Montgomery County Department of Transportation

Planning

Forest Glen Passageway

Feasibility Study Report

January 2013

GEORGIA AVE

FOREST GLEN ROAD

http://www.montgomerycountymd.gov/DOT-DTE/Projects/index.html

Executive Summary

Introduction

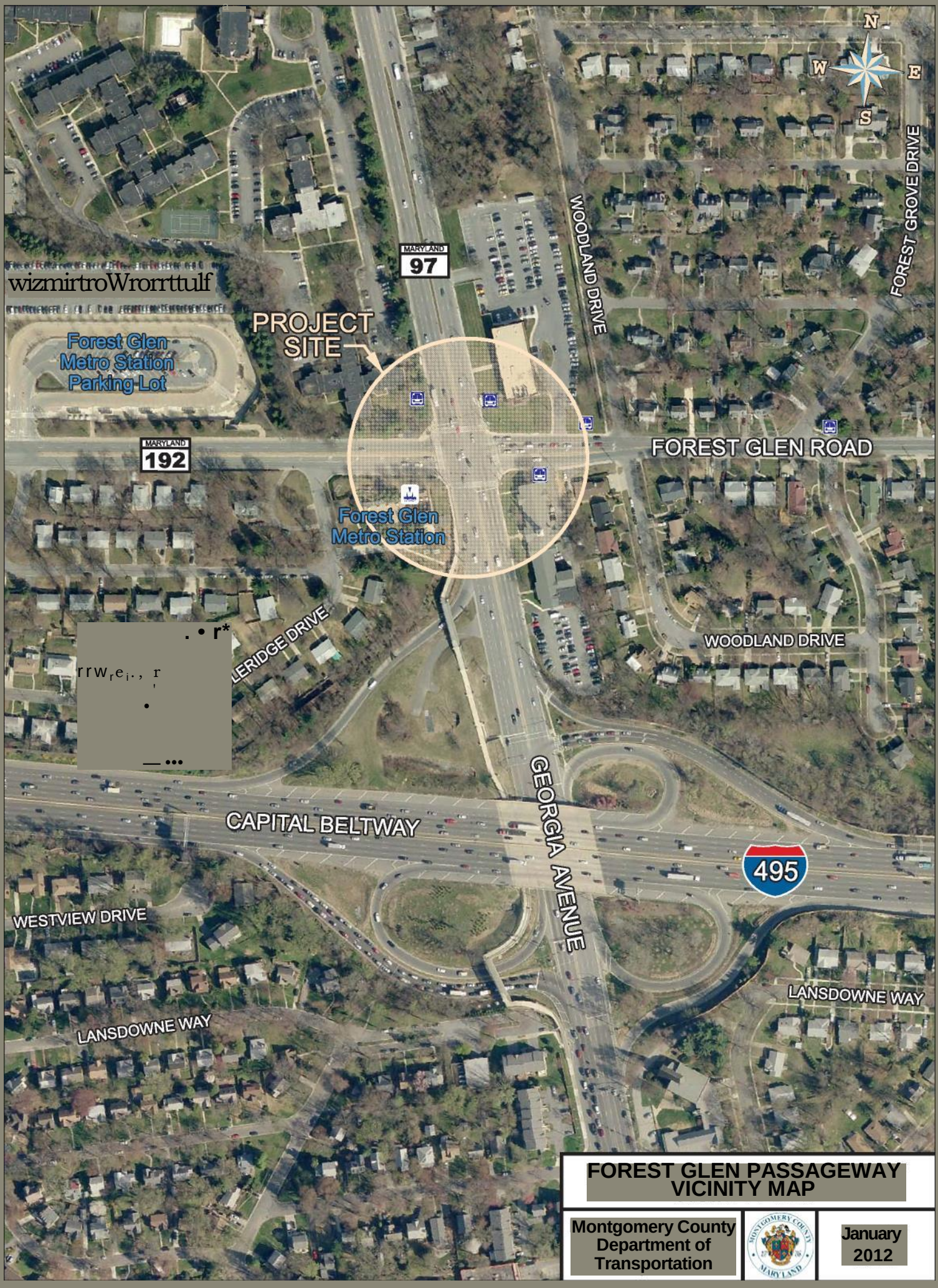
The Montgomery County Department of Transportation (MCDOT) has completed the Forest Glen Passageway Feasibility Study to provide for a safer grade-separated passageway (tunnel or bridge) across Georgia Avenue (MD 97) at Forest Glen Road and enhance pedestrian access to the mezzanine of Forest Glen Metrorail Station. This report concludes the Feasibility Study and will be used by the County's elected officials and decision makers to determine a final alternative to carry forward for design and construction. A project site and vicinity map is presented on the following page.

Background and Description

The Georgia Avenue/Forest Glen Road intersection is one of the most congested intersections in the Washington Metropolitan area. Over 80,000 vehicles per day travel through the intersection It currently operates at Level of Service (LOS) F (Oversaturated; Vehicles wait through multiple signal cycles) during the morning peak hour and level of service C (Influence of congestion becomes more noticeable) during the evening peak hour. Significant delays are experienced by vehicular traffic during both of the peak hour periods, particularly vehicles on Forest Glen Road.

The project site is located within the Forest Glen Sector Plan planning area and North and West Silver Spring Master Plan planning area. The area surrounding the intersection is largely built-out and consists mostly of single-family residential units as well as some multi-family residential units. The immediate surroundings of the intersection include the Forest Glen Medical Center in the northeast quadrant, the Montgomery Hills Baptist Church and Sienna School in the southeast quadrant, Forest Glen Metrorail Station in the southwest quadrant and the Americana Finnmark Condominiums in the northwest quadrant. Holy Cross Hospital, one of the county's largest employers and the second largest hospital in Maryland is located on the south side of Forest Glen Road approximately 2,000 feet east of the intersection. This fact makes it necessary for a large number of people to cross Georgia Avenue to get to their destinations from the Metrorail Station. Currently, over 800 pedestrian trips are completed across Georgia Avenue on a daily basis at this intersection. More than 90% of the pedestrian activity at the intersection is related to the Forest Glen Metrorail Station.

Although, all pedestrian signals are timed to provide sufficient time for pedestrians to cross the streets, conflicts between traffic and pedestrian movements are frequent, creating a hazardous situation for pedestrians. For the five year period 2005 to 2009 eighty-four (84) crashes were reported at this intersection. Seventy-six percent (76%) of the crashes resulted in an injury. There were no reported fatalities. Eight (8) pedestrian-related crashes accounted for 10% of the reported crashes. Along the 0.30 mile segment of Georgia Avenue between the I-495 off-ramp and Tilton Drive, the pedestrian-related crash rate was nearly four times greater than the statewide average for similar roadways and eighty percent (80%) happened at the Forest Glen Road intersection. The community has been lobbying for several years for a grade separated crossing that would eliminate conflicts with automobiles and significantly improve access to the nearby Forest Glen Metrorail Station. On December 2, 2008, the County Council approved funding for the design of the new passageway. The construction has not been funded. The MCDOT is seeking Federal Funds to share the construction costs.



FOREST GLEN PASSAGEWAY VICINITY MAP

Montgomery County Department of Transportation

January 2012

Alternatives Evaluated

As part of the Feasibility Study, six (6) alignments with nine (9) preliminary alternatives (six (6) tunnels and three (3) bridges) were developed. The study team selected the following three (3) alternatives to be evaluated and presented to the public for input:

1. **Tunnel Alternative 1:** Underground passageway from the southeast quadrant of the intersection to the Forest Glen Metrorail Station in the southwest quadrant.
2. **Tunnel Alternative 2:** Underground passageway from the northeast quadrant of the intersection to the Forest Glen Metrorail Station in the southwest quadrant.
3. **Bridge Alternative 1:** Pedestrian bridge from the southeast quadrant of the intersection to the Forest Glen Metrorail Station in the southwest quadrant.

Recommended Preferred Alternative

The recommended preferred alternative is **Tunnel Alternative 2**, which is an underground pedestrian passageway that runs from the northeast corner of the intersection, diagonally underneath the intersection, to connect to the existing pedestrian tunnel at the Forest Glen Metrorail Station. This alternative includes a ramp at the northeast quadrant, and elevators at both the northeast and southwest corners to provide ADA access.

The preferred alternative is recommended for the following reasons:

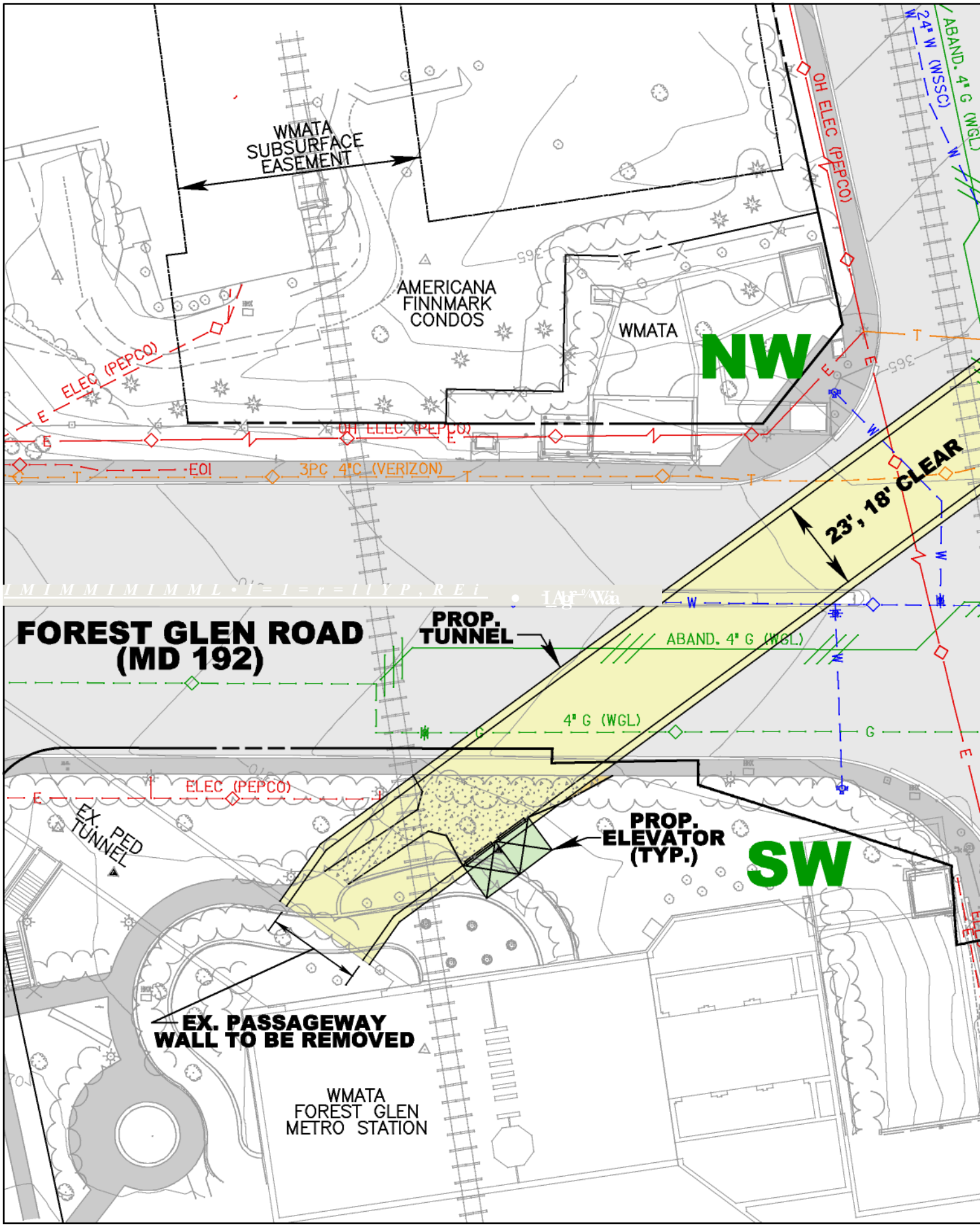
- A larger percentage of tunnel users originate in the northeast quadrant compared to the southeast quadrant.
- The northeast corner access point provides a more direct access to the tunnel for a majority of the tunnel users.
- The northeast corner has more open space available, simplifying construction access and allowing construction of a ramp entrance.
- Tunnel Alternative 2 better accommodates potential future roadway widening on Georgia Avenue by Maryland State Highway Administration.
- The ramp proposed for the northeast entrance of Tunnel Alternative 2 is preferable to the stairway access provided under the other alternatives.
- An underground passageway is preferable compared to a bridge, since it provides a quicker and more direct connection to the existing underground pedestrian tunnel / metro station.
- Tunnel Alternative 2 was strongly preferred by the community.

In association with the recommended preferred alternative, additional pedestrian facilities are also recommended as follows:

- A new sidewalk along the northern side of Forest Glen Road from the northeast entrance of the recommended underground passageway to the Dameron Drive intersection which is signalized with pedestrian signals and crosswalks.

These additional pedestrian improvements will provide a safer pedestrian access link from the eastern entrance of the recommended underground passageway to the community and Holy Cross Hospital on the southern side of the Forest Glen Road.


Americana Finnmark Condo Assn.
MARYLAND 97
WOODLAND DRIVE
Forest Esta Community A
Forest Gro Citizen As
Forest Oat Metro Statio Parking Lot
Preferred Alternative
Forest Glen Med lea! Center
Proposed Sidewall
MARYLAND
Existin ng Tunnel
From li Parking Lot To Metro. Station
Forest Glen Metro Station
Montgomery Hills Baptist Church
North Citizen
The Siena Schoo l
Forest Glen Civic Assn.
COLERIDGE DRIVE
WOODLAN
GEORGIA AVENUE
WESTVIEW DRIVE
Linden Civic Assn.
LANSDOWNE WAY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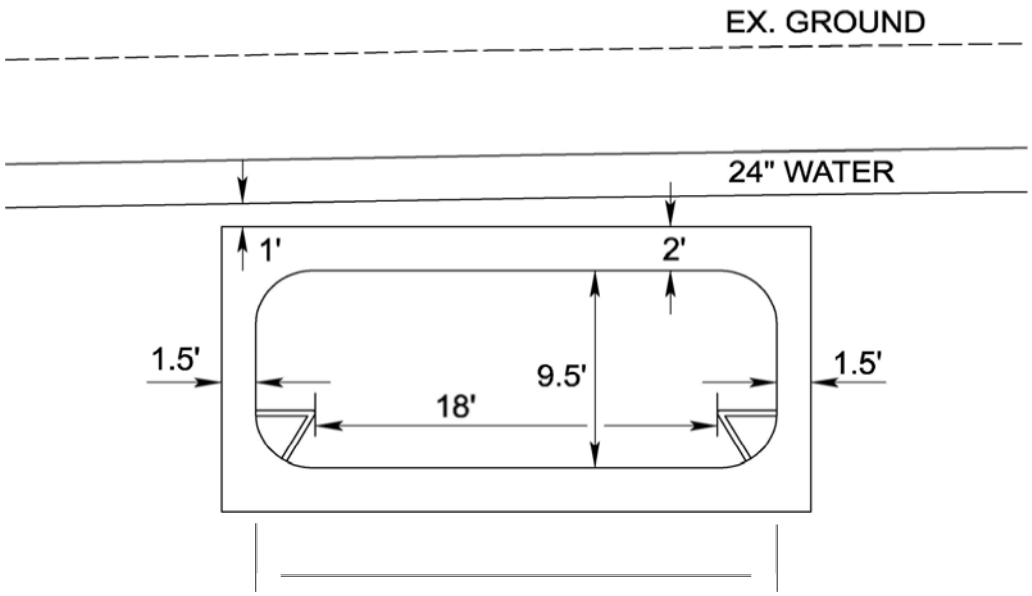
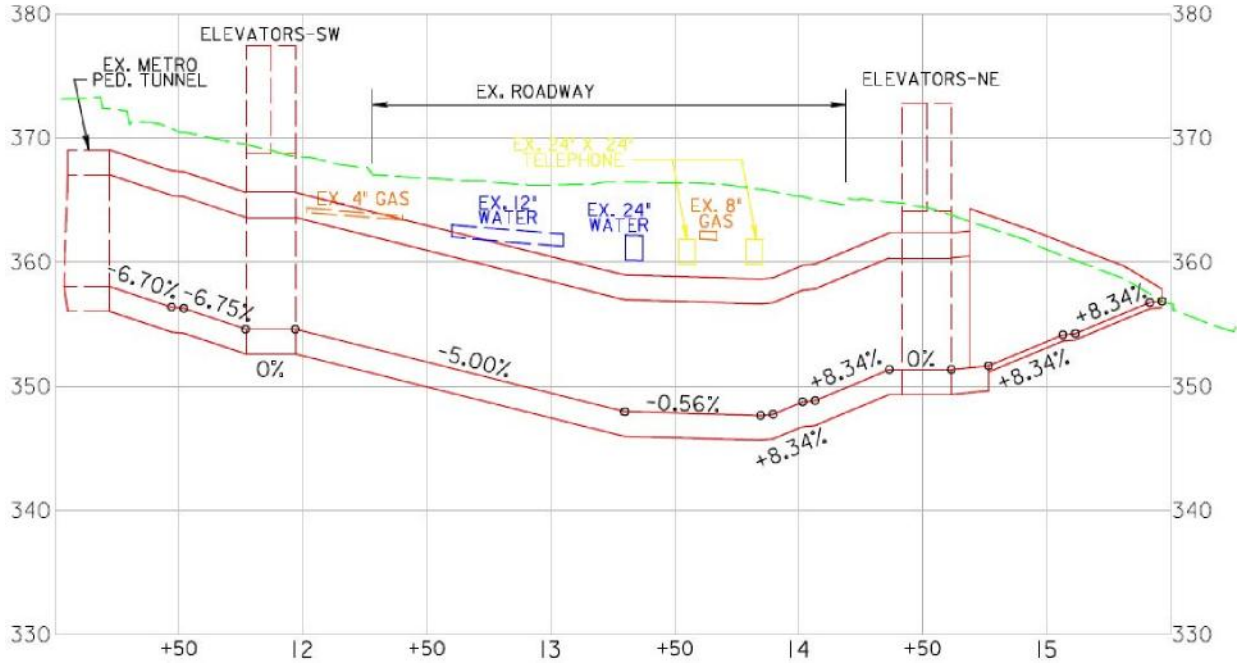
FOREST GLEN ROAD
(MD 192)
PROP.
TUNNEL
ABAND. 4" G (WGL)
4" G (WGL)
ELEC (PEPCO)
EX. PED
TUNNEL
PROP.
ELEVATOR
(TYP.)
SW
EX. PASSAGEWAY
WALL TO BE REMOVED
WMATA
FOREST GLEN
METRO STATION

Tunnel Typical Section



Tunnel Alternative 2 Profile



The alternatives evaluation considered operational performance, estimated pedestrian usage, construction requirements, traffic impacts, environmental impacts, and cost. The evaluations of the Preferred Alternative are summarized in Table ES.1 below.

Table ES.1: Evaluations Summary of Preferred Alternative

Preferred Alternative	**Tunnel Alternative 2 (NE Quadrant to Metrorail Station)**
Length	334 Ft
Width	23 Ft (18 Ft Clear)
Estimated Pedestrian Usage (Crossing MD 97 / Day)	799
Average Travel Time Savings (Sec/Pedestrian)	95
Americans and Disability Act (ADA) Compliance	Yes (Elevators/Ramp)
Construction Duration	39 months
Maintenance of Traffic	• Partial Night Time Work (18 months) • Overnight Lane Closures to 2-3 Lanes on Georgia Ave and Forest Glen Rd
Properties Impacted	1 Property (5,700 Square Feet)
Natural Resource Impacts	Low
Cultural Impacts	None
Utility Impacts	High – Underground, overhead, and traffic signal
Construction Cost	$12.1M
Total Cost*	$17.9M

* Total Cost includes Construction, Planning, Engineering, Land Acquisition, Passageway, and Bike Share Stations.

FOREST GLEN PASSAGEWAY – SUMMARY TABLE	
PROJECT STUDY INFORMATION	
Name of Project and CIP #	Forest Glen Passageway, CIP #0500722
Study Phase	Feasibility Study
Transportation Category	Pedestrian Facilities
Study Performed by	Montgomery County Department of Transportation (MCDOT) Division of Transportation Engineering
Project Manager	Greg Hwang, (240)777-7279
Consultant	Rummel, Klepper & Kahl, LLP (RK&K) Rick Adams, (410)462-9247
Road Name	Georgia Avenue (MD 97)
Project Limits	Intersection of Forest Glen Road (MD 192)
Project Length	• 270 - 330 Foot Long Pedestrian Tunnel
Functional Classification of Roadway	Georgia Avenue: Major Highway MD 97 Forest Glen Road west of MD 97: Arterial Road MD 192 Forest Glen Road east of MD 97: Arterial Road
EXISTING CONDITIONS	
# of Lanes	Georgia Avenue: 8 Forest Glen Road: 5
Average Daily Traffic (ADT)	81,300 (in Year 2012)
# of Bus Stops	4
Signalized Intersections	1 (Georgia Ave (MD 97) / Forest Glen Rd (MD 192))
Posted Speed	Georgia Ave - 35 mph Forest Glen Road - 30 mph
Adjacent Communities	Forest Estates Forest Grove Northmont Forest Glen Americana Finnmark Condos
Schools	The Siena School
Places of Worship	Montgomery Hills Baptist Church
Parks	N/A
Other Places of Interest	Holy Cross Hospital, Forest Glen Metro Station, Forest Glen Medical Center
CRASH HISTORY	
2005 to 2009	84 crashes, includes 8 pedestrian and 3 bicycle involved, no fatalities
FEASIBILITY REPORT SUMMARY	
Transportation Category	Pedestrian Facilities
Referenced Master Plans	N/A
Annual Growth Policy Area	Kensington/Wheaton
Purpose and Need	• Improve pedestrian safety • Improve pedestrian access across Georgia Avenue

Project Start Date	April 2011
Feasibility Study Report Completion Date	January 2013
Alternatives Evaluated	Tunnel Alternative 1 - Southwest-Southeast Tunnel Alternative 2 - Southwest-Northeast (Preferred Alternative) Bridge Alternative 1 - Southwest-Southeast
PUBLIC OUTREACH	
Public Meeting	April 10, 2012
Newsletter	March 2012 March 2013
PERMITS	
Required Permits	• Access Permit – Maryland State Highway Administration • Roadside Tree Permit – Maryland Department of Natural Resources (DNR) • NRI/FSD, Forest Conservation Plan – M-NCPPC • Erosion and Sediment Control and Stormwater Management – Montgomery County Department of Permitting Services • NEPA Permit (estimated completion date: April 2013) • WMATA Adjacent Construction Permit
Agencies Requiring Coordination	• Montgomery County Department of Transportation (MCDOT) • Montgomery County Department of Permitting Services (MCDPS) • Montgomery County Department of Environmental Protection (MCDEP) • Maryland-National Capital Park & Planning Commission (M-NCPPC) • Maryland Department of the Environment (MDE) • Maryland Department of Natural Resources (MDNR) • Maryland Historical Trust (MHT) • Maryland State Highway Administration (MDSHA) • US Fish and Wildlife Service (USFWS) • Washington Metropolitan Area Transit Authority (WMATA)
UTILITIES	
Required Utility Company Coordination	• Pepco • WSSC • Washington Gas • Comcast • Verizon
OTHER	
Basis for Stormwater Management (SWM) Design	• Incorporate the latest Maryland Stormwater Design Manual including the requirements of the Stormwater Management Act of 2007. • Use low impact development (LID) techniques.

Division of Transit Services	• Currently, the Ride ON Routes (7 & 8) as well as Metrobus Q & Y lines serve the Forest Glen Metro Station. The proposed improvements could possibly have an impact on service during the construction period; however, coordination with the Operations group of Division of Transit Services would help facilitate the delays.
Maryland State Highway Administration (SHA)	• To begin the SHA access permit process, a cover letter and seven copies of the plans for work within SHA r/w needs to be submitted to Scott Newill of SHA Access Management Division (AMD) at the mailing address below for their access permit review. D. Scott Newill Regional Engineer West Region Access Management Division Office of Highway Development Maryland State Highway Administration 707 N. Calvert Street, Mailstop C-302 Baltimore, Maryland 21202 • Once SHA receives, the project will be assigned to an SHA internal reviewer who becomes the point of contact for the project. Each comment letter issued by AMD will contain next step to get the applicant through the access permit process and to eventual permitting.
Planning Board Briefing Date/Comments	Date: October 11, 2012 Comments: Montgomery County Planning Board's comments letter dated October 22, 2012
County Council's T&E Committee Presentation Date/Comments	Date: February 4, 2013 Comments: T&E Committee's comments letter dated February 5, 2013

STUDY TEAM CONTACT INFORMATION

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Table of Contents

Appendices

I. Introduction

The intersection of Georgia Avenue (MD 97) and Forest Glen Road in Silver Spring, Maryland is one of the most congested intersections in the Washington Metropolitan area. The community has been lobbying several years for a grade separated crossing that would eliminate conflicts with automobiles and significantly improve access to the nearby Forest Glen Metrorail Station. The Montgomery County Department of Transportation (MCDOT) has completed this feasibility study for a grade separated pedestrian crossing of Georgia Avenue (MD 97) at the Forest Glen Road intersection. A vicinity map of the project site is presented on the following page.

The Feasibility Study included surveys, data collection, traffic counts, traffic analysis, preliminary engineering, and cost/impact assessment for several tunnel and bridge alternatives. Specific services included:

- Topographic and Property Surveys
- Traffic Counts – Vehicular and Pedestrian
- Pedestrian Operation Analysis
- Traffic Operations Analysis
- Utility Identification and Impact Assessment
- Conceptual Alignment, Profile and Typical Section Design
- Geotechnical Assessment
- Conceptual Maintenance of Traffic Assessment
- Natural Resources/Permitting Assessment
- Construction Evaluation
- Cost/Impact Analysis

This report summarizes the alternatives considered and provides an assessment of the advantages and disadvantages for various underground passageway and overhead pedestrian bridge alternatives. The report does not recommend a particular alternative to be selected as preferred. Instead, the purpose of this report is to provide feasible options for MCDOT to review with the community, agency representatives, elected officials, and to consider for more detailed engineering and evaluation.

II. Existing Site Conditions

Land Use

The project site is located within the Forest Glen Sector Plan and North and West Silver Spring Master Plan. The area is largely built-out to proposed land uses and consists mostly of single-family residential units as well as some multi-family residential units near the Metro station. In addition, the area includes other institutional and commercial uses such as churches, medical/office, park and retail.

For instance, the Forest Glen Medical Center is located in the northeast quadrant of the intersection and the Montgomery Hills Baptist Church and Sienna School are located in the southeast quadrant. WMATA's Forest Glen Metro Station is located in the southwest quadrant of the intersection and the Americana Finnmark Condominiums are located in the northwest quadrant. In addition, Holy Cross Hospital, one of the county's largest employers and the second largest hospital in Maryland is located on the south side of Forest Glen Road approximately 2000 feet east of Georgia Avenue.

No zoning changes are anticipated in the vicinity of the project site.

WMATA Facilities

The existing Forest Glen Metro Station opened in September 1990 and is located at the southwest corner of the Georgia Avenue and Forest Glen Road intersection. The station's parking lot, bus bays, and kiss and ride facilities are located on the north side of Forest Glen Road approximately 800 feet west of the intersection. Access to the station from the parking lot is provided by a 250 ft. long underground tunnel beneath Forest Glen Road. The existing tunnel can be accessed directly from the parking lot or from Forest Glen Road by a set of stairs that leads to the passageway portal. Stairs located adjacent to Coleridge Drive provide access to the existing passageway on the south side of Forest Glen Road.

The floor elevation of the station entrance facility and the existing passageway is approximately 20 ft. below the surface of Forest Glen Road. Elevator access is not currently provided from the station mezzanine level to the ground level at Forest Glen Road. Six elevators within the paid area of the station carry users from the station mezzanine level approximately 175 ft. down to the platform level. Vent shafts extending from platform level to ground surface are present on the northwest corner of the Georgia Avenue/Forest Glen Road intersection. The main shaft has an approximate inside diameter of 30' and the upper portion

of the shaft transitions out to an irregular shape to accommodate the emergency stairs and exhaust shaft.

Utilities

Multiple utilities are present above and below grade within the project site and are presented on the concept plans for of the proposed alternatives in Appendices D and E. The Washington Suburban Sanitary Commission (WSSC) maintains several facilities within the areas including a 24-inch water transmission main with two valve and vault structures within Georgia Avenue and a 12-inch water main within Forest Glen Road. Telephone duct banks (owner unidentified) are also present within Georgia Avenue and Forest Glen Road and two (2) telephone vaults are located in Forest Glen Road. Washington Gas facilities within the area include an 8-inch main in Georgia Avenue and 6-inch and 4-inch mains in Forest Glen Road. Pepco overhead utility poles and facilities include primary and secondary electric, telephone and cable running along both sides of Georgia Avenue.

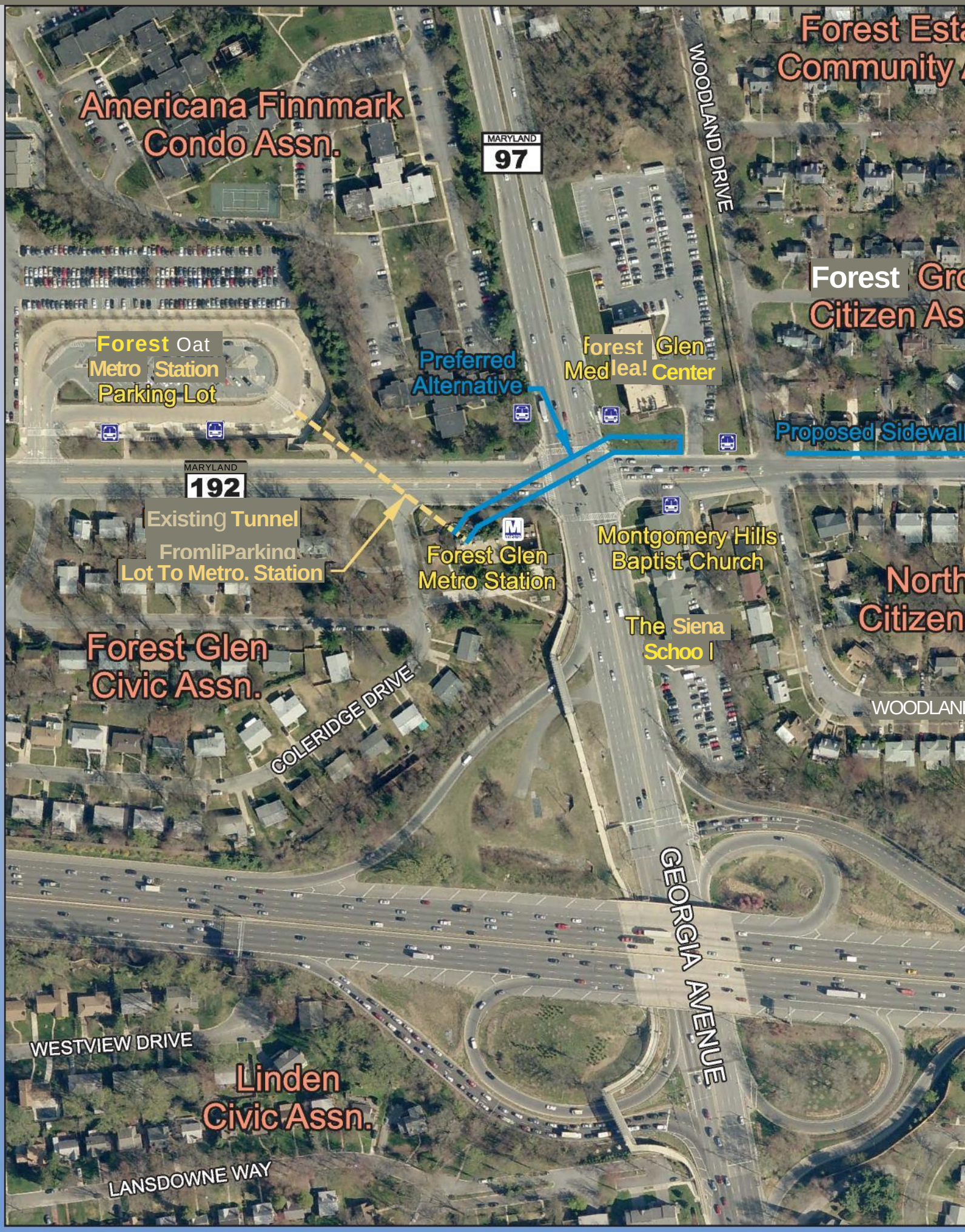
Environmental Resources

RK&K collected data from environmental databases and performed a field reconnaissance to assess potential impacts to natural and cultural (historic/archaeological) resources within the project site. No natural waterway or wetland systems are present at the site. Vegetation consists of mature street trees and landscaping on the WMATA Station site and a few isolated trees on the Forest Glen Medical Center and Montgomery Hills Baptist Church sites. The Montgomery Hills Baptist Church is also being evaluated to determine its potential eligibility for the National Register of Historic Places. This one- and two-story Colonial Revival style church was originally constructed in 1957, with additions made in 1965.

Potential impacts to community, property, natural, cultural and socio-economic resources are anticipated to be minor. Consequently, MCDOT anticipates preparing a Categorical Exclusion (CE) to satisfy NEPA regulations should federal funding be secured for the project. The following permits/authorizations are anticipated to be required for the project:

- Natural Resources Inventory/Forest Stand Delineation- NRI/FSD (M-NCPPC)
- Stormwater Management Approval (MCDPS)
- Sediment Control Permit (MCDPS)
- Roadside Tree Permit (DNR)
- SHA Municipal Permit (SHA District 3)
- WMATA Joint Development and Adjacent Construction Real Estate Permit (WMATA)

In addition, right-of-way acquisition and temporary and permanent construction easements may be necessary depending on the selected alternative.


Americana Finnmark
Condo Assn.
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Forest Esta
Community A
Forest Gro
Citizen As
Forest Oat
Metro Station
Parking Lot
Preferred
Alternative
forest Glen
Med lea! Center
Proposed Sidewall
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North
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The Siena
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Forest Glen
Civic Assn.
COLERIDGE DRIVE
WOODLANI
GEORGIA AVENUE
WESTVIEW DRIVE
Linden
Civic Assn.
LANSDOWNE WAY

III. Existing Traffic Operations

Traffic Study Scope

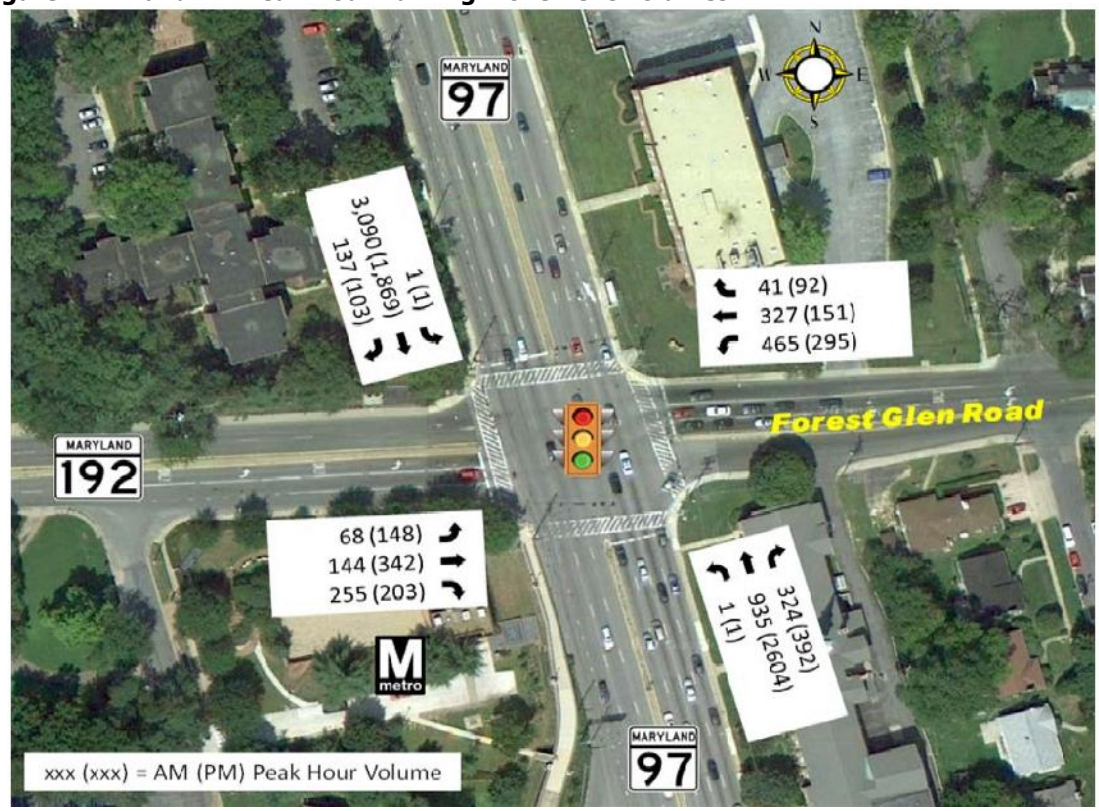
A traffic study was completed to analyze the current and proposed future operating pedestrian and vehicular conditions at the Georgia Avenue and Forest Glen Road intersection. This study included the following specific tasks:

- A 13-hour vehicle and pedestrian turning movement count
- An origin-destination study for pedestrians crossing Georgia Avenue
- Estimation of expected pedestrian usage for each underground passageway and bridge alternative
- Analysis of current vehicular peak hour traffic operations
- An evaluation of the recent crash history at the intersection, focusing on pedestrian-related collisions.

