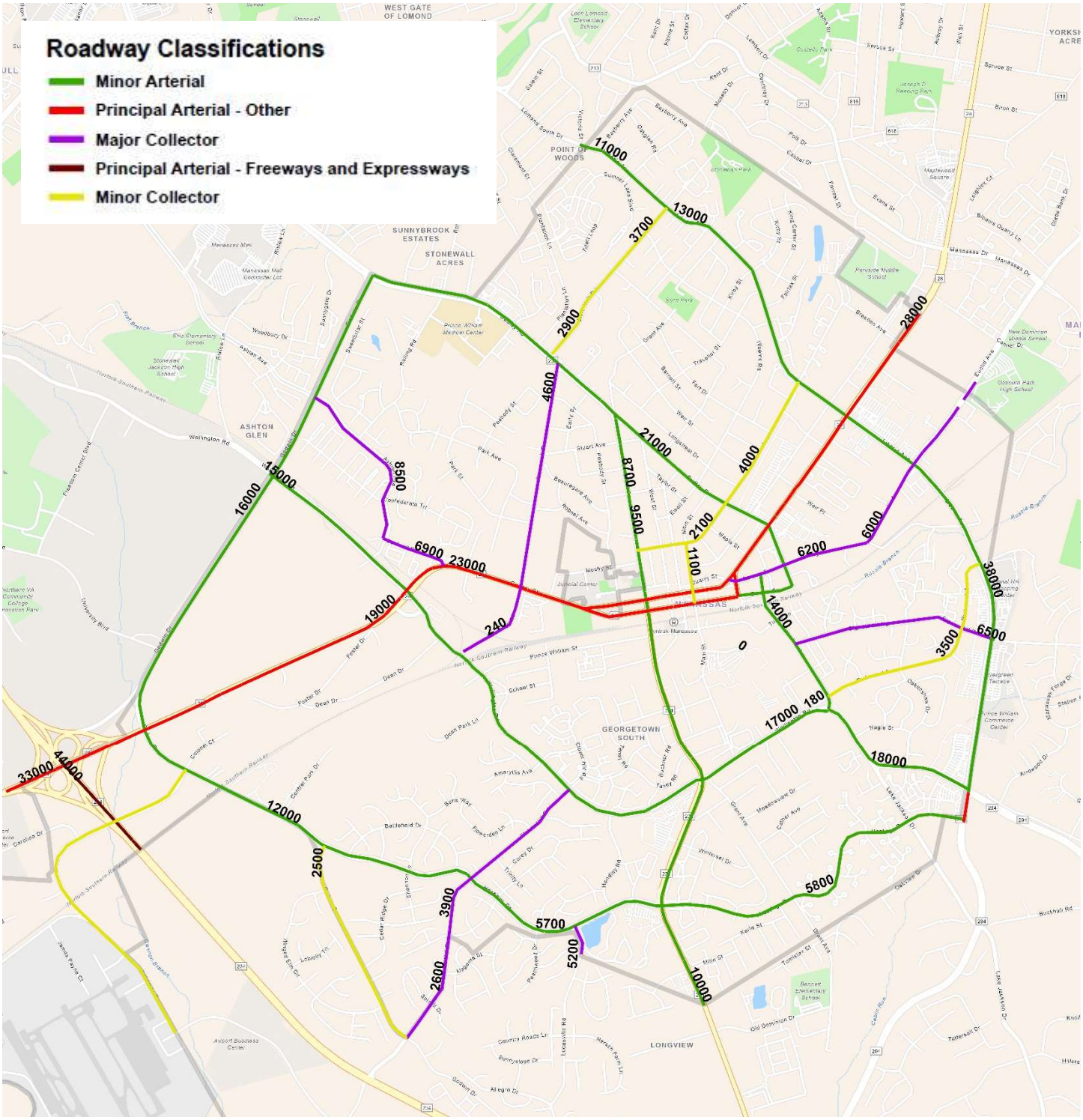


Figure 31: Existing Functional Classification of Roadways (Minor Collector and Above) in Manassas

RECOMMENDED FUNCTIONAL CLASS CHANGES

This classification is used to determine how state and federal transportation funding resources can be applied to the roadway system. As such, it is important to assess the current classifications for roadways within the City and determine if any should be adjusted to better reflect current and future street layout, development patterns, and neighborhood character. The following changes to functional classification are recommended (see Figure 32):

1. Liberia Ave from Prince William Pkwy to Centreville Road (Rte 28) – Change from Minor Arterial to Other Principal Arterial (Principal arterials are supposed to be a continuous network, and the current designations leave a gap in the principal arterial network between 28 and Prince William Parkway).
2. Mathis Ave from Main Street to Manassas Dr – Change from Local Road to Minor Collector (Alternative to 28 between downtown and Liberia Ave/Manassas Drive).
3. Rte 28 (Centreville Rd, Church Street, Zebedee St, Center St, & Nokesville Rd) from Liberia Ave to Prince William Pkwy – Change from Other Principal Arterial to Minor Arterial (With Liberia upgraded to principal arterial, there would be a more direct connection between 28 and 234. Designation of other principal arterial may cause resistance from VDOT on future urban streetscape projects the City wants to implement).
4. Signal Hill Road from Fairview Ave to Liberia Ave – Change from Major Collector to Minor Collector (due to residential character).
5. Clover Hill Road from Wellington Road to Godwin Dr – Change from Major Collector to Minor Collector (due to residential character).
6. Quarry Road from Euclid Ave to Liberia Ave – Change from Local Road to Minor Collector (Likely cut-through from downtown to Liberia Ave).
7. Godwin Drive from Sudley Road to Nokesville Road (Rte 28) – Change from Minor Arterial to Other Principal Arterial to reflect the widening and increased traffic load associated with the Rte 28 bypass. This would also link two Principal Arterials, the Rte 28 bypass and Rte 28 west of Godwin to maintain a complete network of Principle Arterials.

