MD 355 BRT Corridor Planning Study

Phase 2

Traffic and Ridership Forecasting Analysis Summaries

June 18, 2019

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1 Introduction

The Montgomery County Department of Transportation (MCDOT) is preparing a *Corridor Summary Report* for Phase 2 of the MD 355 Bus Rapid Transit (BRT) Planning Study. The project is evaluating detailed alternatives for providing enhanced transit service along MD 355 from Bethesda to Clarksburg in Montgomery County, Maryland.

Phase 2 of the MD 355 BRT Planning Study builds upon work completed in Phase 1, which developed Conceptual Alternatives that were evaluated to determine which should move forward for more detailed analysis. These alternatives have been refined and analyzed in further detail in Phase 2. The purpose of this *Ridership and Traffic Summary* is to describe the alternatives development and screening approach used. Information in this report, described below, will support discussions presented in the *Corridor Summary Report*.

A set of Measures of Effectiveness (MOE) was developed at the beginning of Phase 2 of the MD 355 BRT Planning Study in order to provide a framework for comparing and evaluating each of the Alternatives, with the ultimate intent of selecting a preferred alternative. This Technical Memorandum will outline the results of the ridership and traffic-related MOEs as well as describe the methodology that was used to generate the data used to calculate the MOEs.

The methodology and results for the ridership-related MOEs is provided first in Section 2. The traffic-related MOEs are outlined in Section 3.

1.1 MD 355 BRT Project Purpose and Need

The purpose of the MD 355 BRT Planning Study is to provide a new transit service with higher speed and frequency along MD 355 between Bethesda and Clarksburg. The purpose and need statement has been consolidated into four distinct goals to guide the development of alternatives and as a framework for comparing alternatives**:**

Goal 1. Provide an appealing, functional, and high-quality transit service

Goal 2. Improve mobility opportunities, accessibility, and transportation choices

Goal 3. Support planned development

Goal 4. Support sustainable and cost-effective transportation solutions

1.2 Alternatives

Five alternatives, including the No-Build Alternative, are being evaluated as part of Phase 2 of the MD 355 BRT Planning Study. The findings will be summarized in the *Corridor Summary Report* and are assessed in detail in this Technical Report. The four Build Alternative alignments are shown in **Figures 1-1 through 1-4**.

Figure 1-1: TSM Alternative

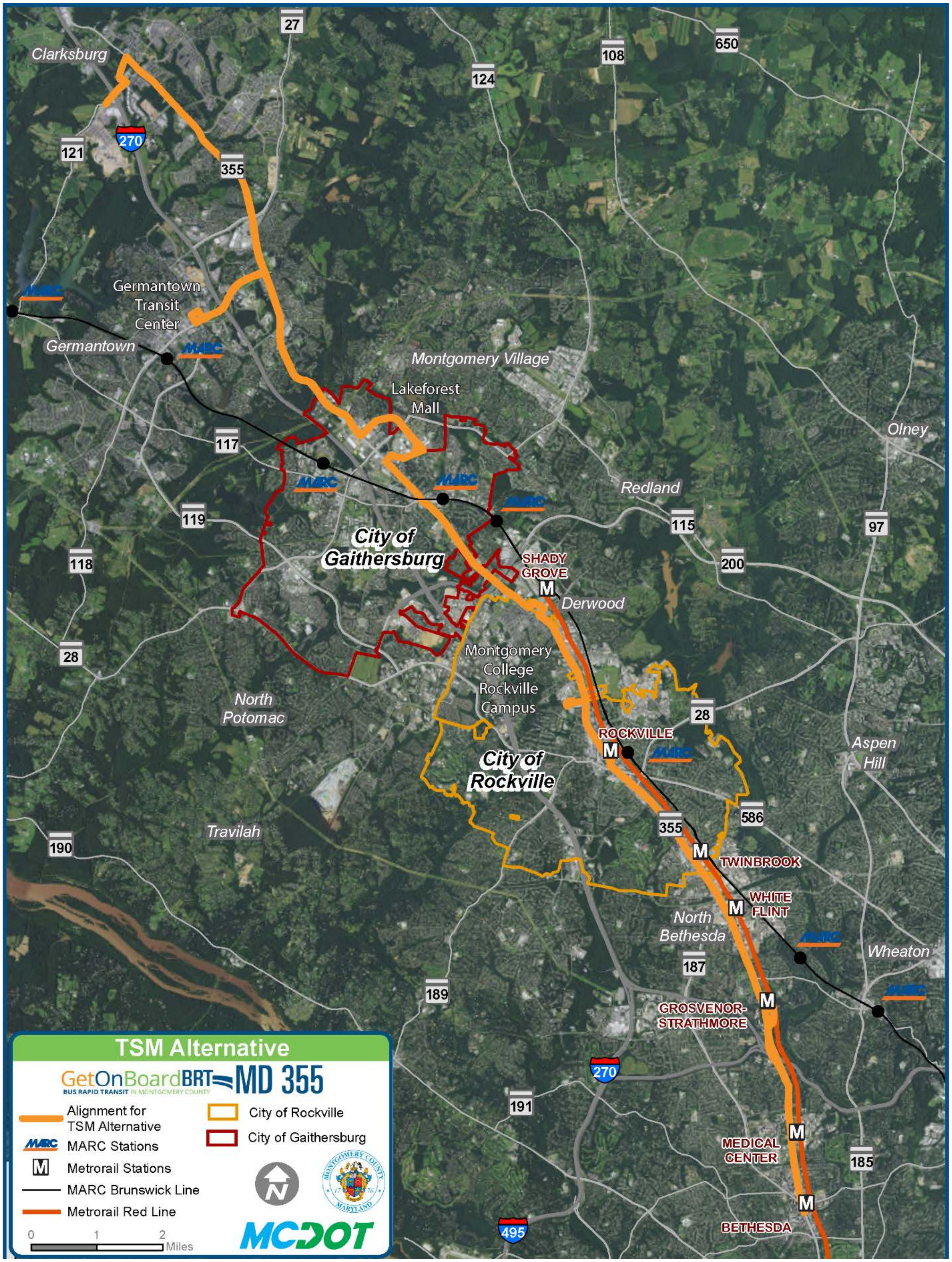


Figure 1-2: Alternative A

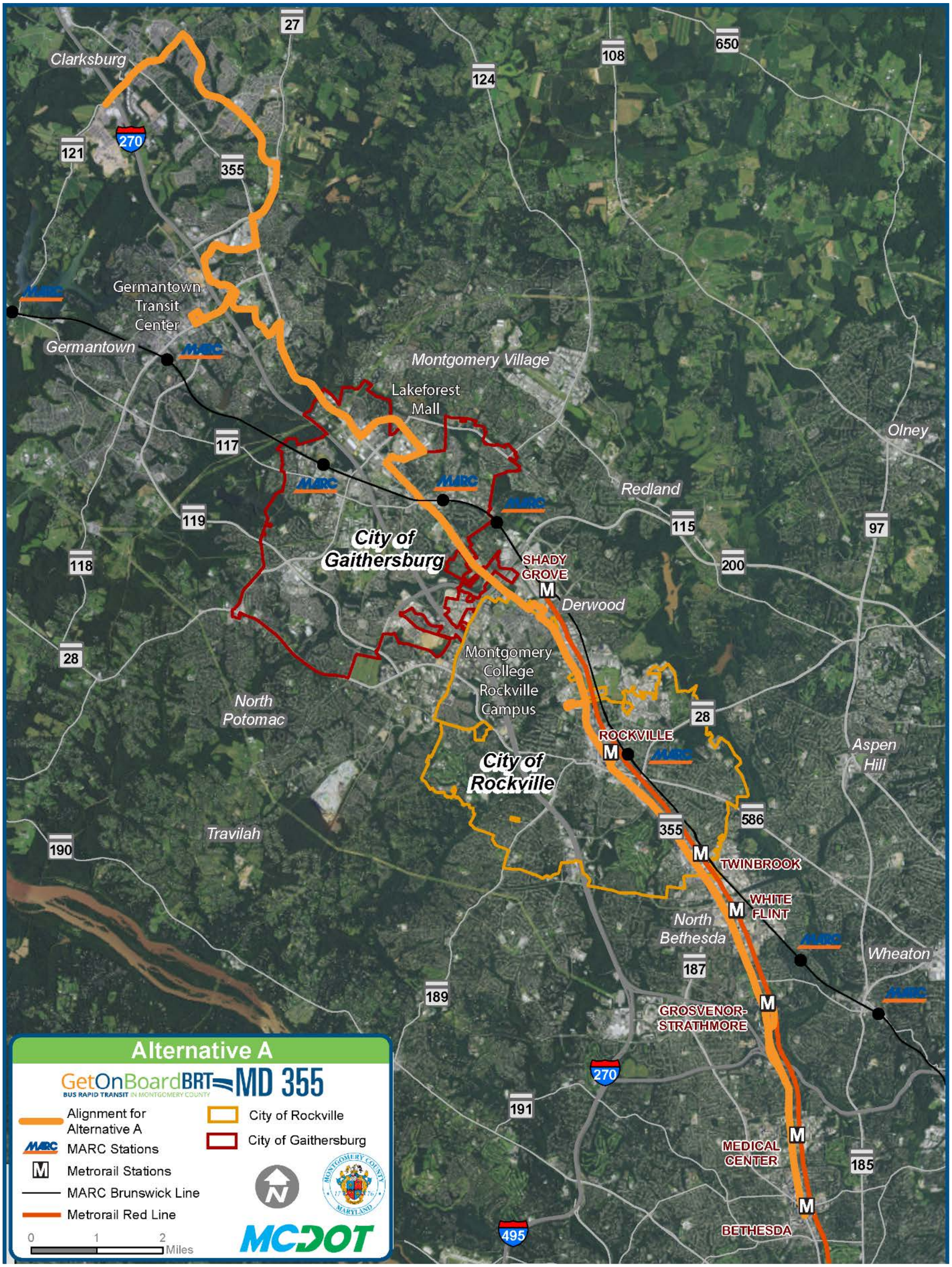


Figure 1-3: Alternative B

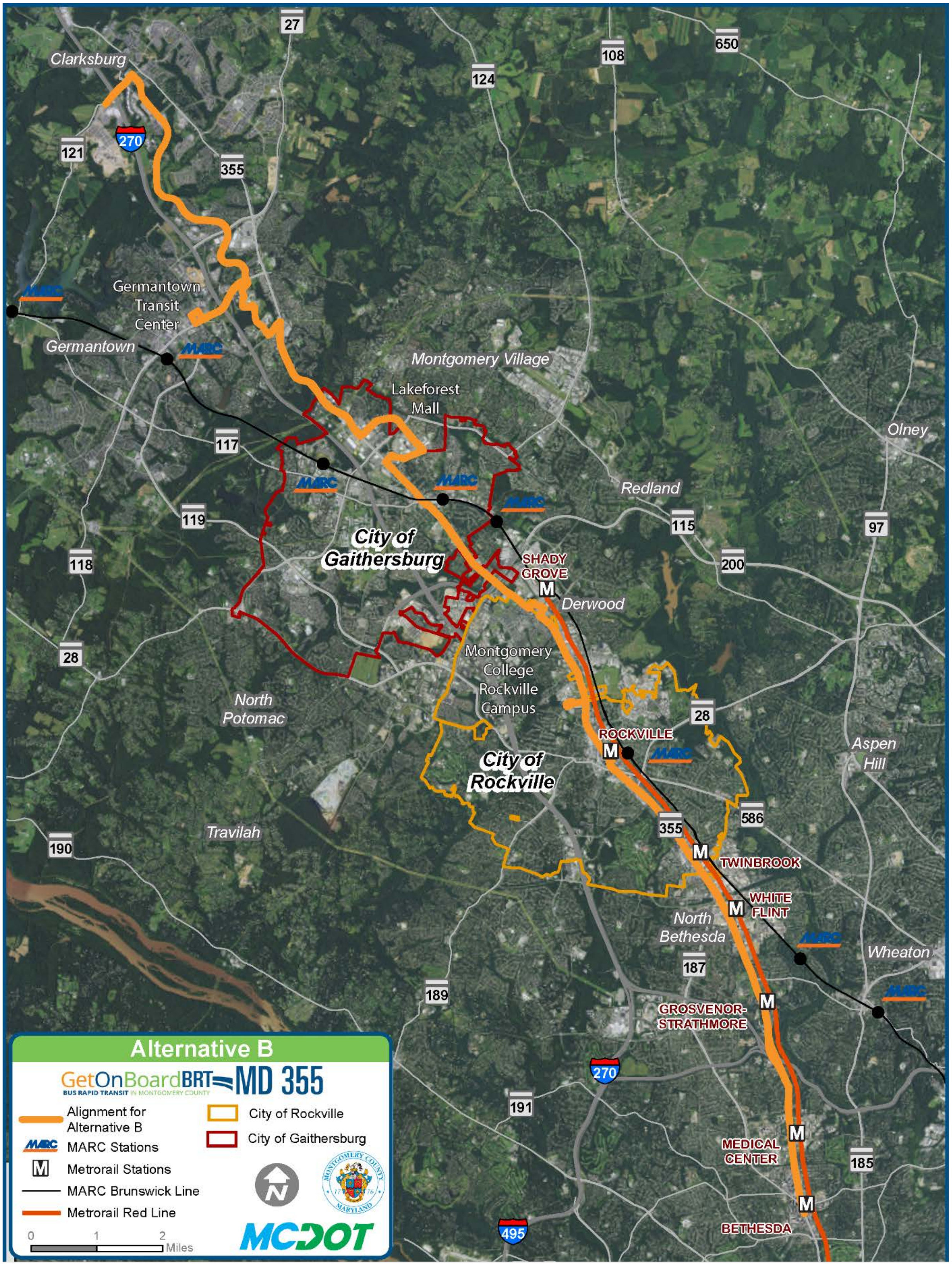
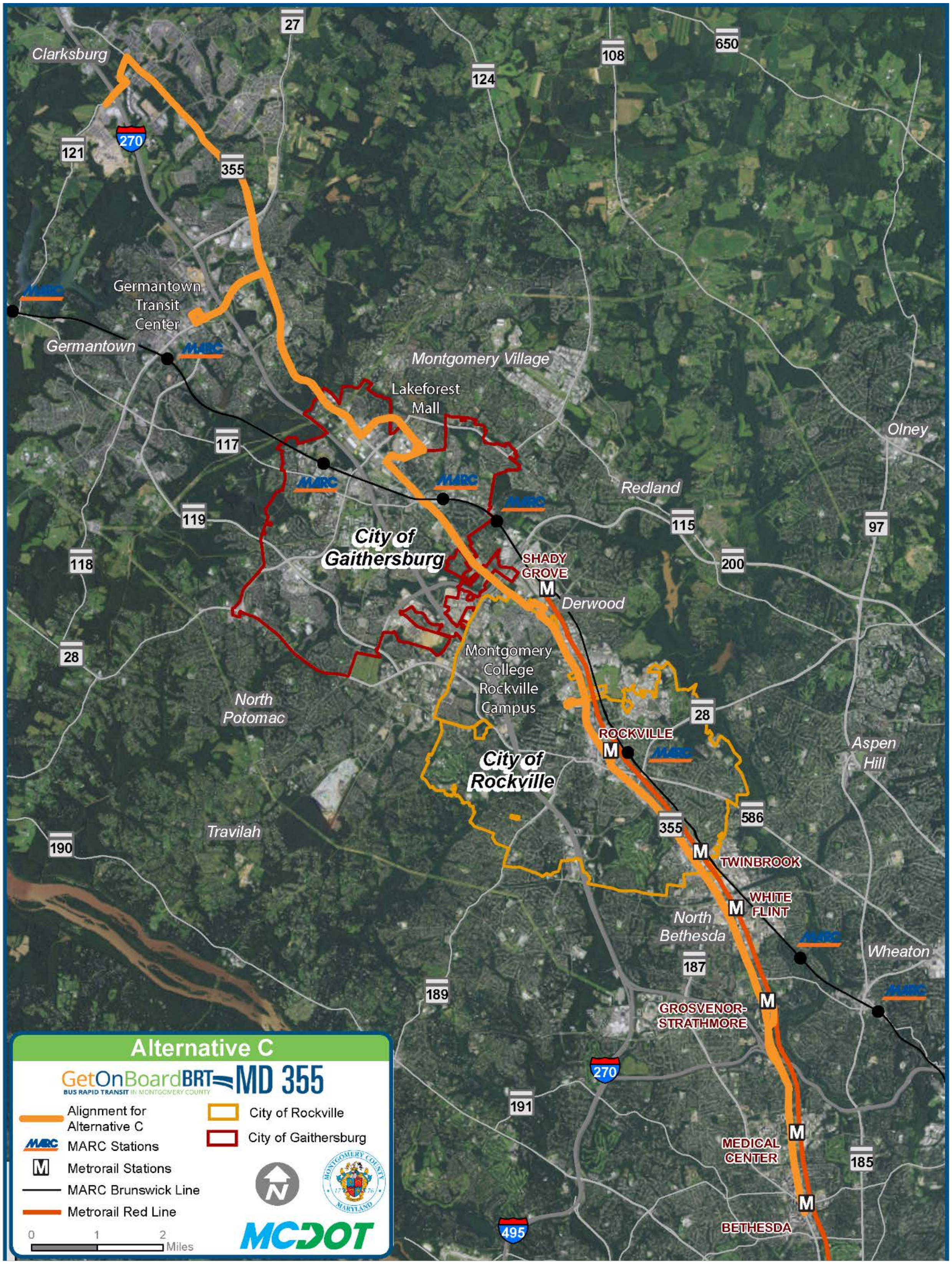