Current Traffic Volumes

A 13-hour turning movement count was performed at the intersection of Georgia Avenue (MD 97) and Forest Glen Road (MD 192) on April 26, 2011 from 6:00 AM to 7:00 PM. This count included a separate tally for automobiles and pedestrians. The complete traffic count data is provided in Appendix A. Based on the count data, the AM peak hour for vehicular traffic is 7:15 AM – 8:15 AM and the PM peak hour for vehicular traffic is 5:00 PM – 6:00 PM. Figure 1 below summarizes the vehicular AM and PM peak hour turning movement volumes at the intersection of Georgia Avenue and Forest Glen Road.

Figure 1: AM and PM Peak Hour Turning Movement Volumes



Current

Pedestrian Volumes

A 13-hour count of all pedestrian movements at the Georgia Avenue / Forest Glen Road Intersection was performed concurrently with the vehicular traffic count. For pedestrians crossing Georgia Avenue, the AM peak hour was from 7:00 AM – 8:00 AM and the PM peak hour was from 5:45 PM – 6:45 PM. Figure 2 summarizes the results of the standard pedestrian volume counts on each of the four existing crosswalks at the intersection, by crossing direction. The total 13-hour crossing volumes are shown, as well as the AM and PM peak hour crossing volumes (based on the pedestrian peaks, not the vehicular traffic peaks).

A special pedestrian count was also performed to determine how many pedestrians currently cross Georgia Avenue from the northeast corner of the intersection to the southwest corner, and vice-versa, using the existing crosswalks. The special count also determined whether the pedestrians making these "diagonal" movements had origins or destinations at the following three locations:

- Forest Glen Metro Station
- Points west of the Metro station along Forest Glen Road
- Points south of the intersection along Georgia Avenue

Figure 3 shows the total 13-hour pedestrian volumes from the special southwest-southeast count for eight different path/origin/destination combinations. Figure 4 shows the AM and PM peak hour pedestrian volumes from the special count for each of these same eight combinations, based on the pedestrian peaks.

A review of the pedestrian counts at the intersection (as shown in Figure 2) reveals that the south leg of the intersection experienced the largest number of pedestrians crossing during the 13-hour turning movement count. The AM and PM peak hours showed the highest pedestrian movement towards the Forest Glen Metro Station during the AM peak hour and away from the station during the PM peak hour.

The special pedestrian count between the northeast corner of the intersection and the Metro station in the southwest corner revealed that a similar number of people cross the intersection using the north and west legs as compared to the east and south legs of the intersection when heading toward the Metro station, but the most common route when exiting the Metro station was to use the west and north legs (see Figure 3).

A separate survey of pedestrians walking along Forest Glen Road between Georgia Avenue and the Forest Glen Metro Station was also performed. According to this survey, approximately 97% of the pedestrians traveling west along Forest Glen Road from Georgia Avenue during the AM peak hour (including those originating from the east side of Georgia Avenue) traveled to the Metro station. Similarly, during the PM peak hour, approximately 99% of the pedestrians walking east along Forest Glen Road towards and/or crossing Georgia Avenue from the west were observed exiting the Metro station.

An additional origin-destination survey was performed during peak periods, and is discussed in the Underground Passageway Alternatives Evaluation section.

Figure 2: **Total 13-hour Pedestrian Crossing Volumes and AM and PM Peak Hour Crossing Volumes**

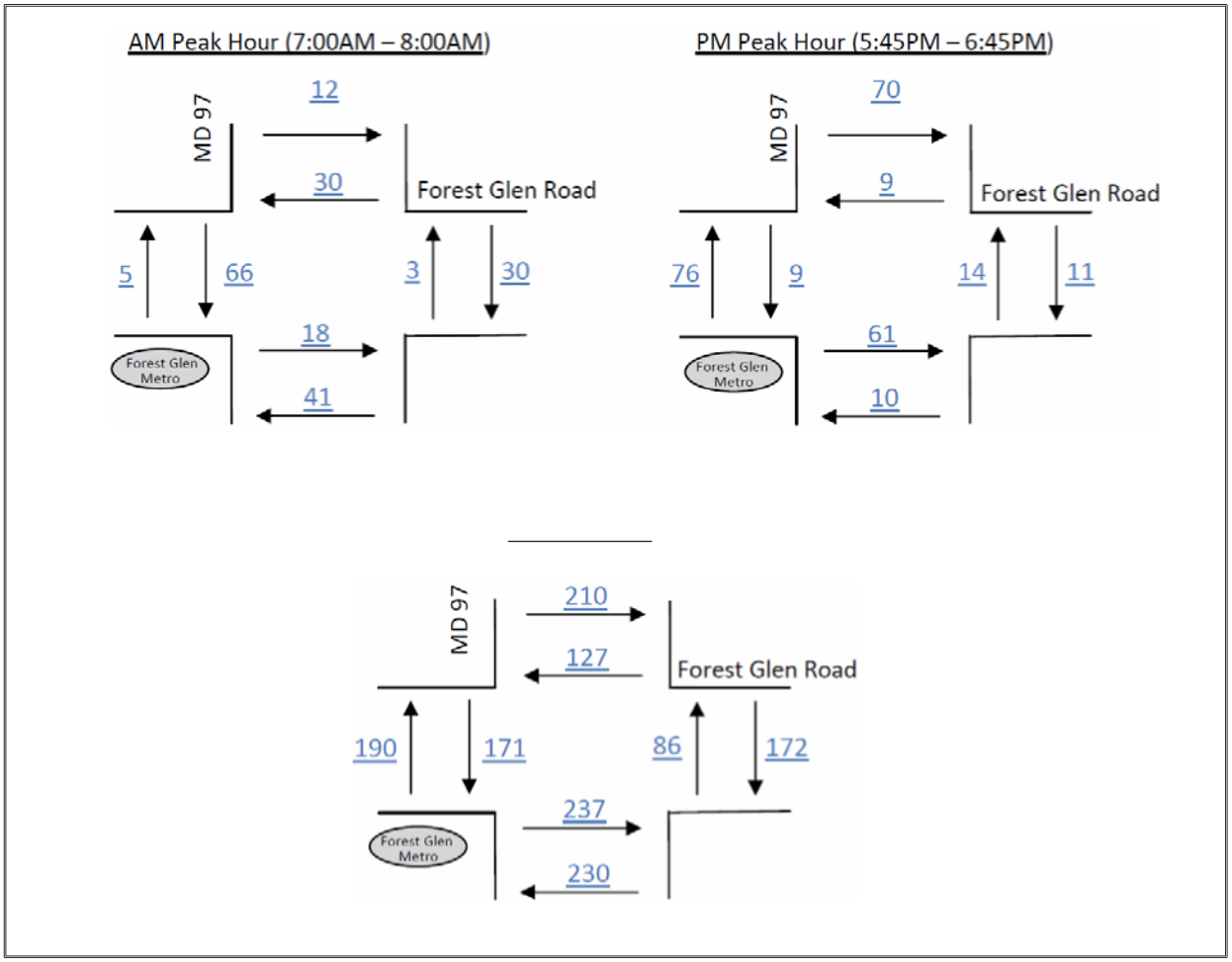


Figure 3: Total 13-Hour Pedestrian Volumes from the Special Southwest-Northeast Count

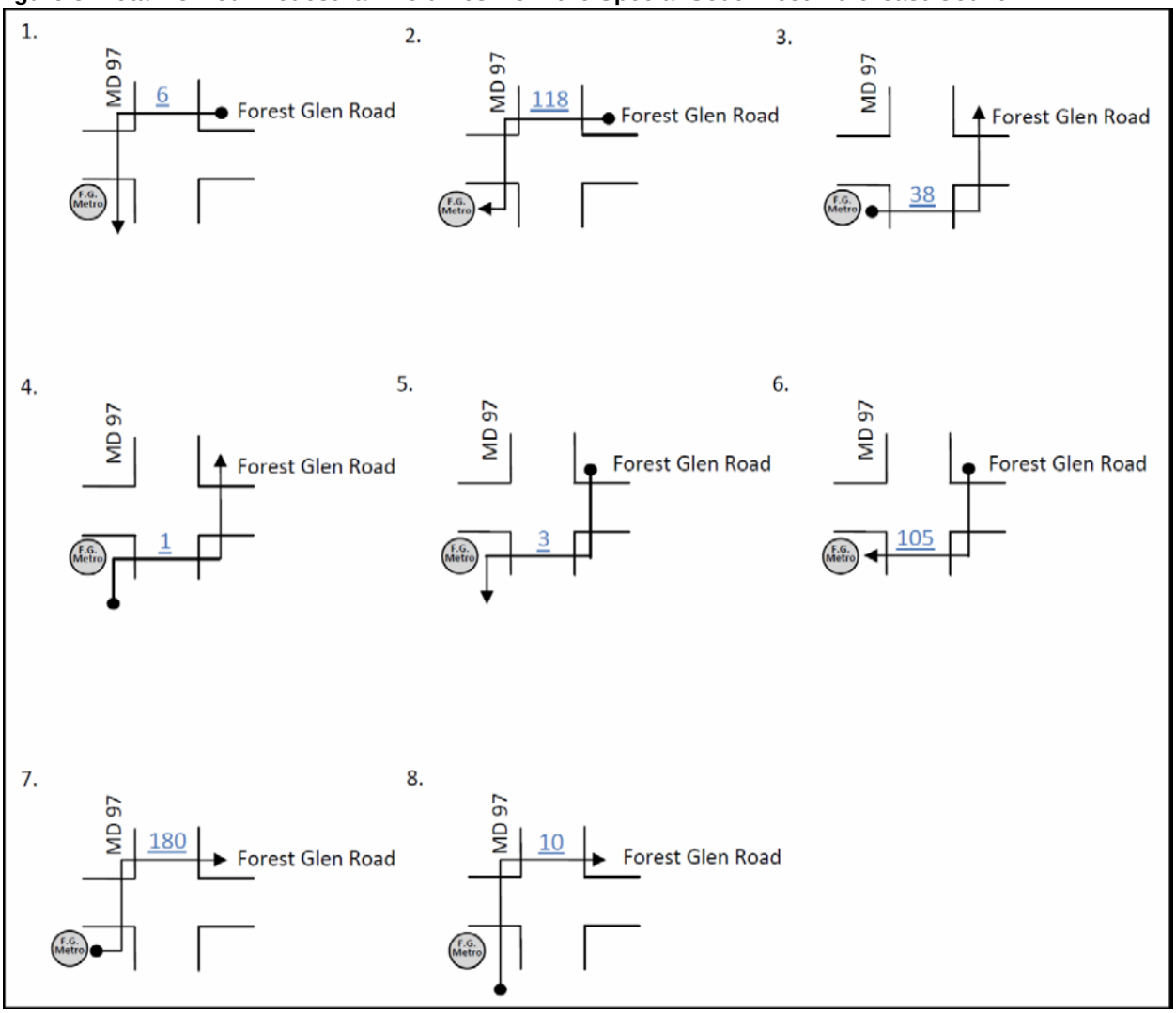
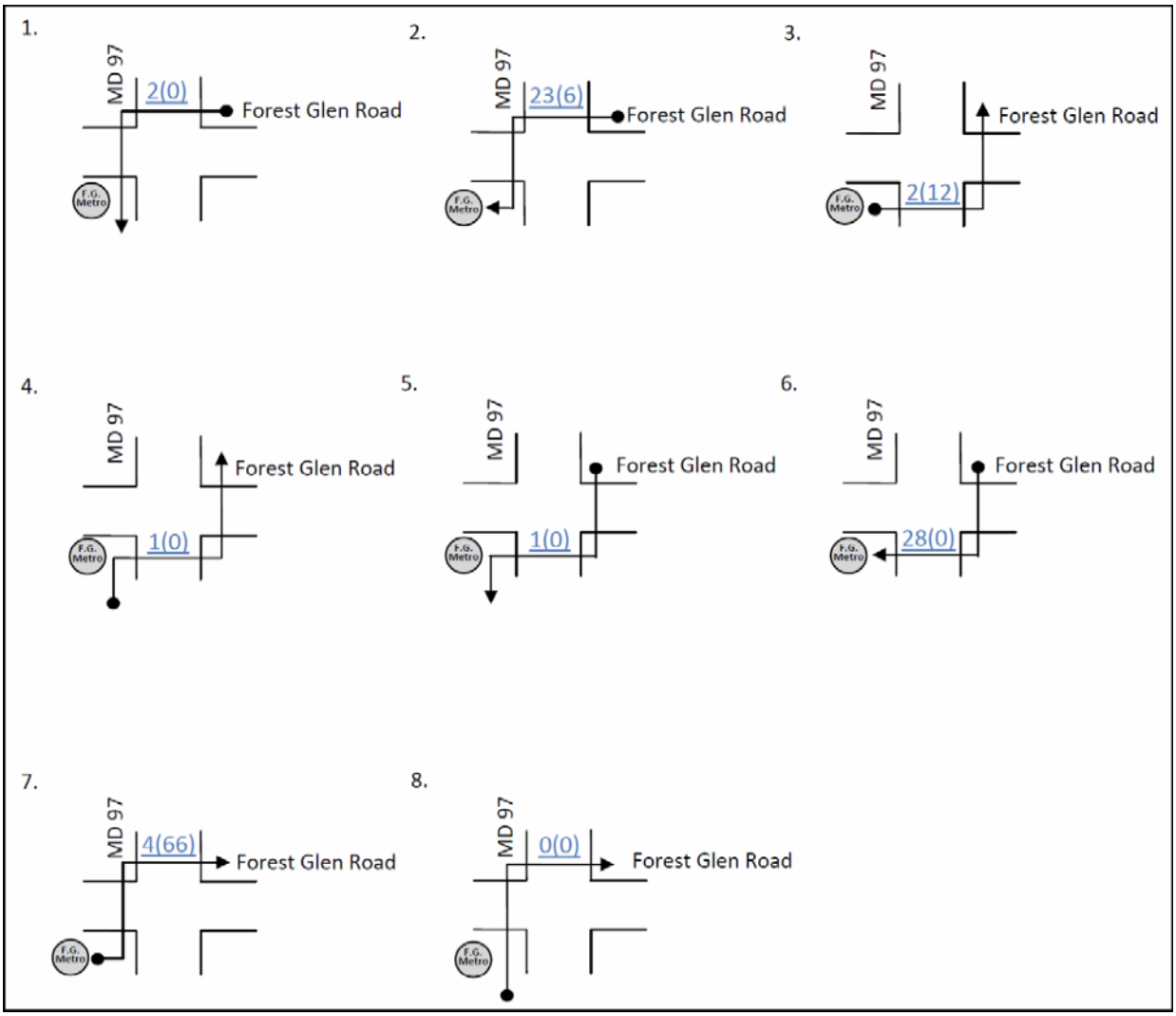


Figure 4: AM (PM) Peak Hour Pedestrian Volumes from the Special Southwest-Northeast Count



Current Traffic Signal Operations

Existing signal timing and phasing information for the intersection was provided by MCDOT and observed in the field. The existing traffic signal at the intersection of Georgia Avenue and Forest Glen Road has different phasing patterns depending on the time of day. During the AM and PM peak periods (6:30 AM-9:30 AM, 4:00 PM-7:00 PM) left turns from northbound and southbound Georgia Avenue are prohibited, and a protected left turn phase is not provided. During the off-peak periods, left turns are allowed from northbound and southbound Georgia Avenue, and protected/permissive left turn phasing is provided.

During these off-peak times, left turns are made from the shared through/left-turn lane in each direction on Georgia Avenue; there are no separate left turn lanes provided along Georgia Avenue at this intersection.

On Forest Glen Road, the eastbound right turn lane is also phased differently during the peak and off-peak hours. During peak hours, the eastbound right turn lane operates as a shared through/right turn lane while during off-peak periods, the lane operates as a right turn only. The eastbound and westbound approaches along Forest Glen Road have concurrent protected-only left turn phases throughout the day. Existing lane configurations at the intersection are illustrated in Figure 5.

Pedestrian movements are accommodated in marked crosswalks across all four legs of the intersection, with push-button actuated Accessible Pedestrian Signals (APS) with "countdown" pedestrian signal heads located at each corner of the intersection. When actuated by a pedestrian, the pedestrian Walk/Flashing Don't Walk phase runs concurrently with the through traffic phase parallel to the crosswalk. Consequently, pedestrians crossing Georgia Avenue must be cognizant of turning traffic from Forest Glen Road as well as right turn on red traffic from Georgia Avenue.

The AM and PM vehicular peak hour turning movement volumes from Figure 1 were used to analyze the current intersection performance with Synchro. One objective of the analysis was to establish the baseline traffic conditions for comparison to future build conditions if certain crosswalks and pedestrian signal phases were eliminated when the proposed passageway is completed. However, due to the current signal phasing, the elimination of pedestrian phases would not have an effect on existing signal operations. The elimination of pedestrian phases would only affect signal operations if the east-west approaches along Forest Glen Road were split-phased. (Split phasing is when an entire approach has a green signal when the entire opposing approach has red.) Split-phasing would allow the north leg crosswalk and pedestrian phase (which would be concurrent with the westbound through traffic phase under split-phasing) to be eliminated, while maintaining the south leg crosswalk and pedestrian phase (which would be concurrent with the eastbound through traffic phase under split-phasing). Under the current phasing, the eastbound and westbound traffic phases operate concurrently, so both the north leg and south leg pedestrian phases also run concurrently. Hence, replacing only one of the crosswalks

with a passageway would require the same pedestrian phasing as if the crosswalk was still there, because the remaining crosswalk would still require a pedestrian phase.

Figure 5: Existing Lane Configuration

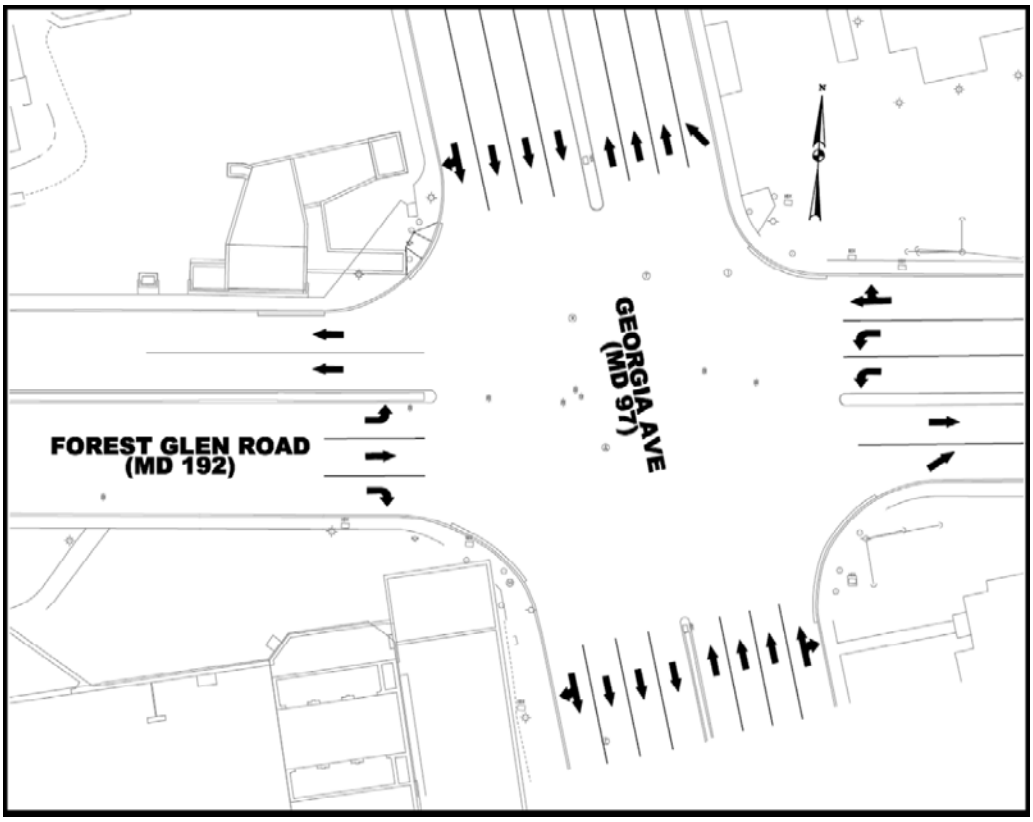


Table 1 summarizes the operation of the intersection using Synchro levels of service and delays by approach and for the overall intersection, using the current signal timing. The analysis indicates that the current timing plan appears to provide better performance for the Georgia Avenue approaches at the expense of increased delay on the side street approaches. Table 2 shows how this intersection would operate if the signal timing was optimized using Synchro to minimize total intersection delay (including the side street approaches). The *Highway Capacity Manual (HCM)* analysis methodology was used. The HCM analysis reports from Synchro are provided in Appendix B.

Table 1: Existing 2011 AM and PM Peak Hour Intersection Performance

HCM Analysis using Synchro		AM Peak Hour		PM Peak Hour	
		LOS	Delay	LOS	Delay
Georgia Avenue (MD 97)	NB	B	11.0	B	19.0
	SB	C	27.4	B	18.1
Forest Glen Road (MD 192)	EB	E	70.2	E	78.6
Forest Glen Road	WB	F	416.3	E	74.2
Whole Intersection		**F**	**83.3**	**C**	**30.2**

The 2009 Manual on Uniform Traffic Control Devices (MUTCD) recommends that the minimum pedestrian clearance interval (i.e., the Flashing Don't Walk interval) at a traffic signal should be sufficient for a pedestrian to cross the street from curb to curb at a walking speed of 3.5 feet per second. MCDOT has since modified the pedestrian clearances and it now meets the required standards. As part of any future improvements to the intersection, the timing for the pedestrian signals at the intersection should be evaluated and adjusted if necessary to comply with the MUTCD standards.

Table 2 summarizes the HCM signalized intersection analysis results using optimized signal timing with the updated pedestrian clearance intervals.

Table 2: Year 2011 AM and PM Peak Hour Intersection Performance Optimized with Updated Pedestrian Clearance Intervals

HCM Analysis using Synchro		AM Peak Hour		PM Peak Hour	
		LOS	Delay	LOS	Delay
Georgia Avenue (MD 97)	NB	C	26.5	C	28.8
	SB	E	60.6	B	19.1
Forest Glen Road (MD 192)	EB	D	53.7	E	64.7
Forest Glen Road	WB	E	75.8	E	66.3
Whole Intersection		**D**	**54.8**	**C**	**33.0**

Crash History Evaluation

Recent crash history information (January 2005 through December 2009) for the intersection of Georgia Avenue (MD 97) and Forest Glen Road (MD 192) was obtained from the Maryland State Highway Administration (SHA). The crash summary tables and study worksheets provided by SHA are included in Appendix C.

The following trends were identified in the five (5) years of crash data provided for this intersection:

- Eighty-four (84) crashes were reported at this intersection during the study period.
- There were no reported fatalities.
- There were eleven pedestrian-related crashes (13% of the total).
    - Five (5) of these crashes occurred in 2006, more than in any other year of the study period.
    - One (1) pedestrian-related crash was reported each in 2008 and 2009.
    - The 8 pedestrian-related crashes during the time period included 5 crashes involving pedestrians crossing Georgia Avenue and 3 crossing Forest Glen Road.
- The most frequent type of crash reported was the rear-end collision (32 crashes, or 38% of the total).
    - Most of these rear-end crashes (81%) occurred along MD 97.
- The second-most common crash type was the left-turn collision (21 crashes, or 25% of the total).
    - The highest number of left-turn crashes was in 2007 (7 total).
    - Three (3) left-turn crashes were reported in 2009.
- The most common probable causes reported were "failure to yield right-of-way" (21 crashes) and "failure to give full attention" (18 crashes).
- Seventy-six percent (76%) of the crashes resulted in an injury.
- Thirty-seven percent (37%) of the crashes reported during the study period occurred at night.
- Eighteen percent (18%) of the crashes occurred on wet pavement surfaces.

Crash data was also obtained from SHA for the same five year period along MD 97 between the off-ramp from westbound I-495 and Tilton Drive, a 0.30 mile segment that includes the Forest Glen Road intersection. This crash data includes a comparison of the crash rates within this segment to the statewide average crash rates for other similar roadways. Crash rates are reported as the number of crashes per 100-million vehicle-miles traveled. This crash data for the five-year period (2005 – 2009) is summarized as follows:

- The pedestrian-related crash rate (24.9) was almost four times the statewide average.
- The sideswipe crash rate (116.3) was almost six times the statewide average.
- The total crash rate (all types combined) was 468, which is more than twice the statewide average.

IV. Tunnel Alternatives Evaluation

Tunnel Typical Section and Design Parameters

The proposed design is based on the guidance from agency representatives and recommendations presented in the WMATA Manual of Design Criteria for Maintaining and Continued Operation of Facilities and Systems, Montgomery County Standards, ADA Accessibility Guidelines for Buildings and Facilities (ADAAG), ACI 318 and MD SHA criteria. The proposed underground passageway is envisioned to be very similar to the existing Forest Glen Metro Station tunnel that provides passage from the station parking lot on the north side of Forest Glen Road to the station located on the south side of the roadway (see photograph). Based on direction from WMATA, the proposed tunnel dimensions would match the existing tunnel and would include a 23'-0" wide passageway with 18'-0" horizontal clearance between railings and a 9'-6" vertical clearance. The tunnel would be constructed of precast concrete, cast-in-place concrete or a combination of the two with architectural finishes, railings, and lighting similar to the existing pedestrian tunnel.

Tunnel Alignment and Profile

Six (6) tunnel alignment concepts were initially evaluated as part of the feasibility study. Figure 6 below illustrates each of the concept alignments. The concepts illustrate the general layout and access locations to the ground surface via stairs, ramps, or elevators. Concepts 1, 3 and 5 simply provide access from the east side of Georgia Avenue to the west side of Georgia Avenue and do not connect to the existing Metro station. Concepts 2, 4 and 6 provide pedestrians the option of walking through the entire tunnel (i.e., both segments A and B) or walking through only a portion of the tunnel (i.e., either segment A or segment B) and have a direct connection with the existing Metro station passageway.

Figure 6: Preliminary Underground Passageway Alignments

Pedestrian Usage

The total number of pedestrians who choose to use the tunnel versus the existing at-grade crossings will be largely influenced by travel time, safety, and inclement weather. Since the tunnel is anticipated to significantly improve travel times and safety for pedestrians crossing Georgia Avenue, historical data presented in Exhibit 3-39 of the AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities indicates that nearly 100% of the pedestrians going to/from the Metro station under Concepts 2, 4 and 6 would be expected to use the entire length of the tunnel. However, for these three concepts, only 80% of the non-Metro pedestrians are estimated to use the tunnel segment that crosses Georgia Avenue, due to the additional travel time associated with travelling the steps/elevator/ramps to the tunnel. Since Concepts 1, 3, and 5 do not provide direct access to Metro and would require additional travel time along steps/elevator/ramps to the tunnel, only 80% of both Metro and non-Metro pedestrians were assumed to choose the tunnel over the at-grade route.

For Concepts 2, 4, and 6, the estimated passageway volumes also assume that pedestrians going to/from the Metro station who do not use the tunnel to cross Georgia Avenue would use the western segment of the tunnel to enter/leave the Metro station if they can conveniently access the tunnel along their travel path. For example, pedestrians travelling from the northwest corner of the intersection to the Metro station are assumed to use the western segment of the Concept 2 alignment. For Concepts 3 and 4, pedestrians travelling to Metro from the northeast corner of the intersection are assumed to divert across the east leg of the intersection to access the tunnel from the southeast corner. Similarly, all pedestrians exiting Metro and traveling to the northeast corner are assumed to use the tunnel under Concepts 3 and 4. On the other hand, pedestrians originating from the southeast corner or traveling to the southeast corner from the southwest corner are not assumed to divert to Concepts 1, 2 (both segments), 5 and 6 (eastern segment).

Table 4 below summarizes the estimated AM peak hour, PM peak hour, and 13-hour pedestrian usage for each of the six alignment concepts based on the results of the standard pedestrian count and the special pedestrian origin-destination study.

Table 4: Estimated Pedestrian Usage for Passageway Alignment Concepts

	Concept 1	Concept 2 Seg.A	Concept 2 Seg.B	Concept 3	Concept 4		Concept 5	Concept 6	
					Seg.A	Seg.B		Seg.A	Seg.B
AM Ped. Peak Hour	58	69	97	69	85	123	61	61	123
PM Ped. Peak Hour	73	90	96	114	142	149	84	84	149
13-Hour Totals	384	472	498	612	759	789	461	724	789

In addition to the values above which were based on observed pedestrian usage, an estimate for additional induced demand was added. Based on WMATA's records of usage of the parking lot at the Forest Glen Metro station, and other metro stations, a significant number of daily trips are generated by users who live within walking distance of the Metro station. It was estimated that 25% of users within 0.5 miles, and 10% of users within 1 mile of the station would change modes to walking, and use the forest glen tunnel. This resulted in an additional 45 trips in the tunnel per day.

Pedestrian Origin-Destination Survey

A pedestrian origin-destination survey was conducted on December 13, 2011. The primary objective for the survey was to determine whether a Southeast-to-Southwest passageway alignment would serve significantly more pedestrians than a Northeast-to-Southwest alignment. The pedestrian usage estimates assume that Metro pedestrians will divert from the northeast corner across Forest Glen Road, to use the SE-SW tunnel, since they would have to cross Forest Glen Road either on the west leg or east leg in any case. Conversely, a Metro pedestrian who arrives on the southeast corner would not be expected to divert to use the NE-SW tunnel, because it would require them to walk further away from their destination.

The O-D survey was performed to verify that a significant number of pedestrians were originating from the south side of Forest Glen Road and that the pedestrians counted in the southeast corner in the original traffic counts were not diverting from the north side of Forest Glen Road. For example, a pedestrian arriving at the southeast corner from the east would have been counted as a pedestrian who would use a SE-SW tunnel, but not a NE-SW tunnel. However, it is possible that the pedestrian crossed

Forest Glen Road further east of the intersection, and thus would actually be served by the NE-SW tunnel alternative. Similarly, the reverse movement is potentially ambiguous, if a pedestrian who travels from the southwest to southeast corner crosses Forest Glen Road to the north at some location further east of the intersection.

The pedestrian origin-destination survey was conducted in the AM and PM peak periods (7AM - 9AM, 5PM - 7PM). Survey personnel were located at each corner of the intersection, and briefly interviewed each person approaching the intersection. The survey staff noted the direction of approach for each respondent, asked what the ultimate destination quadrant (NW, NE, SW, SE) was, and whether the individual had already crossed the road on which they had approached. For example, someone walking westbound along the south side of Forest Glen Road would be asked whether they had already crossed Forest Glen Road. Additionally, anyone traveling to or from the southwest quadrant was also asked whether they were had used/planned to use the Metro station.

The results of the survey at the southeast quadrant showed that while some of the pedestrians had crossed Forest Glen Road further east of the intersection, the number was not very high. For pedestrians who arrived at the southeast corner and were travelling to the southwest corner, 11 out of 52 (21%) in the morning, and 1 out of 13 (8%) pedestrians in afternoon, had already crossed Forest Glen Road and, thus, would likely use a NE-SW tunnel alternative without inconvenience. However, the large majority of pedestrians at the southeast corner originated on the south side of Forest Glen Road and, therefore, would not find the NE-SW tunnel alternative convenient.

Additionally, 23 out of 75 pedestrians interviewed who were crossing Georgia Avenue from the southwest corner, indicated that their destination was in the southeast quadrant. This means that approximately a third of the pedestrians making that movement would not be well served by a NE-SW alternative, but would use a SE-SW alternative. Furthermore, the remaining 52 pedestrians traveling to the northeast quadrant would likely use either of the tunnel alignment alternatives since both are a similar travel distance and both would provide improved safety and a reduction in travel times. Consequently, the O-D survey illustrates that a SE-SW alternative would be expected to accommodate significantly more pedestrians than a NE-SW alternative.

Preferred Tunnel Alternatives

After obtaining feedback from MCDOT, M-NCPPC, WMATA and SHA, reviewing existing building and utility plans, assessing pedestrian volume and operations data and conducting preliminary analysis, the six original concepts were used to develop two preferred tunnel alternatives (1 and 2) for detailed study. Based upon the large pedestrian volume using Metro, it was decided by the Team that any passageway alternative should connect directly to the existing Metro passageway. Therefore, Concepts 1, 3 and 5 were deleted. Concept 4 was retained as Alternative 1 because of its highest estimated usage, shorter length, and lower impacts and costs. Concepts 2 and 6 were reconfigured into Alternative 2 to provide a direct diagonal crossing from the northeast corner of the intersection to the Metro station. Alternative 2 also possesses a high estimated pedestrian usage but has a shorter more direct alignment to the Metro station than Concepts 2 and 6, resulting in a shorter travel distance, reduced travel times and lower impacts and costs.

Tunnel Alternative 1 – Southeast Quadrant to Metro Station

Alignment: Alternative 1 provides an underground passageway between the southeast and southwest corners of the intersection and connects to the existing Metro passageway. This alternative includes a minor "kink" in the alignment near the middle of the passageway. The "kink" is required to make the

connections and avoid interference with below grade service rooms for the existing station. In addition, the alignment avoids conflicts with several major junction boxes and valves under Georgia Avenue.

The east entrance would be located adjacent to the Montgomery Hills Baptist Church. Two elevators and a set of stairs would be provided to access the passageway at the east end. A pair of elevators would also be provided west of Georgia Avenue near the existing station in order to increase convenience for pedestrians originating on the east side of Georgia Avenue who may not be travelling to the Metro station. Similarly, the elevators would provide access to the tunnel and station for disabled persons and for pedestrians who originate on the west side of Georgia Avenue. Per WMATA's policy, two elevators (in lieu of a single elevator) are provided to maintain service during a breakdown or during routine maintenance of the elevators. Closed-circuit cameras, mirrors and other measures would be evaluated during final design to enhance visibility and security for Alternative 1. A reduced size plan of Tunnel Alternative 1 is presented below and full 11"x17" foldout plan is provided in Appendix D.

Profile: The profile for Tunnel Alternative 1 uses a series of ADA-accessible ramps and landings, descending from the existing Metro tunnel. Underneath Georgia Avenue, the profile is at an adequate depth to allow the 24" water main to be located overtop of the tunnel, while maintaining cover and clearance requirements. The profile for Tunnel Alternative 1 can be found in Appendix D.