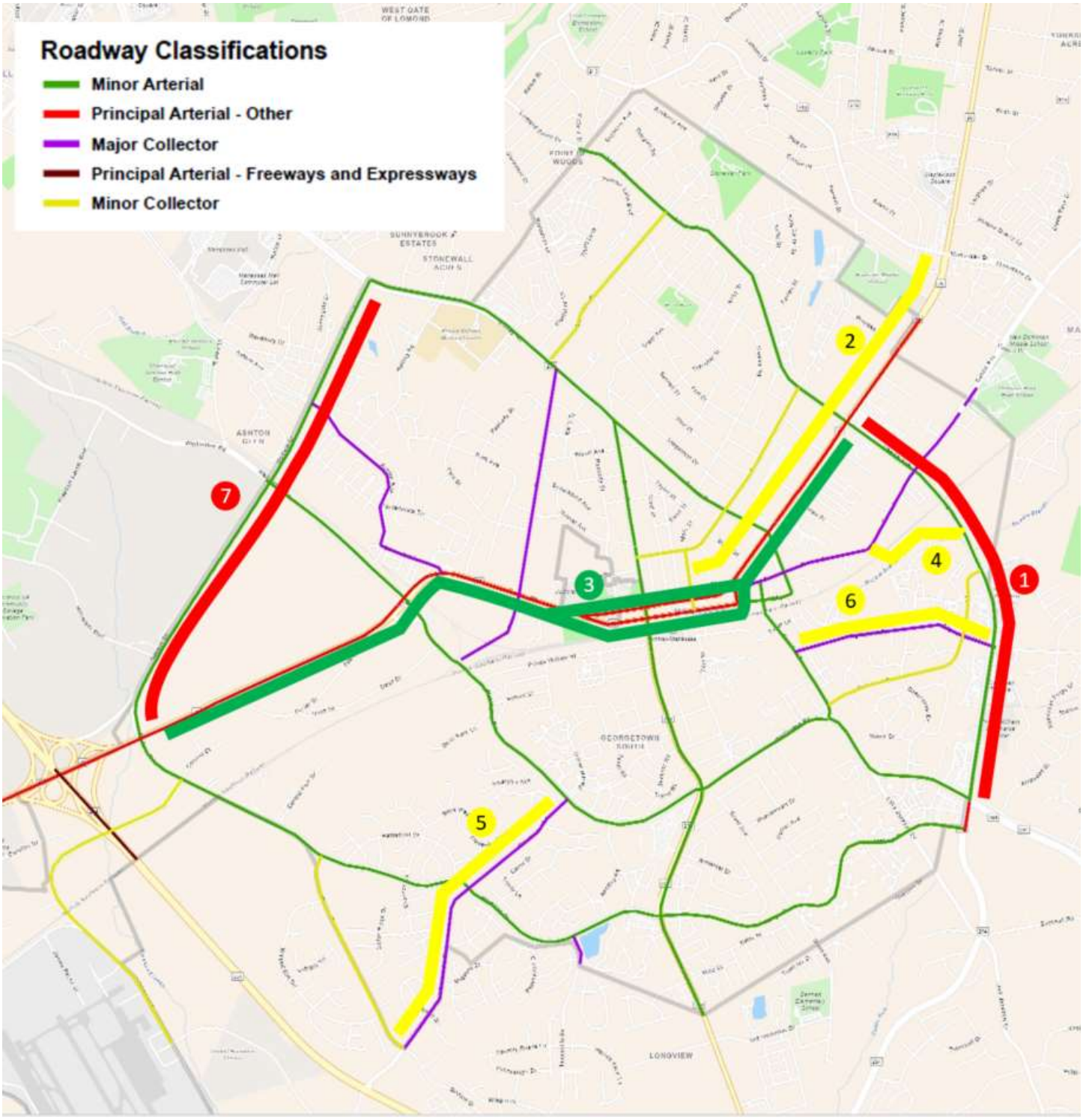


Figure 32: Recommended Functional Classification Changes

Bicycle & Pedestrian Recommendations

Selection Process

BICYCLE NETWORK IMPROVEMENTS

The following factors were utilized to identify improvements to be included in the set of bicycle network recommendations in the TMP:

- Improvements previously identified and funded through the City's CIP.
- Improvements that would help to complete the existing network, providing connections between existing portions of the network that are currently separated.
- Improvements that address issues identified through the City's Community Conversations process and/or through the study team's interviews with key stakeholders from the government, business, and community sectors.
- Preferred level of bicycle accommodation identified in the Complete Streets Typology.

Note that the prescribed level of infrastructure from the typology was evaluated in context with each road segment's fit in the overall network, as well as available right-of-way and presence of on-street parking. In some cases the desired accommodation, in most cases bike lanes, may have been omitted if another preferable adjacent corridor existed, or if the necessary right-of way did not exist. Instances where the infrastructure type called for in the typology was not recommended are captured in Appendix A: Bicycle Recommendations Matrix.

