Countywide Transit Corridors Functional Master Plan

Appendix 10
Initial Draft Recommendations

PARSONS BRINCKERHOFF

Tower 1, 10th Floor
100 S. Charles Street
Baltimore, MD 21201-2727
(410) 727-5050

Memorandum

To: Larry Cole

From: Mike Flood / Monique Ellis

Date: March 8, 2013

Subject: Draft Recommendations Memo – Montgomery County BRT Master Plan of Transportation

Introduction

Decisions on transit infrastructure are typically made through a combination of technical analysis and policy decisions as communities make choices on the type of transit facility that best fits the goals of a community. Parsons Brinckerhoff staff have completed a range of task specific to generating a detailed understanding of factors to be considered in developing the right of way recommendations for the BRT network as has been discussed throughout project delivery. This has been done to provide decision-makers at the Planning Board with information and recommendations on how to consider right of way needs of implementing the envisioned transiitway system. The following pages present technical information used in making decisions on right of way designations associated with design treatments that could be reasonably assumed for corridors forwarded for analysis.

Assumptions for developing recommendations are to identify what may be needed for rights of way. It is not possible in this analysis at the technical level to determine:

- Policies on lane repurposing or operational changes that may be implemented
- Exact levels at which point policy decisions on dedicated lanes may be warranted

It was therefore assumed that if there was a reasonable design option that provided necessary rights of way for all users and provided exclusive lanes for BRT would be the preference, this is an important factor of the work presented here – that is a desire to create separated BRT facilities where possible. It should be noted that cross-sections assumed for this analysis had all components included, including bicycle accommodations, planting strip, sidewalks, stormwater treatment, etc. At some point the decision to address these cross-sections in a way that reduced private property impacts for minor reductions would be considered.

This memorandum presents in the following pages the results of the detailed technical analysis conducted to determine proposed rights of way for the BRT system. The analysis was conducted to accomplish a number of tasks:

1. Determine whether each station to station pair is to be considered viable enough to warrant some type of exclusive lane treatment.
2. Identify a recommended right of way for each corridor based on the following:
   a. Peak hour station to station transit passenger volumes (BRT and local)
   b. Presence of structures near the edge of the existing right of way
   c. Results of conducted lane repurposing test.

The general direction of the project is to identify a right of way based on assumed design parameters that take into account decisions that would typically be made in planning phases and incorporate some general criteria for decision-making. This effort is not intented as a design or even detailed planning exercise, but rather as a method to apply some general guidance for reaching these decisions at the planning level given the extent and complexity of the network.

There were a number of analyses undertaken for this effort, which include:

- Demand forecasting – the demand forecasting model applied on work for the Montgomery County DOT was applied for the purpose of generating ridership estimates. This process determined:
  - Transit ridership – generated to understand values for station to station pairs in terms of passenger volumes
  - Auto system performance – assessing volume/capacity on links to understand implications of mixed-traffic use, as well as system performance in identified geographic districts .
- Basic level GIS analysis – performed using information provided by M-NCPPC Planning staff to understand, in particular, those areas where right of way constraints could limit BRT runningway options due to the presence of structures within areas potentially designated for transportation uses.
- VISSIM Traffic Modeling – conducted to test two conditions in the corridors that may impact decisions on rights of way. These tests included an assessment of a median BRT condition along Route 355 near White Flint and a repurposing lane test along MD 97 between 16th Street and US 29.

The information on the following pages summarizes the planning-level assessments for each of the identified BRT routes. This includes a set of data tables which present the findings of all of the detailed technical analysis as the segment level to better represent all of the factors that were considered leading up to the final right of way recommendations. A series of maps were also complied and present information used in decision making. Given the detailed technical information being presented, it is anticipated that continued dialogue with M-NCPPC staff and primary stakeholders will lead to further clarification of final right-of-way recommendations.

