

# Washington Metropolitan Regional Bus Study

## Phase 2

### Implementation Plans



*Final Report*



DMJM+HARRIS

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## **Executive Summary**

The WMATA Regional Bus Study (September 2003) identified the need for high-quality service, running way, and passenger facility improvements in a number of key transit corridors throughout the Washington region. Given the scope of the original study, which was completed at a strategic level to identify overall regional transit needs, many of the recommendations were at a fairly general level. The purpose of the Phase 2 study is to complete a more detailed analysis of four transit corridors considered in the original study and develop a comprehensive program of improvements that incorporate integrated service enhancements, running way improvements, and passenger facility improvements for each corridor.

The four corridors selected for more detailed analysis in this study phase were:

- 1) The H Street/Benning Road Corridor in Washington DC;
- 2) U.S Route 1 from Laurel, in Prince Georges County Maryland, to the Rhode Island Avenue Metrorail Station in the District of Columbia;
- 3) The Maryland 450 corridor (Annapolis Road) from the New Carrollton Metrorail Station in Prince George's County to the Rhode Island Avenue Metrorail Station in the District of Columbia; and
- 4) Metrorail Support services to provide additional transit capacity parallel to the Metrorail Orange Line in the I-66 corridor in northern Virginia.

Maps of each corridor are provided in Section 3 of the report.

The study process was completed in three steps, with a technical memorandum/report completed to document the results of each step. These steps included:

**Preliminary Recommendations** – The first step in the study planning process was the identification of preliminary recommendations for each of the three elements considered in the analysis (service improvements, running way and signal improvements, and passenger facility improvements), for each corridor. This first step also included the development of cost estimates for each preliminary recommendation.

**Evaluation of Preliminary Recommendations** – This step of the planning process involved a more detailed assessment of each preliminary recommendation's overall cost, cost-effectiveness, productivity, and overall feasibility. The purpose of this evaluation step was to narrow the list of recommendations to include only those improvements that would be cost-effective and productive as well as to assist in the prioritization of recommendations.

**Final Recommendations** – The final step of the planning process was the development of final recommendations for implementation. As noted, this final set of recommendations was the result of a narrowing of the full universe of preliminary recommendations based on a number of inputs, including the results of the evaluation phase, feedback from jurisdictions on priorities, and the overall availability of resources to implement the recommendations. This input was also used to prioritize recommendations and set time frames for implementation: short-term (1-5 years), mid-term (6-10 years) and long-term (after 10 years).

Preliminary recommendations for service in the four corridors varied depending on the nature of the corridor and its ridership demand. RapidBus/BRT service overlays were considered in the H Street/Benning Road and Annapolis Road corridors. A number of service restructuring alternatives between Laurel and the Rhode Island Avenue Metro Station were examined for the U.S. 1 corridor and a series of express services running parallel to the Orange Line in Northern Virginia, from five park and ride lots in Fairfax County, were evaluated for the Metro Support/I-66 corridor.

Running way and signal improvements focused on improvements to support the service recommendations in each corridor. These improvements included bus bypass lanes and queue jumps utilizing existing right hand turn lanes where possible, but in some instances through the construction of additional right-of-way. Improvements also included the use of signal priority to improve bus run times and reliability.

Passenger facility improvements also focused on the support of service recommendations in each corridor. Recommendations included larger shelters, improved information and signing, pedestrian level lighting, additional benches and additional trash receptacles. It was further noted that the facility design should be part of a consistent image for the premium services that would be incorporated into vehicles, shelters, signing, and other passenger information.

More detail on the specific improvements in each corridor is included in Sections 4 through 7 in the body of the report.

The final recommendations and their proposed implementation time frames are summarized in the table below:

### **Short Term Implementation Time Frame**

<b>Time Frame</b>	<b>Recommendation</b>
Short-Term Service	<ol style="list-style-type: none"><li>1. RapidBus/BRT service overlay on H Street/Benning Road (equal frequency concept)</li><li>2. Metro Support Express Service between Fairfax Government Center and downtown Washington</li></ol>
Short-Term Running Way and Signal	<ol style="list-style-type: none"><li>1. Bus bypass improvements in the H Street/Benning Road corridor</li><li>2. Fairfax Government Center bus left hand turn lane</li><li>3. Herndon-Monroe bus bypass recommendations</li></ol>
Short-Term Passenger Facilities	<ol style="list-style-type: none"><li>1. Passenger facility improvements on Benning Road portion of H Street/Benning Road corridor</li><li>2. All passenger facility recommendations in U.S. 1 corridor</li><li>3. Passenger facility improvements at Fairfax Government Center</li></ol>

### **Mid-Term Implementation Time Frame**

<b>Time Frame</b>	<b>Recommendation</b>
Mid-Term Service	<ol style="list-style-type: none"><li>1. Metro Support express service between Stringfellow Road Park and Ride and downtown Washington</li><li>2. Greenbelt/College Park service restructuring in U.S. 1 Corridor</li></ol>
Mid-Term Running Way and Signal	<ol style="list-style-type: none"><li>1. Signal priority in the H Street portion of the H Street/Benning Road corridor</li><li>2. Metro Support signal priority recommendations at Fairfax Government Center, Herndon-Monroe and Stringfellow Road Park and Ride</li><li>3. Mainline signal priority and bus bypass improvements in the U.S. 1 corridor</li></ol>
Mid-Term Passenger Facilities	<ol style="list-style-type: none"><li>1. Passenger facility recommendations on the H Street portion of the H Street/Benning Road corridor</li><li>3. Passenger facility recommendations – Stringfellow Road Park and Ride Lot</li></ol>

## Long-term Implementation Time Frame

Time Frame	Recommendation
Long-Term Service	<ol style="list-style-type: none"><li>1. Metro Support express service between Poplar Tree Park and Ride and downtown Washington</li><li>2. Metro Support express service between Herndon-Monroe and downtown Washington</li><li>3. Metro Support express service between West Falls Church and downtown Washington</li><li>4. Metro Support express service between Fairfax Government Center and Pentagon City/Crystal City</li><li>5. Annapolis Road RapidBus overlay</li></ol>
Long-Term Running Way and Signal	<ol style="list-style-type: none"><li>1. Side street signal priority recommendations in the U.S. 1 corridor</li><li>2. Signal priority and bus bypass recommendations associated with the Poplar Tree Park and Ride lot</li><li>3. Signal priority and bus bypass recommendations associated with the West Falls Church Park and Ride lot.</li><li>4. Signal priority and bus bypass recommendations in Pentagon City and Crystal City</li></ol>
Long-Term Passenger Facilities	<ol style="list-style-type: none"><li>1. Passenger facility recommendations - Poplar Tree Park and Ride</li><li>2. Stringfellow Road Park and Ride expansion</li><li>3. Passenger facility recommendations – Herndon-Monroe Park and Ride</li><li>4. Passenger facility recommendations – West Falls Church</li></ol>

# **Section 1 – Introduction**

## Introduction

The WMATA Regional Bus Study (September 2003) identified the need for high-quality service, running way, and passenger facility improvements in a number of key transit corridors throughout the Washington region. Given the scope of the original study, which was completed at a strategic level to identify overall regional transit needs, many of the recommendations were at a fairly general level. The purpose of the Phase 2 study phase is to complete a more detailed analysis of four transit corridors considered in the original study and develop a comprehensive program of improvements that incorporate integrated service enhancements, running way improvements, and passenger facility improvements for each corridor.

The foundation of the work completed in the Regional Bus Study was the family of services concept, which is based on the idea that different transit markets (i.e. long distance express trips, local trips along urban arterials, or neighborhood and activity center circulation) require different types of services in order to be effectively served; in other words, not all potential transit trips can be adequately served by a local service making stops every one or two blocks and utilizing 35 or 40 foot coaches. Based on this family of services foundation, priority corridors for service, running way, and passenger facility improvements were identified for each of the jurisdictions in the study. The identification of these priority corridors was based on four primary criteria:

- Corridor ridership – is there enough ridership to warrant additional high quality service?
- Current service – does existing service run frequently enough that local service can be scaled back and complemented by high frequency premium service making limited stops?
- Physical characteristics of corridor – are running way improvements to improve bus travel speeds feasible?
- Boarding patterns – is there a subset of heavily used bus stops along the corridor that warrant limited stop premium service?

Based on the results of the Regional Bus Study, the four corridors selected for more detailed analysis in the Phase 2 study phase were:

- 1) The H Street/Benning Road Corridor in Washington DC from the Minnesota Avenue Metrorail Station to 3<sup>rd</sup> Street NW;
- 2) U.S. Route 1 from Laurel, in Prince Georges County Maryland, to the Rhode Island Avenue Metrorail Station in the District of Columbia;
- 3) The Maryland 450 corridor (Annapolis Road) from the New Carrollton Metrorail Station in Prince Georges County to the Rhode Island Avenue Metrorail Station in the District of Columbia (the

- corridor includes Maryland 450, Bladensburg Road, 38<sup>th</sup> Avenue, and U.S. 1); and
- 4) Metrorail Support services to provide additional transit capacity parallel to the Metrorail Orange Line in the I-66 corridor in northern Virginia. The service concepts analyzed included service from two park and ride lots on Stringfellow Road, the Fairfax Government Center, the West Falls Church Metro Station, and the Herndon-Monroe Park and Ride, to destinations in downtown Washington and the Crystal City/Pentagon City area.

More detailed descriptions of each corridor, including maps, are included in Section 3 of the report.

As with the original study, the Phase 2 study is considering the three elements identified above – service, running way, and passenger facilities – as an integrated whole because it is these three elements combined that will dictate the level and quality of service that can be provided to transit passengers in each corridor.

## **Section 2 – Planning Process**

## Planning Process

The study process was completed in three steps, with a technical memorandum/report completed to document the results of each step. These steps included:

**Preliminary Recommendations** – The first step in the study planning process was the identification of preliminary recommendations for each of three elements considered in the study – service, running way, and passenger facilities - for each corridor. This first step also included the development of cost estimates for each preliminary recommendation, including operations and maintenance costs for the service recommendations, capital costs for passenger and running way facility recommendations, and ridership estimates for the service improvement recommendations.

The process for developing these preliminary recommendations was based on a framework for identifying the potential need for the improvement as well as a preliminary evaluation of the recommendation's potential success. The process for identifying preliminary recommendations is outlined in greater detail below.

*Running Way and Signal Improvements* – Preliminary running way and signal improvements were identified in a two step process. In the first step two broad criteria were used to identify overall need for the improvement. The first criterion was the number of bus trips through a corridor or corridor segment, with any segment with 10 trips or more in the peak hour identified as a potential candidate for improvements. The second criterion was bus speed, with any segment with an average speed of less than 20 mph also identified as a potential candidate for improvements.

These broad criteria were then supplemented by more specific criteria that focused on the need for the improvement in greater detail. These criteria included bus operator feedback on issues impacting bus travel times, bus delay data focused on factors causing running time delays, and geometric conditions either causing delays or providing an opportunity for running way improvements. Also considered were criteria related to the potential feasibility of the improvement such as compatibility of the improvements with the existing signal system and institutional issues related to acceptance of the running way improvements by impacted jurisdictions and agencies.

A more detailed definition of the types of running way and signal improvements recommended in the study are included in Appendix 4.

*Service Improvements* – Preliminary service improvement recommendations were based on the recommendations of the original Regional Bus Study, existing corridor ridership, boarding and alighting patterns, and the feedback of the

WMATA regional service planners regarding the need for the improvement and required level of service and service design.

*Passenger Facility Improvements* – Preliminary passenger facility recommendations were based predominantly on the service improvement recommendations as well as other identified needs by local jurisdictions, WMATA, and the Regional Bus Study.

The final product of this step of the planning process was the “Preliminary Recommendations Report” dated February 6, 2004. This document provided the foundation for the final recommendations included in this report.

**Evaluation of Preliminary Recommendations** – This step of the planning process involved a more detailed assessment of each preliminary recommendation’s overall cost, cost-effectiveness, productivity, and overall feasibility. The purpose of the preliminary recommendations step of the planning process was to identify the full range of potential improvements in each of the study corridors. All improvements that were potentially feasible were included in this universe of preliminary recommendations. The purpose of this evaluation step was to narrow the list of recommendations to include only those improvements that would be cost-effective and productive as well as to assist in the prioritization of recommendations. This step provided the foundation for identifying and selecting the recommended improvements outlined in greater detail in Section 9 of this report.

The set of criteria used to evaluate each type of preliminary recommendation included:

**Service:**

- Weekday O&M Total Cost
- Weekday Change in O&M Cost
- Annual O&M Total Cost
- Annual Change in O&M Cost
- Change in Peak Vehicle Requirement
- Vehicle Capital Cost
- Weekday Ridership
- Weekday Change in Ridership
- Annual Ridership
- Weekday Riders Diverted from Metrorail (Metro Support Routes Only)
- Operating Cost per New Rider
- Boarding/Revenue Vehicle Hour
- Service Improvement Utilizes Running Way and Passenger Facilities

### *Running Way Improvements*

- Total Capital Cost
- Traffic Impacts
- Number of Daily Riders Impacted
- Total Capital Cost per Daily Rider Impacted
- Total Daily Travel Times Savings (# of riders impacted \* travel time savings per improvement)
- Total Capital Cost/Annual Hours of Travel Time Saved
- Ease of Implementation
- Supports Service Recommendations

### *Passenger Facility Improvements*

- Total Capital Cost
- Total Daily Usage
- Total Annual Usage
- Total Capital Cost/Daily Using Rider
- Supports Service Recommendations
- Ease of Implementation

The final product of this step of the planning process was the “Preliminary Recommendations – Evaluation Results” dated April 21, 2004.

The evaluation results of the final recommendations are summarized in Section 8 and described in greater detail in Appendix 5.

**Final Recommendations** – The final step of the planning process was the development of final recommendations for implementation. As noted, this final set of recommendations was the result of a narrowing of the full universe of preliminary recommendations based on a number of inputs, including the results of the evaluation phase, feedback from jurisdictions on priorities, and the overall availability of resources to implement the recommendations. This input was also used to prioritize recommendations and set time frames for implementation: short-term (1-5 years), mid-term (6-10 years) and long-term (after 10 years).

A detailed description of the final recommendations, by corridor, is outlined in Section 9. Operating and capital cost by recommendation and total cost by time frame is included in Appendix 6.

## **Section 3 – Corridor Descriptions**

## Corridor Descriptions

Each of the four corridors selected for more detailed analysis is quite different in nature, and very much reflects the wide diversity of land uses throughout the Washington region. Outlined below is a brief description of the four corridors selected for more detailed analysis in this phase of the Regional Bus Study.

**H Street Benning Road** – This corridor starts at the Minnesota Avenue Metrorail Station and runs along H Street/Benning Road, a major east/west arterial running into downtown Washington DC, and terminates at 3<sup>rd</sup> Street NW. Closest to downtown, between North Capitol Street and Benning Road, the corridor is predominantly commercial, with residential neighborhoods on the side streets off of H Street. The corridor has high vehicle volumes and is also served by one of the highest ridership transit routes in the District, the X2. The X2 also intersects with heavily utilized transit routes on 8<sup>th</sup> Street (90,92, and 93) and 14<sup>th</sup> Street (B2). This portion of H Street is also the subject of a study being completed by the District of Columbia Department of Transportation, which is focusing on traffic, pedestrian and transit facility improvements in support of corridor land use and economic development goals. Coordination on the two study efforts has been underway since the beginning of this study.

The second portion of the H Street/Benning Road corridor runs between the intersection of H Street, Benning Road, Maryland Avenue, and Bladensburg Road, and the Minnesota Avenue Metrorail Station. This portion of the corridor is more residential in nature, but still at fairly high urban densities.

A map of the H Street/Benning Road corridor is included as Figure 1.

**U.S. Route 1 Corridor in Maryland and the District**– The second corridor examined in this analysis is the U.S. Route 1 corridor in Maryland and the District of Columbia, between Laurel and the Rhode Island Metrorail Station. This is a long corridor with significant diversity in terms of land use and densities. Much of the corridor outside the Capital Beltway consists of institutional uses such as the Department of Agriculture Research Center and commercial development such as strip shopping centers and small office buildings.

Further south, the corridor is dominated by dense commercial development between the Beltway and the University of Maryland. South of the University the corridor is characterized by a mix of older residential communities and established town centers such as Hyattsville and Mount Rainier. Inside the District line the corridor is characterized predominantly by residential development interspersed with smaller commercial districts, with the development at fairly high urban densities.

Currently, the U.S. 1 corridor is served by a number of routes that run on portions of the corridor, but not its entire length, as well as by east/west routes that run on

the corridor for a short time before leaving the corridor to continue with the east/west portion of the service.

A map of the U.S. 1 Corridor is included as Figure 2.

**Annapolis Road** - The Maryland 450 Corridor (Annapolis Road) stretches from the New Carrollton Metrorail Station in Prince Georges County to the Rhode Island Avenue Metrorail Station in the District of Columbia (the corridor includes Maryland 450, Bladensburg Road, 38<sup>th</sup> Avenue, and U.S. 1). This is a relatively short corridor dominated by a small range of land uses. In Maryland, along the Route 450 portion of the corridor, the dominant land use is a mix of strip mall development and small office buildings, with older suburban residential development on the side streets off of 450. In the District, the corridor is characterized predominantly by residential development interspersed with smaller commercial districts, with the development at fairly high urban densities.

The Annapolis Road portion of the corridor is currently served by the T18 service that runs between the New Carrollton and Rhode Island Metro stations, the same routing as the proposed new RapidBus service. Inside the District, the U.S. corridor is served by a number of lines feeding into the Rhode Island Avenue Metrorail Station.

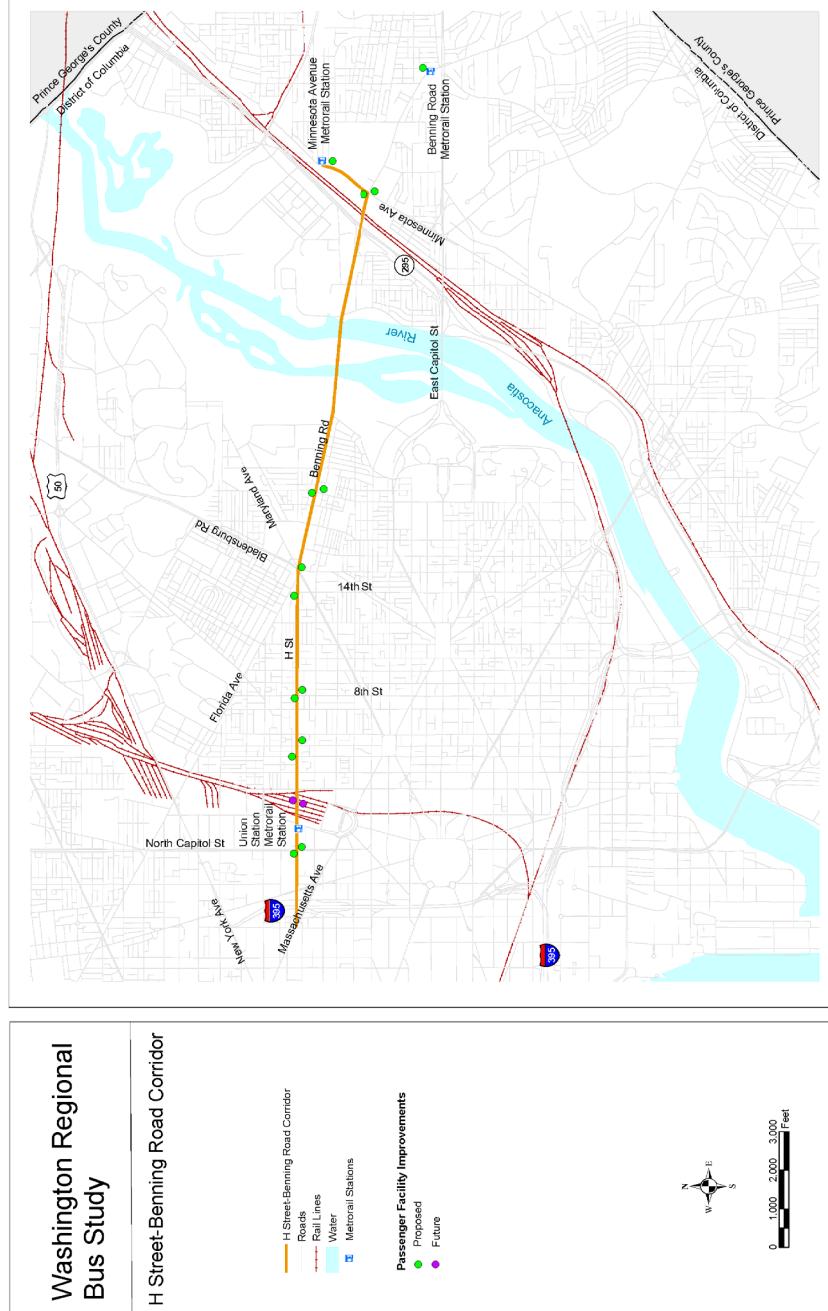
A corridor map is included as Figure 3.

**Metro Support Routes** – Ridership on many of the Metro lines in the Washington region exceed their capacity during the peak period, with little short term opportunity for increasing capacity through longer trains or more frequent service. In addition, station park and ride lots are often full and there is little opportunity for parking expansion at many of these stations. Understanding these capacity constraints, the original Regional Bus Study included an analysis of the feasibility of implementing park and ride based express bus routes running parallel to Metro lines that would provide capacity support to over capacity Metro services. One set of Metro Support routes considered in the Regional Bus Study were services that would run from the Orange Line market area in Fairfax County, providing support to overcrowded Orange Line services starting in Vienna. These Orange Line Metro Support routes were, in turn, selected for more detailed analysis in this planning study.

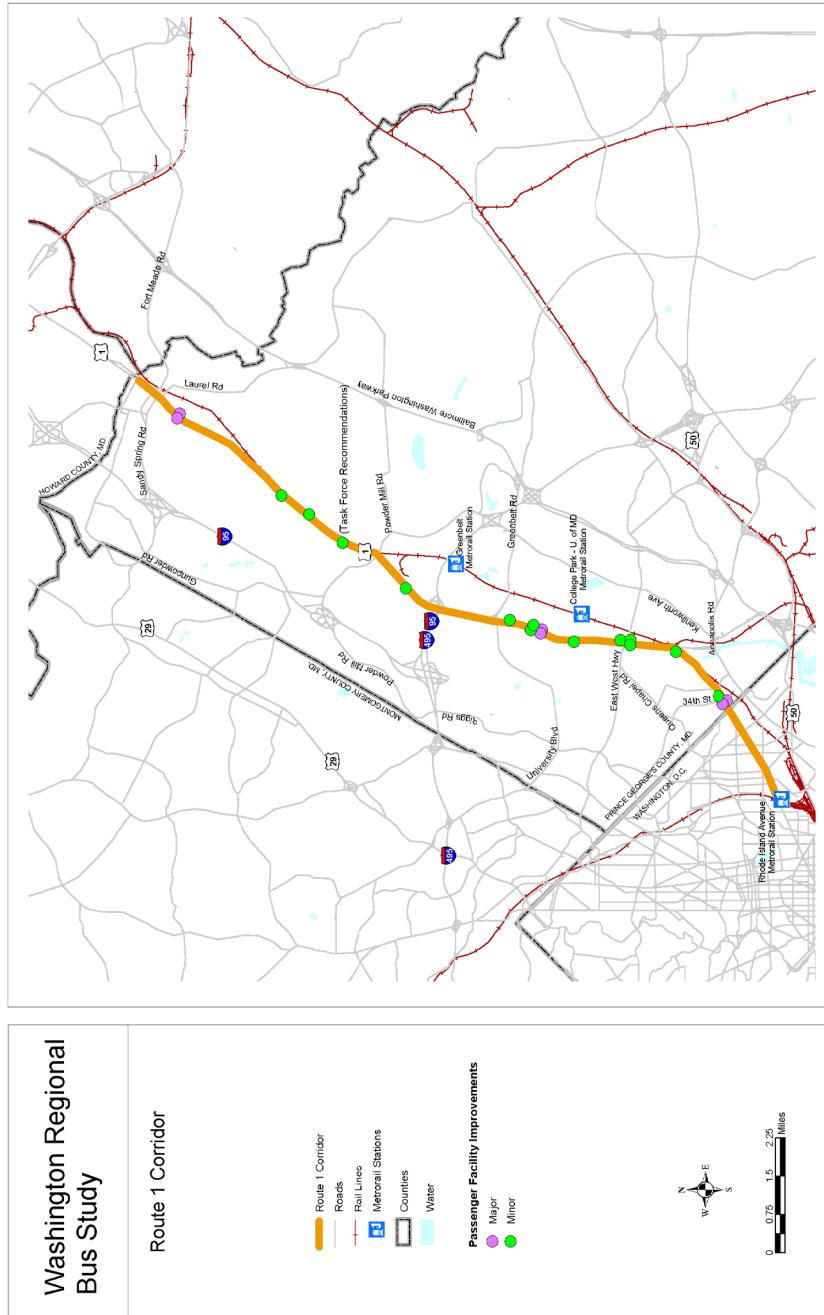
The analysis contained in the original study has been modified to include both different, as well as additional, park and ride lots from which the Orange Line Metro Support services would run. In this phase of the study the Metro Support routes analyzed in greater detail included services running from two different park and ride lots on Stringfellow Road: the Poplar Tree Park and Ride lot and the Stringfellow Road Park and Ride lot; services running from the Fairfax Government Center Park and Ride lot; services running from the south bus bay facilities at the West Falls Church Metro station; and services running from the

Herndon-Monroe Park and Ride lot. Service from each of these park and ride lots to downtown Washington was analyzed for feasibility in the “Preliminary Recommendations Report”. In addition, service to Pentagon City/Crystal City from the Fairfax Government Center was also analyzed for feasibility. The final recommendations for Metro Support service are included in Section 9 of the report. The Metro Support routes analyzed are shown in Figure 4.

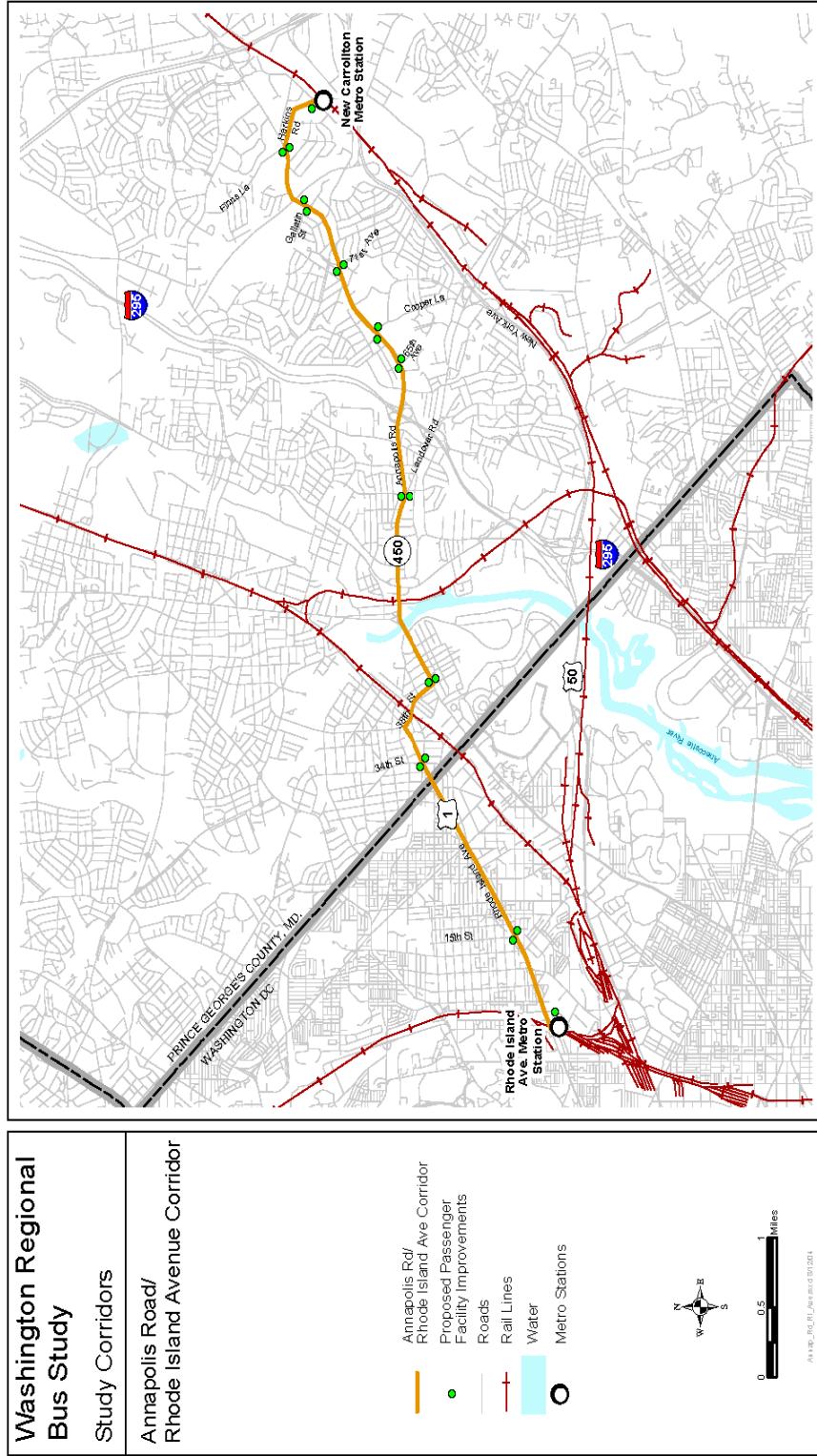
**Figure 1 – H Street/Benning Road Corridor**



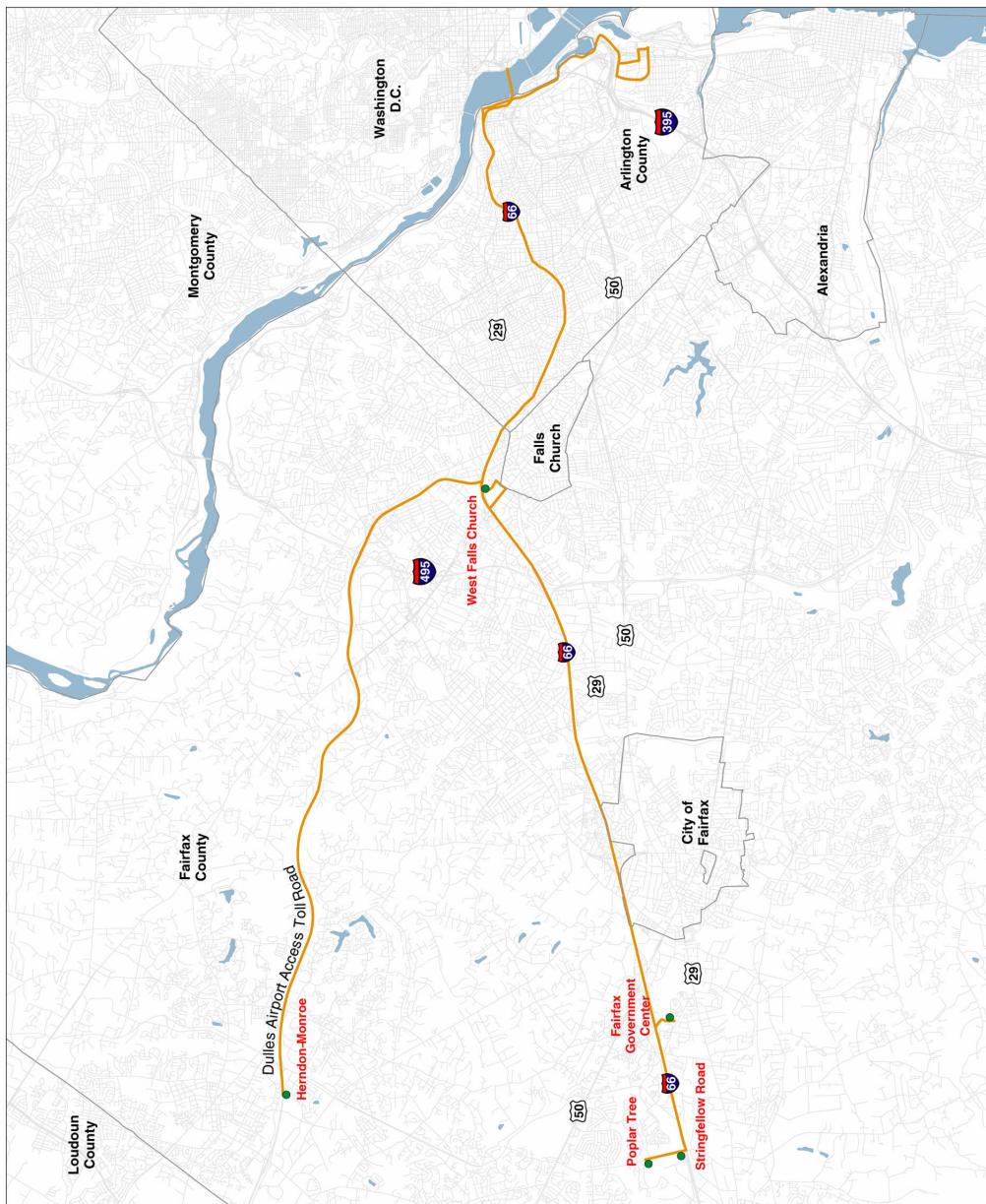
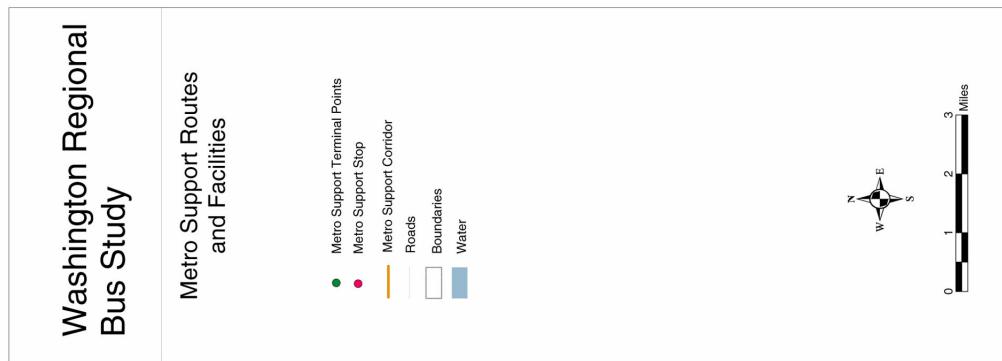
**Figure 2 – U.S. 1 Corridor**



**Figure 3 – Annapolis Road Corridor**



**Figure 4 – Metro Support Routes**



## **Section 4 – Preliminary Recommendations H Street/Benning Road**

# Preliminary Recommendations – H Street/Benning Road Corridor

## A. Service Improvements

The H Street/Benning Road corridor displays many of the characteristics that support implementation of high quality BRT limited stop service, including very high ridership on the existing X2 service and a heavy concentration of boardings and alightings at select stops along the corridor (specifically, 70% of total X2 boardings and alightings occur at the proposed BRT/RapidBus station/stops outlined below, with a full 96% of boardings and alightings occurring at, or within one stop of these major stops). Based on these characteristics the preliminary service recommendations for the H Street Corridor consist of the implementation of a new BRT/RapidBus service that would provide additional service to complement the X2 service that currently runs in the corridor. The proposed alignment of the service would be identical to the existing X2, which currently runs between the Minnesota Avenue Metrorail Station at the eastern end of the corridor to 16<sup>th</sup> Street NW in downtown. Service would run on H Street east of 13<sup>th</sup> Street NW and on the one way pair of H and I Streets between 13<sup>th</sup> Street NW and 16<sup>th</sup> Street NW.