Figure 1-4: Alternative C



1.3 No-Build Alternative

The No-Build Alternative would include no additional infrastructure or operational improvements other than those already planned and programmed, including the Ride On extRa service launched in October 2017 from the Medical Center Metro Station to Lakeforest Transit Center. This service includes Transit Signal Priority (TSP) at key locations along the route.

1.4 Transportation System Management (TSM) Alternative

The TSM Alternative would consist of enhanced bus service operating in mixed traffic using existing lanes from the Bethesda Metrorail Station to Clarksburg along MD 355 and along Clarksburg Road to the Clarksburg BRT terminus.

This Alternative would extend the Ride On extRa service south from the Medical Center Metro Station to Bethesda and north from Lakeforest Transit Center to Clarksburg and would include additional TSP along the route.

1.5 Alternative A

Alternative A would enhance elements of the TSM Alternative by including additional elements such as TSP and queue jumps to create a BRT service with limited infrastructure improvements. Alternative A would consist of BRT service, operating in mixed traffic using existing lanes from the Bethesda Metrorail Station to Clarksburg along MD 355. In Segment 7, the BRT would travel along Middlebrook Road to Observation Drive, Goldenrod Lane, Germantown Road, then back to Observation Drive to Ridge Road, and across MD 355 to Snowden Farm Parkway to Stringtown Road to the BRT Terminus at Clarksburg.

Alternative A would include additional TSP along with queue jumps at key locations along the route. It would also include BRT stations with off-board fare collection and level boarding, articulated buses, and Flash branding.

1.6 Alternative B

Alternative B would generally operate in dedicated median lanes where feasible and in mixed traffic. In Segment 7, the BRT would travel in mixed traffic along Middlebrook Road to Observation Drive, including the unbuilt portion, to Stringtown Road to the BRT Terminus at Clarksburg.

Alternative B would include additional TSP at key locations along the route, BRT stations with off-board fare collection and level boarding, articulated buses, and Flash branding.

1.7 Alternative C

Alternative C would generally operate in dedicated curb lanes where feasible. In Segment 7, the BRT would operate in mixed traffic along MD 355 from Middlebrook Road to the BRT Terminus at Clarksburg, via Clarksburg Road and Stringtown Road.

Alternative C would include additional TSP along with queue jumps at key locations along the corridor. It would also include BRT stations with off-board fare collection and level boarding, articulated buses, and Flash branding.

1.8 Alignment Segments

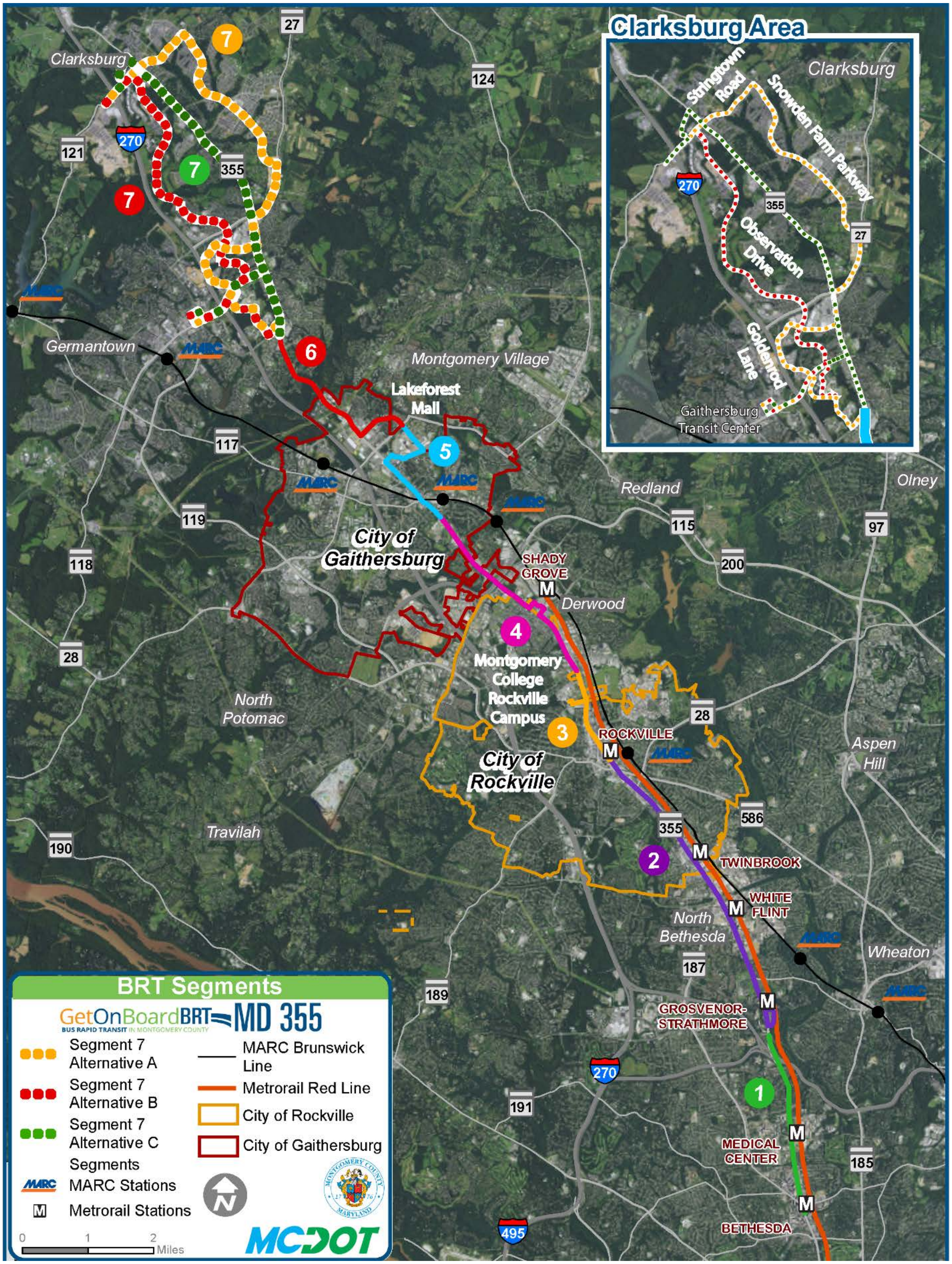
Due to the existing conditions that vary along MD 355 as the roadway transitions from an urban environment in downtown Bethesda to a suburban setting in Clarksburg, the corridor was divided into seven segments during Phase 1 of this study and carried forward into Phase 2. The segments were primarily geographically based with each having its own set of characteristics, opportunities, challenges, and constraints. The seven segment geographic descriptions are listed in **Table 1-1** and shown below in **Figure 1-5**.

Table 1-1: Alternative Alignment Segments

Segment	Geographic Description
1	Bethesda Metrorail Station to Grosvenor Metrorail Station
2	Grosvenor Metrorail Station to Dodge Street
3	Dodge Street to College Parkway
4	College Parkway to Summit Avenue
5	Summit Avenue to MD 124
6	MD 124 to Middlebrook Road
7	Middlebrook Road to Clarksburg

The information in this technical report has been quantified, as appropriate, based on the seven roadway alignment segments.

Figure 1-5: Alternative Alignment Segments



2 Ridership-Related MOEs

2.1 Introduction to Project Ridership Forecasting Analysis

The project ridership forecasting effort was completed with the use of the Metropolitan Washington Council of Governments (MWCOG) Regional Forecasting Model. The primary purpose of the model is to support MWCOG in assessing whether the Washington region is conforming to federal air quality requirements, as mandated by the Environmental Protection Agency (EPA). The model is also used for project planning purposes for large transportation projects throughout the region, including the MD 355 BRT project. In the instance of the MD 355 project, the regional model was customized for use in the project corridor. Model modifications included transportation network changes to ensure all network links were correct, ensuring transit service frequencies and routes as represented in the model were correct, and fine-tuning access paths to bus stops and Metrorail Stations.

Prior to running the model, the project team defined the alternatives that would be modeled. Elements of each alternative definition include BRT routing and terminal points, BRT travel speeds, BRT service frequencies, and the project area transit network, including Metrorail and local bus. Once the definition of each alternative was completed, it was coded into the model in preparation for actual model runs.

Ridership-related outputs from the model for each alternative included daily BRT boardings by day of week, daily boardings and alightings by BRT alignment section by time of day (by day of week), daily person throughput at key locations along the MD 355 corridor, new transit riders resulting from the Build Alternatives, daily total transit ridership and transit mode share. These outputs were then translated into Measures of Effectiveness (MOE) that will be used as the framework for comparing the costs and benefits of each alternative. The primary means of evaluating the impact of the alternatives will be by comparing the incremental change, for each MOE, between the No-Build alternative and each Build alternative.

Each of the ridership-related MOEs is described below.

2.2 Daily BRT Ridership (Boardings) – Weekday, Saturday, and Sunday

Daily BRT Ridership (Boardings) is one of the fundamental pieces of data used for comparing and understanding the differences between the three BRT alternatives. This data is derived from the MWCOG regional forecasting model, as described above in **Section 2.1**. The BRT ridership results by day of week are described below.

Table 2-1: Weekday Daily BRT Ridership

Alternative A	Alternative B	Alternative C
25,000	30,000	27,800

The data in **Table 2-1** shows that the highest daily weekday BRT ridership would occur in Alternative B, which consists of the median dedicated guideway. Alternative C, which consists of dedicated curb lanes, would have the second highest daily weekday ridership; and the lowest ridership alternative would be

Alternative A, which is the mixed traffic alternative with transit priority treatments such as queue jumps and transit signal priority (TSP) incorporated.

Table 2-2: Saturday Daily BRT Ridership

Alternative A	Alternative B	Alternative C
14,500	17,400	16,100

Saturday ridership on each of the alternatives is lower than weekday ridership, but the order of ridership among alternatives is the same as on weekdays. It should be noted that Saturday and Sunday ridership (described below) are extrapolated from the weekday model runs. Separate Saturday and Sunday model runs were not utilized in the project because MWCOG has not developed weekend models.

Table 2-3: Sunday Daily BRT Ridership

Alternative A	Alternative B	Alternative C
9,300	11,100	10,300

Sunday ridership on each alternative is lower than on Saturdays and weekdays, but the order among alternatives remains the same as on Saturday and weekdays.

2.3 BRT Ridership by Alignment Segment - Weekdays

BRT Ridership by alignment segment provides insight into where BRT trips are being generated along the alignment. This data is derived from the MWCOG regional forecasting model, as described above in **Section 2.1**.

Table 2-4: BRT Ridership by Segment

Alternative	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7
A	2,250	7,100	2,550	3,950	3,550	2,400	3,200
B	2,500	7,850	3,450	5,300	4,550	2,600	3,850
C	2,450	7,700	2,950	4,750	3,900	2,700	3,350

The data in Table 2-4 shows differing BRT boardings between each alternative within each segment but does show the same pattern regarding which segments have the highest boardings. The highest boarding segment for each alternative is Segment 2, which runs between the Grosvenor Metrorail Station and Dodge Street at the southern end of Rockville Town Center. This segment includes White Flint and Twinbrook. The second heaviest boarding segment is Segment 4, which runs between College Parkway, at the northern end of Rockville Town Center, and Summit Avenue in Gaithersburg. The third highest segment is Segment 5, which runs between Summit Avenue in Gaithersburg and MD 124 (Montgomery Village Avenue).

2.4 Total Transit Boardings in the Corridor – Weekday, Saturday, Sunday

This data highlights total transit boardings in the corridor, rather than just BRT boardings as outlined in **Sections 2.2 and 2.3**. This data is provided for weekdays, Saturdays, and Sundays, and is derived from the MWCOG regional forecasting model, as described above in **Section 2.1**.

