



APRIL 2015

ADA/ACCESS MANAGEMENT/TRAFFIC ASSESSMENT REPORT



US 211/US 17/29 BUS (BROADVIEW AVENUE) ACCESS MANAGEMENT IMPROVEMENTS

FROM SOUTH OF FROST AVENUE TO
SOUTH OF WINCHESTER STREET
TOWN OF WARRENTON
FAUQUIER COUNTY, VIRGINIA

PREPARED BY:



EXECUTIVE SUMMARY

ADA/ Bicycle Compliance Study

Existing pedestrian and bicycle facilities along Broadview Avenue were evaluated to determine their level of compliance with both ADA requirements and VDOT criteria. Field observations and topographic survey were used to evaluate the existing roadway and roadside features, and compared data related to ADA and VDOT requirements.

Existing sidewalk is present throughout the vast majority of the project area. These existing pedestrian walkways were analyzed to collect data related to various features that correspond to ADA compliance, including: sidewalk width, running slope (curb ramps and at-grade sidewalk), cross slope, landing areas, and the presence of detectable warning surfaces.

Individual commercial entrances were also analyzed to determine their compatibility with established VDOT standards. Existing features were evaluated, including entrance width, cross slope at the edge of pavement, and the provision of an ADA-compliant pedestrian walkway across each entrance.

Investigation of the existing roadway section indicated that Broadview Avenue is not compatible with any level of bicycle traffic.

Bicycle compatibility for Broadview Avenue within the limits of work will be accommodated by providing a revised roadway typical section that incorporates 5-foot bike lanes that will accommodate all levels of potential bicycle traffic.

This project is considered an "Alteration" due to its proposed roadway resurfacing and other proposed improvements. According to the VDOT Road Design Manual, "Alterations shall incorporate accessibility improvements to existing pedestrian facilities to the extent that those improvements are in the scope of the project and are technically feasible, without regard to cost." It is understood that the intended scope of the project may not allow for the provision of all recommended improvements to create a fully ADA compliant corridor along Broadview Avenue. As such, recommendations for improvements have been grouped into two categories, critical and desired. Critical Improvements are defined as those that VDOT is required to provide for a resurfacing project such as this, in accordance with the Department of Justice's "2010 ADA Standards for Accessible Design" and supporting documentation. Critical improvements also include observed instances where VDOT standards are not currently being met, resulting in a need to upgrade existing conditions and/or address safety issues. Desired Improvements are defined as additional recommended improvements that would create a fully ADA compliant corridor for pedestrian accessibility, however these improvements are not intended for inclusion in the development of contract documents for the project at this time.

Critical Improvements will include:

- Provision of pedestrian access route throughout the project limits on both sides of the roadway to the maximum extent feasible.
- Reconstruction of all curb ramps as needed to provide detectable warning surfaces at each curb ramp location as well as provides ADA-compliant cross slopes and running slopes for the curb ramps and landing areas to the maximum extent feasible.
- Correction of the running slopes of at-grade sidewalk that are observed to be greater

than the maximum running slope of 5% according to ADA accessibility guidelines. Running slopes will be corrected where feasible. Provision of railings and/or level landing areas will be evaluated.

- Upgrade any existing sidewalk that is less than 5 feet in width to provide a minimum 5-foot sidewalk width in accordance with the VDOT Road Design Manual where feasible.
- Revision/Reconstruction of existing entrances that do not meet VDOT standards for maximum cross slope at the edge of pavement (safety improvement).

Desired Improvements (not included in proposed design improvements) to create fully ADA-compliant pedestrian facilities within the corridor would include:

- Reconstruction of at-grade sidewalk with substandard cross slopes where feasible to provide ADA-compliant cross slope.
- Revision/Reconstruction of existing entrances that do not meet ADA accessibility guidelines for providing an ADA-compliant pedestrian walkway across each entrance location.

Access Management Study

Existing access conditions were evaluated along Broadview Avenue to determine opportunities to modify, consolidate or realign commercial access points and recommend potential locations for openings within the proposed raised median. The collected turning movement volumes at each driveway for each commercial property identified properties with the highest driveway usage and driveways being underutilized. The following five median opening locations were chosen based on a combination of being near the midpoint of a block that would provide even spacing of median and intersection openings and their high frequency of volumes accessing the properties:

- *Between Frost Avenue/ Waterloo Street and Church Street* – Frost Diner and Burger King Driveways
- *Between Church Street and Gold Cup Drive/ Stuyvesant Street* – Sunoco Gas Station and Oak View Bank Driveways
- *Between Gold Cup Drive/ Stuyvesant Street and Chappell Street* – Moser Funeral Home and Taco Bell Driveways
- *Between Chappell Street and Old Broadview Avenue/ Roebing Street (2 locations)* – Shell Gas Station/ Dr. Carwash and Mattress Warehouse Driveways and McDonalds and Texaco Gas Station Driveways

The following commercial properties have multiple driveways with access points underutilized that is recommended to have one driveway removed:

- Virginia Auto/NAPA/Warrenton Tire (Northbound)
- Warrenton Plaza Shopping Center (Southbound)

It is recommended to relocate the southernmost driveway to the Warrenton Plaza Shopping Center to be directly aligned with Chappell Street to provide an access not impacted by the proposed median.

Traffic Studies

Existing and future vehicular and pedestrian volumes and operations of the Broadview Avenue study corridor and intersections were evaluated to quantify the impacts of providing a raised median along the corridor, to reduce congestion at intersections with operational deficiencies, and to improve pedestrian accommodations crossing Broadview Avenue. Operational analyses using future 2040 volumes indicated the Broadview Avenue at Frost Avenue/ Waterloo Street intersection and minor street approaches along the un-signalized intersections will operate at deficient Levels of Service. Although the un-signalized Broadview Avenue at Old Broadview Avenue/ Roebing Street intersection does warrant a vehicular signal due to high right-turn volumes; it is recommended to provide other intersection improvements at this location without signalization to address the operational deficiencies. None of the un-signalized intersections warranted a pedestrian signal based on pedestrian crossing volumes.

The installation of a raised median along Broadview Avenue will increase left-turn and U-turn volumes at the study intersections, and proposed median openings with separate left-turn lanes provided between the study intersections will allow additional opportunities to more frequently perform left-turn and U-turn movements to access all commercial properties along the corridor. Capacity improvements at Frost Avenue/ Waterloo Street are recommended and discussed in detail in the *Intersection Traffic Analysis Broadview Avenue at Frost Avenue/ Waterloo Street* report. Restricting left-turn and through movements at Gold Cup Drive/ Stuyvesant Street and Old Broadview Avenue/ Roebing Street will improve minor street operations and provides a safe location to install a proposed un-controlled pedestrian marked crossing between Gold Cup Drive and Stuyvesant Street using proper pedestrian signing, pavement markings and a flashing beacon at the crossing.

Corridor Safety Study

Safety conditions of the Broadview Avenue corridor were evaluated to understand the areas with safety concerns to determine opportunities to improve safety and ensure safety is adequately being addressed with the proposed improvements. A review of recent police reported crash data indicated that the majority of the crashes were rear-end and angle collisions that occurred in the southern section between Frost Avenue/ Waterloo Street and Church Street. Capacity improvements at Frost Avenue/ Waterloo Street and left-turn access restrictions to the commercial properties with the raised median in this area will mitigate these collision types by reducing delay and queues along southbound Broadview Avenue and reducing conflict points accessing the commercial driveways.

A review of the existing lighting along the corridor indicated that the existing light levels are slightly below VDOT criteria, and the northern section between Old Broadview Avenue/ Roebing Street and Lee Highway/ Winchester Street does not have roadway lighting. It is recommended to provide additional lighting along Broadview Avenue between Old Broadview Avenue/ Roebing Street and Lee Highway/ Winchester Street, and replace selected existing luminaires with higher wattage fixtures in areas with lower light readings.

A review of *NCHRP 500 Reports* and *AASHTO Highway Safety Manual* publications on strategies and countermeasure to improve roadway safety indicate that the proposed improvements of installing a raised median with left-turn lanes at the median openings and intersections, capacity improvements at Frost Avenue/ Waterloo Street, driveway and turning movement restrictions, and improving pedestrian and bicycle accommodations will effectively improve safety along the corridor.

ADA/ Access Management/ Traffic Assessment Report Broadview Avenue Access Management Improvements

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I. INTRODUCTION

As requested by the Virginia Department of Transportation (VDOT), Wallace Montgomery (WM) has developed the following report to evaluate existing conditions and complete multiple studies related to proposed access management, capacity and safety improvements along Route 17/Bus 29/211 (Broadview Avenue) in the Town of Warrenton.

This report includes a summary of field observations and traffic data that have been collected and compiled. Assembled data was subsequently used to develop design studies related to several key areas of study that are required to determine the best methods for achieving the established project goals of:

- Improved non-motorized accommodations
- Improved access management
- Reduced traffic congestion
- Improved safety
- Improved corridor aesthetics

Design Studies presented herein include:

- II. ADA/ Bicycle Compliance Study
- III. Access Management Study
- IV. Traffic Studies
- V. Corridor Safety Study

A. **Project Description**

The Project is located in the Town of Warrenton, Fauquier County, Virginia. The project limits begin south of the US 211 (Frost Avenue)/ US 211 Business (Waterloo Street) intersection and the northern limit is south of the US 17/ Winchester Street intersection. The project length is approximately 0.87 miles along Broadview Avenue. **Figure 1** displays a map of the study corridor.

Information on existing site conditions was based upon field visits and traffic data performed over the period of October 22 – November 1, 2014, field run topographic survey provided by VDOT, and a review of available information on the project area including previous studies and master plans.

Broadview Avenue, throughout the project limits, is categorized as an Urban Other Principal Arterial. The typical roadway section throughout the majority of the project limits consists of a six-lane cross section with two thru lanes and a striped continuous left-turn lane in each direction, creating corridor-wide opposing left turn lanes. An existing raised median is introduced approximately 350 feet south of the Roebing Street intersection and continues to the US 17/ Winchester Street intersection. Roadway geometrics also vary at the major signalized intersections of US 211 (Frost Avenue)/ US 211 Business (Waterloo Street) and US 17/ Winchester Street. The roadway section is a closed section (curbed) roadway with a storm drain system throughout the project limits. The posted speed limit is 40 mph.

Land uses along Broadview Avenue are primarily commercial properties immediately adjacent to the project corridor, accessed by individual driveways. Other commercial and

residential properties are accessed from Broadview Avenue via a number of intersecting side streets. There are a significant number of access points for properties throughout the corridor between each intersection.

There are seven (7) existing intersections within the corridor that are evaluated within this report (see **Figure 1** for intersection locations):

1. Broadview Avenue (US 211/ US 17/29 Bus)/ Shirley Avenue (US 17/29 Bus) @ Frost Avenue (US 211)/ Waterloo Street (US 211 Bus)
2. Broadview Avenue (US 211/ US 17/29 Bus) @ Church Street
3. Broadview Avenue (US 211/ US 17/29 Bus) @ Gold Cup Drive
4. Broadview Avenue (US 211/ US 17/29 Bus) @ Stuyvesant Street
5. Broadview Avenue (US 211/ US 17/29 Bus) @ Chappell Street
6. Broadview Avenue (US 211/ US 17/29 Bus) @ Old Broadview Avenue/ Roebing Street
7. Broadview Avenue (US 211/ US 17/29 Bus) @ Lee Highway (US 211/ US 29 Bus)/ Winchester Street

As described above, only the intersections of US 211 (Frost Avenue)/ US 211 Business (Waterloo Street) and US 17/ Winchester Street are signalized in the existing condition.

No bus stops or other public transit facilities were observed along Broadview Avenue within the project limits. A Circuit Rider shuttle service is available within the Town of Warrenton, and the Maroon Route does provide service along Broadview Avenue at the Subway Restaurant (102 Broadview Avenue), Warrenton Plaza (Former location of Broadview Lanes), and Warrenton Village Center locations.

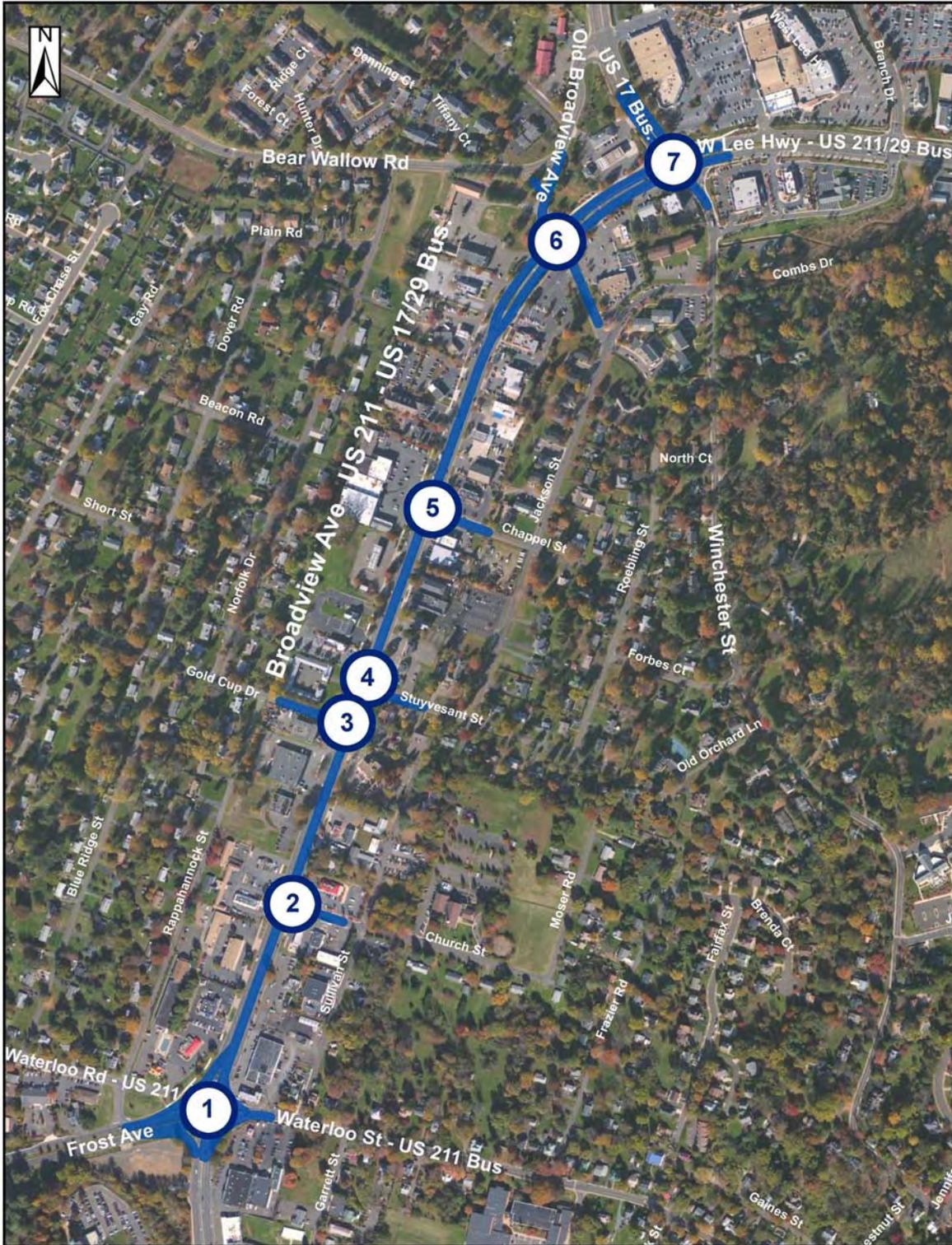


Figure 1 – Study Location Map

B. Background Information

Previous studies for the project area have been completed, including the *2008 Warrenton Broadview Access Management Study* and the *Broadview Avenue Access Management Study – 2012 Update*. These previous studies included the project corridor as well as additional adjacent areas within their overall data collection and analysis. In addition to the current project corridor, other adjacent development options were also addressed within these studies. The most recent study is used as a reference to understand previous investigations; however these were project planning-level studies.

