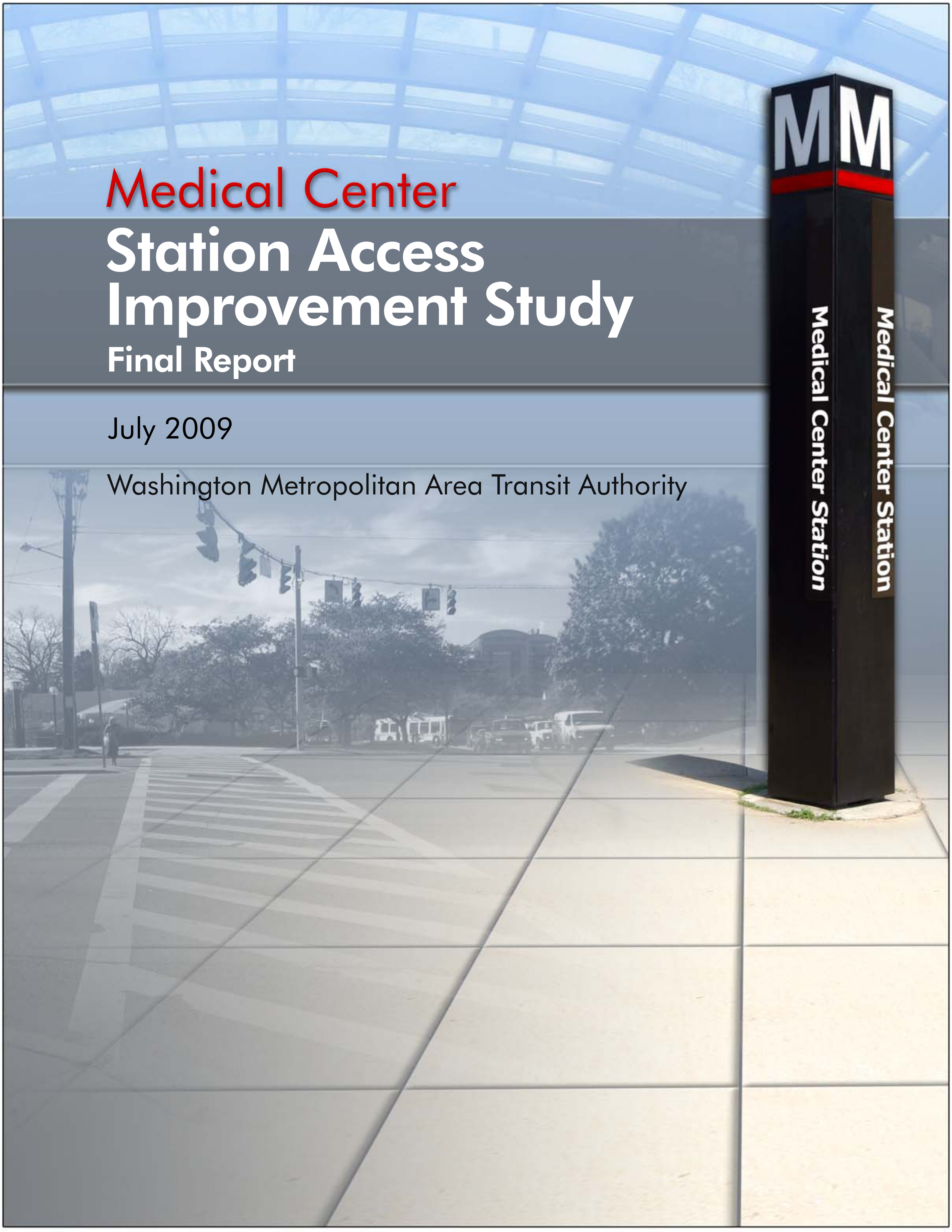
Medical Center
Station Access Improvement Study
Final Report

July 2009

Washington Metropolitan Area Transit Authority



MEDICAL CENTER STATION ACCESS IMPROVEMENT STUDY

Washington Metropolitan Area Transit Authority

Final Report
July 2009

a joint venture of:
- Parsons Transportation Group Inc.
- PB Americas, Inc.
- Delon Hampton & Associates, Chartered

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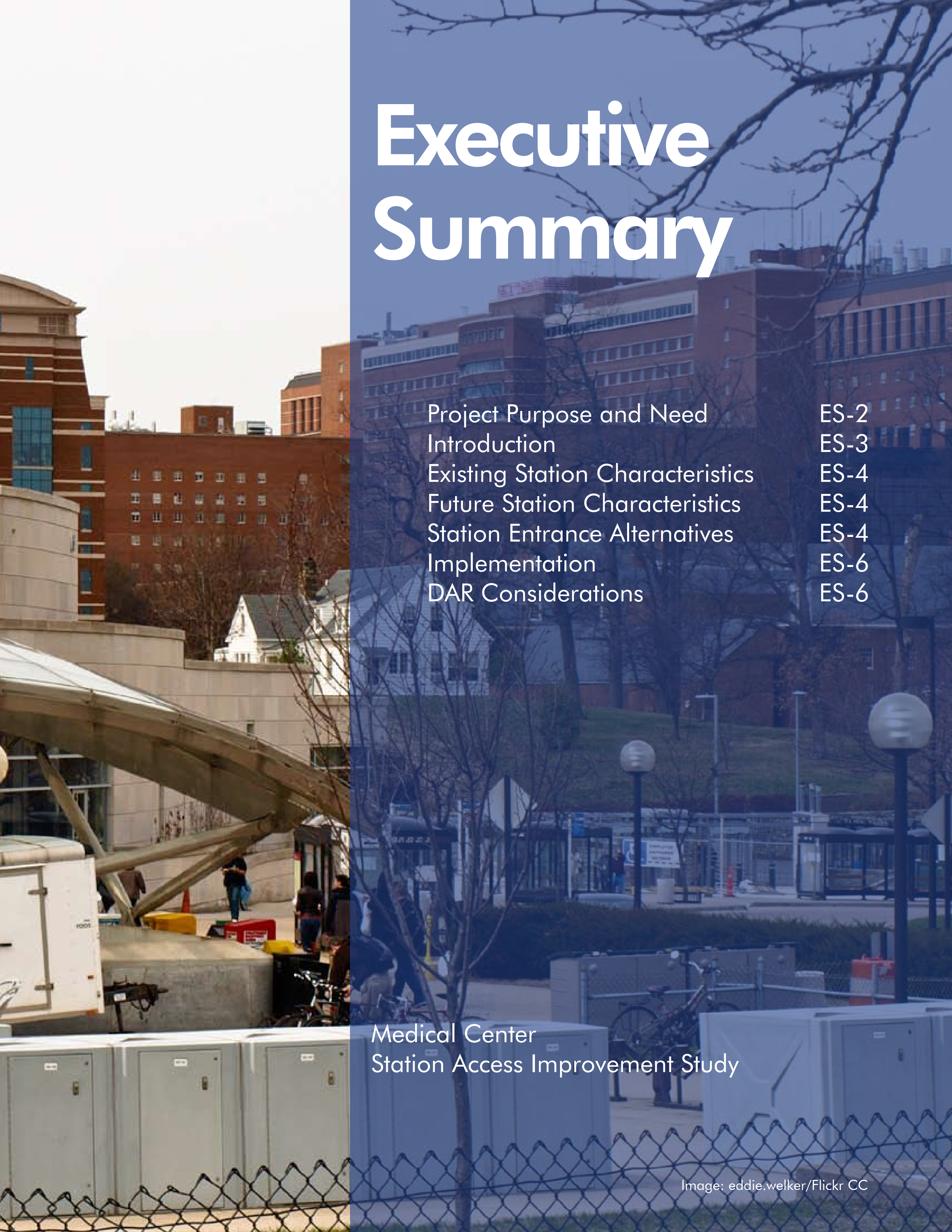

Executive Summary

Medical Center
Station Access Improvement Study

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Executive Summary

Project Purpose and Need

In 2005, the Defense Base Closure and Realignment Commission recommended the termination, realignment, and consolidation of military installations across the country. This process, known as Base Realignment and Closure (BRAC), included a recommendation to close Walter Reed Army Medical Center in Washington, DC and move most of its operations and employees to the National Naval Medical Center (NNMC) in Bethesda, Maryland by September 2011. Once the move is completed, the expanded medical campus will be known as the Walter Reed National Military Medical Center (WRNMMC) and may grow to 10,500 employees, a potential net increase of 2,500 employees.

The 2008 NNMC BRAC Final Environmental Impact Statement (FEIS) identified pedestrian access improvements at Medical Center station to improve pedestrian safety. In May 2008, the Department of the Navy issued a Defense Access Road (DAR) Needs Report that identified transportation needs around NNMC due to BRAC employment growth, including a new bank of elevators for the station on the east side of Rockville Pike to improve access to the station and reduce the number of pedestrians crossing the Rockville Pike and South Drive/South Wood Road intersection.

To that end, the Washington Metropolitan Area Transit Authority (WMATA) in collaboration with the Maryland Department of Transportation (MDOT) and Montgomery County initiated this study to examine access improvements for the Medical Center station. This study assesses existing station access for all travel modes, including pedestrian, bicycle, bus, and personal automobile, as well as the station's ability to accommodate both general and BRAC-related growth in the immediate area. Alternatives to improve station access were conceptually designed and their costs estimated.

The purpose of this study is to:

- Evaluate the need for enhanced station access to reduce the number of pedestrians crossing Rockville Pike
- Develop multiple alternatives for enhanced station access
- Develop various performance measures to evaluate alternatives

Improvements to the Medical Center station are a high priority; the Obama Administration included the project in the Department of Defense (DOD) budget.