Based on existing boardings and alightings, the goals of existing studies being conducted in the corridor, and overall corridor land use goals, BRT/RapidBus stops were proposed at the following intersections:

### ***Westbound***

Minnesota Avenue Metrorail  
Minnesota Avenue at Benning Road NE  
Benning Road at 19<sup>th</sup> Street NE  
Benning Road at 15<sup>th</sup> Street/Maryland Avenue NE  
H Street at 13<sup>th</sup> Street NE  
H Street at 8<sup>th</sup> Street NE  
H Street at 5<sup>th</sup> Street NE  
H Street at North Capitol Street  
H Street at 7<sup>th</sup> Street NW  
H Street at 11<sup>th</sup> Street NW  
I Street at 14<sup>th</sup> Street NW  
H Street at 16<sup>th</sup> Street NW

### ***Eastbound***

H Street at 16<sup>th</sup> Street NW  
H Street at 14<sup>th</sup> Street NW  
H Street at 11<sup>th</sup> Street NW  
H Street at 7<sup>th</sup> Street NW  
H Street at North Capitol Street

H Street at 5<sup>th</sup> Street NE  
H Street at 8<sup>th</sup> Street NE  
H Street at 13<sup>th</sup> Street NE  
Benning Road at Maryland Avenue  
Benning Road at 19<sup>th</sup> Street NE  
Minnesota Avenue at Benning Road NE  
Minnesota Avenue Metrorail

As noted, new service in the H Street corridor would be comprised of the existing X2 service with a BRT/RapidBus overlay, with the BRT/RapidBus service making limited stops at the intersections outlined above. Local stops in the corridor would remain in place for the X2 service.

Two service alternatives were considered in the preliminary analysis. In the first alternative BRT/RapidBus would be as frequent as the current X2 service, with less frequent service on the X2. Specifically, in this alternative, the RapidBus service would use standard length transit buses, while the X2 would continue to use articulated buses. The proposed headways on the RapidBus service would be 7 minutes in the peak, 9 minutes in the mid-day, and 15 minutes in the evening until 8:00 pm, when BRT/RapidBus service would end. The X2 would operate at 15 minute headways in the peak and 20 minutes in the mid-day and early evening. After 8:00 pm, the current X2 schedule would be operated.

Under the second alternative analyzed, frequency on the two services would be equal, and both would use articulated buses. Both the BRT/RapidBus and X2 routes would operate with 12 minute headways in peak periods, 15 minute headways in the mid-day, and 20 minute headways in the evening until 8:00 pm, after which only X2 service would operate.

Weekend RapidBus service would also provided, with Saturday service operating at 15 minute headways from 5 am to 8 pm and Sunday service operating at 20 minute headways between 9 am and 8 pm.

In addition to the service characteristics outlined above, the RapidBus service would utilize vehicles with unique features to distinguish the service from the local X2 service. Design features to provide this unique identity could range from specially painted or wrapped buses to simple features such as uniquely colored destination signs or some other sort of easily visible signing denoting the service as RapidBus. These simpler design features would allow the vehicles to be used in all types of service, providing greater flexibility in the use of the bus fleet.

Estimated RapidBus ridership under service Alternative 1, wherein RapidBus service would run more frequently than the X2, is 10,000 riders. Estimated RapidBus Ridership under service Alternative 2, wherein RapidBus and the X2 would have equal headways, is 7,600. X2 ridership would be approximately 7,700 under Alternative 1 and approximately 9,700 under Alternative 2. **The**

**estimated Operations and Maintenance costs associated with each service improvement alternative are outlined in Appendix 1.**

#### ***B. Running Way and Signal Improvements***

The preliminary running way and signal improvements proposed for the H Street/Benning Road corridor were identified with a full understanding of the constraints imposed by the nature of the corridor, including dense urban development, heavy traffic, heavy turn movements from side streets, on-street parking, and a constrained cross section. The improvement recommendations were also made with an understanding of the proposed sidewalk and streetscape improvements along H Street identified in the “H Street/ NE Corridor Transportation and Streetscape Report” recently completed by the District of Columbia Department of Transportation (DDOT). Specifically, a major improvement recommendation in the DDOT study that directly affects the recommendations included in this study is the proposed installation of curb extensions at select intersections along the corridor (these intersections include 5<sup>th</sup> Street NE, 8<sup>th</sup> Street NE, 13<sup>th</sup> Street NE and at the Starburst intersection). The extensions at 5<sup>th</sup> and 13<sup>th</sup> will have full length extensions on the near side to allow buses to make second lane stops while extensions on the far side at these intersections will be shorter, and will serve the purpose of increasing storage space for pedestrians waiting to cross H Street. The 8<sup>th</sup> Street intersection will have full length extensions on all four corners for bus stop and pedestrian storage purposes. The presence of these curb extensions at select intersections means that queue jumps at these intersections would not be feasible, though curb extensions also provide bus priority based on the fact that the bus is not forced to weave in and out of the traffic lane in order to get to the curb to load and unload passengers.

The installation of curb extensions also led the Regional Bus Study team to recommend near side stops for the BRT/RapidBus service at these intersections. Near side stops, which were recommended because of concerns about conflicts between buses and vehicles turning right onto H Street, means that mainline signal priority will not be as effective as with far side stops (this is because with far side stops the vehicle can pass through the signal and then deal with the variability of the boarding operation, while with near side stops the variability occurs prior to the signal, so there is not as much flexibility in taking advantage of an extended or early green). Far side stops **are** recommended at the intersections where curb extensions are not being installed.

Moving east along the corridor, the following running way improvements were proposed for the H Street portion of the corridor:

- Mainline bus signal priority at the intersections of **Massachusetts Avenue and H Street and 4<sup>th</sup> Street NW** and H Street. Far side bus stops in both directions are proposed.

- Mainline bus signal priority at the intersection of **North Capital Street** and H Street. Far side bus stops in both directions are proposed (a far side stop in the eastbound direction will have to be evaluated in greater detail during implementation to ensure that buses would be able get up the grade of the bridge over the railroad tracks leading into Union Station from a standing start).
- Mainline bus signal priority at the intersection of **5<sup>th</sup> Street NE** and H Street in both directions. Near side bus stops are proposed at this intersection to limit impacts to right turns from 5<sup>th</sup> Street onto H Street, given that the buses at this stop will be stopping in one of the mainline traffic lanes. These near side stops would be facilitated by the curb extensions proposed in the DDOT study.
- Mainline bus signal priority at the intersection of **8<sup>th</sup> Street NE** and H Street in both directions. As with 5<sup>th</sup> Street near side stops are proposed to facilitate right turn movements from 8<sup>th</sup> Street. The stops here would also utilize proposed curb extensions.
- A westbound queue jump treatment between **14<sup>th</sup> Street and 17<sup>th</sup> Street** through the starburst intersection.

The proposed improvements along the H Street portion of the corridor are shown in Figure 5.

Moving east along the corridor, the following running way and signal improvements are proposed for the Benning Road portion of the corridor:

- Utilize the parking lanes as an exclusive bus lane during the peak period, in the peak direction, between **17<sup>th</sup> Street and 24<sup>th</sup> Street NE**. Utilize the parking lanes in the same manner along Benning Road **east of the Benning Bridge** (exclusive peak direction bus lanes on the bridge itself were not recommended because this would involve the removal of traffic capacity. East and west of the bridge the exclusive lanes would utilize parking lanes).
- Make modifications to improve speed and safety of the left hand turn from **Benning Road onto Minnesota Avenue** for buses. The most potentially effective approach would be to restrict left hand turns to buses only, preferably all day but at least during the peak hours.

The proposed improvements along the Benning Road portion of the corridor are shown in Figure 5.

**The estimated costs of implementing these running way and signal improvement recommendations are outlined in Appendix 1.**

### **C. Passenger Facility Improvements**

Passenger facility improvements in the H Street/Benning Road corridor will focus on facility improvements at proposed BRT/RapidBus stops, which include major transfer points and activity centers along the study corridor. Generally, the proposed facility improvement program will include, where feasible given space constraints:

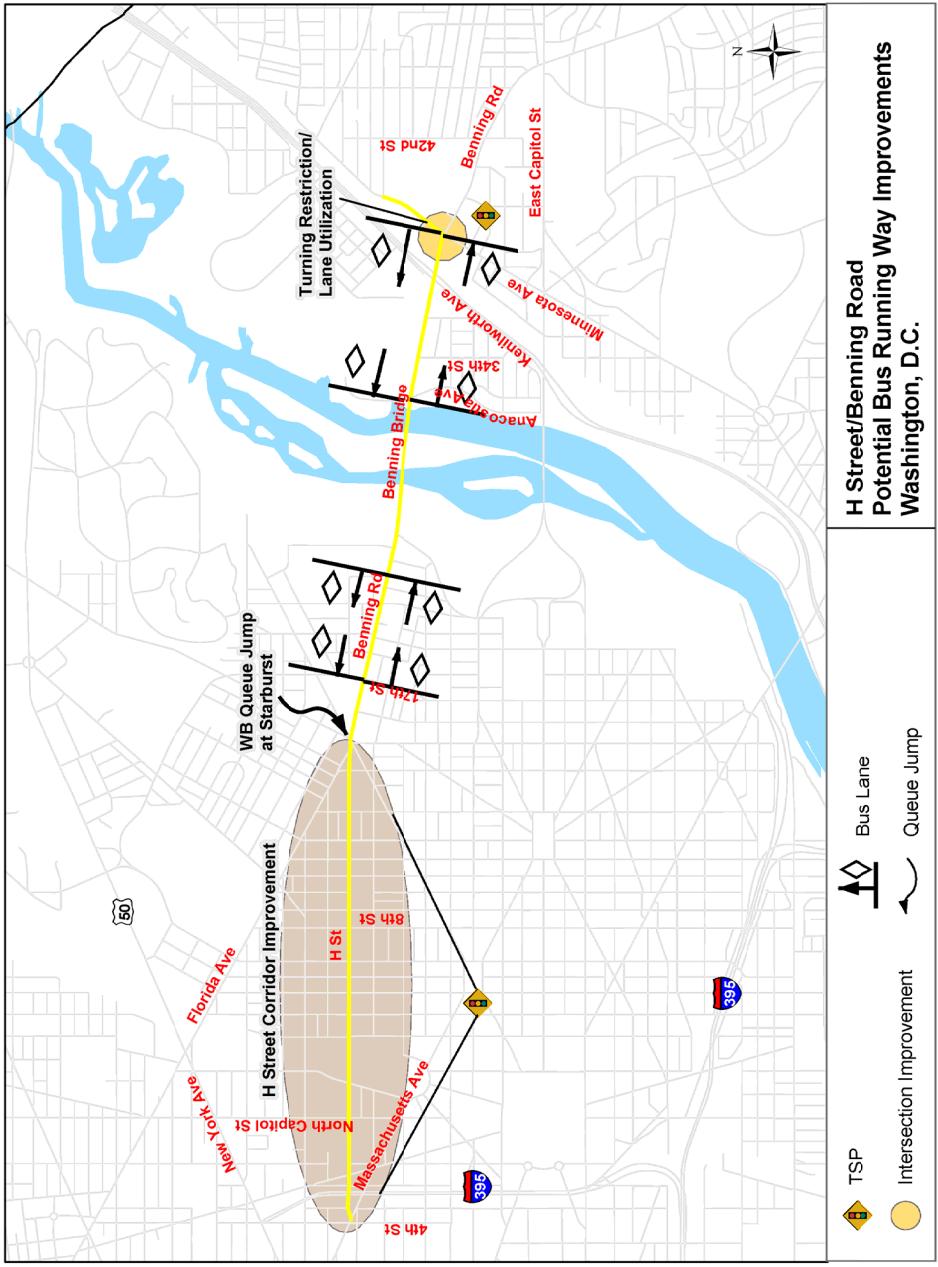
- Enhanced Bus Shelters – larger shelters that are also designed to have a unique identity that will be consistent throughout the length of the corridor (and potentially with other BRT/Rapidbus corridors in the city). This unique identity would be consistent with the unique identity associated with the RapidBus vehicles and would clearly distinguish the stops from local stops. Generally, shelters would be designed to comfortably hold 8-10 people, requiring a shelter that is approximately 100-120 square feet (because available space at each stop varies, the shelter size will also vary).
- Crosswalk improvements – new crosswalks utilizing colored cast-in-place concrete to simulate the look of brick pavers, especially at heavy transfer points
- Larger trash receptacles
- Enhanced lighting – Attractive lighting fixtures that provide more localized, pedestrian level lighting for the bus stop area.
- Improved information and signing, including schedules for routes serving the bus stop, detailed maps of routes, neighborhood maps, and real time next bus information.

The program of improvements, and the elements included in the program, is being designed in conjunction with the work being completed by the District Department of Transportation to identify streetscape enhancements and other pedestrian amenities along the H Street Corridor. Of special note in this corridor is the fact that the year 2000 On-Board bus survey found that the H Street/8<sup>th</sup> Street intersection has the highest number of bus-to-bus transfers in the District of Columbia. To accommodate these heavy transfers, a further recommendation is to locate the bus stops along 8<sup>th</sup> Street on the far side of the intersection to facilitate easy transfers to the near side BRT stops.

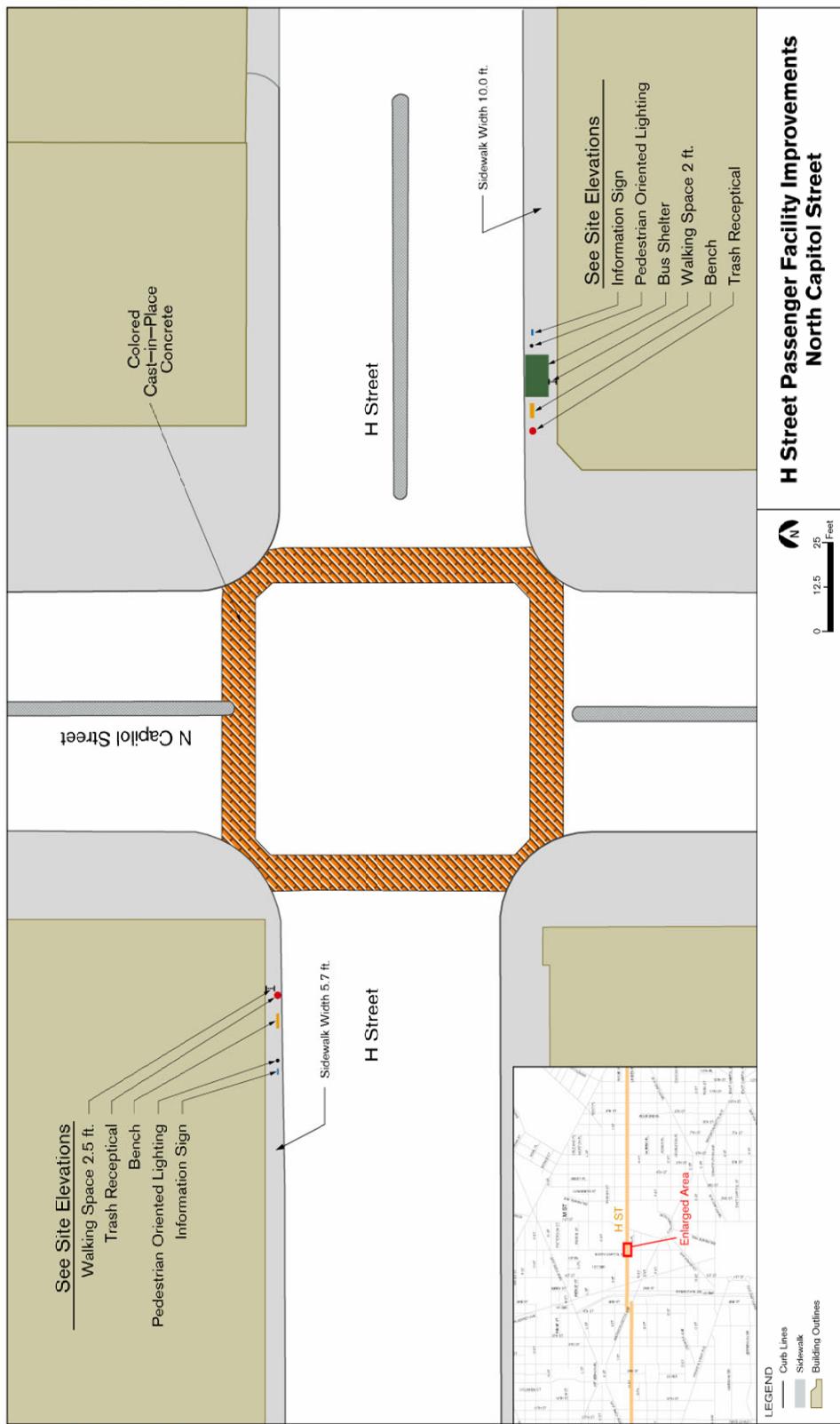
Individual site plans for BRT/RapidBus stops at North Capitol Street, 8<sup>th</sup> Street and 15<sup>th</sup> Street are included as Figures 6, 7, and 8. Also included as Figure 9 is a prototype elevation for the program improvements in the corridor.

**The estimated costs of implementing these passenger facility improvement recommendations in the H Street/Benning Road corridor are outlined in Appendix 1. In addition to capital costs, estimated annual costs for facility maintenance such as emptying trash receptacles added as part of the project is \$15,000.**

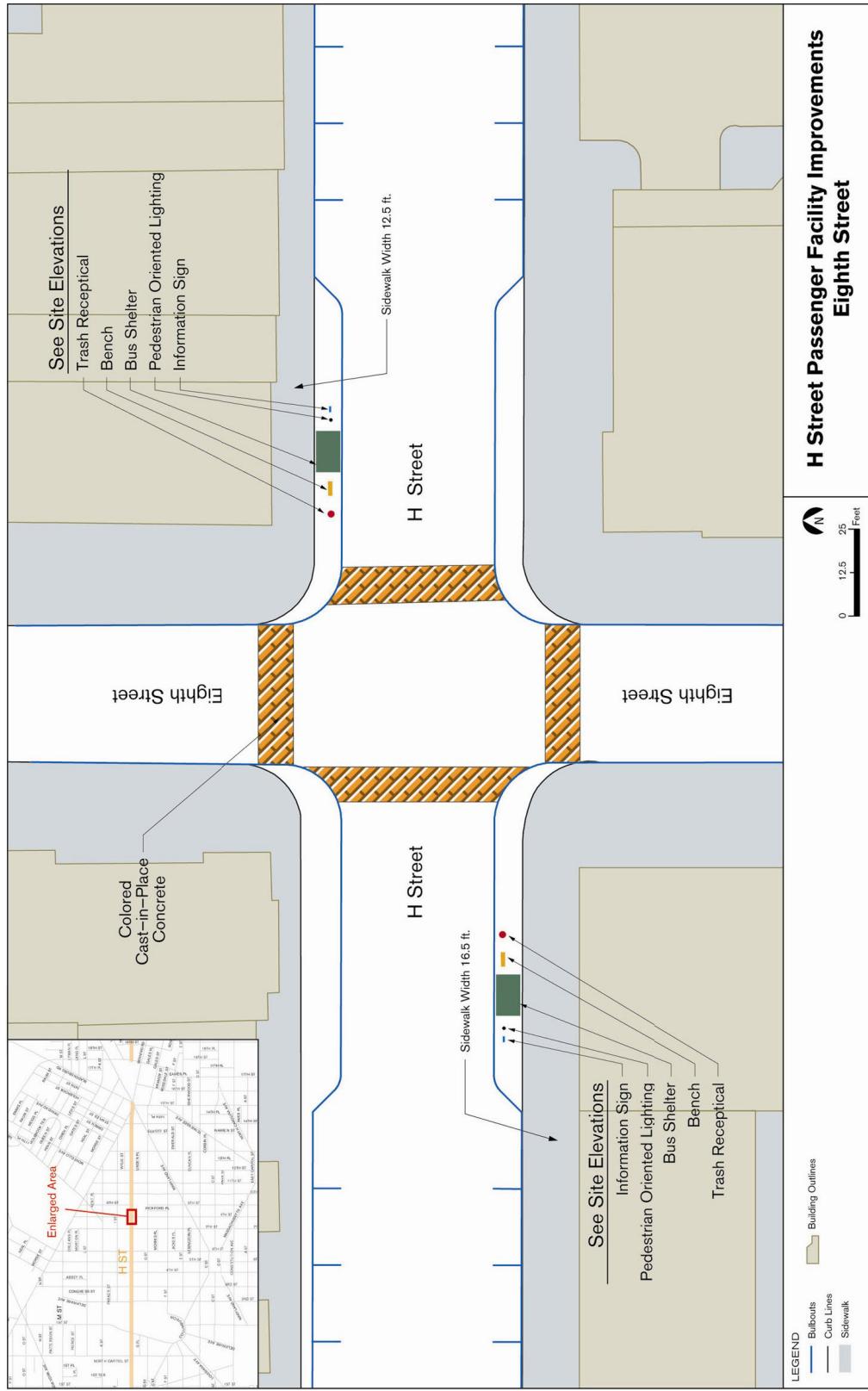
**Figure 5 – H Street/Benning Road Running Way and Signal Improvements**



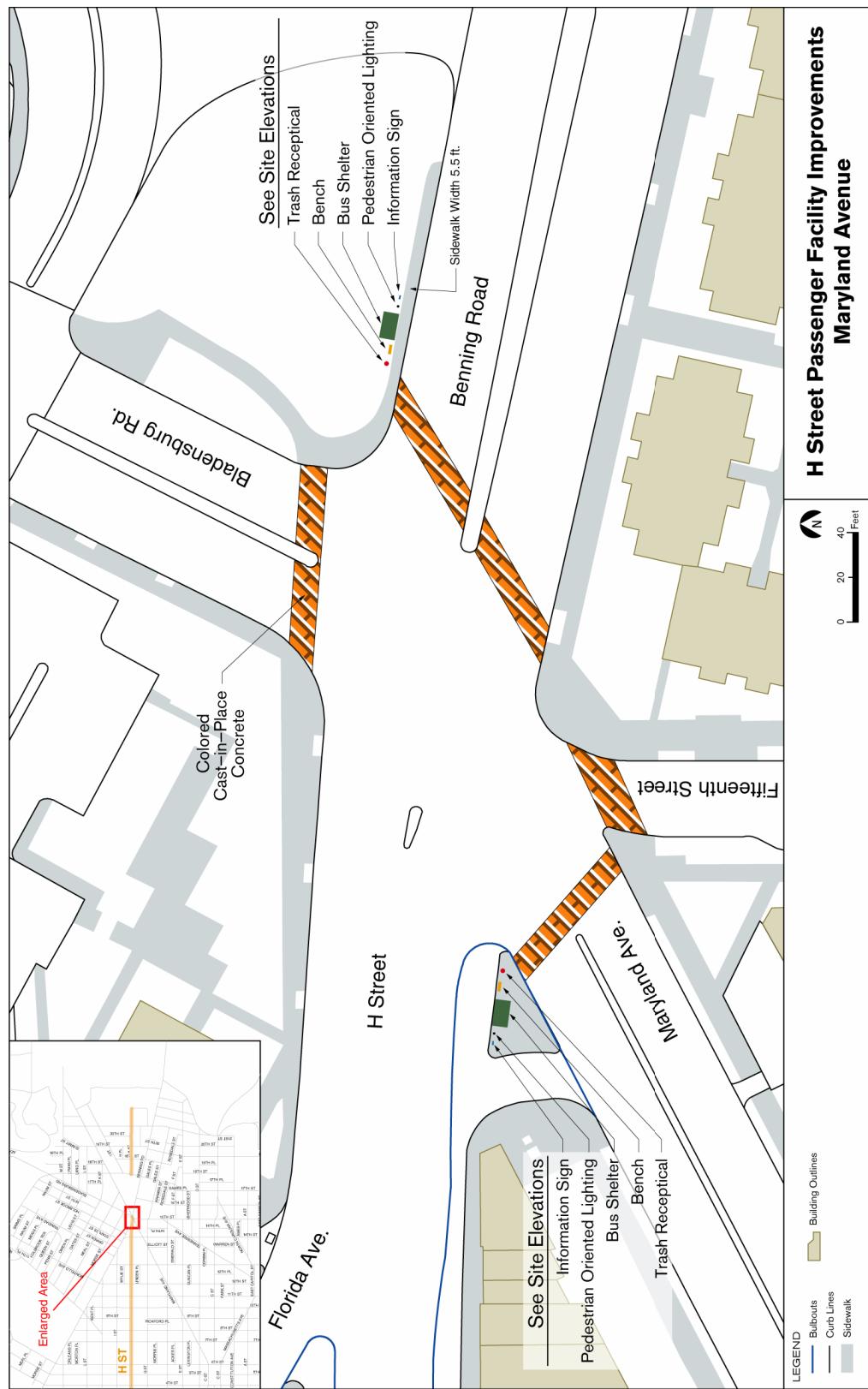
**Figure 6 – North Capitol Street BRT/RapidBus Stop Site Plan**



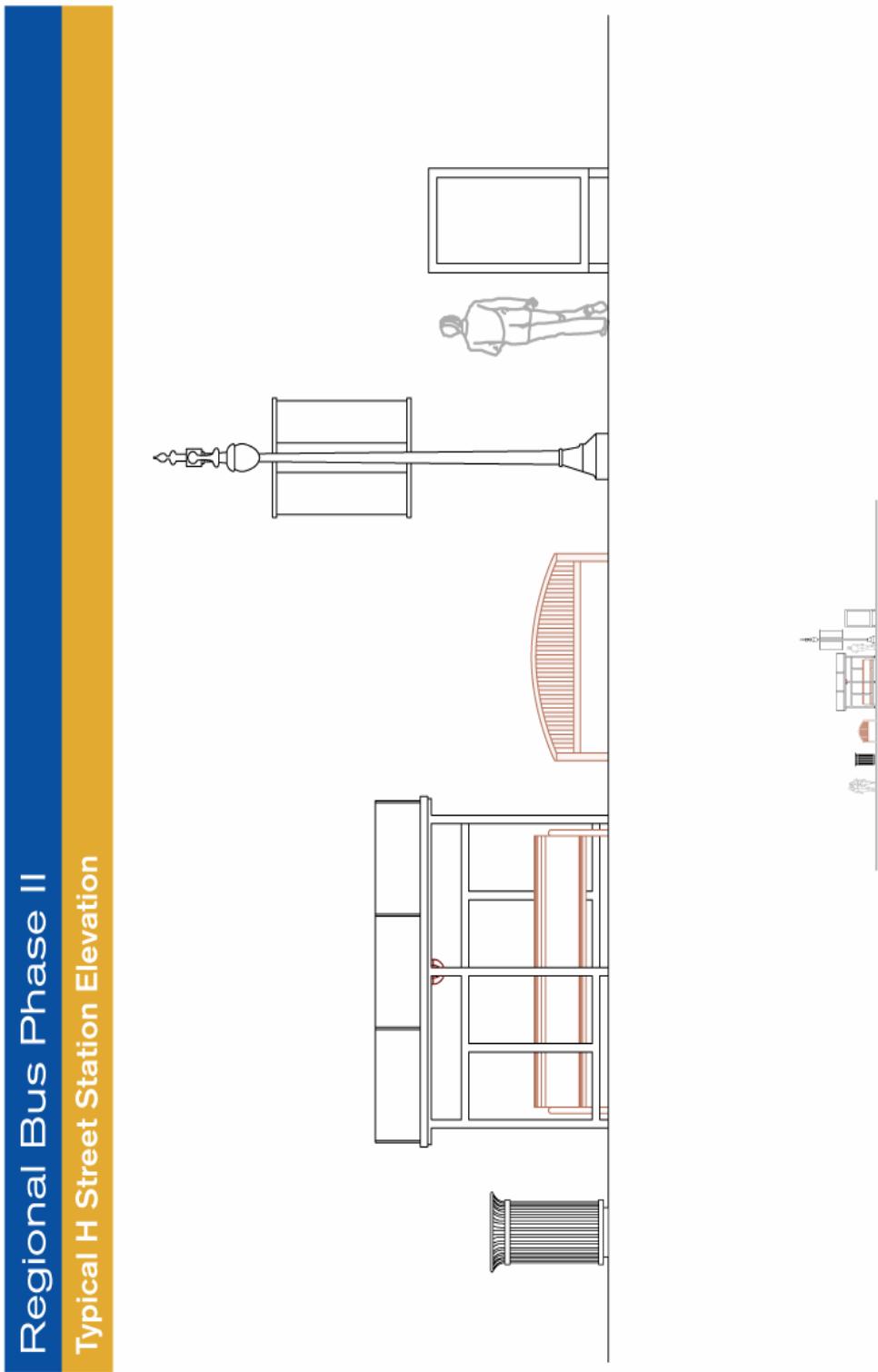
**Figure 7 – 8<sup>th</sup> Street BRT/RapidBus Stop Site Plan**



**Figure 8 – Starburst Intersection BRT/RapidBus Stop Site**



**Figure 9 – Prototype BRT/RapidBus Stop Site Elevation**



# **Section 5 - Preliminary Recommendations U.S. 1 Corridor in Maryland**

# Preliminary Recommendations – U.S. Route 1 Corridor in Maryland

## A. *Service Improvements*

The U.S. 1 corridor was originally selected for inclusion in this study based on the presence of large activity centers such as the University of Maryland, the corridor's role in providing regional connectivity and the nature of adjacent land uses. In assessing the corridor for service improvements, however, it was not considered a candidate for limited stop RapidBus service based on ridership totals that fell below the threshold of 5,000 daily boardings, a lack of concentration of boardings and alightings at stops that would be served by limited stop service, and relatively low boardings per revenue vehicle hour (for instance, the 81, 82, 83, 86 (Maryland Line), the primary service in the corridor, has approximately 4,091 daily boardings and a boardings per revenue vehicle hour of 30, versus approximately 15,000 boardings and boardings per revenue vehicle hour of 97 on the X2).