VDOT has retained WM to prepare construction plans and contract documents for access management improvements along Broadview Avenue for the limits of work as described above. As a first order of business, WM has completed more detailed evaluations and analyses in order to refine the recommendations from the previous studies and recommend proposed improvements based upon collected data.

C. Proposed Improvements

VDOT has identified the need to improve safety along the current Broadview Avenue corridor. The focus of the proposed safety improvements is intended to be the construction of raised medians and dedicated left turn lanes at strategic locations within the project limits.

Proposed improvements will also include milling and resurfacing of the existing roadway, bicycle and pedestrian improvements (ADA upgrades), signing, pavement marking, signalization and lighting modifications. The proposed improvements are intended to remain within the limits of the existing curb and gutter that exists throughout the project limits to the fullest extent feasible.

Alternative geometric layouts for the major signalized intersection of Broadview Avenue at US 211 (Frost Avenue)/ US 211 Business (Waterloo Street) are also being investigated by the Design Team. Proposed geometric improvements at this intersection may require base widening and/or full depth reconstruction in order to properly address operational deficiencies.

A spot speed study, completed by WM, has indicated that the 85th percentile speed percentile does not exceed the posted speed limit. Therefore, 40 mph shall be considered as both the posted and design speed for proposed improvements.

D. Compliance with AASHTO/VDOT Design Guidelines & Policies

Any proposed design in this report shall be in compliance with the latest VDOT design publications; 2011 AASHTO Policy on Geometric Design of Highways and Streets; the latest VDOT Policy for Integrating Bicycle and Pedestrian Accommodations; and the Americans with Disabilities Act Accessibility Guidelines (ADAAG) to the maximum extent feasible. As the design progresses, Design Exceptions/ Waivers will be identified and coordinated according to VDOT policies and procedures.

E. Right-of-Way

One of the objectives of this project is to achieve the stated goals while minimizing right-of-way impacts and/or acquisition created by the proposed improvements.

Broadview Avenue has a bandwidth of existing available right-of-way throughout the project

limits. The majority of the project area is on a tangent section with a consistent right-of-way width of approximately 130 feet. Typically, there is approximately 67 feet of right-of-way on the southbound side of Broadview Avenue as measured from the center of the roadway, and approximately 63 feet on the northbound side of the roadway. In general, the limits of the roadway right-of-way extend outward to encompass the existing tree-lined buffer and offset sidewalk. Through much of the corridor, the limits of available right-of-way closely approximate the back edge of the existing sidewalk. In some limited cases, the existing sidewalk extends into private properties by a small amount.

II. ADA / BICYCLE COMPLIANCE STUDY

VDOT has identified the importance of providing pedestrians and bicyclists greater access to safe transportation on roadways across the state and has established a policy (VDOT Policy for Integrating Bicycle and Pedestrian Accommodations) to address incorporating non-motorized users into project development in addition to motorized transportation. All highway construction projects are to begin with an assumption that the project will accommodate pedestrians and bicyclists, including pedestrians with disabilities. Sidewalks, bike lanes, shared-use paths and other accommodations are to be considered in the design of all new highway and major reconstruction projects, depending on safety issues and need.

All accommodations for walking and bicycling shall be built in accordance with design plans and VDOT's construction standards and specifications.

A. **ADA Compliance**

A complete survey of the project limits was performed to determine the ADA compliance of all existing pedestrian features, including existing sidewalk, curb ramps, driveways, and intersection features throughout the corridor. **Appendix A** is a photo log of existing curb ramps and driveway entrances, provided as an additional reference to the observed conditions. The following represents a summary of the data collected, requirements for ADA compliance, and recommendations for proposed improvements to address ADA deficiencies.

1. Existing Conditions

A recent sidewalk upgrade/improvements project was constructed within the project limits in 2013. Missing portions of the offset sidewalk were constructed to provide continuity through the corridor. As part of this construction project, curb ramp and sidewalk improvements were also constructed within the area of the Frost Avenue intersection.

Throughout the project corridor, existing sidewalk is provided along both the northbound and southbound sides of Broadview Avenue, with the exception of a portion on the northbound side of Broadview Avenue from the Frost Avenue intersection north to approximately 500' north of the intersection. The existing sidewalk is maintained within state-owned right-of-way for the majority of the project. In general, the existing sidewalk is approximately 8 feet in width and the sidewalk is offset from the existing curb and gutter. There is a variable buffer width between the existing curb and gutter and sidewalk, measuring approximately 4 feet to 18 feet in width. The existing buffer width throughout the project limits meets the minimum 4 foot width (6 foot with trees present) required by VDOT standards.

2. Existing Sidewalk Evaluation

The Design Team analyzed the existing sidewalk at regular intervals throughout the project corridor. Each location was reviewed and evaluated based on the following ADA criteria:

- *Sidewalk Width* – VDOT Road Design Manual specifies a minimum width of 5 feet where feasible. A minimum clear width of 4 feet may be provided in unique situation where this is not feasible, provided that 5 foot minimum passing zones are provided

every 200 feet.

- *Running Slope* – VDOT Road Design Manual suggests that existing sidewalk contained within an existing street or highway right-of-way shall not exceed the general grade established for the adjacent street or highway. ADAAG guidelines suggest a maximum running slope/grade of 5%. Steeper grades require consideration for railings and/or level landing areas to accommodate pedestrians with disabilities.
- *Sidewalk Cross Slope* – VDOT standards and ADAAG guidelines both call for a maximum cross-slope 48:1 (2%).

The overall ADA compliance of each observed location was determined by identifying if all three criteria are met. The ADA Assessment Report - Existing Sidewalk Evaluation is included in this report as **Appendix B**.

3. Existing Sidewalk – Analysis and Recommendations

Sidewalk Width

The majority of the project corridor includes an approximate 8-foot wide sidewalk, offset from the existing curb and gutter by a buffer width. Sidewalk widths were observed to vary slightly within the area of the Frost Avenue intersection. Sidewalk widths at the intersection vary between 4 and 8 feet, with the majority of existing sidewalk providing the minimum required 5-foot width or greater.

There are three locations where there is a 4-foot sidewalk width near the Frost Avenue intersection. This occurs in the southeast quadrant, on westbound Frost Avenue beyond the dedicated right turn lane from southbound Broadview Avenue, and a couple of small lengths of sidewalk within the median island in the northwest quadrant (See **Figure 2**).



Figure 2 – Frost Avenue/Waterloo Street Intersection Sidewalk

The Design Team recommends replacing the noted segments of 4-foot sidewalk to provide at least a 5-foot sidewalk width where feasible. According to the p. A109 of the *VDOT Road Design Manual*, if the area is deemed “technically infeasible”, then the minimum clear width of 4 feet shall be provided and a Design Waiver will be required for these areas. No sidewalks less than 4 feet in width will be included in the proposed improvements.

Running Slope

As stated above, the grade of the existing sidewalk should not exceed the general grade established for the adjacent street or highway. As shown in **Appendix B**, there are several variances observed between the running slope of the existing sidewalk and the grade of Broadview Avenue.

The fluctuation in running slope is likely due to the existing roadside grading and the significant buffer width that is typically provided between the existing curb and gutter and sidewalk. Based on the scope of the project and our objective to minimize right-of-way impacts where feasible, as well as the “built-out” nature of the corridor, we would not recommend revising the running slope of the existing sidewalk throughout the corridor solely to match the running slope of the sidewalk to the roadway grade. While the running slope does differ from that of the roadway grade, the observed values are not excessive with regards to ADA compliance.

It is our recommendation that proposed upgrades/improvements concentrate on areas where the running slope exceeds the general ADAAG guidelines of a maximum running slope of 5% (recorded in 3 separate locations). Locations where this maximum 5% grade is exceeded will be upgraded to either revise the running slope, extend the ADA ramp length to 15 feet, or provide railings and/or level landing areas to accommodate pedestrians with disabilities. Improvements to the running slope at these locations should be pursued to the “maximum extent feasible”.

Table 1 – Excessive Running Slope Sidewalk Locations

Location	Adjacent Business	Sidewalk Running Slope
Sta. 41+10 to Sta. 41+75, Left	KFC & Long John Silver’s	8.20%
Sta. 44+75 to Sta. 45+20, Right	Moser Funeral Home/Midas	7.54%
Sta. 45+90 to Sta. 47+20, Left	Warrenton Plaza	5.91%

Sidewalk Cross Slope

As stated above, the maximum cross-slope for sidewalk construction is 2%. Appendix B identifies the sidewalk cross slope at each of the observed locations. All sidewalk slopes measured greater than 2% are noted and that portion of sidewalk was recorded as non-compliant in regards to ADA.

Twenty-six (26) of the recorded existing sidewalk locations were observed to have an existing cross-slope greater than 2%. Reconstruction of these locations would be required for full ADA compliance; however this is considered a Desired Improvement, rather than a Critical Improvement, according to the scope of the project. Minor grading

improvements may be required in order to correct the existing cross-slope without making significant adjustments to the sidewalk layout. Right-of-way constraints must be considered wherever sidewalk improvements are investigated/proposed.

Summary of Recommendations

Critical Improvements recommended for inclusion in the proposed improvements include the reconstruction of sidewalk to address ADA deficiencies in relation to sidewalk width and running slope (exceeding ADAAG maximum running slope). Deficient sidewalk widths and running slopes are limited in observed instances, and each location will be resolved to the maximum extent feasible.

Revision/Reconstruction of existing sidewalk based solely on correcting existing cross slopes is considered a Desired Improvement, and is not recommended for inclusion in the proposed improvements at this time. The U.S. Department of Justice and Federal Highway Administration have issued a memo entitled *Department of Justice/Department of Transportation Joint Technical Assistance on Title II of the Americans with Disabilities Act Requirements to Provide Curb Ramps when Streets, Roads, or Highways are Altered through Resurfacing* that clarifies that the scope of this project specifically requires only the provision of curb ramps where street level pedestrian walkways cross curbs, to ensure the accessibility and usability of the pedestrian walkway for persons with disabilities.

4. Existing Curb Ramps Evaluation

Curb ramps are required to provide access to and from pedestrian routes for all users, particularly to persons with disabilities. According to the VDOT Road Design Manual, "One curb ramp shall be provided for each direction of an intersection crossing, where feasible. Curb ramps shall be in-line with the direction of pedestrian travel to improve wayfinding for visually impaired pedestrians."

The Design Team analyzed each existing curb ramp location, including all driveway crossings throughout the project corridor. Each location was identified and evaluated based on the following ADA criteria:

- *Cross Slope* - VDOT standards and ADAAG guidelines both call for a maximum cross-slope of 48:1 (2%)
- *Running Slope* – VDOT standards and guidelines specify a maximum running slope of 12:1 (8%)
- *ADA Ramp Features (Detectable Warning Surfaces, Landing Area, Landing Area Running Slope)* – Coordination with VDOT representatives indicates that a Detectable Warning Surface (DWS) should be provided at every curb ramp and driveway crossing along Broadview Avenue. VDOT standards and guidelines state that a 4-foot by 4-foot minimum landing area should be provided at each curb ramp location. Additionally, the level landing areas are not permitted to slope more than 48:1 (2%) in any direction.

Each observed location was evaluated for ADA compliance on each of the three individual criteria described above. The ADA Assessment Report - Existing Curb Ramps Evaluation can be referenced within this report in **Appendix C**.

5. Existing Curb Ramps – Analysis and Recommendations

Cross Slope

Similar to the evaluation completed for the existing sidewalk in **Appendix B**, the maximum cross-slope for curb ramps is 2%. **Appendix C** identifies the sidewalk cross slope at each of the observed curb ramp locations. All curb ramp cross slopes measured greater than 2% are noted and that curb ramp was recorded as being non-compliant.

There are a number of locations observed where the existing cross-slope is greater than 2%. Reconstruction of these curb ramps to provide an ADA-compliant cross slope to the maximum extent feasible is considered a Critical Improvement, and is recommended for inclusion in the proposed improvements. Minor grading improvements may be required in order to correct the existing cross-slope without making significant adjustments to the sidewalk layout. Right-of-way constraints must be considered wherever curb ramp improvements are investigated/proposed.

Running Slope

The maximum running slope of a curb ramp is defined as 12:1 (8%), unless the existing roadway grade is steep enough that this maximum slope is not feasible. There are no portions of Broadview Avenue where the existing roadway grade is steeper than 12:1 (8%), so the maximum running slope applies to this project. According to VDOT standards, the length of curb ramp running slopes will not exceed 15 feet in length.

Twenty-nine (29) curb ramp locations were measured and found to have running slopes in excess of the prescribed maximum. This is considered as a Critical Improvement, and it is recommended that each curb ramp be revised for ADA compliance to the maximum extent feasible. Curb ramps should be reconstructed accordingly.

ADA Features

As stated above, VDOT representatives have indicated that a DWS should be installed at each curb ramp location, including driveway crossings. More than half of the total curb ramp locations evaluated in **Appendix C** (89 of 159) do not have a DWS in the existing condition. It is recommended that the proposed improvements for the project include the addition of DWS's at each curb ramp location throughout the project limits.

Throughout the project, the minimum 4-foot by 4-foot dimensions for available landing areas are provided at existing curb ramps. However, in many cases, the running slope of the landing area does not meet the maximum requirements of 48:1 (2%) in any direction. Sidewalk cross slopes are addressed separately herein, but **Appendix C** indicates that seventy-seven curb ramps do not provide a running slope of 2% or less within the landing areas. It is recommended that existing curb ramp locations with deficient landing areas be upgraded/ reconstructed to provide ADA-compliant landing areas, as this is considered a Critical Improvement.

Summary of Recommendations

The U.S. Department of Justice and Federal Highway Administration memo entitled *Department of Justice/Department of Transportation Joint Technical Assistance on Title II of the Americans with Disabilities Act Requirements to Provide Curb Ramps when Streets, Roads, or Highways are Altered through Resurfacing*. This document makes it

clear that the scope of this project specifically requires the provision of curb ramps where street level pedestrian walkways cross curbs, to ensure the accessibility and usability of the pedestrian walkway for persons with disabilities.

