VHB Vanasse Hangen Brustlin, Inc.

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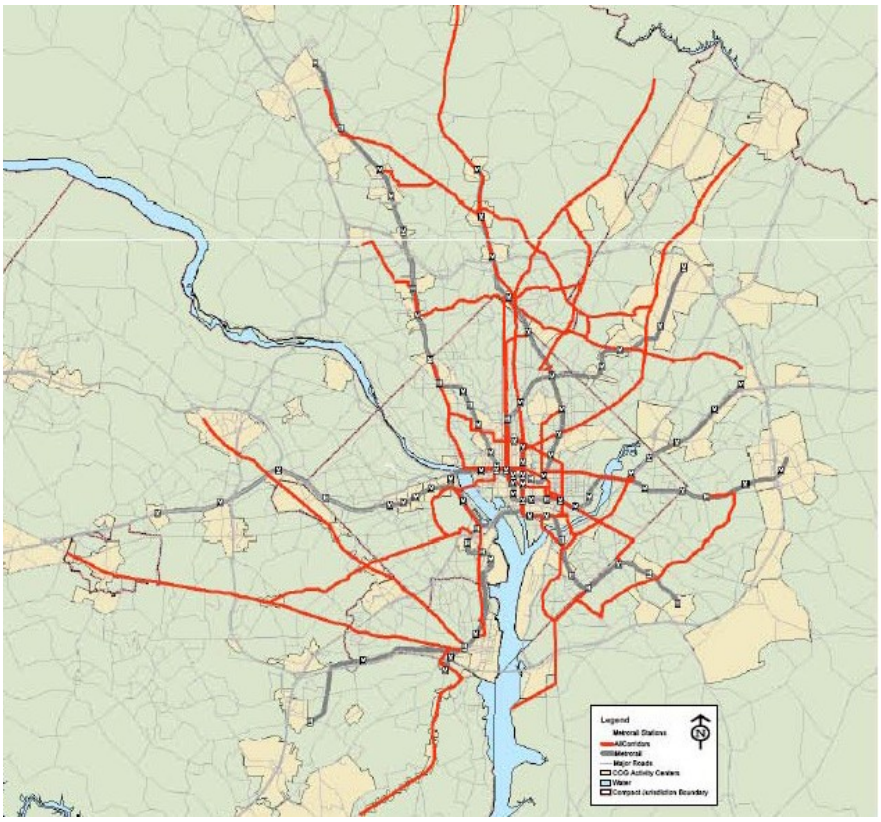
An Evaluation of the Metrobus Priority Corridor Networks

Phase One Technical Memorandum



Submitted to
Metropolitan Washington Council of Governments

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INTRODUCTION

In 2008, the Washington Metropolitan Area Transit Authority (WMATA) developed a bus Priority Corridor Network (PCN) plan to improve bus service travel times, reliability, capacity, productivity, and system access on 24 corridors in the region over a six-year period. The PCN system will include 24 routes operating over 140 miles of roadways in the metropolitan Washington DC area. To support this effort, Vanasse Hangen Brustlin, Inc. (VHB) was contracted to lead a team to develop an analytical framework for evaluating the proposed bus improvements and for identifying the corridor segments where running-way improvements will have the greatest benefit. An evaluation of the regional priority bus network will help establish the regional benefits and impacts and provide recommendations for input to the TPB Constrained Long-Range Transportation Plan (CLRP).

The purpose of this project is twofold:

1. Quantify regional benefits and impacts resulting from implementation of the proposed WMATA Bus Priority Corridor Network (PCN), and

2. Identify and prioritize the most effective running-way improvement strategies for implementation along study corridors.

Over the next five years, corridor implementation plans will be developed to provide for new limited-stop bus routes and to improve the performance of all routes in the corridors with running-way improvements such as dedicated bus lanes, queue jumps, and transit signal priority to reduce transit travel time and provide more reliable and safe bus service. This analysis will apply the TPB regional travel demand model to forecast network-level travel impacts of the PCN and an evaluation of the recommended strategies and expected benefits will be documented in a technical report.

This Technical Memorandum summarizes the results of the first phase of that analysis.

PROJECT GOALS, OBJECTIVES AND MEASURES OF EFFECTIVENESS

As a foundation for this study, goals, objectives, and measures of effectiveness (MOEs) were developed. This section identifies those goals, objectives, and MOEs and indicates the context in which they will be used to conduct an evaluation of the corridors at a system level. While 'goal' and 'objective' are often used interchangeably in colloquial speech, they have distinct definitions in the context of project planning. Goals are broad statements of a desired state. Their purpose is to articulate a vision. An effective goal is general and brief, describing a condition that can be improved upon, but not necessarily fully achieved. Three goals were established for the PCN study:

- Goal 1: Improve the competitiveness of bus transit
- Goal 2: Support existing and planned land use and economic development
- Goal 3: Improve the efficiency of the transportation system

Objectives are specific statements describing the desired outcome. They are quantifiable measures. Achieving an objective should lead to the advancement of its associated goal. Objectives should be quantifiable, time-specific, and measurable. They are often developed in response to specific issues or obstacles, but they can also be used to advance a vision or to define the characteristics of a transportation system. However, objectives should not prejudge one transportation improvement over another.
Objectives were established for each of the study goals:

Goal 1: Improve the competitiveness of bus transit

- Objective 1.1: Increase average bus speed
- Objective 1.2: Increase bus ridership
- Objective 1.3: Increase the number of jobs that are accessible by a 45 minute transit trip.
- Objective 1.4: Improve travel time of transit relative to auto

Goal 2: Support existing and planned land use and economic development

- Objective 2.1: Provide transit service within walking distance of existing and planned households and jobs.

Goal 3: Improve the efficiency of the transportation system

- Objective 3.1: Maximize utilization of roadways by people
- Objective 3.2: Reduce the cost of providing bus service
- Objective 3.3: Increase average speed for bus passengers in corridors
- Objective 3.4: Maintain auto passenger speed within corridors
- Objective 3.5: Improve speed for all passenger trips in corridors
- Objective 3.6: Reduce vehicle-miles traveled (VMT)

MOEs are used to quantify objectives. Their purpose is to understand the transportation need by measuring the extent to which the corresponding objective is achieved. They also serve as a baseline for evaluating the effectiveness of alternative improvements. MOEs were established for each of the study objectives.

Table 1 summarizes the proposed goals, objectives, and MOEs of the study. For each MOE, it indicates how the measure relates to the goals of the study. For example, reducing the travel time of transit compared with the travel time of auto provides an indication of how competitive transit travel is compared to auto travel (Goal 1). MOE targets were provided to the PCN study team when reasonable targets could be ascertained from previous studies, WMATA or Metropolitan Washington Council of Governments (MWCOG) policies, or other sources. Targets for the remaining objectives will be determined when more information is available later in this study. For example, it is generally accepted that transit is competitive with auto travel if there is a travel time ratio of 1.5. In addition, the table indicates whether the MOE is applicable to the entire PCN network, will be used to determine effectiveness of segment treatments, or both, and whether the MOE is designed to be measured during the morning peak period, evening peak period, midday period, or throughout the day.

The goals, objectives, and MOEs defined in this study will be used to evaluate and prioritize transit investments in the priority corridor network.

Table 1: PCN Evaluation Goals, Objectives, and Performance Measures

Goal	Objectives	Measures of Effectiveness	Target	Purpose	Network or Segment Level	Daily	AM Peak	Midday	PM Peak
Goal 1: Improve the competitiveness of bus transit.	Objective 1.1: Increase average bus speed.	Percent increase in average peak period bus speed.	25% better than local	Quantifies the effectiveness of express bus treatments at reducing average peak period bus speed.	Both		X		X
		Percent increase in average off-peak bus speed.	25% better than local	Quantifies the effectiveness of express bus treatments at reducing average off-peak period bus speed.	Both			X	
		Percent change in average travel time per passenger.	25% better than base	Quantifies the effectiveness of express bus treatments at reducing transit travel time per passenger.	System		X	X	X
		Annual passenger travel time saved.	25% better than base	Quantifies the effectiveness of express bus treatments at reducing transit travel time per passenger.	System		X	X	X
	Objective 1.2: Increase bus ridership.	Percent increase in average peak period bus ridership.	TBD	Indicates the success of express bus treatments at making transit more competitive in the peak period.	Both		X		X
		Percent increase in average off-peak bus ridership.	TBD	Indicates the success of express bus treatments at making transit more competitive in the off-peak period.	Both			X	
		Percent change in regional bus ridership.	TBD	Indicates the success of express bus treatments at making transit more competitive overall.	System		X	X	X
	Objective 1.3: Increase number of jobs that are accessible by a 45 minute transit trip.	Percent of jobs within 45 minutes by transit to households.	TBD	Measures the accessibility of jobs by transit.	System		X		
	Objective 1.4: Improve travel time of transit relative to auto.	The ratio of transit travel time to auto travel time.	Decrease to 1.5	Measures how competitive transit is with auto in terms of travel time.	System		X	X	X
Goal 2: Support existing and planned land use and economic development.	Objective 2.1: Provide transit service within walking distance of existing and planned households and jobs.	Increase the number of households within ½ mile of priority bus stops.	TBD	Measures the portion of households that can be considered within walking distance of priority corridor transit.	System	X			
		Percent of households within 45 minutes by bus to job centers.	TBD	Measures the portion of households that are within 45 minutes of jobs by priority corridor transit.	System		X		

Goal	Objectives	Measures of Effectiveness	Target	Purpose	Network or Segment Level	Daily	AM Peak	Midday	PM Peak
		Increase the number of jobs within ½ mile of priority bus stops.	TBD	Measures the portion of jobs that can be considered within walking distance of priority corridor transit.	System	X			
		Percent of jobs within 45 minutes by bus to corridor households.	TBD	Measures the portion of jobs that are within 45 minutes of residences by transit.	System		X		
Goal 3: Improve the efficiency of the transportation system.	Objective 3.1: Maximize utilization of roadways by people.	People served per new lane.	TBD	Measures the ability of new lanes to transport people (as opposed to vehicles).	Both		X	X	X
		People served per converted lane.	TBD	Measures the ability of converted lanes to transport people (as opposed to vehicles).	Both		X	X	X
	Objective 3.2: Reduce the cost of providing bus service.	Bus hours needed for service.	TBD	Improving the speed of bus operations reduces the travel time per run, and therefore operating costs.	System		X	X	X
		Number of buses needed.	TBD	Improving the speed of bus operations reduces the travel time per run, and therefore vehicle requirements. This reduces capital costs.	System		X	X	X
	Objective 3.3: Increase average speed for bus passengers in corridors.	% change in bus passenger times for trips through and within all corridors.	TBD	Measures the effectiveness of express bus treatments at reducing transit travel time per passenger.	System		X	X	X
	Objective 3.4: Maintain auto passenger speed within corridors.	% change in auto passenger times for trips through and within all corridors.	TBD	Ensures that bus service improvements do not adversely impact auto travel.	System		X	X	X
	Objective 3.5: Improve speed for all passenger trips in corridors.	% change in times for all (auto and bus) trips through and within all corridors.	TBD	Measures the effectiveness of express bus treatments at reducing transit travel for all travelers.	System		X	X	X
	Objective 3.6: Reduce vehicle miles traveled (VMT).	% change in bus VMT.	TBD	As a major component of greenhouse gas emissions, reducing VMT directly improves environmental quality.	System	X	X	X	X
		% change in auto VMT.	TBD	As a major component of greenhouse gas emissions, reducing VMT directly improves environmental quality.	System	X	X	X	X

PRIORITY BUS MEASURES AND THEIR POTENTIAL EFFECTS

Projects establishing various forms of bus priority, both in the Washington metropolitan area and across the nation, are not new. The bus lanes on I-395 in Northern Virginia date from about 1974. Bus (and right-turn) only lanes on Arlington Boulevard (US 50) in Arlington were operated in peak-hours prior to the opening of I-66. Contra-flow bus lanes were operated in cities ranging from San Juan, Puerto Rico to Madison, Wisconsin and bus only transit malls were developed in many cities. In the past decade, there has been greater interest in providing enhanced bus operations as part of an entire package of improvements that include not only priority rights-of-way but also other features to improve both the performance and the visibility of the bus services. These other features include priority for transit vehicles at traffic signals, off-board fare collection, queue-jump lanes at key intersections or congestion points, greater spacing between stops, and branding of the service to enhance visibility and customer recognition. The broader package incorporating all of the priority and marketing elements is often identified as Bus Rapid Transit (BRT), but projects incorporating several of the priority elements have been implemented in many metropolitan areas across the nation. Most of these projects have been implemented in only the past few years, but selected information documenting the effects achieved by these projects is beginning to appear in the literature.

A summary of the benefits that had been demonstrated by implementation of various forms of bus priority treatment through 2006 can be found in the Bus Rapid Transit Practitioner's Guide.[1] While a full BRT may be the goal for many agencies, experience has shown that the implementation of selected key elements of the overall package can result in significant improvement in bus operations, increased ridership and customer satisfaction.

[1] Bus Rapid Transit Practitioner's Guide, Transit Cooperative Research Program Report 118, Transportation Research Board, Washington DC, 2007

The previous section of this memorandum identified three goals, nine objectives and 22 measures proposed to be used in evaluating the effectiveness of bus priority actions in the designated corridors.

Twelve of those measures relate directly or indirectly to the reduction in bus travel time that can be achieved. Factors that affect the bus travel time include:

- the extent of transit exclusive roadway space available,
- the use of transit signal priority to reduce bus delays at traffic signals,
- the use of off-board fare collection to reduce boarding times, and
- the spacing of bus stops or stations.

Understanding the time devoted to various activities (e.g. in-motion, picking-up or discharging passengers, stopping at a traffic signal, etc.) provides insights into how each of the factors contributes to the overall travel time for a bus trip and the gains that can be made by implementing the various priority strategies. The data for such analyses are obtained from speed and delay studies on specific routes or corridors. Figure 1 illustrates the components of bus travel time as reported by the New York City Metropolitan Transit Authority (NYCMTA) in its study of the Fordham Road bus priority implementation (known as +selectbus). Figure 2 illustrates the components of bus travel time as observed on WMATA Route 9A in Fairfax County in 2000, while Table 2 presents the data on which the charts are based.

For the Fordham Road corridor in New York with substantial boarding and alighting activity and heavy traffic, the bus is in motion just over half the time (54%) For the Fairfax County studies with less on and off activity, the bus was in motion over three-quarters of the time (77%) on a light traffic summer day and 65% of the time on a fall day with greater traffic. Note that in the Fairfax County study, the actual time in motion for the surveyed trip was essentially the same (43.6 vs. 43.9 minutes) in both observations. The greater passenger activity in the fall added just under a minute to the overall trip time. The greater roadway congestion, with concomitant signal delay, in

September compared to August accounted for almost all the additional time (11.8 vs. 3.9 minutes). Direct comparisons between the effect of signal delay on Fordham Road in New York and Route 1 in Fairfax County are not possible without greater knowledge of the number and spacing of traffic signals in the two locations. Also note that in the Fairfax studies, delay was considered to be "'signal delay" if the bus was stopped in a queue that resulted from traffic back-up at a traffic signal.

Figure 1: Components of bus running time (NYCMTA)

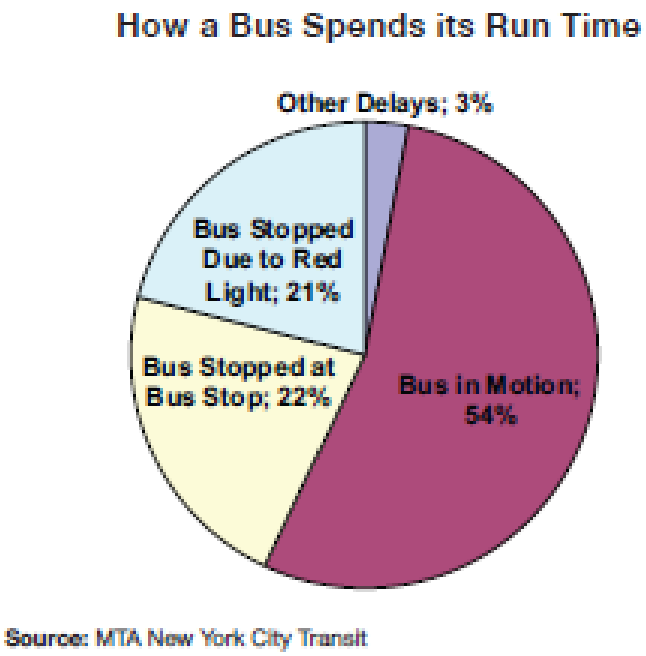


Figure 2: Components of Bus Travel Time, Fairfax County VA

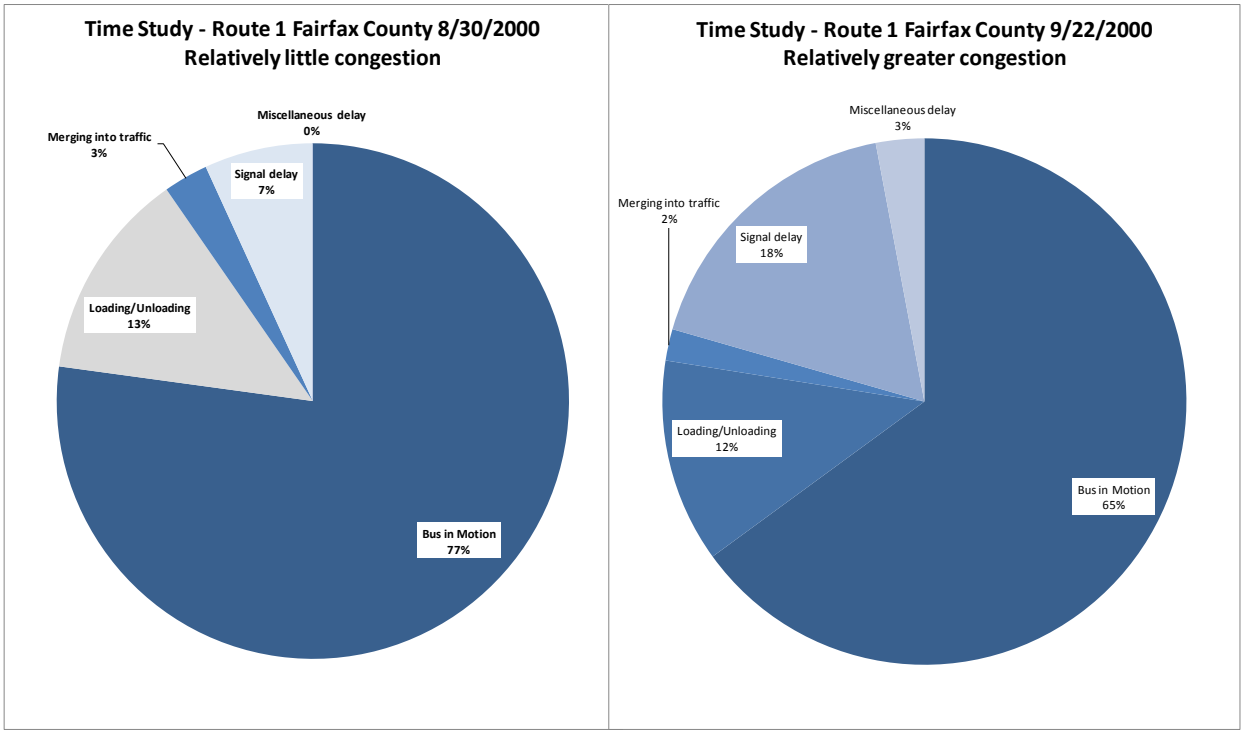


Table 2: Fairfax County Bus Travel Time Study Data

Northbound trips from Lorton VRE Station to Huntington Metrorail Station Morning Peak Hour		
Activity	August 30, 2000 (Wednesday) Lv. 7:22 AM	September 22, 2000 (Friday) Lv. 7:29 AM
	Minutes	Minutes
Bus in Motion	43.9	43.6
Loading/Unloading	7.5	8.4
Merging into traffic	1.6	1.3
Signal delay	3.9	11.8
Miscellaneous delay	0	2
Total	56.9	67.1

For a bus operating on an arterial roadway with adjacent traffic, the gain in maximum operating speed to be achieved by use of an exclusive lane is not likely to be large. The speed, while in motion, will be governed by the roadway conditions, roadside friction, posted speed limits and similar factors. The data from Fairfax County suggest that the reductions in travel time that can be attributed to an exclusive or semi-exclusive bus lane arise not from increased maximum operating speed but rather primarily from the queue-jump opportunities afforded by the bus priority lane.

Effect of exclusive use of roadway space

Many of the bus priority systems in North America use the curb lane on an existing roadway by restricting it, either all day or in peak hours, to use by transit vehicles. Often, these lanes are also used by other vehicles that are turning right at the next intersection. The change in bus speed or travel time that will result from the use by buses of such an exclusive lane depends in large measure on the overall capacity of the roadway, the number of vehicles using the lane to make right turns, the number of

intersections at which right turns are permitted, and the spacing of bus stops. Table 3 illustrates how average bus speeds vary with stop spacing and dwell time for a range of typical conditions. For conditions that would be typical for a priority bus operation (e.g. bus stop spacing of 0.25 to 0.50 miles and 30 second dwell times), the change in travel time that may be expected from the use of a dedicated bus lane is 3 minutes per mile. The overall time saving in a segment or corridor can be estimated by determining the length (in miles) for which the restricted lane is to be provided and multiplying by this factor.

Table 3: Estimated Arterial Bus Speeds with and without dedicated bus lanes

Estimated Average Bus Speeds on General Purpose Traffic Lanes						
Average Stop Spacing (miles)	*Average Dwell Time Per Stop (seconds)*					
	10	*20*	*30*	*40*	*50*	*60*
0.10	6	5	5	4	4	3
0.20	9	8	7	6	6	5
0.25	10	9	8	7	7	6
0.50	11	10	10	9	9	8
Estimated Average Bus Speeds on Dedicated Arterial Street Bus Lanes						
Average Stop Spacing (miles)	*Average Dwell Time Per Stop (seconds)*					
	10	*20*	*30*	*40*	*50*	*60*
0.10	9	7	6	5	4	4
0.20	16	13	11	10	9	8
0.25	18	15	13	11	10	9
0.50	25	22	20	18	16	15

Source: Source for data: Characteristics of Bus Rapid Transit for Decision Makers, FTA, Feb. 2009, Page 3-5

Use of transit signal preemption to reduce bus delays at traffic signals

Many of the bus priority projects implemented have had priority for buses at transit signals as one element. Transit Signal Priority (TSP) has been part of the transit priority package used in cities ranging in size from Springfield, Massachusetts to Los Angeles, California. The effectiveness of signal priority in reducing bus running times will, of course, vary with the degree of existing congestion and the number of signals. This is illustrated, in part by the experience in Las Vegas (Table 4) which shows the most

significant time savings in the peak directions (southbound in the morning and northbound in the afternoon). For this 7.6 mile project involving both mixed lanes and exclusive lanes, the savings are on the order of 2 minutes per mile in the peak hour peak directions and 1.3 minutes per mile in the peak hour off-peak directions. The proportion of the savings due to TSP, as opposed to the other priority elements (e.g. fewer stops) is not reported but the experience from the Metro Rapid in Los Angeles is that about one-third of the savings **(0.40 to .66 min/mile)** result from TSP.

Table 4: Average Weekday Travel Times (min) on Route 113 and MAX by Time of Day

	Route 113 (pre-MAX)		MAX		Percentage Reduction	
	NB	SB	NB	SB	NB	SB
AM	38	49	28	31	26%	43%
Midday	44	49	28	31	36%	37%
PM	37	39	23	28	38%	28%

Use of off-board fare collection to reduce boarding times

Table 5 illustrates the time that is required to serve boarding passengers under a range of fare policies.

Table 5: Bus passenger Service times (Seconds/passenger)

Fare Payment Method	Observed Range	Default (Single-Door Boarding)
BOARDING		
Pre-payment (e.g., passes, no fare, free transfer, pay on exit)	2.25–2.75	2.5
Smart card	3.0–3.7	3.7
Single ticket or token	3.4–3.6	3.7
Exact change	3.6–4.3	4.2
Swipe or dip card	4.2	4.4
ALIGHTING		
Rear door	1.4–2.7	2.3
Front door	2.6–3.7	3.5

Sources: Transit Capacity and Quality of Service Manual, 2nd Edition, p. 4-5; "BRT Implementation Guidelines," Table 8-7.

When exact change is required, the reported time per boarding is over 4 seconds, although fares requiring odd combinations of change (e.g. $1.40, with no bills accepted) could result in substantially longer times. At stops with more than one or two boarding passengers, the time at a bus stop can easily approach a minute. Over the length of a heavily used bus route with many stops, the time to board passengers and collect fares can easily exceed the 12% of trip time observed in Fairfax County. In such conditions, the 22% of trip time devoted to serving passengers at bus stops reported in New York may be more typical.

Off-board fare collection not only reduces the time per transaction required to serve a passenger from about 4 seconds to 2.5 seconds, it also permits the use of all doors for boarding. At a stop with 30 boarding passengers, the time savings that would be required for on-board fare payment would be about 30 x 4 = 120 seconds. With off-board fare payment, this time would drop to 30 x 2.5 = 75 seconds. Use of both the front and rear doors for boarding would reduce this still further to about 40 seconds – one-third of the time for boarding with cash fare payment – and a savings of over a minute per stop.

For a priority bus route with two to three stops per mile, the time saving attributable to off-board fare collection would be about 3 minutes per mile.