Given that this corridor was not a candidate for RapidBus service, two different service concepts for the U.S. 1 Corridor were developed for evaluation in the preliminary recommendations study phase. The goals of each alternative were:

- To take the greatest advantage of the proposed running way and traffic improvements in the U.S. 1 Corridor;
- To consolidate services in the corridor to improve customer understanding of the corridor route structure;
- To improve customer convenience; and
- To improve efficiency of service delivery in the corridor.

The first concept creates one route serving the length of the U.S. 1 corridor from Laurel to the Rhode Island Avenue Metrorail Station. In this concept existing services in the corridor would be eliminated or restructured to accommodate the new route, but all areas currently served would continue to be served in the new plan. Under this plan, current express services from Laurel (Metrobus Routes 87 and 88) would be maintained.

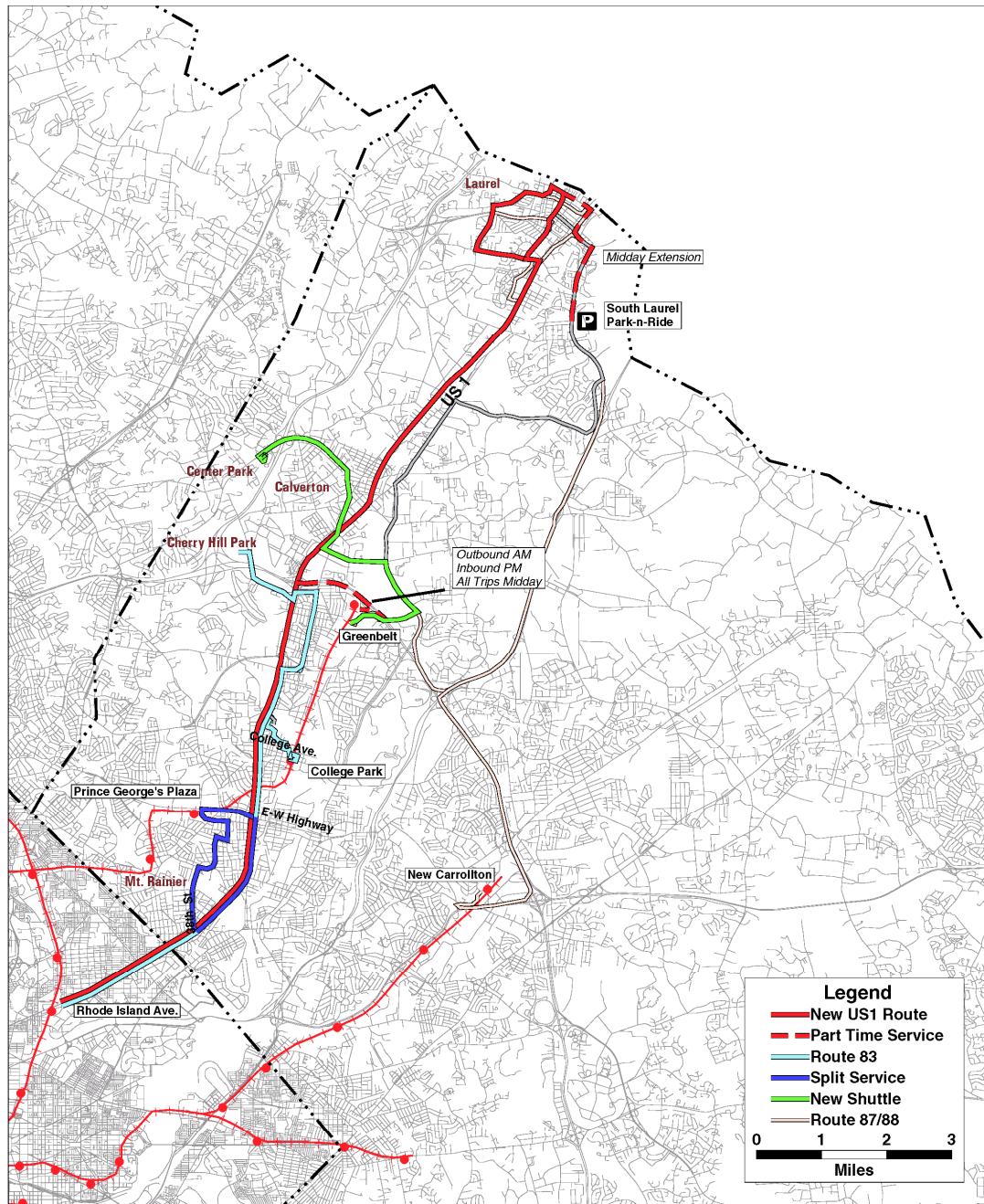
The second concept restructures service in the northern portion of the corridor, combining the current express service between Laurel and Greenbelt (Metrobus 87) with the current local service on U.S. 1 between Laurel and Greenbelt (Metrobus 89, 89M). This new combined route offers new service on Old Baltimore Pike and creates a direct connection between Laurel and the College Park area. The express service between Laurel and New Carrollton (Metrobus 88) is eliminated in this plan while the Maryland Line (Metrobus 83, 86) remains essentially unchanged. Each concept's alignment is outlined below. Service levels for each concept are described in greater detail in the next section.

## **Alignments**

**Single Route Alignment** – As noted, the first service concept evaluated in the preliminary recommendations phase was to institute a new route operating the length of the U.S. 1 from Laurel to the Rhode Island Avenue Metrorail Station (see Figure 10). The alignment specifics are outlined below.

- In the northern portion of the corridor, the new route would use the alignment of the current Metrobus 89 in Laurel and as far south on U.S. 1 as Sunnyside Avenue. Instead of turning onto Sunnyside, as the 89 currently does, the new route would continue on U.S. 1 all the way into the Rhode Island Avenue Metrorail Station. In the morning, on outbound trips only, the route would divert into the Greenbelt Metrorail Station via the Beltway to serve the sizeable reverse commute ridership currently utilizing the Metrobus Route 89. In the afternoon the route would make the same diversion on inbound trips. All mid-day trips would make this diversion in both directions.
- The existing **Metrobus Routes 89 and 89M** (Laurel to Greenbelt) would be eliminated. Service on the new U.S. 1 route would be extended to the South Laurel Park and Ride during the mid-day period, mimicking the current operation of the 89M.
- The **Metrobus Route 86** (Calverton-Centerpark to Rhode Island Avenue Metrorail) would be eliminated, with segments currently covered by the 86 being replaced with other routes. The segment of the 86 between the Greenbelt Metrorail Station and Calverton/Center Park would be replaced by a new shuttle service, potentially to be operated by the Prince George's County The Bus if only this segment is operated or by Metrobus if the shuttle is extended to a new transit center at Plum Orchard and Broadbirch in Montgomery County. Service on U.S. 1 between Sunnyside Avenue and the East-West Highway would be covered by the new U.S. 1 service. Service through local Hyattsville neighborhoods would be replaced by a realigned Metrobus 83.

**Figure 10 – US 1 Service – Length of Corridor**

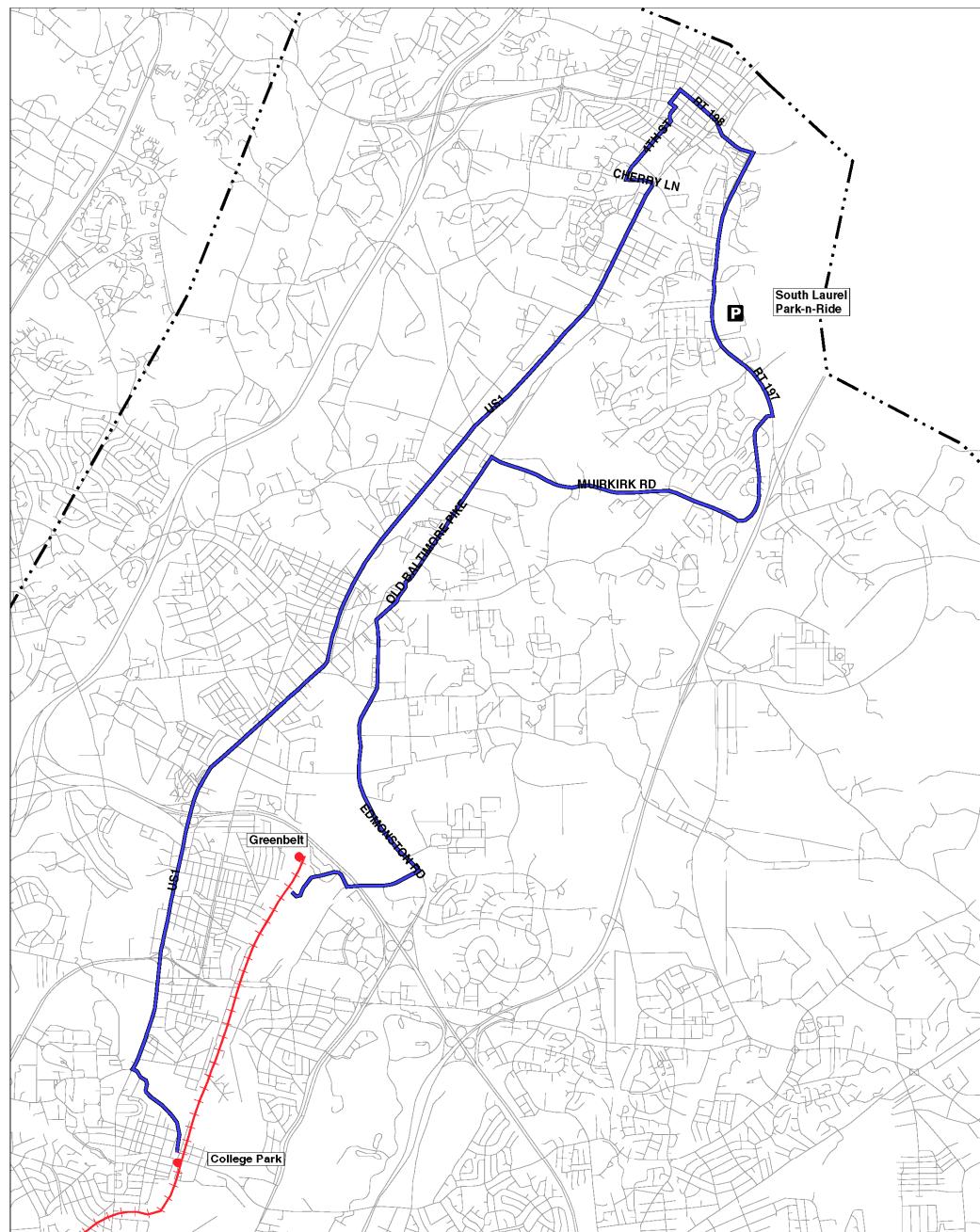


- **Metrobus Route 83** would be realigned to cover the segments that would otherwise lose service if Route 86 were eliminated. No changes would occur to the line north of East-West Highway, but south of this point the route would be split. Half of the trips would follow the alignment of the existing 86 line to the Prince Georges Plaza Metrorail station and then through Hyattsville and Mount Rainier to rejoin U.S. 1 at 38<sup>th</sup> Avenue. The other half of the trips would remain on U.S. 1. This split is proposed in order to maintain an appropriate level of service on each segment. From 38<sup>th</sup> Avenue both patterns would run into the Rhode Island Avenue Metro Station.

**Laurel Restructuring Alignment** - The second service concept makes only minor changes to Metrobus Routes 83 and 86 but restructures Routes 89 and 87 (Laurel to Greenbelt express) more extensively. The change to the 83 and 86 (Maryland Line) would be to eliminate the 86 line's diversion to the College Park Metrorail Station via College Avenue. Instead, all trips on this line would access the Metro station via Paint Branch Parkway.

The restructuring of the service from Laurel assumes replacing the existing 87,88 and 89,89M Metrobus routes with a single line from the Greenbelt Metro station to Laurel to the College Park Metrorail Station (see Figure 11). The routing in the Greenbelt to College Park direction would be via Cherrywood Lane, Edmonton Road, Old Baltimore Pike (with a diversion to the Muirkirk MARC station as needed), Muirkirk Road, Route 197, Route 198, 4<sup>th</sup> Street, Cherry Lane, US 1, Paint Branch Parkway, and River Road. Service between Laurel and New Carrollton, which is lightly used and is a vestige of the time before the Green Line was connected all the way through downtown, would be eliminated.

**Figure 11 – Laurel Restructuring Service Concept**



The benefit of this restructuring concept is that it introduces direct service to the industrial development along Old Baltimore Pike, which is relatively inaccessible from U.S. 1 because of the intervening rail line. This concept is also a less radical restructuring of service on U.S. 1, especially with regard to the Maryland Line routes, and therefore less disruptive to current passengers. It does, however, create some duplication of service between Sunnyside Avenue and Paint Branch Parkway, where Route 86 would overlap with the new 87/89 route, and on Old Baltimore Pike, where the new route overlaps with the G Route operated by the Laurel CTC. In addition, compared to current service on Route 87, Laurel passengers headed to the Greenbelt Metro station would experience an increase in travel times of approximately 7 to 9 minutes (the time from the South Laurel Park and Ride to Greenbelt is estimated to be 30 minutes under the restructuring versus 21 to 23 minutes on the existing Route 87). This increase in travel time may result in some loss of ridership.

### **Service Levels**

Three different potential service levels were developed for the new full length U.S. 1 service. Each is outlined below. In addition, a description of the recommended service level for the restructured Laurel service is also included.

**Equivalent Service Level – Full Length U.S. 1 Service –** Current service levels on the routes that would be impacted by the full length U.S. 1 service recommendation are summarized below:

- Route 89      40 minute peak period headways  
60 minute mid-day headways (when 89M operates)
- Route 86      30 minute peak period headways  
60 minute mid-day and evening headways
- Route 83      15-20 minute peak period headways  
30 minute mid-day and evening headways
- Route 87      20 minute peak of the peak headways  
30 minute peak shoulder headways  
no mid-day or evening service

In order to maintain the service level currently experienced by Route 86 riders, the new U.S. 1 service would have to be operated at a 30-minute peak period headway. As a result, Route 89 riders in the northern half of the U.S. 1 corridor would see peak period frequency improve from 40 minutes to 30 minutes. Route 86 riders who would shift to the realigned Route 83 would experience an improvement in peak frequency from 30 minutes to 15/20 minutes and off-peak frequency from 60 minutes to 30 minutes. Given the proposed split in service south of East-West Highway, riders on the former Route 86 segments through

Prince George's Plaza, Hyattsville, and Brentwood would experience equivalent service to what is currently available rather than improved service.

The proposed span of service for the new U.S. 1 route would mirror that of the current 89/89M service, which runs from 6:00 a.m. to 7:45 p.m. Ridership on the unique Route 86 segment (Baltimore Avenue north of University Boulevard) is minimal after 7:00 p.m. (1 boarding and 20 alightings northbound and 19 boardings and 3 alightings southbound) so it would not be essential to maintain service on that segment of the route any later in the evening than 7:45 p.m. Evening service on Route 83 is proposed to be extended to compensate for the elimination of Route 86 service, with a 15 minute headway maintained until 9:00 p.m. (with service split between US 1 and the Hyattsville diversion on the current Route 86). Weekend service on Route 86 could be maintained as it is currently operated, or the U.S. 1 route could be operated on weekends. The Laurel CTC Route H, which follows the Metrobus 89 alignment, currently operates on Saturday. One alternative is to have Metrobus operate the U.S. 1 Route as a replacement for the H Route. On Sunday it may be possible to alter Metrobus Route 81 to serve the most important markets served by Route 86, or else operate a short –turn version of the new U.S. 1 Route.

The new shuttle service between Greenbelt and Centerpark (to replace Route 86) is proposed to operate from approximately 6:00 a.m. to 7:00 p.m. on weekends (recent ridecheck data show only minimal ridership after 7:00 p.m.). It is further proposed that the route operate at a 30 minute peak period frequency and 60 minutes during the mid-day.

**Compliant Service Level – Full Length U.S. 1 Service** – In the original Regional Bus Study, as part of the Comprehensive Operations Analysis (COA), route level service evaluations measures were developed to assess current service levels and provide guidance in the development of new services. Complying with these standards would require both an increase in span of service and frequency of service on the proposed U.S. 1 service concept. This compliant service level is outlined in greater detail below.

The Maryland line (Metrobus 83, 86) and the Laurel line (89, 89M) both currently meet the service thresholds for weekday span of service. On Saturdays, the Maryland Line meets the threshold, but the Laurel line does not, since it offers no Saturday service. The CTC H Route does compensate for this lack of Saturday service but it does not quite meet the full Saturday span of service. Route H operates from 9:00 a.m. 6:00 p.m. and would need to operate from 8:00 a.m. to 7:00 p.m. Sunday service would not be required for either line based on their classification as suburban feeder/distributor routes and the standards for this classification.

The new U.S. 1 route would be classified as a suburban radial line haul, in which case it should operate from 7:00 a.m. to 8:00 p.m. on weekdays and 8:00 a.m. to

8:00 p.m. on both Saturday and Sundays. Given the current starting times of the 86 and 89, it is proposed to start the U.S. 1 service at 6:00 a.m. The final departure on the 89 Route from the Greenbelt Metro Station is currently 7:05 p.m. and the last departure from Laurel is 6:35 p.m. so meeting the 8:00 p.m. threshold would extend the span of service for both directions of service. On Sundays, Route 86 currently operates until 6:00 p.m. so meeting the suburban/radial line haul threshold would be an improvement for passengers northeast of 34<sup>th</sup> Street (the segment from the Rhode Island Avenue Metrorail station to 34<sup>th</sup> Street is served by Route 82 until midnight on Sundays and until 3:30 a.m. during the rest of the week).

The new shuttle from the Greenbelt Metro station to Centerpark would be classified as a suburban feeder/distributor route. Based on the COA span of service standards, it should operate from at least 7:00 a.m. to at least 7:00 p.m. on weekdays and from 8:00 a.m. to 7:00 p.m. on Saturdays. Given the current service span on Route 86, it is proposed that the service begin at 6:00 a.m. The proposed frequency of service on this service, as discussed above, would suffice to meet the frequency thresholds for suburban services.

**Improved Service Level – U.S. 1 Service** – The goal of this service level would be to offer an attractive service that actually exceeds the minimum thresholds outlined in the original Regional Bus Study. The span of service outlined under the compliant level for US 1 and the new shuttle service would be sufficient for an improved level of service and therefore no change would occur. Given the suburban nature of the US 1 corridor, service beyond that span would likely be unproductive. Instead, the most effective means of making corridor service substantially more attractive would be through improvements in service frequency. For the new U.S. 1 service, the proposed improved service frequency would be 20 minutes in the peak and 30 minutes in the off-peak (as opposed to 30 minutes and 60 minutes, respectively). On weekends, the proposed frequency under this scenario would be 30 minutes from 11:00 a.m. to 5:00 p.m. and 60 minutes during the rest of the day.

Under the improved service level scenario, service on the new shuttle would be maintained at 30 minutes on weekdays while Saturday service would continue to operate at a 60-minute frequency.

Finally, under this scenario, the 83 Route, in its altered form, would operate for another hour in the late evening (with a final departure sometime around 10:40 p.m.) on weekdays. The frequency of service on weekdays is already quite good, but in this scenario service would improve on weekends from a 60-minute headway to a 30-minute headway, at least from 11:00 a.m. to 5:00 p.m.

**Laurel Restructuring Service Level** – The new combined 87/89 route proposed in the Laurel restructuring would operate at a 20-minute headway in the peak direction (Greenbelt Metro station to Laurel to College Park) in the peak hour and

30 minutes for the remainder of the peak period as well as in the off-peak direction. Mid-day headways would be 60 minutes in both directions. There would be no weekend service on this route.

Compared to the current service on Route 87, this new option would offer inferior service for residents of Laurel and users of the South Laurel Park and Ride who wish to get to the Green Line via the Greenbelt Metro Station. Route 87 currently offers a 30 minute trip from 4<sup>th</sup> and Cherry in the heart of Laurel and a 21 to 23 minute trip from the South Laurel Park and Ride, at a peak frequency of 20 minutes. The new service would offer a travel time that is 7 to 9 minutes longer at a 30-minute frequency. Many of the current Route 87 riders board west of U.S. 1, and they may choose to ride to the College Park Metro station via U.S. 1. These passengers will have the advantage of the 20 minute frequency for peak direction trips, but the travel time to the Metro station would still be significantly longer than the current Route 87 trip. The estimated time for the new service is 46 minutes from 4<sup>th</sup> and Cherry to the College Park Metrorail station. Laurel residents destined to the College Park area would see a benefit from the new connection.

The Maryland line (83,86) would remain essentially unchanged from a service level perspective. The minor change in alignment outlined above would have a minimal impact on running times.

**The Operations and Maintenance costs associated with each of the scenarios described above (alignments and service levels) are outlined in greater detail in Appendix 1. Also included in Appendix 1 is a detailed summary of the peak vehicle requirements under each scenario.**

#### **B. Running Way and Signal Improvements**

The U.S. 1 study corridor provides a number of opportunities for implementation of improvements to increase transit service speeds in the corridor. Two different sets of signal priority improvements were recommended in the preliminary recommendations phase of the study. In the first instance, bus signal priority was recommended to improve speeds for services crossing or entering the U.S. 1 corridor from side streets. Intersections where this side- street priority is recommended include:

1. Rhode Island Avenue/Ewing Road (side street)
2. Cherry Hill Road (side street)
3. Greenbelt Road (side street)
4. Campus Drive/Paint Branch Parkway (side street)
5. 34<sup>th</sup> Street (side street)
6. Franklin Street (side street)
7. 12<sup>th</sup> Street (side street)

In addition to side street bus signal priority, mainline signal priority on U.S. 1 is recommended at the Cherry Lane and Odell Road intersections and at selected signalized intersections between the Rhode Island Avenue Metro Station and 38<sup>th</sup> Street in Mount Rainier, including:

1. Rhode Island Avenue at 38<sup>th</sup> Street
2. Rhode Island Avenue at Eastern
3. Rhode Island Avenue at South Dakota
4. Rhode Island Avenue at 24<sup>th</sup> Street
5. Rhode Island Avenue at 14<sup>th</sup> Street

A broader application of mainline signal priority along U.S. 1 may be desirable if the U.S. 1 service concept (a service running the full length of the corridor from Laurel to the Rhode Island Avenue Metrorail Station) were implemented, though interim benefits would also accrue to existing services. This wider application could result in the reduction of side street priority opportunities in certain locations. In those instances where side street and mainline signal priority conflict, the final signal priority implementation plans will necessarily reflect the service structure that is present in the corridor and the goals for corridor service. The final signal priority recommendations outlined in Section 9 reflect the proposed service recommendations for the U.S. 1 corridor.

In addition to the signal priority recommendations outlined above, there are a number of opportunities for bus queue jump treatments in the corridor, given the extensive number of right hand turn lanes. Queue jumps are recommended at the following intersections:

1. northbound at Contee Road
2. southbound at Muirkirk Meadows Road
3. southbound at Sunnyside Road
4. southbound at Cherry Hill Road
5. northbound at Greenbelt Road
6. northbound at EB I-495 off-ramp
7. northbound and southbound at Campus Drive/Paint Branch Parkway
8. northbound and southbound at MD 410 (East-West Highway)

At several intersections bus bypass lanes could be developed along U.S. 1 with minimal cost where there is a right turn lane and existing pavement far side of the intersection to allow buses to go through the intersection in the right turn lane without signal priority. These locations include:

1. southbound at Ritz Way
2. northbound at Selman Road
3. southbound I-495 off-ramp
4. southbound at 41<sup>st</sup> Place
5. southbound at Eastern Avenue

The queue jump/bus bypass recommendations are based on field observation and an assessment of available existing street width to allow for bypass operations. More detailed testing will be required as part of implementation to determine if available space is sufficient. State Highway Administration review has identified potential lack of right-of-way at Greenbelt Road, I-495 off-ramp, and Paint Branch Road.

There are also a number of near side stops in the corridor that negatively impact transit operations and also results in transit delay. A further analysis of stops along the entire corridor to determine where stops can be moved to the far side is recommended.

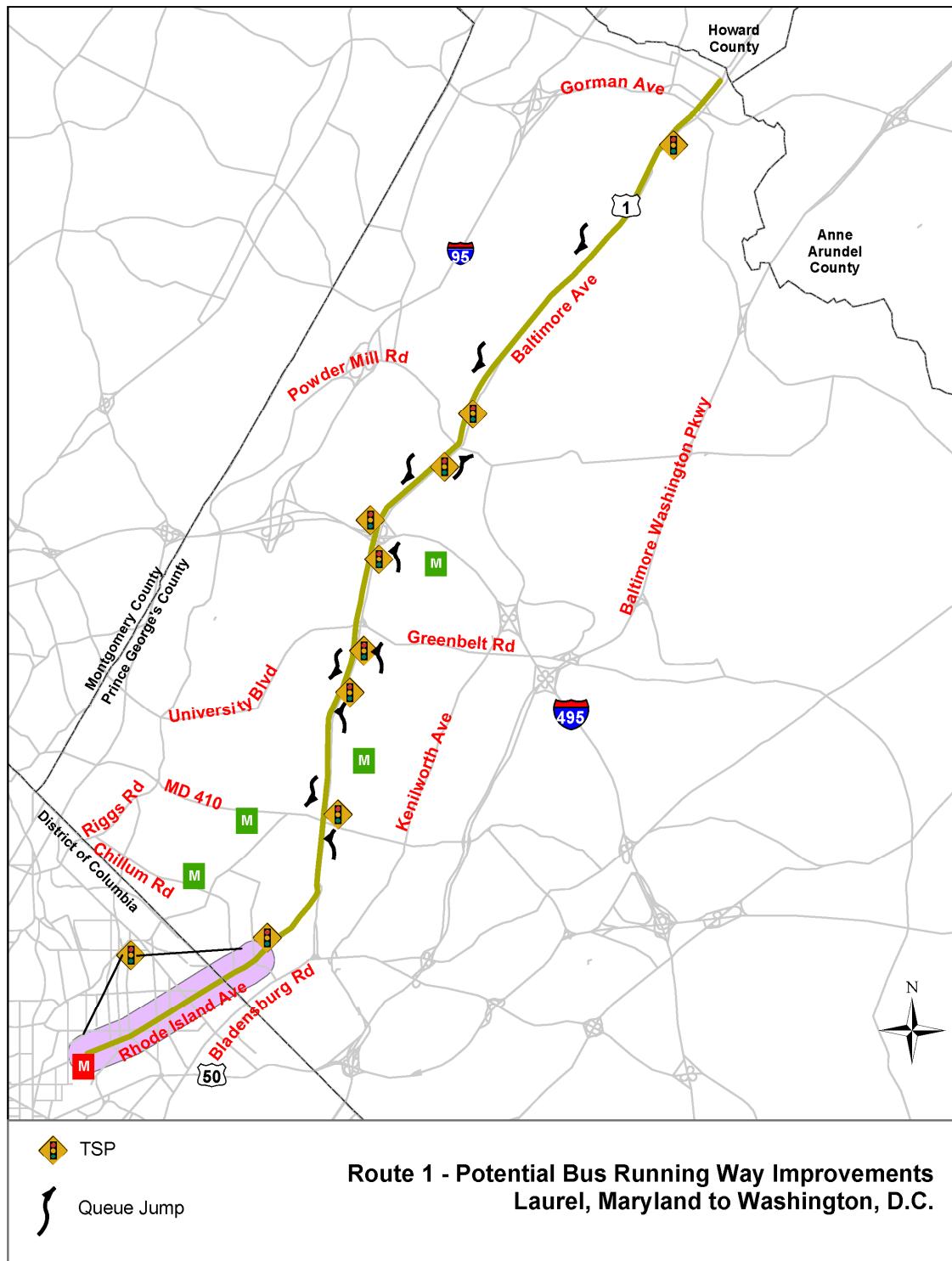
Finally, curb extensions at points along the Rhode Island Avenue section of the corridor within Washington where on-street parking exists would reduce delay for buses pulling back into traffic. Curb extensions could be developed in lieu of, or in conjunction with, bus signal priority along this segment. Initial analysis indicates that curb extensions would be beneficial at the following locations:

1. Rhode Island Avenue at Eastern Avenue (westbound)
2. Rhode Island Avenue at South Dakota Avenue (westbound)
3. Rhode Island Avenue at 24<sup>th</sup> Street (eastbound)
4. Rhode Island Avenue at 14<sup>th</sup> Street (both directions)

It must be noted that a number of other initiatives beyond this study are underway in the corridor, including a Maryland State Highway Administration (SHA) study that is focused on streetscape and median improvements in the College Park area. Final recommendations from that study may conflict with recommendations made in this study. In addition, SHA has expressed general concern regarding the impacts of Transit Signal Priority on overall traffic operations along the corridor. The recommendations in this document reflect SHA comments. In addition, as the recommendations move forward for implementation, continued coordination with SHA will be required to ensure that general traffic needs and transit needs are balanced.

**The recommendations described above are shown on Figure 12.**

**Figure 12 – U.S. 1 Running Way Improvements**



**The estimated costs of implementing these running way and signal improvement recommendations are outlined in Appendix 1.**

### **C. Passenger Facility Improvements**

An improvements program similar to what is proposed for H Street is recommended for two major stops within the corridor. The two locations are:

- 4<sup>th</sup> Street in Laurel, behind the Laurel Centre Mall on U.S. 1, for transfers between WMATA, CTC, and MTA services (need for this facility may be replaced by construction of a Transit Center on the Laurel Mall property)
- U.S. 1 at Campus Drive, in the vicinity of the University of Maryland, for transfers to the C2 and C4 services coming cross county along University Boulevard (facilities would be located north of University Boulevard/Paint Branch Parkway in both directions).

The location of these facilities is shown in Figure 2 in Section 3.

A third major facility in Mt. Rainier at Route 1 and 34<sup>th</sup> Street already exists for transfers between the proposed Annapolis Road RapidBus service and the U.S. 1 corridor service. Minor improvements to provide signing and additional passenger information, including real time information, consistent with other major stops in the corridor are warranted but changes beyond this are not appropriate given that the facility was designed to be consistent with the surrounding Mt. Rainier area.

Proposals for improvements at other stops with daily boardings greater than 20 boardings a day will be identified on a case by case basis. The focus of the improvements will be the installation of shelters, if none exists, upgrading access to the facility, upgrading lighting and upgrading passenger information as required. The stops along the corridor that have boardings exceeding 20 a day include:

<b>Southbound</b>	<b>Boardings</b>
• Cherry Lane at Baltimore Avenue	37
• Baltimore Ave at Muirkirk Road	23
• Baltimore Ave at Lincoln Avenue	40
• Baltimore Ave at Chestnut Hills Shopping Center	70
• Baltimore Ave at Navahoe Road	49
• Baltimore Ave at Campus Drive	36
• Baltimore Ave at Hartwick Road	53
• Baltimore Ave at Queensbury Road	49
• Rhode Island Ave at County Service Bldg.	44
• Rhode Island Ave at 37th Street	41

<b>Northbound</b>	<b>Boardings</b>
• Baltimore Ave at Queensbury Road	25
• Baltimore Ave at Sheridan Street	33
• Baltimore Ave at Paint Branch Parkway	29
• Baltimore Ave at Navahoe Road	35
• Baltimore Ave at Tecumseh Street	22

These same sort of improvements are also appropriate for a series of stops in the Beltsville area that have been identified as problem stops by the U.S. 1 Task Force. The specific stops identified by the Task Force are:

- Northbound at Lincoln Avenue (nearside);
- Northbound at Ammendale Road (far side);
- Northbound at 12000 U.S.1 (near side); and
- Nortbound at Muirkirk Meadows Drive (near side).