Curb ramp improvements are considered Critical Improvements for this project. There are a significant amount of existing curb ramp locations that are identified as ADA-deficient for various design characteristics as described above. As part of the proposed improvements, a large number of the curb ramps will need to be upgraded/reconstructed in order to provide access to pedestrian routes throughout the project corridor. It is recommended that all ADA-deficient curb ramps be reconstructed to meet ADA accessibility guidelines.

B. Existing Commercial Entrances Evaluation

A comprehensive evaluation of the existing commercial entrances along Broadview Avenue is required for both access management studies and ADA compliancy. The information in this ADA assessment report is limited to discussion of standard design characteristics and ADA compatibility. Additional discussion within the Section III of the report may also reference data presented in **Appendix D**.

The Design Team analyzed each existing commercial entrance location throughout the project corridor. Each entrance location was identified and evaluated based on the following VDOT design criteria and ADA characteristics:

- *Entrance Width* – VDOT Road Design Manual (Appendix F) indicates that a standard single two-way entrance width should be 30'-40' for commercial entrance designs along highways with curb and gutter. (Figure 4-10)
- *Cross Slope of Driveway (At Edge of Pavement)* – VDOT Road and Bridge Standards for Standard Entrance Gutter (CG-9A-D) indicate that the maximum slope of an entrance is 12% from the flow line.
- *Pedestrian Walkway* - According to VDOT Road and Bridge Standards, if pedestrian access routes are being provided, a minimum 4' traversable width is required with a maximum 2% cross slope.

The ADA Assessment Report - Existing Commercial Entrances Evaluation is included in **Appendix D**.

1. Existing Commercial Entrances – Analysis and Recommendations

There are a total of 72 individual driveway entrances along Broadview Avenue.

It should be noted that a large number of existing entrances are identified as “asphalt” in **Appendix D**. These entrances appear to have been constructed based upon an obsolete design standard that included the concrete gutter pan and an additional 2-foot wide strip of concrete at the edge of the existing roadway and then were paved with asphalt pavement rather than providing full concrete driveway aprons as per current VDOT standards. Based upon the scope of work, we are not recommending that existing entrances be reconstructed solely to upgrade the pavement materials. Entrances should be evaluated on the design criteria when considering reconstruction.

Entrance Width

Thirty-nine (39) entrance locations were determined to have an entrance width greater than 40 feet. Only one entrance location was determined to have an entrance width greater than 50 feet. Conversely, 14 entrance locations were observed to be less than 30 feet in width. Considering the project goals and expected scope of improvements, reducing or expanding existing entrance widths by just a few feet for the sole purpose of bringing them within the VDOT standard range of dimensions is not considered a Critical Improvement and is not recommended for inclusion in the proposed improvements.

As design progresses, there is always the potential for unforeseen issues that may create conflicts with an existing entrance. In these specific instances, the existing entrance width may be considered to determine if a reduction in entrance width would allow for resolution of another design issue while still providing an entrance width within the parameters established in the VDOT Road Design Manual.

Cross Slope of Driveway

This design characteristic is related to the slope of the entrance in direct relation to the flow line at the edge of pavement. Meeting the requirements of the VDOT standards for “Standard Entrance Gutter” is important for the prevention of a break in roadway grade that may cause driver discomfort and/or cause the vehicle to “bottom out” while using the entrance.

Reconstruction of an entrance to meet VDOT standards at the edge of pavement is considered a Critical Improvement. Only one entrance location (Trusted Auto Care, Sta. 50+25, Right) was observed to be deficient in cross slope at the edge of pavement (see **Figure 3**). Reconstruction of this driveway entrance is recommended to correct this deficient condition.



Figure 3 – Deficient Driveway Cross Slopes

Pedestrian Walkway

Continuous pedestrian access routes are provided along Broadview Avenue on both sides of the roadway. In order for the project to provide a continuous ADA-compliant pedestrian access route along Broadview Avenue, provision of a 4-foot minimum ADA-compliant pedestrian path with a sidewalk cross slope of 2% maximum at every entrance location within the project area is required.

Fifty (50) of the 76 existing entrances within the corridor were observed to not include an ADA-compliant pedestrian walkway. The U.S. Department of Justice and Federal Highway Administration memo entitled Department of Justice/Department of Transportation Joint Technical Assistance on Title II of the Americans with Disabilities Act Requirements to Provide Curb Ramps when Streets, Roads, or Highways are Altered through Resurfacing clarifies that the scope of this project specifically requires only the provision of curb ramps where street level pedestrian walkways cross curbs, to ensure the accessibility and usability of the pedestrian walkway for persons with disabilities. Reconstruction of these driveway entrances to provide a 4-foot minimum pedestrian path with a sidewalk cross slope of 2% maximum at every entrance location is not considered a Critical Improvement.

Summary of Recommendations

Critical Improvements recommended for inclusion in the proposed improvements include the reconstruction of driveway entrances where the grade break at the edge of pavement exceeds VDOT standards for “Standard Entrance Gutter”.

The reconstruction of driveway entrances to adjust entrance widths and/or provide a 4-foot minimum pedestrian path with a 2% maximum cross slope would be considered Desired Improvements and are not recommended for inclusion in the proposed improvements at this time.

Based upon the project objectives and scope of work for this project, it is not recommended to adjust existing entrance widths in order to meet VDOT standards and guidelines as a part of the proposed improvements.

C. Bicycle Compatibility

1. Existing Conditions

The Town of Warrenton Comprehensive Plan identifies Broadview Avenue as priority for the incorporation of both pedestrian and bicycle accommodations as it is a primary arterial route. Additionally, the Fauquier-Warrenton Bicycle & Pedestrian Loop Completion Master Plan Prioritization Map indicates that there are proposed pedestrian/bicycle facility improvements to several connecting routes, including Frost Avenue, Gold Cup Drive, and Stuyvesant Street.

Existing Broadview Avenue through the project limits does not provide any specific bicycle accommodations. There are no bicycle-compatible shoulders or designated bicycle lanes within the existing roadway section. The “usable width” (does not include gutter pan) in the outside travel lane adjacent to the existing gutter pan is approximately 13 feet through the corridor.

According to the VDOT Road Design Manual, Appendix A; a minimum “usable width” of 14 feet is required to accommodate Group A bicyclists (advanced bicyclists) for a 40

mph roadway in an urban section without parking. Similarly, a 5-foot bike lane is required to accommodate Group B/C (Basic/Children) bicyclists. Therefore, Broadview Avenue is not compatible with any level of bicycle traffic in the existing condition.

2. Recommendations/Proposed Improvements

The Design Team has coordinated with VDOT in the development of a new proposed roadway typical section, maintained within the existing closed section footprint of Broadview Avenue (see **Figure 4**). The proposed typical section will provide 5-foot bike lanes in order to accommodate all potential bicycle users in accordance with the VDOT Road Design Manual. Appropriate traffic control will be incorporated to provide proper guidance to both bicyclists and motorists.

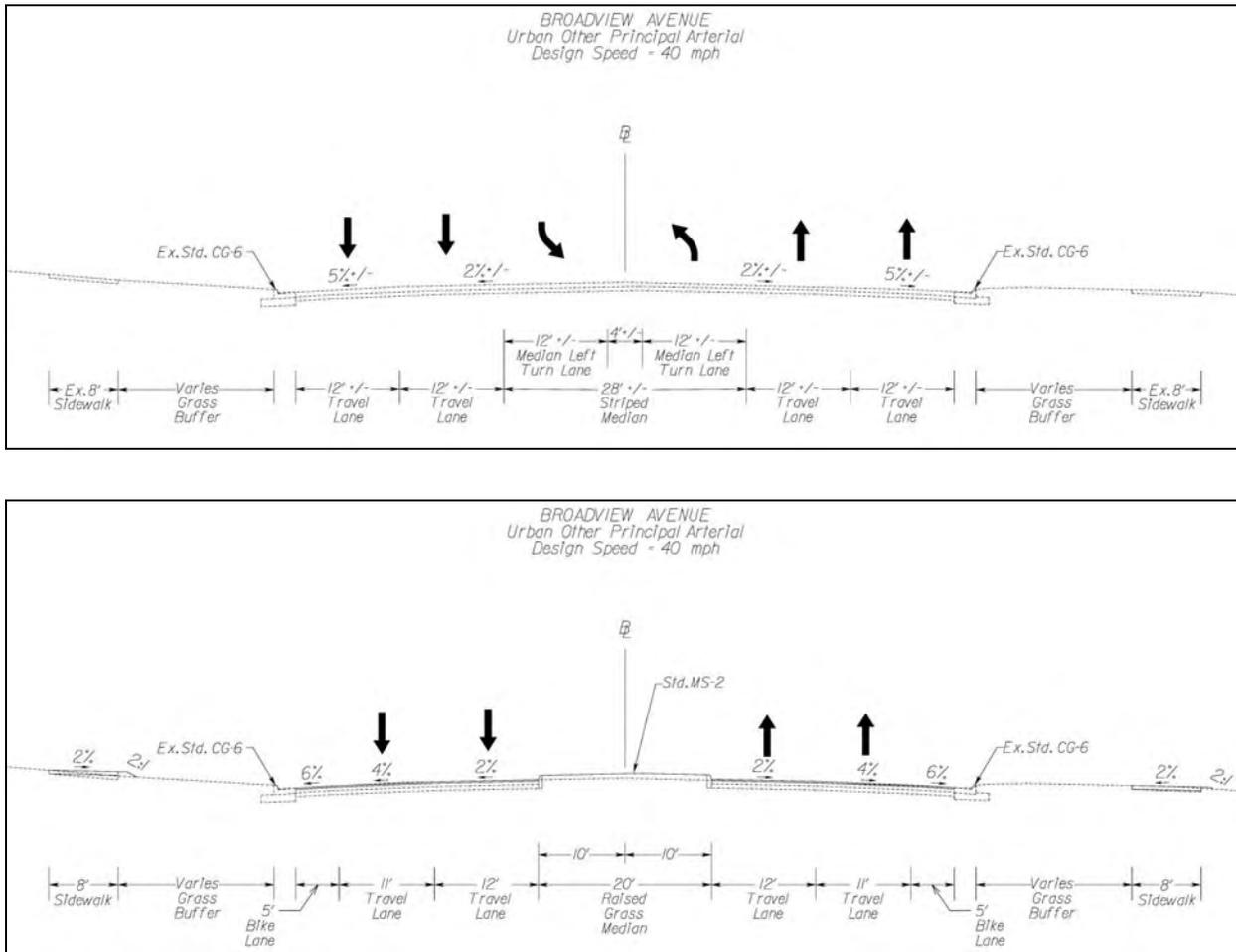


Figure 4 – Existing and Proposed Roadway Typical Section

III. ACCESS MANAGEMENT STUDY

An evaluation was performed of the existing access conditions along Broadview Avenue to determine opportunities to modify, consolidate or realign commercial access points and recommend potential locations for openings within the proposed raised median.

A. Driveway Volumes

Weekday morning (7 am – 9 am), mid-day (11 am – 1 pm), evening (4 pm – 6 pm) and mid-day weekend (11 am – 3 pm) peak period turning movement counts of each driveway for each property along the Broadview Avenue study corridor were performed on Wednesday, October 22, 2014 and Saturday, November 1, 2014. Public schools were in session during the weekday count, and no special events in Warrenton were taking place during the weekend count.

The driveway count data was reviewed to identify the most frequently used property access points and to understand the turning movement patterns for each property. **Tables 2 and 3** identify the properties with the highest driveway usage, and detailed driveway count information is included in **Appendix F**.

B. Field Observations

The following field observations were documented during the driveway count periods:

- There are a total of 23 properties with 39 driveways along northbound and 21 properties with 33 driveways along southbound Broadview Avenue within the study limits (44 properties and 72 driveways total).
- Motorists wanting to turn left out of many driveways would frequently turn right, then make a U-turn in the two opposing center turn lanes due to the infrequency of adequate gaps in the mainline traffic stream to complete a left-turn movement.
- Motorists would often turn left into the center turn lanes and use as a refuge to merge onto Broadview Avenue.
- The cross slope at some driveway locations were significant and observed vehicles slowly negotiating their turning movement in and out of the driveways in order to avoid scraping the bottom of their vehicle.
- Many properties have multiple (up to three) driveways with a number of the access points underutilized.

Table 2 – Northbound Property Driveway Usage

Block	Properties	AM	MID	PM	SAT
Waterloo St to Church St	JD Handyman				
	Virginia Auto/ Napa Warrenton Tires			R	R
	Wells Auto Sales				
	Frost Diner	B	B	B	B
	Shell Gas Station	R	B	B	B
Church St to Stuyvesant St	Pizza Hut				R
	House				
	Sunoco Gas Station	B	B	B	B
	House				
	Wells Fargo Bank		B	B	B
Stuyvesant St to Chappell St	RF Kube Horizon				
	Cash Point				
	Moser Funeral Home				
	Midas				
	Rexel LK Foley				
Chappell St to Roebling St	Wendy's		B	B	B
	Trusted Autocare				
	Shell Gas Station/ Dr. Car Wash	R	B	B	B
	Wilson Automotive		R		
	McDonalds	B	B	B	B
Roebling St to Winchester St	UPS/ Dunkin Donuts	R	R	R	R
	McClanahan Camera				R
	Care RX				

1. At least 20 turning movements in and out of a property during a 2 hour period were identified as significant volumes.
2. B = Significant Left + Right volumes
 R = Significant Right turn volumes only
 L = Significant Left turn volumes only

Table 3 – Southbound Property Driveway Usage

Block	Properties	AM	MID	PM	SAT
Frost Ave to Church St	Howard Johnson/ Fosters Grille		R		R
	Burger King	B	B	B	B
	JK Auto Parts/ Wells Auto	R	B	R	
	Jefferson Motel/ El Toro Restaurant				
Church St to Gold Cup Dr	Jefferson Motel/ Subway		B	R	B
	Oak View Bank		B		
	Tractor, Inc./ Karate Sports Academy/ Sherman Williams		R	R	B
	Cecils				
Gold Cup Dr to Chappell St	Rip Van Winkle Motel				
	KFC		R	B	B
	Union Bank		B		
	Taco Bell	R	B	B	B
	Vacant Lot				
Chappell St to Old Broadview Ave	Warrenton Plaza Shopping Center		B	B	B
	Jiffy Lube				R
	Matress Warehouse		B	B	L
	Piedmont Motors				R
	Texaco Gas Station	R	R		B
	Red Hot & Blue		R	R	R
	Cheswick Motel/ Pub				
Old Broadview Ave to Broadview Ave	Exxon Gas Station	R	R	R	R

1. At least 20 turning movements in and out of a property during a 2 hour period were identified as significant volumes.
2. B = Significant Left + Right volumes
 R = Significant Right turn volumes only
 L = Significant Left turn volumes only

The results indicate that the following properties exhibit significant access volumes:

Northbound

- Frost Diner
- Shell Gas Station
- Sunoco Gas Station
- Wells Fargo Bank
- Wendy's
- Shell Gas Station/ Dr. Carwash
- McDonalds
- UPS/ Dunkin Donuts

Southbound

- Burger King
- JK Auto Parts/Wells Auto
- Jefferson Motel/Subway
- Tractor's Inc./Karate Sports Academy/Sherwin Williams
- Kentucky Fried Chicken
- Taco Bell
- Warrenton Plaza Shopping Center
- Mattress Warehouse
- Texaco Gas Station
- Red Hot and Blue
- Exxon Gas Station

C. Recommendations

1. Median Opening Locations

It is recommended to provide median openings with exclusive left-turn lanes and restrict left-turns from existing properties where the proposed median would prohibit this movement. The goal was to avoid locations too close to existing intersections and provide enough spacing to accommodate adequate left-turn bay lengths for the median openings. The following locations were evaluated based on a combination of proximity to the midpoint of a block that would provide even spacing of median and intersection openings (400 – 500 feet) and their high frequency of volumes accessing the properties.