Introduction

The Medical Center Metrorail station, located on the Metrorail Red Line, primarily serves employees of the National Institutes of Health (NIH) and NNMC in Bethesda, Maryland. The station has a single entrance, located at the southwest corner of Rockville Pike (MD 355) and South Drive/South Wood Road near the NIH Gateway Center. The BRAC process may add 2,500 employees to NNMC by 2011, significantly increasing ridership at the Medical Center station.

Currently, NNMC employees cross Rockville Pike at-grade or utilize the NNMC shuttle service to access the Metrorail station. WMATA in collaboration with MDOT and Montgomery County are studying the feasibility of station modifications, including a new entrance on the NNMC side of Rockville Pike. Four goals guided the development of station improvements:

Encourage and support transit ridership. Since some nearby roadways and intersections are either at or nearing capacity, new or upgraded station access should encourage and support transit ridership to alleviate congestion and provide for an efficient means of travel for employees and area residents.

Reduce trip time. A decrease in transit trip time would help accommodate future employee growth in the area and increase the attractiveness of alternative transportation modes. In addition, reducing vehicular trip time by reducing vehicle and pedestrian conflicts would improve mobility to and around NNMC.

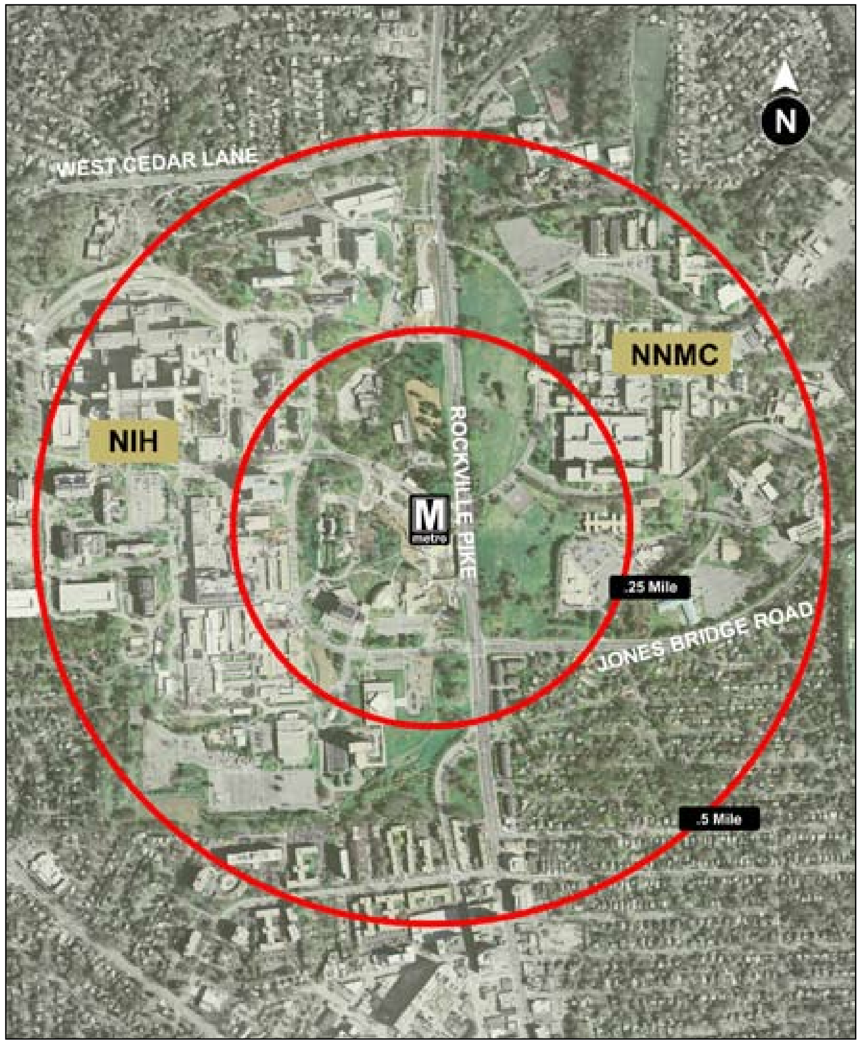


Figure ES-1: Medical Center Station Area
Source: Google Earth

Enhance pedestrian safety. The intersection of Rockville Pike and South Drive/South Wood Road has potential pedestrian safety issues. Vehicle turning movements, limited pedestrian amenities, and long wait times to cross create an inhospitable pedestrian environment.

Maximize cost-effectiveness. Because funding is limited at all levels of government, WMATA developed alternatives that would offer the most benefit for the least cost. Because a range of alternatives were explored, preliminary cost estimates as well as various measures of effectiveness were developed.

Existing Station Characteristics

The Medical Center station, through both Metrorail and bus service, provides good transit access to NNMC, NIH, and the surrounding area. The station carried an average of 10,422 Metrorail passengers per weekday in 2007, including 5,240 boardings and 5,182 alightings. Since then, daily ridership has grown over seven percent. In the peak periods, the vast majority of riders enter or exit the station by walking. The NNMC campus is within one-half mile of the Metrorail station, which is considered a comfortable walking distance for the majority of passengers.

Passengers also access the station by NNMC or NIH shuttles, Metrobus, Ride On, personal automobiles, and bicycles. Pedestrian facilities around the station are generally good and the crossing of Rockville Pike at South Drive is compliant with the American with Disabilities Act (ADA). While there have been few accidents between pedestrians and vehicles in recent years, some issues exist at this intersection:

- Long signal phase for Rockville Pike
- Conflicts with turning vehicles

In the peak hour, approximately 250 pedestrians cross Rockville Pike at the South Drive intersection.

Other station issues include the need for additional bike lockers and the need for a Kiss & Ride lot. WMATA has plans to restore the Kiss & Ride lot, as NIH recently transferred the former lot back to the agency. Inside the station, the facilities adequately accommodate passenger flows and there are no existing capacity issues.

Future Station Characteristics

Growth at both the NNMC and NIH campuses can reasonably expect to encapsulate the vast majority of future development surrounding the station. BRAC actions will potentially bring up to 2,500 new jobs to the NNMC campus, the majority of which will be located at the main hospital facilities. According to the FEIS, patient and visitor load will double to 981,000 per year once construction is complete. Employment growth at NNMC and NIH will be the primary driver of daily passenger growth at the Medical Center station.

NNMC has committed to increase the existing transit mode share of 11 percent to 30 percent by BRAC build-out in September 2011. The NNMC transit goals have a substantial impact on future station ridership. The analysis in this study estimates that ridership will increase almost 56 percent between 2007 and 2020. NNMC and NIH employees are expected to constitute about 72 percent of total Medical Center boardings and alightings, as shown in Figure ES-2. Home-related trips are the next largest trip purpose at 19 percent, while patients, visitors, and "other" trips make up the remaining nine percent.

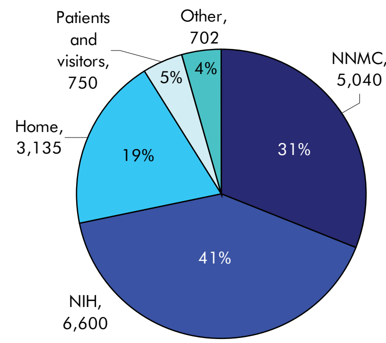


Figure ES-2: 2020 Ridership Estimates by Trip Purpose

Under these conditions, over 6,700 pedestrians will cross Rockville Pike daily in 2020, traveling between NNMC and both the Metrorail station and the bus stops. It is estimated that between 875 and 1,000 people would cross Rockville Pike in the peak hours. This would be a substantial increase in crossings from the existing volumes.

NNMC is expected to increase the shuttle bus service; therefore increased use of the NNMC shuttle bus could potentially decrease this number by up to 240 people during the peak periods.

Station Entrance Alternatives

The study analyzed five alternatives, each of which would address the study goals to varying degrees. Because of the focus on the Rockville Pike crossing due to NNMC growth, the location of the existing entrance and station mezzanine and the security constraints at NNMC, all alternatives are limited to the same general area around the existing crosswalk. The five station access alternatives include:

1. Improved crosswalk
2. East-side elevator access
3. Shallow pedestrian tunnel
4. East-side elevator access and pedestrian tunnel
5. Pedestrian bridge

Some alternatives share common elements, which are delineated in Table ES-1 for clarity.

None of the alternatives would generate new ridership because they all comprise modifications to the existing entrance. However, all the alternatives would be expected to increase the convenience of transit and make transit a more attractive option to varying degrees.

One of WMATA's roles as a regional agency is to study station access alternatives and evaluate their effectiveness. WMATA is supportive of transit access improvements. However, the decision whether this project gets built would be made by others such as DOD, MDOT and/or Montgomery County. As part of that decision making process, the project sponsor(s) would determine which alternative is most desirable and feasible.

Table ES-2 shows a comparison of alternatives with respect to performance measures derived from study goals. Performance measures in the areas of traffic/pedestrian conflict, vehicular delay, and construction traffic impacts are reported on a relative scale that rates each alternative according to the performance measure as High, Medium, or Low as they relate to each other.

Alternative 4 provides the most benefits but is the costliest. Alternative 2 provides significant time-savings to Metrorail patrons, which are estimated to make up 80 percent of the future NNMC employees arriving by transit, but does not reduce the number of traffic and pedestrian conflicts for non-Metrorail transit users. Alternatives 3 and 5 would serve all pedestrians, but would not lower travel times over the existing station configuration. Alternative 1 enhances pedestrian safety by adding a new median refuge; however, it would not reduce the number of pedestrians crossing Rockville Pike. In short, all the alternatives would address the study goals to varying degrees.

