ITDP

Demand and Service Planning Report to Montgomery County DOT

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9 East 19th Street, 7th Floor, New York, NY, 10003
tel +1 212 629 8001 fax +1 646 380 2360
www.itdp.org

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This report was prepared by Annie Weinstock, Christopher Van Eyken, Walter Hook, on behalf of the Institute for Transportation and Development Policy, and Arthur Szasz on behalf of Logit Consultoria. It was funded by a grant from the Rockefeller Foundation.

Introduction

Montgomery County, Maryland, has ambitious plans to built bus rapid transit (BRT)-type infrastructure throughout the County on some 160 miles of surface roads as rapidly as possible. The selection of this core network of BRT corridors, and some effort to envision what this system might look like, was assigned to a Task Force comprised of stakeholders and chaired by Mark Winston, appointed by the County Executive Ike Leggett. The basis of this network selection was work done by Parsons Brinckerhoff under contract to Montgomery County Department of Transportation (MCDOT) which used a multi-criteria analysis that gave significant weight to future development potential along each corridor and the projected ridership in a 2040 scenario. The Task Force in turn hired The Traffic Group, a local consulting firm with no particular experience in BRT system design, to develop some conceptual designs for a typology of roads for a BRT system that were general rather than site-specific in nature. The Traffic Group was also tasked with developing a rough estimate of the project cost. To finance this core network, Montgomery County has discussed several options, including a special tax, but has not finally decided which approach to pursue. The Traffic Group's input was used to estimate the rough level of funding the entire proposed network might require. The extent of the network proposed, unique among BRT projects around the world and in the US, resulted from the belief that they would need to build a network that served many parts of the County very quickly in order to secure the necessary votes in the County Council for any new tax measures.

As a practical matter of public administration, however, Montgomery County has limited experience with managing projects of this scope, scale, and complexity. Developing even one BRT corridor will be an administrative challenge in Montgomery County, let alone an attempt to develop and deliver multiple corridors simultaneously; a task no other municipality has ever attempted.

ITDP recommends a measured approach, in which one corridor, which can be built within the next three to five years, is identified as Phase I. Beyond Phase 1, a full BRT network in Montgomery County would include those corridors which will be realistic to build and operate within a ten to fifteen year period. Outside of these, we would recommend lighter bus treatments which would not constitute part of the BRT network.

To aid in the process of selecting these corridors, we mapped the existing demand on the bus system route by route and link by link. Those four corridors with the highest existing demand were then prioritized as a shortlist. From this shortlist, we looked at where the County was directing growth. This allowed ITDP to recommend one corridor for Phase 1 with the assumption that the other three would make up the full BRT network. Following this, we prepared a basic service plan for this full network build-out, as a guide to the sort of infrastructure and physical designs needed on the corridors.

In preparation for this work, ITDP reviewed the Parsons Brinkerhoff (PB) materials. This report identified a long term BRT network. In general, we agreed with the

conclusions of the PB study and hold that the overall list of corridors was a good starting point. We also felt that PB had complied more or less with the request made of them in their Scope of Work.

However, for the purpose of determining which of these corridors would make sense as true BRT, and prioritizing them, a more detailed analysis was necessary. Upon interviews, we discovered that the data necessary to do this analysis was available from MCDOT, Ride On, and WMATA. This included existing route by route ridership data, the existing speeds on the current bus routes, and projected land use changes. These three types of data should generally be used when making BRT system planning route priority decisions.

In ITDP's Memorandum of Understanding (MOU) with the Montgomery County Department of Transportation (MCDOT), we agreed to provide technical assistance to the County in the development of this network. We subsequently agreed to develop the baseline demand analysis for four realistic BRT corridors in Montgomery County, and then to develop three service plan scenarios for what would operate on any BRT infrastructure on those four corridors. In order to do this, ITDP developed a model that provided the existing transit ridership route by route, link by link, and hour by hour for the entire County bus system. From this, ITDP was also able to collate this demand for multiple routes using the same corridor, and provide a reasonable rough estimate for demand levels under any alternative service scenarios that were not significantly divergent from existing services.

Methodology

ITDP generally uses a four step process when advising a city or county on the selection of BRT corridors and the development of service plans:

1. Analysis of existing transit demand

ITDP begins all BRT planning projects by mapping existing transit demand in the region. In almost every case, existing transit demand is more or less reflective of demand for new BRT services as the existing riders will become the ridership base for any new services. Thus, a map of existing demand is critical to predicting ridership over the first five to ten years of operation. ITDP generally focuses on peak hour peak direction demand, as most BRT system design parameters such as vehicle fleet sizes, station sizing, and other metrics, are driven by the peak hour peak direction volume.

2. Evaluation of growth plans

Once we have mapped all existing demand, we look into where the County expects to grow. Where spatial growth plans and developer interest align with a corridor of reasonably high existing demand, we then begin to consider that corridor for BRT treatments. Ideally we would look at granted and pending building permits, but discussions with key planning bodies and developers is sometimes sufficient.

3. Corridor selection

We select corridors for BRT that both have some existing demand, and where growth

plans demonstrate an urbanizing corridor. Further, we recommend linking any BRT investments to other efforts on the corridor to increase density and more urban land uses.

In many places throughout the US, the tendency is to choose BRT corridors based on completely new routes which serve developments in the pipeline either in order to allow that development to be built (because of regulations) or simply in order to serve that new development. A new route with no existing ridership behind it, however, is likely to take several years to generate ridership. Over the years, the County will likely suffer significant operating losses, as it runs empty buses along the corridor. This is why we prioritized corridors which both have existing demand and growth aspirations.

We assumed that all of the selected corridors together would be the realistic build-out of a BRT network over the next ten to fifteen years, and that only one corridor will be implemented first – this would become Phase 1.

4. Service planning

Once a set of corridors was selected, we developed service plans. Since we assumed one corridor for Phase 1 and four total corridors for the BRT network, we developed a service plan for Phase 1 infrastructure only and another service plan for the full build-out. Because we are recommending a Phase 1 and a full build-out, we developed two broad scenarios: one for services that would use BRT infrastructure built along Phase 1 only, and one for services that would use all four of the corridors with some sort of high-quality BRT infrastructure. There were only a few minor interaction effects between these corridors, so it was not necessary to develop more detailed service plans which assumed a roll-out of one corridor at a time.

We then developed three alternative service plans for both Phase I and the full BRT network.

Service Plan A

Service Plan A assumes gold-standard, median-aligned BRT infrastructure with center stations shared by both directions of travel. Service Plan A generally incorporates into BRT services all routes in which a large portion of the existing route is on the corridor. Some of these routes only operate within the new BRT infrastructure and hence only require buses with doors on the left. Other routes operate partly within BRT infrastructure and partly within a mixed traffic environment. For these routes, buses with doors on both sides are required. For service plan A, we consider the possibility of routes which can be rerouted from nearby corridors onto part of the BRT corridor to take advantage of the higher speeds. These buses may or may not stop along the corridor but would still use the dedicated lane. As long as they do not stop, they will not require any new bus procurement besides perhaps for branding purposes. Some existing routes in which only a small portion of the route operates on the corridor may be detoured off the corridor. Other routes which run for slightly more significant sections but are not delivering significant demand to the corridor will run inside the BRT infrastructure but will not stop so will not require new vehicles except for branding purposes. By allowing bus routes to operate both inside the BRT trunk corridor infrastructure and off the corridor at

traditional curbside bus stops, the services will have the flexibility to circulate through neighborhoods, and provide as many passengers as feasible with a one-seat ride. The image below demonstrates in generic form the type of service pattern utilized under Service Plan A.

The advantages of Service Plan A are that: there are a large number of beneficiaries

Figure 1: Service Plan A, buses with doors on both sides

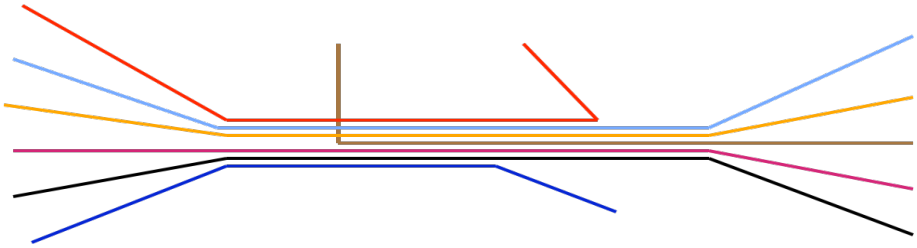


Figure 2: Cleveland's HealthLine uses Service Plan A, with buses operating on and off corridor

which can use the BRT infrastructure; the bus lane looks reasonably full and is easier to enforce; and the buses are removed from the parallel mixed traffic lane, thus improving the level of service to parallel mixed traffic. However, it also requires the largest fleet procurement of the three service plan options. Turning buses would also have to pull out of the busway at intersections to avoid complicating traffic signals. This requires that any grade separating barriers be removed at those points.

Service Plan B

Service Plan B also assumes gold-standard, median-aligned BRT infrastructure with center stations shared by both directions of travel. However, it employs a modified trunk-and-feeder model in which only one bus route travels up and down the corridor and stops at the BRT stations. Some other routes become feeders to the main BRT route. The remainder operate in the busway but they never stop at the BRT stations. In a typical trunk-and-feeder BRT service plan, only trunk buses would be allowed to operate in the busway, as trunk-and-feeder systems are generally introduced on BRT systems with very high bus frequency where station saturation is a significant risk. However, this is not generally recommended in low demand areas since it severs many existing bus routes, forcing passengers to make transfers. This often leads to ridership losses, rather

than ridership gains. It also results in a bus lane that appears empty much of the time. To minimize these problems in this case, however, the benefits of the exclusive bus lane are enjoyed by most services currently using the corridor, but most of the benefits of the trunk BRT stations only accrue to trunk routes, in order to minimize the vehicle procurement costs. The primary advantage of Service Plan B is that it requires procurement of far fewer new buses with doors on the left side compared to Service Plan A, but it also has far fewer passenger benefits.

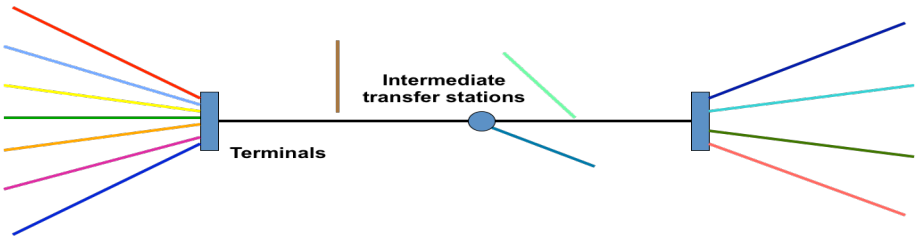


Figure 3: Service Plan B, buses with doors on the left side only

Figure 4: Quito, Ecuador uses Service Plan B with BRT buses operating only on corridor and all other buses acting as feeders

Service Plan C

Service Plan C assumes central median-aligned BRT but with a cross section less likely to reach gold-standard. It assumes that all existing bus routes that currently overlap the corridor, for even a small percentage of their routes, will remain as part of the BRT service plan. Because this would mean many more bus routes using the BRT infrastructure, it would likely maintain the current bus fleet rather than procuring new buses (though, if funds are available, this would still be the recommended course of action). This would mean that, while BRT lanes may remain in the center median, stations would have to be accessed by right-side boarding as the existing fleet does not have left-side doors. Stations could therefore not be shared by both directions of travel and would be slightly more costly to construct as each stop would require two stations. It also means that buses can travel off-corridor and stop at the curbside. This service plan allows the most bus routes to become integrated into the BRT system but generally has the trade-off of lower-quality BRT infrastructure and a less clearly defined BRT ‘brand’.

Figure 6: Service Plan C, no new buses

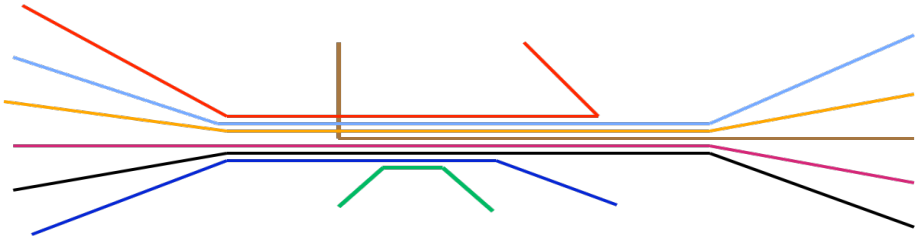


Figure 6: Chicago's proposed East-West BRT Corridor (left) and Ottawa's BRT corridors (right) use Service Plan C

Having a service plan is critical to the design of infrastructure as it determines how many buses should be operating on a corridor, how many passengers are likely to get on and off at each station, and from these figures how to properly size and locate stations and where lanes can be physically segregated and where they can't. Unless bus volumes are so high that only one bus service can operate in a corridor (far from the case in Montgomery County), we highly recommend designing service plans which allow many bus routes to operate on and off corridor (i.e., Service Plan B or Service Plan C). This will maximize the number of passengers using the existing bus routes to benefit from any new BRT infrastructure. This is important to increase the number of project beneficiaries, to increase bus frequency along the trunk lines, and to make the busway look as 'occupied' as possible.

Normally, when designing service plans, the following sometimes conflicting factors come into consideration:

1. As many passengers as possible should benefit from the new BRT infrastructure investments, including some passengers that might currently be using buses on other corridors to reach destinations that could also be reached from the BRT corridor.

2. As few passengers as possible should be subjected to needless transfers.

3. Bus routes should as directly as possible connect trip origins and destinations.

4. The frequency of buses should be maximized.

5. The average load factors on each bus should be maximized (to minimize the size of the fleet needed to maximize the frequency).

6. The number of new buses that you need to buy should be minimized.

7. The bus type should not force infrastructure designs that are sub-optimal from other perspectives such as road safety.

8. Any delay caused by saturation of the busway should be avoided by re-routing less important routes out of the BRT infrastructure where appropriate.

With so many variables to optimize in a single set of decisions, service planning remains more of an art than a science.

Analysis of existing transit demand in Montgomery County

ITDP did not estimate the likely future ridership on any BRT corridor. However, we did review the existing transit demand on the corridors, and this data should form the basis of any future demand projections.

Because there are multiple service providers operating bus services in Montgomery County, we first had to collate the ridership data from each operator in order to place it on a map. Given the vastly different formats of the ridership data, this was a non-trivial exercise. However, it has provided the County with a valuable map of existing route-by-route ridership data, something that most regions do not have.

This analysis showed that peak hour demand is not particularly concentrated along corridors in Montgomery County, with the exception of Route 29 (800 pphpd) and I-270. Rather, demand tends to be concentrated on the approaches to metro stations.

The most passengers traveling through a future BRT corridor on any given segment is called the 'maximum load on the critical link.' This is an important design parameter in BRT system planning as it is used to set the necessary bus frequency. This number differs from the peak hour passengers or daily riders by the 'rotation rate,' or the number of passengers getting on and off at any given point.

The maximum load on the critical link on Route 355 is about 3,000 daily and about 250 during the peak hour in the peak direction (pphpd); this is at the approach to downtown Rockville and the Rockville metro station. On Veirs Mill Road, it is about 3,500 daily and about 250 pphpd and only at the approach to the Wheaton metro. Georgia Avenue is about 2,400 daily and 150 pphpd, and only south of the Wheaton Metro. There is negligible demand north of Glenmont on Georgia.

Route 29 and I-270 carry the most passengers in the peak hour. Route 29 carries about 4,200 daily and about 800 pphpd. This is likely because there is no competing metro service in the Route 29 corridor. This demand is heavily concentrated inside the Beltway, and particularly heavy in downtown Silver Spring. A more in depth analysis of the demand pattern along US 29 shows that most of them function as corridors with longer distance trips concentrated on them.