Theoretical Traffic Lane Capacity

One issue particular to discussion for a network at this level is the number of auto passengers that can pass through a corridor. Theoretical capacity of a single lane of traffic is pertinent to evaluating BRT options that involve either partial or complete repurposing of existing lanes for use as BRT priority lanes. The Highway Capacity Manual (HCM) presents theoretical lane capacities for a number of different types of facilities including freeways and rural highways, however, lane capacity on interrupted-flow facilities (signalized arterial corridors on which the Montgomery County BRT system would predominantly operate) is highly dependent on field conditions, including:

- Total number of lanes of traffic
- Posted speed limit / prevailing speed under low-volume conditions
- Number of access points (driveways, commercial entrances, etc.)
- Degree of traffic signal coordination
- Presence of a divided median
- Width of shoulders

The numerous variables make it difficult to generalize lane capacity. However, it is possible to specify a range of capacities within which a signalized arterial will likely operate based on traffic engineering principles. Key drivers of lane capacity under interrupted-flow conditions along a signalized arterial are **saturation flow rate**, or the maximum rate at which vehicles can pass a given point under stable conditions, and **cycle share**, or the ratio of time during which a signal serves the mainline through movement.

The Maryland SHA defines saturation flow rate as 1600 veh/hr/lane for assigning Level of Service (LOS) thresholds in Critical Lane Analysis (CLA) calculation; CLA values above 1600 vphpl being indicative of over-capacity or LOS “F” conditions. Regarding cycle share, based on signal timings provided by Montgomery County the observed signal timings reflect a split of anywhere between 50% and 75% of the total cycle length being dedicated to the “major street” phases.

The combination of saturation flow rate and cycle share ratio represents an estimated per-lane capacity of between 800 and 1200 vphpl. In validation of this estimate, all observed vehicle throughputs along mainline corridors evaluated in the VISSIM modeling (described later in this memo) effort fell into this range. This range will be important for the purposes of understanding decisions on whether to assign a lane dedicated to transit.

By applying a passenger per vehicle factor of 1.06 supplied by MNCPPC staff it is therefore generalized that person throughput on arterials in Montgomery County would range from 850 to 1275 auto passengers in various areas, with lower volumes

PARSONS BRINCKERHOFF

in the more urbanized areas and higher volumes along corridors with more dispersed land uses.

Demand Forecasting

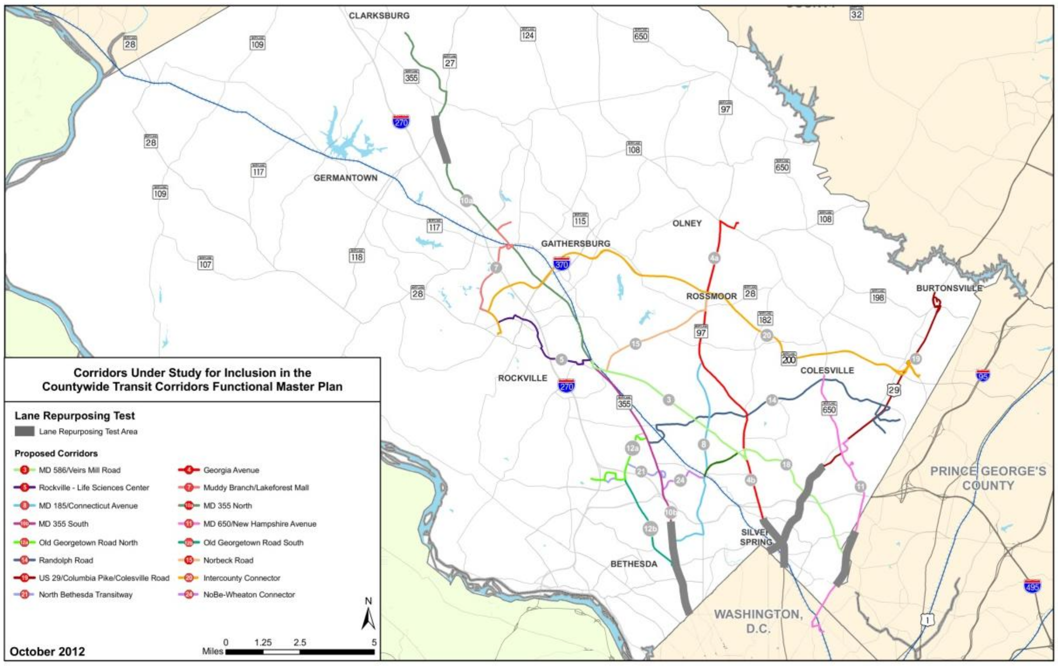
The issue of system viability was an important consideration when planning for a BRT system to an extent as identified for this analysis. A method similar to that employed on the MCDOT BRT study was used: that is, a higher-end system was assumed. For the forecasting analysis a dedicated running way was also assumed, with delays approximated at intersections where BRT vehicles would be crossing other roadways along the corridor. An adjustment to the forecasting process was made for this round of estimates, to better reflect potential future conditions. Those adjustments included the development of a local bus operations plan, as well as the addition of extension segments and new routes forwarded at the request of the County Executive. The planning horizon year used in the forecasting analysis is 2040.