**The estimated costs of implementing these passenger facility improvement recommendations are outlined in Appendix 1. Annual costs associated with maintaining the facilities, including trash removal, is estimated to be approximately \$10,000**

# **Section 6**

## **Preliminary Recommendations -**

### **Annapolis Road Corridor**

## Preliminary Recommendations – Annapolis Road Corridor

### A. *Service Improvements*

The proposed service improvements for the Annapolis Road corridor would consist of the implementation of a new BRT/RapidBus service to provide additional service to complement the existing WMATA T18 service that currently runs in the corridor. The T18 currently runs between the New Carrollton Metrorail station and the Rhode Island Avenue Metrorail station via Annapolis Road (MD 450), Bladensburg Road (Alt. U.S. 1), 38<sup>th</sup> Avenue, and Rhode Island Avenue. The RapidBus service would use the same alignment. Based on existing boardings, RapidBus stops are proposed at the following locations:

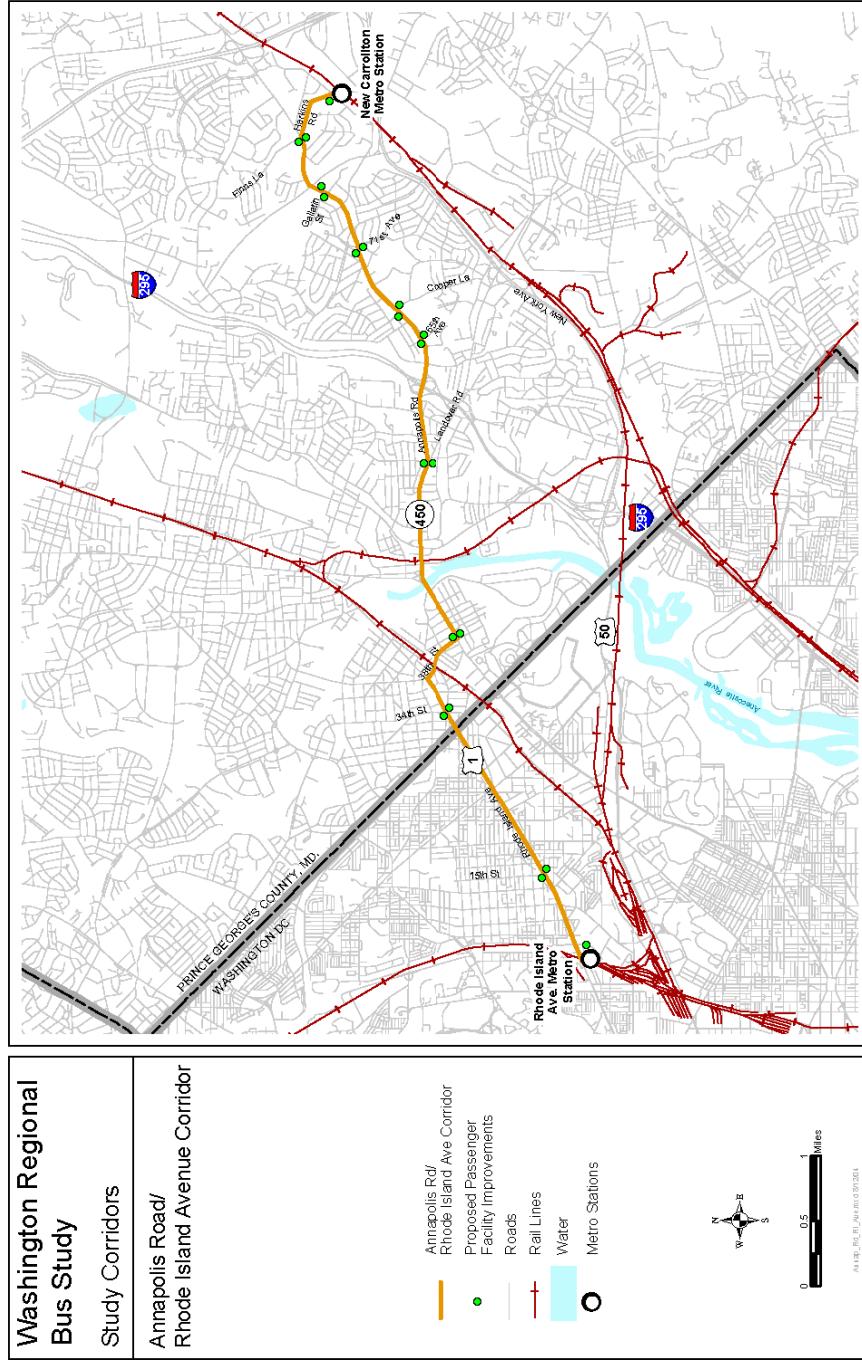
- New Carrollton Metrorail Station
- Harkins Road at Annapolis Road
- Annapolis Road at Gallatin Street
- Annapolis Road at 71<sup>st</sup> Avenue
- Annapolis Road at Cooper Lane
- Annapolis Road at 65<sup>th</sup> Avenue
- Annapolis Road at Landover Road
- Bladensburg Road at 38<sup>th</sup> Avenue
- Rhode Island Avenue at 34<sup>th</sup> Street
- Rhode Island Avenue at 15<sup>th</sup> Street/Franklin Street
- Rhode Island Avenue Metro Station

Stops would be located on both sides of the street to support both eastbound and westbound service. The alignment is show in Figure 13.

The proposed headways for the RapidBus service are 10 minutes in the peak periods and every 20 minutes in the mid-day, evenings, and on weekends. Weekday RapidBus service would begin at approximately 6:00 a.m. and operate until 8:00 pm, when service would end. The T18 would continue to operate on its current schedule, roughly every 20 minutes in peak periods and every 33 minutes in the mid-day. On Saturdays, RapidBus would operate from 8:00 am to 8:00 pm and on Sundays from 9:00 am to 7:00 pm.

**Estimated operations and maintenance costs for this service addition are included in Appendix 1.**

**Figure 13 – Annapolis Road RapidBus Alignment**



## ***B. Running Way and Signal Improvements***

A number of opportunities for implementation of improvements to increase overall transit speeds in the corridor as well as to support a RapidBus service overlay exist in the Annapolis Road study corridor. Two sets of preliminary running way and signal improvements were identified in the corridor; transit signal priority and queue jumps. An additional opportunity is curb extensions on the Rhode Island Avenue portion of the corridor, which have already been noted in the U.S. 1 running way improvements description. Intersections where transit signal priority is recommended include:

- Annapolis Road at Harkins Road
- Annapolis Road at Cooper Lane
- Annapolis Road at 56<sup>th</sup> Avenue
- Rhode Island Avenue at 38<sup>th</sup> Avenue
- Rhode Island Avenue at Eastern Avenue
- Rhode Island Avenue at South Dakota Avenue
- Rhode Island Avenue at 24<sup>th</sup> Street
- Rhode Island Avenue at 14<sup>th</sup> Street

Queue jumps are proposed at Annapolis Road and Edmonston Avenue in the westbound direction, which would require the addition of a right hand turn lane and queue jump, Annapolis Road and Kenilworth Avenue in the westbound direction, which would also require the addition of an additional lane, and Rhode Island Avenue and Eastern Avenue in the eastbound direction (this would use an existing right hand turn lane).

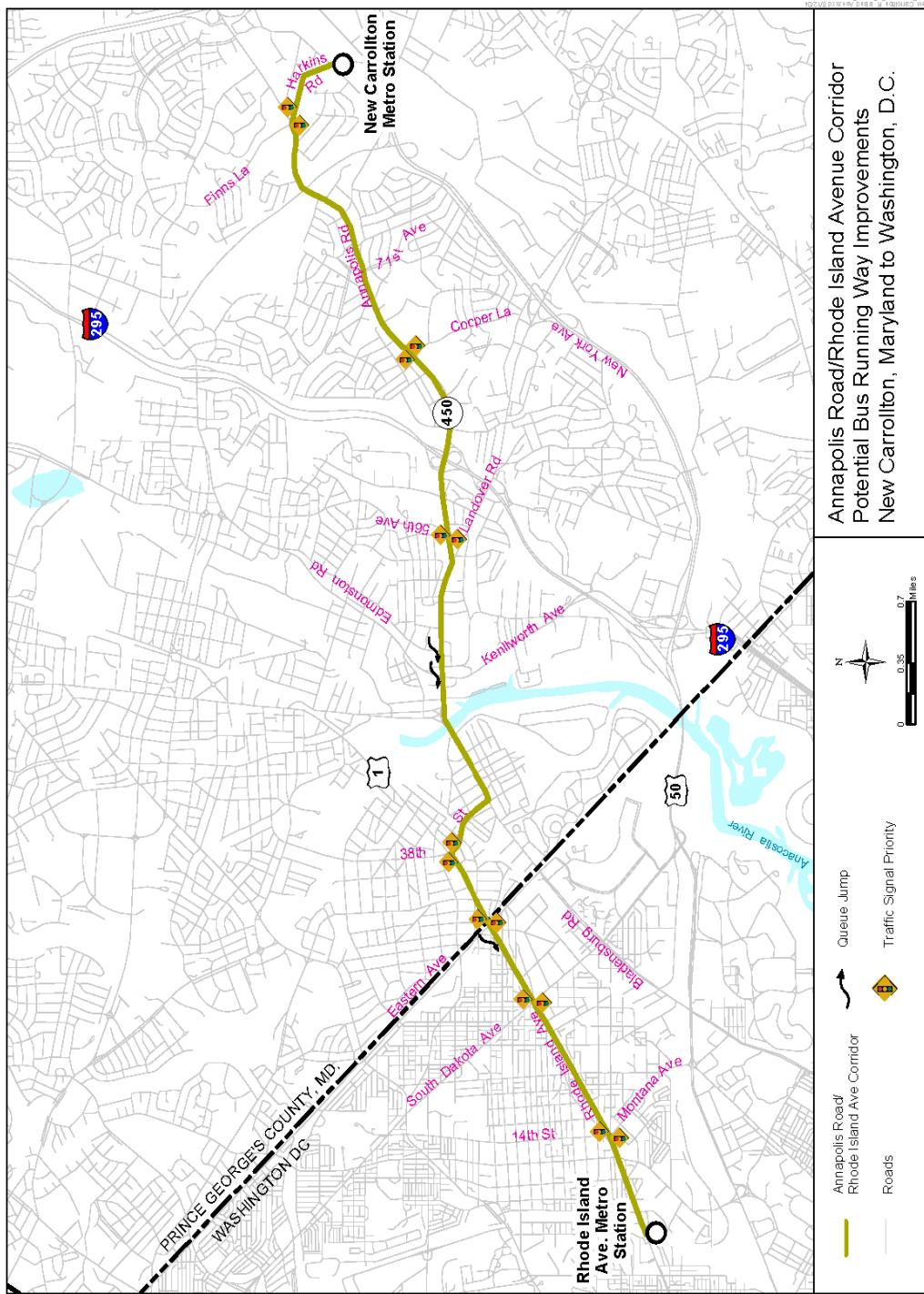
The location of these proposed improvements is shown in Figure 14.

Curb extensions are recommended at:

- Rhode Island Avenue at Eastern Avenue (westbound)
- Rhode Island Avenue at South Dakota Avenue (westbound)
- Rhode Island Avenue at 24<sup>th</sup> Street (eastbound)
- Rhode Island Avenue at 14<sup>th</sup> Street (both directions)

**The estimated cost of implementing these running way and signal improvement recommendations is outlined in Appendix 1.**

**Figure 14 – Annapolis Road Running Way and Signal Improvements**



### **C. Passenger Facility Improvements**

Preliminary recommendations for passenger facility improvements in the Annapolis Road corridor focus on facility improvements at proposed RapidBus stops. Generally, the proposed facility improvement program will be similar to improvements recommended in the H Street corridor and include, where feasible given space constraints:

- Enhanced Bus Shelters – larger shelters that are also designed to have a unique identity that will be consistent throughout the length of the corridor (and potentially with other BRT/Rapidbus corridors in the region). This unique identity would be consistent with the unique identity associated with the RapidBus vehicles and would clearly distinguish the stops from local stops. Generally, shelters would be designed to comfortably hold 8-10 people, requiring a shelter that is approximately 100-120 square feet (because available space at each stop varies, the shelter size will also vary).
- Crosswalk improvements – new crosswalks utilizing colored cast-in-place concrete to simulate the look of brick pavers, especially at heavy transfer points
- Larger trash receptacles
- Enhanced lighting – Attractive lighting fixtures that provide more localized, pedestrian level lighting for the bus stop area.
- Improved information and signing, including schedules for routes serving the bus stop, detailed maps of routes, neighborhood maps, and real time next bus information.

**The estimated costs of implementing these passenger facility improvement recommendations are outlined in Appendix 1. The annual costs associated with maintaining the added facilities, including trash removal, is estimated to be approximately \$15,000.**

## **Section 7- Preliminary Recommendations Metro Support Routes**

## Preliminary Recommendations – Metro Support Services

### A. *Service Improvements*

As noted earlier in the corridor descriptions in Section 3, many Orange Line trains to and from Vienna are currently over capacity in the peak period, with little short term opportunity to add capacity to the line through longer trains or more frequent service. In addition, Orange Line station parking lots are full and little opportunity is available to increase parking capacity at many of the stations. The focus of the proposed Metro Support Routes described in greater detail below is to relieve crowding on the Orange Line by providing additional transit capacity in the form of park and ride lot express buses that would run parallel to the Orange Line directly into downtown Washington (and in one instance to Pentagon City/Crystal City). The specific objectives of the parallel service are to:

- Provide express bus options to serve Orange Line demand with no additional parking capacity;
- Relieve overcrowding on Metrorail;
- Provide bus travel times competitive with rail; and
- Provide an attractive frequency of service.

Further, the proposed services were developed based on three key foundations:

- The new services would be operated on highways, particularly on HOV lanes;
- Services that currently terminate at Metrorail stations would be extended directly into downtown; and
- Some downtown circulation service would be provided through the use of the express buses.

A total of six new express routes have been proposed for the Orange Line corridor in northern Virginia, with five of these services operating directly into downtown and one serving Pentagon City/Crystal City rather than downtown Washington.

The specific Metro Support routes identified in the preliminary recommendations are:

- Herndon-Monroe Park and Ride to Downtown
- West Falls Church Metrorail Station to Downtown;
- Fairfax Government Center Park and Ride to Pentagon City/Crystal City;
- Fairfax Government Center Park and Ride to Downtown;
- Stringfellow Road Park and Ride to Downtown; and
- Poplar Tree Park and Ride to Downtown.

The services are shown in Figure 15.

**Service Levels** – Each of the Metro Support routes would have a comparable span of service and headways:

- Span of Service and headways – all services
  - Morning Peak      6:00 am to 8:30 am – 10 minutes  
                        8:30 am to 9:00 am – 15 minutes
  - Afternoon Peak     4:00 pm to 6:30 pm – 10 minutes  
                        6:30 pm to 7:00 pm – 15 minutes

**Downtown Routing** – The Metro Support trips would take a routing through the northern portion of downtown, with buses entering downtown via the Theodore Roosevelt Bridge(a study is currently being completed to examine the feasibility of adding HOV lanes to the bridge. This would further support this service). Once in downtown the trips would run north on 27<sup>th</sup> Streets to K Street (an alternative routing would be E Street to 18<sup>th</sup> Street to K. 27<sup>th</sup> Street was chosen to provide service to George Washington University and to avoid congestion). Once on K Street the service would run on the surface around Washington Circle to 14<sup>th</sup> and then return to Virginia via 14<sup>th</sup> Street and Constitution Avenue (see Figure 16). Downtown stops would be located at:

- Foggy Bottom/Washington Circle;
- 17<sup>th</sup> and K, and;
- McPherson Square.

An alternative that may be considered during implementation would be an extension of some trips to Union Station. If this extension is considered, proposed stops would be located at:

- 13<sup>th</sup> Street and K;
- Mount Vernon Square; and
- Union Station.

Stops on the service from Fairfax Government Center to Crystal City would be located at:

- Pentagon City Metro Station
- Crystal City Metro Station; and
- Crystal Drive and 23<sup>rd</sup> Street.

**Estimated Ridership** – It is estimated that the six routes described in the previous section would attract approximately 4,600 daily riders (9,200 daily

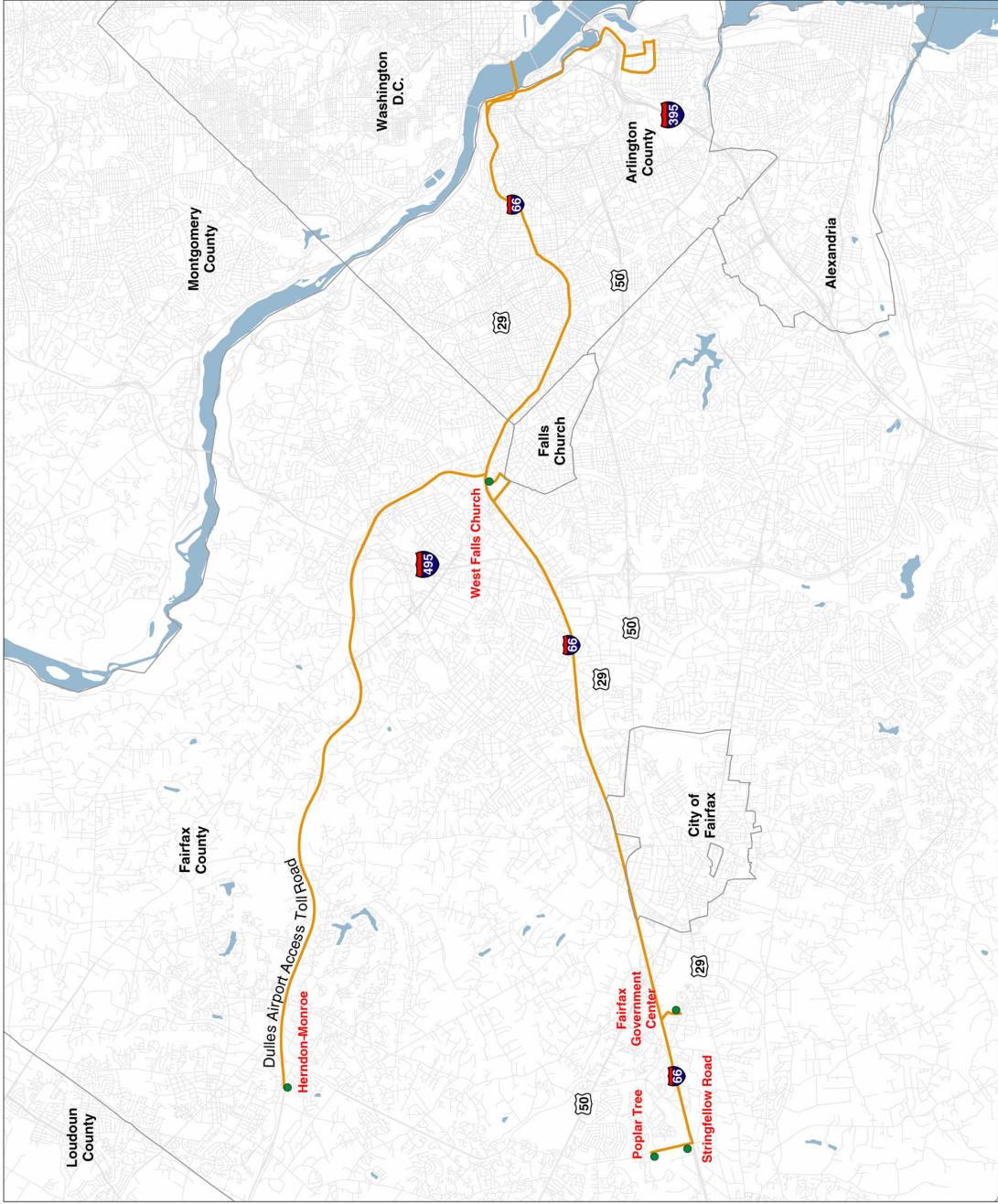
boardings) with approximately 3,700 riders (7,400 boardings) diverted from the Orange Line and approximately 900 new riders (1,800 boardings). This translates into approximately 770 riders (1,540 boardings) per route and a load of 51 riders per trip (assumes over the road coaches with 57 seats).

A diversion of 3,700 trips in each peak period translates into approximately 31 cars, or five, six car, trains of capacity. If all Metro Support services were implemented, there would be real potential for capacity relief along the Orange Line.

During planning and implementation of the Metro Support services, coordination will be required to determine integration with the 12 services, which in some instances will provide parallel service to the Metro Support services. Service from Herndon-Monroe will not impact Fairfax County 989 service to the Pentagon because it will be running into downtown Washington. Integration with Fairfax County 980 service into West Falls Church will be required for the service from Herndon-Monroe.

**Estimated operations and maintenance costs associated with these Metro Support services are shown in Appendix 1.**

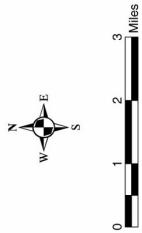
**Figure 15 – Metro Support Services Routing**



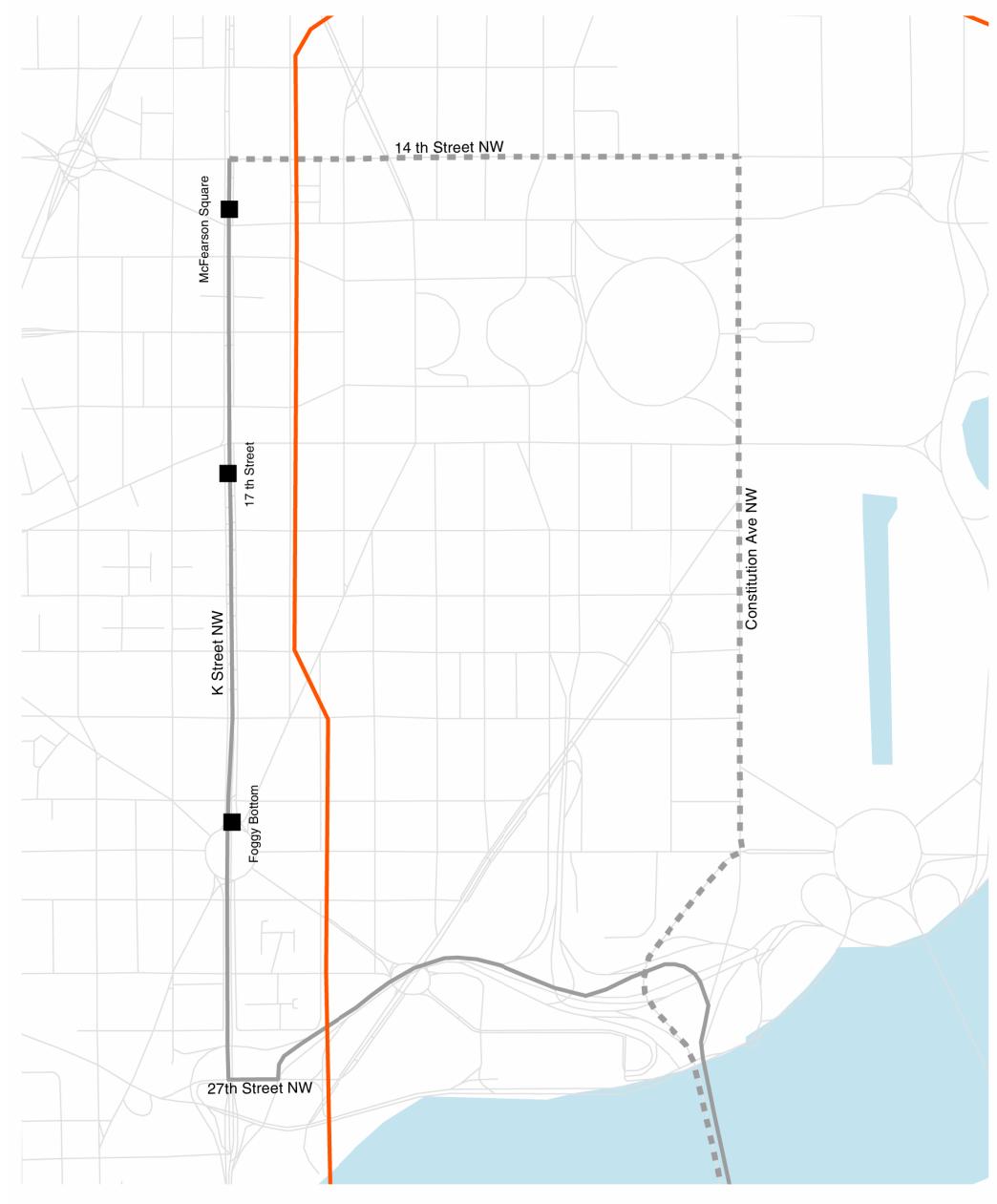
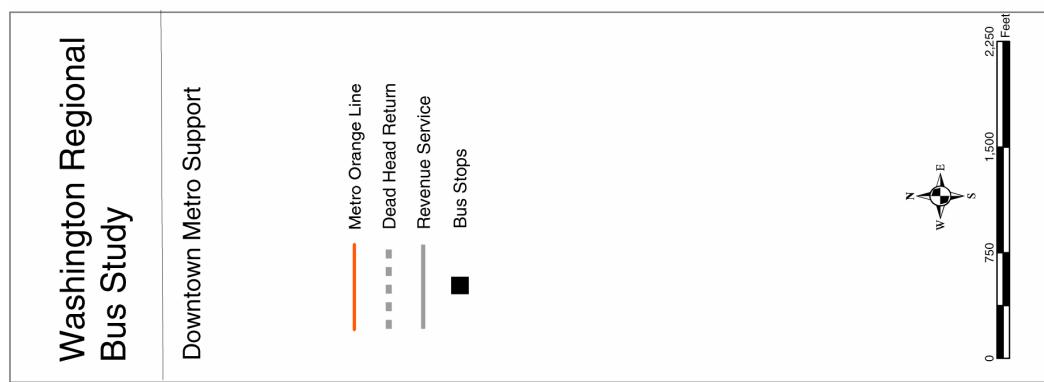
## Washington Regional Bus Study

### Metro Support Routes and Facilities

- Metro Support Terminal Points
- Metro Support Stop
- Metro Support Corridor
- Roads
- Boundaries
- Water



**Figure 16 – Metro Support Services – Downtown Routing**



## **B. Running Way and Signal Improvements**

- 1. Stringfellow Road Corridor (Poplar Tree and Stringfellow Road Park and Ride Lots)** – The focus of the running way and signal improvements in this corridor are along Stringfellow Road and concentrate on improving access to the HOV entrance to I-66 at the intersection of I-66 and Stringfellow Road. Bus signal priority is recommended at the four signalized intersections along the corridor between the Park and Rides and I-66. These signals exist at: a) the I-66 HOV lane access, b) the Stringfellow Road Park and Ride access, c) Fair Lakes Boulevard, and d) Fair Lakes Parkway. As an alternative to implementation of signal priority at these four signalized intersections, right turn lanes on southbound Stringfellow at Fair Lakes Parkway and the Stringfellow Park and Ride entrance, and on northbound Stringfellow at Fair Lakes Boulevard and Fair Lakes Parkway, could be utilized for bus queue jump or bus bypass lanes. Finally, the existing access into the Poplar Tree Park and Ride is not currently signalized. It is recommended that this intersection be signalized initially for bus access and eventually for auto access to the park and ride facility.

In addition to improvements within the corridor, bus access to the HOV lane entrance to I-66 will be required. It is essential to ensure that this gate is always open during the hours of service.

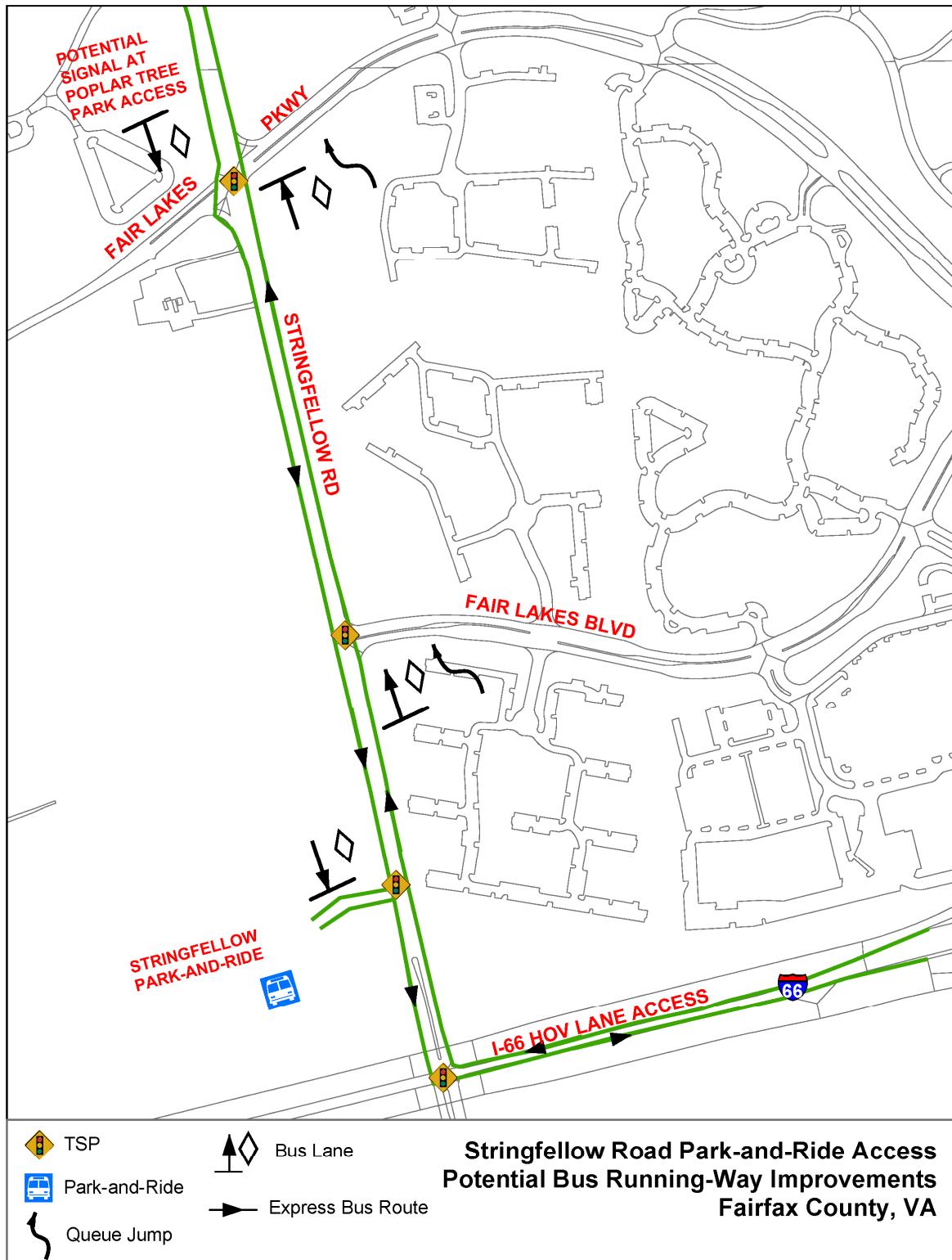
The preliminary recommended running way improvements along Stringfellow Road are shown in Figure 17.

**Estimated costs for this program of running way improvements are outlined in Appendix 1.**

- 2. Fairfax County Government Center** – The focus of the running way improvements for this park and ride lot is bus preferential treatments between the Park and Ride along Government Center Parkway and the HOV entrance to I-66 at the intersection of I-66 and Monument Drive. Bus signal priority at the following intersections is proposed: a) the westbound left turn from the I-66 HOV access ramp to Monument Drive (for afternoon outbound movements), b) the northbound left turn from Government Center Parkway to Monument Drive (for morning inbound movements) and c) the southbound through movement through the intersection of Post Forest Drive and Government Center Parkway (for outbound movements in the afternoon).

In addition to these signal priority treatments, it is recommended that a bus only left turn lane be developed at the entrance to the Fairfax Government Center along Government Center Parkway (one intersection

**Figure 17 – Stringfellow Road Running Way Improvements**



south of Post Forest) to reduce the turnaround time for buses to the bus stop along Post Forest.

In addition to improvements along the access path to the I-66 HOV ramp, bus access to the HOV lane entrance will be required. As with the Stringfellow Road ramp, it will be essential to ensure that this gate is open during hours of service.

The recommended improvements for the Fairfax County Government Center Park and Ride are shown in Figure 18.