Table 2-5: Total Weekday Transit Boardings in Corridor

Transit Mode	No-Build Alternative	TSM Alternative	Alternative A	Alternative B	Alternative C
Local Bus	14,900	23,000	2,700	2,200	1,900
Metrorail	60,400	60,100	59,700	59,700	59,700
BRT	-	-	25,000	30,000	27,800
Total	**75,300**	**83,100**	**87,400**	**91,900**	**89,400**

The data in **Table 2-5** show that total transit boardings follow the same patterns as the BRT boarding data shown in **Section 2.2**, specifically that the highest transit ridership would occur under Alternative B, followed by Alternative C, Alternative A, the Transportation Systems Management (TSM) Alternative, and then the No-Build Alternative. Three additional findings from the data:

- The TSM Alternative, which includes Transit Signal Priority but no physical improvements to the roadway, would provide an increase in transit boardings relative to the No-Build Alternative but less than the mixed traffic BRT alternative, Alternative A, which includes both TSP and queue jumps.
- The Build Alternatives (A, B, and C) attract a large number of riders from local bus, as shown by the difference between local bus ridership under these alternatives and local bus ridership in the TSM and No-Build alternatives.
- There is only a small change in Metrorail ridership between the No-Build and TSM Alternatives and the three BRT alternatives.

Saturday and Sunday total transit boardings in the corridor are outlined in **Tables 2-6 and 2-7**, respectively. As was the case for BRT boardings, Saturday boardings are lower than on weekdays, though the same boarding patterns persist. Sunday boardings are lower than on Saturdays while the boarding patterns remain consistent with Saturdays and weekdays.

Table 2-6: Total Saturday Transit Boardings in Corridor

Transit Mode	No-Build	TSM	Alternative A	Alternative B	Alternative C
Local Bus	8,600	13,400	1,600	1,300	1,100
Metrorail	27,500	27,400	27,800	27,900	27,800
BRT	-	-	14,500	17,400	16,100
Total	36,100	40,800	43,900	46,600	45,000

Note: the small increases in Metrorail on Saturday under Alternatives A, B, and C compared to the No-Build, in contrast to decreases on weekdays and Sundays, reflects the extrapolation process, which in turn reflects the current usage patterns utilized as part of the extrapolation process.

Table 2-7: Total Sunday Transit Boardings in Corridor

Transit Mode	No-Build	TSM	Alternative A	Alternative B	Alternative C
Local Bus	5,400	8,000	1,000	800	700
Metrorail	20,100	20,100	17,100	16,900	17,100
BRT	-	-	9,300	11,100	10,300
Total	25,500	28,100	27,400	28,800	28,100

2.5 New Transit Riders in the Corridor - Weekday

Implementation of BRT service and physical improvements may result in making transit a more attractive mobility option for people who used their car before BRT implementation. This MOE measures the number of people who would switch to transit after implementation of BRT (note: this MOE measures riders rather than boardings. A single rider may generate more than one boarding because of a transfer, for instance between bus and Metrorail).

Total new riders by Alternative are shown in **Table 2-8**.

Table 2-8: New Transit Riders in the Corridor – Weekday

Alternative	New Transit Riders
TSM	4,400
Alternative A	8,900
Alternative B	9,400
Alternative C	8,900

The data in **Table 2-8** shows that there would be new riders resulting from the service improvements associated with each alternative, including the TSM. Overall, each of the Build Alternatives would result in a larger number of new riders compared to the TSM. The highest number of new riders would occur under Alternative B, which follows the data patterns displayed in **Sections 2.2 through 2.4**.

2.6 Transit Mode Share within Corridor

Transit Mode share is the percentage of total trips (all modes) that are made by transit. In this analysis, transit mode share is calculated in four different ways:

- Transit mode share for trips originating in the corridor
- Transit mode share for trips destined for the corridor
- Transit mode share for all trips originating in Montgomery County

The mode share for each of these approaches is shown in **Tables 2-9, 2-10, and 2-11, 2-12, and 2-13** respectively.

Table 2-9: Transit Mode Share for Trips Originating in the Corridor

Alternative	Transit Mode Share
No-Build Alternative	8.3%
TSM Alternative	8.7%
Alternative A	9.0%
Alternative B	9.0%
Alternative C	9.0%

The data in **Table 2-9** show that the three Build alternatives would result in an increase in transit mode share of approximately 0.7% compared to the No-Build Alternative, reflecting the new transit riders discussed in the previous section. It should also be noted that any increase in transit mode share is a positive benefit for the corridor and the County, though the increase shown in **Table 2-9** is relatively small simply because of the very large number of total trips (all modes) that originate in the corridor and the continued dominance of automobile even after BRT implementation.

Mode share for trips to the corridor is shown in **Table 2-10**.

Table 2-10: Transit Mode Share for Trips Destined for the Corridor

Alternative	Transit Mode Share
No-Build Alternative	6.6%
TSM Alternative	6.9%
Alternative A	7.3%
Alternative B	7.2%
Alternative C	7.2%

The data in **Table 2-10** show an increase in transit mode share between the Build Alternatives and the No-Build Alternative of approximately 0.6% to 0.7%, for trips destined for the corridor (note: the small difference between Alternative A and Alternatives B and C is marginal and reflects model output "noise").

Data on transit mode share for trips originating in Montgomery County as a whole is shown in **Table 2-11**.

Table 2-11: Transit Mode Share for Trips Originating in Montgomery County

Alternative	Mode Share
No-Build Alternative	8.3%
TSM Alternative	8.5%
Alternative A	8.8%
Alternative B	8.7%
Alternative C	8.6%

The data in **Table 2-11** show that the MD 355 BRT would have an impact on mode share for all trips originating in Montgomery County. Though the percentage change is not as great as for trips to and from the corridor, the mode share change is important because the BRT alternatives would have a countywide impact (note, the small differences between Alternatives, as above, reflect small differences, or "noise" between model runs).

2.7 Daily Person Throughput

Person throughput is a measure of how productively a roadway is being used and measures the number of people who cross over a select group of locations along the corridor (these locations are also called screen lines). This MOE compares the change in person throughput between the No-Build Alternative and each Build Alternative. The greater the increase in throughput, the more productively the roadway is being used. The underlying concept is that the focus should be on moving people, not vehicles, through the corridor. Heavily used BRT service would increase throughput because one BRT vehicle may comfortably carry as many as 80 people while the average vehicle occupancy of an automobile is 1.1 passengers. The person throughput data relies on outputs from the ridership forecasting model and from the traffic simulation model VISSIM (described in greater detail in **Section 3**).

Peak period throughput by segment is outlined below in Table **2-12**, by alternative.

Table 2-12: Peak Period (AM & PM) Weekday Person Throughput

Segment	Screen Line	No-Build Alternative	TSM Alternative	Alternative A	Alternative B	Alternative C
1	Cedar Lane	32,800	32,700	33,100	31,800	32,500
2	Twinbrook Parkway	32,300	32,500	33,500	33,700	33,400
3	N. Washington Street	27,800	28,500	28,100	29,700	28,300
4	Shady Grove Road	30,800	31,600	31,300	35,300	32,100
5	Chestnut Street	27,200	27,900	27,900	31,700	28,700
6	Watkins Mill Road	25,900	26,100	27,100	29,000	27,900
7	Ridge Road (1)	19,700	20,300	20,300	20,700	22,800

(1) Alt. A - Screen Line on Ridge Road between MD 355 and Brink Road; Alt B – Screen Line at Observation Drive & Ridge Road; Alt C – Screen Line at MD 355 & Ridge Road

The data in **Table 2-12** show that the BRT Alternatives, with the exceptions of Alternatives B and C at Cedar Lane, would result in an increase in person throughput when comparing the alternatives to the No-Build Alternative. These increases, however, are generally relatively small. This small increase reflects the fact that even though transit ridership increases under each of the BRT alternatives, the large majority of trips are still made via automobile and therefore significant changes in roadway usage are difficult to execute.

2.8 Number of Jobs Accessible by Transit within 30, 45, and 60 Minutes for Households Located on the Corridor

This MOE is a measure of the change in transit accessibility between the No-Build Alternative and the BRT Alternatives. The concept underlying the MOE is that transit travel time improvements resulting from the BRT alternatives will result in an expanded set of jobs that can be reached by transit within a certain amount of time (also called a transit market shed). In essence, the concept is that the combination of a shorter wait for a bus because of more frequent service and the shorter travel time because of transit priority means more jobs can be reached by someone using transit in the same time than were accessible in the No-Build Alternative.

The data to measure this MOE is derived from the ridership forecasting model and is based on transit travel times that are built into the model. The model calculates a shed that spreads out from the corridor for each travel time scenario (30, 45, and 60 minutes) and incorporates all of the jobs that fall within each travel time shed.

The data for each travel time scenario and each alternative is outlined below in **Table 2-13**.

Table 2-13: Number of Jobs Accessible by Transit for Households Located in the Corridor

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	130,900	395,500	832,300
TSM Alternative	131,100	397,100	836,100
Alternative A	139,400	414,100	864,900
Alternative B	140,300	414,400	860,600
Alternative C	139,700	414,700	863,000

The data shows that each of the Build alternatives would result in an increase in the number of jobs that can be reached by transit within each of the travel time scenarios evaluated when compared to the No-Build Alternative. The differences between each of the three BRT alternatives are less than 1% and predominantly reflect differences in alignment in Segment 7.

2.9 Number of Activity Centers Accessible by Transit within 30, 45, and 60 Minutes for Households Located in the Corridor

Calculating this MOE follows a comparable technical approach as is used for the MOE described in **Section 2.8**. In this instance the number of MWCOG-designated Regional Activity Centers that fall within the transit travel time shed for each Alternative are calculated. The importance of this MOE is that Regional Activity Centers as defined by MWCOG are mixed used areas where multiple activities (employment, shopping, recreational activities, doctor and medical-related visits) occur. Improved transit access to these areas provides great benefit for people making trips to these locations. The results for this MOE are shown below in **Table 2-14** (note: the data in **Table 2-14** represents the average accessibility over the entire corridor, thus resulting in the fractions present in **Table 2-14**).

Table 2-14: Number of Regional Activity Centers Accessible by Transit for Households Located in the Corridor

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	5.7	17.4	38.5
TSM Alternative	5.7	17.4	38.7
Alternative A	6.4	18.1	38.6
Alternative B	6.5	18.2	38.3
Alternative C	6.4	18.2	38.6

The data show that there would be small increases in the number of Regional Activity Centers that are accessible by transit for the 30-minute and 45-minute travel time sheds when the BRT Alternatives are compared to the No-Build, though there are only small differences between the three Build Alternatives. The changes under the 60 minute travel time shed are very small, reflecting the fact that as more centers become accessible, the household accessibility benefits of the BRT alternatives diminish.

2.10 Number of Households that Can Reach Jobs in the Corridor by Transit within 30, 45, and 60 Minutes

This MOE uses a technical process that is comparable to that used for the MOEs described in **Sections 2.8 and 2.9**. In this instance the MOE measures the number of households, both within the corridor and outside the corridor, that can access, by transit, jobs located within the corridor within 30, 45, and 60 minutes. As with the other related MOEs, the travel time shed is built out from the corridor and captures the households that fall within the shed. This data is summarized below in **Table 2-15**.

Table 2-15: Number of Households that Can Reach Jobs by Transit in the Corridor

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	98,400	260,800	547,800
TSM Alternative	94,400	261,100	549,400
Alternative A	98,400	268,900	562,000
Alternative B	99,900	269,300	560,100
Alternative C	98,900	267,700	559,700

The data in **Table 2-15** show that there would be marginal changes in the number of additional households that can access jobs within the corridor under the 30-minute travel time shed but that accessibility to jobs within the corridor would increase under the 45-minute and 60-minute travel time sheds. Also of note is that the accessibility increase would occur for each BRT Alternative and that the differences between the BRT Alternatives are relatively minor.

2.11 Number of Households that Can Reach Activity Centers within the Corridor by Transit within 30, 45, and 60 Minutes

In this MOE, a transit travel time shed is built around each of the MWCOG-designated Regional Activity Centers within the corridor for the three different travel time scenarios - 30 minutes, 45 minutes, and 60 minutes. All of the households that fall within each travel time shed, for each alternative, are then used in measuring the MOE. The data for this MOE is provided through a separate table for each MWCOG-designated Regional Activity Center within the corridor, starting with **Table 2-16** (Clarksburg Activity Center).

A series of general findings were identified during the analysis of accessibility to individual Activity Centers. These are summarized here:

- For some Activity Centers, accessibility actually declines under some Alternative/Travel Time combinations. A detailed analysis of the model results indicate that the declines were related to changes made to the local bus network in the Build Alternatives. It is very important to note that these local bus route network changes were developed for testing purposes only and identified based on the best information available. The model results and findings contained in this section will be used to refine the local bus network in the next work phase. Local bus network refinements will go through multiple iterations before being finalized.
- Despite the fact that accessibility declines in some instances, forecasted demand to regional activity centers undergoing development or redevelopment (see Table 2-29) increases for each activity center under each Build Alternative, showing that accessibility does not necessarily dictate demand.

Table 2-16: Number of Households that Can Reach the Clarksburg Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	3,900	11,000	56,900
TSM Alternative	3,900	13,300	62,100
Alternative A	6,300	27,200	47,300
Alternative B	4,200	37,200	49,000
Alternative C	6,900	52,200	65,000

The data in **Table 2-16** show increases in accessibility to the Clarksburg Regional Activity Centers under the 30-minute and 45-minute transit travel time scenarios but actual decreases for Alternatives A and B under the 60-minute scenario. The data also shows, even when there is an increase in accessibility relative to the No-Build Alternative, substantial differences among the three BRT alternatives. The differences in accessibility relate to the different travel times to Clarksburg for each BRT alternative, based on the different routings at the northern end of the BRT alignment (as an example, Alternative C runs directly up MD 355, which is the quickest way to the Clarksburg Activity Center).

Table 2-17 shows household accessibility to the Germantown Activity Center.

Table 2-17: Number of Households that Can Reach the Germantown Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	47,900	56,400	146,800
TSM Alternative	47,900	56,400	146,800
Alternative A	47,900	59,500	147,800
Alternative B	47,900	59,500	146,800
Alternative C	47,900	60,500	146,800

The data for the Germantown activity center shows small increases under the 45-minute transit travel time scenario but little or no increases for the 30-minute or 60-minute scenarios. The reasons for the small or no change are because the Germantown Activity Center is already well served by transit so the implementation of the BRT alternatives does not significantly change access to the Activity Center.