PEDESTRIAN NETWORK IMPROVEMENTS

The following factors were utilized to identify improvements to be included in the set of bicycle network recommendations in the TMP:

- Improvements previously identified and funded through the City's CIP.
- Improvements identified through a walkshed analysis process, in which the 1/2-mile walkable area around each public school, and the 1-mile walkable area around the Manassas VRE station, were identified utilizing GIS (see Appendix F for all maps and Figure 33 for an example). Locations where a gap in the existing network of sidewalks and paved paths constrained the walksheds were identified as priority locations for network recommendations.

Figure 33: Walkshed Analysis for Metz Middle School

- Improvements that would help to complete the existing network, providing connections between existing portions of the network that are currently separated.
- Improvements that address issues identified through the City's Community Conversations process and/or through the study team's interviews with key stakeholders from the government, business, and community sectors.

Note that off-street shared use path recommendations were considered to be part of both the bicycle and pedestrian recommendations sets, since those paths functionally provide both pedestrian and bike connectivity.

Summary of Recommendations

BICYCLE

After evaluating the need for bicycle network improvement needs throughout the City, the study team selected one of the following recommendation (sorted from lowest- to highest-order) types for each location selected for inclusion:

- **Signed Shared Roads with Lane Markings**. A signed shared road is intended to facilitate the sharing of right-of-way between bicycles and automobiles by alerting drivers to the presence of cyclists through both roadside signage and share-the-road markings, or *sharrows*, on the pavement. Streets where this level of infrastructure is selected should have relatively low speeds and restricted right-of-way widths in order to facilitate the safe sharing of space.
- **Bike Lanes**. Bike lanes are any sort of facility that is specifically set aside for bicycles only within the right-of-way. The specific *type* of bike lane (basic, buffered, barrier-protected, or parking-protected) would be determined by the preferred infrastructure type identified in the Complete Streets Typology, although a localized design process should be conducted before each bike lane improvement is installed to ensure that local conditions are appropriately considered. All bike lanes should include green pavement markings in the final 100'-200' of approach to an intersection, with the specific extent and type of markings to be determined by an engineering design process.
- **Shared Use Paths**. These paths are located outside of the roadway, either parallel to a street or connecting streets through undeveloped land. The minimum prescribed width for shared use paths should be ten feet with a center line indicating direction of travel.
- **Shared Streets**. As described in the Complete Streets Typology, shared streets allow pedestrian, bicycle, and vehicular modes to share the same right-of-way, with safety ensured by design features that hold vehicular travel speeds to very low levels.

Bicycle Network Recommendations were categorized by short- and long-term based on the ease of implementation and the need for major construction, with 2022 considered the short-term target year and 2040 considered the long-term target year. In general, signed shared roadways were characterized as short-term, due to the fact that their implementation typically only required the installation of signs and pavement markings. Bike lanes and shared use paths were characterized as long-term unless they were already included in funded CIP projects.

Table 13, Figure 34 and Figure 35 detail the full set of bicycle network recommendations.

Table 13: Summary of Bicycle Network Recommendations

Improvement Category	# of Locations			Length (mi.)
	Existing	Existing + Funded	Recommended	
Signed Shared Roadway	10	12	30	17.9
Bike Lanes	6	9	29	18.2
Shared use Path	7	12	22	8.4
Shared Street			4	0.3