Tunnel Alternative 2 – Northeast Quadrant to Metro Station

Alignment: Alternative 2 provides a connection between the northeast and southwest corners of the intersection and connects to the existing Metro passageway. It also provides for an optional connection to the northwest corner. The northeast entrance would be located adjacent to the Forest Glen Medical Center and would include a ramp and two elevators to provide ADA compliant access. Similar to Alternative 1, this alternative provides two elevators west of Georgia Avenue for disabled persons and for pedestrians not using the Metro station or not crossing Georgia Avenue. If constructed, the northwest entrance would be provided with two elevators and a set of stairs; care would need to be exercised during construction in this area to avoid impacts to WMATA's vent shafts.

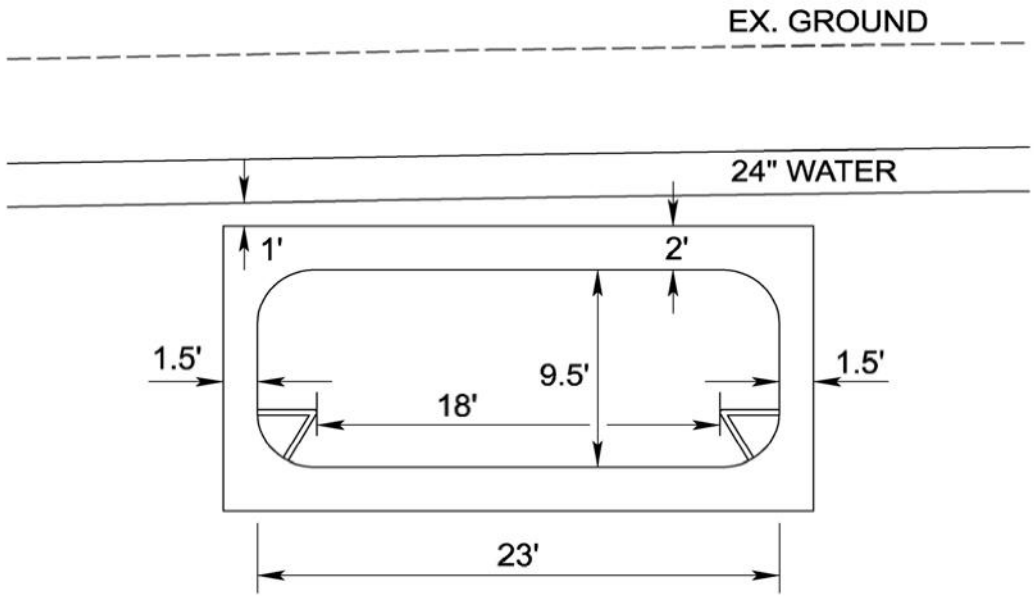
The alignment for Alternative 2 is straight for the majority of the length providing sight lines from one end to the other which creates a safer feeling for users. Closed circuit cameras, mirrors and other security measures would be evaluated during final design to enhance visibility and security. A reduced size plan of Alternative 2 is presented below and full 11"x17" foldout plan is provided in Appendix D.

Profile: The profile for Tunnel Alternative 2 is similar to Tunnel Alternative 1, in that it uses ADA-accessible ramps and landings, and provides for the 24" water main to be located overtop the tunnel. One difference is that this alternative raises back up to access the east side of the intersection via a ramp, instead of staying low and accessing grade only via elevators/stairs. The profile for Tunnel Alternative 2 can be found in Appendix D.

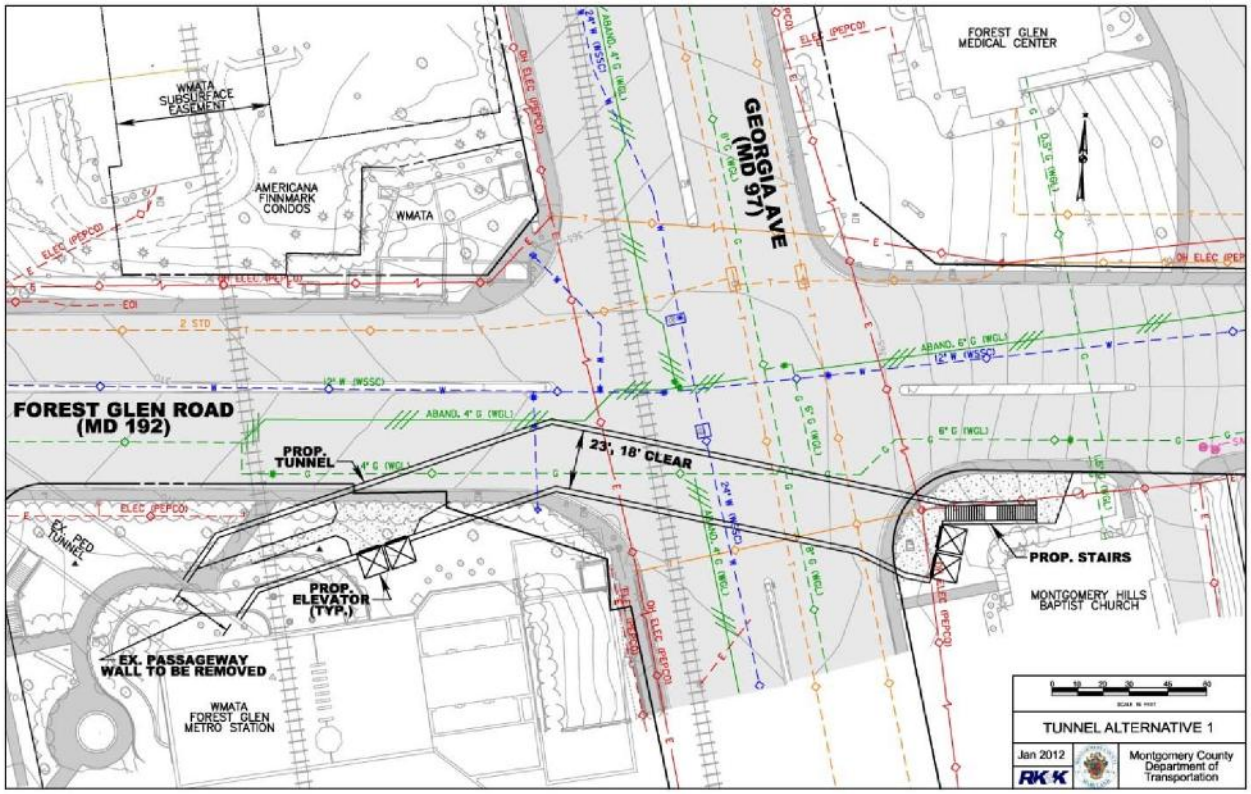
Tunnel Typical Section

Both tunnel alternatives utilize the same typical section, which is based on WMATA requirements and matches the existing pedestrian tunnel dimensions. The tunnels would be 23 feet wide, with rounded corners and railings that would reduce the usable width to a total of 18 feet. The vertical clearance would be 9.5 feet. These dimensions are wider than would strictly be necessary to accommodate pedestrian traffic, and are selected in order to make the tunnel feel more open and safer. The typical section is shown below.

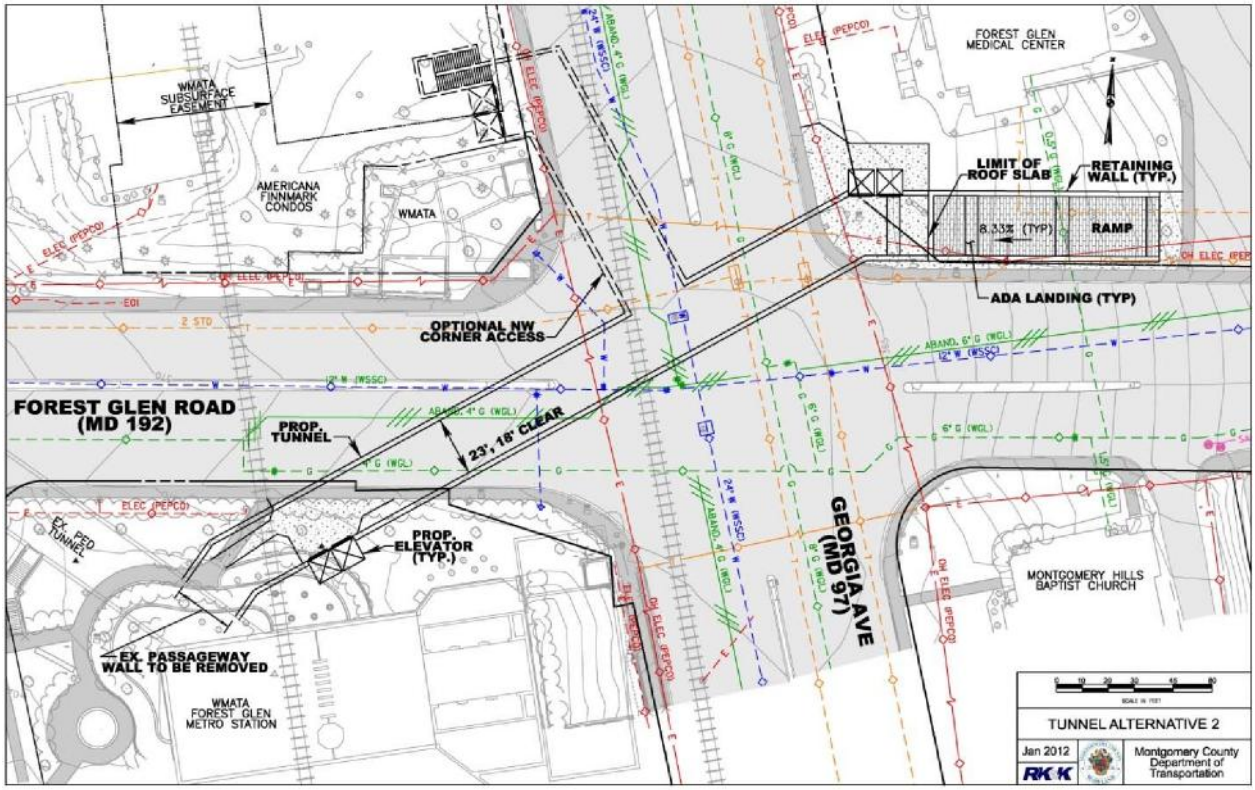
Tunnel Typical Section



Tunnel Alternative 1 –Southeast Quadrant to Metro Station



Tunnel Alternative 2 – Northeast Quadrant to Metro Station



Estimated Time Savings

Tunnel Alternatives 1 and 2 are estimated to save each pedestrian approximately 119 seconds and 103 seconds, respectively. These savings includes time from shorter walking distances, as well as the 71-second average wait time for the pedestrian phase of the traffic signal. For Alternative 1, the total time savings for the estimated 759 pedestrians captured in the 13-hour period would be approximately 25 hours per day. For Alternative 2, that savings for the 461 pedestrians would total 13 hours per day. For vehicular traffic, pedestrians diverting to the proposed tunnel would reduce the number of calls for the extended pedestrian crossing interval, reducing average delay at the intersection. Using a sample of four one-hour periods between 6 AM and 7 PM (including the actual AM and PM peak hours), the average delay reduction per hour due to the pedestrian passageway is 3.2 seconds per vehicle entering the intersection. Based on having 63,603 vehicles entering the intersection during this 13-hour period, the total delay reduction due to the passageway would be 57 hours per day.

Constructability

Construction Methods: A preliminary evaluation of the potential construction methods and phasing was performed to determine the feasibility of constructing a tunnel and to evaluate the potential impacts to traffic and adjacent community facilities. Since the intersection carries a very high volume of vehicular and pedestrian traffic, the ability to implement a safe and efficient construction operation faces several challenges. The ability to close lanes in order to provide work zones during the daytime hours is severely limited since the existing intersection is currently over capacity and lane closures during daytime hours would create significant delays.

To minimize impacts to intersection operations, a goal of the tunnel design is to minimize construction activities from the roadway surface and to maximize operations below grade. Furthermore, most surface activities will need to be restricted to night time operations when traffic volumes are lower and lane closures can be more readily accommodated. Various construction methodologies for the proposed passageway were considered. Because of the desire to tie the tunnel into the existing tunnel and station entrance located approximately 20 feet below grade, the depth of the proposed passageway is relatively shallow. Therefore, the use of a tunnel boring machine was not considered because the required cover for such methods is significantly greater and would push the required invert of the passageway deeper and make it impossible to make a simple connection to the existing passageway. In addition, the initial cost for mobilization of a tunnel boring machine is high and would not be cost effective for the short length of tunnel needed for this project. Therefore, shallow tunneling and cut and cover methodologies were evaluated as more effective and economical approaches for the Forest Glen Passageway. Various excavation systems for constructing a pedestrian tunnel underneath Georgia Avenue are presented below.

Horizontal Jet Grouting: Horizontal jet grouting involves producing a fan array of horizontal concrete piles above the top of the tunnel to support the earth/roadway during construction of the tunnel. The horizontal piles are produced from successive headings in which horizontal holes are augered and filled with high strength grout. Additional holes are augered and grouted until an arch shape is formed above the tunnel site. Excavation can then proceed beneath the grouted arch to construct the proposed tunnel. The advantage of horizontal jet grouting in an arch shape over conventional cut-and-cover techniques is that this technique can be employed under live load, eliminating the need for maintenance of traffic and allowing the work to be completed faster. However, horizontal jet grouting induces large pressures on the adjacent soil and existing utilities and would try to heave the roadway surface. In addition, the required geometry of the arch to accommodate a 23' wide passageway while providing sufficient roadway and utility clearance does not make this option feasible. The required depth of the tunnel would be excessive and would not enable the tunnel to be constructed with grades meeting ADA guidelines that could still be tied into the existing tunnel or station. Therefore, all access to the tunnel in the NE, SE or SW quadrants would need to be achieved via elevators, which would increase travel times and make the tunnel less convenient for pedestrians.

Cut and Cover: Because of the shallow depth of the tunnel, the most practical construction technique is cut-and-cover. The approach would include installation of temporary support of excavation and decking around the proposed tunnel site to maintain roadway traffic operations while permitting construction of the tunnel below the decking. The temporary support of excavation would consist of a soldier pile and lagging wall that would support steel beams and timber decking that would act as a temporary bridge over the tunnel site to maintain traffic. Diaphragms would be utilized between beams to provide lateral stability. All temporary support of excavation construction would be performed from the roadway surface during night time hours while the construction of the proposed tunnel could be performed during daytime hours underneath the temporary decking.

Secant Pile Wall: A secant pile wall would consist of augering approximately 600 holes within Georgia Avenue and filling the holes with grout to form the temporary support walls around the tunnel site. Then, the roadway surface would be excavated and precast planks would be installed to form a temporary bridge over the tunnel site so that traffic could be maintained on Georgia Avenue. After the planks are installed, excavation for the tunnel would proceed beneath the temporary bridge. Tie-backs or another strengthening system would need to be installed to provide lateral stability to the grouted columns. This option would not allow construction to proceed any faster than utilizing soldier piles and

lagging and would be less economical. The advantage of this type of system would be that it could potentially be designed to be incorporated into the final structure.

Construction Duration and Phasing: The estimated construction duration for the tunnel alternatives is approximately 39 months. Activities during the first 18 months would be performed during nighttime hours and would include relocating utilities and constructing the temporary support of excavation and decking. After completing the temporary support of excavation system, the proposed tunnel excavation and construction would be completed during daytime hours from below the existing roadway. A detailed sequence of construction for the cut-and-cover tunnel utilizing a soldier pile and lagging wall support of excavation system is presented below.

I. Phase One – Advanced Utility Relocations – 6 months

1. Sequentially relocate overhead utility poles, power and communication lines.
2. Concurrent with the overhead utility relocation, relocate underground utilities such as water and gas lines and communication duct banks along with their related manholes and vaults.
3. Once the overhead and underground utilities have been relocated, staging areas that were used by the utility contractors can be converted to staging areas for construction of the passageway.

II. Phase Two – Install Initial Support of Excavation – 6 months

1. Establish staging areas to store equipment during non-work hours and stockpile materials.
2. To ensure traffic can be restored for each peak traffic period, construction methods will have to be implemented to limit construction impacts on surfaces that will have to be returned to service. Installation of the support pile will start with saw cutting a 3 foot square in the existing pavement and removing the section of roadway. To expedite work, saw cutting may be done in advance of the augering operation.
3. During overnight hours, remove a section of pavement and position a drill rig over the saw cut opening and drill a hole for the pile. If unstable soils are encountered, a casing or sleeve may have to be lowered into the hole to prevent soil from sloughing into the excavation.
4. After all of the spoil has been removed, lower a soldier pile into the augered hole, align the pile, and fill the bottom 10 feet ± of the hole with concrete followed by lean grout or flowable fill to within 6 inches of the surface of the roadway. Set and secure a steel plate over the hole. After the grout has gained sufficient strength, remove the steel plate and fill the void with temporary asphalt. Typically, the steel plates can be removed and asphalt placed the night after the pile was set and grouted. In some instances, overhead obstructions may require splicing two short sections of pile to complete the installation. Pile installation will be completed at the rate of approximately 1 per night.
5. Repeat steps 2 through 4 to install all of the remaining soldier piles.
6. Where it will not excessively impact Maintenance of Traffic operations, Phase Three - Install Deck over Structure may be allowed to commence while the last of the remaining piles are being installed.

III. Phase Three – Install Deck over Structure – 6 months

1. Saw cut the existing pavement and excavate a trench between two piles to install a steel beam. Once the beam is set, cover the trench with steel plates to restore traffic.
2. During subsequent nights, saw cut and excavate for setting additional beams and diaphragms. Remove the pavement between beams and install timber mats. Any gaps between the timber mats and existing pavement shall be covered with steel plates.

3. Progress the installation of the beams and timber mats along the alignment of passageway.

IV. Phase Four- Excavate for Passageway and Support Remaining Utilities – 3 months

1. Without adversely affecting traffic, the first level of excavation can commence while the remaining sections of beams and timber mats are being installed. Excavation of the first level will require temporary removal of timber mats so that the spoil can be removed from above.
2. While excavating spoil from the first level, lagging will be placed between the soldier piles and support systems will be installed to maintain the existing underground utilities within the alignment.
3. As installation of the utility supports and excavation of the first level of spoil progresses along the alignment, excavation of spoil within the deck over structure (under the temporary bridge) can commence. This will require excavating material from a vertical face, placing the spoil in carts and hauling the carts to the end of the passageway, dumping the carts and returning them to the face or heading of the mining operation. Except for loading out the dump trucks, mining of spoil can be done with little or possibly no impacts to traffic.
4. As the second level of excavation nears completion, pipe struts and wales shall be set to brace the soldier piles prior to excavating and installing lagging through the third and final level of excavation. It is important to note that once the lower strut is set, access to the work below the strut becomes more difficult. For example, spoil below the strut will have to be raised to a level above a cart that will be riding on tracks that are supported by the struts. Similarly, lagging will have to be transported in carts and then lowered into the excavation.
5. Once the excavation reaches bottom, approximately 1.5 feet of No. 57 Stone will be placed to act as a drainage layer for the underdrain system and as a work platform for constructing the invert.

V. Phase Five - Building the Passageway – 12 months

1. Using the No. 57 Stone as a work platform and soldier piles and lagging as an exterior form, place reinforcing steel for the invert of the passageway.
2. After the reinforcing steel for the invert is in place, the starter walls and keyways shall be formed by suspending the formwork from the struts followed by placing concrete in the invert and subsequently stripped and cured.
3. Once the invert concrete has attained sufficient strength, the lower wales and struts can be removed.
4. Working from one end towards the other, or both ends towards the middle, precast wall and roof segments can be set on rubber tired transport frames, wheeled into position, lowered onto the invert followed by grouting and post tensioning the joints.

VI. Phase Six - Backfill and Roadway Restoration – 6 months

1. As the installation of the precast segments progresses toward the end of the passageway, the void between the passageway wall and the support of excavation can be filled with lean grout followed by the waterproofing of the roof and backfilling to the underside of the support beams. Work above the passageway roof may require temporary removal and resetting of the timber mats.
2. As areas of the passageway roof are backfilled to the underside of the beams, the timber mats, beams and diaphragms can be removed to allow for reconstruction of the roadway.

3. Upon completion of the removal of the entire deckover system, the temporary asphalt roadway surface can be milled and overlaid with surface asphalt followed by placing the final pavement markings.

Maintenance of Traffic (MOT)

As presented above, the installation of soldier piles, as well as excavation and placement of the deck-over structure will require overnight work within the intersection and within the travel lanes of Georgia Avenue and Forest Glen Road. In order to provide adequate work zones for the required construction equipment, it is anticipated that as many as three out of the four through lanes in each direction would need to be closed during the overnight construction period. A traffic analysis was performed to assess the impacts of the closure and to determine feasible work hours for the project. To perform the traffic analysis for this closure, the 13-hour daytime turning movement counts collected for the study were combined with 24-hour volumes provided by SHA, in order to create an estimate of the overnight turning movements for analysis in Synchro (v8.0).

The Synchro analysis indicates that with the northbound and southbound legs reduced to one lane in each direction, the intersection would function at a level of service (LOS) D or better only between the hours of 10 PM and 6 AM. This analysis assumes all turning movements (i.e., lefts, throughs, and rights) would be permitted from this single lane. To simplify traffic operations and enhance safety, an alternative traffic management plan is to eliminate the left turn movements from Georgia Avenue**, and** all left and through movements from Forest Glen Road. This would allow the intersection to operate as a two-way stop-controlled intersection, with the signal indications for Georgia Avenue on flashing yellow and Forest Glen flashing red. This flashing signal operation would reduce the overall delay.

A preliminary work zone queuing analysis was also performed using LCAP Basic (v1.2) to verify that the multiple-lane closures along Georgia Avenue would not generate excessive queues. This preliminary evaluation shows, for the southbound direction, no queues would be generated when the lane closures are established at 10 PM, but there would be a queue of approximately $^1/_3$ mile between 5 – 6 AM, which would dissipate quickly once the lane closures are removed at 6 AM. For the northbound direction, a queue of approximately $^1/_3$ mile would form between 10 – 11 PM when the lane closures are established at 10 PM. The queue would then dissipate prior to 11 PM, and no queue would be present when the lanes are re-opened by 6 AM.

The Work Zone queue lengths are based only on the delays/congestion caused by the lane drops and closures. The fact that the northbound queue would overlap adjacent signals and the Capital Beltway ramps will further complicate operations and may increase actual delays. Additional detailed work zone traffic analysis will be required during the design phase using Synchro to ensure that the lane closures do not cause excessive queues on the Beltway ramps.

In summary, the maintenance of traffic analysis shows that while there would be delays caused by the anticipated lane closures, the delays would be reasonable, and the intersection should be able to maintain a satisfactory level of service during night time work operations. Additionally, all of the above analysis assumes no reduction in traffic volumes; experience indicates that some drivers will divert to alternative travel routes during construction which would improve actual travel operations at the project site.

Property Impacts

Tunnel Alternative 1 will require the acquisition of approximately 2200 square feet of property from the Montgomery Hills Baptist Church in the southeast quadrant of the intersection to construct the eastern entrance to the passageway.

Tunnel Alternative 2 will require the acquisition of approximately 5700 square feet of property from the Forest Glen Medical Center in the northeast quadrant of the intersection to construct the eastern entrance to the passageway.

Both alternatives will require permits from WMATA and SHA to construct the passageway within their existing property/right-of-way.

Environmental Impacts

Both alternatives will require removal of mature street trees and landscaping on the WMATA Metro Station site and a few isolated trees on the Forest Glen Medical Center or Montgomery Hills Baptist Church sites. The Montgomery Hills Baptist Church is also being evaluated to determine its potential eligibility for the National Register of Historic Places. If the church is determined to be eligible for the National Register, the potential affects to the property would need to be assessed in accordance with Section 106 of the National Historic Preservation Act of 1966 (NHPA).

Utility Impacts

The construction of an underground passageway will require relocation of several overhead and underground utilities as listed in the table below.

Table 5: Utility Relocation Required

Utility		Tunnel Alternative 1	Tunnel Alternative 2
WSSC Water	24" Main	200 LF*	200 LF*
	12" Main	-	200 LF*
	Fire Hydrant Service Lines	1 Ea.	2 Ea.
Verizon Underground Telephone†	Duct	-	-
	Vault	-	-
Washington Gas	8" Main	100 LF	100 LF
	6" Main	50 LF	-
	4" Main	200 LF	75 LF
Pepco Overhead Electric, Comcast Telephone, Cable	Poles	2 Ea.	2 Ea.
	Vertical Adjustment	-	-

*Water main relocation lengths include both interim and ultimate water main relocation to address WSSC requirements for pipe bedding/compaction.
†Avoidance of impacts to underground telephone ducts was prioritized due to high cost and delay for relocation of active fiber optic lines.

Construction Costs

The estimated construction costs for Tunnel Alternatives 1 and 2 are $11.5M and $12.1M, respectively. The cost difference comes from a small difference in tunnel length (Tunnel 1 being slightly shorter), costs associated with construction of the ramp for Tunnel 2, and utility relocation costs being slightly higher for Tunnel 2. Itemized cost estimates are provided in Tables 5 and 6 below.

Table 6: Construction Cost Estimate for Alternative 1 - Southeast Quadrant to Metro Station

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
1	Support of Excavation	SF	12,200	$60.00	$732,000.00
2	Auger for Piling	LF	2,730	$100.00	$273,000.00
3	Drilled Shaft	LF	780	$500.00	$390,000.00
4	Low Strut	LF	1,170	$62.50	$73,125.00
5	Girder	LF	1,248	$125.00	$156,000.00
6	Diaphragms	LF	915	$40.00	$36,600.00
7	Timber Decking	SF	7,680	$15.00	$115,200.00
8	Excavation	CY	6,778	$75.00	$508,350.00
9	Stone Base	SF	9,150	$15.00	$137,250.00
10	Concrete Passageway	CY	1,830	$1,500.00	$2,745,000.00
11	Demolition	CY	18	$750.00	$13,500.00
12	Pile Set-ups	NIGHTS	78	$2,500.00	$195,000.00
13	Maintenance of Traffic	LUMP	1	$640,000.00	$640,000.00
14	Utility Relocation	LUMP	1	$450,000.00	$450,000.00
15	Backfill	CY	2,530	$50.00	$126,500.00
16	Roadway Restoration	SF	7,680	$75.00	$576,000.00
17	Stair Construction	EA	1	$100,000.00	$100,000.00
18	Elevators	EA	4	$400,000.00	$1,600,000.00
					SUBTOTAL $8,867,525.00
					Contingency 30% $2,660,258.00
					TOTAL COST $11,527,783.00

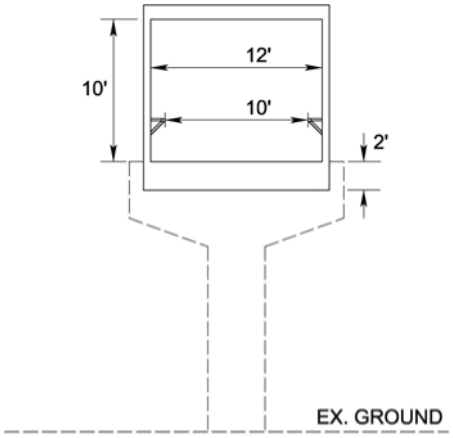
Table 7: Construction Cost Estimate for Alternative 2 - Northeast Quadrant to Metro Station

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
1	Support of Excavation	SF	12,600	$60.00	$756,000.00
2	Auger for Piling	LF	2,870	$100.00	$287,000.00
3	Drilled Shaft	LF	840	$500.00	$420,000.00
4	Low Strut	LF	1,230	$62.50	$76,875.00
5	Girder	LF	1,312	$125.00	$164,000.00
6	Diaphragms	LF	945	$40.00	$37,800.00
7	Timber Decking	SF	7,680	$15.00	$115,200.00
8	Excavation	CY	7,000	$75.00	$525,000.00
9	Stone Base	SF	9,450	$15.00	$141,750.00
10	Concrete Passageway	CY	1,890	$1,500.00	$2,835,000.00
11	Demolition	CY	18	$750.00	$13,500.00
12	Pile Set-ups	NIGHTS	82	$2,500.00	$205,000.00
13	Maintenance of Traffic	LUMP	1	$640,000.00	$640,000.00
14	Utility Relocation	LUMP	1	$560,000.00	$560,000.00
15	Backfill	CY	2,613	$50.00	$130,650.00
16	Roadway Restoration	SF	7,680	$75.00	$576,000.00
17	Ramp Construction	EA	1	$200,000.00	$200,000.00
18	Elevators	EA	4	$400,000.00	$1,600,000.00
					SUBTOTAL $9,283,775.00
					Contingency 30% $2,785,133.00
					TOTAL COST $12,068,908.00

V. Pedestrian Bridge Alternatives Evaluation

Bridge Typical Section and Design Parameters

In addition to evaluating underground tunnel alternatives, MCDOT also evaluated the feasibility of constructing an overhead pedestrian bridge across Georgia Avenue. Preliminary analysis and design of the pedestrian bridge alternatives was conducted in accordance with the AASHTO LRFD Guide Specifications for Design of Pedestrian Bridges, the ADA Accessibility Guidelines for Buildings and Facilities (ADAAG) and the WMATA Manual of Design Criteria for Maintaining and Continued Operation of Facilities and Systems. The proposed pedestrian bridge would have a clear walkway width and a vertical interior clearance of 10'-0" which is similar to, or greater than, other pedestrian bridges in WMATA's system. A 10'-0" clear width would accommodate 3-4 pedestrians walking abreast and allow pedestrians to easily pass each other without feeling confined. A narrower width can be utilized for the pedestrian bridge option as compared to the tunnel option since the tunnel requires a larger width to facilitate user comfort and provide a feeling of safety and security.



FOREST GLEN BRIDGE SECTION

Several bridge types were considered for the crossing including a steel girder superstructure and a pre-fabricated steel truss. A prefabricated steel truss bridge has several potential advantages for the site including faster erection times and lower cost. In addition, the prefabricated truss design places the deck between the structural members of the truss as opposed to a girder bridge which places the deck on top of the steel girders. As a result, the prefabricated truss bridge can be constructed at a lower elevation above the roadway surface which reduces the number of stairs and overall height of the bridge structure. Since the greatest span is very long (approximately 170 feet), the truss would need to be shipped in 3 sections and spliced together at the project site.

Bridge Alignment and Profile

The proposed alignment for the pedestrian bridge would begin in the southeast corner of the intersection on the Montgomery Hills Baptist Church property and extend across the south leg of the intersection to the Forest Glen Metro Station in the southwest corner of the site. The south leg alignment was selected because this location will maximize the potential usage of the bridge as presented above for the traffic analysis and the tunnel evaluation. Three alternatives were developed for the proposed bridge alignment These three (3) alternatives are each comprised of a 270-foot +/-long, two-span bridge with a center pier located on the west side of the intersection. The center pier is located immediately west of the below-grade portion of the Metro station. Access to the bridge will be provided by elevators and stairs on each side of the intersection. An option of utilizing a ramp for a bridge alternative is not feasible due to the length of ramp that would be required to meet ADA criteria.

The alignments for each of the three alternatives are very similar with the primary differences being focused on the connection to the existing Metro Station. The features of each alternative are described below. Plans for each alternative are also presented below and full size 11"x17" drawings are provided within Appendix E.

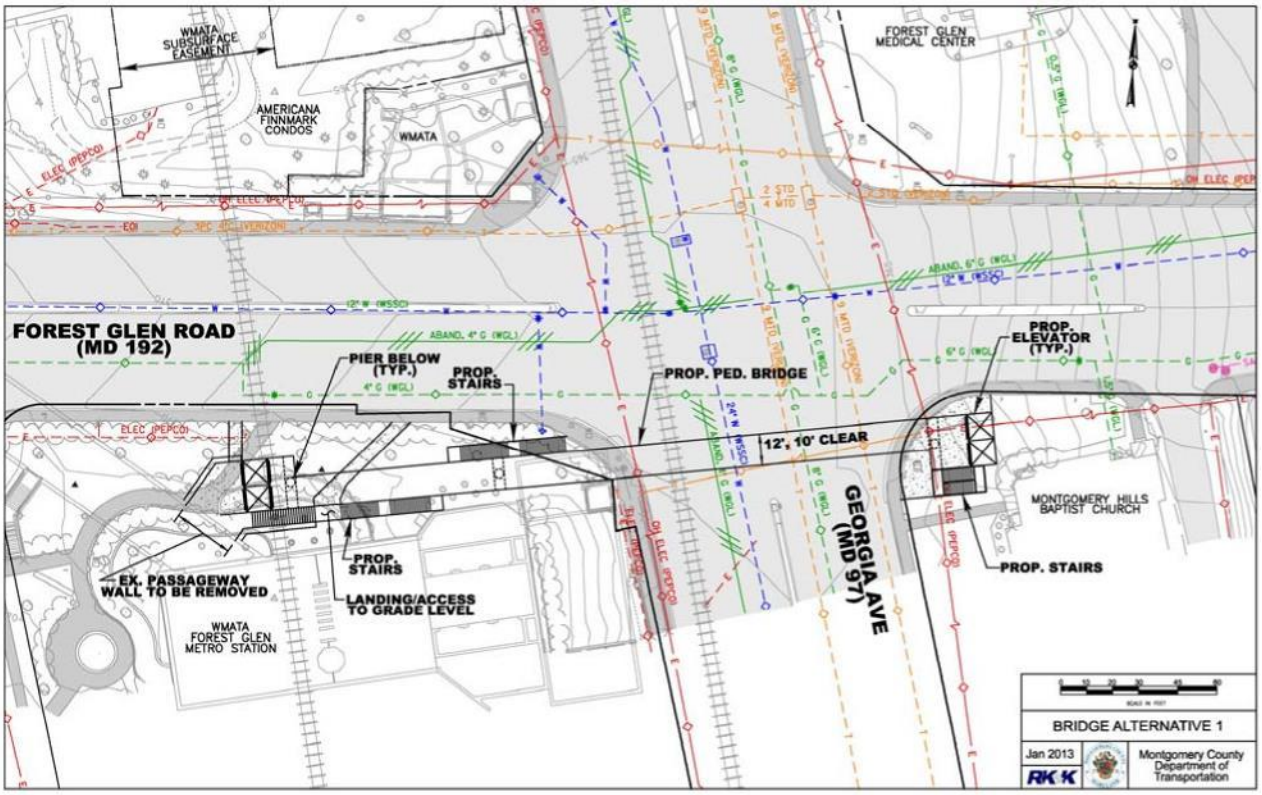
Bridge Alternative 1 was developed to facilitate a connection between the bridge and the existing Metro passageway instead of the station as proposed under Alternative 1. The bridge alignment would be straight. Modifications and demolition to the existing Metro passageway would need to be conducted and a short passageway would need to be constructed to facilitate the new connection. The west end of the bridge would include two (2) elevators and a straight run of stairs that would provide access into the existing tunnel under Forest Glen Road. Similar to Alternative 1, these elevators and stairs would be designed to provide access to the ground level at Forest Glen Road in addition to the station and bridge deck levels. The proposed connection would not require any modifications to the station structure and would not require any temporary or permanent modifications to station operations. The elevator and stair layout at the east end has been designed to be as compact as possible to limit impacts to the Montgomery Hills Baptist Church property.

Bridge Alternative 2 was developed to facilitate a connection directly to the existing Metro station, as close to the existing station wall as possible. Therefore, a slight kink in the bridge alignment was incorporated at the center bridge pier to align the western elevators directly with the station wall. Two (2) elevators and a stairway with switch-backs would be provided at each end of the bridge. A landing with the same width as both elevators is presented at the east end to provide a 10-foot queuing distance. The eastern pier would be set back to the point where the bridge transitions to the narrower width and a cantilever slab or bracket from the pier cap will be utilized to serve as the landing. The elevator and stair layout shown at the east end of the bridge is similar to that of Alternative 1.