**Estimated costs for this program of running way and signal improvements are outlined in Appendix 1.**

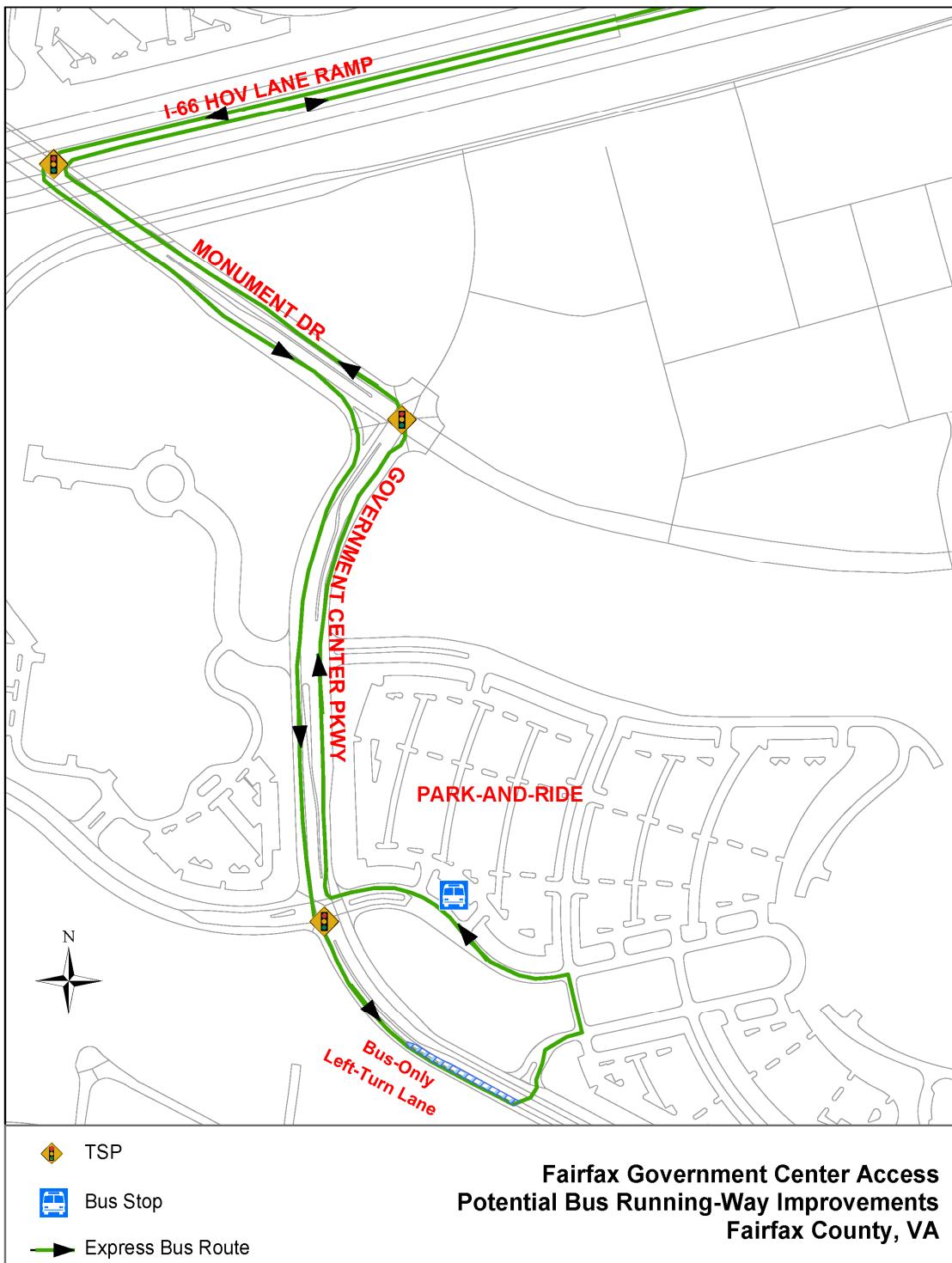
3. **West Falls Church** – Inbound buses in the morning will utilize the West Falls Church Metro Station Park and Ride internal roadway system and therefore bus preferential treatments for these trips will not be required. The focus of the improvements, therefore, is to improve access to the park and ride facility for afternoon outbound trips into the station. Two different elements to improve this access are recommended. The first is the implementation of signal priority at three signalized intersections on the access route to the station. These signals/intersections include: 1) the southbound through movement through the signal at the intersection of Leesburg Pike and the I-66 eastbound off ramp, 2) the southbound left turn from Leesburg Pike to Haycock Road, and 3) the eastbound left turn from Haycock Road to the access driveway to the southside intermodal facility at the West Falls Church station.

In addition to signal modifications, it is also recommended that available space on the west side of Leesburg Pike be used to provide a bus only lane for bus bypass through the intersection of Leesburg Pike and the eastbound I-66 off- ramp.

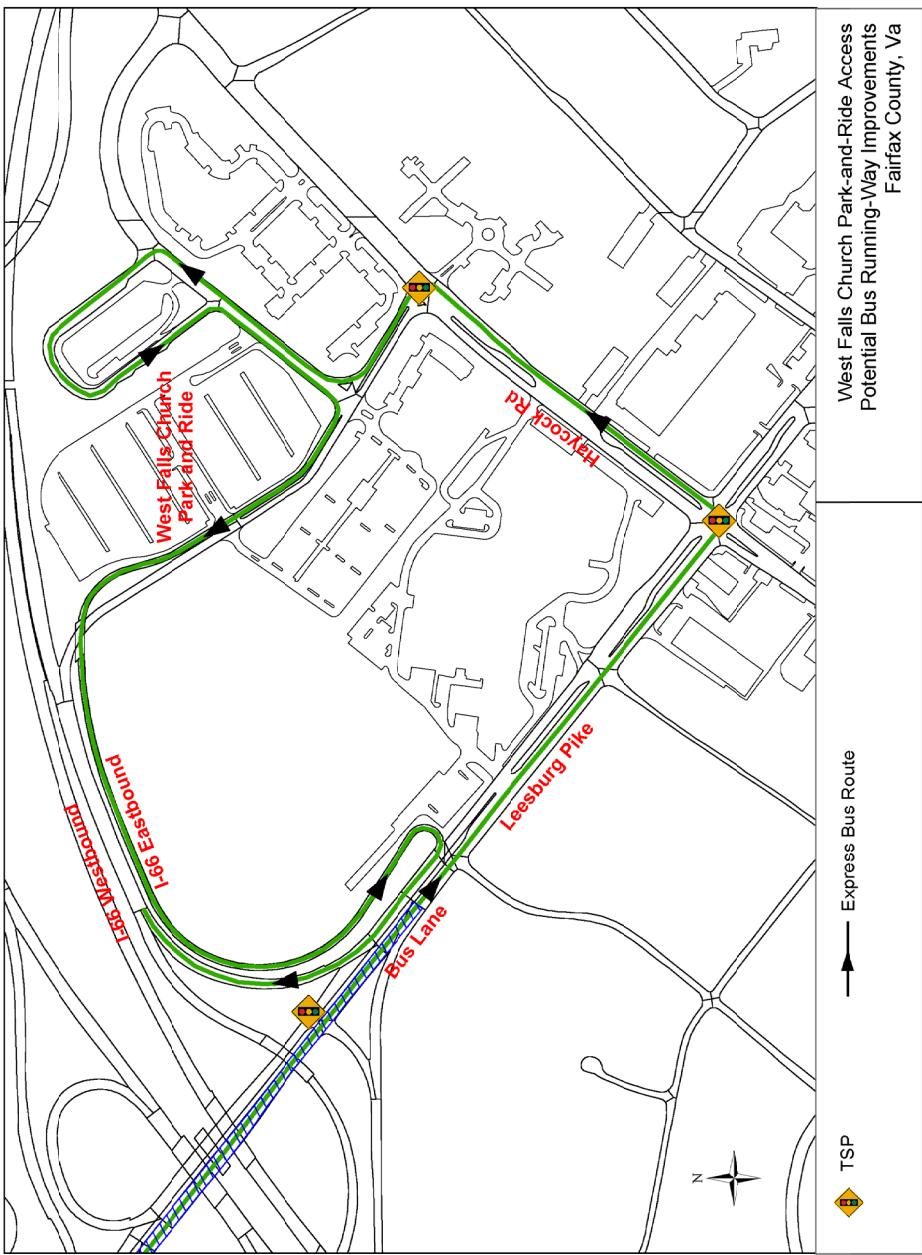
The recommended running way improvements for the West Falls Church Metro Station Park and Ride are shown in Figure 19 (during implementation, WMATA bus planners may want to consider the use of the easternmost entrance into the station to avoid excessive impacts to the townhouses facing on Haycock).

**Estimated costs for this program of running way and signal improvements are outlined in Appendix 1.**

**Figure 18 – Fairfax County Government Center Running Way Improvements**



**Figure 19 – West Falls Church Running Way Improvements**



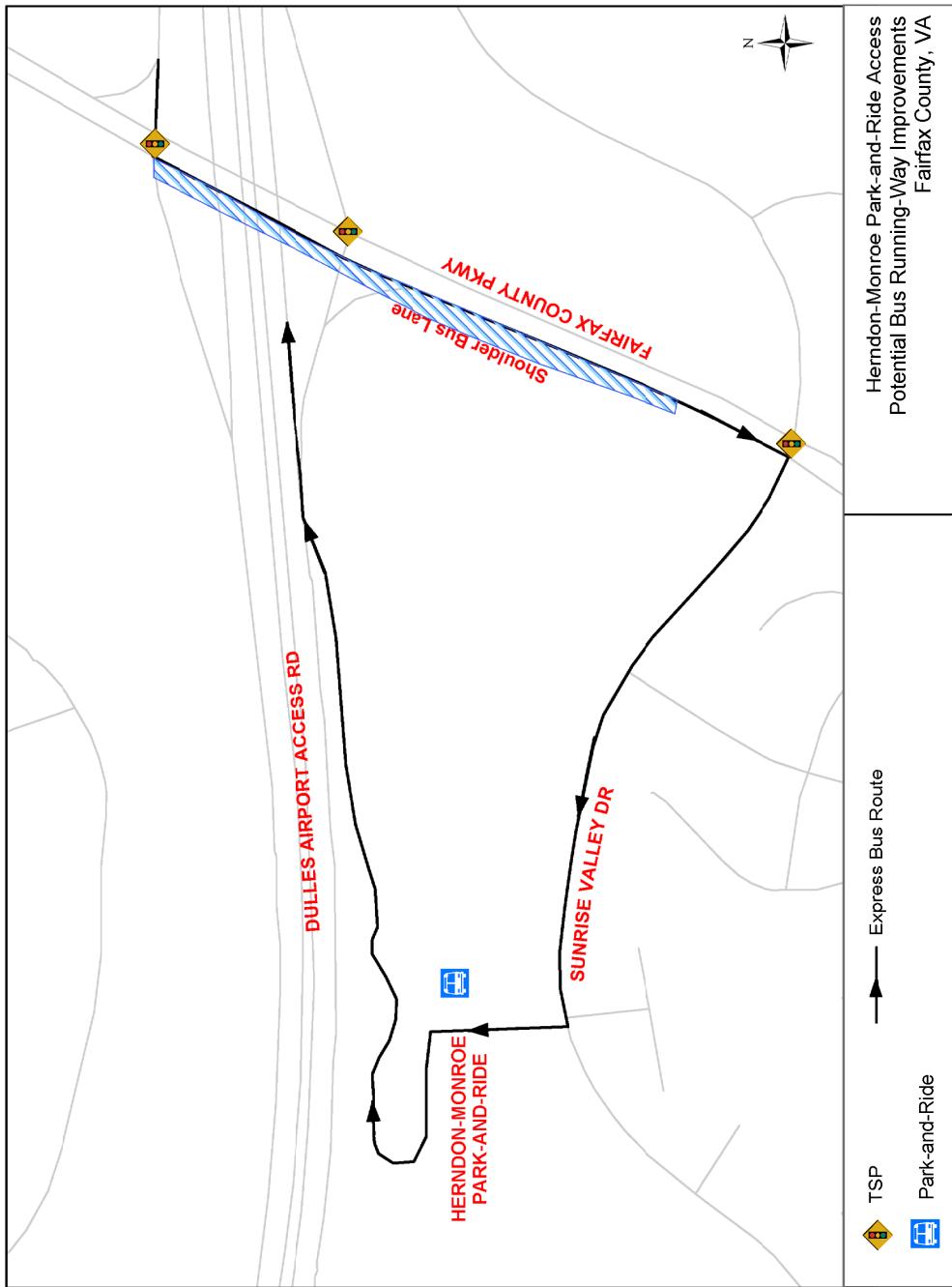
- 4. Herndon-Monroe** – Inbound buses in the morning will have direct access to the Dulles Toll Road via slip ramps from the Herndon-Monroe Park and Ride facility so the focus of the improvements outlined here are for outbound buses in the afternoon that will be required to access the Herndon-Monroe facility via local streets. Bus signal priority is proposed at two signalized intersections on the access route to the facility: 1) left turn priority off the westbound Toll Road off-ramp at Fairfax County Parkway, and 2) southbound through move priority on Fairfax County Parkway at the eastbound Toll Road off-ramp.

In addition to the signal priority treatments, either a shoulder bus lane on the west side of the Fairfax County Parkway from the westbound Toll Road off-ramp to the Sunrise Valley Drive intersection, or extension of the southbound right turn lane at this intersection is also recommended. Either treatment would allow buses to bypass long queues of vehicles along Fairfax County Parkway before turning onto Sunrise Valley Drive, with the extended shoulder bus lane creating the longest bypass condition.

The preliminary recommended improvements for the Herndon-Monroe Park and Ride are shown in Figure 20.

**Estimated costs for this program of running way and signal improvements are outlined in Appendix 1.**

**Figure 20 – Herndon-Monroe Running Way Improvements**



5. **Pentagon City/Crystal City** – As noted, one proposed Metro Support express service will run from the Fairfax Government Center to Pentagon City/Crystal City. The proposed routing in the area would be for buses to exit Jefferson Davis Highway onto Army-Navy Drive, turn left onto Hayes Street to serve Pentagon City, and then follow Hayes into the heart of Crystal City via 18<sup>th</sup> Street. From 18<sup>th</sup> Street service would turn left onto Crystal Drive and run to 15<sup>th</sup> Street where it would turn left before entering Jefferson Davis Highway for a return to Fairfax Government Center for a second trip or a return to the garage. In the afternoon, trips would start on Hayes Street in Pentagon City and the run through Crystal City in a routing similar to the morning trip.

Based on this routing signal priority is proposed at the following signalized intersections:

- westbound through movement on Army-Navy Drive at Eads Street;
- westbound through movement on Army-Navy Drive at Fern Street;
- westbound left turn from Army-Navy Drive onto Hayes Street;
- southbound through movement on Hayes Street at 12<sup>th</sup> Street;
- eastbound through movement at 18<sup>th</sup> Street at Fern Street; and
- eastbound through movement at 18<sup>th</sup> Street at Eads Street.

In addition to the signal priority identified above, a bus queue jump in the southbound direction at 15<sup>th</sup> Street and Hayes Street is recommended to allow buses to pull out of the bus bay area in front of the Pentagon City Fashion Centre with minimal delay. A curb extension along 18<sup>th</sup> Street in front of the Crystal City Metro station is also proposed where the Crystal City stop for the new service would be located.

**Estimated costs for this program of running way improvements are outlined in Appendix 1.**

#### **C. Passenger Facilities**

Each of the Metro Support routes will be operating from existing park and ride lots which, with the exception of the Poplar Tree Park and Ride, currently have at least some existing transit service running from them. The lots with existing transit service also have some passenger facilities already in place. Given this situation, the improvement recommendations outlined in greater detail below focus predominantly on upgrading rider information at each park and ride and along access routes to the park and ride facility, developing a specific Metro Support identity including signage, pavement treatments, and unique shelters that will allow passengers to quickly recognize where the Metro Support routes can be boarded. Improvements will also include providing the necessary

infrastructure for potential off-board fare purchase and Intelligent Transportation Systems. The Poplar Tree Park and Ride will require additional improvements such as bus bays and paved parking to make it suitable for a park and ride based transit service. The passenger facility recommendations for each of the park-and-ride based services are outlined in greater detail below.

**1. Poplar Tree Park and Ride** – The Poplar Tree Park and Ride is located at the intersection of Melville Lane and Stringfellow Road in the Centreville section of Fairfax County (See Figure 4). The lot is currently unpaved (the lot surface is comprised of gravel) and is adjacent to the Poplar Tree County Park. Field visits to the lot indicated that no cars were parked in the lot at about 10:00 am, meaning the lot is under-utilized as a commuter park and ride. The proposed improvements for the lot are outlined below.

*Signage on Access Paths to Parking Lot* – Path finder signs similar to signs showing access paths to Metro stations are recommended for key access paths to the facility. It is recommended that these signs incorporate an orange circle or color scheme that underscores the relationship of the bus service to the Orange Line. The proposed location of these signs is shown in Appendix 2. Signs are recommended at the following locations:

- along U.S. Route 50 near the intersection of U.S. Route 50 and Stringfellow Road (both directions)
- along Stringfellow Road at Poplar Tree Road (southbound direction); and
- near the park-and-ride entrance (southbound direction).

The proposed sign would be only a slight modification of the existing Metrorail Station pathfinder sign (the sign would have a MS in the orange circle instead of the M in a circle that is on the Metrorail pathfinder signs) to help, as noted, develop a consistent identity between Metro and the Metro Support services.

*New Bus Bays* – As noted, the existing Poplar Tree Park and Ride currently has no passenger facilities to support a park and ride based express service. Therefore, the first required passenger facility element is bus bays. Two bays are recommended along the western edge of the facility in an area that now is used as parking spaces for automobiles. A facility site plan is provided in Figure 21.

*Shelters and Waiting Areas* – No shelters or passenger waiting areas currently exist at Poplar Tree. A shelter with the dimensions 10' x 12' (enough to accommodate 10-11 waiting passengers comfortably) is recommended at each bus bay (each shelter would also have a bench along its back wall). Each bay would also be supported by a waiting area

of approximately 300 square feet, enough to accommodate an additional 25 passengers. The location of these shelters and waiting areas are shown in the site plan. It is proposed that this shelter be consistent in look with the shelters at each Metro Support park and ride in Fairfax County (and eventually with all Metro Support services region wide if the program is expanded regionally). Further, it is recommended that the shelter potentially be designed to provide a connection to Metrorail through an aesthetic that is similar to Metro stations. Each shelter/waiting area would also have a trash receptacle, an outside bench, and pedestrian level lighting.

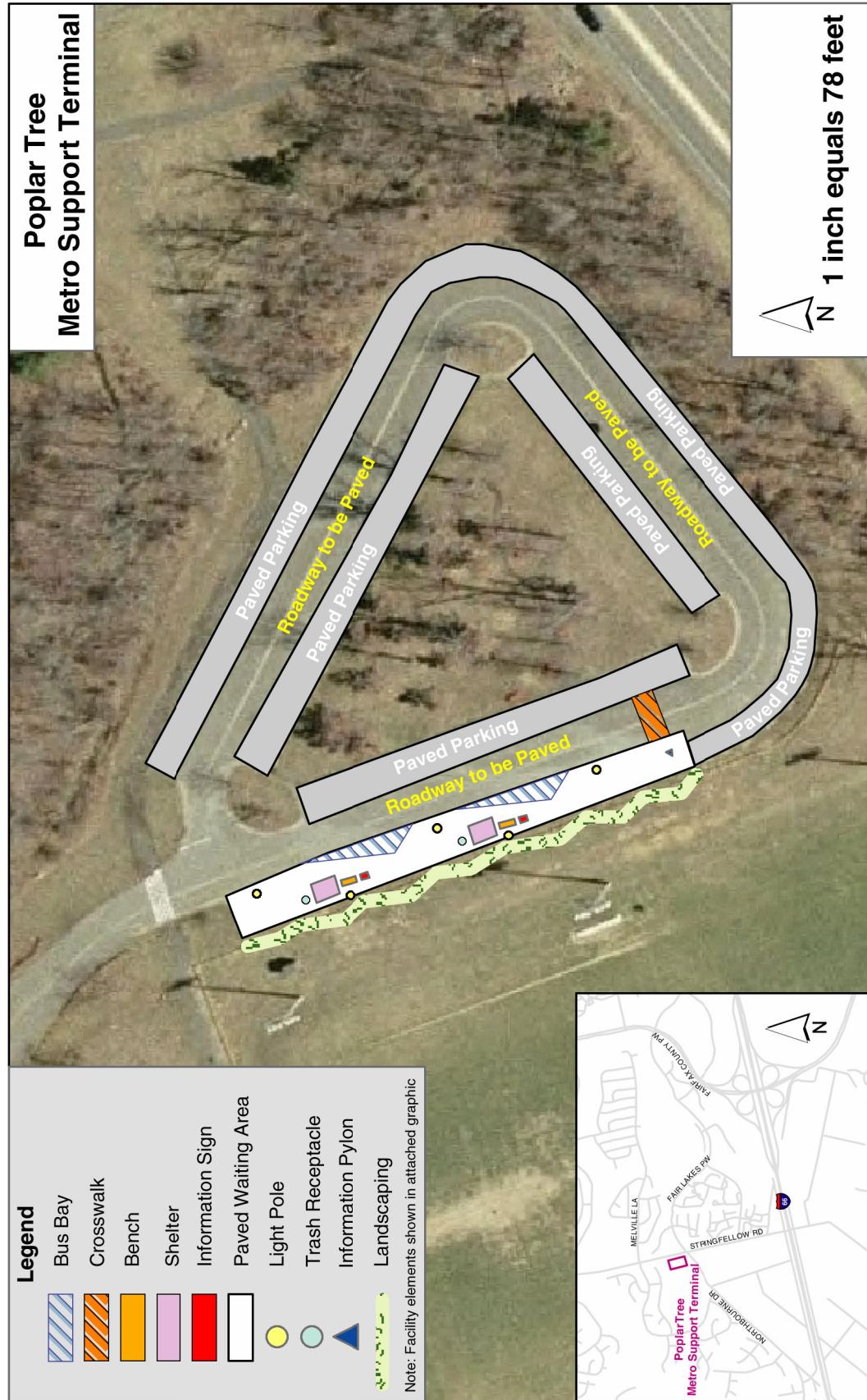
*Passenger Information* – Passenger information associated with each bus bay will include a map showing the Metro Support route running from the Poplar Tree Park and Ride, including detailed routing in downtown Washington, a detailed schedule showing each departing and arriving trip, and a next bus departure or arrival display that utilizes Intelligent Transportation systems such as Automatic Vehicle Location. A prototype of the information sign is shown in Appendix 3. It is also proposed that a pylon with the park and ride name and the name of the Metro Support service also be located adjacent to the bus bays, in a manner similar to the pylons located at the entrance to existing Metrorail stations. As with the pathfinder signs, the passenger information will be designed such that it has a consistent identity with the overall Metro Support identity.

*Paving* – To upgrade the Poplar Tree park and ride to standards for park and ride based express services, the vehicle parking area will be paved.

**The estimated cost of passenger facility improvements at the Poplar Tree Park and Ride lot are summarized in Appendix 1. Estimated annual maintenance costs, including trash removal, is estimated to be \$7,500.**

2. **Stringfellow Road** – The Stringfellow Road Park and Ride is located approximately two miles south of the Poplar Tree facility along Stringfellow Road, directly adjacent to I-66 (see Figure 4). The lot is currently utilized by the Metrobus 12S service, which runs to the Vienna Metrorail station. The Stringfellow facility consists of a paved parking lot containing about 380 spaces, as well as a bus loop and three bus bays. The entrance to the facility is protected by a traffic signal. The lot is more heavily utilized than the Poplar Tree facility, though it is typically about 50% full during the week. Given the existing passenger facilities at the Stringfellow Road facility, required improvements will be much less extensive than those required at Poplar Tree Park. The site plan showing the proposed improvements is shown in Figure 22.

**Figure 21 – Poplar Tree Park and Ride Site Plan**



*Signage on Access Paths to Parking Lot* – Path finder signs similar to the signs described above for the Poplar Tree lot are also proposed for this facility. Signs are recommended for access paths from both the south and north, with the proposed location of these signs shown in Appendix 2.

Signs are recommended on U.S. 29/Lee Highway near the intersection of Stringfellow Road and Lee Highway (in both directions), south of I-66 (in the northbound direction) along Stringfellow, at the park and ride entrance (both north and southbound direction along Stringfellow) and south of the Poplar Tree facility (in the southbound direction).

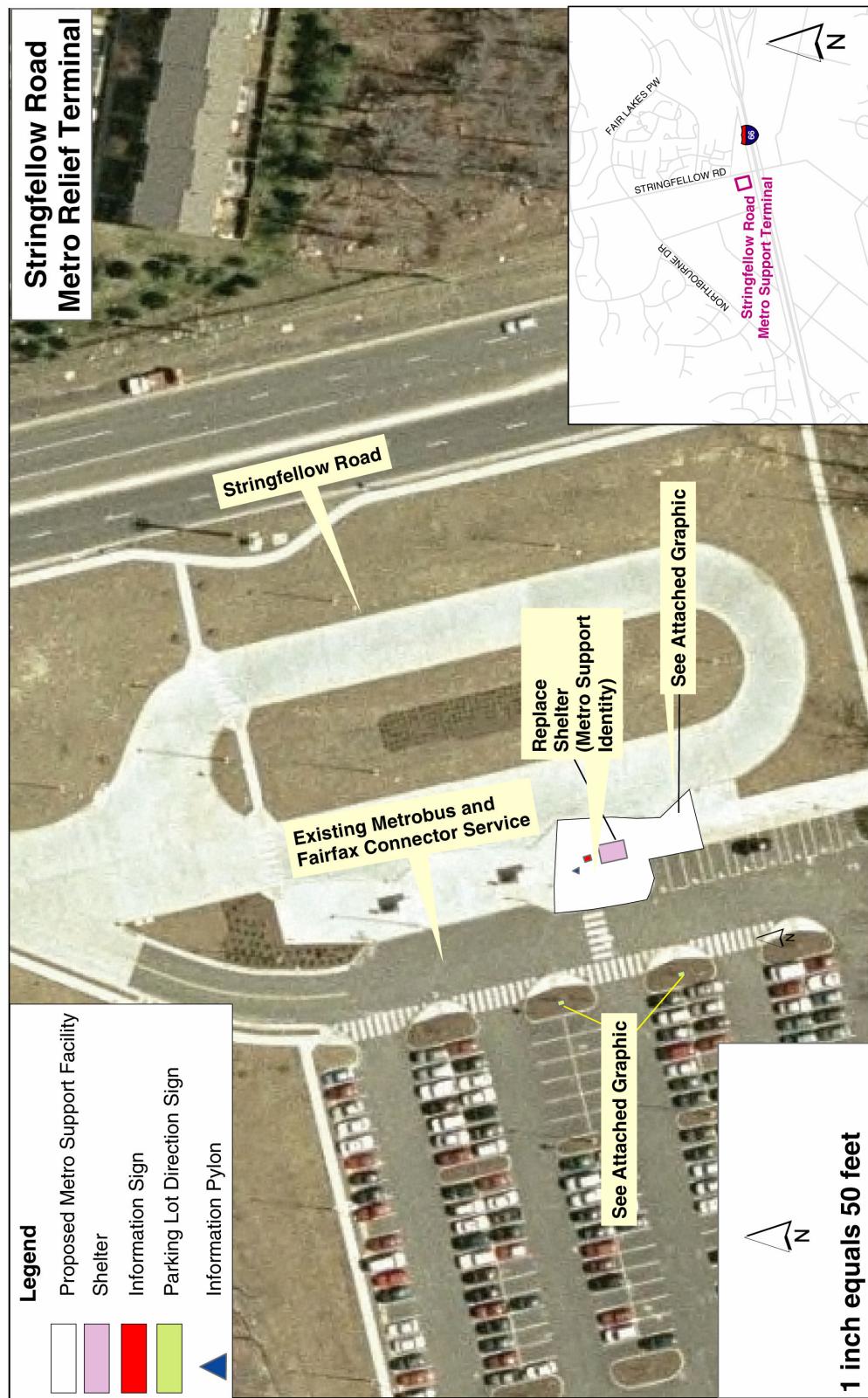
*Shelters* – Standard plexiglass shelters already exist at the three bays but it is recommended that the shelter at the Metro Support bay be replaced with the shelter described above for the Poplar Tree facility. This new shelter would be consistent with shelters at other Metro Support facilities and would potentially have an aesthetic theme consistent with Metrorail stations.

*Passenger Information* – As with the Poplar Tree facility, passenger information associated with each bus bay will include a map showing the Metro Support route running from the Stringfellow Road park-and-ride, a next bus departure or arrival display, and a Metro Support pylon.

**The estimated cost of passenger facility improvements at the Stringfellow Road Park and Ride lot are summarized in Appendix 1. Estimated annual maintenance costs, including trash removal, is estimated to be \$7,500.**

3. **Fairfax County Government Center** – The Fairfax County Government Center Park and Ride is located off the Government Center entrance road in one of the outer lots of the large number of parking lots that provide parking for County employees and visitors to the Government Center. The lot is currently served by the Fairfax Connector 621 and 623 routes, which provide service to the Vienna Metrorail Station. Existing facilities at the Park and Ride include vehicle parking for 170 cars and a single shelter bus stop along the Government Center entrance road. A site plan of recommended improvements is shown in Figure 23 and summarized below.

**Figure 22 – Stringfellow Road Park and Ride Site Plan**



*Signage on Access Paths to Parking Lot* – Path finder signs similar to the signs described above for the Poplar Tree and Stringfellow Road facilities are recommended for the multiple access routes to this facility (map included in Appendix 2). Adjacent to the facility, a pathfinder sign would be located at the intersection of Post Forest Drive and Government Center Parkway (in the westbound direction), and at the intersection of Government Center Parkway and the entrance road to the Government Center (in the eastbound direction). Signs would also be located directly at the entrance to the facility off of both Post Forest and the Government Center entrance Road. Additional signs further from the facility would be located:

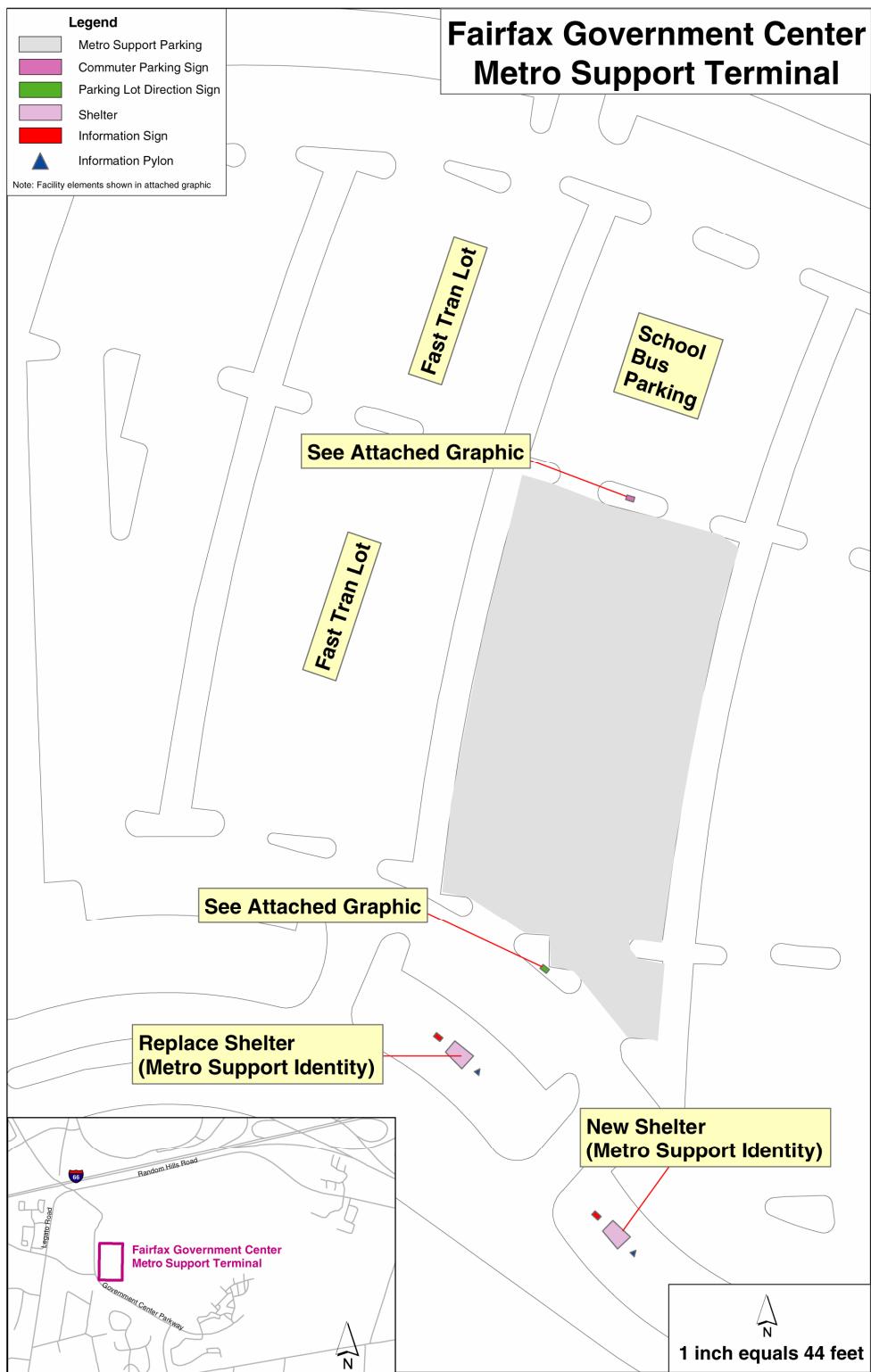
- along Monument Drive at the western intersection of Monument Drive and Government Center Parkway (in both directions);
- along Fair Lakes Parkway (eastbound direction) and along Monument Drive (southbound direction) at the intersection of Monument Drive and Fair Lakes Parkway;
- along West Ox Road (both directions) at the intersection of West Ox and Post Forest Drive;
- along Monument Drive at the eastern intersection of Monument Drive and Government Center Parkway (in the northbound direction); and
- on U.S. 29/Lee Highway (both directions) at the intersection of U.S. 29 and Monument Drive.