City of Manassas Master Plan

Bicycle Facilities - Short Term Recommendations

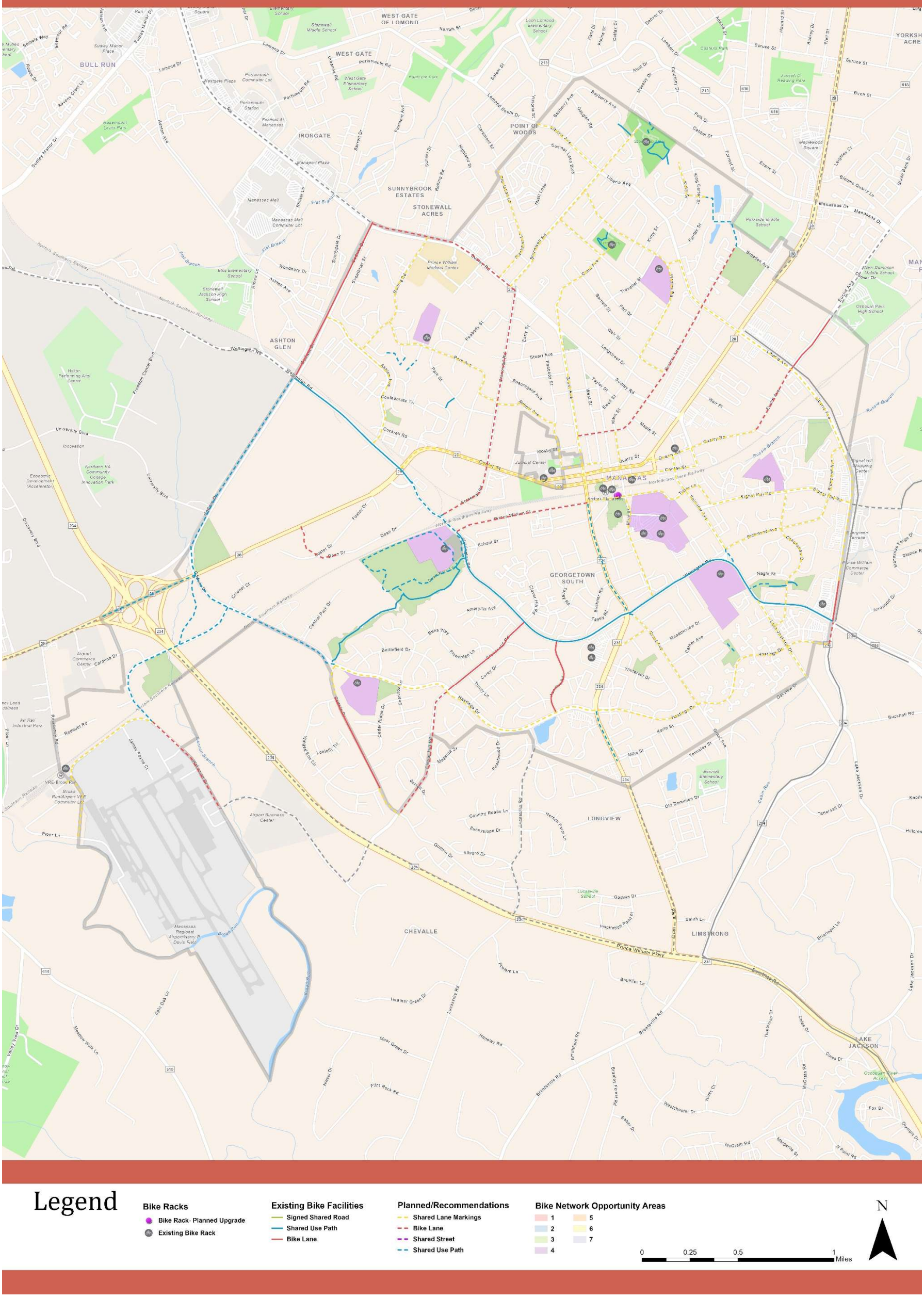


Figure 34: Short-term Bicycle Network Recommendations

City of Manassas Transportation Master Plan

Bicycle Facilities - Short and Long Term Recommendations

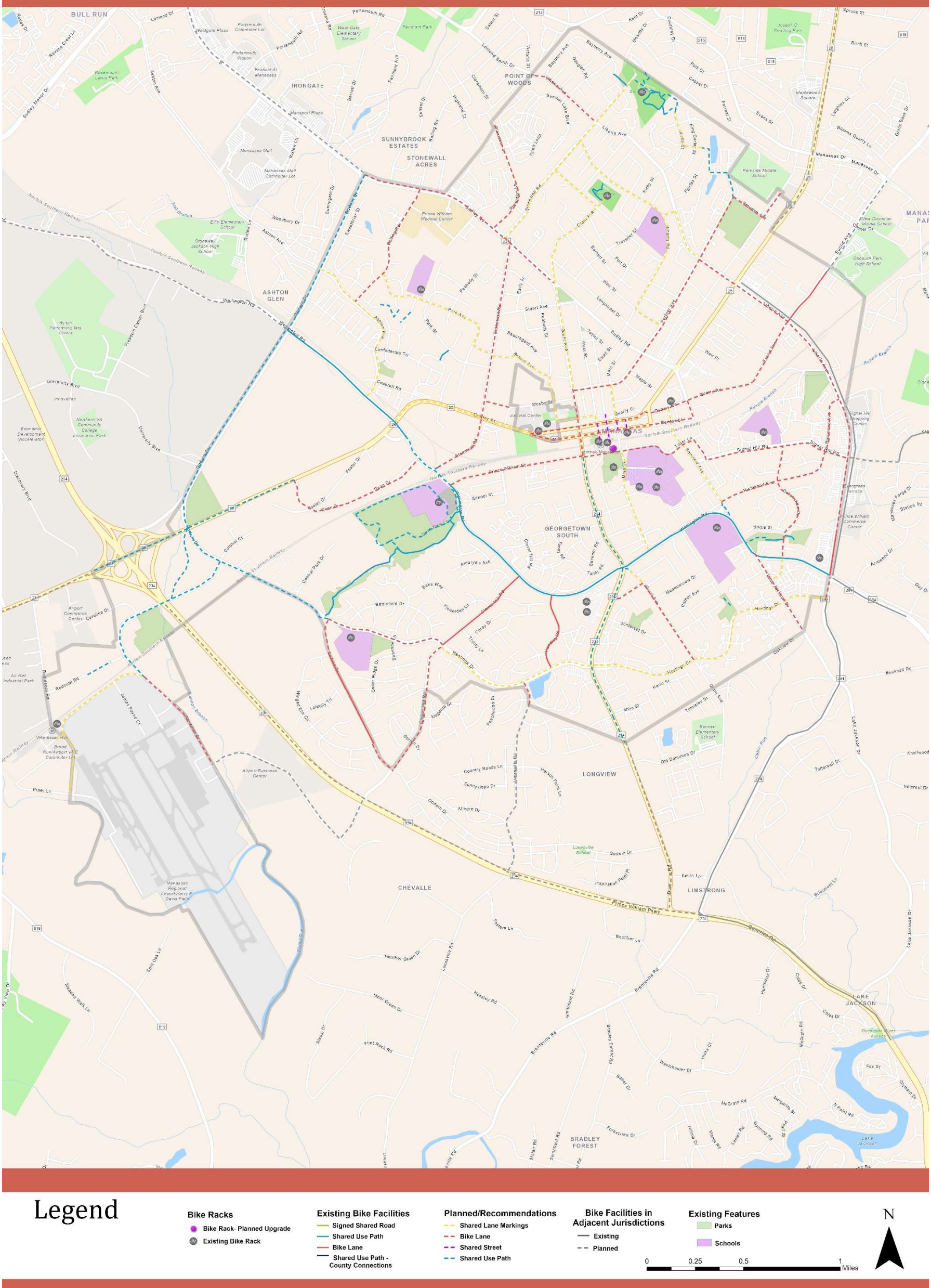


Figure 35: Long-term Bicycle Network Recommendations

PEDESTRIAN

After evaluating the need for pedestrian network improvement needs throughout the City, the study team selected one of the following recommendation types for each location selected for inclusion:

- **Sidewalk Gap Connections**. Additional sidewalks where they are missing from either one or both sides of a street, and the completion of a gap would enhance overall connectivity.
- **Shared Use Paths**. These paths are located outside of the roadway, either parallel to a street or connecting streets through undeveloped land. The minimum prescribed width for shared use paths should be ten feet with a center line indicating direction of travel.
- **Intersection Safety Improvements**. These are recommendations for further study, either for a single intersection or on a corridor-level, to address known safety issues at intersections. Potential improvements as a result of specific studies could include signal timing modifications, installation of pedestrian signals or warning devices, construction of corner bulb-outs or refuge medians, or improvements to existing crosswalks.

Pedestrian network recommendations were not categorized by short- and long-term, as the recommended prioritization process determined which improvements should be done first.

Table 14 and Figure 36 detail the full set of pedestrian network recommendations.

Table 14: Summary of Pedestrian Network Recommendations

Improvement Category	Street Type	# of Locations	Length (mi.)
Sidewalk Gap Connections	Mixed-Use Street	4	1.0
	Commercial Corridor	1	0.3
	Collector/Connector	7	2.2
	Neighborhood Connector	8	2.0
	Neighborhood Street	19	4.2
		Total:	9.6
Shared use Path Connections	Commercial Corridor	1	1.2
	Collector/Connector	7	5.0
	Neighborhood Connector	1	0.1
	Industrial/ Suburban Business Road	2	0.5
	[Off-Street Paths]	13	1.4
		Total:	8.1
Intersection Safety Improvements (single and corridor)		16	N/A