Table ES-1: Components of Alternatives

	Alternative				
Components	1	2	3	4	5
Upgraded crosswalk	X	X			
East-side Kiss & Ride	X	X	X	X	X
New platform stairway and escalator		X		X	
East-side elevators		X		X	
Shallow pedestrian tunnel			X	X	
Pedestrian bridge					X

Table ES-2: Evaluation of Alternatives

	Alternative				
Performance Measure	1	2	3	4	5
			Pedestrian Safety		
Number of traffic and pedestrian conflicts*	High	Medium	Low	Low	Low
			Trip Time		
Vehicular delay	High	Medium	Low	Low	Low
Metrorail passenger travel time** (minutes)	6.7	3.3	6.7	3.3	6.7
Bus passenger travel time*** (minutes)	3.8	3.8	3.8	3.8	3.8
			Cost Effectiveness		
Estimated project cost**** FY09$ (M)	0.7	30.5	31.5	59.4	14.6
Construction traffic impacts	Low	Low	Low	Low	Medium

* Assumes average pedestrian wait time is 1.25 minutes to cross Rockville Pike; maximum wait is 2.5 minutes.
** Travel time from faregates to the NNMC security checkpoint. Assumes 3.5 feet per second walking speed.
*** Travel time from first bus bay to the NNMC security checkpoint. Assumes 3.5 feet per second walking speed.
**** Estimates include construction, planning, engineering, construction management, and administrative costs. Alternatives 3 and 4 utilize a mining construction method for pedestrian tunnel.

Implementation

Each alternative has physical requirements and considerations regarding architecture, structures, and mechanical, electrical, and system components. A key consideration is to avoid the underground substation, station vent shaft, and escalator passage on the west side of Rockville Pike in Alternatives 2, 3, 4, and to a lesser extent, 5. Access improvements to the Medical Center station could be built by a variety of parties.

The timeframe for implementation of Alternatives 2, 3, 4 and 5 would vary between 36 to 42 months, which is based on WMATA experience with similar scale projects. This schedule is dependent on availability of sufficient funds at the outset of the project for project initiation, environmental clearance, preliminary engineering, development of design build documents, and availability of construction funds prior to issuance of an RFP for project implementation.

The project sponsor(s) and the alternative selected would likely depend on funding sources and levels. Preliminary cost estimates, shown in Table ES-3, were developed for all alternatives, which include construction costs and project delivery costs. The range of accuracy of this estimate at this conceptual level of development is -10 percent to +30 percent. These cost estimates will be further refined during design. This report is intended to provide information and sound analysis to support decision-making, but does not recommend a specific alternative.

DAR Considerations

The Navy is seeking information for the DAR funding request, which identified transportation needs around NNMC, including new elevator access for the Medical Center station on the east side of Rockville Pike. Improvements are needed because the proposed BRAC action will impact the intersection of South Wood Road and Rockville Pike by contributing to the significant backup of traffic in the afternoon rush hour. According to MDSHA and WMATA, the traffic volumes entering and exiting NNMC are projected to increase by over 50 percent and NNMC-related pedestrian volumes will triple.

Due to the increase in these volumes, pedestrian-vehicle conflicts are expected to heighten following the BRAC action. Given the projected increase in pedestrians crossing Rockville Pike daily, the station entrance alternatives, to varying degrees, serve this volume by enhancing access to NNMC and reducing conflicts between pedestrians and vehicles. The congestion leaving the NNMC campus, particularly in the PM peak period, limits access to the facility and negatively impacts the quality of life for patients, visitors and employees of the hospital. As such, it detracts from the hospital's mission to serve the military community.

Figure ES-3: Medical Center Station Entrance
Source: Schumin Web Transit Center

Table ES-3: Cost Estimates (FY09, $ million)

	Alternative				
Costs*	1	2	3	4	5
Construction	0.5	22.6	23.3	44.0	10.8
Project delivery	0.2	7.9	8.2	15.4	3.8
Total	0.7	30.5	31.5	59.4	14.6

* Accuracy range of -10 to +30 percent.

Introduction

Medical Center
Station Access Improvement Study

Section 1

Image: thisisbossi/Flickr CC

Introduction

The Medical Center Metrorail station, located on the Metrorail Red Line (see Figure 1 and 2), primarily serves employees of the National Institutes of Health (NIH) and the National Naval Medical Center (NNMC) in Bethesda, Maryland. The station has a single entrance, located at the southwest corner of Rockville Pike (MD 355) and South Drive/ South Wood Road near the NIH Gateway Center. The platform of the Medical Center station runs under Rockville Pike and the existing station entrance is near the north end of the platform. The station provides connections to nine Metrobus and Ride On routes as well as NNMC and NIH shuttle service, includes a signalized and ADA-accessible pedestrian crossing at Rockville Pike, and is within walking distance to both NNMC and NIH.

Figure 1: Medical Center Vicinity

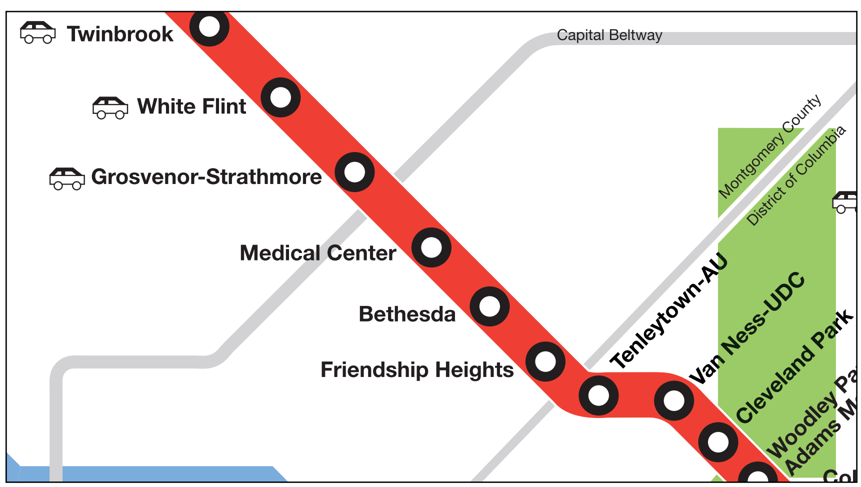


Figure 2: Medical Center and Red Line
Source: WMATA

Project Purpose and Scope

In 2005, the Defense Base Closure and Realignment Commission recommended the termination, realignment, and consolidation of military installations across the country. This process, known as Base Realignment and Closure (BRAC), included a recommendation to close Walter Reed Army Medical Center in Washington, DC and move most of its operations and employees to NNMC by September 2011. Once the move is completed, the expanded medical campus will be known as the Walter Reed National Military Medical Center (WRNMMC) and may grow to 10,500 employees, a potential net increase of 2,500 employees.

In May 2008, the Department of the Navy issued a Defense Access Road (DAR) Needs Report that identified transportation needs around NNMC due to BRAC employment growth. This report was informed by a Final Environmental Impact Statement (FEIS) and previous conceptual planning by the Washington Metropolitan Area Transit Authority (WMATA). Among the transportation needs identified was new elevator access for the Medical Center station on the east side of Rockville Pike to improve access to the station and reduce the number of pedestrians crossing Rockville Pike.

WMATA in collaboration with the Maryland Department of Transportation (MDOT) and Montgomery County initiated this study to examine access improvements for the Medical Center station due to anticipated employment growth. This study assesses existing station access for all travel modes, including pedestrian, bicycle, bus, and personal automobile, as well as the station's ability to accommodate both general and BRAC-related growth in the immediate area. Alternatives to improve station access were conceptually designed and their costs were estimated. Four goals guided the development of station improvements:

Encourage and support transit ridership. Since some nearby roadways and intersections are either at or nearing capacity, new or upgraded station access should encourage and support transit ridership. This would alleviate congestion and provide for an efficient means of travel for employees and area residents.

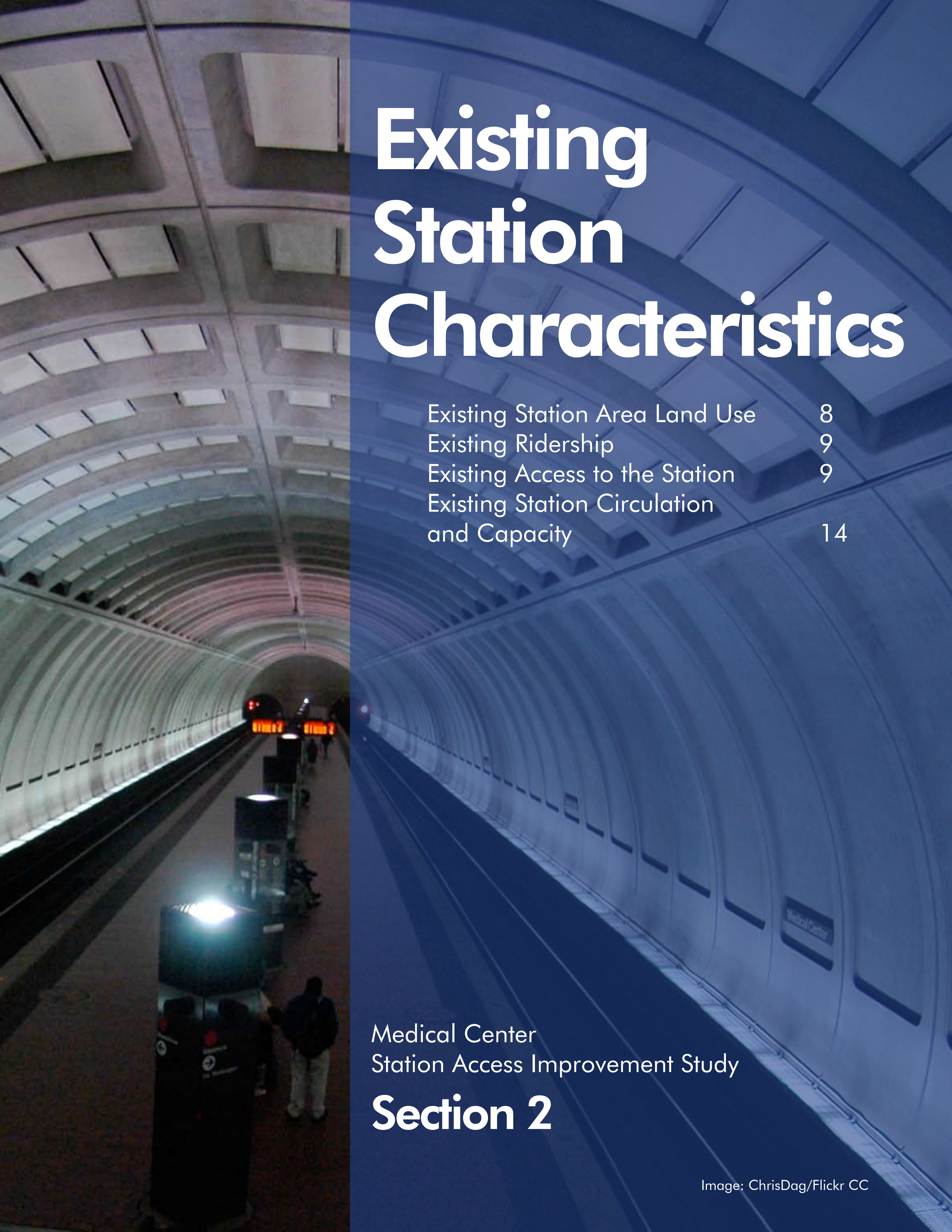
Reduce trip time. A decrease in transit trip time would help accommodate future employee growth in the area and increase the attractiveness of alternative transportation modes. In addition, reducing vehicular trip time by reducing vehicle and pedestrian conflicts would improve mobility to and around NNMC.