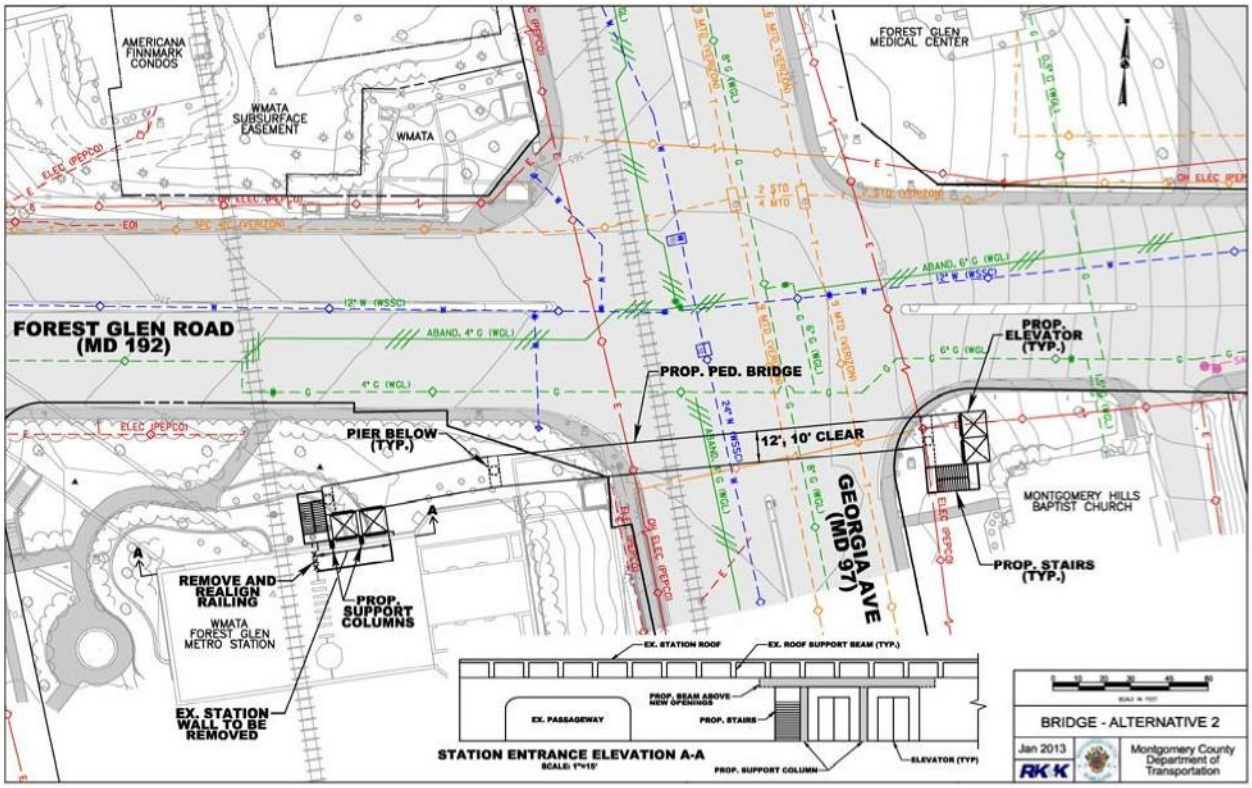
Alternative 2 requires modification to the existing Metro station walls to provide access from the bridge to the station. To provide an opening in the station walls for the elevators and stairs from the bridge, a portion of the station wall would need to be demolished and structural modifications would be required to the wall to provide adequate support for the station roof beams. The roof beams would need to be temporarily supported during the demolition process and then new support columns and beams would be constructed to facilitate the new opening and support of the station roof. In addition, modifications to the fare gates and vending areas within the station would be required to provide adequate queuing distance to the new elevators and stairway. The new elevators and stairs to the Metro station would provide stops/access to the station, ground level (Forest Glen Road) and the bridge deck.

Bridge Alternative 3 connects directly to the Metro station similarly to Alternative 1, except that the bridge alignment is straight. To maintain the straight alignment, the western terminus of the bridge is offset from the station and a small lobby area/passageway would need to be constructed at the west end to facilitate connection to the existing station. As with Alternative 1, modifications and demolition to the existing station wall would need to be conducted, including installation of a new support beam over the new elevator/stairway opening to support the existing roof beams. Modifications to the fare gates, vending and paid areas inside the station would also be necessary. The elevator and stair layout at the east end would be similar to Alternatives 1 and 2.

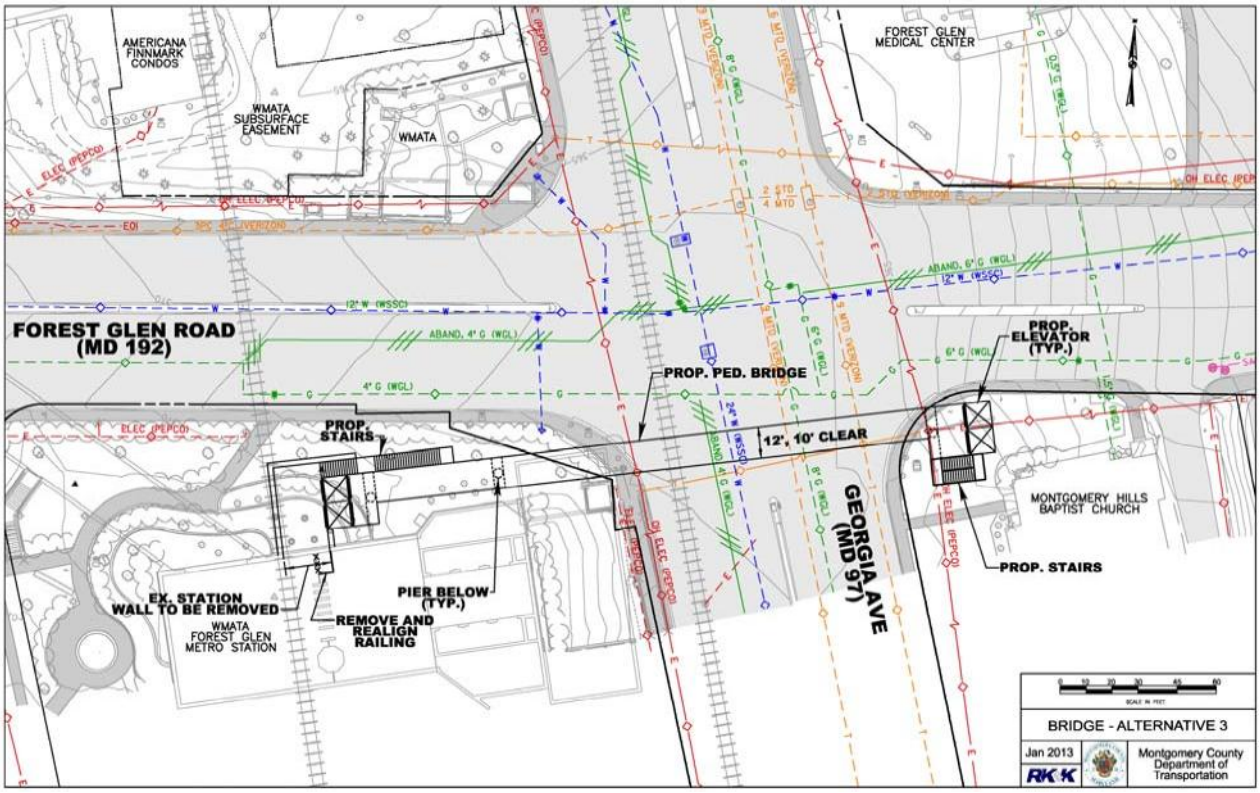
Bridge Alternative 1 – Connection to Existing Passageway



Bridge Alternative 2 – Direct Connection to Existing Station



Bridge Alternative 3 – Straight Bridge Alignment with Indirect Connection to Existing Station



Preferred Bridge Alternative

Based on comments and feedback collected from MCDOT, M-NCPPC, WMATA and SHA, the Study Team selected Bridge Alternative 1 as the preferred bridge alternative because it would not require modifications to the existing station walls and would not require temporary and permanent modifications to the existing fare gates and fare operations. Bridge Alternative 1 was also modified to include an additional straight-run stairway near the center pier to provide access to the bridge from the west side of Georgia Avenue. This would provide pedestrians not needing to use Metro to quickly cross from the east side to the west side of Georgia Avenue, and vice versa, by using these added stairs instead of having to travel to the western end of the bridge. The updated Bridge Alternative 1 layout is provided in Appendix E.

Architectural Features

The frame formed by the prefabricated steel truss will be enclosed with metal mesh/fabric to provide safety, security and visibility into and from the bridge, while also accommodating air flow and ventilation. A glass enclosure was not preferred by the team because it restricts air flow and can create high temperatures within the enclosure during the summer. Glass also requires routine cleaning to maintain visibility and is more costly. The roof may be constructed of translucent polycarbonate panels or architectural fabric to protect the bridge and pedestrians from inclement weather while also allowing daylight into the walking space.

Consideration can also be given to photovoltaic panels on the roof to provide power for interior lighting. Consistent lighting within the walking space would be designed to avoid glare and dark spaces. The bridge elevator towers will be constructed of metal framing with a glass enclosure to allow high visibility into and out of the elevators. Terra cotta baguettes, or similar small scale materials, can be applied at

the base. Bicycle trays will be provided on the stairs. A 10 ft. clear queuing space adjacent to the elevators and clear access to the stairs and elevators will be provided for patrons.

Optional architectural features for the plaza at street level that may also be considered include:

- Pervious paving
- Pedestrian scale lighting
- Low maintenance rain garden type landscaping for stormwater management
- New tree plantings where space permits
- Bicycle storage
- Seating
- Signage

Architectural renderings and enclosure details for Bridge Alternative 1 are provided in Appendix F.

Pedestrian Usage

Pedestrian bridges frequently have lower utilization rates as compared to pedestrian tunnels, when considering similar amounts of time savings. Fortunately, Bridge Alternative 1 provides direct access to the Metro station passageway and pedestrian counts indicate that approximately 97% of pedestrians crossing Georgia Avenue are destined or originating from the Metro station. Additionally, the traffic signal at this intersection has such a long cycle length (150 seconds) that the bridge will represent significant time savings, further increasing the expected utilization. Based on research summarized by AASHTO and ITE, approximately 90% (683 of the estimated 759 pedestrians) of pedestrians would be anticipated to utilize Bridge Alternative 1 in lieu of the existing at-grade crossing. The goal of the bridge design will be to provide clear visibility, easy access via elevators and stairs, good air circulation, protection from inclement weather, and an attractive design that enhances usage, comfort and safety.

Constructability

Construction Methods: A preliminary evaluation of the potential construction methods and phasing was performed to determine the feasibility of constructing a bridge and to evaluate the potential impacts to traffic and the adjacent facilities. As noted previously for the tunnel alternatives, the intersection carries a very high volume of vehicular and pedestrian traffic, and the ability to implement a safe and efficient construction operation faces several challenges. The ability to close lanes in order to provide work zones during the daytime hours is severely limited since the existing intersection is currently over capacity and lane closures during daytime hours would need to be minimized. Another significant obstacle for constructing a bridge is the presence of several overhead electrical, communication, and traffic signal utilities along Georgia Avenue.

Major below grade construction requirements include the foundation construction for the three bridge piers. Existing soils data and information from prior projects indicates that the bridge will likely need to be supported by piers with deep foundations. It is anticipated that the piers will consist of a cap, single circular column, and foundation with micropiles. Micropiles can be efficiently installed without impacting the existing Metro station or tunnels below.

Construction Duration and Phasing: The construction of a pedestrian bridge is estimated to require approximately 15 months, significantly less time than the 39 months estimated for the tunnel alternatives. Most of the construction is anticipated to occur during off-peak daytime hours with the potential closure of the curbside lane along eastbound Forest Glen Road. The erection of the

prefabricated truss bridge will require a late night closure and detour of Georgia Avenue. Construction of the bridge deck and enclosure will also require lane closures along Georgia Avenue and associated night time work.

A detailed sequence of construction for Bridge Alternative 1 is presented below.

I. Phase One – Advanced Utility Relocations and Support of Excavation – 3 months

1. Sequentially relocate overhead utility poles, power and communication lines.
2. Establish staging areas to store equipment during non-work hours and stockpile materials.
3. Install support of excavation system adjacent to existing station and passageway and excavate soil to construct new entrance.

II. Phase Two – Modify Existing Passageway and Construct New Passageway and Pier at West End of Bridge – 3 months

1. Install temporary support for roof slab of existing passageway.
2. Saw cut opening in passageway wall for new entrance.
3. Install beams as required to support roof slab.
4. Construct passageway at west end of bridge and adjacent pier. The pier could also be incorporated into the support of excavation system.

III. Phase Three – Construct Piers at Midspan and East End of Bridge – 3 months

1. Construct the remaining two pedestrian bridge piers, one at the east end of the bridge and one near midspan, west of the below grade service rooms.
2. Relocate signal poles in which visibility is affected by the bridge.

IV. Phase Four – Install Pedestrian Bridge Superstructure – 3 months

1. Completely close Georgia Avenue and Forest Glen Road at the intersection for 1-2 nights and install the pedestrian bridge. The bridge could potentially be staged along Forest Glen Road, moved into place and erected in a single night. On successive nights, with multiple-lane closures, install the deck and bridge enclosure.

V. Phase Five – Install Elevators and Stairs and Restore Site – 3 months

1. Install the elevators and stairs at each end of the bridge and restore the site.

Maintenance of Traffic (MOT) - Impacts and Constraints

As noted above, a large portion of the bridge alternative can be constructed during daytime hours with a single lane closure along the eastbound curb lane to provide access for construction vehicles and equipment. Erection of the prefabricated truss bridge would be performed under a complete closure of Georgia Avenue for 1-2 night time periods. Temporary detours would need to be installed for the night time closures. Construction of the bridge deck and enclosure would be performed with lane closures during night time hours. To accelerate deck construction and minimize the night time lane closures on Georgia Avenue, precast concrete deck sections could be installed in lieu of cast in place concrete. The precast sections would be post-tensioned and grouted together.

Property Impacts

Bridge Alternative 2 will require the acquisition of approximately 1500 square feet of property from the Montgomery Hills Baptist Church in the southeast quadrant of the intersection to construct the eastern access to the bridge.

The alternative will also require permits from WMATA and SHA to construct the bridge within their existing property/right-of-way.

Environmental Impacts

Bridge Alternative 2 will require removal of mature street trees and landscaping on the WMATA Station site and landscaping in the vicinity of the Montgomery Hills Baptist Church. The Montgomery Hills Baptist Church is also being evaluated to determine its potential eligibility for the National Register of Historic Places. If the church is determined to be eligible for the National Register, the potential affects to the property would need to be assessed in accordance with Section 106 of the National Historic Preservation Act of 1966 (NHPA).

Utility Impacts

The construction of a pedestrian bridge over Georgia Avenue would require relocation of several overhead electric, telephone and cable television utilities that are currently located on poles along southbound and northbound Georgia Avenue. It is anticipated that two poles would need to be relocated laterally, and seven poles would need vertical adjustment in order to maintain adequate clearances to the proposed bridge structure.

Construction Costs

The estimated construction cost for Bridge Alternative 1 is $5.8M. An itemized estimate is presented below in Table 8.

Table 8. Construction Cost Estimate for Pedestrian Bridge Alternative 1.

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
1	Pedestrian Bridge w/ Enclosure	SF	3120	$350.00	$1,092,000.00
2	Support of Excavation	SF	2400	$60.00	$144,000.00
3	Excavation	CY	889	$75.00	$66,675.00
4	Stair Construction	EA	3	$100,000.00	$300,000.00
5	Modify Metro Station	LUMP	1	$150,000.00	$150,000.00
6	Utility Relocation	LUMP	1	$500,000.00	$500,000.00
7	Traffic Signal Replacement	LUMP	1	$250,000.00	$250,000.00
8	Maintenance of Traffic	LUMP	1	$100,000.00	$100,000.00
9	Site Restoration	LUMP	1	$300,000.00	$300,000.00
10	Elevators	EA	4	$400,000.00	$1,600,000.00
	SUBTOTAL $4,502,675.00 Contingency 30% $1,350,803.00 TOTAL COST $5,853,478.00				

VI. Alternatives Evaluation Summary

Alternatives

MCDOT evaluated three alternatives for a proposed grade separated pedestrian crossing of Georgia Avenue at Forest Glen Road to improve pedestrian safety and access to the Forest Glen Metro Station. The three alternatives include:

1. **Tunnel Alternative 1:** Underground passageway from the southeast quadrant of the intersection to the Forest Glen Metro Station in the southwest quadrant.
2. **Tunnel Alternative 2:** Underground passageway from the northeast quadrant of the intersection to the Forest Glen Metro Station in the southwest quadrant.
3. **Bridge Alternative 1:** Pedestrian bridge from the southeast quadrant of the intersection to the Forest Glen Metro Station in the southwest quadrant.

Evaluation

The alternatives evaluation considered operational performance, pedestrian usage, construction requirements, traffic impacts, environmental impacts, and cost. A summary of the alternatives evaluation is presented in the table below.

Table 9: Comparison of Alternatives

	Tunnel Alternative 1 (SE Quadrant to Metrorail Station)	Tunnel Alternative 2 (NE Quadrant to Metrorail Station)	Bridge Alternative 1 (SE Quadrant to Metrorail Station)
Preferred Alternative	No	**Yes**	No
Length	303 Ft	334 Ft	270 Ft
Width	23 Ft (18 Ft Clear)	23 Ft (18 Ft Clear)	12 Ft (10 Ft Clear)
Estimated Pedestrian Usage (Crossing MD 97 / Day)	834	799	751
Average Travel Time Savings (Sec/Pedestrian)	119	95	57
Americans and Disability Act (ADA) Compliance	Yes (Elevators)	Yes (Elevators/Ramp)	Yes (Elevators)
Construction Duration	39 months	39 months	15 months
Maintenance of Traffic	• Partial Night Time Work (18 months) • Overnight Lane Closures to 2-3 Lanes on Georgia Ave and Forest Glen Rd	• Partial Night Time Work (18 months) • Overnight Lane Closures to 2-3 Lanes on Georgia Ave and Forest Glen Rd	• Partial Night Time Work (3 months) • Overnight Lane Closures to 2-3 Lanes on Georgia Ave. • Single overnight complete closure of Georgia Ave
Properties Impacted	1 Property (2,200 Square Feet)	1 Property (5,700 Square Feet)	1 Property (1,500 Square Feet)

	Tunnel Alternative 1 (SE Quadrant to Metrorail Station)	Tunnel Alternative 2 (NE Quadrant to Metrorail Station)	Bridge Alternative 1 (SE Quadrant to Metrorail Station)
Natural Resource Impacts	Low	Low	Low
Cultural Impacts	Potential Impacts to Montgomery Hills Baptist Church	None	Potential Impacts to Montgomery Hills Baptist Church
Utility Impacts	High - Underground, overhead, and traffic signal	High - Underground overhead, and traffic signal	Moderate - Overhead and traffic signal
Construction Cost	$11.5M	$12.1M	$5.8M
Total Cost*	$15.6M	$17.9M	$8.6M

* Total Cost includes Construction, Planning, Engineering, Land Acquisition, Tunnel/Bridge, and Bike Share Stations.

Preferred Alternative

The preferred alternative is Tunnel Alternative 2, which is a tunnel that runs from the northeast corner of the intersection, diagonally underneath the intersection, to connect to the existing pedestrian tunnel at the Forest Glen Metro station. This alternative includes a ramp at the northeast quadrant, and elevators at both the northeast and southwest corners to provide ADA access.

To address concerns for providing pedestrian connectivity to the Northeast corner from the surrounding communities, this project is also proposed to include construction of sidewalk along the north side of Forest Glen Road, between Woodland Drive and Dameron Drive. See Figure 7 for a depiction of the recommended limits of new proposed sidewalk to be constructed as part of the preferred alternative. Note that the recommended limits of the proposed sidewalk are preliminary and subject to change during final design.

Figure 7: Recommended Limits of Proposed Sidewalk for Preferred Alternative

Tunnel Alternative 2 was selected for the following reasons:

- **A larger percentage of tunnel users originate in the northeast quadrant compared to the southeast quadrant.**
    - Based on pedestrian counts and origin-destination surveys, approximately 60% of pedestrians trips crossing Georgia Avenue have origins or destinations in the northeast, compared to 40% from the southeast
- **The northeast corner access point provides a more direct access to the tunnel for a majority of the tunnel users.**
    - While Tunnel Alternative 1 has slightly higher usage numbers compared to Tunnel Alternative 2 (the preferred alternative), this is because Tunnel 1 is on the "natural" diversion path for northeast pedestrians crossing to the metro station. Tunnel Alternative 2 better addresses the desired travel path for a majority of tunnel users.
- **Tunnel Alternative 2 better accommodates potential future roadway widening on Georgia Avenue**
    - The proposed improvements at the northeast corner can be located far enough back from the roadway to allow for future lane widening, without requiring concrete barrier or other protection of the elevators.
- **The northeast corner has more open space available, simplifying construction access and allowing construction of a ramp entrance.**
    - Under Tunnel Alternative 2, the preferred alternative, the large work zone would allow the contractor to work freely, and directly access the tunnel excavation via ramps.
    - Under Tunnel Alternative 1, the constrained work zone adjacent to the church in the southeast quadrant, while feasible, would restrict the contractor's ability to work and maneuver to excavate the eastern portion of the tunnel. Material would have to be raised/lowered with heavy equipment.

- **The ramp proposed for the northeast entrance of Tunnel Alternative 2 is preferable to the stairway access provided under the other alternatives.**
    - The ramp provides more direct and efficient access, compared to stairs, and provides natural light and a feeling of openness within the tunnel.
- **A tunnel alternative is preferable compared to a bridge, since it provides a quicker and more direct connection to the existing underground pedestrian tunnel / metro station.**
    - The drawbacks of a bridge are reflected both in the reduced travel time savings (due to the additional time needed to ascend / descend), and in the reduced pedestrian usage (with the slight time savings on the bridge, AASHTO-referenced study predicts 90% utilization rate).
- **Tunnel Alternative 2 was strongly preferred by the community.**
    - 148 responses were received subsequent to the April 2012 public meeting
        - 3 supported Tunnel Alt 1 (2%)
        - **102 supported Tunnel Alt 2 (69%)**
        - 5 supported Bridge Alt 1 (3%)
        - 22 supported either Tunnel Alternative (15%)
        - 12 supported any alternative (8%)
        - 4 opposed any alternative (3%)
    - Additionally, 83 respondents expressed opposition to a bridge alternative.

VII. Public Involvement

Newsletter

In March, 2012, a newsletter was mailed to the surrounding community and other members of the public who had expressed interest in the project. The purpose of the newsletter was to provide a brief overview of the project, and invite the community to attend a public meeting to be held on April 20, 2012, at Sligo Middle School.

Public Meeting

On April 10, 2012, the public meeting was held at Sligo Middle School as advertised in the March newsletter. The public meeting was meant to provide information to the public on the alternatives being considered, and to solicit their comments on which alternatives they may prefer. The public meeting began with a presentation which explained the project process, and provided detailed descriptions of the two tunnel alternatives and single bridge alternative being considered. After the presentation, a question and answer period was held, during which the MCDOT responded to questions from members of the public about the proposed alternatives. A summary of the questions and answers is provided in Appendix G.

At the meeting, MCDOT also solicited written comments from the public, and encouraged those present to fill out forms, or alternately write letters or emails to Greg Hwang to express their support or opposition to any of the alternatives. In the weeks following the public meeting, MCDOT received 148 written comments providing feedback on the alternatives. Table 10, below, includes a summary of the opinions expressed in the letters and emails.

Table 10 - Public Meeting Response Summary

Alternative Preferred	Total	Percentage
Tunnel Alt. 1 - SE Quadrant to Metro	3	2%
Tunnel Alt. 2 - NE Quadrant to Metro	102	69%
Bridge Alt. 1 - SE Quadrant to Metro	5	3%
Either Tunnel Alternative	22	15%
Any Alternative	12	8%
Does Not Support Project	4	3%
Total	**148**	**100%**

Appendix A1
Traffic Technical Memorandum

T E C H N I C A L M E M O R A N D U M

Date: January 6, 2012 (Revised February 21, 2012)

To: Mr. Gwo-Ruey (Greg) Hwang, Project Manager
Montgomery County Department of Transportation (MCDOT)

By: Jeff Parker, RK&K
Jake Wilson, RK&K
Rick Adams, RK&K

Reference: Forest Glen Passageway Study
MCDOT Contract # 8504520010-AF
Task 4

Subject: Analysis of Existing and Proposed Pedestrian and Vehicular Traffic Operations

I. Introduction

The intersection of Georgia Avenue and Forest Glen Road is considered one of the most congested intersections located adjacent to a WMATA Metro station in the Washington metropolitan area. The congestion has raised community concerns about the safety of pedestrians who must cross Georgia Avenue to access the station and other nearby destinations. To address pedestrian safety concerns, the Montgomery County Department of Transportation (MCDOT) requested that RK&K perform a feasibility study of alternatives for a proposed passageway underneath Georgia Avenue at Forest Glen Road. The study includes evaluation of six (6) passageway alignment alternatives.

As part of the feasibility study, RK&K performed a traffic study analyzing the current and proposed future operating conditions at the Georgia Avenue/Forest Glen Road intersection. This study includes the following specific items:

- A 13-hour vehicle and pedestrian turning movement count
- A special count of pedestrians crossing Georgia Avenue to/from the Forest Glen metro station
- An origin-destination survey was conducted to obtain more detailed information on pedestrian travel patterns than was available from the special pedestrian counts
- The estimated pedestrian usage for each of the six (6) passageway alignment alternatives
- Analysis of current peak hour traffic operations
- An evaluation of the recent crash history at the intersection, focusing on pedestrian-related collisions.

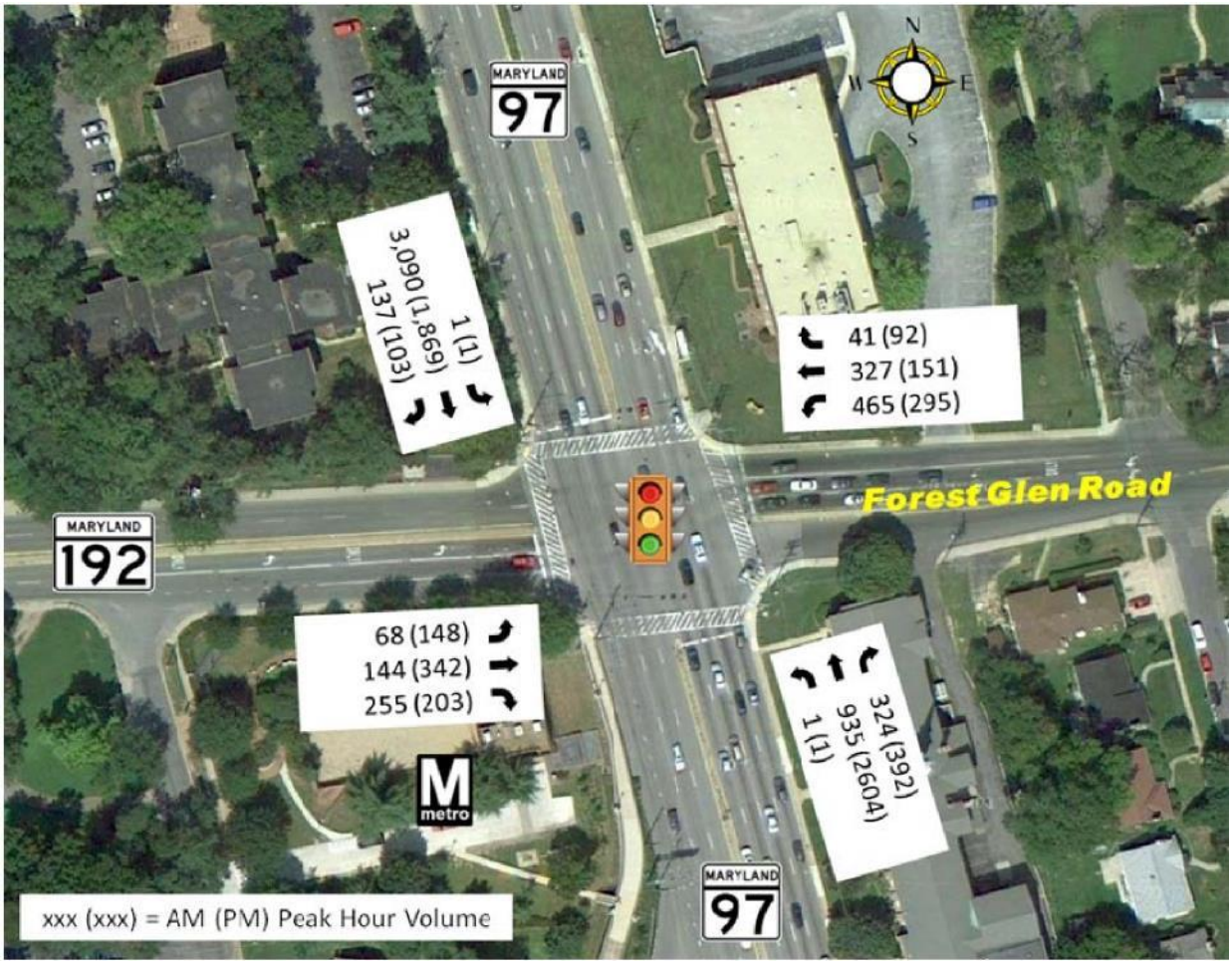
This technical memorandum summarizes the data collected for the traffic study and the results of the analysis items described above.

II. Current Traffic Volumes

RK&K conducted a 13-hour turning movement count at the intersection of Georgia Avenue (MD 97) at Forest Glen Road (MD 192) on April 26, 2011 from 6:00 AM to 7:00 PM. This count included a separate tally for automobiles and pedestrians. The traffic count data is provided in Appendix A.

Based on the count data, the AM peak hour for vehicular traffic is 7:15 AM – 8:15 AM and the PM peak hour for vehicular traffic is 5:00 PM – 6:00 PM. The AM and PM peak hours for pedestrians crossing Georgia Avenue varied slightly from the vehicular peak hours. For pedestrians crossing Georgia Avenue, the AM peak hour was from 7:00 AM – 8:00 AM and the PM peak hour was from 5:45 PM – 6:45 PM. The analysis of the current traffic operations at the intersection is based on the vehicular AM and PM peak hour volumes only. **Figure 1** below summarizes the vehicular AM and PM peak hour turning movement volumes at the intersection of Georgia Avenue and Forest Glen Road.

Figure 1: AM and PM Peak Hour Turning Movement Volumes



III. Current Pedestrian Volumes and Origins-Destinations

Concurrent with the vehicular traffic count presented in Section II, RK&K performed a 13-hour count of all pedestrian movements at the Georgia Avenue / Forest Glen Road Intersection. **Figure 2** summarizes the results of the standard pedestrian volume counts on each of the four existing crosswalks at the intersection, by crossing direction. The total 13-hour crossing volumes are shown, as well as the AM and PM peak hour crossing volumes (based on the pedestrian peaks, not the vehicular traffic peaks).

RK&K also performed a special pedestrian origin-destination count to determine how many pedestrians currently cross Georgia Avenue from the northeast corner of the intersection to the southwest corner, and vice-versa, using the existing crosswalks. The special count also determined whether the pedestrians making these "diagonal" movements had origins or destinations at the following three locations:

- Forest Glen Metro Station
- Points west of the metro station along Forest Glen Road
- Point south of the intersection along Georgia Avenue

Figure 3 shows the total 13-hour pedestrian volumes from the special origin-destination count for eight (8) different path/origin/destination combinations. **Figure 4** shows the AM and PM peak hour pedestrian volumes from the special count for each of these same eight (8) combinations, based on the pedestrian peaks, not the vehicular traffic peaks.

A review of the pedestrian counts at the intersection reveals that the south leg of the intersection experienced the largest number of pedestrians crossing during the 13-hour turning movement count. The AM and PM peak hours showed the highest pedestrian movement towards the Forest Glen Metro Station during the AM peak hour and away from the station during the PM peak hour, as shown in **Figure 2**.

The special pedestrian count between the northeast corner of the intersection and the metro station in the southwest corner revealed the most common route to and from the metro station to be across the north and west legs of the intersection (see **Figure 3**).

A separate origin-destination survey of pedestrians walking along Forest Glen Road between Georgia Avenue and the Forest Glen Metro Station was also performed. According to this survey, approximately 97% of the pedestrians traveling west along Forest Glen Road from Georgia Avenue during the AM peak hour (including those originating from the east side of Georgia Avenue) traveled to the metro station. Similarly, during the PM peak hour, approximately 99% of the pedestrians walking east along Forest Glen Road towards and/or crossing Georgia Avenue from the west were observed exiting the metro station.