City of Manassas Transportation Master Plan

Pedestrian Network

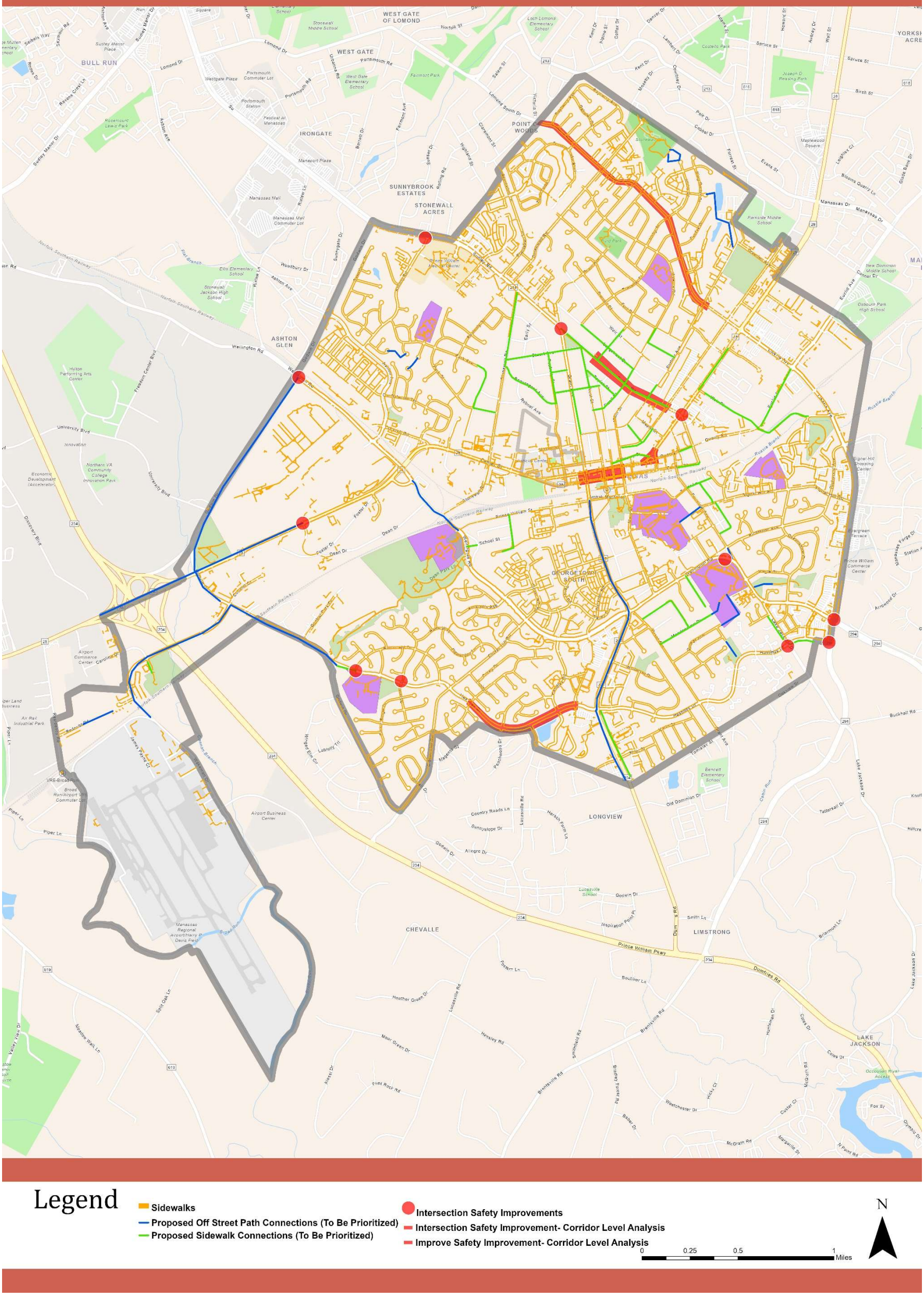


Figure 36: Pedestrian Network Recommendations

Prioritization Criteria

In support of the Transportation and Mobility Master Plan development, The City prepared a set of criteria to provide guidance and help prioritize recommendations to improve bicycling and pedestrian access in the City. In developing the criteria, the City's goals for the Plan were considered, particularly an emphasis on complete streets. Three main categories were identified as significant in the consideration of improvements and recommendations for the bicycle and pedestrian network: Access and Connectivity, Safety and Comfort, and Equity. Two other categories, Opportunity and Public Support/Request, will be tracked to identify those improvements that might be moved up in the prioritization ranking beyond their raw score. The criteria for ranking pedestrian and bicycle improvements are detailed in Table 15 and Table 16, respectively.

Access and Connectivity (9 pts)

Identification of top priorities for improving pedestrian and bicycle access in order for the City to meet its goals is imperative to the success of the Plan. Site-specific access concerns and/or destinations where walking and biking should be considered as a viable means of transportation may include access to schools, parks, transit, or food resources (grocery stores/farmer's market). Outside of improved access to those specific destinations, improvements will receive points if they create connections that result in a more complete pedestrian and/or bike network for the City. Pedestrian improvements that are located on the following street types in the Complete Streets Typology (Urban Street, Mixed-Use Street, Commercial Corridor, Collector/Connector, or Neighborhood Connector) will receive additional points. Based on feedback received from employers in the City that employees have frequently expressed their desire to bike to work, improvements that improve or create new connections between residential neighborhoods and one of five high-employment areas will also receive points.

Safety and Comfort (3 pts)

Improvements at locations where collision data indicates the need to mitigate safety hazards should receive points for safety improvements. Additionally, bike and pedestrian improvements that are along wide, high speed, high traffic volume streets receive additional points over residential and local collector streets with lower speeds and volume.

Equity (3 pts)

In order to ensure that improvements to the network fairly meet the needs of all community members, particularly traditionally underserved populations, the following may be considered in prioritizing improvements.

- Street is in a Lower Auto Ownership Census Tract
- Street is in a Lower Income Census Tract
- Street is in a census tract with a high proportion of residents over 65 years of age.

Opportunity (Non-Scored)

The City may also prioritize bicycle and pedestrian improvements by coordinating design and implementation with other projects already in planning or engineering phases. Bicycle improvements and crosswalk improvements may be prioritized if they are on a street segment that is on City's resurfacing schedule. Likewise, constructability may improve the prioritization ranking of sidewalk infill projects where curb and gutter are already in place, ROW acquisition is not necessary, and no utilities would potentially be disturbed by construction or utilities are already underground. Note that this category will not be scored with points, but would rather simply result in a yes/no indication.

Public Support/Request (Non-Scored)

If there have been requests for a specific improvement, it will be noted in the ranking system. This criterion should not be weighted and included in the final score but used more to cross check. It can be added on the last column and state Yes/No.

Table 15: Pedestrian Improvement Criteria Points Allocation Details

Criteria	Point Value
Access and Connectivity	**(9.0 max)**
Access to Schools	(3.5 max)
Improvement is within the ½-mile walkshed of one or more schools.	0.5
Improvement brings additional residential areas within the ½-mile walkshed of one or more schools.	2 for a single school, 0.5 per additional (max 3 pts)
Access to Parks	(1.5 max)
Improvement *creates* a new pedestrian connection (within ½ mile) between a residential area and one or more parks that previously did not exist.	1.5
Improvement *upgrades* an existing pedestrian connection (within ½ mile) between a residential area and one or more parks.	1
Access to Transit	(1.5 max)
Improvement is within the 1-mile walkshed of the Manassas or Broad Run VRE Stations.	0.5
Improvement would *expand* the 1-mile walkshed of the Manassas or Broad Run VRE Stations.	0.5
Improvement is on a street with bus service.	0.5
Access to Food	(1.0 max)
Improvement would improve connections (within ½ mile) between residential areas and existing grocery stores or farmers market locations (Harris Pavilion or Prince William Commuter Lot).	1
Connectivity	(1.5 max)
Improvement is located on a street section belonging to one of the following street types from the Complete Streets Typology: Urban Street, Mixed-Use Street, Commercial Corridor, Collector/Connector, or Neighborhood Connector.	1
Improvement is located on a street section where there is currently no sidewalk on either side of the street.	0.5
Safety and Comfort	**(3.0 max)**
Improvement mitigates a known safety hazard (e.g. narrow or crumbling sidewalk, poorly marked crosswalk, overly-long crossing distance, or lack of sufficient curb cuts).	1-2, depending on severity of unsafe condition to be mitigated.
Improvement is located on a roadway with a speed limit of 35 mph or higher.	1
Equity	**(3.0 max)**
Improvement is in a Lower Auto Ownership Census Tract (below 75% of citywide average).	1
Improvement is in a Lower Income Census Tract (below 75% of citywide median income).	1
Improvement is in a census tract with a high proportion of residents over 65 years of age (above 125% of citywide average).	1