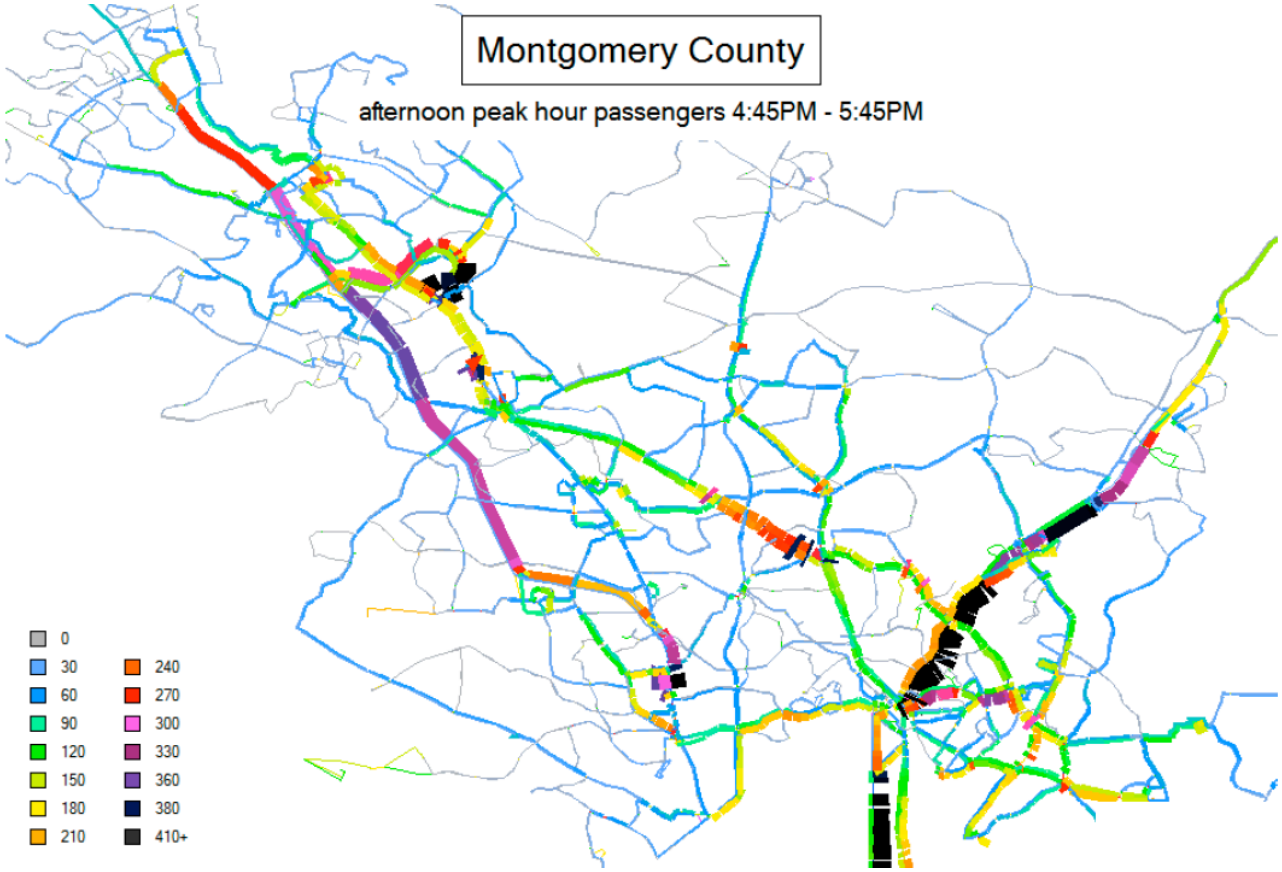


Figure 7: Existing peak hour bus ridership in Montgomery County

I-270 also shows a high peak hour passenger demand, but because a separate study was ongoing for BRT on I-270, we did not study it here.

MD 355, which has the second highest concentration of trips, mainly has high bus demand levels approaching the Shady Grove, Rockville, and Bethesda metro stations, and around Lakeforest Mall which is not precisely on the 355 corridor.

Veirs Mill Road also has a significant concentration of demand in downtown Wheaton approaching the Wheaton metro.

While it was not ITDP's task to project the future demand on these corridors, we did develop some reasonable expectations with respect to future demand. To do this, we began by observing what happened in other US cities like Cleveland, Ohio, and Pittsburgh, Pennsylvania. Cleveland's HealthLine BRT corridor is the highest ranking BRT in the US using The BRT Standard. It more or less replaced what was previously the #6 bus line. Ridership on the #6 bus line was about 8,300 riders a day, or about 700 at the peak hour peak direction in 2007 before the new BRT system opened. Since the BRT was announced, there has been over $5.8 billion in new real estate development along the HealthLine, attracting virtually all new investment in the Cleveland Metropolitan area. It is the most successful leveraging of BRT for new real estate development in the US; a success story well worth emulating. As a result of significant travel time improvements and this new development, ridership has increased to over 14,000 riders a day, with peak hour flows around 1,200, an impressive 58% increase in ridership in only 5 years. Pittsburgh's East Busway BRT corridor has a pphpd of 3,500, even more impressive, but it has stimulated very little transit oriented development and ridership

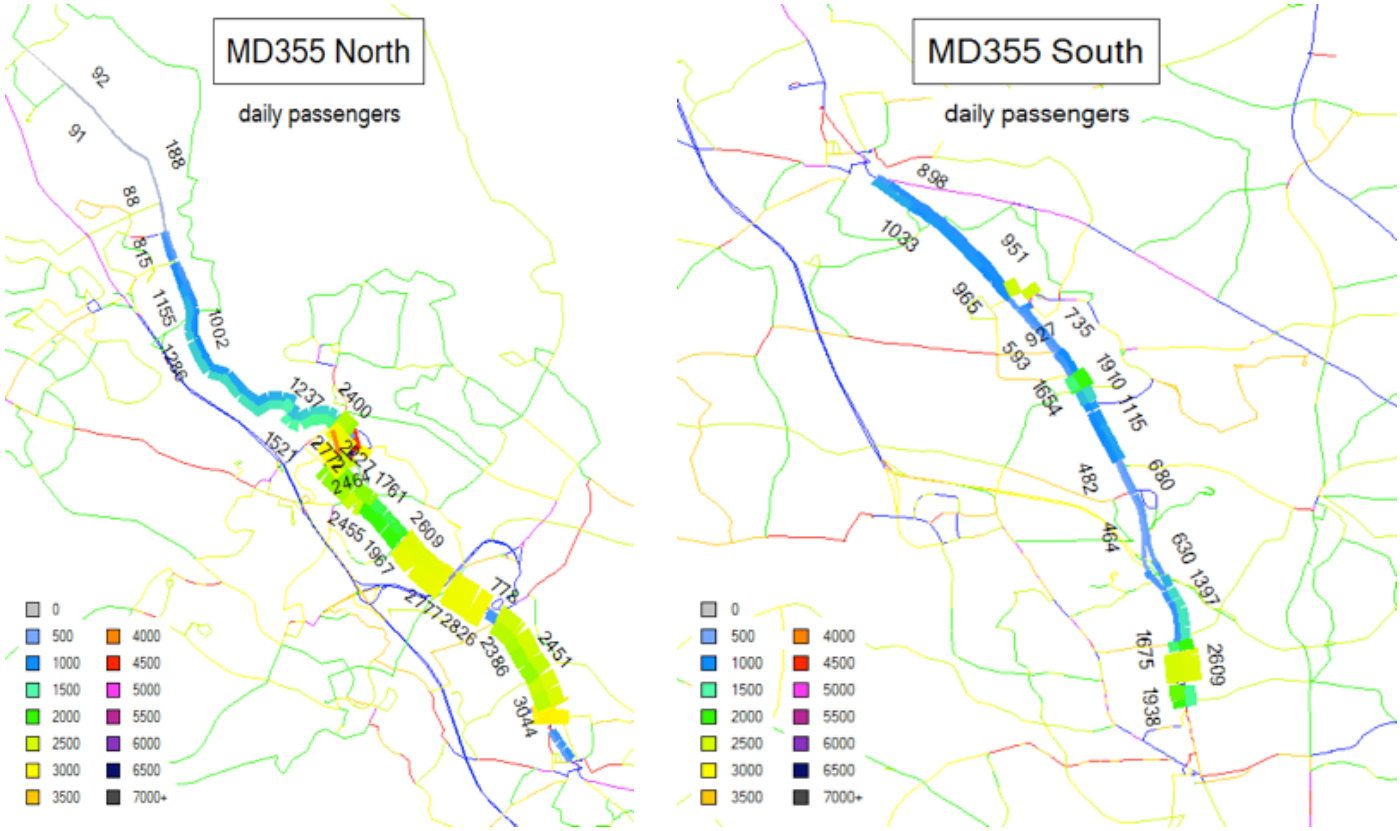


Figure 8: Existing daily bus ridership on the northern (left) and southern sections of MD 355

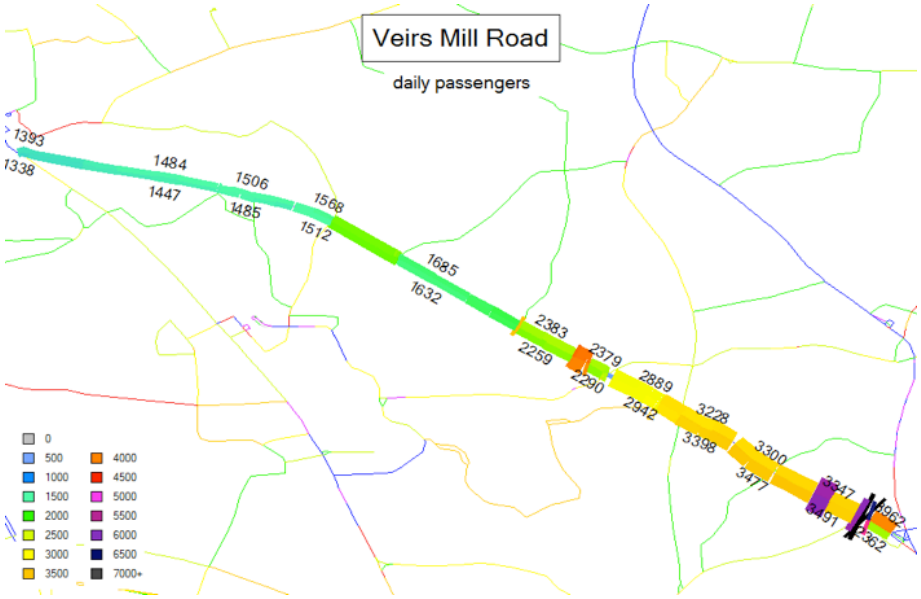


Figure 9: Existing daily bus ridership on Veirs Mill Road

Figure 10: Peak hour, peak directional ridership of BRT corridors around the world

BRT Corridors Ridership Compared	
BRT Corridor	PPHPD
Bogota, TransMilenio	36,000
Sao Paulo, Corredor Santo Amaro	35,000
Porto Alegre, Corredor Assis Brasil	28,000
Curitiba, Eixo Sul	10,500
Mexico City, Metrobus	11,000
Pittsburgh, PA	3,500
Los Angeles Orange Line	2,100
Cleveland HealthLine	1,200
Route 29 (Silver Spring)	800
Veirs Mill Road (Wheaton)	280
Route 355 (Rockville/Bethesda)	250
FTA Recommended Minimum	1,200

has been reasonably stable. Most other BRT corridors, even very good ones, have not attracted quite as many new riders; most of them are in the 20% range over a similar period of time.

These other corridors are urban, rather than suburban, that serve destinations with a dense network of other transit, walking, and biking options to reach final destinations. Beyond ridership generated by anticipated new transit-oriented development, BRT must rely on speed increases to attract new ridership.

The projected speed improvements even from the best case BRT scenario show travel time improvements of a relatively modest magnitude over current speeds. Congestion is worst on US 29 southbound, also bad on Georgia Avenue, reasonably bad on MD 355, and not that serious on Veirs Mill Road. Hence the travel time savings on these corridors per trip are in the range of 10 minutes over current travel times in a reasonably optimistic scenario.

This ten minute travel time improvement needs to compare favorably to total in-car travel time to attract a significant number of passengers currently driving to use the bus. In Montgomery County most people can park their cars directly in front of their homes, and also very close to their place of work. By contrast, most people would need to walk some distance to the nearest bus stop and wait for a bus with a frequency of greater than ten or fifteen minutes. Assume the average times for both of these movements are in the range of 20 minutes. For the vast majority of drivers, congestion delay will have to worsen to the point where the average car trip is another 10 minutes slower than it currently is before many passengers will chose to switch to BRT, no matter the quality.

In Montgomery County, the highest bus demand corridor is Route 29 with about 800 pphpd. Route 355 is tied for second highest at about 250 pphpd. However, a lot more

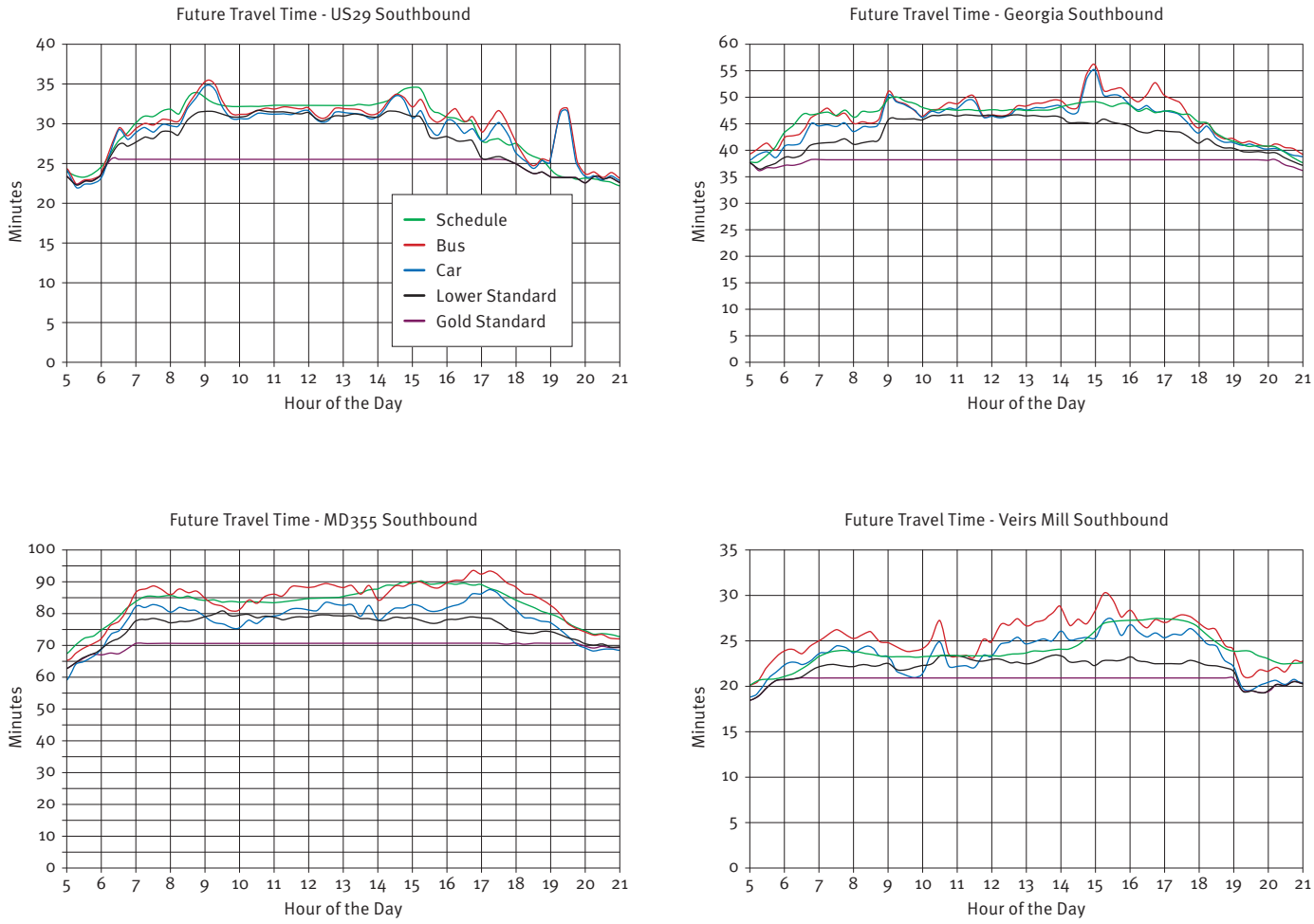


Figure 11: Projected travel times, by mode compared to gold- and lower-standard BRT

new development is planned along Route 355. Even if we provide a very liberal estimate that congestion and new development lead to an unprecedented 100% increase in demand on Route 355, nearly double the best comparable case we have in the US, it would still be *less than half* the current ridership on Cleveland's HealthLine, and would not even be as high as the *initial* demand on Cleveland's Euclid Avenue #6 bus route. It is less than 1/7 of Pittsburgh's East Busway peak hour ridership. We must therefore take a measured approach in Montgomery County, as ridership on even the best corridor is not going to come close to matching Cleveland's ridership, the most successful project in the country at stimulating new transit oriented development.

Normally, it is quite difficult politically to dedicate a lane of traffic to BRT if the ridership numbers are significantly below the current number of passengers using the lane in other vehicle types. While some modal shift is likely to occur at the outset due to the increase in bus speeds and system quality, the existing low density land uses in Montgomery County, coupled with reasonably high mixed traffic speeds and widespread availability of parking, makes significant modal shift unlikely until the surface streets actually saturate, something we understand from discussions with MCDOT is still five or more years away. At this point, a more significant modal shift may begin. However, it is not until land use patterns truly begin to change that BRT ridership in this context will grow to any meaningful volumes. It is for this reason that we consider

growth plans in the County in conjunction with existing ridership volumes.

We then looked at the number of boarding and alighting passengers at each station stop both at the peak hour and daily. Concentrations of boarding and alighting passengers tend to indicate locations of critical bus delay and high volumes of transferring passengers or popular origins or destinations. As BRT infrastructure's main benefit is reducing delay from the boarding and alighting process, larger volumes of boarding and alighting passengers indicate locations where BRT infrastructure will bring the most time savings benefits.

The points that stand out as critical points of boarding and alighting delay are the metro stations, particularly the Rockville Metro and Silver Spring Metro, but also the Wheaton, Shady Grove, Bethesda, and Medical Center Metro stations. In addition, downtown Rockville, downtown Wheaton, Lakeforest Mall, downtown Bethesda, North Bethesda, Veirs Mill Road, and Randolph Road (perhaps because of the shopping centers), and Veirs Mill and Connecticut also stood out somewhat. Off-board fare collection could bring the most benefits in these locations. Notably, nothing along Route 29 stood out except for downtown Silver Spring.