Figure 2 - Total 13-hour pedestrian crossing volumes, and AM and PM peak hour crossing volumes

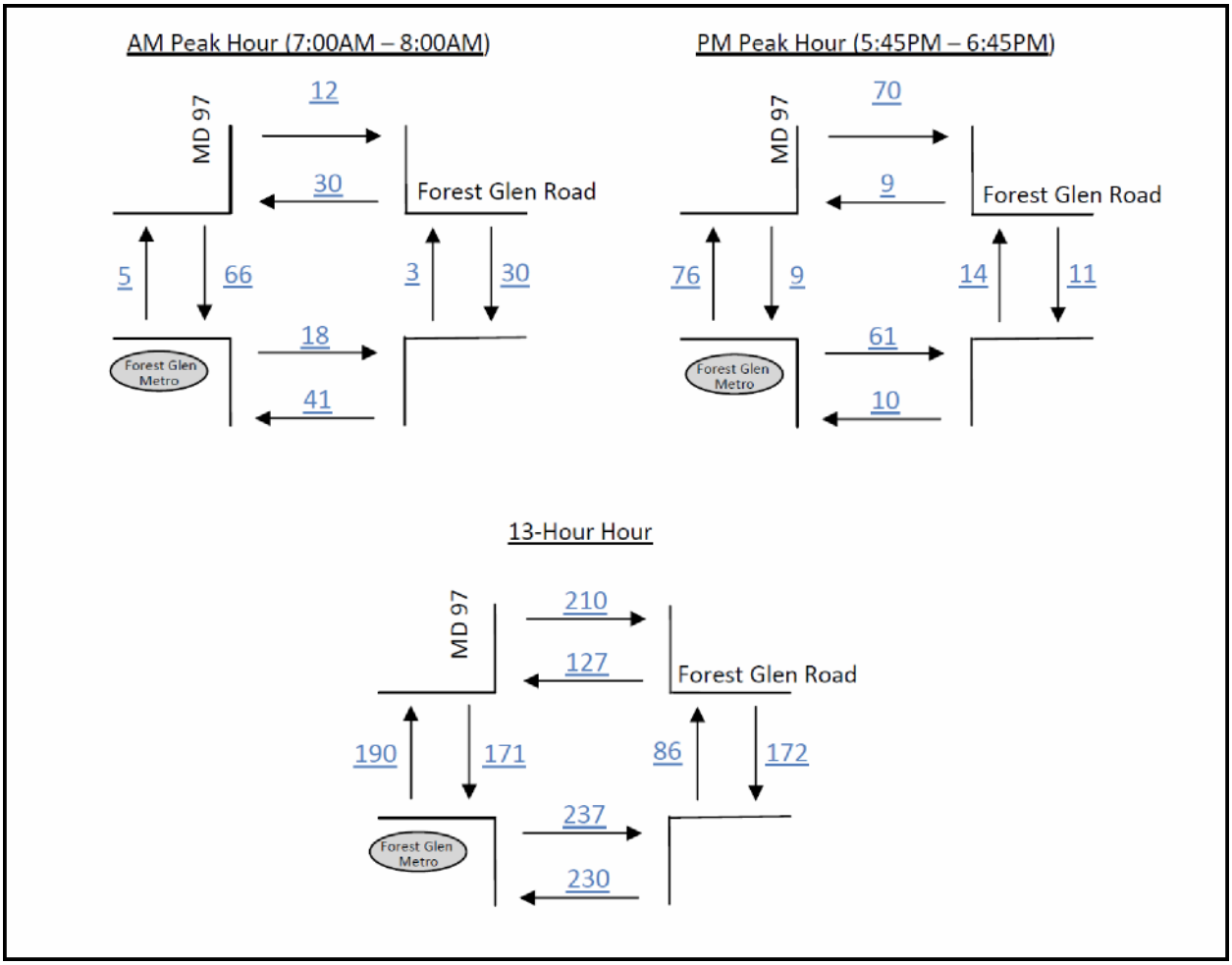


Figure 3 - Total 13-hour pedestrian volumes from the special origin-destination **count**

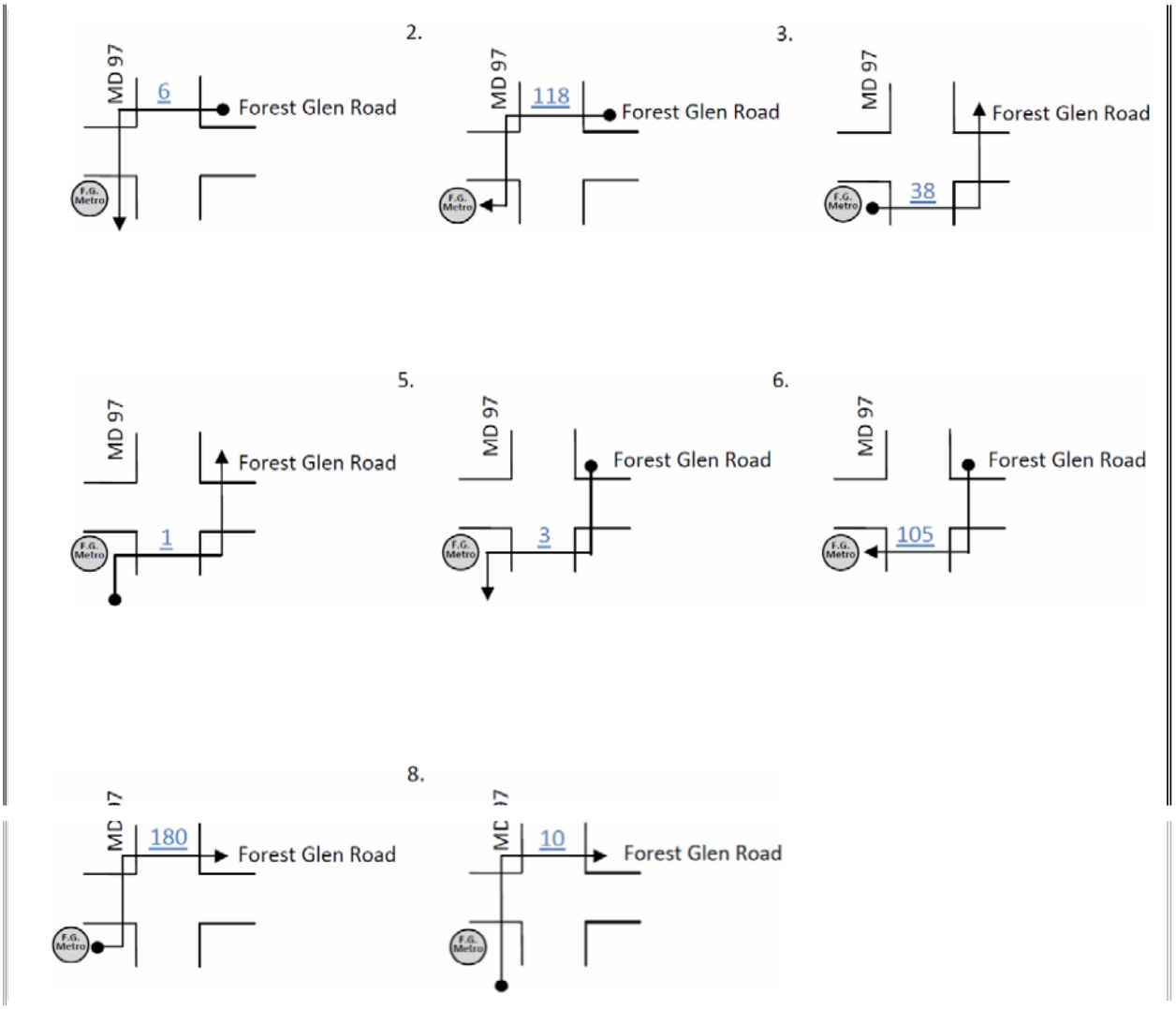
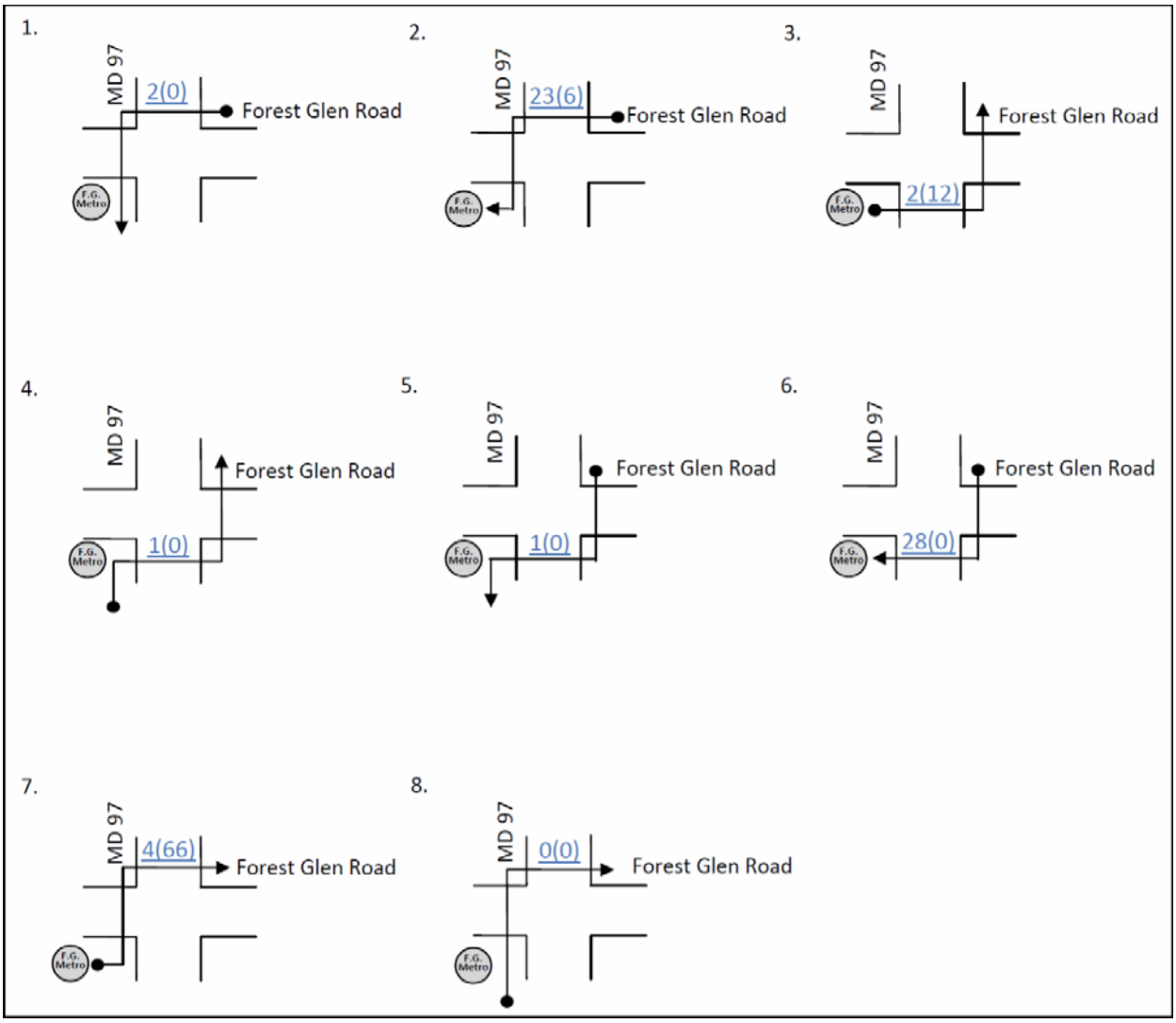


Figure 4 - AM (PM) peak hour pedestrian volumes from the special origin-destination count



IV. Pedestrian Usage Estimates for Passageway Concepts

Six (6) underground passageway alignment alternatives are being evaluated as part of this feasibility study. **Figure 5** below illustrates each of the concept alignments. The tunnel access points to the surface (via stairs, ramps, or elevators) are shown for each alternative. Alternatives 1, 3 and 5 simply provide access from the east side of Georgia Avenue to the west side of Georgia Avenue. For Alternatives 2, 4 and 6, pedestrians have the option of walking through the entire tunnel (i.e., both segments A and B) or walking through only a portion of the tunnel (i.e., either segment A or segment B).

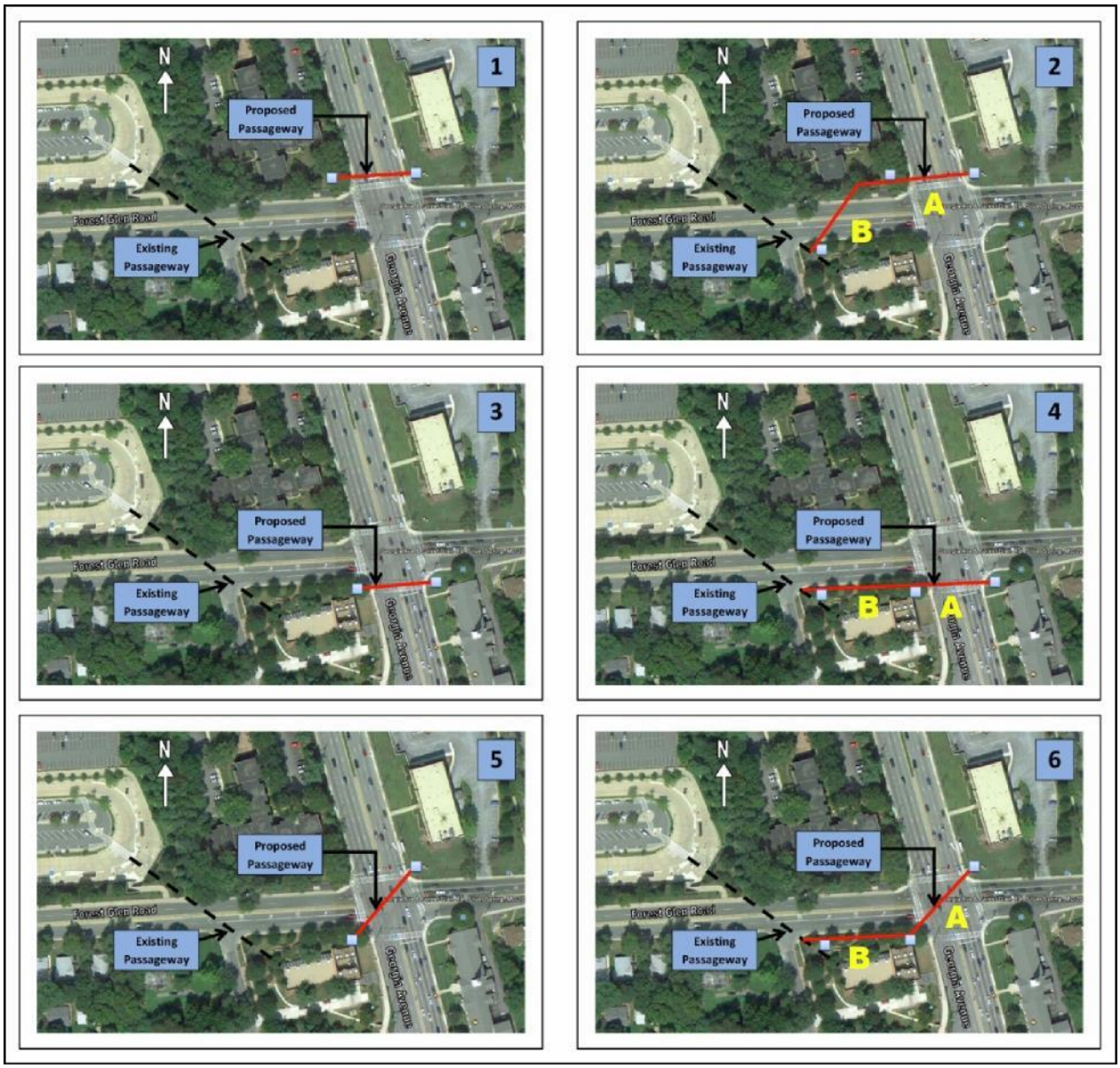


Figure 5: Preliminary Underground Passageway Alignments

The total number of pedestrians who choose to use the tunnel versus the existing at-grade crossings will be largely influenced by travel time, safety, and inclement weather. Since the tunnel is anticipated to improve travel times (based on optimized signal timing and the MUTCD-recommended minimum walk

speed of 3.5 feet per second) and safety for pedestrians crossing Georgia Avenue, RK&K assumed 100% of the pedestrians going to/from the Metro station under Alternatives 2, 4 and 6 would choose to use the entire length of the tunnel. However, for these three alternatives, only 80% of the non-Metro pedestrians would use the tunnel segment that crosses Georgia Avenue, due to increased travel time along steps/elevator/ramps to the tunnel . Since Alternatives 1, 3, and 5 do not provide direct access to Metro and would require increased travel time along steps/elevator/ramps to the tunnel, only 80% of both Metro and non-Metro pedestrians were assumed to choose the tunnel over the at-grade alternative.

For Alternatives 2, 4, and 6, the estimated passageway volumes also assume that pedestrians going to/from the Metro station who do not use the tunnel to cross Georgia Avenue would use the western segment of the tunnel to enter/leave the Metro station if they can conveniently access the tunnel along their travel path. For example, pedestrians travelling from the northwest corner of the intersection to the Metro station are assumed to use the western segment of the Alternative 2 alignment. For Alternatives 3 and 4, pedestrians travelling to Metro from the northeast corner of the intersection are assumed to divert across the east leg of the intersection to access the tunnel from the southeast corner. Similarly, all pedestrians exiting Metro and traveling to the northeast corner are assumed to use the tunnel with Alternatives 3 and 4. On the other hand, pedestrians originating from the southeast corner or traveling to the southeast corner from the southwest corner are not assumed to divert to Alternatives 1, 2 (both segments), 5 and 6 (eastern segment).

Table 1 below summarizes the estimated AM peak hour, PM peak hour, and 13-hour pedestrian usage for each of the six alignment alternatives based on the results of the standard pedestrian count and the special pedestrian origin-destination study.

Table 1: Estimated Pedestrian Usage for Passageway Alignment Alternatives

	Alt. 1	Alt. 2		Alt. 3	Alt. 4		Alt. 5	Alt. 6	
		Seg.A	Seg.B		Seg.A	Seg.B		Seg.A	Seg.B
AM Ped. Peak Hour	58	69	97	69	85	123	61	61	123
PM Ped. Peak Hour	73	90	96	114	142	149	84	84	149
13-Hour Totals	384	472	498	612	759	789	461	724	789

Pedestrian Origin-Destination Survey

A pedestrian origin-destination (O-D) survey was conducted on December 13, 2011. The primary objective for the survey was to determine whether a Southeast-to-Southwest passageway alignment would serve significantly more pedestrians than a Northeast-to-Southwest alignment. The pedestrian usage estimates assume that Metro pedestrians will divert from the northeast corner across Forest Glen Road, to use the SE-SW tunnel, since they would have to cross Forest Glen Road either on the west leg or east leg in any case. Conversely, a Metro pedestrian who arrives on the southeast corner would be less likely to divert to use the NE-SW tunnel, because it would require them to walk further away from their destination.

The O-D survey was performed to verify that a significant number of pedestrians were originating from the south side of Forest Glen Road and that the pedestrians counted in the southeast corner in the original traffic counts were not diverting from the north side of Forest Glen Road. For example, a pedestrian arriving at the southeast corner from the east would have been counted as a pedestrian who

would use a SE-SW tunnel, but not a NE-SW tunnel. However, it is possible that the pedestrian crossed Forest Glen Road further east of the intersection, and thus would actually be served by the NE-SW tunnel alternative. Similarly, the reverse movement is potentially ambiguous, if a pedestrian who travels from the southwest to southeast corner crosses Forest Glen Road to the north at some location further east of the intersection.

The pedestrian origin-destination survey was conducted during the AM and PM peak periods (7AM - 9AM, 5PM - 7PM). Survey personnel were located at each corner of the intersection, and briefly interviewed each person approaching the intersection. The survey staff noted the direction of approach for each respondent, asked what the ultimate destination quadrant (NW, NE, SW, SE) was, and whether the individual had already crossed the road on which they had approached. For example, someone walking westbound along the south side of Forest Glen Road would be asked whether they had already crossed Forest Glen Road. Additionally, anyone traveling to or from the southwest quadrant was also asked whether they were had used or planned to use the Metro station.

The results of the survey at the southeast quadrant showed that while some of the pedestrians had crossed Forest Glen Road further east of the intersection, the number was not very high. For pedestrians who arrived at the southeast corner and were travelling to the southwest corner, 11 out of 52 (21%) in the morning, and 1 out of 13 (8%) pedestrians in afternoon, had already crossed Forest Glen Road and, thus, would likely use a NE-SW tunnel alternative without inconvenience. However, the large majority of pedestrians at the southeast corner originated on the south side of Forest Glen Road and, therefore, would not find the NE-SW tunnel alternative to be as convenient as the SE-SW tunnel alternative.

Additionally, 23 out of 75 pedestrians interviewed who were crossing Georgia Avenue from the southwest corner, indicated that their destination was in the southeast quadrant. This means that approximately a third of the pedestrians making that movement would be served better by a SE-SW alternative than by a NE-SW alternative. Furthermore, the remaining 52 pedestrians traveling to the northeast quadrant would likely use either of the tunnel alignment alternatives since both are a similar travel distance and both would provide improved safety and a reduction in travel times. Consequently, the O-D survey illustrates that a SE-SW alternative would be expected to accommodate significantly more pedestrians than a NE-SW alternative.

The propensity for pedestrians to use a specific tunnel alignment, as described above, was based solely on the observed pedestrian travel patterns, and assumes that pedestrians will always prefer to use the most direct route between their origin and their destination. It assumes that diverting off of this direct route to use a tunnel to avoid the at-grade crossings on Georgia Avenue is never as attractive as adhering to the most direct route between their origin and destination. Therefore, the assumptions described above regarding the number of pedestrians that would likely use each tunnel alignment alternative represent the worst-case scenario, because some pedestrians will feel that the grade-separation provided by the tunnel is worth walking a short distance off the most direct route between their origin and destination.

V. Current Peak Hour Traffic Operations

The existing traffic signal at the intersection of Georgia Avenue and Forest Glen Road has different phasing patterns depending on the time of day. During the AM and PM peak periods, left turns from northbound and southbound Georgia Avenue are prohibited, and there is no protected left turn phase

provided. During the off-peak periods, left turns are allowed from northbound and southbound Georgia Avenue, and protected/permissive left turn phasing is provided. During these off-peak times, left turns are made from the shared through/left-turn lane in each direction on Georgia Avenue: There are no separate left turn lanes provided along Georgia Avenue at this intersection. The eastbound and westbound approaches along Forest Glen Road have concurrent protected/permissive left turn phases throughout the day. There are marked crosswalks across all four legs of the intersection, with push-button actuated Accessible Pedestrian Signals (APS) with "countdown" pedestrian signal heads. When actuated by a pedestrian, the pedestrian Walk/Flashing Don't Walk phase runs concurrently with the through traffic phase parallel to the crosswalk. Consequently, pedestrians crossing Georgia Avenue must be cognizant of left/right turning traffic from Forest Glen Road as well as right turn on red traffic from Georgia Avenue.

RK&K used the AM and PM vehicular peak hour turning movement volumes from Figure 1 to analyze the current intersection performance using Synchro. Existing lane configurations at the intersection are illustrated in **Figure 6**. One objective of this analysis is to establish the baseline traffic conditions for comparison to future conditions if certain crosswalks and pedestrian signal phases were eliminated when the proposed tunnel is completed. However, due to the current signal phasing, the elimination of pedestrian phases would not have an effect on existing signal operations. The elimination of pedestrian phases would only affect signal operations if the east-west approaches along Forest Glen Road were split-phased. (Split phasing is when an entire approach has a green signal when the entire opposing approach has red.) Split-phasing would allow the north leg crosswalk and pedestrian phase (which would be concurrent with the westbound through traffic phase under split-phasing) to be eliminated, while maintaining the south leg crosswalk and pedestrian phase (which would be concurrent with the eastbound through traffic phase under split-phasing). Under the current phasing, the eastbound and westbound traffic phases operate concurrently, so both the north leg and south leg pedestrian phases also run concurrently. Hence, replacing only one of the crosswalks with a tunnel would require the same pedestrian phasing as if the crosswalk was still there, because the remaining crosswalk would still require a pedestrian phase.

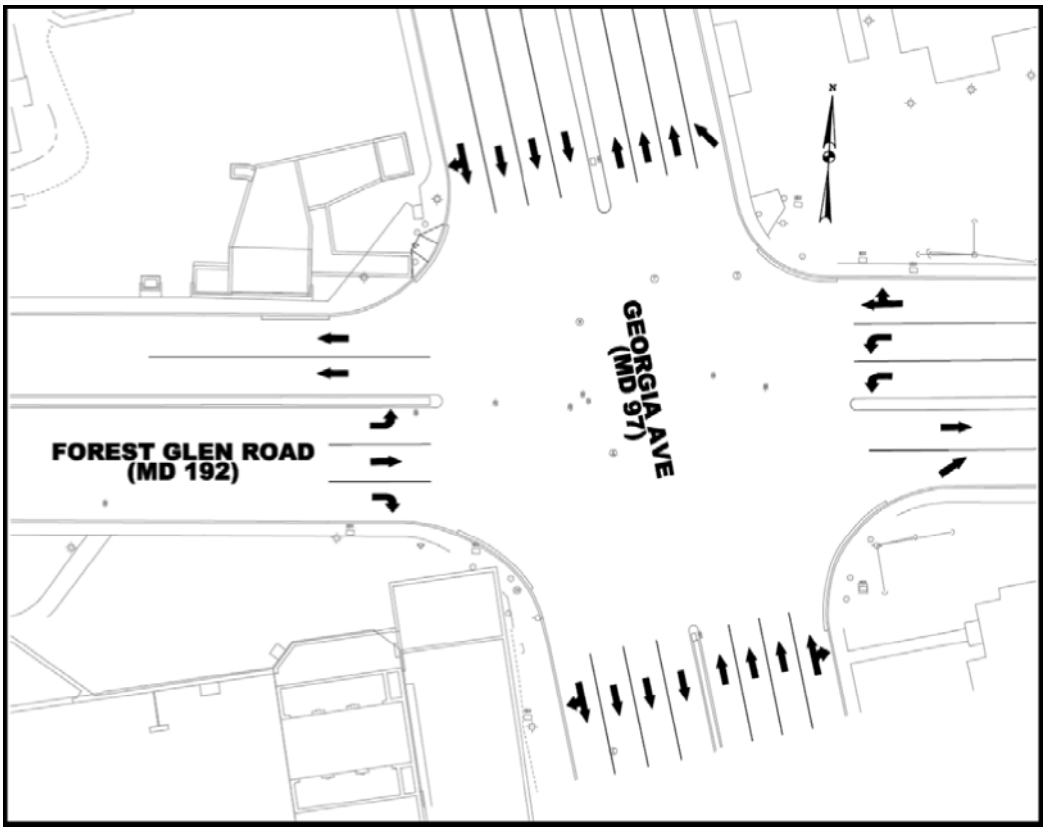


Figure 6: Existing Lane Configuration

Existing signal timing and phasing information was provided by MCDOT. **Table 2** summarizes the operation of the intersection using Synchro levels of service and delays by approach and for the overall intersection, using the current signal timing. The current timing plan appears to provide better performance for the Georgia Avenue approaches, at the expense of increased delay on the side street approaches. **Table 3** shows how this intersection would operate if the signal timing was optimized using Synchro to minimize total intersection delay (including the side street approaches). The *Highway Capacity Manual (HCM)* analysis methodology was used. The HCM analysis reports from Synchro are provided in Appendix B.

Table 2: Existing 2011 AM and PM Peak Hour Intersection Performance

HCM Analysis using Synchro		AM Peak Hour		PM Peak Hour	
		LOS	Delay	LOS	Delay
Georgia Avenue (MD 97)	NB	B	11.0	B	19.0
	SB	C	27.4	B	18.1
Forest Glen Road (MD 192)	EB	E	70.2	E	78.6
Forest Glen Road	WB	F	416.3	E	74.2
Whole Intersection		**F**	**83.3**	**C**	**30.2**

Table 3: Year 2011 AM and PM Peak Hour Intersection Performance with Optimized Splits

HCM Analysis using Synchro		AM Peak Hour		PM Peak Hour	
		LOS	Delay	LOS	Delay
Georgia Avenue (MD 97)	NB	B	19.3	C	21.9
	SB	D	46.1	C	22.4
Forest Glen Road (MD 192)	EB	E	66.2	E	64.8
Forest Glen Road	WB	E	70.5	E	67.1
Whole Intersection		**D**	**45.5**	**C**	**30.8**

The amount of time the traffic signal provides for pedestrians to cross Georgia Avenue or Forest Glen Road was recently increased to be compatible with the new, slower standard walking speed of 3.5 feet per second, as recommended in the latest Manual on Uniform Traffic Control Devices (MUTCD). However, the Synchro analysis for this study was completed prior to the implementation of this longer pedestrian crossing interval. Therefore, the analysis results described below are based on the previous signal timing plan with the shorter-duration pedestrian crossing intervals.

Using the Synchro-optimized existing timing plan with the shorter pedestrian crossing intervals as the baseline, increasing these pedestrian clearance intervals to satisfy the MUTCD recommended walk speed would increase the delay per vehicle for the whole intersection from 45.5 seconds per vehicle to 54.8 seconds per vehicle during the AM peak hour, and from 30.8 seconds per vehicle to 33.0 seconds per vehicle during the PM peak hour. The Synchro optimization adjusts the amount of time the green indication is displayed during each phase of the signal cycle. Synchro does not optimize the length of the pedestrian crossing intervals – these values are provided by the analyst based on field observations, existing signal timing reports, or calculations using MUTCD walk speed criteria and the required crossing distance. **Table 4** summarizes the signalized intersection analysis results based on the Highway Capacity Manual (HCM) methodology for determining delay and level of service, using the Synchro-optimized signal timing with adequate pedestrian clearance intervals. Increases in delay would also result from providing adequate pedestrian clearance intervals without optimizing the signal timing at this intersection.

Table 4: 2011 AM & PM Peak Hour Intersection Performance Optimized with Adequate Ped Xing Intervals

HCM Analysis using Synchro		AM Peak Hour		PM Peak Hour	
		LOS	Delay	LOS	Delay
Georgia Avenue (MD 97)	NB	C	26.5	C	28.8
	SB	E	60.6	B	19.1
Forest Glen Road (MD 192)	EB	D	53.7	E	64.7
Forest Glen Road	WB	E	75.8	E	66.3
Whole Intersection		**D**	**54.8**	**C**	**33.0**

VI. Crash History Evaluation

RK&K obtained recent crash history information (January 2005 through December 2009) for the intersection of Georgia Avenue (MD 97) and Forest Glen Road (MD 192) from the Maryland State Highway Administration (SHA). The crash summary tables and study worksheets provided by SHA are included in Appendix C.

The following trends were identified in the five (5) years of crash data for this intersection:

- Eighty-four (84) crashes were reported at this intersection during the study period. There were zero (0) reported fatalities during this period.
- There were eight (8) pedestrian-related crashes (10% of the total), not including 3 bicycle-related crashes..
    - Three (3) of these crashes occurred in 2006, more than in any other year of the study period.
    - One (1) pedestrian-related crash was reported each in 2005, 2008 and 2009.
    - Five (5) of the crashes with pedestrians occurred while the pedestrian was crossing Georgia Avenue, and three (3) of the crashes with pedestrians occurred while the pedestrian was crossing Forest Glen Road.
- The most frequent type of crash reported was the rear-end collision (32 crashes, or 38% of the total).
    - Most of these rear-end crashes (81%) occurred along MD 97.
- The second-most common crash type was the left-turn collision (21 crashes, or 25% of the total).
    - The year with the highest number of left-turn crashes was 2007 (7 total).
    - Three (3) left-turn crashes were reported in 2009.
- The most common probable causes reported were "failure to yield right-of-way" (21 crashes) and "failure to give full attention" (18 crashes).
- Seventy-six percent (76%) of the crashes resulted in an injury.
- Thirty-seven percent (37%) of the crashes reported during the study period occurred at night.
- Eighteen percent (18%) of the crashes occurred on wet pavement surfaces.

RK&K also obtained crash data for this same five year period along MD 97 between the off-ramp from westbound I-495 and Tilton Drive, a 0.30 mile segment that includes the MD 192/Forest Glen Road intersection. This crash data includes a comparison of the crash rates within this segment to the statewide average crash rates for other similar roadways. Crash rates are reported as the number of crashes per 100-million vehicle-miles traveled. This crash data for the five-year period (2005 – 2009) is summarized as follows:

- The pedestrian-related crash rate (24.9) was almost four times the statewide average.
- The sideswipe crash rate (116.3) was almost six times the statewide average.
- The total crash rate (all types combined) was 468, which is more than twice the statewide average.

VII. Conclusions

The following is a summary of the key findings of this traffic study:

- The peak hours for vehicular traffic are 7:15 AM to 8:15 AM and 5:00 PM to 6:00 PM
- The peak hours for pedestrian crossings are 7:00 AM to 8:00 AM and 5:45 PM to 6:45 PM
- The south leg of the Georgia Avenue / Forest Glen intersection experiences the highest volume of pedestrian traffic.
- Up to 90% of the pedestrian activity at the Georgia Avenue / Forest Glen Road intersection is related to the Forest Glen Metro Station
- Of the pedestrians walking along Forest Glen Road between Georgia Avenue and the Forest Glen Metro Station, 97% of the westbound pedestrian traffic enters the station during the AM peak hour, and 99% of the eastbound pedestrian traffic comes from the station during the PM peak hour.
- Passageway Alternative 4 (SE-SW corners with a direct connection to the existing passageway) would likely have the heaviest pedestrian usage, assuming that all pedestrians prefer to adhere to the most direct walking route between their origin and destination, regardless of the availability of a grade-separated crossing.
- The Georgia Avenue/Forest Glen Road intersection currently operates at an overall LOS F (C) with 82.5 (30.2) seconds of delay per vehicle during the AM (PM) peak hours.
    - The worst-performing approach during the AM peak hour is the westbound direction
    - The worst-performing approach during the PM peak hour is the eastbound direction
    - This overall level of congestion could make it difficult for pedestrians to cross Georgia Avenue using at-grade crosswalks.
- The existing pedestrian clearance (Flashing Don't Walk) intervals are not long enough for a pedestrian to cross either Georgia Avenue or Forest Glen Road at the MUTCD-recommended walking speed of 3.5 feet per second.
    - Increasing the pedestrian clearance intervals to meet the MUTCD walking speed recommendations would result in greater delays during the AM peak hour, and a small delay increase during the PM peak hour, with proposed signal timing optimization.
    - This would also increase delays if the current signal timing is not optimized.
- Pedestrian-related crashes at the Forest Glen Road intersection accounted for 10% of the crashes reported from 2005 through 2009.
- Along the segment of Georgia Avenue between the I-495 off-ramp and Tilton Drive (which includes the Forest Glen Road intersection), the crash rate for pedestrian-related crashes was nearly four times greater than the statewide average for similar roadways.