- *Between Frost Avenue/ Waterloo Street and Church Street* – Frost Diner and Burger King Driveways
- *Between Church Street and Gold Cup Drive/ Stuyvesant Street* – Sunoco Gas Station and Oakview Bank Driveways
- *Between Gold Cup Drive/ Stuyvesant Street and Chappell Street* – Moser Funeral Home and Taco Bell Driveways
- *Between Chappell Street and Old Broadview Avenue/ Roebing Street (2 locations)* – Shell Gas Station/Dr. Carwash and Mattress Warehouse Driveways and McDonalds and Texaco Gas Station Driveways

Including the existing intersections, a total of 10 median breaks are proposed within the Broadview Avenue study corridor, which is the same amount of median breaks proposed

in the *Broadview Access Management Planning Study - 2012 Update*. The operational impacts of the median to turning movements to/from the commercial driveways is discussed in Section IV of this report. Conceptual plans of the median openings are included in **Appendix M**.

2. Entrance Consolidation

The following commercial properties have multiple driveways with access points underutilized:

Northbound

- Virginia Auto/NAPA/Warrenton Tire (3 driveways)
- RF Kube Horizon (2 driveways)
- Shell Gas Station/Dr. Carwash (3 driveways)

Southbound

- Warrenton Plaza Shopping Center (3 driveways)

Removing one driveway from each of these properties will help reduce the number of conflict points onto Broadview Avenue; however the circulation patterns will be impacted.

It is recommended to consolidate the Virginia Auto/ NAPA/ Warrenton Tire driveways to two, because the circulation patterns would not be significantly impacted for this property. It is also recommended to relocate the southernmost driveway to the Warren Plaza Shopping Center to be directly aligned with Chappell Street to provide an access not impacted by the proposed median. This driveway relocation would provide an opportunity to consolidate to two property driveways without significant impacts to circulation and removal of parking spaces.

3. U-Turn Geometry

The proposed raised median will provide exclusive left-turn lanes to perform left-turn and U-turn movements to access commercial properties located within the closed median section areas. Therefore the opposing proposed roadway footprint will need to be wide enough to accommodate turning vehicles. The proposed width from the outermost edge of the left-turn bay striping to the curb face on the opposing side will be 51 feet. Based on the AASHTO *Geometric Designs of Highways and Streets* turning characteristics of a standard passenger car (larger car), the typical turning path will fit within the available space.

It is assumed larger vehicles would typically utilize side streets and alternate roadways to access their destinations from the appropriate directions. Therefore U-turns from commercial delivery vehicles would be discouraged and not typically utilized as a design vehicle for this type of roadway.

4. TRAFFIC STUDIES

Various traffic studies were conducted to understand the existing and future vehicular and pedestrian volumes and operations of the Broadview Avenue study corridor and intersections. These findings were used to develop recommendations to quantify the impacts of providing a raised median along the corridor, to improve congestion at intersections with operational deficiencies, and to improve pedestrian accommodations crossing Broadview Avenue.

A. Existing Conditions

1. Existing Volumes

Thirteen (13) hour turning movement counts of vehicular, pedestrian and bicycle traffic were performed on Thursday, October 24, 2014 and Saturday, October 26, 2014 at the seven (7) study intersections. Public schools were in session during the weekday count, and no special events in Warrenton were taking place during the weekend count. The Virginia Gold Cup Steeplechase was taking place in nearby The Plains that Saturday, which may have slightly increased traffic volumes along Broadview Avenue and Frost Avenue. Balanced AM, PM and Saturday peak hour volumes are summarized in **Figure 5**, and detailed traffic count data is included in **Appendix G**.

The existing AADT along Broadview Avenue is 33,000 based on the 2013 VDOT *Average Daily Traffic Volumes with Vehicle Classification Data on Interstate, Arterial, and Primary Routes* document.

2. Existing Speeds

A spot speed study was conducted on Wednesday, October 23, 2014 from 11:30 am to 1:00 pm between Stuyvesant Street and Chappell Street to evaluate the existing speeds under free flow conditions and identify an appropriate design speed. **Table 4** summarizes the speed data for each direction, and detailed spot speed study worksheets are included in **Appendix H**. The current 85th percentile travel speeds are consistent with the posted speed limit of 40 mph.

Table 4 – Existing Speeds Summary

Broadview Avenue	Posted Speed (MPH)	Average Speed (MPH)	85th Percentile Speed (MPH)
Northbound	40	38	41
Southbound	40	37	39

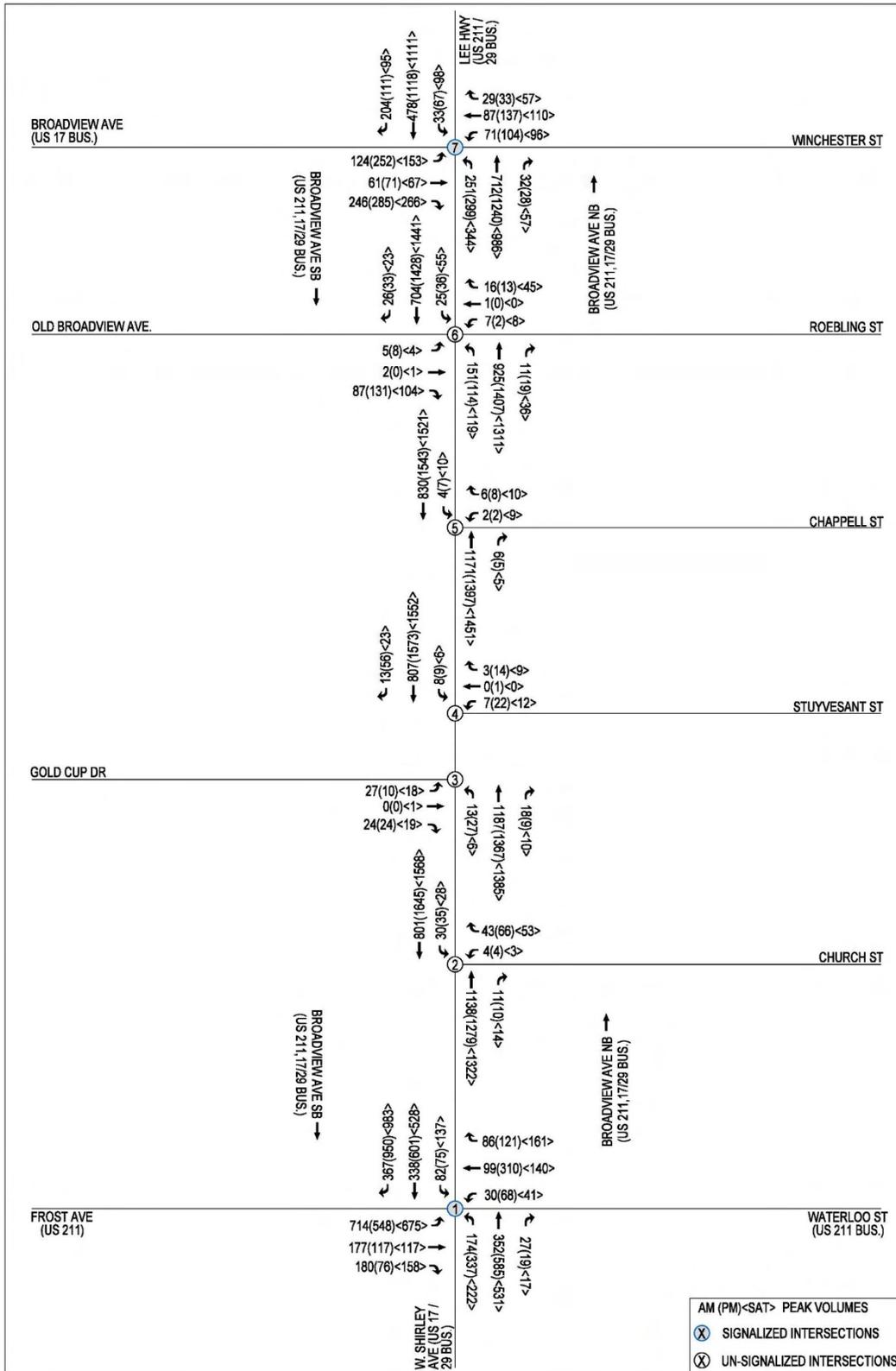


Figure 5 – Existing 2014 Peak Hour Volume Summary

3. Existing Operations

Operational analyses of the existing peak hour volumes were developed for the seven study intersections in accordance to the 2010 Highway Capacity Manual (HCM) techniques for signalized and un-signalized intersections using the Synchro 9 and SimTraffic modeling software. The HCM technique quantifies a Level of Service (LOS) grade to an intersection based on average vehicle delay. **Table 5** summarizes the LOS grade (A - F) based on the results of the analyses.

Table 5 – Level of Service Criteria

LOS	Control Delay (sec/veh)		Characteristics
	Un-Signalized	Signalized	
A	<= 10.0	<= 10.0	Free traffic flow with high level of maneuverability
B	10.1 – 15.0	10.1 – 20.0	Stable traffic flow with maneuverability affected by other users within traffic stream
C	15.1 – 25.0	20.1 – 35.0	Stable traffic flow with maneuverability affected by other users within traffic stream
D	25.1 – 35.0	35.1 – 55.0	High density but stable traffic flow with speed and freedom to maneuver in traffic stream severely restricted
E	35.1 – 50.0	55.1 – 80.0	Unstable traffic flow with freedom to maneuver in traffic stream very difficult
F	> 50.0	> 80.0	Breakdown in traffic flow with queues forming and operations within traffic stream characterized by stop and go

Figure 6 summarizes the LOS results, and detailed analysis worksheets are included in **Appendix I**.

Currently the Frost Avenue/ Waterloo Street intersection operates at a deficient LOS during the PM and Saturday peak hours, with significant delay and queues experienced along the Broadview/ Shirley Avenue and eastbound Frost Avenue approaches. Although the resulting queue lengths are not deficient, most of the un-signalized study intersections experience deficient minor street LOS due to excessive delays. Gold Cup Drive, Stuyvesant Street and Old Broadview Avenue/ Roebing Street experience the most significant minor street delays.

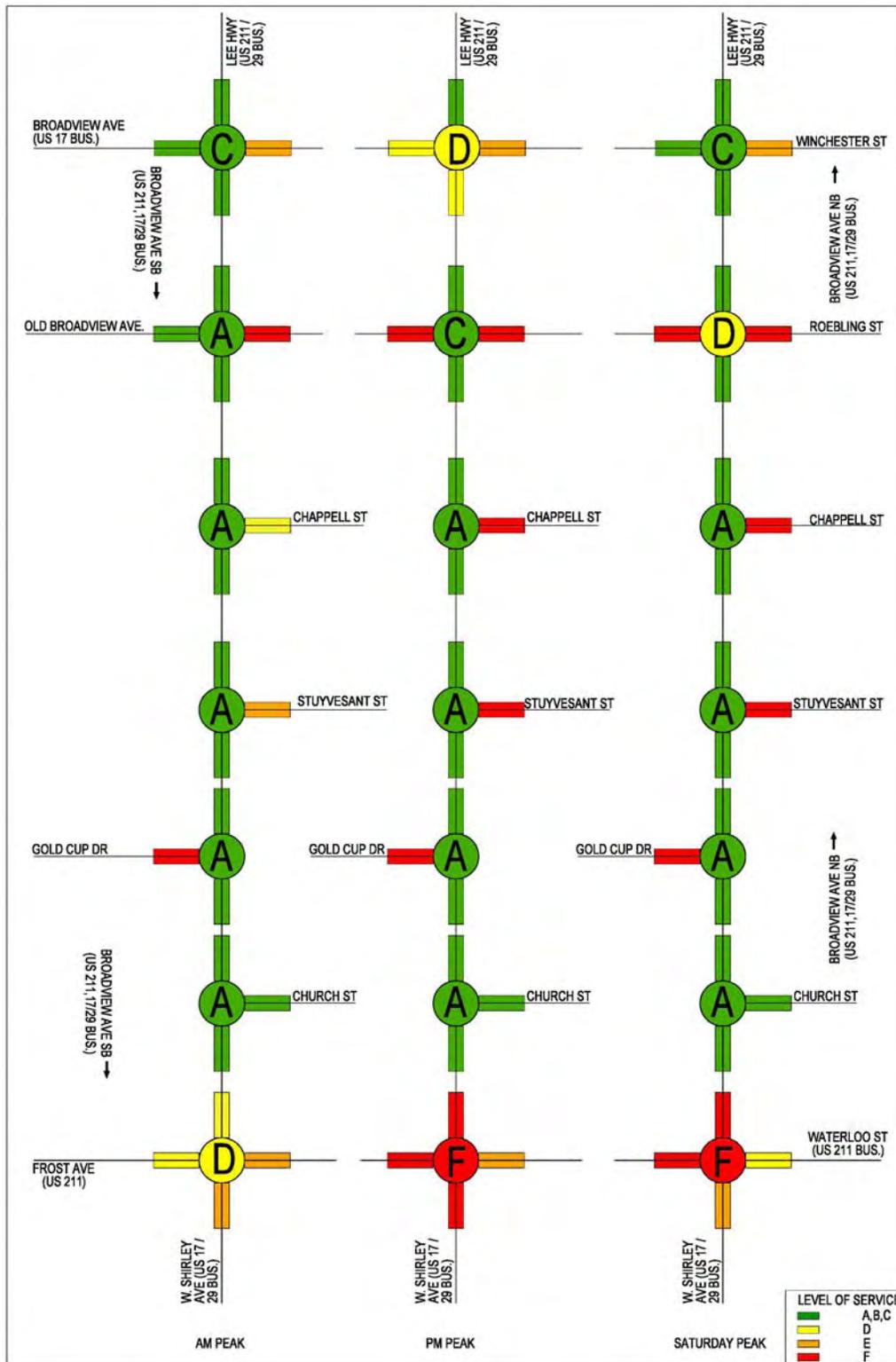


Figure 6 – Existing 2014 Intersection LOS Summary

4. Signal Warrant Analyses

Signal warrant analyses were performed at the five un-signalized study intersections using existing 2014 traffic volumes in accordance to the 2011 Virginia Manual on Uniform Traffic Control Devices (VaMUTCD). The VaMUTCD criterion includes a total of nine separate warrants to determine the need and appropriateness of a traffic signal installation at an intersection. **Table 6** summarizes a description of each warrant and identifies which warrants were met for each un-signalized intersection, and detailed warrant volume and analysis information is included in **Appendix K**.