*Additional Stop* – The Fairfax Government Center is the terminal point for two Metro Support services, one to downtown Washington and one to Pentagon City/Crystal City. To handle both services, an additional stop (to the one that already exists) would be required.

*Shelters* – A standard plexiglass shelter already exists at the on-street bus stop on the Government Center entrance road. It is recommended that this shelter be replaced with the shelter described above for the Poplar Tree and Stringfellow facilities. The second stop would also have a similar shelter.

*Passenger Information* – As with the other facilities described above, passenger information associated with the Government Center entrance road on-street stops would include a map and schedule of the services running from the facility, a next bus departure or arrival display, and a pylon with the name of the Metro Support Support services operating from the facility.

**Figure 23 – Fairfax Government Center Site Plan**



*Delineation of Parking Facility* – The commuter park and ride lot at the Fairfax Government Center is part of a very large complex of parking lots supporting the Government Center. In addition, lots directly adjacent to the park and ride are used for school and paratransit bus storage. Combined, these factors can make finding the lot and deciding which spots can be used for commuter parking, confusing. The pathfinder signs described above will assist in finding the lot, but additional tools to distinguish the lot are also recommended. These include additional signs within the parking facility identifying the facility as Metro Support and a separation of the Metro Support lot from the school bus parking using a curb or grass median. Though often difficult to maintain, painting the pavement of the lot a different color can also help distinguish it from the surrounding facilities.

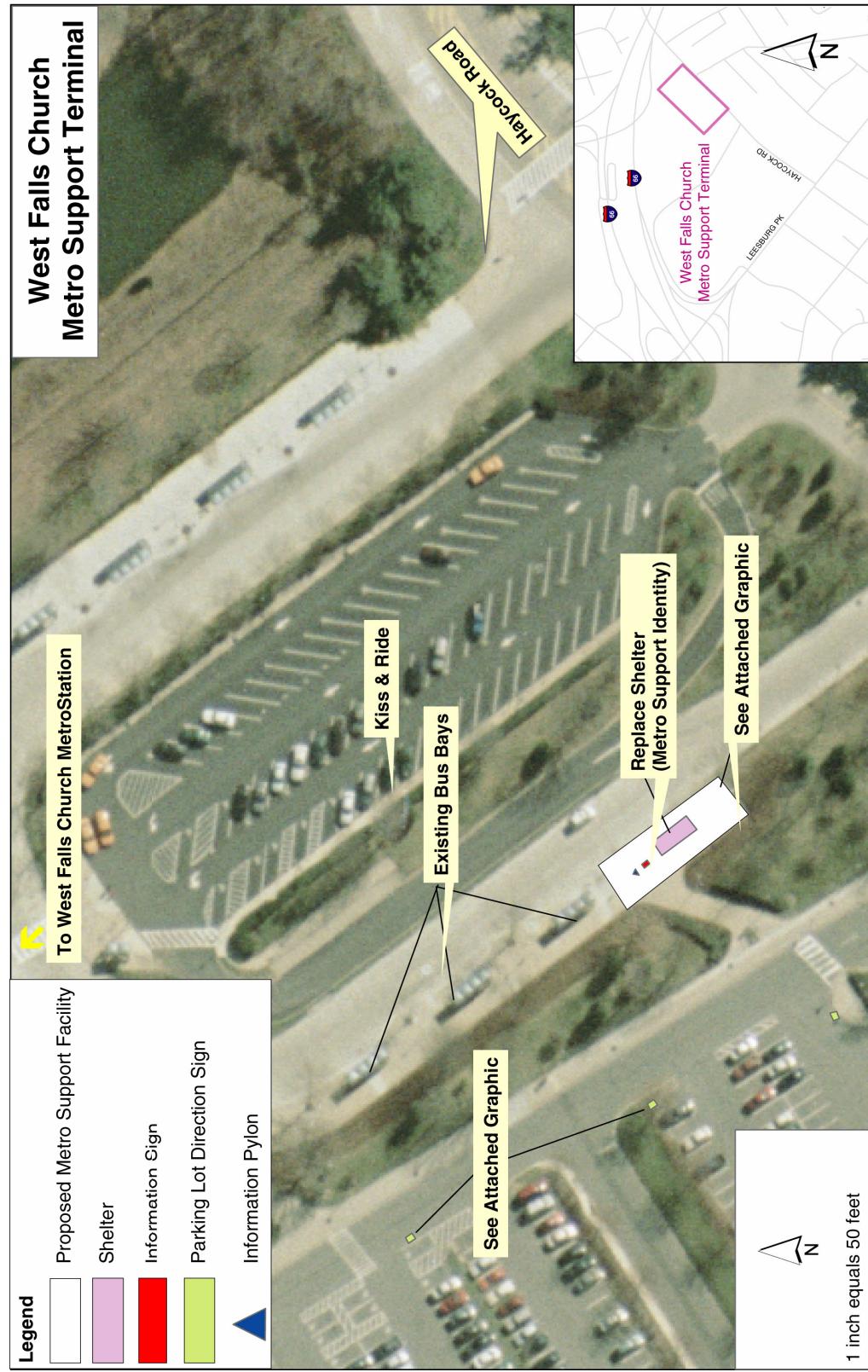
**The estimated cost of passenger facility improvements at the Fairfax Government Center Park and Ride lot are summarized in Appendix 1. Estimated annual maintenance costs, including trash removal, is estimated to be \$7,500.**

4. **West Falls Church Metro Station** – The Metro Support services at the West Falls Church Metro station would run from the bus bay facilities on the south side of the station, adjacent to the station parking. The facility would be located at the southernmost bus bay on the west side of the south side bus loop, at an existing bay that is not currently used for other service. Recommended improvements at the facility are outlined below and shown in Figure 24.

*Signage on Access Paths to Parking Lot* – Path finder signs similar to the signs described above for the other Metro Support lots are recommended for the primary access routes to this facility. Adjacent to the facility, a pathfinder sign would be located on Haycock Road, in both directions, at the entrance to the Metro station. Signs would also be located along Route 7, in both directions at the intersection of Route 7 and Haycock Road. South of the station, signs would be located along Route 7 northbound at West Street and Washington Street. North of the station along Route 7 southbound signs would be located at the intersection with I-66 and at Kings Garden Street. The location of the proposed pathfinder signs is shown in Appendix 2.

*Shelters* – A standard plexiglass shelter already exists at the bay proposed for the Metro Support service. It is recommended that this shelter be replaced with a shelter with a Metro Support identity similar to that described for the other Metro Support facilities.

**Figure 24 – West Falls Church Site Plan**



*Passenger Information* – The passenger information program at this facility would be similar to that described above for other Metro Support facilities. In addition, the program would include signs in the West Falls Church station parking lot directing people to the Metro Support services.

**The estimated cost of passenger facility improvements at the West Falls Church Metro Station are summarized in Appendix 1. Estimated annual maintenance costs, including trash removal, is estimated to be \$7,500.**

5. **Herndon-Monroe Park and Ride** - The Metro Support services at the Herndon-Monroe Park and Ride would run from an unused bus bay at the western end of the facility, on the north side of the bus bay island. The facility site plan is shown in Figure 25.

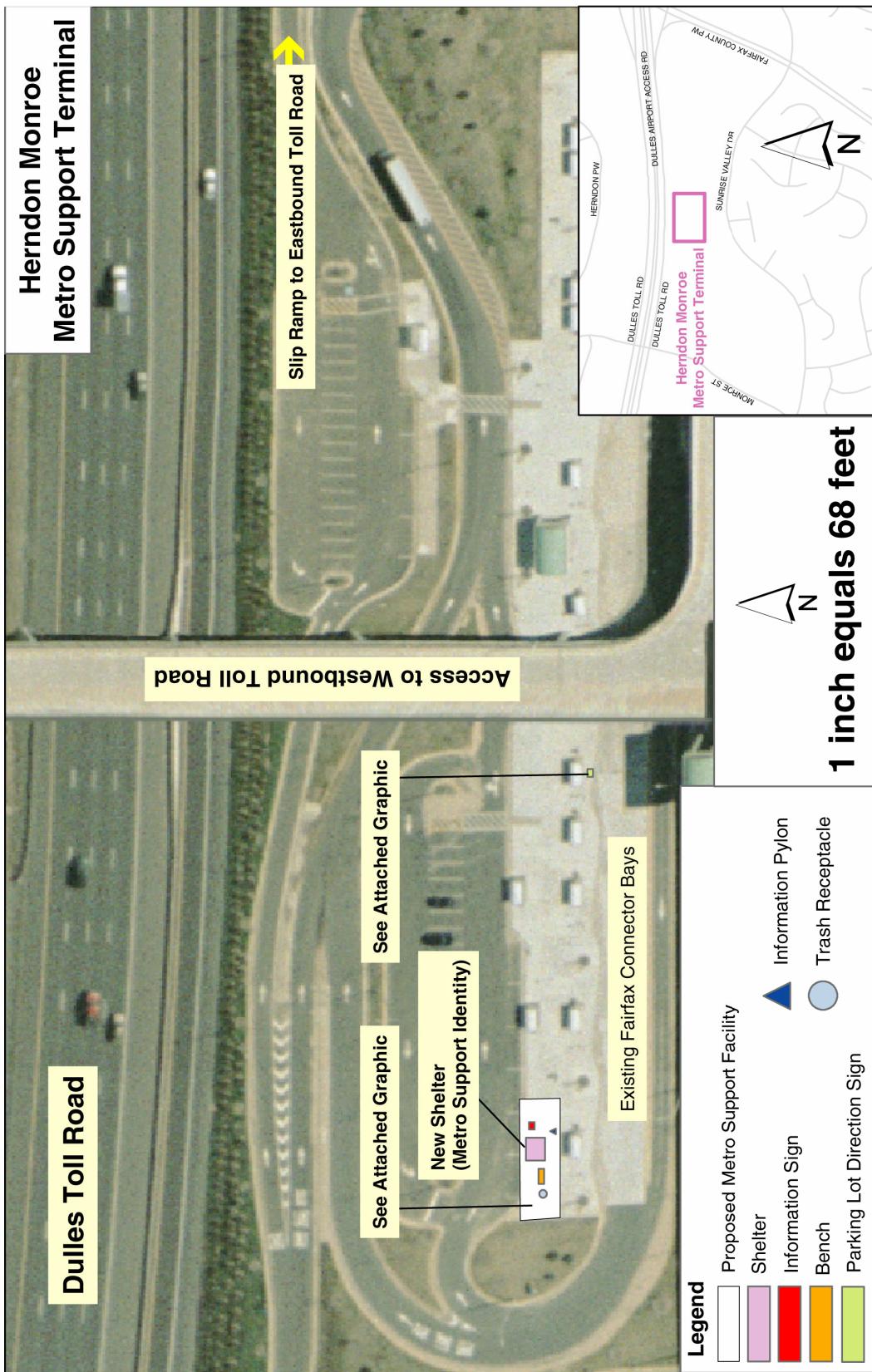
*Signage on Access Paths to Parking Lot* – Path finder signs similar to the signs described above for the other Metro Support lots are recommended for the primary access path to this facility. Pathfinder signs for the Herndon-Monroe facility would be located along the Fairfax County Parkway in both directions at the intersection with Sunrise Valley Drive, along Sunrise Valley Drive in both directions at the entrance to the Herndon-Monroe Park and Ride, along Monroe Street in both directions at the intersection with Sunrise Valley Drive, and along Centreville Road in both directions at the intersection with Sunrise Valley Drive. The location of the proposed pathfinder signs are shown in Appendix 2.

*Shelters* – No shelter currently exists at the bay proposed for the Metro Support service at Herndon-Monroe. A shelter with a Metro Support identity similar to that described for the other Metro Support facilities is recommended.

*Passenger Information* – The same passenger information program identified for the other facilities is also recommended here. Signs would also be located at the crosswalk from the parking garage to the bus bay island at Herndon-Monroe directing people to the Metro Support services.

**The estimated cost of passenger facility improvements at Herndon-Monroe are summarized in Appendix 1. Estimated annual maintenance costs, including trash removal, is estimated to be \$7,500.**

**Figure 25 – Herndon-Monroe Site Plan**



# **Section 8**

## **Evaluation of Preliminary Recommendations**

## Evaluation of Preliminary Recommendations

One of the methods used for selecting and prioritizing the final recommendations outlined in the next section of the report was an evaluation of each preliminary recommendation within the context of a framework that focused on each recommendation's estimated cost-effectiveness, productivity, and likely success. The framework used to complete this evaluation of preliminary alternatives is outlined below. The results of the evaluation relative to each of the preliminary recommendations described in Sections 4 through 7 are outlined in Appendix 5.

### Service Recommendations

- **Weekday O&M Cost** – This criterion is an absolute figure and is used to identify total resources that would be required to run the proposed service improvement.
- **Weekday Incremental O&M Cost** – This criterion is used to identify the increase in resources that will be required to run the proposed service improvement.
- **Annual O&M Cost** – This criterion is also an absolute figure that is used to identify total annual resources that will be required to run the proposed service.
- **Annual Incremental O&M Cost** – This criterion is used to identify the increase in annual resources that will be required to run the proposed service.
- **Peak Vehicle Requirement/Vehicle Capital Cost** – This criterion identifies the number of vehicles that will be required to operate the service for the new proposal, including the number of new vehicles, and also identifies the capital resources required to purchase the vehicles.
- **Total Daily Ridership** – This criterion is used to identify all riders that would be impacted by the service changes, as well as to calculate service productivity.
- **Increase in Daily Ridership** – This is an absolute number that is used to identify the incremental impacts of the proposed service change.
- **Total Annual Ridership** – This criterion is used to identify all riders on an annual basis that would be impacted by the service changes, as well as to calculate service productivity.

- **Increase in Annual Ridership** – This is an absolute figure that is used to identify the annual impacts of the proposed service change.
- **Weekday Riders Removed from Overcrowded Metrorail Routes** – This criterion shows the benefits provided to Metrorail by diverting riders from the most crowded segments of the Metrorail system.
- **Incremental Operating Cost Per New Rider** - This criterion is used to show the resources required to provide service to new riders.
- **Boarding per Revenue Vehicle Hour** – This criterion is the most widely used measure for assessing a service's productivity and is calculated using the total ridership and revenue-hours for the service.
- **Makes Use of Facility and Running Way Recommendations** – This criterion focuses on whether the service improvement provides a sufficient justification for the associated running way and facility recommendations.

## **Running Way and Signal**

- **Total Capital Cost** – This criterion is used to identify the total capital resources that will be required to implement each individual recommendation as well the full program of recommendations for each corridor.
- **Traffic Impacts** – Since implementation of some forms of bus priority can result in the removal of traffic capacity, it is important to understand the impacts of implementation of the improvement on traffic operations. This criterion addresses this impact through a qualitative assessment of the recommendation's impacts, relying on factors such as traffic volumes and the level of disruption to general vehicular traffic resulting from implementation.
- **Number of Daily Riders Affected** – This criterion is an absolute figure that identifies the number of daily riders that would be positively affected by the implementation of the running way improvement.
- **Capital Cost per Daily Rider Impacted** – This criterion is one of two cost-effectiveness measures used to evaluate the running way improvements and provides an understanding of how much it will cost per passenger to provide the benefits associated with the running way improvement.
- **Total Travel Time Savings (daily riders impacted \* time saved per trip = passenger hours saved)** – This criterion focuses on the positive benefit of each running way improvement and is used to compare the benefits of

travel time savings for each recommendation to each other. The same type of assessment can be completed for the full corridor program of improvements.

- **Capital Cost per Passenger-Hour Saved** – This criterion is the second measure to assess the cost-effectiveness of each running way improvement recommendation and focuses on the cost of providing passenger travel time savings.
- **Ease of Implementation** – This criterion is used to assess the overall feasibility of implementation and includes elements such as institutional openness to transit priority by the agency controlling traffic control devices in the corridor, whether traffic control is controlled by a single agency in the corridor, and the level of other modes competing for limited capacity.
- **Support of Service Recommendations** – This criterion focuses on whether the running way improvement is required to support specific service recommendations.

## Passenger Facilities

- **Total Capital Cost** – This criterion is used to identify the total capital resources that will be required to implement individual passenger facility recommendations as well as corridor wide recommendations.
- **Total Weekday and Annual Usage** – This criterion is used to identify the magnitude of usage of the new passenger facility and therefore can be used to assess overall benefit.
- **Capital Cost per Daily Using Rider** – This criterion is used to identify each passenger facility improvement's cost effectiveness.
- **Ease of Implementation** – This criterion is used to assess whether quick implementation of the improvement is feasible, and focuses on property and space availability and ease of constructability.
- **Support of Service Recommendations** – This criterion focuses on whether the passenger facility improvement is required to support specific service recommendations. This is important in evaluating and prioritizing each recommendation.

As noted, tables outlining each recommendation's performance relative to the evaluation framework for the three improvement categories are included in Appendix 5. A brief summary of the results of the evaluation is outlined below.

## **Summary of Results by Corridor**

**H Street** – The H Street Corridor service, running way, and passenger facility improvements all perform well relative to each of the evaluation criterion, especially in terms of cost-effectiveness and productivity. In terms of service, the recommendations have the highest productivity of all the recommendations made for all four corridors, and also easily exceed the productivity standards set in the original Regional Bus Study. The annual operating cost per new rider is also the lowest of all service recommendations, especially for the lower cost service alternative. The running way improvement recommendations are also the most cost effective, predominantly because of the high number of riders that will be positively impacted by the improvements. Finally, the passenger facility recommendations are also in the range of being the most cost effective, predominantly because of the relatively modest facility programs, in conjunction with the large number of riders that would be impacted by the improvements.

**U.S. 1** – The evaluation results for the U.S. 1 recommendations are mixed relative to the three areas of recommendations. The service recommendations result in small increases in daily ridership but the cost per new rider and the boardings per revenue vehicle hour are fairly reasonable and exceed the standards set in the original Regional Bus Study. Four different service alternatives are outlined and the range of annual change in O&M cost is significant, from a low of \$200,000 to a high of \$2,305,000. Because the number of riders impacted by the running way improvement recommendations is small, the cost-effectiveness of the improvements, as measured by capital cost per daily rider impacted, is, in general, significantly lower than the recommendations made in the H Street and Metro Support Corridors. This same lower cost-effectiveness applies to the U.S. 1 passenger facility recommendations.

**Annapolis Road** – The Annapolis Road service recommendations have relatively poor productivity and a relatively high cost per new rider, because a relatively small number of new riders will be attracted. The transit signal priority improvements are relatively cost effective compared to recommendations in other corridors, but the queue jump recommendations are quite expensive because, unlike the U.S. 1 corridor, right hand turn lanes are not available so new right-of-way would have to be constructed. Passenger facilities are also relatively cost-ineffective compared to the other corridors because of the relatively small number of passengers impacted by the improvements.

**Metro Support** – The Metro Support service recommendations show mixed results based on the hybrid nature of the service. The proposed routes have productivities ranging from 19 to 30 boardings per revenue hour, with the majority of the routes at 22 to 23 boardings per revenue hour. An additional important measure for this service is the number of weekday riders diverted from Metrorail, which is relatively high. Approximately 3,700 trips would be diverted from Metrorail in each peak period. This number of trips converts into a capacity need

of approximately 31 Metrorail vehicles at a loading standard of 120. The absolute cost of the service recommendations is relatively high, based on the frequency of the service. In terms of the running way improvements, the cost-effectiveness, as measured by total capital cost per daily rider impacted, is lower than the H Street recommendations but higher than the U.S. 1 recommendations. This difference in cost-effectiveness relates directly to the number of riders that will benefit from implementation of the recommendation. The cost-effectiveness of the passenger facility recommendations are generally high based on the low costs of the facility improvements (because existing facilities are being used for all but one of the services) and the relatively high number of passengers using the facilities. The one exception is at the Poplar Road Park and Ride, where new infrastructure would have to be installed to handle the service.

# **Section 9**

## **Final**

# **Recommendations/Implementation**

## **Time Frame**

The final step of the planning process is the development of final implementation recommendations. This final set of recommendations is the result of a narrowing and prioritization of the full universe of preliminary recommendations based on a number of inputs, including the results of the evaluation phase, feedback from jurisdictions on priorities, and the overall availability of resources to implement the recommendations. This input was also used to prioritize recommendations and set time frames for implementation: short-term (1-5 years), mid-term (6-10 years) and long-term (after 10 years).

A detailed description of the final recommendations by corridor is outlined below. A summary of the prioritized list, including operating and capital cost by recommendation and total cost by time frame, is included in Appendix 6.

Outlined below are the final recommendations by corridor.

#### **A. *Final Recommendations – H Street/Benning Road***

As noted in the preliminary recommendations section, two different structures for service improvements were developed and evaluated in the H Street/Benning Road corridor. In the first, new RapidBus service would run every 7 minutes in the peak, 9 minutes in the mid-day, and 15 minutes in the evening until 8:00 pm. X2 service would operate at 15 minute headways in the peak and 20 minutes in the mid-day and early evening. In this alternative, RapidBus service would utilize standard length transit buses, while the X2 service would continue to utilize articulated buses.

Under the second alternative, frequency on both services would be equal, with 12 minute peak headways, 15 minute mid-day frequencies, and 20 minute evening headways on both services (RapidBus service would run to 8:00 pm).

**Based on the demand and cost analysis, the final recommendation for service in the H Street/Benning Road corridor is implementation of the second service alternative (equivalent X2 and RapidBus service frequencies) in the short-term.**

The proposed running way improvements for the H Street/Benning Road corridor would consist of a combination of signal priority and bus bypass lane /queue jump improvements. An additional priority treatment in the corridor is the curb extensions along H Street that are part of the District of Columbia's streetscape improvements in the corridor.

The bus bypass lanes can be implemented quickly and are not dependent on other initiatives in the corridor. To be most effective, the signal priority improvements would be implemented in concert with WMATA's Automatic Vehicle Location (AVL) system (without the integration with the AVL system,

instituting signal priority would be in the control of bus drivers, which is less than optimal for minimizing impacts to traffic operations). At this point, AVL system implementation is not far enough along to handle the integration with signal priority and therefore implementation will be longer term. Based on this set of implementation constraints and opportunities, **the final recommendation for running way and signal improvements in the H Street/Benning Road corridor is to implement bus bypass lanes in the short term, with implementation of signal priority recommendations in the mid-term, when integration with the AVL system can be accomplished.**

Proposed passenger facility improvements include a full program of improvements and amenities at each RapidBus stop in the corridor. Development of the stop improvements in the H Street portion of the corridor will have to await the completion of the streetscape improvements by the District of Columbia. Based on discussions with the District, these are not likely to be completed until the mid-term time frame. Improvements in the Benning Road portion of the corridor do not have these barriers and therefore can be implemented in the short term. Therefore, **the final recommendation for passenger facilities in the H Street/Benning Road Corridor is to implement improvements at stops in the Benning Road portion of the corridor in the short-term and improvements in the H Street portion of the corridor in the mid-term.**

The full program of H Street improvements and their proposed implementation time frame is outlined in Appendix 6.

#### ***B. Final Recommendations – U.S. 1***

Four different structures for service improvements were developed and evaluated in the U.S. 1 corridor in Maryland. In the first, a new service would be developed to run the entire length of U.S. 1 from Laurel to the Rhode Island Avenue Metrorail station to replace the rather fractured route structure that exists today (today services run along part of U.S. 1 and then terminate, or east-west services utilize a portion of the corridor before continuing east-west, but no services run the entire length of the corridor). For this service structure three levels of service were developed and evaluated. The first would provide an equivalent level of service in terms of frequency and span of service to what exists today. The second would be a level of service that would meet the service level standards outlined in the Comprehensive Operations Analysis (COA) portion of the Regional Bus Study, and the third level of service would actually exceed the minimum standards outlined in the COA.

In addition to the three versions of a single U.S. 1 service structure, a fourth service structure was developed and evaluated. This service structure would combine routes between Laurel and the Greenbelt Metro station into a single route that would run between the Greenbelt and College Park Metro stations via Laurel and U.S. 1.

Based on the evaluation of the different services as well as the input of the WMATA bus planners, **the final service recommendation for the U.S. 1 Corridor is to implement the Greenbelt to College Park service restructuring in the mid-term time frame.**

The proposed running way and signal improvements in the U.S. 1 corridor are a combination of bus bypass lanes/queue jumps and mainline and side street signal priority. The complexity of the corridor in terms of signal control, road widths, traffic levels, and adjacent land uses make quick implementation of the signal priority recommendations difficult. In addition, the lack of an AVL system for WMATA buses further complicates implementation of the signal priority improvements. Finally, the length of the corridor and the concurrent number of signals makes implementation of the full set of improvements along the entire length of the corridor at one time problematic. Therefore, based on this assessment of implementation feasibility, **the final recommendation for running way and signal improvements in the U.S. 1 corridor is to implement bus bypass lanes and queue jumps in the entire corridor in the mid-term, and implement the signal priority recommendations for mainline bus movements in the mid-term, when integration with the AVL system can be accomplished. Implementation of the side-street transit priority will occur in the long-term, if future evaluation identifies a need and also shows that mainline service will not experience excessive negative impacts.**

As noted in Section 5, SHA has expressed general concern regarding the impacts of Transit Signal Priority on overall traffic operations along the corridor. The recommendations in this document reflect SHA comments. In addition, as the recommendations move forward for implementation, continued coordination with SHA will be required to ensure that general traffic needs and transit needs are balanced.

Proposed passenger facility improvements are relatively modest and are focused on improvements that will provide for a more comfortable environment at heavy transfer points and also to address passenger needs and safety issues at local stops. These improvements will support current and future service configurations and therefore will provide immediate benefits. Therefore, **the final recommendation for passenger facilities in the U.S. 1 corridor is to implement these improvements in the short-term time frame.**

The full program of U.S. 1 improvements and their proposed implementation time frame is outlined in Appendix 6.

#### **C. Final Recommendations – Annapolis Road**

The proposed service structure developed for the Annapolis Road corridor involves a RapidBus overlay on the existing T18 local service, with no changes to

existing T18 service levels. Specifically, the RapidBus service would run every 10 minutes in the peak and every 20 minutes in the off-peak, following the same alignment as the T18. The T18 would continue to operate on its current schedule, roughly every 20 minutes in peak periods and every 33 minutes in the Mid-day.

The running way and passenger facility improvements would be completed in support of this service plan. Based on the evaluation of the alternative, the **final recommendation for the Annapolis Road corridor is implementation of all improvements (including service improvements, running way improvements, and passenger facility improvements) in the long-term.**

The full program of Annapolis Road improvements and their proposed implementation time frame is outlined in Appendix 6.

#### **D. Final Recommendations – Metro Support**

A detailed service plan was developed in the “Preliminary Recommendations” report for service from each of the six park and ride lots considered in the analysis. The specifics of the revised services from each park and ride are outlined below, with a greater level of detail provided in Section 7 of the report.

- Span of Service and headways – all services
  - Morning Peak      6:00 am to 8:30 am – 10 minutes  
                          8:30 am to 9:00 am – 15 minutes
  - Afternoon Peak     4:00 pm to 6:30 pm – 10 minutes  
                          6:30 pm to 7:00 pm – 15 minutes

The origin park and rides and the destinations are identified in Section 7, with different implementation time frames for each service (based on discussions on priorities with Fairfax County and the results of the evaluation). The associated running way and passenger facility recommendations for each park and ride would correspond with the implementation time frame for the service recommendations, except for signal priority for the Fairfax Government Center to downtown signal priority improvements, which will have to await the implementation of the WMATA AVL system, and the implementation of the Herndon-Monroe bus bypass lane, which can provide benefits for existing Fairfax Connector service. **Outlined below are the specific final recommendations for the Metro Support services and their implementation time frames.**

- Fairfax County Government Center
  - Service to Downtown – short-term
  - Service to Pentagon City/Crystal City – long-term
  - Signal Priority Improvements – mid-term – when AVL is available
  - Running Way Improvements – short-term
  - Passenger Facility Improvements – short-term to support service
- Stringfellow Road Park and Ride
  - Service to Downtown – mid-term
  - Signal Priority Improvements – mid-term
  - Passenger Facility Improvements – mid-term
    - Surface Parking Expansion – long-term
- Poplar Tree Park and Ride
  - Service to Downtown – long-term
  - Signal Priority Improvements – long term
  - Running Way Improvements – long-term
  - Passenger Facility Improvements – long-term
- Herndon-Monroe Park and Ride
  - Service to Downtown – long-term
  - Signal Priority Improvements – mid-term – when AVL is available
  - Running Way Improvements – short-term
  - Passenger Facility Improvements – long-term
- West Falls Church Metro Station
  - Service to Downtown – long-term
  - Signal Priority Improvement – long term
  - Running Way Improvements – long-term
  - Passenger Facility Improvements – long-term

Two additional points of clarification are required. First, based on current utilization, it appears that enough parking capacity will be available at Stringfellow Park and Ride to support implementation of a Metro Support service to downtown in the mid-term time frame. Demand estimates indicate that in the long-term, additional surface parking at Stringfellow Road may be required. The

current park and ride does not take up the entire parcel owned by VDOT so expansion could be completed without any additional property purchases.

The second point of clarification relates to running way improvements at Herndon-Monroe. Analysis and discussion with Fairfax County regarding their priorities resulted in a recommendation for long-term implementation of the service and passenger facility improvements at Herndon-Monroe. However, since the facility is currently heavily used by express buses from West Falls Church coming off the Dulles Toll Road, implementation of the running way improvements in the short-term would provide significant benefit. Therefore, this element of the improvements at Herndon-Monroe was recommended for short-term implementation.

The full program of Metro Support improvements and their proposed implementation time frames is outlined in Appendix 6.

