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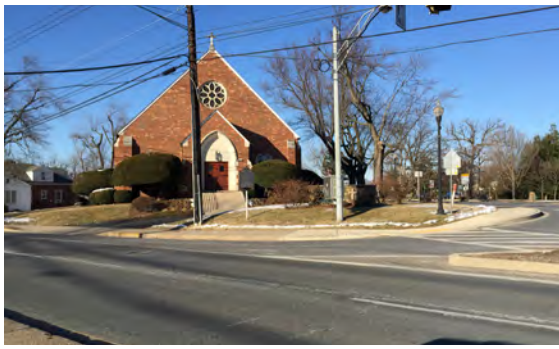
City of Gaithersburg

Final MD 355 Bus Rapid Transit Study REPORT



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Background

Montgomery County is currently in the initial planning and design stage for a bus rapid transit network along key County corridors in response to growing congestion and support for future development and economic growth. Two of those corridors would travel through the City of Gaithersburg. The Corridor Cities Transitway is currently in the design phase and would connect Clarksburg to the Shady Grove Metro Station via the Life Sciences Center. The other BRT corridor would travel along MD 355 from Clarksburg to Bethesda. This would introduce BRT to the five mile segment of MD 355 within the City of Gaithersburg. The entire 23-mile corridor is currently being studied by the Maryland State Highway Administration.

The initial BRT planning studies for bus rapid transit along the MD 355 corridor did not determine the type of transitway that could be accommodated within the City of Gaithersburg. A concept for exclusive guideway has been envisioned, but the impacts to traffic, property owners, and transit operations have not been evaluated. This study seeks to answer the question of what BRT design option for MD 355 in the City of Gaithersburg provides the best balance between the overall BRT experience, traffic operations throughout the corridor, and impacts to property owners along the corridor.

Existing Conditions

MD 355, also known as Frederick Avenue, is the major arterial non-freeway, north-south route through the City of Gaithersburg. The road is generally a conventional suburban roadway, lined by strip malls and office parks in the northern part of the City, and residential neighborhoods to the south. MD 355 is primarily a local route; however it is sometimes used as an alternative to I-270 during periods of heavy traffic associated with recurring congestion or traffic incidents.

The study area for the BRT evaluation includes all of MD 355 within the City of Gaithersburg, with a more detailed focus on the one-mile segment from Odendhal Avenue to South Summit

Avenue. The focal study area contains the most constrained segment of MD 355 in the City of Gaithersburg. North and south of the focal study area, MD 355 has a much wider street section, including a six-lane divided roadway with separate left turn lanes at major intersections and more generous public ROW. Some signalized intersections on MD 355 in the City of Gaithersburg have enough ROW for multiple exclusive left turn lanes.

Between Odendhal Avenue and South Summit Avenue, MD 355 is more constrained with a narrower ROW, buildings closer to the road edge, and fewer sections of median. The focal study area also includes the Father Cuddy Bridge, a major bridge over the Amtrak/Brunswick MARC/CSX railroad. The bridge is approximately 90 feet wide, with a small median separation and narrow sidewalks on both sides of MD 355.

The MD 355 roadway layout between Odendhal Avenue and Chestnut Street is approximately 60 feet wide in this section, providing two northbound lanes, three southbound lanes, and a continuous two-way left-turn lane (TWLTL), sometimes referred to as a shared left-turn lane.

Between Chestnut Street and the Father Cuddy Bridge MD 355 curves to accommodate the bridge alignment. The roadway is approximately 65 feet wide in this section, providing two northbound lanes and two southbound lanes with an approximately six-foot wide raised median extending to just north of Brooks Avenue. The roadway begins to widen to the south, providing an additional southbound right-turn lane over the Father Cuddy Bridge.

On the Father Cuddy Bridge, MD 355 maintains an approximately 76 foot wide curb-to-curb width. The bridge accommodates three northbound lanes and three southbound lanes and a four-foot wide median. The outside lanes in both directions are designated as right turn lanes.

South of the Father Cuddy Bridge, MD 355 transitions into a more traditional suburban major arterial roadway, with a six-lane median-divided roadway with three through lanes per direction. The roadway width is approximately 92 feet and exclusive left turn lanes are provided in the median south of the bridge.

The focal study area includes three signalized intersections: Odendhal Avenue, Chestnut Street, and Summit Avenue. Recent traffic study results suggest the focal area intersections currently operate at generally acceptable levels of service during the critical weekday commuter peak periods.

Historically, development along MD 355 in the study area consists of single parcels that were developed separately, each requiring direct access to MD 355 with little to no physical interconnectivity between parcels. Each parcel supports individual uses, with most commercial and office uses existing in isolation from one another or adjacent residential uses.

There are numerous private properties with direct driveway curb-cut access to MD 355, particularly between Chestnut Street and Odendhal Avenue. The many curb-cuts coupled with narrow, frequently-obstructed sidewalks increase overall turning movement activity and the potential for vehicle-bicycle/pedestrian conflicts. This, combined with the number of small parcels make it challenging to create a unified streetscape, and potentially acquire additional ROW.

Bus Rapid Transit Design

Planning-level designs for the BRT on MD 355 in the Gaithersburg focal segment were developed and evaluated to provide critical information regarding the feasibility of each alternative. Sufficient right-of-way can likely be provided to construct a dual-lane median guideway on MD 355 both north and south of the focal segment (from Game Preserve Road to Odendhal Avenue and from Summit Avenue to O'Neill Drive). In response to the narrower right-of-way observed in the focal segment, and the concerns related to potential property impacts, several other alternatives were evaluated for the focal segment. These alternatives may address some property concerns, but introduce operational and functional changes that will need to be weighed against the lower impact to properties along the corridor. These tradeoffs will be documented in more detail with each alternative.

The four alternative BRT guideway options considered for the focal segment include:

- Dual-lane Median Guideway
- Single-lane Median Guideway
- Lane Repurposing
- Mixed Traffic

The Maryland State Highway Administration has defined a range of design criteria for median BRT guideways that was applied to both the dual-lane and single-lane median guideway in the Gaithersburg focal segment. Each of these sub-alternatives represent different degrees of operational enhancement for the corridor, as well as encroachment on the adjacent properties for the dual- and single-lane median guideway alternatives. The name of each version reflects the scale of the design:

- Standard Design Dimensions - Uses SHA's preferred design criteria
- Minimum Design Dimensions - Uses SHA's minimum design criteria
- Reduced Impact Dimensions - Uses SHA's minimum design criteria, but also seeks to reduce impacts further by applying changes to existing lane configurations and sidewalk widths

The design layouts are intended to provide a planning-level visualization of the potential roadway and BRT guideway alignment on the corridor, identify probable impacts, and provide a basis for estimating costs. Copies of the design layout concepts are included in Appendix B.

Where the planned roadway geometry shown on the design layout drawings exceeds the existing adjacent property boundaries, private property within the extents of the roadway envelope will need to be acquired as public property. The design layouts included in Appendix B highlight two types of significant property impacts: Building/Entire Property Impacts and Potential Building Impacts. Building/Entire Property Impacts refer to locations where the planned roadway geometry for a specific alternative will encroach on an existing building, which will likely necessitate dedication or acquisition of the entire property as public land. Potential Building Impacts refer to locations where the planned roadway geometry for a specific alternative could be located within five feet of an existing building. These are labeled "potential" impacts because the roadway or sidewalk design could possibly be modified during the detailed design process to adequately avoid impacting these building.

For consistency during the design layout development, several planning-level design assumptions were developed for all of the BRT design alternatives for the focal segment. These assumptions include the following:

- A BRT station will be located at the MD 355/Odendhal Avenue intersection
- A median station at Odendhal Avenue will provide far-side platforms, allowing BRT vehicles to travel through the traffic signal prior to stopping at the station.
- The single-lane guideway will operate with BRT vehicles using the guideway only in the peak direction, and BRT vehicles traveling in the opposite direction will travel in mixed traffic.
- Traffic signal control and full turning movement access will be maintained at the existing traffic signals on MD 355 at Odendhal Avenue, Chestnut Street, and Summit Avenue.
- The existing number of left turn lanes will be maintained on MD 355 at signalized intersections.
- The median guideway design will not provide median breaks at unsignalized intersections to allow left turns to and from side streets.

Given existing property constraints and the desire to minimize property impacts in the focal segment, on-street bicycle facilities are not included in any of the design alternatives.

Mixed Traffic

A mixed traffic BRT design does not technically provide a guideway for the bus to operate in. The bus travels in the general traffic lanes and does not receive exclusivity from the impacts of congestion associated with traffic. This alternative is not assumed to require construction or improvements in the focal segment, except to construct stations. As part of the larger BRT system, the bus will likely receive signal priority along the corridor within the mixed traffic segments, but this benefit is limited because the bus can go no faster than the surrounding traffic. Consideration for how the bus will transition from a dedicated guideway to mixed traffic operations is important to provide for seamless bus operation. Stations within the focal segment would need to be located at curbside.

This design alternative would result in no property impacts associated with the guideway within the focal segment. Curbside station platforms may require some additional right-of-way. With no impact to the roadway cross-section, this alternative would have no impact on traffic diversions, intersection operations, or roadway capacity. BRT operations for this alternative would be limited by traffic conditions, with peak period traffic conditions degrading bus speeds.

Lane Repurposing

The lane repurposing guideway design seeks to provide an improved bus experience by converting existing general traffic lanes to exclusive bus lanes to reduce road widening. This alternative modifies the number of vehicle travel lanes on the road to minimize the need for roadway widening and reduce impacts to adjacent properties. To achieve reduced roadway widening and property impacts, the roadway design layout eliminates the following vehicle travel lanes:

- One southbound travel lane on MD 355, between Odendhal Avenue and Chestnut Street
- One northbound travel lane on MD 355, between Summit Avenue and Brookes Avenue

Due to the loss of general traffic lanes, the lane repurposing alternative results in traffic diversions onto Perry Parkway and Russell Avenue. This concept would result in significantly elevated southbound vehicle delay, queuing, and congestion during the weekday morning peak period. The intent to provide exclusive bus lanes and maintain existing turning lane geometry under this alternative is likely to result in some localized roadway widening at signalized intersections. Bus operations would be improved over the mixed traffic alternative but still restricted due to the narrow lanes and minimal separation between the bus lanes and general purpose lanes.

Single-lane Median Guideway

The single-lane median guideway represents an attempt to provide BRT operational functionality for the corridor, but also responds to the need for greater roadway widening associated with the dual-lane alternatives. The use of a single-lane guideway results in some impacts to BRT operations by virtue of minimizing the number of bus lanes to save property impacts.

Two operational models can be utilized with the single-lane guideway. The lane could be reversible, only allowing buses traveling in one direction to take advantage of the exclusivity from general traffic. Buses traveling in the other direction would need to travel in general traffic. This is typically done along corridors where the traffic peaks directionally, resulting in heavier volumes in one direction in the morning and the other direction in the evening. The other operating alternative involves buses traveling within the guideway in both directions at all times. This arrangement requires greater coordination of schedules and signals to ensure that two buses traveling in opposite directions do not conflict within the guideway. Limitations of this operating model include service frequency and the length of the segment under consideration. At this time, a preferred operating model has not been selected.

Three separate design variations were evaluated for the single-lane median guideway treatment similar to the dual-lane alternatives. These include standard, minimum, and reduced impact variations of the roadway design to incorporate the BRT guideway. Each variation provides a single-lane median guideway separated from adjacent traffic lanes, but various design attributes, such as lane and BRT median separator widths, were adjusted in each variation to provide a range of design options for review. Copies of all the single-lane median design layout concepts are included in Appendix B.

All three single-lane median guideway alternatives result in some level of traffic diversion onto Perry Parkway and Russell Avenue, with the greatest diversion associated with the reduced impact alternative, which eliminates some existing general traffic lanes. Both the standard and minimum alternatives provide for acceptable levels of service for the signalized intersections and roadway capacity. The reduced impact alternative provides a slightly improved intersection level of service associated with the greater traffic diversion, but the southbound roadway capacity is highly constrained. The standard and minimum alternatives also results in reconstruction of Father Cuddy Bridge and multiple property impacts. BRT operations are

improved for the buses traveling in the guideway. A limitation of the bi-directional model is the frequency the buses can operate.

Dual-lane Median Guideway

The dual-lane median guideway represents the highest level of BRT operational functionality for the corridor, entailing the greatest degree of roadway widening to both construct the guideway and maintain existing traffic capacity on the corridor. The City of Gaithersburg intends to support dual-lane median guideway on MD 355 outside of the focal segment, and consistency in the BRT design throughout the city is generally preferred.

Three separate design variations were evaluated for the dual-lane median guideway treatment on the MD 355 focal segment. These include standard, minimum, and reduced impact variations of the roadway design to incorporate the BRT guideway. Each variation provides a dual-lane median guideway separated from adjacent traffic lanes, but various design attributes, such as lane and BRT median separator widths, were adjusted in each variation to provide a range of design options for review. Copies of all the dual-lane median design layout concepts are included in Appendix B.

Similar to the single-lane guideway, all three dual-lane median guideway alternatives result in some level of traffic diversion onto Perry Parkway and Russell Avenue, with the greatest diversion associated with the reduced impact alternative. Both the standard and minimum alternatives provide for acceptable levels of service for the signalized intersections and roadway capacity. The reduced impact alternative provides a slightly improved intersection level of service associated with the greater traffic diversion, but the southbound roadway capacity is highly constrained. The standard and minimum alternatives also result in reconstruction of Father Cuddy Bridge and have the greatest property impacts. All of the dual-lane alternatives provide the greatest level of bus operations because buses can travel in both directions, simultaneously, within the guideway.

Hybrid Design Alternative

The MD 355 corridor from Odendhal Avenue to Summit Avenue is not consistent in design and character. These differences suggest that combining attributes of the previously-described alternatives may be advantageous for different portions of the focal area. A more concentrated look at the focal study area was conducted to understand whether a blending of more than one alternative could be achieved to provide a greater balance of the benefits and impacts. In identifying the hybrid design the intent was to provide a balance between BRT operations, traffic operations, and property impacts.

The guideway treatments selected for each part of the corridor includes the following:

- Odendhal Avenue to Chestnut Street - Single-lane Median Minimum design
- Chestnut Street to Father Cuddy Bridge - Dual-lane Median Minimum design
- Father Cuddy Bridge - Dual-lane Median Reduced Impact design
- Father Cuddy Bridge to Summit Avenue - Dual-lane Reduced Impact design

A copy of the hybrid alternative design layout concept is included in Appendix B. This concept identifies both building/entire property impacts and potential property impacts associated with the planned roadway geometry.

The hybrid alternative that emerged from a review of those alternatives appears to achieve the greatest balance of BRT operations, traffic impacts, and property impacts throughout the corridor. It produced the lowest impact on traffic operations with minimal traffic diversions onto Perry Parkway and Russell Avenue, while maintaining acceptable levels of service at the signalized intersections. The proposed alternative does not require reconstruction of the Father Cuddy Bridge and reduces the number of impacted properties. Bus operations will require signal coordination with the shortened single-lane median guideway segment. By reducing the length of the single-lane segment, bi-directional operations are more feasible. Bus speeds within the guideway are similar to both the single- and dual-lane guideway alternatives.

Summary

The following table summarizes the outcomes for the different guideway alternatives tested as well as the preferred hybrid alternative. The table provides a comparison of how each of the design alternatives described above scores in terms of traffic impacts, BRT operations, and property impacts. Those alternatives that score well receive a solid circle while those receiving a hollow circle score poorly. Alternatives that fall somewhere between a high score and a low score receive a partially-filled circle, with the partially filled left half being better than the partially filled right half. In addition to the scoring, each alternative's total capital cost is included in the table.

	BRT Operations		Traffic Operations				Property Impacts	Cost ($ million)
	Operating Speed	Stop Locations	Traffic Density/ Congestion	Intersection Capacity	Unsignalized Turning Movements	Land Use Access/ Egress		
Dual-lane Standard	●	●	●	●	○	○	○	$251.6
Dual-lane Minimum	●	●	●	●	○	○	○	$230.0
Dual-lane Reduced	●	●	○	●	○	○	◑	$188.7
Single-lane Standard	◐	◐	●	●	○	○	○	$236.7
Single-lane Minimum	◐	◐	●	●	○	○	◑	$222.9
Single-lane Reduced	◐	◐	○	●	○	○	◐	$181.7
Lane Repurposing	◑	○	○	●	○	○	◐	$183.1
Mixed Traffic	○	◑	◐	●	●	●	●	$156.5
Hybrid Alternative	◐	◐	●	●	○	○	◐	$189.1

● ◐ ◑ ○

Better ⟷ Worse

Station Locations

Stations are the "front door" for any bus rapid transit system. As opposed to bus stops for local bus service, which typically include just a sign on a pole and possibly a shelter, BRT stations often provide an expanded level of amenities, more akin to light rail transit, to further reinforce BRT as a premium transit service. While the scope of this study is not focused on the design of the BRT stations, it is necessary to think about the types of amenities and passenger loads when appropriately sizing the station. BRT stations are typically larger than traditional bus stops to accommodate the increased passenger loads and amenities associated with BRT.

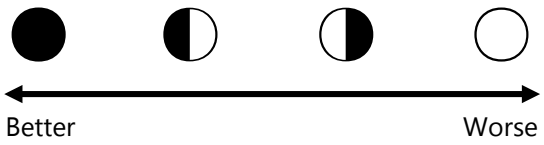
An assessment of potential station locations started with the proposed locations from the *Countywide Transit Corridors Functional Master Plan*. Those stations include the following locations:

- Professional Drive
- Watkins Mill Road
- Montgomery Village Avenue
- Odendhal Avenue
- Brookes Avenue
- Education Boulevard

Through this assessment, significant constructability and accessibility challenges were identified at the Montgomery Village and Brookes Avenue locations. The Montgomery Village Avenue intersection is already a very large intersection with multiple turn lanes and heavy traffic on all approaches. The addition of a station would only further expand the footprint of this intersection, impacting pedestrian accessibility. The Brookes Avenue location is very close to the base of the Father Cuddy Bridge, limiting constructability, potential for future redevelopment, and access. The existing intersection geometry and lack of a traffic signal also present challenges.

Based on this assessment, additional locations were explored and evaluated using consistent criteria. The results for both the CTCFMP stations and additional potential locations are included in the following table:

	Existing Ridership	Land Use	Connectivity	Existing Traffic
Professional Drive	○	◑	◑	●
Travis Avenue/Spectrum Avenue	○	◑	◑	●
Watkins Mill Road	◑	●	●	◑
Christopher Avenue	○	◑	◑	◑
Montgomery Village Drive (MD 124)	○	◑	◑	○
Lakeforest Boulevard	●	●	◑	◑
Odendhal Avenue	●	◑	◑	◑
Chestnut Street/Walker Avenue	●	◑	◑	◑
Brookes Avenue	◑	○	○	○
Cedar Avenue/Fulks Corner Avenue	◑	◑	◑	◑
Summit Avenue	◑	○	◑	◑
Education Boulevard	○	◑	●	●
Deer Park Road	◑	◑	◑	◑
North Westland Drive	◑	◑	◑	◑



The following list of preferred stations is proposed based on the results of the station evaluations:

- Professional Drive
- Watkins Mill Road
- Lakeforest Boulevard/Perry Parkway
- Chestnut Street/Walker Avenue
- Cedar Avenue/Fulks Corner Avenue
- Education Boulevard
- North Westland Drive

The Lakeforest Boulevard/Perry Parkway location provides a preferred alternative to the Montgomery Village Avenue location. This location would center the station on the Lakeforest Mall and surrounding sites, improving redevelopment potential. This location's proximity to Odendhal Avenue eliminates the need for the Odendhal Avenue station. Shifting the Brookes Avenue station north to Chestnut Street improves accessibility for those within the focal segment. An additional station at Cedar Avenue/Fulks Corner Avenue would improve access to Olde Towne Gaithersburg and the MARC train station as well as redevelopment potential. Lastly, the addition of a station at North Westland Drive would provide additional access to BRT in the substantial gap between planned stations at Education Boulevard and Shady Grove Road.

Right-of-Way

The feasibility of the Bus Rapid Transit system in the City of Gaithersburg, and throughout Montgomery County, is dependent on the availability of publicly owned property to construct the planned BRT guideways and maintain appropriate roadway capacity. Any roadway widening required to construct BRT guideways will require the city, county, and/or state to acquire additional property along the corridor.

The concept of right of way for MD 355 is divided into to two categories for portions of MD 355 outside of the focal segment: typical BRT corridor right of way and typical BRT station area right of way. These right of way elements are primarily based on Maryland State Highway Administration dual-lane median BRT guideway and roadway design dimensions. The right of way dimensions developed for portions of the corridor outside of the focal segment include minimum and preferred values. The minimum right of way requirements refer to the least amount of publicly owned property required to accommodate the BRT guideway and maintain existing roadway capacity according to minimum Maryland SHA roadway dimensions. The preferred right of way provides the same BRT and roadway capacity accommodations, but is based on Maryland SHA standard design dimensions.

Design Element	Standard Width (feet)	Minimum Width (feet)
BRT Guideway Lanes	24	22
BRT Median Separators	12	4
General Traffic Lanes	72	66
Bicycle Lanes	10	10
Gutter Pans	6	6
Landscape Buffers	8	0
Sidewalks	12	10
Utility/Maintenance Buffers	4	4
Total Roadway Width	**148**	**122**

The suggested right of way for the MD 355 focal segment is based on the dimensions defined in the planning-level design concepts and typical cross-sections for the hybrid design alternative. The cross-section attributes for the focal segment differ somewhat from the SHA design dimensions as they were developed to accommodate an appropriate BRT guideway, using existing roadway design dimensions to minimize impacts to adjacent properties.

MD 355 Focal Segment Location	Corridor Right of Way Width
Odendhal Avenue to Montgomery Avenue	97 feet
Montgomery Avenue to Chestnut Street	88 feet
Chestnut Street to Father Cuddy Bridge	102 feet
Father Cuddy Bridge	89 feet
Father Cuddy Bridge to Summit Avenue	120 feet

Existing Right of Way

The existing right of way on MD 355 in the City of Gaithersburg varies significantly depending on the location within the corridor. In some locations, the existing public right of way may be sufficient to construct the preferred BRT guideway without acquiring additional property along MD 355. However, the roadway extents throughout much of the MD 355 corridor in the City of Gaithersburg, particularly in the focal segment, have already reached the limits of the existing public right of way.

North and south of the focal area, the MD 355 corridor maintains a relatively uniform right of way width for significant stretches, but gradually increases or decreases at several locations to provide a wider roadway cross-section or accommodate intersection turning lanes. In the focal segment, the right of way is defined by irregular property boundaries and little consistency in the overall right of way dimensions. The existing right of way is extremely irregular from Cedar Avenue/Fulks Corner Avenue to Brookes Avenue. North of Brookes Avenue, the MD 355 right of way is narrowest and very irregular, up to Odendhal Avenue.

Station Considerations

Station locations will require additional right of way beyond the typical BRT corridor or focal segment rights of way suggested in the previous section. The requirements for station area

right of way are based on typical dimensions for station elements and assumptions regarding planned intersection geometry.

Each of the potential BRT station locations was assessed for right of way requirements, based on a combination of the typical BRT corridor right of way for the roadway segment containing the station, the station platform dimensions, and the existing number of turning lanes. The following table summarizes the suggested minimum BRT station area right of way dimensions on MD 355:

MD 355 BRT Station Locations	Station Area Right of Way Width
Professional Drive	180 feet
Watkins Mill Road	205 feet
Lakeforest Boulevard/Perry Parkway	180 feet
Odendhal Avenue	140 feet
Chestnut Street/Walker Avenue	140 feet
Cedar Avenue/Fulks Corner Avenue	140 feet
Education Boulevard	155 feet
North Westland Drive	155 feet

Preferred MD 355 BRT Right of Way

The suggested MD 355 BRT right of way was developed based on a combination of the typical BRT corridor right of way and BRT station area right of way requirements. The typical BRT corridor right of way width is 150 feet and the suggested minimum BRT corridor right of way width is 125 feet, outside of the focal segment. The focal segment typical BRT corridor right of way varies based on the dimensions identified in the hybrid alternative design.

BRT station areas will require significant additional right of way to accommodate station platforms and turning lanes. The additional right of way required at station areas is dependent on the selected BRT guideway and the number of turning lanes provided at each intersection. The additional station area right of way dimensions range from 30 to 80 feet.

To the greatest extent possible, this study attempts to suggest a reasonably consistent and conservative right of way configuration. No detailed design with information regarding the selection of preferred BRT guideways, modifications to the number of intersection turning lanes, or the most appropriate locations to transition roadway cross-sections has been developed for the MD 355 corridor in Gaithersburg at this time. The most appropriate and conservative basis for establishing the preferred right of way is to select dimensions that accommodate the preferred station locations and the hybrid design alternative. To minimize potential confusion for stakeholders or limitations on the detailed design process, transitions between different right of way dimensions along the corridor are limited to critical points where different station right of way requirements abut. The following table summarizes the preferred right of way dimensions for MD 355 in the City of Gaithersburg. Diagrams identifying the suggested right of way limits for the MD 355 corridor, based on the suggested right of way dimensions offset from the roadway centerline, are included in Appendix F.

MD 355 Corridor Segment Location	Suggested Right of Way Width
Game Preserve Road to Paramount Park Drive	180 feet
Paramount Park Drive to 700 feet south of MD 124	205 feet
700 feet south of MD 124 to Odendhal Avenue	180 feet
Odendhal Avenue to 200 feet north of Chestnut Street	110 feet
200 feet north of Chestnut Street to 400 feet south of Summit Avenue	140 feet
400 feet south of Summit Avenue to O'Neill Drive	155 feet

The preferred right of way suggestions included in this study are intended for consideration and adoption by the City of Gaithersburg to complete concept planning and detailed design for the MD 355 corridor. During the detailed design process, some station intersections could be designed to achieve the minimum standards for station platform design or accommodate fewer turning lanes based on anticipated shifts in future traffic volume. Such modifications would reduce the necessary right of way to achieve the BRT system design and could ultimately reduce the amount of property required for public acquisition prior to construction.

The preferred ROW values provide reasonable and balanced flexibility for detailed design of the BRT system. The City of Gaithersburg may want to consider more detailed evaluations of individual station locations and assess potential designs that require less real estate to support adequate BRT and roadway infrastructure.

1

Existing Conditions

1.1 Introduction

The City of Gaithersburg is one the Maryland's largest cities, located in Montgomery County. The City is home to approximately 66,000 residents and is comprised of a mixture of small-scale urban and suburban residential, commercial, and office uses.[1] Gaithersburg is home to the National Institute of Standards and Technology (NIST) as well as a number of biotech firms.[2]

In response to growing traffic congestion, Montgomery County has proposed the development of a Rapid Transit System (RTS) also known as BRT, along key corridors. The proposed BRT system provides dedicated lanes for premium bus service along all or a portion of identified corridors. Two of the proposed corridors would travel through the City. The Corridor Cities Transitway (CCT), A Maryland Transit Administration (MTA) project, would connect Clarksburg to the Shady Grove Metro Station. The route would travel through the City, connecting the Metropolitan Grove MARC station, NIST, and the Kentlands. This project is in the design phase. The second BRT line in the City is the MD 355, Frederick Avenue, corridor, which would connect Clarksburg to Bethesda. This project would introduce BRT to the 5-mile segment of MD 355 within the City of Gaithersburg. The entire 23-mile corridor is currently being studied by the Maryland State Highway Administration (SHA). The County's planning for the MD 355 BRT envisions it operating within a busway.

A Montgomery County Department of Transportation (MCDOT) study determined that the MD 355 corridor had the second highest concentration of transit trips within the County. These were focused on the approaches to Metro stations, and around Lakeforest Mall.[3] This

[1] Source: City of Gaithersburg. *Profile and History*. Retrieved on May 7th, 2015, from http://www.gaithersburgmd.gov/about-gaithersburg/profile-and-history.
[2] Source: City of Gaithersburg Office of Economic Development. *Major Employers*. Retrieved on May 7th, 2015, from http://www.growgaithersburg.com/business-community/major-employers.
[3] Source: *Demand and Service Planning Report to Montgomery County DOT*, Institute for Transportation and Development Policy, December 2012.

finding highlights the importance of providing high quality transit along the MD 355 corridor and the concentration of transit trips within the City of Gaithersburg

The Montgomery County Council approved and adopted the *Countywide Transit Corridors Functional Master Plan* (CTCFMP) in December 2013. The plan recommends an 11 corridor, 102-mile bus rapid transit network. The plan is focused on increasing person throughput within the proposed master plan right-of-way (ROW) to reduce the impact to property owners. The plan recognizes that in order to create a rapid transit network that improves person throughput and shifts people away from driving, the transitways need to be exclusive to transit. The plan does not go so far as to prescribe specific treatments to any segment, leaving those decisions instead to later study effort. The ROW within the City was not prescribed by the County planning report, but the segments to the north was listed at 250 feet and 150 feet to the south.[4]

Previous planning efforts have proposed multiple station locations along MD 355 in the City of Gaithersburg. Locations that have been proposed include: Watkins Mill Road, MD 124, Odendhal Avenue, Brookes Avenue, and Education Boulevard. These locations are potential locations and must be in agreement with the City's master plan.

This study will focus on the placement of BRT along the MD 355 corridor within the City of Gaithersburg. While most of the corridor has the available ROW to accommodate a dual-lane dedicated guideway for BRT buses, the segment from Odendhal Avenue to South Summit Avenue is constrained by a narrower right-of-way. This study will examine the one-mile segment from Odendhal to South Summit to determine what level of guideway treatment can be accommodated within the available ROW, and the associated impacts to traffic and transit operations. The entire corridor within the City will also be examined to identify the preferred location for stops and station platforms. The study will also assist the City in determining the appropriate right-of-way necessary for providing BRT along the entire five mile stretch of MD 355 in the City.

1.2 Study Area Location and Character

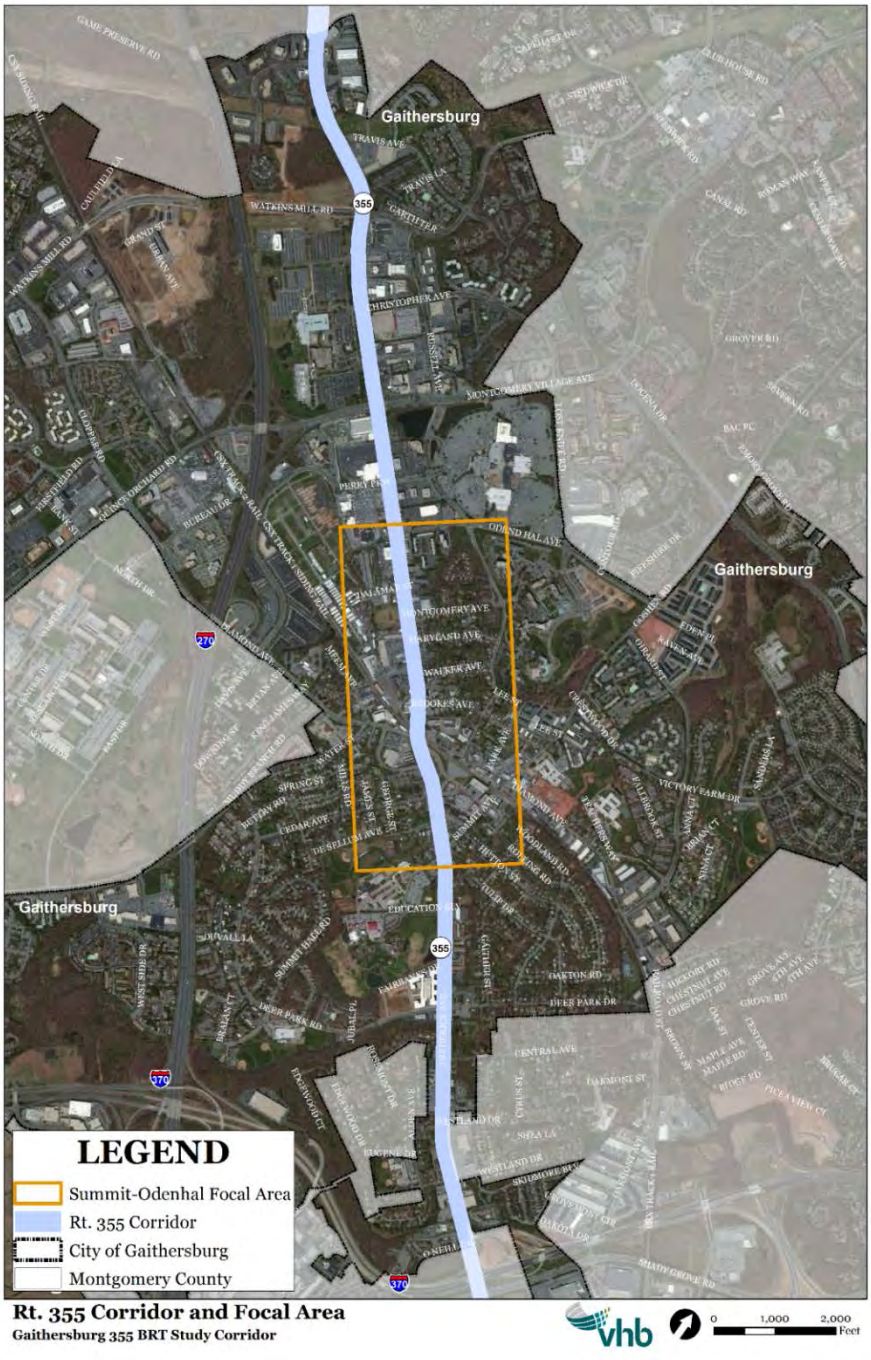
Maryland State Route 355 (MD 355), also known as Frederick Avenue, is the major arterial non-freeway, north-south route through the City of Gaithersburg. MD 355 is generally a conventional suburban roadway, lined by strip malls and office parks in the northern part of the City, and residential neighborhoods to the south. MD 355 carries mainly local traffic; however it is sometimes used as an alternative to I-270 during periods of heavy traffic associated with recurring congestion or traffic incidents. In the City of Gaithersburg, MD 355 contains numerous traffic signals and has a posted speed that ranges from 30 to 45 miles per hour.

The study area for the BRT evaluation includes all of MD 355 within the City of Gaithersburg, with a more detailed focus on the one-mile segment from Odendhal Avenue to South Summit Avenue (Figure 1-1). This segment of MD 355 contains a variety of land uses which exist within several different zoning categories. Opportunities for future redevelopment, including Lakeforest Mall, parcels around Olde Towne, and the Montgomery County Fairgrounds, are

[4] Source: *Approved and Adopted Countywide Transit Corridors Functional Master Plan*, Montgomery County Planning Department M-NCPPC, December 2013.

located near the study area. Redevelopment of Lakeforest Mall and/or the Fairgrounds would significantly increase traffic levels on MD 355. According to the Maryland State Highway Administration's Annual Average Daily Traffic (AADT) Locator, an average of 35,000 vehicles per day, and an average of 37,500 per weekday, drove on this stretch of MD 355 in 2014.[5]

Figure 1-1: MD 355 Corridor and Focal Study Area



The focal study area contains the most constrained segment of MD 355 in the City of Gaithersburg (Figure 1-2). North and south of the focal study area, MD 355 has a much wider

[5] Source: http://shagbhisdadt.mdot.state.md.us/AADT_Locator_Public/

street section with a more generous public ROW. Between Odendhal Avenue and South Summit Avenue, MD 355 is more constrained with a narrower ROW, buildings closer to the road edge, and fewer sections of median. The study area includes the Father Cuddy Bridge, a major bridge over the Amtrak/Brunswick MARC/CSX railroad. The bridge is approximately 90 feet wide, with a small median separation and narrow sidewalks on both sides of MD 355.

Figure 1-2: MD 355 Focal Study Area Parcels and Setbacks

Montgomery County has recommended a ROW of 150 feet for MD 355 both north and south of the City of Gaithersburg and assumed a 120 foot ROW in the City based on an initial planning study for bus rapid transit in the County. The study area corridor has many existing buildings and historic resources located close to, and in many places within, the recommended 120 foot ROW.

1.3 Historic Development Trends

Historically, the development along MD 355 in the study area consists of single parcels that were developed separately, each requiring direct access to MD 355 with little to no physical interconnectivity between parcels. Each parcel supports individual uses, with most commercial and office uses existing in isolation from one another or adjacent residential uses.

There are numerous curb-cuts on MD 355 servicing the various parcels' driveways. The many curb-cuts coupled with narrow, frequently-obstructed sidewalks increase the possibility of likely vehicle-bicycle/pedestrian conflicts. This, combined with the number of small parcels make it challenging to create a unified streetscape, and potentially acquire additional ROW.

There are very limited building setbacks along the focal area, with many buildings extremely close to the road edge. These include an apartment building at 439 North Frederick Avenue, a carpet and tile store at 435 North Frederick Avenue, and an apartment building at 302 North Frederick Avenue. There are several establishments that are directly adjacent to the road/sidewalk edge, including 309 North Frederick Avenue, a bank at 209 North Frederick Avenue, an insurance agency at 201 North Frederick Avenue, and a jewelry shop at 117 North Frederick Avenue. These buildings further limit the available ROW in the study area.

The Historic Preservation Element of the City Master Plan has identified many possible historic resources along this segment of MD 355, including a cemetery in the 300 block and the historic structure on the Wilson Property near the corner of DeSellum Avenue and South Frederick Avenue. These properties create additional challenges in achieving a desirable ROW for expanded transit.

1.4 MD 355, Frederick Avenue, Corridor Conditions and Roadway Characteristics

North and south of the focal study area, MD 355 is a six-lane divided roadway with separate left turn lanes at major intersections. Some signalized intersections on MD 355 in the City of Gaithersburg have enough ROW for multiple exclusive left turn lanes.

Within the focal area, several discrete segments of the MD 355 corridor can be characterized separately. Figure 1-3 identifies four separate regions of the corridor with similar characteristics, and highlights a variety of segment attributes and issues. These segments are from Odendhal to Chestnut, Chestnut to the Father Cuddy Bridge, the Father Cuddy Bridge,

and the Father Cuddy Bridge to South Summit. Three key intersections are the signalized intersections at Odendhal, Chestnut, and South Summit.

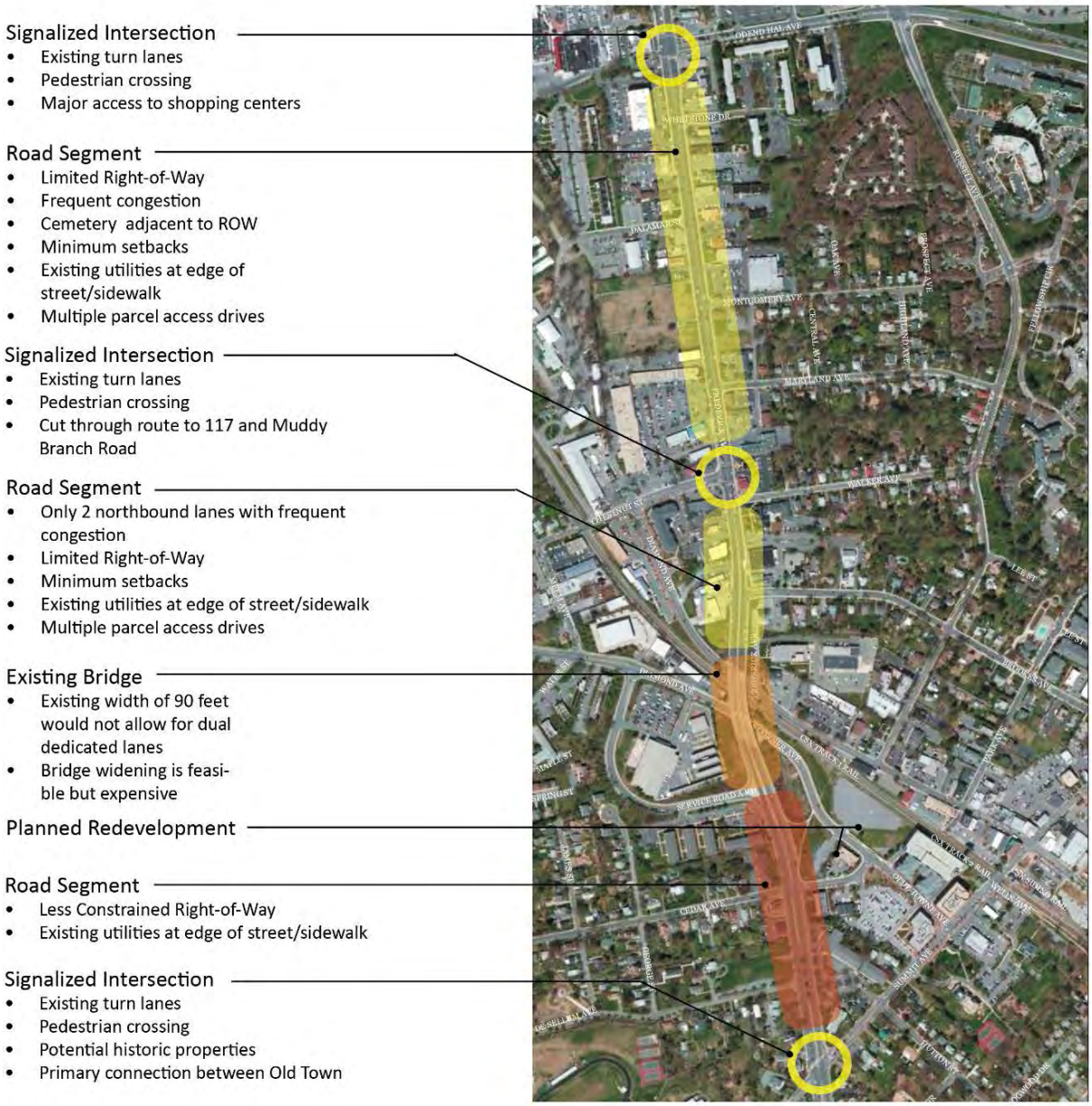


Figure 1-3: Focal Study Area and Summary of Issues

MD 355 from Odendhal Avenue to Chestnut Street

The MD 355 roadway layout between Odendhal Avenue and Chestnut Street is characterized by its relatively narrow cross-section and the presence of numerous commercial/private driveways. The roadway is approximately 60 feet wide in this section, providing two northbound lanes, three southbound lanes, and a continuous two-way left-turn lane (TWLTL), sometimes referred to as a shared left-turn lane. The constrained cross-section and active commercial activity contribute to greater traffic congestion in this segment relative to other parts of the corridor. The roadway maintains a very straight alignment and ascends gently from north to south through this section. Relatively narrow sidewalks are provided immediately adjacent to the roadway on both sides of the street. Marked pedestrian crossings of MD 355 are only provided at the intersections of Odendhal Avenue and Chestnut Street. Utility poles are located directly beside the sidewalk on both sides of the street. In some instances, utility and traffic signal poles are located within the sidewalk.

(Above) Looking south along MD 355 south of Odendhal Avenue

(Left) Looking south along MD 355 showing utility poles in the sidewalk

MD 355 from Chestnut Street to Father Cuddy Bridge

MD 355 between Chestnut Street and the Father Cuddy Bridge is a transitional section of the roadway, emerging from the heavily commercial area to the north and curving to accommodate the bridge alignment. The roadway is approximately 65 feet wide in this section, providing two northbound lanes and two southbound lanes with an approximately six-foot wide raised median extending to just north of Brooks Avenue. The roadway begins to widen to the south, providing an additional southbound right-turn lane over the Father Cuddy Bridge. Sidewalks are provided immediately adjacent to the roadway on both sides of the street. The effective width of the sidewalks in this segment are still impacted by utilities, planting strips, and other street furniture. Overhead utility poles transition away from the roadway as they approach the Father Cuddy Bridge.

(Top-left) Looking north along MD 355 south of Chestnut Avenue

(Bottom-left) Looking north along MD 355 showing the effective width of the sidewalk

Father Cuddy Bridge (MD 355)

On the Father Cuddy Bridge, MD 355 maintains an approximately 76 foot wide curb-to-curb width. The bridge accommodates three northbound lanes and three southbound lanes and a four-foot wide median. The outside lanes in both directions are designated as right turn lanes, with the northbound right lane terminating at Brookes Avenue and the southbound right lane providing access to MD 117, West Diamond Avenue. Sidewalks are provided immediately adjacent to the roadway on both sides of the street. The sidewalks along the bridge are narrow at five feet wide. The bridge was designed with a curved alignment and a super-elevated cross-slope, resulting in the west edge of the bridge being elevated several feet higher than the east edge of the bridge to minimize the potential for drivers to lose control along the curved roadway section.

(Above) Looking north along MD 355 at the Father Cuddy Bridge

(Left) Looking south along MD 355 showing the five foot sidewalks along the bridge

MD 355 from Father Cuddy Bridge to South Summit Avenue

South of the Father Cuddy Bridge, MD 355 transitions into a more traditional suburban major arterial roadway, with a six-lane median-divided roadway with three through lanes per direction. The roadway width is approximately 92 feet and exclusive left turn lanes are provided in the median south of the bridge. Here, the sidewalk on the northbound side of MD 355 is separated from the roadway edge by a two-foot landscape buffer. The southern end of this road segment is immediately adjacent to Olde Towne Gaithersburg and close to Gaithersburg High School.

(Top-left) Looking south along MD 355 at the intersection with Cedar Avenue

(Bottom-left) Looking north along MD 355 showing utilities in the sidewalk near South Summit Avenue

1.5 Key Intersections

MD 355 at Montgomery Village Avenue

The intersection of MD 355 at Montgomery Village Avenue (MD 124), just to the north of the focal study area, is regularly identified as one of the most congested in Montgomery County. Although this intersection is outside of the focal area, this intersection plays a significant role in the traffic patterns of MD 355 in the City of Gaithersburg. The planned construction of the Watkins Mill Road interchange on Interstate 270 by SHA, just to the north of this intersection, will have a major impact on local area traffic patterns, including the focal area, and may provide added flexibility for traffic movement. Although the future interchange is north of the focal area, the City of Gaithersburg and the MD 355 corridor, as a whole, should benefit from additional access to Interstate 270.

MD 355 at Odendhal Avenue

Odendhal Avenue terminates at a signalized intersection with MD 355. Odendhal Avenue connects MD 355 to Lakeforest Mall, and the Lakeforest Transit Center. The intersection of MD 355 at Odendhal Avenue is the northern-most intersection in the focal study area. North of this intersection, MD 355 is a six lane roadway divided by a concrete median, with space for exclusive left turn lanes. South of this intersection, MD 355 is a six lane undivided roadway with three southbound through lanes, two northbound through lanes and a center continuous two-way left-turn lane. This intersection has a high volume of motorists making the left turn movement from Odendhal Avenue onto southbound MD 355 during both the morning peak period (529 vehicles) and evening peak period (332 vehicles). There is a gas station exit on the western side of the intersection that is controlled by the same traffic signal. This intersection experiences frequent congestion, especially in the northbound direction during the evening peak period. On westbound Odendhal Avenue, there is a bus stop with a shelter for Ride On bus routes 55 and 59.