The Old Broadview Avenue/ Roebling Street intersection was the only location that warranted a signal because of the high right-turn volumes along the eastbound Old Broadview Avenue approach. This approach provides a single lane for a shared left-through-right turn movement. A signal would not warrant at this intersection if the right turns were separated from the shared through and left-turn movements, and restricting the minor street approaches to right-turns only would also eliminate the need for a signal.

Table 6 – Existing 2014 Signal Warrant Summary

MUTCD Warrant	Description	Church St	Stuyvesant St/ Gold Cup Dr	Chappell St	Roebling St/ Old Broadview Ave
1 Eight-Hour Vehicular Volume	The volumes of traffic on the major and minor streets meet specified minimum amounts for at least 8 hours of an average weekday. Either of two sets of minimum criteria may be used. Condition A - Minimum Vehicular Volume – specifies minimum traffic volume levels that must be observed during any eight-hours of an average day. Condition B – Interruption of Continuous Traffic – also specifies minimum traffic volume levels that must be observed during any eight hours of an average day. Combination of Conditions A and B –The MUTCD provides for passage of Warrant 1 when Condition A and Condition B are not satisfied individually, yet exceed 56% of the volume thresholds for both Condition A and Condition B simultaneously for basic conditions.	Not Met	Not Met	Not Met	Met Meets 100% Condition B
2 Four-Hour Vehicular Volume	For any four hours of an average day, the points representing major and minor street volume pairs plot above a specified curve.	Not Met	Not Met	Not Met	Met
3 Peak Hour	For at least one hour of an average day, minor street traffic exceeds a minimum volume and suffers at least 4 vehicle-hours of total delay, or the points representing major and minor street volumes plot above a specified curve.	Not Met	Not Met	Not Met	Met
4 Pedestrian Volume	For each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) all fall above the curve in Figure 4C-5; or For 1 hour (any four consecutive 15-minute periods) of an average day, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) falls above a curve.	Not Met	Not Met	Not Met	Not Met
5 School Crossing	The frequency and adequacy of gaps in the traffic stream must not otherwise be sufficient for the number of children crossing.	N/A	N/A	N/A	N/A
6 Coordinated Signal System	Signalized control is required to maintain proper grouping of vehicles in a coordinated, progressive signal system.	N/A	N/A	N/A	N/A
7 Crash Experience	Five or more reported crashes of type susceptible to control by a traffic signal have occurred at the location within a 12-month period. Other less restrictive remedies and enforcement have failed to reduce accidents. Either Warrant 1 or Warrant 2 is at least 80% met. A signal will not seriously disrupt traffic flow.	Not Met	Not Met	Not Met	Not Met
8 Roadway Network	An intersection of two major routes has either high five-year projected peak-hour traffic volumes or high volumes for at least five hours on an average Saturday and/or Sunday.	N/A	N/A	N/A	N/A
9 Intersection Near Grade Crossing	The intersection is within 140 feet of a grade crossing on and intersection approach controlled by a STOP or YIELD sign and the points representing major and minor street volumes plot above a specified curve.	N/A	N/A	N/A	N/A

B. Future Conditions

1. Future Volumes

Future 2040 volumes were developed by increasing the 2014 volumes along Broadview Avenue, Old Broadview Avenue, Frost Avenue and Shirley Avenue using a nominal 0.70% annual growth rate as directed by VDOT. Volumes along other minor streets approaches were not adjusted as development along these roadways has saturated and future traffic growth will be negligible. Future AM, PM and Saturday peak hour volumes are summarized in **Figure 7**.

Based on a 0.70% annual growth rate, the future 2040 AADT will be approximately 40,000.

2. Future No-Build Operations

Operational analyses of the future 2040 peak hour volumes were developed for the seven study intersections under existing geometry and control (no-build) in accordance to the 2010 HCM techniques. **Figure 8** summarize the LOS results, and detailed analysis worksheets are included in **Appendix J**.

The Frost Avenue/ Waterloo Street intersection will operate at a deficient LOS during all peak hours, with significant delay and queues experienced along the Broadview/ Shirley Avenue and eastbound Frost Avenue approaches with existing geometric configurations and optimized signal timings. All of the un-signalized study intersections will continue to experience deficient minor street LOS due to excessive delays.

3. Signal Warrant Analyses

Signal warrant analyses were performed at the five un-signalized study intersections using future 2040 traffic volumes in accordance to the VaMUTCD, and the detailed warrant volume and analysis information is included in **Appendix K**. The Old Broadview Avenue/ Roebing Street intersection continues to be the only signal that warrants a signal; however other intersection improvements previously described would eliminate the need for a signal at this location.

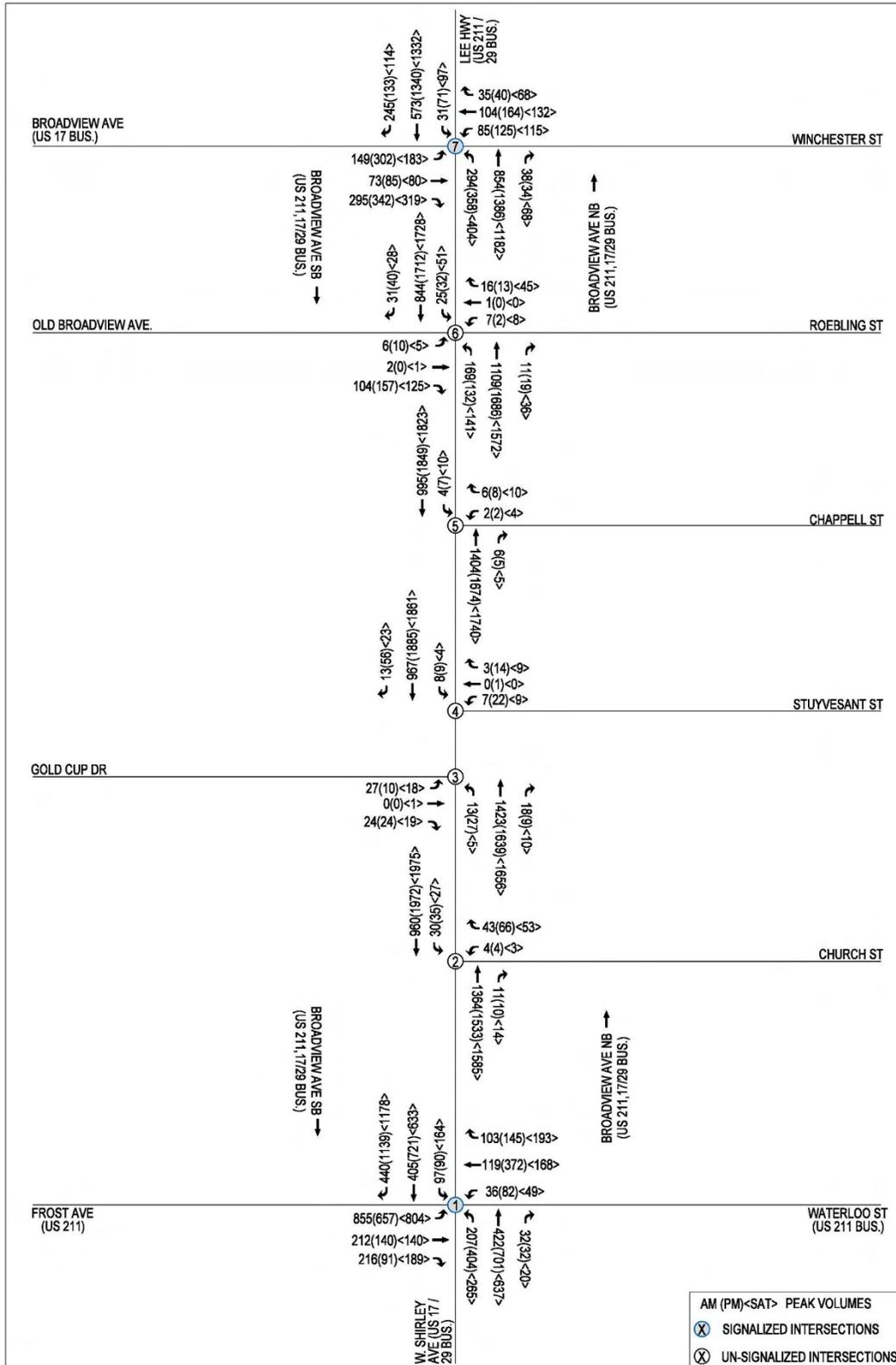


Figure 7 – Future 2040 Peak Hour Volume Summary

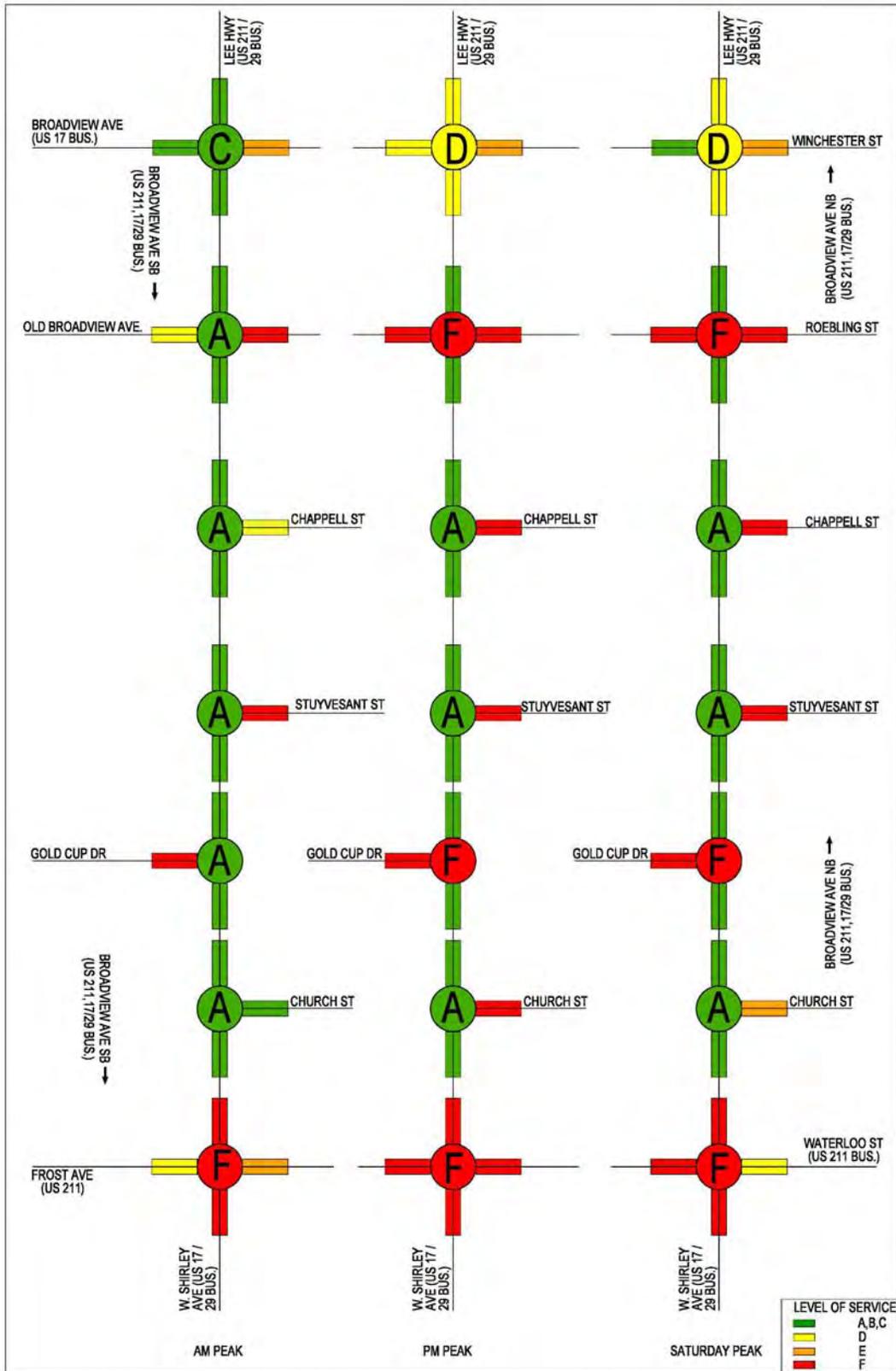


Figure 8 – Future 2040 No-Build Intersection LOS Summary

C. Alternative Geometric Improvements

1. Broadview Median

In order to accommodate the numerous commercial access points along Broadview Avenue with a raised median, additional openings within the median at the intersections and mid-block should to be included. The new median openings and intersections will provide exclusive left-turn lanes to accommodate the left-turn and U-turn movements anticipated by the impacted properties. The recommended median opening locations summarized in Section III of this report were further reviewed to understand the operational impacts of the additional left-turn movements on the corridor.

Median Opening Volumes

The properties with left-turn movements in and out of their respective driveways that are no longer accessible after the construction of a median will have to use the adjacent downstream median openings or intersections to make a U-turn movement to access the property. **Figure 9** displays average hourly left-turn/U-turn peak period volumes at each proposed median opening and intersection based on the collected driveway count data. The left-turn volumes are not significant at the median openings, and a 100 foot maximum left-turn lane will be able to accommodate these volumes.

Intersection Operational Analyses

Operational analyses of the additional left-turn volumes at the study intersections using future 2040 peak hour volumes under no-build intersection conditions were developed for the seven study intersections in accordance to the 2010 HCM techniques. **Figure 10** summarize the LOS results, and detailed analysis worksheets are included in **Appendix L**.

The additional left-turn volumes will have further adverse operational impacts to the intersections. However the resulting LOS should not significantly change with the additional impacts.

Median Opening Recommendations

Based on the median opening volumes, business characteristics of the properties at the openings and geometric constraint of the corridor the following five median openings considered (in order of need) are recommended for full median openings with exclusive left-turn lanes:

1. *Sunoco Gas Station and Oakview Bank* – Southbound Broadview Avenue has the highest left-turn peak hour volumes along the corridor based on the Sunoco Gas Station access volumes at this location, and full access to gas stations are considered critical to their business livelihood.
2. *McDonalds and Texaco Gas Station* - Southbound Broadview Avenue has the second highest left-turn peak hour volumes along the corridor based on the McDonalds access volumes at this location, and full access to gas stations are considered critical to their business livelihood.
3. *Shell Gas Station/ Dr. Carwash and Mattress Warehouse* - Full access to gas stations are considered critical to their business livelihood.

4. *Moser Funeral Home and Taco Bell* - The left-turn volumes at the median opening are less significant; however it is recommended to provide at least a depressed median treatment in this area to accommodate funeral events as needed.
5. *Frost Diner and Burger King* - The left-turns at the median opening are also less significant, and the close proximity to the Frost Avenue/ Waterloo Street intersection creates safety concerns.