Table 2-18 shows household accessibility to the Metropolitan Grove Activity Center.

Table 2-18: Number of Households that Can Reach the Metropolitan Grove Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	46,600	117,300	199,500
TSM Alternative	46,600	117,300	203,300
Alternative A	46,600	121,200	182,200
Alternative B	46,600	122,000	182,200
Alternative C	47,100	122,000	182,200

The accessibility data for Metropolitan Grove shows small increases in accessibility for the 45-minute travel time scenario but minor decreases in accessibility under the 60-minute travel time scenario. This decrease under the 60-minute scenario is related to preliminary changes made to the local bus system between the TSM and BRT Alternatives which add a few minutes to door-to-door travel times for certain Origin-Destination pairs. As noted, these local bus network changes will be re-evaluated and refined based on the analysis results.

Table 2-19 shows household accessibility to the Gaithersburg Central Activity Center.

Table 2-19: Number of Households that Can Reach the Gaithersburg Central Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	51,300	93,400	239,000
TSM Alternative	57,400	113,800	312,600
Alternative A	60,400	124,600	316,900

Alternative	30 minutes	45 minutes	60 minutes
Alternative B	60,500	132,000	326,800
Alternative C	60,400	133,800	328,200

The data in **Table 2-19** shows that each of the BRT Alternatives would increase accessibility to the Gaithersburg Central Activity Center under each transit travel time scenario when compared to the No-Build Alternative. This reflects the improved service frequencies through Gaithersburg based on multiple BRT route patterns running concurrently through the area.

Table 2-20 shows household accessibility to the King Farm/Rockville Research Center/Shady Grove Activity Center.

Table 2-20: Number of Households that Can Reach the King Farm/Rockville Research Center/Shady Grove Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	102,600	287,500	445,900
TSM Alternative	101,900	288,600	445,900
Alternative A	165,300	322,300	622,000
Alternative B	177,000	318,000	614,000
Alternative C	160,200	315,500	616,200

The data in **Table 2-20** shows increases in accessibility to the King Farm/Rockville Research Center/Shady Grove Activity Center for each of the three BRT alternatives when compared to the No-Build Alternative. This is the result of the extension of high quality transit service north of the Germantown Transit Center relative to the low level of service available in the No-Build Alternative. This improvement expands the transit market shed for people in the northern portion of the County accessing activity centers farther south.

Table 2-21 shows household accessibility to the Rockville – Montgomery College Activity Center.

Table 2-21: Number of Households that Can Reach the Rockville – Montgomery College Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	16,000	129,300	341,100
TSM Alternative	16,000	130,200	341,100
Alternative A	18,400	159,100	346,000
Alternative B	21,800	174,300	347,500
Alternative C	16,900	123,500	334,200

The data in **Table 2-21** show that household accessibility to the Montgomery College Activity Center would increase in Alternatives A and B when compared to the No-Build Alternative but would fall in Alternative C under the 45 and 60-minute transit travel time scenarios. This decrease under the 45 and 60-minute scenario is the related to changes made to the local bus system between the TSM and BRT Alternatives which add a few minutes to door-to-door travel times for certain Origin-Destination pairs. The impacts of local bus changes, and the refinements to be completed in the next phase, have been noted in the discussion of previous Activity Centers.

Table **2-22** shows household accessibility to the Rockville Town Center Activity Center.

Table 2-22: Number of Households that Can Reach the Rockville Town Center Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	205,400	368,200	704,700
TSM Alternative	205,400	368,200	703,700
Alternative A	270,300	390,000	808,500
Alternative B	271,700	385,700	807,400
Alternative C	272,000	386,600	806,200

The data in **Table 2-22** shows increases in accessibility to the Rockville Town Center Activity Center for each of the three BRT alternatives when compared to the No-Build Alternative. This is the result of the extension of high quality transit service north of the Germantown Transit Center relative to the low level of service available in the No-Build Alternative, thus expanding the transit market for trips to Rockville.

Table 2-23 shows household accessibility to the Rockville – South/Twinbrook Activity Center.

Table 2-23: Number of Households that Can Reach the Rockville – South/Twinbrook Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	227,800	403,100	796,300
TSM Alternative	228,400	403,100	795,700
Alternative A	283,600	462,100	941,900
Alternative B	283,600	458,900	939,800
Alternative C	283,600	460,000	939,300

The data in **Table 2-23** shows increases in household accessibility to the Rockville – South/Twinbrook Regional Activity Center under all three BRT alternatives and under all three transit travel time scenarios. This relates to service improvements and faster transit travel times from both directions when compared to the No-Build Alternative, especially for those parts of the activity center not served by Metro.

Table 2-24 shows household accessibility to the White Flint Activity Center.

Table 2-24: Number of Households that Can Reach the White Flint Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	212,600	445,900	903,500
TSM Alternative	213,700	445,900	903,400
Alternative A	199,100	443,500	898,200
Alternative B	199,100	439,800	895,600
Alternative C	199,200	439,800	895,700

The data in **Table 2-24** show that household accessibility would fall for all three BRT Alternatives, for all transit travel time scenarios. As noted for other Activity Centers, this decrease is related to changes made to the local bus system between the TSM and BRT Alternatives which add a few minutes to door-to-door travel times for certain Origin-Destination pairs. The impacts of local bus changes will be evaluated in detail in the next project phase and network refinements will be made and further tested for all Activity Centers.

Table 2-25 shows household accessibility to the Grosvenor Activity Center.

Table 2-25: Number of Households that Can Reach the Grosvenor Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	212,900	531,600	1,083,200
TSM Alternative	212,900	531,600	1,084,100
Alternative A	185,200	527,800	1,084,300
Alternative B	184,600	524,600	1,083,800
Alternative C	184,400	524,200	1,083,900

The data in **Table 2-25** shows declines in household accessibility for all BRT alternatives relative to the No-Build Alternative under the 30-minute and 45-minute travel time scenarios and marginal or no change for the 60-minute travel time scenario. As with other Activity Centers, the reason for the fall under the 30 and 45-minute travel time scenarios is related to changes made to the local bus system between the TSM and BRT Alternatives which add a few minutes to door-to-door travel times for certain Origin-Destination pairs.

Table **2-26** shows household accessibility to the NIH/Walter Reed Activity Center.

Table 2-26: Number of Households that Can Reach the NIH/Walter Reed Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	179,200	502,200	1,124,800
TSM Alternative	179,200	502,200	1,125,100
Alternative A	159,900	497,100	1,125,700
Alternative B	159,000	493,000	1,124,200
Alternative C	157,700	491,600	1,124,700

The data in **Table 2-26** shows declines in household accessibility for all BRT alternatives relative to the No-Build Alternative under the 30-minute and 45-minute travel time scenarios and marginal or no change for the 60-minute travel time scenario. The reason for the fall under the 30 and 45-minute travel time scenarios is again related to changes in the local bus network, which will be evaluated in greater detail in the next project phase.

Table 2-27 shows household accessibility to the Bethesda Activity Center.

Table 2-27: Number of Households that can Reach the Bethesda Regional Activity Center by Transit

Alternative	30 minutes	45 minutes	60 minutes
No-Build Alternative	246,300	768,600	1,368,300
TSM Alternative	246,300	768,000	1,366,800
Alternative A	245,800	769,400	1,376,500
Alternative B	245,800	769,800	1,365,700
Alternative C	245,800	768,600	1,368,300

The data in **Table 2-27** shows marginal changes in household accessibility under all travel time scenarios for all alternatives. The lack of change relates to the dense transit network already in place in the Bethesda area and therefore the addition of BRT does not shift accessibility dramatically.

2.12 Travel Time between Key Origin-Destination Pairs

This MOE evaluates the travel time for key origins and destinations both within the MD 355 corridor, for each alternative being evaluated. This travel time data is shown in **Table 2-28**.

Table 2-28: Travel Time by Transit Between Key Origin Destination Pairs Inside and Outside the Corridor

Origin	Destination	No-Build Alternative	TSM Alternative	Alternative A	Alternative B	Alternative C	Notes
Clarksburg	Shady Grove	50	56	62	50	46	Bus Only
Clarksburg	White Flint	90	90	77	79	61	Bus-to-Metrorail

Origin	Destination	No-Build Alternative	TSM Alternative	Alternative A	Alternative B	Alternative C	Notes
Germantown	Shady Grove	44	42	40	33	35	Bus Only
Lakeforest	Rockville	43	43	38	29	31	Bus Only
Lakeforest	Bethesda	53	53	46	42	43	Bus-to-Metrorail
White Flint	Bethesda	30	26	23	21	23	Bus Only
Rockville	Bethesda	57	42	40	36	39	Bus Only

The data in **Table 2-28** shows decreases in travel time for each of the BRT alternatives for all but one of the Origin-Destination (O-D) pairs. The one O-D pair that does not show an improvement is the Clarksburg to Shady Grove pair, specifically for Alternatives A and B. The increase for these two BRT Alternatives relates to the longer distances they travel between Clarksburg and Middlebrook Road (where all three alternatives join the common MD 355 alignment) because they leave MD 355 and take less direct routes, while Alternative C runs straight down MD 355.

2.13 Transit Ridership to Planned Developments

This MOE highlights estimated BRT ridership to activity centers along the corridor that are undergoing significant development or redevelopment. The data underlying this MOE is outlined in **Table 2-29**.

Table 2-29: Estimated Daily BRT Ridership to Corridor Activity Centers Undergoing Development or Redevelopment

	Germantown	Great Seneca	Shady Grove	Twinbrook	White Flint
No-Build Alternative	5,500	11,000	2,100	2,800	4,500
TSM Alternative	6,200	11,200	2,100	2,800	4,700
Alternative A	7,100	11,600	2,200	3,000	5,100
Alternative B	7,100	11,500	2,200	3,000	5,100
Alternative C	6,900	11,500	2,200	3,000	5,000

Each of the BRT alternatives would result in an increase in ridership to each activity center relative to the No-Build Alternative, though in some instances the ridership increase is large while for others the increase is relatively marginal. The largest increase relative to the No-Build Alternative is for the Germantown activity center. This increase likely relates to the direct BRT service to the Germantown Transit Center, which would expand the transit market to Germantown by connecting residential areas to the south of Germantown to the Germantown activity center.

3 Traffic-Related MOEs

3.1 Introduction to Project Traffic Simulation Analysis

Simulation of the traffic operations and impacts of each Build Alternative was completed utilizing the traffic simulation model VISSIM. VISSIM is a robust traffic analysis model and was selected for the project traffic analysis because it provides a more comprehensive understanding of BRT travel speeds as part of the overall corridor traffic operations. Travel speeds are one of the key BRT operational inputs into the ridership forecasting model (MWCOG) and therefore the use of VISSIM was deemed essential to ensure the forecasting model input was accurately forecasted.

The detailed definition of each of the alternatives noted under the ridership forecasting description was also undertaken on the traffic side. Key elements of the alternatives definition, for each alternative, included roadway configuration (including location of dedicated bus lanes – median or curb), intersection configuration (including which intersections have queue jumps and the queue jump configuration at intersections where applied), traffic volumes, traffic signal timing (including whether the intersection is equipped with Transit Signal Priority), and the methods for transitioning between alignment types (for instance, how BRT vehicles transition from median dedicated lane to general traffic). Each of these elements was coded into the VISSIM model prior to the actual model runs.

VISSIM generated four key outputs that were then translated into the range of traffic-related MOEs that are being used to compare the alternatives. These include BRT, local bus, and auto travel speeds and travel times for each alternative. They also include intersection delay and Level of Service (LOS), intersection-to-intersection link LOS based on free-flow travel speeds, and the forecasted separation between BRT vehicles at a key screen line at Cedar Avenue in Gaithersburg. As with the ridership-related MOEs, the impacts of the Build Alternatives are evaluated by comparing the change in each MOE between the No-Build and BRT Alternatives.

3.2 Transit Reliability along Corridor

This transit reliability MOE is measured based on how well the forecasted separation of BRT vehicles arriving at Cedar Avenue and MD 355 in Gaithersburg correspond to the scheduled separation of buses (this analysis is done for each of the three northern BRT routes for both the AM and PM peak hours). The closer the actual separation is to scheduled separation, the more reliable service is. Strong reliability means waiting passengers can be confident a bus will arrive within a reasonable amount of time and will have a reasonable passenger load. In situations where separation is poor and buses "bunch", or arrive too close together relative to the schedule, there will be a large gap behind the trailing bus in the bunch, thus resulting in a longer wait time for passengers arriving at the stop after the trailing bus has left. Also, this gap means that the first bus to arrive after the bunch will likely have passenger crowding because it is forced to carry passengers who would have been more evenly distributed across multiple buses if the buses had been correctly separated.

To evaluate bus separation, outputs from the project VISSIM traffic simulation model were used to identify when vehicles arrived at the Cedar Avenue screen line during the AM peak hour and the PM peak hour, by BRT route, as well as their separation from the vehicle in front of them. All three routes evaluated would run every ten minutes, so the ideal separation would also be ten minutes for each route. In addition, ten VISSIM model runs were completed for each route to reflect variable operating conditions from day to day.

The data in **Table 3-1** shows the percentage of BRT vehicles whose separation from the vehicle in front of them falls within a range of 7 minutes to 13 minutes (three minutes on each side of the scheduled headway of 10 minutes). This range reflects the difficulty in maintaining exact scheduled separation under real-world conditions but also incorporates an acceptable range of separation that would not impose an undue burden on passengers.

The data in **Table 3-1** show that in the AM peak all Build Alternative/route pattern combinations have greater than 80% of their vehicle arrivals at Cedar Avenue fall within the range of being separated from the vehicle in front of it by 7 to 13 minutes. Alternatives B and C each generally perform comparably to each other, while Alternative A has a lower performance relative to Alternatives B and C. This likely reflects the fact that Alternative A runs in mixed traffic and therefore is subject to more traffic disruptions than the two dedicated lane alternatives (B and C).

The same separation percentage patterns generally hold true in the PM peak, except in one instance (Under Alternative A, on the Orange Route, only 64% of vehicle arrivals fall into the range of being separated from the vehicle in front of it by 7 to 13 minutes). In the PM peak, Alternative B generally performs the best of the three alternatives, followed by Alternative C, and then by Alternative A. As with AM peak, this likely reflects the level of transit dedication under each alternative, with Alternative B providing the highest level of separation from traffic disruptions.