Spacing of Bus Stops or Stations

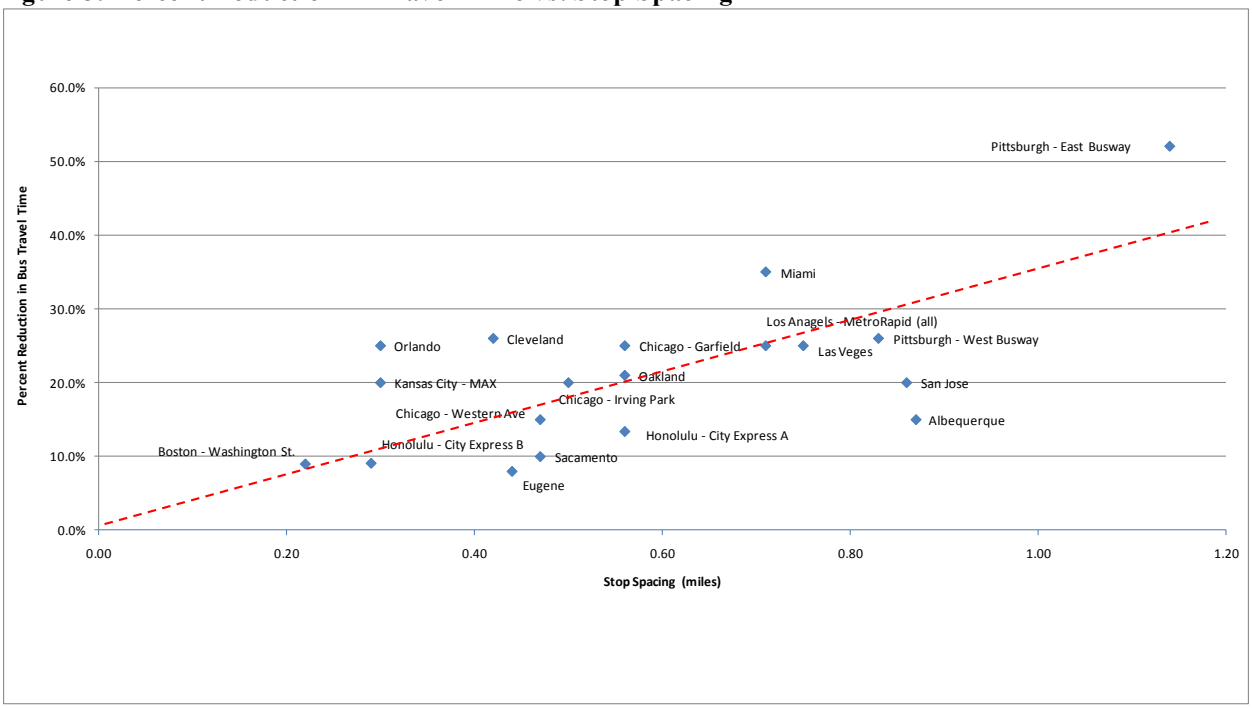
The number of bus stops can have a significant effect of bus running times. At a stop with no boarding or alighting passengers, the effects may be small, but even at these stops the driver must reduce speed and be prepared stop in the anticipation of a request for service. When a passenger is waiting to board or there is a request for a stop, the driver must decelerate, maneuver to the stop location, operate the doors, check to be sure that boarding and alighting passengers have cleared the vehicle, and maneuver back into traffic. All of these steps are required and are independent of the number of passengers boarding or alighting. Reducing the number of bus stops has been a major factor in reducing the travel time for most of the priority bus projects reported in the

United States. The degree of time savings depends on multiple factors including the number of stops per mile in both the before and after conditions and the boarding and alighting volumes. Unfortunately, from the data reported it is not always possible to isolate the effects of reducing the number of bus stops from the effects of off-board fare collection or establishment of bus priority lanes.

Figure 3 illustrates the relationship between the spacing of bus stops on the priority bus services implemented in eighteen cities and the percentage reduction in travel time. A linear regression on these data suggests that for every additional tenth of a mile between stops there is a 3.5% reduction in travel time compared to the non-priority bus service.

The time savings attributable only to fewer stops per mile is directly related to the average operating speed of the bus, and the prior stop spacing. For a prior stop spacing of 0.167 miles (6 stops per mile), the time savings expected would range from 0.9 minutes per mile for buses operating at an average speed of 8 m.p.h. to 0.5 minutes per mile for buses operating at an average speed on 20 m.p.h.

Figure 3: Percent Reduction in Travel Time vs. Stop Spacing



Source for data: Characteristics of Bus Rapid Transit for Decision Makers, FTA, Feb. 2009, Pages3-9 ff

Summary

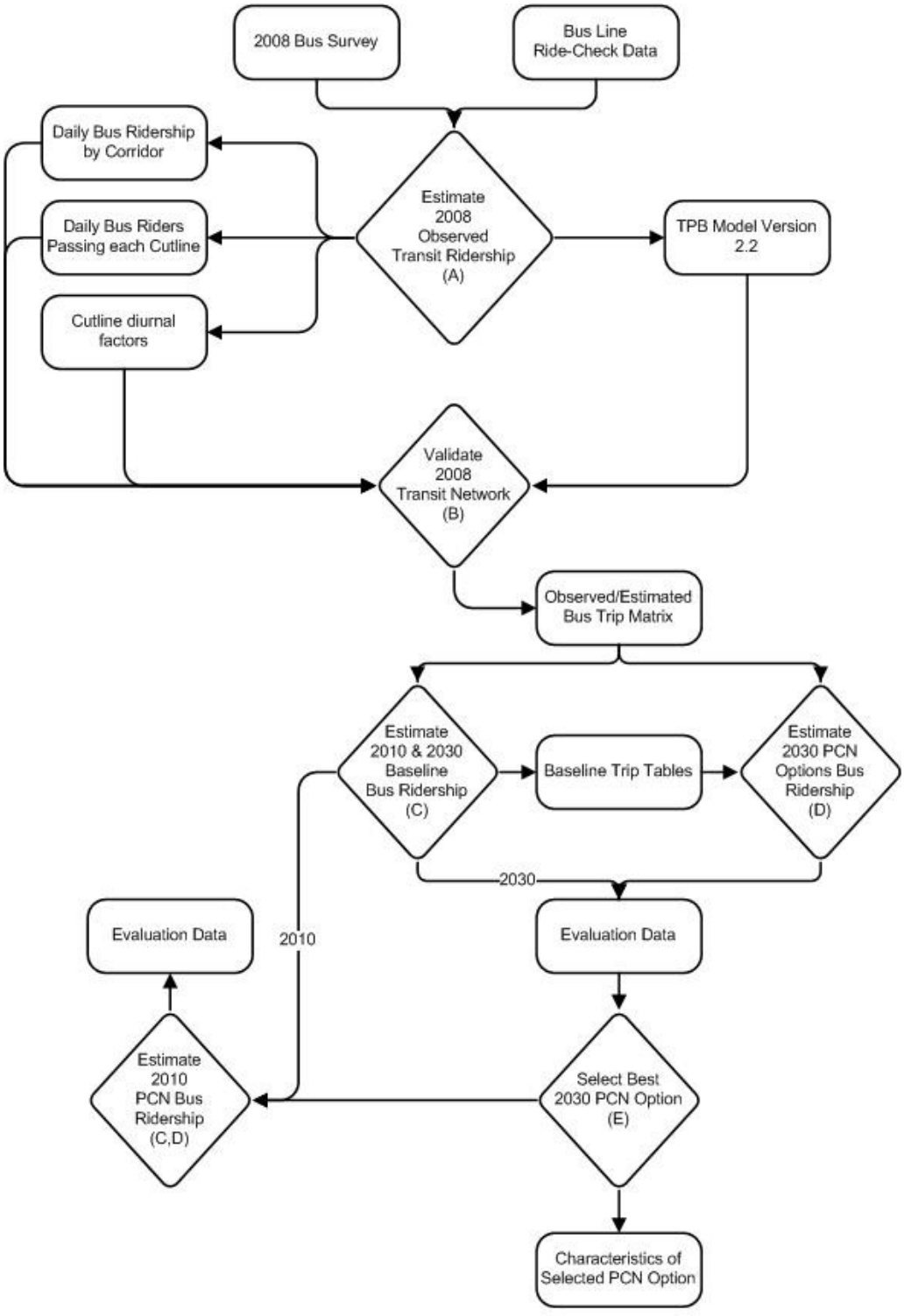
Factors that affect the bus travel time	Time savings (minutes per mile)
Exclusive use of roadway	3
Transit signal priority	0.40 to 0.66
Off-board fare collection	3
Spacing of bus stops or stations	0.5 to 0.9

DEVELOPMENT OF ANALYTIC APPROACH

It is very important that the travel demand model used for analysis of the PCN options can reasonably estimate corridor level ridership on bus lines. MWCOG does not assign transit trips as part of its modeling process for a number of reasons including the difficulty of accurately assigning trips to bus lines. Furthermore, the nested logit post-processor developed for WMATA and MWCOG has only been successfully applied for individual corridor studies, but has never been successfully applied by MWCOG for the entire region.

For all the reasons described above, a new approach will be used to evaluate the effect of bus improvements on the PCN corridors. This approach uses the MWCOG Version 2.2 model set, as applied by MWCOG for the 2008 Constrained Long Range Plan (CLRP) and the aspiration study, augmented by bus counts and a pivot point model using coefficients derived from reliable sources relevant to the Washington region and the nature of the PCN strategies being evaluated. A high level flowchart of the approach is shown in Figure 4.

Figure 4: Analysis Approach



(A) Detailed flowchart

Step 1 – Estimate Existing Bus Ridership

As shown in Figure 4, the approach includes multiple components. The first component is the gathering of available bus patronage data to estimate existing ridership that will be compared to model results for 2008. A detailed representation of this first step is shown in Flowchart1- A in Appendix 1. Ride-check and other data were obtained for most of WMATA and local provider bus lines that travel in the 24 PCN corridors. Ride-check data, which are counts of passengers boarding and alighting at each bus stop, provide estimates of total daily riders on each bus line, by time of day. They also provide the number of riders passing selected locations (i.e., cutlines) along the PCN corridors to estimate the number of bus passengers on PCN routes at different points along the corridor. The ride check data will be normalized to reflect May 2008 bus ridership by line that was provided from the 2008 WMATA bus survey conducted by MWCOG. The results of the first step include:

- Observed daily ridership of bus routes associated with each PCN corridor,
- Daily bus riders passing each cutline,
- Factors to estimate AM peak period, PM peak period, and midday ridership from daily ridership.

Step 2 – 2008 Model Adjustment

The second component of the process is to validate the transit network and factor the model results for 2008 to match 2008 observed data. Details of this step, which serves several purposes, are shown in Flowchart1- B of Appendix 1. The first will be to provide a validation of the transit network used by the model, and the second is to provide corridor by corridor assignments for 2008 conditions.

The 2008 model results will be examined to determine how well the model forecasts transit ridership in each of the 24 corridors. Based on the results of that analysis, a revised network will be run using adjustments to centroid connectors and network modifications that will improve the performance of the model. Even with these adjustments, we do not anticipate that that the model results will match observed data

within an acceptable error range (e.g., 25%) in every corridor. Therefore, the count data will then be used to develop a correction factor for each corridor, and in a few cases sub-corridors, that will be applied to all future year forecasts. This factor will be developed based on the percentage difference and absolute difference between assignments and passenger counts. The passenger counts will also be used to create a set of factors that will be used to adjust future year bus trips by origin-destination (O-D) pair. The products of this step will include:

- An acceptable model that provides corridor-wide volumes for each of the 24 PCN corridors
- Comparison of 2008 observed and modeled estimated daily bus ridership for:
    - Corridor level total bus ridership
    - Total bus ridership at individual cutlines
    - Ratio of observed and estimated daily bus ridership by origin and destination pair for bus trips in the 24 PCN corridors

Step 3 - Develop Baseline 2010 and 2030 Conditions

The third component of the analysis process in Figure 4 (shown in detail in Appendix 1 Flowchart1- C) is to develop baseline 2010 and 2030 forecasts of transportation conditions. This will be accomplished using the CLRP networks for 2010 and 2030, and socioeconomic data (MWCOG Round 7.1 Cooperative Forecasts) within the Version 2.2 model. This forecast will form the basis of most of the required analysis of 2030 conditions. It will provide baseline bus patronage without the PCN improvements for each of the 24 corridors, and a baseline highway assignment. A select link analysis will be used to identify the O-D zones that use bus in all of the corridors. The trips for these O-D zones will be adjusted to reflect the revised trips resulting from the factored corridor and cutline volumes. The resulting trip tables will serve as the basis for the next step, pivot point modeling. It also provides information about estimated baseline

2030 conditions that will be compared to the situation with the enhanced PCN network for that year.

The products of this step will include:

- Daily bus passenger trips crossing each cutline without PCN enhancements for 2010 and 2030
- Daily bus passenger trips in each corridor without PCN enhancements for 2010 and 2030
- Trip table of bus passenger trips using all PCN corridors prior to enhancements for 2010 and 2030
- Trips (i,j pairs) that would use buses in PCN corridors before enhancements in 2010 and 2030
- Baseline automobile data without PCN enhancements for 2010 and 2030
    - Auto Trip Table
    - Regional Vehicle-Miles Traveled (VMT) ,Vehicle-Hours Traveled (VHT), and Person-Hours Traveled (PHT) for auto users
    - Daily automobile vehicle trips crossing each cutline
    - Peak hour capacity of each cutline
- Zone to zone out-of-vehicle and in-vehicle times prior to enhancements
- Baseline transit supply and demand data for 2010 and 2030 to compare with results of PCN evaluation

Step 4 – 2030 PCN Bus Ridership Forecasts and Resulting Changes in Highway Conditions

The fourth component of the forecasting process Figure 4 (shown in detail in Appendix 1 Flowchart1- D) is the forecast of 2030 transit demand with the PCN improvements, and to estimate the effect that the PCN improvements will have on auto travel. This forecast will use the adjusted base year trip tables developed in step 3 and a pivot point

model (i.e., incremental logit model). For this component, the highway and transit networks will be recoded to include the appropriate highway and transit network changes for each of the PCN options. These PCN option networks will be used to determine the in-vehicle and out of-vehicle changes in travel time for both bus trips and auto trips within the PCN network. The difference in time related to PCN improvements will be evaluated to estimate the resulting change in bus passengers and auto drivers. This may require running through the pivot point process at least twice if the bus ridership increases enough to affect performance of the highway system. This iterative process will capture the impact that increased bus ridership and reduced auto trips would have on highway speeds.

The resulting transit trip tables will be adjusted to reflect the differences found between 2008 observed and modeled trips in step 2. Adjustments will only be made to those trips between O-D pairs that were determined to use buses serving the PCN corridors in the 2008 baseline. New trips between O-D pairs not served in the baseline will not be adjusted.

The adjusted transit trip table will be used to modify the highway trip table to reflect the impact of the PCN options. The modified trip tables will then be assigned to the highway and transit networks to determine utilization of bus service and the impact on the highway network. Most, if not all performance measures, will be determined using the results of these assignments. The products of this step will include:

- Assignment of all transit trips to bus and rail routes
- Daily bus passenger trips in each corridor
- Adjusted trip table of bus passenger trips using all corridors after PCN enhancements for each alternative for 2030
- 2030 automobile network data for after PCN enhancements for each alternative
    - Regional VMT , VHT, and PHT for auto users
    - Daily automobile vehicle trips crossing each cutline

  - Peak hour capacity of each cutline

- Zone to zone out-of-vehicle and in-vehicle times with PCN measures
- Highway and transit supply and demand data to evaluate PCN measures

Step 5 Evaluation of 2030 PCN options

The fifth component of the analysis process in Figure 4 is to evaluate the impacts of the PCN network on the highway and transit systems. This step uses data derived in the previous steps to quantify the MOEs. MOE values for the "high priority" PCN measures (e.g., dedicated bus lanes, signal priority, 10 minutes or better headways in during the peak period, etc.) will be analyzed to determine in which corridors they are effective without dramatically degrading the highway system, and where they make the most sense. A second network with "medium priority" measures (e.g., improved headways, queue jumpers, signal preemption, etc.) will be developed. Segments from the "high priority" option that have a low level of ridership (to be determined) and/ or high impact on roadway capacity due to reserving a lane in each direction for bus only operations) will be identified and unwarranted transit-exclusive segments will be removed from the network. Furthermore, corridors where the "medium priority" measures provide comparable results to "high priority" measures will also be candidates for removal of exclusive lanes.

A third PCN network (modified network) will be developed keeping the "high priority" measures where appropriate, and where they are not appropriate include less obtrusive measures. The results of the analysis of the modified network will then be compared to MOEs for the full "high priority", the "medium priority" scenarios, and the baseline to estimate the relative regional benefits of the PCN system. This evaluation will result in a final PCN network derived from the modified network for which a new set of MOEs will be estimated and benefits predicted. The products of this step will be:

- MOEs for each alternative

- An evaluation matrix that demonstrates the pros and cons of each alternative
- Selected PCN alternative

Step 6 2010 Evaluation of Selected PCN System

The last component of the analysis process will be to evaluate the effect of PCN measures selected for 2030 on 2010 conditions. This will use the 2010 baseline conditions developed in step 3 and perform the same pivot point analysis as was accomplished in step 4 using the 2010 trip tables. MOEs will be produced for this analysis so that the 2010 impact of the PCN network can be illustrated.

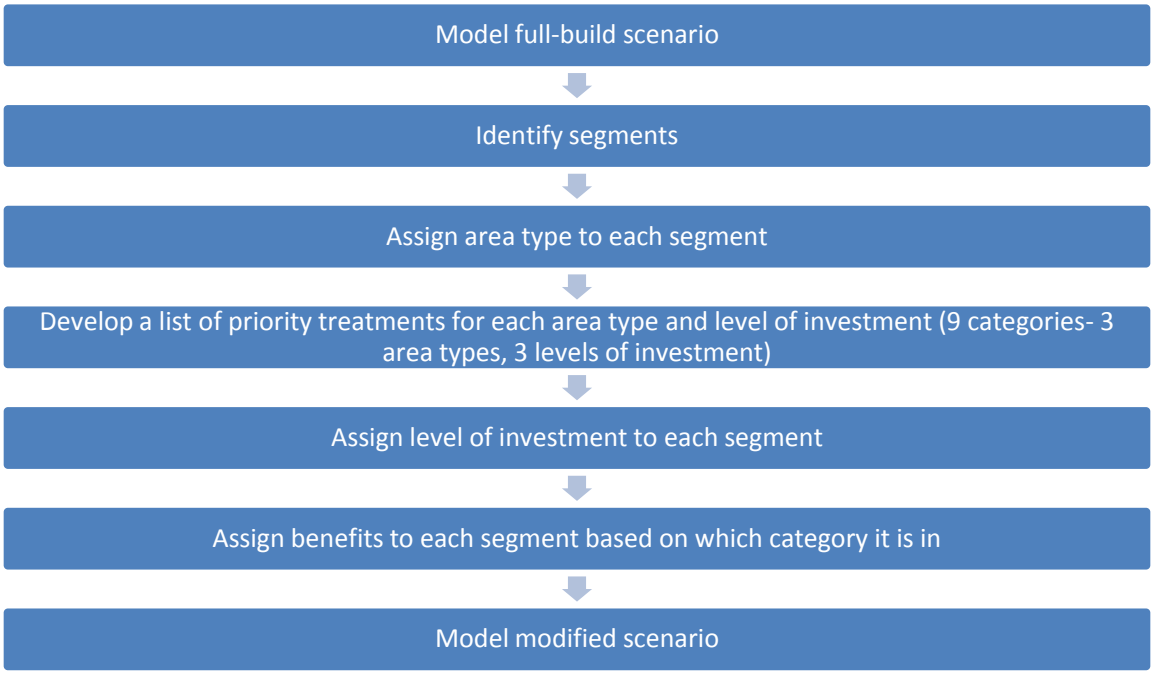
PCN CORRIDOR DEFINITIONS

Background and Purpose of Segmentation

The PCN is comprised of 24 corridors throughout the WMATA compact area that have been identified as candidates for improvements to bus operating conditions. The corridors are illustrated in Appendix 2. The network was developed by WMATA in conjunction with input from the compact area jurisdictions, and includes nine corridors that are primarily in the District of Columbia, five that are primarily in Virginia, and ten that are primarily in Maryland. In total, the 24 corridors cover nearly 250 miles of roadway that WMATA and its partners have identified for improvements, including the addition or conversion of a lane to bus-only operations, signal priority, queue jumpers, off-board fare collection, and branding. Some improvements have already been implemented in a few of these corridors and have yielded operational benefits for bus service, including along Richmond Highway (US-1) in Virginia and Sixteenth Street in the District.

In order to effectively manage what improvements should be considered for such a large network, the network was divided into manageable segments based on the number of through lanes and household and employment density. The evaluation of the PCN will begin by first running the regional travel demand model with a "full-build" scenario, where an exclusive bus lane would be assumed to be operational on all parts of the network. Once the results of that analysis are complete, the outcomes, along with information from industry research on bus priority treatments, will be utilized to assign a "modified" set of priority treatments to model for each segment of the network. The process that will be followed is outlined in Figure 5.

Figure 5: Process for Using Segments to Develop Modified Scenario



Segmentation Methodology

In order to determine where to break the segments, a few basic premises were assumed. First, segments would always begin and end at an intersection. In addition, some of the key components of segment determination were the number of lanes and roadway functional classification. While a change from one lane to two did not necessarily drive a decision to break a segment, a change from two through lanes to three did, as conversion of an existing lane into an exclusive bus lane is more realistic when there are three or more through lanes. In addition to the number of lanes, the biggest drivers for determining the start and end points of a segment were the household and employment densities on either side of the corridor. Additionally, in many cases, segments were cut at jurisdictional boundaries in order to allow the two jurisdictions to decide on different levels of investment to be modeled on the corridor. Finally, any Metrorail stations that were served mid-corridor generally served as a segment cut point.

In order to make informed decisions on the segmentation, a geographic information system (GIS) was developed that included all of the information that would be needed

as the corridors were reviewed. Data in the GIS that were used to determine the segmentation included:

- PCN Corridors
- Metrorail lines and stations
- WMATA bus network
- Effective bus headway layer (including WMATA and local service)
- MARC and VRE stations
- Roadway network from travel model
- Number of through lanes (including any peak period changes)
- Functional classification
- Area type (combination of household and employment densities)
- Aerial photography
- Household and employment densities from Round 7.1 Cooperative Forecasts (2005 and 2030)

The original intent was to keep segments at least two miles long, but as the process progressed, it became clear that was not possible, especially in places where the number of lanes changed from three to fewer.

Once the segments were developed, each one was assigned an area type based on the household and employment density: Urban, Inner Suburban, or Outer Suburban. The area types were not tied to the regional location of the segment, but rather to the density of the surrounding land use. For example, parts of corridors running through Tysons Corner are considered "urban," while parts of corridors in the District of Columbia are considered "inner suburban." Using these area type definitions along with the level of investment that will later be identified for each segment will result in a list of improvements that will be modeled as part of the "modified" network. This process is detailed in Figure 5, above, and explained further in the Next Steps section, below.

In addition to the characteristics used to determine where the segments should be cut, the following information was included for each corridor or segment:

- Corridor Level Information
    - Other WMATA bus routes operating on corridor (aside from main ones identified by WMATA)
    - Local and commuter bus routes operating on the corridors
    - Transit ridership
- Segment Level Information
    - Available median and/ or parking lanes
    - Effective bus headway
    - Availability of existing park and ride locations (including at Metrorail stations and park-and-ride facilities)

Segmentation Results

Upon completion of the segmentation analysis, the length of the corridors totaled approximately 233 miles as roughly measured in GIS. This number will be solidified as part of the modeling process. The 24 corridors contain 120 segments with an average segment length of 1.95 miles; the shortest segment is 0.2 miles and the longest is 5.9 miles. While the original plan was to keep the segments no shorter than two miles, the realities of the changes in roadway cross-sections and adjacent urban form resulted in many segments shorter than that.

It is also important to note that some portions of the corridors are actually not on the main corridor itself but are "access roads" to the corridor, i.e. between the Metrorail station and the corridor. While the access portions of the corridors are included in the segmentation, it is likely that there will not be much, if any, improvements modeled for these portions of the corridors.

The basic characteristics of the segments are shown in Table 6. The full complement of segment characteristics is located in Appendix 3.