Conceptual plans of the median openings are provided in **Appendix M**.

2. Broadview Avenue at Frost Avenue/ Waterloo Street

The Broadview Avenue and Frost Avenue/ Waterloo Street intersection was further evaluated to determine the geometric improvements required to mitigate the LOS deficiencies. Various alternative intersection improvement analyses and concepts are provided in a separate report titled *Intersection Traffic Analysis Broadview Avenue at Frost Avenue/ Waterloo Street*.

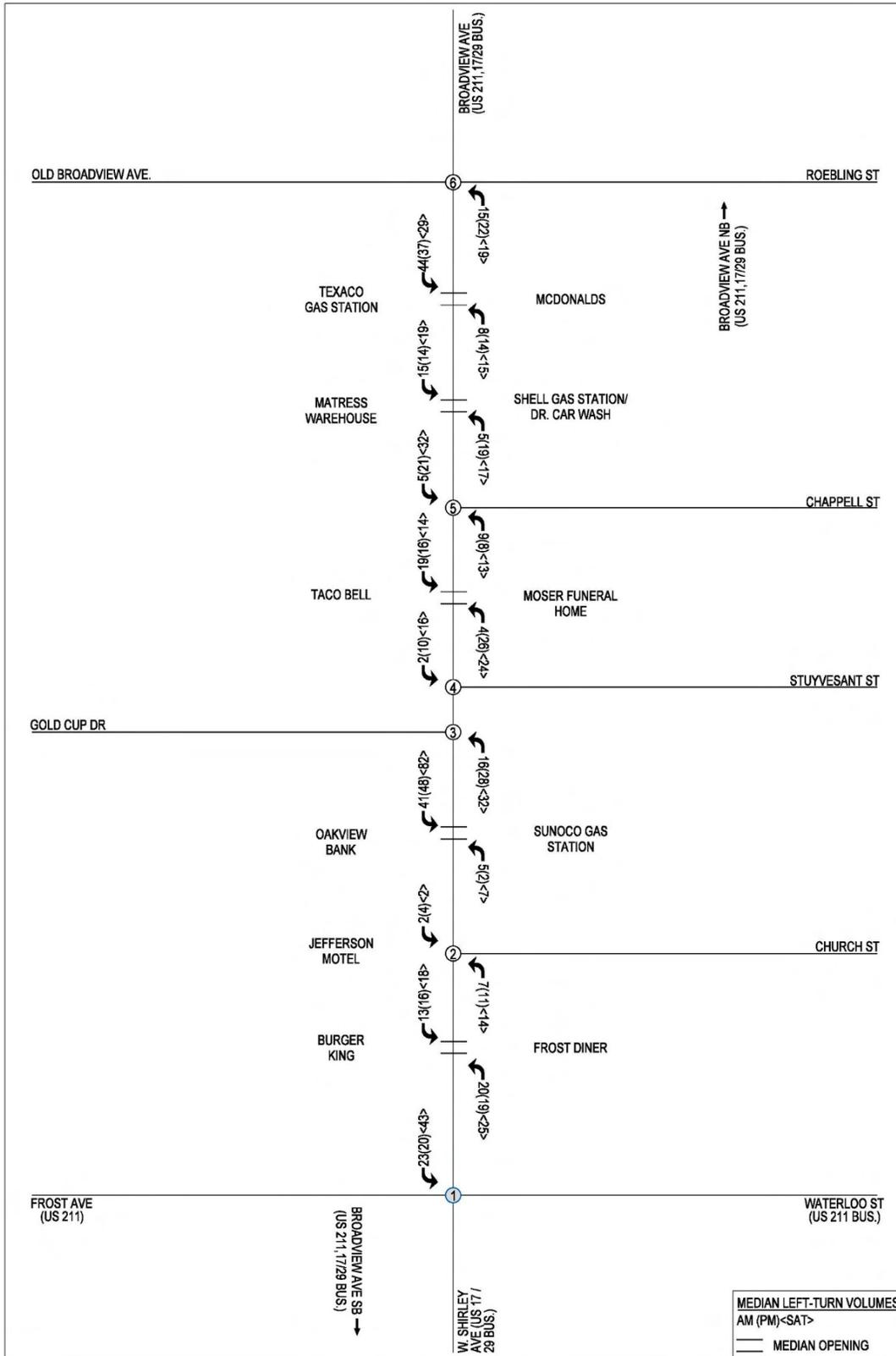


Figure 9 – Broadview Ave Median Left-Turn and U-Turn Volumes

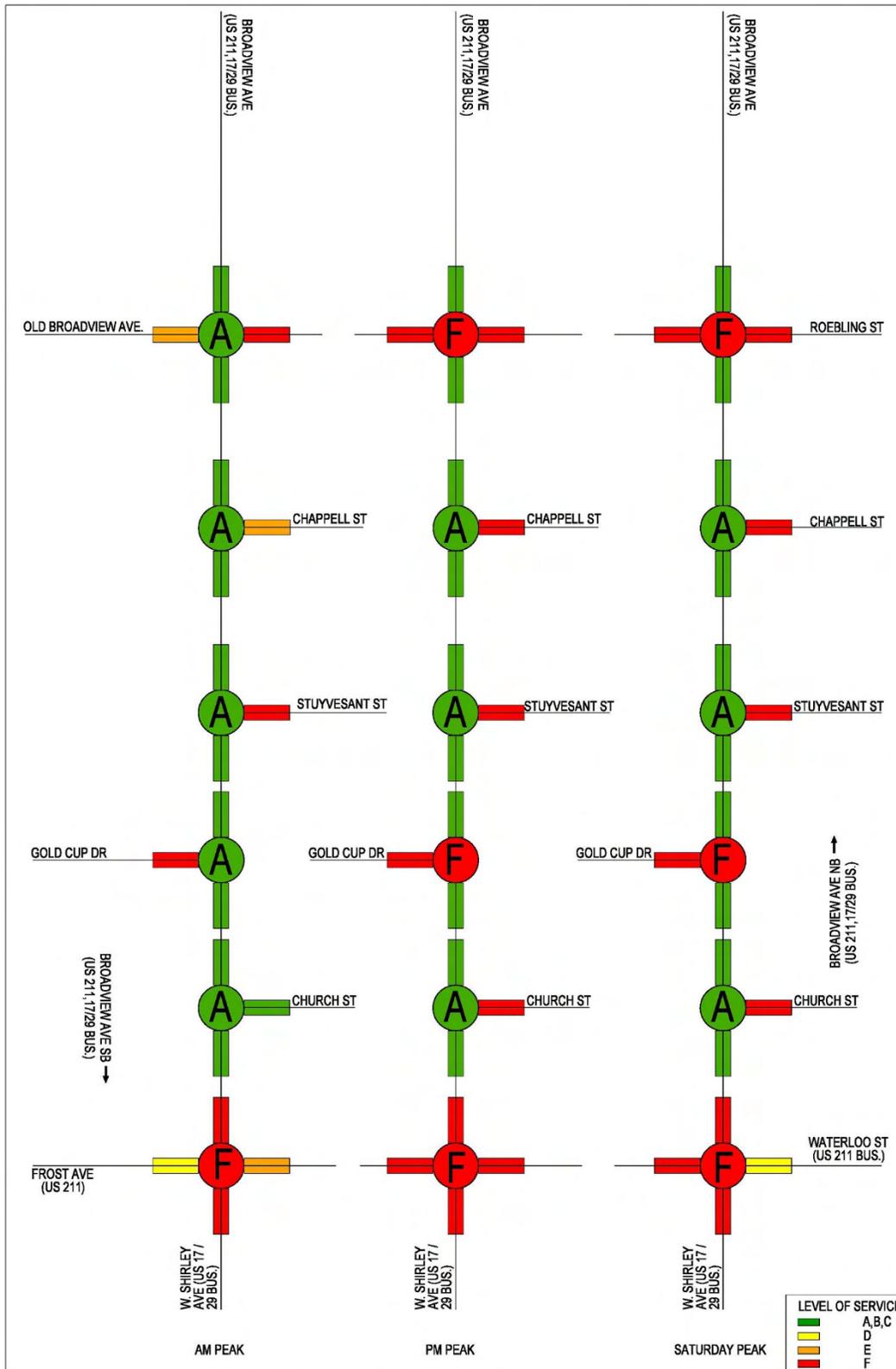


Figure 10 – Future 2040 Median Improvements Intersection LOS Summary

3. Broadview Avenue at Gold Cup Drive/ Stuyvesant Street

The Broadview Avenue and Gold Cup Drive/ Stuyvesant Street intersections were evaluated to determine the operational impacts of restricting thru and left-turn movements at both intersections. The closely spaced T-intersections provide an opportunity to install a safe marked pedestrian crossing between the two cross streets if the conflicts of the left-turn movements were eliminated. Broadview Avenue left-turn lanes within the median to access the cross streets can still be accommodated since they would not be in conflict the marked pedestrian crossing. Left-turning traffic from the cross streets would be required to turn right and then make a U-turn at the adjacent median openings, or use the adjacent street network to access Broadview Avenue. The turn restrictions will also significantly improve the side street delay. The existing and proposed lane configuration improvements are displayed in **Figure 11**, and a conceptual design plan is provided in **Appendix M**.

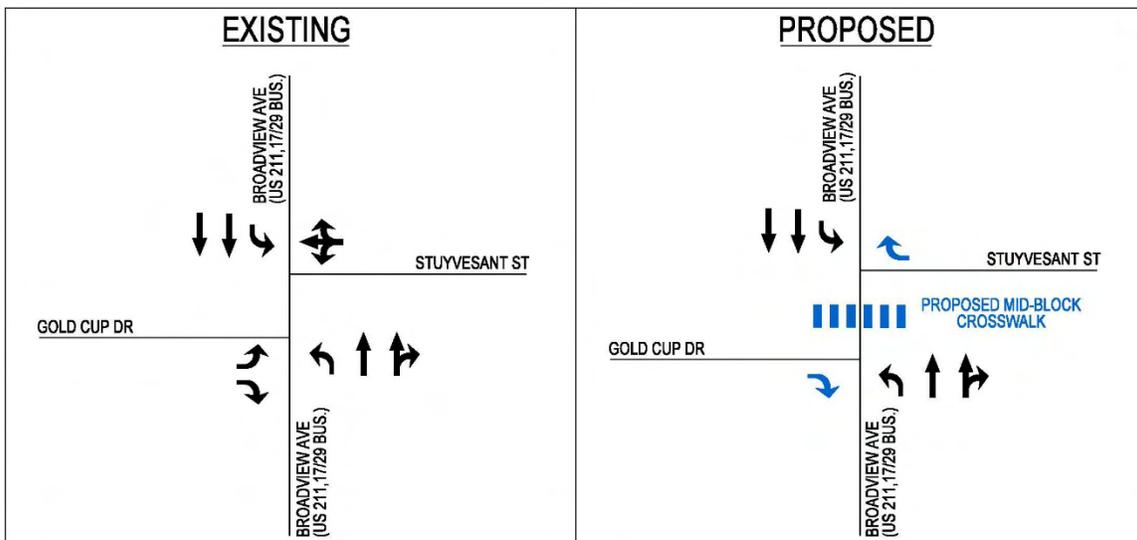


Figure 11 – Broadview Ave at Gold Cup Dr/ Stuyvesant St Lane Configurations

4. Broadview Avenue at Old Broadview Avenue/ Roebing Street

The Broadview Avenue and Old Broadview Avenue/ Roebing Street intersection was further evaluated to determine the operational impacts of restricting cross street thru and left-turn movements. The turn restrictions will significantly improve side street delay and reduce the likelihood of angle collisions from occurring. Broadview Avenue left-turn lanes within the median to access the cross streets can be accommodated or restricted as well by completely closing the median at this intersection. Left-turning traffic from the cross streets would have the option to turn right and then make a U-turn at the adjacent median opening or intersection, or use the adjacent street network to access Broadview Avenue. The existing and proposed lane configuration improvements are displayed in **Figure 12**, and a conceptual alternative design plans are provided in **Appendix M**.

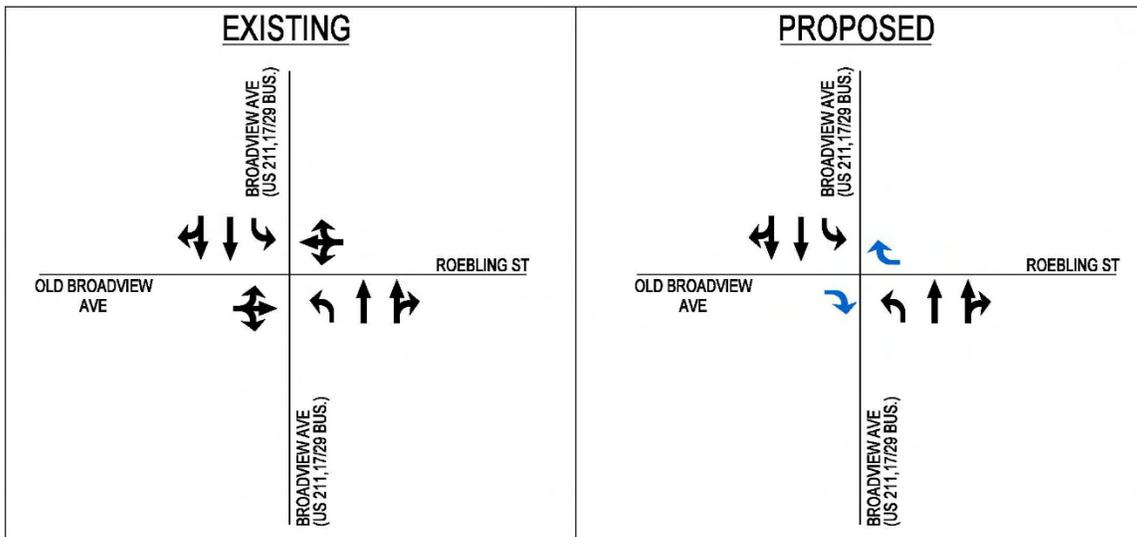


Figure 12 – Broadview Ave at Old Broadview Ave/ Roebing St Lane Configurations

5. Alternative Intersection Improvement Operations

Operational analyses of the alternative intersection improvements using future 2040 peak hour volumes were developed for the six study intersections (excluding the Frost Avenue/ Waterloo Street intersection) in accordance to the 2010 HCM techniques.

Figure 13 summarizes the LOS results, and detailed analysis worksheets are included in **Appendix L**.

The intersection improvements of restricting left and through movements at Gold Cup Drive, Stuyvesant Street, and Old Broadview Avenue/ Roebing Street significantly improve the resulting LOS at each of these intersections during all peak hours.