To understand implications of implementing the BRT system, a set of model runs were prepared. These included:

- No Build – the base condition model used to generate an understanding of what the county would look like in the future given reasonable expectations. This model includes land use projected by the M-NCPPC for its MWCOG cooperative forecasting process as well as transportation projects contained in the MWCOG Long Range Transportation Plan. For this purpose the No Build model includes the Purple Line LRT, the Corridor Cities Transitway BRT, and other roadway improvements identified for the region.
- Build 1 – this model developed an understanding of potential ridership for the network under Year 2040 conditions. This model and results assume dedicated busways throughout the system and would be considerd an optimum system with desirable attributes like off-board fare collection, sheltered bus stops and other high quality high-capacity BRT system enhancements.
- Build 2 – this model was developed to test the implications of repurposed lanes in certain locations in the region where lanes might make sense given the supporting surrounding networkand level of existing transit ridership. These repurposed segments include the following (see figure 1 below):
  - Georgia Avenue: 16th Street to Eastern Avenue – 1.7 miles
  - US 29: Lockwood Drive to Eastern Avenue – 3.5 miles
  - MD 355 North: Ridge Road to Middlebrook Road – 1.7 miles
  - MD 355 South: Cedar Lane to Western Avenue – 2.3 miles
  - New Hampshire Avenue: Piney Branch Road to Ethan Allen Avenue – 2.0 miles

Transit speeds in the repurposed areas were lowered from those identified in the Build 1 model to reflect some interference from automobile travel.

Figure 1 - Lane Repurposing Test Segments



Where Dedicated Lanes Could be Assumed

The discussion of a dedicated lane or facility is dependent on the number or riders on the facility in the peak hour. For our purposes we generally applied guidance found in TCRP Synthesis 83 and the second edition of the Transit Capacity and Quality of Service Manual (TCQSM) to identify those treatments that would potentially be appropriate given conditions along the corridor. The TCQSM provides some guidance on when to consider exclusive lane treatments of any type.

> *"Policy and cost considerations generally set the lower limit for bus volumes that warrant priority treatments on arterials, while bus capacity sets the upper limit."*
>
> *"A comparison of person volumes on buses operating in mixed traffic with person volumes in other vehicles operating on the street can also be used to help decide when to dedicate one or more lanes to exclusive bus use"*

The document also contains the following table to help guide decisions on when to consider treatment options for differing conditions.

TCQSM Table on Identified Volumes

Treatment	Min one-way peak hour bus volumes	Min one-way peak hour passenger volumes	Related LU and transportation factors
Bus streets or malls	80-100	3200-4000	Commercially-oriented frontage
CBD curb bus lane, main street	50-80	2000-3200	Commercially-oriented frontage
Curb bus lane, normal flow	30-40	1200-1600	At least 2 lanes available for other traffic in same direction
Median bus lanes	60-90	2400-3600	At least 2 lanes available for other traffic in same direction; ability to separate vehicular turn conflicts from buses

The typical volume identified for a median bus lane above has been set to reflect the level of ridership required to support construction of these types of lanes. The bus volumes identified as a standard result in person throughput on the corridor in the peak hour at multiples of what is possible for an automobile lane, unless one assumes that at least four passengers are in each vehicle in the peak period. Many communities are making decisions to construct median transitways at less than the 2,400 one-way peak hour passenger volumes so different assumptions were used for this analysis.