Table 3-1: Percent of Bus Separations that Fall Between 7 and 13 Minutes – 3 Minutes Above or Below 10 Minute Scheduled Headways (Peak Direction)

AM Peak Southbound			
Route Pattern	Alternative		
	A	B	C
Navy - Lakeforest to Grosvenor	100%	100%	100%
Blue - Germantown to Montgomery College	83%	96%	81%
Orange - Clarksburg to Montgomery College	84%	82%	95%
PM Peak Northbound			
Route Pattern	**Alternative**		
	A	**B**	**C**
Navy - Lakeforest to Grosvenor	92%	87%	93%
Blue - Germantown to Montgomery College	82%	94%	88%
Orange - Clarksburg to Montgomery College	64%	96%	83%

One additional factor that may have an impact on BRT reliability is a phenomenon known as non-recurring congestion. Non-recurring congestion is congestion that occurs because of incidents such as traffic accidents, vehicle breakdowns or road work that occurs on a variable basis and thus cannot be planned for. The data provided in **Table 3-1** reflect modeling of "normal" conditions and therefore do not consider the impacts of potential incidents.

To understand the impact non-recurring congestion has on the MD 355 corridor and the approximate magnitude of the variability it creates in travel time, INRIX traffic data was analyzed. Travel time data for the MD 355 corridor was reviewed for 2018 over a 24-hour period for two segments: Clarksburg to Rockville and Rockville to Bethesda. **Figures 3-1 through 3-4** display the average travel time for these two segments in both the northbound and southbound directions. The average travel time closely aligns with travel time experienced under "normal" conditions. The darker buffer shows the 25th and 75th percentile travel times for the corridor – travel times fall within this range on 50 percent of weekdays. The lighter buffer shows the 5th and 95th percentile – travel times fall within this range on 90 percent of weekdays. These buffers indicate how travel time for cars can vary along the corridor by time of day. During the peak commuting periods (AM and PM), the travel time can vary as much as 20 minutes, or 64 percent longer than average for travel between Clarksburg and Rockville. Drivers need to factor this additional time into their commute in order to arrive on time every time. This variability in travel time manifests itself as unreliable corridor conditions that frustrate travelers.

Figure 3-1: Southbound Travel Time Data (2018) between Clarksburg and Rockville

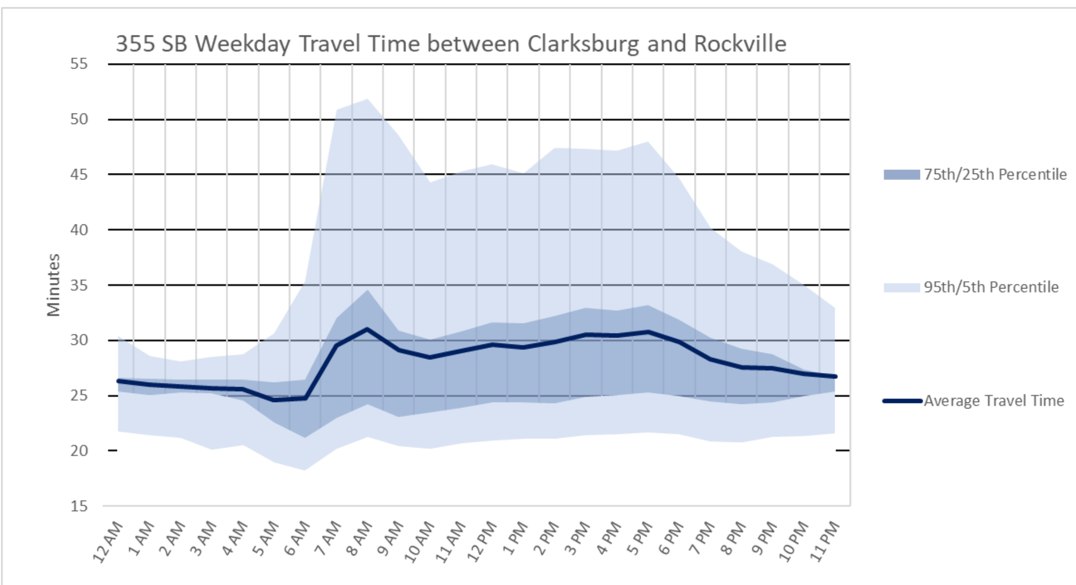


Figure 3-2: Southbound Travel Time Data (2018) between Rockville and Bethesda

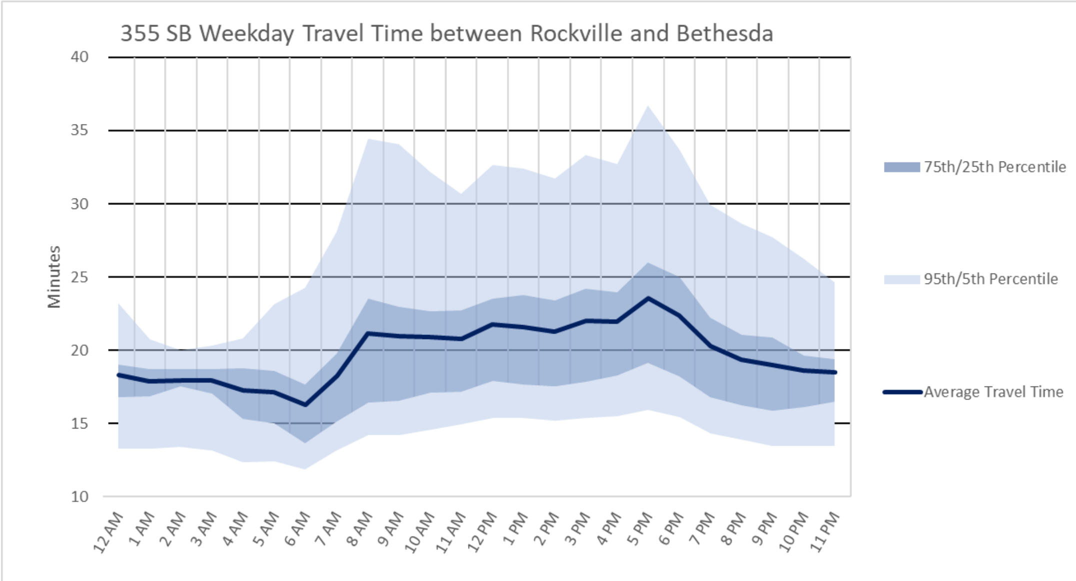


Figure 3-3: Northbound Travel Time Data (2018) between Bethesda and Rockville

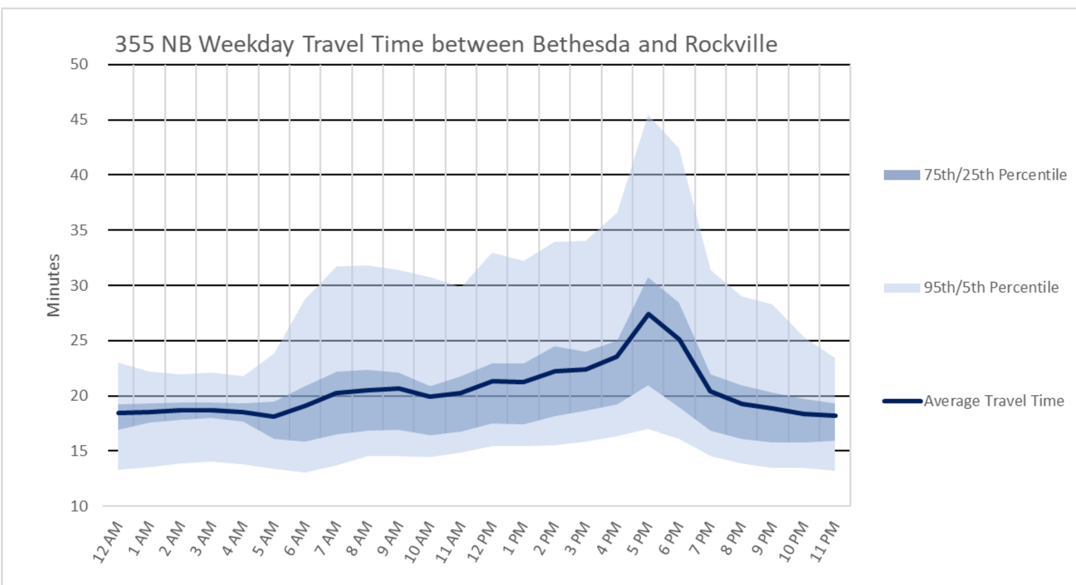
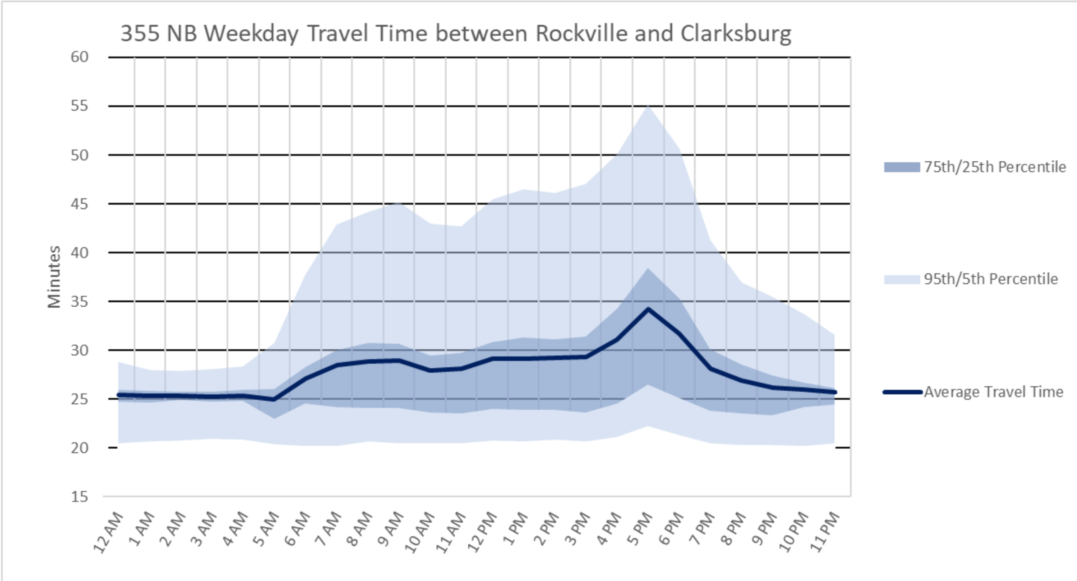


Figure 3-4: Northbound Travel Time Data (2018) between Rockville and Clarksburg



Non-recurring congestion events would have a greater impact on BRT reliability under Alternatives A and C because they are more impacted by general traffic conditions. The impacts would be greatest for Alternative A, which runs in mixed traffic. The dedicated transit lanes completely separated from general traffic under Alternative B would be the most effective in mitigating the impacts of non-recurring congestion on BRT reliability.

3.3 Number of Miles of Level of Service E or F by Alternative

Level of Service (LOS) is one means of assessing the impacts of providing BRT priority on overall traffic operations along the MD 355 corridor. The data for this MOE shows how many miles of the corridor are at either LOS E or LOS F under each of the alternatives being evaluated (how LOS is measured is outlined below **Table 3-2** and is based on forecasted speed within each roadway link compared to free flow speed).

The data in **Table 3-2** shows that there would be some increase in miles of LOS E or F under nearly all BRT Alternatives, in both directions and during both peaks, when compared to the No-Build Alternative. Exceptions are Alternative C in the AM southbound (peak) direction and Alternative A in the PM northbound (peak) direction. The improvement in the AM peak for Alternative C is likely due to lessening the impacts of right turn queues on traffic due to the dedicated curb lane. In the PM peak for Alternative A (which is mixed traffic) the decrease is likely due the fact that Alternative A leaves MD 355 and runs on uncongested roads north of Middlebrook Road, thus decreasing total miles of LOS E or F.

The increases in miles of LOS or F under most alternatives are based on impacts to traffic operations resulting from different priorities provided to BRT such as transit signal priority, queue jumps, and transit only signal phases.

Table 3-2: Number of Miles of LOS E or F by Alternative

2040 AM					
Direction	**No-Build Alternative**	**TSM Alternative**	**Alternative A**	**Alternative B**	**Alternative C**
Northbound	2.6	2.7	2.7	3.0	3.2
Southbound	7.6	9.4	8.1	8.4	5.9
2040 PM					
Direction	**No-Build Alternative**	**TSM Alternative**	**Alternative A**	**Alternative B**	**Alternative C**
Northbound	8.4	8.1	7.2	9.4	8.8
Southbound	5.0	5.5	6.4	5.5	5.7
(red)	Cells marked in red indicate that the number of miles of LOS E or F Increased by 10% or more compared to the No-Build Alternative				
(green)	Cells marked in green indicate that the number of miles of LOS E or F decreased by 10% or more compared to the No-Build Alternative				

LOS Criteria:

Speed/Free flow speed	LOS
>85%	A
>67%-85%	B
>50%-67%	C
>40%-50%	D
>30%-40%	E
<=30%	F

3.4 Average Person Delay (in minutes) within Corridor by Alternative

This MOE is another measure of the impacts of the different BRT alternatives on MD 355 traffic operations. The actual measure is the average delay, in minutes, for each person who runs through the MD 355 BRT corridor and includes delay on side streets. The data in **Table 3-3** shows that average delay per person would change only slightly between the No-Build Alternative and the three BRT Alternatives, meaning, on average, that the implementation of BRT would not result in a major increase in delay for a person moving through the MD 355 corridor network. It should be noted that because the delay presented under all alternatives is an average, individual trips may have less delay than the average delay presented in the Table while other individual trips may experience longer delay than the average. For instance, a short trip on the corridor may have less delay than the average while a longer trip may have a longer delay than the average.

Table 3-3: Average Person Travel Delay (in minutes)

Alternative	AM	PM
No-Build Alternative	3.0	3.0
TSM Alternative	3.0	3.0
Alternative A	3.0	3.6
Alternative B	3.6	3.6

Alternative	AM	PM
Alternative C	3.6	3.6

3.5 BRT Travel Times Compared to Local Bus Travel Times

Tables 3-4 through 3-7 lay out data comparing BRT travel times to local bus travel times by time of day, direction and alignment segment. Conclusions for each Direction/Time of Day table follow each Table.

Prior to the discussion of travel time findings, it is important to reiterate the point made in **Section 3.2** regarding non-recurring congestion relative to the travel time comparisons between BRT and local bus in this section as well as the comparisons between BRT and auto travel times in **Section 3.6**. The data presented in the tables is for "normal" conditions and does not account for potential non-recurring incidents that can impact traffic operations on a one-time basis. As noted in **Section 3.2**, the dedicated transit lanes separated from general traffic under Alternative B has the greatest potential to mitigate the impacts of these non-recurring incidents.