Evaluation of growth plans in Montgomery County

In addition to existing ridership data, we also collected information about projected new land development in the County. We focused on the following four major development efforts:

- **Navy Medical Center and National Institutes of Health** – Expansion of the Navy Medical Center and the National Institutes of Health, both along Route 355 are committed projects and are expected to result in significant new trip generation along that corridor. Both will be large campus-style suburban developments in character but parking restrictions will force many of the new trips onto transit.

- **White Flint** – White Flint is being planned as an urban center in North Bethesda. Also along the 355 corridor, the development plans follow many of the most important urban design guidelines and this could become a vibrant mixed-use neighborhood along Rockville Pike. This development will also generate a significant number of new trips, and, given its urban nature, it is possible that many of the trips will be on transit. The White Flint Sector Plan provides height bonuses to developers who support transit and this gives the County an additional funding source for transit on 355 as well as a mode to pick up many of the new trips generated.

- **Greater Seneca Science Corridor** – The Greater Seneca Science Corridor is a development corridor surrounding I-270, that covers parts of Gaithersburg, Germantown, and Clarksburg. It includes the future Life Sciences Center, the Western Quince Orchards neighborhoods, the National Institute of Standards and Technology, and Rosemont. The corridor is viewed as the County's future economic engine and aims to develop in a mixed-use, transit-, pedestrian-,

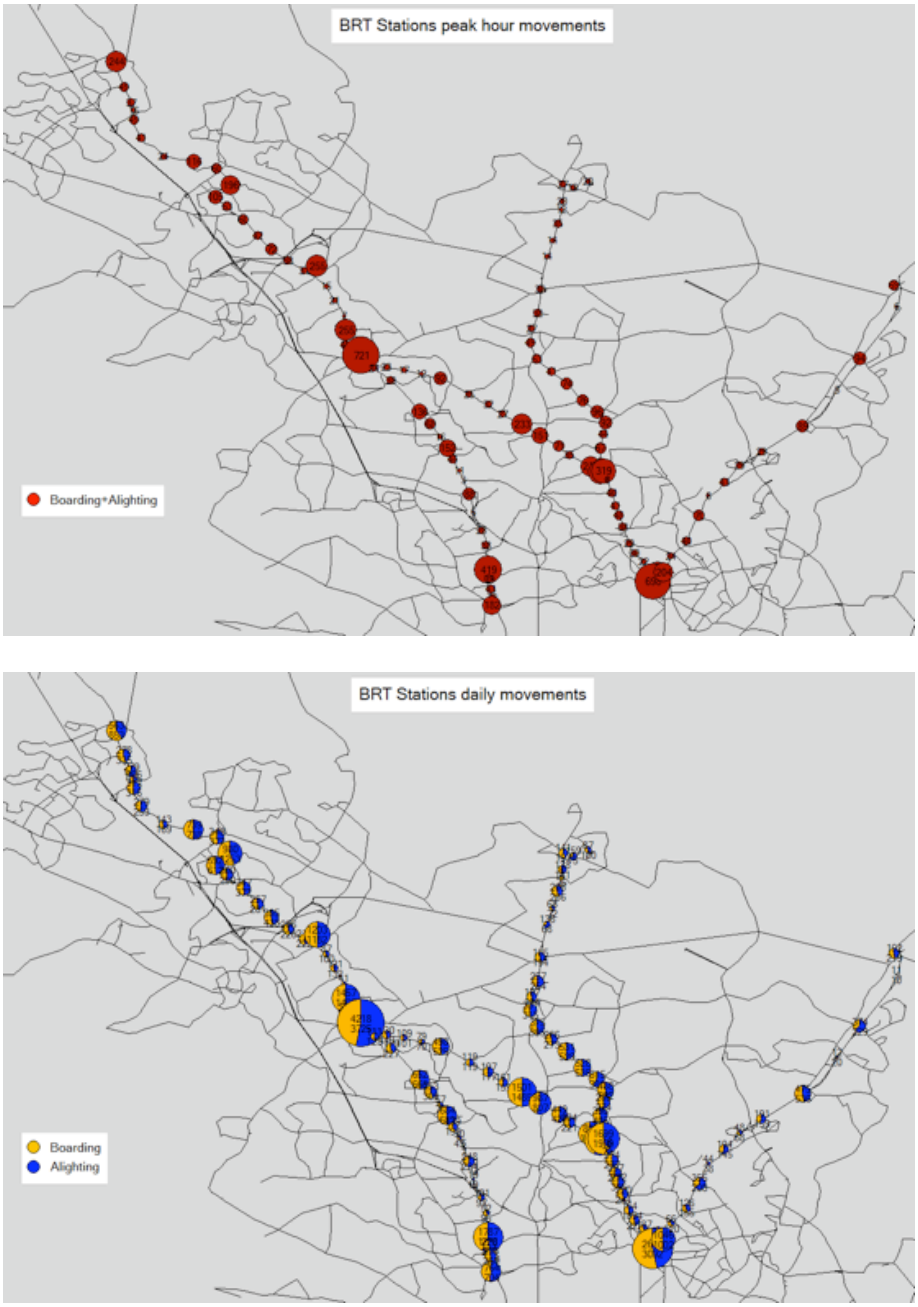


Figure 12: Existing boarding & alighting delay on four study corridors - peak hour (above), daily (below)

and bicycle-friendly way. Build-out is expected to take approximately 25-35 years. Like the White Flint Sector Plan, in accordance with the Adequate Public Facilities Ordinance, the Greater Seneca Science Corridor Master Plan requires construction of a rapid transit link in order to build to the densities specified in the plan.

- **FDA White Oak Campus** – Construction on the FDA White Oak Campus is mostly complete. Positioned between New Hampshire Avenue and US 29, the development will also be a major economic generator in the County. However, the character of the development is highly suburban in nature and parking will be plentiful. It is unlikely that a significant number of employees and visitors to this development will use transit to get there and it does not lie directly on any one corridor.

Montgomery County corridor selection

Corridor selection began with a shortlist of the four corridors with the highest existing transit demand. These were: Route 355, Veirs Mill Road, Route 29, and Georgia Avenue. If any of these corridors had existing demand high enough to warrant taking a lane, and/or existing BRT-supportive land uses, we would likely have selected that as the Phase 1 corridor. However, demand on all of these corridors was below what FTA considers to be the minimum threshold for a bus lane (about 1,200 pphpd) and existing land use patterns are currently suburban in nature. Therefore, we paired existing demand with future urban growth plans – a reasonable determinant of where demand is likely to grow. Route 355 emerged as the only corridor with both decent bus demand and growth plans. We therefore, recommend Route 355 as Phase 1 for Montgomery County's BRT network. This BRT corridor would complement the WMATA red line service which currently also operates along Route 355 with station stops at much greater spacings than will be necessary to serve a lot of the existing and planned new development along the corridor.

We then suggested to the County that they link any BRT investments to other efforts on the corridor to increase density and more urban land uses. It is inconvenient from a time perspective and inhospitable to walk from a shopping mall across a surface parking lot to a BRT line in the middle of a suburban arterial. Further, the sorts of bus service delays that were observed along these suburban arterials, primarily roadway congestion and multi-phase traffic signals, are not the primary causes of delay that are well addressed by gold-standard BRT elements. Therefore, a fundamental change in land uses along the BRT corridor and high-quality pedestrian amenities, are strongly recommended. In other words, true BRT really only makes sense in Montgomery County in the context of a broader array of changes including changes in land uses and urban design.

Route 29 had some specific difficulties from the perspective of BRT. As was shown by the boarding and alighting data, the very limited number of boarding and alighting passengers along Route 29 indicates that most of the trips along Route 29 are on express buses, making very few stops until they reach downtown Silver Spring or even continuing on into the District of Colombia. For this corridor, the primary problem that BRT solves - delays due to boarding and alighting – is largely absent except at the Silver Spring metro and downtown Silver Spring. The land uses along Route 29 – office parks, dedicated highway road reserve, and single family homes – also do not generally create the sorts of curb-side delays that BRT is designed to resolve. The main cause of delay on Route 29 was normal congestion which can be resolved with simple dedicated bus lanes in the peak direction, so full BRT on Route 29 does not seem warranted at this time.

This is not to say that no bus priority measures should be implemented on Route 29, as bus lanes would bring significant benefits; however, the improvements needed would not constitute BRT, and hence we do not recommend that Route 29 should be included on a short list of future BRT corridors despite having the highest demand in the county.

As we have already observed progress towards urbanization and densification on Rockville Pike in the White Flint area, and in Wheaton along Georgia Avenue, we

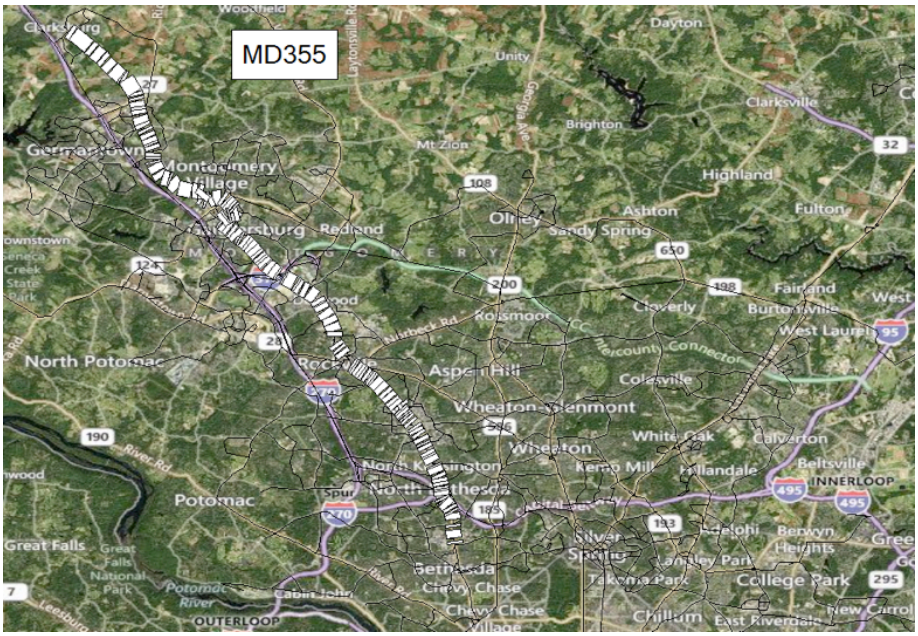
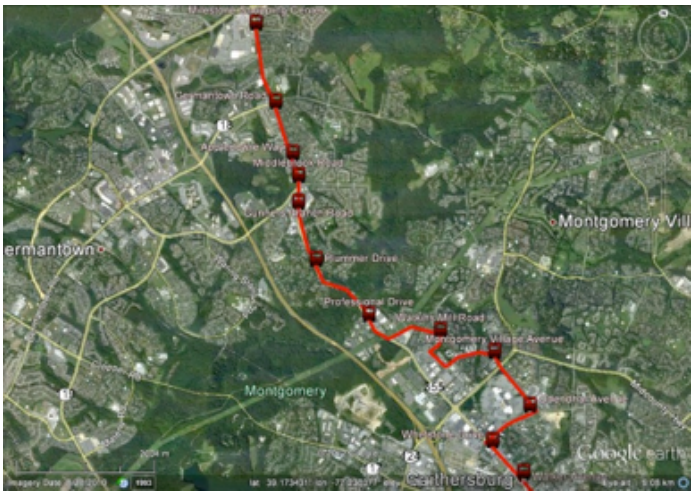
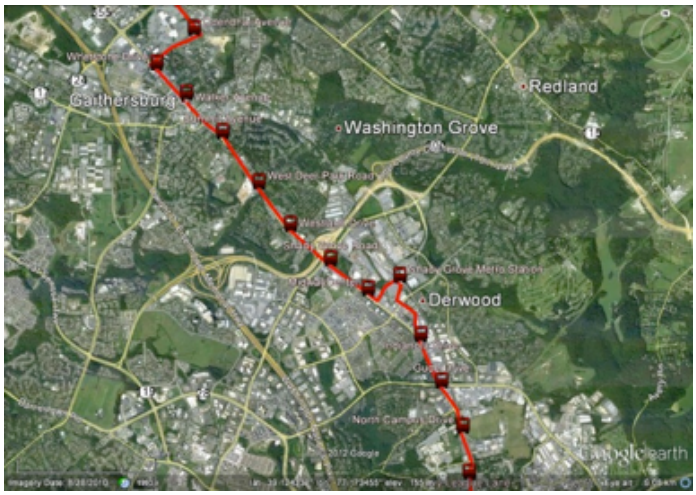
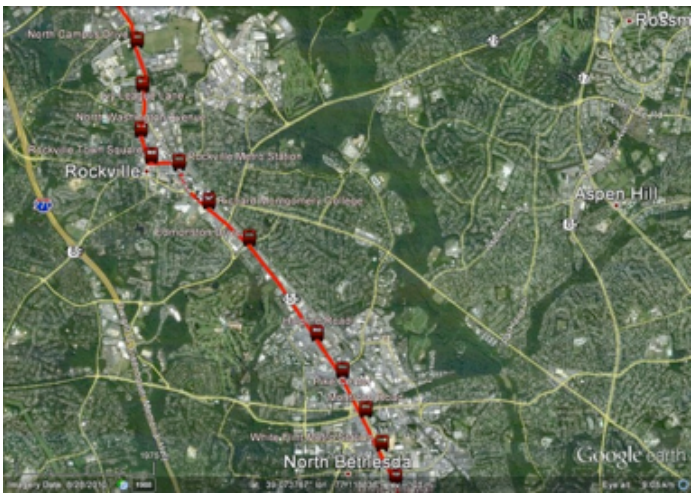
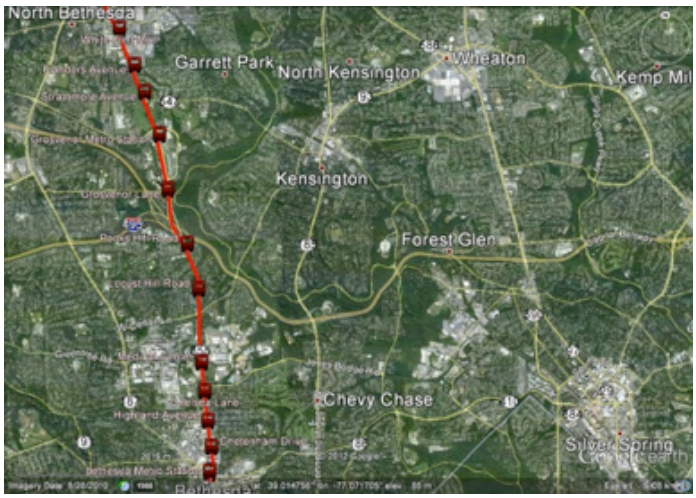


Figure 13: Recommended Phase 1 - MD 355 from Clarksburg to Bethesda









again, suggest starting with Route 355 as Phase I. We then treated Route 355, Veirs Mill Road, and Georgia Avenue as the full BRT network. We included Route 29 in our service planning analysis, although we are recommending less than full BRT treatments, since demand is high and some treatments will be necessary. This recommendation is roughly in line with the broad recommendations made by the Task Force. We did not

Figure 14 (above): Recommended BRT corridor on MD 355, northern sections

Figure 15 (below): Recommended BRT corridor on MD 355, southern sections

study possible future corridors as it is difficult to predict anything beyond this ten to fifteen year time horizon.

The specific recommended route for the Phase 1 corridor is not completely contiguous with Route 355. It would include a spur to serve Lakeforest Mall, another spur to the Shady Grove Metro, and a detour or a second BRT link through downtown Rockville on North Washington Avenue.

If the corridor fails to include full BRT infrastructure to each of these popular trip origins and destinations a lot of the ridership and benefits will be lost.

We are also aware of plans to build a BRT on the Corridor Cities Transitway (CCT) to serve the Greater Seneca Science Corridor. We did not study this in detail as it has already been studied as part of a separate study. However, we recognize the growth potential in this corridor and believe it would be worth studying further a connection between the CCT, which lies near Route 355, and the Route 355 BRT corridor. Such a connection could have a positive impact on ridership for both corridors.

Proposed Service Plans for Route 355, Veirs Mill, Georgia, and Route 29

Because we are recommending a Phase 1 with gold-standard BRT infrastructure only on the Route 355 corridor, and a full BRT network on Route 355, Georgia Avenue, and Veirs Mill Road, we developed two broad scenarios: one for services for the Phase I infrastructure (355 only) and one for services on the full BRT network infrastructure. We included US 29 in the latter since ridership is high and a new service plan will need to be developed to serve any infrastructure built on it, even if not BRT. There are only a few minor interaction effects between these corridors, so it was not necessary to develop more detailed service plans which assumed a roll-out of one corridor at a time.