Opportunity	
Improvement is located in a roadway segment that is on a street segment that is on City's resurfacing schedule (crosswalk improvements only).	**Y/N**
Constructability	
Improvement is located in a roadway segment with existing Curb & Gutter.	**Y/N**
Improvement is located in a roadway segment with sufficient existing public right-of-way for planned sidewalks/path.	**Y/N**
Utility relocation would not be necessary for planned improvement or utilities are already underground.	**Y/N**
Public Support/Request	
Same or related improvement has been requested through public involvement/feedback channels	**Y/N**

Table 16: Bicycle Improvement Criteria Points Allocation Details

Criteria	Point Value
Access and Connectivity	**(9.0 max)**
Access to Schools	(2.0 max)
Improvement *creates* a new bicycle connection between a residential area and one or more schools (within 1 mile) that previously did not exist (i.e. no designated bicycle corridor connected the two locations).	2
Improvement *upgrades* an existing bicycle connection between a residential area and one or more schools (within 1 mile) by replacing the existing bicycle infrastructure with higher-order infrastructure. **Highest** — ***Off-Street Shared use Path*** ↑ — *Bike Lanes* ↓ — *Signed, Shared Roadway with Sharrows* **Lowest** — *Signed, Shared Roadway*	1
Access to Parks	(1.0 max)
Improvement *creates* a new bicycle connection between a residential area and one or more parks (within 1 mile) that previously did not exist (i.e. no designated bicycle corridor connected the two locations).	1
Improvement *upgrades* an existing bicycle connection between a residential area and one or more parks by replacing the existing bicycle infrastructure with higher-order infrastructure (see above).	0.5
Access to Transit	(1.5 max)
Improvement *creates* a new bicycle connection between a residential or high-employment area and either VRE station (within 2 miles) that previously did not exist (i.e. no designated bicycle corridor connected the two locations).	1
Improvement *upgrades* an existing bicycle connection between a residential or high-employment area and either VRE station (within 2 miles) by replacing the existing bicycle infrastructure with higher-order infrastructure (see above).	0.5
Improvement is on a street with bus service.	0.5
Access to Employment	(1.0 max)

Improvement *creates* a new bicycle connection between a residential area and a high-employment character area (Hospital/Sudley Area, Godwin Technology Corridor, Airport Area, Downtown Area, Mathis Corridor).	1
Improvement *upgrades* an existing bicycle connection between a residential area and a high-employment character area (Hospital/Sudley Area, Godwin Technology Corridor, Airport Area, Downtown Area, Mathis Corridor).	0.5
Access to Food	(1.0 max)
Improvement would improve connections (within 1 mile) between residential areas and existing grocery stores or farmers market locations (Harris Pavilion or Prince William Commuter Lot).	1
Connectivity	(2.5 max)
Improvement would bridge an existing gap in the City's bicycle network.	Up to 2.5, depending on the gap being addressed.
Safety and Comfort	**(3.0 max)**
Improvement is located on a street section belonging to one of the following street types from the Complete Streets Typology: Commercial Corridor, Industrial/Suburban Business or Collector/Connector.	3
Improvement is located on a street section belonging to one of the following street types from the Complete Streets Typology: Urban Street, Mixed-Use, or Neighborhood Connector	1.5
Equity	**(3.0 max)**
Improvement is in a Lower Auto Ownership Census Tract (below citywide average)	1
Improvement is in a Lower Income Census Tract (below 75% of citywide average)	1
Improvement is in a census tract with a high proportion of residents over 65 years of age (above 125% of citywide average)	1
Opportunity	
Improvement is located in a roadway segment that is on a street segment that is on City's resurfacing schedule.	**Y/N**
Constructability	
Improvement is located in a roadway segment with sufficient existing public right-of-way for planned path (off-street path improvements only).	**Y/N**
Public Support/Request	
Same or related improvement has been requested through public involvement/feedback channels	**Y/N**

Appendix D (Pedestrian) and Appendix E (Bicycle) present the full set of recommendations, with scoring details included. Note that some categories are yet to be scored by the City, and all scoring is anticipated to adjust regularly as conditions on the ground change, new needs are identified, and projects are completed.

Additional Policy Recommendations

Traffic Calming – Existing Policy

The City's existing policy for traffic calming was reviewed along with neighboring jurisdictions for comparison. The Existing City of Manassas Policy Statement #P-99-06 was established in 1999. The existing policy is to determine the merits of installing a traffic calming device on a residential City street. A traffic calming study may be initiated by residents or City Council. Eligible streets are residential in nature with a VDOT functional classification of local or collector, daily traffic volumes between 200 and 6,000 vehicles, and a speed limit of 25 mph or less. It cannot be a primary or snow emergency response route. A speed study must indicate an average speed limit of 30 mph or higher. A neighborhood task force will be established to work with City staff to develop a plan, and appropriate agencies (fire, police, affected businesses, etc.) will be notified. The City Manager is responsible for the final decision to implement the proposed traffic calming plan. Installed traffic calming devices may also be removed by a residential petition or finding of a safety hazard.

Traffic Calming – Proposed Updates

The existing traffic calming policy should be updated by adding the following sections.

The "Eligible Streets" section should clarify that typology-labeled 25-mph neighborhood collectors and neighborhood streets are generally those eligible for a traffic calming study.