Appendix A
Intersection Turning Movement Count Data

Rummel, Klepper & Kahl, LLP

Consulting Engineers
81 Mosher Street
Baltimore MD, 21217

Location: MD 97 at Glen Forest
Road County: Montgomery
Date: 4/26/2011
Then Click the Comments Tab

Groups Printed- Cars - Motocycles

	MD 97 From North					Forest Glen Road From East					MD 97 From South					
Start Time	Left	Thru	Rght	U-Turn	App. Total	Left	Thru	Rght	U-Turn	App. Total	Left	Thru	Rght	U-Turn	App. Total	Left
06:00 AM	2	440	11	0	453	30	19	5	0	54	6	120	33	0	159	3
06:15 AM	2	493	14	0	509	31	41	6	0	78	5	139	50	0	194	5
06:30 AM	0	600	15	0	615	65	46	11	0	122	1	193	77	0	271	7
06:45 AM	0	596	15	0	611	94	60	19	0	173	0	202	100	0	302	13
Total	4	2129	55	0	2188	220	166	41	0	427	12	654	260	0	926	28
07:00 AM	1	713	29	0	743	105	60	14	0	179	0	198	80	0	278	7
07:15 AM	0	803	30	0	833	115	80	12	0	207	0	241	74	0	315	14
07:30 AM	0	806	29	0	835	110	90	15	0	215	0	221	71	0	292	21
07:45 AM	1	756	35	0	792	116	93	6	0	215	0	235	80	0	315	21
Total	2	3078	123	0	3203	446	323	47	0	816	0	895	305	0	1200	63
08:00 AM	0	725	43	0	768	124	64	8	0	196	1	238	99	0	338	12
08:15 AM	0	678	25	0	703	115	68	15	0	198	0	251	84	0	335	9
08:30 AM	0	757	25	0	782	114	60	17	0	191	0	261	71	0	332	8
08:45 AM	0	734	28	0	762	83	60	16	0	159	0	233	79	0	312	17
Total	0	2894	121	0	3015	436	252	56	0	744	1	983	333	0	1317	46
09:00 AM	0	692	27	0	719	90	48	21	0	159	0	267	66	0	333	18
09:15 AM	5	668	32	0	705	84	36	17	0	137	0	288	64	0	352	18
09:30 AM	9	566	31	0	606	67	32	18	0	117	4	288	72	5	369	16
09:45 AM	11	503	21	1	536	68	35	24	0	127	9	301	63	2	375	14
Total	25	2429	111	1	2566	309	151	80	0	540	13	1144	265	7	1429	66
10:00 AM	8	468	13	1	490	54	21	14	1	90	10	294	63	4	371	9
10:15 AM	16	373	12	1	402	64	17	26	0	107	13	317	65	5	400	7
10:30 AM	17	386	11	2	416	72	25	17	0	114	3	339	62	1	405	10
10:45 AM	10	359	16	0	385	54	16	17	0	87	10	355	63	0	428	11
Total	51	1586	52	4	1693	244	79	74	1	398	36	1305	253	10	1604	37
11:00 AM	12	386	17	1	416	65	14	30	0	109	8	345	63	0	416	11
11:15 AM	7	388	9	0	404	62	14	24	0	100	14	379	71	2	466	23
11:30 AM	10	380	21	2	413	67	16	31	0	114	6	352	63	0	421	15
11:45 AM	14	398	7	0	419	65	17	16	0	98	6	339	70	1	416	10
Total	43	1552	54	3	1652	259	61	101	0	421	34	1415	267	3	1719	59
12:00 PM	12	387	19	1	419	69	17	29	0	115	12	355	49	0	416	12
12:15 PM	4	430	12	0	446	71	20	23	0	114	13	431	54	2	500	15
12:30 PM	8	367	13	1	389	71	17	18	0	106	2	446	85	0	533	18
12:45 PM	12	432	12	1	457	56	21	22	0	99	12	420	97	3	532	21
Total	36	1616	56	3	1711	267	75	92	0	434	39	1652	285	5	1981	66

Rummel, Klepper & Kahl, LLP

Consulting Engineers
81 Mosher Street
Baltimore MD, 21217

Location: MD 97 at Glen Forest
Road County: Montgomery
Date: 4/26/2011
Then Click the Comments Tab

Groups Printed- Cars - Motocycles

	MD 97 From North					Forest Glen Road From East					MD 97 From South					
Start Time	Left	Thru	Rght	U-Turn	App. Total	Left	Thru	Rght	U-Turn	App. Total	Left	Thru	Rght	U-Turn	App. Total	Left
01:00 PM	14	362	4	1	381	64	20	19	0	103	5	404	78	3	490	19
01:15 PM	12	393	11	1	417	51	18	15	0	84	9	406	76	1	492	16
01:30 PM	9	340	11	0	360	68	20	17	0	105	13	376	74	1	464	17
01:45 PM	11	386	9	0	406	59	24	21	0	104	12	376	78	0	466	18
Total	46	1481	35	2	1564	242	82	72	0	396	39	1562	306	5	1912	70
02:00 PM	18	430	14	1	463	73	18	20	0	111	10	411	63	1	485	21
02:15 PM	20	480	9	2	511	71	18	22	0	111	12	429	83	0	524	10
02:30 PM	12	436	8	1	457	80	24	29	1	134	16	434	54	1	505	18
02:45 PM	10	394	13	0	417	83	20	26	0	129	16	470	70	0	556	19
Total	60	1740	44	4	1848	307	80	97	1	485	54	1744	270	2	2070	68
03:00 PM	9	390	13	3	415	77	33	28	0	138	15	431	64	1	511	23
03:15 PM	9	465	7	0	481	77	26	35	0	138	9	503	76	2	590	15
03:30 PM	5	415	10	0	430	78	26	36	0	140	9	512	74	0	595	22
03:45 PM	13	459	10	2	484	72	30	36	0	138	4	540	71	0	615	29
Total	36	1729	40	5	1810	304	115	135	0	554	37	1986	285	3	2311	89
04:00 PM	1	411	18	0	430	69	31	27	0	127	0	588	70	0	658	31
04:15 PM	2	436	18	0	456	90	32	32	1	155	0	633	57	0	690	29
04:30 PM	1	471	24	0	496	76	38	23	0	137	1	654	74	0	729	35
04:45 PM	0	441	13	0	454	70	30	29	0	129	0	636	87	0	723	36
Total	4	1759	73	0	1836	305	131	111	1	548	1	2511	288	0	2800	131
05:00 PM	0	457	22	0	479	78	31	27	0	136	0	641	88	0	729	45
05:15 PM	1	478	28	0	507	74	30	22	0	126	1	653	100	0	754	27
05:30 PM	0	464	33	0	497	71	43	18	0	132	0	657	91	0	748	32
05:45 PM	0	470	20	0	490	71	47	25	1	144	0	653	113	0	766	43
Total	1	1869	103	0	1973	294	151	92	1	538	1	2604	392	0	2997	147
06:00 PM	1	429	21	0	451	60	50	25	1	136	0	625	109	0	734	33
06:15 PM	0	470	30	0	500	67	51	15	0	133	1	600	126	0	727	20
06:30 PM	0	393	26	0	419	58	35	14	1	108	0	585	142	0	727	26
06:45 PM	0	375	13	0	388	56	33	14	0	103	1	510	111	0	622	35
Total	1	1667	90	0	1758	241	169	68	2	480	2	2320	488	0	2810	114
Grand Total	309	25529	957	22	26817	3874	1835	1066	6	6781	269	20775	3997	35	25076	984
Apprch %	1.2	95.2	3.6	0.1		57.1	27.1	15.7	0.1		1.1	82.8	15.9	0.1		19.7
Total %	0.5	40.1	1.5	0	42.1	6.1	2.9	1.7	0	10.6	0.4	32.6	6.3	0.1	39.4	1.5
Cars	309	25483	956	22	26770	3868	1829	1065	6	6768	269	20737	3994	35	25035	979
% Cars	100	99.8	99.9	100	99.8	99.8	99.7	99.9	100	99.8	100	99.8	99.9	100	99.8	99.5
Motocycles	0	46	1	0	47	6	6	1	0	13	0	38	3	0	41	5
% Motocycles	0	0.2	0.1	0	0.2	0.2	0.3	0.1	0	0.2	0	0.2	0.1	0	0.2	0.5

Rummel, Klepper & Kahl, LLP
Consulting Engineers
81 Mosher Street
Baltimore MD, 21217

Location: MD 97 at Glen Forest
Road County: Montgomery
Date: 4/26/2011
Then Click the Comments Tab

	MD 97 From North					Forest Glen Road From East					MD 97 From South					
Start Time	Left	Thru	Rght	U-Turn	App. Total	Left	Thru	Rght	U-Turn	App. Total	Left	Thru	Rght	U-Turn	App. Total	Left
Peak Hour Analysis From 06:00 AM to 09:45 AM - Peak 1 of 1 Peak Hour for Entire Intersection Begins at 07:15 AM																
07:15 AM	0	803	30	0	833	115	80	12	0	207	0	241	74	0	315	14
07:30 AM	0	806	29	0	835	110	90	15	0	215	0	221	71	0	292	21
07:45 AM	1	756	35	0	792	116	93	6	0	215	0	235	80	0	315	21
08:00 AM	0	725	43	0	768	124	64	8	0	196	1	238	99	0	338	12
Total Volume	1	3090	137	0	3228	465	327	41	0	833	1	935	324	0	1260	68
% App. Total	0	95.7	4.2	0		55.8	39.3	4.9	0		0.1	74.2	25.7	0		14.6
PHF	.250	.958	.797	.000	.966	.938	.879	.683	.000	.969	.250	.970	.818	.000	.932	.810
Peak Hour Analysis From 10:00 AM to 01:45 PM - Peak 1 of 1 Peak Hour for Entire Intersection Begins at 12:15 PM																
12:15 PM	4	430	12	0	446	71	20	23	0	114	13	431	54	2	500	15
12:30 PM	8	367	13	1	389	71	17	18	0	106	2	446	85	0	533	18
12:45 PM	12	432	12	1	457	56	21	22	0	99	12	420	97	3	532	21
01:00 PM	14	362	4	1	381	64	20	19	0	103	5	404	78	3	490	19
Total Volume	38	1591	41	3	1673	262	78	82	0	422	32	1701	314	8	2055	73
% App. Total	2.3	95.1	2.5	0.2		62.1	18.5	19.4	0		1.6	82.8	15.3	0.4		28.5
PHF	.679	.921	.788	.750	.915	.923	.929	.891	.000	.925	.615	.953	.809	.667	.964	.869
Peak Hour Analysis From 02:00 PM to 06:45 PM - Peak 1 of 1 Peak Hour for Entire Intersection Begins at 05:00 PM																
05:00 PM	0	457	22	0	479	78	31	27	0	136	0	641	88	0	729	45
05:15 PM	1	478	28	0	507	74	30	22	0	126	1	653	100	0	754	27
05:30 PM	0	464	33	0	497	71	43	18	0	132	0	657	91	0	748	32
05:45 PM	0	470	20	0	490	71	47	25	1	144	0	653	113	0	766	43
Total Volume	1	1869	103	0	1973	294	151	92	1	538	1	2604	392	0	2997	147
% App. Total	0.1	94.7	5.2	0		54.6	28.1	17.1	0.2		0	86.9	13.1	0		21.2
PHF	.250	.978	.780	.000	.973	.942	.803	.852	.250	.934	.250	.991	.867	.000	.978	.817

Appendix B
Synchro HCM Analysis Reports

Movement	EBL	EBT	EBR	WBL WBT WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	68	144	255	465 327 41	0	935	324	0	3090	137
Ideal Flow (vphpl)	1900	1900	1900	1900 1900 1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	5.0	5.0	6.0 5.0		5.0			5.0	
Lane Util. Factor	1.00	1.00	1.00	0.97 1.00		0.86			0.86	
Frt	1.00	1.00	0.85	1.00 0.98		0.96			0.99	
Flt Protected	0.95	1.00	1.00	0.95 1.00		1.00			1.00	
Satd. Flow (prot)	1770	1863	1583	3433 1832		6160			6367	
Flt Permitted	0.95	1.00	1.00	0.95 1.00		1.00			1.00	
Satd. Flow (perm)	1770	1863	1583	3433 1832		6160			6367	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00 1.00 1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	68	144	255	465 327 41	0	935	324	0	3090	137
RTOR Reduction (vph)	0	0	1	0 0 0	0	42	0	0	4	0
Lane Group Flow (vph)	68	144	254	465 368 0	0	1217	0	0	3223	0
Turn Type	Prot		Perm	Prot						
Protected Phases	7	4		3 8		1			5	
Permitted Phases			4							
Actuated Green, G (s)	7.8	26.8	26.8	8.0 27.0		94.2			94.2	
Effective Green, g (s)	8.8	28.8	28.8	9.0 29.0		96.2			96.2	
Actuated g/C Ratio	0.06	0.19	0.19	0.06 0.19		0.64			0.64	
Clearance Time (s)	7.0	7.0	7.0	7.0 7.0		7.0			7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0 3.0		3.0			3.0	
Lane Grp Cap (vph)	104	358	304	206 354		3951			4083	
v/s Ratio Prot	0.04	0.08		c0.14 c0.20		0.20			c0.51	
v/s Ratio Perm			c0.16							
v/c Ratio	0.65	0.40	0.84	2.26 1.04		0.31			0.79	
Uniform Delay, d1	69.1	53.1	58.3	70.5 60.5		12.0			19.5	
Progression Factor	1.00	1.00	1.00	1.00 1.00		0.90			1.36	
Incremental Delay, d2	13.8	0.7	17.7	581.1 58.5		0.2			0.8	
Delay (s)	82.9	53.8	76.1	651.6 119.0		11.0			27.4	
Level of Service	F	D	E	F F		B			C	
Approach Delay (s)		70.2		416.3		11.0			27.4	
Approach LOS		E		F		B			C	

Intersection Summary			
HCM Average Control Delay	83.3	HCM Level of Service	F
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	147	342	203	295	151	92	0	2604	392	0	1869	103
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	4.0	4.0	5.0	4.0	4.0		4.0			4.0	
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	0.86		0.86			0.86	
Frt	1.00	1.00	0.85	1.00	0.94	0.98		0.99				
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		1.00				
Satd. Flow (prot)	1770	1863	1583	3433	1757	6282		6358				
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		1.00				
Satd. Flow (perm)	1770	1863	1583	3433	1757	6282		6358				
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	147	342	203	295	151	92	0	2604	392	0	1869	103
RTOR Reduction (vph)	0	0	14	0	0	0	0	18	0	0	5	0
Lane Group Flow (vph)	147	342	189	295	243	0	0	2978	0	0	1967	0
Turn Type	Prot		Perm	Prot								
Protected Phases	7	4		3	8			1			5	
Permitted Phases			4									
Actuated Green, G (s)	13.7	28.3	28.3	14.0	28.6			89.7			89.7	
Effective Green, g (s)	14.7	30.3	30.3	15.0	30.6			91.7			91.7	
Actuated g/C Ratio	0.10	0.20	0.20	0.10	0.20			0.61			0.61	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	173	376	320	343	358			3840			3887	
v/s Ratio Prot	0.08	c0.18		c0.09	0.14			c0.47			0.31	
v/s Ratio Perm			0.12									
v/c Ratio	0.85	0.91	0.59	0.86	0.68			0.78			0.51	
Uniform Delay, d1	66.6	58.5	54.2	66.5	55.2			21.5			16.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00			0.82			1.08	
Incremental Delay, d2	30.2	25.0	2.9	19.2	5.1			1.3			0.4	
Delay (s)	96.8	83.6	57.2	85.7	60.2			19.0			18.1	
Level of Service	F	F	E	F	E			B			B	
Approach Delay (s)		78.6			74.2			19.0			18.1	
Approach LOS		E			E			B			B	

Intersection Summary	
HCM Average Control Delay	30.2 HCM Level of Service C
HCM Volume to Capacity ratio	0.81
Actuated Cycle Length (s)	150.0 Sum of lost time (s) 13.0
Intersection Capacity Utilization	81.5% ICU Level of Service D
Analysis Period (min)	15
c Critical Lane Group	

Movement	EBL	EBT	EBR	WBL WBT WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	68	144	255	465 327 41	0	935	324	0	3090	137
Ideal Flow (vphpl)	1900	1900	1900	1900 1900 1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	5.0	5.0	6.0 5.0		5.0			5.0	
Lane Util. Factor	1.00	1.00	1.00	0.97 1.00		0.86			0.86	
Frt	1.00	1.00	0.85	1.00 0.98		0.96			0.99	
Flt Protected	0.95	1.00	1.00	0.95 1.00		1.00			1.00	
Satd. Flow (prot)	1770	1863	1583	3433 1832		6160			6367	
Flt Permitted	0.95	1.00	1.00	0.95 1.00		1.00			1.00	
Satd. Flow (perm)	1770	1863	1583	3433 1832		6160			6367	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00 1.00 1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	68	144	255	465 327 41	0	935	324	0	3090	137
RTOR Reduction (vph)	0	0	4	0 0 0	0	41	0	0	4	0
Lane Group Flow (vph)	68	144	251	465 368 0	0	1218	0	0	3223	0
Turn Type	Prot		Perm	Prot						
Protected Phases	7	4		3 8		1			5	
Permitted Phases			4							
Actuated Green, G (s)	14.4	27.0	27.0	22.4 35.0		79.6			79.6	
Effective Green, g (s)	15.4	29.0	29.0	23.4 37.0		81.6			81.6	
Actuated g/C Ratio	0.10	0.19	0.19	0.16 0.25		0.54			0.54	
Clearance Time (s)	7.0	7.0	7.0	7.0 7.0		7.0			7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0 3.0		3.0			3.0	
Lane Grp Cap (vph)	182	360	306	536 452		3351			3464	
v/s Ratio Prot	0.04	0.08		0.14 c0.20		0.20			c0.51	
v/s Ratio Perm			c0.16							
v/c Ratio	0.37	0.40	0.82	0.87 0.81		0.36			0.93	
Uniform Delay, d1	62.8	52.9	58.0	61.8 53.3		19.4			31.6	
Progression Factor	1.00	1.00	1.00	1.00 1.00		0.98			1.36	
Incremental Delay, d2	1.3	0.7	16.0	13.8 10.8		0.3			3.2	
Delay (s)	64.1	53.6	74.0	75.6 64.0		19.3			46.1	
Level of Service	E	D	E	E E		B			D	
Approach Delay (s)		66.2		70.5		19.3			46.1	
Approach LOS		E		E		B			D	

Intersection Summary			
HCM Average Control Delay	45.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	147	342	203	295	151	92	0	2604	392	0	1869	103
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	4.0	4.0	5.0	4.0	4.0		4.0			4.0	
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	0.86		0.86				
Frt	1.00	1.00	0.85	1.00	0.94	0.98		0.99				
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		1.00				
Satd. Flow (prot)	1770	1863	1583	3433	1757	6282		6358				
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		1.00				
Satd. Flow (perm)	1770	1863	1583	3433	1757	6282		6358				
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	147	342	203	295	151	92	0	2604	392	0	1869	103
RTOR Reduction (vph)	0	0	11	0	0	0	0	17	0	0	5	0
Lane Group Flow (vph)	147	342	192	295	243	0	0	2979	0	0	1967	0
Turn Type	Prot		Perm	Prot								
Protected Phases	7	4		3	8		1	5				
Permitted Phases			4									
Actuated Green, G (s)	16.8	31.4	31.4	15.5	30.1		85.1	85.1				
Effective Green, g (s)	17.8	33.4	33.4	16.5	32.1		87.1	87.1				
Actuated g/C Ratio	0.12	0.22	0.22	0.11	0.21		0.58	0.58				
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0				
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)	210	415	352	378	376		3648	3692				
v/s Ratio Prot	0.08	c0.18		c0.09	0.14		c0.47	0.31				
v/s Ratio Perm			0.12									
v/c Ratio	0.70	0.82	0.55	0.78	0.65		0.82	0.53				
Uniform Delay, d1	63.5	55.5	51.6	65.0	53.8		25.1	19.1				
Progression Factor	1.00	1.00	1.00	1.00	1.00		0.80	1.15				
Incremental Delay, d2	9.8	12.5	1.7	10.0	3.8		1.8	0.5				
Delay (s)	73.3	68.0	53.3	75.0	57.6		21.9	22.4				
Level of Service	E	E	D	E	E		C	C				
Approach Delay (s)		64.8			67.1			21.9			22.4	
Approach LOS		E			E			C			C	

Intersection Summary	
HCM Average Control Delay	30.8 HCM Level of Service C
HCM Volume to Capacity ratio	0.79
Actuated Cycle Length (s)	150.0 Sum of lost time (s) 9.0
Intersection Capacity Utilization	81.5% ICU Level of Service D
Analysis Period (min)	15
c Critical Lane Group	

Movement	EBL	EBT	EBR	WBL WBT WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Volume (vph)	68	144	255	465 327 41	0	935	324	0	3090	137
Ideal Flow (vphpl)	1900	1900	1900	1900 1900 1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	5.0	5.0	6.0 5.0		5.0			5.0	
Lane Util. Factor	1.00	1.00	1.00	0.97 1.00		0.86			0.86	
Frt	1.00	1.00	0.85	1.00 0.98		0.96			0.99	
Flt Protected	0.95	1.00	1.00	0.95 1.00		1.00			1.00	
Satd. Flow (prot)	1770	1863	1583	3433 1832		6160			6367	
Flt Permitted	0.95	1.00	1.00	0.95 1.00		1.00			1.00	
Satd. Flow (perm)	1770	1863	1583	3433 1832		6160			6367	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00 1.00 1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	68	144	255	465 327 41	0	935	324	0	3090	137
RTOR Reduction (vph)	0	0	2	0 0 0	0	42	0	0	4	0
Lane Group Flow (vph)	68	144	253	465 368 0	0	1217	0	0	3223	0
Turn Type	Prot		Perm	Prot						
Protected Phases	7	4		3 8		1			5	
Permitted Phases			4							
Actuated Green, G (s)	13.6	37.4	37.4	20.0 43.8		71.6			71.6	
Effective Green, g (s)	14.6	39.4	39.4	21.0 45.8		73.6			73.6	
Actuated g/C Ratio	0.10	0.26	0.26	0.14 0.31		0.49			0.49	
Clearance Time (s)	7.0	7.0	7.0	7.0 7.0		7.0			7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0 3.0		3.0			3.0	
Lane Grp Cap (vph)	172	489	416	481 559		3023			3124	
v/s Ratio Prot	0.04	0.08		c0.14 c0.20		0.20			c0.51	
v/s Ratio Perm			c0.16							
v/c Ratio	0.40	0.29	0.61	0.97 0.66		0.40			1.03	
Uniform Delay, d1	63.6	44.2	48.5	64.2 45.3		24.2			38.2	
Progression Factor	1.00	1.00	1.00	1.00 1.00		1.14			1.32	
Incremental Delay, d2	1.5	0.3	2.5	32.3 2.8		0.4			20.8	
Delay (s)	65.1	44.5	51.0	96.4 48.1		28.0			71.3	
Level of Service	E	D	D	F D		C			E	
Approach Delay (s)		51.1		75.1		28.0			71.3	
Approach LOS		D		E		C			E	

Intersection Summary			
HCM Average Control Delay	60.8	HCM Level of Service	E
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	147	342	203	295	151	92	0	2604	392	0	1869	103
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	4.0	4.0	5.0	4.0	4.0		4.0			4.0	
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	0.86		0.86				
Frt	1.00	1.00	0.85	1.00	0.94	0.98		0.99				
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		1.00				
Satd. Flow (prot)	1770	1863	1583	3433	1757	6282		6358				
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		1.00				
Satd. Flow (perm)	1770	1863	1583	3433	1757	6282		6358				
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	147	342	203	295	151	92	0	2604	392	0	1869	103
RTOR Reduction (vph)	0	0	10	0	0	0	0	17	0	0	5	0
Lane Group Flow (vph)	147	342	193	295	243	0	0	2979	0	0	1967	0
Turn Type	Prot		Perm	Prot								
Protected Phases	7	4		3	8		1	5				
Permitted Phases			4									
Actuated Green, G (s)	16.0	32.3	32.3	15.5	31.8		84.2	84.2				
Effective Green, g (s)	17.0	34.3	34.3	16.5	33.8		86.2	86.2				
Actuated g/C Ratio	0.11	0.23	0.23	0.11	0.23		0.57	0.57				
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0				
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0				
Lane Grp Cap (vph)	201	426	362	378	396		3610	3654				
v/s Ratio Prot	0.08	c0.18		c0.09	0.14		c0.47	0.31				
v/s Ratio Perm			0.12									
v/c Ratio	0.73	0.80	0.53	0.78	0.61		0.83	0.54				
Uniform Delay, d1	64.3	54.7	50.8	65.0	52.2		25.8	19.6				
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.06	0.96				
Incremental Delay, d2	12.8	10.5	1.5	10.0	2.8		1.9	0.5				
Delay (s)	77.1	65.1	52.3	75.0	55.0		29.2	19.3				
Level of Service	E	E	D	E	E		C	B				
Approach Delay (s)		63.9			66.0			29.2			19.3	
Approach LOS		E			E			C			B	

Intersection Summary			
HCM Average Control Delay	33.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Appendix C

Crash Data Summaries

Maryland State Highway Administration
Office of Traffic and Safety - Traffic Development and Support
Division SHA 52.1 ADC Study Worksheet Output rev. 09/2010-2

Name: Yeshitla Argaw
Date: 03/14/2011

Location: MD0097 (Georgia Avenue) @ MD0192 (Forest Glen Road)
County: Montgomery, D3 Period: January 01, 2007 To December 31, 2009

Logmiles: 001.61 At 002.82 Radius: 100 ft.
Note:

YEAR »	2007	2008	2009	Total
Fatal	0	0	0	0
No. Killed	0	0	0	
Injury	11	12	5	28
No. Injured	19	15	6	.40
Prop. Damage	6	14	6	26
Total Crashes	17	26	11	54
Severity Index	50	55	29	Avg 45
Opposite Dir.	0	0	0	' 0
Rear End	. 4	11	5	20
Sideswipe	1	6	• 0	7
Left Turn	7	5	3	15
Angle	I	3	2	6
Pedestrian	3	1	1	5
Parked Veh.	0	0	0	0
Fixed Object	0	0	0	0
Other	1	0	0	1
11-Turn	1	0	0	1
Backing	0	0	0	0
Animal	.0	0	0	0
Railroad	.0	0	0	0
Fire / Expl.	0	0	0 -..	0
Overturn	0	0	0	0
Truck Related	' 0	0	0	0
Night Time	7	. 13	5	• 25
Wet Surface	. 2	5	3	10
Alcohol	1	1	0	2
Intersection	17	26 •	11	54
Total Vehicles	34	57	22	113
Total Truck's '	0	0	0	0
Truck %	•0.0	0.0	0.0	0.0

Comments:

Maryland State Highway Administration Name: Yeshitla Argaw

Office of Traffic and Safety - Traffic Development and Support Division Date: 03/14/2011

SHA 52.1 ADC Summary Output rev. 03/2010-1

Location: MD0097 (Georgia Avenue) @ MD0192 (Forest Glen Road) Logmiles: 001.61 At 002.82 Radius: 100 ft.

County: Montgomery, D3 Period: January 1, 2007 To December 31, 2007 Note:

SEVERITY FATAL INJURY P-DAMAGE TOTAL
Accidents 11 6 17
Veh Occ I6
Pedestrian 3 Severity Index: 50

DAY OF THE WEEK
SUN MON TUE WED THU FRI SAT UNK
2 2 2 4 I 1 5

MONTH OF THE YEAR
JAN FEB MAR APR MAY JUN JUL AUG " SEP OCT NOV DEC UNK
2 1 2 2 2 1 1 3 3 ,

CONDITION DRIVER PED
Normal: 26 3
Alcohol: 1
Other: 7

T1ME 12 01 02 03 04 05 06 07 08 09 10 11 UNK
AM: 2 1 1 1 1
PM: 3 2 1 1 1 1 1 1

1 VEHICLES INVOLVED PER ACCIDENT
1 2 3 4 5 6+ UNK TOTAL
3 11 3 34

VEHICLE TYPE
Motorcycle/Moped Tractor Trailer
23 Passenger Vehicle 2 Passenger Bus
Sport Utility Veh School Bus
Pick-Up Truck Emergency Veh
Trucks (2+3 axles) 9 Other Types I

I SURFACE
2 Wet
15 Dry
1 Sno/Ice
Mud
Other

i MOVEMENTS
NORTH SOUTH EAST WEST
I • LF ST RT ; LF ST RI 1 LF ST RT 1 LF ST RT
4 7 1 3 12
I 1 1 2
OTHER MOVEMENTS 5

PROBABLE CAUSES
Influence of Drugs Improper Lane Change
Influence of Alcohol Improper Backing
Influence of Medication Improper Passing - -
Influence of Combined Subst. Improper Signal
Physical/Mental Difficulty Improper Parking
. Fell Asleep/Fainted, etc. Passenger Interfere/Obstruct.
4 Fail to give full Attention Illegally in Roadway
Lic. Restr. Non-compliance Bicycle Violation
Fail to Drive in Single Lane Clothing Not Visible
Improper Right Turn on Red Sleet, Hail, Freezing Rain
•5 Fail'to Yield Right-of-way Severe Crosswinds
Fail to Obey Stop Sign Rain, Snow
2 Fail to Obey Traffic Signal - A
Fail to Obey Other Control .1 Vision Obstruction
Fail to Keep Right of Center Vehicle Defect
Fail to Stop for School Bus . Wet
Wrong Way on One Way _ Icy' r Snow Covered
Exceeded Speed Limit Debris or Obstruction
Operator Using Cell Phone 1 Ruts, Holes-or Bumps
Stopping in Lane Roadway Road Under Construction
Too Fast for Conditions Traffic Control Device Imp. -
2 Followed too Closely Shoulders Low, Soft or High
Improper Turn 2 Other- or Unknown .

COLLISION TYPES FATAL INJURY PROP TOTAL
Opposite Dir Related:
UnRelated:
Rear End _ Related: _ 2 2 4
UnRelated:
Sideswipe Related: . 1 1
UnRelated:
Left Turn Related: 4 3 7
UnRelated: -
Angle Related: 1 1
UnRelated:
Pedestrian • . Related: 3 3
UnRelated:
Parked Vehicle Related:. .
UnRelated:nimal
Other Collision Related:1 1
UnRelated:

F	
I	Building 02
X	Culvert/Ditch 03
E	Curb 04
D	Guardrail/Barrier 05 .
	Embankment • 06
0	Fence 07
B	Light Pole 08
J	Sign Pole . 09
E	Other Pole 10
C	Tree/Shrubbery 11 .
T	Contr. Barrier 12
S	Crash Attenuator 13
	Other Fixed Object

WEATHERILLUMINATION
16 Clear / Cloudy -
Foggy
1 Raining
Snow / Sleet
O t h e r O t h'e r

10 Day
Dawn/Dusk
7 Dark - Lights On-
•Dark - No Lights

TOTALS
2007 ' 17

Maryland State Highway Administration
Office of Traffic and Safety - Traffic Development and Support
Division SHA 52.1 ADC Summary Output rev. 03/2010-1

Name: Yeshitla Argaw
Date: 03/14/2011

Location: MD0097 (Georgia Avenue) @ MD0192 (Forest Glen Road)
County: Montgomery, D3 Period: January I, 2008 To December 31, 2008

Logmiles: 001.61 At 002.82 Radius: 100 ft.
Note:

SEVERITY FATAL INJURY P-DAMAGE TOTAL
Accidents 12 14 26 .
Veh Occ 14
Pedestrian I Severity Index: 55

DAY OF THE WEEK
SUN MON TUE WED T1-10 FRI SAT UNK
2, 4 4 5 2 3 6

MONTH OF THE YEAR
JAN FEB MAR APR MAY JUN JUL AUG SEP
5 1 4 3 1 3 2 . 3
OCT NOV DEC UNK I

1 CONDITION . DRIVER PED
Normal: 45 1
3 1 1 Alcohol: '1
Other: 11

TIME 12 01 02 03 04 05 06 07 08 09
AM: 1 1 I I
PM: 1 3 1 2 2 5
10 11 UNK 1 VEHICLES INVOLVED PER ACCIDENT
. 2 2 1 2 3 4 5 6+ UNK TOTAL
2 2 i 1 19 6 57

VEHICLE TYPE
2 Motorcycle/Moped Tractor Trailer
35 Passenger Vehicle 2 Passenger Bus
10 Sport Utility Veh School Bus
. 2 Pick-Up Truck Emergency Veh
Trucks (2+3 axles) 6 Other Types

SURFACE
5 Wet
21 Dry I
Sno/Ice
Mud
Other I

MOVEMENTS
NORTH SOUTH ' EAST WEST
ST RT . 1 LF ST RT ••1LF ST RT 1 LF ST RT
17 I_L3 17 1 3 [1 5
LF
i 5
OTHER MOVEMENTS 6

PROBABLE CAUSES .
Influence of Drugs 2 Improper Lane Change
1 Influence of Alcohol Improper Backing
Influence of Medication I Improper Passing
Influence of Combined Subst. Improper Signal
1 Physical/Mental Difficulty Improper Parking •
Fell Asleep/Fainted, etc. Passenger Interfere/Obstruct.
3 Fail to give full Attention Illegally in Roadway
Lic. Restr. Non-compliance Bicycle Violation
2 Fail to Drive in Single Lane Clothing Not Visible
Improper Right Turn on Red Sleet, Hail, Freezing Rain
4 Fail to Yield Right-of-way Severe Crosswinds
Fail to Obey Stop Sign Rain, Snow
1 Fail to Obey Traffic Signal Animal •
Fail to Obey Other Control Vision Obstruction
Fail to Keep Right of Center Vehicle. Defect
Fail to Stop for School Bus Wet
Wrong Way on One Way Icy or Snow Covered '
Exceeded Speed Limit Debris or Obstruction
Operator Using Cell Phone Ruts, Holes or Bumps
Stopping in Lane Roadway Road Under Construction
2 Too Fast for Conditions Traffic.Control Device Imp.
4 Followed too Closely Shoulder& Low, Soft or High
1 Improper Turn • 4 Other or Unknown

WEATHER
23 Clear / Cloudy
. Foggy
3 Raining
Snow / Sleet
Other

ILLUMINATION
11 Day
2 Dawn/Dusk
12 Dark - Lights On
1 Dark - No Lights
Other .

TOTALS 26
2008

COLLISION TYPES FATAL INJURY PROP TOTAL
Opposite Dir Related:
UnRelated:
Rear End Related: _ 6 5 II
UnRelated:
Sideswipe Related: 1 5 6
UnRelated:
Left Turn Related:4 1 5
UnRelated:
Angle , Related:3 3
UnRelated:
Pedestrian Related:1 1
UnRelated:
Parked Vehicle Related:
UnRelated:
Other Collision Related:
UnRelated:

FIXED OBJECTS.

	•
	Building 02
	Culvert/Ditch 03
	Curb 04
	Guardrail/Barrier 05
	Embankment 06
	Fence 07
	Light Pole 08
	Sign Pole 09 •
	Other Pole 10
	Tree/Shrubbery 11
	Contr. Barrier 12
	Crash Attenuator 13
	Other Fixed Object

Maryland State Highway Administration
Office of Traffic and Safety - Traffic Development and Support
Division SHA 52.1 ADC Summary Output rev. 03/2010-1

Name: Yeshitla Argaw
Date: 03/14/2011

Location: MD0097 (Georgia Avenue) @ MD0192 (Forest Glen Road)
County: Montgomery, D3 Period: January 1, 2009 To December 31, 2009

Logmiles: 001.61 At 002.82 Radius: 100 ft.
Note:

SEVERITY	FATAL	INJURY	P-DAMAGE	TOTAL
Accidents			5' 6	11
Veil Occ		5		
Pedestrian		1 Severity Index: 29		

DAY OF THE WEEK
SUN MON TUE WED THU FR1 SAT UNK
3 2 2 1 1 2

MONTH OF THE YEAR
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC UNK
I • 2 1 2 1 3 1
... .._ ... ___.. .

TIME 12 01 02 03 04 05 06 07 08 09 10 11 UNK
AM: 2
PM: 1 1 1 1
I 2 1 I i

VEHICLES
CONDITION DRIVER PED
Normal: " 18 1
Alcohol:
Other: 4 '

INVOLVED PER ACCIDENT
2 3 4 5 6+ UNK TOTAL
1 1
9 1 22

VEHICLE TYPE
Motorcycle/Moped
18 Passenger Vehicle
1 Sport Utility Veh
2 Pick-Up Truck
Trucks (2+3 axles) 1
Tractor Trailer
Passenger Bus
School Bus
Emergency Veh
Other Types
I

SURFACE
3 Wet
7 Dry
Sno/Ice
Mud
1 Other

I

NORTH SOUTH
ST RT LF ST RT
1 1 10
LF
2
5 1

OTHER MOVEMENTS

MOVEMENTS
EAST WEST -
LF ST RT LF ST RT
2 1
1

PROBABLE CAUSES
Influence ofDrugs Influence
of Alcohol Influence of
Medication Influence of
Combined Subst.
Physical/Mental Difficulty
Fell Asleep/Fainted, etc.
4 Fail to give full Attention Lic.
Restr. Non-cOmpliance Fail
to Drive in Single Lane
Improper Right Turn on Red
3 Fail to Yield Right-of-way
Fail to Obey Stop Sign Fail
to Obey Traffic Signal Fail
to Obey Other Control Fail
to Keep Right of Center
Fail to Stop for School Bus
Wrong Way on One Way
Exceeded Speed Limit
Operator Using Cell Phone
Stopping in Lane Roadway
Too Fast for Conditions
4 Followed too Closely ,
Improper Turn

Improper Lane Change
Improper Backing
Improper Passing
Improper Signal
Improper Parking •
Passenger Interfere/Obstruct.
Illegally in Roadway
Bicycle Violation
Clothing Not Visible
Sleet, Hail, Freezing Rain
Severe Crosswinds
Rain, Snow
Animal
Vision Obstruction
Vehicle Defect .
Wet •
• Icy or Snow
Covered Debris or
Obstruction Ruts; Holes or
Bumps Road Under
Construction Traffic Control
Device Mop. Shoulders
Low, Soft or High .
Other or Unknown •

COLLISION TYPES FATAL INJURY PROP TOTAL
Opposite Dir Related:
UnRelated:
Rear End Related: 2 3 5
UnRelated:
Sideswipe . Related:
UnRelated:
Left Turn Related: 2 1 3
UnRelated:
Angle Related: 2 2
UnRelated:
Pedestrian Related: I 1
UnRelated:
Parked Vehicle Related:
UnRelated:
Other Collision Related:
UnRelated:

FIXED OBJECTS	
0	Bridge 01
	Building 02
	Culvert/Ditch 03
	Curb 04
	Guardrail/Barrier . 05
	Embankment • 06 •
	Fence 07
	•Light Pole 08
	Sign 'Pole . .09
	Other Pole . 10
	TreTree/Shrubbery• 11
	Contr. Barrier 12
	Crash Attenuator • i3
	Other Fixed Object

WEATHER
8 Clear / Cloudy
Foggy
2 Raining -
1 Snow / Sleet
Other

ILLUMINATION
6 Day
Dawn/Dusk
•5 Dark - Lights
On
Dark - No Lights
• Other

TOTALS 11
2009

Maryland State Highway Administration Name: Yeshitla Argaw

Office of Traffic and Safety - Traffic Development and Support Division Date: 03/14/2011

SHA 52.1 ADC Summary Output rev. 03/2010-1

Location: MD0097 (Georgia Avenue) @ MD0192 (Forest Glen Road) Logmiles: 001.61 At 002.82 Radius: 100 ft.

County: Montgomery, D3 Period: January 1, 2007 To December 31, 2009 Note:

SEVERITY FATAL	INJURY P-DAMAGE TOTAL	DAY OF THE WEEK
Accidents	28 26 54	SUN MON TUE WED THU FRI SAT UNK
Veh Occ	357	8 6 11 4 5 13
Pedestrian	5 AVG Severity Index: 45	

MONTH OF THE YEAR

JAN FEB MAR APR

8 2 8 6

MAY JUN JUL . AUG SEP

3 6 2 5

OCT NOV DEC UNK I Normal: 89 5'

6 7 1 1 Alcohol: 2

Other: 22 '

TIME 12 01 02 03

AM: 2 1 1

PM: 4 3 I

04 05 06 07 08 09

I 1 3 2

4 3 5 3 7

10 I I UNK VEHICLES INVOLVED PER ACCIDENT

4 4 I -12 3 4 5 6+ UNK TOTAL

3 2

5 39 10 113

VEHICLE TYPE	SURFACE		MOVEMENTS
2 Motorcycle/Moped Tractor Trailer	10 Wet 43	NORTH SOUTH	EAST WEST
76 Passenger Vehicle 4 Passenger Bus	Dry	ST RT LF ST RT	1 LF ST RT • LF ST RT
11 Sport Utility Veh School Bus	Sno/Ice	i LF 29 7 39 11	3 1 [3 7 1
4 Pick-Up Truck Emergency Veil	Mud	OTHER MOVEMENTS	12
Trucks (2+3 axles) 16 Other Types	1 Other		

PROBABLE CAUSES

Influence of Drugs

1 Influence of Alcohol

Influence of Medication

Influence of Combined Subst.