Mimium Volume Assumptions for Designated Lane Treatments

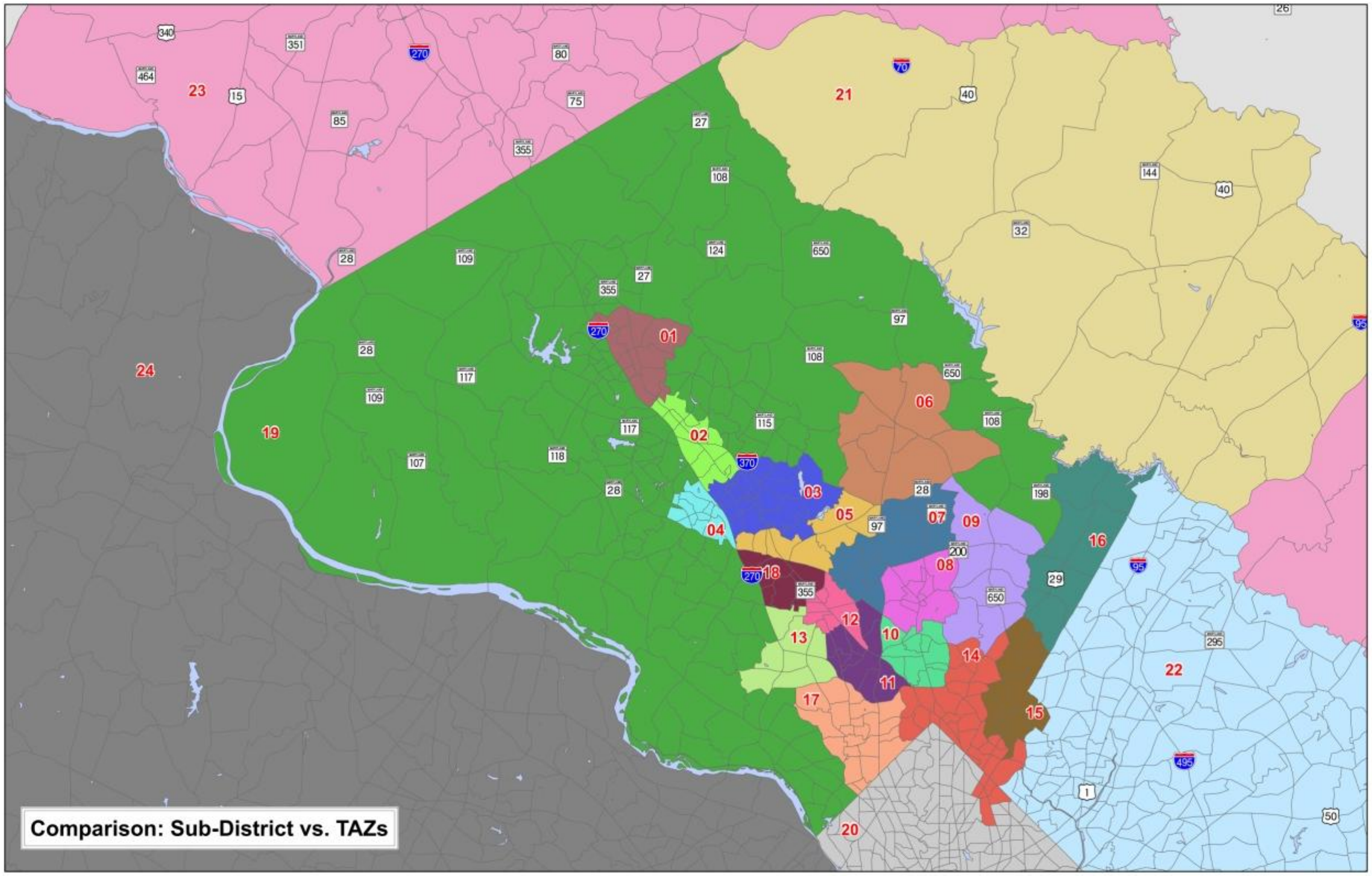
A methodology was applied based on the volumes identified in literature outlined above while also recognizing that there may be a range of potential outcomes associated with the demand forecasting model. Some flexibility of application was needed so a lower limit of consideration was established for whether a particular link would advance for future consideration. For this purpose a lower limit of 800 passengers per segment in the peak directional period was established as a minimum threshold for providing any type of dedicated lane facility. Part of the reasoning for this decision was that the future forecast year of 2040 is 28 years in the future. If a corridor is not truly viable to and beyond that time frame that it is probably not correct to assume that a decision impacting rights of way will be made within the timeframe of the master plan of transportation. Also forecasting models are not expected to provide an extraordinary level of precision so a set of planning level values had to be identified to use as decision-points for the model. The lower bound for this decision (dedicated lane) was set at 800 passengers per direction in the peak hour.

District Level Analysis

A series of districts was designated to help determine the travel conditions in the county for various build conditions. The intent of this exercise was to generate and understanding of what happens beyond those noticed on the facilities themselves. This helps to better understand how the transportation recommendation will benefit/impact all users of the roadway network.