Table 6: Segment List

#	Corridor Name	Routes[2]	Other Routes on Corridor[3]	One Way Length (mi)	Corridor/Segment Limits	
1	**Columbia Pike (Pike Ride)**	**16ABDEFJ 16GHKW 16L 16Y**	**ART 41, 42, 73, 74, 75**	**6.7**	**Pentagon Metro**	**Columbia Pike and Little River Tpk**
1a				1.6	Pentagon Metro	Columbia Pike and Courthouse Rd
1b				2.7	Columbia Pike and Courthouse Rd	Columbia Pike at Leesburg Pike/Baileys Crossroads
1c				4	Columbia Pike at Leesburg Pike/Baileys Crossroads	Columbia Pike and Little River Tpk
				8.3		
1d				1.2	McPherson Square Metro	18th St and E St Expwy (including stops at Farragut North and West)
1e				0.8	18th St and E St Expwy	E St Expwy and TR Memorial Bridge
1f				0.8	E St Expwy and TR Memorial Bridge	US-50 (after ramp from I-66)
1g				2	US-50 (after ramp from I-66)	Washington Blvd Exit of Arlington Blvd
1h				0.6	Washington Blvd Exit of Arlington Blvd	Courthouse Rd and Columbia Pike
				5.4		

[2] Black font = existing local route, Orange font = existing priority route, Blue font = new express route, Green font = new route, Red font = discontinued route
[3] Ibid

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
2	**Richmond Highway Express**	**REX**	**MB 9A; FC 151, 152, 161, 162, 171; AT 1, 6, 7**	**13.6**	**Eisenhower Metro**	**Ft. Belvoir**
2a				1.6	Eisenhower Metro	Huntington Ave and Richmond Hwy (including stop at Huntington Metro)
2b				3.9	Huntington Ave and Richmond Hwy	Route 235/Old Mt. Vernon Rd
2c				3.5	Route 235/Old Mt. Vernon Rd	Ft. Belvoir
				9.0		
3	**Georgia Ave./7th Street**	**70 71 79**	**MB A9, V7, V8, V9, Circ-NS, 13B, 13F, A42, A46, A48, P17, P19, W13, K1, 32, 34, 36, 39, 60, 62, 63; MTA 901, 904, 905, 915, 929**	**9.0**	**P St and Half St SW (S of Navy Yard and Waterfront Metros)**	**Silver Spring Metro**
3a				1.1	P St and Half St SW (including stop at Waterfront Metro)	7th and I
3b				1.0	7th and I	7th and Pennsylvania
3c				0.2	7th and Pennsylvania	7th and E
3d				0.5	7th and E	7th and K (including stop at Gallery Place Metro)
3e				2.6	7th and K	New Hampshire Ave (GA Ave-Petworth Metro, plus stops at Mt. Vernon Square Metro and Shaw-Howard Metro)
3f				3.3	New Hampshire Ave (GA Ave-Petworth Metro)	Eastern Ave
3g				0.7	Eastern Ave	Silver Spring Metro
				9.4		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
4	**Crystal City-Potomac Yard**	**9A 9E 9S**	**MB 5A, 23A, 23C; ART 90; FC 595, 597**	**4.9**	**Pentagon Metro**	**Braddock Rd Metro**
4a				1.0	Pentagon Metro (Eads St)	JD Hwy and 20th St (Includes stop at Crystal City Metro)
4b				0.9	JD Hwy and 20th St	JD Hwy at S Glebe
4c				1.5	JD Hwy at S Glebe	JD Hwy at Monroe Ave
4d				1.4	Monroe Ave	Braddock Rd Metro
				4.8		
5	**Southern Ave. Metro-National Harbor**	**NH-1**	**MB A2, A42, P12, P17, P18, P19, D12, D13, D14, W13, W15, W19**	**8.3**	**Southern Ave Metro Station**	**Oxon Hill Rd at National Harbor**
5a				0.4	Southern Ave Metro Station (Southern Ave SE)	Southern Ave and 13th Street (United Medical Center)
5b				1.4	Southern Ave and 13th Street (United Medical Center)	Southern Ave and Indian Head Hwy
5c				1.4	Southern Ave and Indian Head Hwy	Indian Head Hwy at Oxon Hill Rd
5d				2.0	Indian Head Hwy at Oxon Hill Rd	Oxon Hill Rd at National Harbor
				5.2		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
6	**Wisconsin Ave./Pennsylvania Ave.**	**30 32 34 35 36**	**MB F14, M2, 39, M6, B2, K11, 37, 39, 38B, D5, CIRC-EW, 31, N22, P17, P19, W13, 70, 71, V8, 13A 13G, 13B, 13F, A42, A46, A48, 54, 38B, 11Y, G8, 43, X2, N2, H4, X3, S2, S4; MTA 902, 903, 904, 905, 909, 922**	**12.7**	**Naylor Road Metro Station**	**Friendship Heights Metro**
6a				1.2	Naylor Road Metro Station	Southern Ave and Pennsylvania Ave SE
6b				1.7	Southern Ave and Pennsylvania Ave SE	I-395 (including stops at Potomac Ave and Eastern Mkt Metros)
6c				5.4	I-395	Wisconsin and M St (including stops at Archives, Federal Triangle, McPherson and Farragut West Metros)
6d				0.9	Wisconsin and M St	Wisconsin and 35th St. (including stop at Foggy Bottom Metro)
6e				2.9	Wisconsin and 35th St.	Friendship Heights Metro at Western Ave (including a stop at Tenleytown Metro)
				12.1		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
7	**University Blvd / East-West Highway**	**J1 J2 J3 J4**	**MB C2, C4, F8; RO 47, 70, 1, 2, 11, 28, 12, 15, 19, 16, 20, 24**	**10.1**	**Montgomery Mall Transit Center (Westlake Drive)**	**College Park Metro**
7a				1.3	Montgomery Mall Transit Center (Westlake Drive)	Democracy Blvd and Old Georgetown
7b				1.6	Democracy Blvd and Old Georgetown	Old Georgetown and Cedar Lane
7c				0.7	Old Georgetown and Cedar Lane	Cedar Lane and 355
7d				1.5	Cedar Lane and 355	Bethesda Metro (including stop at Medical Center Metro)
7e				1.8	Bethesda Metro	E-W Hwy at Jones Mill Rd (Including stop at Silver Spring Transit Center)
7f				2.4	E-W Hwy at Jones Mill Rd	Wayne and Cedar
7g				1.9	Wayne and Cedar	Piney Branch and University
7h				2.7	Piney Branch and University Blvd	University Blvd and Adelphi Rd
7i				2.2	University Blvd and Adelphi Rd	College Park Metro
				16.1		
8	**Sixteenth Street (DC)**	**S1 S2 S4**	**MB S9; MTA 915**	**7.9**	**McPherson Square Metro**	**Silver Spring Metro**
8a				1.6	McPherson Square	16th St and Florida Ave
8b				0.5	16th St and Florida Ave	16th St and Columbia Rd
8c				0.9	16th St and Columbia Rd	16th St and Arkansas Ave
8d				3.6	16th St and Arkansas Ave	16th St and Colesville Road
8e				0.4	16th St and Colesville Road	Silver Spring Metro
				7.0		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
9	**Leesburg Pike**	**28AB 28FG 28T**	**MB: 4A, 26A, 26B, 26E, 26W, 3B, 25A, 25C, 16H, 16P, 16J, 16E, 16F, 16B, 3B, 2T; AT5, AT6; FC574**	**12.3**	**King St Metro**	**Tysons Westpark**
9a				2.1	King St Metro	Leesburg Pike and Quaker Lane
9b				1.5	Leesburg Pike and Quaker Lane	Leesburg Pike and Beauregard St
9c				1.4	Leesburg Pike and Beauregard St	Leesburg Pike and Columbia Pike
9d				2.1	Leesburg Pike and Columbia Pike	Arlington Blvd/7 Corners at New 7 Corners Transit Center
9e				2.8	Arlington Blvd/7 Corners at New 7 Corners Transit Center	I-66 with possible stop at West Falls Church Metro
9f				1.4	I-66	I-495
				2.4	I-495	Tysons Westpark
				13.7		
10	**Veirs Mill Road**	**Q2**	**MB Y5, Y7, Y8, Y9, J5, C4; RO 7, 34, 38, 48, 26, 45, 46, 55**	**13.6**	**Silver Spring Metro**	**Shady Grove Metro**
10a				0.5	Silver Spring Metro	Spring Street
10b				0.6	Georgia Ave and Spring Street	Georgia Ave and 16th St
10c				0.6	Georgia Ave and 16th St	Georgia Ave and I-495 (Forest Glen Metro)
10d				1.6	Georgia Ave and I-495 (Forest Glen Metro)	Georgia and Veirs Mills Rd (Wheaton Metro)
10e				1.7	Georgia and Veirs Mills Rd (Wheaton Metro)	Veirs Mill Rd and Connecticut
10f				2.5	Veirs Mill Rd and Connecticut	Veirs Mill Rd and Twinbrook Pkwy
10g				2.1	Veirs Mill Rd and Twinbrook Pkwy	Rockville Metro
10h				2.7	Rockville Metro	Shady Grove Metro
				12.3		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
11	**New Hampshire Avenue**	**K6**	**MB C8; RO 16, 20, 24, 10, 22**	**8.5**	**Fort Totten Metro**	**White Oak (Columbia Pike and Stewart Lane)**
11a				1.5	Fort Totten Metro	New Hampshire Ave and Eastern Ave
11b				1.8	New Hampshire Ave and Eastern Ave	New Hampshire and University Blvd
11c				2.2	New Hampshire and University Blvd	New Hampshire and I-495
11d				2.3	New Hampshire and I-495	White Oak (Columbia Pike and Stewart Lane)- with a stop at the new White Oak Transit Center
				7.8		
12	**H Street / Benning Road**	**X2**	**MB X1, X3, 80, P6, S2, S4, S9, U4, D8, G8, 42, 43; MTA 950**	**5.1**	**Minnesota Ave Metro**	**McPherson Square Metro**
12a				2.2	Minnesota Ave Metro	Benning Rd and Bladensburg Rd
12b				2.5	Benning Rd and Bladensburg Rd	McPherson Square Metro (including stops at Union Station, Gallery Place and Metro Center Metros)
				4.7		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
13	**Georgia Ave. (MD)**	**Y5 Y7 Y8 Y9**	**MB J5, Q2; RO 7, 33, 41, 51, 52, 53**	**13.5**	**Silver Spring Metro**	**Montgomery General Hospital**
13a				0.5	Silver Spring Metro	Spring Street
13b				0.6	Georgia Ave and Spring Street	Georgia Ave and 16th St
13c				0.6	Georgia Ave and 16th St	Georgia Ave and I-495 (Forest Glen Metro)
13d				1.6	Georgia Ave and I-495 (Forest Glen Metro)	Georgia and Veirs Mills Rd (Wheaton Metro)
13e				1.5	Georgia and Veirs Mills Rd (Wheaton Metro)	Georgia Ave and Randolph Road
13f				4.1	Georgia Ave and Randolph Road	Georgia Ave and Norbeck Road (including stop at Glenmont Metro)
13g				3.0	Georgia Ave and Norbeck Road	Georgia Ave and Olney-Sandy Spring Rd
13h				1.1	Georgia Ave and Olney-Sandy Spring Rd	Montgomery General Hospital
				13.0		
14	**Greenbelt-Twinbrook**	**C2 C4**	**MB F4, R2, R3, R1, R5, 15, J4, Q2, C8, J5; RO 7, 8, 9, 10, 19, 34, 38, 48; TB 14**	**14.4**	**Prince George's Plaza Metro**	**Twinbrook Metro**
14a				2.9	Prince George's Plaza Metro	Riggs Rd and University Blvd
14b				1.4	Riggs Rd and University Blvd	East University Blvd and Piney Branch Rd
14c				4.9	East University Blvd and Piney Branch Rd	Wheaton Metro Station
14d				2.0	Wheaton Metro Station	Veirs Mills Road and Randolph Road
14e				1.4	Veirs Mills Road and Randolph Road	Randolph Road and Parklawn Dr
14f				1.0	Randolph Road and Parklawn Dr	Twinbrook Metro
				13.6		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
15	**East-West Highway (Prince Georges)**	**F4 F6**	**MB C4, R2, R3, 84; RO 16,17; TB 13, 14, 16**	**13.0**	**Silver Spring Metro**	**New Carrollton Metro**
15a				1.5	Silver Spring Metro	Philadelphia Ave and Piney Branch Road
15b				2.2	Philadelphia Ave and Piney Branch Road	Ethan Allen and Riggs Rd
15c				2.8	Ethan Allen and Riggs Rd	East-West Hwy and Baltimore Ave (including stop at Prince George's Plaza Metro)
15d				2.1	East-West Hwy and Baltimore Ave	E-W Hwy at B-W Pkwy
15e				3.0	E-W Hwy at B-W Pkwy	New Carrollton Metro
				11.6		
16	**Anacostia-Congress Heights**	**A2-8, A42-48**	**MB A9, P1, P2, V5, 52, 54, V7, V8, V9, P17, P18, P19, W13, W14, W4**	**5.2**	**L'Enfant Plaza Metro**	**S Capitol St and Southern Ave SE**
16a				1.6	7th and D St SW	Beginning of Fred Douglass Bridge
16b				2.1	Beginning of Fred Douglass Bridge	MLK Ave SE and Lebaum St SE (including stop at Anacostia Metro)
16c				2.1	MLK Ave SE and Lebaum St SE	S Capitol St and Southern Ave SE at Park and Ride Lot on Southern Ave
				5.8		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
17	**Little River Turnpike/Duke Street**	**29KN 29CEGHX**	**MB 8X, 8Z, 16A, 16B, 16D, 16E, 16L, 17A, 17B, 17M, 7A, 7F, 7X, 7H, 3A; AT 1, 2, 8; FC 306, 401; CUE Green**	**15.9**	**King St. Metro**	**Route 123**
17a				2.5	King St Metro (Duke and Callahan)	Duke St and Jordan St.
17b				1.9	Duke St and Jordan St.	Duke St and Beauregard St
17c				4.2	Duke St and Beauregard St	I-495
17d				2.9	I-495	Pickett Rd
17e				1.9	Pickett Rd	Route 123
				13.4		
18	**Rhode Island Ave. Metro to Laurel**	**81 82 83 86 87 88 89 89M**	**MB B8, B9, T18, 84, C2; TB 13, 17**	**12.9**	**Rhode Island Ave Metro**	**Cherry Lane (Laurel)**
18a				1.9	Rhode Island Ave Metro	Eastern Ave
18b				3.5	Eastern Ave	Baltimore Ave and Mowatt Lane
18c				2.9	Baltimore Ave and Mowatt Lane	I-495
18d				2.7	I-495	Ammendale Road
18e				3.5	Ammendale Road	Cherry Lane
				14.5		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
19	**Mass Ave/ U St./ Florida Ave./ 8th St./ MLK Ave.**	**90 92 93**	**MB A42, A46, A48, P1, P2, P6, V5, X3, 96, 98, U2, N22, L2; MTA 903**	**8.2**	**Anacostia Metro**	**Woodley Park Metro**
19a				1.6	Anacostia Metro	M St and 8th St. SE
19b				2	M St and 8th St. SE	8th St. and FL Ave NE (including stop at Eastern Mkt Metro)
19c				1.0	8th St. and FL Ave NE	FL and N Capitol St NE (including stop at NY Ave Metro)
19d				2.6	FL and N Capitol St NE	Woodley Park Metro (including stop at U Street Metro)
				7.2		
20	**Rhode Island Avenue**	**G8**	**MB D8, B8, B9, T18, 81, 82, 83, 86, 84, R4**	**7.4**	**Shaw Howard Univ Metro**	**Eastern Ave and Michigan Ave NE**
20a				1.6	Shaw Howard Univ Metro	RI and 4th St NE
20b				1	RI and 4th St NE	Brookland Metro (including potential stop at Rhode Island Ave Metro)
20c				2.1	Brookland Metro	Randolph St and Eastern Ave
20d				0.8	Randolph St and Eastern Ave	Eastern Ave and Michigan Ave NE
				5.5		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
21	**Eastover - Addison Road**	**P12**	**MB W19, W15, D12, D13, D14, K11, K12, K13; TB 20, 24**	**15.2**	**Southern Ave and Indian Head Hwy**	**Addison Rd Metro**
21a				1.4	Southern Ave and Indian Head Hwy	13th Street at United Medical Center (with potential stop at Southern Ave Metro)
21b				3.3	13th Street at United Medical Center	Iverson St and Branch Ave
21c				3.5	Iverson St and Branch Ave	Walker Mill Road and Addison Rd (with potential stop at Suitland Metro)
21d				2.2	Walker Mill Road and Addison Rd	Shady Glen Drive and Central Avenue
21e				1.0	Shady Glen Drive and Central Avenue	Addison Rd Metro
				11.4		
22	**Colesville Rd./ Columbia Pike - MD US 29**	**Z2 Z6 Z8 Z9,29 Z11,13**	**RO 8, 9, 10, 12, 13, 14, 22; MTA 915, 929**	**12.1**	**Silver Spring Metro**	**Columbia Pike and Sandy Spring Rd**
22a				1.1	Silver Spring Metro	Colesville Rd and Sligo Creek Pkwy
22b				2.1	Colesville Rd and Sligo Creek Pkwy	Columbia Pike and Lockwood Drive
22c				3.0	Columbia Pike and Lockwood Drive	Columbia Pike and E Randolph/Cherry Hill Rd
22d				4.2	Columbia Pike and E Randolph/Cherry Hill Rd	Columbia Pike and Sandy Spring Rd
				10.4		

#	Corridor Name	Routes	Other Routes on Corridor	One Way Length (mi)	Corridor/Segment Limits	
23	**Fourteenth Street**	**52 53 54**	**MB 11Y, 13A, 13B, 13G, 13F, V7, V9; MTA 909, 902, 907, 922**	**6.5**	**L'Enfant Plaza Metro**	**Takoma Park Metro**
23a				2.7	L'Enfant Plaza Metro	14th and R St NW (including stops at Smithsonian Metro and McPherson Metro)
23b				4.1	14th and R St NW	14th and Aspen (including stop at Columbia Heights Metro)
23c				1.1	14th and Aspen	Takoma Park Metro
				7.9		
24	**North Capitol Street**	**80**	**MB X2, 3Y, 16Y, S1, S2, S4, S9, D1, D3, D5, D6, P6, 9P, H1, H2, H3, H4, 96, G8, CIRC-EW, N2, N4, N6; MTA 903, 922, 915**	**9.1**	**19th and K (Farragut N and W)**	**Fort Totten Metro**
24a				1	19th and K (Farragut N and W)	13th and H (including stop at McPherson Square Metro)
24b				1.3	13th and H	H and North Capitol (including stop at Union Station Metro)
24c				0.9	H and North Capitol	North Capitol and Florida
24d				1.1	North Capitol and Florida	North Capitol and Michigan (including stop at Brookland-CUA Metro)
24e				2.3	North Capitol and Michigan	Monroe and 12th St
24f				1.8	Monroe and 12th St	Fort Totten Metro
				8.4		

Next Steps

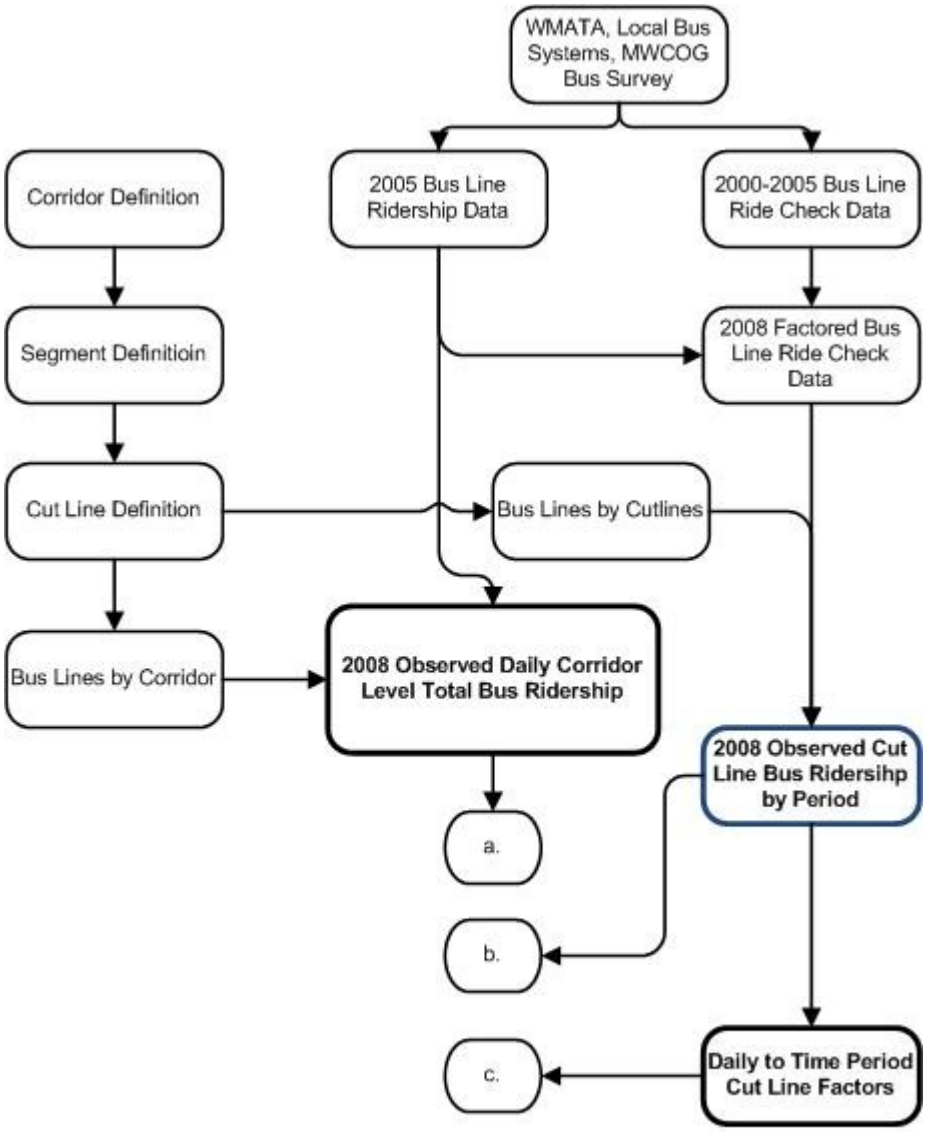
Using the information obtained as part of the best-practices research, a set of improvements will be identified for each of the nine categories outlined in Figure 6. Each segment, which already has an area type assigned to it, will then be assigned a level of investment, based on what makes sense for that area given its roadway characteristics and other information, such as results from the full-build model run, i.e. that an exclusive bus lane has too great an impact on general traffic in that segment of roadway.

Figure 6: Categories of Improvements for Segments

		Area Type		
		Urban	Inner Suburban	Outer Suburban
Investment Level	High	*Example:* - Exclusive Lane -Signal Priority -Off-board fare collection -2 queue jump lanes per mile -Peak headway 5 minutes -1 mile stop spacing -etc.	…	…
	Medium	…	…	…
	Low	…	…	…

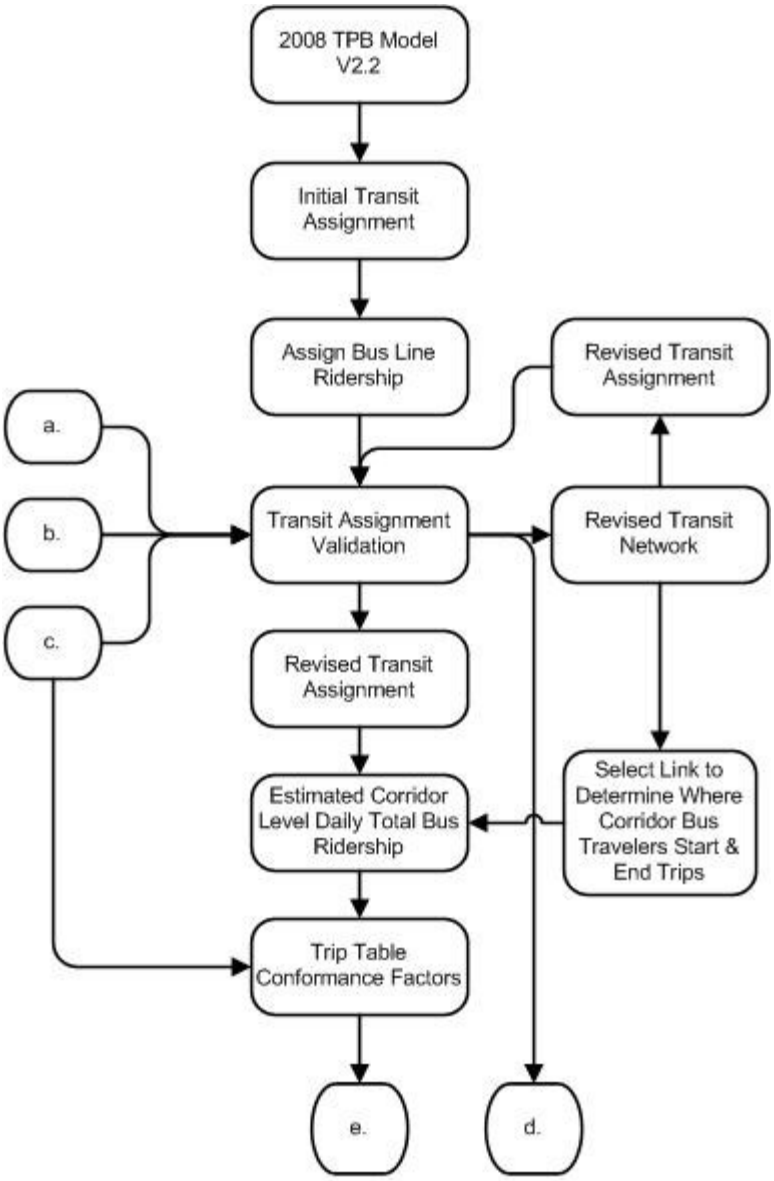
Appendix 1

Flowchart1- A: Estimating Ridership



a. Observed daily ridership of bus routes associated to each corridor
b. Daily total bus riders passing each cut line
c. Factors splitting total bus riders to different time periods by direction for each cut line

Flowchart1- B: Validation of Transit Network

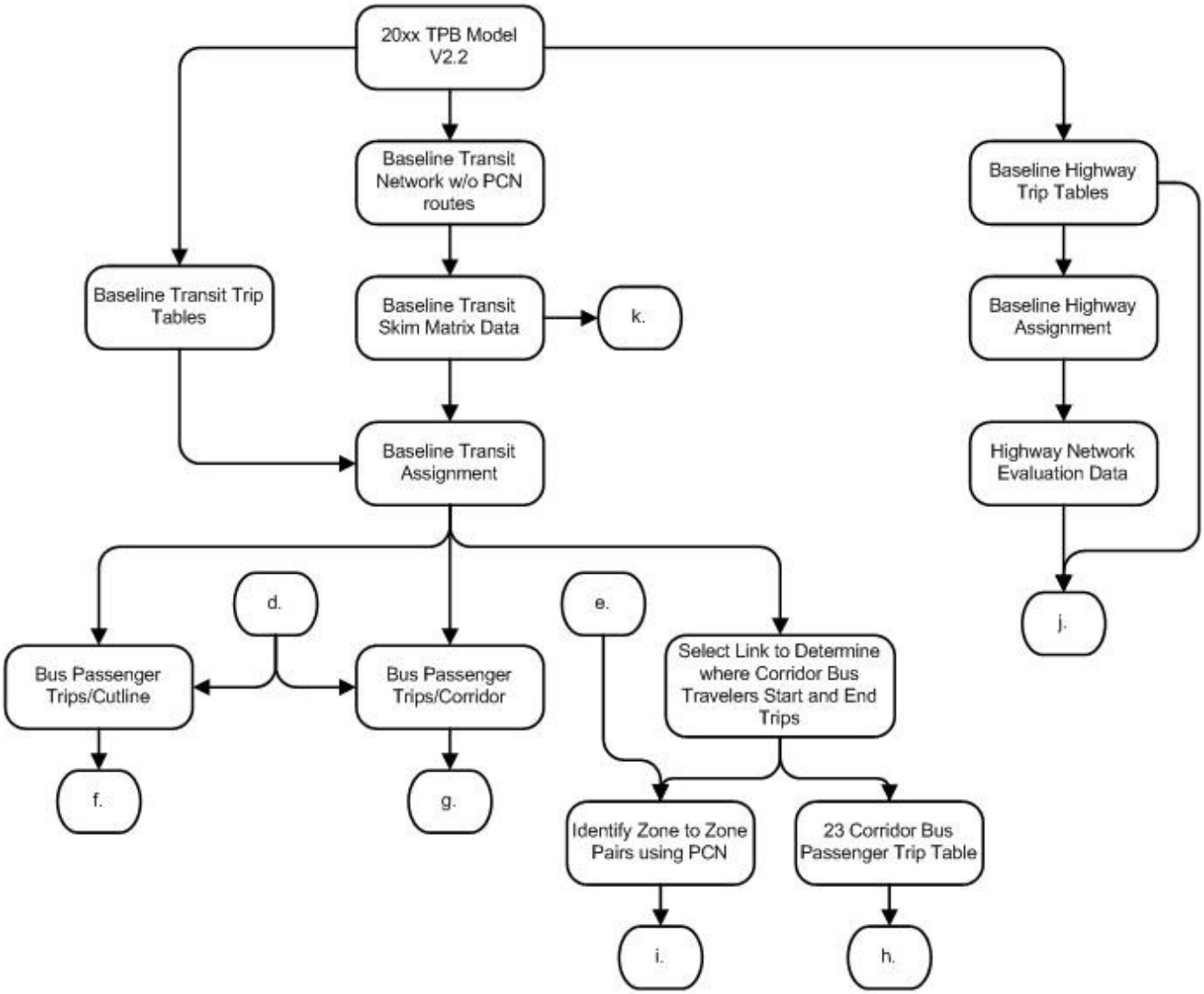


d. Comparison of observed and model estimated daily bus ridership with regard to:

1. Corridor bus lines
2. Corridor level total bus ridership
3. Total bus ridership at individual cut lines

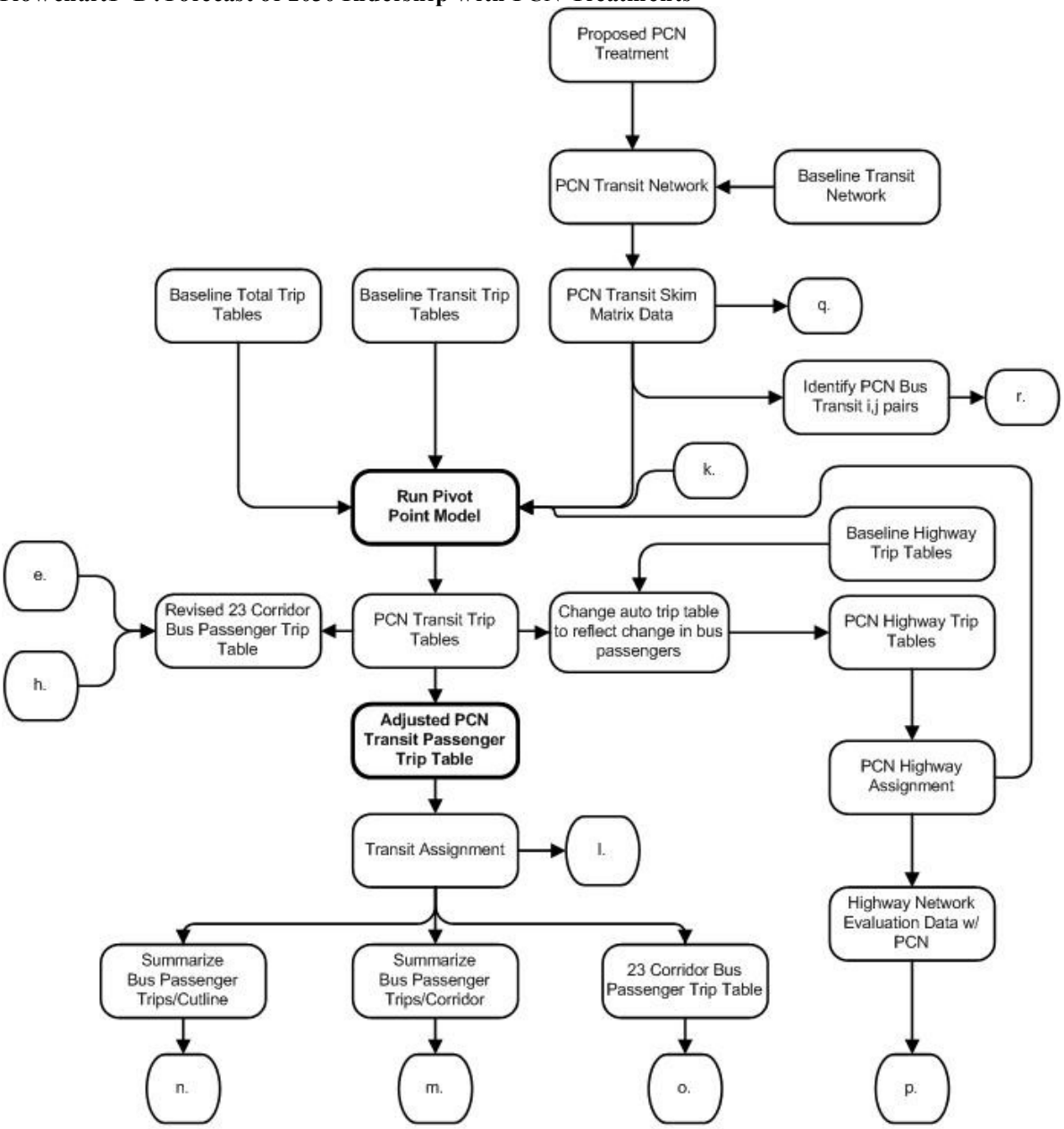
e. Ratio of observed and estimated daily bus ridership per origin and destination pair bus trips in 23 corridors

Flowchart1- C: Estimating 2010 and 2030 Baseline Ridership



f. Daily bus passenger trips crossing each cutline without PCN enhancement for 2010 and 2030
g. Daily bus passenger trips in each corridor without PCN enhancements for 2010 and 2030
h. Trip table of bus passenger trips using all PCN corridor prior to enhancements for 2010 and 2030
i. Trips (i,j pairs) that use buses in PCN corridor before enhancements in 2010 and 2030
j. Baseline automobile data without PCN enhancements for 2010 and 2030
    1. Auto Trip Table
    2. Regional VMT, VHT and PHT for auto users
    3. Daily automobile vehicle trips crossing each cutline
    4. Peak hour capacity of each cutline
k. Zone-to-zone out-of-vehicle and in-vehicle times prior to enhancements

Flowchart1- D: Forecast of 2030 Ridership with PCN Treatments

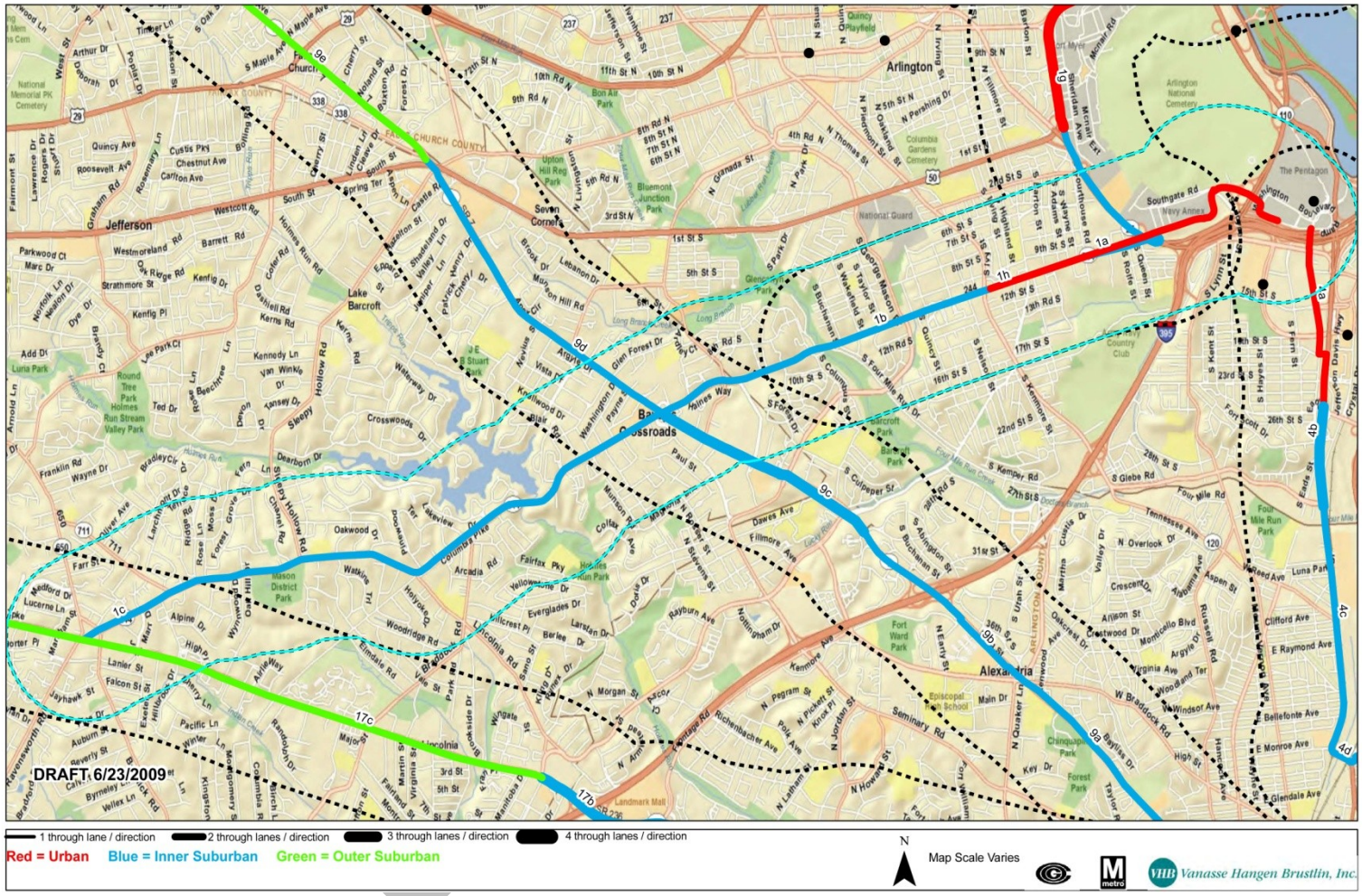


l. Assignment of all transit trips to rail and bus routes
m. Daily bus passenger trips in each corridor
n. Bus passenger trips/cutline
o. Adjusted trip table of bus passenger trips using all corridors after PCN enhancements for each alternative for 2030w
p. Automobile network data for after each PCN enhancements for each alternative for 2030
    1. Regional VMT, VHT, and PHT for auto users
    2. Daily automobile vehicle trips crossing each cutline
    3. Peak hour capacity of each cutline
q. Zone to zone out-of-vehicle and in-vehicle times
r. Zone to zone pairs using PCN

Appendix 2

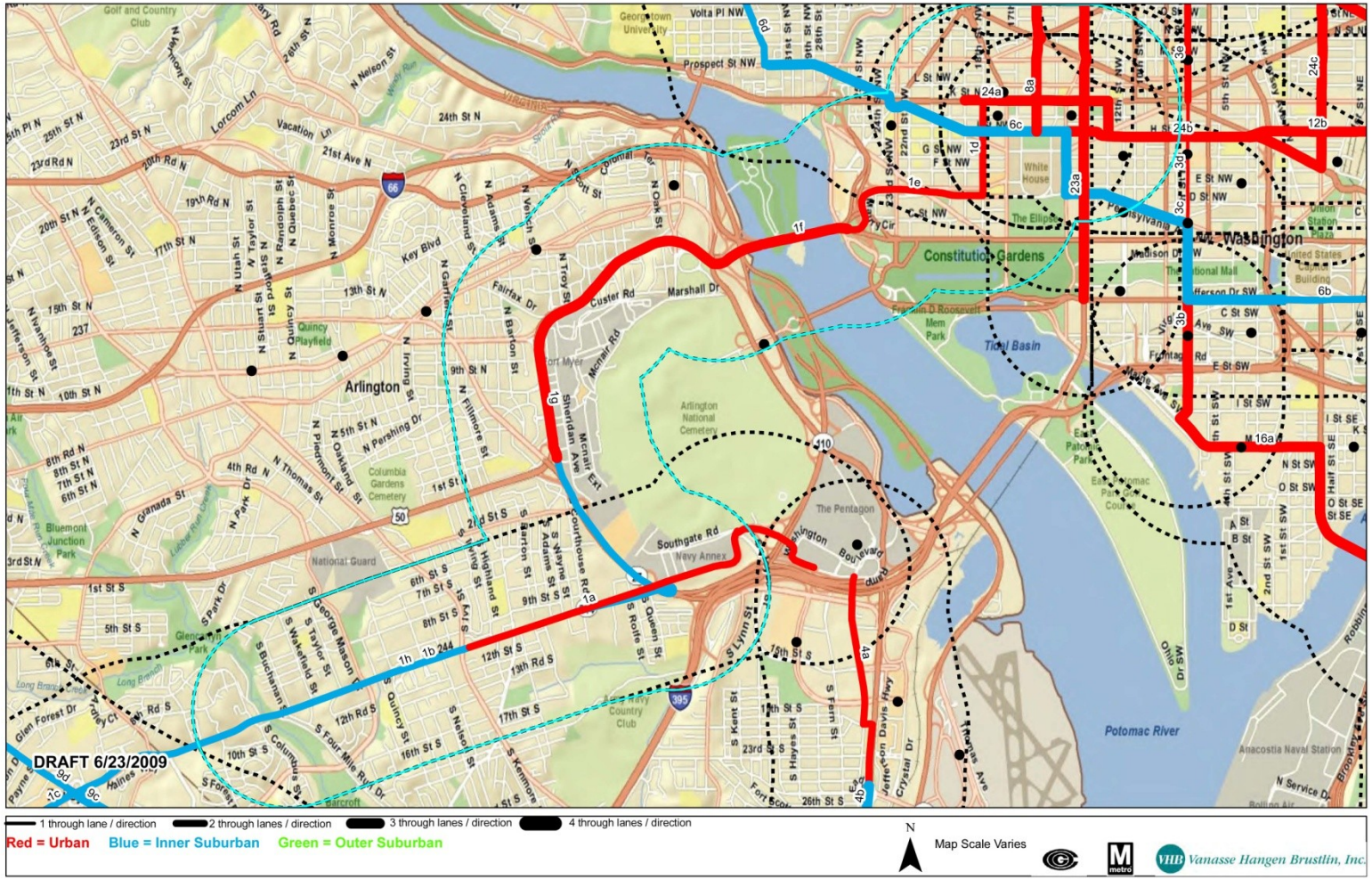
Map: 2- A

COLUMBIA PIKE (PIKE RIDE)



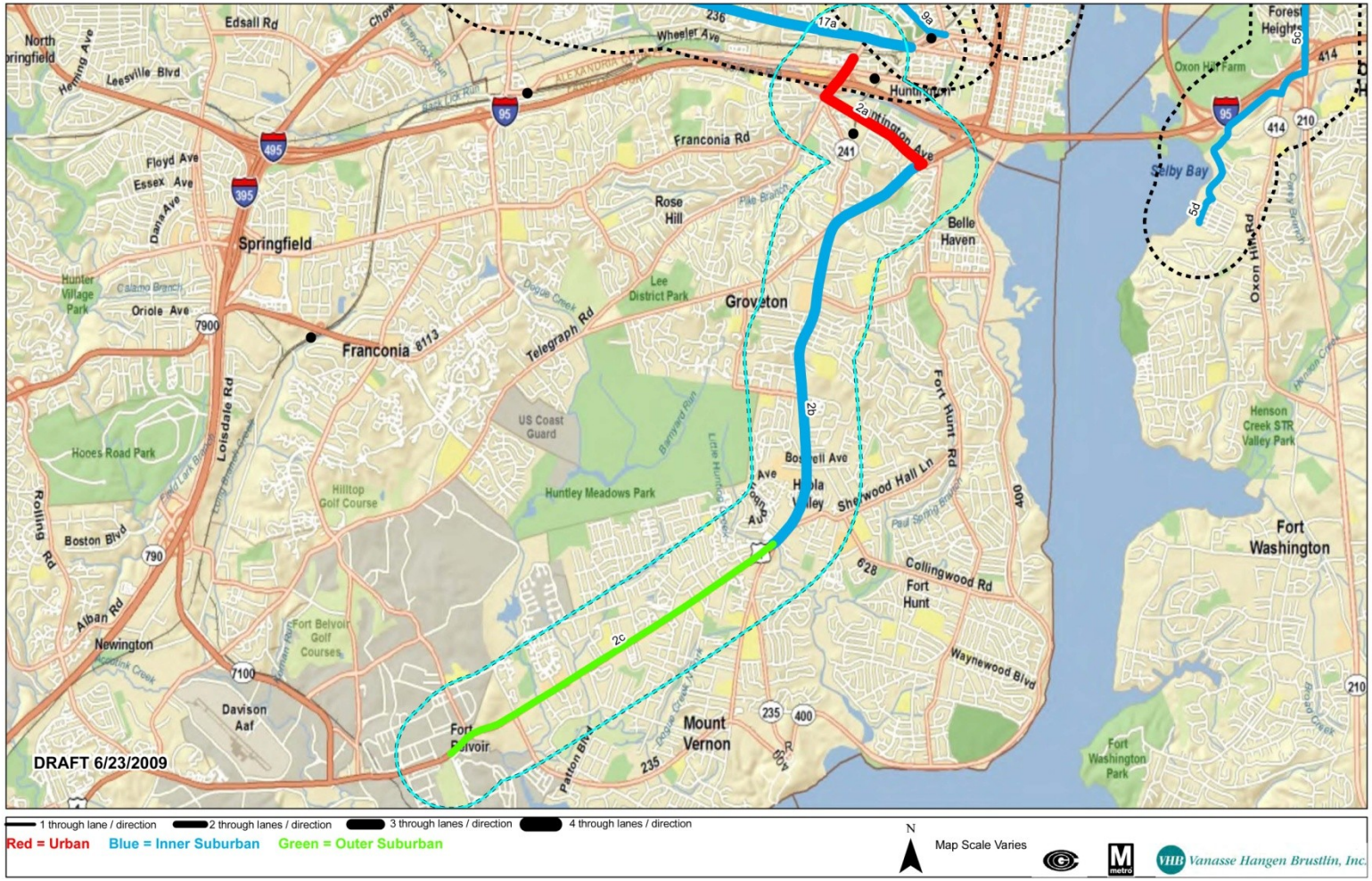
Map: 2- B

COLUMBIA PIKE (PIKE RIDE)



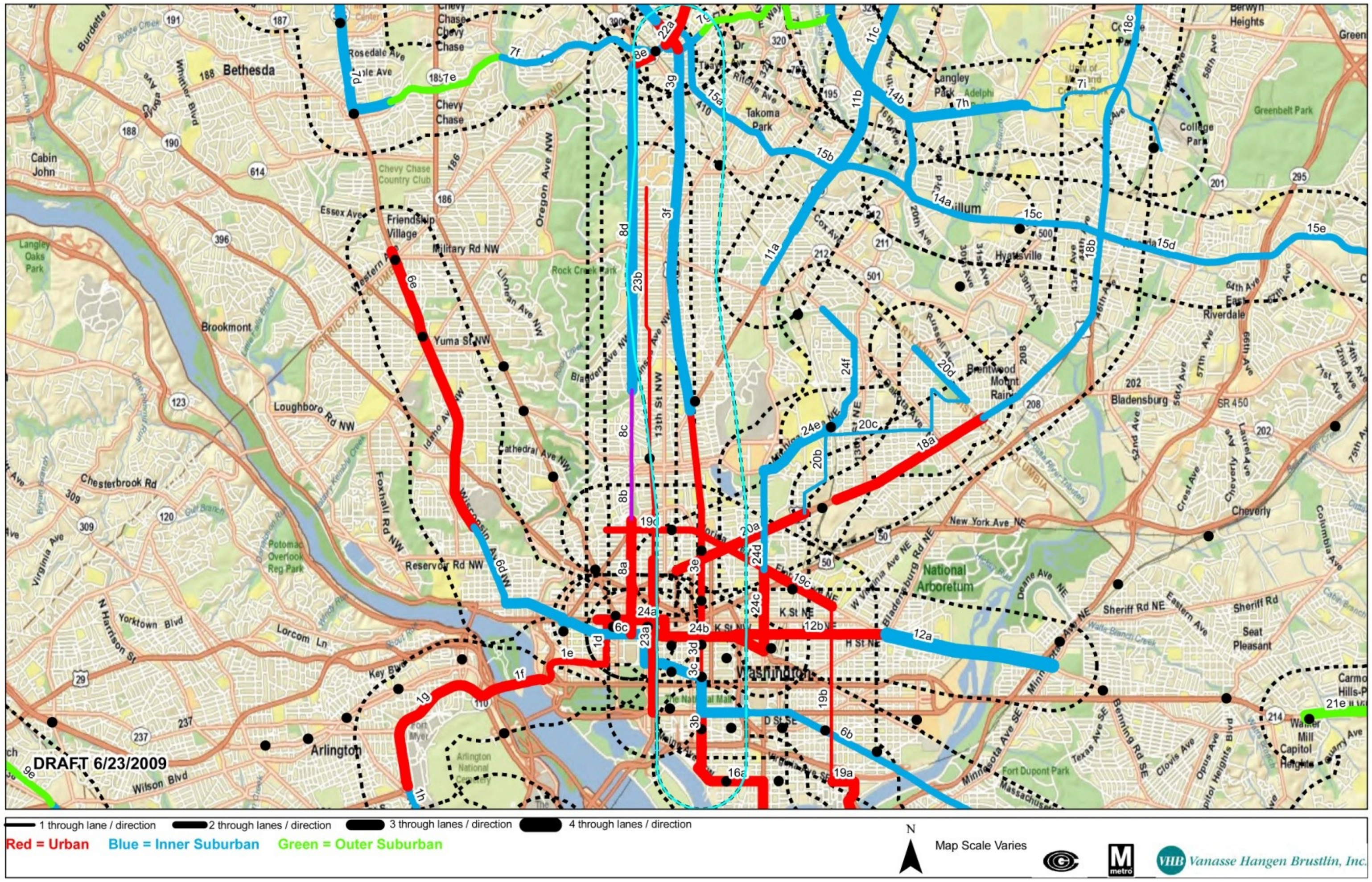
Map: 2- C

RICHMOND HIGHWAY EXPRESS (REX)



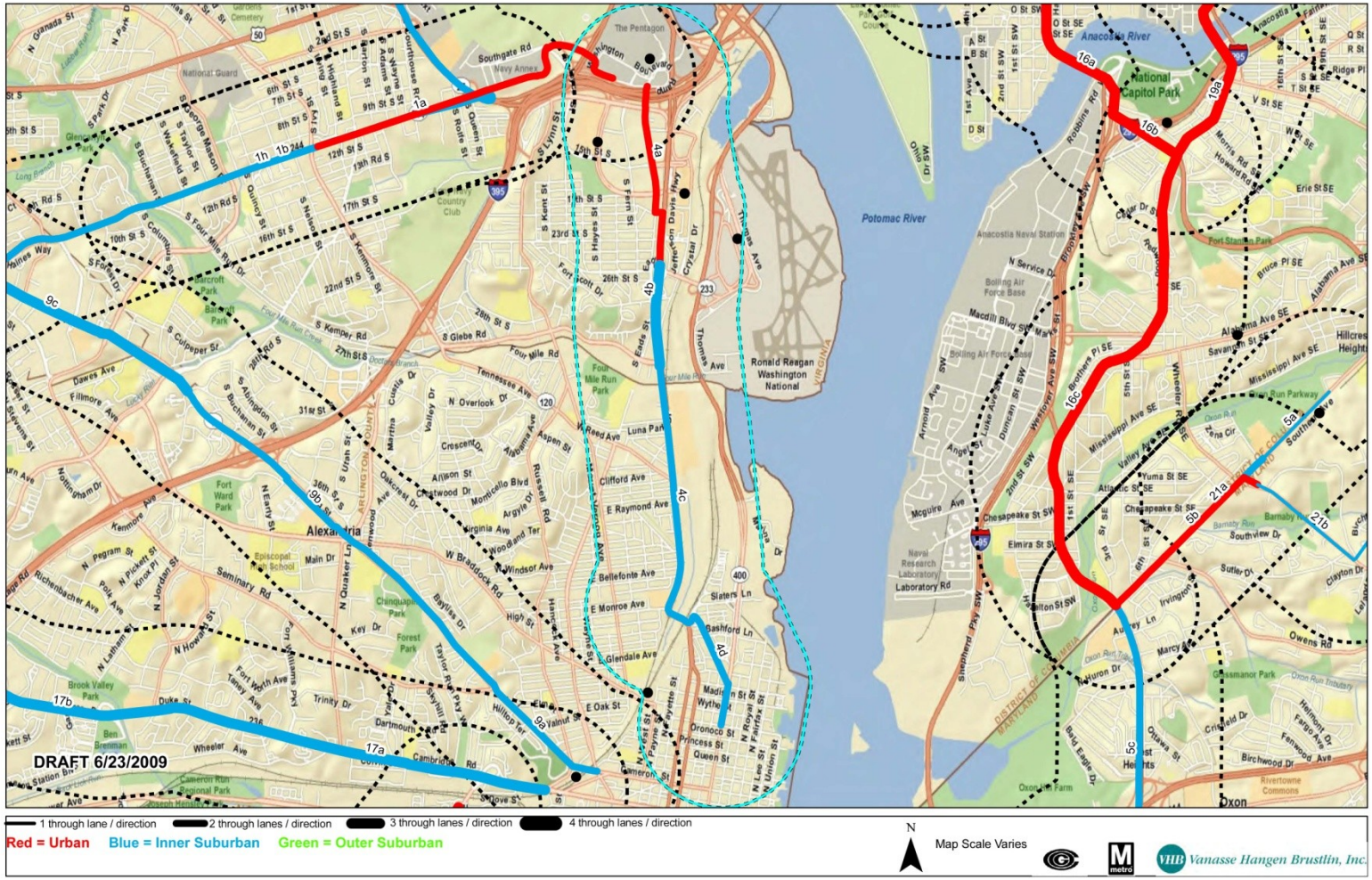
Map: 2- D

GEORGIA AVE / 7TH ST (DC)