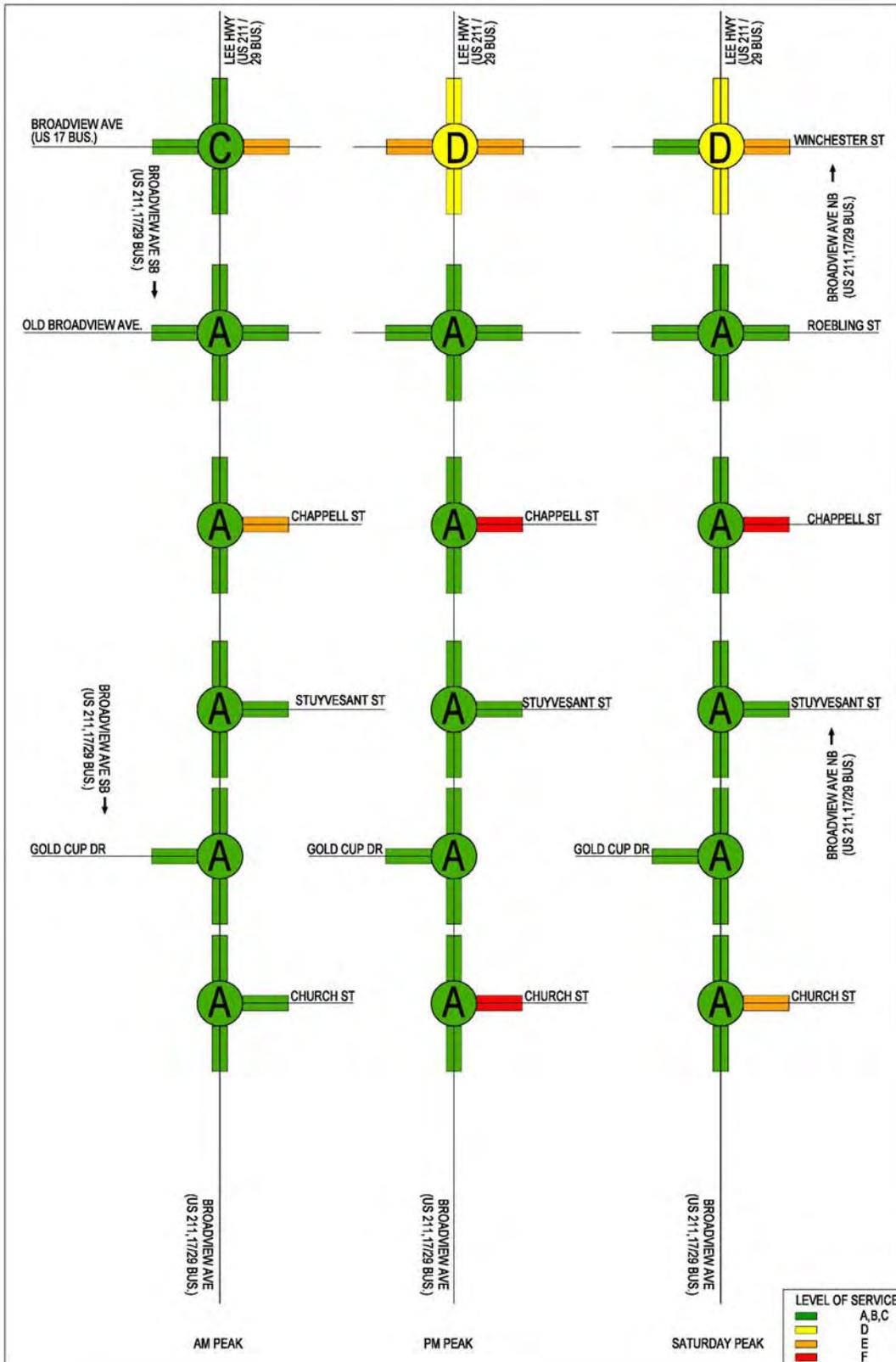


Figure 13 – Future 2040 Proposed Improvements Intersection LOS Summary

B. Pedestrian Flow Study

1. Pedestrian Walking Patterns

Corridor-wide pedestrian flow observations were conducted during the 13-hour weekday and weekend turning movement counts on Thursday, October 24, 2014 and Saturday, October 26, 2014 to understand the walking patterns along Broadview Avenue and areas of concentrated pedestrian activity. Pedestrian crossing volumes collected at the study intersections during the turning movement counts were also used to verify and compliment the pedestrian observations for each intersection. The location and walking path of each pedestrian that entered the corridor were tracked until they exited the corridor. The data was compiled together in a line diagram to understand pathway and crossing patterns. **Figures 14** and **15** summarize the pedestrian volumes and crossing patterns during each 13-hour count period, and more detailed line diagrams that display specific walking patterns are included in **Appendix N**.

Most of the pedestrians crossing Broadview Avenue occurred at Frost Avenue, Church Street, and mid-block between Chappell Street and Roebing Street. School pedestrians from the high school mainly walked along Frost Avenue and crossed Broadview Avenue. The motels, fast food restaurants, and gas stations were popular destinations for pedestrians along Broadview Avenue.

The only marked crosswalks along Broadview Avenue are located at each end of the study area at Frost Avenue/ Waterloo Street and Lee Highway/ Winchester Road. Although not at high frequencies, most of the pedestrian crossings of Broadview Avenue occur at unmarked, uncontrolled mid-block or intersection locations. Pedestrians were observed using the double center turn lanes as a refuge for crossing half of the roadway at a time.

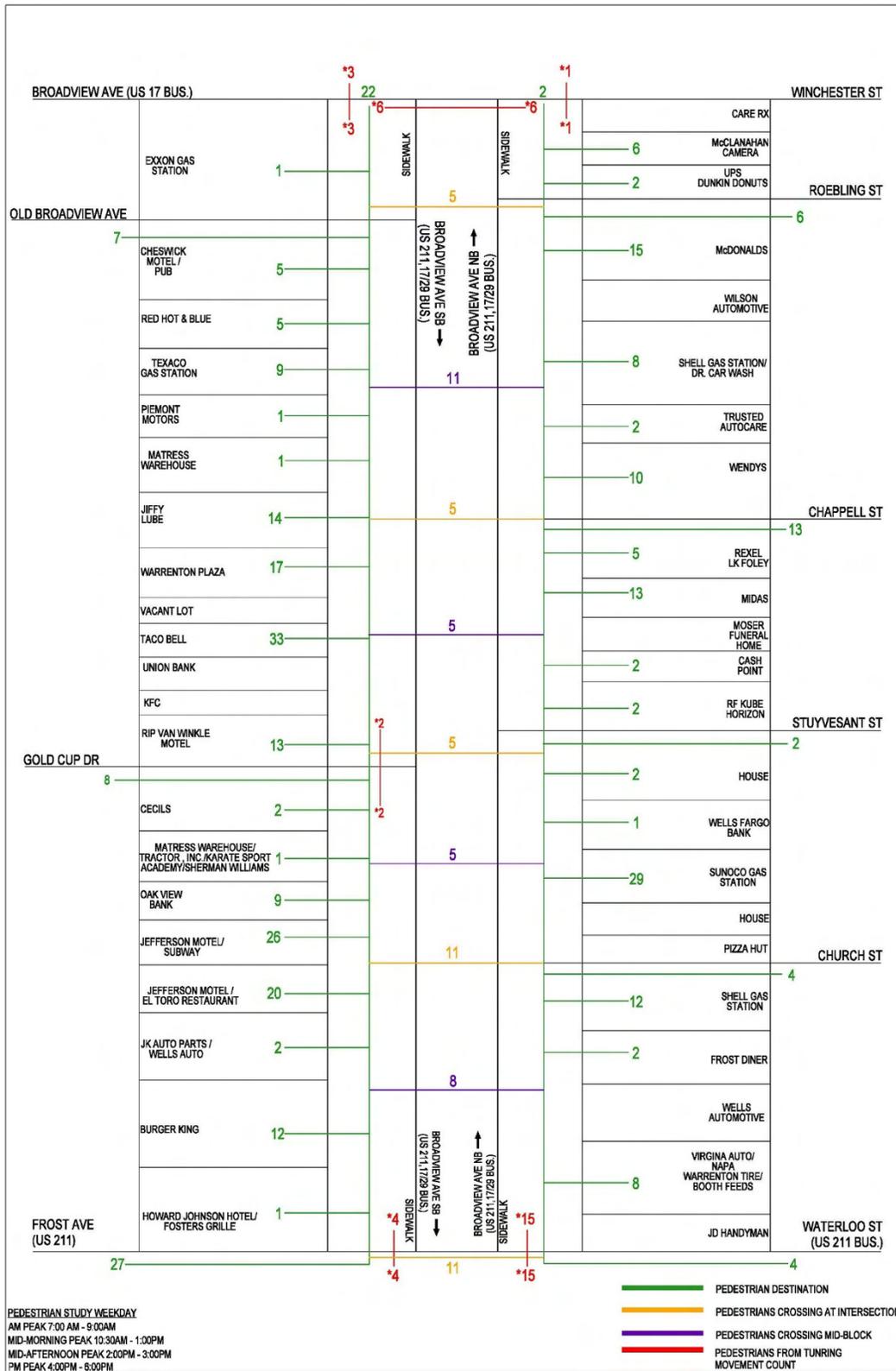


Figure 14 – Weekday Pedestrian Activity

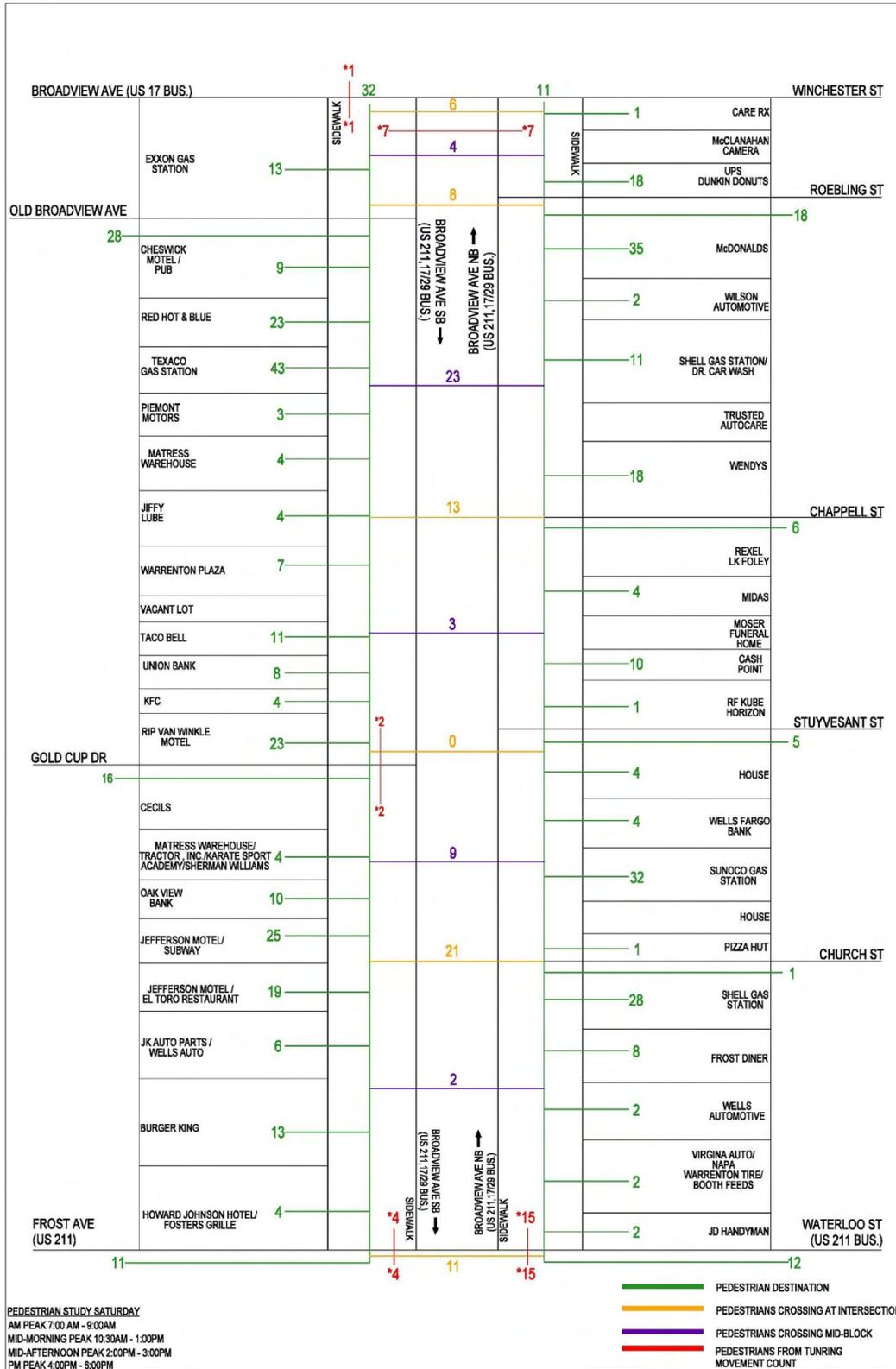


Figure 15 – Weekend Pedestrian Activity

2. Pedestrian Signal Warrant Analyses

The pedestrian volumes crossing Broadview Avenue were reviewed to determine if any of the un-signalized study intersections would warrant a pedestrian-actuated signal based on the 2011 VaMUTCD criteria or justify an uncontrolled marked crosswalk based on VDOT guidelines. The crossing volumes include adjacent mid-block crossings at each study intersection, assuming a marked intersection crossing would attract pedestrians to cross at legal crossings. **Table 7** summarizes the highest two-hour crossing volume at each un-signalized intersection.

Table 7 – Highest Pedestrian Crossing Volumes

Broadview Ave Intersection	Weekday		Weekend	
	Peak Time Period	Peak Volume	Peak Time Period	Peak Volume
1. Frost Ave/ Waterloo St	7am - 9am	2	4pm - 6pm	8
2. Church St	4pm - 6pm	17	11am - 1pm	13
3/4. Gold Cup Dr/ Stuyvesant St	11am - 1pm	10	11am - 1pm 4pm - 6pm	8
5. Chappell St	4pm - 6pm	12	4pm - 6pm	7
6. Old Broadview Ave/ Roebbling St	11am - 1pm	5	7am - 9am	12
7. Broadview Ave/ Winchester St	4pm - 6pm	2	7am - 9am	8

Warrant 4 of the VaMUTCD specifies a minimum number of pedestrians crossing a major street at an intersection for either a single hour (133 pph) or any four hours (107 pph) of an average weekday. None of the study intersection experience enough pedestrian crossing volumes during any two-hour time period to warrant a signal.

3. Pedestrian Crossing Analyses

The VDOT Guidelines for the Installation of Marked Crosswalks provides the following basic justification for marking a crosswalk:

- Sufficient demand exists by demonstrating the crossing is on a direct route to or from a pedestrian generator such as a school, library, hospital, senior center, shopping center, park, employment center and transit center or service.
- The location is 300 feet or more from another crossing location or a controlled crossing location.
- The location has sufficient sight distance (400 feet along Broadview Avenue) and/or sight distance will be improved prior to crosswalk marking.
- Safety considerations do not preclude a crosswalk.

Because Broadview Avenue has 4+ lanes, with an ADT over 15,000 and an 85th percentile speed at 40 mph; a Level 5 device (pedestrian actuated signal) is the most desirable treatment. Since a signal is not warranted at any of the un-signalized intersections, multiple treatments from Level 2 (high-visibility crosswalks), Level 3 (refuge areas or bulbouts) or Level 4 (overhead signs or flashing beacons) devices should be used. Excerpts of the Guidelines are included in **Appendix O**.