The map and table on the following pages present the results of the forecasting results for this project. The vehicle miles traveled / vehicle hours traveled (vmt/vht) summaries are presented to depict the impact/benfit of various build assumptions. The differences noted show the potential network effects of the various build conditions for automobiles with vehicle miles traveled being reduced with implementation of the BRT network. Vehicle speeds are also improved in the Build1 model due to less vehicles on the roadway.

PARSONS BRINCKERHOFF



PARSONS BRINCKERHOFF

	NO BUILD (PeakOnly)			BUILD 1 (PeakOnly)			BUILD 2 (PeakOnly)			VMT CHANGE			% SPD CHANGE		
DISTRICT	VMT	VHT	Avg Spd (mph)	VMT	VHT	Avg Spd (mph)	VMT	VHT	Avg Spd (mph)	NB-B1	NB-B2	B1-B2	NB-B1	NB-B2	B1-B2
1	223,006	11,085	20.12	217,623	10,498	20.73	216,816	10,500	20.65	-5,383	-6,190	-807	3.04%	2.64%	-0.39%
2	315,126	40,421	7.80	310,461	37,682	8.24	310,936	37,988	8.19	-4,665	-4,190	475	5.68%	4.99%	-0.65%
3	478,418	45,572	10.50	467,467	41,451	11.28	468,834	41,771	11.22	-10,951	-9,585	1,367	7.43%	6.91%	-0.48%
4	404,441	32,105	12.60	397,441	29,882	13.30	398,692	30,287	13.16	-7,001	-5,750	1,251	5.58%	4.50%	-1.03%
5	245,652	26,990	9.10	239,026	24,384	9.80	239,685	24,700	9.70	-6,626	-5,968	659	7.70%	6.62%	-1.01%
6	370,693	25,016	14.82	365,292	23,711	15.41	367,039	23,872	15.38	-5,402	-3,655	1,747	3.97%	3.76%	-0.20%
7	466,627	35,891	13.00	455,909	32,066	14.22	457,709	32,403	14.13	-10,718	-8,918	1,800	9.36%	8.65%	-0.65%
8	229,622	21,412	10.72	223,809	19,127	11.70	224,140	19,390	11.56	-5,814	-5,482	332	9.11%	7.79%	-1.21%
9	499,310	30,580	16.33	490,504	27,720	17.70	488,848	27,080	18.05	-8,806	-10,462	-1,656	8.37%	10.56%	2.02%
10	529,047	45,836	11.54	520,703	42,226	12.33	521,144	42,667	12.21	-8,344	-7,904	441	6.84%	5.82%	-0.95%
11	338,173	39,191	8.63	329,832	35,523	9.28	328,544	34,745	9.46	-8,341	-9,629	-1,288	7.60%	9.58%	1.84%
12	203,539	28,364	7.18	197,015	25,394	7.76	197,105	25,351	7.78	-6,524	-6,434	90	8.12%	8.35%	0.21%
13	442,873	42,362	10.45	436,006	38,947	11.19	436,442	38,966	11.20	-6,867	-6,431	436	7.08%	7.13%	0.05%
14	765,507	82,844	9.24	752,963	77,570	9.71	720,273	78,309	9.20	-12,544	-45,233	-32,690	5.05%	-0.46%	-5.25%
15	352,545	41,929	8.41	346,733	38,882	8.92	335,443	39,216	8.55	-5,812	-17,103	-11,291	6.06%	1.73%	-4.08%
16	484,507	40,577	11.94	479,512	39,339	12.19	478,281	38,991	12.27	-4,995	-6,226	-1,231	2.08%	2.73%	0.63%
17	591,381	82,236	7.19	581,576	77,489	7.51	567,378	80,089	7.08	-9,804	-24,002	-14,198	4.37%	-1.49%	-5.61%
18	346,735	35,820	9.68	340,474	32,358	10.52	340,972	32,819	10.39	-6,261	-5,763	498	8.70%	7.33%	-1.26%
19	4,784,798	367,167	13.03	4,725,735	351,539	13.44	4,743,219	357,369	13.27	-59,063	-41,579	17,484	3.16%	1.85%	-1.27%
MC Total	12,072,003	1,075,398	11.23	11,878,082	1,005,785	11.81	11,841,499	1,016,514	11.65	-193,921	-230,503	-36,583	5.20%	3.77%	-1.36%