We first explored all the existing bus routes which operate for some part of their route along Route 355. We analyzed the degree to which the routes overlap the BRT corridor, the amount of time each route spent along the BRT corridor, the ridership on each

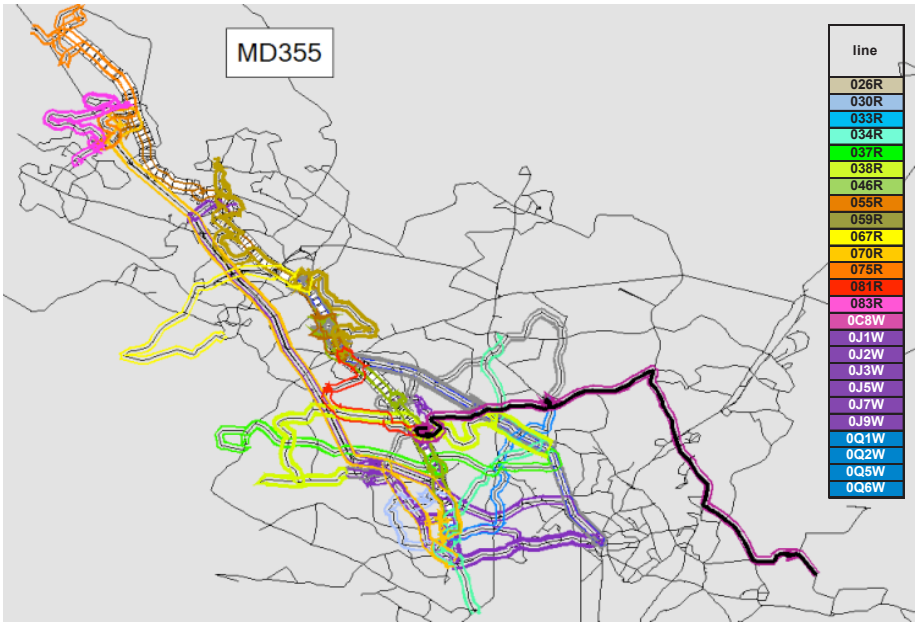


Figure 16: Map of existing bus services that overlap MD 355

route, and the estimated fleet size for each route.

The figure below presents the existing bus service plan for all routes that overlap with MD 355. The subsequent table provides detailed information on each of these routes (those with an 'R' designation are Ride On routes and those with a 'W' designation are WMATA routes).

Line	# of Daily Trips	Fleet	All Line		In Corridor	
			Total Pax	Vehicle Miles	Route Extension	Pssgr. Time
026R	89	8	3,328	1,382	4%	5%
030R	59	4	640	405	25%	36%
033R	32	3	353	224	5%	9%
034R	93	7	2,721	819	23%	27%
037R	27	3	224	244	5%	6%
038R	69	5	1,385	923	8%	15%
046R	126	8	4,023	1,200	100%	100%
055R	134	11	7,579	2,140	89%	99%
059R	98	7	3,859	1,247	35%	39%
067R	12	1	141	120	12%	12%
070R	55	7	721	1,070	12%	25%
075R	56	2	392	518	11%	17%
081R	31	2	217	184	22%	37%
083R	86	4	673	641	7%	4%
0C8W	64	6	2,200	1,147	3%	1%
0J1W	30	3	341	136	8%	13%
0J2W	140	9	4,829	1,761	20%	35%
0J3W	25	4	711	277	17%	33%
0J5W	20	2	303	226	22%	24%
0J7W	11	2	110	172	17%	32%
0J9W	22	3	357	363	19%	26%
0Q1W	9	-	400	120	21%	13%
0Q2W	34	-	1,666	445	21%	9%
0Q5W	5	-	303	49	30%	25%
0Q6W	75	8	2,416	812	37%	31%

Figure 17: Route by route breakdown of existing bus services that overlap MD 355

As described in the methodology section above, we developed three service plans (A, B, and C) for each of the two build-outs (Phase 1 and all four corridors). Phase 1 Service Plan A is our recommended service plan.

It assumes that all of the most important bus routes (those with relatively more passengers and those where the route significantly overlaps the BRT trunk corridor) will be incorporated into the corridor. We assume that all of these routes would need to procure new buses that would best interface with new BRT infrastructure but also interface with normal surface street conditions. It assumes that bus routes that only use the corridor for a short distance would use the BRT trunk infrastructure but run express and not stop so that the benefits could be accrued but that no new buses would be needed for those routes. It was assumed that the J2 and the J3, which currently do not use Route 355 but rather reach Bethesda from the Montgomery Mall area via Old Georgetown Road, would now go to the Grosvenor Metro station, and from there would run express on 355 South to Bethesda, as the travel times for this route would be competitive compared with the more direct route along Old Georgetown Road due to the BRT improvements. This service plan also reroutes away from the 355 corridor a few routes that do not really need to use 355 to serve their passengers. This service plan would require a new bus fleet procurement of about 31 vehicles, maintaining roughly existing frequencies on most existing bus routes.

Service Plan B for Phase 1 slightly reduces the size of the bus procurement needed by running a few more existing bus routes express rather than stopping in the corridor, and by severing one important bus route and turning it into a 'feeder' bus until the Veirs Mill Road corridor is also built out as BRT.

Service Plan C for Phase 1 assumes that all of the existing buses currently using 355 would use the dedicated BRT infrastructure, and that instead of optimizing the BRT infrastructure design from the perspective of minimization of station costs, maximizing speed, and road safety, that the design would aim to first and foremost accommodate all of the existing bus types currently using the corridor. This would be the cheapest way to optimize the existing system with targeted BRT type investments but it would compromise somewhat designs that would be more optimal as the system expands and matures. This scenario is virtually the same as the existing bus services using the corridor, but it brings J2 and J3 into the corridor, and one route would be routed off the corridor.Possible reroutings for each of the effected routes in each of the three service plan scenarios can be found in Appendix A. We ran the same service planning scenarios for the full BRT network which can be found in the Appendix B. For the remainder of this document we will assume that Service Plan A, under Phase 1 is chosen as the best service planning alternative.

Possible reroutings for each of the effected routes in each of the three service plan scenarios can be found in Appendix A. We ran the same service planning scenarios for the full BRT network which can be found in the Appendix B. For the remainder of this document we will assume that Service Plan A, under Phase 1 is chosen as the best service planning alternative.

The total travel time savings of gold-standard BRT on Route 355 is on the order of 863 passenger hours per day. In Scenario B the travel time savings is only 668 hours per

day due to the time lost to passengers who are forced to make transfers they previously did not have to make. Scenario C has the highest time savings at 927 hours per day, but either requires a huge new fleet procurement, or else it requires a BRT infrastructure configuration that probably requires more right-of-way than would be politically acceptable in any of these corridors. For this reason, we recommend Scenario A as the

Route	Phase 1, Service Plan A		
	Change	Operation in Corridor	Procurement # of Buses
026R	No change	(express)	
030R	Detour off	-	
033R	No change	(express)	
034R	No change	(express)	
037R	No change	(express)	
038R	No change	(express)	
046R	Trunk	Left door	6
055R	Trunk	Left door	9
059R	No change	Both sides	7
067R	Detour Off	-	
070R	No change north; Detour off south	(express); -	
075R	No change	(express)	
081R	No change	(express)	
083R	No change	(express)	
0C8W	No change	(express)	
0J1W	No change	(express)	
0J2W	Detour in	(express)	
0J3W	Detour in	(express)	
0J5W	No change	Both Sides	2
0J7W	Detour off	-	
0J9W	Detour off	-	
0Q1W	Trunk	Both Sides	7
0Q2W	Trunk		
0Q5W	Trunk		
0Q6W	Trunk		

Route	Phase 1, Service Plan B		
	Change	Operation in Corridor	Procurement # of Buses
026R	No change	(express)	
030R	Detour off	-	
033R	No change	(express)	
034R	Detour off	-	
037R	No change	(express)	
038R	No change	(express)	
046R	Trunk	Left door	6
055R	Trunk	Left door	9
059R	No change	(express)	
067R	Detour Off	-	
070R	No change north; Detour off south	(express); -	
075R	No change	(express)	
081R	No change	(express)	
083R	No change	(express)	
0C8W	No change	(express)	
0J1W	No change	(express)	
0J2W	No change	(express)	
0J3W	No change	(express)	
0J5W	No change	(express)	2
0J7W	Detour off	-	
0J9W	Detour off	-	
0Q1W	Trunk/feeder (feeder=Q4)	Left door	2 (6 became feeder)
0Q2W			
0Q5W			
0Q6W			

preliminary service plan moving forward. This service plan requires the procurement of 31 new 40-foot special order buses with doors on both sides, and this cost should be included in any cost estimate of the Montgomery County BRT system.

For the four corridors studies, there would be roughly 2,259 hours saved per day under Scenario A, 1,639 hours per day under Scenario B, and 2,393 under Scenario C.

Route	Phase 1, Service Plan C		
	Change	Operation in Corridor	Procurement # of Buses
026R	No change	Regular	
030R	No change	Regular	
033R	No change	Regular	
034R	No change	Regular	
037R	No change	Regular	
038R	No change	Regular	
046R	No change	Regular	
055R	No change	Regular	
059R	No change	Regular	
067R	No change	Regular	
070R	No change	Regular	
075R	No change	Regular	
081R	No change	Regular	
083R	No change	Regular	
0C8W	No change	Regular	
0J1W	No change	Regular	
0J2W	Detour in	Regular	
0J3W	Detour in	Regular	
0J5W	No change	Regular	
0J7W	No change	Regular	
0J9W	No change	Regular	
0Q1W	No change	Regular	
0Q2W	No change	Regular	
0Q5W	No change	Regular	
0Q6W	No change	Regular	

Total Time Savings (passenger hours per day)			
	Service Plan A	Service Plan B	Service Plan C
Phase 1A	863	668	927
Full Phase 1	2259	1639	2393

For similar reasons we recommend Service Plan A as the preliminary concept moving forward. This is not a detailed service plan and should not be taken as such. The specifics of route and scheduling need to be further examined in greater detail in coordination with Ride On and WMATA.

Next Steps to Gold

Based on this work, ITDP came to the following conclusions with respect to a 'Roadmap to Gold' for Montgomery County's BRT system. Note that these next step recommendations do not include the Corridor Cities Transitway as we did not study this.

First, we recommend that the County begin by building one gold-standard BRT corridor on Route 355 as Phase I, and then wait to determine if sufficient demand and benefits are achieved to justify the investments before expanding the system to other corridors. However, this should not preclude the County from including future corridors in the Countywide Transit Corridors Functional Master Plan, nor should it preclude the County from implementing non-BRT measures that might still improve transit performance.

Selecting a corridor that is one of the top ten corridors based on existing demand would earn 2 points in *The BRT Standard*. It would still get 2 points as part of a planned multi-corridor network. We also recommend that full BRT infrastructure be built for services that leave Route 355 briefly to reach the Life Sciences Center, Lakeforest Mall, and the Shady Grove Metro. We also recommend that BRT infrastructure be built through downtown Rockville via North Washington Street.

Second, we recommend that gold-standard BRT attributes, such as platform-level boarding, central median alignment, off-board fare collection, etc., be used on this corridor, which would yield a total of 27 points.

Third, we recommend Service Plan A for the service plan in Phase I described above. By allowing both express and local services with multiple routes to use the BRT corridor, the system would achieve 4 points for multiple routes, and 3 points for having express, local and limited services. Bus frequency and its resulting score have yet to be determined.

Reaching a gold-standard BRT in Montgomery County needs to include the following next steps:

A. Establish a project management team

Right now, it is not really clear who is running this project. As implementing the service plan being suggested above requires the procurement of buses, careful coordination between existing institutions such as Ride On and WMATA, and careful timing coordination between the required public works and the required operational changes, whoever or whatever institution that runs this project will need to have a clear mandate from the County Executive. It is unclear to us the relative decision making authority of MCDOT with respect to the Task Force, or even whether this latter body continues to exist, and what its mandate might be. It is therefore imperative that the project management be sorted out immediately. Whatever institutional body ends up operating BRT services in Montgomery County, if the BRT system is not housed under an existing public entity, then a new administrative body or institution will need to be created, and this is likely

to take several years to put in place. Nevertheless, work needs to be done immediately if anything is likely to become operational even in the medium term, and it needs to be clear now who has the authority to make decisions on everyday matters. Further, as an institution cannot be created out of nothing, normally new BRT entities begin as project teams operating under the direct authority of a Mayor or County Executive. Staff then function under this entity, and when a new legal entity can eventually be created, these trained staff are then generally transferred over to the new administrative entity. Therefore, a critical first step is that the County Executive create a clear project team with a clear political mandate to make decisions and a clear leadership structure.

It may be that management consultants or ITDP or our on- call consultants should be brought in to advise on the various advantages and disadvantages of different institutional structures for managing BRT operations. ITDP has broad information about the institutional structures of BRT systems across the world, and some of this experience is pertinent to Montgomery County, particularly if PPP financing ends up being considered.

B. Decide which corridor will be built first

It is growing imperative that the corridor which will actually be built first be decided. There are a host of reasons why it would not be advisable to build more than one or a maximum of two corridors at once. The first reason is simply administrative difficulty. Nobody in Montgomery County has ever built a BRT system before and the complexity of the task should not be underestimated. The second is that the County may not want to tie up all of its traffic at once with construction. It is much easier to divert traffic onto alternative routes if those routes are not also under construction.

C. Decide on the basic service plan

A decision needs to be taken early on with respect to the basic approach to the BRT services. With even a basic service plan such as those proposed by ITDP, one can already make critical design and administrative decisions. Should one of the basic approaches suggested here be accepted, the routes that are currently being operated by WMATA and Ride On can already be identified and discussions with these institutions initiated to bring them under a single administrative authority. Also, with the basic service plan decided, the size of the needed bus procurement, the bus type, and hence the project cost, can all be better estimated.

D. Detailed analysis of the current and projected future causes of delay

Should Montgomery County choose to maintain a very high quality of service throughout the first trunk corridor, then basic minimum station design standards and running way standards could be applied. However, if Montgomery County is worried about the cost of the system, then it would be useful to do a more detailed analysis of the specific locations and causes of delay in the corridor. This entails first analyzing in greater detail link-by-link speed and demand data on the corridor, and then a visual identification of the causes of delay. BRT type interventions can then be prioritized to specific locations of delay rather than throughout the entire system so that the infrastructure investments can be more closely aligned with where they will yield the greatest benefits.

Analysis of existing mixed traffic levels of service along the BRT corridor will also be

useful. It may be that there are non-BRT related changes that could be made to traffic signals, lane widths, etc. which could mitigate mixed traffic delay and which could be implemented simultaneously with new BRT interventions so that the net level of service impact of the project on mixed traffic is as low as possible.

E. Parking analysis

It is likely that BRT in Montgomery County will pass through areas, particularly sections running through downtown areas like Bethesda and Rockville, where decisions about whether to convert a through lane or a parking lane to BRT would be more advisable. To make such a determination, it is sometimes necessary to do a parking analysis. Such an analysis will compare existing supply of on street parking, the current utilization rates, the availability of other public parking nearby, and the current charging rates, to the demand for this parking. Typically, when businesses are concerned about the loss of parking, there is often sufficient paid parking available in the immediate vicinity.

F. Complete detailed physical design on corridor

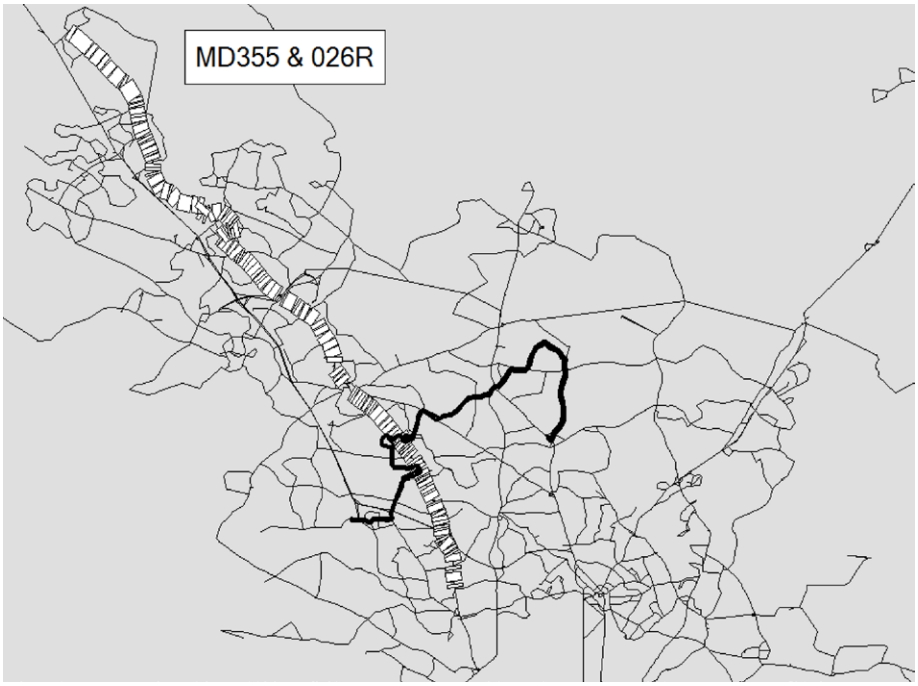
Once the basic service plan has been agreed upon, a reasonable estimate can be made about the numbers of passengers that are likely to be boarding and alighting at each planned BRT stop along the corridor during the peak hour, at least in the initial years of operation. Some reasonable assumptions can then be made about likely future demand, and the station-specific boarding and alighting numbers can be modified accordingly. Based on these projected demand numbers, the specific locations where the cost of off-board fare collection can be justified can be better determined. The necessary size of the stations can also be determined.

This analysis will need to make determinations about turning movements and traffic signalization as well. Where possible, signalized left turns across a central median-aligned busway should be avoided. Removal of left turns will tend to increase vehicle throughput on the trunk corridor for both mixed traffic and the BRT system at the expense of traffic levels on perpendicular streets which are more likely able to accommodate increased traffic volumes without saturation.