# **Appendix 1**

## **Preliminary Recommendations**

### **Cost Estimates**

Appendix 1-A  
H Street/Benning Road Corridor

<b>H Street/Benning Road Running Way Improvements Cost Estimates</b>	
<b>Signal Priority</b>	
<i>Intersection Location</i>	<i>Cost</i>
4th Street/H Street /Massachusetts Avenue (both directions)	\$60,000
North Capitol Street/H Street (both directions)	\$40,000
5th Street NE/H Street (both directions)	\$40,000
8th Street NE/H Street (both directions)	\$40,000
17th Street/Benning Road (both directions)	\$40,000
Minnesota Avenue/Benning Road (left turn priority)	\$20,000
<b>Total Signal Priority</b>	<b>\$240,000</b>
<b>Bus Bypass/Queue Jump/Exclusive Lane</b>	
<i>Location</i>	<i>Cost</i>
14th Street to 17th Street	\$75,000
17th Street to Anacostia Avenue (both directions)	\$75,000
Anacostia Avenue to Minnesota Avenue (both directions)	\$75,000
<b>Total Bus Bypass/Queue Jump/Exclusive Lane</b>	<b>\$225,000</b>
<b>Total H Street/Benning Road Running Way Improvements</b>	<b>\$465,000</b>

<b>H Street/Benning Road Passenger Facility Cost Estimates</b>	
BRT Stop Passenger Facility Program	
Facility Element	
Shelter	\$5,000
Shelter Bench	\$600
Information Sign	\$700
Outside Bench	\$1,000
Pedestrian Level Lighting	\$1,575
Trash Receptacle	\$350
Next Bus Arrival Display	\$1,500
Enhanced Crosswalks	\$3,859
Total Per Stop	\$14,584
Number of Stops in Corridor	24
<b>Total Passenger Facility Cost</b>	<b>\$350,021</b>
<b>Total H Street/Benning Road Capital Costs</b>	<b>\$815,021</b>

<b>H Street/Benning Road RapidBus Service - Annual Increase in O&amp;M Costs</b>	
Option	
Frequent RapidBus Alternative	\$1,471,000
Equal Frequency Alternative	\$635,000

<b>H Street/Benning Road RapidBus Service - Vehicle Requirements/Vehicle Hours</b>				
Option	Weekday Peak Vehicle Requirements (RapidBus)	Weekday Peak Vehicle Requirements (X2)	Weekday Revenue Hours (RapidBus)	Weekday Revenue Hours (X2)
Frequent RapidBus Alternative	12	7	144	106
Equal Frequency Alternative	7	9	86	125

Appendix 1-B  
U.S 1 Corridor

<b>U.S. 1 Running Way Improvements Cost Estimates</b>	
<b>Signal Priority</b>	
<i>Intersection Location</i>	<i>Cost</i>
Cherry Lane (both directions)	\$40,000
Odell Road (both directions)	\$40,000
Rhode Island Avenue & Ewing (side street)	\$40,000
U.S. 1 and Cherry Hill Road (side street)	\$40,000
U.S. 1 and Greenbelt Road (side street)	\$40,000
U.S. 1 and Paint Branch-Campus Drive (side street)	\$40,000
Rhode Island Avenue & 34th Street (side street)	\$40,000
Rhode Island Avenue & Franklin Street (side street)	\$40,000
Rhode Island Avenue & 12th Street (side street)	\$40,000
Rhode Island Avenue & 38th Street (mainline)	\$40,000
Rhode Island Avenue & Eastern (mainline)	\$40,000
Rhode Island Avenue & South Dakota (mainline)	\$40,000
Rhode Island Avenue & 24th Street (mainline)	\$40,000
Rhode Island Avenue & 14th Street (mainline)	\$40,000
<b>Total Signal Priority</b>	<b>\$560,000</b>

<b>Bus Bypass/Queue Jump/Exclusive Lane</b>	
<i>Location</i>	<i>Cost</i>
U.S. 1 and Contee Road (northbound)	\$75,000
U.S. 1 and Muirkirk Meadows Road (southbound)	\$75,000
U.S. 1 and Ritz Way (southbound bypass lane)	\$5,000
U.S. 1 and Cherry Hill Road (southbound)	\$75,000
U.S. 1 and Sellman Road (northbound bypass lane)	\$5,000
U.S. 1 and Sunnyside Avenue (southbound)	\$290,000
U.S. 1 and Greenbelt Road (northbound)	\$75,000
U.S. 1 and WB I-495 off-ramp (southbound bypass lane)	\$5,000
U.S. 1 and EB I-495 off-ramp (northbound)	\$75,000
U.S. 1 and Paint Branch/Campus Drive (both directions)	\$150,000
U.S. 1 and MD 410 (both directions)	\$150,000
U.S. 1 and 41st Place (southbound bypass lane)	\$5,000
Rhode Island Avenue and Eastern Avenue (southbound bypass lane)	\$5,000
<b>Total Bus Bypass/Queue Jump/Exclusive Lane</b>	<b>\$990,000</b>
<b>Total U.S. 1 Running Way/Signal Priority Improvements</b>	<b>\$1,550,000</b>

<b>U.S. 1 Passenger Facility Cost Estimates</b>	
Major Stop Passenger Facility Program	
Facility Element	
Shelter	\$5,000
Shelter Bench	\$600
Information Sign	\$700
Outside Bench	\$1,000
Pedestrian Level Lighting	\$1,575
Trash Receptacle	\$350
Next Bus Arrival Display	\$1,500
Enhanced Crosswalks	\$3,859
Total Per Stop	\$14,584
Number of Stops in Corridor	2
<b>Total Major Stop Facility Cost</b>	<b>\$29,168</b>
Minor Stop Improvements (cost per stop)	\$1,500
Number of Minor Stops in Corridor	19
<b>Total Minor Stop Facility Cost</b>	<b>\$28,500</b>
<b>Total Route 1 Passenger Facility Costs</b>	<b>\$57,668</b>
<b>Total U.S. 1 Capital Costs</b>	<b>\$1,607,668</b>

### U.S. 1 Service Alternatives – Incremental O&M Cost Changes

<b>Alternative</b>	<b>Route</b>	<b>Change</b>	<b>Impact</b>
Equivalent	83	Alter alignment and add evening service	+\$400,000
	86	Eliminate weekday service (regional service)	-\$1,620,000
	89,89M	Eliminate (non-regional service)	-\$560,000
	US1	New route (using regional rate)	+\$1,625,000
	Shuttle	New route (using generic non-regional rate)	+\$355,000
			<b>NET CHANGE</b>
			<b>+\$200,000</b>
Compliant	83	Alter alignment and add evening service	+\$400,000
	86	Eliminate all service (regional service)	-\$1,935,000
	89,89M	Eliminate (non-regional service)	-\$560,000
	US1	New route (using regional rate)	+\$2,100,000
	Shuttle	New route (using generic non-regional rate)	+\$400,000
			<b>NET CHANGE</b>
			<b>+\$405,000</b>
Improved	83	Alter alignment and add evening service	+\$400,000
	86	Eliminate all service (regional service)	-\$1,935,000
	89,89M	Eliminate (non-regional service)	-\$560,000
	US1	New route (using regional rate)	+\$4,000,000
	Shuttle	New route (using generic non-regional rate)	+\$400,000
			<b>NET CHANGE</b>
			<b>+\$2,305,000</b>
Laurel Rest.	87	Eliminate all service (non-regional service)	-\$561,000
	88	Eliminate all service (non-regional service)	-\$187,000
	89,89M	Eliminate (non-regional service)	-\$560,000
	87/89	New route (using WMATA non-regional rate)	+\$1,850,000
			<b>NET CHANGE</b>
			<b>+\$542,000</b>

### Route 1 Service Alternatives – Peak Vehicle Requirements

<b>Route</b>	<b>Existing</b>	<b>Equivalent</b>	<b>Compliant</b>	<b>Improved</b>	<b>Laurel Rest.</b>
83	8	9	9	9	8
86	5	n/a	n/a	n/a	5
87	4	4	4	4	n/a
88	2	2	2	2	n/a
89	2	n/a	n/a	n/a	n/a
US1	n/a	6	6	9	n/a
Shuttle	n/a	2	2	2	n/a
87/89	n/a	n/a	n/a	n/a	8
<b>Total</b>	<b>21</b>	<b>23</b>	<b>23</b>	<b>26</b>	<b>21</b>

Appendix 1-C  
Annapolis Road

<b>Annapolis Road Road Running Way Improvements</b>	
<b>Cost Estimates</b>	
<b>Signal Priority</b>	
<i>Intersection Location</i>	<i>Cost</i>
Annapolis Road and Harkins Road	\$40,000
Annapolis Road and Cooper Lane	\$40,000
Annapolis Road and 56th Avenue	\$40,000
Rhode Island Avenue/38th Avenue	\$40,000
Rhode Island Avenue/Eastern Avenue	\$40,000
Rhode Island Avenue/South Dakota Avenue	\$40,000
Rhode Island Avenue/24th Street	\$40,000
Rhode Island Avenue/14th Street	\$40,000
<b>Total Signal Priority</b>	<b>\$320,000</b>
<b>Bus Bypass/Queue Jump/Exclusive Lane</b>	
<i>Location</i>	<i>Cost</i>
Annapolis Road at Edmonton Avenue	\$250,000
Annapolis Road at Kenilworth Avenue	\$250,000
Rhode Island Avenue & Eastern (southbound bus bypass)	\$5,000
<b>Total Bus Bypass/Queue Jump/Exclusive Lane</b>	<b>\$505,000</b>
<b>Total Annapolis Road Running Way Improvements</b>	<b>\$825,000</b>

<b>Annapolis Road Passenger Facility Cost Estimates</b>	
BRT Stop Passenger Facility Program	
Facility Element	
Shelter	\$5,000
Shelter Bench	\$600
Information Sign	\$700
Outside Bench	\$1,000
Pedestrian Level Lighting	\$1,575
Trash Receptacle	\$350
Next Bus Arrival Display	\$1,500
Enhanced Crosswalks	\$3,859
Total Per Stop	\$14,584
Number of Stops in Corridor	22
<b>Total Passenger Facility Cost</b>	<b>\$320,852</b>
<b>Total Annapolis Road Capital Costs</b>	<b>\$1,145,852</b>

<b>Annapolis Road RapidBus Service - Annual Increase in O&amp;M Costs</b>	
Annapolis Road RapidBus Service	\$2,784,000

**Appendix 1-D**  
**Metro Support Routes Capital Costs**  
**Stringfellow Road**  
**(Poplar Tree and Stringfellow P&R)**

<b>Stringfellow Road - Signal Priority</b>	
<i>Intersection Location</i>	<i>Cost</i>
I-66 HOV Lane Access (southbound)	\$20,000
Stringfellow Road P&R Access (northbound)	\$20,000
Fair Lakes Boulevard (southbound)	\$20,000
Fair Lakes Parkway (northbound)	\$20,000
Poplar Tree Park and Ride	\$150,000
<b>Total Signal Priority</b>	<b>\$230,000</b>
<b>Bus Bypass/Queue Jump/Exclusive Lane</b>	
<i>Location</i>	<i>Cost</i>
Stringfellow Road P&R Access (southbound queue jump)	\$20,000
Fair Lakes Blvd (northbound queue jump)	\$20,000
Fair Lakes Parkway (queue jump - both directions)	\$75,000
<b>Total Bus Bypass/Queue Jump/Exclusive Lane</b>	<b>\$115,000</b>
<b>Total Stringfellow Road Running Way Improvements</b>	<b>\$345,000</b>

<b>Poplar Tree Park and Ride Lot - Passenger Facility Improvements</b>	
Bus Bays	\$34,500
Waiting Area	\$30,250
Utilities	\$171,120
Bus Roadway	\$237,600
Parking	\$660,000
Shelters	\$10,000
Shelter Bench	\$1,200
Information Sign	\$1,400
Outside Bench	\$2,000
Pedestrian Level Lighting	\$3,150
Trash Receptacle	\$700
Next Bus Arrival Display	\$3,000
Service Name	
Pylon	\$2,000
<b>Total Poplar Tree Passenger Facility Costs</b>	<b>\$1,156,920</b>

<b>Stringfellow Road Park and Ride Lot - Passenger Facility Improvements</b>	
Shelters	\$5,000
Shelter Bench	\$600
Information Signs	\$2,100
Outside Bench	\$1,000
Pedestrian Level Lighting	\$1,575
Trash Receptacle	\$350
Next Bus Arrival Display	\$1,500
Service Name	
Pylon	\$1,000
<b>Total Stringfellow Road Passenger Facility Costs</b>	<b>\$13,125</b>
<b>Total Stringfellow Road Passenger Facility Improvements</b>	<b>\$1,170,045</b>
<b>Total Stringfellow Road Capital Costs</b>	<b>\$1,475,045</b>

Appendix 1-D  
 Metro Support Routes Capital Costs  
 Fairfax County Government Center

<b>Fairfax Government Center - Signal Priority</b>	
<i>Intersection Location</i>	<i>Cost</i>
I-66 HOV Lane Access/Monument Drive (northbound)	\$30,000
Government Center Pkwy/Monument Drive (southbound)	\$30,000
Government Center Pkwy/Post Forest (southbound)	\$30,000
Bus Only Left Turn Lane	\$35,000
<b>Total Signal Priority</b>	<b>\$125,000</b>
<b>Total Fairfax Government Center Running Way Improvements</b>	<b>\$125,000</b>
<b>Fairfax Government Center Park and Ride - Passenger Facility Improvements</b>	
Shelters	\$10,000
Shelter Bench	\$1,200
Information Signs	\$2,800
Outside Bench	\$2,000
Pedestrian Level Lighting	\$3,150
Trash Receptacle	\$700
Next Bus Arrival Display	\$3,000
Service Name	
Pylon	\$2,000
Landscaping	\$10,000
<b>Total Govt Center Passenger Facility Costs</b>	<b>\$34,850</b>
<b>Total Fairfax County Government Center Capital Costs</b>	<b>\$159,850</b>

Appendix 1-E  
Metro Support Routes Capital Costs  
West Falls Church

<b>West Falls Church - Signal Priority</b>	
<i>Intersection Location</i>	<i>Cost</i>
Leesburg Pike/I-66 EB Off-Ramp	\$30,000
Haycock/Leesburg Pike	\$30,000
Haycock to Station Access Road	\$30,000
<b>Total Signal Priority</b>	<b>\$90,000</b>
<b>Bus Bypass/Queue Jump/Exclusive Lane</b>	
<i>Location</i>	
Leesburg Pike Bus Lane	\$75,000
<b>Total Bus Bypass/Queue Jump/Exclusive Lane</b>	<b>\$75,000</b>
<b>Total West Falls Church Running Way Improvements</b>	<b>\$165,000</b>

<b>West Falls Church - Passenger Facility Improvements</b>	
Shelters	\$5,000
Shelter Bench	\$600
Information Signs	\$2,800
Outside Bench	\$1,000
Pedestrian Level Lighting	\$1,575
Trash Receptacle	\$350
Next Bus Arrival Display	\$1,500
Service Name	
Pylon	\$1,000
<b>Total WFC Passenger Facility Costs</b>	<b>\$13,825</b>
<b>Total West Falls Church Capital Costs</b>	<b>\$178,825</b>

Appendix 1-F  
 Metro Support Routes Capital Costs  
 Herndon-Monroe

<b>Herndon-Monroe - Signal Priority</b>	
<i>Intersection Location</i>	<i>Cost</i>
WB Toll Road Off-Ramp (southbound)	\$30,000
EB Toll Road Off-Ramp (southbound)	\$30,000
<b>Total Signal Priority</b>	<b>\$60,000</b>
<b>Bus Bypass/Queue Jump/Exclusive Lane</b>	
<i>Location</i>	
Fairfax County Parkway Shoulder Bus Lane	\$75,000
<b>Total Bus Bypass/Queue Jump/Exclusive Lane</b>	<b>\$75,000</b>
<b>Total Herndon-Monroe Running Way Improvements</b>	<b>\$135,000</b>

<b>Herndon-Monroe - Passenger Facility Improvements</b>	
Shelters	\$5,000
Shelter Bench	\$600
Information Signs	\$2,100
Outside Bench	\$1,000
Pedestrian Level	
Lighting	\$1,575
Trash Receptacle	\$350
Next Bus Arrival Display	\$1,500
Service Name Pylon	\$1,000
<b>Herndon-Monroe Passenger Facility Costs</b>	<b>\$13,125</b>
<b>Total Herndon-Monroe Capital Costs</b>	<b>\$148,125</b>

Appendix 1-G  
 Metro Support Routes Capital Costs  
 Pentagon City/Crystal City

<b>Pentagon City/Crystal City - Signal Priority</b>	
<i>Intersection Location</i>	<i>Cost</i>
Army-Navy and Eads (westbound)	\$30,000
Army-Navy and Fern(westbound)	\$30,000
Army-Navy and Hayes (westbound)	\$30,000
Hayes Street and 12th Street (southbound)	\$30,000
18th Street and Fern (eastbound)	\$30,000
18th Street and Eads (eastbound)	\$30,000
<b>Total Signal Priority</b>	<b>\$180,000</b>
<b>Bus Bypass/Queue Jump/Exclusive Lane</b>	
<i>Location</i>	
Hayes Street and 15th Street (Queue Jump)	\$30,000
18th and Metro Station (curb extension)	\$20,000
<b>Total Bus Bypass/Queue Jump/Exclusive Lane</b>	<b>\$50,000</b>
<b>Total Pentagon/Crystal City Running Way Improvements</b>	<b>\$230,000</b>

**Appendix 1-H**  
**Metro Support Vehicle Costs and O&M Costs**

**Metro Support Peak Vehicle Requirements**

<b>Route</b>	<b>Peak Vehicles</b>	<b>Fleet</b>
Herndon-Monroe	14	16
West Falls Church	11	13
Fairfax GC to Downtown	11	13
Fairfax GC to Crystal City	8	9
Stringfellow Road	12	14
Poplar Tree	12	14
Total	68	79
Per Vehicle Cost		\$375,000
Total Vehicle Costs		\$29.63 million

**Metro Support Daily and Annual O&M Costs**

<b>Metro Support Services</b>	
Cost Per Platform Hour	\$70.92
Daily Platform Hours	400
Daily Operating Cost	\$28,300
Annual Operating Cost	\$7,085,000

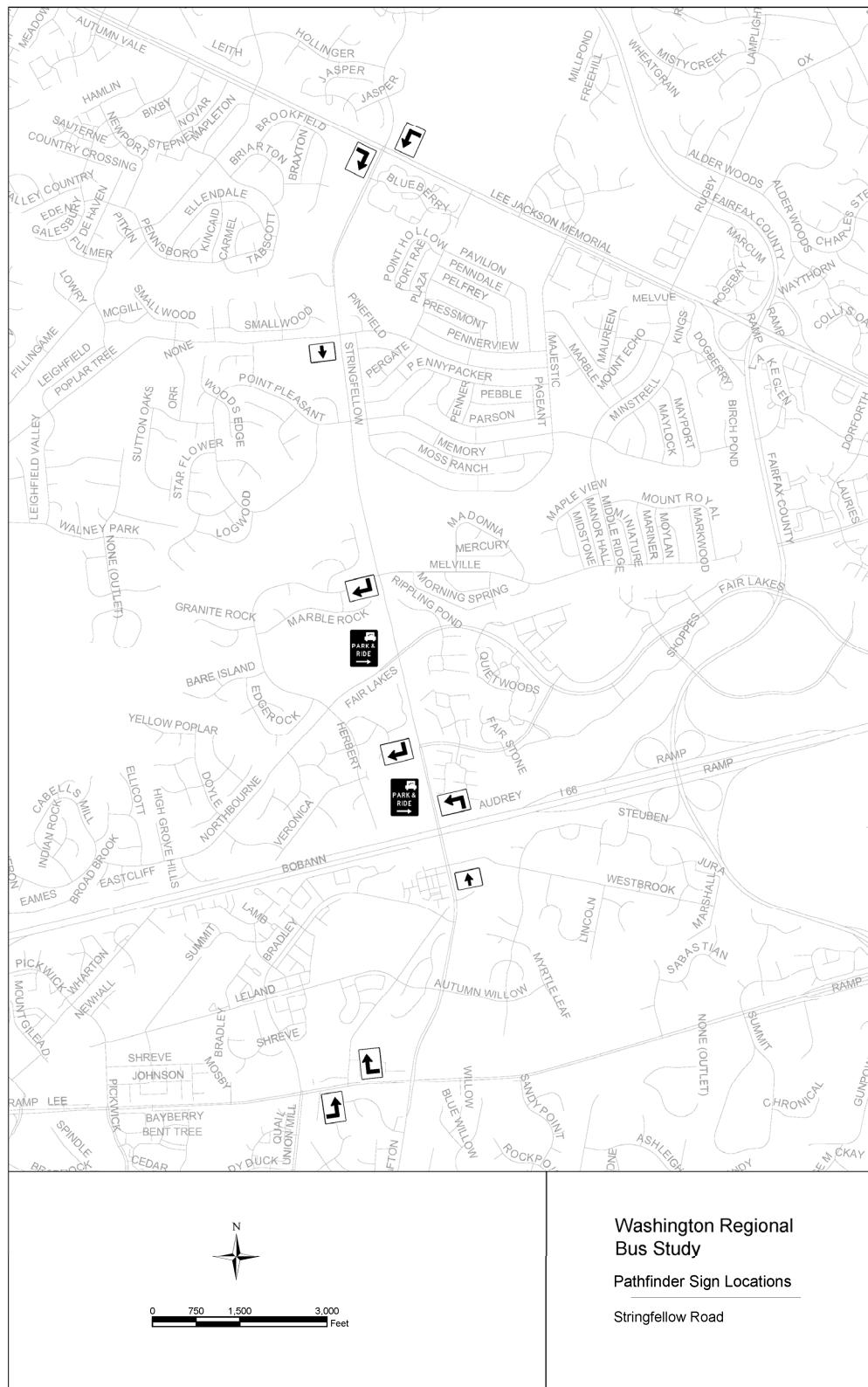
Metro Support Daily and Annual O&M Costs – by Route

<b>Route</b>	<b>Weekday Platform Hours</b>	<b>Weekday Cost</b>	<b>Annual Cost</b>
Fairfax Gov't Center to DT	66	\$4,680	\$1,117,000
Stringfellow Road to DT	69	\$4,890	\$1,220,000
Poplar Tree P&R to DT	69	\$4,890	\$1,220,000
Herndon-Monroe to DT	82	\$5,800	\$1,450,000
West Falls Church to DT	66	\$4,680	\$1,170,000
Fairfax Gov't Center to Crystal City	48	\$3,400	\$850,000

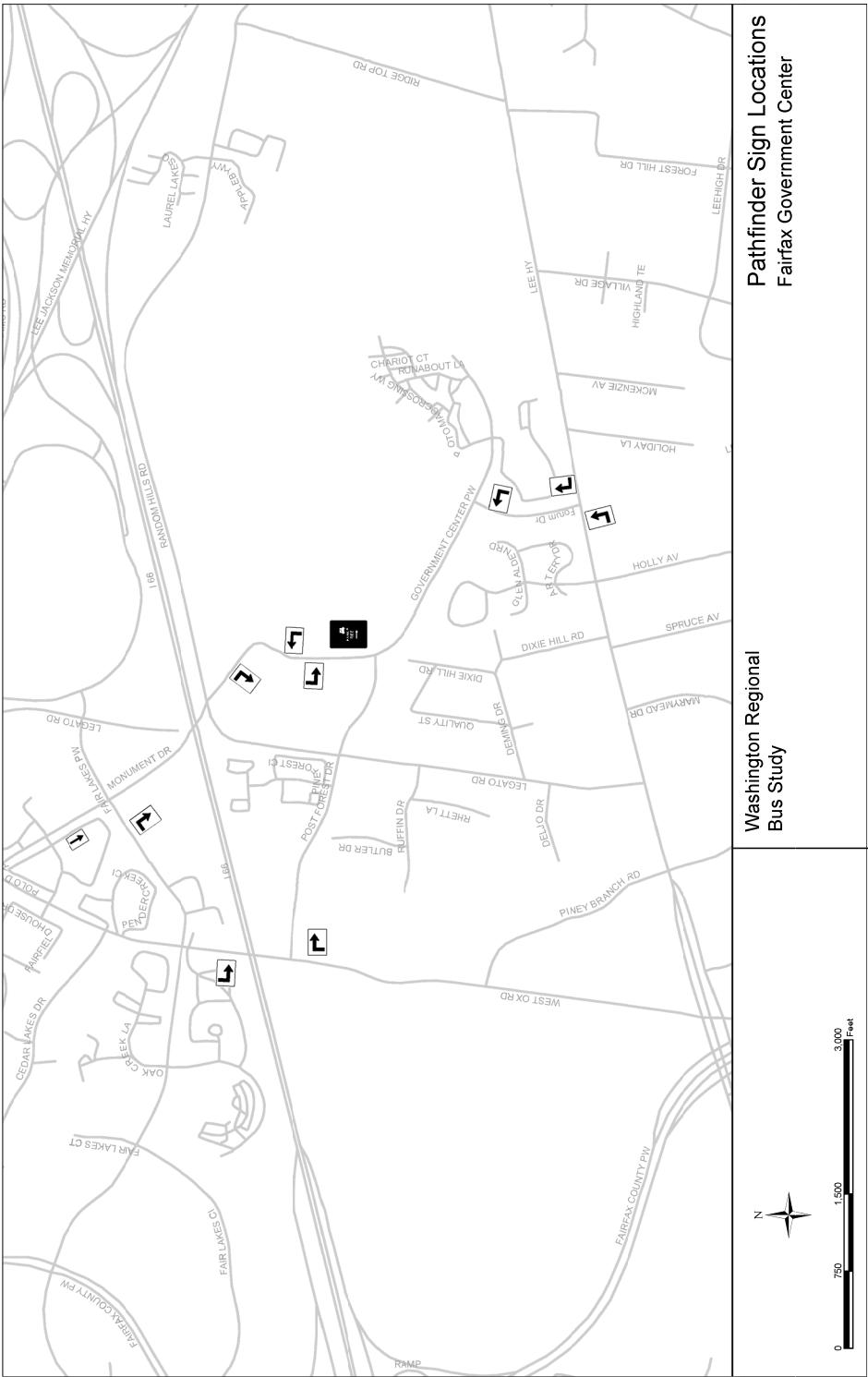
# Appendix 2

## Pathfinder Maps

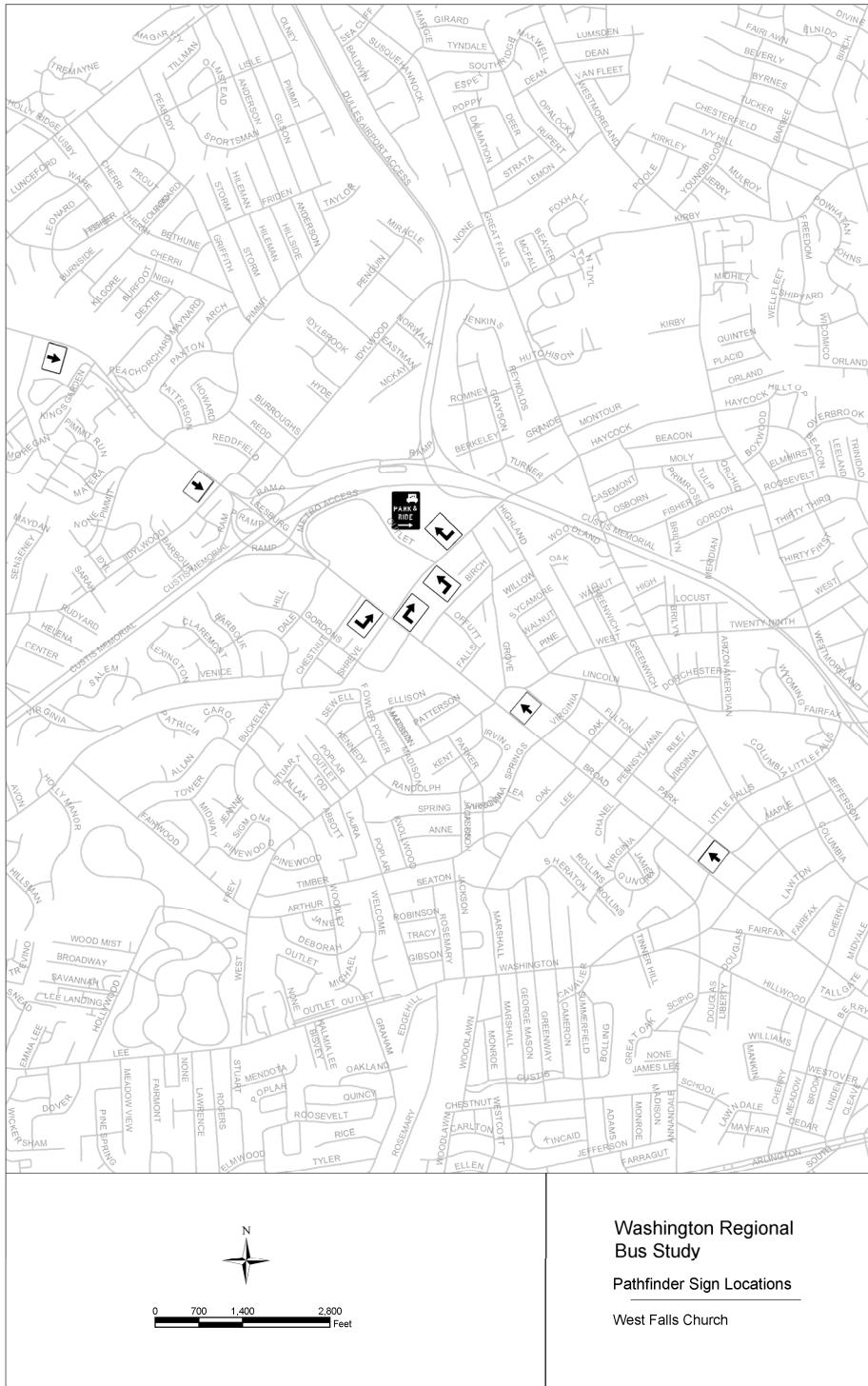
# Stringfellow Road



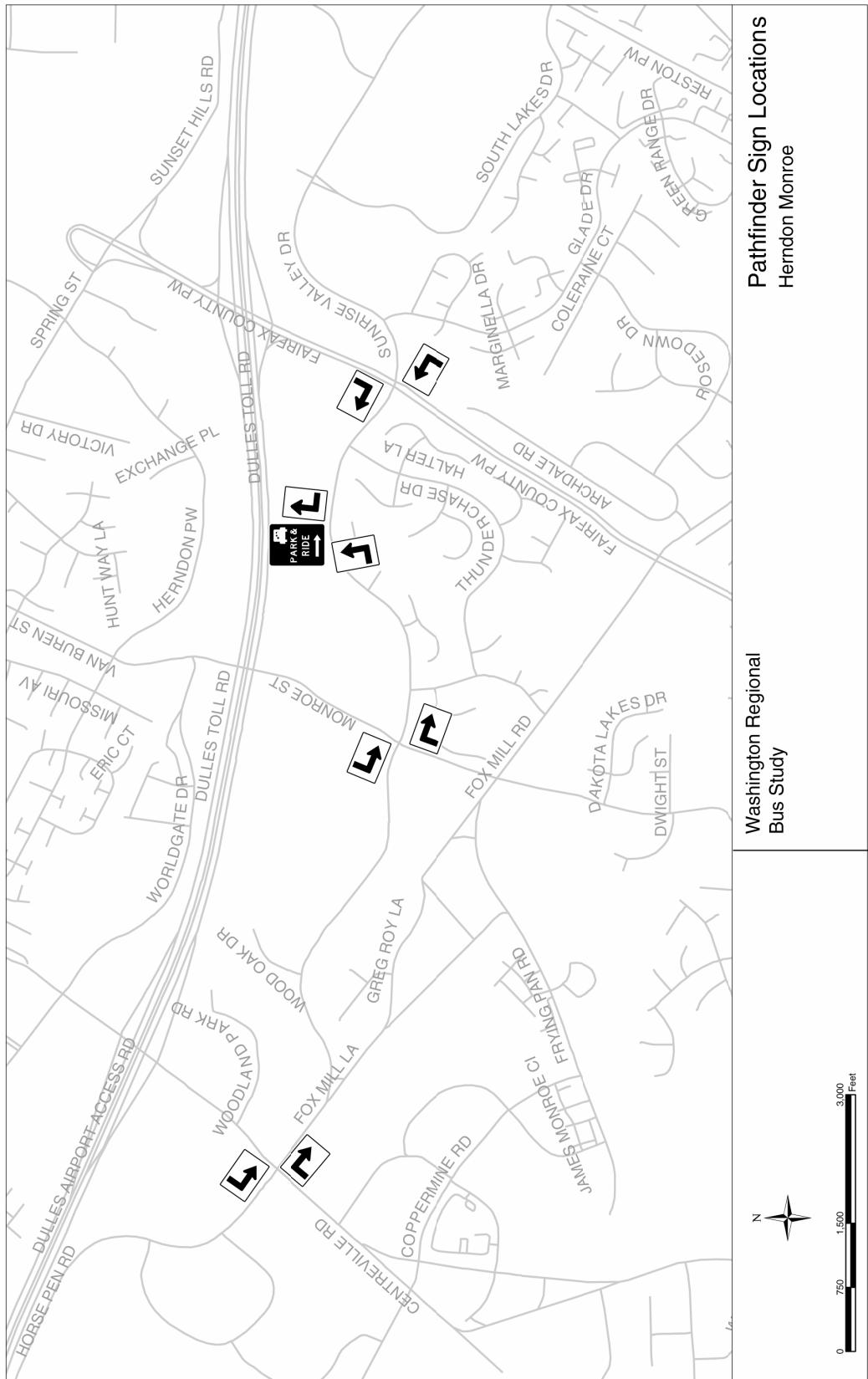
## Fairfax Government Center



## West Falls Church



## Herndon-Monroe

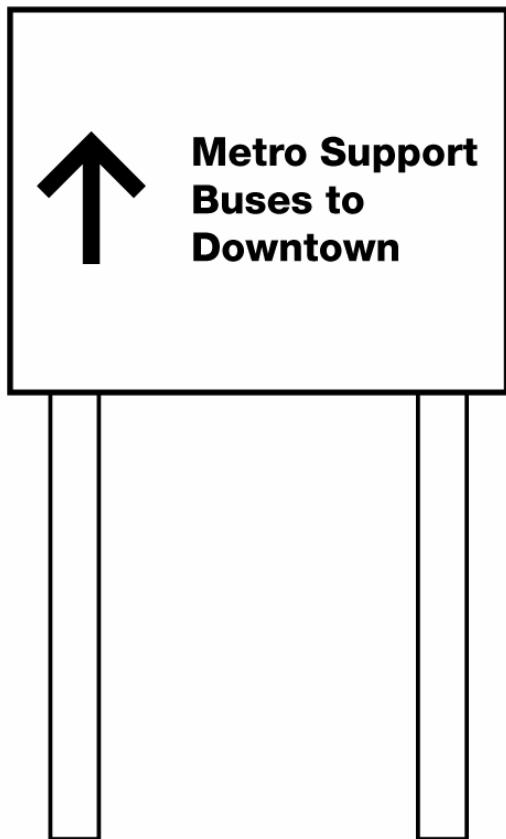


# Appendix 3

## Typical Information Signs

## Parking Lot Direction Signs

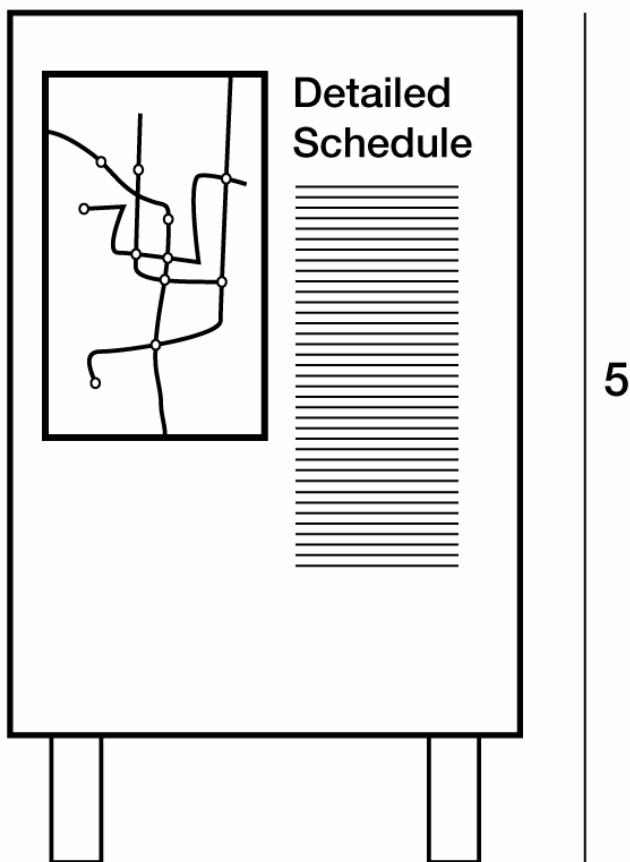
3'



5'

## Bus Stop Detailed Information Sign

3'



# Appendix 4

## Running Way and Signal Improvement Descriptions

## Detailed Description of Running Way Improvements

1. **Transit Signal Priority** – Transit signal priority (TSP) is the process of altering signal timing to give a priority or advantage to transit operations. Signal *priority modifies* the normal signal operation to benefit transit within the coordinated operation of the signal system along a corridor, while signal *preemption interrupts* the normal signal operation to accommodate a special traffic event such as the passing of an emergency vehicle through an intersection.