Notes

1. VMT and VHT caluted for Peak period only (i.e. AM and PM, no OP)
2. Avg. Speed (mph) calculated as VMT/VHT
3. Both VMT and VHT are calculated for all non-centroid-connector links (unlike the daily where VHT used centroid connectors also)

Travel Time and Speed for Selected Hwy Corriors from the Model

					Travel Time (min)						Avg Speed (mph)					
					No Build			Build2			No Build			Build2		
Corridor	Dir	From	To	Dist	AM	PM	OP	AM	PM	OP	AM	PM	OP	AM	PM	OP
MD 355	NB	Western Ave	Cedar Ln	3.24	10.4	33.6	11.4	11.6	39.3	13.1	18.7	5.8	17.0	16.7	4.9	14.8
	SB	Cedar Ln	Western Ave	3.24	15.5	30.6	11.7	18.4	36.2	13.7	12.6	6.4	16.6	10.6	5.4	14.2
MD 97	NB	Philadelphia Ave	Plyers Mill Rd	3.33	9.5	40.9	11.2	9.6	43.7	11.6	21.1	4.9	17.8	20.8	4.6	17.2
	SB	Plyers Mill Rd	Philadelphia Ave	3.33	20.2	25.5	11.4	21.0	27.0	12.1	9.9	7.8	17.6	9.5	7.4	16.5
US 29	NB	Georgia Ave	Cherry Hill Rd / Randolph Rd	6.09	15.1	69.2	16.8	16.4	71.2	19.1	24.1	5.3	21.7	22.2	5.1	19.2
	SB	Cherry Hill Rd / Randolph Rd	Georgia Ave	6.09	38.9	45.6	18.5	39.8	49.7	20.4	9.4	8.0	19.7	9.2	7.4	17.9
US 29	NB	University Blvd	Stewart Ln	2.39	4.8	22.6	5.2	5.0	23.5	5.8	29.9	6.3	27.5	28.6	6.1	24.9
	SB	Stewart Ln	University Blvd	2.39	13.0	17.8	6.0	13.4	19.4	6.8	11.1	8.0	24.0	10.7	7.4	21.1
MD 650	NB	Ray Rd	Rosemere Ave	7.15	17.9	78.3	18.1	17.9	75.8	18.9	24.0	5.5	23.7	23.9	5.7	22.7
	SB	Rosemere Ave	Ray Rd	7.15	39.6	44.2	19.3	37.4	47.2	20.4	10.8	9.7	22.3	11.5	9.1	21.1

Travel Time Test for Alternatives

An assessment of travel times along corridors identified for lane repurposing was conducted to determine the potential impacts to travelers remaining on those corridors, recognizing that some drivers would choose alternate routing. The table above presents the results of the travel time test across the models applied for this analysis.

Corridor Maps

A set of corridor Maps were prepared to highlight a few key issues when considering assumed transitway treatments and the implications on roadway rights of way. They are intented to compliment the tables provided. The maps depict two specific conditions:

- the corridors showing the BRT supportive density (at the TAZ level) expected to 2040, station locations and areas of potential building impact beyond the master plan right of way

- existing zoning in the corridors that could be considered supportive to BRT service

The rights of way values and building impacts were generalized based on information provided by MNCPPC staff for right of way width for a line file in GIS format. They are not intended to be representative of existing conditions or be at a level that can be used for anything other than this planning level assessment. The effort was undertaken to understand potential constraints posed by existing buildings or structures that might limit the ability to expand the rights of way. Two measures were used to generalize impacts and were based on right of way values contained in the master plan layer. 5 feet (to either side) was used to determine links where very little if any room was available for expansion. 15 feet (to either side) was used as a method to approximate links where limited room was available but not enough to achieve recommended build out conditions.

Corridor Tables

Corridor Tables have been prepared to summarize the findings of the data analysis and identify the recommended right of way considerations. In general the table follows the following methodology:

1. Identify the “Corridor Typology Recommendation” and geographic area within the County through which the route segment would traverse to determine the rights of way needed to accommodate a transit facility. This typology designation was identified in earlier work and is specific to the land uses along

the corridor and the expected trip interactions along the corridor. Example: the cross section of a dual-lane median busway within a constrained urban area is 142 feet.

2. If ROW is available and the link carries viable ridership (based on total surface transit ridership along a route) then use of planned ROW is carried forward.

3. Peak-hour auto v/c ratios are presented to identify whether roadway conditions are such that a facility is needed to provide service to maintain link viability.