Map: 2- E

CRYSTAL CITY-POTOMAC YARD

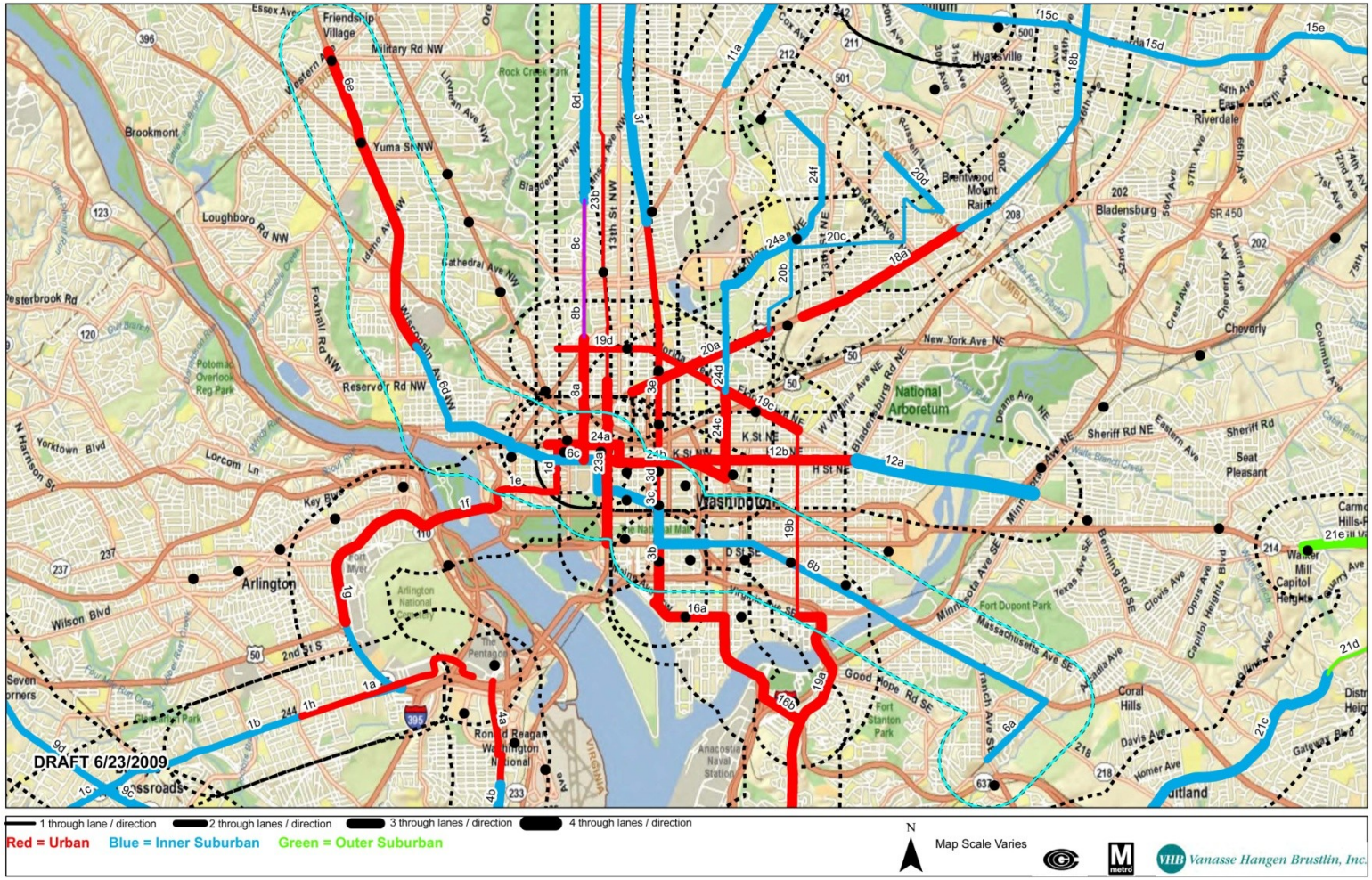


Map: 2- F

SOUTHERN AVE METRO NATL HARBOR

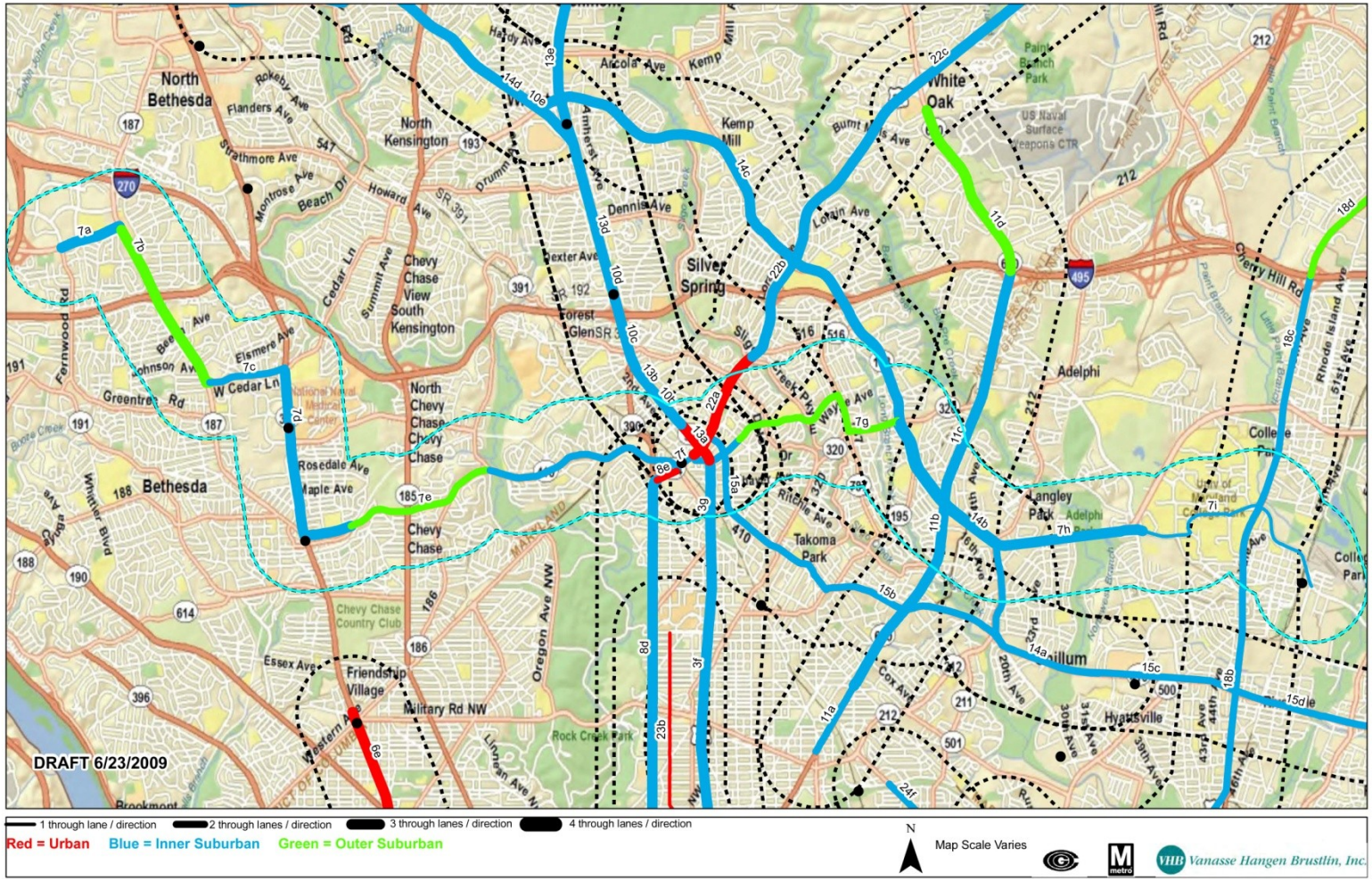
Map: 2- G

WISCONSIN AVE/PENNSYLVANIA AVE



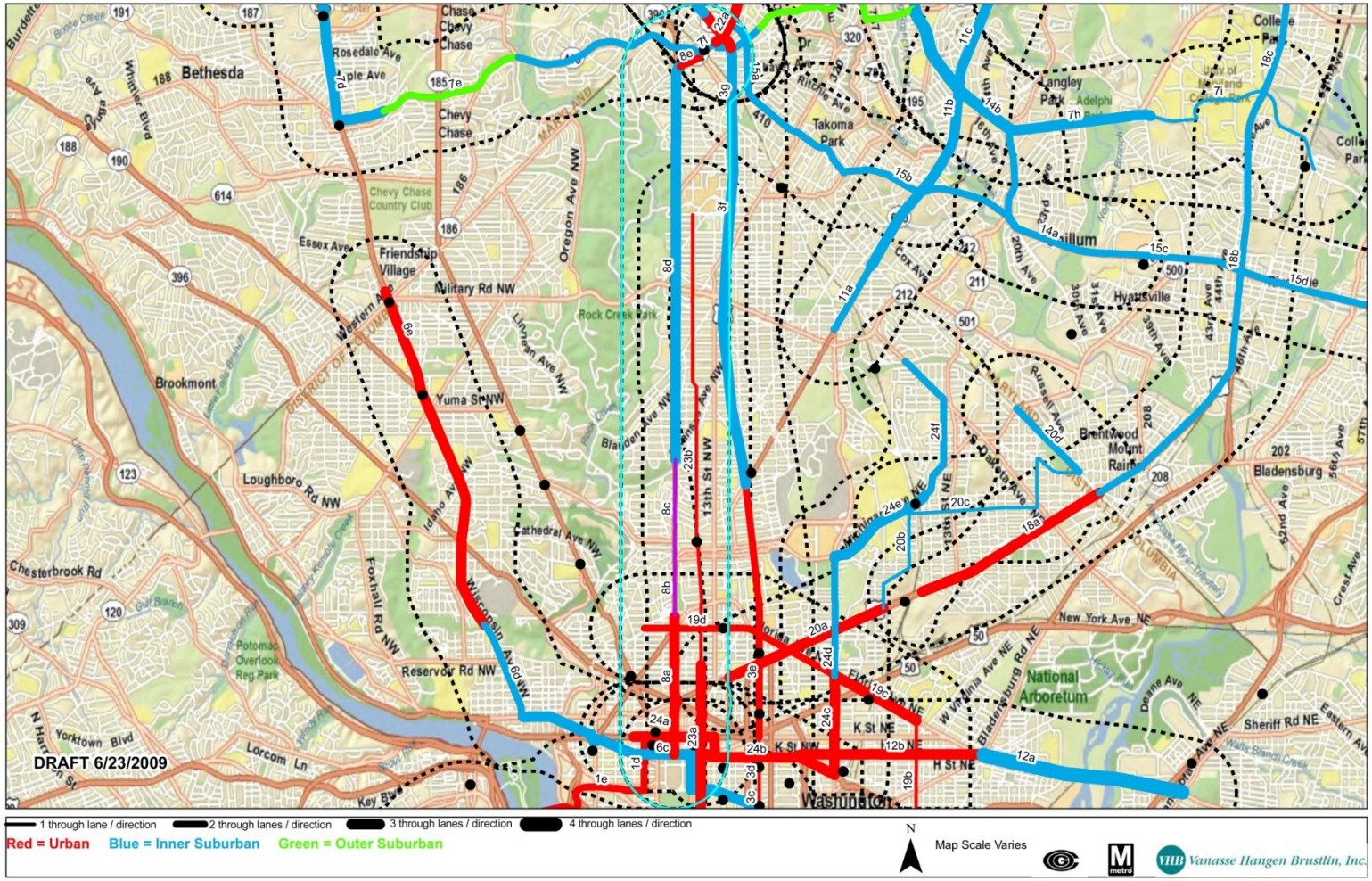
Map: 2- H

UNIVERSITY BLVD/EAST-WEST HWY



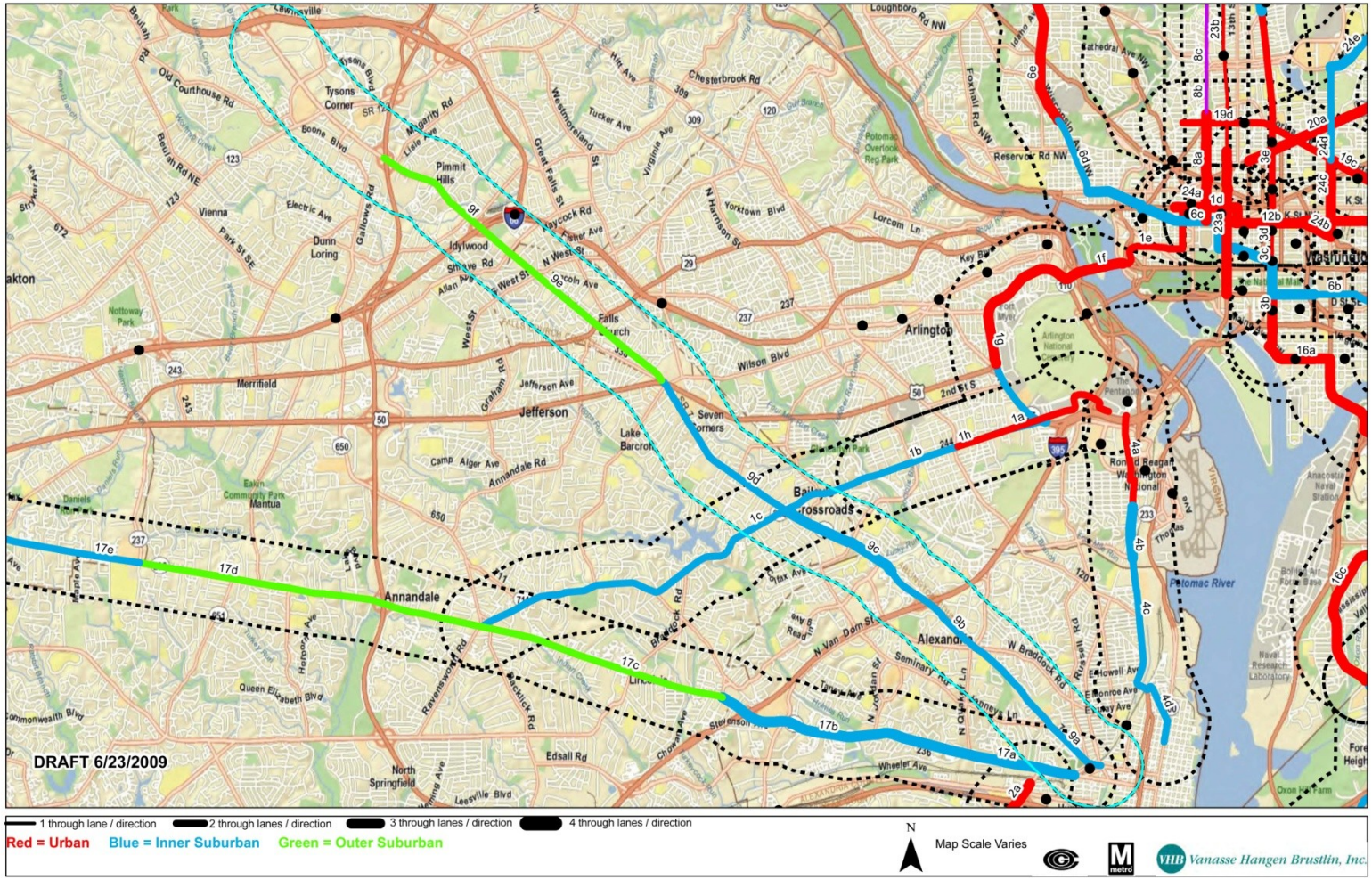
Map: 2- I

SIXTEENTH ST



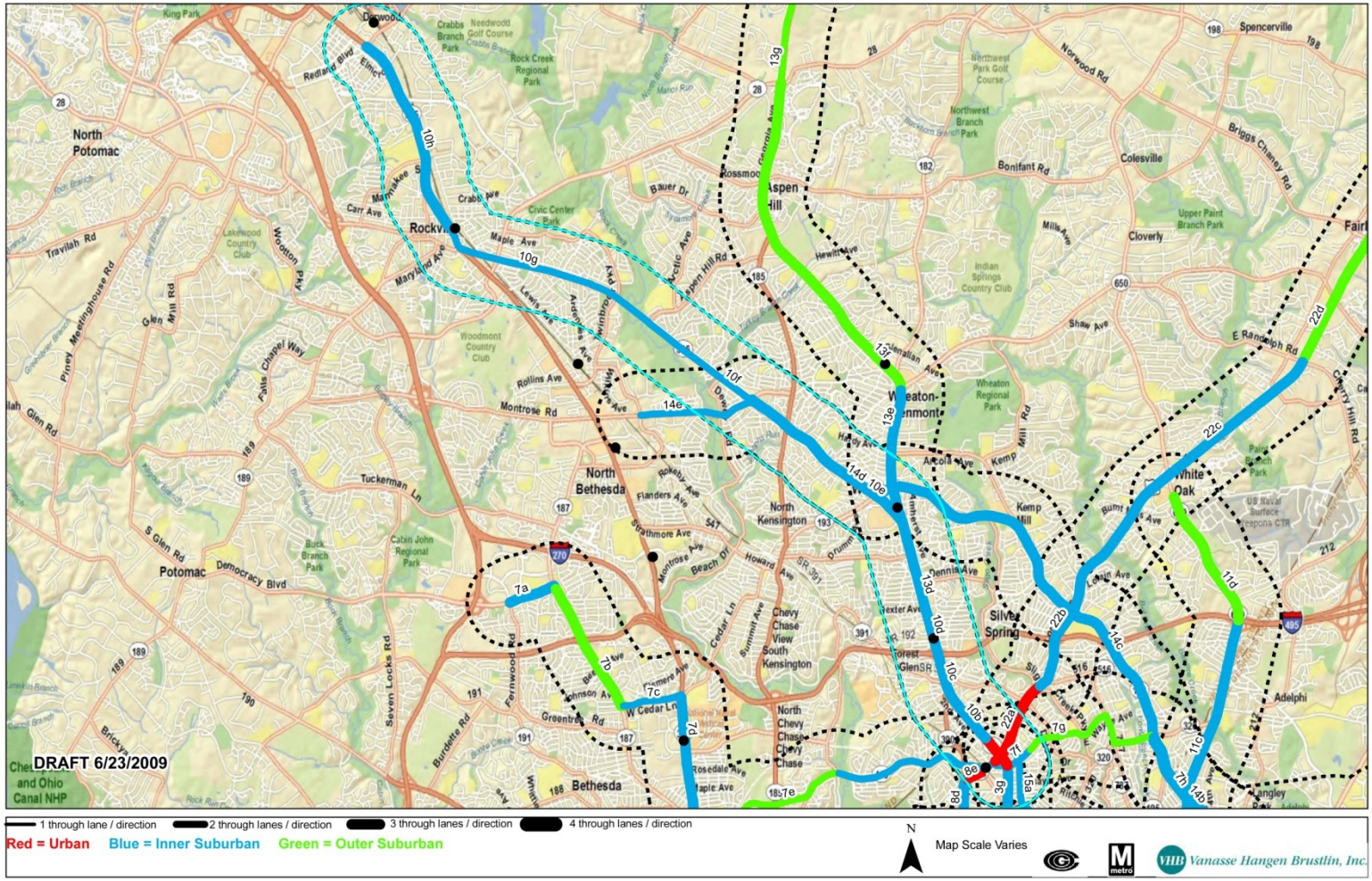
Map: 2- J

LEESBURG PIKE



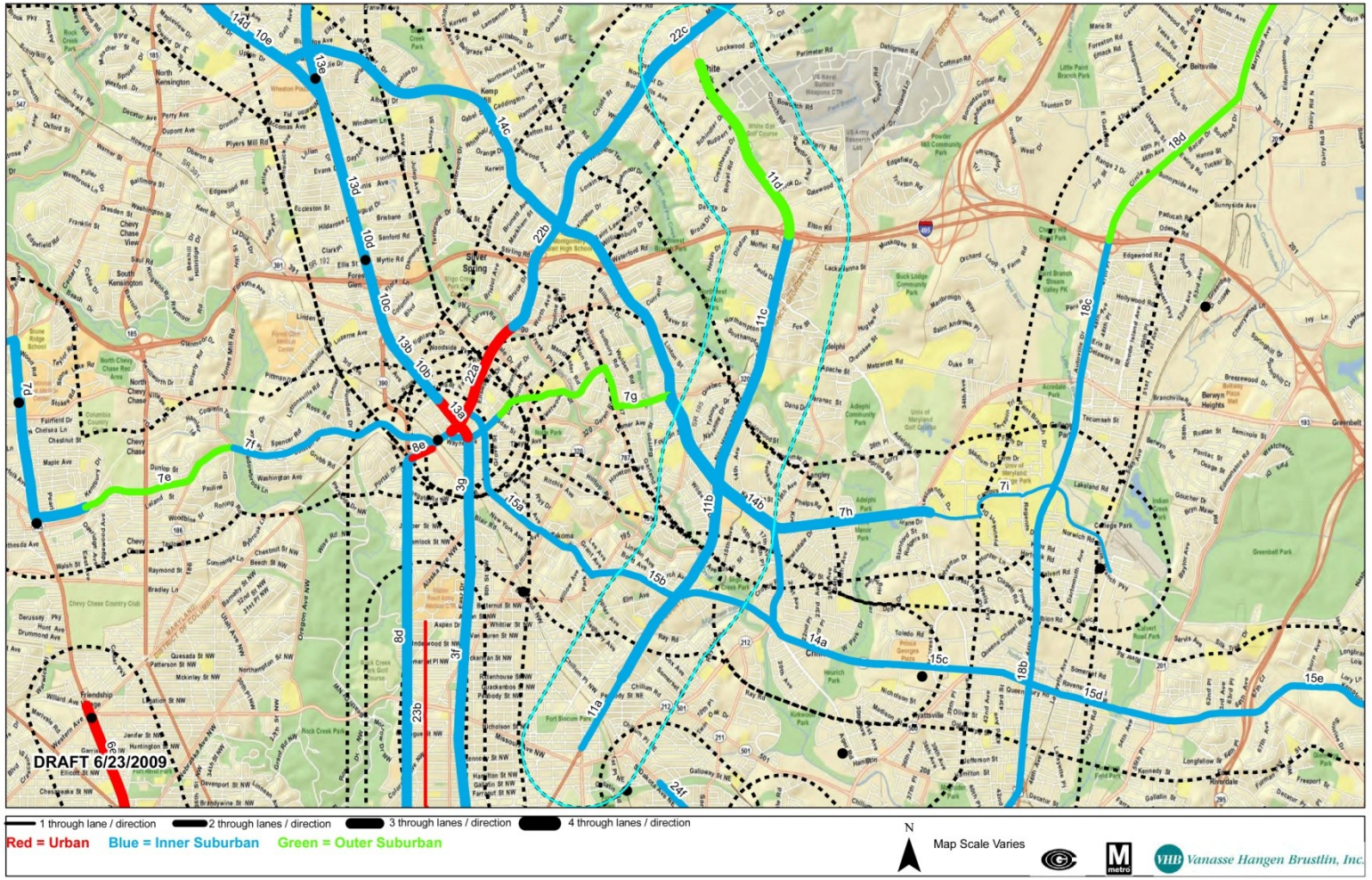
Map: 2- K

VEIRS MILL RD



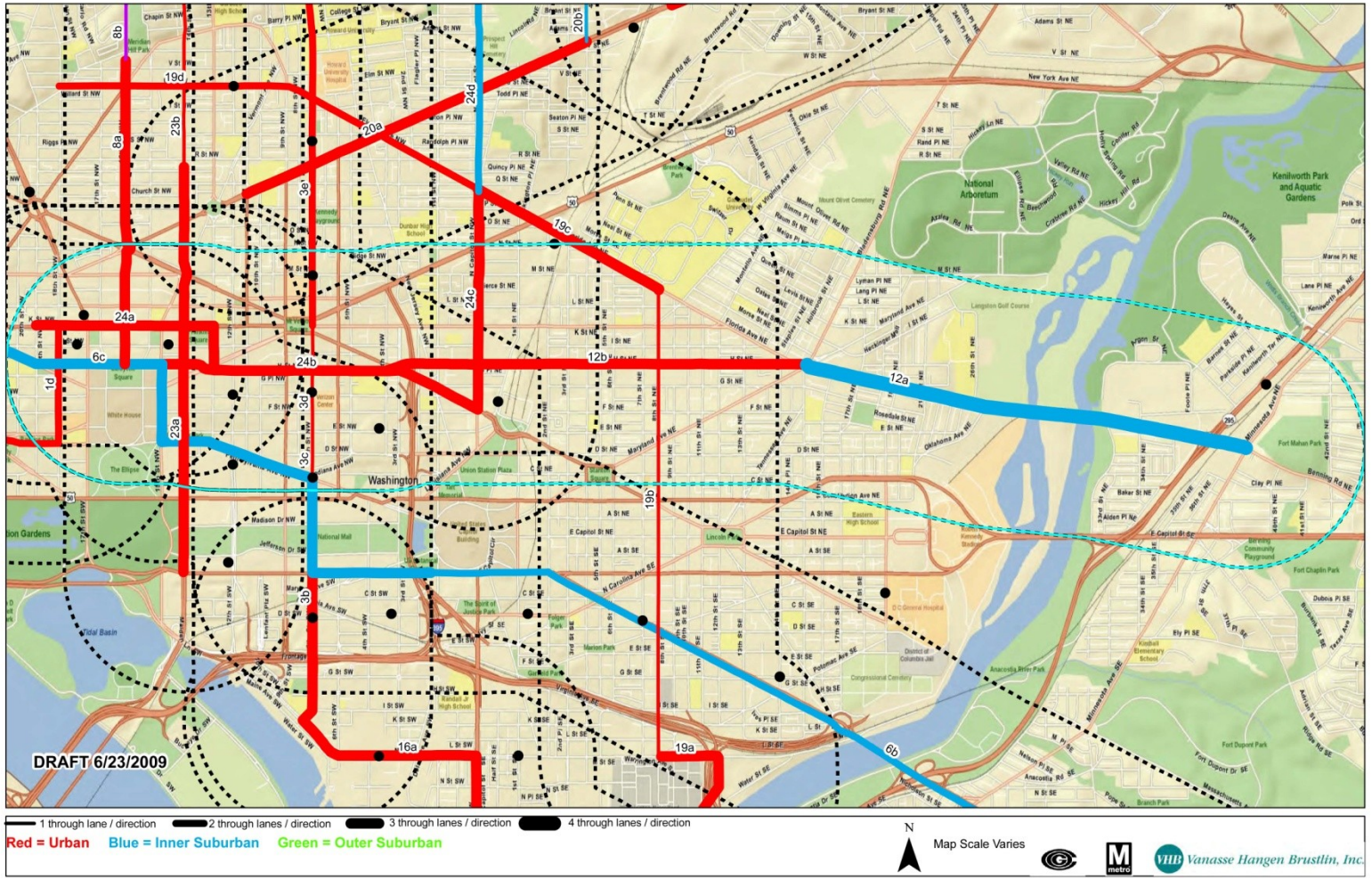
Map: 2- L

NEW HAMPSHIRE AVE



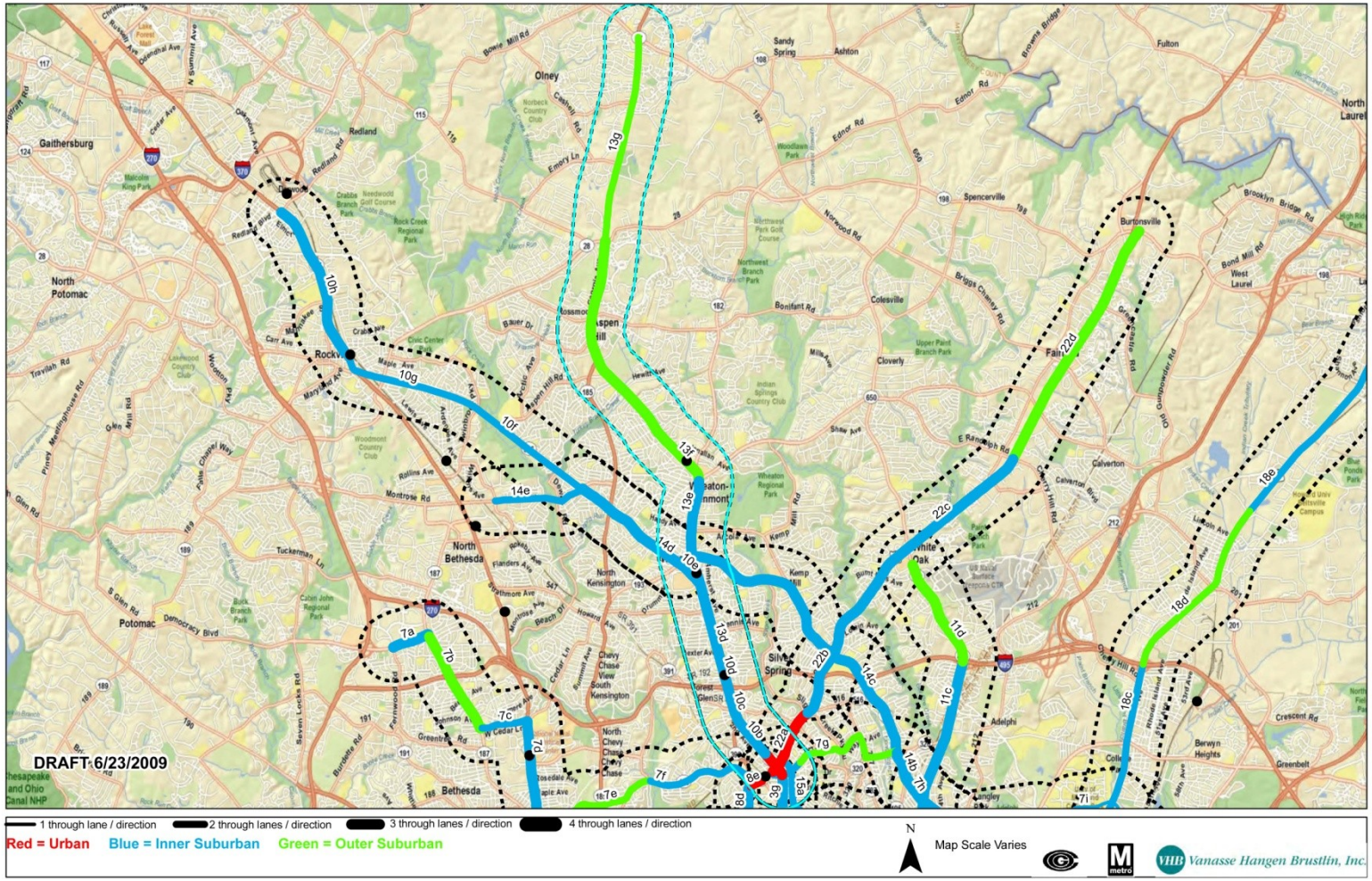
Map: 2- M

H ST / BENNING RD



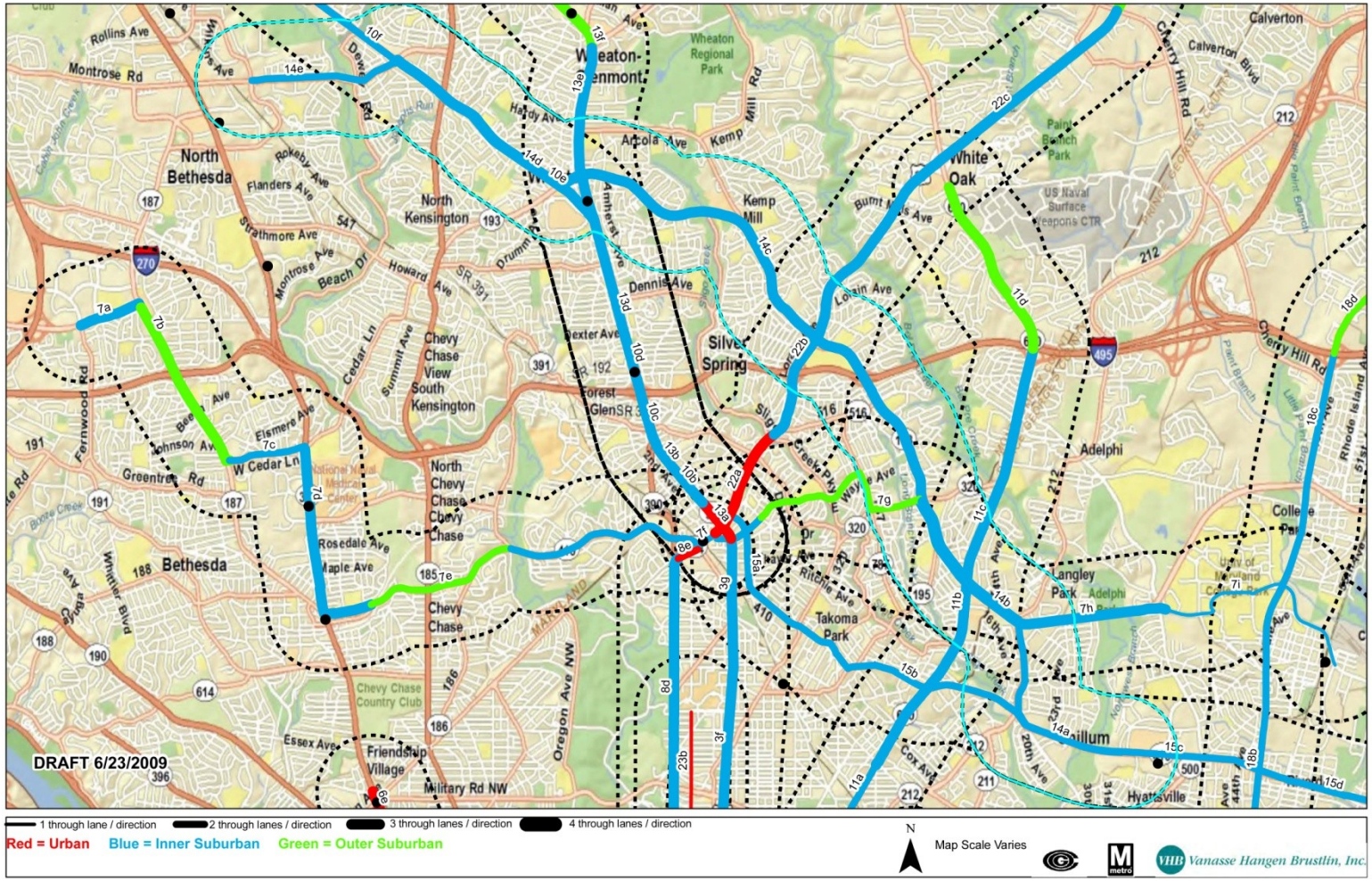
Map: 2- N

GEORGIA AVE (MD)