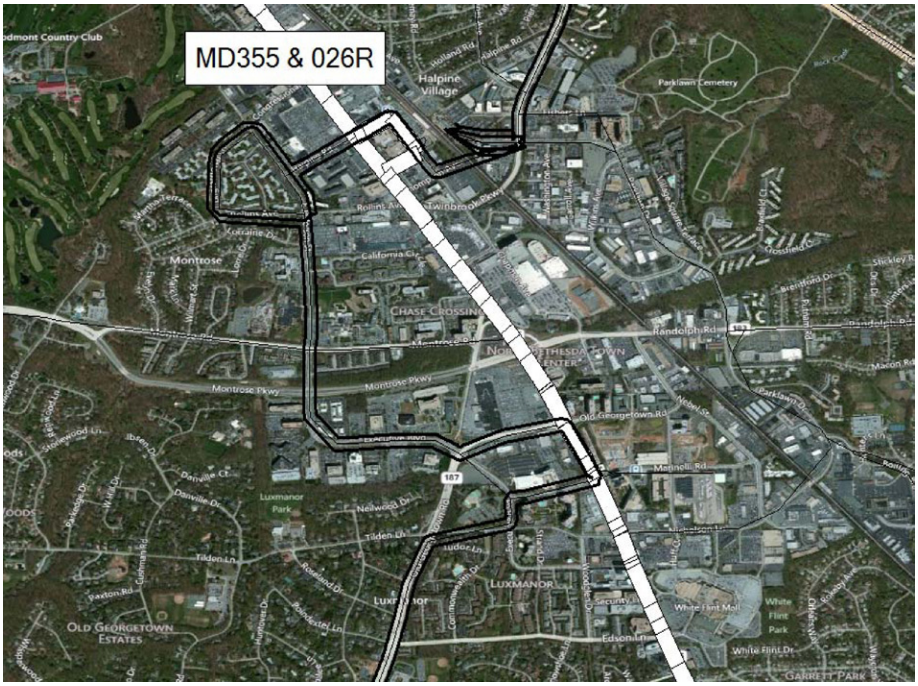
G. Project timetable

It is a good idea to ensure that BRT operations are brought on line at roughly the same time that the infrastructure is completed. In practice this is quite difficult to achieve as the two processes are distinct and unrelated. The timetable required for the construction of public works is generally better understood than the timetable required to bring a BRT into operation. It is very easy for BRT operational contracting issues to drag on, leaving a situation where the infrastructure is sitting idle, annoying the public and subject to possible vandalism, while the problems with operational contracting or bus procurement are overcome. We therefore suggest that the project management team develop a project timetable early on and stick to it, identifying in advance precisely how long it is likely to take to complete each stage of the project, and adjusting each deadline as needed.