Enhance pedestrian safety. The intersection of Rockville Pike and South Drive/South Wood Road is a potential pedestrian safety issue. Vehicle turning movements, limited pedestrian amenities, and long wait times create an inhospitable and potentially dangerous pedestrian environment.

Maximize cost-effectiveness. Because funding is limited at all levels of government, WMATA developed alternatives that would offer the most benefit for the least cost. Because a range of alternatives were explored, they include preliminary cost estimates as well as various measures of effectiveness.

Because of previous planning efforts, the visibility of the BRAC activities, and the multiagency partnerships, stakeholder outreach was a key part of this project. The study team met regularly with a multiagency stakeholder group and met with the public BRAC Implementation Committee three times. These meetings are summarized in Appendix A.


Medical Center



Existing Station Characteristics

Medical Center
Station Access Improvement Study

Section 2

Image: ChrisDag/Flickr CC

Existing Station Characteristics

Existing Station Area Land Use

Medical Center station is situated approximately one mile north of downtown Bethesda and the Bethesda Metrorail station, and is surrounded by medium- to high-density administrative and medical buildings in a campus setting. Figure 3 shows the station area. The station entrance is on NIH property adjacent to the NIH Gateway Center. The South Wood Road gate to NNMC is located east of the station and Rockville Pike. Beyond the NIH and NNMC campuses are single-family housing to the north and commercial buildings and multifamily residential just past the intersection of Rockville Pike and Jones Bridge Road to the south.

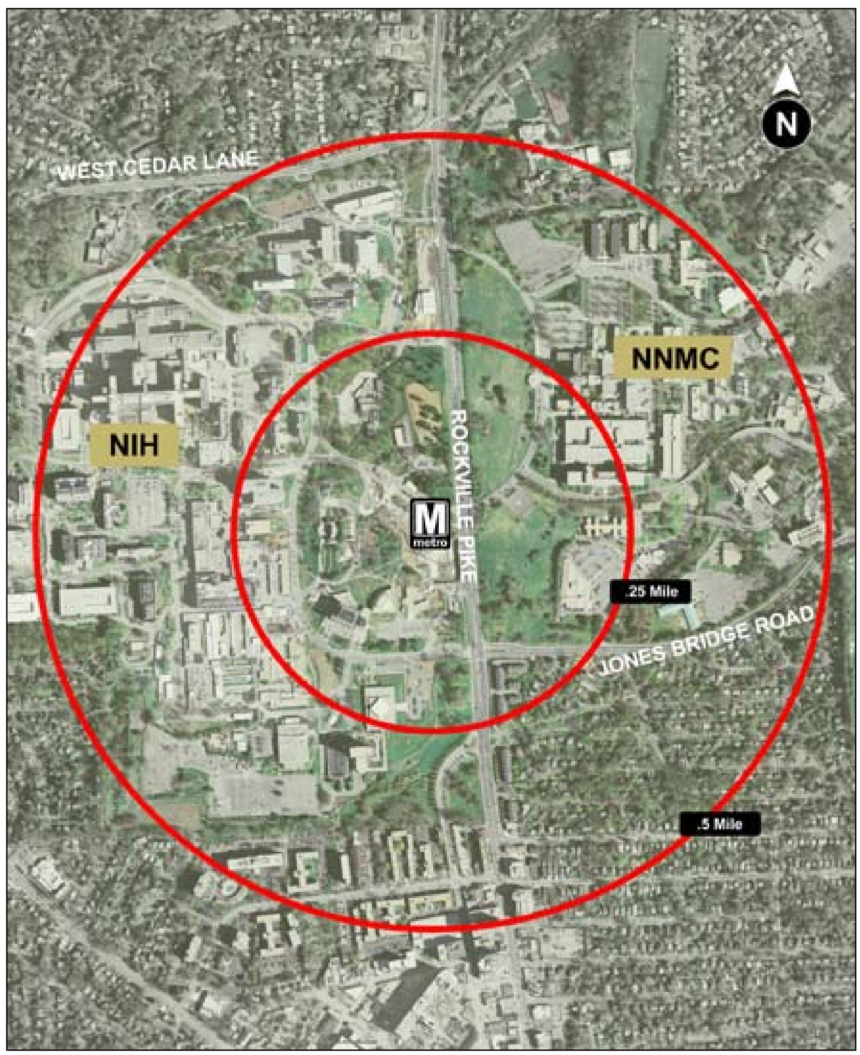


Figure 3: Medical Center Station Area
Source: Google Earth

Existing Ridership

The Medical Center station carried an average of 10,422 passengers per weekday in 2007, including 5,240 boardings and 5,182 alightings.

Ridership patterns are shown in Figure 4. Ridership during the peak periods is uneven, with nearly 300 more riders during the morning peak hour versus the evening peak hour. Such spikes of passengers during peak periods demonstrate that the station is primarily used for commuting purposes. As would be expected from a commuter station located at an employment center, the highest number of alightings occurs during the morning peak when riders are traveling to work while the highest number of boardings takes place throughout the afternoon peak as riders are leaving work. Ridership data collected from WMATA, displayed in Table 1, shows that the existing peak hours are 8:00 – 9:00 AM and 5:00 – 6:00 PM. Anecdotal reports suggest that the peak for passengers traveling to and from NNMC occurs earlier.

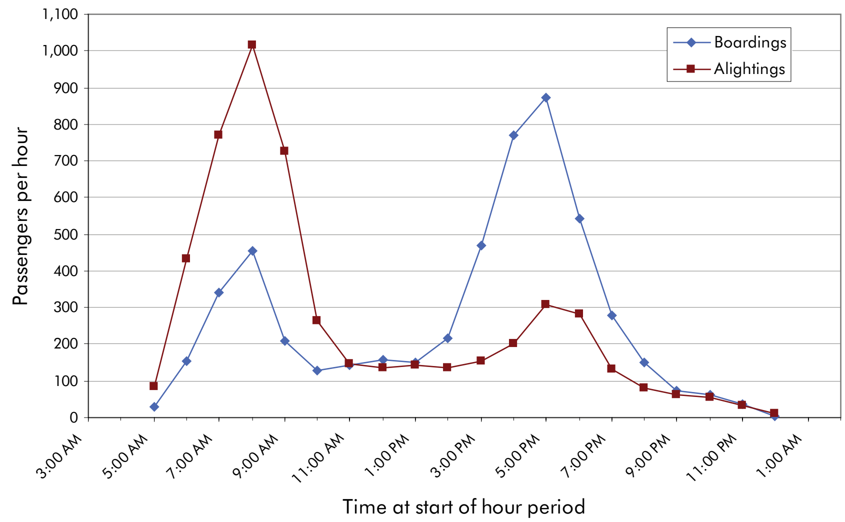


Figure 4: Existing Medical Center Metrorail Station Boardings and Alightings
Source: WMATA Faregate data, May 2007

Table 1: Average Weekday Boardings and Alightings, 2007

Time Period		Boardings	Alightings	Total
AM peak hour	8:00 - 9:00 AM	455	1,015	1,470
PM peak hour	5:00 - 6:00 PM	874	308	1,182

Source: WMATA Faregate data, May 2007

Existing Access to the Station

According to the 2007 Metrorail Passenger Survey, the vast majority of passengers exiting the station during the AM peak period—78 percent—walk to their destination. This suggests that most passengers are destined for NNMC or NIH, which are within walking distance. About 10 percent of passengers exiting the station transfer to "other bus" and six percent transfer to a Metrobus. The survey does not identify what constitutes "other bus," but this study assumes this category represents NNMC and NIH shuttle bus service.

Similarly, in the PM peak period, the majority of riders—85 percent—walk to the station. "Other bus" is the next most common access mode with seven percent of the total, while the remaining eight percent is fairly evenly distributed between Metrobus, Ride On, and personal automobiles. Table 2 and Figure 5 show station access and egress in more detail.

Station Bus Service and Facilities

Medical Center station is well served by both WMATA's Metrobus and Montgomery County's Ride On bus service. Metrobus routes J1, J2, J3, and J9 and Ride On routes 30, 33, 34, 46, and 70 directly serve the station's six bus bays (shown in Figure 6). Metrobus route J7 does not stop directly at Medical Center station; it is accessible along Rockville Pike only. There is a bus stop pull off area along the southbound lanes of Rockville Pike, just south of South Drive. Field observations revealed that this bus stop is frequently blocked by Kiss & Ride activity by personal automobiles.