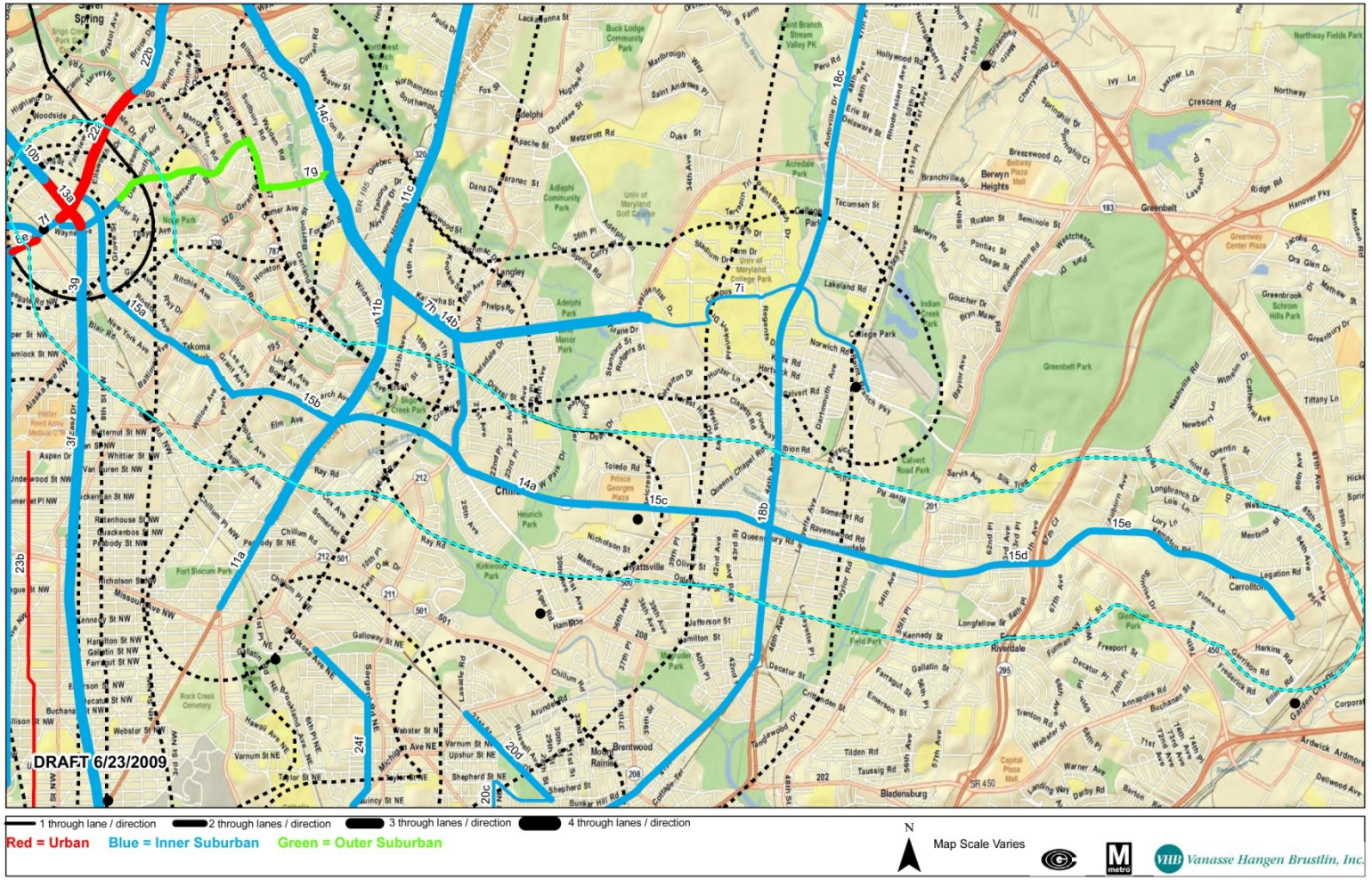
Map: 2- O

GREENBELT - TWINBROOK



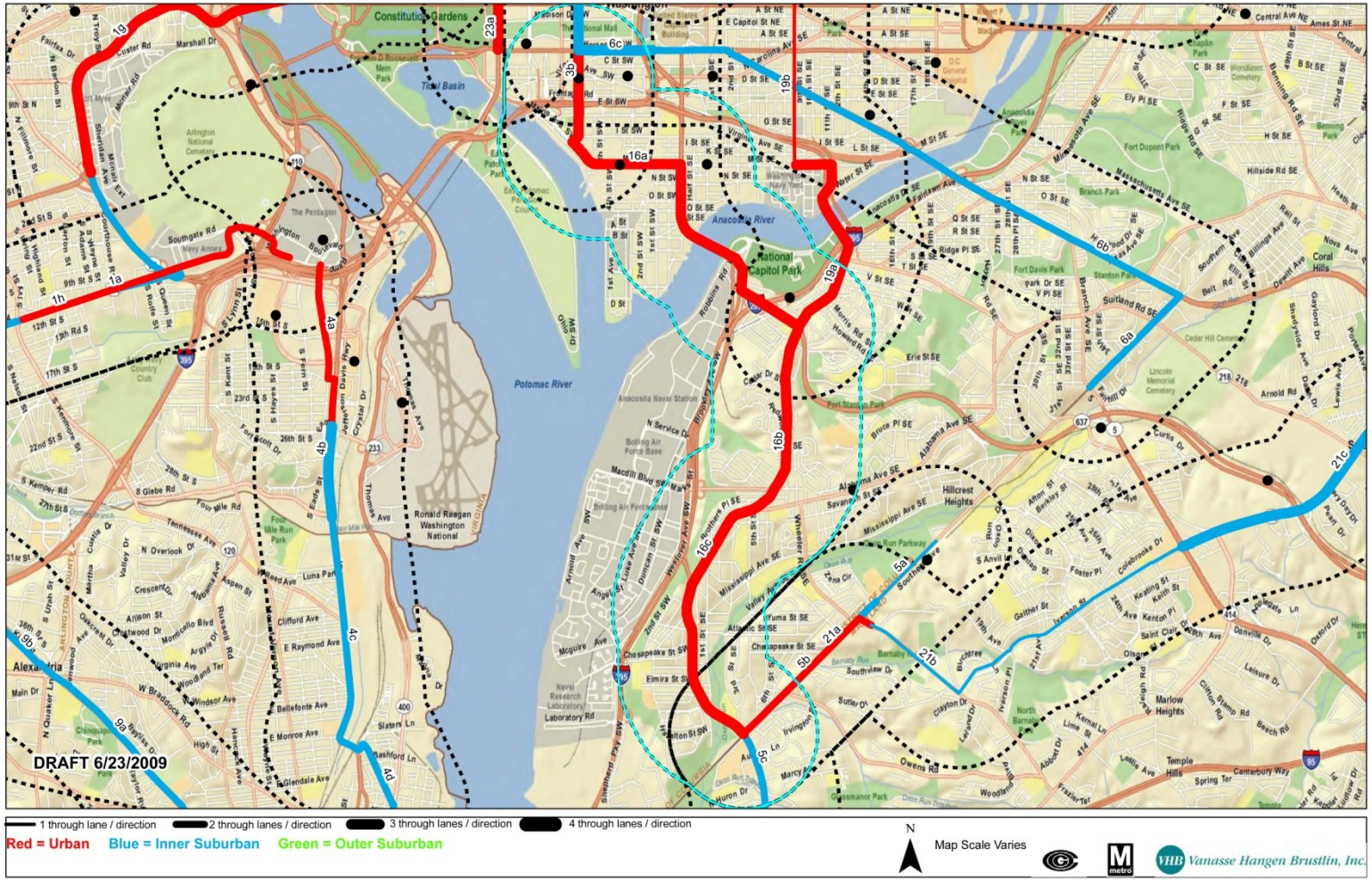
Map: 2- P

EAST-WEST HWY



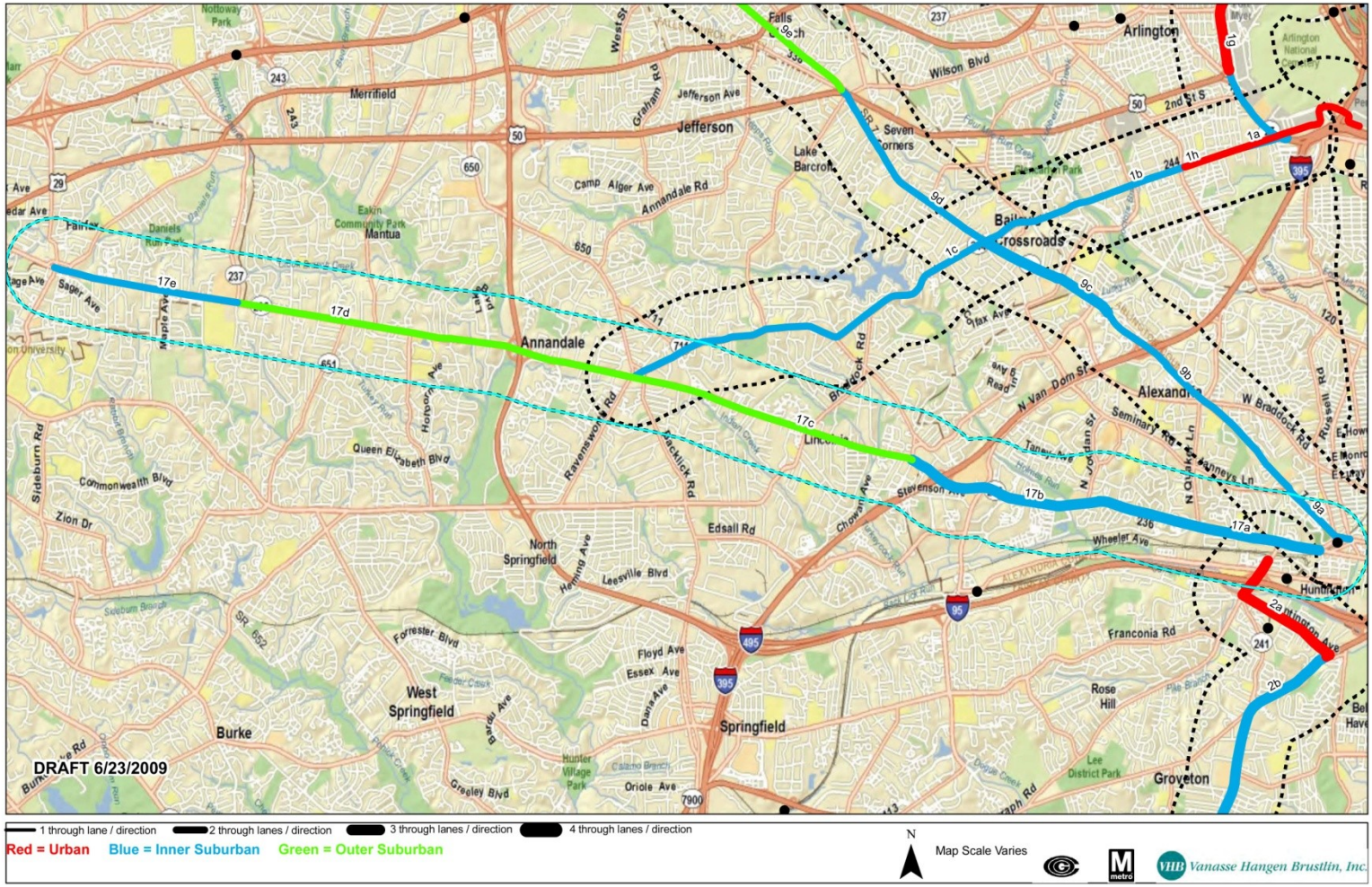
Map: 2- Q

ANACOSTIA - CONGRESS HGTS



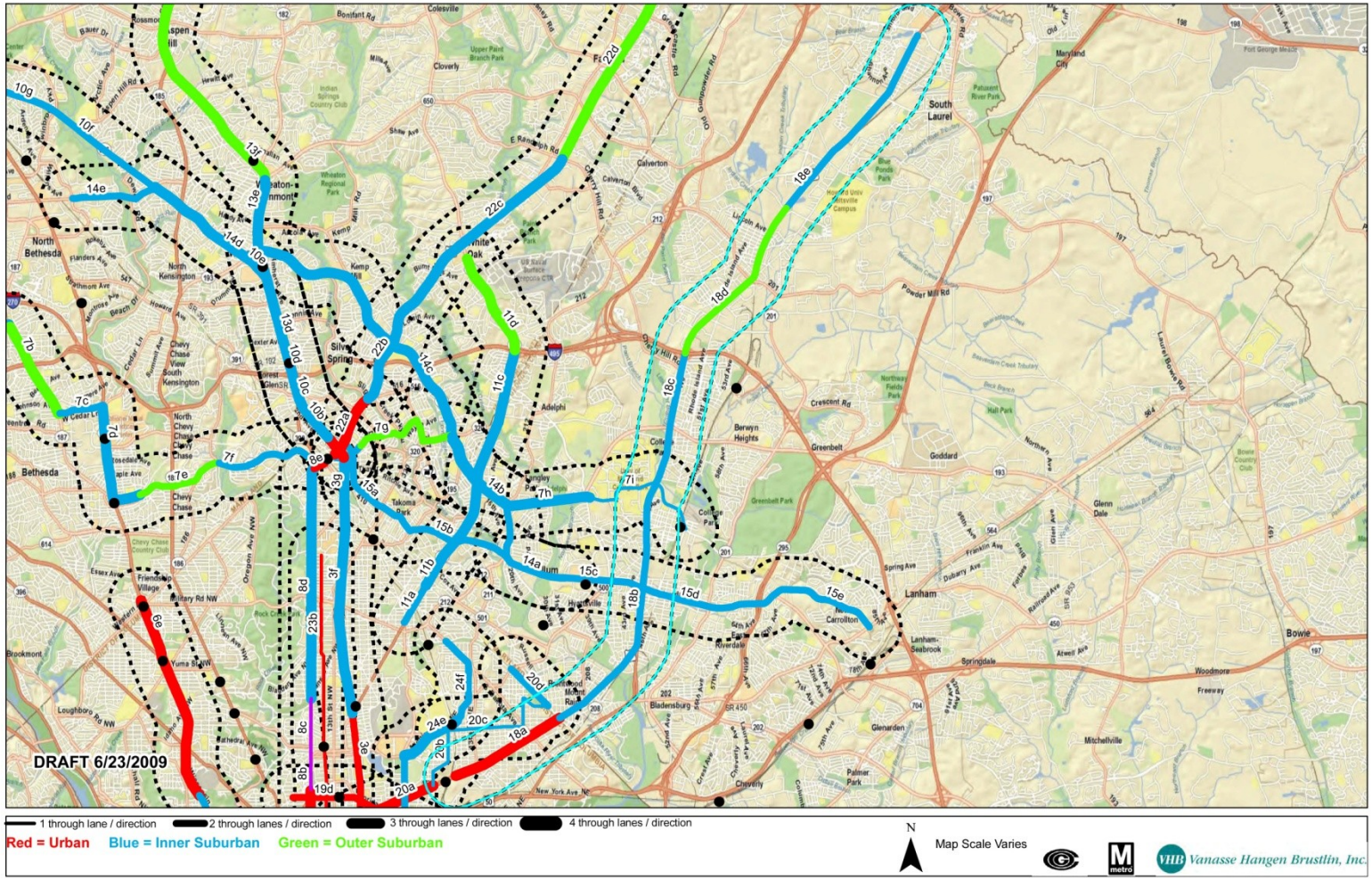
Map: 2- R

LITTLE RIVE TPKE / DUKE ST



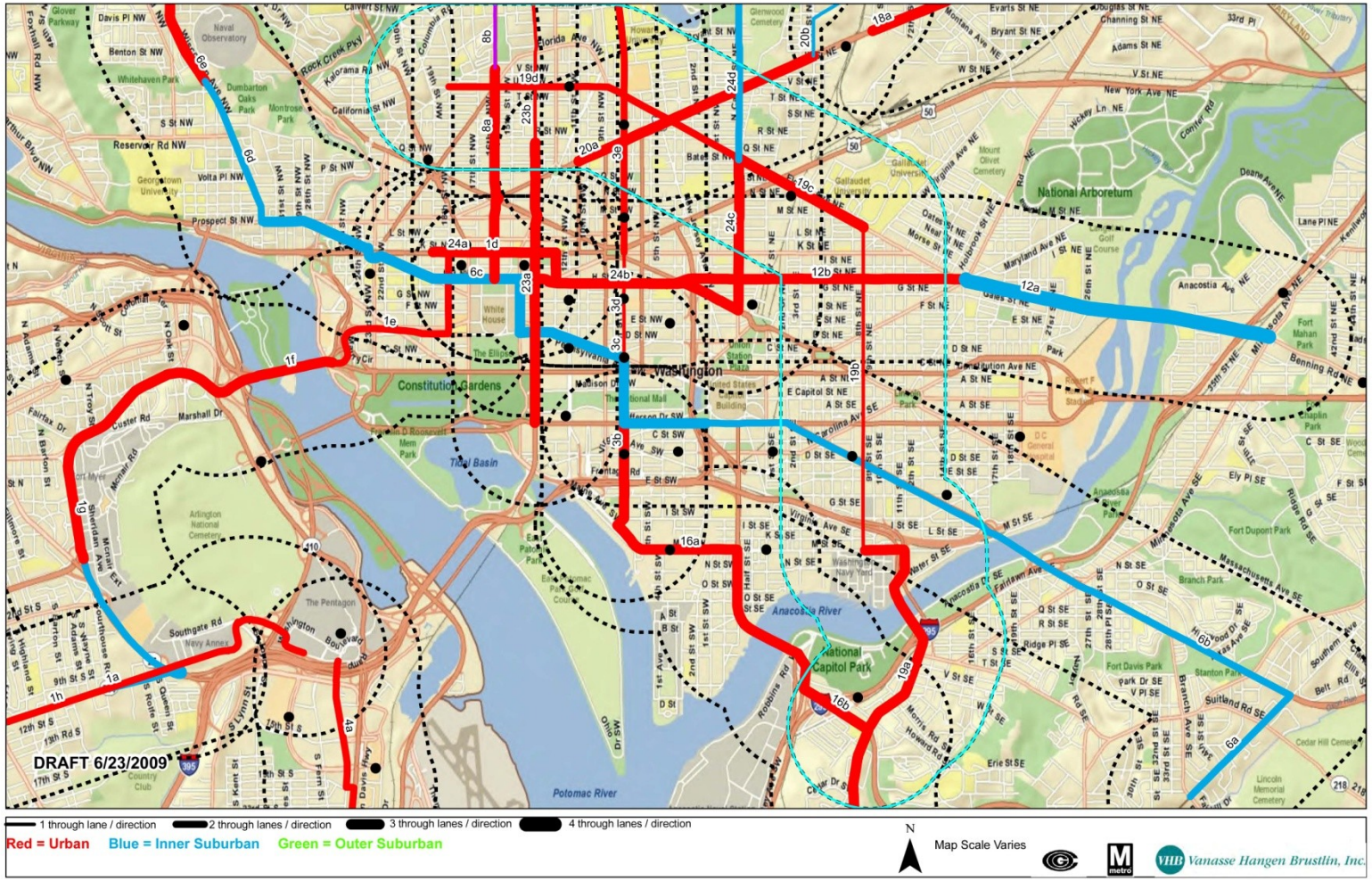
Map: 2- S

RHODE ISLAND/METRO TO LAUREL



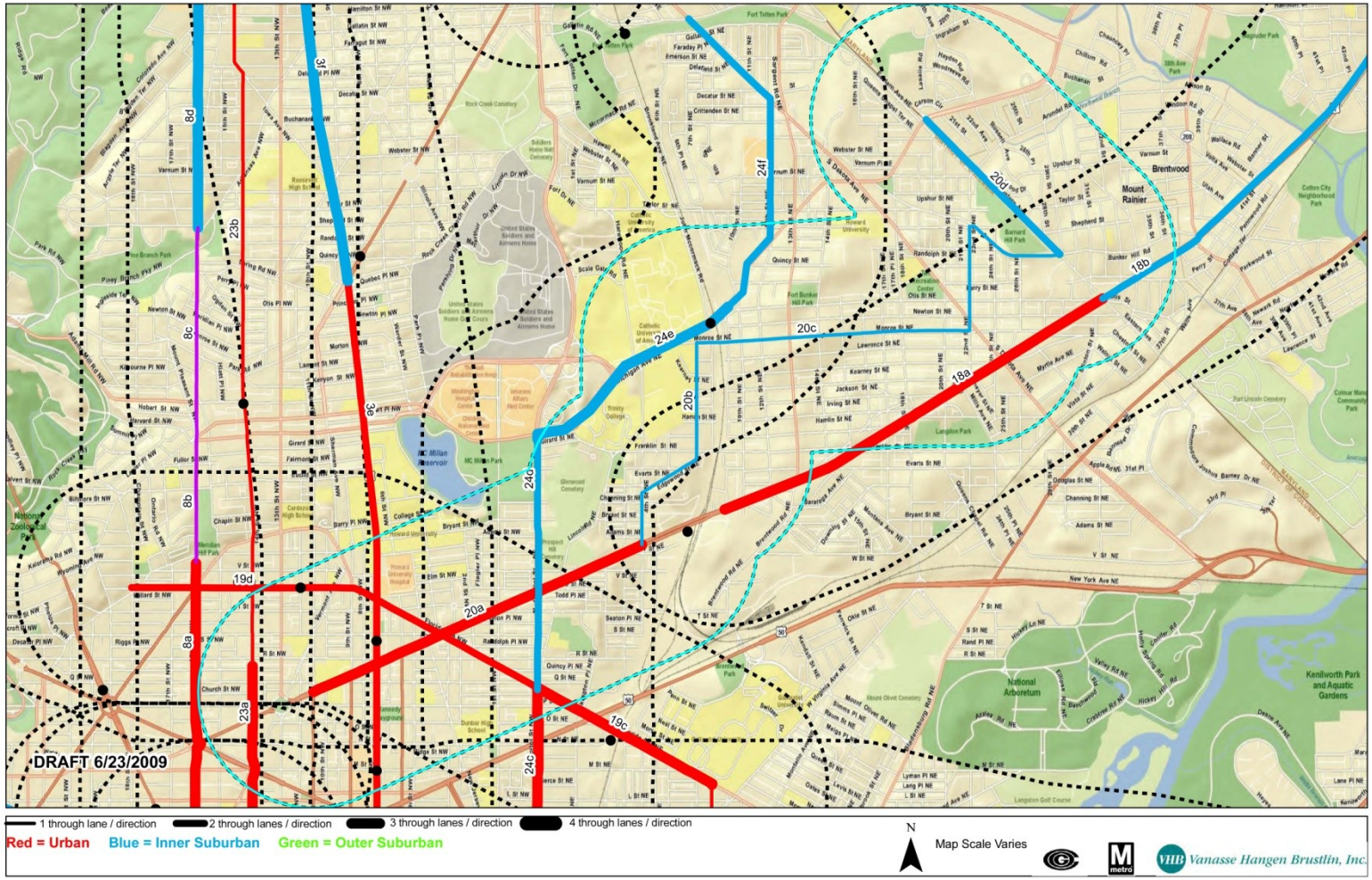
Map: 2- T

MASS/U/FLORIDA/8TH/MLK



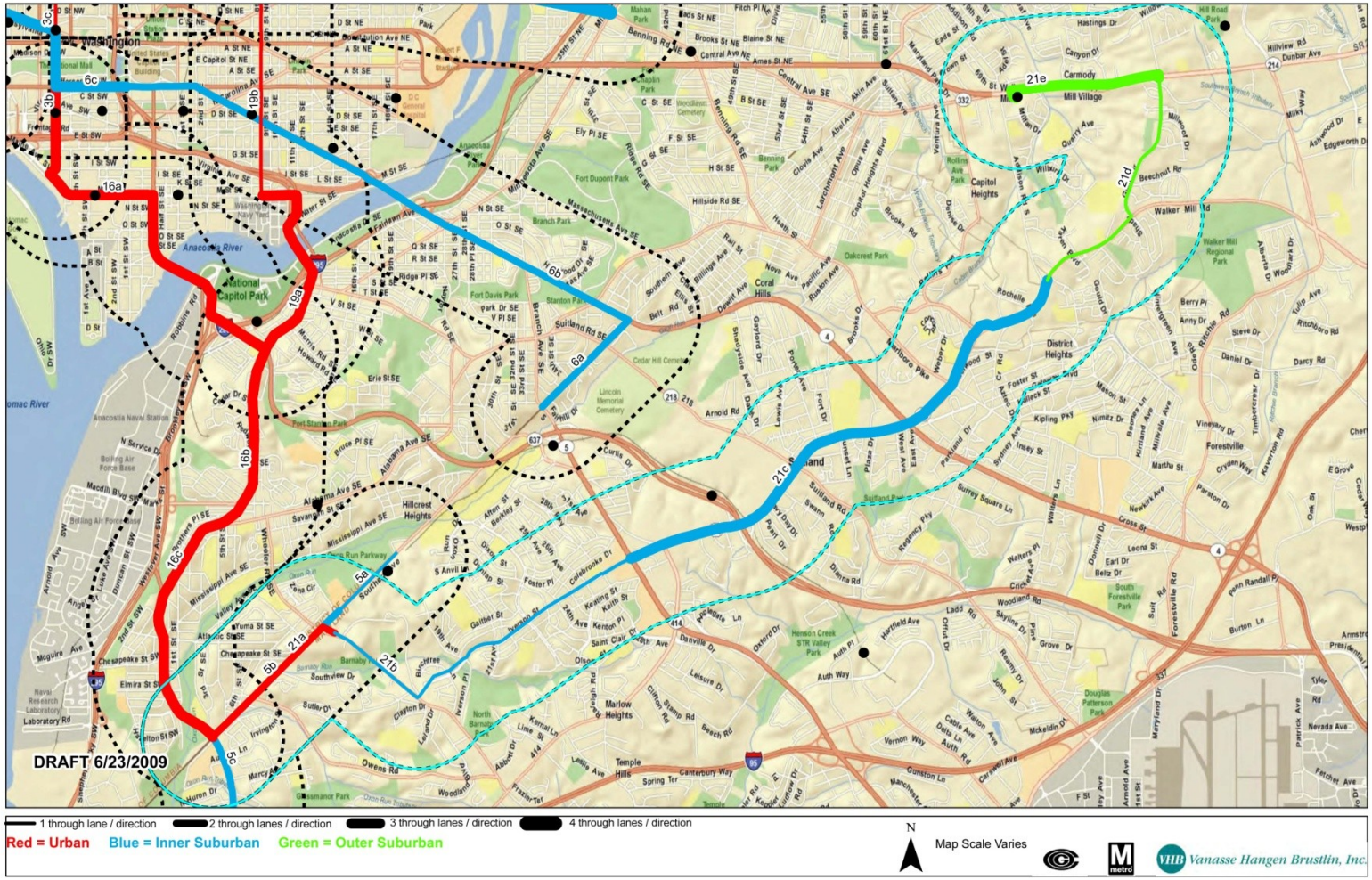
Map: 2- U

RHODE ISLAND AVE



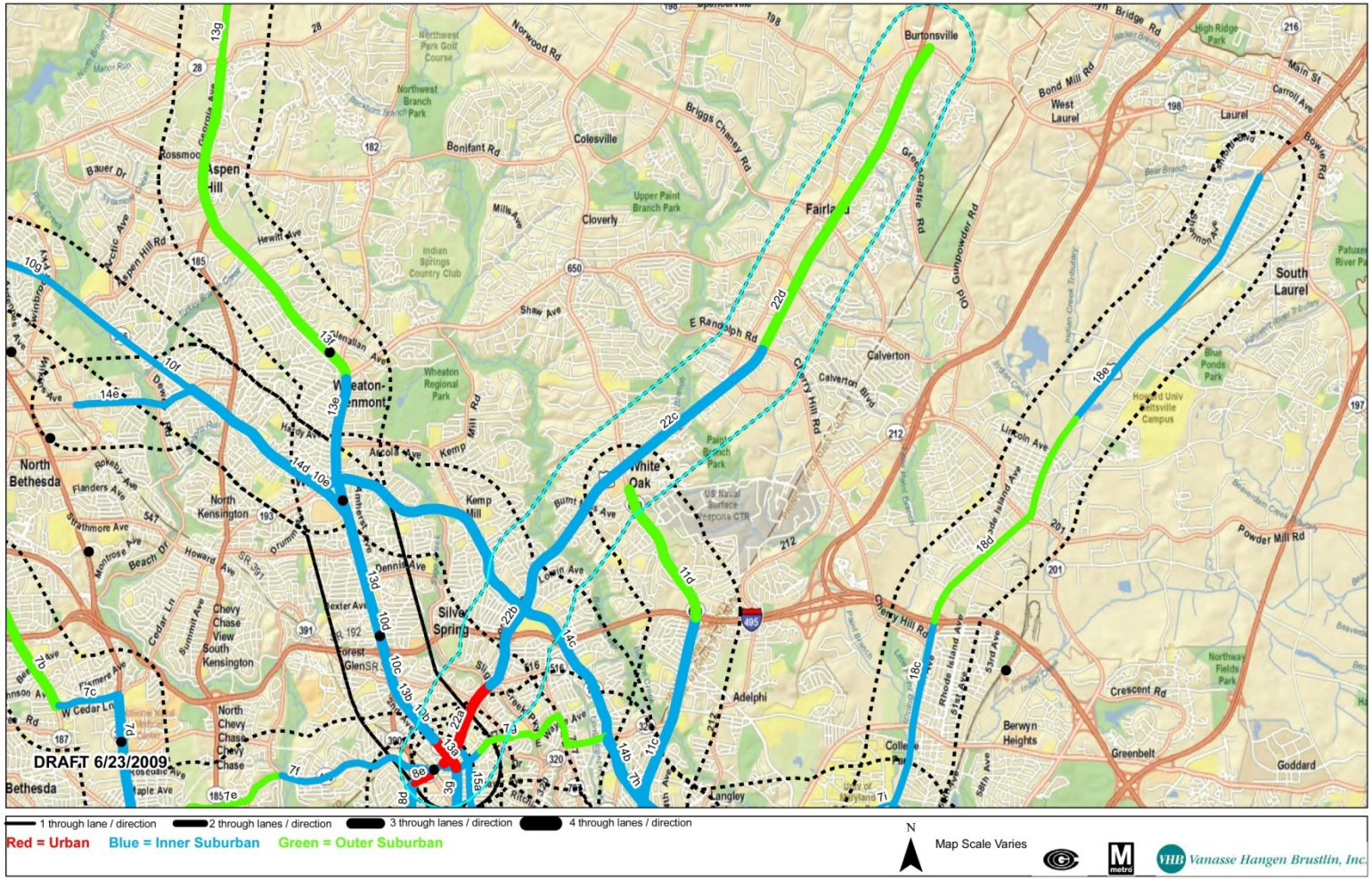
Map: 2- V

EASTOVER - ADDISON RD

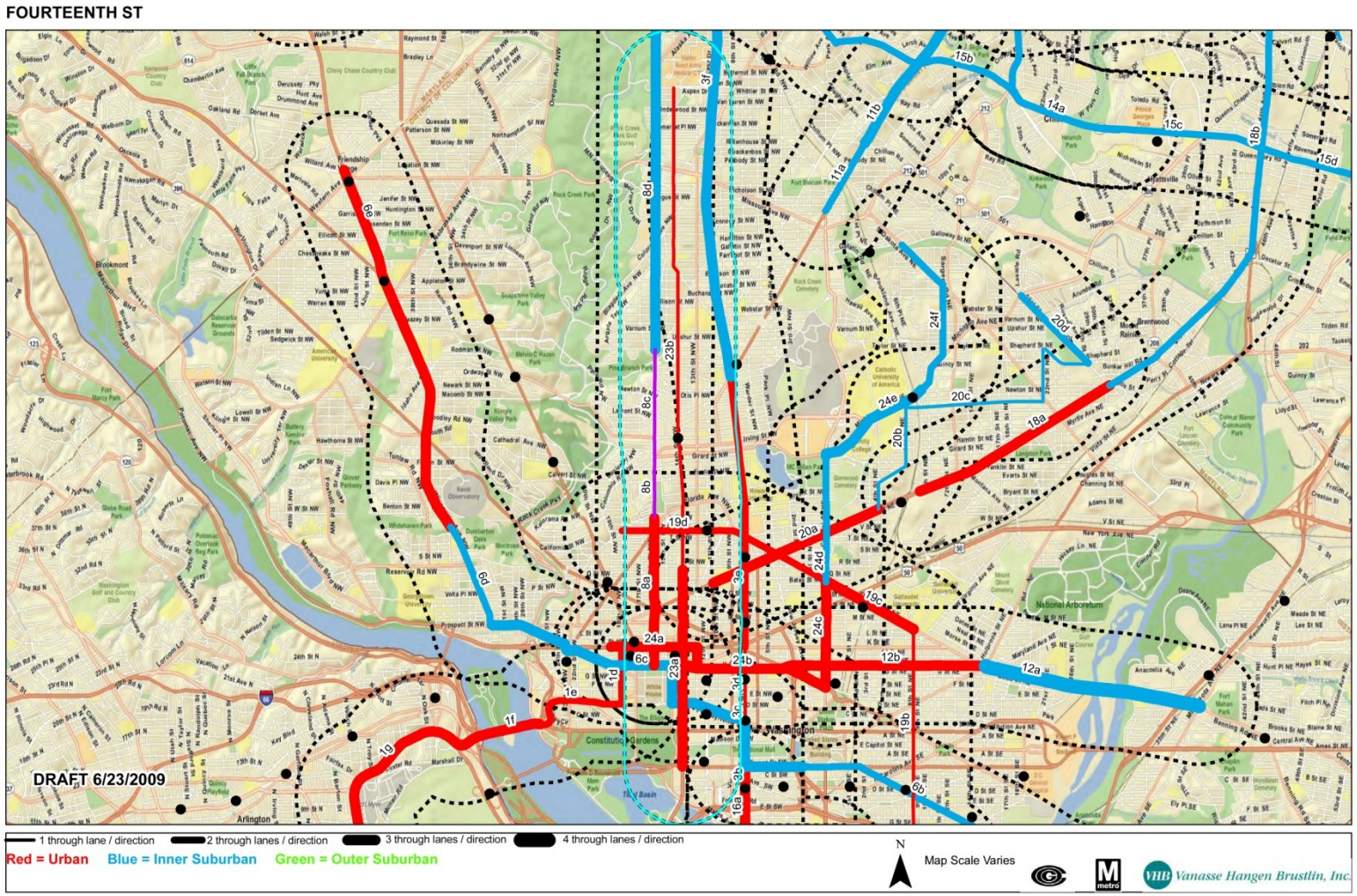


Map: 2- W

COLESVILLE/COLUMBIA PIKE (MD)

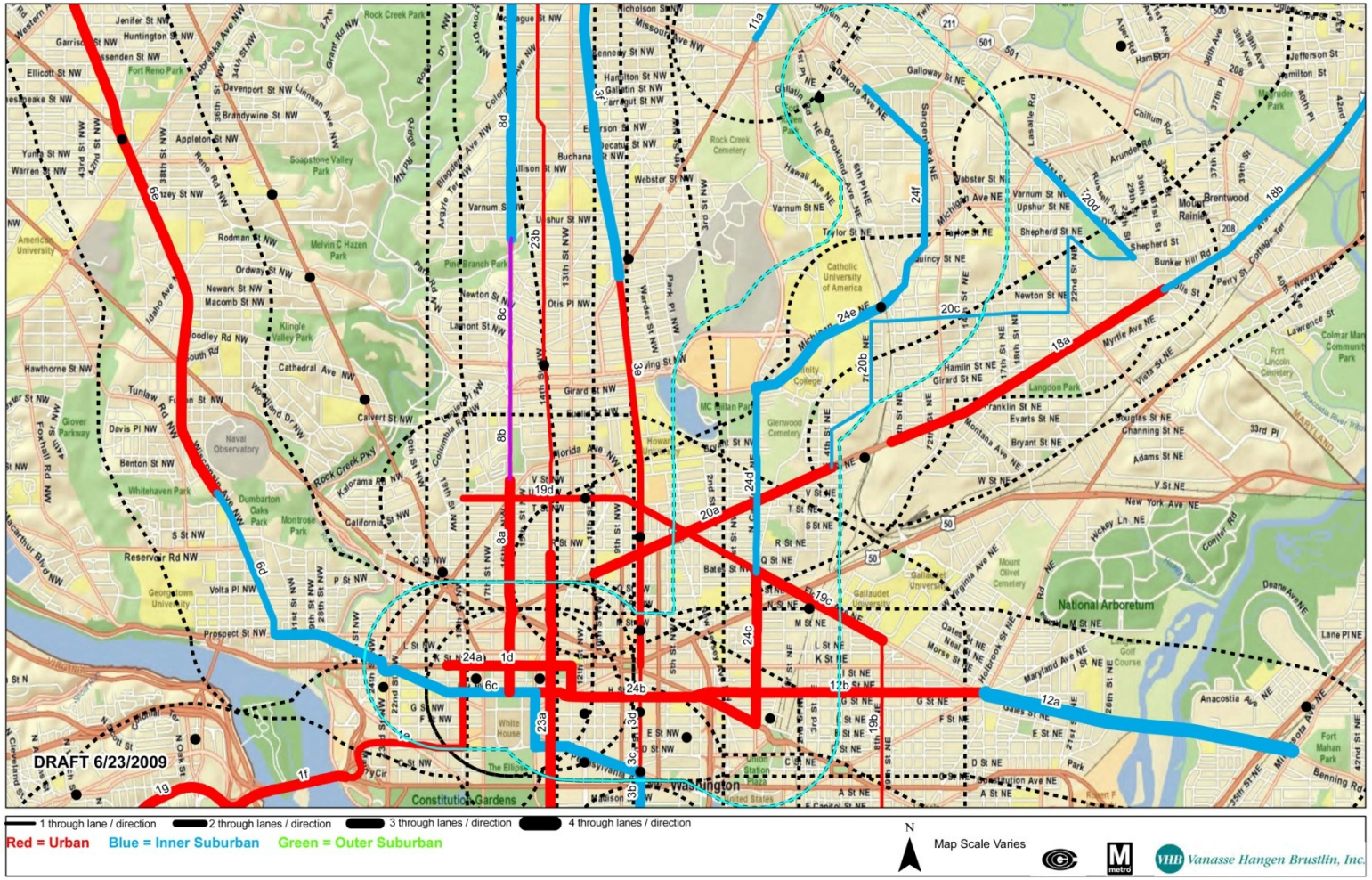


Map: 2- X


FOURTEENTH ST
DRAFT 6/23/2009
1 through lane / direction
2 through lanes / direction
3 through lanes / direction
4 through lanes / direction
Red = Urban
Blue = Inner Suburban
Green = Outer Suburban
N
Map Scale Varies
Vanasse Hangen Brustlin, Inc.

Map: 2- Y

NORTH CAPITOL ST



Appendix 3

WMATA Priority Corridor Network Analysis

Draft Corridor Segmentation

Definitions:

Through Lanes:
Number of general purpose lanes in each direction

Household Density:
2005 Data from Round 7.1 Cooperative Forecasts.
1=0-3 households/acre
2=3-6 households/acre
3=6-9 households/acre
4=>9 households/acre

Employment Density:
2005 Data from Round 7.1 Cooperative Forecasts.
1=0-4 jobs/acre
2=4-8 jobs/acre
3=8-16 jobs/acre
4=>16 jobs/acre

General Area Type:
U = urban
IS = inner suburban
OS = outer suburban

Median/Parking Lanes:
M=median
P=parking
B=both

#	Corridor Name	Corridor/Segment Limits		Functional Classification	Through Lanes	Household Density	Employment Density	General Area Type	Median/Parking/ Both Lanes	Drive Access: Park and Rides	Effective Bus Service 2030 (buses/hr)
1	**Columbia Pike (Pike Ride)**	**Pentagon Metro**	**Columbia Pike and Little River Tpk**								
1a		Pentagon Metro	Columbia Pike and Courthouse Rd	Arterial Ramp, Major Arterial	2	starts at 1 goes up to mix of 3 and 4	4 at Pentagon, then 1, 2 and 3	U	M - from Pentagon Parking Lot to Columbia Pike @ Navy Annex	Pentagon, Pentagon City	21 to 60
1b		Columbia Pike and Courthouse Rd	Columbia Pike at Leesburg Pike/Baileys Crossroads	Major Arterial	2	Mostly 2 and 3 with pockets higher and lower	3 and 2, 4 for last 0.5 mile	IS	M - S Glebe to S Lincoln; P - WB S Oakland to S Randolph; M - Midblock S Columbus to S Frederick; M - S Jefferson to Leesburg Pike; P - WB S Highland to S Glebe	Four Mile Run P&R	7 to 20
1c		Leesburg Pike/Baileys Crossroads	Columbia Pike and Little River Tpk	Major Arterial	2	starts at 2/3, then 1 for most of it	1 and 2	IS	M - Leesburg Pike to Evergreen Ln		1 to 6
1d		McPherson Square Metro	18th St and E St Expwy (including stops at Farragut North and West)	Major Arterial and Collector	2	1 for most, 4 at end	4	U	P - both sides to 17th & Pennsylvania Ave; P - both sides NY Ave from 17th to E St Expwy	Metro Center, Farragut North, Farragut West,	7 to 20