4. Property impacts are identified for specific links to identify whether there are buildings in the needed rights of way for corridors. If they are there and no other option exists then "Operational" strategies are recommended which could include lane repurposing, lane controls or mixed traffic operation, not impacting the designated right of way.

Traffic Analysis Results

As noted above a series of VISSIM models were built to test a set of assumptions for BRT operation along two corridors. The first corridor, MD 97, tested the repurposing of the shoulder lane as a dedicated BRT lane to asses the impact on traffic operations at intersections. The second corridor, MD 355, tested median BRT operations along the corridor (with no lane reductions).

It should be noted that the analysis conducted using the VISSIM model was specific to understanding the implications on operations along the two test segments before and after implementing a BRT priority treatment along one corridor. Work conducted on the MD 97 corridor was specific to understanding implications of lane repurposing on the transportation network and work conducted on MD 355 was specific to understanding the implications of a median BRT operation and its effect on corridor functioning. The results of this analysis were intended to provide background on which policy decisions could be made.

The analysis results presented below highlight results from this analysis.

Test Corridor 1: MD 97 from Colesville Road (MD 384/US 29) to 16th Street (MD 390)

BRT Alternative:

Repurpose shoulder lane as BRT-only (right-turning vehicles allowed to use BRT lane).

PARSONS BRINCKERHOFF

Physical Improvements:

None, other than striping and signing and modifications to traffic signals to implement transit signal priority.

Level Of Service:

	Existing		No Build		Build	
	AM	PM	AM	PM	AM	PM
MD 97 & 16th Street	B	C	B	D	C	F
MD 97 & Spring Street	D	E	E	F	E	F
MD 97 & Cameron Street	C	C	C	C	C	D
MD 97 & Colesville Road	D	D	E	F	E	F

Travel Time (entire study segment, end to end):

	AM SB	AM NB	PM SB	PM NB
Existing (measured)	254	198	160.4	182.8
Existing (modeled)	236.1	294.4	229.4	301.7
2040 No-Build*	346.4	285.5	227.8	593.0
2040 Build**	594.8	331.9	340.5	649.6
2040 Build (BRT mode only)***	309	310.4	334.3	274.6

** 2040 No-build model reflects general-purpose traffic and transit service operating along corridor under future conditions; it does not assume BRT is operating under future conditions*

***2040 Build model reflects general-purpose traffic and transit service expected along corridor under future conditions; it assume BRT and right-turning vehicles are operating in shoulder lane under future conditions*

****2040 Build (BRT mode only) reflects travel time of BRT vehicles only*

Operational Feasibility of Lane Repurposing Alternative

Repurposing a curb lane provides favorable operations for BRT, allowing the BRT mode to bypass traffic queues. However, Future "Build" condition LOS shows slightly more congested conditions for general purpose traffic lanes than is observed for the future "No Build" conditions. The feasibility of this alternative is dependent on mainline traffic volumes and may not be suitable in locations where future traffic conditions are expected to be near the capacity of the highway facility.

Advantages

- Separates BRT from congested general-purpose traffic lanes
- Curbside loading simplifies station design
- Facilitates arterial signal coordination
- Provides for pedestrian crossings through normal signal timing
- Infrequent BRT headways allow spare capacity in BRT priority lane for use by other transit vehicles if desired

Disadvantages

- Degradation to LOS for arterial traffic due to reduction of available lanes
- Introduces conflict between BRT vehicles and cars wanting to make right turns

Test Corridor 2: MD 355 from Security Lane to Old Georgetown Road (MD 187)

BRT Alternative:

Dedicated median guideway including closure of all median crossings except at signalized intersections

Physical Improvements:

- Added second northbound left-turn lane at MD 355 / Old Georgetown Road intersection
- Added second southbound left-turn lane at MD 355 / Nicholson Lane intersection
- Modified traffic signals to implement transit signal priority

Level Of Service:

	Existing		No Build		Build	
	AM	PM	AM	PM	AM	PM
MD 355 & Old Georgetown Rd.	C	E	E	F	E	F
MD 355 & Marinelli Road	C	E	F	F	F	F
MD 355 & Nicholson Ln.	C	C	C	C	C	D
MD 355 & Security Ln.	B	B	C	C	D	D

Travel Time (entire study segment, end-to-end):