Table 2: Medical Center AM Peak Egress and PM Peak Access Modes

Time Period	Total	Bicycle	Pick Up/Drop Off	Drive Car	Metrobus	Ride On	Other Bus	Rode w/ Someone, parked	Taxi	Walk
AM peak	3,117	9	86	39	187	36	313	0	28	2,419
percentage	-	0.29%	2.76%	1.25%	6.00%	1.15%	10.04%	0.00%	0.90%	77.61%
PM peak	2,552	0	57	38	48	38	191	0	0	2,180
percentage	-	0.00%	2.23%	1.49%	1.88%	1.49%	7.48%	0.00%	0.00%	85.42%

Source: 2007 Metrorail Passenger Survey

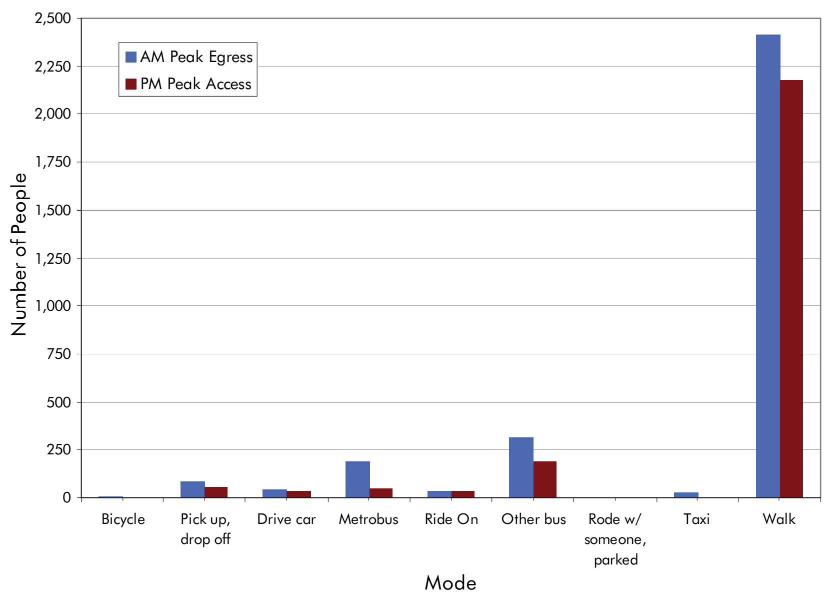


Figure 5: Egress and Access Mode for Peak Movements
Source: 2007 Metrorail Passenger Survey

Metrobus routes J1, J2, and J3 provide east-west service between downtown Silver Spring, downtown Bethesda, Medical Center station, and Montgomery Mall with peak period headways between 10 and 15 minutes. The J7 and J9 offer express bus service between downtown Bethesda, Medical Center station, and the Lakeforest Transit Center at Lakeforest Mall in Gaithersburg. The J9 operates under a 15-minute peak period headway while the J7, which runs in the non-peak direction during peak commuting times, operates under a 20-minute headway.

Ride On bus service connects Medical Center station to other areas within Montgomery County including Bethesda station (30), Glenmont station (33), Friendship Heights station and Aspen Hill (34), Shady Grove (46), and Milestone Center in Germantown (70). Headways on these routes range from 10 to 30 minutes.

Figure 6: Medical Center Station Bus Bays

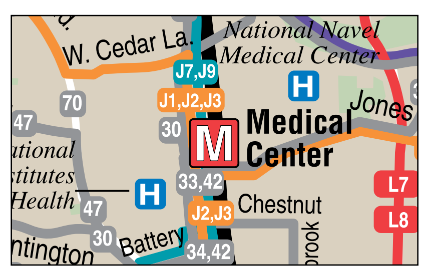


Figure 7: Station Bus Routes
Source: WMATA

Shuttle Bus Service

NNMC and NIH provide free shuttle services for patients, visitors, and employees that connect to Medical Center station. In particular, NNMC provides shuttle service from the station to Building 10, the main hospital, primarily for patients, but also for visitors and employees as space permits. This is known as the "Metro Line Shuttle." In addition, NNMC has several free on-campus shuttles which are provided to patients, visitors, and employees, as shown in Figure 8.

The weekday-only "Metro Line Shuttle" operates continuously between 6:10 AM and 5:30 PM with an average headway of four to seven minutes, depending on traffic conditions and security clearance at the gate. All shuttles comply with ADA accessibility requirements and feature a capacity of 24 passengers.

Based on the most recent data, daily ridership for the "Metro Line Shuttle" averages 415 passengers, including employees and visitors. Figure 9 displays the shuttle's average hourly ridership between December 2008 and January 2009. The data reveal that peak shuttle ridership closely coincides with peak usage of Medical Center station. However, because service terminates at 5:30 PM, the number of passengers shown in Figure 9 for the period beginning at 5:00 PM only represents a half-hour period. The relatively high number of passengers during this half hour suggests an unmet need for shuttle service beyond the established schedule. NNMC is currently reviewing the feasibility of adding additional shuttles before and after each shift to support the needs of patients, and visitors and employees as space permits.

Several shuttle improvement strategies identified in the NNMC transportation management plan (TMP), such as real-time travel information, stop shelters, and routing and scheduling information displays at stops, are awaiting implementation.

NIH manages seven different shuttle routes, six of which stop at Medical Center station. NIH

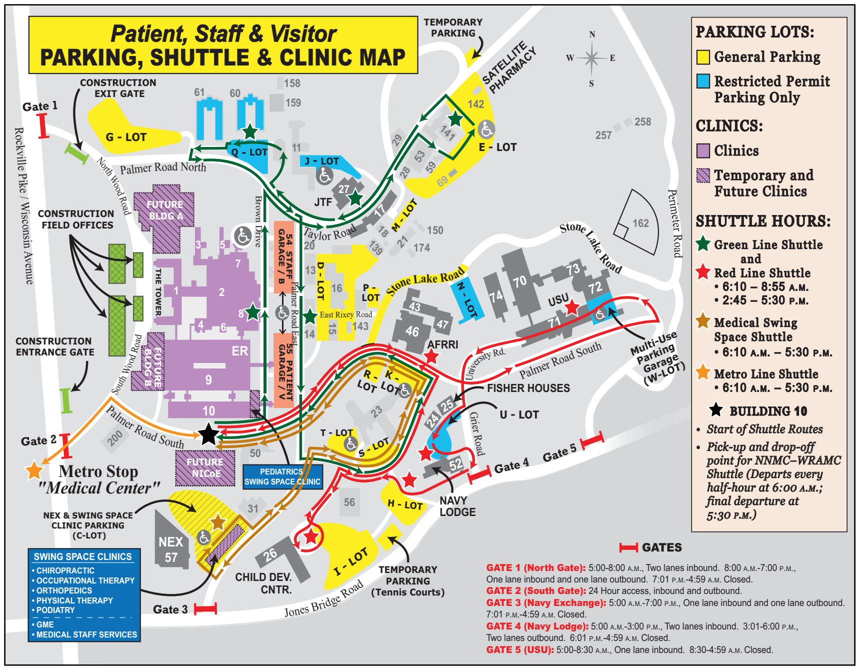


Figure 8: NNMC Shuttle Map
Source: National Naval Medical Center website

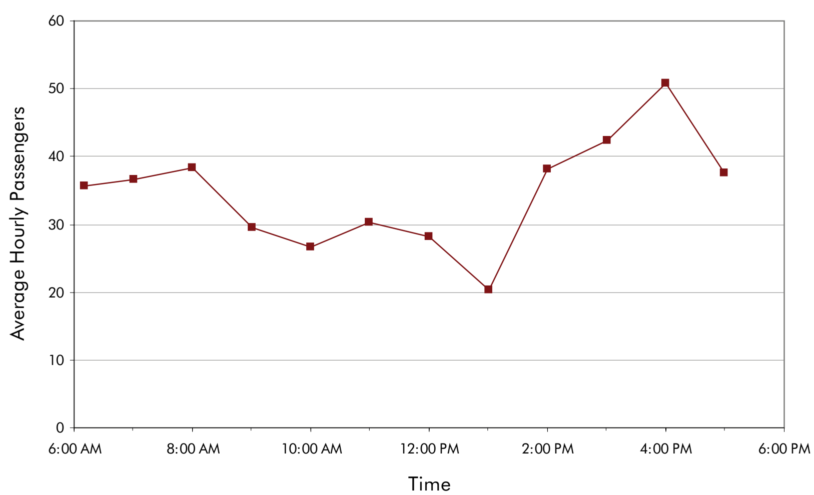


Figure 9: Average Hourly "Metro Line Shuttle" Ridership, December 2008 to January 2009
Source: National Naval Medical Center

shuttles are frequent (10 to 25 minute headways) and generally operate between 6:00 AM to 7:00 PM. The NIH Clinical Center "After Hours Route" only serves the campus during the evening hours of 6:00 PM to 11:40 PM with 20-minute headways. NIH counted shuttle passengers boarding and alighting at Medical Center station for the week of March 17 through March 23, 2009. In total, 1,335 passengers boarded and 891 were dropped off for an average of 267 shuttle boardings and 178 shuttle alightings per day at Medical Center station.

Pedestrian and Bicycle Facilities

Both sides of Rockville Pike feature sidewalks with varying degrees of quality. Rockville Pike's western side includes a shared bike and pedestrian path with sections paved with either asphalt or concrete. Along the east side of Rockville Pike, a narrow asphalt path runs south of South Wood Road, while a slightly wider concrete sidewalk runs to the north.