Table 3-4: BRT Travel Times Compared to Local Bus Travel Times - AM Peak Southbound, Peak Direction

			No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
Segment	Segment Mid-Points		Local Bus	RO Extra	Local Bus	RO Extra	Local Bus	BRT	Local Bus	BRT	Local Bus	BRT
7-6	Ridge Road	Watkins Mill Road	---	---	---	15.3	-	21.0	-	15.8	-	15.2
6-5	Watkins Mill Road	Chestnut Street	---	---	---	11.9	14.4	13.2	16.1	13.3	14.5	12.9
5-4	Chestnut Street	Shady Grove Road	9.9	13.5	13.3	10.5	12.9	9.6	13.8	7.1	11.7	7.1
4-3	Shady Grove Road	Washington Street	18.8	23.0	14.3	15.5	21.5	15.9	23.6	12.7	15.4	12.5
3-2	Washington Street	Twinbrook Parkway	20.0	17.0	21.2	15.2	21.5	15.5	24.0	12.4	18.2	11.5
2-1	Twinbrook Parkway	Cedar Lane	17.2	16.2	19.6	19.5	20.1	17.0	20.9	15.6	18.7	14.4

The data in **Table 3-4** show that BRT travel times would be lower than local bus travel times in each BRT alternative and would also be lower when compared to the No-Build Alternative local bus travel times. In addition, BRT would have lower travel times than Ride On extRa under the No-Build Alternative and TSM Alternatives in all but a few instances. This data shows that BRT meets the goal of providing a travel time premium relative to local bus as well as Ride On extRa service.

It should also be noted that in most instances local bus travel times under BRT Alternatives A and B would increase relative to local bus travel times under the No-Build Alternative. This increase in travel time under Alternative A is likely the result of more transit vehicles running in the curb lane under mixed traffic operations, thus impacting local bus operations. Under Alternative B, the increase in local bus travel times is most likely the result of the impacts of BRT priority on general traffic operations, which also impact local buses running in mixed traffic. In the case of Alternative C, local bus travel times would actually decrease relative to the No-Build Alternative, most likely as a result of the dedicated transit lane provided in Alternative C, which benefits local bus in addition to BRT.

Table 3-5: BRT Travel Times Compared to Local Bus Travel Times - AM Peak Northbound, Off-Peak Direction

			No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
Segment	Segment Mid-Points		Local Bus	RO Extra	Local Bus	RO Extra	Local Bus	BRT	Local Bus	BRT	Local Bus	BRT
1-2	Cedar Lane	Twinbrook Parkway	20.5	16.7	7.6	4.7	8.5	5.0	8.1	4.9	13.0	7.0
2-3	Twinbrook Parkway	Washington Street	14.9	12.3	21.2	17.4	20.6	13.5	23.2	16.3	19.7	13.5
3-4	Washington Street	Shady Grove Road	17.4	25.3	10.1	10.5	17.7	10.6	18.2	10.3	18.0	10.8
4-5	Shady Grove Road	Chestnut Street	9.5	5.4	14.4	18.3	15.0	14.2	13.5	12.4	13.7	17.0
5-6	Chestnut Street	Watkins Mill Road	---	---	9.3	5.5	10.6	5.5	12.6	6.1	10.7	5.5
6-7	Watkins Mill Road	Ridge Road	---	---	---	13.1	12.5	13.9	12.3	14.8	12.5	13.2

The same patterns seen in the AM peak southbound direction generally hold true for the AM peak northbound direction. Specifically, BRT travel times would generally be less than local bus travel times in each BRT alternative and are also less than No-Build Alternative local bus travel times. In addition, local bus travel times under the BRT alternatives would generally increase relative to No-Build Alternative local bus travel times.

Table 3-6: BRT Travel Times Compared to Local Bus Travel Times - PM Peak Northbound, Peak Direction

			No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
Segment	Segment Mid-Points		Local Bus	RO Extra	Local Bus	RO Extra	Local Bus	BRT	Local Bus	BRT	Local Bus	BRT
1-2	Cedar Lane	Twinbrook Parkway	6.9	---	6.8	6.3	9.2	6.5	9.4	7.3	7.3	6.0
2-3	Twinbrook Parkway	Washington Street	30.4	24.9	30.1	25.0	29.1	24.2	32.3	18.9	26.1	22.0
3-4	Washington Street	Shady Grove Road	21.1	19.2	17.8	17.4	18.8	13.7	23.1	14.4	18.5	12.0
4-5	Shady Grove Road	Chestnut Street	15.1	18.6	14.5	14.2	16.1	13.5	18.8	12.6	15.7	16.0
5-6	Chestnut Street	Watkins Mill Road	10.4	6.3	10.3	6.6	11.6	6.8	12.9	6.5	12.0	6.8
6-7	Watkins Mill Road	Ridge Road	---	---	---	16.6	13.1	17.7	13.2	17.3	13.1	15.7

The same general patterns apparent in the AM peak as shown in **Tables 3-4 and 3-5** are also present in the PM peak northbound direction.

Table 3-7: BRT Travel Times Compared to Local Bus Travel Times - PM Peak Southbound, Off-Peak Direction

			No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
Segment	Segment Mid-Points		Local Bus	RO Extra	Local Bus	RO Extra	Local Bus	BRT	Local Bus	BRT	Local Bus	BRT
7-6	Ridge Road	Watkins Mill Road	---	---	---	12.2	-	19.1	-	16.4	-	11.7
6-5	Watkins Mill Road	Chestnut Street	---	---	---	12.2	18.2	13.0	13.9	12.4	18.4	12.6
5-4	Chestnut Street	Shady Grove Road	10.6	5.6	10.6	7.1	11.4	7.2	10.9	6.9	11.2	7.1
4-3	Shady Grove Road	Washington Street	10.6	15.0	11.7	15.1	19.3	16.2	28.5	13.6	16.3	11.4
3-2	Washington Street	Twinbrook Parkway	18.2	16.1	18.2	13.2	19.3	12.8	23.4	9.3	18.8	11.0
2-1	Twinbrook Parkway	Cedar Lane	21.0	16.5	20.6	15.8	21.9	16.2	21.6	15.7	19.9	14.3

The data in **Table 3-7** for the PM southbound direction follow the same general patterns as is present during other parts of the day and in different directions as highlighted in **Tables 3-4, 3-5, and 3-6**.

3.6 BRT Travel Times Compared to Automobile Travel Times

Tables 3-8 through 3-11 lay out data comparing BRT travel times to automobile travel times by time of day, direction and alignment segment. Conclusions for each Direction/Time of Day table follow each Table.

Table 3-8: BRT Travel Times Compared to Auto Travel Times - AM Peak Southbound, Peak Direction

			No-Build Alternative	TSM Alternative	Alternative A		Alternative B		Alternative C	
Segment	Segment Mid-Points		Automobile	Automobile	Auto	BRT	Auto	BRT	Auto	BRT
7-6	Ridge Road	Watkins Mill Road	11.4	12.0	12.5	21.0	16.2	15.8	13.4	15.2
6-5	Watkins Mill Road	Chestnut Street	3.7	3.7	3.8	13.2	4.5	13.3	4.0	12.9
5-4	Chestnut Street	Shady Grove Road	8.5	8.3	6.9	9.6	8.0	7.1	6.7	7.1
4-3	Shady Grove Road	Washington Street	11.6	11.9	10.2	15.9	12.6	12.7	11.3	12.5
3-2	Washington Street	Twinbrook Parkway	10.5	11.6	11.7	15.5	13.8	12.4	12.1	11.5
2-1	Twinbrook Parkway	Cedar Lane	12.8	15.5	12.9	17.0	15.2	15.6	11.7	14.4

Two general patterns are present in the auto versus BRT travel time data displayed in **Table 3-8**. The first is that in most instances BRT travel times are higher than auto travel time, meaning that even with priority treatments, the auto would still provide a more time-competitive trip than BRT. The smallest difference between auto and BRT travel times would occur under Alternative B, which makes sense given that Alternative B provides the highest level of transit separation from traffic delays/incidents. It is important to note that the times shows in **Tables 3-8 through 3-11** are modeled results and do not account for non-recurring congestion and corridor variability. During these events the corridor travel times would be more impacted for autos, the TSM Alternative, Alternative A, and Alternative C compared to Alternative B.

The second general trend is that auto travel times would increase under the BRT alternatives relative to the No-Build Alternative. This increase reflects the fact that the priority treatments installed as part of the BRT alternatives would have negative impacts on corridor traffic operations. The greatest impact to auto travel times would occur under Alternative B.

Table 3-9: BRT Travel Times Compared to Auto Travel Times - AM Peak Northbound, Off-Peak Direction

			No-Build Alternative	TSM Alternative	Alternative A		Alternative B		Alternative C	
Segment	Segment Mid-Points		Automobile	Automobile	Auto	BRT	Auto	BRT	Auto	BRT
1-2	Cedar Lane	Twinbrook Parkway	12.5	12.5	12.4	13.5	12.4	16.3	12.8	13.5
2-3	Twinbrook Parkway	Washington Street	8.2	8.0	8.1	10.6	8.7	10.3	8.6	10.8
3-4	Washington Street	Shady Grove Road	7.6	7.7	7.7	14.2	7.4	12.4	7.6	17.0
4-5	Shady Grove Road	Chestnut Street	3.9	4.2	4.0	5.5	4.3	6.1	4.0	5.5
5-6	Chestnut Street	Watkins Mill Road	4.3	4.5	4.5	13.9	4.5	14.8	4.5	13.2
6-7	Watkins Mill Road	Ridge Road	7.1	7.2	7.0	20.8	7.5	17.9	7.5	9.5

The same general trends displayed in **Table 3-9** for the AM peak southbound direction also occur in the AM peak northbound direction, though the increase in auto travel times under the BRT alternatives compared to the No-Build Alternative is not as pronounced in the off-peak direction.

Table 3-10: BRT Travel Times Compared to Auto Travel Times - PM Peak Northbound, Peak Direction

			No-Build Alternative	TSM Alternative	Alternative A		Alternative B		Alternative C	
Segment	Segment Mid-Points		Automobile	Automobile	Auto	BRT	Auto	BRT	Auto	BRT
1-2	Cedar Lane	Twinbrook Parkway	21.3	21.0	21.7	24.2	24.0	18.9	23.2	22.0
2-3	Twinbrook Parkway	Washington Street	15.2	14.7	10.4	13.7	15.4	14.4	15.8	12.0

			No-Build Alternative	TSM Alternative	Alternative A		Alternative B		Alternative C	
3-4	Washington Street	Shady Grove Road	10.6	10.4	9.1	13.5	12.9	12.6	8.8	16.0
4-5	Shady Grove Road	Chestnut Street	5.0	5.1	5.1	6.8	6.0	6.5	5.0	6.8
5-6	Chestnut Street	Watkins Mill Road	7.8	8.3	8.3	17.7	8.0	17.3	10.6	15.7
6-7	Watkins Mill Road	Ridge Road	9.1	8.7	9.0	22.0	8.3	15.9	10.9	13.0

The same patterns occur in the PM northbound direction as in both directions in the AM peak. One exception is at the southern end of the alignment in Alternatives B and C, where BRT travel times would be lower than auto travel times. The lower BRT travel times in this portion of the alignment are likely due to the benefit to BRT of dedicated guideway while autos are in heavily congested mixed traffic.

Table 3-11: BRT Travel Times Compared to Auto Travel Times - PM Peak Southbound, Off-Peak Direction

			No-Build Alternative	TSM Alternative	Alternative A		Alternative B		Alternative C	
Segment	Segment Mid-Points		Automobile	Automobile	Auto	BRT	Auto	BRT	Auto	BRT
7-6	Ridge Road	Watkins Mill Road	9.5	9.4	9.2	19.1	10.0	16.4	8.9	11.7
6-5	Watkins Mill Road	Chestnut Street	5.1	5.2	5.1	13.0	4.8	12.4	4.9	12.6
5-4	Chestnut Street	Shady Grove Road	5.0	5.1	5.2	7.2	5.2	6.9	5.2	7.1
4-3	Shady Grove Road	Washington Street	6.5	6.5	6.9	16.2	8.4	13.6	6.8	11.4
3-2	Washington Street	Twinbrook Parkway	10.3	10.4	10.6	12.8	11.5	9.3	12.8	11.0
2-1	Twinbrook Parkway	Cedar Lane	15.0	14.4	15.3	16.2	15.3	15.7	17.6	14.3

The same general patterns seen in the previous tables are also present for the data displayed in **Table 3-11**, specifically BRT travel times that would be generally higher than auto travel times and an increase in auto travel times in the BRT alternatives when compared to the No-Build Alternative. The pattern of lower BRT travel times at the southern end of the alignment under Alternative B and C that occurred in the PM northbound direction also occurs here in the PM off-peak direction. The reasons for this, as described for the PM northbound direction, also apply here.

3.7 Intersection Level of Service

This section outlines intersection Level of Service and delay under the No-Build Alternative, TSM Alternative, and BRT alternatives, and is another way of assessing the impact of providing BRT priority on general traffic operations.

Two sets of data are presented. The first is Level of Service (LOS) and delay for the AM peak period for each of the signalized intersections along the MD 355, Observation Drive, and Snowden Farm Parkway alignments. This is provided in **Table 3-12**. The second set of data, provided in **Table 3-13**, is comparable data for the PM peak period.

The key findings from the data presented in **Table 3-12** (AM peak) are as follows:

- In most instances an intersection operating at LOS of E or F in the AM peak under the BRT alternatives would also operate at LOS E or F in the No-Build Alternative.
    - However, there are four instances where the Build Alternative would result in an intersection falling to LOS E or F from a non-failing intersection in the No-Build. Three of these intersections occur under Alternative B. The first, **Tuckerman Lane,** occurs because there is a transition into, or out of, a median dedicated lane, thus requiring the addition of a transit-only signal phase to the signal cycle, thus impacting general traffic operations. The decline at the other two intersections, **Professional Drive and Spectrum Avenue,** is the result of a change at Watkins Mill Road, which is south of these two intersections. Specifically, the northbound left turn at Watkins Mill is protected-permissive in the No-Build, meaning there is a protected left turn signal, but vehicles can also make left turns when there is a break in southbound traffic during the through green phase. This allows for more vehicles to make the left turn outside the protected phase. Under Alternative B, the permissive left turn is removed because it could result in conflicts/accidents between left-turning autos and the median BRT. The removal of the permissive left means that more time must be given to the protected left turn phase for northbound left turning vehicles. This additional time for the protected left must be taken from other phases of the cycle, including the southbound through movement. This shorter southbound through-phase results in fewer autos getting through during each signal cycle, therefore leading to longer queues that back into Spectrum Avenue and Professional Drive, thus resulting in the fall into LOS F. These findings point to the consideration of adding a second left turn lane at Watkins Mill Road, which would help clear the intersection with less time given to the protected left signal phase, thus mitigating the issues noted above. This improvement will be modeled in the next project phase in order to assess the effectiveness of dual left turn lanes.
    - The fourth instance of an intersection falling to LOS F in the Build Alternative during the AM peak would be at **South Drive** in Bethesda under Alternative C. In this instance the intersection falls to a LOS E. This decay is likely a result of the repurposing of the southbound curb lane under Alternative C as well as fallout from failing operations at Jones Bridge Road.