An Engineering Review section should be added between the "Criteria" and "Plan Development with Community" sections. In this section, the following items would be required. A speed study should verify that the 85th-percentile speed is greater than 30 miles per hour. Also, an updated traffic count is required. The count should include vehicles classified by type, bicycles, and pedestrians. The frequency of other vehicles like school buses or trucks should also be noted. The review process should record roadway geometry (lane widths, sight distance, grade, alignment, etc.), the presence of pedestrian and bicycle facilities, the extent of cut-through traffic, and crash data for the last five years. Consideration should be given to balancing the need for access to community facilities and school and any alternate routes drivers may choose if traffic calming devices are installed.

As part of the community development plan, the neighborhood task force should be provided awareness and education resources. City staff should speak to residents regarding the necessity of safe driving in their neighborhoods, advantages/disadvantages of traffic calming devices, associated costs, and anticipated project timing. The neighborhood task force should be given a menu of traffic calming options acceptable to the City, along with the results of the engineering study, to aid in developing a traffic calming plan. These may include:

- Raised crosswalks or speed tables
- Traffic circles or mini-roundabouts
- Chokers
- Curb extensions
- Raised median islands (with a pedestrian refuge)
- Lane narrowing
- Striped on-street parking and/or bike lanes
- Speeding additional $200 fine policy
- Other traffic calming measure as approved by the City Manager

In some cases, education and enforcement are appropriate measures. Additionally, VDOT's traffic calming guide may be used as a reference and is found on their website at: http://www.virginiadot.org/programs/resources/Traffic-Calming-Guide-For-Neighborhood-Streets.pdf

Future Signal Timing

Research and experience have shown that retiming traffic signals is one of the most cost-effective tasks that an agency can do to improve traffic flow. Traffic flow improvements of up to 26 percent have been reported.[3]

Traffic signals are one of the primary constraints on corridor capacity and is heavily depended on the quality of the signal timings. Poor signal timings can result in significant congestion that could otherwise be avoided or minimized. The results of congestion typically include driver delay and frustration, increased air pollution, wasted fuel, and lost productivity. Traffic signal timings manage the flow of traffic. The maintenance of traffic signal timings, especially those associated with coordinating a series of traffic signals to optimize the safe and efficient movement of traffic, is an important aspect of traffic signal maintenance. Proper traffic signal retiming results in reductions in overall travel time, delay, and fuel consumption, at the same time improving air quality.

According to the Federal Highway Administration's Traffic Signal Timing Manual, a traffic signal that is properly designed and timed can be expected to provide one or more of the following benefits:

- Provide for the orderly and efficient movement of people.
- Effectively maximize the volume movements served at the intersection.
- Reduce the frequency and severity of certain types of crashes.
- Provide appropriate levels of accessibility for pedestrians and side street traffic.

Signal retiming is one of the better tools in improving the safety and operations along a corridor. The degree to which these benefits are realized is based partly on the design and partly on the need for a signal. A poorly designed signal timing plan or an unnecessary signal may make the intersection less efficient, less safe, or both. The National Cooperative Highway Research Program (NCHRP) recently published a report on Low Cost Safety Improvements that identify employing signal retiming /coordination as an objective.

Per ITE estimates, it takes about 20 to 25 staff hours per intersection to conduct a retiming project. The steps in signal timing are outlined below:

- Traffic Data Collection
- Intersection Data Collection
- Input information into traffic signal coordination software (e.g. Synchro)
- Run analysis and adjust based on experience
- Review
- Implement
- Field monitoring (driving) and field adjustments
- Documentation

ITE recommends that signal timing should be considered at least every three years. In addition, the following changes also warrant retiming of traffic signals:

- Addition of a signal or upgrade of an existing signal.
- When traffic or pedestrian volumes or turning movements change significantly.
- When access to a roadway changes.
- When there is a change in the geometry of a roadway.

Using ITE estimates, traffic signal retiming costs are relatively small – ranging from $1,000 to $3,500 per intersection depending on the amount of data collection. Traffic signal retiming is also very cost effective, producing benefit to cost ratios as high as 40 to 1, with a minimum ratio of 15:1.

[3] *SIGNAL TIMING ON A SHOESTRING, Federal Highway Administration (FHWA)*

The City currently has three timing plans that are used during morning, evening and off-peak periods. The City's signals will be re-timed in 2019 and should be retimed every 3 – 5 years. the traffic operations should be monitored on a regular basis. The primary reason to monitor traffic flows is to be able to determine when the timing plans need to be updated.

Additionally, it is recommended that City develop a "Traffic Signal Master Plan" that addresses and identifies the following for evaluation and proposed enhancements for the traffic signal system.

- State of operations
- Signal Phasing
- Signal Timing Optimization
- Future Improvements
- Traffic signal rehabilitation and equipment needs
- Staffing
- Operations and Maintenance
- Traffic signal deficiencies

Also, with the advent of AV and CV that is rapidly evolving, the City should adopt a policy to implement AV/CV over time. This would require new equipment (communications) to be installed in traffic signal cabinet.

APPENDICES:

Appendix A: Matrix of Previous Transportation Recommendations in Manassas

Appendix B: Stakeholder Interview Schedule

Appendix C: Manassas Bike Share Analysis Report

Appendix D: Pedestrian Network Recommendations Prioritization Matrix

Appendix E: Bicycle Network Recommendations Prioritization Matrix

Appendix F: Walkshed Analysis Maps