(Left) Looking south along MD 355 at the intersection with Odendhal Avenue

MD 355 at Chestnut Street

Chestnut Street terminates at a signalized intersection with MD 355. This roadway connects the MD 355 Corridor to Muddy Branch Road and southwestern Gaithersburg and North Potomac. It also connects the corridor to Olde Towne Gaithersburg and nearby Washington Grove via East Diamond Avenue. Chestnut Street has an at-grade crossing of the Amtrak/Brunswick MARC/CSX railroad about 750 feet southwest of MD 355. The intersection of MD 355 at Chestnut Street has a high volume of motorists making the right turn movement from southbound MD 355 onto Chestnut Street during the morning peak period and the left-turn movement from Chestnut Street onto northbound MD 355 during the evening peak period, with vehicle stacking often extending back to East Diamond Avenue. The alignment of MD 355 shifts slightly to the west of this intersection.

(Left) Looking south along MD 355 at the intersection with Chestnut Avenue

MD 355 at South Summit Avenue

The intersection of MD 355 at South Summit Avenue is the southern-most intersection in the focal study area. At this intersection, MD 355 is a six-lane divided roadway with exclusive left turn lanes. There is a lane drop on the northbound MD 355 approach to the intersection as the right lane must turn right onto South Summit Avenue. Gaithersburg High School lies west of this intersection with access from South Summit Avenue. Summit Avenue connects MD 355 to Olde Towne Gaithersburg and Midcounty Highway. At this intersection, there are two exclusive left turn lanes and a shared through-left turn lane from South Summit Avenue onto southbound MD 355. Just north of this intersection on northbound MD 355, there is a bus stop with shelter for Ride On route 55.

(Left) Looking north along MD 355 at the intersection with South Summit Avenue

1.6 Traffic Operations

MD 355 in the City of Gaithersburg is a heavily-traveled commuter and commercial/office corridor. MD 355 is a major arterial roadway, providing a parallel and alternative commuter route to I-270 between upper Montgomery County and the District of Columbia. In the City of Gaithersburg, several other major regional roadways, including MD 124 (Quince Orchard Road/Montgomery Village Avenue) and MD 117 (West Diamond Avenue), as well as numerous local collector and minor collector roadways intersecting MD 355. The regional commuter activity contributes to elevated traffic volume traveling within the city during the typical weekday morning and evening commuter peak periods.

North of the Father Cuddy Bridge, MD 355 is lined by small and medium-sized commercial and office parcels. Additionally, the Lakeforest Mall is located just east of MD 355, at MD 124. The commercial and office land uses proximate to MD 355 contribute to significant localized trip activity during both weekday and weekend peak periods.

Traffic signals on MD 355 were designed to accommodate large volumes of through traffic and operate in a coordinated system. Operations at several major signalized intersections on MD 355 have historically been impacted by limited roadway capacity and significant turning movement traffic volumes during the peak travel periods. Signalized intersections on MD 355 typically provide separate left-turn lanes to minimize delay for through traffic, and several major signalized intersection provide either dual or triple left turn lanes (MD 124) on one or more approaches.

Several recent traffic studies in the City of Gaithersburg, including the 2011 "*Midcounty Corridor Traffic Study*" and the 2013 "*Frederick Avenue Corridor and Vicinity Development Capacity Study*", have identified the level of service at signalized intersections on MD 355. These studies indicate that traffic operations on MD 355 are most congested during the weekday evening peak period, when regional commuter traffic traveling north overlaps localized commercial and office trips in the City of Gaithersburg. The MD 355 intersection with MD 124 (Montgomery Village Avenue/Quince Orchard Road) is considered to be one of the

busiest intersections in the entire county and operates at failing levels of service during all peak periods.

The focal area for the BRT feasbility evaluation is the portion of MD 355 between Odendhal Avenue and South Summit Avenue. Traffic operations results from recent traffic studies for signalized intersections in the focal area are summarized in Table 1-1. These results include the critical lane volume (CLV), which is a measure of capacity of an intersection, and the related level of service (LOS) results. The City's standard for CLV is 1,450, and none of the intersections in the table below exceed that standard.

Table 1-1: MD 355 Focal Area Existing Traffic Operations Summary

Location	Weekday AM Peak Hour		Weekday PM Peak Hour	
	CLV	LOS	CLV	LOS
MD 355 at Odendhal Avenue	1,088	B	927	A
MD 355 at Chestnut Street	931	A	825	A
MD 355 at South Summit Avenue	889	A	880	A

These results suggest the focal area intersections currently operate at generally acceptable levels of service during the critical weekday commuter peak periods. These results provide a baseline condition for comparison with traffic operations analyses accounting for future traffic projections and the proposed BRT system.

1.7 Public Transportation

Local Service

Public bus transit service in the City of Gaithersburg is provided by Ride On, operated by Montgomery County; and by Metrobus, operated by the Washington Metropolitan Area Transit Authority. Ride On maintains 13 routes within the City. Two Metrobus express lines operate in the City with direct connections from the regional transit center located at Lakeforest Mall to the Shady Grove Metro Station. The Lakeforest Regional Transit Center stop is located near the intersection of Lost Knife Road and Odendhal Avenue, approximately a half mile from the study area. The transit center supports seven Ride On routes and two Metrobus routes and provides 300 free parking spaces.

MD 355 between Odendhal Avenue and South Summit Avenue is currently served by Ride On Routes 55 and 59, with service to Lakeforest Transit Center, and Rockville and Shady Grove Metrorail stations. There are several bus stops with shelters along the corridor, including northbound and southbound MD 355 at Brooks Avenue, southbound MD 355 at Cedar Avenue and northbound MD 355 at South Summit Avenue.

1.8 Summary of Findings

A review of the existing roadway design and traffic operations for the MD 355 corridor in the City of Gaithersburg highlights some challenges that will require attention as the right approach to incorporating BRT into the corridor is considered. While the existing traffic operations within the focal study area from Odendhal to South Summit currently operate at acceptable levels of service, there are other intersections along MD 355 in the City that do not. The BRT design decisions that are made in the focal study area will likely have impacts that stretch beyond this one-mile stretch of MD 355. Understanding those impacts, as well as the potential impacts for nearby alternative routes, will be critical to choosing the right BRT treatment to meet the City's needs as well as the larger BRT corridor goals.

The existing suburban commercial development along the corridor present challenges to the range of BRT treatments that can be considered. The numerous business driveways along the corridor require the current two-way left turn lane. Considering those conditions when identifying potential BRT treatments is critical to limit adverse impacts to current businesses. However, the overriding goal of BRT is to provide a level of transit service that can promote future economic growth.

The initial BRT planning studies for bus rapid transit along the MD 355 corridor did not determine the type of transitway that could be accommodated within the City of Gaithersburg. A concept for exclusive guideway has been envisioned, but the impacts to traffic, property owners, and transit operations have not been evaluated. This study seeks to answer the question of what BRT design option for MD 355 provides the best balance between the overall BRT experience, traffic operations throughout the corridor, and impacts to property owners along the corridor.

The next chapters of this report will describe different guideway treatments for BRT; the benefits and impacts of each to existing traffic, properties along the corridor, and transit operations; and which option(s) is best suited for the City of Gaithersburg

2

Bus Rapid Transit Design

2.1 Purpose

The City of Gaithersburg desires to provide a combination of the highest quality design and operational provisions for the bus rapid transit system within the city. Conceptually, the City supports construction of a dual-lane BRT guideway, however, it recognizes that potential constraints on the focal segment of MD 355, between Odendhal Avenue and Summit Avenue may dictate that an alternative guideway treatment or design standard is necessary to achieve an effective design configuration and minimize property impacts adjacent to the roadway. A design evaluation is necessary to evaluate the feasibility of constructing one of several BRT guideway alternatives.

2.2 Focal Segment Conceptual Design Alternatives

Planning-level designs for the BRT on MD 355 in the Gaithersburg focal segment were developed and evaluated to provide critical information regarding the feasibility of each alternative. Sufficient right-of-way can likely be provided to construct a dual-lane median guideway on MD 355 both north and south of the focal segment (from Game Preserve Road to Odendhal Avenue and from Summit Avenue to O'Neill Drive). In response to the narrower right-of-way observed in the focal segment, and the concerns related to potential property impacts, several other alternatives were evaluated for the focal segment. These alternatives may address some property concerns, but introduce operational and functional changes that will need to be weighed against the lower impact to properties along the corridor. These tradeoffs will be documented in more detail with each alternative.

The four alternative BRT guideway options considered for the focal segment include:

- Dual-lane Median Guideway
- Single-lane Median Guideway
- Lane Repurposing
- Mixed Traffic

The Maryland State Highway Administration has defined a range of design criteria for median BRT guideways (Appendix A) and this range was applied to both the dual-lane and single-lane median guideway in the Gaithersburg focal segment. Each of these sub-alternatives represent different degrees of operational enhancement for the corridor, as well as encroachment on the adjacent properties for the dual- and single-lane median guideway alternatives. The name of each version reflects the scale of the design:

- Standard Design Dimensions - Uses SHA's preferred design criteria
- Minimum Design Dimensions - Uses SHA's minimum design criteria
- Reduced Impact Dimensions - Uses SHA's minimum design criteria, but also seeks to reduce impacts further by applying changes to existing lane configurations and sidewalk widths

Design layouts were produced for each of the BRT guideway alternatives at a conceptual level using aerial base mapping for the MD 355 focal segment; Gaithersburg, Montgomery County, and SHA GIS data; and the preliminary Gaithersburg BRT guideway cross-section dimensions (Appendix B). No detailed field survey has been conducted to identify existing roadway limits, property boundaries, building locations, utilities, or any other existing roadway design feature.

The design layouts are intended to provide a planning-level visualization of the potential roadway and BRT guideway alignment on the corridor, identify probable impacts, and provide a basis for estimating costs. The layouts illustrate the BRT guideway treatment, potential roadway alignment, intersection geometries, and roadway widening impacts on adjacent properties. The following sections describe each of the Gaithersburg MD 355 BRT design alternatives and their design implications in detail. Copies of the design layout concepts are included in Appendix B.

Where the planned roadway geometry shown on the design layout drawings exceeds the existing adjacent property boundaries, private property within the extents of the roadway envelope will need to be acquired as public property. The design layouts included in Appendix B highlight two types of significant property impacts: Building/Entire Property Impacts and Potential Building Impacts. Building/Entire Property Impacts refer to locations where the planned roadway geometry for a specific alternative will encroach on an existing building, which will likely necessitate dedication or acquisition of the entire property as public land. Potential Building Impacts refer to locations where the planned roadway geometry for a specific alternative could be located within five feet of an existing building. These are labeled "potential" impacts because the roadway or sidewalk design could possibly be modified during the detailed design process to adequately avoid impacting these building. On the design layout diagrams included in Appendix B, the Building/Entire Property Impacts are identified by purple shading, including a dashed purple outline around the entire property boundary, and the Potential Building Impacts are identified with blue shading.

Several design assumptions are common to all of the BRT design alternatives for the focal segment. These assumptions include the following:

- A BRT station will be located at the MD 355/Odendhal Avenue intersection
- A median station at Odendhal Avenue will provide far-side platforms, allowing BRT vehicles to travel through the traffic signal prior to stopping at the station.

- The single-lane guideway will operate with BRT vehicles using the guideway only in the peak direction, and BRT vehicles traveling in the opposite direction will travel in mixed traffic.
- Traffic signal control and full turning movement access will be maintained at the existing traffic signals on MD 355 at Odendhal Avenue, Chestnut Street, and Summit Avenue.
- The existing number of left turn lanes will be maintained on MD 355 at signalized intersections.
- The median guideway design will not provide median breaks at unsignalized intersections to allow left turns to and from side streets.
- Given existing property constraints and the desire to minimize property impacts in the focal segment, on-street bicycle facilities are not included in any of the design alternatives.

The roadway design layouts identify buildings that are likely to be significantly impacted by the roadway design. This is defined as buildings located within three feet of the proposed roadway edge. The layouts also identify buildings that are possibly impacted by the roadway design, where sidewalks still encroach on the buildings; however, these building impacts may be avoided through localized modifications to the sidewalk design intended to preserve the existing building. These roadway design layouts are conceptual, based on design assumptions developed specifically for the focal segment. Detailed roadway design will be required to determine a final roadway layout and define the actual degree of building or property impacts associated with the BRT in the City of Gaithersburg.

Dual-Lane Median Guideway Design

The dual-lane median guideway represents the highest level of BRT operational functionality for the corridor, entailing the greatest degree of roadway widening to both construct the guideway and maintain existing traffic capacity on the corridor. The City of Gaithersburg intends to support dual-lane median guideway on MD 355 outside of the focal segment, and consistency in the BRT design throughout the city is generally preferred.

Three separate design variations were evaluated for the dual-lane median guideway treatment on the MD 355 focal segment. These include standard, minimum, and reduced impact variations of the roadway design to incorporate the BRT guideway. Each variation provides a dual-lane median guideway separated from adjacent traffic lanes, but various design attributes, such as lane and BRT median separator widths, were adjusted in each variation to provide a range of design options for review. Copies of all the dual-lane median design layout concepts are included in Appendix B.

Dual-lane Median Guideway Standard Design Alternative

The dual-lane median guideway standard design is characterized by a roadway cross-section that provides preferred guideway lane widths (12 feet) and BRT median separator widths (six feet). Additionally, this alternative assumes that wide sidewalks and landscape buffers will be provided on both sides of the street.

A design layout drawing for this alternative is provided in Appendix B and identifies both building/entire property impacts and potential property impacts associated with the planned

roadway geometry. This design exceeds the existing roadway width and property boundaries throughout the corridor. The design layout indicates that portions of most properties along MD 355, from Odendhal Avenue to the Father Cuddy Bridge, will need to be acquired to achieve this design, and the roadway edge will encroach on several existing buildings between Odendhal Avenue and Chestnut Street. Even where buildings aren't significantly impacted, off-street parking on several properties appears to be affected. The roadway design also encroaches on a portion of the cemetery on the west side of MD 355 south of Dalamar Street, requiring acquisition of a property sliver along the roadway edge. Table 2-1 summarizes the number of buildings significantly impacted, buildings possibly impacted, and private parking lots significantly impacted, by the dual-lane median guideway standard design alternative.

Table 2-1: MD 355 Focal Segment – Dual-lane Guideway Standard Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	2	1	0	1	5	4
Chestnut Street to Father Cuddy Bridge	1	0	1	2	0	1
Father Cuddy Bridge to Summit Avenue	0	0	0	1	1	0
Total Buildings/Properties	**3**	**1**	**1**	**4**	**6**	**5**

The design layout will require widening of the Father Cuddy Bridge to accommodate the eight travel lanes (six general traffic and two busway), BRT median separators (6 feet), and planned sidewalks (10 feet) specified. The existing bridge includes both a horizontal curve and super-elevation, which means the bridge has an angled cross-slope to reduce lateral vehicle drifting while traveling along the curve. As a result of these design attributes, any widening of the Father Cuddy Bridge likely will require full reconstruction of the bridge to provide adequate structural design and minimize potential railroad and roadway clearance conflicts below the bridge span.

On both the north and south sides of the Father Cuddy Bridge, the dual-lane median guideway standard design layout encroaches on steep roadside slopes. Significant retaining walls would need to be constructed (or reconstructed) on both sides of the road, north and south of the bridge, to support the design.

The dual-lane median guideway standard design would allow preferred BRT operations by providing two 12 foot bus lanes to allow buses traveling in both directions to operate unencumbered from interference from general traffic (except at intersections). Travel speeds along the corridor would be improved over existing bus service operating in the corridor. It is estimated that buses operating within a dual-lane median guideway standard design could maintain an average speed between 18 and 22 miles per hour, depending on time of day. The dual-lane guideway design allows for BRT station platforms to be constructed on both sides to serve each direction of travel. Stations can also be constructed on opposite sides of the intersection, improving BRT operations by providing far-side stops, and reducing the overall footprint within the intersection.

Dual-lane Median Guideway Minimum Design Alternative

The Dual-lane Guideway Minimum design is characterized by a roadway cross-section that provides the minimum guideway lane width (11 feet) and BRT median separator widths (two feet). This alternative assumes that sidewalks, but no landscape buffers, will be provided on both sides of the street.

A design layout drawing for this alternative is provided in Appendix B and identifies both building/entire property impacts and potential property impacts associated with the planned roadway geometry. This design generally exceeds the existing roadway width and property boundaries along the northern portion of the corridor. The design layout indicates that portions of many properties along MD 355, from Odendhal Avenue to the Father Cuddy Bridge, will need to be acquired to achieve this design, and the roadway edge will encroach on several existing buildings between Odendhal Avenue and Chestnut Street. Even where buildings aren't significantly impacted, off-street parking on several properties appears to be affected. The roadway design avoids direct impacts to the cemetery on the west side of MD 355 south of Dalamar Street. Table 2-2 summarizes the number of buildings significantly impacted, buildings possibly impacted, and private parking lots significantly impacted, by the Dual-lane Guideway Minimum design alternative.

Table 2-2: MD 355 Focal Segment – Dual-lane Guideway Minimum Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	2	0	0	1	3	1
Chestnut Street to Father Cuddy Bridge	1	0	0	0	0	1
Father Cuddy Bridge to Summit Avenue	0	0	0	0	1	0
Total Buildings/Properties	**3**	**0**	**0**	**1**	**3**	**2**

Similar to the dual-lane median standard design the minimum design will require widening of the Father Cuddy Bridge to accommodate the eight travel lanes (six general traffic and two busway), BRT median separators (2 feet), and planned sidewalks (10 feet) specified. This expansion of the bridge will likely require a full reconstruction of the bridge. Additionally, retaining walls would need to be constructed (or reconstructed) to address the widening as well.

The dual-lane median guideway minimum design would allow reasonable BRT operations by providing two 11 foot bus lanes to allow buses traveling in both directions to operate unencumbered from interference from general traffic (except at intersections). Travel speeds along the corridor would be similar to those estimated for the standard design alternative, allowing the bus to maintain an average speed between 18 and 22 miles per hour, depending on time of day. This design alternative provides the same station benefits as the standard design alternative.

Dual-lane Median Guideway Reduced Impact Design Alternative

The dual-lane guideway reduced impact design is characterized by a roadway cross-section that provides the minimum guideway lane width (11 feet) and BRT median separator widths (two feet). This alternative modifies the number of vehicle travel lanes and sidewalk widths to minimize the need for roadway widening and reduce impacts to adjacent properties. To achieve reduced roadway widening and property impacts, the roadway design layout eliminates the following vehicle travel lanes:

- One southbound travel lane on MD 355, between Odendhal Avenue and Chestnut Street
- One northbound travel lane on MD 355, between Cedar Avenue/Fulks Corner Avenue and Brookes Avenue

A design layout drawing for this alternative is provided in Appendix B and identifies both building/entire property impacts and potential property impacts associated with the planned roadway geometry. This design still exceeds the existing roadway width and encroaches on some existing property boundaries because the existing intersection geometries are maintained at the signalized intersections, particularly along the northern portion of the corridor. The design layout avoids encroaching on properties wherever possible, but portions of several properties along MD 355 will need to be acquired to achieve this design. The roadway edge may encroach on several existing buildings between Odendhal Avenue and Chestnut Street, but several of these buildings may be retained with localized sidewalk modifications that reduce typical sidewalk width standards. The roadway design avoids direct impacts to the cemetery on the west side of MD 355 south of Dalamar Street and generally minimizes impacts to off-street parking. Table 2-3 summarizes the number of buildings significantly impacted, buildings possibly impacted, and private parking lots significantly impacted, by the dual-lane guideway reduced impact design alternative.

Table 2-3: MD 355 Focal Segment – Dual-lane Guideway Reduced Impact Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	0	0	1	1	0	0
Chestnut Street to Father Cuddy Bridge	0	0	1	0	0	1
Father Cuddy Bridge to Summit Avenue	0	0	0	0	0	0
Total Buildings/Properties	**0**	**0**	**2**	**1**	**0**	**1**

The design layout will require no widening of the Father Cuddy Bridge. In addition to the dual-lane median guideway, two northbound travel lanes and three southbound travel lanes can be accommodated on the bridge without widening. The existing sidewalks, representing the minimum standard sidewalk, are retained. No significant roadway widening is required along the steeply sloped roadside north or south of the bridge, so new retaining walls should not be required.

The dual-lane median guideway reduced impact design would provide for similar BRT operations to the dual-lane median guideway standard and minimum design alternatives. This design would still provide two 11 foot bus lanes to allow buses traveling in both directions to operate unencumbered from interference from general traffic. Buses operating within a dual-lane median guideway reduced impact design could maintain an average speed between 18 and 22 miles per hour, depending on time of day. The reduced impact guideway design provides the same station benefits as the other two dual-lane guideway design alternatives.

Single-Lane Median Guideway Design

The single-lane median guideway represents an attempt to provide BRT operational functionality for the corridor, but also responds to the need for greater roadway widening associated with the dual-lane alternatives. The use of a single-lane guideway does come with some impacts to BRT operations as a result of dropping a bus lane to save property impacts. Two operational models can be utilized with the single-lane guideway. The lane could be reversible, only allowing buses traveling in one direction to take advantage of the exclusivity from general traffic. Buses traveling in the other direction would need to travel in general traffic. This is typically done along corridors where the traffic is peaked, resulting in heavier volumes in one direction in the morning and the other direction in the evening. The other operating alternative involve operating the single lane in both directions. This arrangement requires greater coordination of schedules and signals to ensure that two buses traveling in opposite directions do not occupy the same lane. Limitations of this operating model include service frequency and the length of the segment under consideration. At this time, a preferred operating model has not been selected.

Three separate design variations were evaluated for the single-lane median guideway treatment similar to the dual-lane alternatives. These include standard, minimum, and reduced impact variations of the roadway design to incorporate the BRT guideway. Each variation provides a single-lane median guideway separated from adjacent traffic lanes, but various design attributes, such as lane and BRT median separator widths, were adjusted in each variation to provide a range of design options for review. Copies of all the single-lane median design layout concepts are included in Appendix B.

Single-lane Median Guideway Standard Design Alternative

The single-lane guideway standard design is characterized by a roadway cross-section that provides preferred guideway lane widths (12 feet) and BRT median separator widths (six feet). Additionally, this alternative assumes that wide sidewalks and landscape buffers will be provided on both sides of the street.

A design layout drawing for this alternative is provided in Appendix B and identifies both building/entire property impacts and potential property impacts associated with the planned roadway geometry. This design exceeds the existing roadway width and property boundaries throughout the corridor. The design layout indicates that portions of most properties along MD 355, from Odendhal Avenue to the Father Cuddy Bridge, will need to be acquired to achieve this design, and the roadway edge will encroach on several existing buildings between Odendhal Avenue and Chestnut Street. Even where buildings aren't significantly impacted, off-street parking on several properties appears to be affected. The roadway design avoids

direct impacts to the cemetery on the west side of MD 355 south of Dalamar Street. Table 2-4 summarizes the number of buildings significantly impacted, buildings possibly impacted, and private parking lots significantly impacted, by the single-lane guideway standard design alternative.

Table 2-4: MD 355 Focal Segment – Single-lane Guideway Standard Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	2	0	1	2	4	2
Chestnut Street to Father Cuddy Bridge	1	0	0	0	0	1
Father Cuddy Bridge to Summit Avenue	0	0	0	0	1	0
Total Buildings/Properties	**3**	**0**	**0**	**2**	**5**	**3**

While the single-lane standard design layout provides a narrower curb-to-curb width over the Father Cuddy Bridge compared to the dual-lane standard design, it will still require widening of the Father Cuddy Bridge to accommodate the seven travel lanes (six general traffic and one busway), BRT median separators (6 feet), and planned sidewalks (10 feet) specified. Similarly, retaining walls would need to be constructed (or reconstructed) on both sides of the road, north and south of the bridge, to support the design.

The single-lane median guideway standard design would result in an improvement in bus speeds when compared to existing bus service. However, a reversible busway would only allow buses in a single direction to operate unencumbered from interference from general traffic (except at intersections). Buses operating in the "peak" direction could achieve speeds comparable to those of the dual-lane standard design (18 to 22 miles per hour). In the opposite direction (non-peak), buses would operate in mixed traffic at speeds similar to existing conditions (11 to 15 miles per hour). This operational configuration would provide for improved travel times in the peak travel direction, and slightly improved travel times in the non-peak direction associated with stop spacing and other BRT system improvements. This type of design also requires that the non-peak bus be able to enter and exit the busway in a coordinated way. In this arrangement a southbound bus traveling in the non-peak direction would exit the guideway at Lakeforest Boulevard or Odendhal Avenue (depending on station location) and enter the general traffic lanes. The bus would then reenter the dual-lane busway south of Summit Avenue. The bus will need to receive a priority green signal when exiting the guideway to allow it to enter the general travel lanes.

A second option for BRT operations in a single-lane guideway would be to provide bi-directional bus travel that is coordinated. This operating model adds a level of complexity to bus operations to ensure that buses traveling in opposite directions do not enter the single-lane segment at the same time. Much like rail operations, this is accomplished through vehicle tracking and signal technology. Buses will typically be held at the last station prior to entering the single-lane segment. This operating model places a limitation on how many buses can be process through the single-lane segment in a given period of time, ultimately the BRT

frequency. Assuming that the bus is averaging 20 miles per hour in the busway and the single-lane segment in Gaithersburg is one mile long, it should take approximately three minutes to travel from end to end. Initial planning for the BRT envisions five minute peak frequency for the MD 355 corridor. This level of service should be achievable with this guideway type, but does not leave a lot of room for error. As further design occurs along the MD 355 corridor, operational considerations will need to be factored if a single-lane median guideway is advanced as the preferred alternative for Gaithersburg, or any other segment of the larger BRT corridor.

Station location for the single-lane guideway alternative would either result in curb-side stops along the general traffic lanes in the peak-direction alternative or a design similar to the dual-lane design alternative where stations are constructed on both sides of the guideway if the guideway is bi-directional.

Single-lane Median Guideway Minimum Design Alternative

The single-lane guideway minimum design is characterized by a roadway cross-section that provides the minimum guideway lane width (11 feet) and BRT median separator widths (two feet). This alternative assumes that sidewalks, but no landscape buffers, will be provided on both sides of the street.

A design layout drawing for this alternative is provided in Appendix B and identifies both building/entire property impacts and potential property impacts associated with the planned roadway geometry. This design generally exceeds the existing roadway width and property boundaries along the northern portion of the corridor. The design layout indicates that portions of many properties along MD 355, from Odendhal Avenue to the Father Cuddy Bridge, will need to be acquired to achieve this design, and the roadway edge will encroach on several existing buildings between Odendhal Avenue and Chestnut Street. Even where buildings aren't significantly impacted, off-street parking on several properties appears to be affected. The roadway design avoids direct impacts to the cemetery on the west side of MD 355 south of Dalamar Street. Table 2-5 summarizes the number of buildings significantly impacted, buildings possibly impacted, and private parking lots significantly impacted, by the single-lane guideway minimum design alternative.

Table 2-5: MD 355 Focal Segment – Single-lane Guideway Minimum Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	0	0	1	0	1	1
Chestnut Street to Father Cuddy Bridge	1	0	0	0	0	0
Father Cuddy Bridge to Summit Avenue	0	0	0	0	0	0
Total Buildings/Properties	**1**	**0**	**1**	**0**	**1**	**1**

The widening associated with the single-lane minimum design will require reconstruction of the Father Cuddy Bridge to accommodate the seven travel lanes (six general traffic and one busway), BRT median separators (2 feet), and planned sidewalks (10 feet) specified.

On the east side of the road, both north and south of the Father Cuddy Bridge, the single-lane minimum roadway design layout encroaches on steep roadside slopes. Significant retaining walls would need to be constructed (or reconstructed) along the east side of the road to support the design.

The BRT operations for the single-lane median guideway minimum design would be very similar to the standard design alternative. The busway could operate in a single peak direction with the bus in the opposite direction traveling in mixed traffic, or as a bi-directional operation requiring additional coordination. The estimated bus speeds would be expected to be similar to those of the standard design within the busway (18 to 22 miles per hour). Station locations would be consistent across all the single-lane guideway design alternatives. The configuration is dependent on the operating structure chosen.

Single-lane Median Guideway Reduced Impact Design Alternative

The single-lane guideway reduced impact design is characterized by a roadway cross-section that provides the minimum guideway lane width (11 feet) and BRT median separator widths (two feet). This alternative modifies the number of vehicle travel lanes and sidewalk widths to minimize the need for roadway widening and reduce impacts to adjacent properties. To achieve reduced roadway widening and property impacts, the roadway design layout eliminates the following vehicle travel lanes:

- One southbound travel lane on MD 355, between Odendhal Avenue and Chestnut Street

A design layout drawing for this alternative is provided in Appendix B and identifies both building/entire property impacts and potential property impacts associated with the planned roadway geometry. This design largely conforms to the existing roadway limits, but portions of several properties along MD 355 will need to be acquired at signalized intersections where station platforms or turning lanes are required, particularly along the northern portion of the corridor. The roadway edge encroaches on one existing building at Chestnut Street, but the building may possibly be retained with localized sidewalk modifications that reduce typical sidewalk width standards. The roadway design avoids direct impacts to the cemetery on the west side of MD 355 south of Dalamar Street and generally minimizes impacts to off-street parking. Table 2-6 summarizes the number of buildings significantly impacted, buildings possibly impacted, and private parking lots significantly impacted, by the single-lane guideway reduced impact design alternative.

Table 2-6: MD 355 Focal Segment – Single-lane Guideway Reduced Impact Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	0	0	0	0	0	0
Chestnut Street to Father Cuddy Bridge	0	0	1	0	0	0
Father Cuddy Bridge to Summit Avenue	0	0	0	0	0	0
Total Buildings/Properties	**0**	**0**	**1**	**0**	**0**	**0**

The design layout will require no widening of the Father Cuddy Bridge. In addition to the single-lane median guideway, three northbound travel lanes and three southbound travel lanes can be accommodated on the bridge without widening. The existing sidewalks, representing the minimum standard sidewalk, are retained. No significant roadway widening is required along the steeply sloped roadside north or south of the bridge, so new retaining walls should not be required.

The single-lane median guideway reduced impact design would provide similar BRT operating conditions to the single-lane standard and minimum designs (18 to 22 miles per hour). The other potential impact to travel speed could be the frequency of the service if it operates under a bi-directional guideway configuration. This is a limitation of any of the single-lane alternatives. Station location for this design alternative would be the same as the standard and minimum design alternatives for single-lane guideway design.

Lane Repurposing Guideway Design

The lane repurposing guideway design seeks to provide an improved bus experience by providing exclusive lanes, but at the expense of general traffic lanes to reduce road widening. This alternative modifies the number of vehicle travel lanes on the road to minimize the need for roadway widening and reduce impacts to adjacent properties. To achieve reduced roadway widening and property impacts, the roadway design layout eliminates the following vehicle travel lanes:

- One southbound travel lane on MD 355, between Odendhal Avenue and Chestnut Street
- One northbound travel lane on MD 355, between Summit Avenue and Brookes Avenue

A copy of the lane repurposing design layout concept is included in Appendix B.

Lane Repurposing Guideway Design Alternative

The lane repurposing guideway design is characterized by a roadway cross-section providing the minimum guideway lane width (11 feet) and no median separators between the BRT guideway and the vehicle travel lanes. This design essentially entails pavement marking modifications to the existing roadway to provide two dedicated BRT guideway lanes in the center of the road. The BRT guideway would be separated from vehicular traffic by a buffer

or stripe, potentially including flexible post-mounted delineators to provide physical separation.

This alternative modifies the number of vehicle travel lanes on the road to minimize the need for roadway widening and reduce impacts to adjacent properties. To achieve reduced roadway widening and property impacts, the roadway design layout eliminates the following vehicle travel lanes:

- One southbound travel lane on MD 355, between Odendhal Avenue and Chestnut Street
- One northbound travel lane on MD 355, between Summit Avenue and Brookes Avenue

A design layout drawing for this alternative is provided in Appendix B and identifies both building/entire property impacts and potential property impacts associated with the planned roadway geometry. This design largely conforms to the existing roadway limits, but portions of several properties along MD 355 will need to be acquired at signalized intersections where station platforms or turning lanes are required, particularly along the northern portion of the corridor. The roadway edge encroaches on one existing building at Chestnut Street, but the building may possibly be retained with localized sidewalk modifications that reduce typical sidewalk width standards. The roadway design avoids direct impacts to the cemetery on the west side of MD 355 south of Dalamar Street and generally minimizes impacts to off-street parking. Table 2-7 summarizes the number of buildings significantly impacted, buildings possibly impacted, and private parking lots significantly impacted, by the lane repurposing design alternative.

Table 2-7: MD 355 Focal Segment – Lane Repurposing Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	0	0	0	0	0	0
Chestnut Street to Father Cuddy Bridge	0	0	1	0	0	0
Father Cuddy Bridge to Summit Avenue	0	0	0	0	0	0
Total Buildings/Properties	**0**	**0**	**1**	**0**	**0**	**0**

The design layout will require no widening of the Father Cuddy Bridge. In addition to the two BRT guideway lanes, two northbound travel lanes and three southbound travel lanes can be accommodated on the bridge without widening. The existing sidewalks, representing the minimum standard sidewalk, are retained. No significant roadway widening is required along the steeply sloped roadside north or south of the bridge, so new retaining walls should not be required.

The lane repurposing guideway design would provide for less than desirable BRT operations by providing two 11 foot bus lanes to allow buses traveling in both directions to operate, but without a physical separation from general traffic. The lack of a median separator and small

distance between busway and general purpose lanes will result in greater interference from general traffic. It is estimated that buses operating within repurposed lanes could maintain an average speed between 13 and 18 miles per hour, depending on time of day. The lane repurposing guideway design provides similar station benefits to the three dual-lane guideway design alternatives.

Mixed Traffic Guideway Design

A mixed traffic BRT design does not technically provide a guideway for the bus to operate in. The bus travels in the general traffic lanes and does not receive exclusivity from the impacts of congestion associated with traffic. This alternative is not assumed to require construction or improvements in the focal segment, except to construct stations. As part of the larger BRT system, the bus will likely receive signal priority along the corridor within the mixed traffic segments, but this benefit is limited because the bus can go no faster than the surrounding traffic. Consideration for how the bus will transition from a dedicated guideway to mixed traffic operations is important to provide for seamless bus operation.

Mixed Traffic Guideway Alternative

The mixed traffic guideway alternative is characterized by a roadway cross-section that provides no exclusive bus lane and keeps the existing traffic lane configuration, lane widths, and roadway geometry for the entire focal segment from Odendhal Avenue to Summit Avenue. This design assumes that the existing sidewalk widths will be retained throughout the entirety of the corridor as well.

A design layout drawing for this alternative is provided in Appendix B. This design conforms to the existing roadway limits, requiring no construction within the roadway and no property acquisition along the focal segment. In order to not have any property impact within the segment from Odendhal to Summit, a BRT station cannot be located at Odendhal because of the property impacts that would be required to expand the existing intersection. This design alternative would require that the station be located at Lakeforest Boulevard instead. Because no roadway widening is necessary, this design avoids direct impacts to the cemetery on the west side of MD 355 south of Dalamar Street and has no impacts to off-street parking. Table 2-8 summarizes the number of buildings significantly impacted, buildings possibly impacted, and private parking lots significantly impacted, by the mixed traffic design alternative.

Table 2-8: MD 355 Focal Segment – Mixed Traffic Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	0	0	0	0	0	0
Chestnut Street to Father Cuddy Bridge	0	0	0	0	0	0
Father Cuddy Bridge to Summit Avenue	0	0	0	0	0	0
Total Buildings/Properties	**0**	**0**	**0**	**0**	**0**	**0**

The design layout will require no widening of the Father Cuddy Bridge. The existing lane configuration of three southbound and three northbound lanes would remain. The center raised median would also be retained. The existing sidewalks, representing the minimum standard sidewalk, are retained. No significant roadway widening is required along the steeply sloped roadside north or south of the bridge, so new retaining walls are not required.

BRT operations under the mixed traffic design alternative would realize no benefits in terms of speed and travel time. The bus would travel in the general traffic lanes from Odendhal Avenue to Summit Avenue, traveling at the same speed as the traffic along MD 355. The overall travel time for the entire route may be improved slightly through the benefit of receiving transit signal priority, but so would any traffic traveling with the bus. Generally, the entire corridor would be impacted by this mile long stretch of mixed traffic operations, resulting in an overall average speed between 11 and 15 miles per hour. This design alternative also means that the bus must exit and enter the BRT guideway at the boundary intersections of the focal segment. This operation will need to be coordinated by traffic signals to provide for safe and exclusive access to the BRT guideway by the BRT vehicles. Under the mixed traffic configuration, stations should either not be provided within the focal segment or should be provided along the curb-side of the road. If stations are constructed along the curb, the bus would need to transition from the curb lane from the center lane and would also be stopping in the general traffic lane, which would further impact traffic.

Summary of Alternatives

The following tables provides a quick summary of the property and infrastructure impacts of each alternative. Included in the table is a column that indicates whether the bus receives a benefit from the alternative through improved travel speeds.

Table 2-9: Summary of Land Impacts, Infrastructure Impacts, and Operating Speeds

Alternative	Property Impacts	Bridge Impacts	Slope Impacts	Improved bus speeds
Dual-lane Standard	✗	✗	✗	✓
Dual-lane Minimum	✗	✗	✗	✓
Dual-lane Reduced Impact	✓	✓	✓	✓
Single-lane Standard	✗	✗	✗	✓
Single-lane Minimum	✗	✗	✗	✓
Single-lane Reduced Impact	✓	✓	✓	✓
Lane Repurposing	✓	✓	✓	✓
Mixed Traffic	✓	✓	✓	✗

2.3 Focal Segment Conceptual Design Alternative Cross-sections

The focal segment from Odendhal Avenue to Summit Avenue is characterized by varying roadway geometry and design challenges in several different locations along the segment. The existing character of these areas was described in Chapter 1 of this report. The four smaller segments include the following areas:

- Odendhal Avenue to Chestnut Street
- Chestnut Street to Father Cuddy Bridge
- Father Cuddy Bridge
- Father Cuddy Bridge to Summit Avenue

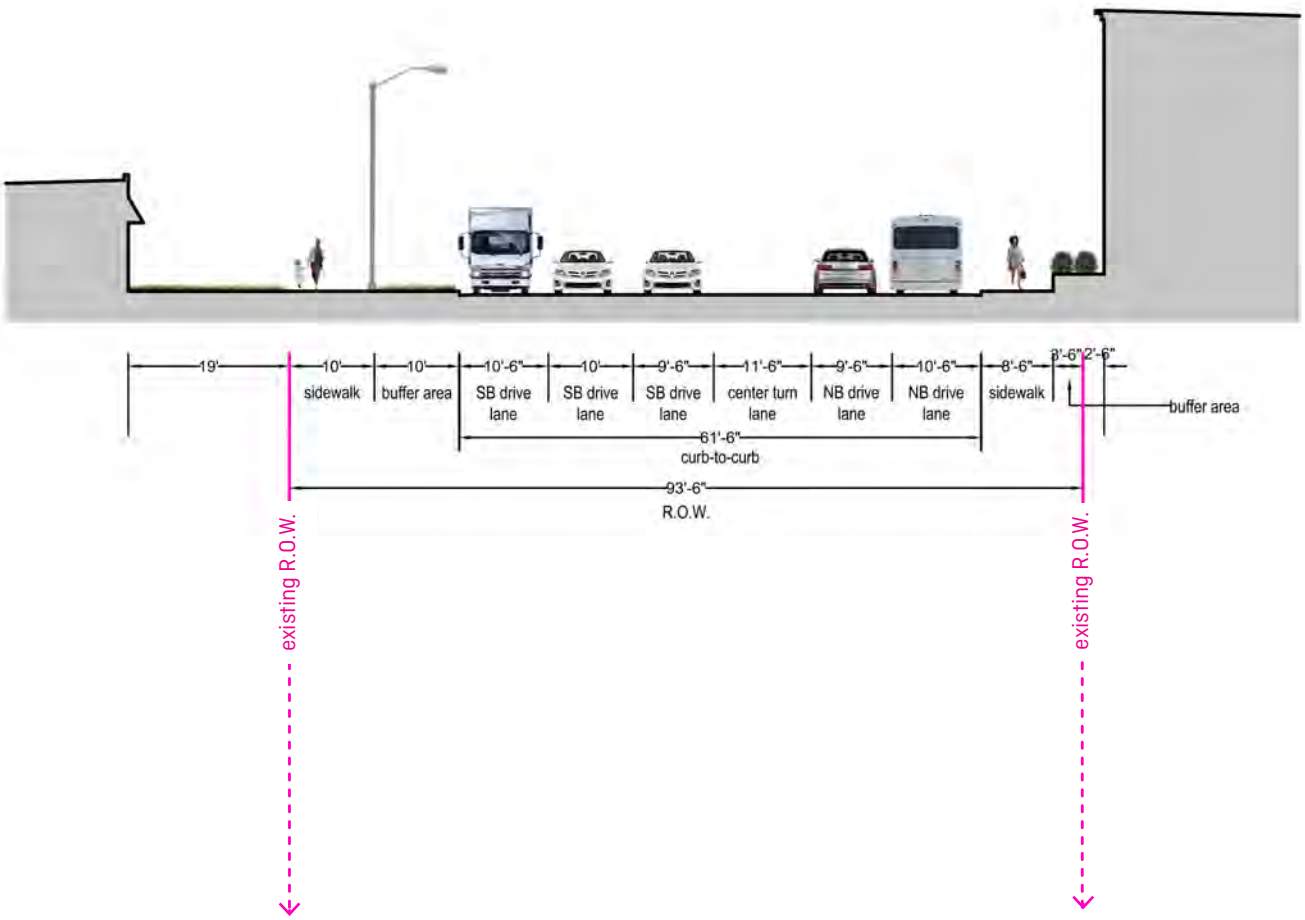
To show how the different BRT guideway alternatives would fit within the different character areas of the focal segment, five locations were identified where roadway cross-sections would be developed to identify the potential design changes and influences on existing roadside elements. Each of these locations represents distinct design characteristics within the segment and many present particular challenges related to building setbacks, existing roadway width, sensitive properties, or roadway structures. The five locations include:

- MD 355 south of Whetstone Drive
- MD 355 at Montgomery Avenue
- MD 355 between Brookes Avenue and Walker Avenue
- MD 355 at Father Cuddy Bridge
- MD 355 north of Desellum Avenue

The following pages display each location, the existing lane widths and configuration, and each of the eight design alternatives described above. Each cross-section shows the proposed lane, median, and sidewalk widths, changes in roadway alignment, and necessary curb-to-curb width and right-of-way. Also indicated on the cross-sections are any potential property impacts.