4. Recommendations

It is recommended to install a marked uncontrolled crossing between the Gold Cup Drive and Stuyvesant Street intersections. This location provides a safe crossing point halfway between the corridor, provides a direct link for school foot traffic to Fauquier High School (approximately 1,800 feet to the west), and Gold Cup Drive and Stuyvesant Street are identified as future priority bicycle and pedestrian routes in the Fauquier-Warrenton Master Plan.

The installation of a wide median along Broadview Avenue and restricting left-turns along the Gold Cup Drive and Stuyvesant Street approaches will provide safe accommodations for an uncontrolled crossing by reducing the number of lanes to cross, provide pedestrian refuge, and reduce the number of conflict points for crossing pedestrians. It is recommended to install high-visibility crosswalk markings with hatching in each direction, advanced pedestrian signing, and pedestrian signing at the crossings installed on flashing beacons. The flashing beacons can be pedestrian actuated to only flash when pedestrians are present



IV. CORRIDOR SAFETY STUDY

An evaluation was performed on the safety conditions of the Broadview Avenue study corridor to understand the areas with safety concerns, to determine opportunities to improve safety and ensure safety is adequately being addressed with the proposed improvements.

A. Historical Crash Data

Police reported crash data was obtained from VDOT from 2010 through 2014 along the Broadview Avenue study corridor to evaluate crash patterns and identify locations with higher crash frequencies. **Table 8** summarizes the crash data in four corridor segments, and detailed crash information including aerial displays are included in **Appendix P**.

The following statistics highlight the most notable trends:

- Most of the 134 total crashes resulted in property damage (76%), and none of the crashes resulted in a fatality.
- The predominant collision type was **rear-end collisions**, which accounted for 59 of the 134 crashes (44%). Most of the rear-end collisions (33) occurred between Frost Avenue/Waterloo Street and Church Street (Segment 1). Most of the rear-end collisions in this area occurred along southbound Broadview Avenue and were related to either congestion at the Frost Avenue/ Waterloo Street intersection or motorist accessing the multiple driveways. The proposed capacity improvements at this intersection would help reduce these types of crashes by improving traffic flow and reducing the southbound queues.
- **Angle collisions** accounted for 53 of the 134 crashes (40%), and most of the angle collisions (27) also occurred between Frost Avenue/Waterloo Street and Church Street. Most of the angle collisions occurred at the southernmost driveways near the Frost Avenue/ Waterloo Street intersection. The proposed median would help reduce these types of crashes by reducing the number of conflict points to/from the multiple driveways.
- **Sideswipe collisions** accounted for 9 of the 134 crashes (7%), where 8 of the 9 sideswipe collisions occurred within the double center turn lanes. The proposed median would help reduce these types of crashes.
- Three (3) pedestrian collisions occurred within the study area. Each collision occurred at different locations, and 2 or the 3 collisions occurred during daytime hours.
- 78 of the 134 crashes (58%) occurred between 12:00 pm and 6:00 pm.
- Eight (8) of the 134 crashes (6%) involved a driver under the influence of alcohol or drugs.
- Only one of the crashes was work zone related.

Table 8 – Crash Data Summary

	Frost Ave/Waterloo St to Church St SEGMENT 1	Church St to North of Stuyvesant St SEGMENT 2	North of Stuyvesant St to McDonalds SEGMENT 3	McDonalds to Lee Hwy/Winchester St SEGMENT 4	Corridor Totals
	# of Crashes				
<i>Time of Day</i>					
12:00 AM to 6:00 AM	2	1	0	2	5
6:00 AM to 12:00 PM	11	7	5	10	33
12:00 PM to 6:00PM	48	11	10	9	78
6:00 PM to 12:00 AM	10	1	1	6	18
Total	71	20	16	27	134
<i>Reported Year</i>					
2010	8	2	3	4	17
2011	14	4	4	7	29
2012	22	4	3	5	34
2013	13	4	4	7	28
2014	14	6	2	4	26
Total	71	20	16	27	134
<i>Severity</i>					
Fatal	0	0	0	0	0
Injury	16	9	3	4	32
Property Damage	55	11	13	23	102
Total	71	20	16	27	134
<i>Collision Type</i>					
Rear-end	33	9	4	13	59
Angle	27	9	8	9	53
Sideswipe- Same Directon	5	1	2	1	9
Fixed Object- Off Road	3	0	0	2	5
Pedestrian	1	1	0	1	3
Head On	0	0	2	0	2
Other/Unkown	1	0	0	1	2
Fixed Object- On Road	1	0	0	0	1
Total	71	20	16	27	134

B. Corridor Lighting Analyses

An evaluation of the existing lighting along Broadview Avenue was conducted to understand the existing corridor lighting characteristics and identify locations with adequate or deficient light levels. Locations of the existing light poles along Broadview Avenue are displayed on aerial plans in **Appendix Q**.

1. Existing Conditions

Night-time light level readings were collected along the top of curb in 25 foot increments in both directions of Broadview Avenue on Wednesday, October 22, 2014. The light readings are included in **Appendix Q**, and the resulting observations are summarized below:

- The study area includes 37 40-foot light poles with 250 Watt High Pressure Sodium luminaires with various bracket arm lengths (8 or 15 foot arms)
- All existing light poles and fixtures are in good working condition
- Many of the light poles are located adjacent to mature trees that impede the light distribution.
- The businesses along the southbound Broadview Avenue are higher elevation than the roadway, and the businesses along northbound Broadview Avenue are at the same elevation as the road. The ambient lighting from the businesses along northbound Broadview Avenue provided additional light and therefore higher readings.
- The following locations exhibited low light readings of 0.2 foot-candles (fc) or less:



Northbound

- From Lee Hwy/ Winchester Road to just north of Roebling Street
- Rexel LK Foley
- Wells Fargo Bank
- Midas
- RF Kube Horizon
- Sunoco Gas Station

Southbound

- From Lee Hwy/ Winchester Road to just north of Old Broadview Avenue
- Oak View Bank
- Union Bank
- Rip Van Winkle Motel
- Howard Johnson Hotel/ Fosters Grille

A lighting model was developed using the AGi32 software along the corridor roadway and sidewalk, which was calibrated using the field readings, for each block in each direction. The resulting readings were compared to the criteria found in Section 5 of the *2011 VDOT Traffic Engineering Design Manual* on Roadway Lighting, which stipulate providing the level and uniformity of light suggested in the current IESNA publication *Recommended Practices for Roadway Lighting* (RP-8-00). The lighting roadway and sidewalk characteristics evaluation criteria along Broadview Avenue include the following:

Roadway Characteristics

Roadway Classification – **Major**

Pavement Classification – **R3**

Pedestrian Conflict Area – **Medium**

Recommended Roadway Illuminance (Table 2)

Minimum Maintained Average Illuminance - **1.3 fc**

Uniformity Ratio (**Eavg/Emin**) - **3:1**

Recommended Walkway Illuminance (Table 6)

Average Horizontal Illuminance (**Eh**) - **0.5 fc**

Minimum Vertical Illuminance (**Evmin**) - **0.2 fc**

The existing roadway and sidewalk modeled lighting analysis results are summarized in **Tables 9** and **10**.

Table 9 – Existing Roadway Lighting Analysis Summary

NB Zones	Zone Limits	Ave (fc)	Ave/Min
1	Frost St to Church St	1.04	5.20
2	Church St to Stuyvasant St	1.02	5.10
3	Stuyvasant St to Chappell St	0.74	7.40
4	Chappell St to Roebing St	1.33	4.43
5	Roebing St to Lee Hwy/Winchester St	0.15	N.A
SB Zones	Zone Limits	Ave (fc)	Ave/Min
1	Lee Hwy/Winchester St to Roebing St	0.13	N.A
2	Roebing St to Gold Cup Dr	1.08	5.40
3	Gold Cup Dr to Frost St	1.03	5.15

Table 10 – Existing Sidewalk Lighting Analysis Summary

NB Zones	Zone Limits	Ave (fc)	Min (fc)
1	Frost St to Church St	0.45	0.0
2	Church St to Stuyvasant St	0.37	0.1
3	Stuyvasant St to Chappell St	0.30	0.0
4	Chappell St to Roebing St	0.51	0.0
5	Roebing St to Lee Hwy/Winchester St	0.04	0.0
SB Zones	Zone Limits	Ave (fc)	Min (fc)
1	Lee Hwy/Winchester St to Roebing St	0.11	0.0
2	Roebing St to Gold Cup Dr	0.56	0.1
3	Gold Cup Dr to Frost St	0.50	0.1

Note: Values in **red** represent light level readings below the VDOT criteria.

Roadway Northbound Zones 1-3 and Southbound Zones 2-3 are slightly below the VDOT lighting criteria. Roadway Northbound Zone 5 and Southbound Zone 1 are significantly below the VDOT lighting criteria, because there are currently no existing overhead lights between Old Broadview Avenue/ Roebing Street and Lee Highway/ Winchester Street. Similar results are shown for the sidewalk analyses.

2. Recommendations

The following are recommendations to meet the VDOT lighting criteria.

- Install lighting along northbound and southbound Broadview Avenue north of Old Broadview Avenue and Roebing Street.
- Replace the existing luminaires with higher wattage fixtures (400 watt) in areas with lower light readings.

The proposed lighting improvements were modeled, and the roadway and sidewalk lighting analysis results are summarized in **Tables 11** and **12**. Proposed improvement locations are shown in **Appendix Q**.

Table 11 – Proposed Roadway Lighting Analysis Summary

NB Zones	Intersection	Ave (fc)	Ave/Min
1	Frost St to Church St	1.32	4.40
2	Church St to Stuyvasant St	1.27	6.35
3	Stuyvasant St to Chappell St	1.22	6.10
4	Chappell St to Roebing St	1.91	6.37
5	Roebing St to Lee Hwy/Winchester St	2.13	2.13
SB Zones	Intersection	Ave (fc)	Ave/Min
1	Lee Hwy/Winchester St to Roebing St	1.82	2.60
2	Roebing St to Gold Cup Dr	1.33	6.65
3	Gold Cup Dr to Frost St	1.38	4.60

Table 12 – Proposed Sidewalk Lighting Analysis Summary

NB Zones	Intersection	Ave (fc)	Min (fc)
1	Frost St to Church St	0.54	0.10
2	Church St to Stuyvasant St	0.46	0.10
3	Stuyvasant St to Chappell St	0.50	0.10
4	Chappell St to Roebing St	0.73	0.10
5	Roebing St to Lee Hwy/Winchester St	1.47	0.30
SB Zones	Intersection	Ave (fc)	Min (fc)
1	Lee Hwy/Winchester St to Roebing St	1.27	0.50
2	Roebing St to Gold Cup Dr	0.69	0.10
3	Gold Cup Dr to Frost St	0.65	0.10

Note: Values in **red** represent light level readings below the VDOT criteria.

C. **Viability Safety Improvement Methodologies**

The National Cooperative Highway Research Program (NCHRP) *Report 500* provides possible safety strategies to mitigate collisions at intersections (both un-signalized and signalized) and with pedestrians. Strategies that are relevant to the safety concerns along the Broadview Avenue corridor that are discussed in the reports include the following:

Intersections (NCHRP 500 Volumes 5 and 12)

- Driveway access and cross-median restrictions and relocations
- Left turn lane installations
- Restrictions of turning maneuvers
- Direct median crossover installations
- Improved pedestrian and bicycle facilities
- Improved lighting

Pedestrians (NCHRP 500 Volume 10)

- Sidewalk and ramp installations
- Pedestrian signals
- Pedestrian refuge islands and medians
- Vehicle turn restrictions
- Crosswalk enhancements
- Crosswalk lighting
- Roadway narrowing

The AASHTO *Highway Safety Manual* (HSM) developed safety performance measures to predict crashes along roadways by providing Crash Modification Factors (CMF) associated with various safety countermeasures. These CMFs are multiplicative factors used to compute the expected number of crashes that might occur after implementing a given countermeasure at a specific site. Countermeasures along a multi-lane street, at a multi-lane intersection, or for pedestrian safety that are relevant to the safety concerns along the Broadview Avenue corridor that are discussed in Chapter 12 of the HSM include the following:

<u>Multi-Lane Intersections</u>	<u>Multi-Lane Streets</u>	<u>Pedestrians</u>
<ul style="list-style-type: none"> • Left-turn lanes • Left-turn restrictions • Improved pedestrian and bicycle facilities • Lighting 	<ul style="list-style-type: none"> • Fixed objects • Median widths • Lighting 	<ul style="list-style-type: none"> • Reduce access density • Sidewalks and shoulders • Medians with crosswalks • Lighting • Signal timing clearance intervals • Countdown pedestrian signals

Table 13 provides a list of known safety countermeasure CMF values found on the HSM clearinghouse database website that could address safety concerns along Broadview Avenue. The lower the CMF value, the greater effect on reducing crashes.

Table 13 – HSM CMF Summary

Facility Type	Mitigation Technique	Countermeasure	Approximate CMF Values
Multi-Lane Intersection	Restrict Left Turn/ U-Turn Movements	Prohibit left-turns and U-Turns with Signs	0.26
	Indirect Left Turn Restriction	Increase separation distance between driveway exit and downstream U-turn by 10% (m)	0.96
	Improve Ped/Bike Facilities	Install High Visibility Crosswalk	0.81
	Lighting	Provide Intersection Illumination	0.91 - 1.05
Multi-Lane Street	Fixed Objects	Remove or relocate fixed objects outside of clear zone	0.62
	Lighting	Install roadway lighting	0.49 - 0.87
Pedestrians	Crosswalks	Raised median with marked crosswalk (uncontrolled)	0.54
		Raised median with unmarked crosswalk (uncontrolled)	0.61
	Signal Timing	Increase yellow interval and add all red interval	0.96 - 0.99

D. Safety Recommendations

Both NCHRP 500 and HSM publications endorse the following safety strategies/ countermeasures that are proposed recommendations along Broadview Avenue:

- *Installation of medians* – Provide separation of directional traffic, refuge area and shorter crossing distances for pedestrians, and reduce conflict points with crossing traffic throughout the corridor
- *Installation of left-turn lanes* – Provide separation of through traffic within the median at the existing intersections and proposed median openings
- *Turning movement restrictions* – Reduce cross street vehicular and pedestrian conflict points at Gold Cup Drive, Stuyvesant Street and Old Broadview Avenue/ Roebing Street
- *Driveway access restrictions* - Reduce vehicular and pedestrian conflict points as a result of the raised median installation
- *Improved lighting* – Enhanced driver awareness of vehicular and pedestrian traffic at intersections and crossings at night with the recommended proposed lighting improvements
- *Improved pedestrian and bicycle facilities* – Provide separation of motorized and non-motorized facilities to reduce conflict points and improved driver awareness with the installation of the raised median, bicycle lanes and marked crosswalk treatment and control at Gold Cup Drive and Stuyvesant Street.