It should be noted that each of the intersections that degrade to failing (in both AM and PM peak) will be evaluated in the next work phase to determine if refinements can be made to mitigate some of the traffic impacts.

The data in **Table 3-13**, representing PM peak LOS and delay show the same general trends as the AM peak, though more intersections would fall to LOS E or F when compared to the No-Build Alternative. These intersections, from north to south, include:

- **Redgrave Place and MD 355 and Stringtown Road and MD 355**: Under Alternative C, the decline in intersection operations at these two adjacent intersections would be caused by the northbound queues originating from the Clarksburg Road and MD 355 intersection. MD 355 would attract more traffic in Alternative C due to future road widening by others in Segment 7. However, the intersection of Clarksburg Road is not capable of handling the additional trips; therefore, the northbound queues would extend to Redgrave Place and Stringtown Road (note: this only happens in Alternative C because only in this alternative does BRT run through these intersections).
- **Gunners Branch and MD 335**: Under Alternative C, the decline in intersection operations at this intersection would be caused by extra delays at Middlebrook Road. The signal timing would be adjusted at Middlebrook Road and MD 355 to accommodate a longer pedestrian crossing at Middlebrook Road due to road widening to accommodate the dedicated transit lanes. The reduced timing for the northbound approach at Middlebrook Road would impact the traffic operations at the Gunners Branch Road intersection.
- **Christopher Avenue and MD 355**: Under Alternatives B and C, the decline in intersection operations at this intersection would be related to the traffic operation at Watkins Mill Road and MD 355.
- **King Farm Boulevard and MD 355 and Redland Road and MD 355**: Under Alternative B, the decline in intersection operations at these two adjacent intersections would be related to transit-only phases to accommodate vehicles turning into and out of the median guideway in order to access the Shady Grove Metrorail station.
- **Watkins Pond Boulevard and MD 355**: Under Alternative B, the decline in intersection operations at this intersection would be caused by signal timing adjustments to accommodate an exclusive transit phase at Redland Road and King Farm Boulevard. The northbound queues would extend from the two impacted intersections to the Watkins Pond Boulevard intersection and increase the delays at this intersection.
- **Gude Drive and MD 355**: Under Alternative C, the decline in intersection operations at this intersection would be caused by signal timing adjustments to accommodate a longer pedestrian crossing time.
- **Congressional Lane and MD 355 and Halpine Road and MD 355**: Under Alternatives B and C, the decline in intersection operations at these two adjacent intersections would be related to signal retiming to provide sufficient crossing time for passengers accessing the Twinbrook Metro Station.
- **Old Georgetown Road and MD 355**: Under Alternatives B, the slight decline in intersection operations at this intersection would be related to protected left turns necessary in Alternative B as compared to protected-permissive left turns in other scenarios.
- **Marinelli Road and MD 355**: Under Alternative B, the decline in intersection operations at this intersection would be related to the required signal timing adjustments to accommodate increased pedestrian volumes accessing the median BRT station here.
- **Edson Lane and MD 355**: Under Alternative C, the decline in intersection operations at this intersection would be caused by the northbound queues from the Nicholson Lane and southbound queues from MD 547. The signal timing at Nicholson Lane and MD 547 would be adjusted to provide sufficient crossing time for pedestrians.

- **Grosvenor Lane and MD 355**: Under Alternatives B and C, the decline in intersection operations at this intersection would be caused by delays and queues at adjacent intersections. In Alternative B, the intersection would be impacted by the Tuckerman Lane intersection which would have an exclusive transit phase. In Alternative C, the intersection would be impacted by MD 547 which would be signal re-timed to provide sufficient crossing time for pedestrians.
- **Jones Bridge Road and MD 355**: Under Alternatives A and C, the decline in intersection operations at this intersection would be caused by necessary signal timing adjustments to accommodate curb lane operations in each alternative. This would include re-timing under Alternative C to accommodate the PM peak northbound lane repurposing to provide a dedicated transit lane during in the PM peak direction.

Note: Red cells in **Tables 3-12 and 3-13** represent intersections that are operating at LOS F. Gold colored cells represent intersections that are operating at LOS E.

Table 3-12: AM Peak Intersection LOS, By Alternative

Intersection		No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	Clarksburg Road and MD 355	45.7	D	46.5	D	n/a	n/a	n/a	n/a	48.0	D
2	Spire Street and MD 355	29.9	D	31.7	D	n/a	n/a	n/a	n/a	23.3	C
3	Redgrave Place and MD 355	13.6	B	13.6	B	n/a	n/a	n/a	n/a	15.2	C
4	Stringtown Road and MD 355	35.9	D	36.5	D	n/a	n/a	n/a	n/a	38.6	D
5	Shawnee Lane and MD 355	78.4	F	92.2	F	n/a	n/a	n/a	n/a	53.8	F
6	Foreman Blvd and MD 355	39.5	D	45.5	D	n/a	n/a	n/a	n/a	19.1	B
7	Little Seneca Parkway and MD 355	81.0	F	84.5	F	n/a	n/a	n/a	n/a	31.7	C
8	W Old Baltimore Road and MD 355	47.8	D	50.2	D	n/a	n/a	n/a	n/a	18.1	B
9	Brink Road and MD 355	15.1	B	15.8	B	n/a	n/a	n/a	n/a	6.6	A
10	MD 27 and MD 355	42.5	D	42.6	D	43.7	D	n/a	n/a	42.1	D
11	Henderson Corner Road and MD 355	17.9	B	17.9	B	21.9	C	n/a	n/a	15.2	B
12	Milestone Center and MD 355	2.3	A	2.3	A	2.7	A	n/a	n/a	2.2	A
13	Shakespeare Blvd and MD 355	14.1	B	14.3	B	12.0	B	n/a	n/a	13.6	B
110	Observation Drive T Intersection	n/a	n/a	n/a	n/a	n/a	n/a	35.1	E	n/a	n/a
111	Observation Drive and Boland Farm	n/a	n/a	n/a	n/a	n/a	n/a	30.7	D	n/a	n/a
112	Observation Drive and Ridge Road	n/a	n/a	n/a	n/a	n/a	n/a	56.3	E	n/a	n/a
113	Observation Drive and Milestone Center	n/a	n/a	n/a	n/a	n/a	n/a	120.2	F	n/a	n/a
114	Observation Drive and Dorsey Mill Road	n/a	n/a	n/a	n/a	n/a	n/a	42.1	D	n/a	n/a
115	Observation Drive and Water Discovery Lane	n/a	n/a	n/a	n/a	n/a	n/a	10.7	B	n/a	n/a
116	Observation Drive and W Old Baltimore Road	n/a	n/a	n/a	n/a	n/a	n/a	30.9	C	n/a	n/a
117	Observation Drive and Little Seneca Parkway	n/a	n/a	n/a	n/a	n/a	n/a	43.3	D	n/a	n/a
118	Observation Drive and Shawnee Lane	n/a	n/a	n/a	n/a	n/a	n/a	19.2	B	n/a	n/a
14	Amber Ridge Cir and Shakespeare Blvd	10.9	B	n/a	n/a	11.0	B	n/a	n/a	n/a	n/a
15	Observation Drive and Shakespeare Blvd	21.8	C	n/a	n/a	21.8	C	17.0	B	n/a	n/a
16	Germantown Road and MD 355	46.3	D	46.7	D	n/a	n/a	n/a	n/a	34.8	C
17	Observation Drive and Germantown Road	16.8	B	16.9	B	n/a	n/a	25.5	C	n/a	n/a
18	Seneca Meadows Parkway and	6.7	A	6.7	A	7.2	A	n/a	n/a	n/a	n/a

	Intersection	No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
	Germantown Road										
19	Middlebrook Road and MD 355	65.1	E	64.0	E	64.9	E	69.1	E	84.4	F
20	Observation Drive and Middlebrook Road	5.2	A	5.2	A	6.2	A	9.2	A	n/a	n/a
21	Gunners Branch Road and MD 355	10.9	B	10.8	B	10.3	B	18.6	B	9.4	A
22	Plummer Drive and MD 355	10.0	A	10.3	B	10.0	A	13.4	B	10.5	B
23	Professional Drive and MD 355	19.7	B	25.2	C	37.2	D	87.9	F	29.4	C
24	Spectrum Avenue and MD 355	32.3	C	44.0	D	58.0	E	88.9	F	52.2	D
25	Watkins Mill Road and MD 355	138.2	F	135.4	F	137.1	F	142.5	F	136.8	F
26	Christopher Avenue and MD 355	10.8	B	9.2	A	9.9	A	17.7	B	8.3	A
27	Lockheed Martin and MD 355	8.5	A	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
28	MD 124 and MD 355	41.1	D	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
29	Perry Parkway and MD 355	30.7	C	30.7	C	31.5	C	35.9	D	31.8	C
30	Odendhal Avenue and MD 355	29.1	C	27.4	C	23.9	C	32.1	C	26.0	C
31	Chestnut Street and MD 355	10.7	B	10.3	B	10.4	B	22.8	C	10.5	B
32	Cedar Avenue and MD 355	21.0	C	22.4	C	19.7	C	3.2	A	19.6	C
33	S Summit Avenue and MD 355	21.7	C	26.3	C	21.3	C	35.2	D	20.8	C
34	Education Blvd and MD 355	10.0	A	10.1	B	7.6	A	13.7	B	7.2	A
35	E Deer Park Drive and MD 355	31.7	C	31.1	C	23.9	C	31.7	C	21.5	C
36	S Westland Drive and MD 355	66.3	E	63.2	E	45.5	D	57.0	E	43.7	D
37	O'Neill Drive and MD 355	62.1	E	64.2	E	59.0	E	60.5	E	57.5	E
38	Shady Grove Road and MD 355	91.8	F	83.2	F	87.5	F	83.1	F	78.0	E
39	Ridgemont Avenue and MD 355	37.6	D	37.6	D	38.7	D	51.5	D	29.4	C
40	King Farm Blvd and MD 355	48.4	D	48.8	D	51.3	D	52.1	D	43.9	D
41	Redland Road and MD 355	58.5	E	60.6	E	54.0	D	69.9	E	52.9	D
42	Somerville Drive and Redland Road	15.4	B	24.2	C	22.0	C	16.4	B	17.8	B
43	Redland Ext and Redland Road	44.6	D	46.6	D	45.0	D	45.1	D	45.3	D
44	Watkins Pond Blvd and MD 355	61.1	E	57.8	E	27.9	C	78.7	E	49.7	D
45	Rockville Corporate Ctr and MD 355	51.8	D	50.8	D	3.5	A	39.8	D	49.7	D
46	E Gude Drive and MD 355	126.7	F	123.7	F	110.7	F	112.2	F	127.6	F
47	College Parkway and MD 355	10.7	B	10.4	B	17.2	B	13.2	B	8.8	A
48	N Campus Drive and MD 355	19.0	B	19.4	B	26.3	C	21.7	C	12.4	B
60	Mannakee Street and MD 355	61.0	E	59.4	E	61.5	E	43.5	D	62.6	E
61	Frederick Avenue and MD 355	25.0	C	26.5	C	29.3	C	17.7	B	35.3	D
62	N Washington Street and MD 355	27.4	C	28.8	C	34.8	C	41.7	D	41.5	D
63	Hungerford Plaza and MD 355	18.6	B	38.7	D	54.8	D	51.0	D	65.3	E
64	Beall Avenue and MD 355	34.0	C	47.8	D	53.3	D	49.2	D	57.6	E
65	E Middle Lane and MD 355	50.1	D	55.4	E	56.9	E	59.5	E	59.7	E
66	Monroe Place and MD 355	15.5	B	13.8	B	13.9	B	15.7	B	13.7	B
67	MD 28 and MD 355	33.6	C	31.3	C	28.7	C	45.8	D	28.1	C
68	Dodge Street and MD 355	22.5	C	21.8	C	17.9	B	37.0	D	17.4	B
69	Wootton Parkway and MD 355	98.5	F	97.8	F	91.4	F	103.8	F	85.5	F
70	Edmonston Drive and MD 355	37.6	D	40.6	D	37.8	D	39.0	D	39.7	D
71	Country Club Road and MD 355	8.2	A	7.7	A	7.9	A	8.6	A	9.2	A
72	Templeton Place and MD 355	9.0	A	8.9	A	9.4	A	23.4	C	10.9	B
73	Congressional Lane and MD 355	17.3	B	17.1	B	17.8	B	26.9	C	25.2	C
74	Halpine Road and MD 355	18.0	B	18.5	B	18.2	B	39.8	D	18.5	B
77	Bouic Avenue and MD 355	2.8	A	3.4	A	3.4	A	n/a	n/a	1.6	A
78	Twinbrook Parkway and MD 355	21.7	C	21.1	C	22.0	C	33.2	C	20.9	C
79	Federal Plaza and MD 355	5.3	A	5.2	A	5.9	A	12.6	B	5.5	A
80	Bou Avenue and MD 355	50.2	D	32.9	C	34.0	C	45.5	D	30.6	C
81	Hubbard Drive and MD 355	8.2	A	8.7	A	9.3	A	13.4	B	8.5	A