Appendix A: Reroutings for affected Phase 1 bus routes under three scenarios

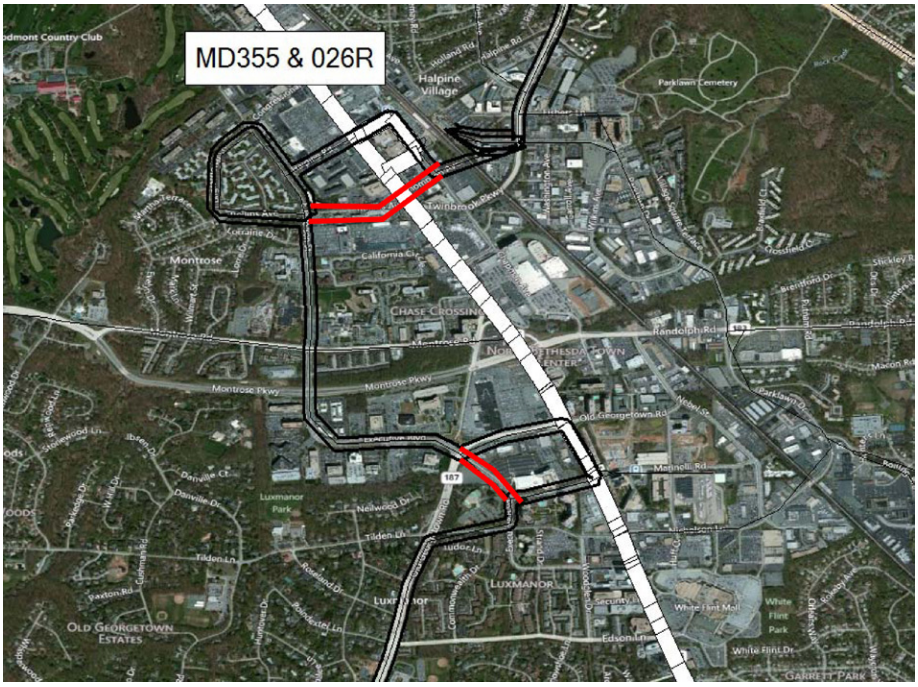


MD 355 Existing Route: Route 026R

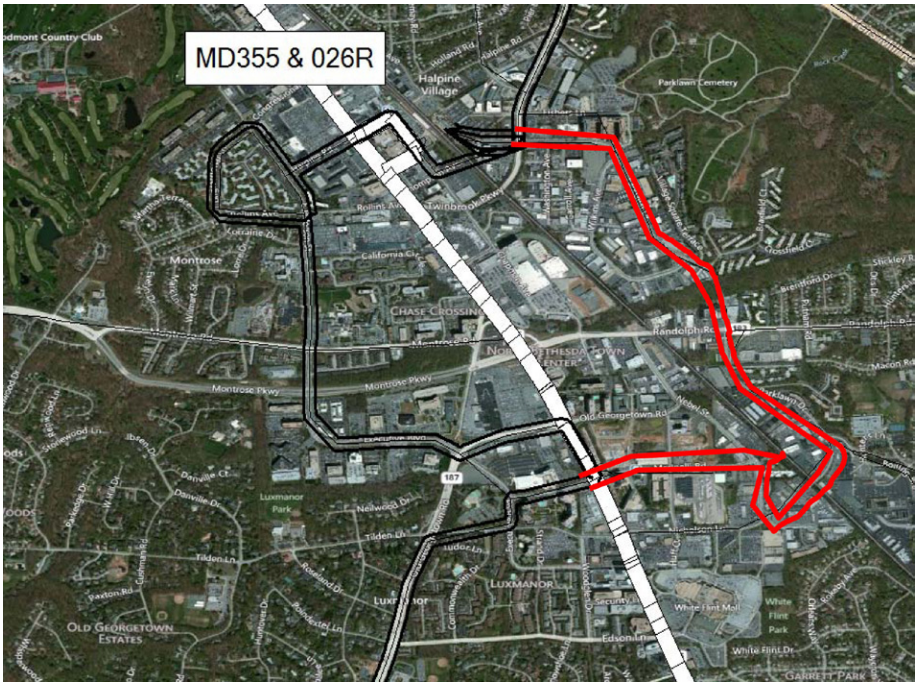


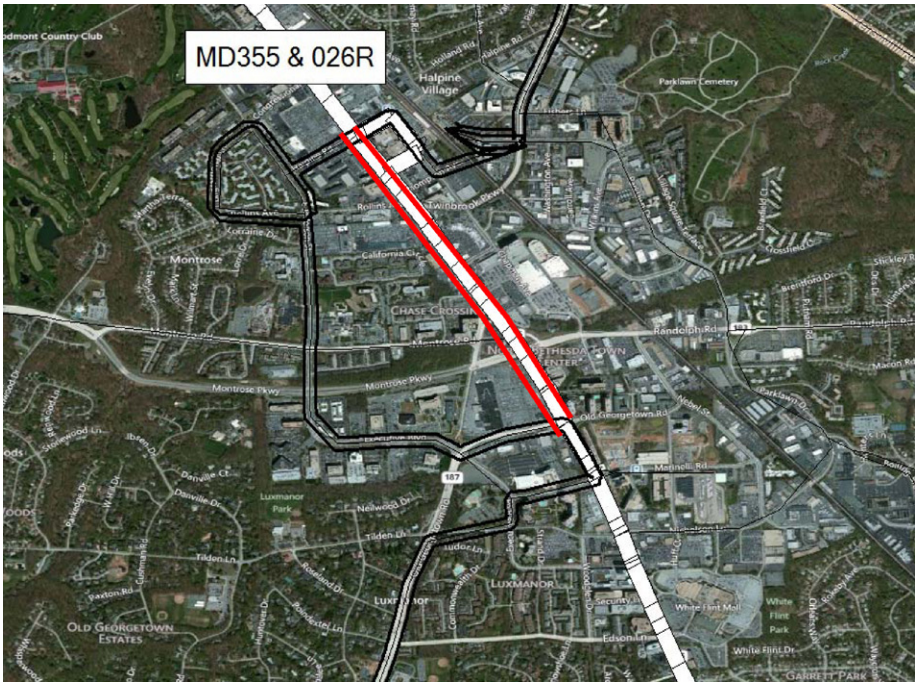
MD 355 Existing Route: Route 026R

MD 355 Service Plan A: Route 026R
Option 1

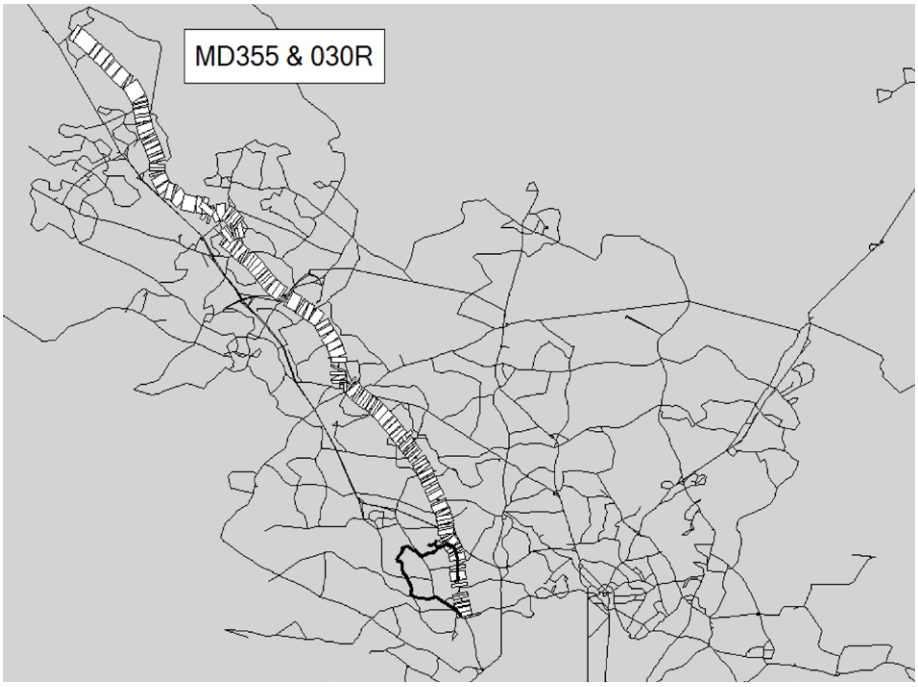


MD 355 Service Plan A: Route 026R
Option 2



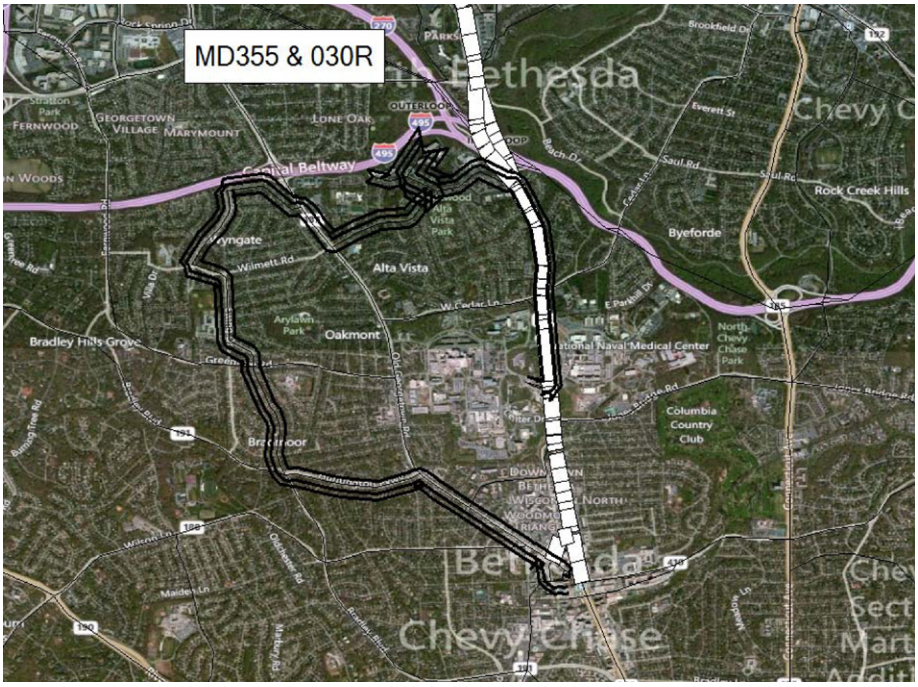


MD 355 Service Plan C: Route 026R

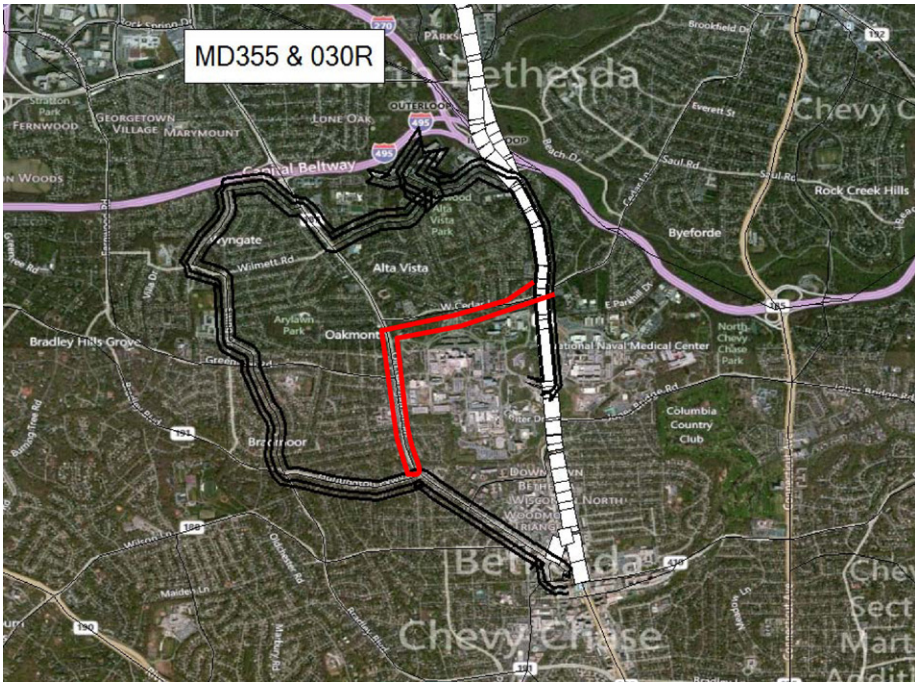


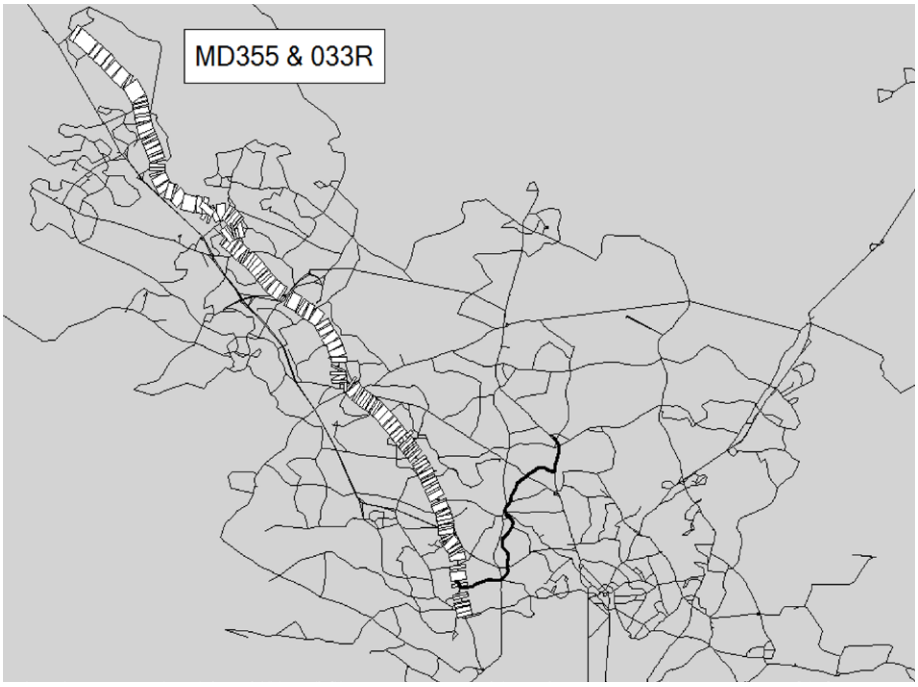
MD 355 Existing Route: Route 030R

MD 355 Existing Route: Route 030R



MD 355 Service Plan A: Route 030R



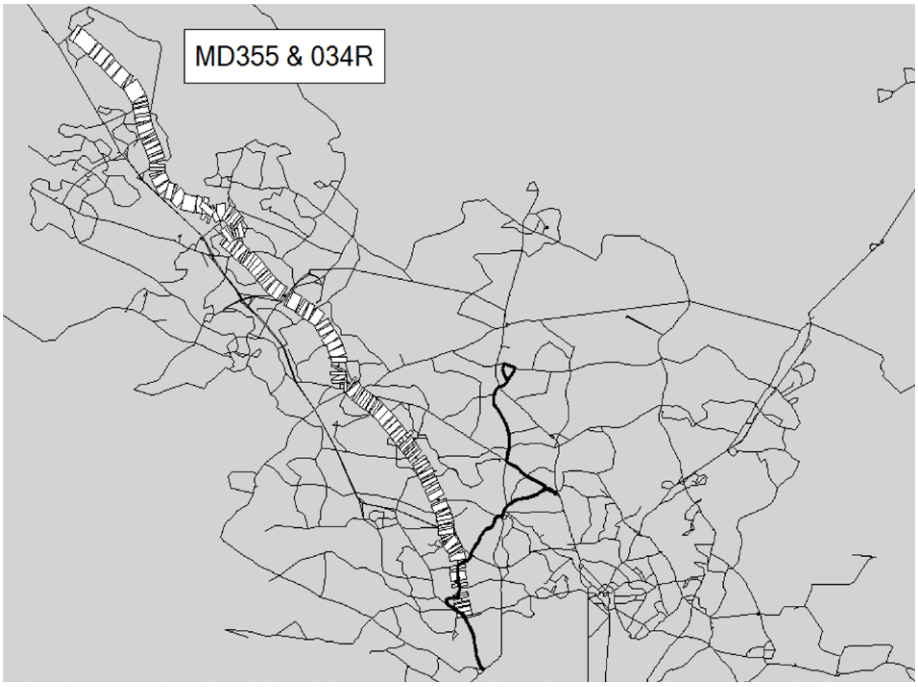


MD 355 Existing Route: Route 033R

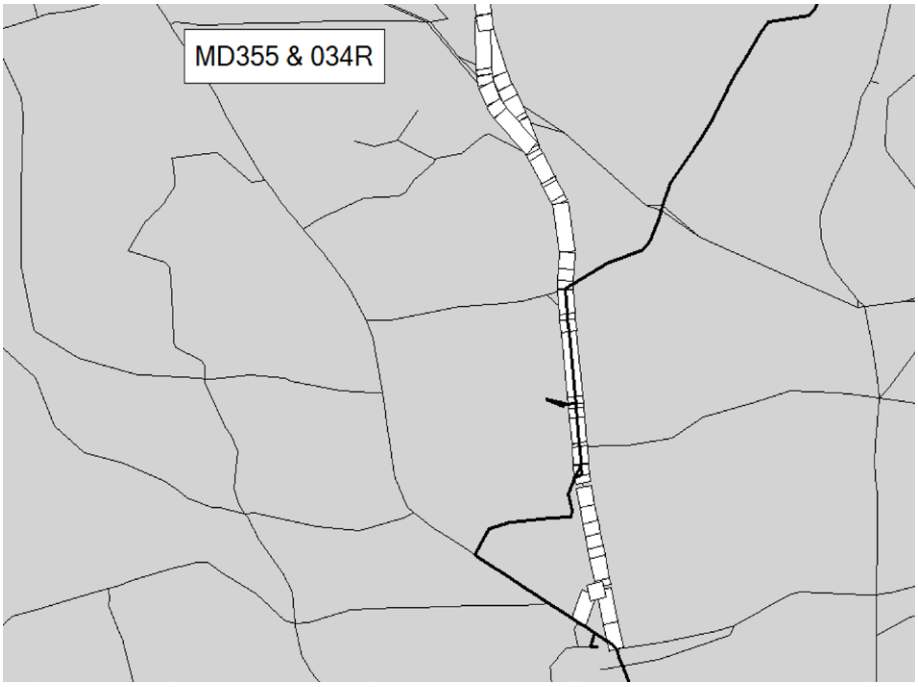
MD 355 Existing Route: Route 033R (zoomed in)

MD 355 Existing Route: Route 033R

MD 355 Service Plans A or B: Route 033R
No change (no stops along corridor)

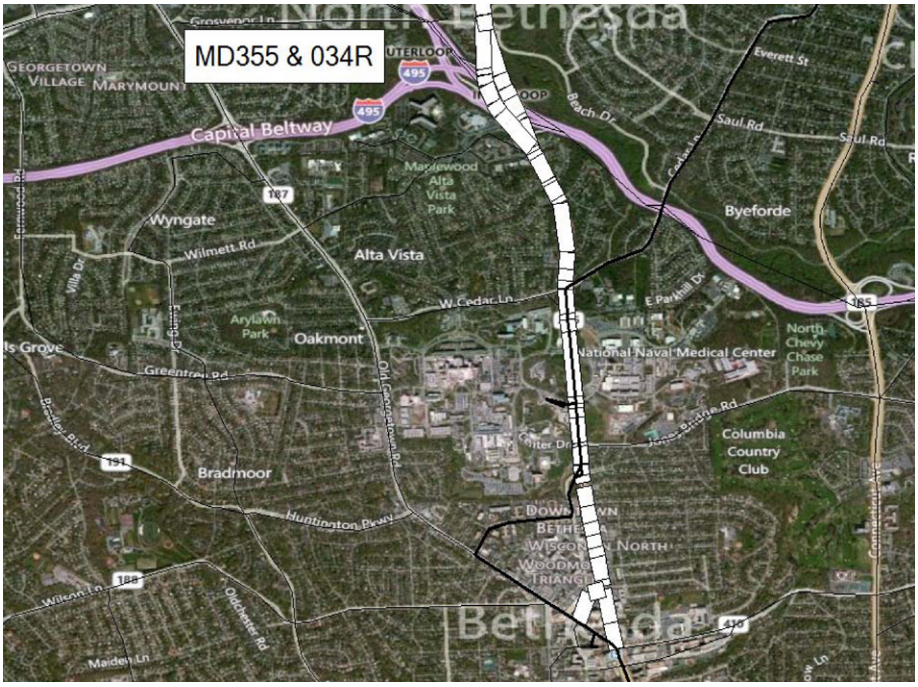


MD 355 Existing Route: Route 034R

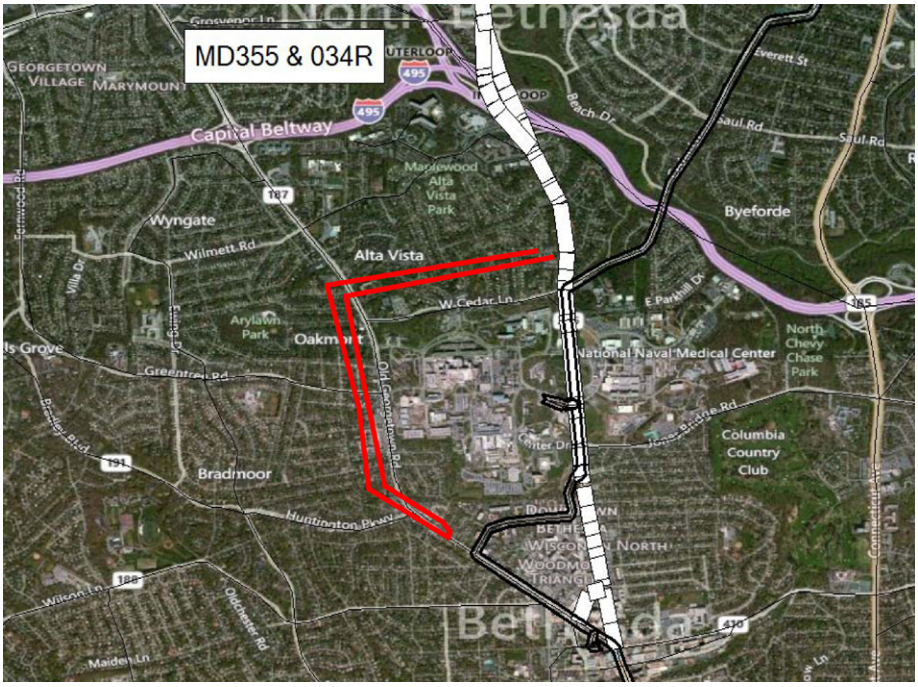


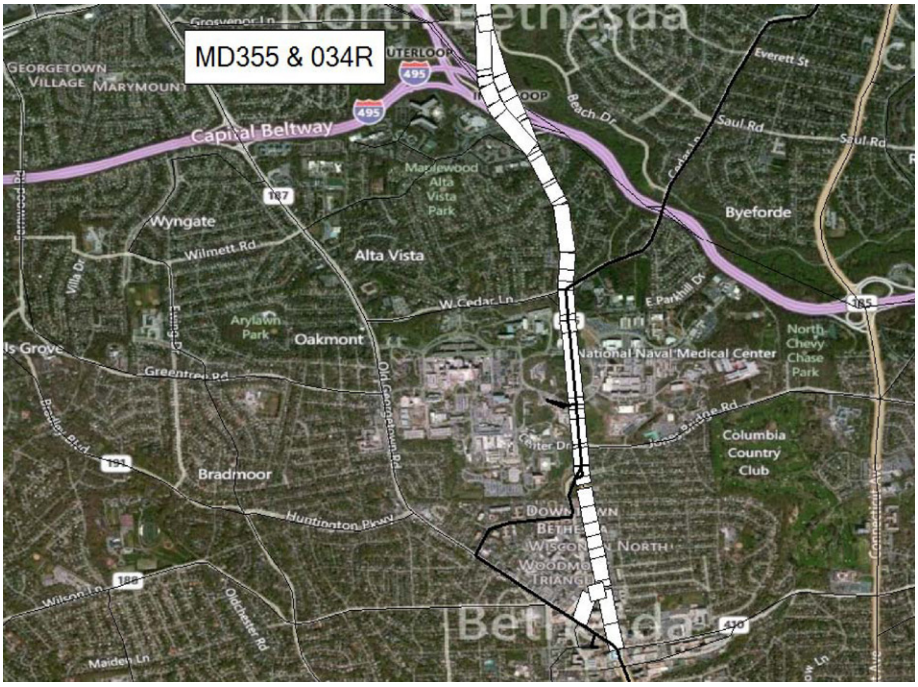
MD 355 Existing Route: Route 034R (zoomed in)

MD 355 Existing Route: Route 034R

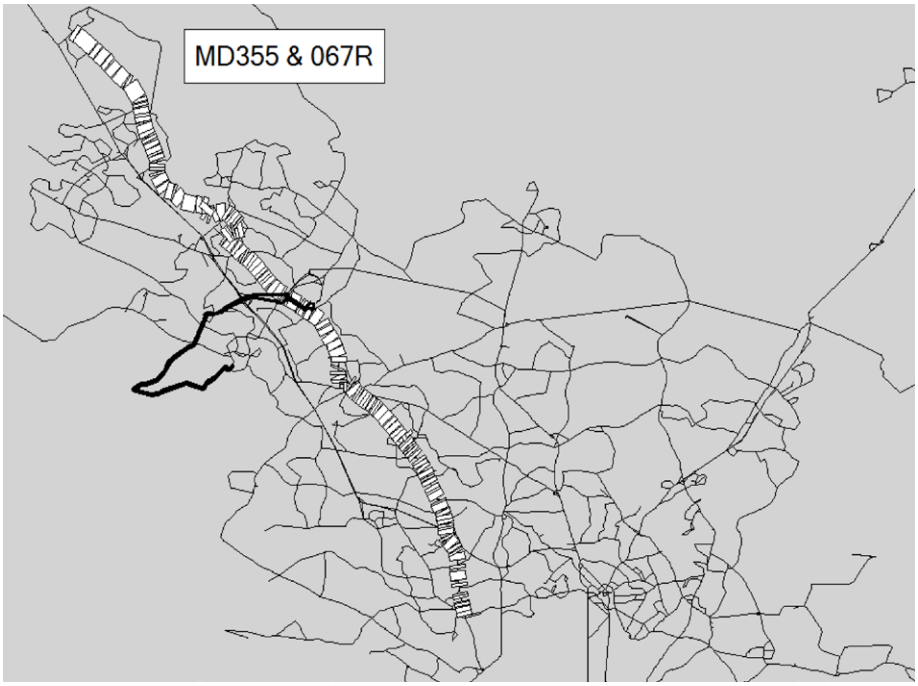


MD 355 Service Plans A or B: Route 034R
One option is to detour



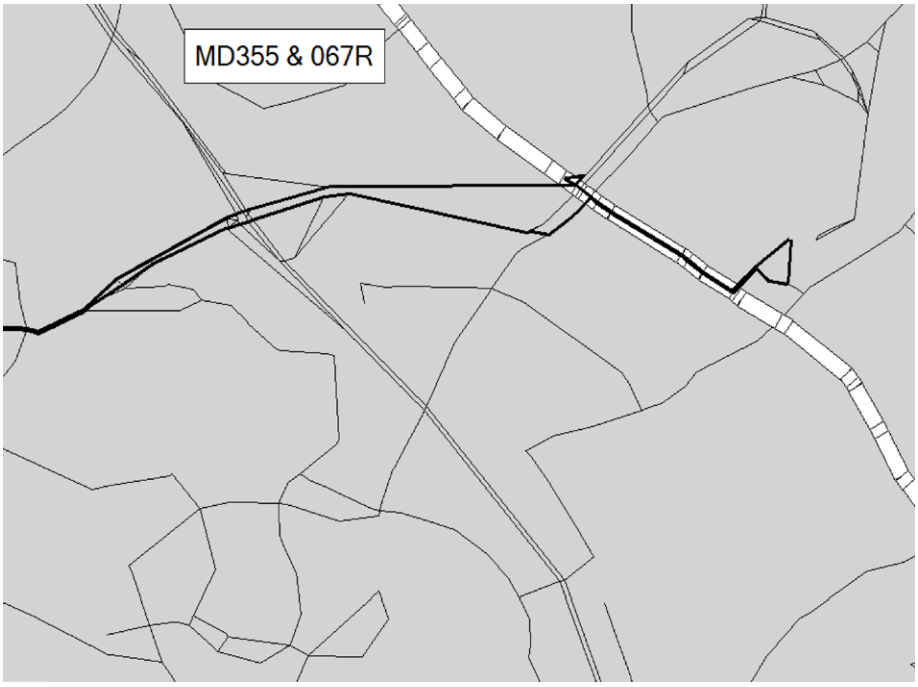


MD 355 Service Plans A or B: Route 034R
Another option is no stops along the corridor

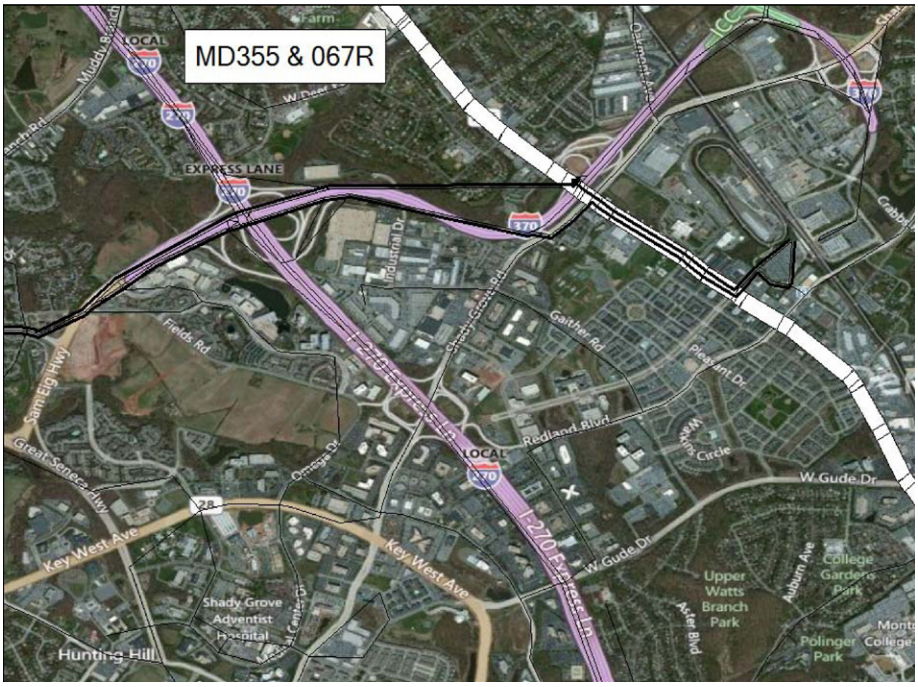


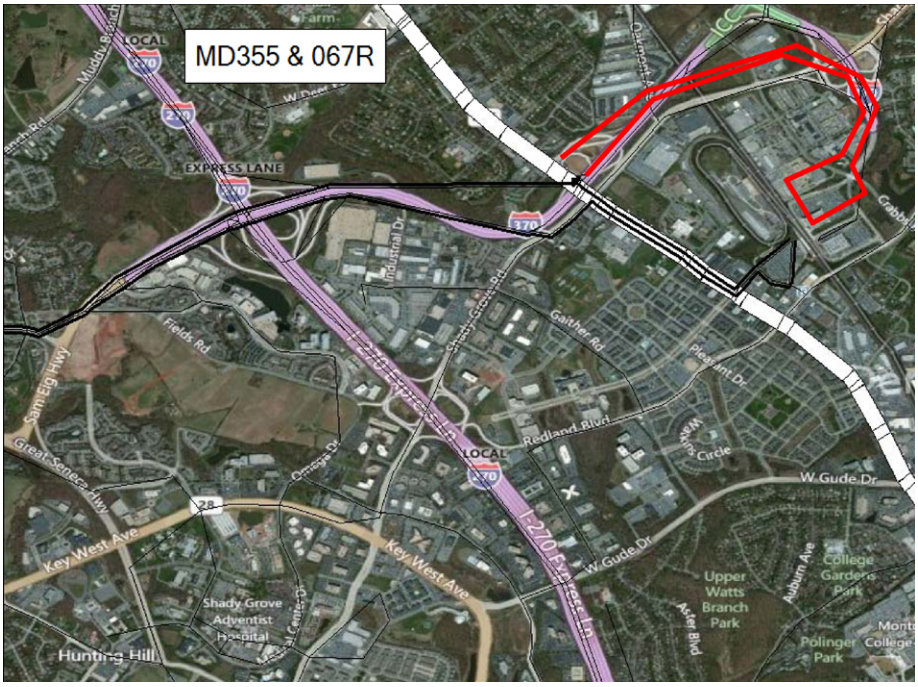
MD 355 Existing Route: Route 067R

MD 355 Existing Route: Route 067R (zoomed in)