	AM SB	AM NB	PM SB	PM NB
Existing (measured)	97	200.4	148.4	118.4
Existing (modeled)	186.2	181.1	336.2	348
2040 No-Build*	316.4	326.4	306.1	392.3
2040 Build**	322.0	297.5	332.7	342.9
2040 Build BRT***	188.7	186.9	190.4	195.3

** 2040 No-build model reflects general-purpose traffic and transit service operating along corridor under future conditions; it does not assume BRT is operating and no median closures occur under future conditions*

***2040 Build model reflects general-purpose traffic and transit service expected along corridor under future conditions; it assume only BRT is operating within a median transitway and median are closed at unsignalized intersections under future conditions*

****2040 Build (BRT mode only) reflects travel time of BRT vehicles only*

Operational Feasibility of Median Transitway Alternative

Generally speaking, a BRT system running in a median transitway can be managed to operate with minimal impact to adjacent and crossing street traffic. Coordinating the passage of the BRT vehicles with green phases on parallel routes means that no additional delay is imparted to approaches that are already stopped for red signals.

Given the minimal impact of a median BRT on traffic operations, the feasibility of running BRT in a median transitway is primarily dependent on the ability to widen the roadway cross section to accommodate the transitway and to provide adequate left turn storage capacity at signalized intersections. Therefore, the applicability of a median-running BRT facility should be evaluated on a case-by-case basis.

Advantages

- Total separation of BRT from congested general-purpose traffic lanes
- Accommodates transit signal priority phasing
- Provides for pedestrian crossings concurrent with parallel traffic movements

Disadvantages

- BRT operating in median precludes use of permissive left-turns from major street
- Closure of median crossings necessitates rerouting of left turns to/from side streets; increase of U-turns at retained full-movement intersections
- Consideration for improvements to left-turn lanes to make up for loss of permissive left turn capacity
- In the absence of an existing wide median, requires widened cross section to accommodate median transitway between existing lanes

Overall Conclusion on VISSIM Analysis:

It should be noted that, along both corridors, the throughput for traffic was constrained at one end in both peaks for the identified traffic volume. These constraints act as a type of filter to traffic by restricting the amount that could enter the corridor to be analyzed for traffic impacts. Similar conditions would be expected at an intersection or set of intersections prior to these corridor.

Implementing BRT

As local and regional leaders begin to assume the challenge of implementing a BRT system in Montgomery County and discuss the results of this report, it is important to note that there are typical methods for implementing BRT systems. Recent dialogue in the County has been centered on assessing the identified corridors for higher end runningway treatments only. Very few systems nationally and internationally have progressed immediately to higher end design along particular corridors. Most systems working to implement a wider system of improvements have relied on various strategies for implementation.

While this document is focused on developing right-of-way assumptions to facilitate BRT operations through the year 2040, readers must realize that the full use of that right-of-way would be expected in many cases in later years when corridor ridership develops to a point where investment decisions would make the most sense, such as when supportive land uses can help sustain higher levels of ridership throughout daily service. Montgomery County officials may want to consider a phased approach to BRT implementation and the coordinated development of corridors and surrounding communities over time. Typical approaches to implementation include the following (not necessarily in order of progression):

- Initial **"BRT-lite"** implementation, which would include vehicle purchases, longer station spacing, branding, stylized stations, "Next Bus" displays and other improvements that would help establish the BRT system as a viable, reliable transit option
- Implementation of spot improvements such as **queue jump lanes and transit signal priority**, which provide additional right-of-way or operational improvements to improve speed and reliability
- Implementation of **peak-period BRT lanes**, which allow BRT vehicles to operate in lanes during the peak period and open those lanes to general-purpose traffic during the off-peak periods when traffic flows more freely
- **Full BRT implementation** for corridors that have viable transit currently and can serve as initial implementation of links in developing an overall network. Refined traffic analysis would have to be undertaken to understand implications of lane conversion for BRT use.

Such an incremental approach to implementing a BRT network will help ensure its success to the end users and the operating agency. Moving toward implementation of transit-only lanes without supportive ridership should only be consider after carefully considering the input from all users of the corridor.. Lanes built to accommodate few riders reduces enthusiasm for future investments and fuel resentment from constituents who either choose to or must drive. More refined corridor planning should be done on any corridor identified for improvement to insure that a benefit/cost assessment points to a viable corridor for implementation.

The system envisioned for Montgomery County assessed for this analysis has corridors considered viable for BRT application, a strategy focused on phased implementation applying the right design for conditions found along the corridors will be critical to its success.