	Intersection	No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
82	Montrose Road and Towne Road	20.6	C	20.6	C	20.6	C	20.8	C	20.5	C
83	Montrose Parkway and MD355 Ramp	37.0	D	37.0	D	37.0	D	36.9	D	36.9	D
84	Mid-Pike Plaza and MD 355	21.9	C	25.3	C	23.9	C	18.9	B	18.1	B
85	Old Georgetown Road and MD 355	38.3	D	38.2	D	39.2	D	46.5	D	40.1	D
86	Marinelli Road and MD 355	53.1	D	53.9	D	53.2	D	47.9	D	53.9	D
87	Nicholson Lane and MD 355	66.7	E	66.8	E	65.8	E	68.7	E	69.0	E
88	Security Lane and MD 355	12.9	B	12.7	B	13.4	B	28.2	C	14.4	B
89	Edson Lane and MD 355	15.4	B	15.2	B	15.5	B	18.0	B	18.2	B
90	MD 547 and MD 355	57.2	E	56.7	E	57.8	E	79.9	E	58.5	E
91	Tuckerman Lane and MD 355 (North)	51.5	D	50.0	D	49.2	D	89.9	F	52.0	D
92	Music Center and Tuckerman Lane	8.2	A	n/a	n/a	8.4	A	8.8	A	8.4	A
93	Strathmore Park Court and Tuckerman Lane	16.9	C	n/a	n/a	16.9	C	16.9	C	16.9	C
94	Tuckerman Lane and MD 355 (South)	7.3	A	22.9	C	7.1	A	10.2	B	7.1	A
95	Grosvenor Lane and MD 355	23.9	C	35.0	C	23.1	C	23.0	C	22.8	C
96	Pooks Hill Road and MD 355	69.1	E	79.8	E	71.4	E	57.9	E	41.2	D
97	Alta Vista Road and MD 355	15.1	B	35.5	D	13.6	B	12.9	B	12.3	B
98	Cedar Lane and MD 355	51.9	D	48.3	D	40.4	D	38.2	D	52.2	D
99	Wood Road and MD 355	19.8	B	13.1	B	11.9	B	11.9	B	20.1	C
100	Wilson Drive and MD 355	23.7	C	12.8	B	11.9	B	12.0	B	24.6	C
101	South Drive and MD 355	51.8	D	39.1	D	40.5	D	40.5	D	71.4	E
102	Jones Bridge Road and MD 355	90.7	F	90.2	F	80.4	F	82.0	F	100.0	F
103	Woodmont Avenue and MD 355	11.8	B	11.8	B	11.4	B	13.0	B	23.1	C
104	Rosedale Avenue and MD 355	18.4	B	18.8	B	18.8	B	18.7	B	26.6	C
105	Cordell Avenue and MD 355	4.6	A	4.8	A	5.1	A	4.9	A	4.7	A
106	Cheltenham Drive and MD 355	9.2	A	9.5	A	9.5	A	10.0	A	9.3	A
107	East-West Highway and MD 355	41.6	D	41.3	D	40.4	D	37.4	D	41.0	D
108	Montgomery Avenue and MD 355	29.5	C	32.2	C	33.2	C	32.5	C	14.4	B

Table 3-13: PM Peak Intersection LOS, By Alternative

	Intersection	No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	Clarksburg Road and MD 355	68.7	E	68.3	E	n/a	n/a	n/a	n/a	93.9	F
2	Spire Street and MD 355	26.0	D	24.5	C	n/a	n/a	n/a	n/a	29.1	D
3	Redgrave Place and MD 355	21.9	C	22.6	C	n/a	n/a	n/a	n/a	81.9	F
4	Stringtown Road and MD 355	47.4	D	48.9	D	n/a	n/a	n/a	n/a	81.1	F
5	Shawnee Lane and MD 355	29.1	D	26.7	D	n/a	n/a	n/a	n/a	28.6	D
6	Foreman Blvd and MD 355	10.2	B	11.0	B	n/a	n/a	n/a	n/a	7.1	A
7	Little Seneca Parkway and MD 355	31.1	C	30.9	C	n/a	n/a	n/a	n/a	20.8	C
8	W Old Baltimore Road and MD 355	22.1	C	24.9	C	n/a	n/a	n/a	n/a	13.4	B
9	Brink Road and MD 355	52.4	D	54.6	D	n/a	n/a	n/a	n/a	18.0	B
10	MD 27 and MD 355	52.4	D	50.9	D	52.2	D	n/a	n/a	46.8	D
11	Henderson Corner Road and MD 355	34.8	C	35.8	D	35.3	D	n/a	n/a	35.2	D
12	Milestone Center and MD 355	9.5	A	9.6	A	8.7	A	n/a	n/a	10.5	B
13	Shakespeare Blvd and MD 355	16.0	B	16.2	B	23.9	C	n/a	n/a	13.5	B
110	Observation Drive T Intersection	n/a	n/a	n/a	n/a	n/a	n/a	14.2	B	n/a	n/a
111	Observation Drive and Boland Farm	n/a	n/a	n/a	n/a	n/a	n/a	45.4	E	n/a	n/a
112	Observation Drive and Ridge Road	n/a	n/a	n/a	n/a	n/a	n/a	59.4	E	n/a	n/a
113	Observation Drive and Milestone	n/a	n/a	n/a	n/a	n/a	n/a	35.8	D	n/a	n/a

	Intersection	No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
	Center										
114	Observation Drive and Dorsey Mill Road	n/a	n/a	n/a	n/a	n/a	n/a	17.8	B	n/a	n/a
115	Observation Drive and Water Discovery Lane	n/a	n/a	n/a	n/a	n/a	n/a	9.5	A	n/a	n/a
116	Observation Drive and W Old Baltimore Road	n/a	n/a	n/a	n/a	n/a	n/a	23.1	C	n/a	n/a
117	Observation Drive and Little Seneca Parkway	n/a	n/a	n/a	n/a	n/a	n/a	38.0	D	n/a	n/a
118	Observation Drive and Shawnee Lane	n/a	n/a	n/a	n/a	n/a	n/a	22.1	C	n/a	n/a
119	Observation Drive and Stringtown Road	n/a	n/a	n/a	n/a	n/a	n/a	60.3	E	n/a	n/a
14	Amber Ridge Cir and Shakespeare Blvd	25.5	D	n/a	n/a	25.5	D	n/a	n/a	n/a	n/a
15	Observation Drive and Shakespeare Blvd	33.3	C	n/a	n/a	33.1	C	28.9	C	n/a	n/a
16	Germantown Road and MD 355	54.0	D	52.4	D	n/a	n/a	n/a	n/a	43.1	D
17	Observation Drive and Germantown Road	32.1	C	32.3	C	n/a	n/a	38.5	D	n/a	n/a
18	Seneca Meadows Parkway and Germantown Road	26.7	C	26.4	C	29.4	C	n/a	n/a	n/a	n/a
19	Middlebrook Road and MD 355	74.2	E	93.9	F	99.0	F	61.6	E	75.7	E
20	Observation Drive and Middlebrook Road	8.4	A	32.0	C	30.0	C	8.7	A	n/a	n/a
21	Gunners Branch Road and MD 355	33.0	C	32.3	C	36.3	D	44.1	D	61.6	E
22	Plummer Drive and MD 355	6.7	A	6.6	A	6.5	A	13.0	B	12.2	B
23	Professional Drive and MD 355	16.1	B	15.8	B	16.2	B	22.2	C	16.5	B
24	Spectrum Avenue and MD 355	9.8	A	9.5	A	10.1	B	13.8	B	8.9	A
25	Watkins Mill Road and MD 355	151.6	F	152.2	F	156.1	F	167.5	F	142.8	F
26	Christopher Avenue and MD 355	45.7	D	50.3	D	48.1	D	75.3	E	61.3	E
27	Lockheed Martin and MD 355	13.2	B	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
28	MD 124 and MD 355	80.8	F	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
29	Perry Parkway and MD 355	51.8	D	51.5	D	52.9	D	49.1	D	57.5	E
30	Odendhal Avenue and MD 355	32.4	C	32.4	C	33.2	C	38.9	D	33.8	C
31	Chestnut Street and MD 355	19.1	B	19.2	B	18.6	B	16.4	B	18.6	B
32	Cedar Avenue and MD 355	22.9	C	23.3	C	23.9	C	9.9	A	22.4	C
33	S Summit Avenue and MD 355	23.1	C	23.1	C	24.4	C	27.7	C	25.9	C
34	Education Blvd and MD 355	12.7	B	12.7	B	12.7	B	19.1	B	13.4	B
35	E Deer Park Drive and MD 355	24.0	C	23.4	C	24.3	C	32.6	C	23.5	C
36	S Westland Drive and MD 355	23.7	C	23.0	C	24.3	C	30.1	C	24.1	C
37	O'Neill Drive and MD 355	12.9	B	12.7	B	12.4	B	16.9	B	12.6	B
38	Shady Grove Road and MD 355	116.9	F	115.4	F	108.8	F	97.7	F	115.1	F
39	Ridgemont Avenue and MD 355	23.8	C	25.2	C	15.7	B	14.9	B	13.6	B
40	King Farm Blvd and MD 355	37.7	D	38.2	D	31.1	C	66.6	E	34.2	C
41	Redland Road and MD 355	61.2	E	62.4	E	48.8	D	110.5	F	54.2	D
42	Somerville Drive and Redland Road	15.9	B	15.9	B	15.8	B	21.4	C	14.9	B
43	Redland Ext and Redland Road	24.1	C	24.0	C	24.6	C	19.5	B	20.0	B
44	Watkins Pond Blvd and MD 355	23.9	C	22.2	C	21.2	C	64.7	E	19.8	B
45	Rockville Corporate Ctr and MD 355	3.8	A	3.4	A	3.3	A	24.8	C	3.0	A
46	E Gude Drive and MD 355	51.1	D	49.2	D	48.7	D	55.0	D	66.5	E
47	College Parkway and MD 355	9.6	A	9.4	A	9.4	A	10.6	B	9.3	A
48	N Campus Drive and MD 355	16.4	B	14.9	B	15.3	B	14.9	B	13.4	B
60	Mannakee Street and MD 355	21.7	C	16.6	B	25.8	C	14.5	B	14.2	B
61	Frederick Avenue and MD 355	9.3	A	9.2	A	8.4	A	8.1	A	10.4	B

	Intersection	No-Build Alternative		TSM Alternative		Alternative A		Alternative B		Alternative C	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
62	N Washington Street and MD 355	31.1	C	31.0	C	32.0	C	45.4	D	30.2	C
63	Hungerford Plaza and MD 355	10.1	B	11.6	B	12.1	B	10.8	B	9.0	A
64	Beall Avenue and MD 355	21.7	C	22.5	C	23.1	C	18.2	B	28.0	C
65	E Middle Lane and MD 355	69.1	E	69.6	E	61.0	E	56.3	E	71.6	E
66	Monroe Place and MD 355	33.0	C	32.0	C	18.8	B	21.4	C	24.1	C
67	MD 28 and MD 355	48.4	D	48.3	D	38.1	D	39.7	D	42.2	D
68	Dodge Street and MD 355	29.7	C	27.1	C	13.0	B	20.7	C	19.5	B
69	Wootton Parkway and MD 355	75.7	E	75.4	E	67.8	E	90.4	F	94.1	F
70	Edmonston Drive and MD 355	77.8	E	77.3	E	69.3	E	69.9	E	97.3	F
71	Country Club Road and MD 355	29.0	C	24.2	C	9.5	A	32.3	C	36.6	D
72	Templeton Place and MD 355	20.0	B	17.5	B	8.7	A	31.7	C	26.0	C
73	Congressional Lane and MD 355	52.5	D	51.3	D	46.2	D	85.9	F	70.2	E
74	Halpine Road and MD 355	36.6	D	37.2	D	31.9	C	74.2	E	36.2	D
77	Bouic Avenue and MD 355	19.4	C	18.4	C	14.1	B	n/a	n/a	7.3	A
78	Twinbrook Parkway and MD 355	32.4	C	32.1	C	31.0	C	54.8	D	34.6	C
79	Federal Plaza and MD 355	19.3	B	20.4	C	19.7	B	21.5	C	19.4	B
80	Bou Avenue and MD 355	40.1	D	40.5	D	43.2	D	44.0	D	36.2	D
81	Hubbard Drive and MD 355	52.8	D	50.8	D	53.4	D	44.1	D	47.0	D
82	Montrose Road and Towne Road	19.4	B	19.4	B	19.1	B	19.3	B	19.3	B
83	Montrose Parkway and MD355 Ramp	34.5	C	34.5	C	34.5	C	34.5	C	37.4	D
84	Mid-Pike Plaza and MD 355	46.7	D	41.3	D	44.2	D	35.4	D	39.2	D
85	Old Georgetown Road and MD 355	54.9	D	51.4	D	56.4	E	63.4	E	59.8	E
86	Marinelli Road and MD 355	46.4	D	43.5	D	43.2	D	85.2	F	47.7	D
87	Nicholson Lane and MD 355	113.5	F	113.4	F	111.8	F	68.5	E	108.7	F
88	Security Lane and MD 355	41.5	D	39.5	D	47.4	D	36.8	D	47.9	D
89	Edson Lane and MD 355	46.2	D	44.6	D	54.9	D	29.8	C	65.5	E
90	MD 547 and MD 355	89.1	F	88.5	F	91.5	F	92.1	F	97.2	F
91	Tuckerman Lane and MD 355 (North)	94.5	F	94.6	F	97.8	F	124.0	F	102.6	F
92	Music Center and Tuckerman Lane	20.4	C	n/a	n/a	17.4	B	15.4	B	17.0	B
93	Strathmore Park Court and Tuckerman Lane	20.6	C	n/a	n/a	20.6	C	20.3	C	19.4	C
94	Tuckerman Lane and MD 355 (South)	18.6	B	17.7	B	17.9	B	34.3	C	26.8	C
95	Grosvenor Lane and MD 355	40.2	D	38.7	D	38.8	D	70.0	E	55.2	E
96	Pooks Hill Road and MD 355	21.2	C	21.0	C	21.1	C	20.5	C	34.7	C
97	Alta Vista Road and MD 355	12.7	B	12.1	B	12.4	B	12.8	B	26.3	C
98	Cedar Lane and MD 355	64.1	E	63.6	E	64.4	E	70.1	E	83.2	F
99	Wood Road and MD 355	35.0	C	35.1	D	35.0	C	41.4	D	49.6	D
100	Wilson Drive and MD 355	20.2	C	20.0	B	19.9	B	34.2	C	47.5	D
101	South Drive and MD 355	21.0	C	20.4	C	21.0	C	22.9	C	28.7	C
102	Jones Bridge Road and MD 355	42.8	D	42.5	D	56.0	E	47.7	D	63.9	E
103	Woodmont Avenue and MD 355	22.6	C	22.4	C	22.5	C	21.4	C	29.6	C
104	Rosedale Avenue and MD 355	22.2	C	22.3	C	22.1	C	22.0	C	21.5	C
105	Cordell Avenue and MD 355	5.5	A	7.1	A	6.2	A	4.8	A	5.3	A
106	Cheltenham Drive and MD 355	20.3	C	29.6	C	24.8	C	20.9	C	15.5	B
107	East-West Highway and MD 355	80.0	E	85.8	F	78.0	E	85.8	F	58.8	E
108	Montgomery Avenue and MD 355	52.0	D	56.2	E	59.5	E	67.6	E	37.4	D