Most sidewalks along Rockville Pike include a grass buffer that separates pedestrians and vehicles by several feet, but portions along the western edge of the South Wood Road intersection are immediately adjacent to the curb. Additionally, several hundred feet of sidewalk along the eastern side of Rockville Pike north of South Wood Road are adjacent to the curb, creating an unwelcoming pedestrian environment along the heavily travelled roadway. Security fencing along the western perimeter of NNMC's campus separates the public right-of-way from the secured facility.

The Rockville Pike and South Drive/South Wood Road intersection has ADA-compliant crosswalks across all legs except the northern side, each with pedestrian countdown signals and ramps. Pedestrians are therefore obliged to cross on the southern side of the intersection to move between Medical Center station and NNMC, as shown in Figure 10. This crossing has the following pedestrian impediments:

Conflicts with turning vehicles. At this intersection, pedestrians and vehicles turning to and from Rockville Pike share the same space during the same signal phase. This is a particular issue during the evening rush hour when employees leaving NNMC turn left from westbound South Wood Road onto southbound Rockville Pike. During this same signal phase, pedestrians have the "walk" symbol across the southern leg of the intersection. Because left-turning vehicles yield to pedestrians during their green phase, significant back-ups were observed onto South Wood Road towards NNMC. Another conflict during the evening peak at this crosswalk occurs with drivers turning right from eastbound South Drive onto southbound Rockville Pike. Because eastbound drivers travel during the pedestrian walk phase, right-turning drivers must also yield to pedestrians. The result is often back-ups onto the NIH campus, bus delays, and bus bay congestion.

Relatively short pedestrian crossing phase. Pedestrians have 29 seconds to cross Rockville Pike, which includes the flashing walk phase. The crossing distance of 76 feet requires pedestrians to travel approximately 2.6 feet per second to make it safely across. Due to the proximity of hospital facilities, mobility-impaired patients may find such walking speeds difficult to maintain, though this walking speed is more manageable than the 3.5 feet per second design walking speed for Montgomery County crosswalks.

Figure 10: Pedestrians Crossing Rockville Pike, Looking West

Long signal phase for Rockville Pike. Rockville Pike is a major roadway that features a 2.5-minute signal cycle length to accommodate heavy traffic volumes. According to SHA, this cycle length is coordinated with other Rockville Pike intersections. This means pedestrians may have to wait upwards of 2.5 minutes to cross Rockville Pike. Because of this long wait time, several pedestrians were observed crossing during the "don't walk" phase. With the estimated increase in the number of pedestrians crossing this intersection, it is likely that more pedestrians would cross during the "don't walk" phase in the future.

The intersection of Rockville Pike and South Drive/South Wood Road (Figure 11) was the site of 27 crashes between January 2005 and May 2008, two of which involved a pedestrian crossing Rockville Pike. One of the two pedestrian crashes included a pedestrian crossing Rockville Pike with the pedestrian signal at the south end of the intersection, while the other included a jaywalking pedestrian at the north end of the intersection. Both crashes occurred during wet conditions and non-daylight hours.

On Monday, October 6, 2008, pedestrian activity was recorded between 8:00 to 8:30 AM at the Rockville Pike & South Wood Road crosswalk. There were 127 recorded crossings (123 pedestrians and 4 cyclists), 70 percent of which were heading east towards NNMC. Field observations revealed a relatively low number of crossings to and from the north. Three pedestrians were observed crossing during the "no walk" phase.

Several nearby trails provide good bicycle access to the Medical Center station. A paved multi-use path skirts the southern perimeter of the NIH campus, connecting the station to Old Georgetown Road. The North Bethesda Trail and the Capital Crescent Trail may be reached from Old Georgetown Road depending upon which direction one travels. The North Bethesda Trail runs between the NIH campus and the Twinbrook Metrorail station on exclusive rights of way and shared sidewalks, depending on the section. The Capital Crescent Trail connects Georgetown to downtown Bethesda via a paved trail along a former railroad right of way. An unpaved section of the Capital Crescent Trail also connects downtown Bethesda to downtown Silver Spring.

In addition, the Rock Creek multi-use trail just east of NNMC is an asset to area cyclists commuting to Medical Center.

Figure 11: Rockville Pike Intersection Area
Source: Google Earth

Figure 12: Medical Center Station Bike Racks and Lockers

The Medical Center station has one of the highest bike access mode shares in the Metrorail system. Morning access and evening egress reveal high cycling activity, which are seven and five percent of the trips during these time periods, respectively. The cycling mode share shown in Table 2, however, is low. This is because the table displays mode share for peak AM egress and peak PM access, which are the primary pedestrian movements associated with the station during the busiest portions of the day, not the primary cycling movements.

Medical Center station has 88 bike racks, 35 percent of which were utilized in 2006. There are also 38 bike lockers, of which 100 percent are utilized as of April 2009. The complete utilization of lockers indicates that more lockers or a bike station are needed to accommodate both existing passengers and future growth at the station.

Kiss & Ride

A Kiss & Ride lot is located near the NIH entrance, across South Road from the station bus bays. After the events of September 11, 2001, NIH converted the Kiss & Ride to a security checkpoint. Vehicle congestion from the checkpoint during peak periods encouraged drivers to drop off passengers along the western (southbound) side of Rockville Pike. This activity blocks the bus stop area, requiring buses to stop in the vehicular lane and block traffic, resulting in vehicle queues.

NIH recently completed construction of a new security checkpoint immediately south of the station, and has transferred the old Kiss & Ride property back to WMATA. The former Kiss & Ride facility will return to full operation in the near future, which will help alleviate the queuing issues. There are no Park & Ride facilities at the station.

Existing Station Circulation and Capacity

Medical Center station operates efficiently during peak hours as there are no significant passenger capacity or circulation issues. Table 3 shows that the station facilities are adequate for existing passenger volumes.

The station does not meet emergency egress standards set by the National Fire Protection Association (NFPA) Standard for Fixed Guideway Transit and Passenger Rail Systems 2007 (NFPA 130), which calls for clearing the platform in four minutes and reaching a point of safety in six minutes. Evacuation time analysis is based on a worst-case-scenario with full trains arriving and needing to evacuate. WMATA is not required to meet these evacuation times since Medical Center station predates this standard, but the agency uses them as design goals when modifying station facilities.

Table 4 shows that emergency egress of passengers is nearly three to four times longer than NFPA 130 standards. This is because the station is limited by its platform-to-mezzanine location (north end of the platform only) and minimal vertical capacity.

A more detailed discussion of existing and future capacity is in Section 4 of this report.

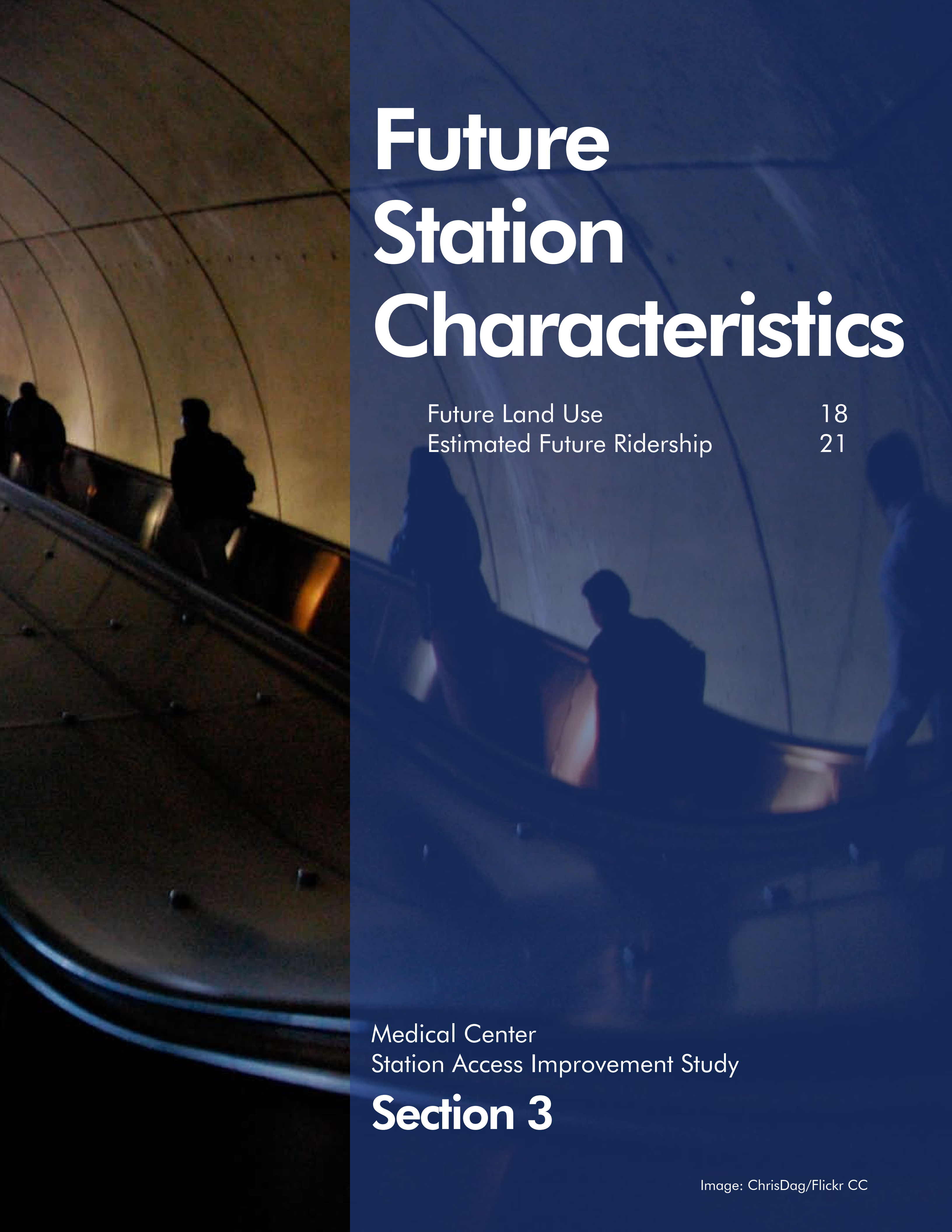
Table 3: Existing Infrastructure Capacity Summary