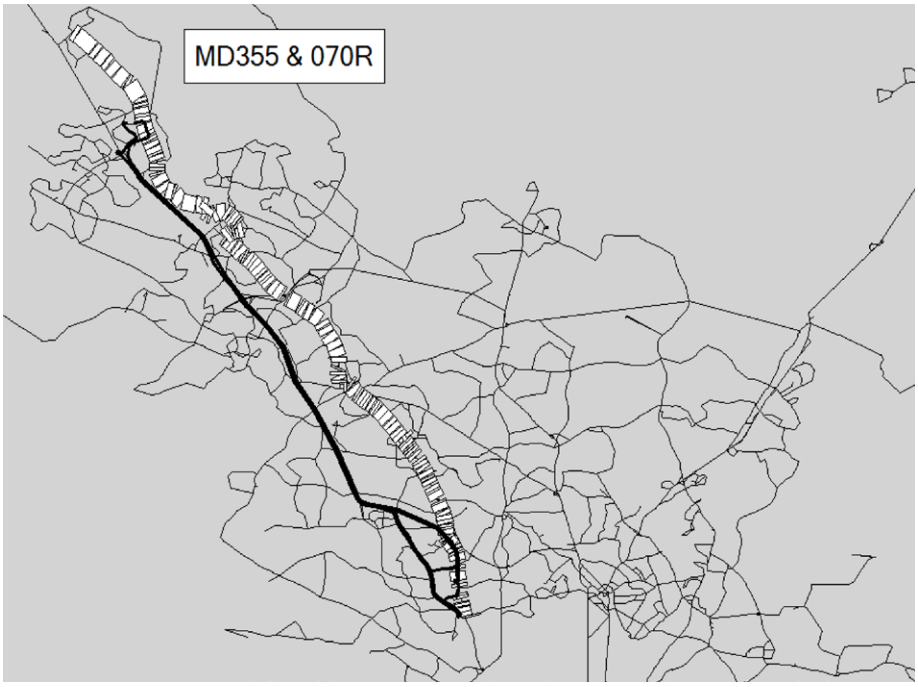


MD 355 Existing Route: Route 067R



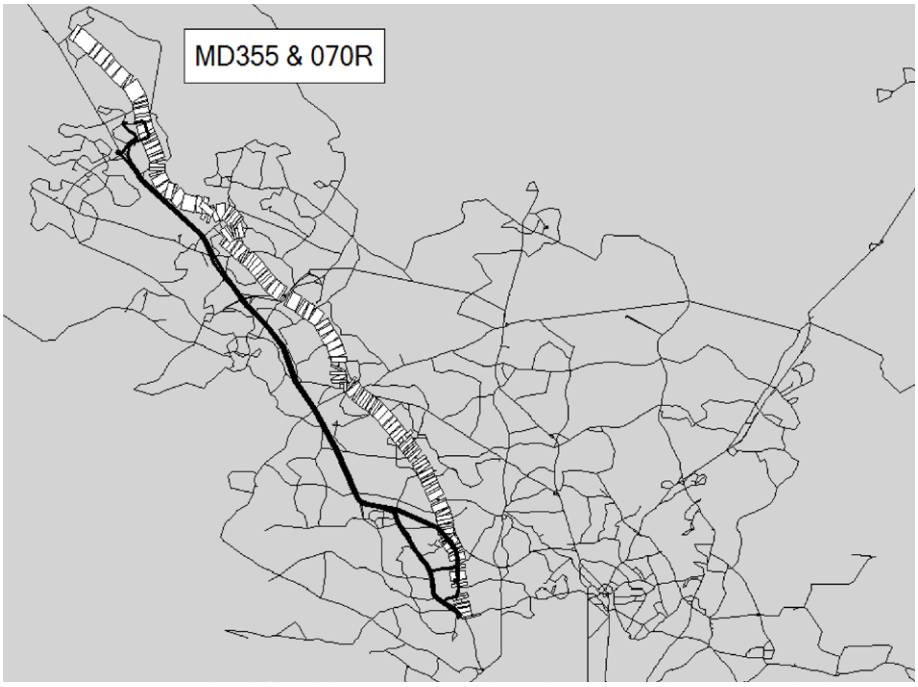


MD 355 Service Plans A or B: Route 067R
Detour off the corridor



MD 355 Existing Route: Route 070R

MD 355 Existing Route: Route 070R
North section

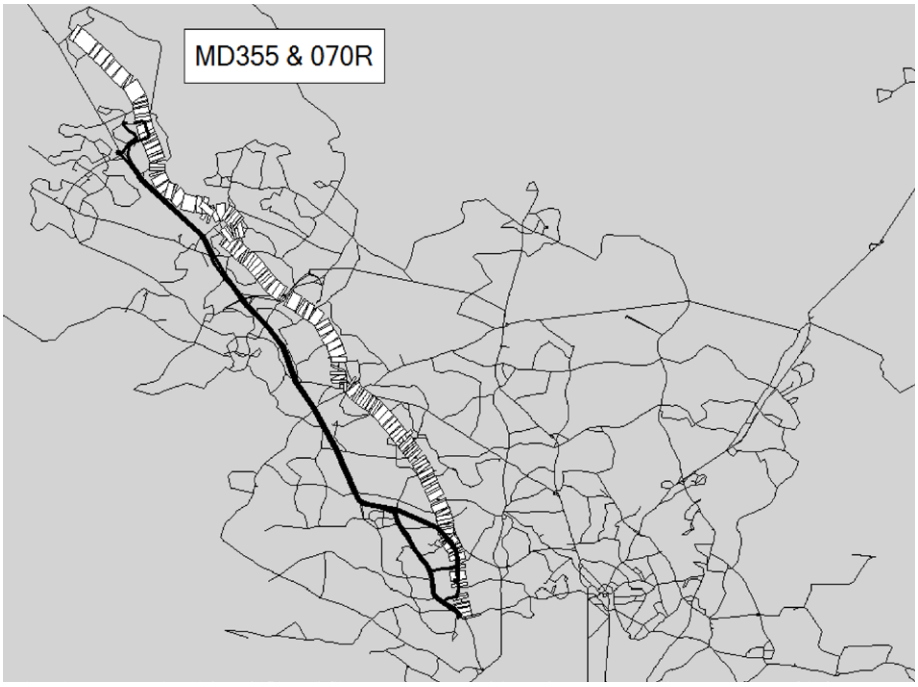


MD 355 Existing Route: Route 070R
North section (zoomed in)

MD 355 Existing Route: Route 070R
North section

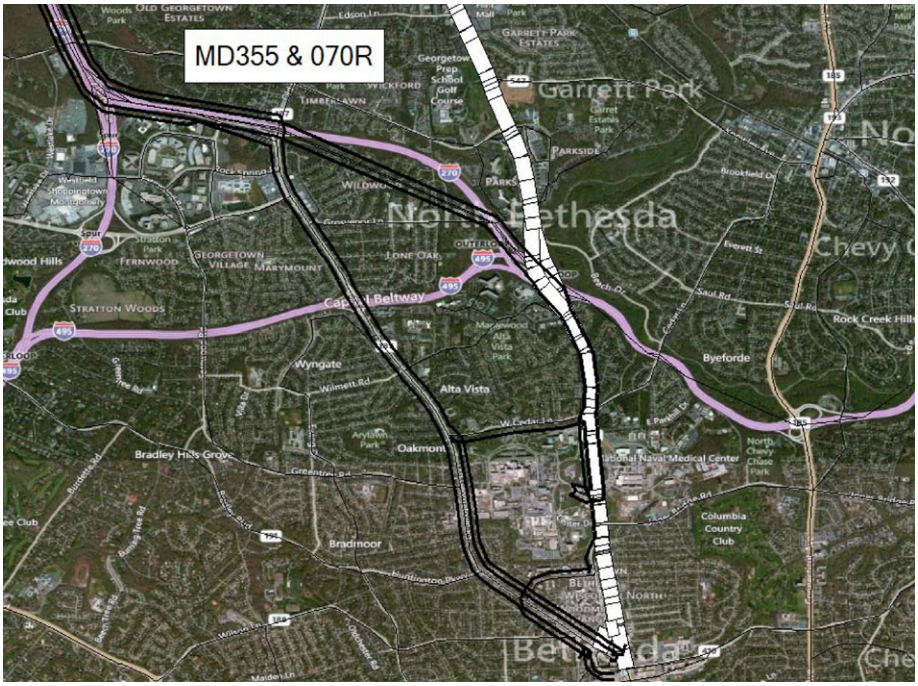
MD 355 Service Plans A or B: Route 070R
North section

MD 355 Existing Route: Route 070R
South section



MD 355 Existing Route: Route 070R
South section (zoomed in)

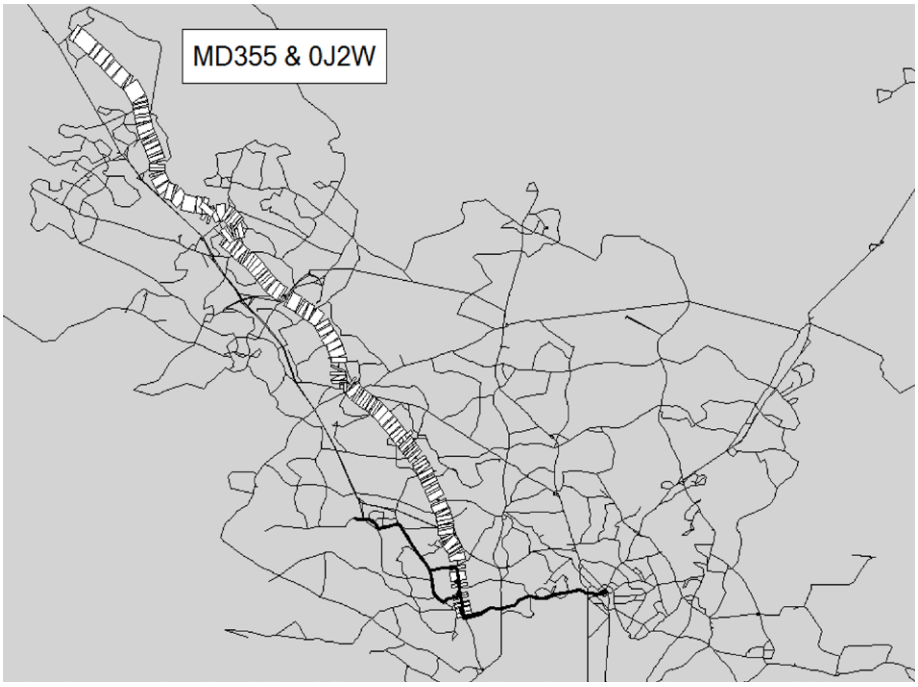
MD 355 Service Plans A or B: Route 070R
South section: Detour off the corridor

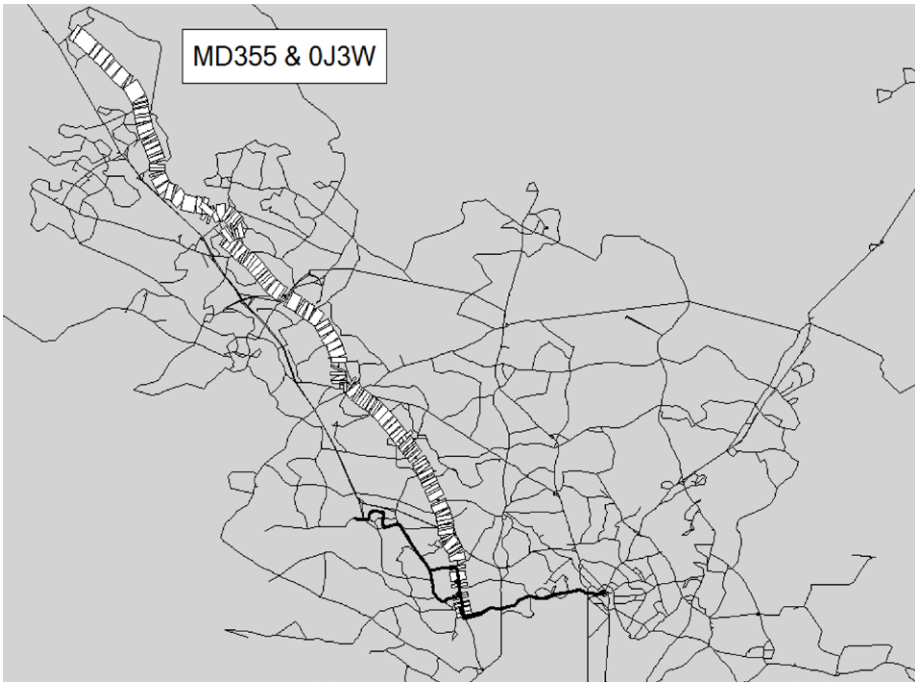


MD 355 Service Plans A or B: Route 070R
South intersection only: Detour off the corridor