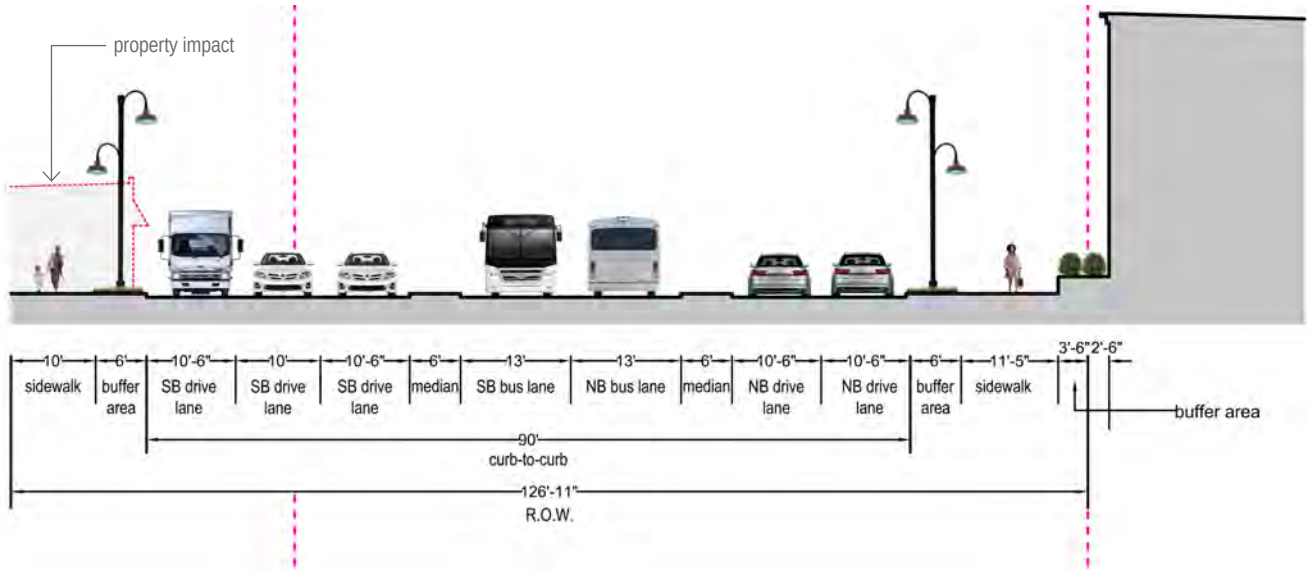
SECTION 1: MD 355 south of Whetstone Drive | LOCATOR MAP + EXISTING CONDITIONS

1 EXISTING CONDITIONS

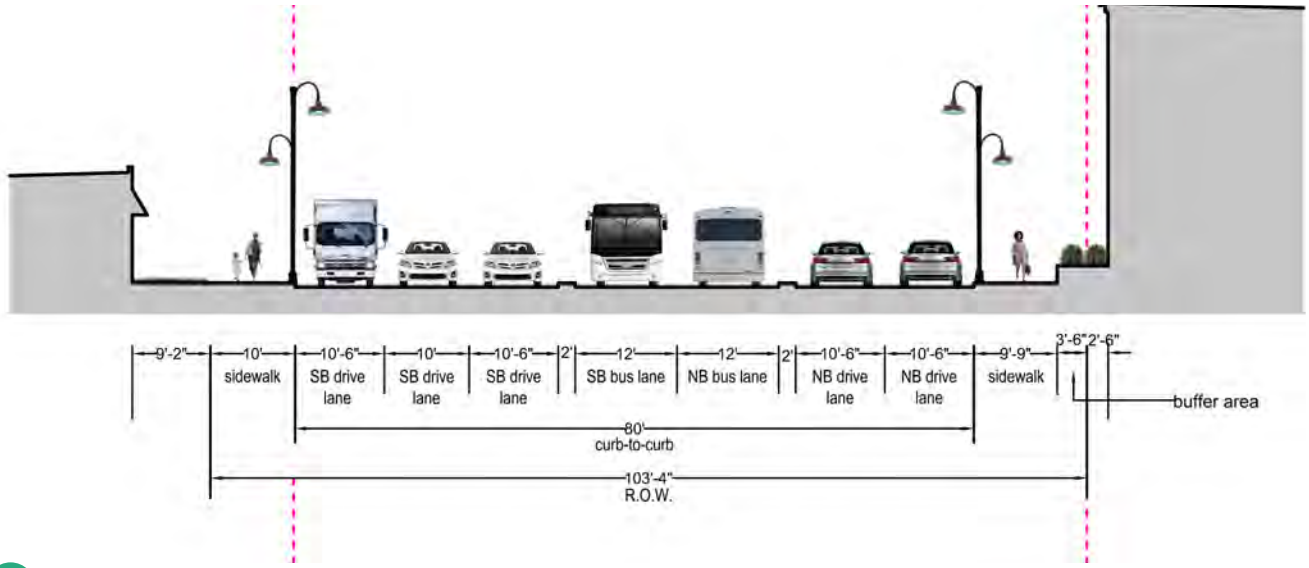


SECTION 1: MD 355 south of Whetstone Drive | ALTERNATIVES

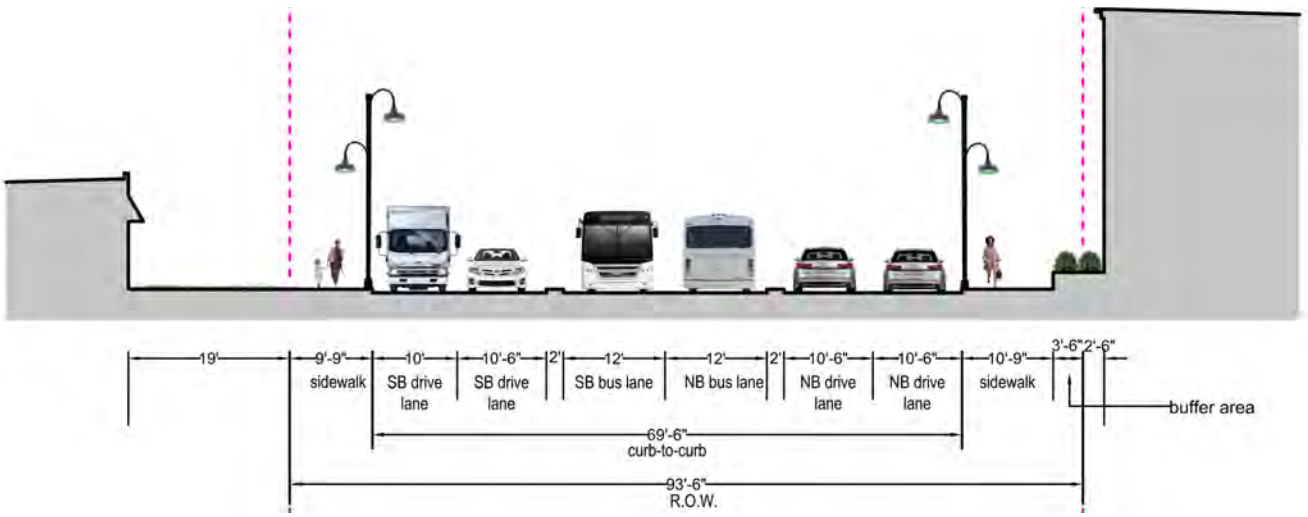
1.A DUAL-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



1.B DUAL-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

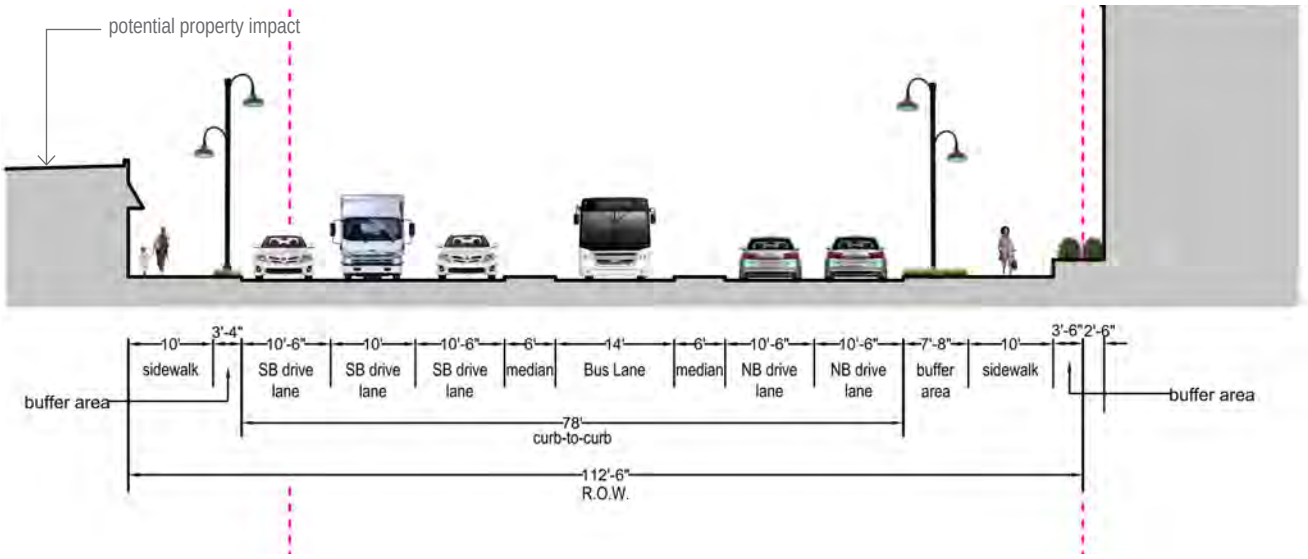


1.C DUAL-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

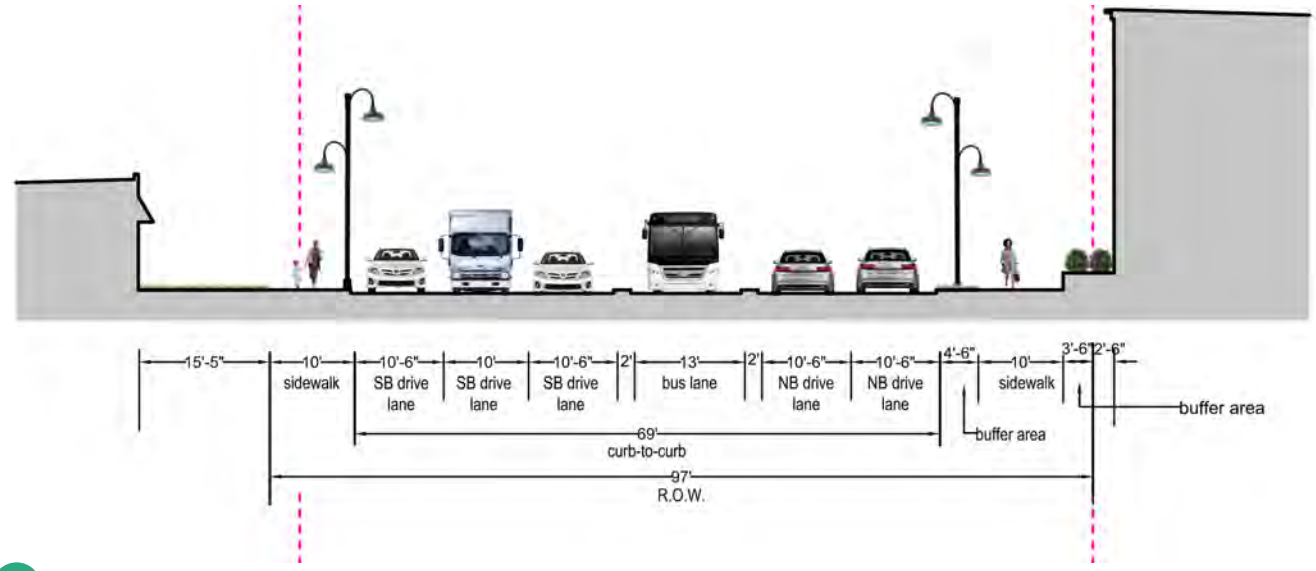


SECTION 1: MD 355 south of Whetstone Drive | ALTERNATIVES

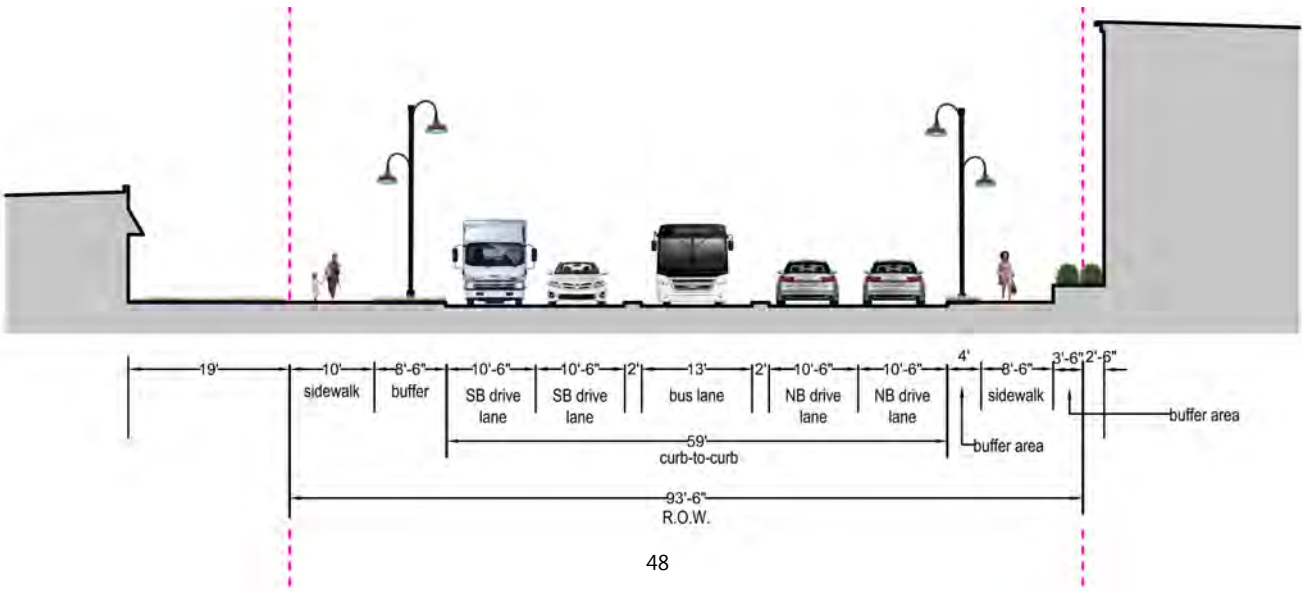
1.D SINGLE-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



1.E SINGLE-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

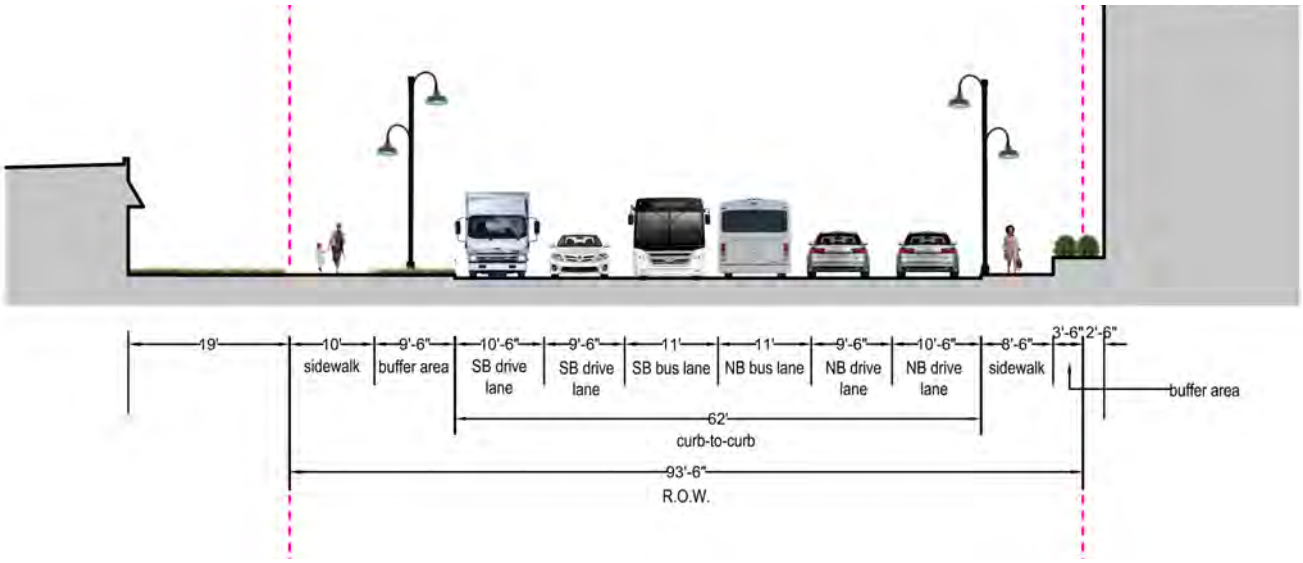


1.F SINGLE-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

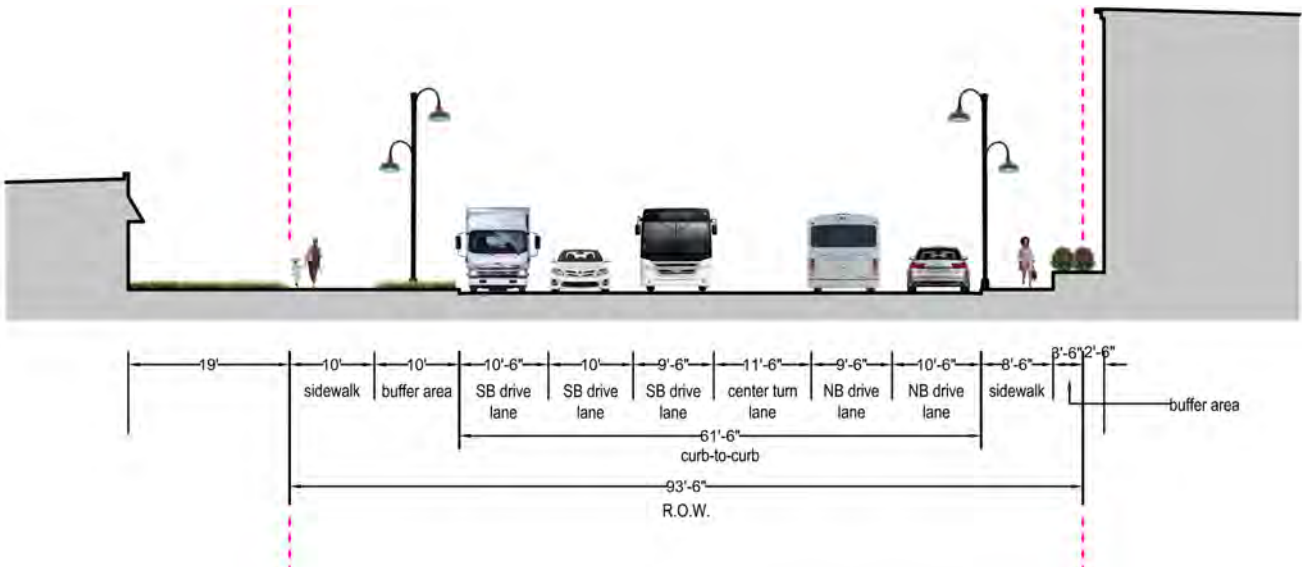


SECTION 1: MD 355 south of Whetstone Drive | ALTERNATIVES

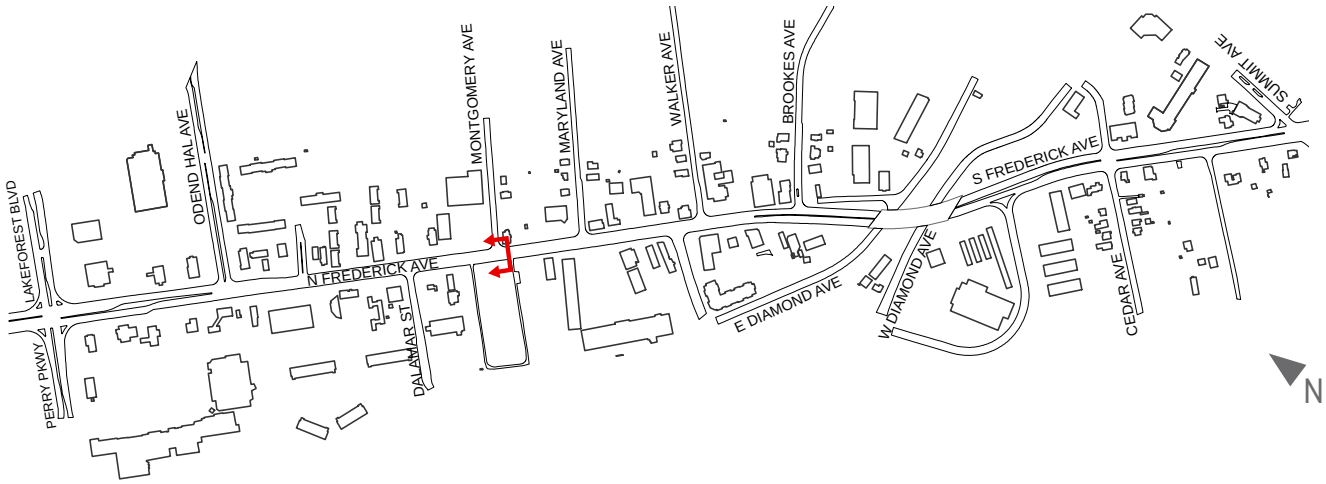
1.G LANE REPURPOSING ALTERNATIVE



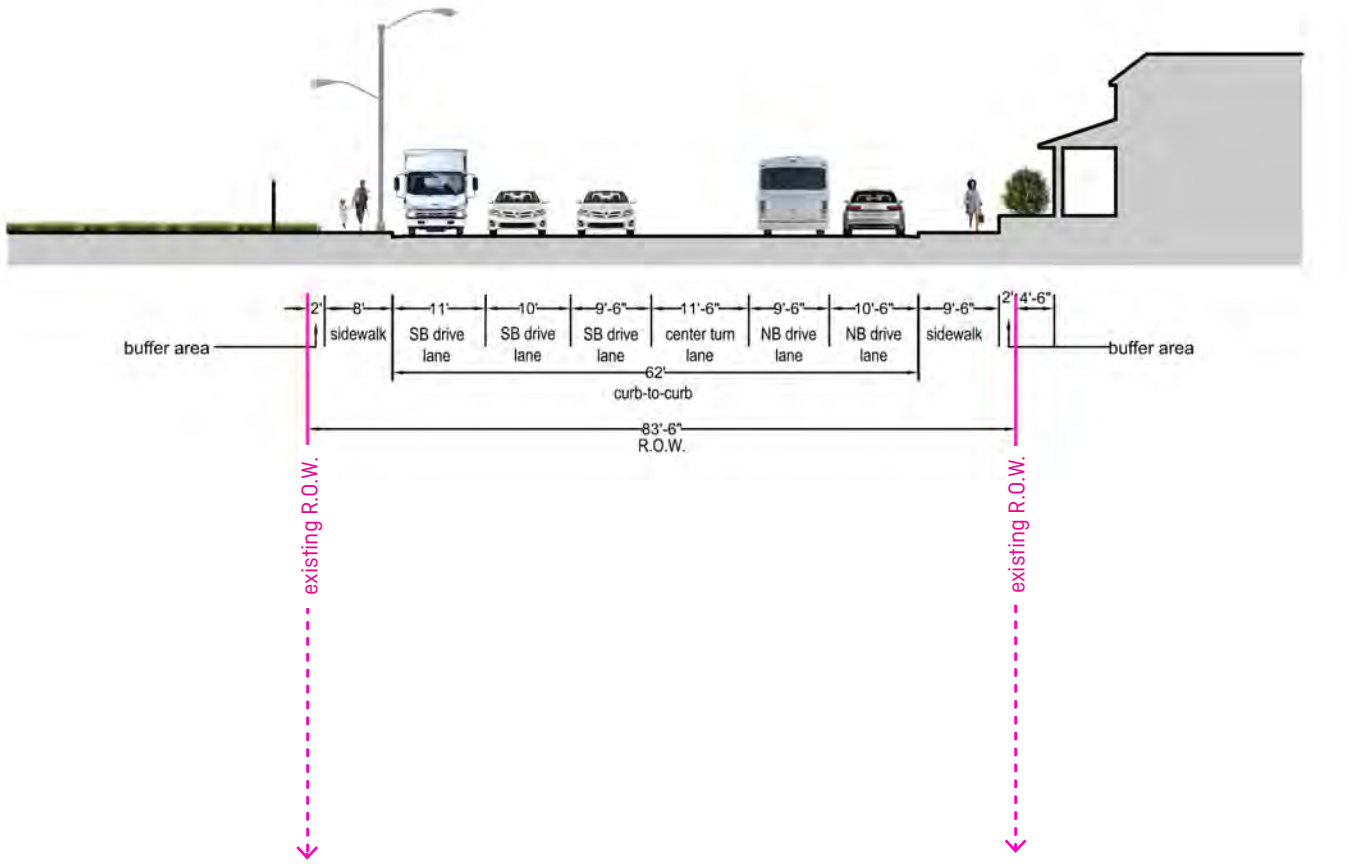
1.H MIXED TRAFFIC ALTERNATIVE



SECTION 2: MD 355 at Montgomery Avenue | LOCATOR MAP + EXISTING CONDITIONS

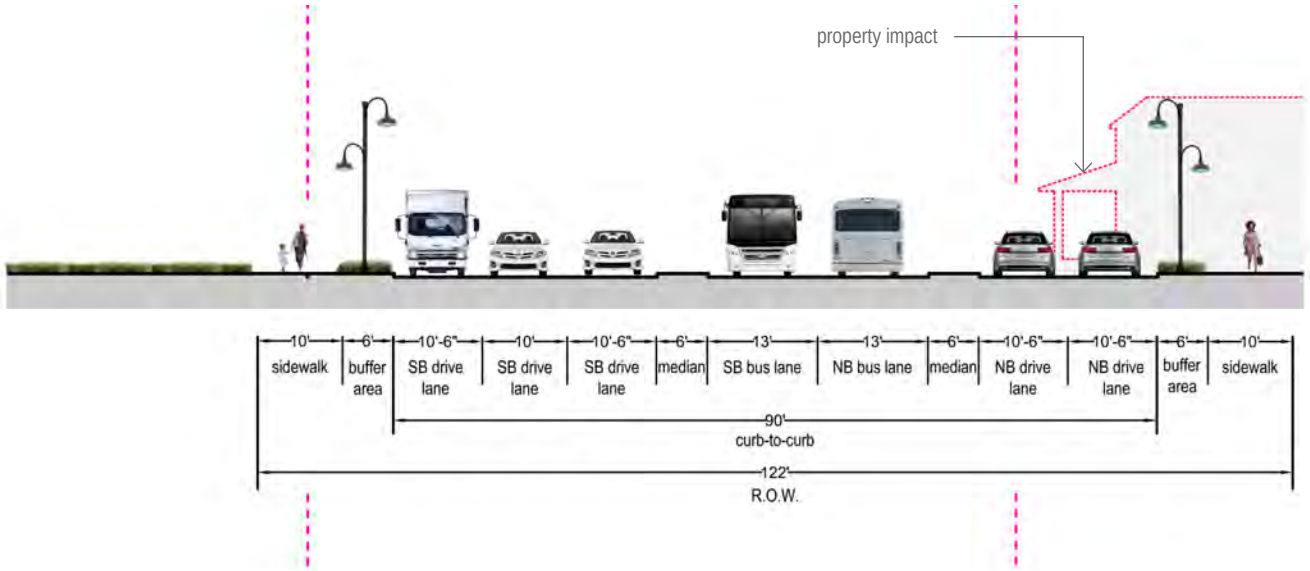


2 EXISTING CONDITIONS

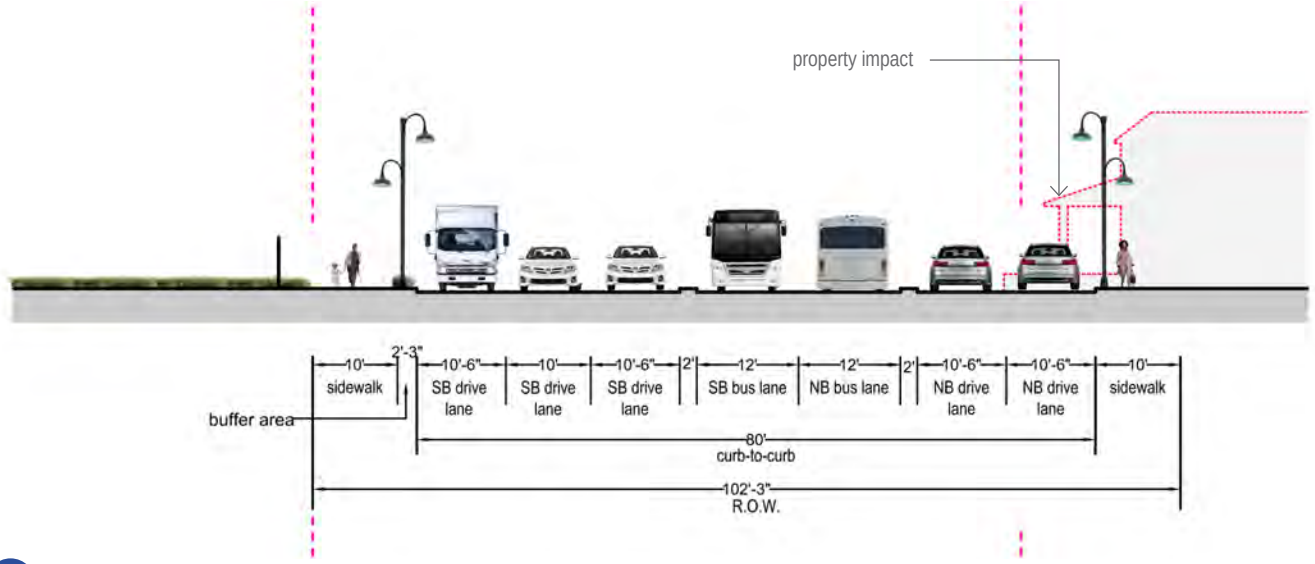


SECTION 2: MD 355 at Montgomery Avenue | ALTERNATIVES

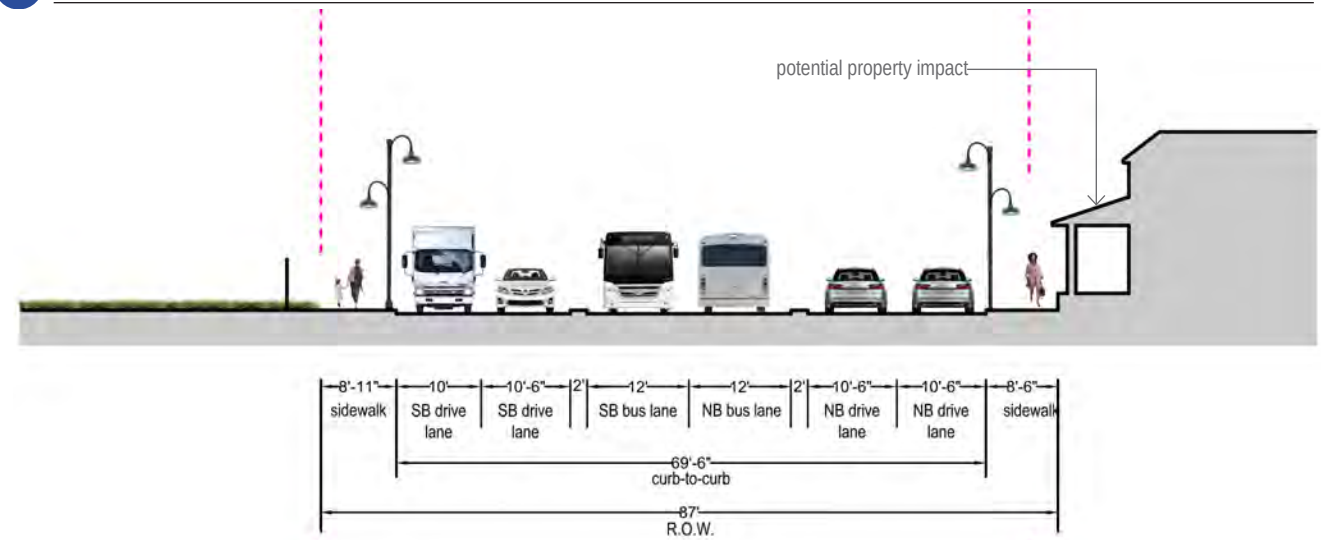
2.A DUAL-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



2.B DUAL-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

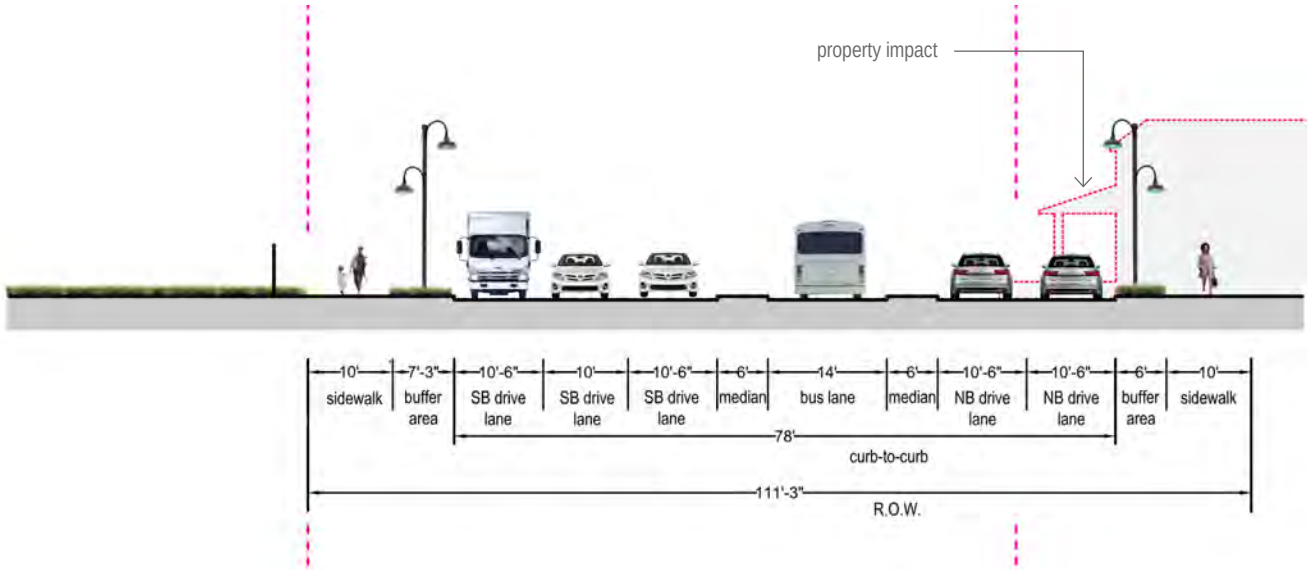


2.C DUAL-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

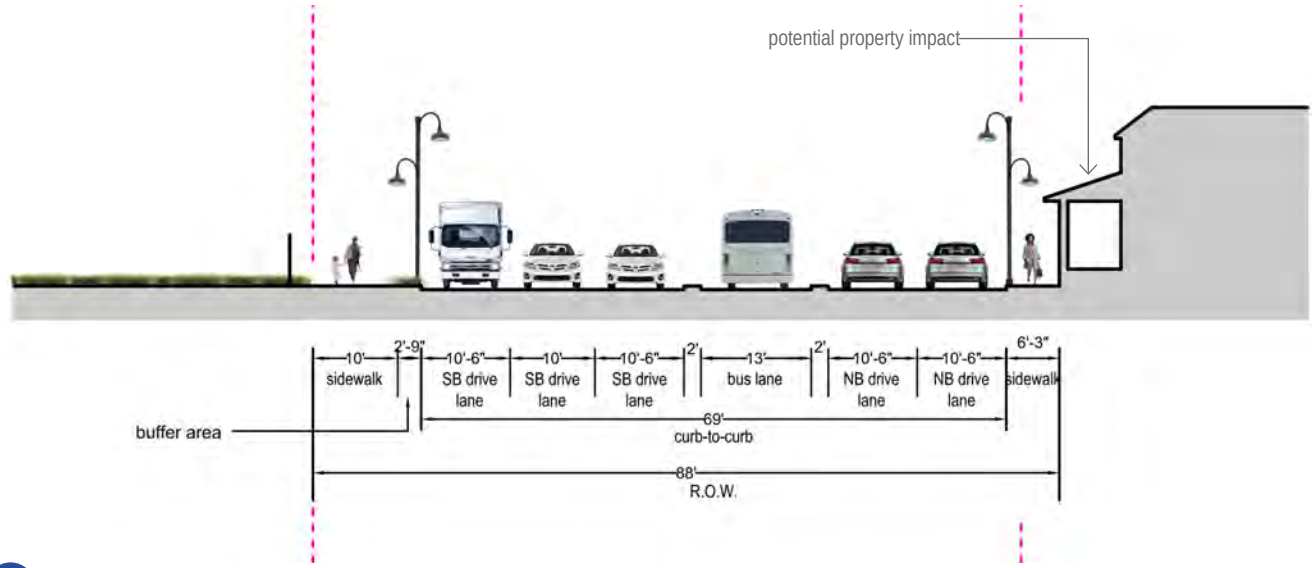


SECTION 2: MD 355 at Montgomery Avenue | ALTERNATIVES

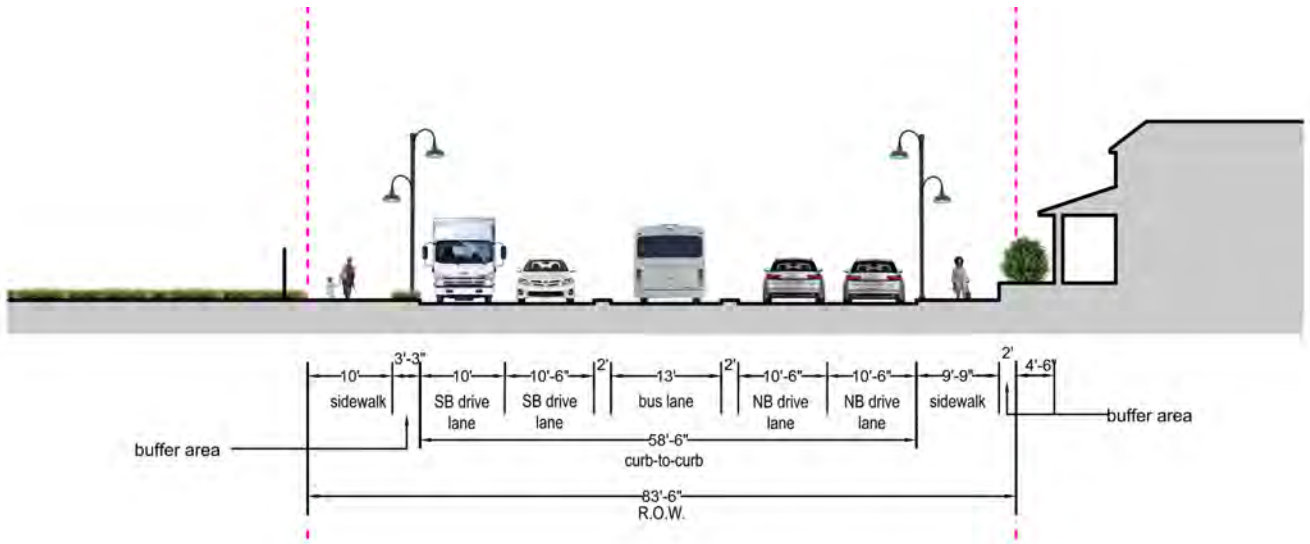
2.D SINGLE-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