1 Physical/Mental Difficulty

Fell Asleep/Fainted, etc.

11 Fail to give full Attention

Lic. Restr. Non-compliance

2 Fail to Drive in Single Lane

Improper Right Turn on Red

12 Fail to Yield Right-of-way

Fail to Obey Stop Sign

3 Fail to Obey Traffic Signal

Fail to Obey Other Control

Fail to Keep Right of Center

Fail to Stop for School Bus

Wrong Way on One Way

Exceeded Speed Limit

Operator Using Cell Phone

Stopping in Lane Roadway

2 Too Fast for Conditions

• 10 Followed too Closely

1 Improper Turn

2 Improper Lane Change

Improper Backing

1 Improper Passing

Improper Signal

Improper Parking

Passenger Interfere/Obstruct.

Illegally in Roadway

Bicycle Violation

Clothing Not Visible

Sleet, Hail, Freezing Rain-

Severe Crosswinds

Rain, Snow

Animal

I Vision Obstruction .

Vehicle Defect '

Wet

Icy or Snow Covered

Debris or Obstruction

1 Ruts, Holes or Bumps

Road Under Construction

Traffic Control Device Inop.

Shoulders Low, Soft or 1-figh

6 Other or Unknown

WEATHER	ILLUMINATION	TOTALS. 54
47 Clear / Cloudy	27 Day	07-09
Foggy	2 Dawn/Dusk	
6 Raining	24 Dark - Lights On	
1 Snow / Sleet	' 1 Dark-- No Lights	
Other	Other	

COLLISION TYPES . ' FATAL INJURY PROP TOTAL

Opposite Dir Related:

UnRelated:

Rear End Related: 10 10 20

UnRelated: -

Sideswipe Related: 1 6 7

UnRelated:

Left Turn Related: 10 5 15

UnRelated:

Angle Related: 1 5 6

UnRelated:

Pedestrian Related: 5 5

UnRelated:

Parked Vehicle Related:

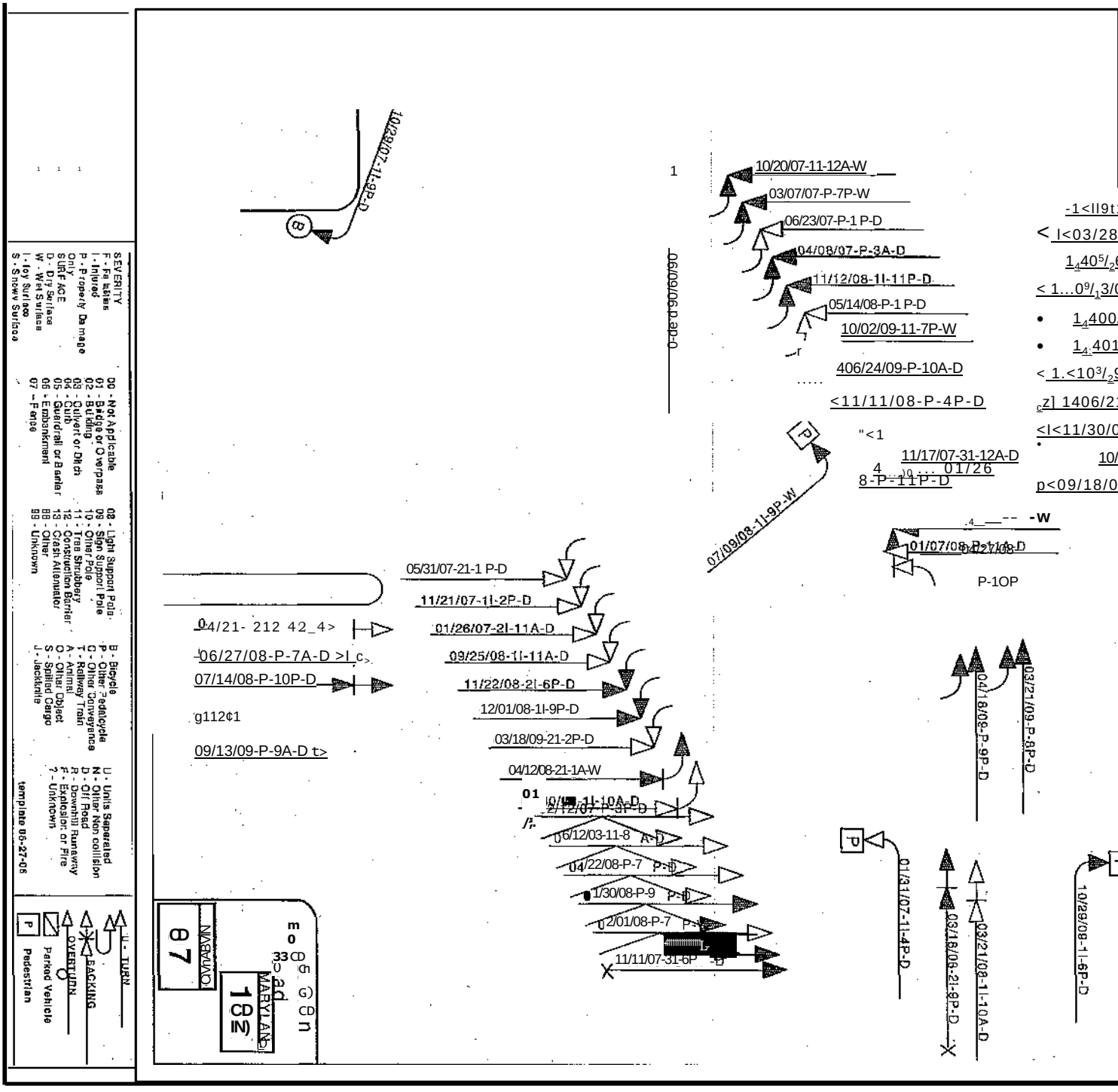
•UnRelated:

Other Collision Related: 1 1

UnRelated:

FIXED OBJECTS

Building 02
Culvert/Ditch 03
Curb 04
Guardrail/Barrier 05
Embankment • 06
Fence 07
Light Pole 08
Sign Pole . 09
•Other Pole 10
Tree/Shrubbery 1 i -
Contr. Barrier '12
Crash Attenuator 13
Other Fixed Object


SEVERITY
K - Killed
F - Fatalities
I - Injured
P - Property Damage Only
SURFACE
W - Wet Surface
D - Dry Surface
I - Icy Surface
S - Snow Surface
00 - Not Applicable
01 - Bridge or Overpass
02 - Building
03 - Culvert or Ditch
04 - Curb
05 - Guardrail or Barrier
06 - Embankment
07 - Fence
08 - Light Support Pole
09 - Sign Support Pole
10 - Other Pole
11 - Tree Shrubbery
12 - Construction Barrier
13 - Crash Attenuator
88 - Other
99 - Unknown
B - Bicycle
P - Other Pedalcycle
C - Other Conveyance
T - Railway Train
A - Animal
O - Other Object
S - Spilled Cargo
J - Jackknife
U - Units Separated
N - Other Non collision
D - Off Road
R - Downhill Runaway
F - Explosion or Fire
? - Unknown
template 05-27-05
P
Pedestrian
Parked Vehicle
OVERTURN
BACKING
U - TURN
87
MARYLAND
33
MARYLAND
10/28/07-11-9P-D
10/20/07-11-12A-W
03/07/07-P-7P-W
06/23/07-P-1 P-D
04/08/07-P-3A-D
11/12/08-1I-11P-D
05/14/08-P-1 P-D
10/02/09-11-7P-W
406/24/09-P-10A-D
<11/11/08-P-4P-D
11/17/07-31-12A-D
8-P-11P-D
07/09/08-11-9P-W
05/31/07-21-1 P-D
11/21/07-1I-2P-D
01/26/07-2I-11A-D
09/25/08-1I-11A-D
11/22/08-2I-6P-D
12/01/08-1I-9P-D
03/18/09-21-2P-D
04/12/08-21-1A-W
06/12/03-11-8 A-D
04/22/08-P-7 P-D
1/30/08-P-9 P-D
02/01/08-P-7 P-D
11/11/07-31-6P
04/21- 212 42_4>
06/27/08-P-7A-D >I_c>
07/14/08-P-10P-D
g112¢1
09/13/09-P-9A-D t>
01/07/08-P-2I-4P-D
P-1OP
04/18/08-P-9P-D
03/21/09-P-8P-D
01/31/07-11-4P-D
03/18/08-21-8P-D
03/21/08-1I-10A-D
10/29/08-1I-6P-D

Maryland State Highway Administration
Office of Traffic and Safety - Traffic Development and Support
Division SHA 52.1 ADC Study Worksheet Output rev. 09/2010-2

Name: Alex Lewis
Date: 04/25/2011

Location: MD0097 @ MD0192 / Forest Glen Rd
Logmiles: 001.61 At 002.82 Radius: 100 ft.

County: Montgomery, D3 Period: January 01, 2005 To December 31, 2006
Note:

YEAR »	2005	2006	Total
Fatal	0	0	0
No. Killed	0	0	0
Injury	5	13	18
No. Injured	7	17	24
Prop. Damage	5	7	12
Total Crashes	10	20	30
Severity Index	32	56	Avg 44
Opposite Dir.	0	0	0
Rear End	4	8	12
Sideswipe	2	1	3
Left Turn	2	4	6
Angle	1	1	2
Pedestrian	1	5	6
Parked Veh.	0	0	0
Fixed Object	0	0	0
Other	0	1	1
U-Turn	0	0	0
Backing	0	1	1
Animal	0	0	0
Railroad	0	0	0
Fire / Expl.	0	0	0
Overturn	0	0	0
Truck Related	0	0	0
Night Time	2	4	6
Wet Surface	2	3	5
Alcohol	0	1	1
Intersection	10	20	30
Total Vehicles	19	37	56
Total Trucks	0	0	0
Truck %	0.0	0.0	0.0

Comments:

Maryland State Highway Administration
Office of Traffic and Safety - Traffic Development and Support
Division SHA 52.1 ADC Summary Output rev. 03/2010-1

Name: Alex Lewis
Date: 04/25/2011

Location: MD0097 @ MD0192 / Forest Glen Rd
Logmiles: 001.61 At 002.82 Radius: 100 ft.
County: Montgomery, D3 Period: January 1, 2005 To December 31, 2005
Note:

SEVERITY FATAL INJURY P-DAMAGE TOTAL
Accidents 5 5 10
Veh Occ 6
Pedestrian 1 Severity Index: 32

DAY OF THE WEEK

SUN	MON	TUE	WED	THU	FRI	SAT	UNK
1	2	2	1	3	1		

MONTH OF THE YEAR

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	UNK
1	2	2	1	1	1				2			

CONDITION DRIVER PED
Normal: 18 1
Alcohol:
Other: 1

TIME

	12 01 02 03 04 05 06 07 08 09	10 11 UNK
AM:	1 1	1 2
PM:	1 2 2	

VEHICLES INVOLVED PER ACCIDENT

1	2	3	4	5	6+	UNK	TOTAL
1	9						19

11 VEHICLE TYPE
Motorcycle/Moped Tractor Trailer
Passenger Vehicle 2 Passenger Bus
Sport Utility Veh School Bus
Pick-Up Truck Emergency Veh
Trucks (2+3 axles) 6 Other Types

SURFACE
2 Wet
8 Dry
Sno/Ice
Mud
Other

NORTH
ST RT
3
LF
1

SOUTH
LF ST RT
1 10
OTHER MOVEMENTS

MOVEMENTS
EAST
I LF ST RT
I_i2

WEST
I LF ST RT
I_i2

PROBABLE CAUSES
Influence of Drugs 1 Improper Lane Change
Influence of Alcohol Improper Backing
Influence of Medication Improper Passing
Influence of Combined Subst. Improper Signal
Physical/Mental Difficulty Improper Parking
Fell Asleep/Fainted, etc. Passenger Interfere/Obstruct.
4 Fail to give full Attention Illegally in Roadway
Lic. Restr. Non-compliance Bicycle Violation
Fail to Drive in Single Lane Clothing Not Visible
Improper Right Turn on Red Sleet, Hail, Freezing Rain
1 Fail to Yield Right-of-way Severe Crosswinds
Fail to Obey Stop Sign Rain, Snow
Fail to Obey Traffic Signal Animal
Fail to Obey Other Control Vision Obstruction
Fail to Keep Right of Center Vehicle Defect
Fail to Stop for School Bus Wet
Wrong Way on One Way Icy or Snow Covered
Exceeded Speed Limit Debris or Obstruction
Operator Using Cell Phone Ruts, Holes or Bumps
Stopping in Lane Roadway Road Under Construction
Too Fast for Conditions Traffic Control Device Inop.
3 Followed too Closely Shoulders Low, Soft or High
Improper Turn 1 Other or Unknown

COLLISION TYPES FATAL INJURY PROP TOTAL
Opposite Dir Related:
UnRelated:
Rear End Related: 1 3 4
UnRelated:
Sideswipe Related: 1 1 2
UnRelated:
Left Turn Related: 1 1 2
UnRelated:
Angle Related: 1 1
UnRelated:
Pedestrian Related: 1 1
UnRelated:
Parked Vehicle Related:
UnRelated:
Other Collision Related:
UnRelated:

WEATHER
9 Clear / Cloudy
Foggy
1 Raining
Snow / Sleet
Other

ILLUMINATION
6 Day
2 Dawn/Dusk
2 Dark - Lights On
Dark - No Lights
Other

TOTALS 10
2005

- x LU CJ 0 w-, ttl U E- (,)

Bridge 01
Building 02
Culvert/Ditch 03
Curb 04
Guardrail/Barrier 05
Embankment 06
Fence 07
Light Pole 08
Sign Pole 09
Other Pole 10
Tree/Shrubbery 11
Contr. Barrier 12
Crash Attenuator 13
Other Fixed Object

Maryland State Highway Administration
Office of Traffic and Safety - Traffic Development and Support
Division SHA 52.1 ADC Summary Output rev. 03/2010-1

Name: Alex Lewis
Date: 04/25/2011

Location: MD0097 @ MD0192 / Forest Glen Rd
Logmiles: 001.61 At 002.82 Radius: 100 ft.

County: Montgomery, D3 Period: January 1, 2006 To December 31, 2006
Note:

SEVERITY FATAL INJURY P-DAMAGE TOTAL
Accidents 13 7 20
Veh Occ 9
Pedestrian 8 Severity Index: 56

DAY OF THE WEEK

SUN	MON	TUE	WED	THU	FRI	SAT	UNK
2	5	4	3	3	3		

MONTH OF THE YEAR

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	UNK
I	1	2	2	4	1	1	2		1	2	3	

CONDITION DRIVER PED
Normal: 33 5
Alcohol: 1
Other: 3

TIME 12 01 02 03 04 05 06 07 08 09 10 11 UNK

	12	01	02	03	04	05	06	07	08	09	10	11	UNK
AM:		1	1	1							3	1	
PM:	1	2	1	1	2	2	2	2					

VEHICLES INVOLVED PER ACCIDENT

1	2	3	4	5	6+	UNK	TOTAL
5	13	2					37

VEHICLE TYPE
Motorcycle/Moped Tractor Trailer
28 Passenger Vehicle 2 Passenger Bus
Sport Utility Veh School Bus
Pick-Up Truck 1 Emergency Veh
Trucks (2+3 axles) 6 Other Types

SURFACE
3 Wet
17 Dry
Sno/Ice
Mud
Other

NORTH

LF	ST	RT
3	12	

SOUTH

LF	ST	RT
2	9	

MOVEMENTS

EAST

LF	ST	RT
2		

OTHER MOVEMENTS 3

WEST

LF	ST	RT
5	1	

PROBABLE CAUSES
Influence of Drugs Improper Lane Change
1 Influence of Alcohol 1 Improper Backing
Influence of Medication Improper Passing
Influence of Combined Subst. Improper Signal
Physical/Mental Difficulty Improper Parking
Fell Asleep/Fainted, etc. Passenger Interfere/Obstruct.
6 Fail to give full Attention Illegally in Roadway
Lic. Restr. Non-compliance Bicycle Violation
1 Fail to Drive in Single Lane Clothing Not Visible
Improper Right Turn on Red Sleet, Hail, Freezing Rain
5 Fail to Yield Right-of-way Severe Crosswinds
Fail to Obey Stop Sign Rain, Snow
I Fail to Obey Traffic Signal Animal
Fail to Obey Other Control Vision Obstruction
Fail to Keep Right of Center 1 Vehicle Defect
Fail to Stop for School Bus Wet
Wrong Way on One Way Icy or Snow Covered
Exceeded Speed Limit Debris or Obstruction
Operator Using Cell Phone Ruts, Holes or Bumps
Stopping in Lane Roadway Road Under Construction
1 Too Fast for Conditions Traffic Control Device Inop.
Followed too Closely Shoulders Low, Soft or High
Improper Turn 3 Other or Unknown

WEATHER
17 Clear / Cloudy
Foggy
3 Raining
Snow / Sleet
Other

ILLUMINATION
15 Day
1 Dawn/Dusk
4 Dark - Lights On
Dark - No Lights
Other

TOTALS 20
2006

COLLISION TYPES FATAL INJURY PROP TOTAL
Opposite Dir Related:
UnRelated:
Rear End Related: 3 5 -8 -
UnRelated:
Sideswipe Related: 1 1
UnRelated:
Left Turn Related: 4 4
UnRelated:
Angle Related: 1 I
UnRelated:
Pedestrian Related: 5 5
UnRelated:
Parked Vehicle Related:
UnRelated:
Other Collision Related: 1 I
UnRelated:

FIXED OBJECTS
Bridge 01
Building 02
Culvert/Ditch 03
Curb 04
Guardrail/Barrier 05
Embankment 06
Fence 07
Light Pole 08
Sign Pole 09
Other Pole 10
Tree/Shrubbery 11
Contr. Barrier 12
Crash Attenuator 13
Other Fixed Object

Maryland State Highway Administration
Office of Traffic and Safety - Traffic Development and Support
Division SHA 52.1 ADC Summary Output rev. 03/2010-1

Name: Alex Lewis
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Location: MD0097 @ MD0192 / Forest Glen Rd
Logmiles: 001.61 At 002.82 Radius: 100 ft.

County: Montgomery, D3 Period: January 1, 2005 To December 31, 2006
Note:

SEVERITY FATAL INJURY P-DAMAGE TOTAL
Accidents IS 12 30
Veh Occ 15
Pedestrian 9 AVG Severity Index: 44

DAY OF THE WEEK
SUN MON TUE WED THU FRI SAT UNK
3 2 7 4 4 6 4

MONTH OF THE YEAR
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC UNK
1 2 4 4 4 2 1 1 3 1 2 5

CONDITION DRIVER PED
Normal: 51 6
Alcohol: 1
Other: 4

TIME 12 01 02 03 04 05 06 07 08 09 10 11 UNK
AM: 2 1 1 1 4 3
PM: 1 2 1 2 4 2 2 4

VEHICLES INVOLVED PER ACCIDENT
1 2 3 4 5 6+ UNK TOTAL
6 22 2 56

VEHICLE TYPE
Motorcycle/Moped Tractor Trailer
39 Passenger Vehicle 4 Passenger Bus
Sport Utility Veh School Bus
Pick-Up Truck 1 Emergency Veh
Trucks (2+3 axles) 12 Other Types

SURFACE
5 Wet
25 Dry
Sno/Ice
Mud
Other

NORTH
ST RT
15
LF
4

SOUTH
LF ST RT
3 19

MOVEMENTS
EAST
LF ST RT
4

OTHER MOVEMENTS
3

WEST
LF ST RT
7 1

{

PROBABLE CAUSES
Influence of Drugs 1 Improper Lane Change
1 Influence of Alcohol 1 Improper Backing
Influence of Medication Improper Passing
Influence of Combined Subst. Improper Signal
Physical/Mental Difficulty Improper Parking
Fell Asleep/Fainted, etc. Passenger Interfere/Obstruct.
10 Fail to give full Attention Illegally in Roadway
Lic. Restr. Non-compliance Bicycle Violation
1 Fail to Drive in Single Lane Clothing Not Visible
Improper Right Turn on Red Sleet, Hail, Freezing Rain
6 Fail to Yield Right-of-way Severe Crosswinds
Fail to Obey Stop Sign Rain, Snow
1 Fail to Obey Traffic Signal Animal
Fail to Obey Other Control Vision Obstruction
Fail to Keep Right of Center 1 Vehicle Defect
Fail to Stop for School Bus Wet
Wrong Way on One Way Icy or Snow Covered
Exceeded Speed Limit Debris or Obstruction
Operator Using Cell Phone Ruts, Holes or Bumps
Stopping in Lane Roadway Road Under Construction
1 Too Fast for Conditions Traffic Control Device Inop.
3 Followed too Closely Shoulders Low, Soft or High
Improper Tum 4 Other or Unknown

WEATHER
26 Clear / Cloudy
Foggy
4 Raining
Snow / Sleet
Other

ILLUMINATION
21 Day
3 Dawn/Dusk
6 Dark - Lights On
Dark - No Lights
Other

TOTALS 30
05-06

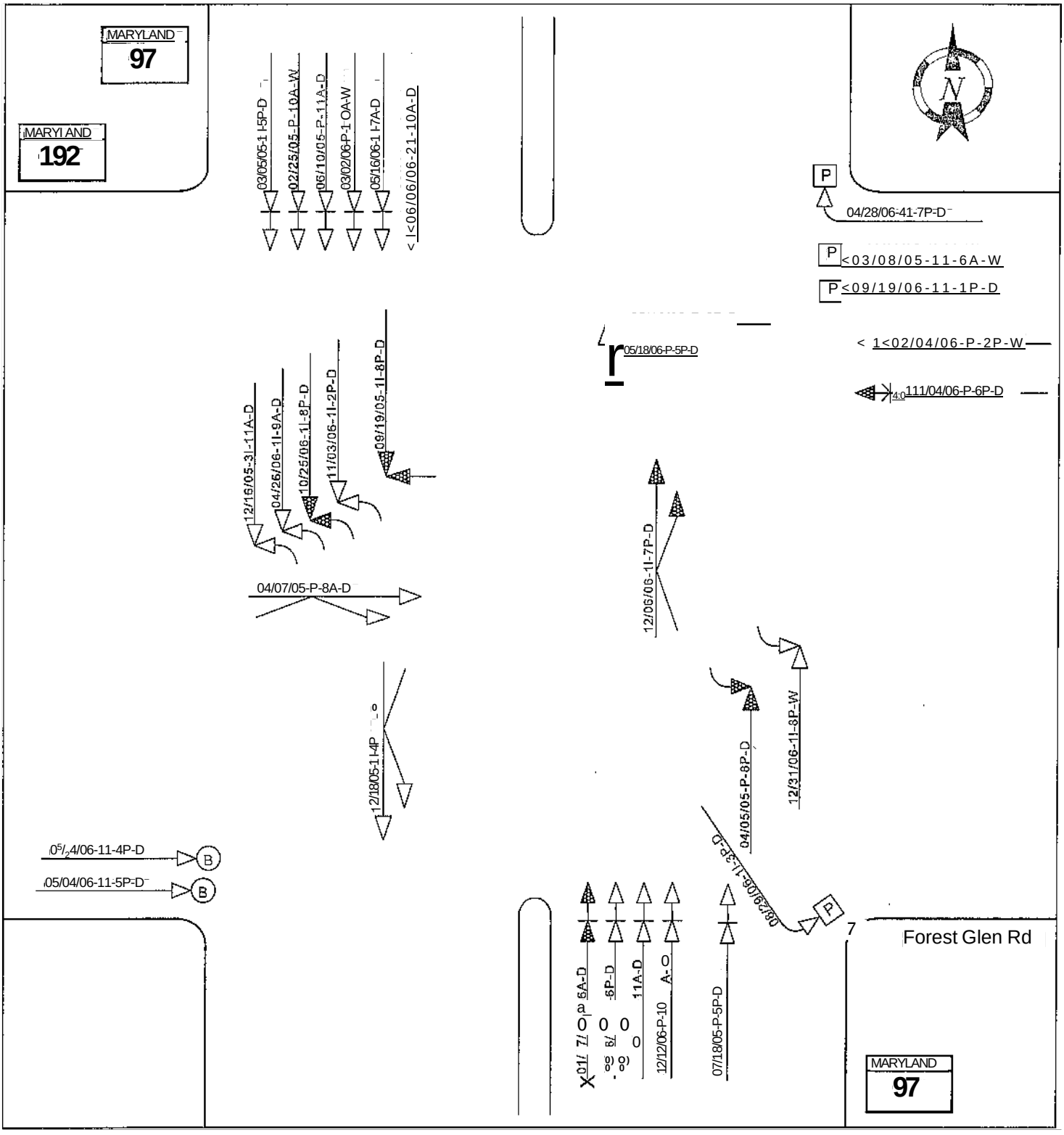
COLLISION TYPES FATAL INJURY PROP TOTAL
Opposite Dir Related:
UnRelated:
Rear End Related: 12
UnRelated:
Sideswipe ' Related: 2 1 3
UnRelated:
Left Turn Related: 5 1 6
UnRelated:
Angle Related: 1 1 2
UnRelated:
Pedestrian Related: 6 6
UnRelated:
Parked Vehicle Related:
UnRelated:
Other Collision Related: 1 1
UnRelated:

FIXED OBJECTS 0

Bridge 01	
Building 02	
Culvert/Ditch 03	
Curb 04	
Guardrail/Barrier 05	
Embankment 06	
Fence 07	
Light Pole 08	
Sign Pole 09	
Other Pole 10	
Tree/Shrubbery 11	
Contr. Barrier 12	
Crash Attenuator 13	
Other Fixed Object	

Office of Traffic & Safety
Traffic Development & Support Division
Crash Analysis Safety Team

Location: and 97 @ MD 192 / Forest Glen Rd
County: MONTGOMERY
Study Period: 01/01/2005 to 12/31/2006
Analyst: ALEWIS Date: 04/25/2011



<DATE nEwErarriv T1.15 CltpECP
. 4 3 1 1 N I G H T
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< nRtins

SEVERITY
F -Fatalities
I - Injured
P Property Dam age Only
SURF ACE
- *Dry* Surface
W -Wet Surface
I - Icy Surface
S Snowy S urface

00 - Not Applicable
01 -Bridge or 0 verpass
02 - Building
03 - Culvert *or* Ditch
04 -Curb
05 - Guardrail or B artier
58 Embankment
07 —Fence

08 - Light Support Pole
09 - Sign Support Pole
10 - Other Pole
11 - Tree Shrubbery
12 - Construction Barrier
13 - Crash Attenuator
88 - Other
99 - Unknown

B - Bicycle
P - Other Pedalcycle
C - Other Conveyance
T - Railway Train
A - Animal
0 - Other Object
S Spilled Cargo
J Jackknife

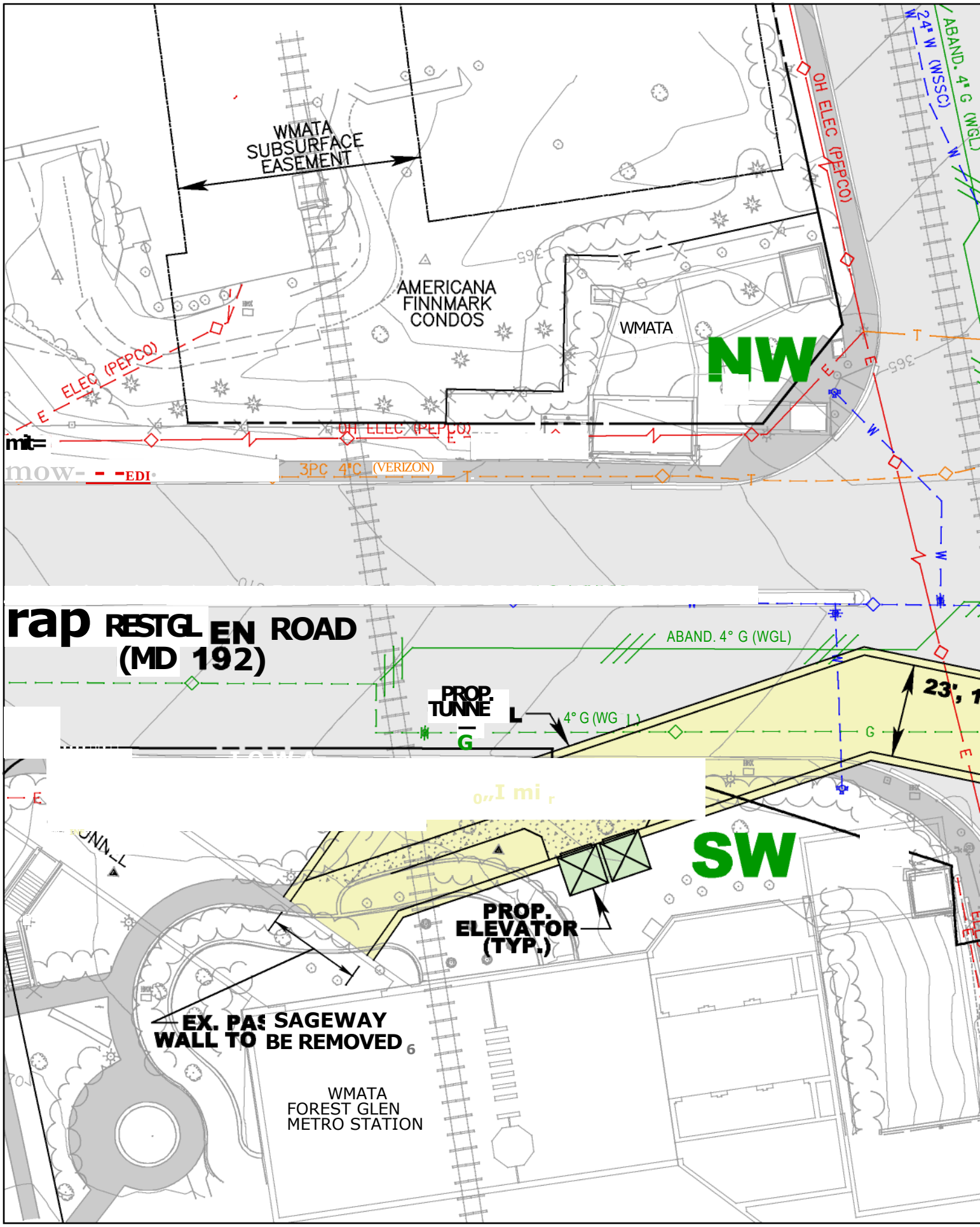
U • Units Separated
N - Other Non collision
D - Off Road
R - Downhill Runaway
F - Explosion or Fire 7 - Unknown