Infrastructure Element			Number of Elements Required	Number of Existing Elements
Vertical circulation	Street to mezzanine	Escalators	2	3
		Elevators	1*	1
	Mezzanine to platform	Escalators	2	2
		Elevators	1*	1
Farecard vendors			1	4

**Only one elevator is needed to accommodate passenger volumes. However, WMATA's current design standards require two elevators to ensure access.*

Table 4: Existing Emergency Egress Results

Measure	NFPA Standard	AM Peak	PM Peak
Time to clear platform (min.)	4.0	12.4	11.8
Time to point of safety (min.)	6.0	22.9	21.1



Future Station Characteristics

Medical Center
Station Access Improvement Study

Section 3

Image: ChrisDag/Flickr CC

Future Station Characteristics

Future Land Use

Aside from the NNMC and the NIH, Medical Center Station is surrounded by environments that are either built out or protected, including several parks, a country club, a private school, and many single family homes. Consequently, growth at both the NNMC and NIH campuses can reasonably be expected to encapsulate the vast majority of future development surrounding the station. In March 2008, the Navy completed the FEIS for the BRAC expansion of the NNMC into the Walter Reed National Military Medical Center (WRNMMC).

The BRAC actions will potentially bring a maximum of 2,500 new jobs to the NNMC campus, the vast majority of which will be located within the main hospital facilities. Patient and visitor load is expected to double to 981,000 per year once construction is complete. The FEIS assumes that patients and visitors will primarily arrive during the week, estimating an average of 1,862 additional visitors and patients per weekday. New facilities to accommodate such growth are highlighted in Figure 13.

The preferred alternative of the FEIS anticipates the construction of approximately 1,652,000 square feet of building space. Specifically, new buildings account for 1,144,000 square feet of construction while the renovation of existing buildings represents the remaining 508,000 square feet.

Growth in parking is expected throughout the site. The TMP projects that new parking facilities will collectively add approximately 2,000 spaces to the existing supply of 6,083. Employee parking will actually decrease by 400 spaces to 2,462 to reach the National Capital Planning Commission's (NCPC) goal of one employee space for every three employees. This means that all new parking spaces will be assigned for patients, visitors, retail patrons of the PX store, and other uses.

NIH has plans for growth as well. The 2005 update to the 2003 Master Plan states that total employees will reach 22,000 by 2020, an 18 percent increase over the 18,627 employees as of 2007. Employee growth will fuel the need for more facilities and parking spaces. By 2020, the NIH campus is expected to contain over 10.7 million square feet of office, research, medical, and general building space, as shown in Figure 14. This represents a potential 46 percent increase over total square feet in 2003. The campus may also contain as many as 11,000 parking spaces due to the organization's adherence to a 0.50 parking space to employee ratio. The Master Plan Update states that the campus will try to lower the parking space to employee ratio to 0.45 through its traffic management programs.

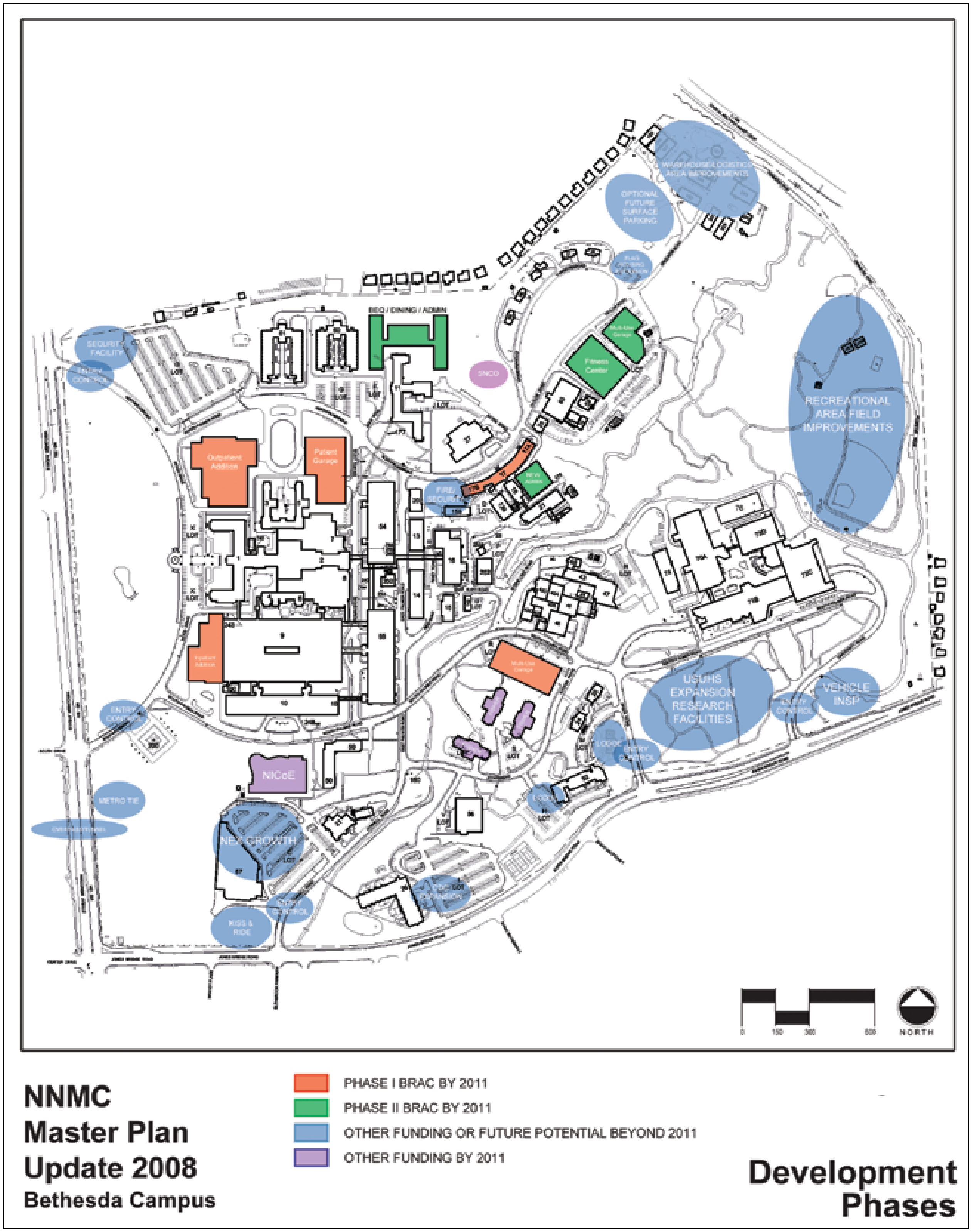


Figure 13: Existing and Proposed NNMC Facilities
Source: National Naval Medical Center Master Plan Update 2008

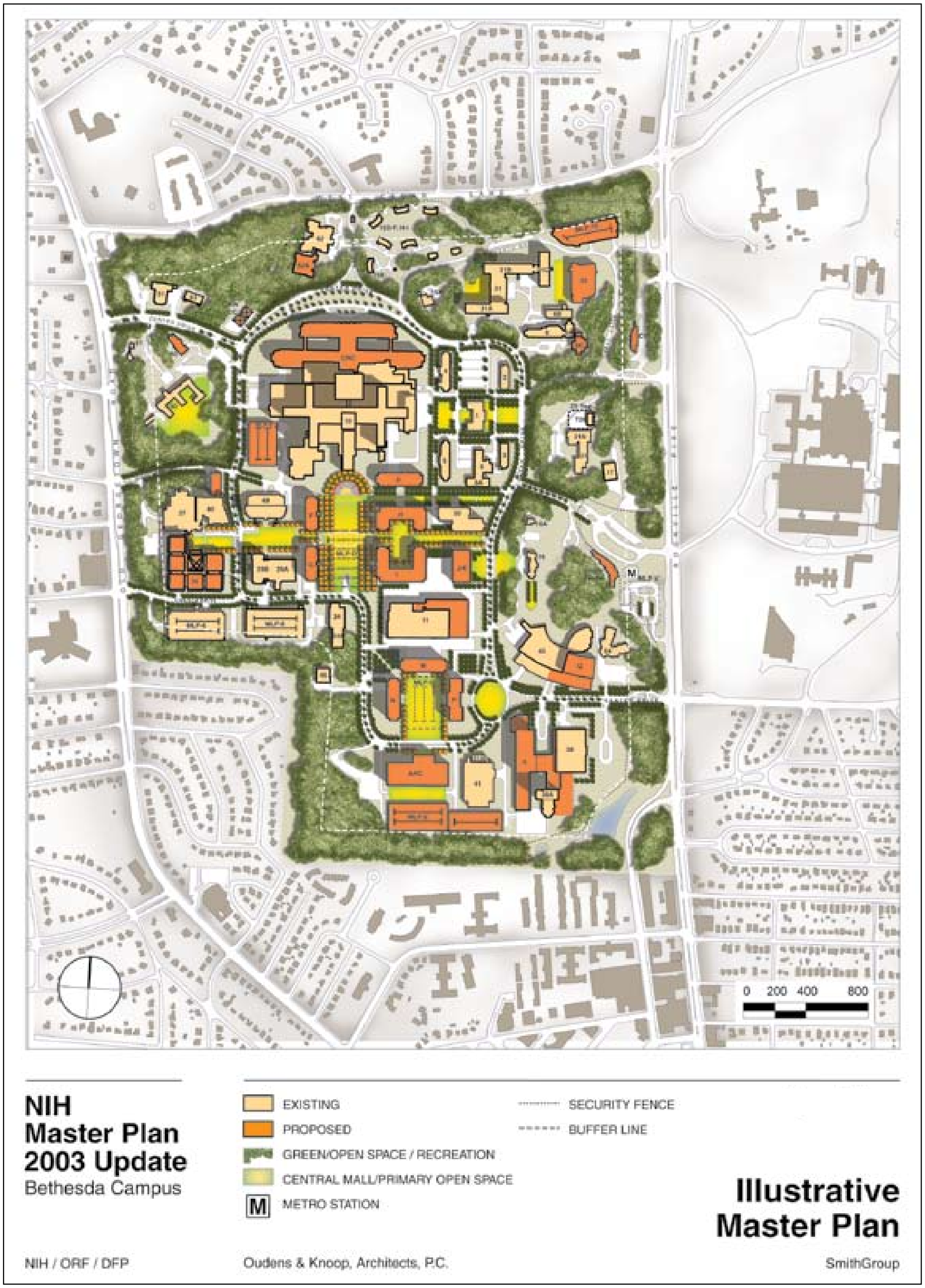


Figure 14: Existing and Proposed NIH Facilities
Source: NIH Master Plan 2003 Update, March 2005