2.E SINGLE-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

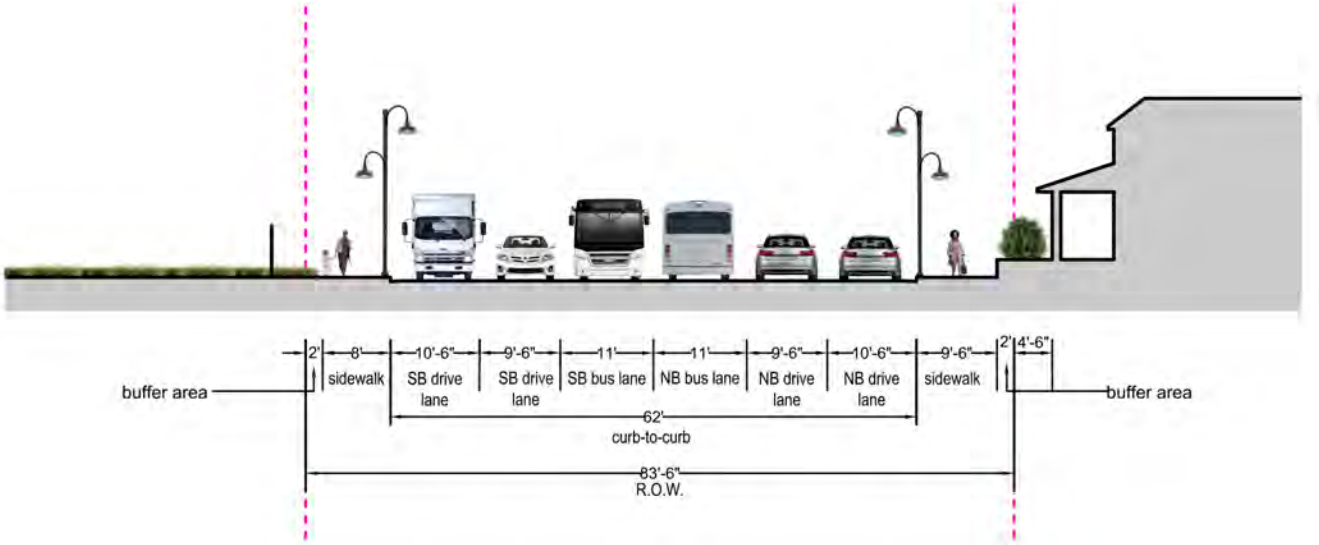


2.F SINGLE-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

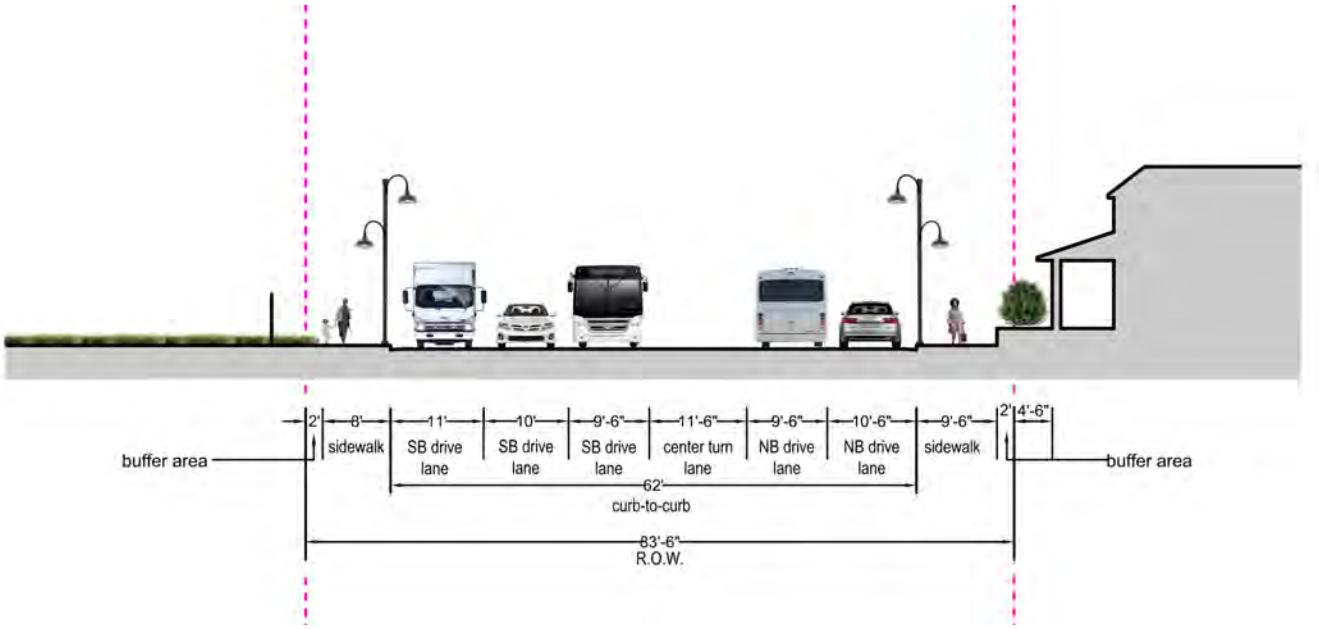


SECTION 2: MD 355 at Montgomery Avenue | ALTERNATIVES

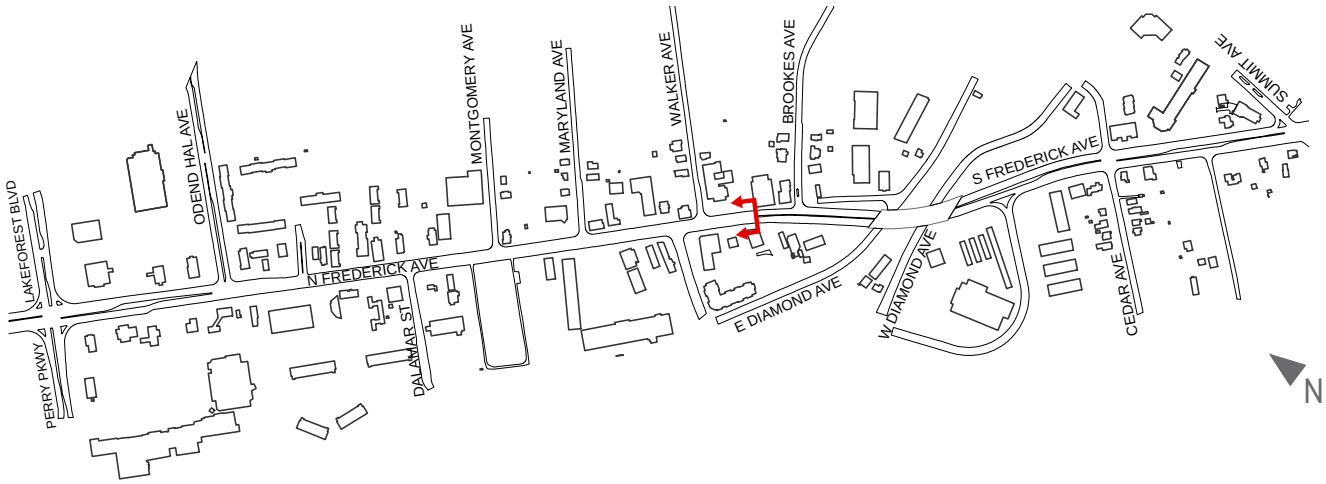
2.G LANE REPURPOSING ALTERNATIVE



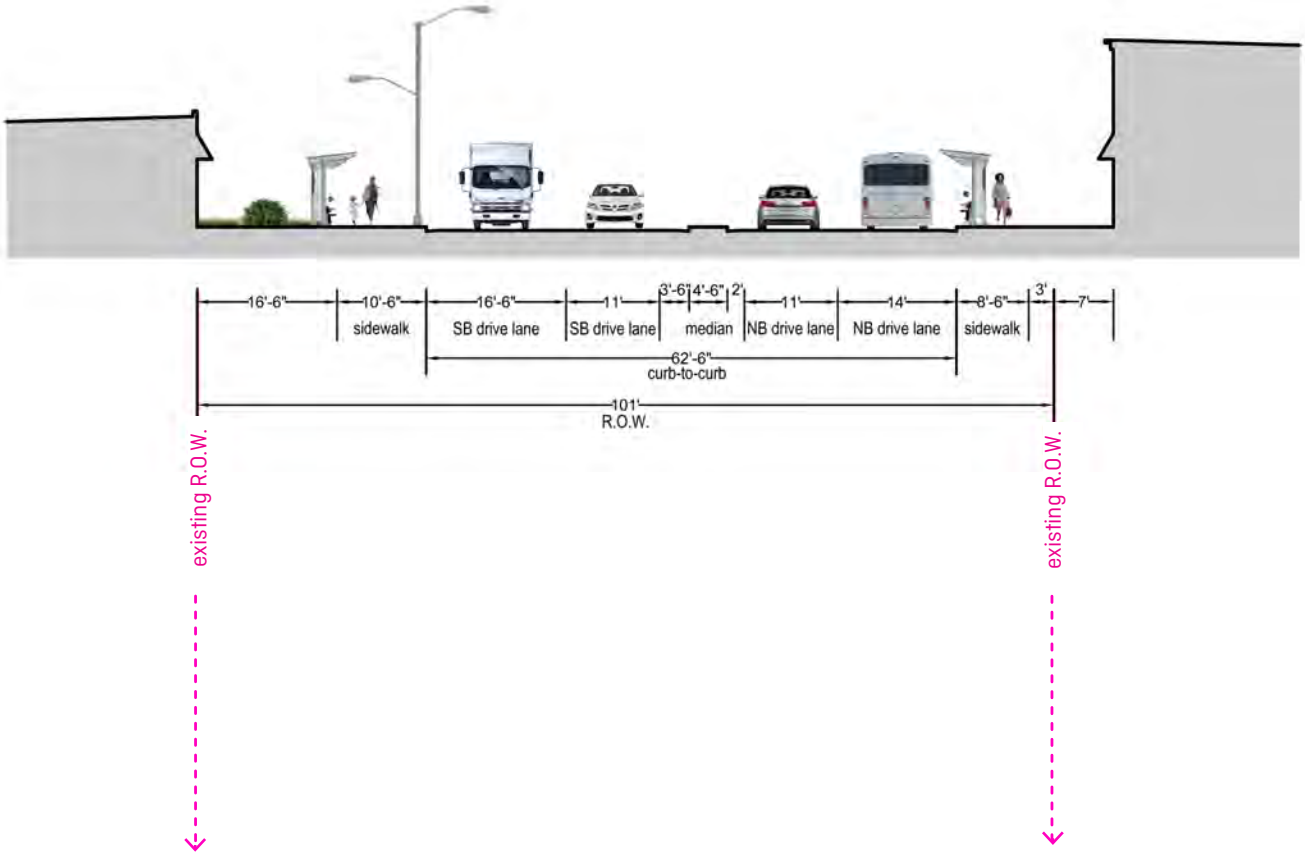
2.H MIXED TRAFFIC ALTERNATIVE



SECTION 3: MD 355 between Brookes and Walker | LOCATOR MAP + EXISTING CONDITIONS

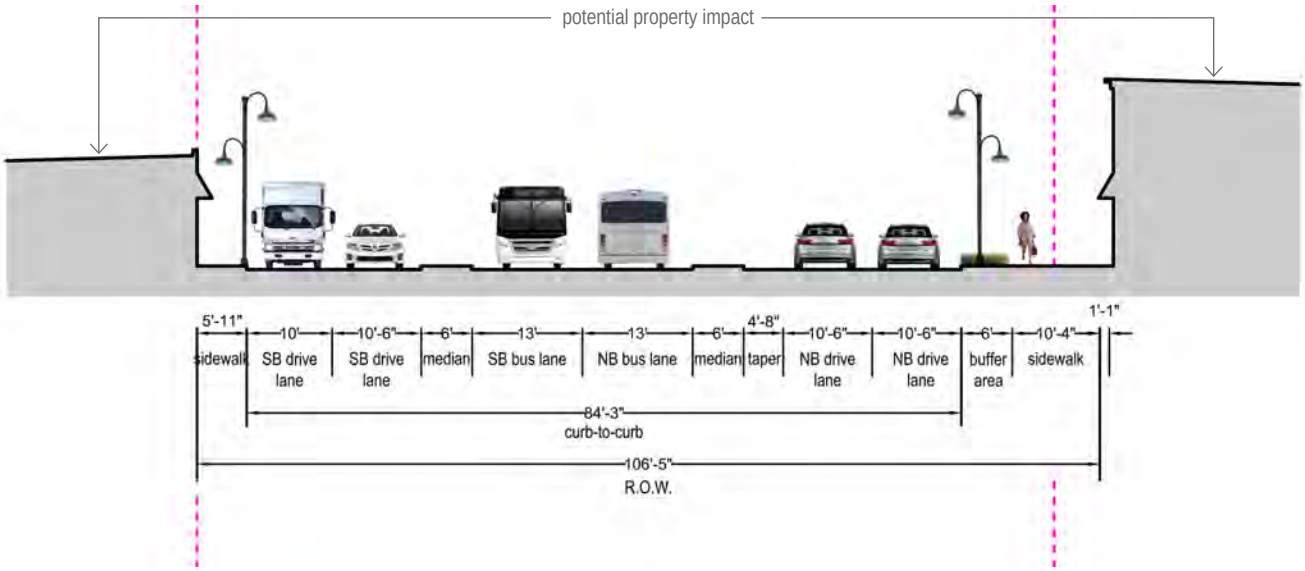


3 EXISTING CONDITIONS



SECTION 3: MD 355 between Brookes and Walker | ALTERNATIVES

3.A DUAL-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



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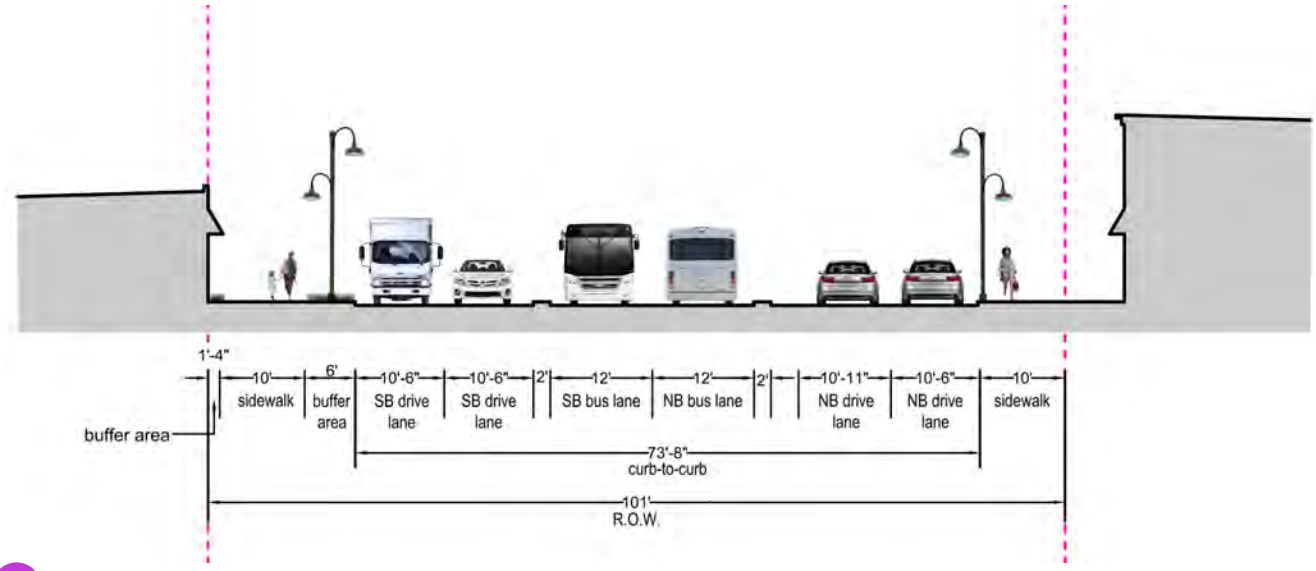
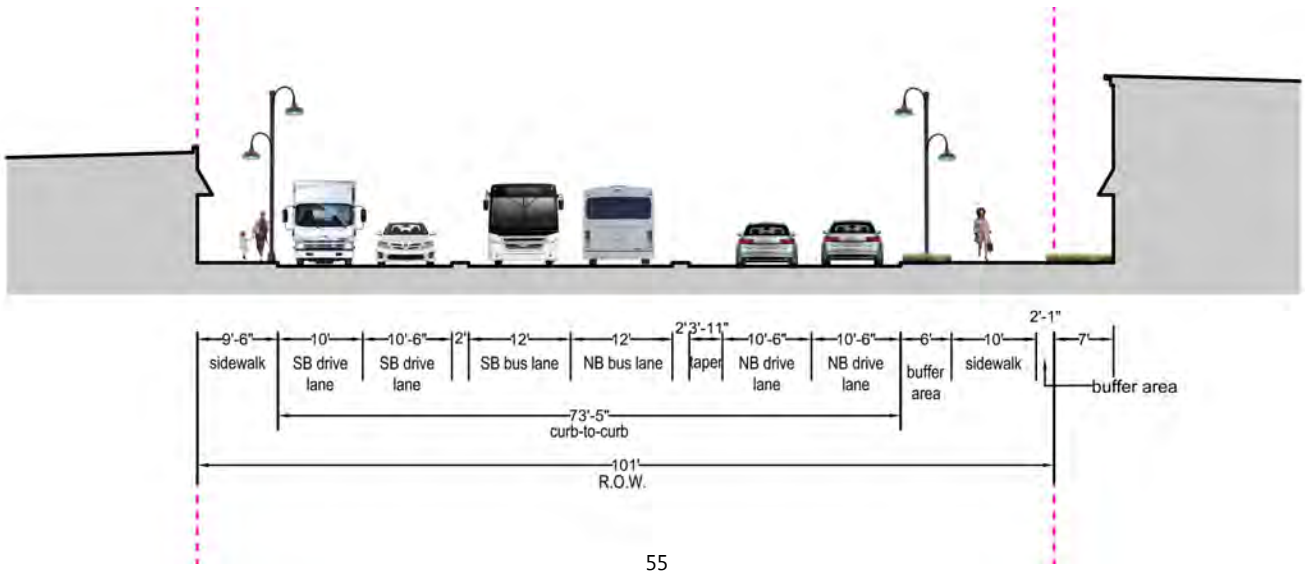
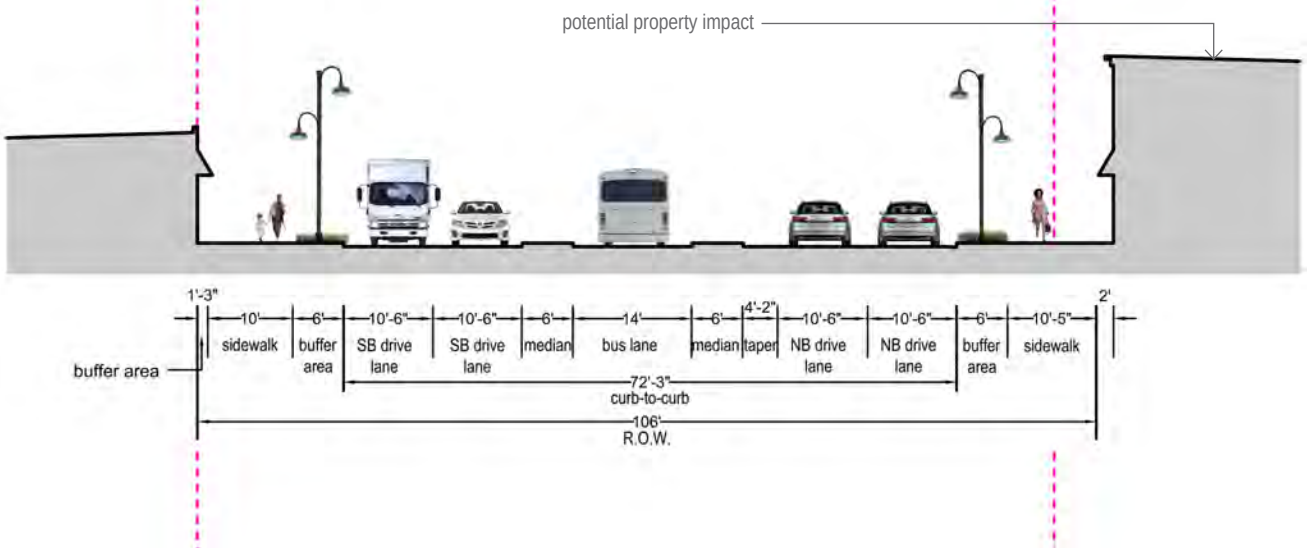


3.C DUAL-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

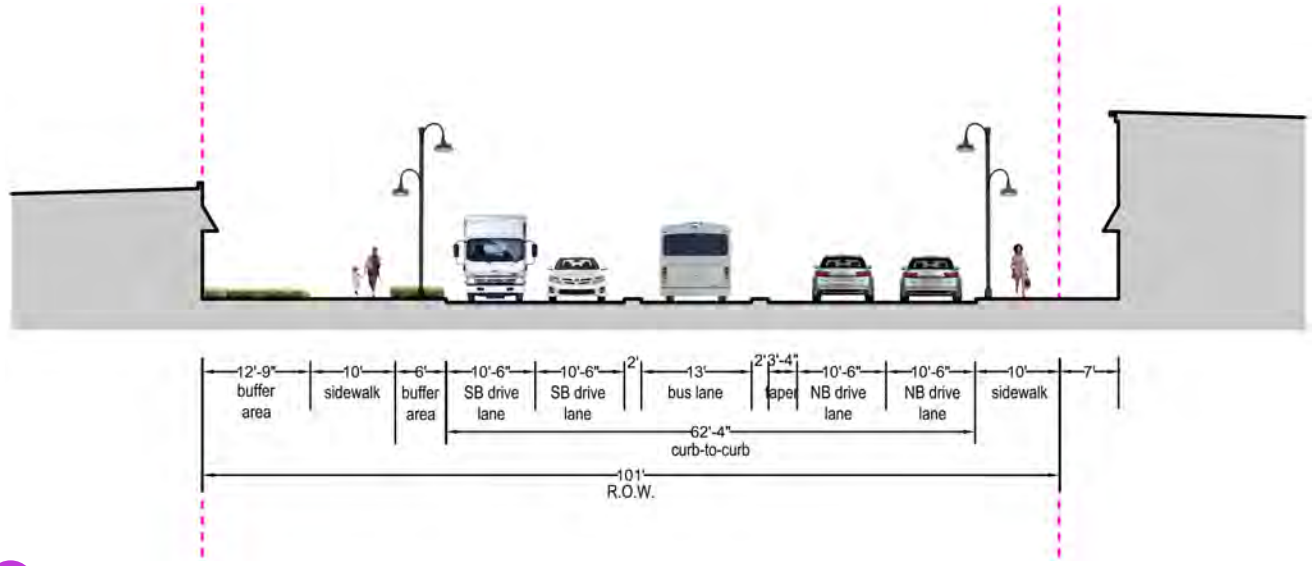


SECTION 3: MD 355 between Brookes and Walker | ALTERNATIVES

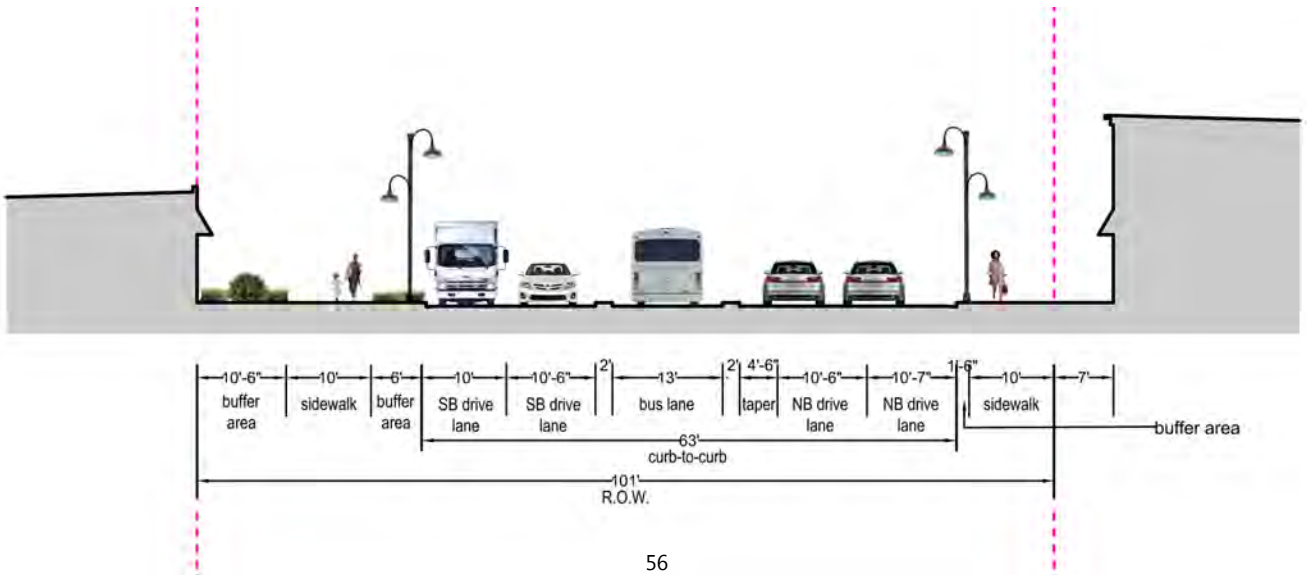
3.D SINGLE-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



3.E SINGLE-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

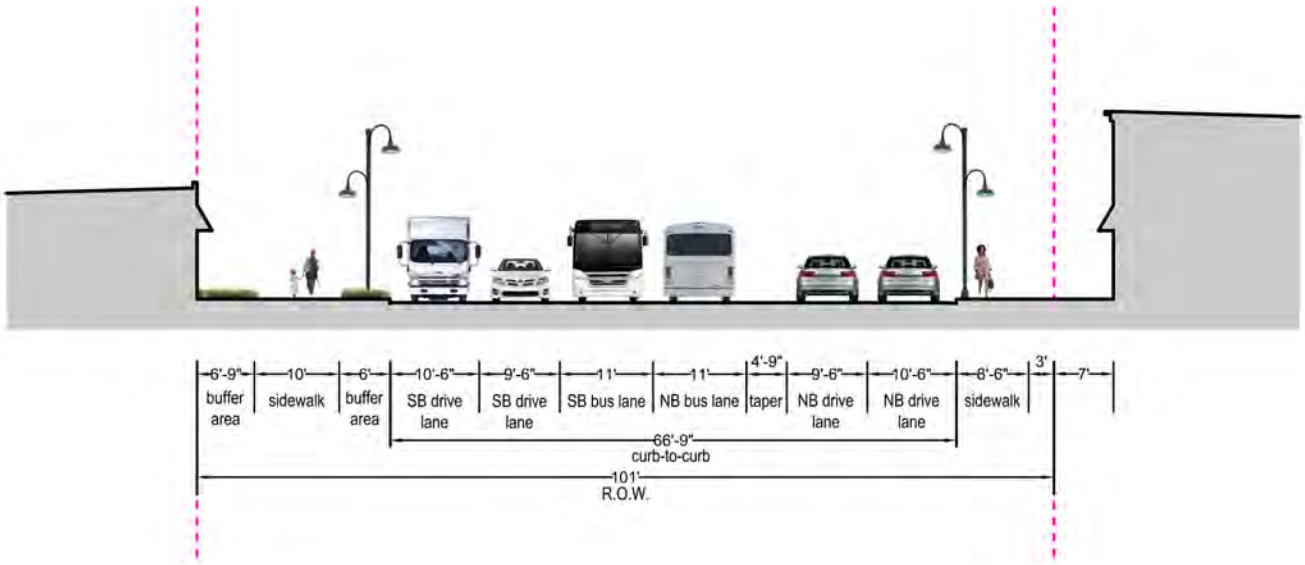


3.F SINGLE-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

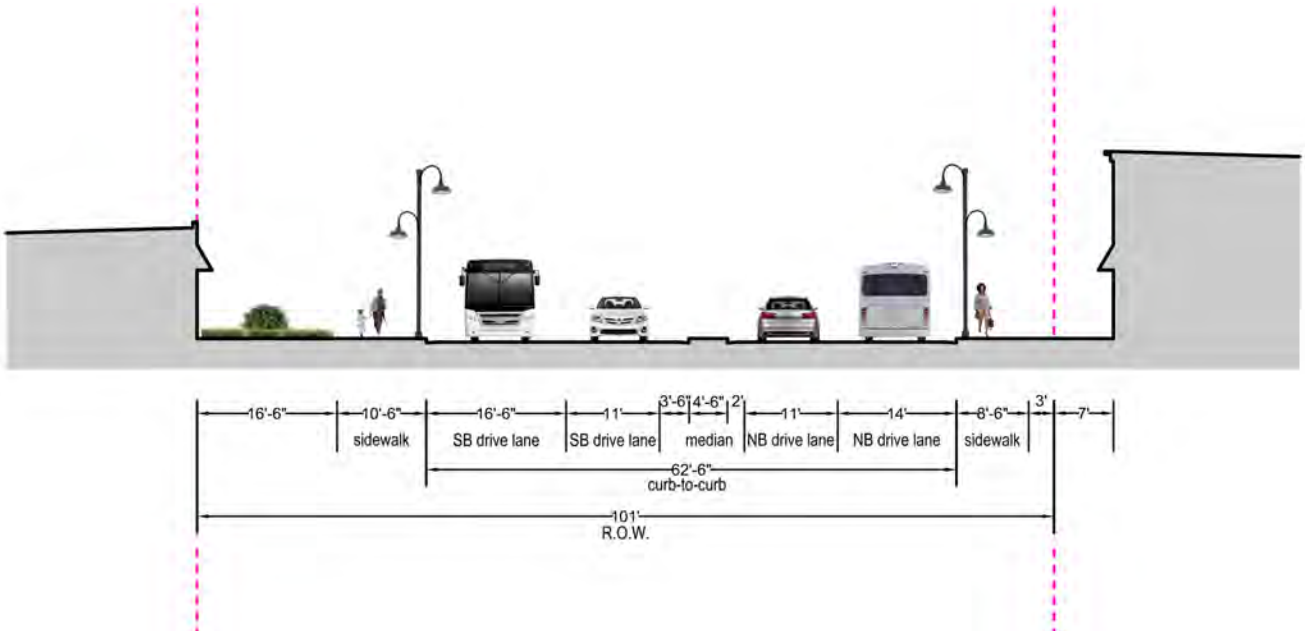


SECTION 3: MD 355 between Brookes and Walker | ALTERNATIVES

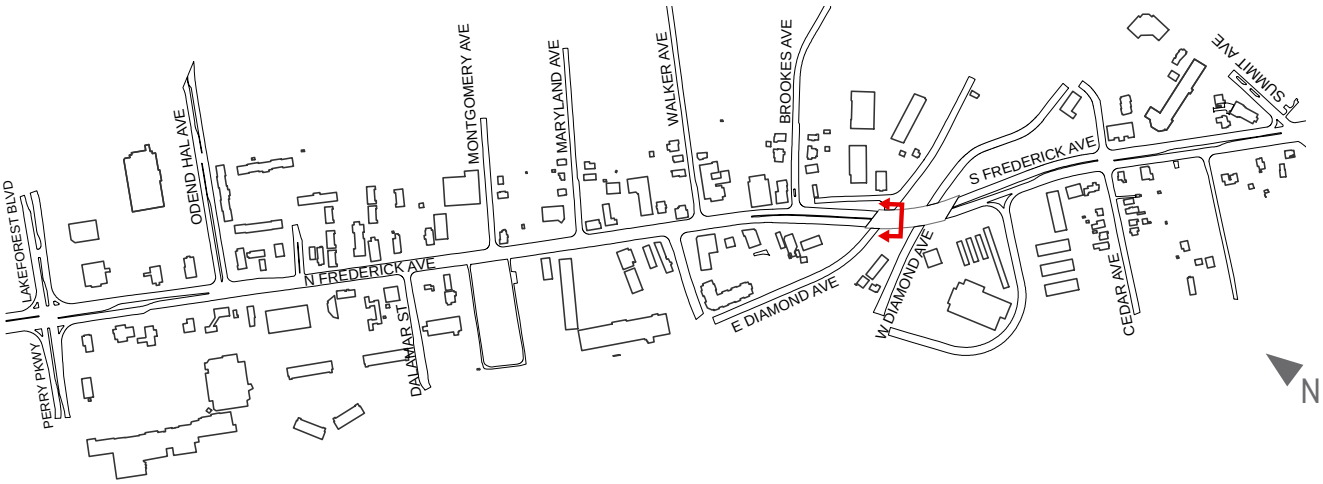
3.G LANE REPURPOSING ALTERNATIVE



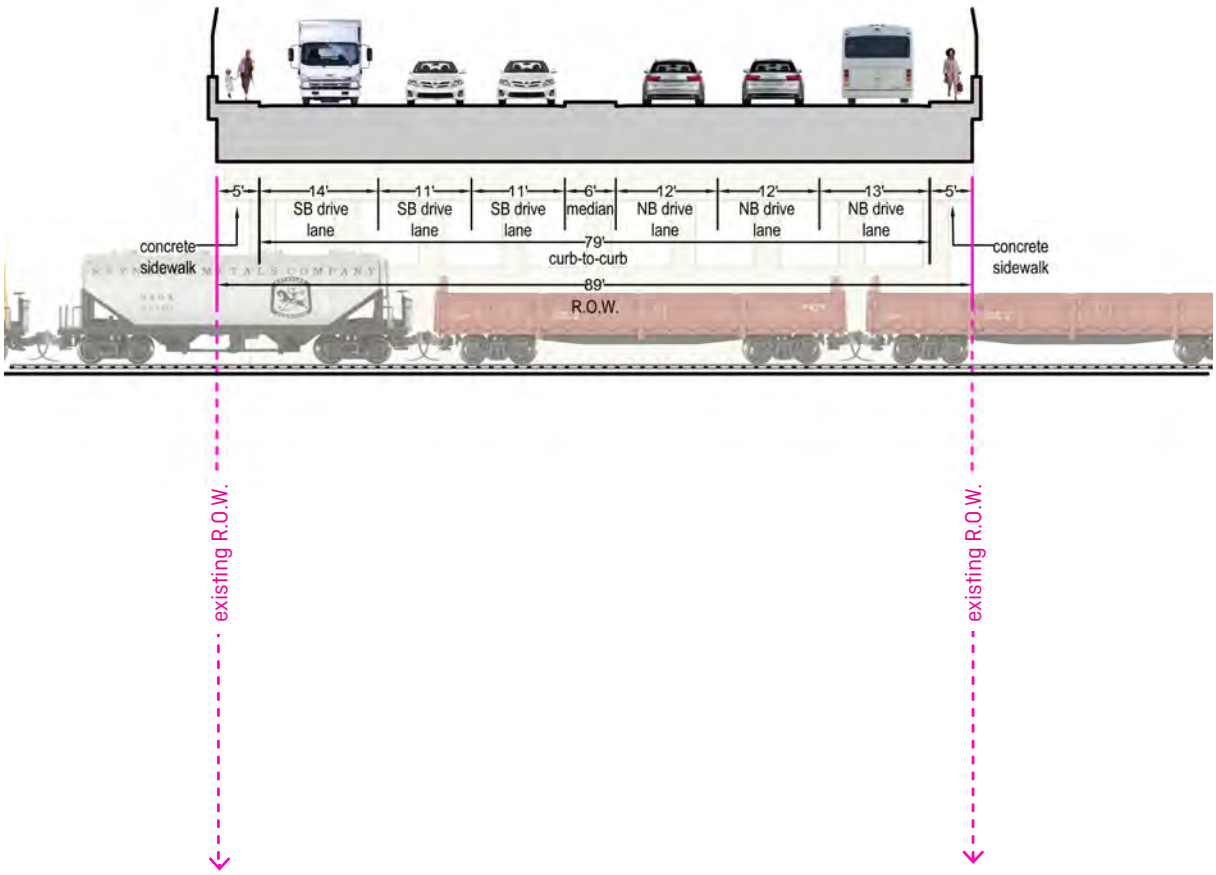
3.H MIXED TRAFFIC ALTERNATIVE



SECTION 4: MD 355 at Father Cuddy Bridge | LOCATOR MAP + EXISTING CONDITIONS

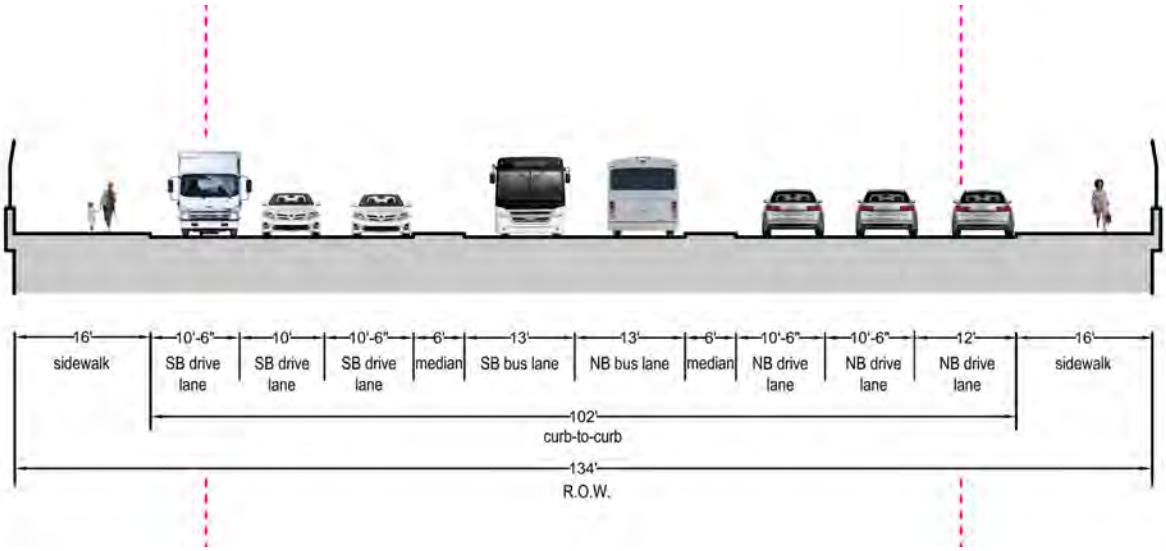


4 EXISTING CONDITIONS

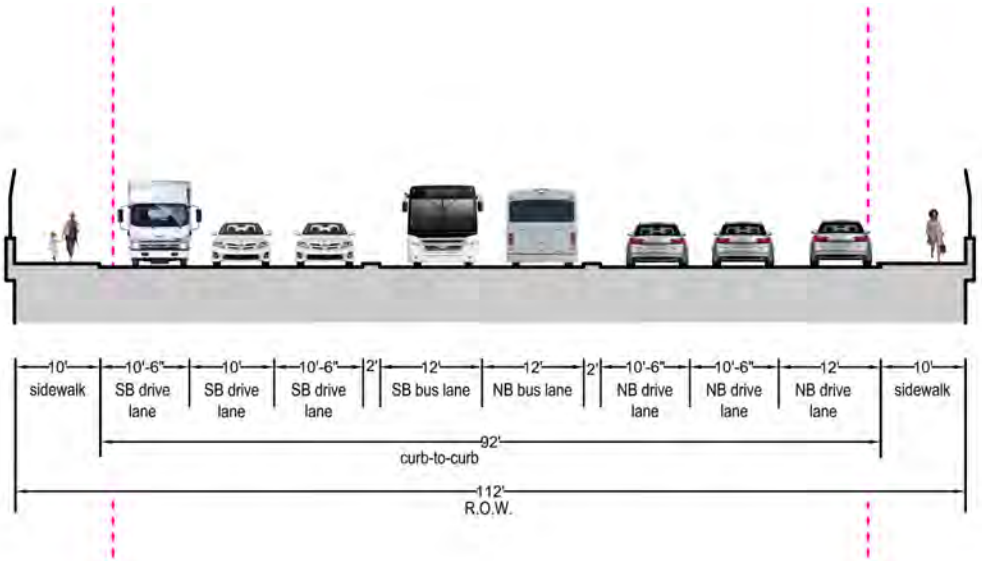


SECTION 4: MD 355 at Father Cuddy Bridge | ALTERNATIVES

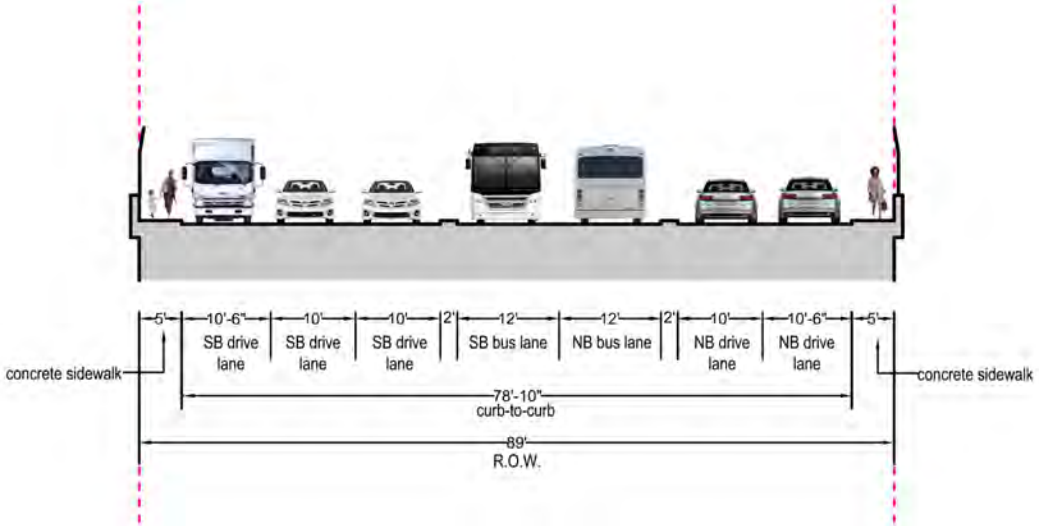
4.A DUAL-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



4.B DUAL-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

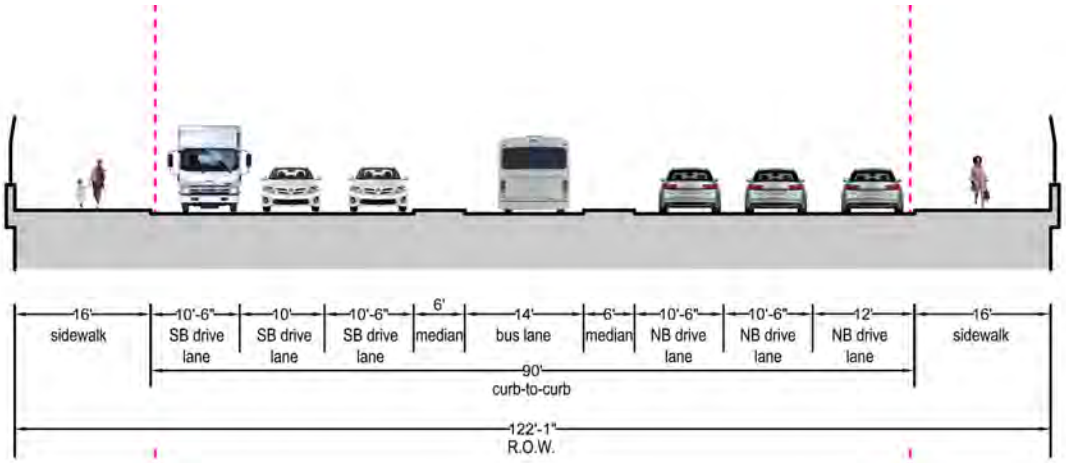


4.C DUAL-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

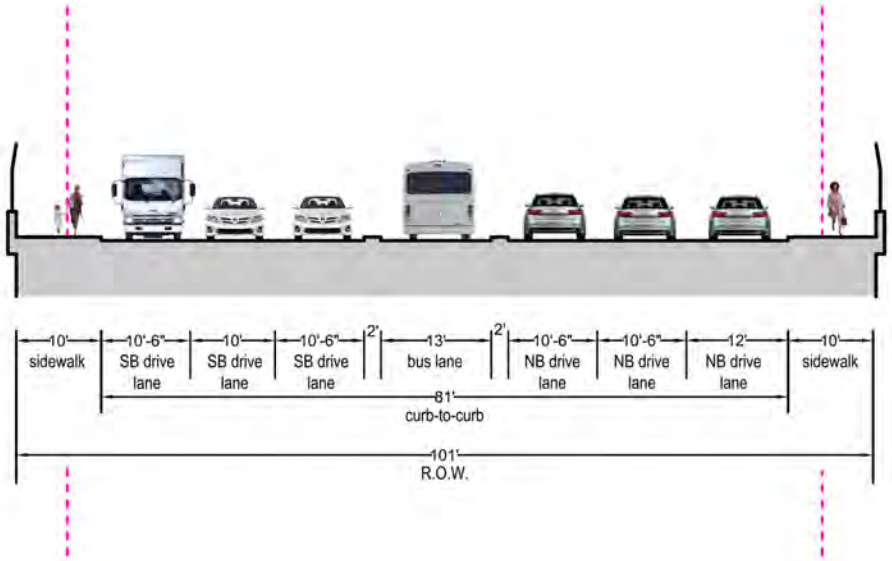


SECTION 4: MD 355 at Father Cuddy Bridge | ALTERNATIVES

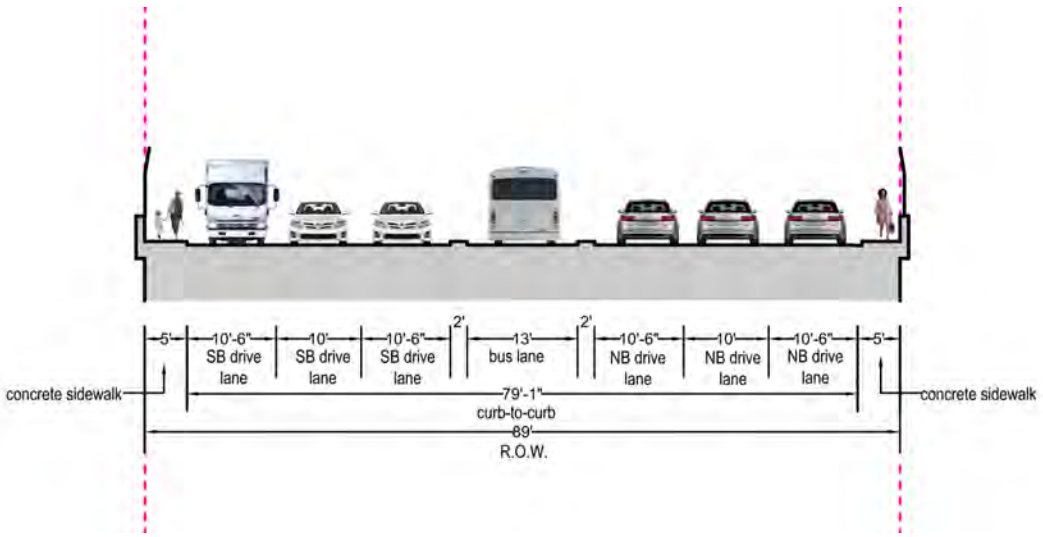
4.D SINGLE-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



4.E SINGLE-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

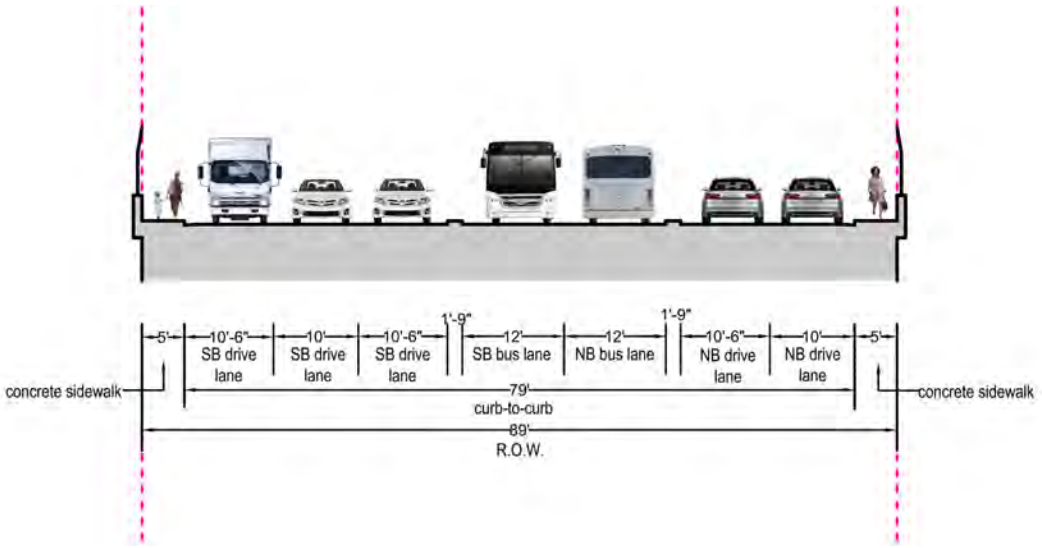


4.F SINGLE-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

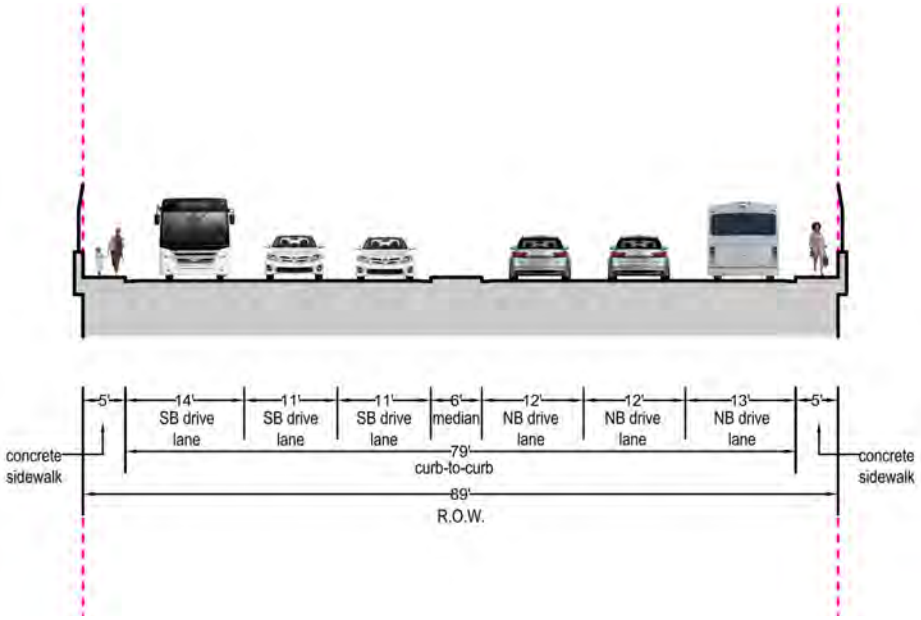


SECTION 4: MD 355 at Father Cuddy Bridge | ALTERNATIVES

4.G LANE REPURPOSING ALTERNATIVE

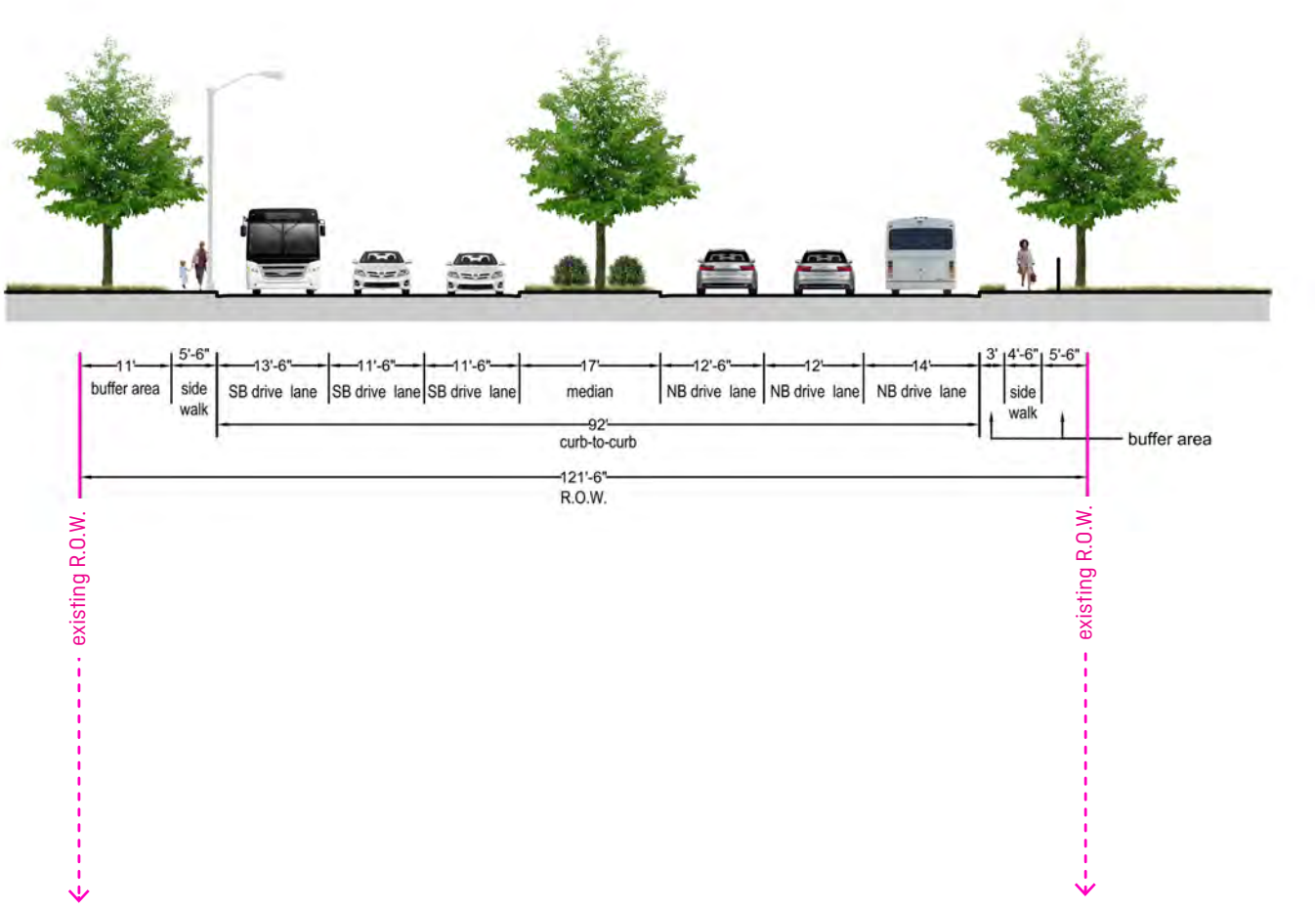


4.H MIXED TRAFFIC ALTERNATIVE



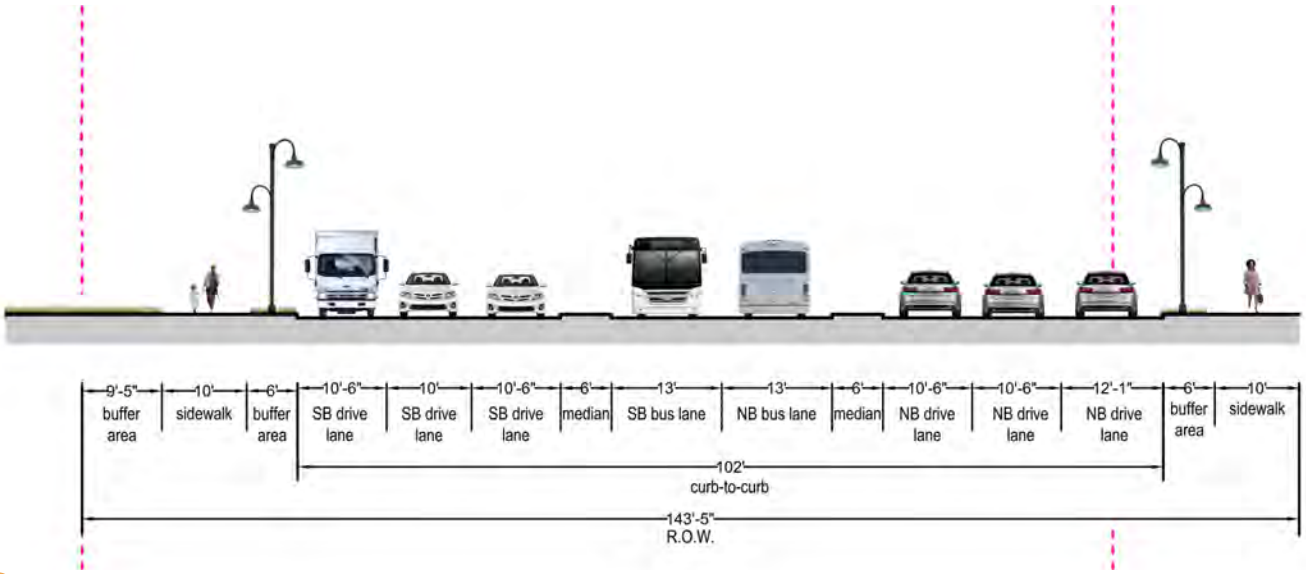
SECTION 5: MD 355 north of Desellum Ave. | LOCATOR MAP + EXISTING CONDITIONS