TSP systems can either be manually implemented by the bus operator or automatically implemented using on-vehicle technology. On-vehicle technology is typically the preferred method for priority because it removes the need for the driver to remember to activate the emitter. In many cases, the automated TSP will only emit a signal for priority if the bus is behind schedule.

As noted, the TSP is not a pre-emption of the traffic signal, but rather a slight alteration of the traffic signal timing intended to be hardly noticeable to the rest of the transportation system. Signal timing alteration can occur in one of two different forms:

Green Extension – occurs if the bus arrives at the intersection while the traffic signal is green on its approach. The green time is then extended in order for the bus to progress through the intersection without having to stop and wait for the next green phase of the cycle.

Red Truncation – occurs if the bus arrives while the traffic signal is red on the bus' approach. The green time on the other phases at the intersection are reduced in order to return the traffic signal to green on the bus' approach and thus shorten or truncate the amount red time/delay the bus experiences at the intersection.

2. **Bus Lanes** – Arterial street bus lanes provide partially segregated rights-of-way for buses. Because these facilities have interrupted flow due to intersections with other streets, they provide a lower level of priority to transit than facilities on exclusive rights-of-way. Nevertheless they offer transit significant advantages over mixed traffic operations by lowering the delays that otherwise reduce bus speed and reliability. Bus lanes can be created along an arterial in a number of ways, including:
  - Re-designating an existing travel lane as a bus lane
  - Narrowing existing lanes to provide an additional lane
  - Widening the street to add a new lane, and
  - Restricting on-street parking (part or full-time) to provide a bus lane.

Where there is a high volume of buses on a roadway, coupled with significant bus and automobile congestion, exclusive bus lanes can provide more attractive and reliable bus service.

3. **Queue Bypass Lanes** – Queue bypass lanes allow buses to avoid long queues of vehicles at signalized intersections by using a bus-only lane or allowing through buses to use right-turn only lanes to enable them to travel through congested intersections with reduced delay. A queue bypass treatment is only feasible if there is a receiving lane on the far side of the intersection for the bus to continue traveling in and merge back into traffic. In addition, in order to fully utilize a queue bypass lane, the lane should extend beyond the point at which most traffic queues occur in the adjacent through lanes.
4. **Queue Jump Operations** – A queue jump operations treatment is similar to the queue bypass treatment except that it also incorporates a signal timing alteration element similar to TSP. Unlike TSP, however, where notable green time is taken from the non-bus approaches to the intersection, in this instance the green time on other approaches in the intersections is hardly changed. Instead, a few seconds of early green are given to the bus on a separate, clearly marked bus only signal head so that the bus can progress through the intersection and merge back into the through lanes on the far side of the intersection, ahead of the other vehicles queued on the bus' approach. The queue jump treatment is especially useful if a near side bus stop is feasible, and there is no receiving lane on the far side of the intersection.
5. **Curb Extensions** – Curb extensions, also known as bus bulbs, are a section of the sidewalk that extends from the curb of a parking lane to the edge of a through lane. The advantage of a bus bulb is that buses can stop at bus stops in the traffic lane rather than at a curb side stop. This means that buses are not forced to weave in and out of the travel lane in order to pick up passengers, thus reducing bus delays and travel time. In addition, bus bulbs can reduce congestion at heavily used bus stops, thus facilitating quicker boardings.
6. **Parking Restriction** – Parking restrictions will be part of the implementation of many of the transit preferential treatments described above. In some instances, parking restrictions may allow re-striping to provide a right-turn only lane that can also be used by buses as a queue jump lane. Part-time parking restrictions can also be used to provide part-time exclusive bus lanes.

# **Appendix 5**

## **Preliminary Recommendation Evaluation Results**

## Service Recommendations Evaluation

	Wkdy O&M Total Cost	Wkdy O&M Change in Cost	Annual O&M Change in Cost (million)	Vehicle Capital Cost	Wkdy Change in	Annual Change in	Wkdy Boardings Diverted from	Operating Cost Per New Boarding	Boarding/Revenue Veh. Hour	Uses Running Way and Facilities
Recommendation	Wkdy O&M Total Cost	Wkdy O&M Change in Cost	Annual O&M Change in Cost (million)	Vehicle Capital Cost	Wkdy Change in	Annual Change in	Wkdy Boardings Diverted from	Operating Cost Per New Boarding	Boarding/Revenue Veh. Hour	Uses Running Way and Facilities
<b>Metro Support</b>										
Poplar Tree P&R	\$4,890	\$4,890	\$1,222,500	\$1,222,500	12	\$5,160,000	1,540	300	385,000	75,000
Stringfellow Road P&R	\$4,890	\$4,890	\$1,222,500	\$1,222,500	12	\$5,160,000	1,540	300	385,000	75,000
Fairfax Gov't Center (DT)	\$4,680	\$4,680	\$1,170,000	\$1,170,000	11	\$4,730,000	1,540	300	385,000	75,000
Fairfax Gov't Center (CC/PC)	\$3,400	\$3,400	\$850,000	\$850,000	8	\$3,440,000	1,540	300	385,000	75,000
Hemdon-Monroe	\$5,800	\$5,800	\$1,450,000	\$1,450,000	14	\$6,020,000	1,540	300	385,000	75,000
West Falls Church	\$4,680	\$4,680	\$1,170,000	\$1,170,000	11	\$4,730,000	1,540	300	385,000	75,000
<b>U.S. 1</b>										
Single Route - Equivalent Service	\$16,320	\$6667	\$4,896,000	\$200,000	2	\$600,000	6,427	75	1,928,100	22,500
Single Route - Compliant Service	\$16,420	\$1,350	\$4,926,000	\$405,000	2	\$600,000	6,497	145	1,949,100	43,500
Single Route - Improved Service	\$22,320	\$7,683	\$6,696,000	\$2,305,000	5	\$1,500,000	7,237	885	2,171,100	265,500
Greenbelt/College Park Restructuring	\$17,020	\$1,807	\$5,106,000	\$542,000	0	\$0	6,577	225	1,973,100	67,500
H Street Benning Road (A)	\$22,688	\$4,597	\$7,260,000	\$1,471,000	3	\$900,000	10,000	1,700	3,200,000	544,000
H Street Benning Road (B)	\$20,063	\$1,984	\$6,420,000	\$635,000	0	\$0,00	7,600	1,300	2,432,000	416,000
Annapolis Road	\$9,281	\$9,281	\$2,784,400	\$2,784,400	9	\$2,700,000	2,400	600	720,000	180,000

## Running Way and Signal Priority Evaluation

Recommendation	Total Capital Cost	Traffic Impacts	Number of Daily Riders Impacted	Total Capital Cost per Daily Rider Impacted	Total Daily Travel Time Savings (Hours)	Total Capital Cost/Annual Hours of Travel Time Saved	Ease of Implementation	Supports Service Recommend.
<b>H Street - Signal Priority</b>								
4th Street/H Street/Massachusetts Avenue	\$60,000	Moderate	3,806	\$15.76	6.34	\$37.83	1	Y
North Capitol Street/H Street	\$40,000	Low	4,204	\$9.51	11.68	\$13.70	1	Y
5th Street NE/H Street	\$40,000	Low	4,610	\$8.68	12.81	\$12.49	1	Y
8th Street NE/H Street	\$40,000	Moderate	5,152	\$7.76	14.31	\$11.18	2	Y
17th Street/Benning Road	\$40,000	Moderate	4,120	\$9.71	11.44	\$13.98	2	Y
Minnesota Avenue/Benning Left Turn	\$20,000	Moderate	3,744	\$5.34	12.48	\$6.41	2	Y
<b>H Street Bus Bypass/Queue Jump/Exclusive Lane</b>								
14th Street to 17 <sup>th</sup>	\$75,000	Low	4,697	\$15.97	49.58	\$6.05	3	Y
17th Street to Anacostia Avenue	\$75,000	High	3,744	\$20.03	75.92	\$3.95	2	Y
Anacostia Avenue to Minnesota Avenue	\$75,000	High	3,744	\$20.03	18.72	\$16.03	2	Y

Scale for Measuring Ease of Implementation

1 = Easy Implementation

2 = Moderately Difficult

3 = Difficult

Recommendation	Total Capital Cost	Traffic Impacts	Number of Daily Riders Impacted	Total Capital Cost per Daily Rider Impacted	Total Daily Travel Time Savings (Hours)	Total Capital Cost/Annual Hours of Travel Time Saved	Ease of Implementation	Supports Service Recommend.
<b>U.S. 1 - Signal Priority</b>								
U.S. 1 and Cherry Lane	\$40,000	Low	180	\$222.22	0.40	\$400.00	2	N
U.S. 1 and Odell Road	\$40,000	Low	600	\$66.67	1.33	\$120.00	2	N
U.S. 1/Rhode Island Avenue/Ewing	\$40,000	Low	480	\$83.33	1.07	\$150.00	2	N
U.S. 1 and Cherry Hill Road	\$40,000	Low	500	\$80.00	1.11	\$144.00	2	N
U.S. 1 and Greenbelt Road	\$40,000	Low/Med.	80	\$500.00	0.18	\$900.00	2	N
U.S. 1 and Paint Branch/Campus Drive	\$40,000	Medium	3,500	\$11.43	7.78	\$20.57	2	N
Rhode Island & 34th Street	\$40,000	Low	500	\$80.00	1.11	\$144.00	1	N
Rhode Island & Franklin Street	\$40,000	Low	1,250	\$32.00	2.78	\$57.60	1	N
Rhode Island and 12th Street	\$40,000	Low	400	\$100.00	0.89	\$180.00	1	N
Rhodel Island and 38 <sup>th</sup> Street	\$40,000	Low	800	\$50.00	1.78	\$90.00	1	Y
Rhode Island and Eastern	\$40,000	Low	800	\$50.00	1.78	\$90.00	1	Y
Rhode Island and South Dakota	\$40,000	Low	850	\$47.06	1.89	\$84.71	1	Y
Rhode Island and 24th	\$40,000	Low	900	\$44.44	2.00	\$80.00	1	Y
Rhode Island and 14th	\$40,000	Low	950	\$42.11	2.11	\$75.79	1	Y

**Scale for Measuring Ease of Implementation**

1 = Easy Implementation

2 = Moderately Difficult

3 = Difficult

U.S. 1 - Bus Bypass/Queue Jump/Exclusive Lane						
U.S. 1 and Contee Road	\$75,000	Low/Med	225	\$333.33	0.75	2
U.S. 1 and Muirkirk Meadows Road	\$75,000	Low	240	\$312.50	0.80	2
U.S. 1 and Ritz Way	\$5,000	Low	240	\$20.83	0.80	2
U.S. 1 and Cherry Hill Road	\$75,000	Low	320	\$234.38	1.07	3
U.S. 1 and Sellman Road	\$5,000	Low	320	\$15.63	1.07	2
U.S. 1 and Sunnyside Avenue	\$290,000	Low/Med	310	\$935.48	2.41	3
U.S. 1 and Greenbelt Road	\$75,000	Low/Med	740	\$101.35	2.47	3
U.S. 1 and WB I-495 off-ramp	\$5,000	Low	240	\$20.83	0.80	2
U.S. 1 and EB I-495 off-ramp	\$75,000	Medium	320	\$234.38	1.07	2
U.S 1 and Paint Branch/Campus Drive	\$150,000	Medium	1000	\$150.00	3.33	3
U.S. 1 and MD 410	\$150,000	Low	1100	\$136.36	3.67	2
U.S. 1 and 41st Place	\$5,000	Low	480	\$104.42	1.60	2
Rhode Island Avenue and Eastern Avenue	\$5,000	Low	700	\$7.14	2.33	2

## Scale for Measuring Ease of Implementation

- 1 = Easy Implementation  
2 = Moderately Difficult  
3 = Difficult

Recommendation	Total Capital Cost	Traffic Impacts	Number of Daily Riders Impacted	Total Capital Cost per Daily Rider Impacted	Total Daily Travel Time Savings (Hours)	Total Capital Cost/Annual Hours of Travel Time Saved	Ease of Implementation	Supports Service Recommendation
<b>Annapolis Road - Signal Priority</b>								
Annapolis Road and Harlins Road	\$40,000	Low	714	\$56.02	1.19	\$115.91	2	Y
Annapolis Road and Cooper Lane	\$40,000	Low	806	\$49.63	1.34	\$102.68	2	Y
Annapolis Road and 56th Avenue	\$40,000	Low	900	\$44.44	1.50	\$91.95	2	Y
Rhode Island Avenue/38th Avenue	\$40,000	Medium	942	\$42.46	1.57	\$87.85	2	Y
Rhode Island Avenue/Eastern Avenue	\$40,000	Medium	841	\$47.56	1.40	\$98.41	2	2
Rhode Island Avenue/South Dakota Avenue	\$40,000	Medium	843	\$47.45	1.41	\$98.17	2	2
Rhode Island Avenue/24th Street	\$40,000	Medium	843	\$47.45	1.41	\$98.17	2	Y
Rhode Island Avenue/14th Street	\$40,000	Medium	793	\$50.44	1.32	\$104.36	2	Y
<b>Annapolis Road - Queue Jump-Bus Bypass</b>								
Annapolis Road at Edmonton Avenue	\$250,000	Low	912	\$274.12	1.52	\$567.15	2	Y
Annapolis Road at Kenilworth Avenue	\$250,000	Low	912	\$274.12	1.52	\$567.15	2	Y
Rhode Island Avenue at Eastern Avenue	\$5,000	Low	841	\$5.95	1.40	\$12.30	2	Y

**Scale for Measuring Ease of Implementation**

1 = Easy Implementation

2 = Moderately Difficult

3 = Difficult

Recommendation	Total Capital Cost	Traffic Impacts	Number of Daily Trips Impacted	Total Capital Cost per Daily Trip Impacted	Total Daily Travel Time Savings (Hours)	Total Capital Cost/Annual Hours of Travel Time Saved	Ease of Implementation	Supports Service Recommendation
<b>Metro Support - Stringfellow Road - Signal Priority</b>								
I-66 HOV Lane Access	\$20,000	Medium	3,080	\$6.49	17.11	\$4.68	1	Y
Stringfellow Road P&R Access	\$20,000	Low	3,080	\$6.49	17.11	\$4.68	1	Y
Fair Lakes Boulevard	\$20,000	Low	1,540	\$12.99	8.56	\$9.35	1	Y
Fair Lakes Parkway	\$20,000	Low	1,540	\$12.99	8.56	\$9.35	1	Y
Poplar Tree Park and Ride	\$150,000	Medium	1,540	\$97.40	8.56	\$70.13	2	Y
<b>Metro Support - Stringfellow Road - Bus Bypass</b>								
Stringfellow Road P&R Access	\$20,000	Low	770	\$25.97	6.42	\$12.47	2	Y
Fair Lakes Boulevard	\$20,000	Low	770	\$25.97	6.42	\$12.47	2	Y
Fair Lakes Parkway	\$75,000	Low	770	\$97.40	6.42	\$46.75	3	Y
<b>Metro Support - Fairfax Gov. Ctr. - Signal Priority</b>								
I-66 HOV Lane Access/Monument Drive	\$30,000	Low	770	\$38.96	4.28	\$28.05	1	Y
Government Center Pkwy/Monument Drive	\$30,000	Low	770	\$38.96	4.28	\$28.05	1	Y
Government Center Pkwy/Post Forest	\$30,000	Low	770	\$38.96	4.28	\$28.05	1	Y
<b>Metro Support - Fairfax Gov. Ctr. Other Priority</b>								
Bus Only Left Hand Turn Lane	\$35,000	Low	770	\$45.45	3.21	\$43.64	3	Y
<b>Metro Support - West Falls Church - Signal Priority</b>								
Leesburg Pike/I-66 EB Off-Ramp	\$30,000	Medium	770	\$38.96	4.28	\$28.05	2	Y
Haycock/Leesburg Pike	\$30,000	Low	770	\$38.96	4.28	\$28.05	1	Y
Haycock to Station Access Road	\$30,000	Low	770	\$38.96	4.28	\$28.05	1	Y

Recommendation	Total Capital Cost	Traffic Impacts	Number of Daily Riders Impacted	Total Capital Cost per Daily Rider Impacted	Total Travel Time Savings	Cost/Hour of Travel Time Saved	Ease of Implementation	Supports Service Recommend.
<b>Metro Support - West Falls Church - Bus Bypass</b> Leesburg Pike Bus Lane	\$75,000	Medium	770	\$97.40	6.42	\$46.75	2	Y
<b>Metro Support - Herndon Monroe - Signal Priority</b> WB Toll Road Off-Ramp EB Toll Road Off-Ramp	\$30,000 \$30,000	Medium Medium	770 770	\$38.96 \$38.96	4.28 4.28	\$28.05 \$28.05	3 3	Y Y
<b>Metro Support - Herndon Monroe - Bus Bypass</b> Fairfax County Parkway Shoulder Bus Lane	\$75,000	Medium	1,540	\$48.70	12.83	\$23.38	3	Y
<b>Metro Support - Pentagon City/Crystal City Signal</b> Army-Navy and Eads Army-Navy and Fern Army-Navy and Hayes Hayes and 12th Street 18th Street and Fern 18th Street and Eads	\$30,000 \$30,000 \$30,000 \$30,000 \$30,000 \$30,000	Low Low Low Low/Med Low/Med Low/Med	770 770 770 516 516 516	\$38.96 \$38.96 \$38.96 \$58.15 \$58.15 \$58.15	4.28 4.28 4.28 2.87 2.87 2.87	\$28.05 \$28.05 \$28.05 \$41.87 \$41.87 \$41.87	3 3 3 2 2 2	Y Y Y Y Y Y
<b>Metro Support - Pentagon City/Crystal City Bypass</b> Hayes Street and 15th Street 18th Street and Metro Station	\$30,000 \$20,000	Low Low	385 385	\$77.92 \$51.95	3.21 3.21	\$37.40 \$24.94	3 3	Y Y

## Passenger Facility Recommendations Evaluation

Recommendation	Total Capital Cost	Total Daily Usage	Total Annual Usage	Total Capital Cost/ Daily Using Rider	Support Service Recommend.	Ease of Implementation*
Metro Support - Poplar Tree P&R	\$1,156,920	770	192,500	\$1,502.49	Y	2
Metro Support - Stringfellow Road P&R	\$13,125	770	192,500	\$17.05	Y	1
Metro Support - Fairfax Gov't Center	\$34,850	1,540	385,000	\$22.63	Y	1
Metro Support - Herndon-Monroe	\$13,125	770	192,500	\$17.05	Y	1
Metro Support - West Falls Church	\$13,825	770	192,500	\$17.95	Y	1
Route 1 - 4th Street in Laurel	\$14,584	110	33,000	\$132.58	N	2
Route 1 - Campus Drive	\$14,584	150	45,000	\$97.23	N	2
Minor Stops (19)	\$28,500	760	228,000	\$37.50	N	1
H Street Benning Road	\$350,021	16,600	4,993,300	\$21.09	Y	2
Annapolis Road	\$320,852	2,400	696,000	\$133.69	Y	1

\* Scale for Measuring Ease of Implementation

1 = Easy Implementation

2 = Moderately Difficult

3 = Difficult

# Appendix 6

## Capital and Operating Cost by Implementation Time Frame

As noted in Section 6, each of the proposed final recommendations has been assigned an implementation time-frame based on the results of the evaluation analysis described in the previous appendix, the priorities of each of the jurisdictions in which study corridors fall, and an estimate of available resources. The capital and O&M costs associated with the three implementation time frames, short-term, mid-term, long term, and a summary for all three time-frames are outlined below.

<b>Short Term Implementation Time Frame</b>		
Recommendation	Total Capital Cost	Annual O&M Cost
H Street/Benning Road	\$341,672	\$635,000
U.S. 1 Corridor	\$57,668	\$0
Annapolis Road	\$0	\$0
Metro Support	\$5,019,850	\$1,170,000
<b>Total</b>	<b>\$5,419,190</b>	<b>\$1,805,000</b>

<b>Mid-Term Implementation Time Frame</b>		
Recommendation	Total Capital Cost	Annual O&M Cost
H Street/Benning Road	\$473,344	\$0
U.S. 1 Corridor	\$1,270,000	\$542,000
Annapolis Road	\$0	\$0
Metro Support	\$5,838,125	\$1,220,000
<b>Total</b>	<b>\$7,581,469</b>	<b>\$1,762,000</b>

<b>Long Term Implementation Time Frame</b>		
Recommendation	Total Capital Cost	Annual O&M Cost
H Street/Benning Road	\$0	\$0
U.S. 1 Corridor	\$280,000	\$0
Annapolis Road	\$3,915,852	\$2,784,413
Metro Support	\$22,434,870	\$4,690,000
<b>Total</b>	<b>\$26,630,722</b>	<b>\$7,474,413</b>

Recommendations - Short Term Implementation Time Frame		
	Total Capital Cost	Annual O&M Cost Increase
<b>H Street/Benning Road</b>		
Bus Bypass/Exclusive Lane 14th Street/H Street/Benning Road (westbound) 17th Street to Anacostia Avenue (both directions) Anacostia Avenue to Minnesota Avenue	\$75,000 \$75,000 \$75,000	
Equal Frequency RapidBus Overlay	\$0	\$635,000
Passenger Facility Improvements (Benning Road Segment)	\$116,672	
<b>Total H Street Benning Road</b>	<b>\$341,672</b>	<b>\$635,000</b>
<b>U.S. 1</b>		
Passenger Facility Improvements (two major stops) Passenger Facility Improvements (local stops)	\$29,168 \$28,500	
<b>Total U.S. 1</b>	<b>\$57,668</b>	<b>\$0</b>
<b>Metro Support</b>		
Fairfax Government Center Bus Only Left Hand Turn Lane	\$35,000	
Herndon-Monroe - Exclusive Bus Lane Fairfax Cty Parkway - Shoulder Lane	\$75,000	
Peak Period Service to Downtown (Gov't Center)	\$4,875,000	\$1,170,000
Passenger Facility Improvements (Gov't Center)	\$34,850	
<b>Total Metro Support</b>	<b>\$5,019,850</b>	<b>\$1,170,000</b>
<b>Total Short-Term Time Frame</b>	<b>\$5,419,190</b>	<b>\$1,805,000</b>

Recommendations - Mid-Term Implementation Time Frame		
	Total Capital Cost	Annual O&M Cost
<b>H Street/Benning Road</b>		
Signal Priority		
4th Street/H street/Mass Avenue	\$60,000	
North Capitol Street/H Street	\$40,000	
3rd Street NE/H Street	\$40,000	
8th Street NE/H Street	\$40,000	
17th Street/Benning Road	\$40,000	
Minnesota Avenue/Benning Road	\$20,000	
Passenger Facility Improvements (H Street Segment)	\$233,344	
<b>Total H Street/Benning Road</b>	<b>\$473,344</b>	<b>\$0</b>

<b>U.S. 1</b>		
Greenbelt/College Park Service Restructuring		\$542,000
Mainline Signal Priority		
U.S. 1 and Cherry Lane	\$40,000	
U.S. 1 and Odell Road	\$40,000	
Rhode Island and 38th	\$40,000	
Rhode Island and Eastern	\$40,000	
Rhode Island and South Dakota	\$40,000	
Rhode Island and 24th	\$40,000	
Rhode Island and 14th	\$40,000	
Queue Jumps/Bus Bypass		
U.S. 1 and Contee Road	\$75,000	
U.S. 1 and Muirkirk Meadows	\$75,000	
U.S. 1 and Ritz Way	\$5,000	
U.S. 1 and Cherry Hill	\$75,000	
U.S. 1 and Sellman Road	\$5,000	
U.S. 1 and Sunnyside	\$290,000	
U.S. 1 and Greenbelt	\$75,000	
U.S. 1 and EB I-495 Off-Ramp	\$75,000	
U.S. 1 and WB 1-495 off-ramp	\$5,000	
U.S. 1 and Paint Branch/Campus Drive	\$150,000	
U.S. 1 and MD 410	\$150,000	
U.S. 1 and 41st Place	\$5,000	
Rhode Island Avenue and Eastern Avenue	\$5,000	
<b>Total U.S. 1</b>	<b>\$1,270,000</b>	<b>\$542,000</b>

<b>Metro Support</b>		
Fairfax Government Center - Signal Priority		
I-66 HOV Lane Access/Monument Drive	\$30,000	
Government Ctr. Pkwy/Monument		
Drive	\$30,000	
Government Ctr. Pkwy/Park Forest	\$30,000	
Herndon-Monroe - Signal Priority		
WB Toll Road Off-Ramp	\$30,000	
EB Toll Road Off-Ramp	\$30,000	
Stringfellow Road P&R Signal Priority		
I-66 HOV Lane Access	\$20,000	
Park & Ride		
Access	\$20,000	
Stringfellow Road Service to Downtown	\$5,635,000	\$1,220,000
Stringfellow Road Passenger Facilities	\$13,125	
<b>Total Metro Support</b>	<b>\$5,838,125</b>	<b>\$1,220,000</b>

<b>Total Mid-Term Time Frame</b>	<b>\$7,581,469</b>	<b>\$1,762,000</b>
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Recommendations - Long-Term Implementation Time Frame		
	Total Capital Cost	Annual O&M Cost
<b>U.S. 1</b>		
Side Street Signal Priority		
U.S. 1 and Cherry Hill	\$40,000	
U.S. 1 and Greenbelt Road	\$40,000	
U.S. 1 and Paint Branch - Campus Drive	\$40,000	
Rhode Island and Ewing	\$40,000	
Rhode Island and 34th Street	\$40,000	
Rhode Island and Franklin Street	\$40,000	
Rhode Island and 12th Street	\$40,000	
<b>Total U.S. 1</b>	<b>\$280,000</b>	<b>\$0</b>
<b>Annapolis Road</b>		
Signal Priority		
Annapolis Road and Harkins Road	\$40,000	
Annapolis Road and Cooper Lane	\$40,000	
Annapolis Road and 56th Avenue	\$40,000	
Rhode Island Avenue/38th Avenue	\$40,000	
Rhode Island/Eastern	\$40,000	
Rhode Island Avenue/South Dakota Avenue	\$40,000	
Rhode Island Avenue/24th Street	\$40,000	
Rhode Island Avenue/14th Street	\$40,000	
Queue Jump/Bus Bypass		
Annapolis Road at Edmontonson	\$250,000	
Annapolis Road at Kenilworth	\$250,000	
Rhode Island at Eastern Avenue	\$75,000	
Annapolis Road RapidBus Overlay	\$2,700,000	\$2,784,413
Passenger Facility Improvements	\$320,852	
<b>Total Annapolis Road</b>	<b>\$3,915,852</b>	<b>\$2,784,413</b>

<b>Metro Support</b>		
<i>Stringfellow Road</i>		
Poplar Tree Signal Priority Fair Lakes Boulevard	\$20,000	
Fair Lakes Parkway	\$20,000	
Poplar Tree P&R	\$150,000	
 Poplar Tree Bus Bypass		
Stringfellow Road P&R Access	\$20,000	
Fair Lakes Boulevard	\$20,000	
Fair Lake Parkway	\$75,000	
 Poplar Tree Service to Downtown	\$5,635,000	\$1,220,000
 Poplar Tree Passenger Facility Improvements	\$1,156,920	
 Stringfellow Road Parking Expansion (200 spaces)	\$666,000	
 <b>Total Stringfellow Road</b>	<b>\$7,762,920</b>	<b>\$1,220,000</b>

<i>Herndon-Monroe</i>		
Herndon-Monroe Service to Downtown	\$6,000,000	\$1,450,000
Herndon-Monroe Passenger Facilities	\$13,125	
 <b>Total Herndon-Monroe</b>	<b>\$6,013,125</b>	<b>\$1,450,000</b>

<i>West Falls Church</i>		
West Falls Church Signal Priority Leesburg Pike/I-66 EB Off-Ramp	\$30,000	
Haycock/Leesburg Pike	\$30,000	
Haycock/Station Access	\$30,000	
 West Falls Church Bus Bypass Leesburg Pike Bus Lane	\$75,000	
 West Falls Church Service to Downtown	\$4,875,000	\$1,170,000
 West Falls Church Passenger Facilities	\$13,825	
 <b>Total West Falls Church</b>	<b>\$5,053,825</b>	<b>\$1,170,000</b>

<i>Pentagon City/Crystal City</i>		
Pentagon City/Crystal City Signal Priority Army-Navy and Eads	\$30,000	
Army-Navy and Fern	\$30,000	
Army-Navy and Hayes	\$30,000	
Hayes and 12th 18th Street and Fern	\$30,000	
18th Street and Eads	\$30,000	
Pentagon City/Crystal City Queue Jump Hayes Street and 15th Street	\$30,000	
18th Street and Metro Station	\$20,000	
Fairfax Government Center to Crystal City Service	\$3,375,000	\$850,000
<b>Total Crystal City/Pentagon City</b>	<b>\$3,605,000</b>	<b>\$850,000</b>
<b>Total Metro Support</b>	<b>\$22,434,870</b>	<b>\$4,690,000</b>
<b>Total Long Term Time Frame</b>	<b>\$26,630,722</b>	<b>\$7,474,413</b>