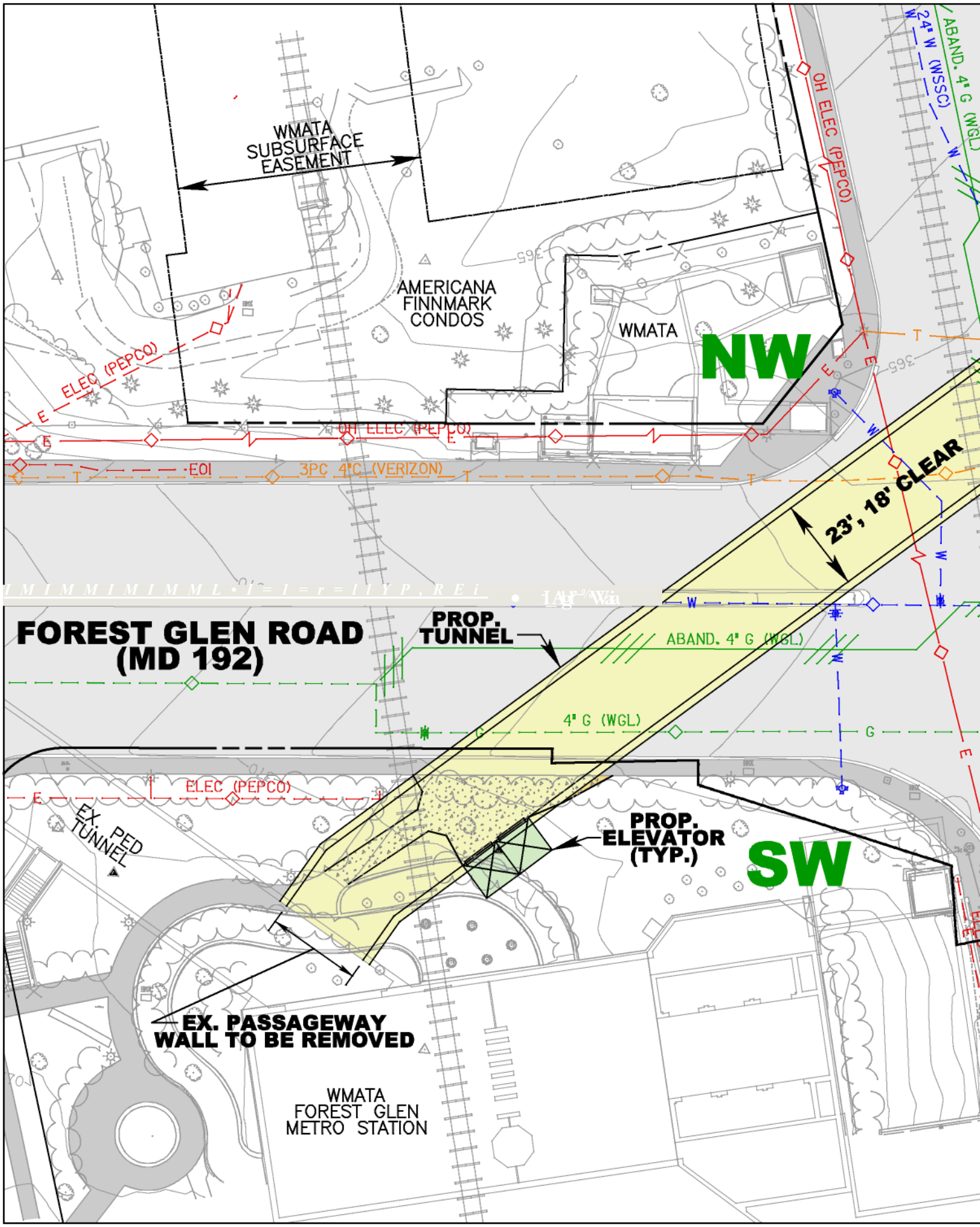
template 06-27-06

13 1 TURN
)< RACKING
<OVERT RN Parked Vehicle
pl Pedestrian

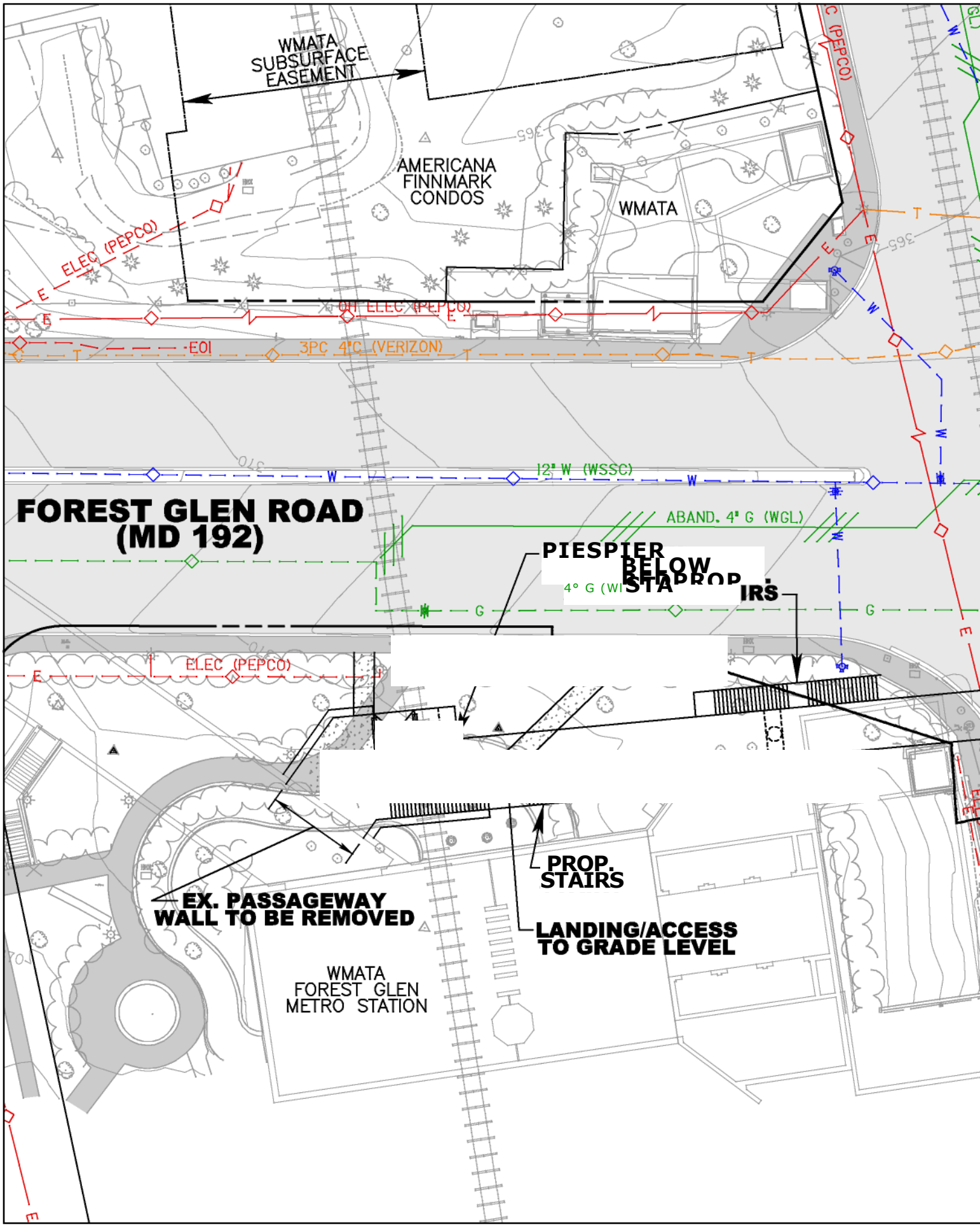
Appendix D

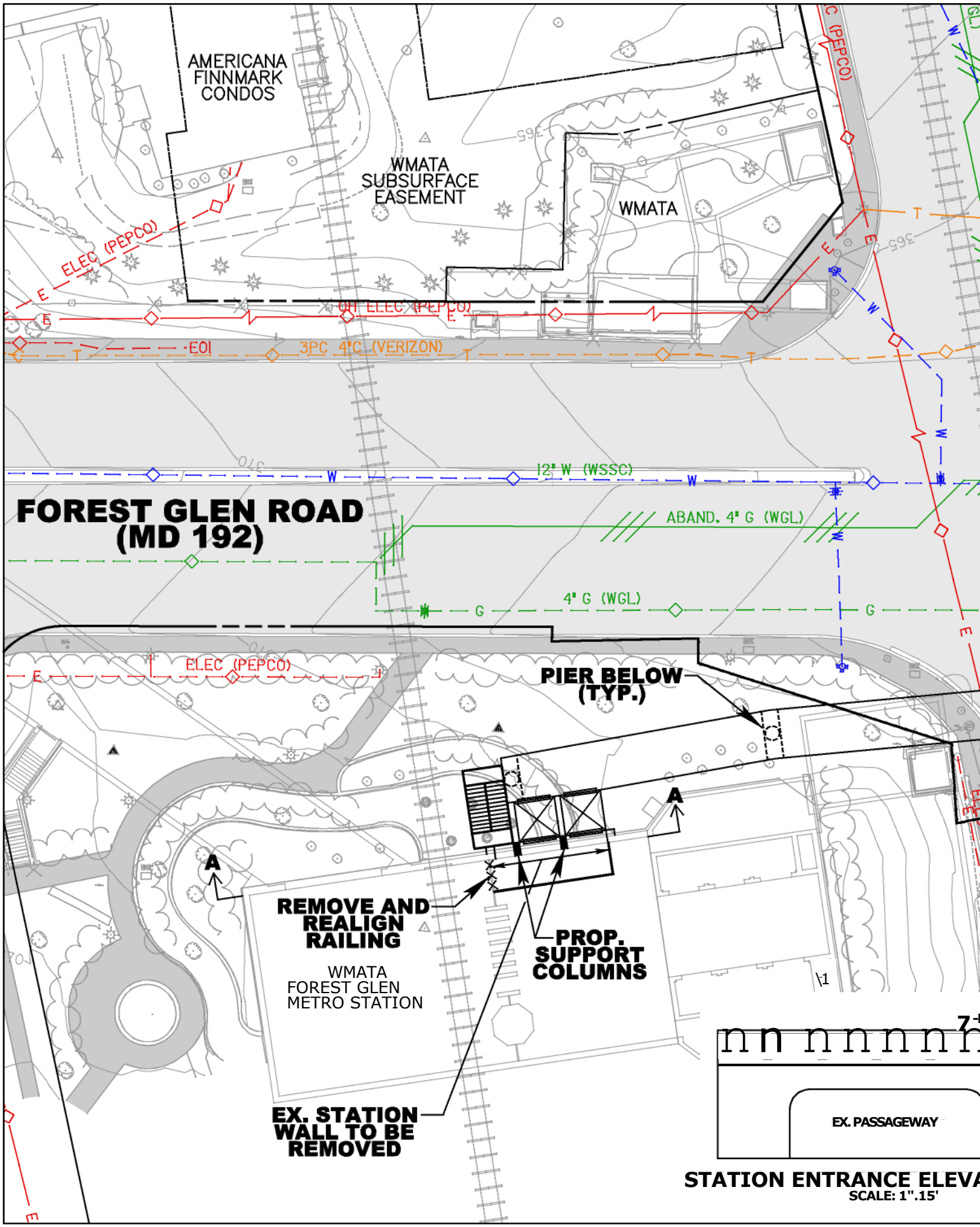
Tunnel Alternatives

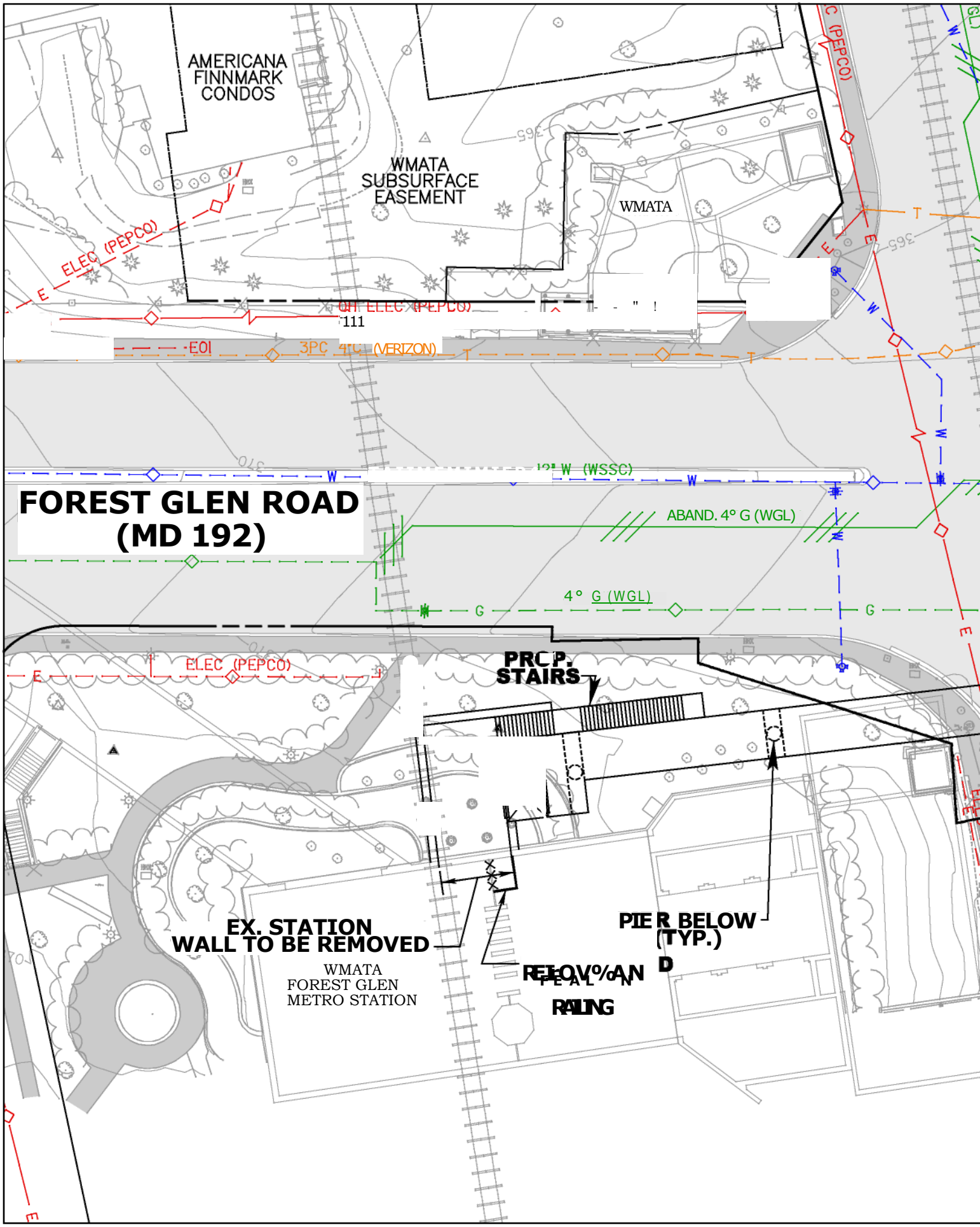

WMATA
SUBSURFACE
EASEMENT
AMERICANA
FINNMARK
CONDOS
WMATA
NW
OH ELEC (PEPCO)
ABAND. 4" G (WGL)
24" W (WSSC)
ELEC (PEPCO)
3PC 4"C (VERIZON)
rap RESTGL EN ROAD
(MD 192)
ABAND. 4° G (WGL)
PROP.
TUNNE L
4° G (WG L)
SW
PROP.
ELEVATOR
(TYP.)
EX. PAS SAGEWAY
WALL TO BE REMOVED
WMATA
FOREST GLEN
METRO STATION


WMATA
SUBSURFACE
EASEMENT
AMERICANA
FINNMARK
CONDOS
WMATA
NW
OH ELEC (PEPCO)
ABAND. 4" G (WGL)
24" W (WSSC)
ELEC (PEPCO)
OH ELEC (PEPCO)
EOI
3PC 4"C (VERIZON)
23', 18' CLEAR
FOREST GLEN ROAD
(MD 192)
PROP.
TUNNEL
ABAND. 4" G (WGL)
4" G (WGL)
ELEC (PEPCO)
EX. PED
TUNNEL
PROP.
ELEVATOR
(TYP.)
SW
EX. PASSAGEWAY
WALL TO BE REMOVED
WMATA
FOREST GLEN
METRO STATION

Appendix E
Pedestrian Bridge Alternatives

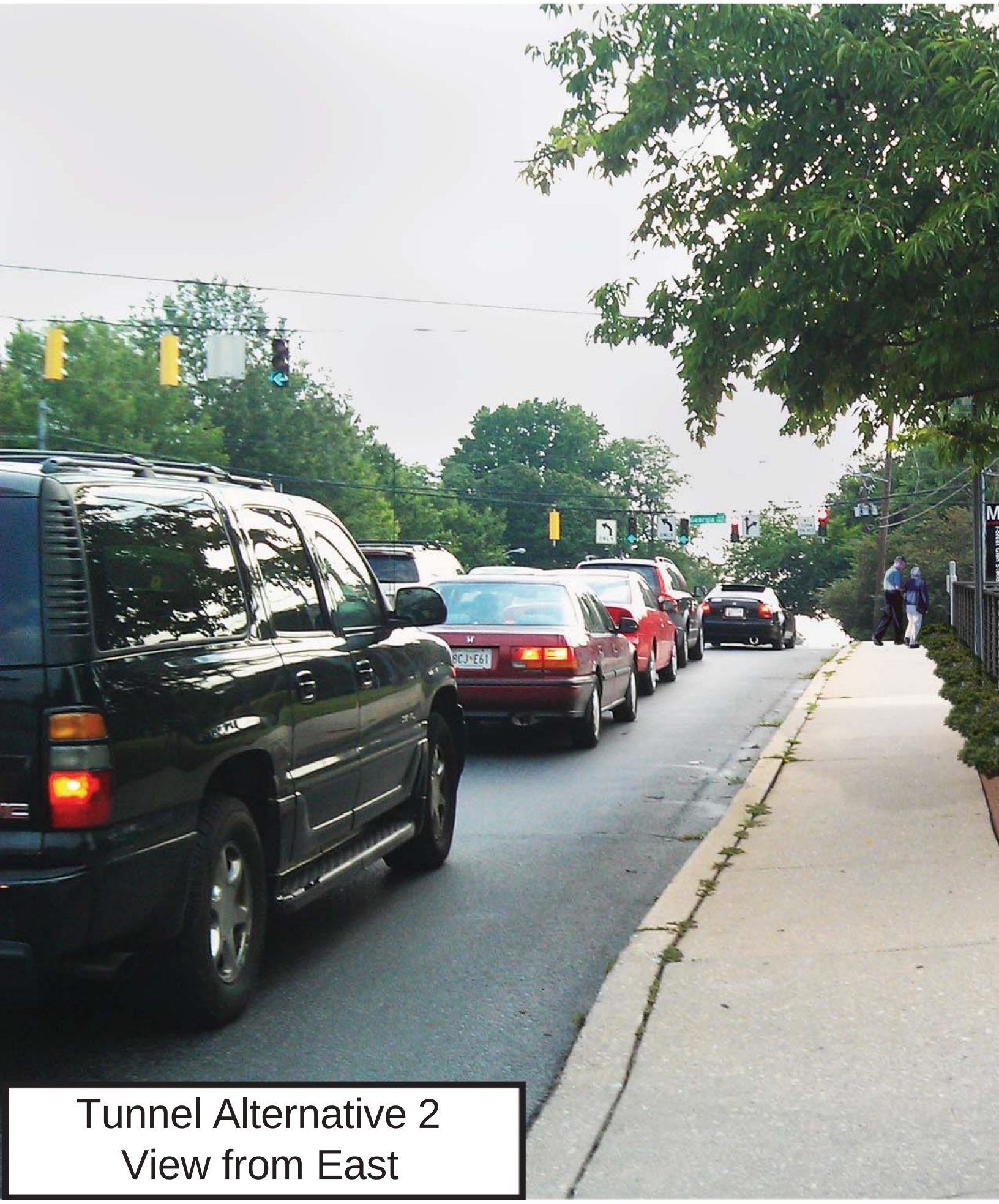

WMATA
SUBSURFACE
EASEMENT
AMERICANA
FINNMARK
CONDOS
WMATA
ELEC (PEPCO)
OH ELEC (PEPCO)
EOI
3PC 4"C (VERIZON)
12" W (WSSC)
FOREST GLEN ROAD
(MD 192)
ABAND. 4" G (WGL)
PIESPIER
BELOW
STA
IRS
ELEC (PEPCO)
EX. PASSAGEWAY
WALL TO BE REMOVED
PROP.
STAIRS
LANDING/ACCESS
TO GRADE LEVEL
WMATA
FOREST GLEN
METRO STATION


AMERICANA
FINNMARK
CONDOS
WMATA
SUBSURFACE
EASEMENT
WMATA
ELEC (PEPCO)
OH ELEC (PEPCO)
EOI
3PC 4"C (VERIZON)
12" W (WSSC)
FOREST GLEN ROAD
(MD 192)
ABAND. 4" G (WGL)
4" G (WGL)
ELEC (PEPCO)
PIER BELOW
(TYP.)
A
A
REMOVE AND
REALIGN
RAILING
WMATA
FOREST GLEN
METRO STATION
PROP.
SUPPORT
COLUMNS
EX. STATION
WALL TO BE
REMOVED
EX. PASSAGEWAY
STATION ENTRANCE ELEVA
SCALE: 1".15'


AMERICANA
FINNMARK
CONDOS
WMATA
SUBSURFACE
EASEMENT
WMATA
ELEC (PEPCO)
OHT ELEC (PEPCO)
3PC (VERIZON)
W (WSSC)
FOREST GLEN ROAD
(MD 192)
ABAND. 4° G (WGL)
4° G (WGL)
ELEC (PEPCO)
PRCP.
STAIRS
EX. STATION
WALL TO BE REMOVED
WMATA
FOREST GLEN
METRO STATION
PIER BELOW
(TYP.)
REMOVAL
RAILING

Appendix F
Architectural Rendering of Tunnel Entrances

Tunnel Alternative 1
View from North



Tunnel Alternative 2
View from East


EDGE
LEASE
301-222-0200
WWW.EDGECRE.COM

Appendix G
Architectural Rendering of Pedestrian Bridge and Material Options

Elevation looking south

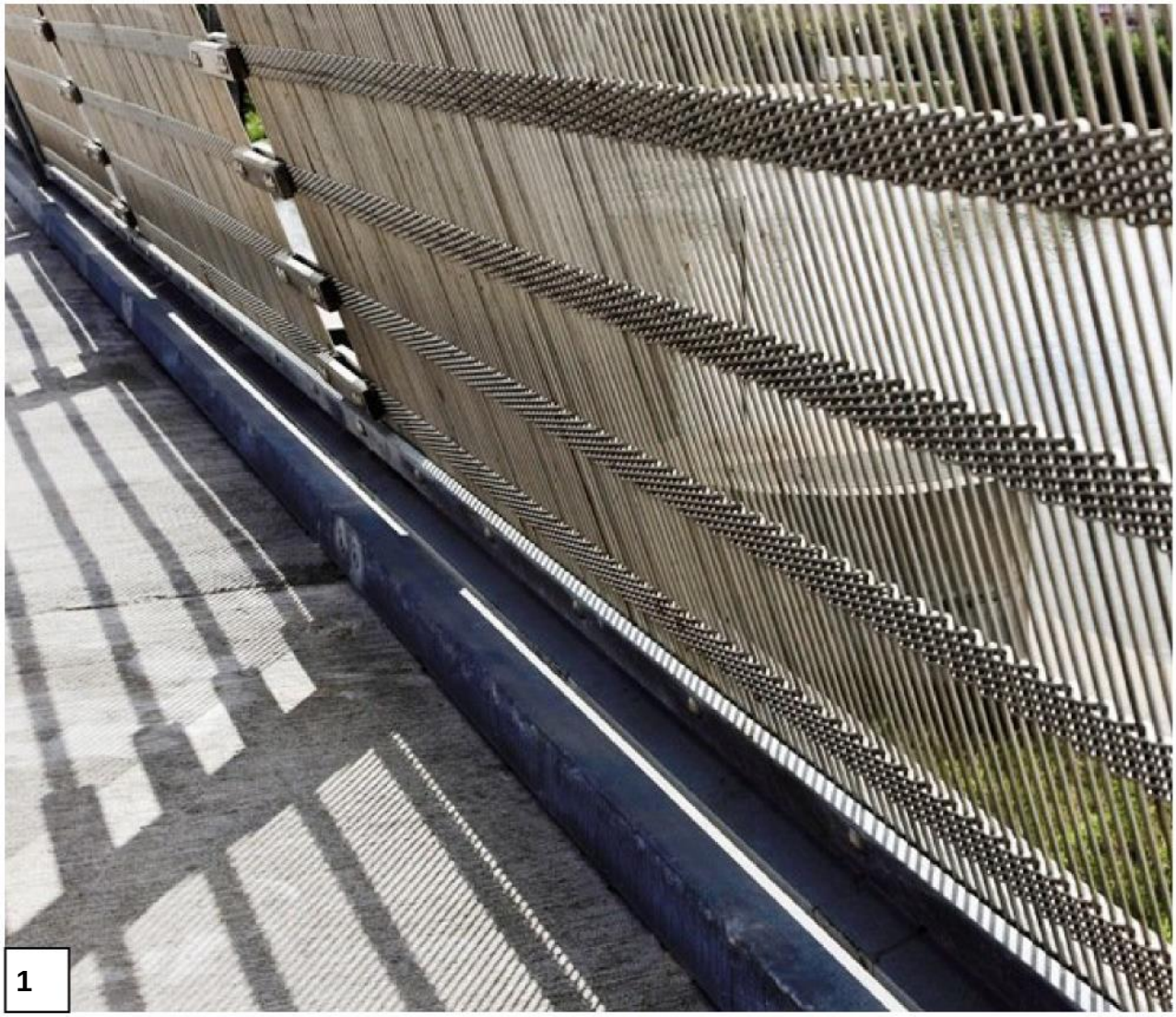
- Metal mesh panels attached to exterior of truss structure, allows high tranparency

- Panels overlap to create depth and rhythm on facade

- Translucent polycarbonate used on roof, allows daylight into bridge interior

- Gap between panels and roof to increase light, air and feeling of openness

- Steel structure painted in light color



1

2

METAL FABRIC

- Proposed on sides of bridge for enclosure

- Allows light and air to pass through, level of transparency can vary

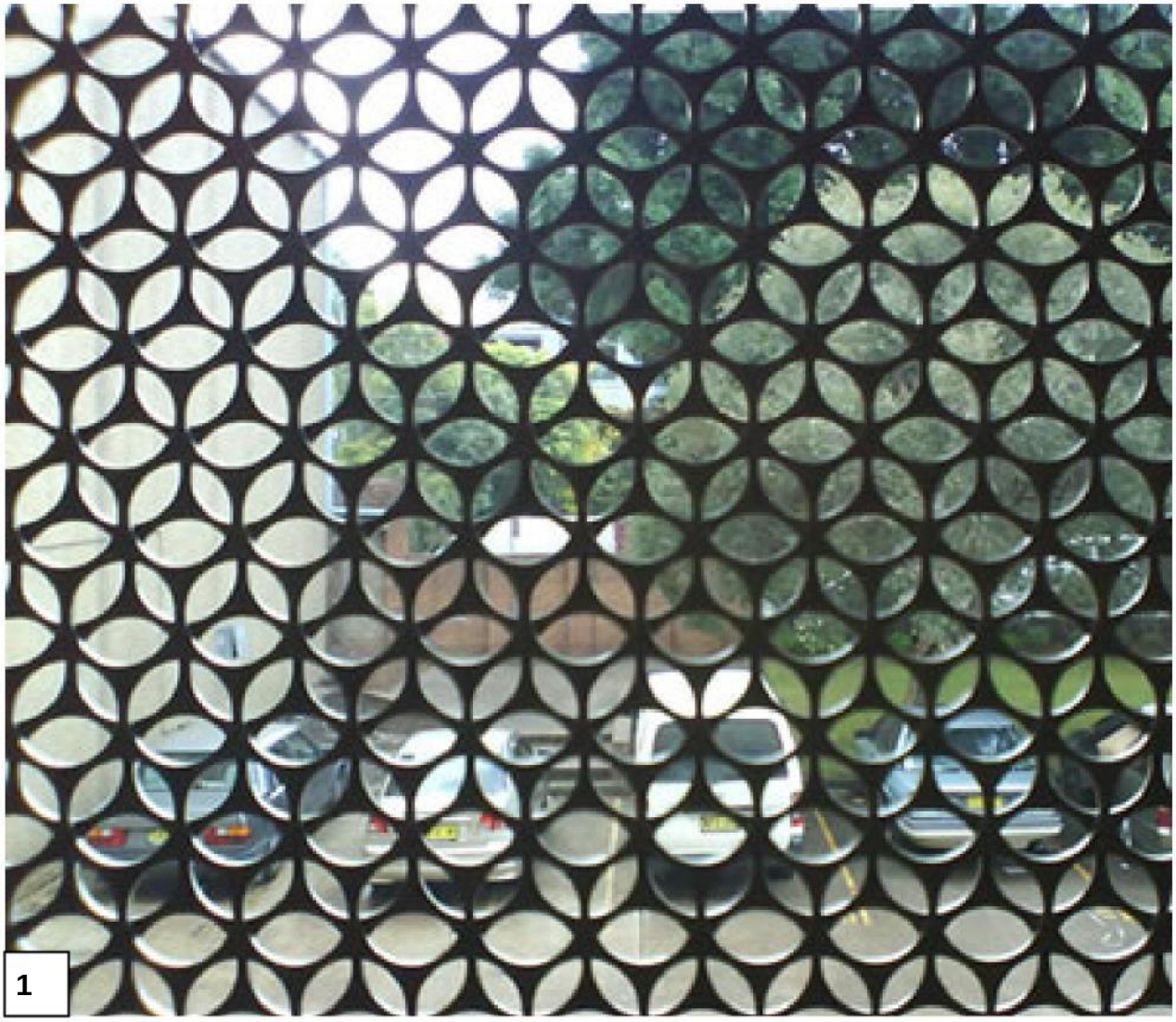
- Can be framed rigid panels or tension mounted

- Functional material that can also be light and graceful

- Stainless steel is most common

- Can be layered for variation and added dimension

- Low maintenance



1

2

PERFORATED METAL PANEL

- Proposed on sides of bridge for enclosure

- Allows light and air to pass through

- Framed rigid panels

- Several metals available, including corten steel, stainless steel, aluminum and zinc

- Perforations can vary for different levels of transparency and visual interest

- Low maintenance

1

POLYCARBONATE

- Proposed on roof of bridge

- Allows light to pass through, protects from weather

- Rigid panels, standard sheets or custom forms available

- UV protection layer to prevent discoloration

- Hail and impact resistant

- Many colors available

1

2

ARCHITECTURAL FABRIC

- Proposed on roof of bridge

- Allows light to pass through, protects from weather

- Flexible panels, standard or custom sizes and shapes

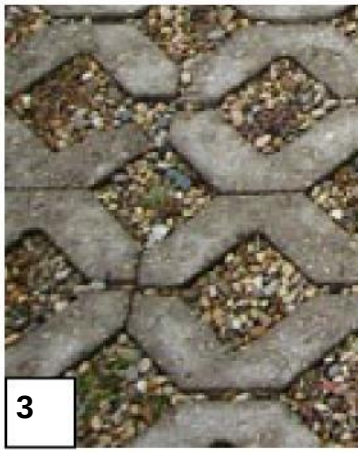
- PVC coated polyester is most common

- High strength and elasticity

- Can achieve greater than 25 year useful life span


1


2


3

SOLAR PANELS

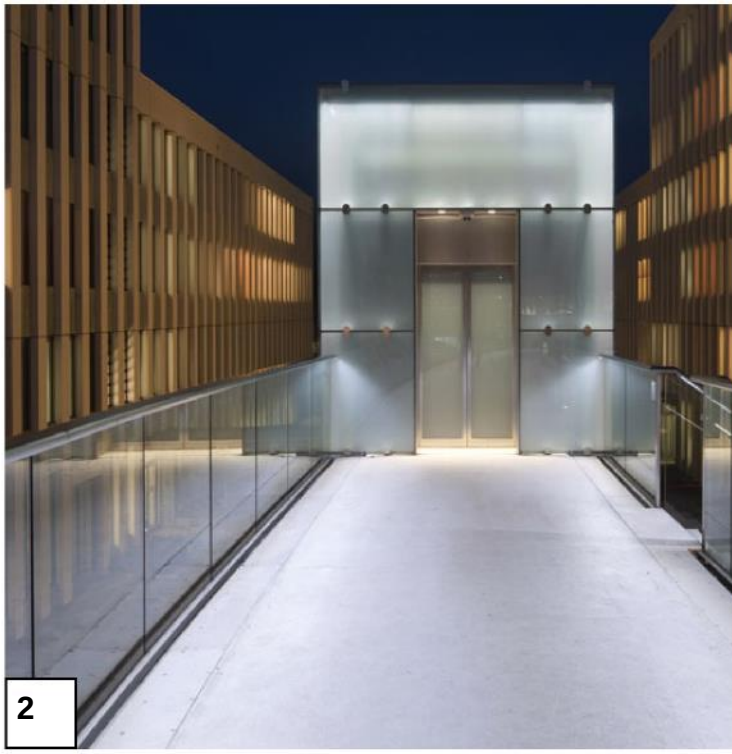
- Flexible film or rigid panels
- Maintain light transmittance through roof enclosure

STORMWATER MAN

- Drainage from roof diverted to low maintenance rain garden at statio
- LED lightin
- Can be solar powered
- Pervious surface and entry level

RECYCLED/RECYCLABLE MATERIALS

- Many of the proposed enclosure and roof materials are recycled and/or recyclable



- Stainless steel framing

- Glass enclosure and elevators for visibility and safety

- Stair can be open or part of enclosure

Appendix H
April 2012 Public Meeting - Summary of Questions and Answers

MEMORANDUM

81 Mosher Street
Baltimore, MD 21217
Phone 410.728.2900
Fax 410.728.3160
www.rkk.com

Date: 4/16/12

To: Greg Hwang, MCDOT

From: Jake Wilson, Rick Adams, Donald Tusing, RK&K

CC: Courtney Nunez, KGP

Re: Forest Glen Public Meeting Q&A Summary

On April 10, 2012, MCDOT held a public meeting to present the preliminary alternatives for the Forest Glen Passageway. This memo summarizes the comments/questions and responses from the collective Q&A session that followed the presentation. **Bold text** indicates attendee comments/questions.

- **Bridges at Wheaton and Rockville are not used; why do you think people will use the proposed bridge?**
  - Based on studies summarized in AASHTO, MCDOT estimates that about 90% of pedestrians travelling through the intersection will use the bridge. The fact that it ties directly to the Metro station is an asset and will encourage use.
- **People often feel trapped on a bridge; crime is a concern for many potential users.**
- **Where did the estimated pedestrian usage numbers come from? Why does tunnel Alternative 1 have more users than the bridge if they originate in the same location?**
  - The pedestrian usage was calculated based on studies summarized in AASHTO. These were developed from previous studies and relate to the time savings provided by the pedestrian facility. The tunnel would have close to 100% usage, since it provides good time savings and the bridge has 90% usage with good time savings.
- **There are no sidewalks on the north side of Forest Glen Road east of the medical center; will new sidewalks be part of the project if tunnel Alternative 2 is chosen?**
  - If tunnel Alternative 2 is chosen, MCDOT would evaluate the potential for connecting the tunnel to the surrounding pedestrian network.
- **Has the County used the 4-step process identified in the presentation for other projects?**
  - The facility planning process being used for the Forest Glen Passageway project is the county's typical process for evaluating, designing and constructing projects
- **Pedestrians that arrive at the NE corner may not use the bridge because the travel distance to cross to the SE and then get up, over, and back down is longer than just crossing the street.**
- **It may be incorrect to say that pedestrians arriving at the SE corner will not cross to the NE corner to use the tunnel. The travel distance to cross to the NE and use the tunnel seems about the same as going up, over, and down to use the bridge. If you assume that pedestrians will do one then wouldn't they also do the other?**
- **Will pedestrian signals be shortened once the new facility is in place?**
  - Once a preferred alternative is chosen, the team will study potential modifications to the intersection that will encourage use of the facility.
    - **Attendee responded that discouraging pedestrian crossings at grade will decrease Metro usage by pedestrians.**

- **Why is there not a bridge alternative originating in the NE corner?**
    - The advantage of the NE corner tunnel alternative is that it allows for a ramp, but would likely not have as much usage as the SE corner. A bridge from the NE corner would not have significant advantages compared to the other alternatives considered.
- **Why is the tunnel wider than the bridge? Wouldn't a narrower tunnel be cheaper or allow for two tunnels at the same cost, one from each corner?**
    - The tunnel dimensions are guided by WMATA standards and are intended to provide a safe and comfortable environment in the tunnel. The final design would be required to meet their standards for dimensions and materials because it ties directly to the station.
- **Are there more people arriving at the SE corner because there are no sidewalks on the north side of Forest Glen Road?**
    - The team conducted an origin and destination study and confirmed that significant percentages of pedestrians were originating from the south side of Forest Glen Road.
- **The AASHTO guidelines are flawed in this study because they relate to highways.**
- **The study does not account for Metro users that would walk to the station but don't today because of safety concerns at the intersection. These people currently get dropped off at the kiss-and-ride or park in the parking lot to access the station. The number of pedestrians that would use the new facility should be higher to account for these people.**
- **There are significant numbers of pedestrian accidents and near-misses, more than the number summarized in police reports.**
- **The Metro parking lot is full by 10:00am; a secondary benefit of the passageway would be alleviating the parking at the station, allowing for more users to access Metro closer to their origins.**
- **If the preferred alternative originates in the SE corner, will there be any improvements to the pedestrian crossing on Forest Glen Road from NE to SE?**
    - The crossing would be evaluated to determine if safety improvements are needed.
- **A potential cost savings for tunnel Alternative 2 would be to eliminate the elevators.**
    - The elevators are necessary to ensure accessibility of the tunnel in wintry conditions or if the ramp is slippery.
- **If the elevators are provided to ensure ADA access when the ramp is slippery or in wintry conditions, wouldn't a canopy over the ramp ensure safe access and be cheaper than two elevators?**
    - A canopy or cover would be considered if this alternative is chosen.
- **The bridge should not be recommended; it looks unsafe and slippery, especially if the stairs are not protected from weather. The existing stairs to the passageway are dangerous in rain or snow because they are not covered. The bridge should also be attractive.**
    - The safety of the bridge stairs would be evaluated. The bridge would be designed to provide air circulation and light, with safety and visibility as priorities. Bridge appearance and materials would be further evaluated during final design.
- **The alternative with the lowest cost and that requires the least amount of disruption should be considered as a preference.**
- **The County should consider eliminating the elevators in the NE corner, in order to minimize costs and make the tunnel option more competitive.**
- **It's a positive benefit that the tunnel alternatives will be more like the existing passageway, which people like because it does not feel like a tunnel.**
- **People are concerned with the safety, maintenance, and waiting period for the elevators.**
- **A number of neighborhood streets are already used to bypass Georgia Ave.; will there be an impact study to evaluate the traffic on neighborhood streets during construction?**
    - The county has a process for these evaluations and citizens can apply for a specific evaluation.

- **Can the tunnel connect to the east end of the station?**
    - This would be very difficult and costly due to existing uses and the station structure. The service rooms would be impacted and have to be relocated at significant expense.
- **The church is in favor of the project, but wants to be brought into the conversation seriously. How will the county acquire the church property if it is needed?**
    - The church has been contacted. If property is required, the county will purchase the property at fair market value through negotiations with the property owner.
- **The intersection needs traffic enforcement, including red light cameras.**
    - The police department manages the red light camera program. A request for a camera at the intersection has been sent to the police department, and they can be contacted for an update on the status.
- **Has WMATA been involved in the project? Will they be paying for the project?**
    - WMATA has been working with the project team. WMATA does not have dedicated funding, so their contribution would come from local or state funding. They would likely maintain the facility because it ties directly to the station.
- **Does WMATA have a preference of the alternatives?**
    - All of the trade-offs have to be considered.
- **Maintenance costs should be included in the project estimate.**
- **Where will funding come from?**
    - The county applied for a TIGER grant for the full cost of the project. In an effort to increase multi-modality in the area, bikeshare stations were included in the proposal.
- **Why didn't WMATA construct a tunnel when the station was originally built?**
    - **Attendee responded that before the station was built the county stated that tunnels are unsafe and no one would use a bridge.**
- **What happens to vehicular traffic during construction?**
    - Minor disruption to traffic is anticipated during daytime hours. Because of heavy traffic volumes, the majority of the work required in Georgia Avenue will occur during nighttime hours with lane closures and shifts.