5 EXISTING CONDITIONS

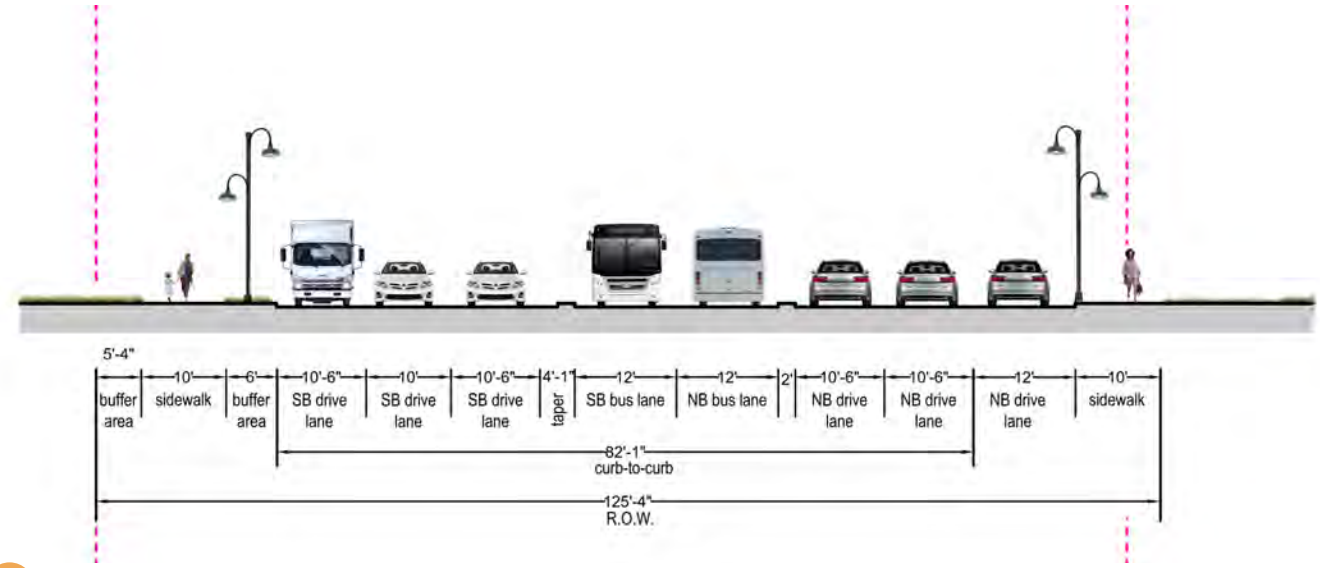


SECTION 5: MD 355 north of Desellum Ave. | ALTERNATIVES

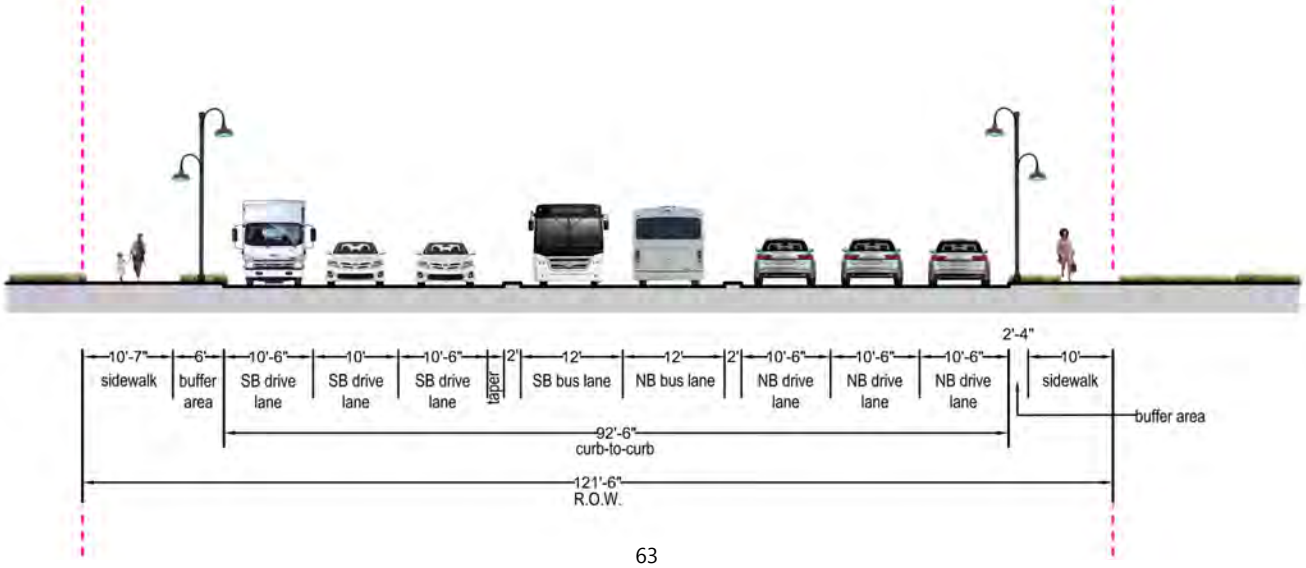
5.A DUAL-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



5.B DUAL-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

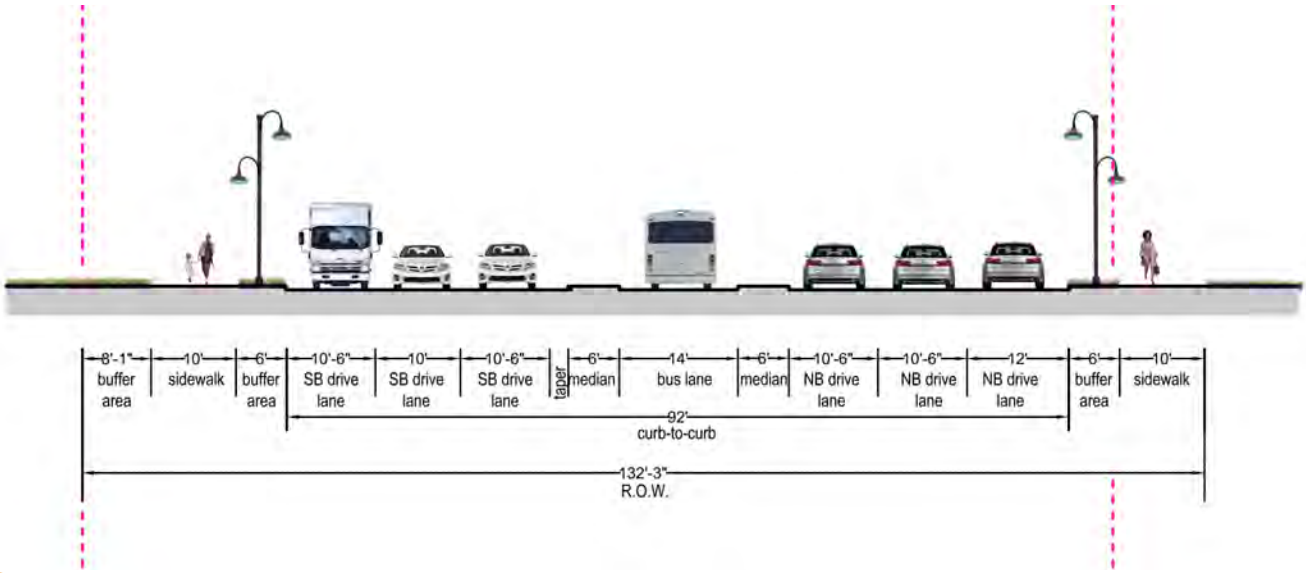


5.C DUAL-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

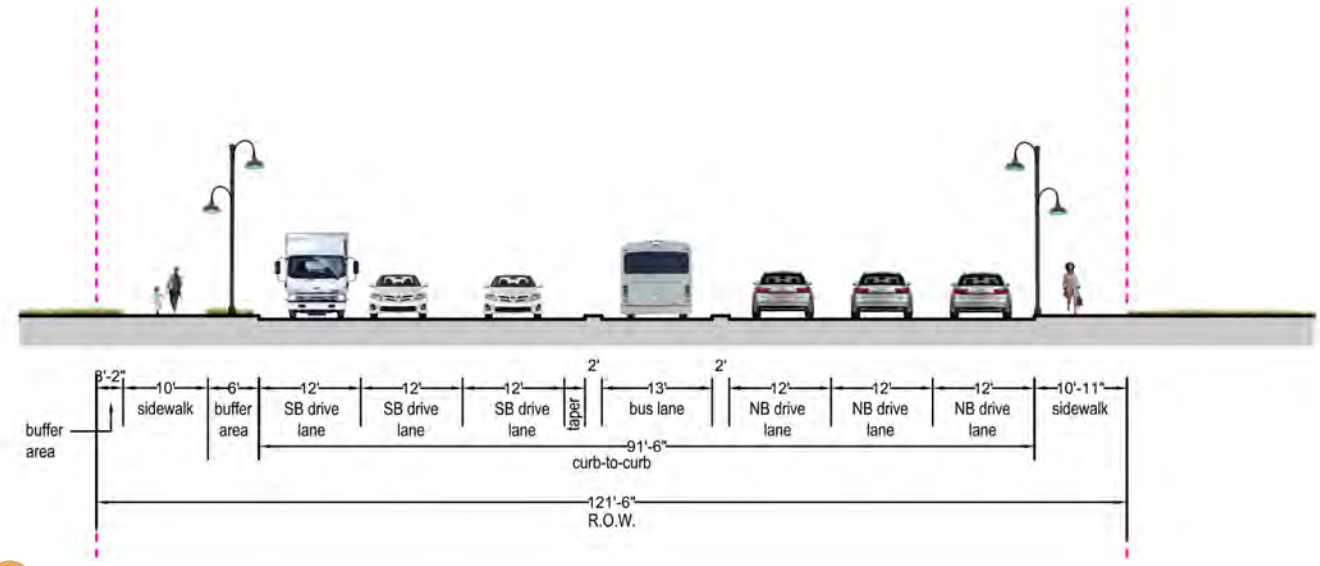


SECTION 5: MD 355 north of Desellum Ave. | ALTERNATIVES

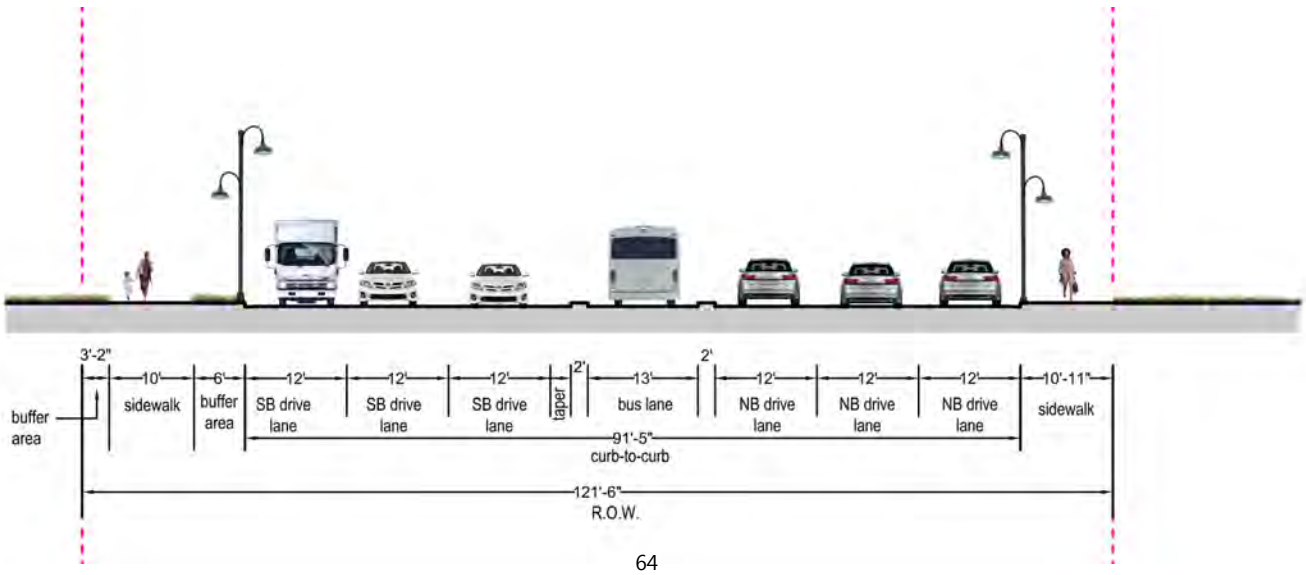
5.D SINGLE-LANE MEDIAN BRT - STANDARD DESIGN ALTERNATIVE



5.E SINGLE-LANE MEDIAN BRT - MINIMUM DESIGN ALTERNATIVE

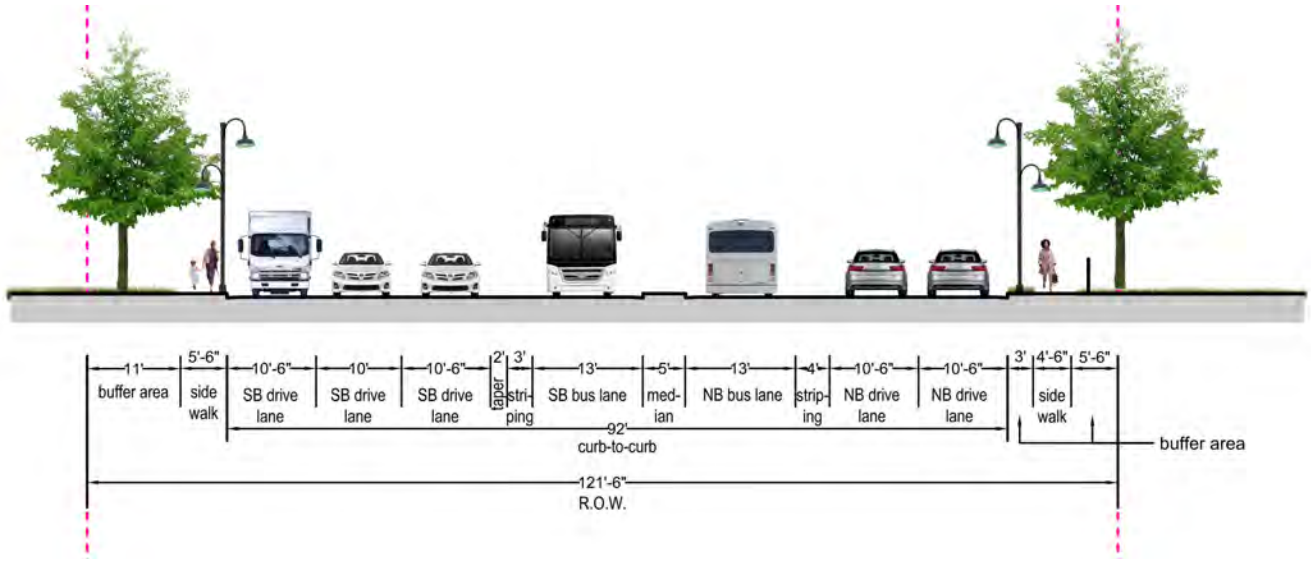


5.F SINGLE-LANE MEDIAN BRT - REDUCED IMPACT ALTERNATIVE

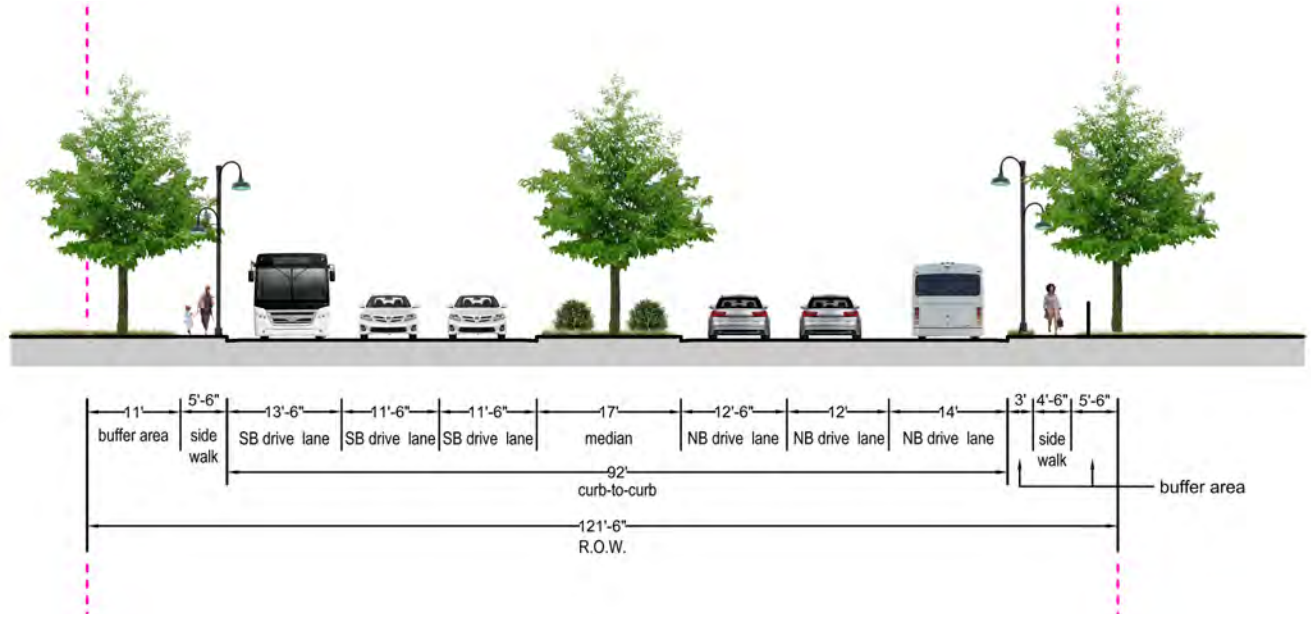


SECTION 5: MD 355 north of Desellum Ave. | ALTERNATIVES

5.G LANE REPURPOSING ALTERNATIVE



5.H MIXED TRAFFIC ALTERNATIVE



2.4 Traffic Operations Analysis

The BRT will provide an attractive alternative to driving for residents, employees, and visitors in the City and reduce future traffic demands on the MD 355 corridor. Ultimately, the city expects the BRT will attract significant ridership to support long-term redevelopment along MD 355.

The City of Gaithersburg recognizes that it is important to maintain acceptable traffic operations on MD 355 to support regional access to and through the City. The scope of this study does not include development of long-term ridership or traffic operational projections associated with redevelopment on MD 355, but it is important to evaluate the projected traffic conditions for near-term BRT completion and how each BRT design option is likely to affect traffic operations on MD 355. The BRT design will modify the roadway and intersection design on MD 355 throughout the city, but the focal segment of MD 355 is the likely to be most impacted by the preferred BRT design. To understand the likely traffic operations impacts of the various BRT guideway design options, a traffic operations analysis of the focal segment was performed for each option and a comparison of the results is provided in this section.

Available traffic volume data from the Maryland State Highway Administration and City of Gaithersburg provide the basis for developing traffic projections and conducting traffic analysis for the MD 355 corridor. SHA conducted turning movement traffic counts in 2013 and 2014 for the three signalized intersections in the focal area, and these traffic volumes provide the basis for traffic forecasts and analysis. The existing traffic volume data is summarized in Figure 2-1.

Figure 2-1: Existing Focal Segment Peak Hour Traffic Volumes

Some of the BRT design alternatives include several elements that are likely to affect traffic operations, including the following:

- Modifies lane geometry on the MD 355 focal segment, including lane elimination
- Eliminates left turn access from unsignalized side streets onto MD 355
- Modifies traffic signal timings to support BRT operations on MD 355

A 2025 planning horizon was selected to represent the near-term built condition of the BRT in Gaithersburg. Traffic volume projections were developed for both existing conditions and for each of the BRT design alternatives in the 2025 planning horizon using the Metropolitan Washington Council of Governments (MWCOG) Version 2.3 Travel Model[6].

The 2025 mixed traffic scenario assumes no physical modifications to the corridor will be completed and, thus, represents the baseline for comparison with the other future condition alternatives. Figure 2-2 summarizes the baseline future traffic volume projections associated with the mixed traffic scenario.

[6] 2025 traffic volumes were developed by applying the MWCOG travel model forecasted growth rates from 2010 to 2020 to the 2013-14 peak hour traffic counts data for the study intersections.

Figure 2-2: 2025 Future Baseline BRT Peak Hour Traffic Volumes

All other future BRT alternatives involve modifications to the roadway that will influence traffic on the focal segment. Traffic volume projections for the future BRT alternatives reflect two important influences on traffic volumes for the corridor:

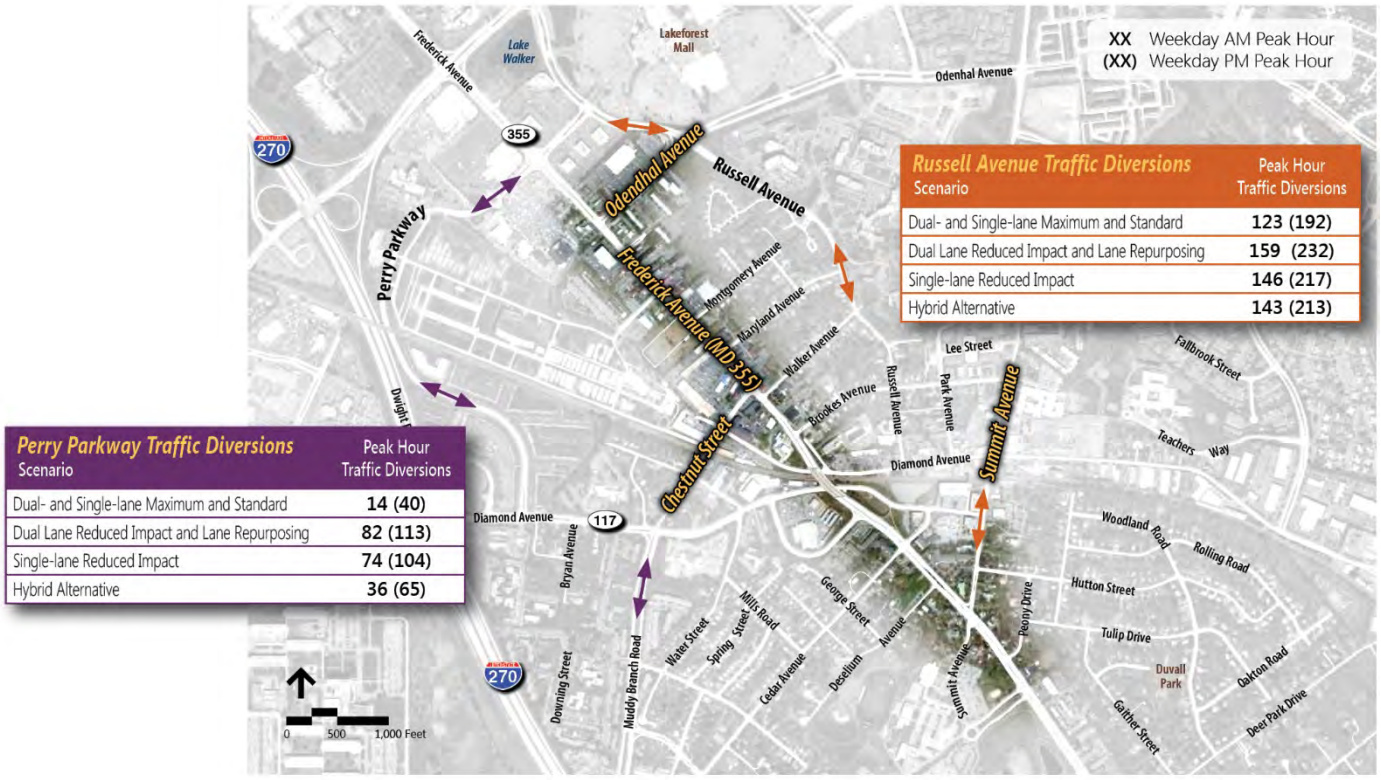
- Diversions to alternative corridors related to reduced roadway capacity
- Median guideways will eliminate left turn access to and from some side streets

Changes in the number of lanes provided along the focal segment will reduce the overall roadway capacity and are likely to result in some traffic diversions to parallel corridors. Potential traffic diversions were calculated for individual portions of the MD 355 focal segment based on the number of traffic lanes provided in each BRT design alternative and traffic volume screenline analysis derived from the MWCOG travel demand forecast model, using NCHRP-255 refinement methodologies. These potential diversions were then additionally factored based on relative travel time differences between MD 355 and the alternative corridors during peak conditions. The resulting traffic volume diversions from the MD 355 focal segment to parallel corridors range from approximately one to three percent of individual traffic movement volumes. These diversions were applied to the signalized intersection traffic volume forecasts, but only for traffic using public streets and exclude traffic entering or exiting properties.

Peak hour traffic volume data for approximately eight unsignalized intersections on the MD 355 focal segment were reviewed to identify left turn movement traffic volumes impacted by

future BRT median guideways. Where left turn access will be eliminated, projections for the left turn traffic volumes to divert along alternative routes were developed. After implementation of a BRT median guideway, existing left turn traffic to or from unsignalized intersections within the focal segment will likely turn at one of the signalized intersection to take an alternative route to their destinations. These diversions may involve using other roadways or performing a U-turn at the closest signalized intersection. Left turn traffic volume diversion estimates were developed for a total of 181 and 300 vehicles during the weekday morning and weekday evening peak hours, respectively. The left turn diversions were applied to the peak hour signalized intersection traffic volume projections. Figure 2-3 summarizes the anticipated traffic volume diversions to alternative routes associated with each BRT alternative.

Figure 2-3: Gaithersburg BRT-related Traffic Volume Diversions



The evaluation criteria used to analyze area intersections and roadways in this traffic evaluation are based on two methodologies: the Critical Lane Volume (CLV) standards adopted by the Maryland State Highway Administration, Montgomery County, and City of Gaithersburg for evaluation of adequate public facilities and the 2010 Highway Capacity Manual (HCM)[7]. The Critical Lane Volume methodology is used for signalized intersections and the HCM Multilane Highway analysis methodology for roadway segments.

Level of Service (LOS) is the term used to denote the different operating conditions which occur on a given roadway segment under various traffic volume loads. Under the CLV

[7] Transportation Research Board, Highway Capacity Manual, Washington, D.C., 2010

methodology, LOS is a quantitative calculation of the greatest conflicting traffic volumes, considering the intersection geometry, and representing the critical intersection capacity.

The CLV analysis was conducted for the three signalized intersections within the focal segment: MD 355 at Odendhal Avenue, MD 355 at Chestnut Street, and MD 355 at Summit Avenue. The CLV methodology calculates a peak hour volume for opposing left-turn and through/right-turn movements, adjusted by a set of factors which account for the lane geometry, signal phasing, and right-turn operations. The highest opposing volumes on the northbound/southbound directions and eastbound/westbound directions are considered the critical lane volumes. Where split signal phasing is present, such as the MD 355/Summit Avenue intersection, the traffic volumes for both opposing approaches are considered critical. The aggregate of the highest north/south and east/west critical lane volume values is compared to critical lane volume thresholds for level-of-service adopted by SHA. Table 2-10 provides a summary of the CLV methodology level-of-service thresholds. The level-of-service threshold considered acceptable for signalized intersections in the City of Gaithersburg is a critical lane volume per hour value of 1,450 (LOS D).

Table 2-10: CLV Level-of-Service Thresholds

Level of Service	CLV Methodology (Critical lane volume per hour expressed in vehicles)
A	< 1,000
B	1,000 - 1,150
C	1,150 - 1,300
D	1,300 - 1,450
E	1,450 - 1,600
F	1,600

The HCM Multilane Highway analysis methodology was used to evaluate the roadway segment performance for two segments of MD 355 within the focal segment: Odendhal Avenue to Chestnut Street and Chestnut Street to Summit Avenue. The roadway characteristics for each segment are distinct and the roadway analysis reflects variations in traffic volume associated with the northern and southern portions of the focal segment

Traffic volume projections for MD 355 in each direction were derived from the intersection traffic volume forecasts used for the CLV analysis. For each roadway segment, the higher peak hour approach volume from either of the bordering signalized intersections was used for the multilane segment volume. The multilane highway analysis uses the ideal free flow speed of the roadway, peak hour traffic volume, and roadway geometry characteristics to calculate the roadway's traffic density in passenger cars per mile per lane (pc/mi/ln) for each travel direction. The HCM provides thresholds for LOS based on traffic density, as summarized in Table 2-11 for a corridor with the lowest allowable free flow speed like MD 355.

Table 2-11: HCM Multilane Highway Level of Service Thresholds

Level of Service	Density (pc/mi/ln)
A	>0-11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	>45

The intersection and roadway traffic operations analysis was completed for the Existing, 2025 BRT Mixed Traffic, and 2025 BRT Alternatives conditions. The results of the intersection and roadway capacity analyses are summarized in Tables 2-12 and 2-13. The detailed traffic operations analysis worksheets and results are included in Appendix C.

Table 2-12: Signalized Intersection Critical Lane Volume LOS Results Summary

Condition/Time Period	MD 355 at Odendhal Avenue		MD 355 at Chestnut Street		MD 355 at Summit Avenue	
	CLV	LOS	CLV	LOS	CLV	LOS
Existing Condition						
Weekday AM Peak Hour	1,088	B	931	A	889	A
Weekday PM Peak Hour	927	A	825	A	880	A
2025 BRT Mixed Traffic						
Weekday AM Peak Hour	1,299	C	1,136	B	1,063	B
Weekday PM Peak Hour	1,107	B	1,006	B	1,053	B
2025 BRT Dual-lane Standard						
Weekday AM Peak Hour	1,316	D	1,147	B	1,063	B
Weekday PM Peak Hour	1,241	C	1,025	B	1,049	B
2025 BRT Dual-lane Minimum						
Weekday AM Peak Hour	1,316	D	1,147	B	1,063	B
Weekday PM Peak Hour	1,241	C	1,025	B	1,049	B
2025 BRT Dual-lane Reduced Impact						
Weekday AM Peak Hour	1,283	C	1,147	B	1,057	B
Weekday PM Peak Hour	1,110	B	1,025	B	1,042	B
2025 BRT Single-lane Standard						
Weekday AM Peak Hour	1,316	D	1,147	B	1,063	B
Weekday PM Peak Hour	1,241	C	1,025	B	1,049	B
2025 BRT Single-lane Minimum						
Weekday AM Peak Hour	1,316	D	1,147	B	1,063	B
Weekday PM Peak Hour	1,241	C	1,025	B	1,049	B
2025 BRT Single-lane Reduced Impact						
Weekday AM Peak Hour	1,283	C	1,147	B	1,063	B
Weekday PM Peak Hour	1,110	B	1,025	B	1,049	B
2025 BRT Lane Repurposing						
Weekday AM Peak Hour	1,283	C	1,147	B	1,057	B
Weekday PM Peak Hour	1,110	B	1,025	B	1,042	B

The signalized intersection traffic operations analysis results for each intersection are similar for many of the alternatives. The differences between the results for the various future BRT alternatives generally reflect traffic volume shifts associated with modifications to lane geometry or eliminated left turns at unsignalized intersections.

In general, the BRT design alternatives maintain the existing intersection lane geometry, including turn lanes, which will limit the potential impact on the progression of through traffic in the corridor. Eliminating turning lanes at signalized intersections on MD 355 is likely to cause significant additional vehicular delay, queuing, and safety issues, creating an unacceptable traffic operational condition.

The signalized intersection traffic analysis results indicate that all of the study intersections currently operates at acceptable LOS and are anticipated to operate at acceptable LOS during the both peak hours under all future BRT alternatives. All of the BRT alternatives exhibit similar CLV results, and these results do not strongly indicate an advantage for any particular alternative.

The traffic analysis results indicate that adequate traffic lane capacity will be available to accommodate future traffic volume projections at the focal segment intersections. However, the CLV results do not necessarily reflect the level of congestion and queuing observed on the MD 355 corridor during some peak periods. The actual operations of MD 355, particularly at the MD 355/Odendhal Avenue and MD 355/Chestnut Avenue intersections, may be significantly influenced by factors not accounted for in this methodology, such as the narrow lane geometry and turning movements or other disruptive traffic activity associated with numerous commercial land uses on the corridor. Due to overall growth in traffic volume on MD 355, all future scenarios are likely to result in some elevated traffic congestion and queuing at the signalized intersections.

Table 2-13: Roadway Segment Capacity Analysis Results Summary

Condition/Time Period	MD 355 Southbound				**MD 355 Northbound**			
	Odendhal Ave to Chestnut Street		Chestnut Street to Summit Ave		Odendhal Ave to Chestnut Street		Chestnut Street to Summit Ave	
	Density	LOS	Density	LOS	Density	LOS	Density	LOS
Existing Condition								
Weekday AM Peak Hour	26.7	D	16.7	B	12.7	B	4.9	A
Weekday PM Peak Hour	15.8	B	10.3	A	32.1	D	12.8	B
2025 Mixed Traffic								
Weekday AM Peak Hour	32.0	D	20.0	C	15.2	B	5.9	A
Weekday PM Peak Hour	19.0	C	12.3	B	38.5	E	19.4	C
2025 BRT Dual-lane Standard								
Weekday AM Peak Hour	29.9	D	17.5	B	15.0	B	5.9	A
Weekday PM Peak Hour	17.1	B	10.3	A	36.6	E	13.0	B
2025 BRT Dual-lane Minimum								
Weekday AM Peak Hour	29.9	D	17.5	B	15.0	B	5.9	A
Weekday PM Peak Hour	17.1	B	10.3	A	36.6	E	13.0	B
2025 BRT Dual-lane Reduced Impact								
Weekday AM Peak Hour	43.7	E	20.0	C	14.6	B	8.9	A
Weekday PM Peak Hour	25.0	C	11.9	B	35.7	E	22.4	C
2025 BRT Single-lane Standard								
Weekday AM Peak Hour	29.9	D	17.5	B	15.0	B	5.9	A
Weekday PM Peak Hour	17.1	B	10.3	A	36.6	E	13.0	B
2025 BRT Single-lane Minimum								
Weekday AM Peak Hour	29.9	D	17.5	B	15.0	B	5.9	A
Weekday PM Peak Hour	17.1	B	10.3	A	36.6	E	13.0	B
2025 BRT Single-lane Reduced Impact								
Weekday AM Peak Hour	43.7	E	20.1	C	14.6	B	5.9	A
Weekday PM Peak Hour	25.0	C	12.0	B	35.7	E	15.0	B
2025 BRT Lane Repurposing								
Weekday AM Peak Hour	43.7	E	20.0	C	14.6	B	8.9	A
Weekday PM Peak Hour	25.0	C	11.9	B	35.7	E	22.4	C

The results of the traffic operations analysis indicate that the MD 355 roadway segments within the focal segment currently operate at acceptable LOS in both directions during all peak periods. The segment from Odendhal Avenue to Chestnut Street, in both the southbound and northbound directions, currently experiences the greatest congestion (represented by the highest traffic density) during peak hours.

The results indicate that elevated traffic density will occur on the roadway segments under any of the BRT design alternatives, but the segments will continue to operate at acceptable levels of service for most time periods. However, the segment from Odendhal Avenue to Chestnut Street will experience elevated traffic congestion crossing into the LOS E range, which is considered an unacceptable condition, under multiple BRT alternatives during both the weekday morning and evening peak hours. This condition reflects both overall growth in

traffic volume on the corridor by 2025 and modified lane geometry on this segment in some of the BRT alternatives.

The Odendhal to Chestnut segment will operate under LOS E conditions in the northbound direction during the weekday evening peak hour for all future BRT alternatives. None of the BRT alternatives plan to reduce the overall northbound lane capacity, so these results primarily reflect projected overall growth in regional traffic volume. The LOS E results for the northbound direction are generally on the lowest end of the LOS E range (35-37 pc/mi/ln), except for the mixed traffic alternative, which is projected to operate at higher levels of traffic density and congestion.

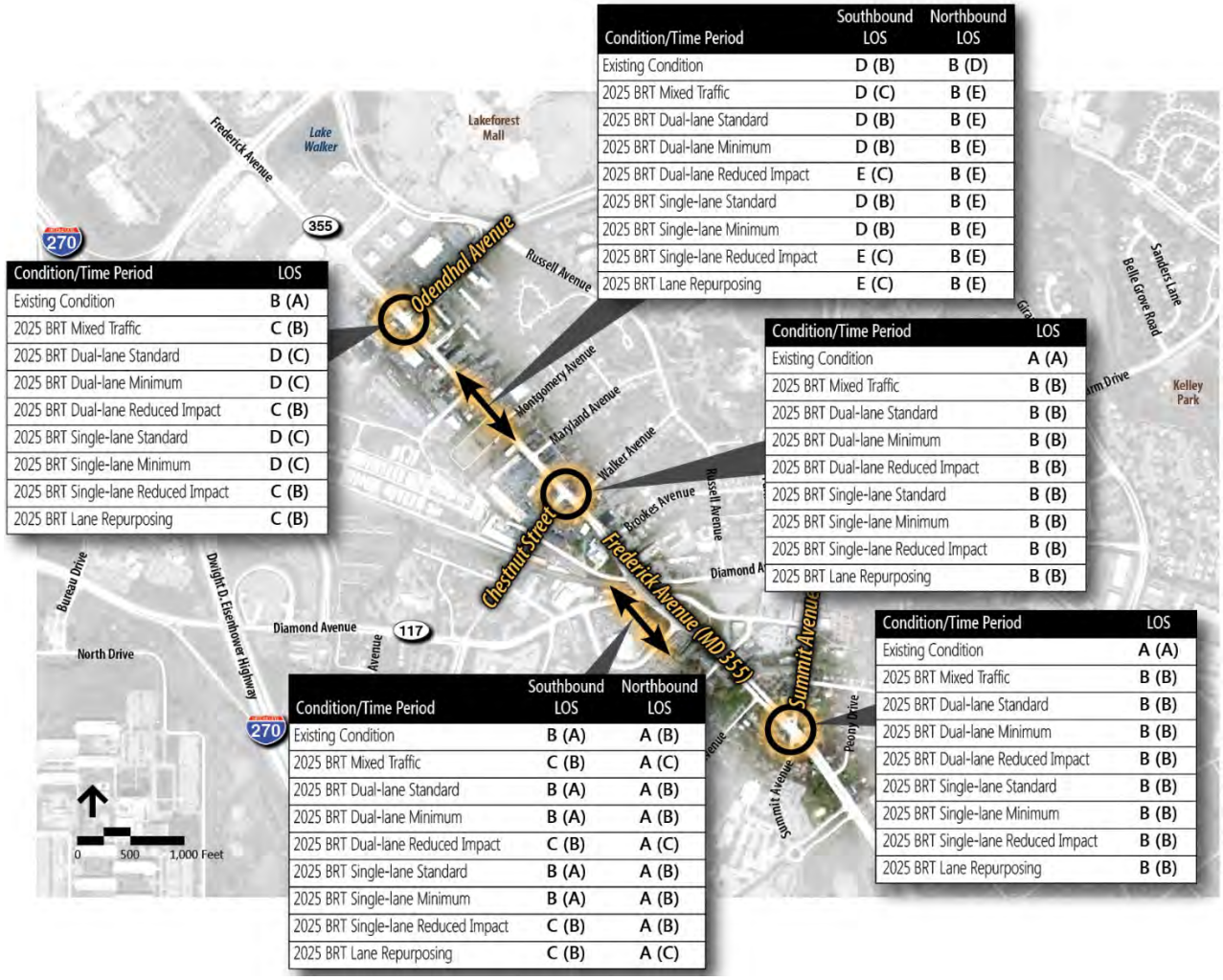
In the southbound direction, the Odendhal to Chestnut segment will operate at LOS D for many of the BRT alternatives during the weekday morning peak hour. However, this segment is projected to experience LOS E conditions under the following BRT alternatives:

- Dual-lane Reduced Impact
- Single-lane Reduced Impact
- Lane Repurposing

The LOS E results for these three alternatives are all near the upper limit of the LOS E range, which suggests traffic operations under these alternatives will approach the roadway's total capacity (45 pc/mi/ln) as defined by the HCM. These results suggest the southbound segment from Odendhal Avenue to Chestnut Street will operate with significantly greater vehicular delay, queuing, merging/weaving challenges, and potentially induce additional traffic diversions onto local and residential streets during the weekday morning peak hour. The BRT alternatives associated with these result were designed to minimize property impacts on the corridor, but are likely to result in significant degradation of traffic operations on the corridor during both the weekday morning peak hour.

Figure 2-4 visually summarizes the Level of Service results for both the signalized intersection and roadway segment evaluations.

Figure 2-4: MD 355 Focal Segment Level of Service Results



Condition/Time Period	Southbound LOS	Northbound LOS
Existing Condition	D (B)	B (D)
2025 BRT Mixed Traffic	D (C)	B (E)
2025 BRT Dual-lane Standard	D (B)	B (E)
2025 BRT Dual-lane Minimum	D (B)	B (E)
2025 BRT Dual-lane Reduced Impact	E (C)	B (E)
2025 BRT Single-lane Standard	D (B)	B (E)
2025 BRT Single-lane Minimum	D (B)	B (E)
2025 BRT Single-lane Reduced Impact	E (C)	B (E)
2025 BRT Lane Repurposing	E (C)	B (E)

Condition/Time Period	LOS
Existing Condition	B (A)
2025 BRT Mixed Traffic	C (B)
2025 BRT Dual-lane Standard	D (C)
2025 BRT Dual-lane Minimum	D (C)
2025 BRT Dual-lane Reduced Impact	C (B)
2025 BRT Single-lane Standard	D (C)
2025 BRT Single-lane Minimum	D (C)
2025 BRT Single-lane Reduced Impact	C (B)
2025 BRT Lane Repurposing	C (B)

Condition/Time Period	LOS
Existing Condition	A (A)
2025 BRT Mixed Traffic	B (B)
2025 BRT Dual-lane Standard	B (B)
2025 BRT Dual-lane Minimum	B (B)
2025 BRT Dual-lane Reduced Impact	B (B)
2025 BRT Single-lane Standard	B (B)
2025 BRT Single-lane Minimum	B (B)
2025 BRT Single-lane Reduced Impact	B (B)
2025 BRT Lane Repurposing	B (B)

Condition/Time Period	Southbound LOS	Northbound LOS
Existing Condition	B (A)	A (B)
2025 BRT Mixed Traffic	C (B)	A (C)
2025 BRT Dual-lane Standard	B (A)	A (B)
2025 BRT Dual-lane Minimum	B (A)	A (B)
2025 BRT Dual-lane Reduced Impact	C (B)	A (C)
2025 BRT Single-lane Standard	B (A)	A (B)
2025 BRT Single-lane Minimum	B (A)	A (B)
2025 BRT Single-lane Reduced Impact	C (B)	A (B)
2025 BRT Lane Repurposing	C (B)	A (C)

Condition/Time Period	LOS
Existing Condition	A (A)
2025 BRT Mixed Traffic	B (B)
2025 BRT Dual-lane Standard	B (B)
2025 BRT Dual-lane Minimum	B (B)
2025 BRT Dual-lane Reduced Impact	B (B)
2025 BRT Single-lane Standard	B (B)
2025 BRT Single-lane Minimum	B (B)
2025 BRT Single-lane Reduced Impact	B (B)
2025 BRT Lane Repurposing	B (B)

2.5 Cost Estimates

Planning-level cost estimates for each of the BRT design layout alternatives were developed using the conceptual design attributes from each layout and 2015 unit cost data developed specifically for the Montgomery County RTS. The cost estimate methodology is consistent with the methodology VHB developed for the Montgomery County Department of Transportation's (MCDOT) updated 2015 BRT Cost Estimates supporting the Montgomery County Transit Task Force BRT financing process.

Basis of Estimate – BRT Conceptual Design Layouts

Estimates of capital costs are often based on a preliminary engineering or more advanced level of design. The Gaithersburg BRT design layouts provide some basis for estimating the cost of each alternative, but these designs represent a high-level feasibility-oriented concept for each alternative, without the benefit of key information required for detailed design, such as field survey, geotechnical data, below-grade utility information, or structural data required for detailed design and cost estimation. Given the early and very preliminary nature of these design concepts, there is more potential variability in cost estimates. The City of Gaithersburg

should be aware of the substantial likelihood of changes as designs are advanced for any of the proposed design alternatives during the Facility Planning/Design Process, and an appropriate contingency was applied to all cost estimates, consistent with the approach adopted for MCDOT.

Capital Cost Estimate Methodology

The capital cost estimate methodology was originally developed for MCDOT's Countywide BRT cost estimate and most recently updated in July 2015 for revised BRT cost estimates provided to the Montgomery County Transit Task Force. Basic templates for BRT guideway and station areas reflecting the recommendations for operational quality provided in the *Approved and Adopted Countywide Transit Corridors Functional Master Plan* were developed to provide consistency in capital cost estimates for a range of BRT design elements. Additional costs related to widening existing streets, utility relocation, bridges, retaining walls and intersection improvements were also developed for locations where implementation of the recommended treatments were likely to necessitate this additional construction.

To estimate the unit prices applied to the BRT components, 2015 cost data from the Federal Transit Administration, Maryland State Highway Administration, Montgomery County, and other relevant transportation resources were compiled, reviewed, and adopted. Standard templates for BRT design components, such as the dual-lane median guideway, number of travel lanes included in roadway widening, or traffic signal reconstruction, were developed based on the aggregated cost of the materials, including asphalt, concrete, drainage structures, landscaping, etc. Costs associated with each template were converted to cost per linear foot, square foot, or item. Lengths, areas, and quantities for each of these components of the BRT system were calculated from the Gaithersburg BRT design layouts.

For stations, templates for the layout of the stations (including left-turn lanes at intersections) and station elements (canopies, fare vending machines, benches, etc.) were developed. The station costs calculated for this cost estimate include the overall cost to reconstruct traffic signals and the entire roadway within several hundred feet of the station area. The station costs account for the guideway type (which influences the number of platforms) and number of traffic lanes.

For guideways, per linear foot costs were developed (including curbing, drainage and stormwater management, paving, etc.) The costs for the basic elements of guideway and stations were developed in collaboration with MCDOT's Division of Transportation Engineering staff. Additional elements (e.g., utility relocation, signal modifications, bridge work, and retaining walls) were then applied to the corridor estimates as appropriate using per linear foot or per location estimates.

The need to acquire private property for the necessary public right of way to accommodate the BRT and roadway modifications was also considered. Using city and state GIS data resources, additional right-of-way beyond that currently publicly-owned land was estimated using parcel-data along each corridor. Assessed property and building value data provided by the City of Gaithersburg were used to produce cost estimates for specific parcel and building acquisitions. The limits of disturbance associated with each BRT design layout on the focal segment were used to identify portions of properties that must be acquired to construct each alternative. Outside of the focal segment, a uniform right-of-way width of 140

feet was applied along the centerline of MD 355, and the costs for any portions of properties within the recommended right-of-way were calculated. For properties where existing buildings are impacted, the cost for the entire property was calculated.

From these assumptions, a 2015 capital cost estimate for MD 355 in the City of Gaithersburg was produced. In general, a 50-percent contingency is applied to all capital costs to account for the planning-level uncertainty associated with specific design details to be addressed in the future.