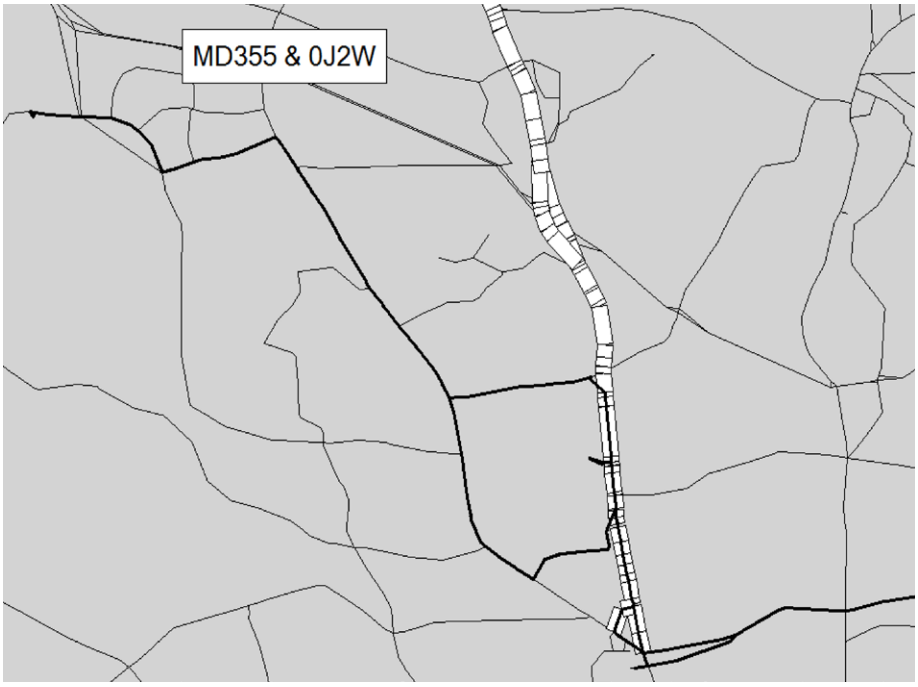
MD 355 Existing Routes: J2 and J3

MD 355 Existing Route: J2





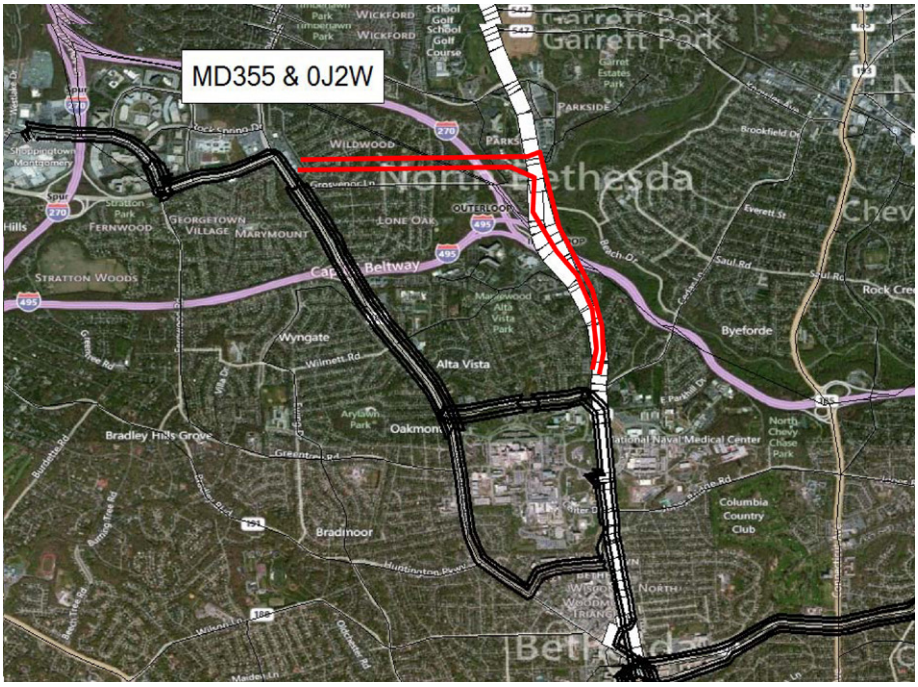
MD 355 Existing Route: J3



MD 355 Existing Routes: J2 and J3

MD 355 Existing Routes: J2 and J3

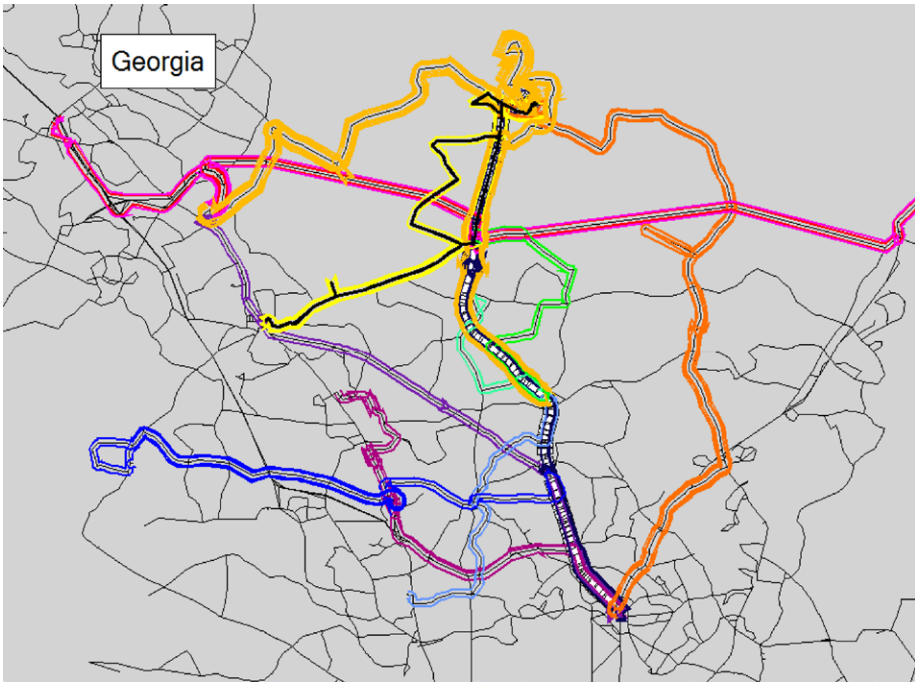
Can gain time if detoured into corridor



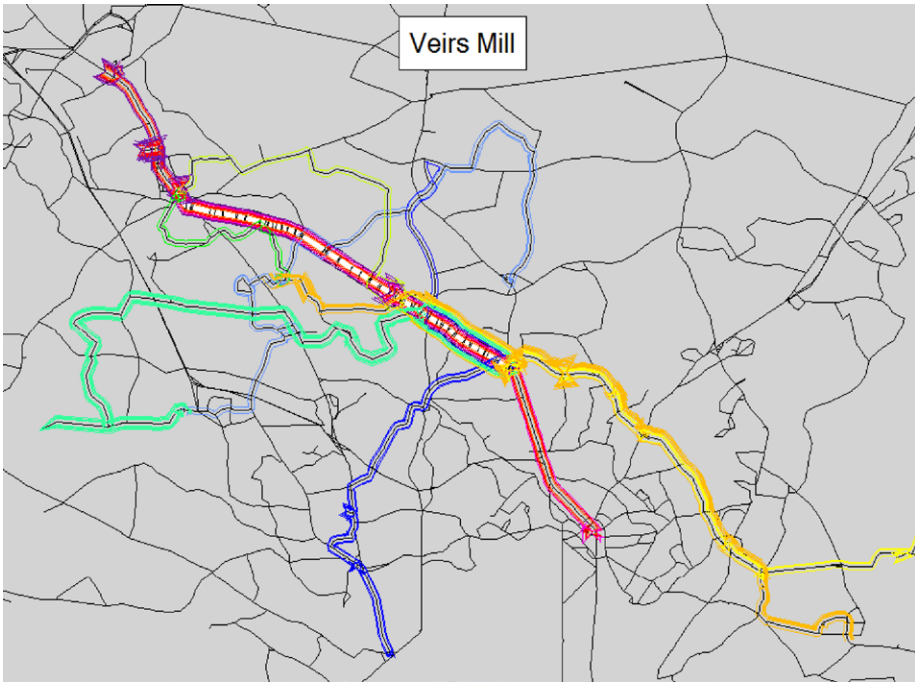
Service alternative

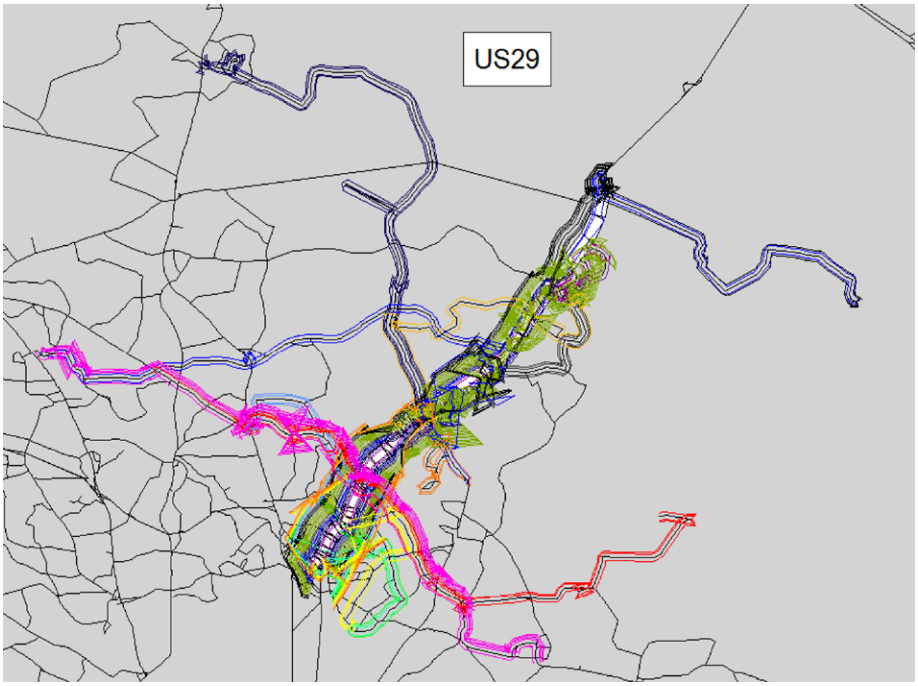
Appendix B: Existing and proposed service plans for full BRT network build-out under three scenarios

Existing service plan: Georgia Avenue



Existing service plan: Veirs Mill Road





Existing service plan: US 29

Line	Service Plan A, All 4 Corridors		
	Change	Operation in Corridor	Procurement # of Buses
009R	No change	Both sides	3
010R	No change	(express)	
012R	No change	(express)	
013R	Detour off	-	
014R	Express	(express)	
021R	No change	Both sides	2
022R	No change	Both sides	3
026R	No change	(express)	
030R	Detour off	-	
033R	No change	(express)	
034R	No change	(express)	
037R	No change	(express)	
038R	No change	(express)	
041R	No change	(express)	
044R	No change	(express)	
046R	Trunk	Left door	6
048R	No change	Both sides	4
051R	No change	Both sides	2
052R	Feeder	-	
053R	Feeder	-	
055R	Trunk	Left door	9
059R	No change	Both sides	7
067R	Detour off	-	
070R	No change north; Detour off south	(express); -	
075R	No change	(express)	
081R	No change	(express)	
083R	No change	(express)	
0C2W	Eliminate one trip	-	
0C4W	No change	Both sides	10
0C8W	No change	(express)	

Line	Service Plan A, All 4 Corridors (Continued)		
	Change	Operation in Corridor	Procurement # of Buses
0J1W	No change	(express)	
0J2W	No change	(express)	
0J3W	No change	(express)	
0J5W	No change	Both sides	2
0J7W	Detour off	-	
0J9W	Detour off	-	
0Q1W	Trunk	Left door	14
0Q2W	Trunk		
0Q4W	Trunk		
0Q5W	Trunk		
0Q6W	Trunk		
0Y5W	Trunk	Left door	8
0Y7W	Trunk		
0Y8W	Trunk		
0Y9W	Trunk		
0Z2W	No change	(express)	
0Z6W	No change		
0Z8W	No change		
0Z9W	No change		
Z11W	No change		
Z13W	No change		
Z29W	No change		
201M	No change	(express)	
202M	No change	(express)	

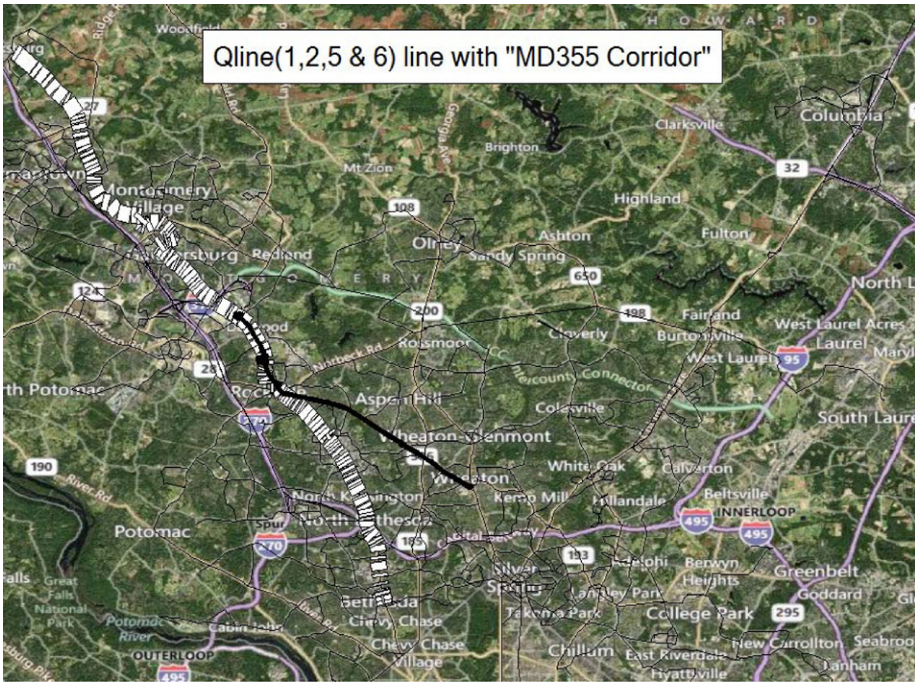
Line	Service Plan B, All 4 Corridors		
	Change	Operation in Corridor	Procurement # of Buses
009R	Feeder	-	
010R	No change	(express)	
012R	No change	(express)	
013R	Detour	-	
014R	No change	(express)	
021R	Feeder	-	
022R	Feeder	-	
026R	No change	(express)	
030R	Detour off	-	
033R	No change	(express)	
034R	No change on MD355, Detour off (8 trips) in Veirs Mill	(express) -	
037R	No change	(express)	
038R	No change	(express)	
041R	No change	(express)	
044R	No change	(express)	
046R	Trunk	Left door	6
048R	Feeder	-	
051R	Feeder	-	
052R	Feeder	-	
053R	Feeder	-	
055R	Trunk	Left door	9
059R	No change	(express)	
067R	Detour off	-	
070R	No change north; Detour off south	(express); -	
075R	No change	(express)	
081R	No change	(express)	
083R	No change	(express)	
0C2W	Elimination one trip	-	
0C4W	No change	(express)	

Line	Service Plan B, All 4 Corridors (Continued)		
	Change	Operation in Corridor	Procurement # of Buses
0C8W	No change	(express)	
0J1W	No change	(express)	
0J2W	No change	(express)	
0J3W	No change	(express)	
0J5W	Trunk	Left door	2
0J7W	Detour off	-	
0J9W	Detour off	-	
0Q1W	Trunk	Left door	14
0Q2W	Trunk		
0Q4W	Trunk		
0Q5W	Trunk		
0Q6W	Trunk		
0Y5W	Trunk	Left door	8
0Y7W	Trunk		
0Y8W	Trunk		
0Y9W	Trunk		
0Z2W	No change (express)	(express)	-
0Z6W	No change (express)	(express)	-
0Z8W	Trunk + Feeder	Left door	9
0Z9W	Trunk + Feeder		
Z11W	Trunk + Feeder		
Z13W	Trunk + Feeder		
Z29W	Trunk + Feeder		
201M	No change	(express)	
202M	No change	(express)	

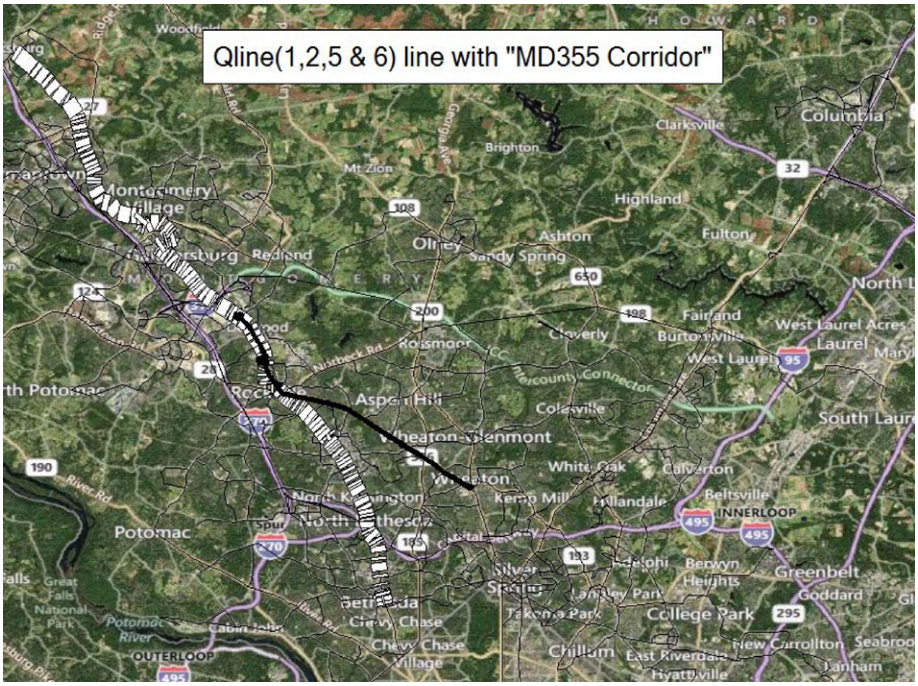
Line	Service Plan C, All 4 Corridors		
	Change	Operation in Corridor	Procurement # of Buses
009R	No change	Regular	-
010R	No change	Regular	-
012R	No change	Regular	-
013R	No change	Regular	-
014R	No change	Regular	-
021R	No change	Regular	-
022R	No change	Regular	-
026R	No change	Regular	-
030R	No change	Regular	-
033R	No change	Regular	-
034R	No change	Regular	-
037R	No change	Regular	-
038R	No change	Regular	-
041R	No change	Regular	-
044R	No change	Regular	-
046R	No change	Regular	-
048R	No change	Regular	-
051R	No change	Regular	-
052R	Feeder	-	
053R	Feeder	-	
055R	No change	Regular	-
059R	No change	Regular	-
067R	No change	Regular	-
070R	No change	Regular	-
075R	No change	Regular	-
081R	No change	Regular	-
083R	No change	Regular	-
0C2W	Eliminate one trip		
0C4W	No change	Regular	-
0C8W	No change	Regular	-

Line	Service Plan C, All 4 Corridors (Continued)		
	Change	Operation in Corridor	Procurement # of Buses
0J1W	No change	Regular	-
0J2W	Detour in (?)	Regular	-
0J3W	Detour in (?)	Regular	-
0J5W	No change	Regular	-
0J7W	No change	Regular	-
0J9W	No change	Regular	-
0Q1W	No change	Regular	-
0Q2W	No change	Regular	-
0Q4W	No change	Regular	-
0Q5W	No change	Regular	-
0Q6W	No change	Regular	-
0Y5W	No change	Regular	-
0Y7W	No change	Regular	-
0Y8W	No change	Regular	-
0Y9W	No change	Regular	-
0Z2W	No change	Regular	-
0Z6W	No change	Regular	-
0Z8W	No change	Regular	-
0Z9W	No change	Regular	-
Z11W	No change	Regular	-
Z13W	No change	Regular	-
Z29W	No change	Regular	-
201M	No change	(express)	
202M	No change	(express)	

Service Difference: Phase 1 vs Full Network
Q Line as complementary route



Service Difference: Phase 1 vs Full Network
Q Line as full route



ITDP | Institute for Transportation & Development Policy

9 East 19th Street, 7th Floor, New York, NY, 10003

TEL +1 212 629 8001 FAX +1 646 380 2360