1e		18th St and E St Expwy	E St Expwy and TR Memorial Bridge	Freeway	2	4	4	U		Foggy Bottom	1 to 6
1f		E St Expwy and TR Memorial Bridge	US50 (after ramp from I-66)	Freeway and Freeway ramp	3 (except on ramp from I-66 to US50)	1	1	U			1 to 6
1g		US-50 (after ramp from I-66)	Washington Blvd Exit of Arlington Blvd	Expressway	3	4 (other than park)	4 for most, then 1 and 2	U	M	Courthouse	7 to 20
1h		Washington Blvd Exit of Arlington Blvd	Courthouse Rd and Columbia Pike	Major Arterial	2	4 on west, 2 on east	2 and 3	IS	M		7 to 20

#	Corridor Name	Corridor/Segment Limits		Functional Classification	Through Lanes	Household Density	Employment Density	General Area Type	Median/Parking/ Both Lanes	Drive Access: Park and Rides	Effective Bus Service 2030 (buses/hr)
2	**Richmond Highway Express**	**Eisenhower Metro**	**Ft. Belvoir**								
2a		Eisenhower Metro	Huntington Ave and Richmond Hwy (including stop at Huntington Metro)	Arterial Ramp until Huntington Ave, then Major Arterial	2	3 and 4	3 and 4, then 1 and 2	U	M	Eisenhower Ave, Huntington, Jones Point P&R	7 to 20
2b		Huntington Ave and Richmond Hwy	Route 235/Old Mt. Vernon Rd	Major Arterial	3	mostly 2 with some 1	1 and 2	IS	M		7 to 20
2c		Route 235/Old Mt. Vernon Rd	Ft. Belvoir	Major Arterial	2	2 west of corridor, 1 east of corridor	1, 2 at very end	OS	M - Woodlawn Rd to Ft Belvoir		7 to 20

#	Corridor Name	Corridor/Segment Limits		Functional Classification	Through Lanes	Household Density	Employment Density	General Area Type	Median/Parking/ Both Lanes	Drive Access: Park and Rides	Effective Bus Service 2030 (buses/hr)
3	**Georgia Ave./7th Street**	**P St and Half St SW (S of Navy Yard and Waterfront Metros)**	**Silver Spring Metro**								
3a		P St and Half St SW (including stop at Waterfront Metro)	7th and I	Major Arterial and Collector	1, 2, 3	4	starts 1, then 4	U	P - WB side P St; P - both side 4th St; B - M St to Maine Ave; M - Maine Ave to 7th and I	Navy Yard, Waterfront-SEU	7 to 20
3b		7th and I	7th and Pennsylvania	Major Arterial	3	starts with a little 1 but then mostly 4	3 and 4	U	B - I St to SW Fwy Bridge; M - E St to D St; B - D St to Virginia; P - Maryland to Pennsylania	Federal Triangle, Smithsonian, L'Enfant Plaza	7 to 20
3c		7th and Pennsylvania	7th and E	Major Arterial	1	4	4	U	P	Archives-Navy Memorial	7 to 20
3d		7th and E	7th and K (including stop at Gallery Place Metro)	Major Arterial	1 plus 1 bus only	3 and 4	4	U	P	Metro Center, Gallery Place-Chinatown, Judiciary Square	7 to 20
3e		7th and K	New Hampshire Ave (GA Ave-Petworth Metro, plus stops at Mt. Vernon Square Metro and Shaw-Howard Metro)	Major Arterial	2 then 1	mostly 4, some 2	3 and 4 (some lower just south of Petworth)	U	P	U St-Cardozo, Columbia Heights, Shaw Howard University, Mount Vernon Square	1 to 6
3f		New Hampshire Ave (GA Ave-Petworth Metro)	Eastern Ave	Major Arterial	3	mostly 2, 3 and 4	mostly 1	IS	P	Georgia Ave-Petworth, Takoma	7 to 20
3g		Eastern Ave	Silver Spring Metro	Major Arterial	3	1 and 3	4	IS	P - Eastern to Wayne; M - Blair Mill to	Silver Spring	7 to 20