Gaithersburg MD 355 Capital Cost Estimate

Capital cost estimates were produced for the each of the BRT design alternatives on MD 355 in the City of Gaithersburg. These cost estimates are provided in 2015 dollars. The following assumptions were used to produce the cost estimates for the various alternatives:

- Dual-lane median BRT guideways were assumed for MD 355 north of Odendhal Avenue and south of Summit Avenue for all alternatives
- BRT guideway selection in the focal segment was based on the planning-level design layouts for each alternative
- Assumptions regarding the amount of roadway widening required for various parts of the corridor are based on typical dimensions for the BRT guideway compared to existing available median space and the focal segment planning-level design layouts.
- All signalized intersections and traffic signals where median guideway is planned are assumed to require reconstruction to relocate signal infrastructure and accommodate new intersection geometry
- Utility poles are assumed to require relocation anywhere the roadway will be widened
- Full bridge reconstruction in the focal segment is assumed for alternatives that indicate the roadway cross-section will exceed the bridge width
- A total of five BRT stations, as identified in the *Countywide Transit Corridors Functional Master Plan,* were included in the cost estimates for all alternatives
- The Brookes Avenue station was not included in the cost estimate because of significant concerns about the utilization and feasibility of this station
- The mixed traffic alternative is assumed to require no land acquisition or major construction elements in the focal segment

The capital cost estimates for MD 355 in the City of Gaithersburg are summarized in Table 2-14. Copies of the detailed cost estimate worksheets and unit cost data assumptions used to calculate the overall BRT facility costs are included in Appendix D.

Table 2-14: 2015 Gaithersburg BRT Capital Cost Estimate Summary

BRT Design Condition	Costs			Total Cost
	Game Preserve Road to Odendhal Avenue	Focal Segment (Odendhal Avenue to Summit Avenue)	Summit Avenue to O'Neill Drive	
Dual-lane Standard				
Design/Construction	$71,581,700	$88,771,300	$49,599,200	$209,952,200
Land Acquistion	$6,506,867	$23,698,031	$11,463,295	$41,668,194
Total	**$78,088,567**	**$112,469,331**	**$61,062,495**	**$251,620,394**
Dual-lane Minimum				
Design/Construction	$72,895,000	$80,704,300	$49,599,200	$203,198,500
Land Acquistion	$7,544,497	$6,395,706	$12,846,710	$26,786,913
Total	**$80,439,497**	**$87,100,006**	**$62,445,910**	**$229,985,413**
Dual-lane Reduced Impact				
Design/Construction	$72,895,000	$42,774,700	$49,599,200	$165,268,900
Land Acquistion	$7,544,497	$3,039,497	$12,846,708	$23,430,702
Total	**$80,439,497**	**$45,814,197**	**$62,445,908**	**$188,699,602**
Single-lane Standard				
Design/Construction	$72,895,000	$79,881,300	$49,599,200	$202,375,500
Land Acquistion	$7,544,497	$13,945,753	$12,846,708	$34,336,958
Total	**$80,439,497**	**$93,827,053**	**$62,445,908**	**$236,712,458**
Single-lane Minimum				
Design/Construction	$72,895,000	$77,415,200	$49,599,200	$199,909,400
Land Acquistion	$7,544,497	$2,550,287	$12,846,708	$22,941,493
Total	**$80,439,497**	**$79,965,487**	**$62,445,908**	**$222,850,893**
Single-lane Reduced Impact				
Design/Construction	$72,895,000	$37,350,600	$49,599,200	$159,844,800
Land Acquistion	$7,544,497	$1,449,934	$12,846,708	$21,841,139
Total	**$80,439,497**	**$38,800,534**	**$62,445,908**	**$181,685,939**
Lane Repurposing				
Design/Construction	$79,246,500	$29,232,700	$52,801,200	$161,280,400
Land Acquistion	$7,544,493	$1,406,273	$12,846,708	$21,797,474
Total	**$86,790,997**	**$30,638,973**	**$65,647,908**	**$183,077,878**
Mixed Traffic				
Design/Construction	$81,237,000	$1,872,400	$52,801,200	$135,910,600
Land Acquistion	$7,544,493	$0	$12,846,708	$20,391,201
Total	**$88,950,644**	**$1,872,400**	**$65,647,908**	**$156,470,952**

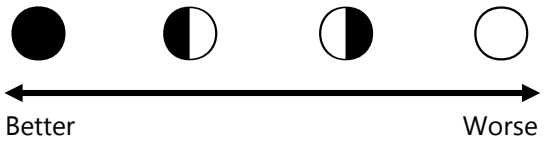
The capital cost estimates indicate that the overall capital costs for the BRT alternatives in the City of Gaithersburg range from $156.5 million to $251.6 million. The Dual-lane Standard and Single-lane Standard alternatives represent the highest cost options. The Single-lane Reduced Impact, Lane Repurposing, and Mixed Traffic alternatives represents the lowest cost options.

2.6 BRT Alternatives Comparison

The following table provides a comparison of how each of the design alternatives described above rates in terms of traffic impacts, BRT operations, and property impacts. Those alternatives that rate well receive a solid circle while those receiving a hollow circle score poorly. Alternatives that fall somewhere between a high score and a low score receive a partially-filled circle, with the partially filled left half being better than the partially filled right half. In addition to the scoring, each alternative's total capital cost is included in the table.

Table 2-15: Comparison of BRT Alternatives

	BRT Operations		Traffic Operations				Property Impacts	Cost ($ million)
	Operating Speed	Stop Locations	Traffic Density/ Congestion	Intersection Capacity	Unsignalized Turning Movements	Land Use Access/ Egress		
Dual-lane Standard	●	●	●	●	○	○	○	$251.6
Dual-lane Minimum	●	●	●	●	○	○	○	$230.0
Dual-lane Reduced	●	●	○	●	○	○	◑	$188.7
Single-lane Standard	◐	◐	●	●	○	○	○	$236.7
Single-lane Minimum	◐	◐	●	●	○	○	◑	$222.9
Single-lane Reduced	◐	◐	○	●	○	○	◐	$181.7
Lane Repurposing	◑	○	○	●	○	○	◐	$183.1
Mixed Traffic	○	◑	◐	●	●	●	●	$156.5



2.7 Summary of Findings

A review of the different BRT alternatives show that each of the four alternatives have their pluses and minuses. The mixed traffic alternative may provide the least amount of property impacts resulting in no potential property acquisitions or access impacts, and retaining the existing roadway operations along the focal segment. This alternative would result in a BRT that travels at the same speed as general traffic throughout the focal segment and an overall slower speed for the whole BRT corridor. Additionally, there are some traffic impacts.

The lane repurposing alternative appears to provide the fewest benefits. While it does limit property impacts substantially, the resulting negative impact to BRT operations due to the minimal separation between vehicles and buses cannot be overlooked. There are few traffic benefits and numerous impacts resulting from limitations on turning movements and access.

The various single-lane median guideway designs provide reasonable BRT operations. Decisions about whether these design alternatives would operate as peak-directional or bi-directional have different impacts on overall bus speeds and system capacity. Impacts to traffic are not great, but the reduced impact alternative does limit intersection delay. This alternative also results in fewer property impacts than the minimum or standard alternative.

The dual-lane median guideway designs provide the greatest BRT operations benefit of all the alternatives presented. However, these benefits come with a fairly high property impact cost associated with the wider curb-to-curb widths. The reduced impact design does lessen the need to acquire additional property and provides the least impact to intersection delay of the three dual-lane alternatives.

Based on this assessment the minimum and reduced impact alternatives for the dual-lane and single-lane guideway options provide good BRT operations and fewer property impacts than the standard design alternatives. The impacts to traffic congestion will likely be worse in the reduced impact alternatives because of the loss of travel lanes. Further assessment of whether a hybrid alternative that applies more than one of the described alternatives to various segments of the focal segment as opposed to all of MD 355 from Odendhal Avenue to Summit Avenue to achieve a greater balance of the impacts will be explored in the next chapter.

3

Bus Rapid Transit Hybrid Design Alternative

3.1 Introduction

The previous chapter presented eight design alternatives for implementing BRT along MD 355 from Odendhal Avenue to Summit Avenue. These alternatives assumed a consistent application from end to end regardless of the impacts. Four of the alternatives presented show the most promise in achieving a BRT corridor that provides improved bus speeds, low- to moderate traffic impacts, and minimal property impacts compared to the other alternatives.

- Dual-lane Minimum Design
- Dual-lane Reduced Impact Design
- Single-lane Minimum Design
- Single-lane Reduced Impact Design

It has been acknowledged that the MD 355 corridor from Odendhal to Summit is not consistent in design and character. These differences result in some of the above alternatives being more advantageous than others for portions of the focal area. A more concentrated look at the focal study area was conducted to understand whether a blending of more than one alternative could be achieved to provide a greater balance of the benefits and impacts.

3.2 Focal Segment Hybrid Design Alternatives

To produce a hybrid design alternative planning-level layout for the BRT on MD 355 in the Gaithersburg focal segment, most of the design assumptions utilized in Chapter 2 to design the original alternatives are carried forward. These assumptions include the following:

- The single-lane guideway will operate with BRT vehicles using the guideway only in the peak direction, and BRT vehicles traveling in the opposite direction will travel in mixed traffic.
- A BRT station will be located at the MD 355/Odendhal Avenue intersection

- A median station at Odendhal Avenue will provide far-side platforms, allowing BRT vehicles to travel through the traffic signal prior to stopping at the station.
- Traffic signal control and full turning movement access will be maintained at the existing traffic signals on MD 355 at Odendhal Avenue, Chestnut Street, and Summit Avenue.
- The existing number of exclusive turn lanes will be maintained on MD 355 at signalized intersections.
- The median guideway design will not provide median breaks at unsignalized intersections to allow left turns to and from side streets.
- Given existing property constraints and the desire to minimize property impacts in the focal segment, on-street bicycle facilities are not included in any of the design alternatives.

In identifying the hybrid design the intent was to provide a balance between BRT operations, traffic operations, and property impacts. As with the previous roadway design layouts, buildings that are likely to be significantly impacted by the roadway design are identified. The layouts also identify buildings that are possibly impacted by the roadway design, where sidewalks still encroach on the buildings; however, these building impacts may be avoided through localized modifications to the sidewalk design intended to preserve the existing building. These roadway design layouts are conceptual, based on design assumptions developed specifically for the focal segment. Detailed roadway design will be required to determine a final roadway layout and define the actual degree of building or property impacts associated with the BRT in the City of Gaithersburg.

The following sections describe the development of the hybrid design alternative by breaking the focal study area into four segments:

- MD 355 from Odendhal Avenue to Chestnut Street
- MD 355 from Chestnut Street to the Father Cuddy Bridge
- MD 355 at the Father Cuddy Bridge
- MD 355 from the Father Cuddy Bridge to Summit Avenue

A copy of the hybrid design alternative layout concept is included in Appendix B.

Transitions between Single-lane and Dual-lane Guideway Segments

The hybrid design alternatives considers the potential to provide both single-lane and dual-lane guideway on different parts the focal segment. For design purposes, it is assumed that the single-lane design alternatives will result in a BRT operation that travels in the guideway in the peak direction only and in general traffic in the non-peak direction. This operational configuration provides the ability for BRT vehicles to travel in both directions at any frequency without conflicts within a single-lane guideway.

However, the interface between a single-lane guideway and dual-lane guideway segment requires a specialized traffic signal with a "queue jump" phase designed to allow for bus-only movements, particularly to exit the guideway. When a bus traveling in the non-peak direction reaches the single-lane guideway, the traffic signal will provide a bus-only phase designed to give the bus priority to enter the mixed traffic lanes. When a non-peak direction bus, traveling in mixed traffic, reaches a segment where dual-lane guideway is provided, the bus needs to

be positioned in the leftmost through lane to maneuver into the dual-lane guideway, or a merging area into the median guideway can be provided at a midblock location. Stations located along the single-lane guideway segment will need provide one or two curbside platforms for BRT vehicles operating in mixed traffic. To minimize the need for curbside platforms and BRT vehicles exiting the dual-lane guideway in advance of a station, it is generally preferable not to locate BRT stations at intersections where the guideway transitions between single-lane and dual-lane guideway.

An alternative operational option for the single-lane guideway could allow bi-directional travel in the guideway, which would place limits on the maximum service frequency that can be achieved in order to preclude simultaneous BRT bus operation in opposite directions within the single-lane guideway. Given the relatively short length of the segment between Odendhal Avenue and Chestnut Street (approximately 2,200 feet), an average BRT operating speed of 20 miles per hour would result in less than 2 minutes of travel time for this roughly half mile segment. A bi-directional operation within a single-lane guideway for this segment should be able to accommodate five minute frequencies. This frequency would still provide a very high quality BRT service, but buses may, at times, be required to idle in the dual-lane guideway at either of the transition points while waiting for a bus traveling in the opposite direction to clear the single-lane guideway.

MD 355 from Odendhal Avenue to Chestnut Street

The Dual-Lane Median Minimum design showed multiple building impacts, while the Dual-Lane Median Reduced Impact and Single-Lane Median Minimum design alternatives showed potential building impacts that may be avoidable. The only alternative out of the four that showed no apparent building impacts for this segment was the Single-Lane Median Reduced Impact design.

All four of the designs result in improved bus speeds due to the exclusive BRT guideway. Traffic operations are most negatively impacted by the Reduced Impact alternatives, which maintain existing lane capacity at intersections, but require eliminating the third southbound travel lane on MD 355 between Odendhal Avenue and Chestnut Street. A reduction in the number of travel lanes would result in increased congestion along MD 355. Retaining the existing signalized intersection lane configurations allows each intersection to continue operating at acceptable levels for all four design alternatives.

The Single-Lane Median Minimum design was selected for this segment in the hybrid design alternative because it provides for improved bus speeds and BRT operations, one potential property impact, and acceptable levels of service and roadway capacity. The transition from dual-lane median guideways to the single-lane guideway at both Odendhal Avenue and Chestnut Street will require specialized traffic signals to provide bus access to and from mixed traffic lanes. Placement of a BRT station at Odendhal Avenue will also require non-peak buses in the southbound direction to exit the median guideway at Lakeforest Boulevard to access a curbside platform at Odendhal Avenue. These design considerations suggest that locating the station at Lakeforest Boulevard may be preferable for operations. This will be explored further in the next chapter.

MD 355 from Chestnut Street to the Father Cuddy Bridge

This short segment of roadway consists of two through lanes in each direction, but widens slightly before approaching the Father Cuddy Bridge, where a third lane in each direction is provided. Despite the widening that occurs between Walker Avenue and Brookes Avenue, all of the design alternatives potentially impact one building on the northeast corner of the MD 355/Walker Avenue intersection. The Single-Lane and Double-Lane Minimum design alternatives are most likely to impact the building. No other buildings along this segment were impacted by any of four design alternatives.

The exclusive BRT guideway for all alternatives results in improved bus speeds and BRT operations along this segment. Traffic operations results are consistent in this segment because similar lane geometry is provided for all alternatives. The intersection at Chestnut Street would operate at the same level of service (LOS B) in each alternative, and the roadway capacity is only slightly decreased in the Dual-Lane Reduced Impact alternative in the peak direction.

The Dual-Lane Median Minimum design was selected for this segment in the hybrid design alternative because it provides for improved bus speeds and BRT operations, only one property impact, and acceptable levels of service and roadway capacity. The traffic signal at MD 355 and Chestnut Street is the planned transition point between the dual-lane median guideway and the single-lane median guideway to the north, and it will need to provide a bus-only phase to allow buses to enter or exit mixed traffic at this location.

MD 355 at Father Cuddy Bridge

This segment of the corridor is one of the most constrained because any alternative that is wider than the existing bridge deck would likely require full bridge replacement, at significant cost, to maintain traffic lane capacity but avoid impacts to the CSX railroad tracks and roadways below the bridge. Because of this, no alternative that would result in bridge widening is being considered as part of the hybrid design. This eliminates both the Single-Lane and Dual-Lane Median Minimum alternatives.

The Dual-Lane Reduced Impact was selected for this segment because it would allow for a consistent guideway design from Chestnut Street headed south. This design would result in three southbound and two northbound general traffic lanes on the bridge. This configuration will require traffic traveling north in the right lane on MD 355, between Summit Avenue and the bridge, to merge into the center lane. The traffic analysis indicates that levels of service will remain acceptable in the planning horizon year 2025, despite the reduction in lane capacity. This alternative provides two exclusive BRT median lanes with no requirement for bridge widening. The sidewalks along the bridge will remain five feet wide, meeting ADA minimum requirements for pedestrian mobility.

MD 355 from Father Cuddy Bridge to Summit Avenue

The segment from south of the Father Cuddy Bridge to Summit Avenue is the widest roadway cross-section of the focal study area. It currently includes three lanes in each direction and a wide median. None of the four alternatives being considered as part of the hybrid showed building impacts, but the two minimum design alternatives would require roadway widening.

Bus speeds and BRT operations are improved under any of these alternatives. Based on the hybrid design chosen for the segment from Chestnut Street to this point, selecting a single-lane design alternative would add another level of complexity. A transition from a dual-lane guideway to a single-lane guideway would be further complicated by requiring a new traffic signal south of the bridge to manage the transition between the different guideway types. These challenges suggest that one of the two dual-lane design alternatives is preferred.

Traffic operations along this segment are only slightly impacted in both of the Reduced Impact design alternatives, and only in the peak direction of travel. Roadway capacity from Chestnut Street to Summit Avenue would remain at acceptable levels of service in all four scenarios. The MD 355 at Summit Avenue intersection is anticipated to continue operating at acceptable levels (LOS B).

The Reduced Impact design for the Father Cuddy Bridge segment as part of the hybrid design provides only two northbound lanes on the bridge. The Dual-lane Reduced Impact alternative was designed to include a northbound merge on MD 355, and minimizes the need to widen the roadway south of the bridge. South of the Route 117 intersection with MD 355, there is a significant retaining wall along the west side and a significant descending slope along the east side of MD 355. This design sacrifices the wider sidewalks included in the Dual-lane Minimum design.

The Dual-Lane Median Reduced Impact design was selected for this segment in the hybrid design alternative and results in improved bus speeds and BRT operations. There are limited property impacts and no building impacts associated with this alternative. Traffic operations were shown to meet acceptable levels of service (D or better) for the segment between Chestnut Street and Summit Avenue. Under the hybrid alternative, northbound traffic in the right lane would merge into the center lane prior to the Father Cuddy Bridge.

Hybrid Alternative

The hybrid alternative that emerged from a review of those alternatives appears to achieve the greatest balance of BRT operations, traffic impacts, and property impacts throughout the corridor. The guideway treatments selected for each part of the corridor includes the following:

- Odendhal Avenue to Chestnut Street - Single-lane Median Minimum design
- Chestnut Street to Father Cuddy Bridge - Dual-lane Median Minimum design
- Father Cuddy Bridge - Dual-lane Median Reduced Impact design
- Father Cuddy Bridge to Summit Avenue - Dual-lane Reduced Impact design

A copy of the hybrid alternative design layout concept is included in Appendix B and identifies both building/entire property impacts and potential property impacts associated with the planned roadway geometry. Table 3-1 summarizes the property impacts for the hybrid design alternative.

Table 3-1: MD 355 Focal Segment – Hybrid Guideway Design Property Impacts

Location	Significant Building Impacts		Possible Building Impacts		Significant Parking Lot Impacts	
	East Side	West Side	East Side	West Side	East Side	West Side
Odendhal Avenue to Chestnut Street	0	0	1	0	2	2
Chestnut Street to Father Cuddy Bridge	1	0	0	0	0	1
Father Cuddy Bridge to Summit Avenue	0	0	0	0	0	0
Total Buildings/Properties	**1**	**0**	**1**	**0**	**2**	**3**

The design layout will require no widening of the Father Cuddy Bridge. In addition to the dual-lane median guideway, two northbound travel lanes and three southbound travel lanes can be accommodated on the bridge without widening. The existing sidewalks, representing the minimum standard sidewalk, are retained. No significant roadway widening is required along the steeply sloped roadside north or south of the bridge, so new retaining walls should not be required.

The hybrid guideway design would allow for improved BRT travel speeds throughout the length of the corridor. Buses traveling within either single-lane or dual-lane guideway are estimated to average speeds between 18 and 22 miles per hour, depending on time of day. The dual-lane guideway segments allows for buses in both directions to achieve these speeds. Buses traveling in the single-lane segments would achieve the same speeds when operating within the guideway, but would see lower speeds (11 to 15 miles per hour) when operating in the general traffic lanes. As detailed design of the BRT advances, operational decisions will be required to determine how buses should operate in the single-lane segments of the corridor. Two operating scenarios are possible:

- Only peak direction travel in the single-lane median guideway
- Bi-directional travel allowing two-way BRT travel within the median guideway at all times, but limiting the frequency of BRT service

In the hybrid design, a bi-directional operating scenario is achievable because of the short segment of single-lane guideway between two signalized intersections. The traffic signals can be design to provide coordination for buses approaching and within the single-lane median guideway.

Both the dual- and single-lane median guideway designs allow for BRT station platforms to be constructed within the median, including support for a single-lane bi-directional BRT operational design. The single-lane guideway design with a peak direction of travel operating scenario would require curbside stations for the non-peak buses, or eliminate stations within this segment.

3.3 Focal Segment Hybrid Design Alternative Cross-sections

As described in Chapter 2 the four smaller segments of the focal study area by character include the following areas:

- Odendhal Avenue to Chestnut Street
- Chestnut Street to Father Cuddy Bridge
- Father Cuddy Bridge
- Father Cuddy Bridge to Summit Avenue

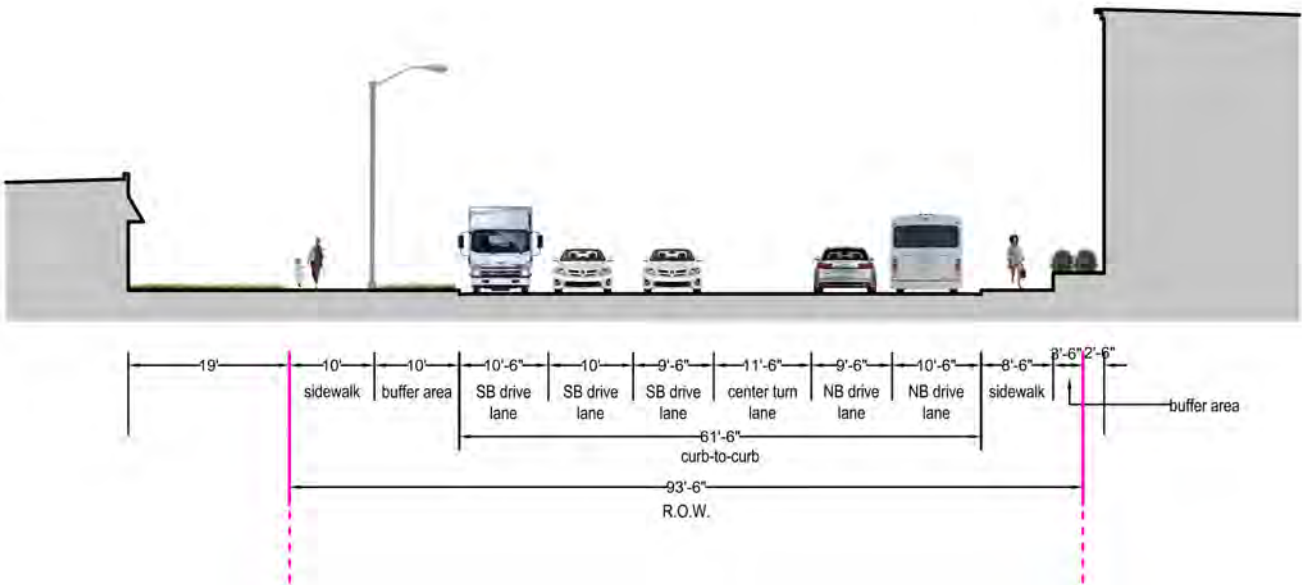
The same cross section locations used for the previous review of alternatives is used for the hybrid alternatives as well to provide a consistent comparison. The locations selected for cross sections include the following:

- MD 355 south of Whetstone Drive
- MD 355 at Montgomery Avenue
- MD 355 between Brookes Avenue and Walker Avenue
- MD 355 at Father Cuddy Bridge
- MD 355 north of Desellum Avenue

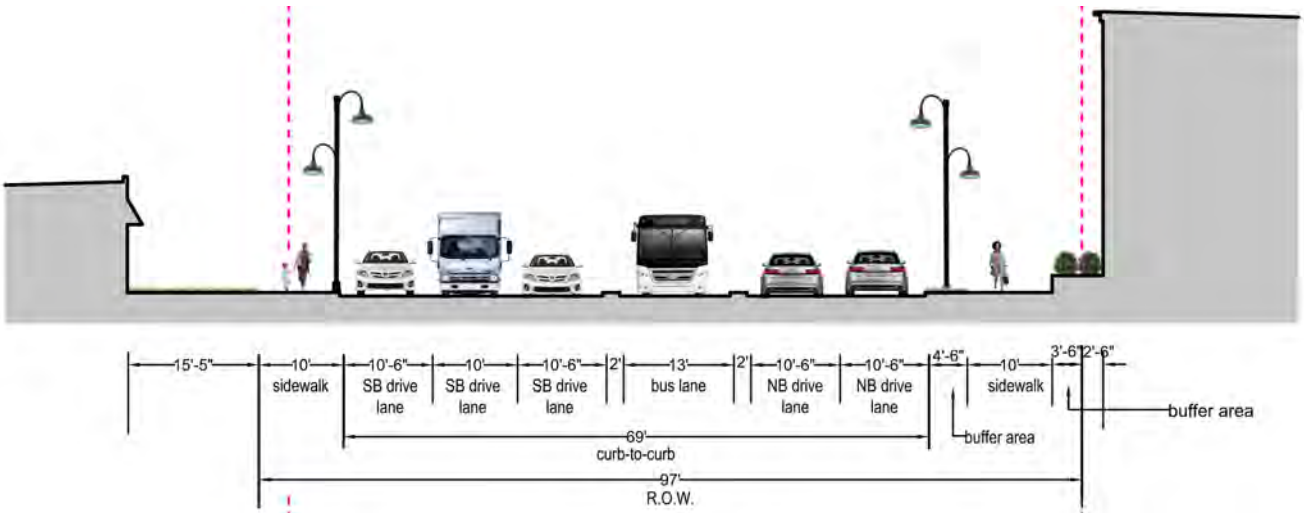
The following pages display each location, the existing lane widths and configuration, and the hybrid alternative. Each cross-section shows the proposed lane, median, and sidewalk widths, changes in roadway alignment, and necessary curb-to-curb width and right-of-way. Also indicated on the cross-sections are any potential property impacts.

SECTION 1: MD 355 south of Whetstone Drive | LOCATOR MAP, EXISTING CONDITIONS, HYBRID ALTERNATIVE

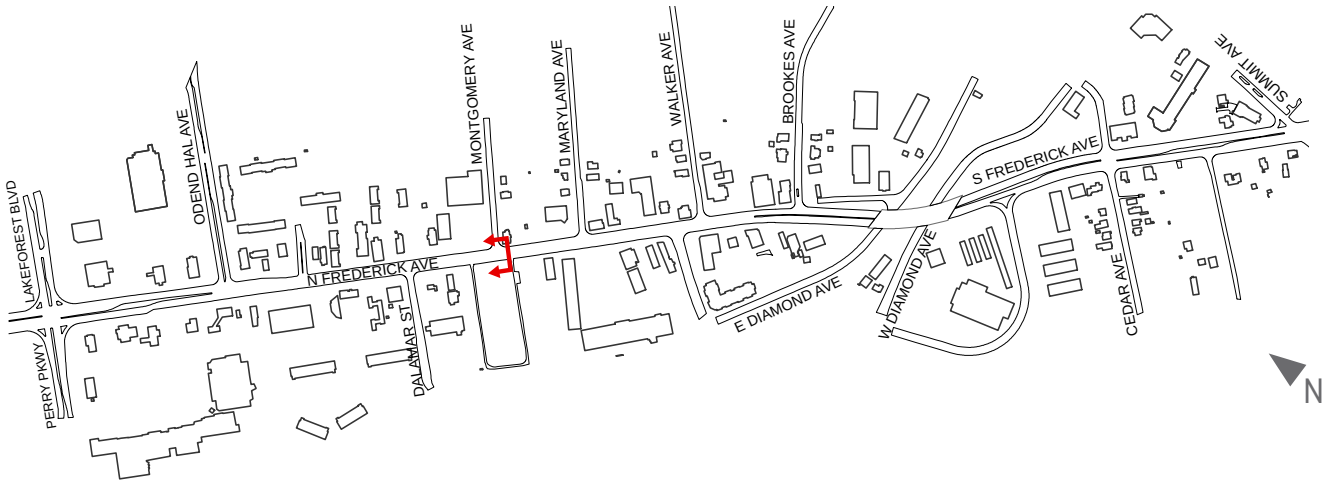
1 EXISTING CONDITIONS



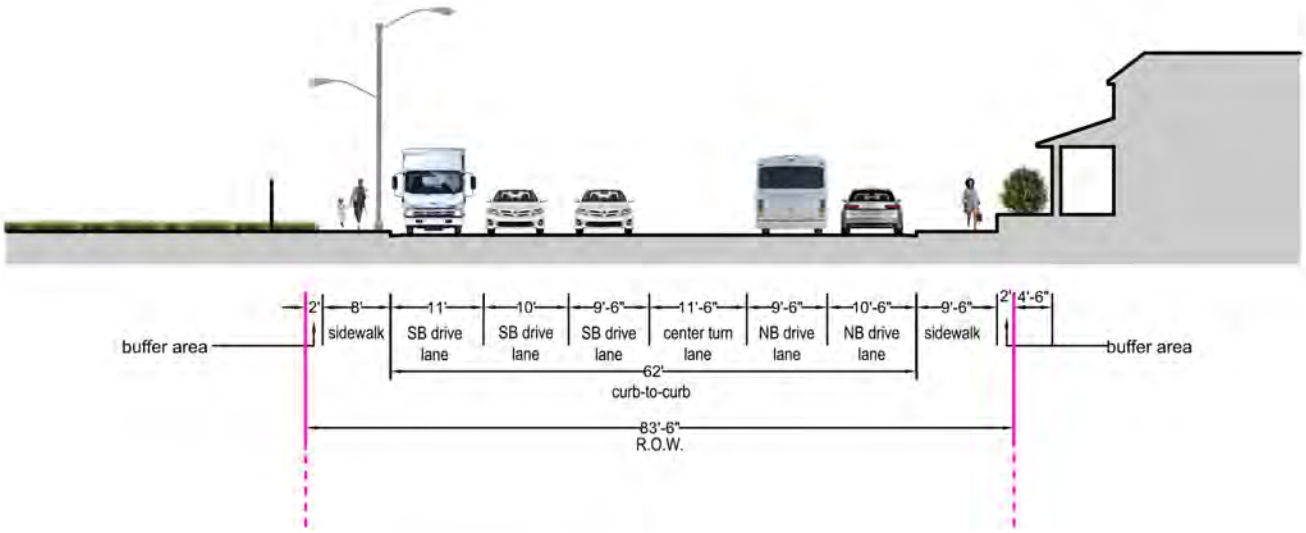
1.1 HYBRID DESIGN ALTERNATIVE



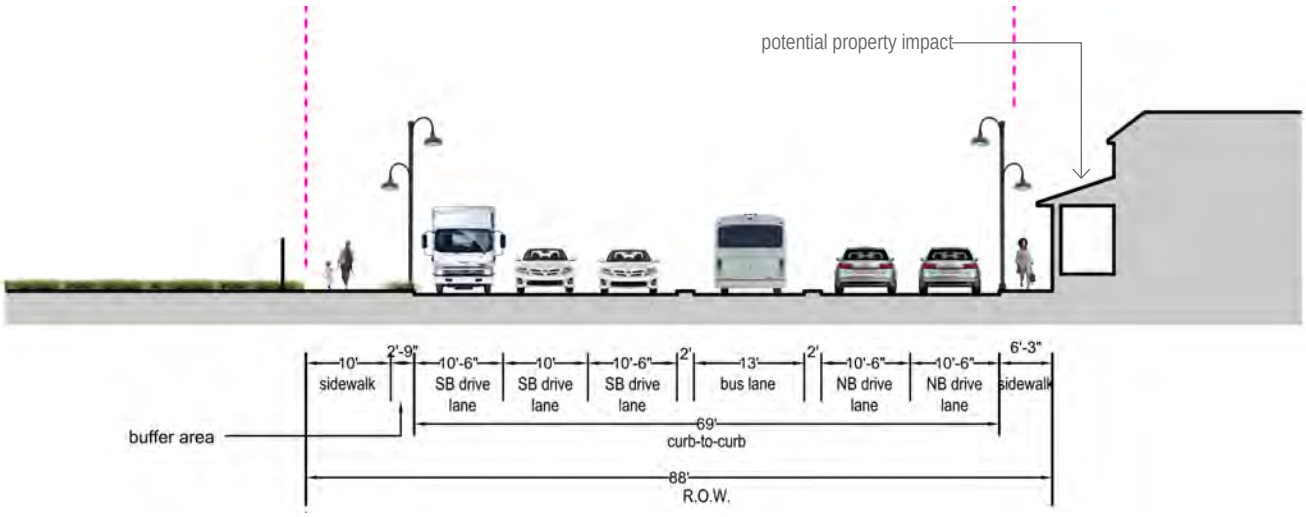
SECTION 2: MD 355 at Montgomery Avenue | LOCATOR MAP, EXISTING CONDITIONS, HYBRID ALTERNATIVE



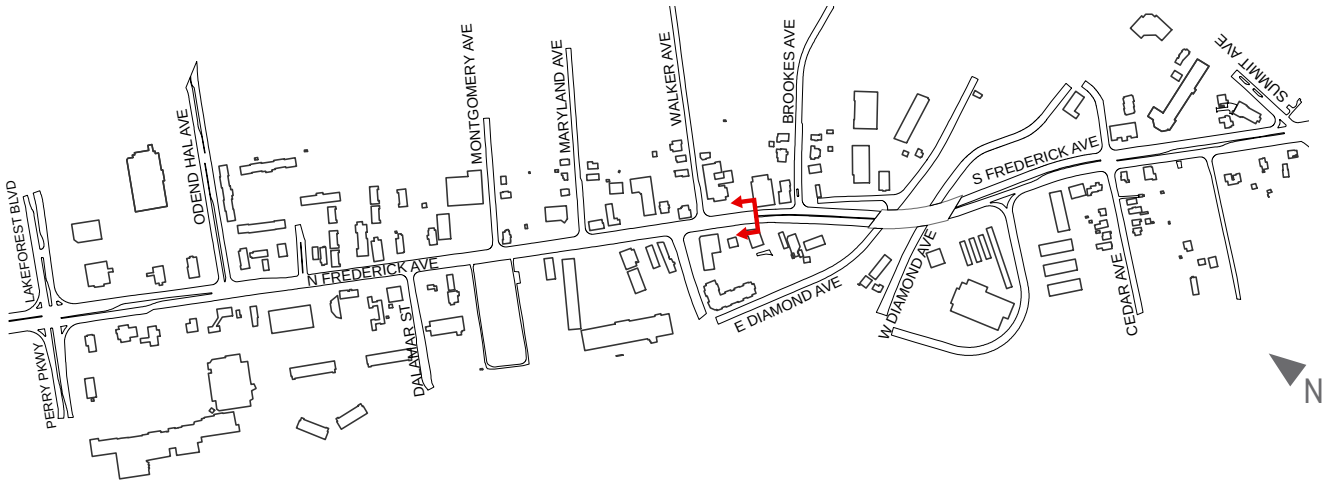
2 EXISTING CONDITIONS



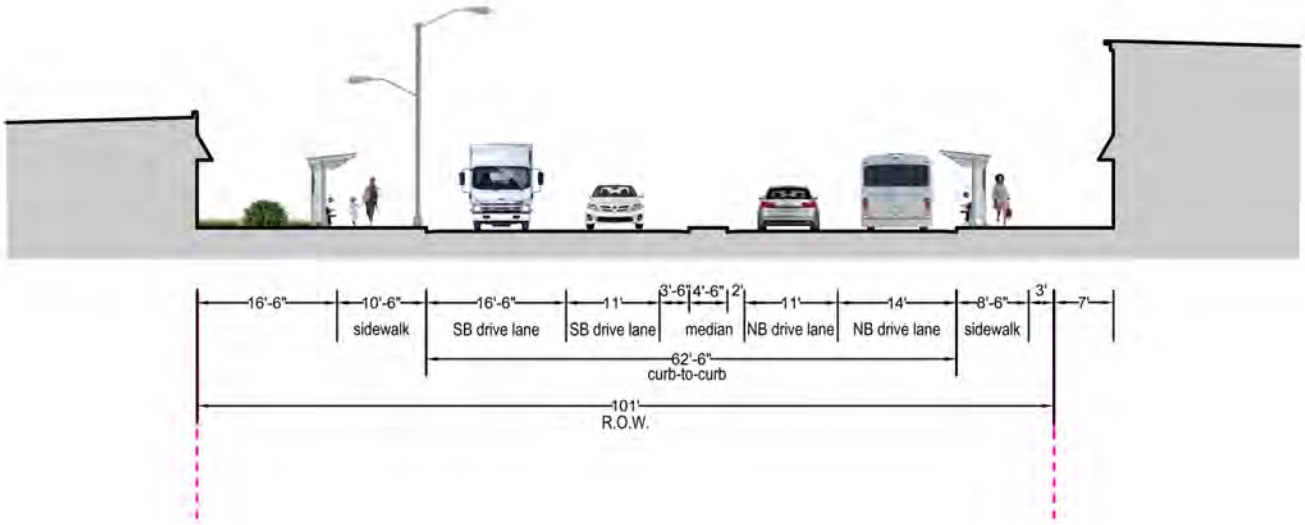
2.1 HYBRID DESIGN ALTERNATIVE



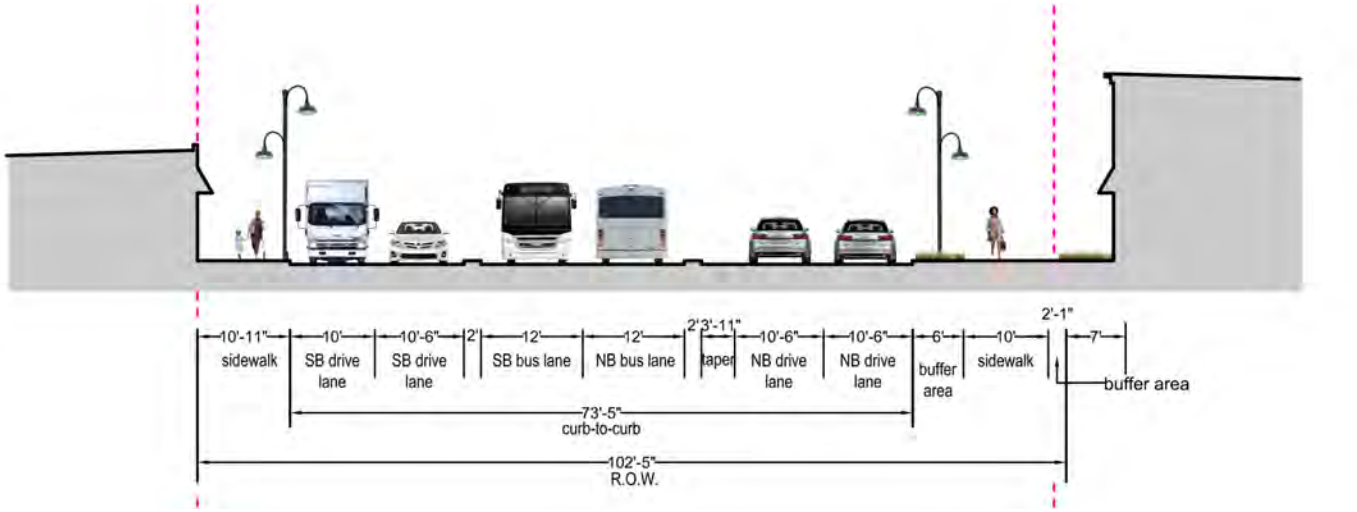
SECTION 3: MD 355 between Brookes and Walker | LOCATOR MAP, EXISTING CONDITIONS, HYBRID ALTERNATIVE



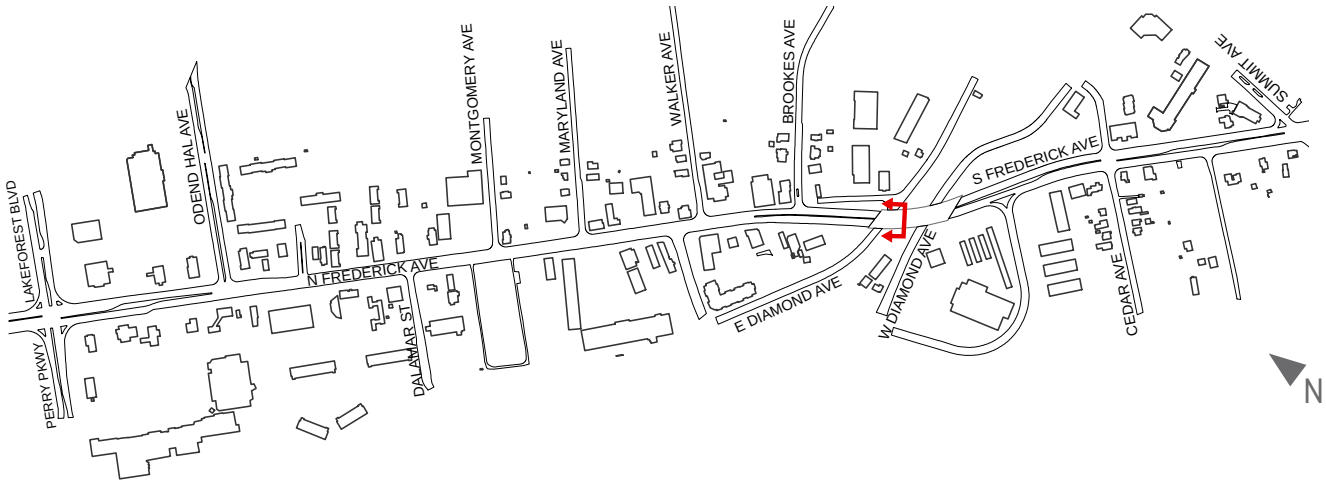
3 EXISTING CONDITIONS



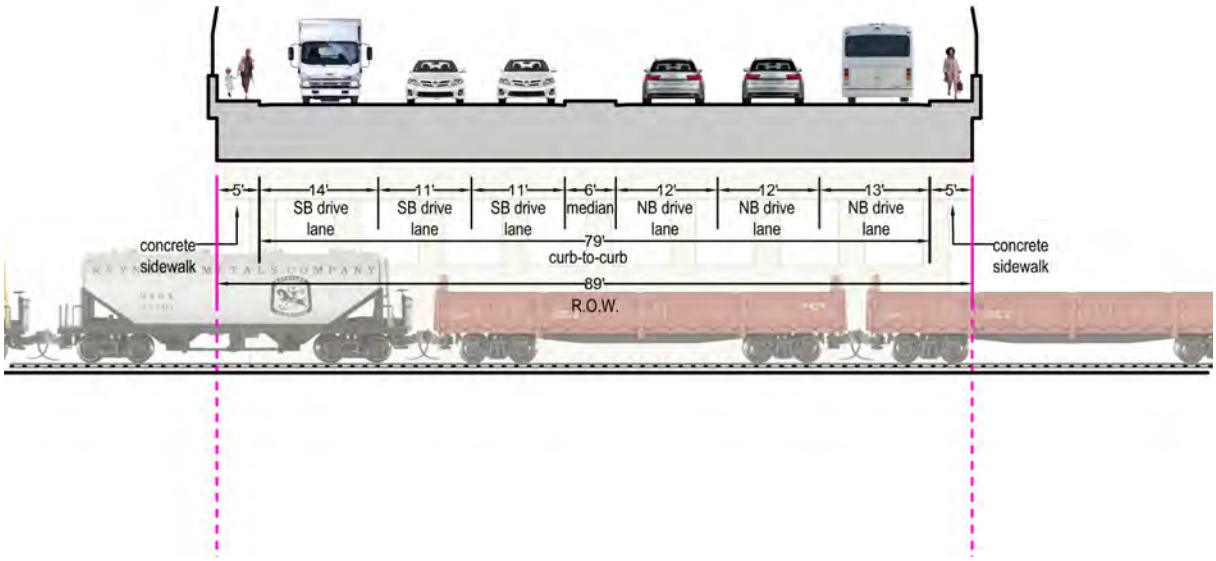
3.I DUAL-LANE MEDIAN BRT - HYBRID DESIGN ALTERNATIVE



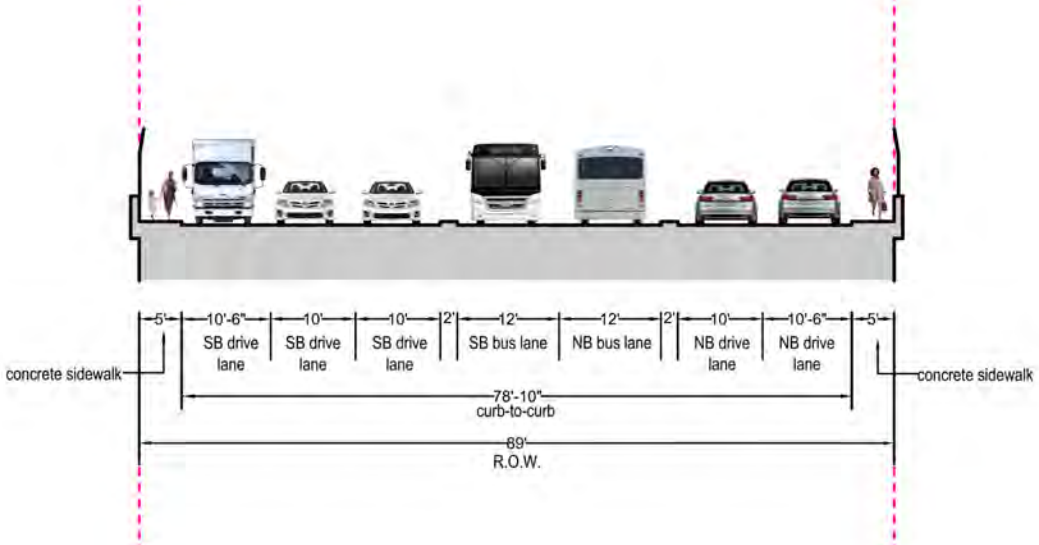
SECTION 4: MD 355 at Father Cuddy Bridge | LOCATOR MAP, EXISTING CONDITIONS, HYBRID ALTERNATIVE



4 EXISTING CONDITIONS

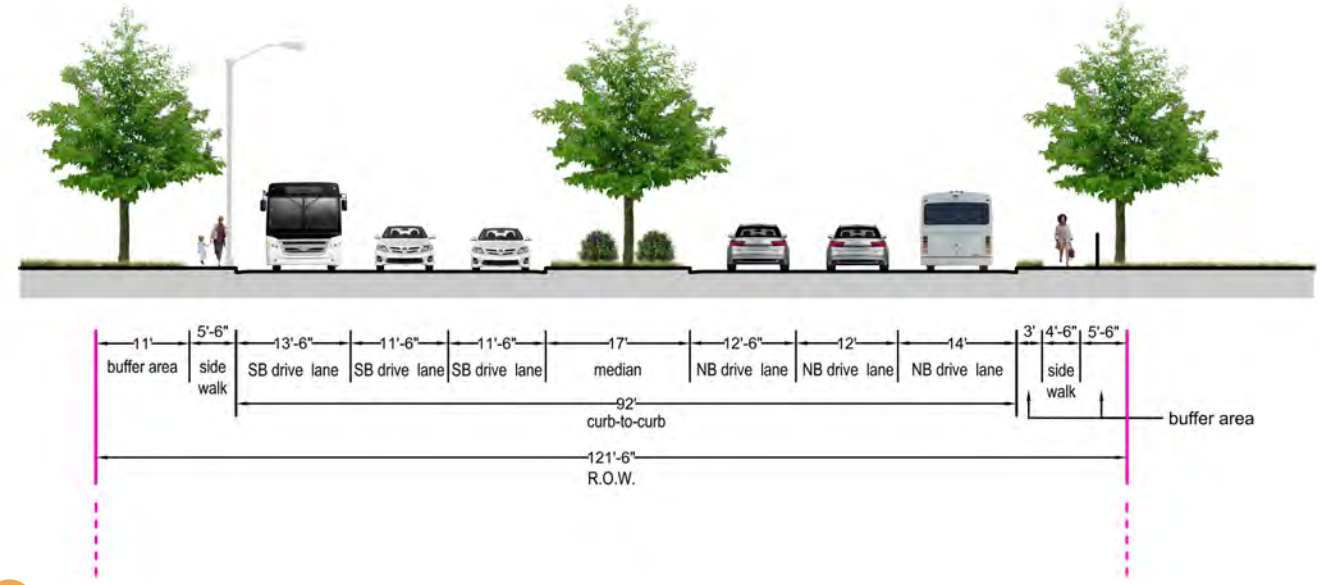


4.1 HYBRID DESIGN ALTERNATIVE

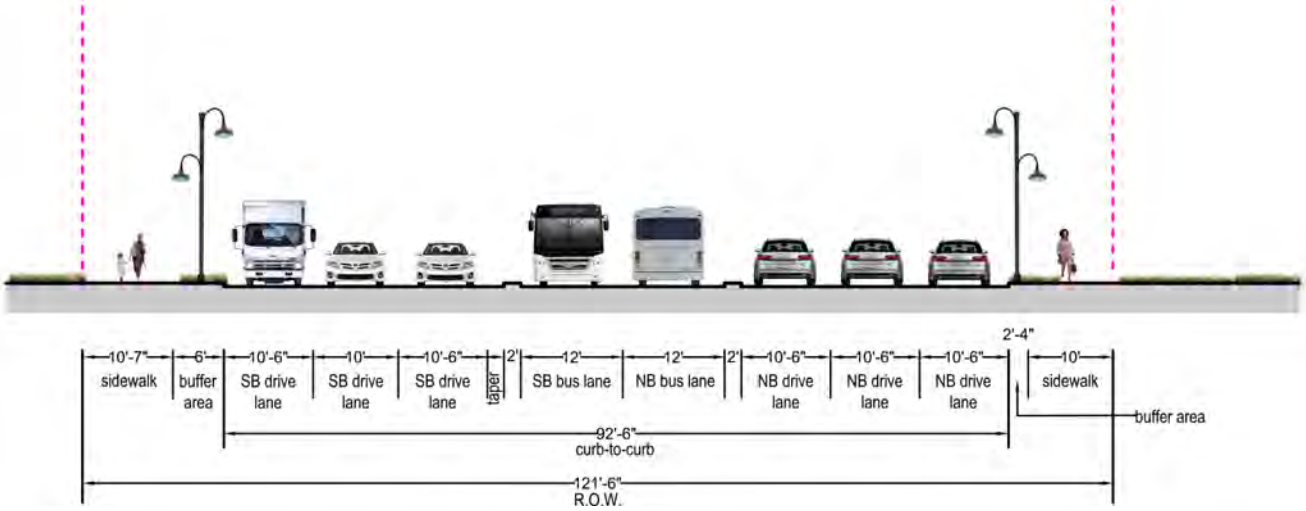


SECTION 5: MD 355 north of Desellum Ave. | LOCATOR MAP, EXISTING CONDITIONS, HYBRID ALTERNATIVE

5 EXISTING CONDITIONS



5.1 HYBRID DESIGN ALTERNATIVE



3.4 Traffic Operations Analysis

Traffic operations analysis was performed for the hybrid alternative, using the same methodologies employed for the other design options. The intersection and roadway traffic operations analysis was completed for the Existing, 2025 BRT Mixed Traffic, and 2025 BRT Alternatives conditions. The results of the intersection and roadway capacity analyses are summarized in Tables 3-2 and 3-3, including results from the other design alternatives for comparison. The detailed traffic operations analysis worksheets and results are included in Appendix C.

Table 3-2: Signalized Intersection Critical Lane Volume LOS Results Summary

Condition/Time Period	MD 355 at Odendhal Avenue		MD 355 at Chestnut Street		MD 355 at Summit Avenue	
	CLV	LOS	CLV	LOS	CLV	LOS
Existing Condition						
Weekday AM Peak Hour	1,088	B	931	A	889	A
Weekday PM Peak Hour	927	A	825	A	880	A
2025 BRT Mixed Traffic						
Weekday AM Peak Hour	1,299	C	1,136	B	1,063	B
Weekday PM Peak Hour	1,107	B	1,006	B	1,053	B
2025 BRT Dual-lane Standard						
Weekday AM Peak Hour	1,316	D	1,147	B	1,063	B
Weekday PM Peak Hour	1,241	C	1,025	B	1,049	B
2025 BRT Dual-lane Minimum						
Weekday AM Peak Hour	1,316	D	1,147	B	1,063	B
Weekday PM Peak Hour	1,241	C	1,025	B	1,049	B
2025 BRT Dual-lane Reduced Impact						
Weekday AM Peak Hour	1,283	C	1,147	B	1,057	B
Weekday PM Peak Hour	1,110	B	1,025	B	1,042	B
2025 BRT Single-lane Standard						
Weekday AM Peak Hour	1,316	D	1,147	B	1,063	B
Weekday PM Peak Hour	1,241	C	1,025	B	1,049	B
2025 BRT Single-lane Minimum						
Weekday AM Peak Hour	1,316	D	1,147	B	1,063	B
Weekday PM Peak Hour	1,241	C	1,025	B	1,049	B
2025 BRT Single-lane Reduced Impact						
Weekday AM Peak Hour	1,283	C	1,147	B	1,063	B
Weekday PM Peak Hour	1,110	B	1,025	B	1,049	B
2025 BRT Lane Repurposing						
Weekday AM Peak Hour	1,283	C	1,147	B	1,057	B
Weekday PM Peak Hour	1,110	B	1,025	B	1,042	B
2025 BRT Hybrid Alternative						
Weekday AM Peak Hour	1,308	D	1,147	B	1,057	B
Weekday PM Peak Hour	1,132	B	1,025	B	1,042	B

The traffic analysis results indicate that the signalized intersections will continue to operate at acceptable levels of service under the hybrid design alternative, similar to other options. The most constrained operations are anticipated at the MD 355/Odendhal Avenue intersection during the weekday morning peak hour, which is projected to operate at LOS D.

Table 3-3: Roadway Segment Capacity Analysis Results Summary

Condition/Time Period	MD 355 Southbound				**MD 355 Northbound**			
	Odendhal Ave to Chestnut Street		Chestnut Street to Summit Ave		Odendhal Ave to Chestnut Street		Chestnut Street to Summit Ave	
	Density	LOS	Density	LOS	Density	LOS	Density	LOS
Existing Condition								
Weekday AM Peak Hour	26.7	D	16.7	B	12.7	B	4.9	A
Weekday PM Peak Hour	15.8	B	10.3	A	32.1	D	12.8	B
2025 Mixed Traffic								
Weekday AM Peak Hour	32.0	D	20.0	C	15.2	B	5.9	A
Weekday PM Peak Hour	19.0	C	12.3	B	38.5	E	19.4	C
2025 BRT Dual-lane Standard								
Weekday AM Peak Hour	29.9	D	17.5	B	15.0	B	5.9	A
Weekday PM Peak Hour	17.1	B	10.3	A	36.6	E	13.0	B
2025 BRT Dual-lane Minimum								
Weekday AM Peak Hour	29.9	D	17.5	B	15.0	B	5.9	A
Weekday PM Peak Hour	17.1	B	10.3	A	36.6	E	13.0	B
2025 BRT Dual-lane Reduced Impact								
Weekday AM Peak Hour	43.7	E	20.0	C	14.6	B	8.9	A
Weekday PM Peak Hour	25.0	C	11.9	B	35.7	E	22.4	C
2025 BRT Single-lane Standard								
Weekday AM Peak Hour	29.9	D	17.5	B	15.0	B	5.9	A
Weekday PM Peak Hour	17.1	B	10.3	A	36.6	E	13.0	B
2025 BRT Single-lane Minimum								
Weekday AM Peak Hour	29.9	D	17.5	B	15.0	B	5.9	A
Weekday PM Peak Hour	17.1	B	10.3	A	36.6	E	13.0	B
2025 BRT Single-lane Reduced Impact								
Weekday AM Peak Hour	43.7	E	20.1	C	14.6	B	5.9	A
Weekday PM Peak Hour	25.0	C	12.0	B	35.7	E	15.0	B
2025 BRT Lane Repurposing								
Weekday AM Peak Hour	43.7	E	20.0	C	14.6	B	8.9	A
Weekday PM Peak Hour	25.0	C	11.9	B	35.7	E	22.4	C
2025 BRT Hybrid Alternative								
Weekday AM Peak Hour	29.7	D	20.0	C	14.9	B	8.9	A
Weekday PM Peak Hour	17.0	B	11.9	B	36.4	E	22.4	C

The results of the roadway segment traffic analysis indicate that the hybrid design alternative will operate at acceptable LOS for all locations and time periods, except one. These results are similar to several of the other highest performing design alternatives.

The Odendhal Avenue to Chestnut Street segment will operate at LOS E conditions in the northbound direction during the weekday evening peak hour for all future BRT alternatives, including the hybrid design alternative. None of the BRT alternatives plan to reduce the overall northbound lane capacity, so these results primarily reflect projected overall growth in regional traffic volume. The LOS E results for the northbound direction are generally on the lowest end of the LOS E range (35-37 pc/mi/ln), except for the mixed traffic alternative, which is projected to operate at slightly higher levels of traffic density and congestion.

3.5 Cost Estimates

Planning-level cost estimates for the hybrid design layout alternative were developed using the same methodology for the other alternatives in Chapter 2. The capital cost estimates for each of the BRT design alternatives are compared to the hybrid alternative in the table below. These cost estimates are provided in 2015 dollars. Copies of the detailed cost estimate worksheets and unit cost data assumptions used to calculate the overall BRT facility costs are included in Appendix D.

The capital cost estimates indicate that the overall capital costs for the hybrid alternative in the City of Gaithersburg is approximately $228 million. This cost falls between the dual-lane minimum and single-lane minimum alternatives, and close to the average cost for all of the alternatives.

Table 3-4: 2015 Gaithersburg BRT Capital Cost Estimate Summary

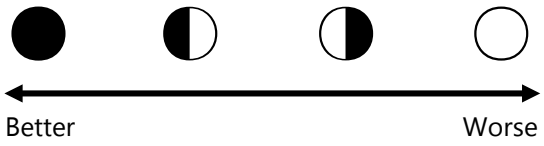
BRT Design Condition	Costs			Total Cost
	Game Preserve Road to Odendhal Avenue	Focal Segment (Odendhal Avenue to Summit Avenue)	Summit Avenue to O'Neill Drive	
Dual-lane Standard				
Design/Construction	$71,581,700	$88,771,300	$49,599,200	$209,952,200
Land Acquistion	$6,506,867	$23,698,031	$11,463,295	$41,668,194
Total	**$78,088,567**	**$112,469,331**	**$61,062,495**	**$251,620,394**
Dual-lane Minimum				
Design/Construction	$72,895,000	$80,704,300	$49,599,200	$203,198,500
Land Acquistion	$7,544,497	$6,395,706	$12,846,710	$26,786,913
Total	**$80,439,497**	**$87,100,006**	**$62,445,910**	**$229,985,413**
Dual-lane Reduced Impact				
Design/Construction	$72,895,000	$42,774,700	$49,599,200	$165,268,900
Land Acquistion	$7,544,497	$3,039,497	$12,846,708	$23,430,702
Total	**$80,439,497**	**$45,814,197**	**$62,445,908**	**$188,699,602**
Single-lane Standard				
Design/Construction	$72,895,000	$79,881,300	$49,599,200	$202,375,500
Land Acquistion	$7,544,497	$13,945,753	$12,846,708	$34,336,958
Total	**$80,439,497**	**$93,827,053**	**$62,445,908**	**$236,712,458**
Single-lane Minimum				
Design/Construction	$72,895,000	$77,415,200	$49,599,200	$199,909,400
Land Acquistion	$7,544,497	$2,550,287	$12,846,708	$22,941,493
Total	**$80,439,497**	**$79,965,487**	**$62,445,908**	**$222,850,893**
Single-lane Reduced Impact				
Design/Construction	$72,895,000	$37,350,600	$49,599,200	$159,844,800
Land Acquistion	$7,544,497	$1,449,934	$12,846,708	$21,841,139
Total	**$80,439,497**	**$38,800,534**	**$62,445,908**	**$181,685,939**
Lane Repurposing				
Design/Construction	$79,246,500	$29,232,700	$52,801,200	$161,280,400
Land Acquistion	$7,544,493	$1,406,273	$12,846,708	$21,797,474
Total	**$86,790,997**	**$30,638,973**	**$65,647,908**	**$183,077,878**
Mixed Traffic				
Design/Construction	$81,237,000	$1,872,400	$52,801,200	$135,910,600
Land Acquistion	$7,544,493	$0	$12,846,708	$20,391,201
Total	**$88,950,644**	**$1,872,400**	**$65,647,908**	**$156,470,952**
Hybrid				
Design/Construction	$72,895,000	$43,621,200	$49,599,200	$166,115,400
Land Acquistion	$7,544,497	$2,569,922	$12,846,708	$22,961,127
Total	**$80,439,497**	**$46,191,122**	**$62,445,908**	**$189,076,527**

3.6 Alternatives Comparison

Table 3-5 summarizes how the hybrid design alternative compares to the other MD 355 BRT design alternatives using several metrics for overall performance.

Table 3-5: Comparison of BRT Alternatives

	BRT Operations		Traffic Operations				Property Impacts	Cost ($ million)
	Operating Speed	Stop Locations	Traffic Density/ Congestion	Intersection Capacity	Unsignalized Turning Movements	Land Use Access/ Egress		
Dual-lane Standard	●	●	●	●	○	○	○	$251.6
Dual-lane Minimum	●	●	●	●	○	○	○	$230.0
Dual-lane Reduced	●	●	○	●	○	○	◑	$188.7
Single-lane Standard	◐	◐	●	●	○	○	○	$236.7
Single-lane Minimum	◐	◐	●	●	○	○	◑	$222.9
Single-lane Reduced	◐	◐	○	●	○	○	◐	$181.7
Lane Repurposing	◑	○	○	●	○	○	◐	$183.1
Mixed Traffic	○	◑	◐	●	●	●	●	$156.5
Hybrid Alternative	◐	◐	●	●	○	○	◐	$189.1



3.7 Summary of Findings

The hybrid alternative minimizes many of the building impacts associated with the other alternatives while still maintaining higher bus speeds than a mixed traffic or entirely single-lane median guideway BRT operation. The bus operations associated with the hybrid alternative would require additional signal coordination to provide for the transition from the dual-lane and single-lane segments of the corridor and may require buses to idle at transition points while waiting for buses traveling in the opposite direction to pass through the single-lane median guideway. Overall, bus speeds will be improved compared to the existing local service. The traffic impacts associated with the hybrid alternative are similar to other design alternatives, and generally demonstrate acceptable levels of service throughout the focal segment. The hybrid alternative does not eliminate all potential impacts associated with the BRT system, but achieves a strong balance between the various construction, operational, and cost-related metrics considered for all of the design alternatives.

4 Bus Rapid Transit Stations and Right of Way

4.1 Introduction

Stations are the "front door" for any bus rapid transit system. As opposed to bus stops for local bus service, which typically include just a sign on a pole and maybe amenities like a shelter, BRT stations often provide an expanded level of amenities, more akin to light rail transit, to further reinforce the image that BRT is a premium bus service. While the scope of this study is not focused on the design of the BRT stations, it is necessary to think about the types of amenities and passenger loads when appropriately sizing the station. BRT stations are typically larger than traditional bus stops to accommodate the increased passenger loads and amenities associated with BRT.

When developing a concept for a BRT station the following decisions need to be made:

- **Where will the station be located?** Stations can be located on the street, within the busway, or as part of a larger transit center. Depending on the design of the BRT guideway they can be located in the center of the roadway or along the curb like traditional bus stops. BRT stations are often physically separated from the surrounding pedestrian environment. This is done to keep the station from impeding pedestrian flows, but to also provide more controlled access to the system. Many systems provide off board fare collection, and controlling access to the station platform is one method of reducing fare evasion.
- **What type of station?** There is a range of station types based on size and the level of amenities and complexity. A simple station may just include a bus shelter, while a transit center would provide opportunities for many different modes of travel (car, bus, train), high levels of passenger amenities and information, and potentially parking.
- **What is the appropriate level of passenger amenities?** Passenger amenities, like station type, can vary based on the design of the BRT system and scale of the station. Smaller stations may only provide basic passenger information and seating. Larger stations can include digital displays for passenger information, vending machines, landscaping, and shelters of a higher quality material or finish.

Due to the increased size and cost associated with BRT stations, they are often viewed in the same light with light rail or streetcar stations in terms of promoting higher levels of property development around them. This fact, combined with the greater spacing requirement, requires another level of focus and study when determining the proper placement.

The following sections describe some of the considerations that should be factored into station location and design, followed by a review of how the *Countywide Transit Corridors Functional Master Plan* (CTCFMP) station locations fare in that regard. Alternative station locations are also suggested to address certain concerns or limitations with the CTCFMP locations. Finally, a set of policy considerations are provided to help the City consider optional station locations as a function of their most important policy goals for both improving mobility for current transit system users and facilitating investment in future transit-oriented development.

This chapter also addresses the right of way requirements for the MD 355 BRT in the City of Gaithersburg. The right of way requirements are heavily driven by station locations and attributes. The right of way requirements will inform the policy decisions adopted by the Gaithersburg City Council.

4.2 Station Location Functional Considerations

When determining station locations for BRT, a number of factors should be considered. This section discusses a range of station considerations for the MD 355 corridor.

Existing Transit Ridership

Existing transit ridership is often the first factor considered in siting BRT stations. Existing ridership is a good indicator of the potential for future ridership. BRT stations should be located in areas where there is a solid foundation of existing transit use.

Stop-by-stop ridership for existing transit routes along the MD 355 corridor was reviewed for those locations near proposed BRT stations in the City of Gaithersburg[8]. Table 4-1 shows the typical weekday boardings and alighting for stops along the MD 355 corridor in the City of Gaithersburg[9].

Table 4-1: Transit Ridership along MD 355 in the City of Gaithersburg at Proposed BRT Stations

Location	Boardings	Alightings
MD 355 & Professional Dr	106	106
MD 355 & Watkins Mill Rd	317	317
MD 355 & MD 124	177	257
MD 355 & Odendhal Ave	920	960
MD 355 & Brookes Ave	361	376
MD 355 & Education Blvd	249	276

[8] Ridership figures pulled from Logit data used as part of the *Demand and Service Planning Report to Montgomery County DOT*, Institute for Transportation and Development Policy, December 2012.
[9] Existing stop ridership was identified by proximity (1/4 mile) to an existing intersection identified as a potential BRT station through previous planning efforts.

Existing and Future Land Use

Existing and future land uses are an important factor in identifying locations where there is the potential for latent demand for transit services. Major residential or commercial developments or planned developments that would generate large numbers of people should be served by the BRT. In addition to locations with high levels of existing transit ridership, locations with the potential for future transit ridership should be also be considered for BRT station locations.

Future population and employment density for the corridor are shown in Figures 4-1 and 4-2. The regional land use forecast for 2040 from the MWCOG shows that the area along MD 355 from Montgomery Village Avenue (MD 124) to Diamond Avenue is forecasted to have the highest density of households along the MD 355 corridor in the City. The same forecast shows that the 2040 employment density will be greatest in the zone west of MD 355 from MD 124 to Diamond Avenue. The level of detail provided by the region' land use forecast does not allow for a specific intersection(s) to be identified for a station, but does provide a sense for where the focus should lie along the corridor.

Figure 4-1: Household Density - Year 2040

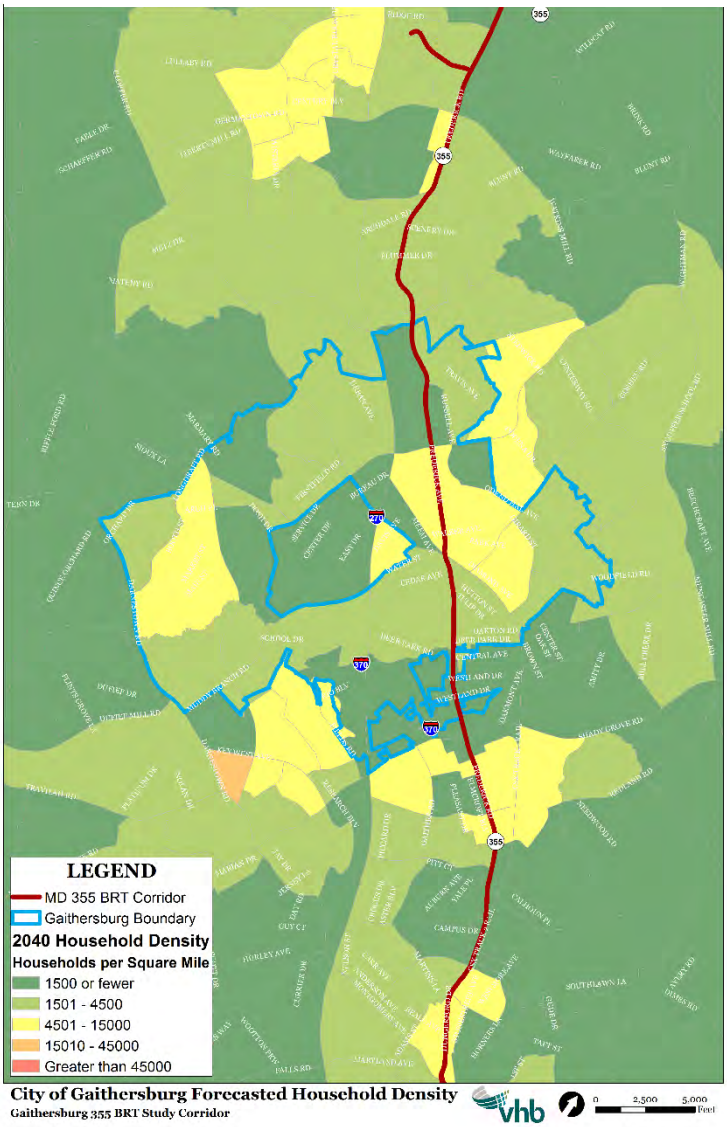
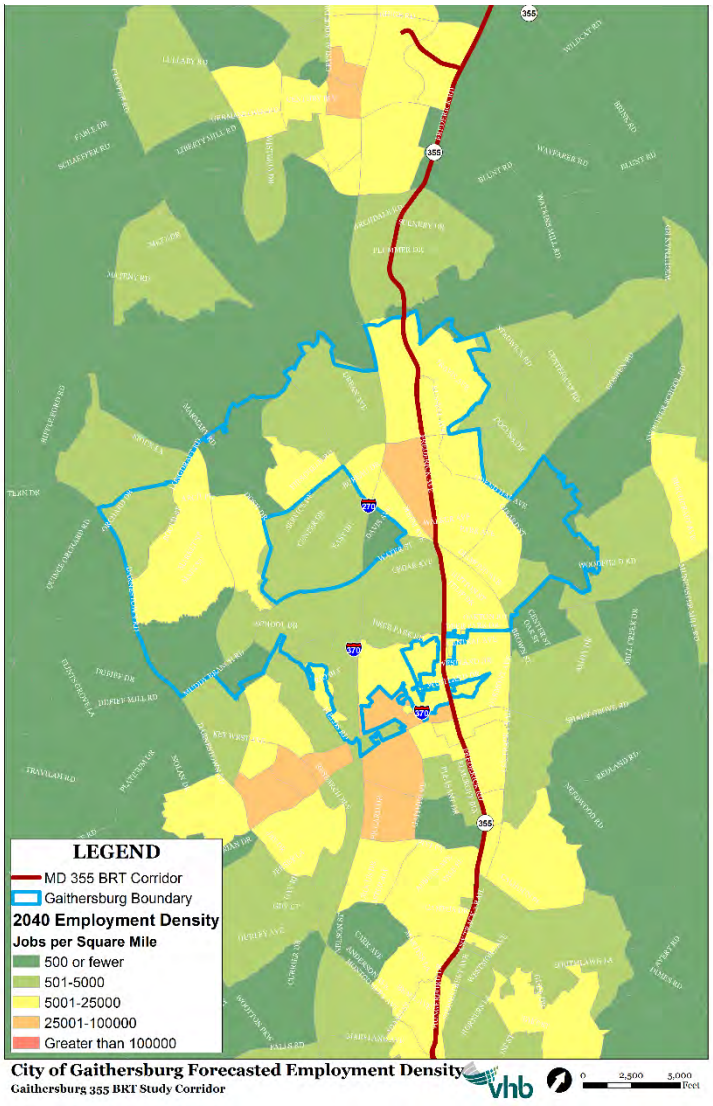


Figure 4-2: Employment Density - Year 2040



Pedestrian, Bicycle, and Other Transportation Connections

Pedestrian, bicycle and other transportation connections are important to enhance and improve overall connectivity for the transit system. This includes sidewalks/bicycle trails, pedestrian friendly intersections, presence of a traffic signal. BRT stations should be located in areas that capitalize on existing transportation connections. These connections, often referred to as the "last-mile", provide vital links for those accessing transit.

The focus of this study was the BRT feasibility on MD 355 in the City and did not entail documenting where bike and pedestrian facilities should be provided. However, when siting future BRT stations the existing bike and pedestrian connections should be acknowledged and taken advantage of. The entire MD 355 corridor has sidewalks, as do many of the cross street connections. In addition there is a shared use path along the west side of MD 355 from beyond the City's boundary at the north down to MD 124. As the BRT concept advances in further stages of planning and design, efforts to coordinate the design with other City efforts focused on planning for bikes and pedestrians should be added.

Traffic/Roadway Network Implications

Station locations require a wider cross section than a typical BRT roadway segment to accommodate platforms, benches, shelters, and intersection turning lanes. BRT stations should be sited in locations that are able to accommodate the required infrastructure and support walkable, transit oriented development. Intersections with existing wide cross-sections, multiple turn lanes, and complex designs, such as Montgomery Village Avenue, should be avoided where possible. Unless a complete reimagining of the intersection and corridor is planned, adding a BRT station at these locations would further widen the road and make an already complex intersection more complicated.

Bus Stop Spacing

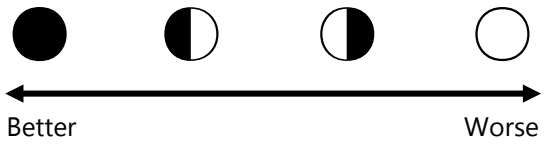
BRT stations should be sited at locations that benefit the overall operations of the corridor, and should ideally be spaced every half mile to mile. This distance is related to the distance people are willing to walk to transit, and is typically in the order of a quarter to a half a mile, which equates to a five- to 10-minute walk. The spacing provides a suitable balance between transit access and speed.

4.3 Potential Station Locations

An assessment of potential station locations started with the proposed locations from the *Countywide Transit Corridors Functional Master Plan*. Each location proposed was assessed using the four primary aspects discussed above:

- Existing Transit Ridership
- Existing and Future Land Use
- Existing Connections
- Traffic Complications

The scoring system used is the same one that was used to rate the different guideway design alternatives.



In addition to the station locations identified through the CTCFMP, additional locations were identified based on challenges identified through the assessment of the Functional Master Plan station, gaps in accessibility or coverage, and a view towards promoted transit-oriented development.

Countywide Transit Corridors Functional Master Plan Stations

The *Countywide Transit Corridors Functional Master Plan* identified multiple potential station locations for the City of Gaithersburg along MD 355, including:

- Professional Drive
- Watkins Mill Road

- Montgomery Village Avenue (MD 124)
- Odendhal Avenue
- Brookes Avenue
- Education Boulevard

These location are used as the starting point for proposed station locations in the City of Gaithersburg. Each station identified is discussed below for consistency with the criteria described above. A presentation of the pros and cons associated with each are location is included. The locations viewed as most viable or challenging will be identified.

Professional Drive

Existing ridership for stops within a quarter mile of the intersection of Professional Drive and MD 355 is around 100 boardings. This station would serve the adjacent office and residential complexes along Professional Drive. The west side of MD 355 is forecasted to see greater growth in both employment and residential density than the eastern side. There are sidewalks and pedestrian connections available on both approaches of Frederick Avenue. There is an existing traffic signal with crosswalks and pedestrian signals across the north, east, and west approaches. There is a shared use path along the west side of MD 355. The roadway cross-section include six through lanes and a single left turn lane for each approach on MD 355. This station would be over one mile from the next station to the north at Middlebrook Road and half a mile from a station at Watkins Mill Road to the south. The stop spacing to the north is greater than average because of the limited development in the Great Seneca Creek, just north of the City boundary.

Looking north along MD 355 at Professional Drive

Table 4-2: Professional Drive Station Rating

Existing Ridership	○
Land Use	◑
Existing Connections	◑
Traffic Complications	●

Watkins Mill Station

A station at Watkins Mill Road would not be near an existing transit stop on MD 355. However, there are stops along Russell Avenue that are within a quarter mile of the intersection. Existing ridership is around 300 boardings. With the future extension of Watkins Mill Road over I-270, a local transit or shuttle service connection could be made available to the Corridor Cities Transitway and the MARC train.

A station at Watkins Mill Road would serve the residential and commercial uses to the east of MD 355. Development is occurring on other sites around the intersection and is planned to continue with the future interchange for I-270.

There are sidewalks and pedestrian connections available on all approaches of this intersection. There is a traffic signal with pedestrian signals, but crosswalks are available only on the north, west, and east approaches of the intersection. The shared use path that is along the west side of MD 355 continues through this intersection to the south.

The cross section at Watkins Mill Road maintains six through traffic lanes and includes a separate left turn lane on each approach. A dedicated right turn lane is provided on the north approach with space provided for a second lane that can be activated when the interchange is complete.

A station at Watkins Mill Road would be about half a mile from the station at Professional Drive to the north and half a mile from a station a Montgomery Village Avenue to the south.

Looking north along MD 355 at Watkins Mill Road

Table 4-3: Watkins Mill Road Station Rating

Existing Ridership	◑
Land Use	●
Existing Connections	●
Traffic Complications	◑

Montgomery Village Avenue Station

A station at Montgomery Village Avenue would not be near an existing transit stop on MD 355, but there are stops on Montgomery Village Avenue (MD 124) as well as stops closer to Lakeforest Boulevard that fall within a quarter mile of the intersection. Total existing ridership is around 200 boardings. MD 124 runs along the north side of Lakeforest Mall where the Lakeforest Transit Center is located, approximately half a mile south on Russell Avenue from MD 124.

A station at Montgomery Village Avenue would serve the Lakeforest Mall and adjacent commercial developments. The Lakeforest Mall is being talked about for redevelopment, as are some of the surrounding properties, although no specific redevelopment proposals have been submitted.

There are sidewalks and pedestrian connections available on all approaches of this intersection. There is a traffic signal with pedestrian signals, but crosswalks are available only on the east, west, and south legs of the intersection. The shared use path that runs along the west side of MD 355 terminates at MD 124.

Northbound MD 355 has three dedicated left turn lanes feeding onto Montgomery Village Road westbound. This connects with I-270 and is a major movement throughout the day. After the Watkins Mill Interchange is complete, it may be possible to eliminate one of the northbound left turn lanes. Additionally there are two left turn lanes from MD 355 to eastbound MD 124. The intersection also includes channelized right turn lanes from each approach. The traffic volumes associated with MD 124 and complicated roadway geometry suggest that placing a station at this location will be more challenging than other locations with less traffic activity. A station at Montgomery Village Avenue would be about a half mile from the station at Watkins Mill Road to the north and approximately 0.4 miles from a station at Odendhal Avenue to the south.

Looking southwest along MD 355 at Montgomery Village Drive (MD 124)

Table 4-4: Montgomery Village Drive (MD 124) Station Rating

Existing Ridership	○
Land Use	◐
Existing Connections	◑
Traffic Complications	○

Odendhal Avenue Station

A station at Odendhal Road would be less than 300 feet from the nearest existing transit stop at Whetstone, with many stops within a quarter mile. The total existing ridership for stops within a quarter mile of the station is around 900 riders. The station would be adjacent to three existing routings for buses serving the Lakeforest Transit Center.

Land uses adjacent to Odendhal Road are low density commercial, with a connection available to the Lakeforest Mall. As mentioned before, the Lakeforest Mall has been part of discussions for development. A station at this location and redevelopment around the mall would create a benefit to both.

There are sidewalks and pedestrian connections available on all approaches of this intersection. There is a traffic signal with pedestrian signals, and crosswalks are available on all legs of the intersection. The fourth side of the intersection includes a gas station driveway. The driveway is signalized as part of the intersection, but consideration for pedestrian safety across active commercial driveways could be a concern.

This intersection is a three-legged intersection with lower traffic volumes than some of the larger intersections to the north. The intersection provides only two southbound lanes from the north approach and a separate left turn lane. The south approach includes three northbound though lanes and the two-way left turn lane. This station would be less about a half mile from the station at Montgomery Village Avenue to the north and about half a mile from a station at Brookes Avenue.

Looking south along MD 355 at Odendhal Avenue

Table 4-5: Odendhal Avenue Station Rating

Existing Ridership	●
Land Use	◐
Existing Connections	◐
Traffic Complications	◐

Brookes Avenue Station

A station at Brookes Avenue would be less than 200 feet from an existing bus stop on MD 355. Ridership for the stops within a quarter mile of the proposed station is around 350 riders. There are two existing routes that utilize this segment of MD 355.

A station at Brookes Avenue would serve adjacent residential properties to the east side of MD 355 and commercial properties along the west. The station would be about 300 feet from the Father Cuddy Bridge. The bridge and railroad tracks would be a major barrier to attracting riders from the south, and significantly limit the redevelopment opportunities associated with this station location. MD 355 is inclined in this location as it approaches the Father Cuddy Bridge, and significant retaining walls are necessary to support the roadway and maintain mobility on adjacent local streets. Additional land would need to be acquired to construct a station, with significant impacts on adjacent street and private property access, as well as elevated construction cost.

There are sidewalks and pedestrian connections available along both sides of MD 355 and into the residential neighborhood to the east. Brookes Avenue intersects MD 355 at a median separated location and no signalized intersection is provided, so there are no marked or controlled crossings on MD 355 at this location.

The cross section for MD 355 includes four though lanes and a third lane in each direction that functions as a right turn lane. The median dividing MD 355 and the lack of any signalization would need to be addressed in order to allow pedestrains to access median platforms. This station would be about a half mile from the station at Odendhal Avenue to the north and three quarters of a mile from a station at Education Boulevard to the south.

Looking south along MD 355 at Brookes Avenue

Table 4-6: Brookes Avenue Station Rating

Existing Ridership	◑
Land Use	○
Existing Connections	○
Traffic Complications	○

Education Boulevard Station

A station at Education Boulevard would be less than 100 feet from the existing local stop. The existing stops within a quarter mile of this location currently serve approximately 250 riders daily.

A station at Education Boulevard would serve Gaithersburg High School, as well as the residential developments on the east side of MD 355. The west side of MD 355 around this station is not forecasted to grow much in terms of households or employment. The east side shows very limited growth in households and more growth in jobs. These are likely located closer to Olde Towne Gaithersburg which is about a half mile walk from Education Boulevard.

There are sidewalks and pedestrian connections available on approaches of this intersection. There is a traffic signal with pedestrian signals, and high-visibility crosswalks are available on all legs of the intersection.

The cross section for MD 355 at Education Boulevard is six though lanes in each direction with a separate left turn lane on each approach from MD 355. The east-bound and westbound portions of Education Boulevard are separated by a wide median that extends the pedestrian crossing distance on that street, but doesn't represent an issues for a BRT station. This station is located about three-quarters of a mile from the previous station at Brookes Avenue and almost 1.5 miles from a station at Shady Grove Route, outside the City of Gaithersburg, to the south.

Looking north along MD 355 at Education Boulevard

Table 4-7: Education Boulevard Station Rating

Existing Ridership	
Land Use	
Existing Connections	
Traffic Complications	

Other Possible Station Locations

The following additional locations have been identified as potential station locations not identified as part of the CTCFMP. The same assessment for these locations was done as the previous locations. The locations were identified in an effort to respond to challenges associated with some of the locations identified in the County's master plan document.

Travis Avenue/Spectrum Avenue Station

Travis Avenue/Spectrum Avenue is a potential replacement for the Professional Drive station. This location is further south of Great Seneca Creek, increasing potential for redevelopment opportunities that could be challenging at Professional Drive. There are already higher intensity developments (Paramount 355) at Travis Avenue with additional development currently under construction at the northwest corner of Watkins Mill Road.

A station at Travis Avenue would be about two-tenths of a mile from the nearest existing bus stop. This stop is not located along MD 355, but east of MD 355 on Travis. If a station was to be located at Travis Avenue reconsideration for the location of other existing bus routes and stops could be made to ensure better synergies between the BRT and local bus.

As mentioned above, the area around Travis Avenue has already developed with mid-rise mixed-use properties on the west side of MD 355. The east side is traditional suburban commercial with residential properties further to the east. Just to the south of Travis Avenue is another mid-ride development currently under construction at Watkins Mill Road. This development would be within the walkshed of a station at either Travis Avenue or Watkins Mill Road. Additional redevelopment may be challenging north of the intersection with Travis Avenue due to the power lines.

The existing pedestrian network here is similar to the network at Professional Drive and Watkins Mill Road. The intersection is signalized with pedestrian accessible pedestrian signals and crossings along the north, west, and east legs.

The intersection provides three though lanes in each direction along MD 355 as well as dedicated left turn lanes. The southern approach also includes a dedicated right turn lane. The cross section for Spectrum Avenue and Travis Avenue is narrower than other streets intersecting MD 355, making the overall intersection footprint smaller than some of the other intersections along the corridor.

Looking south along MD 355 at Travis Avenue/Spectrum Avenue

A station at Spectrum Avenue/Travis Avenue would be about a third of a mile from the Professional Drive and Watkins Mill Road stations. As an alternative not considered as part of the CTCFMP, a decision would need to be made about which stations make the most sense from a transit operations as well as supporting future land use standpoint to ensure proper spacing of a half mile to mile between stations.

Table 4-8: Travis Avenue/Spectrum Avenue Station Rating

Existing Ridership	○
Land Use	◐
Existing Connections	◐
Traffic Complications	●

Christopher Avenue Station

Christopher Avenue is seen as an alternative to the Watkins Mill Road station due to its lower traffic volumes, which would contribute to improved pedestrian access and the possibility as a transit-oriented development focal point. While the Watkins Mill Road intersection does have some higher intensity development going in, the intersection footprint is larger than Christopher Avenue. Additionally, the future interchange with I-270 will likely increase traffic volumes at Watkins Mill Road and MD 355.

There are currently no existing bus stops or routes that travel along MD 355 at Christopher Avenue. The majority of the transit service occurs a block to the east on Russell Avenue.

The existing land use around Christopher Avenue is a combination of suburban office campus, big box retail, and auto sales. The combination of the smaller intersection footprint, lower traffic volumes, and BRT would provide opportunities for redevelopment in a walkable and transit-oriented scale.

Looking north along MD 355 at Christopher Avenue

The existing pedestrian network is adequate with sidewalks and connections. The intersection is signalized with pedestrian signals and crosswalks across the east, west, and north approaches. The mixed use path that runs along the west side of MD 355 provides connections for bikes and pedestrians.

The intersection at Christopher Drive provides three though lanes in each direction along MD 355 and dedicated left turn lanes for the north and south approaches. The east, south, and west legs provide channelized right turns with a yield condition.

A station at Christopher Avenue would be about a third of a mile from the Watkins Mill Road and MD 124 stations. Given the close spacing to the other stations identified in the CTCFMP, this station location should only be considered if one of the adjacent stations is eliminated.

Table 4-9: Christopher Avenue Station Rating

Existing Ridership	○
Land Use	◑
Existing Connections	◑
Traffic Complications	◑

Lakeforest Boulevard/Perry Parkway Station

The Lakeforest Boulevard/Perry Parkway location was identified to respond to two challenging locations. The MD 124 location presents challenges associated with the scale of the intersection in its current design. The addition of a station platform along with the widening required just to add the BRT guideway would further increase the intersection width and extend pedestrian crossing distances. Additionally, a station at this location would likely never

be able to fully realize any redevelopment opportunities oriented toward a walkable, transit-friendly design because of this size.

The next station to the south at Odendhal Avenue is a logical station location because of the interaction with the existing transit routes that serve the Lakeforest Transit Center. However, the hybrid design alternative identifies a transition from a two-lane guideway to a single-lane guideway at Odendhal Avenue could present some operational challenges associated with a single-lane reversible guideway design. Buses would need to exit the guideway into mixed traffic headed south and enter the guideway headed north from mixed traffic during non-peak travel times. This design alternative also results in the need for a curbside BRT station in the southbound direction.

Lakeforest Boulevard would still be proximate to many existing bus stops and transit routes. The future redevelopment of Lakeforest Mall and other surrounding properties could be combined with relocation of the Lakeforest Transit Center and restructuring of local bus routes that would position them closer to Lakeforest Boulevard and MD 355. The land use benefits cited for MD 124 and Odendhal Avenue apply to this location as well. The Lakeforest location is more central to the Lakeforest Mall and ring properties while MD 124 and Odendhal Avenue flank the sides. The combination of design, land use, and operational considerations suggest that a station at Lakeforest Boulevard is a preferred alternative to replace the MD 124 and Odendhal Avenue stations.

The existing pedestrian network is strong with ample sidewalks and connections. The intersection is signalized with pedestrian signals and crosswalks across the east, west, and south approaches.

The intersection layout is not ideal with three though lanes in each direction and two left turn lanes on both approaches from MD 355. The intersection, like MD 124, also includes channelized right turn lanes on all four approaches. The intersection could be redesigned to provide a more compact and pedestrian-oriented layout and support transit-oriented redevelopment of the surrounding parcels.

A Lakeforest Boulevard station would be located about 0.2 miles from the MD 124 and Odendhal Avenue stations. This station location is intended as a replacement for one or both of the adjacent stations identified in the CTCFMP.

Looking north along MD 355 at Lakeforest Boulevard

Table 4-10: Lakeforest Boulevard Station Rating

Existing Ridership	●
Land Use	●
Existing Connections	◑
Traffic Complications	◑

Chestnut Street/Walker Avenue Station

The previous section discussed some of the challenges with locating a station at Brookes Avenue. The design and land acquisition challenges with the Brookes Avenue location suggest that station should be eliminated entirely. However, this would force those living in the focal study area to walk further to access the BRT. The land use density in the area south of Odendhal Avenue only weakly supports a station near Chestnut Street, but any potential redevelopment in this area would benefit from a station location.

An alternative to considering Brookes as the location for a station would be to consider Chestnut Street and Walker Avenue as the station location. This location is similarly close to existing bus stops and routes as the Brookes location.

Existing land use for this area is traditional suburban commercial. Future forecasts for the area west of MD 355 shows the greatest density in jobs and households. If this portion of MD 355 redevelops with higher density land uses, the BRT could support economic growth and transit-oriented development potential.

A traffic signal is essential to provide safe pedestrian access to BRT stations on MD 355, and Chestnut Street is the only traffic signal location in this portion of the corridor. The location provides sidewalks on both sides of MD 355 and connectivity to the residential neighborhoods on the east and commercial businesses to the west. The intersection at Chestnut Street is signalized with pedestrian signals and marked crosswalks on the north, south, and west legs of this three-legged intersection. Walker Avenue, which is about 80 feet south of Chestnut, is not signalized.

The intersection at Chestnut Street includes two though lanes in each direction, a separate left turn left in the northbound direction, and a separate right turn lane in the southbound direction. North of Chestnut is the two-way left turn lane. Adding a station at this location would require additional right-of-way beyond what is shown in the design layout alternatives included in Appendix B.

The misalignment between Chestnut Street and Walker Avenue complicates the potential station layout. Optimizing vehicular access and pedestrian access to Walker Avenue would require realignment of Chestnut Street to intersect MD 355 opposite Walker Avenue, which is only possible through future dedication of private property for the new roadway alignment. This option is best considered through the redevelopment and land use review process. A

new Chestnut Street alignment could help to normalize the street grid, minimize traffic operations issues, and improve future redevelopment opportunities in this portion of the corridor.

The location of the Chestnut Street intersection within the hybrid design alternative is at the southern transition point between the dual-lane and single-lane guideway. As a result, a curbside platform and mixed traffic operation north of Summit Avenue may be required for northbound buses to operate acceptably.

A station near Chestnut Street and Walker Avenue would be located approximately half a mile from a station at either Lakeforest Boulevard or Odendhal Avenue. A Chestnut Street/ Walker Avenue station would be located three-quarters of a mile from a station at Education Boulevard.

Looking north along MD 355 at Chestnut Street and Walker Avenue

Table 4-11: Chestnut Street/Walker Avenue Station Rating

Existing Ridership	●
Land Use	◐
Existing Connections	◐
Traffic Complications	◐

Cedar Avenue/Fulks Corner Avenue Station

The location of the Education Boulevard station a half mile away from downtown Gaithersburg limits the potential for a station to take advantage of the interactions that would happen between downtown Gaithersburg and the BRT. Placing a station closer to downtown Gaithersburg would provide better access for transfers between the BRT and MARC train. It could also support development/redevelopment opportunities centered on downtown.

Cedar Avenue and Fulks Corner Avenue are currently served by a bus stop in each direction and two Ride On routes. The downtown Gaithersburg MARC station is about a quarter mile from the intersection of MD 355 and Cedar/Fulks Corner.