#	Corridor Name	Corridor/Segment Limits		Functional Classification	Through Lanes	Household Density	Employment Density	General Area Type	Median/Parking/ Both Lanes	Drive Access: Park and Rides	Effective Bus Service 2030 (buses/hr)
4	**Crystal City-Potomac Yard**	**Pentagon Metro**	**Braddock Rd Metro**								
4a		Pentagon Metro (Eads St)	JD Hwy and 20th St (Includes stop at Crystal City Metro)	Collector	2	4	4	U	P - both sides	Pentagon, Pentagon City, Crystal City	1 to 6
4b		JD Hwy and 20th St	JD Hwy at S Glebe	Major Arterial	3	starts 4, then 1 and 2	starts 4, then 1 and 2	IS	M		1 to 6
4c		JD Hwy at S Glebe	JD Hwy at Monroe Ave	Major Arterial	2 (it appears to be 3 in some parts in S/B direction only)	1, 2, 3	1, 2, 3	IS	M		1 to 6
4d		Monroe Ave	Braddock Rd Metro	Major Arterial, Collector	2 to Pendleton St. then 1	3 and 4	4	IS	M - Monroe Ave to First St; P - both sides of First St	Braddock Rd	1 to 6
5	**Southern Ave. Metro-National Harbor**	**Southern Ave Metro Station**	**Oxon Hill Rd at National Harbor**								
5a		Southern Ave Metro Station (Southern Ave SE)	Southern Ave and 13th Street (United Medical Center)	Collector	1	1 and 2	1 and 3	IS		Southern Ave	7 to 20
5b		Southern Ave and 13th Street (United Medical Center)	Southern Ave and Indian Head Hwy	Collector then Minor Arterial	2	3 and 4	1	IS	P - Wheeler to 9th St; P - Chesapeake to 6th St SE		1 to 6
5c		Southern Ave and Indian Head Hwy	Indian Head Hwy at Oxon Hill Rd	Major Arterial	1 then 2 then 3 (at I-495 only)	1 on west, 4 on east	1	IS	M	Eastover Shopping Center P&R	1 to 6
5d		Indian Head Hwy at Oxon Hill Rd	Oxon Hill Rd at National Harbor	Collector	2	1	1	IS	P - Fort Foote Rd to Claudia Dr	Oxen Hill P&R	21 to 60

#	Corridor Name	Corridor/Segment Limits		Functional Classification	Through Lanes	Household Density	Employment Density	General Area Type	Median/Parking/ Both Lanes	Drive Access: Park and Rides	Effective Bus Service 2030 (buses/hr)
6	**Wisconsin Ave./Pennsylvania Ave.**	**Naylor Road Metro Station**	**Friendship Heights Metro**								
6a		Naylor Road Metro Station	Southern Ave and Pennsylvania Ave SE	Major Arterial (Branch Ave), Minor Arterial (Southern Ave)	2	1 and 3	1 and 3	IS	P - Branch Ave to Pennsylvannia Ave	Naylor Rd	1 to 6
6b		Southern Ave and Pennsylvania Ave SE	I-395 (including stops at Potomac Ave and Eastern Mkt Metros)	Major Arterial	2	mix	1	IS	P - Southern Ave to Alabama Ave; M - Minnesota Ave to Barney Cir SE; B - Barney Cir SE to 2nd St SE	Capitol South; Potomac Ave	7 to 20
6c		I-395	Wisconsin and M St (including stops at Archives, Fedaral Triangle, McPherson and Farragust West Metros)	Major Arterial	3	4 for 1st and last miles, mostly 1 otherwise	mostly 4	IS	P - 3rd St SE to 7th St SW; P (7th st) National Mall to Pennsylvania Ave; M - @ xwalks 7th St to 15th St; P (15th St) - Pennsylvannia to I St; P (I St) - 15th St to Pennsylvania Ave; P - I St to Wisconsin & M	Federal Center, L'Enfant Plaza, Federal Triangle, Judiciary Square, Metro Center, McPherson Square, Farragut North, Farragut West, Foggy Bottom	7 to 20
6d		Wisconsin and M St	Wisconsin and 35th St. (including stop at Foggy Bottom Metro)	Major Arterial	2	4 on west, 2 and 4 on east	2, 3 and 4	IS	P		7 to 20
6e		Wisconsin and 35th St.	Friendship Heights Metro at Western Ave (including a stop at Tenleytown Metro)	Major Arterial	3	4 on west, 2 on east until NE, then all 2 until 4 at Friendship Heights	3 and 4 until except west side between NE and Friendship Heights	U	P	Friendship Heights, Tenley Town-AU	1 to 6

#	Corridor Name	Corridor/Segment Limits		Functional Classification	Through Lanes	Household Density	Employment Density	General Area Type	Median/Parking/ Both Lanes	Drive Access: Park and Rides	Effective Bus Service 2030 (buses/hr)
7	**University Blvd / East-West Highway**	**Montgomery Mall Transit Center (Westlake Drive)**	**College Park Metro**								
7a		Montgomery Mall Transit Center (Westlake Drive)	Democracy Blvd and Old Georgetown	Major Arterial	3	1	2 and 4	IS	M	Montgomery Mall P&R	21 to 60
7b		Democracy Blvd and Old Georgetown	Old Georgetown and Cedar Lane	Major Arterial	3	1, 2 3	1	IS	M		1 to 6
7c		Old Georgetown and Cedar Lane	Cedar Lane and 355	Minor Arterial	2	3	1 and 4	IS			7 to 20
7d		Cedar Lane and 355	Bethesda Metro (including stop at Medical Center Metro)	Major Arterial	3	1 for first half, then 4	4	IS	M; P - Rosedale to Bethesda Metro	Medical Center, Bethesda	7 to 20
7e		Bethesda Metro	E-W Hwy at Jones Mill Rd (Including stop at Silver Spring Transit Center)	Major Arterial	2	1	1	IS			1 to 6
7f		E-W Hwy at Jones Mill Rd	Wayne and Cedar	Major Arterial until Wayne, then Collector	2	4, some 2	1 for first half, then 4	IS	M - Meadowbrook Ln to Sundale; M - 16th St to Fenton St	Silver Spring	21 to 60
7g		Wayne and Cedar	Piney Branch and University	Collector and Major Arterial	2	2 and 3	mostly 1	IS	M - Barron to University		7 to 20
7h		Piney Branch and University Blvd	University Blvd and Adelphi Rd	Major Arterial	3	2 and 3	mostly 1	IS	M		7 to 20
7i		University Blvd and Adelphi Rd	College Park Metro	Mostly Collector	1	1	4	IS		College Park - UMD	7 to 20

#	Corridor Name	Corridor/Segment Limits		Functional Classification	Through Lanes	Household Density	Employment Density	General Area Type	Median/Parking/ Both Lanes	Drive Access: Park and Rides	Effective Bus Service 2030 (buses/hr)
8	**Sixteenth Street (DC)**	**McPherson Square Metro**	**Silver Spring Metro**								
8a		McPherson Square	16th St and Florida Ave	Major Arterial	3	mostly 4 except some 1 for part of first 0.5 mile	4	U	P	U St - Cordoza, Dupont Circle, Faragut North, Faragut West, McPherson Square, Metro Center,	7 to 20
8b		16th St and Florida Ave	16th St and Columbia Rd	Major Arterial	2 AM, 3 PM	4	4 on west, 2 east	U	P		1 to 6
8c		16th St and Columbia Rd	16th St and Arkansas Ave	Major Arterial	3 AM, 2 PM	4	mostly 2 some 4	U	P		7 to 20
8d		16th St and Arkansas Ave	16th St and Colesville Road	Major Arterial	3	2, 3, 4 on east, 1 on west	1 and 2 except for Walter Reed (4)	IS	M		7 to 20
8e		16th St and Colesville Road	Silver Spring Metro	Major Arterial	2 until E-W Hwy, then 3	4	4	U	B	Silver Spring	7 to 20

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9	**Leesburg Pike**	**King St Metro**	**Tysons Westpark**								
9a		King St Metro	Leesburg Pike and Quaker Lane	Major Arterial	1 to Janneys Lane then 2	starts with 2 and 3, then mostly 1	4 at beginning, then 1	IS	P - Btw Highland Pl and W View Ter; M - at Quaker	King St	1 to 6
9b		Leesburg Pike and Quaker Lane	Leesburg Pike and Beauregard St	Major Arterial	2	2 to 4	2, 3 and 4	IS	M - Quaker to S 28th St		7 to 20
9c		Leesburg Pike and Beauregard St	Leesburg Pike and Columbia Pike	Major Arterial	3	2 to 4	2, 3 and 4	IS	M - Dawes Ave to Columbia Pike		1 to 6
9d		Leesburg Pike and Columbia Pike	Arlington Blvd/7 Corners at New 7 Corners Transit Center	Major Arterial	2 until Patrick Hentry Drive, then 3	2 to south, 1, 3 and 4 to north	1 to south, 2 and 3 to north	IS	M - Columbia Pike to Payne St; M - Patrick Henry to 7 Corners		1 to 6
9e		Arlington Blvd/7 Corners at New 7 Corners Transit Center	I-66 with possible stop at West Falls Church Metro	Major Arterial	2	1 and 2	mostly 2 and 3	OS	M - @ N West St; M - Gordon Rd to I66		1 to 6
9f		I-66	I-495	Major Arterial	2	1, 2, and 3	1 and 2	OS	M		1 to 6
		I-495	Tysons Westpark	Major Arterial	3	mostly 1 some 2	4	IS	M		1 to 6
10	**Veirs Mill Road**	**Silver Spring Metro**	**Shady Grove Metro**								
10a		Silver Spring Metro	Spring Street	Major Arterial	3	2 and 4	4	U	B	Silver Spring	7 to 20
10b		Georgia Ave and Spring Street	Georgia Ave and 16th St	Major Arterial	3	1 and 2	1	IS	M		1 to 6
10c		Georgia Ave and 16th St	Georgia Ave and I-495 (Forest Glen Metro)	Major Arterial	4 (peak direction), o/w 3	1 and 2	1 and 2	IS	M - 495 to Forest Glenn		1 to 6
10d		Georgia Ave and I-495 (Forest Glen Metro)	Georgia and Veirs Mills Rd (Wheaton Metro)	Major Arterial	3	1, 2, 3	1 (3 and 4 around both Metros)	IS	M		7 to 20
10e		Georgia and Veirs Mills Rd (Wheaton Metro)	Veirs Mill Rd and Connecticut	Major Arterial	3	2	1 (3 and 4 around Wheaton)	IS	M	Wheaton	7 to 20
10f		Veirs Mill Rd and Connecticut	Veirs Mill Rd and Twinbrook Pkwy	Major Arterial	2	1 and 2	1 and 2	IS	M		1 to 6
10g		Veirs Mill Rd and Twinbrook Pkwy	Rockville Metro	Major Arterial	2	1 and 2	2 (4 around Rockville Metro)	IS	M	Rockville	1 to 6
10h		Rockville Metro	Shady Grove Metro	Major Arterial	3	2 at very beginning and very end of corridor, 1 in middle	3 and 4 for most of corridor, 2 for 0.5 mile in middle	IS	M	Shady Grove	7 to 20

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11	**New Hampshire Avenue**	**Fort Totten Metro**	**White Oak (Columbia Pike and Stewart Lane)**								
11a		Fort Totten Metro	New Hampshire Ave and Eastern Ave	Major Arterial	2	2 and 3, some 1 and 4	2 and 3	IS		Fort Totten	1 to 6
11b		New Hampshire Ave and Eastern Ave	New Hampshire and University Blvd	Major Arterial	3	2	1 and 2	IS	M		7 to 20
11c		New Hampshire and University Blvd	New Hampshire and I-495	Major Arterial	3	2 and 3	1	IS	M		7 to 20
11d		New Hampshire and I-495	White Oak (Columbia Pike and Stewart Lane)- with a stop at the new White Oak Transit Center	Major Arterial	3	1, 2/3 at end	1 and 2	OS	M		7 to 20
12	**H Street / Benning Road**	**Minnesota Ave Metro**	**McPherson Square Metro**								
12a		Minnesota Ave Metro	Benning Rd and Bladensburg Rd	Major Arterial	4	2 and 3	1 and 2	IS	M	Benning Rd, Minnesota Ave	7 to 20
12b		Benning Rd and Bladensburg Rd	McPherson Square Metro (including stops at Union Station, Gallery Place and Metro Center Metros)	Major Arterial until 3rd St, then Minor Arterial	3	1 for first mile, then mixed	3 for first mile then 4	U	P	NY Ave/ FL Ave, Union Station, Judiciary Square, Mount Vernon Square, Federal Triangle, Metro Center, Faragut West, Faragut North,	7 to 20

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13	**Georgia Ave. (MD)**	**Silver Spring Metro**	**Montgomery General Hospital**								
13a		Silver Spring Metro	Spring Street	Major Arterial	3	2 and 4	4	U	B	Silver Spring	7 to 20
13b		Georgia Ave and Spring Street	Georgia Ave and 16th St	Major Arterial	3	1 and 2	1	IS	M		1 to 6
13c		Georgia Ave and 16th St	Georgia Ave and I-495 (Forest Glen Metro)	Major Arterial	4 (peak direction), o/w 3	1 and 2	1 and 2	IS			1 to 6
13d		Georgia Ave and I-495 (Forest Glen Metro)	Georgia and Veirs Mills Rd (Wheaton Metro)	Major Arterial	3	1, 2, 3	1 (3 and 4 around both Metros)	IS	M		7 to 20
13e		Georgia and Veirs Mills Rd (Wheaton Metro)	Georgia Ave and Randolph Road	Major Arterial	3	1, 2 (some 4 at Randolph)	1 (3 and 4 around Wheaton and Randolph	IS	M	Wheaton	7 to 20
13f		Georgia Ave and Randolph Road	Georgia Ave and Norbeck Road (including stop at Glenmont Metro)	Major Arterial	3	1 and 2	1 except right at GA and CT (2)	OS	Wide median Rippling Brooke to Norbeck	Glenmont, Glenmont P&R,	21-60
13g		Georgia Ave and Norbeck Road	Georgia Ave and Olney-Sandy Spring Rd	Major Arterial	2	1	1	OS	Wide median Norbeck to 0.25 miles south of Olney-Sandy Spring Road	Norbeck Rd P&R	7 to 20
13h		Georgia Ave and Olney-Sandy Spring Rd	Montgomery General Hospital	Not in MWCOG network	Not in MWCOG network	1	1	OS	M - Olney-Sandy Spring to Spartan		

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14	**Greenbelt-Twinbrook**	**Prince George's Plaza Metro**	**Twinbrook Metro**								
14a		Prince George's Plaza Metro	Riggs Rd and University Blvd	Major Arterial	2	2	1 except right at PG Plaza Metro (4)	IS	M	Prince Georges Plaza,	7 to 20
14b		Riggs Rd and University Blvd	East University Blvd and Piney Branch Rd	Major Arterial	3	2, 3, some 4 nearby	1 and 2	IS	M		7 to 20
14c		East University Blvd and Piney Branch Rd	Wheaton Metro Station	Major Arterial	3	1 and 2 (3 right at Wheaton Metro)	1 (4 right at Wheaton Metro)	IS	M		7 to 20
14d		Wheaton Metro Station	Veirs Mills Road and Randolph Road	Major Arterial	3	2	1 (3 and 4 around Wheaton Metro)	IS	M	Wheaton	7 to 20
14e		Veirs Mills Road and Randolph Road	Randolph Road and Parklawn Dr	Major Arterial	2	1 and 2	1 and 2	IS	M - Viers Mill to Rocking Horse	White Flint	7 to 20
14f		Randolph Road and Parklawn Dr	Twinbrook Metro	Collector	2	1 and 2	2, 4 around Twinbrook Metro	IS			
15	**East-West Highway (Prince Georges)**	**Silver Spring Metro**	**New Carrollton Metro**								
15a		Silver Spring Metro	Philadelphia Ave and Piney Branch Road	Collector and Major Arterial	2	4 and 2	4 and 1	IS	P - Fenton to Philadelphia;	Silver Spring	7 to 20
15b		Philadelphia Ave and Piney Branch Road	Ethan Allen and Riggs Rd	Major Arterial	mix of 1 and 2	2	1, some 2	IS	P - New Hampshire to Fairview	Takoma	7 to 20
15c		Ethan Allen and Riggs Rd	East-West Hwy and Baltimore Ave (including stop at Prince George's Plaza Metro)	Major Arterial	2	1, 2, a little 3	1 and 2, some 4 (at PG Plaza)	IS	M	Prince George's Plaza Metro	7 to 20
15d		East-West Hwy and Baltimore Ave	E-W Hwy at B-W Pkwy	Major Arterial	2	2 and 3	1	IS	M - Baltimore Ave to 61st Pl; P - 61st Pl to 64th Ave		7 to 20
15e		E-W Hwy at B-W Pkwy	New Carrollton Metro	Major Arterial and Collector	2 on Major, 1 on Collectors	1 and 2	1, but 3 for last mile	IS		New Carrollton	7 to 20

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16	**Anacostia-Congress Heights**	**L'Enfant Plaza Metro**	**S Capitol St and Southern Ave SE**								
16a		7th and D St SW	Beginning of Fred Douglass Bridge	Major Arterial	3 (small portion 2 along N Capitol)	4	4	U	M	Smithsonian, L'Enfant Plaza, Federal Center, Navy Yard, Waterfront-SEU	7 to 20
16b		Beginning of Fred Douglass Bridge	MLK Ave SE and Lebaum St SE (including stop at Anacostia Metro)	Major and Minor Arterial (except expressway on Suitland Pkwy)	3 until Anacostia Fwy then 2	3 and 4 for first mile after bridge, then 1	1 and 2 for first mile after bridge, then 3	U	M - S Capitol St to 11th St SE; P - MLK to Howard Rd; P - Sumner to Pomeroy;	Anacostia	7 to 20
16c		MLK Ave SE and Lebaum St SE	S Capitol St and Southern Ave SE at Park and Ride Lot on Southern Ave	Major and Minor Arterial	3 until MLK and S Capitol, then 2	2 to 4	1	U	P - Milwaukee to S Capitol; P - Elmira to 1st St SE	Eastover Shopping Center P&R	1 to 6

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17	**Little River Turnpike/Duke Street**	**King St. Metro**	**Route 123**								
17a		King St Metro (Duke and Callahan)	Duke St and Jordan St.	Major Arterial	3 until Quaker then 2	1 and 2	3 to south 1 to north	IS	M - Callahan to Roth; M - S Quaker to Wheeler Ave;	King St; Eisenhower Ave	1 to 6
17b		Duke St and Jordan St.	Duke St and Beauregard St	Major Arterial	3 until Ripley, then 2	3 and 4	2 and 3	IS	M		1 to 6
17c		Duke St and Beauregard St	I-495	Major Arterial	2	mix of 1 and 2 (more 1) except right before I-495, then 4	1	OS	M - Beauregard to Jon Marr Dr; M - Backlick to Annandale; M - Markham to 495		1 to 6
17d		I-495	Pickett Rd	Major Arterial	2	1	1	OS	M		1 to 6
17e		Pickett Rd	Route 123	Major Arterial	2	1	1 and 3, 4 at end	IS	M - Pickett to Old Lee Hwy	Sipan Lot P&R, North Street Lot P&R	1 to 6

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18	**Rhode Island Ave. Metro to Laurel**	**Rhode Island Ave Metro**	**Cherry Lane (Laurel)**								
18a		Rhode Island Ave Metro	Eastern Ave	Major Arterial	3	1 and 2	mostly 1 and 2, some 3 and 4	U	B	Rhode Island Ave	1 to 6
18b		Eastern Ave	Baltimore Ave and Mowatt Lane	Major Arterial	2	1 and 2	1 and 2	IS	B - Eastern Ave to 38th Ave; M - 38th to 43rd; P - Farragut to Gallatin		1 to 6
18c		Baltimore Ave and Mowatt Lane	I-495	Major Arterial	2	1 and 2	mostly 2 and 3, some 4	IS	M - Mowatt to Lakeland; M - Cherry Hill to 495	College Park - UMD	1 to 6
18d		I-495	Ammendale Road	Major Arterial	2	1	1, 2 and 3	OS	M - 495 to Sunnyside; M - Quimby to Ammendale		1 to 6
18e		Ammendale Road	Cherry Lane	Major Arterial	2 until Contee, then 1	1 and some 2	mostly 1, 3 and 4 and start and end of segment	IS	M - Virginia Manor; M @ Cherry Lane		1 to 6
19	**Mass Ave/ U St./ Florida Ave./ 8th St./ MLK Ave.**	**Anacostia Metro**	**Woodley Park Metro**								
19a		Anacostia Metro	M St and 8th St. SE	Freeway and Major Arterial	3	3 and 4	1 and 2 then 4	U	M - 12th St to 8th St	Anacostia	7 to 20
19b		M St and 8th St. SE	8th St. and FL Ave NE	Collector	1	4	3 and 4	U	P	Eastern Market	7 to 20
19c		8th St. and FL Ave NE	FL and N Capitol St NE (including stop at NY Ave Metro)	Major Arterial	3	1, 2 and 4	4	U		NY Ave/FL Ave	1 to 6
19d		FL and N Capitol St NE	Woodley Park Metro (including stop at U Street Metro)	Major Arterial and Collector	3 and 2	4	1 and 2 for first and last 0.5 miles, otherwise 3 and 4	U	P - U St to Woodley Park Metro	Shaw Howard U, U St-Cordoza, Dupont Circle, Woodley Park-Zoo	1 to 6

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20	**Rhode Island Avenue**	**Shaw Howard Univ Metro**	**Eastern Ave and Michigan Ave NE**								
20a		Shaw Howard Univ Metro	RI and 4th St NE	Major Arterial	3	4, some 3	all, starting with higher	U	B	U St-Cordoza, Shaw Howard U, Mount Vernon Square	1 to 6
20b		RI and 4th St NE	Brookland Metro (including potential stop at Rhode Island Ave Metro)	Collector	1	2 and 4	mix, mostly 1 and 2	IS	P	Rhode Island Ave	7 to 20
20c		Brookland Metro	Randolph St and Eastern Ave	Minor Arterial/Collector	1	2	1 and 2	IS	P		1 to 6
20d		Randolph St and Eastern Ave	Eastern Ave and Michigan Ave NE	Connector	2	1 on west, 4 on east	1	IS			1 to 6
21	**Eastover - Addison Road**	**Southern Ave and Indian Head Hwy**	**Addison Rd Metro**								
21a		Southern Ave and Indian Head Hwy	13th Street at United Medical Center (with potential stop at Southern Ave Metro)	Collector then Minor Arterial	2	3 and 4	1	U	M - Indian Head to Deal; P - Deal to Iverson; P - Iverson to 13th St	Eastover Shopping Center P&R	1 to 6
21b		13th Street at United Medical Center	Iverson St and Branch Ave	Major Arterial except Iverson Pl and St btwn Wheeler and 23rd is Minor Arterial	1	1, 2 and 3	1 and 2	IS	P - Wheeler Hills to Wheeler Hills; B - 19th Ave to Branch		1 to 6
21c		Iverson St and Branch Ave	Walker Mill Road and Addison Rd (with potential stop at Suitland Metro)	Major Arterial	3	mostly 2	1, 2 and 3	IS	M - Branch to Rochelle	Suitland	1 to 6
21d		Walker Mill Road and Addison Rd	Shady Glen Drive and Central Avenue	Minor Arterial and Collector	1	1 and 2	1	OS		Morgan Blvd	1 to 6
21e		Shady Glen Drive and Central Avenue	Addison Rd Metro	Major Arterial	3	1 and 2	1	OS	M	Addison Rd	7 to 20

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22	**Colesville Rd./ Columbia Pike - MD US 29**	**Silver Spring Metro**	**Columbia Pike and Sandy Spring Rd**								
22a		Silver Spring Metro	Colesville Rd and Sligo Creek Pkwy	Collector, Major Arterial	3	4, then 1 and 2	4 then 1	U	P - Silver Spring Metro to Fenton;	Silver Spring	7 to 20
22b		Colesville Rd and Sligo Creek Pkwy	Columbia Pike and Lockwood Drive	Major Arterial	3	1 and 2	1	IS	M		21 to 60
22c		Columbia Pike and Lockwood Drive	Columbia Pike and E Randolph/Cherry Hill Rd	Major Arterial to NH Ave, then Expressway	3	1, 2, and 3	1 and 2	IS	M	Tech Rd P&R	21 to 60
22d		Columbia Pike and E Randolph/Cherry Hill Rd	Columbia Pike and Sandy Spring Rd	Expressway	3	1 on east, 2 on west	1	OS	M	Forcey Memorial P&R, St Marks Church P&R, Briggs Chaney P&R, Green Castle P&R, Burtonsville Crossing P&R	21 to 60

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23	**Fourteenth Street**	**L'Enfant Plaza Metro**	**Takoma Park Metro**								
23a		L'Enfant Plaza Metro	14th and R St NW (including stops at Smithsonian Metro and McPherson Metro)	Major Arterial (14th St) and Minor Arterial and Collector	3 on 14th St, mixed before	1 (except last 0.75 mile is 4)	4	U	P	Faragut North, Faragut West, McPherson Square, Metro Center, Federal Triangle	21 to 60
23b		14th and R St NW	14th and Aspen (including stop at Columbia Heights Metro)	Collector	1	4	4 for first mile, then mostly 2	U	P	U St-Cordoza, Columbia Heights	1 to 6
23c		14th and Aspen	Takoma Park Metro	Collector	1	4, 3, and 2	1 except for Walter Reed (4)	IS	P		

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24	**North Capitol Street**	**19th and K (Farragut N and W)**	**Fort Totten Metro**								
24a		19th and K (Farragut N and W)	13th and H (including stop at McPherson Square Metro)	Major Arterial	3	Mostly 1 some 4	4	U	Street Parking separated by medians on both sides of K St; P - 13th St to H St	Foggy Bottom, Faragut North, Faragut West, McPherson Square,	21 to 60
24b		13th and H	H and North Capitol (including stop at Union Station Metro)	Major Arterial	3	1, 3, 4	4	U	P - 13th St to N Capitol	Mount Vernon Square, Metro Center, Federal Triangle, Gallery Place-Chinatown, Judiciary Square, Union Station	7 to 20
24c		H and North Capitol	North Capitol and Florida	Major Arterial	3	Mix from 1 to 4	Mix from 1 to 4	U	B	NY Ave/FL Ave	1 to 6
24d		North Capitol and Florida	North Capitol and Michigan (including stop at Brookland-CUA Metro)	Major Arterial	2	1, 2, 3	Mix from 1 to 4	IS	B		7 to 20
24e		North Capitol and Michigan	Monroe and 12th St	Major Arterial	3	Mix from 1 to 4	4 (some 1)	IS	P	Brookland-CUA	7 to 20
24f		Monroe and 12th St	Fort Totten Metro	Major and Minor Arterial	1 and 2	2 and 3	Mix from 1 to 4	IS	P - 12th St to S Dakota;	Fort Totten	1 to 6