Existing land use around this intersection is a combination of apartments, low-rise commercial, and office. Opportunities for redevelopment are more likely on the east side of MD 355 due to the established residential properties on the west side. A challenge to future development is the roadside grade north of the intersection associated with the bridge over the railroad tracks.

Sidewalks are currently found on both sides of MD 355. There are no existing bike facilities nearby, and the intersection is not currently signalized. There are only cross-walks across Cedar and Fulks Corner. A station at this location would likely require the addition of a signal and marked crosswalks to provide adequate pedestrian facilities. A traffic signal at Cedar Avenue/Fulks Corner Avenue would be located approximately 900 feet from the nearest traffic signal at Summit Avenue.

Looking north along MD 355 at Cedar Avenue/Fulks Corner Avenue

The existing intersection provides three though lanes in each direction with a dedicated left turn lane. A median break is currently provided at this intersection to allow left turn movements and traffic coming from both Cedar Avenue and Fulks Corner Avenue which are controlled by STOP signs.

A station at Cedar Avenue/Fulks Corner Avenue would be about a third of a mile away from a station at Brookes Avenue or half a mile from a station at Chestnut Street. This location is less than a mile from the station proposed at Odendhal Avenue to the north and approximately a third of a mile from a station at Education Boulevard to the south.

Table 4-12: Cedar Avenue/Fulks Corner Avenue Station Rating

Existing Ridership	◐
Land Use	◐
Existing Connections	◑
Traffic Complications	◑

Summit Avenue Station

A station at Summit Avenue would replace a station at either Education Boulevard or Cedar Avenue/Fulks Corner Avenue. A station at this location would provide many of the same benefits to one at Cedar/Fulks Corner in terms of a strong connection to downtown Gaithersburg. The potential for redevelopment opportunities would be limited due to the historic structures on the northeast and southwest corners.

There is an existing bus stop in each direction along MD 355. The MARC station is about a third of a mile away, and City Hall is even closer. The existing land use is single family residential, institutional, and some office. A significant challenge to constructing a station at this location would be the additional right-of-way required and the associated impacts to the existing historic structures. These structures and the established homes would likely preclude any redevelopment opportunities at this location.

The existing intersection is well served by the sidewalk network and connections to surrounding properties. The intersection is signalized with pedestrian push button signals on the west, east, and north legs of the intersection.

The intersection provides three southbound and two northbound though lanes on MD 355 with a dedicated left turn lane on each approach. There is also a dedicated right turn lane from northbound MD 355 to eastbound Summit Avenue. Right turning traffic from westbound Summit Avenue is channelized into a third northbound lane.

The stop spacing between proposed stations and this location is less than half a mile. If no station is built in the focal study area between Odendhal Avenue and Summit Avenue the spacing would be a mile.

Looking north along MD 355 at Summit Avenue

Table 4-13: Summit Avenue Station Rating

Existing Ridership	◐
Land Use	○
Existing Connections	◐
Traffic Complications	◐

Deer Park Drive Station

The southernmost station proposed in the CTCFMP is the Education Boulevard station. The next station identified by the CTCFMP to the south is the Shady Grove Road station, over a mile away and outside the City of Gaithersburg boundaries. Placing a station between Education Boulevard and Shady Grove Road would provide greater access to the BRT from residents in southern Gaithersburg.

There are existing bus stops in each direction of MD 355 at Deer Park Drive. Deer Park Drive is also where the Ride On 55 and 59 routes stop running together on MD 355 and split, with the 55 continuing north along MD 355 and the 59 turning west onto Deer Park Drive. The existing land uses are primarily residential and single story commercial. Highland Square on the northwest corner of MD 355 and Deer Park Drive is a midrise apartment complex that is the type of design that can be more supportive of transit that other lower intensity residential complexes. The existing right-of-way at Deer Park is narrower than the rest of MD 355 south of the focal segment, which suggests a greater degree of property acquisition and design considerations would be required to site a station at this location than other proximate locations.

The existing intersection is well served by the sidewalk network and connections to surrounding properties. The intersection is signalized with pedestrian push button signals on the west, east, and north legs of the intersection. The intersection provides three southbound and three northbound though lanes on MD 355 with a dedicated left turn lane on each approach.

The Education Boulevard station is located a third of a mile to the north of Deer Park Drive. The Shady Grove Road station is located about one mile to the south.

Looking north along MD 355 at Deer Park Drive

Table 4-14: Deer Park Drive Station Rating

Existing Ridership	◐
Land Use	◑
Existing Connections	◐
Traffic Complications	◐

North Westland Drive Station

A station at North Westland Drive would provide a southern access point between Education Boulevard and Shady Grove Road. The location is served by a stop in each direction that is currently served by the Ride On 55 and 59 routes. Land use around North Westland Drive includes a mix of suburban office and commercial uses with single family residential neighborhoods behind those properties. Property setbacks here are greater than at Deer Park Drive, as is the right of way.

The existing intersection is not signalized, only providing a crosswalk across the east leg. MD 355 at North Westland Drive is comprised of six through lanes, three in each direction, with a left turn lane on the southbound approach. If a station is added at this location, a traffic signal would need to be constructed to provide appropriate traffic control and pedestrian access. This location is approximately 1,000 feet from the closest signal at South Westland Drive.

The spacing between Education Boulevard, to the north, and North Westland Drive is approximately two-thirds of a mile. The spacing between North Westland Drive and Shady Grove Road to the south over half a mile. This location provides better spacing between stations than the Deer Park Drive location would. This station also provides greater potential for future redevelopment and right of way for station construction than the Deer Park station location.

Looking north along MD 355 at North Westland Drive

Table 4-15: North Westland Drive Station Rating

Existing Ridership	
Land Use	
Existing Connections	
Traffic Complications	

4.4 Station Location Policy Considerations

The previous sections on functional considerations focus on ensuring suitable design and operations. The City's consideration of ideal station locations for the BRT service should also include a variety of policy considerations as described in the following sections.

Evolution of Bus Rapid Transit

The implementation of BRT is intended to serve multiple objectives. From a transportation system perspective, the BRT system is intended to improve transportation service options for both existing users and those who will be generated by future development in the City. From a placemaking perspective, the BRT station locations can both help define the form of that future development along Frederick Avenue as well as serve as a catalyst for that development.

The *Countywide Transit Corridors Functional Master Plan* suggests station locations within the City of Gaithersburg that are influenced to a large degree by serving existing transit service and ridership patterns. Stations proposed on MD 355 at junctions like MD 124 and Odendhal Avenue reflect, in part, the potential for transfers to and from existing bus routes.

Over time, however, one objective of the City's Comprehensive Plan is to increase transit-oriented development both along MD 355 and at nearby redevelopment sites such as Lakeforest Mall. These redevelopment sites have the potential to create new focal points for transit-oriented development along Frederick Avenue. For instance, the level of traffic volume (both existing and projected) on Montgomery Village Avenue - MD 124 (even after the completion of the Watkins Mill Road interchange with I-270) suggests that its junction with Frederick Avenue is not likely to be a strong candidate for a focus of walkable, transit-oriented development that would entice choice riders to the system. However, Perry Parkway and Lakeforest Boulevard may serve as a more logical focal point for TOD as the MD 355 North BRT system is developed to connect Gaithersburg to Rockville and Germantown and certain local bus services are restructured to interface with the BRT.

The consideration of alternative CTCFMP station locations needs to be done with a systems perspective in addition to a station-by-station perspective. Using the same logic, an alternative station location scheme could be considered for focusing TOD around a series of more walkable station locations that would address expected high-traffic volume and

potentially reduced walkability at the two highest-traffic cross-streets (Watkins Mill Road and MD 124) might include:

- Establishing a new station north of Watkins Mill Road in the vicinity of Travis Avenue
- Shifting the Watkins Mill Road station about 500' south to Christopher Avenue
- Shifting the MD 124 station about 500' southward to Lakeforest Boulevard/Perry Parkway

The degree to which this type of shifting schema might continue southward depends to some extent on the City's interest in facilitating additional future TOD nodes along the corridor. Similarly, the station location decision process needs to consider both the City's interest in accelerating BRT implementation in concert with the state and County's interests and abilities. On the one hand, one advantage of the BRT mode is that it can evolve in logical segments. The implementation of the Metroway service along Jefferson Davis Highway (US Route 1) in the City of Alexandria is a good example of segmented implementation moving forward even as the larger vision (rail service ultimately connecting both the Jefferson Davis Highway and Columbia Pike corridors) suffers a setback in the cancellation of the Columbia Pike Streetcar project. On the other hand, the City's consideration of design options and station locations needs to consider the likely transit service interests, redevelopment objectives, funding resources, and implementation timeframes of the County and state.

BRT Guideway Design Opportunities and Constraints

The vast majority of the station locations identified in the *Countywide Transit Corridors Functional Master Plan* have a logical basis in existing and or future land use, and potential to connect to the larger transportation network. The Montgomery Village Avenue station would be difficult to construct/implement due to the complicated intersection geometry and movements. Additionally, the station location at Odendhal Avenue presents challenges if a hybrid design alternative is chosen, requiring buses to transition from a dual-lane guideway to a single-lane guideway. These two factors point to the benefits of relocating the station to Lakeforest Boulevard. This would require rerouting some of the existing transit service via Odendhal Avenue.

If a station at Brookes Avenue is not feasible, the distance between the Education Boulevard station and the Chestnut/Walker station would be almost three quarters of a mile apart. To improve connectivity and create a stronger connection to Old Town Gaithersburg (as well as MARC), relocating the station at Education Boulevard further north should be considered. One possible location could be the intersection of Cedar Avenue and Fulks Corner Avenue. The challenges of shifting the station here would be additional right-of-way needs and building impacts, requirements for signalization of an unsignalized intersection to provide safe pedestrian crossings, and additional costs associated with the slopes and retaining walls on either side of MD 355 here. Alternatively, locating the station at Summit Avenue would help serve Olde Towne Gaithersburg but would undoubtedly impact the historic buildings on one or both sides of MD 355.

Potential Redevelopment Opportunities

The space required for BRT station shelters and amenities may in some cases be able to be provided through public sector redevelopment, whether simply by right-of-way reservation or dedication, or through incorporation of station siting in TOD redevelopment plans.

In general, within the focal segment of MD 355, the commercial and institutional parcels are larger on the west side of the roadway than on the east side (where the prevailing land use more quickly turns to established single-family residential neighborhoods). For this reason, it might be expected that west side property owners will be more interested and amenable to participating in the station location and TOD establishment process. Where stations are to be sited it may be desirable to shift all elements of the right of way a few feet to the west regardless of the BRT design treatment (median or curb running, reversible or bidirectional). The City could engage property owners and other interested stakeholders to evaluate BRT station location potential. The City might also consider incentives that could be offered to developers who provide right-of-way or other design or implementation elements that facilitate TOD establishment at BRT stations. Such incentives could potentially include additional density or an exchange of transportation impact mitigation actions or fees. Changes to existing City policies might be considered to encourage such policy approaches that provide a win-win solution for both the private and public sector interests.

4.5 Summary

The table below summarizes the functional review from above of all the locations that have been proposed in the CCTCFMP and this study.

Table 4-16: Summary of Gaithersburg BRT Station Location Ratings

	Existing Ridership	Land Use	Connectivity	Existing Traffic
Professional Drive	○	◑	◐	●
Travis Avenue/Spectrum Avenue	○	◐	◐	●
Watkins Mill Road	◑	●	●	◑
Christopher Avenue	○	◑	◐	◐
Montgomery Village Drive (MD 124)	○	◐	◑	○
Lakeforest Boulevard	●	●	◐	◐
Odendhal Avenue	●	◐	◐	◐
Chestnut Street/Walker Avenue	●	◐	◐	◐
Brookes Avenue	◑	○	○	○

	Existing Ridership	Land Use	Connectivity	Existing Traffic
Cedar Avenue/Fulks Corner Avenue	◐	◐	◑	◑
Summit Avenue	◐	○	◐	◐
Education Boulevard	○	◑	●	●
Deer Park Road	◐	◑	◐	◐
North Westland Drive	◐	◐	◑	◐

Two different approaches to identify BRT stations might be considered and presented to constituents for review and comment before establishing recommended locations in the City's Master Plan. One approach is to use the station locations identified in the *County's Countywide Transitway Corridors Functional Master Plan*, as shown in Figure 4-3. These locations provide a consistent spacing of approximately a half mile between stations, providing for improved bus speeds over local bus when combined with the exclusive guideway treatment. Some of these locations present challenges because of the existing scale of the intersection and the associated expansion that would need to occur to accommodate both the guideway and station platforms. The MD 355/MD 124 intersection is already challenging for pedestrians and would only get worse as the BRT causes the intersection to expand. Other locations, like Brookes Avenue, would further impact properties in the focal area while providing little benefit in terms of access and future redevelopment.

An alternative option would be to modify those station locations that present challenges to design, right-of-way needs, or BRT operations by offsetting them somewhat in the interests of better serving future TOD focal points, summarized in Figure 4-4. The locations selected as part of this approach include:

- Travis Avenue/Spectrum Avenue
- Christopher Avenue
- Lakeforest Boulevard
- Chestnut Street/Walker Avenue
- Cedar Avenue/Fulks Corner Avenue
- Deer Park Drive
- North Westland Drive

The spacing for these locations is comparable to the CTCFMP station locations. While avoiding some of the challenging intersections, some of these station locations come with their own challenges that were documented above.

Figure 4-3: CTCFMP Station Locations

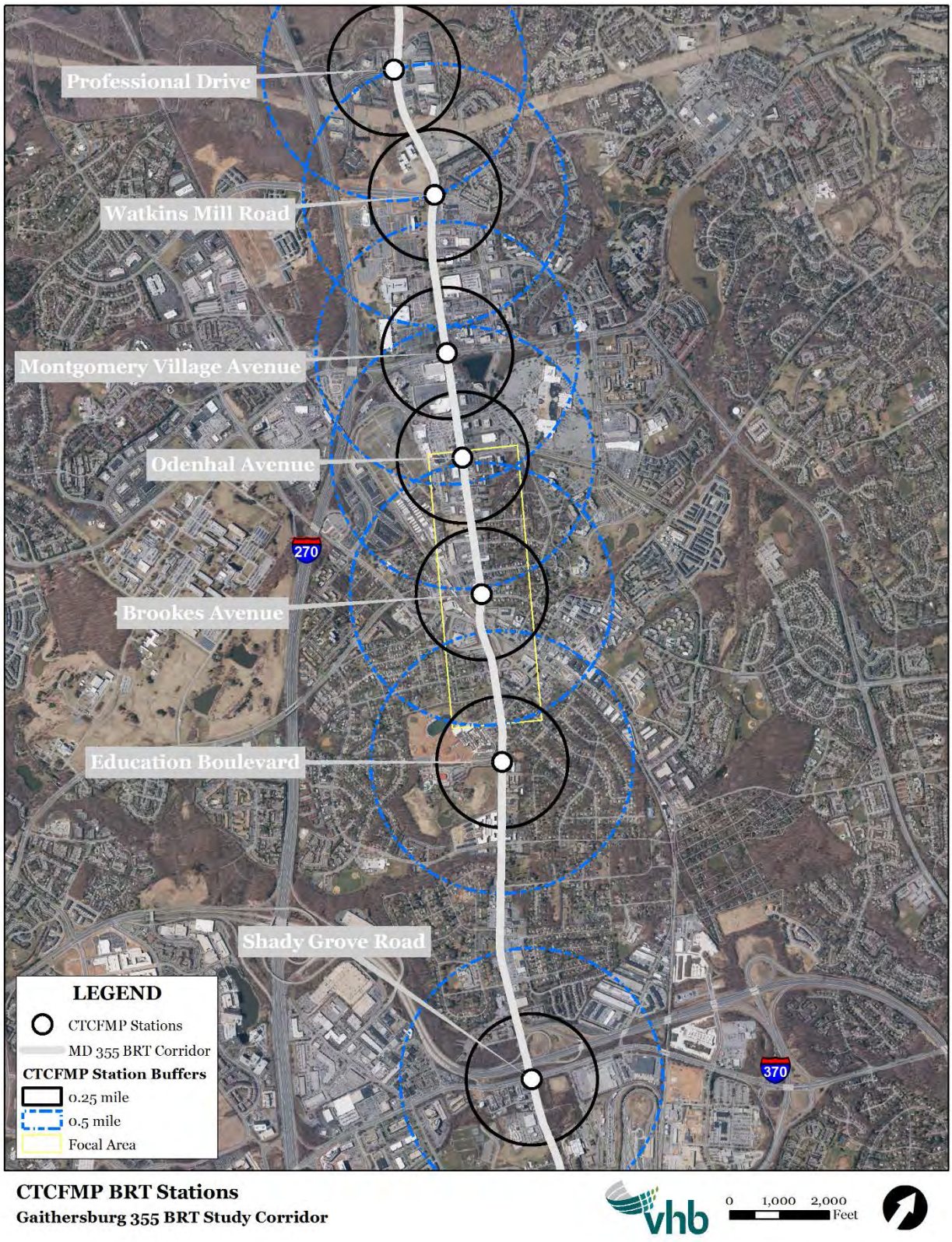
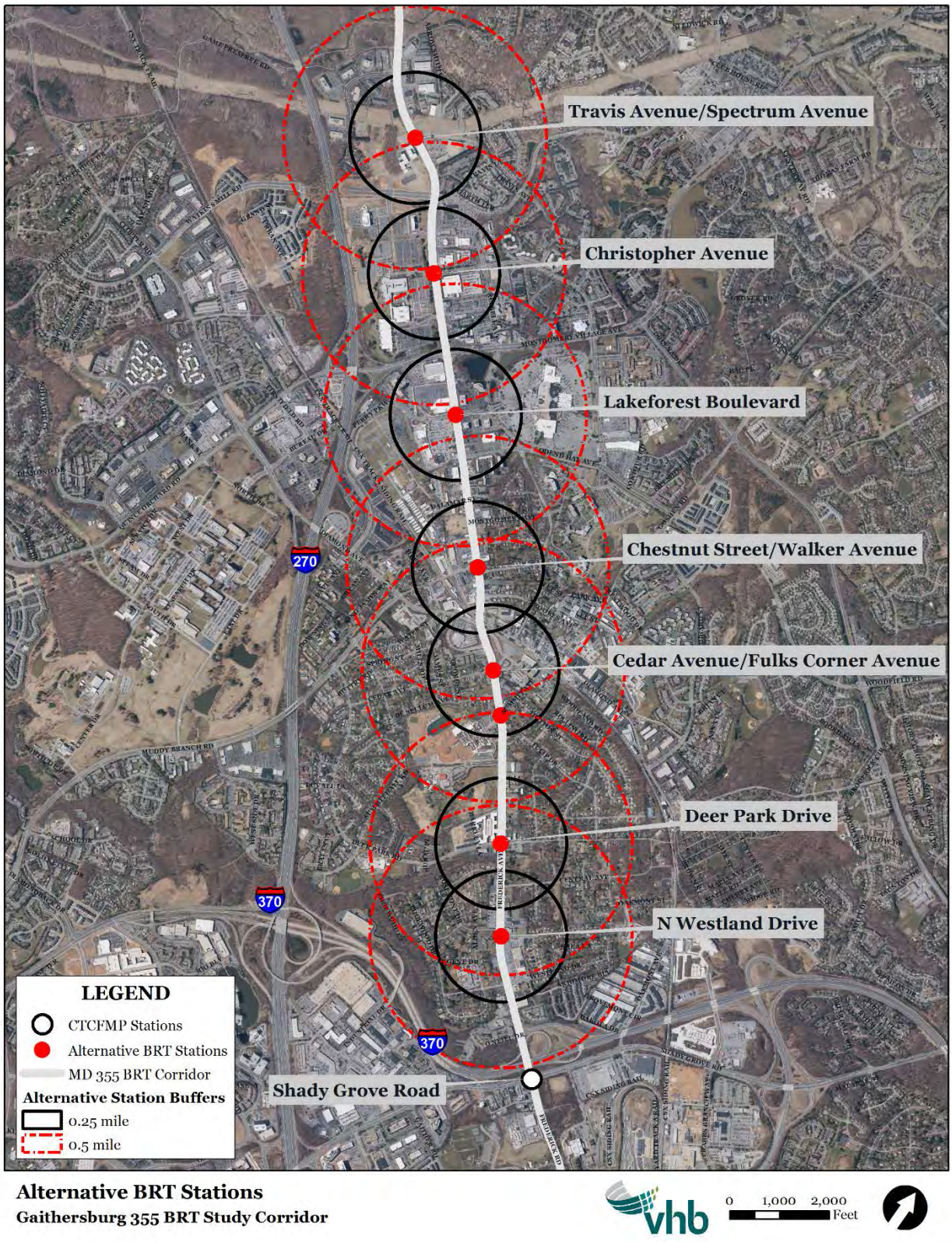


Figure 4-4: TOD Station Scheme



The following discussion seeks to identify a set of preferred station locations that provide the greatest benefit to the City of Gaithersburg, while reducing overall impacts. Using the station ratings from above, a numeric value was given to each rating category (see Appendix E). Those locations with the lowest scores were dropped from consideration. Those locations that scored the highest were advanced for further consideration. The planning team reviewed the potential station spacing for the highest scoring station locations, and considered other subjective criteria, such as potential future land use benefit, to select a preferred set of station locations from the shortlist of options. This approach attempts to balance traffic operations/impacts, BRT operations, station spacing, property impacts, and opportunities for future redevelopment. This set of station locations reflects a longer term look at the BRT corridor, and the redevelopment opportunities that could be achieved with the BRT.

The Professional Drive and Watkins Mill Road stations are carried forward from the CTCFMP. While the Travis Avenue/Spectrum Avenue location provided slightly better overall scoring than the Professional Drive location, neither represents a significantly better station location than the other. The Watkins Mill Road station location was seen as a preferred location over the Christopher Avenue location because of its land use potential. Selecting the Watkins Mill Road station eliminates the Travis/Spectrum station from consideration due to close proximity. MD 124 is eliminated from consideration due to the challenges associated with the size of the intersection and overall traffic operations complications. Shifting this station location to Lakeforest Boulevard/Perry Parkway provides more benefits associated with redevelopment of the Lakeforest Mall and surrounding properties. Both the Lakeforest Boulevard/Perry Parkway station and Odendhal Station locations performed well in the scoring evaluation, but spacing between stations would be too close to justify keeping the Odendhal Avenue station.

Within the focal study area, redevelopment potential between Odendhal Avenue and the Father Cuddy Bridge is likely to support one BRT station. The spacing between Lakeforest Boulevard and a station south of Summit Avenue would be too great. The Brookes Avenue location was eliminated as the lowest scored location, which suggests that Chestnut Street is the best location in the northern portion of the focal segment. This station could either be located at Chestnut Street in its existing road configuration, or considered as part of a redevelopment project including realignment of Chestnut Street with Walker Street, providing a four way signalized intersection and expanded pedestrian connectivity on both sides of MD 355.

Cedar Avenue and Fulks Corner Avenue present opportunities for redevelopment associated with downtown Gaithersburg as well as connection to the MARC train service. This location is preferred over Summit Avenue because of the constraints there with historic properties at the latter location. The Education Boulevard location did not score particularly high, but could provide some redevelopment opportunities south of the intersection and fits well into the station spacing.

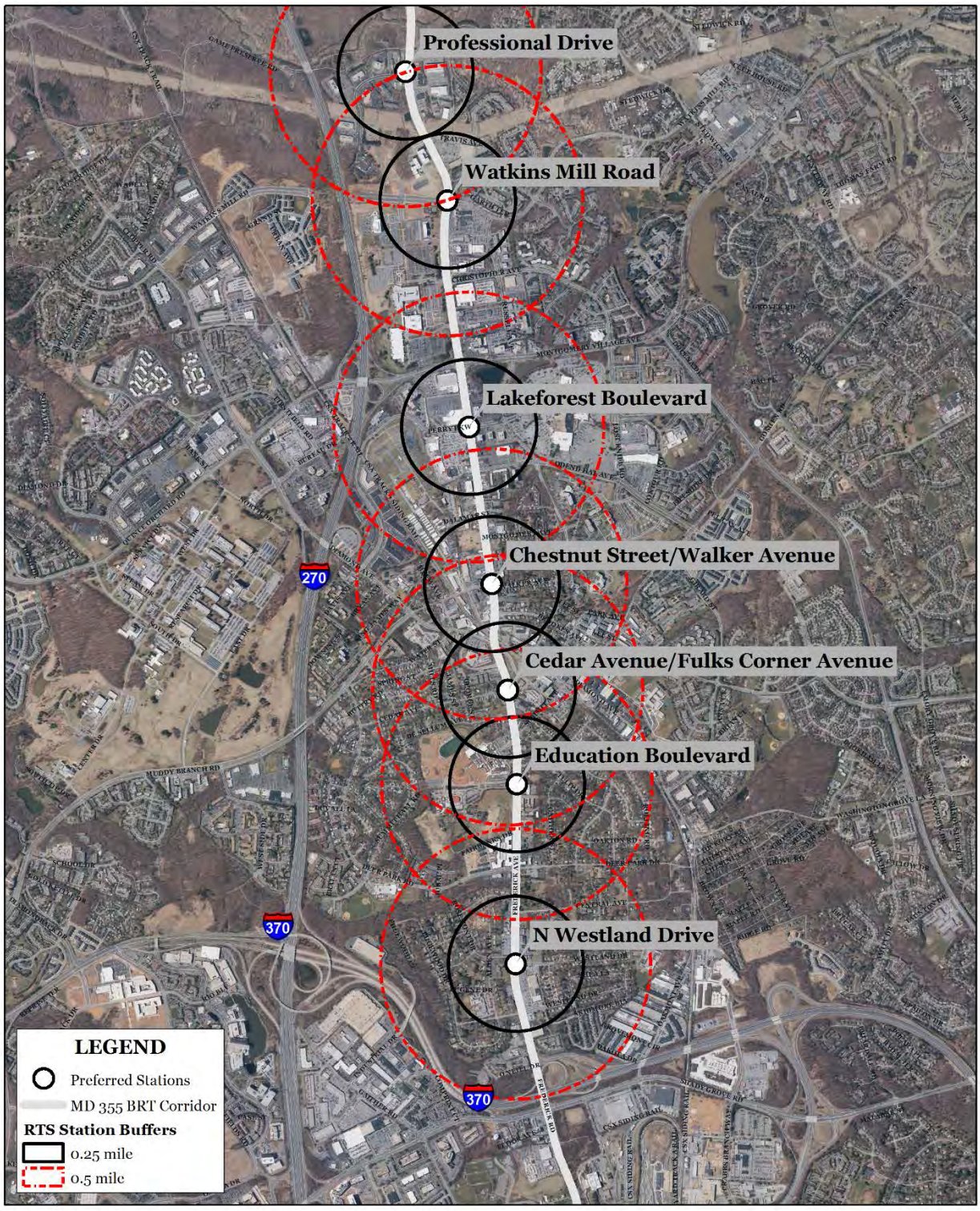
Ignoring station options south of Education Boulevard would create a significant gap in the preferred station spacing schema, given that the next station to the south is planned for Shady Grove Road. Deer Park Drive has greater challenges with available right-of-way than other proximate locations, which suggests the North Westland Drive location is preferable. This location has greater existing right-of-way and provides somewhat better opportunities for redevelopment.

Based on the assessment, the proposed station locations in the City of Gaithersburg include the following locations:

- Professional Drive
- Watkins Mill Road
- Lakeforest Boulevard
- Chestnut Street/Walker Avenue
- Cedar Avenue/Fulks Corner Avenue
- Education Boulevard
- North Westland Drive

The collection of preferred stations provides strong BRT coverage for transit riders in the City of Gaithersburg and establishes multiple viable locations for potential long-term redevelopment. These station locations and their ¼ and ½ mile walkshed distances are depicted in Figure 4-5.

Figure 4-5: Proposed Station Locations



Preferred Station Locations
Gaithersburg 355 BRT Study Corridor

vhb 0 1,000 2,000 Feet

4.6 Bus Rapid Transit Right of Way

The feasibility of the Bus Rapid Transit system in the City of Gaithersburg, and throughout Montgomery County, is dependent on the availability of publicly owned property to construct the planned BRT guideways and maintain appropriate roadway capacity. Any roadway widening required to construct BRT guideways will require the city, county, and/or state to acquire additional property along the corridor. The purpose of this section is to define the preferred right of way dimensions for consideration and adoption by the City of Gaithersburg to complete concept planning and detailed design for the MD 355 corridor.

The concept of right of way for the MD 355 is divided into to two categories, for portions of MD 355 outside of the focal segment: typical BRT corridor right of way and typical BRT station area right of way. These right of way elements are primarily based on Maryland State Highway Administration (SHA) dual-lane median BRT guideway and roadway design dimensions. The right of way dimensions developed for portions of the corridor outside of the focal segment include minimum and preferred values. The minimum right of way requirements refer to the least amount of publicly owned property required to accommodate the BRT guideway and maintain existing roadway capacity according to minimum Maryland SHA roadway dimensions. The preferred right of way provides the same BRT and roadway capacity accommodations, but is based on Maryland SHA standard design dimensions.

Additionally, this section discusses the right of way requirements for the MD 355 focal segment, where planning-level design concepts were developed and provide a more thorough assessment of right of way requirements than other parts of the corridor. Suggestions for the focal segment right of way are based on the roadway dimensions defined in the hybrid alternative concept.

Existing Right of Way

The existing right of way on MD 355 in the City of Gaithersburg varies significantly depending on the location within the corridor. In some locations, the existing public right of way may be sufficient to construct the preferred BRT guideway without acquiring additional property along MD 355. However, the roadway extents throughout much of the MD 355 corridor in the City of Gaithersburg, particularly in the focal segment, have reached the limits of the public right of way under existing conditions.

North and south of the focal area, the MD 355 corridor maintains a relatively uniform right of way width for significant stretches, but the right of way width along the corridor gradually increases or decreases at several locations to provide a wider roadway cross-section or accommodate intersection turning lanes. From O'Neill Drive to Summit Avenue, the corridor right of way is consistently approximately 120 feet wide, except near Deer Park Avenue (110 feet wide) and Education Boulevard (188 feet wide). From Odendhal Avenue to Perry Parkway, the existing right of way is approximately 112 feet wide. From Perry Parkway to Montgomery Village Avenue (MD 124), the right of way gradually increases to a maximum of 166 feet wide, and remains approximately 160 feet wide to Christopher Avenue. Between Christopher Avenue and Watkins Mill Road, the right way gradually decreases to approximately 125 feet wide. North of Watkins Mill Road, the right of way widens to approximately 150 feet, but then decreases again to 125 feet wide after Travis Avenue and remains that width until beyond Professional Drive, near the northern boundary of the City of Gaithersburg.

In the focal segment, the right of way is defined by irregular property boundaries and little consistency in the overall right of way dimensions. From Summit Avenue to Cedar Avenue/Fulks Corner Avenue, the right of way is approximately 121 feet wide. The existing right of way is extremely irregular from Cedar Avenue/Fulks Corner Avenue to Brookes Avenue, widening within a range of approximately 140-400 feet surrounding the Father Cuddy Bridge, and then a narrowing to approximately 125 feet near Brookes Avenue. North of Brookes Avenue, the MD 355 right of way is narrowest and very irregular, ranging from approximately 82-105 feet until widening at Odendhal Avenue.

Typical BRT Corridor Right of Way

The MD 355 corridor, outside of the focal segment, is largely characterized by suburban roadway design, typically providing six lanes for through traffic capacity, a wide center median, and sidewalks on both sides of the road. Much of the corridor conforms to this typical roadway geometry and the typical BRT corridor right of way seeks to define the required dimensions to construct the BRT guideway and maintain the traffic capacity provided by the existing roadway geometry.

The typical corridor right of way refers to the width of publicly owned property along the MD 355 corridor, outside of the influence of signalized intersections with multiple turning lanes, to accommodate a dual-lane BRT guideway and six lanes of through traffic. The intent of identifying the typical BRT corridor right of way is to define the baseline requirement for optimal function of both the BRT and traffic through the corridor. As the detailed design process progresses, it is possible that a single-lane median guideway, or other guideway options requiring less physical area to construct than the dual-lane median guideway, may be selected. Such decisions may dictate that less right of way is required to accomplish the preferred BRT design, and the right of way requirements defined in this study may be revised.

BRT Facility and Roadway Dimensions

The typical BRT corridor right of way is based on the standard and minimum dimensions for roadway and BRT facilities defined by the Maryland SHA BRT design team. The Maryland SHA BRT facility and roadway design dimensions included in Appendix A provide a basis for consideration of right of way requirements for the corridor. Tables 4-17 and 4-18 summarize the standard and minimum design dimensions assumed in this evaluation.

Table 4-17: SHA BRT and Roadway Standard Dimensions

Design Element	Standard Width (feet)	Quantity	Total Width (feet)
BRT Guideway Lane	12	2	24
BRT Median Separator	6	2	12
General Traffic Lane	12	6	72
Bicycle Lane	5	2	10
Gutter Pan	1	6	6
Landscape Buffer	4	2	8
Sidewalk	6	2	12
Utility/Maintenance Buffer	2	2	4
Total Roadway Width	**n/a**	**n/a**	**148**

Table 4-18: SHA BRT and Roadway Minimum Dimensions

Design Element	Minimum Width (feet)	Quantity	Total Width (feet)
BRT Guideway Lane	11	2	22
BRT Median Separator	2	2	4
General Traffic Lane	11	6	66
Bicycle Lane	5	2	10
Gutter Pan	1	6	6
Landscape Buffer	0	0	0
Sidewalk	5	2	10
Utility/Maintenance Buffer	2	2	4
Total Roadway Width	**n/a**	**n/a**	**122**

These dimensions may not account for all conditions present on the corridor or undefined design elements that may be desirable, such as transition areas, bus stops, or wider sidewalks to support localized commercial development. To provide some flexibility for unforeseen design considerations and account for likely limits of disturbance necessary for construction, the suggested preferred and minimum right of way dimensions should provide slightly wider dimensions than the overall roadway dimensions in Tables 4-17 and 4-18.

Focal Segment BRT Corridor Right of Way

The suggested right of way for the MD 355 focal segment is based on the dimensions defined in the planning-level design concepts and typical cross-sections for the hybrid design alternative. The cross-section attributes for the focal segment differ somewhat from the SHA design dimensions as they were developed to accommodate an appropriate BRT guideway, using existing roadway design dimensions to minimize impacts to adjacent properties.

The right of way defined by the hybrid alternative concepts responds to localized conditions and varies in width throughout the focal segment. To minimize unnecessary impact to adjacent land uses, the suggested typical BRT corridor right of way in the focal segment should reflect these variations. Table 4-19 summarizes the right of way dimensions identified by the hybrid design alternative cross-sections at five locations on the corridor. Should future redevelopment afford the opportunity to dedicate additional right of way, the minimum dimensions derived from the Maryland SHA design basis will provide an appropriate alternative to the focal segment typical BRT corridor right of way defined in this evaluation.

Table 4-19: MD 355 Focal Segment Corridor Right of Way Dimensions

MD 355 Focal Segment Location	Corridor Right of Way Width
Odendhal Avenue to Montgomery Avenue	97 feet
Montgomery Avenue to Chestnut Street	88 feet
Chestnut Street to Father Cuddy Bridge	102 feet
Father Cuddy Bridge	89 feet
Father Cuddy Bridge to Summit Avenue	120 feet

Typical BRT Station Area Right of Way

Station locations will require additional right of way beyond the typical BRT corridor or focal segment rights of way suggested in the previous section. The requirements for station area right of way are based on typical dimensions for station elements and assumptions regarding planned intersection geometry.

Station Elements Influencing Right of Way Requirements

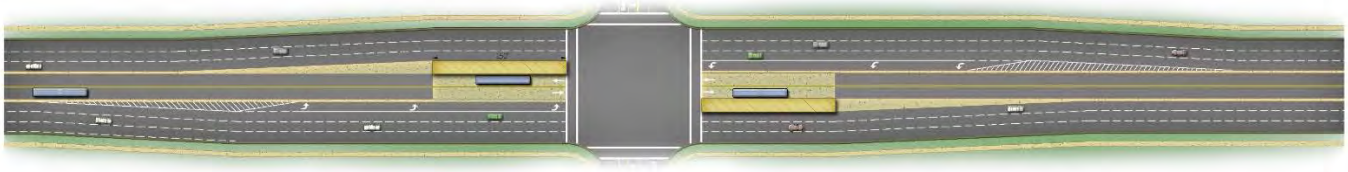
BRT stations on MD 355 will be located at signalized intersections, which provide necessary, safe, and controlled pedestrian access to station platforms. Additional property is needed to accommodate the following elements at intersections with BRT stations:

- Station platforms along the median guideway in both directions
- Possible curbside station platforms where stations are located on a single-lane median guideway segments.
- Turning lanes (right and left), including dual or triple turn lanes at some of the most heavily traveled intersections

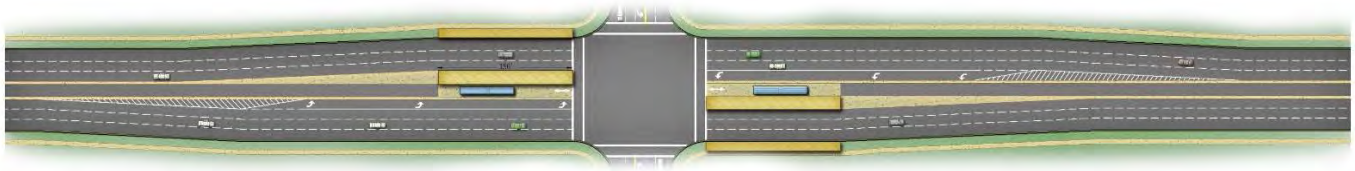
To highlight the influence of station configurations on right of way requirements, three typical station configuration layouts, representative of station types include in the MD 355 planning, were developed. Figure 4-6 shows examples of the dual-lane median, single-lane median reversible, and single-lane median bi-directional station types. All of these station types highlight how incorporation of BRT platforms and intersection turning lane geometry result in a gradual increase in the roadway width approaching the intersection from either direction. The station configuration also influences the right of way required at the intersection, resulting in greater right of way requirements at the intersection than along the corridor segments between stations.

Figure 4-6: Example BRT Station Configurations

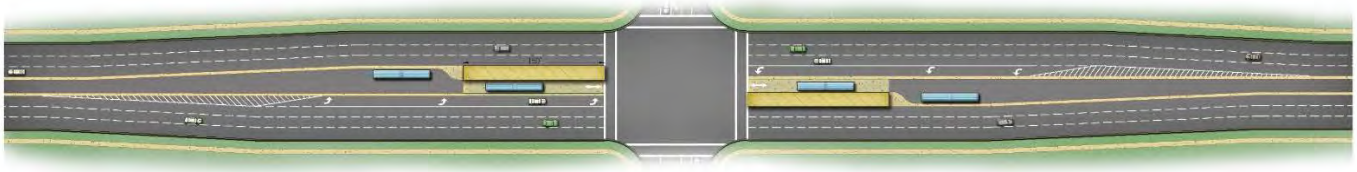
Typical Dual-lane Median Station Configuration (Four Platforms)



Typical Single-lane Median Reversible Station Configuration (Four Platforms)



Typical Single-lane Median Bi-Directional Station Configuration (Two Platforms)



The Maryland SHA design dimensions define a standard width of 15 feet and a minimum width of 10 feet for median station platforms. Curbside station platforms can be 10-12 feet wide, which doesn't include additional sidewalk width. The Maryland SHA Rapid Transit design team also cites the need to provide at least one pedestrian median refuge island that is 6 feet wide on each approach of MD 355 at all signalized intersections, which can be fulfilled by a median station platform (minimum 10 feet wide). It is assumed that the City of Gaithersburg desires to retain the existing number of turning lanes at all BRT station intersection sites at this time.

Most of the station intersections in the city provide a single left turn lane on MD 355 that would need to be replaced at station intersections. Additionally, the station platform is assumed to meet the standard 15 feet wide. These attributes suggest that 30 feet of right of way is required in addition to the typical corridor rights of way at most station sites.

A few station intersections have different or additional requirements that need to be considered. The following is a summary of the station locations requiring additional consideration:

Watkins Mill Road – The MD 355 southbound approach was designed to accommodate up to 3 future turning lanes (right and left). Including the median platforms, this location requires an additional 55 feet of right of way.

Travis Avenue/Spectrum Avenue – The MD 355 northbound approach contains one left turn lane and one right turn lane. Including the median platforms, this location requires an additional 45 feet of right of way.

Christopher Avenue – The MD 355 northbound approach contains one left turn lane and one right turn lane. Including the median platforms, this location requires an additional 45 feet of right of way.

Montgomery Village Avenue (MD 124) – The MD 355 northbound approach contains three left turn lanes and one right turn lane. Only two through lanes are provided on the northbound approach (as opposed to three through lanes at most intersections on the corridor), so one turning lane can be discounted from consideration for additional right of way. Including the median platforms, this location requires an additional 65 feet of right of way.

Lakeforest Boulevard/Perry Parkway – The MD 355 northbound and southbound approaches both contain two left turn lanes. Including the median platforms, this location requires an additional 55 feet of right of way.

Odendhal Avenue – The Odendhal Avenue intersection is a potential transition point between the dual-lane median guideway to a single-lane median guideway, under the hybrid design alternative. To accommodate potential reversible BRT bus travel in mixed traffic in the non-peak direction, median platforms and a curbside platform for southbound buses would be required at this station location (northbound buses could still use the median station). This intersection contains one left turn lane on MD 355 in each direction and requires up to 43 feet of additional right of way.

Chestnut Street/Walker Avenue – The Chestnut Street/Walker Avenue intersection is a potential transition point between the dual-lane median guideway to a single-lane median guideway, under the hybrid design alternative. To accommodate potential reversible BRT bus travel in mixed traffic in the non-peak direction, median platforms and a curbside platform for northbound buses would be required at this station location (southbound buses could still use the median station). This intersection contains one left turn lane on MD 355 in each direction and requires up to 52 feet of additional right of way.

Brookes Avenue – The Brookes Avenue intersection is not currently signalized and is not favored for a station location, but a station at this location would likely provide the same attributes as a station at the Chestnut Street/Walker Avenue intersection. Therefore, the same station area right of way requirements are assigned to this station location.

Each of the potential BRT station locations was assessed for right of way requirements, based on a combination of the typical BRT corridor right of way for the roadway segment containing the station, the station platform dimensions, and the existing number of turning lanes. Table 4-20 summarizes the suggested minimum BRT station area right of way dimensions on MD 355.

Table 4-20: Suggested MD 355 BRT Station Right of Way Dimensions

MD 355 BRT Station Locations	Station Area Right of Way Width
Professional Drive	180 feet
Travis Avenue/Spectrum Avenue	195 feet
Watkins Mill Road	205 feet
Christopher Avenue	195 feet
Montgomery Village Avenue (MD 124)	230 feet
Lakeforest Boulevard/Perry Parkway	180 feet
Odendhal Avenue	140 feet
Chestnut Street/Walker Avenue	140 feet
Brookes Avenue	140 feet
Cedar Avenue/Fulks Corner Avenue	140 feet
Summit Avenue	155 feet
Education Boulevard	155 feet
Deer Park Road	155 feet
North Westland Drive	155 feet

The suggested station area rights of way are provided for all of the possible station areas identified earlier in this chapter, but property acquisition to achieve these dimensions will only be necessary at the locations where stations are actually selected. The alternative design layouts produced for the focal segment (see Appendix B) only included one station located at Odendhal Avenue, so suggested right of way for other potential stations in the focal area exceed the level of property impact depicted on the layout concepts and cross-section diagrams.

Suggested MD 355 BRT Right of Way in the City of Gaithersburg

The suggested MD 355 BRT right of way was developed based on a combination of the typical BRT corridor right of way and BRT station area right of way requirements. The typical BRT corridor right of way width is 150 feet and the suggested minimum BRT corridor right of way width is 125 feet, outside of the focal segment. The focal segment typical BRT corridor right of way varies based on the dimensions identified in the hybrid alternative design.

BRT station areas will require significant additional right of way to accommodate station platforms and turning lanes. The additional right of way required at station areas is dependent on the selected BRT guideway and the number of turning lanes provided at each intersection. The additional station area right of way dimensions range from 30 to 80 feet.

To the greatest extent possible, this study attempts to suggest a reasonably consistent and conservative right of way configuration. No detailed design with information regarding the selection of preferred BRT guideways, modifications to the number of intersection turning lanes, or the most appropriate locations to transitions in roadway cross-sections has been developed for the MD 355 corridor in Gaithersburg at this time. The most appropriate and conservative basis for establishing the preferred right of way is to select dimensions that accommodate the preferred station locations and the hybrid design alternative. The preferred station locations are identified Figure 4-5 in a previous section of this chapter and a copy of

the hybrid alternative layout drawing is included in Appendix B. To minimize potential confusion for stakeholders or limitations on the detailed design process, transitions between different right of way dimensions along the corridor are limited to critical points where different station right of way requirements abut.

Table 4-21 summarizes the suggested right of way dimensions for several roadway segments comprising the MD 355 corridor the City of Gaithersburg to accommodate the preferred station locations and the hybrid design alternative. Diagrams identifying the suggested right of way limits for the MD 355 corridor, based on the suggested right of way dimensions in Table 4-21 offset from the roadway centerline, are included in Appendix F.

Table 4-21: Suggested MD 355 Typical BRT Corridor Right of Way Dimensions

MD 355 Corridor Segment Location	Suggested Right of Way Width
Game Preserve Road to Paramount Park Drive	180 feet
Paramount Park Drive to 700 feet south of MD 124	205 feet
700 feet south of MD 124 to Odendhal Avenue	180 feet
Odendhal Avenue to 200 feet north of Chestnut Street	110 feet
200 feet north of Chestnut Street to 400 feet south of Summit Avenue	140 feet
400 feet south of Summit Avenue to O'Neill Drive	155 feet

The preferred right of way suggestions included in this study are intended for consideration and adoption by the City of Gaithersburg to complete concept planning and detailed design for the MD 355 corridor. The preferred right of way widths are intended to provide the city and BRT design team with adequate property to accommodate a comprehensive and effective BRT system design, but the preferred ROW doesn't account for every design possibility.

In some locations, the preferred ROW may need to be increased to accommodate critical roadway and BRT design elements and the city can acquire additional property to support these needs. For instance, the city may decide new traffic signals or turning lanes are necessary at some intersections; or where the city intends to support future redevelopment, additional ROW may be desirable to accommodate wider sidewalks. In other locations, the BRT design does not necessarily need all of the right of way width to accommodate the required elements. During the detailed design process, some station intersections could be designed to achieve the minimum standards for station platform design or accommodate fewer turning lanes based on anticipated shifts in future traffic volume. Such modifications would reduce the necessary right of way to achieve the BRT system design and could ultimately reduce the amount of property required for public acquisition prior to construction.

The preferred ROW values provide reasonable and balanced flexibility for detailed design of the BRT system. The City of Gaithersburg may want to consider more detailed evaluations of individual station locations and assess potential designs that require less real estate to support adequate BRT and roadway infrastructure.