Estimated Future Ridership

A 2007 survey conducted by NNMC found that approximately 11.3 percent of its 8,000 employees use transit to commute (9.9 percent Metrorail, 0.2 percent bus, and 1.2 percent commuter rail). NNMC has committed to increase this transit mode share to 30 percent by BRAC build-out in September 2011. Various Transportation Demand Management (TDM) measures are identified in the final TMP to help achieve this goal. However, a parking reduction to one employee space for every three employees will be the primary method of attaining this goal.

The NNMC transit goals have a substantial impact on future station ridership. The analysis in this study, which is detailed in Appendix B, estimates that ridership will increase almost 56 percent between 2007 and 2020, as shown in Table 5. The dramatic and sudden employee expansion of NNMC will contribute the majority of this passenger growth, but further development of NIH, a doubling of patients and visitors at NNMC, and steady growth of area residents will also significantly contribute.

Figure 15 shows 2020 ridership estimates by trip purpose. NNMC and NIH employees are expected to constitute about 72 percent of total Medical Center boardings and alightings. Home-related trips are the next largest trip purpose at 19 percent, while patients, visitors, and "other" trips make up the remaining nine percent. "Other" is a catch-all category that includes trips for business, recreation, meals, shopping, and school. Overall, Metrorail trips by NNMC employees are estimated to triple, which will have a profound impact upon pedestrian circulation across Rockville Pike.

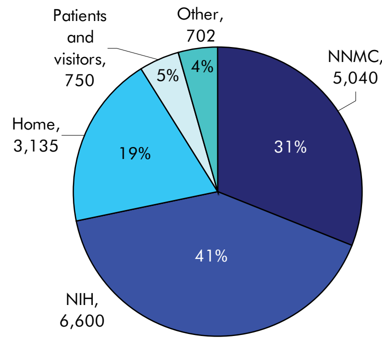


Figure 15: 2020 Ridership Estimates by Trip Purpose

Pedestrian Flow

Figure 16 and Figure 17 show the expected 2020 pedestrian flows to and from the Medical Center station during morning and evening peak hours. Visualizing future station-related pedestrian movements helps to understand what access improvements are needed. It is estimated that over 6,700 pedestrians per weekday will cross Rockville Pike in 2020, traveling between NNMC and both the Metrorail station and the bus stops. This volume would be slightly reduced if passengers decide to ride NNMC's "Metro Line Shuttle," or slightly increased if area residents cross at this intersection to reach the Metrorail station.

Based on estimated future rail and bus ridership associated with NNMC, between 875 and 1,000 pedestrians are estimated to cross Rockville Pike during the peak hours. If utilized to capacity and under ideal traffic and security conditions, shuttle service could potentially reduce crossings by up to 240 people per hour during the peak.

Because all improvement alternatives are located in the same basic location, the capture area of Metrorail passengers is essentially unchanged. While some station improvements, such as elevators on the east side of Rockville Pike, may provide more direct access to transit and therefore increase its attractiveness, the effect that this might have on generating new ridership is small and cannot be measured.

Table 5: Estimated Average Weekday Peak Ridership

Time Period		2007	2020
Boardings per hour	5:00 - 6:00 PM	874	1,361
Alightings per hour	8:00 - 9:00 AM	1,015	1,580
Daily average	All day	10,422	16,227

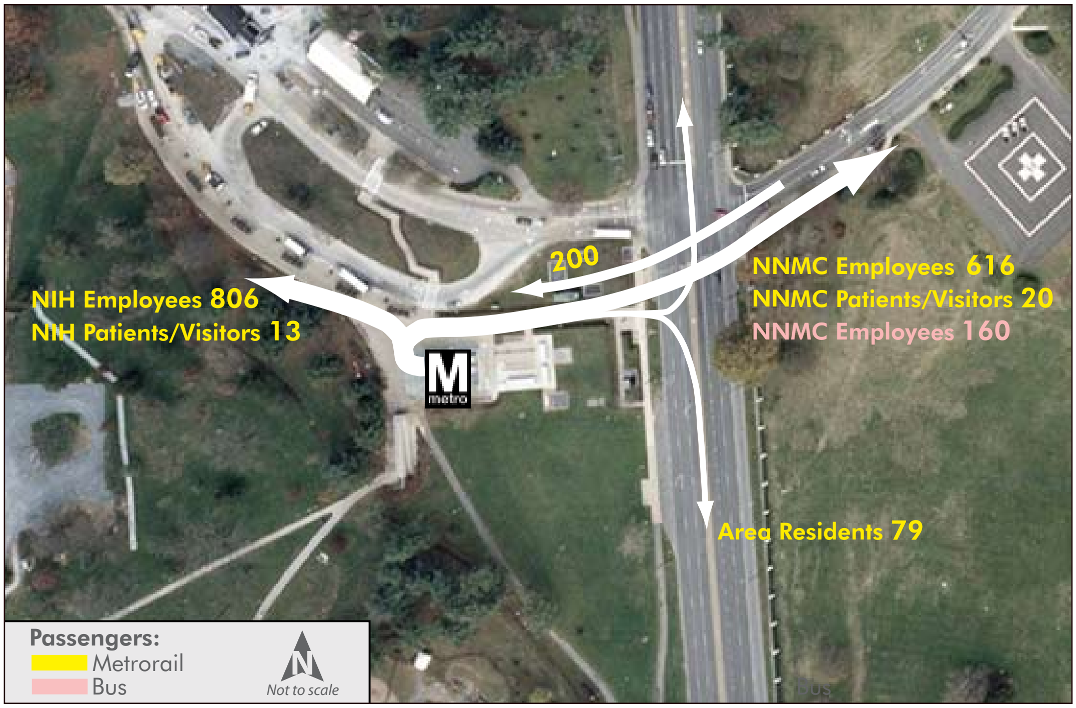


Figure 16: Estimated AM Peak Hour Pedestrian Flow, 2020

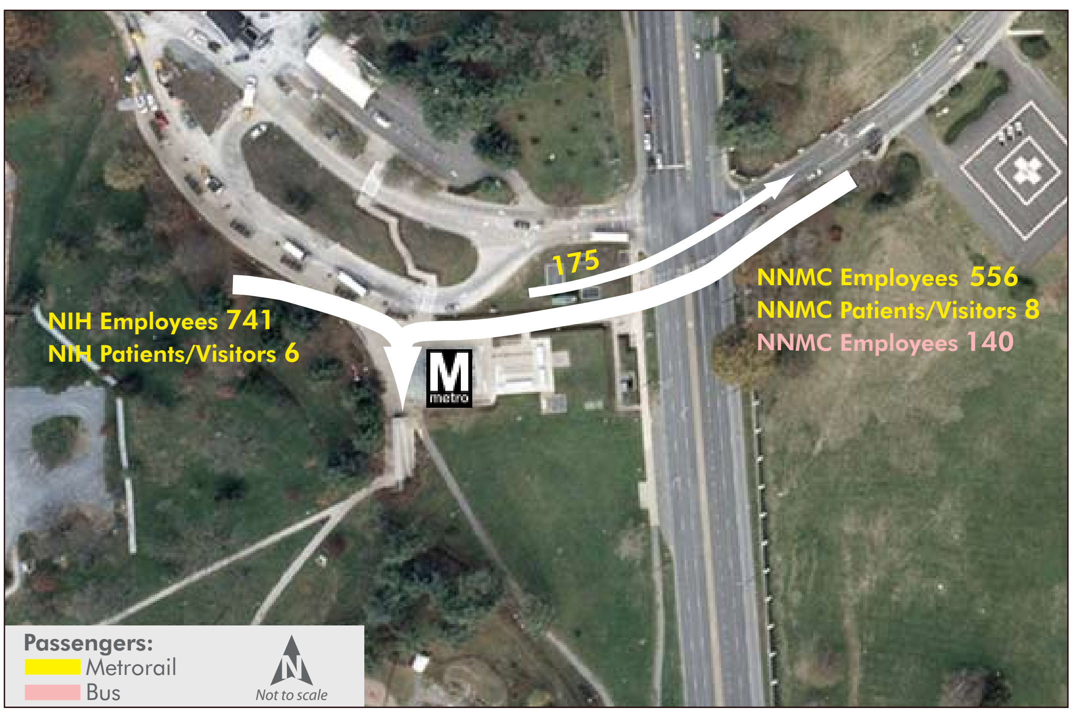


Figure 17: Estimated PM Peak Hour Pedestrian Flow, 2020

Note: "Area Residents" is a conservative estimate based on the Metrorail Passenger Survey. Though 79 passengers leave the station in the AM peak destined for home, some may use modes other than walking to get there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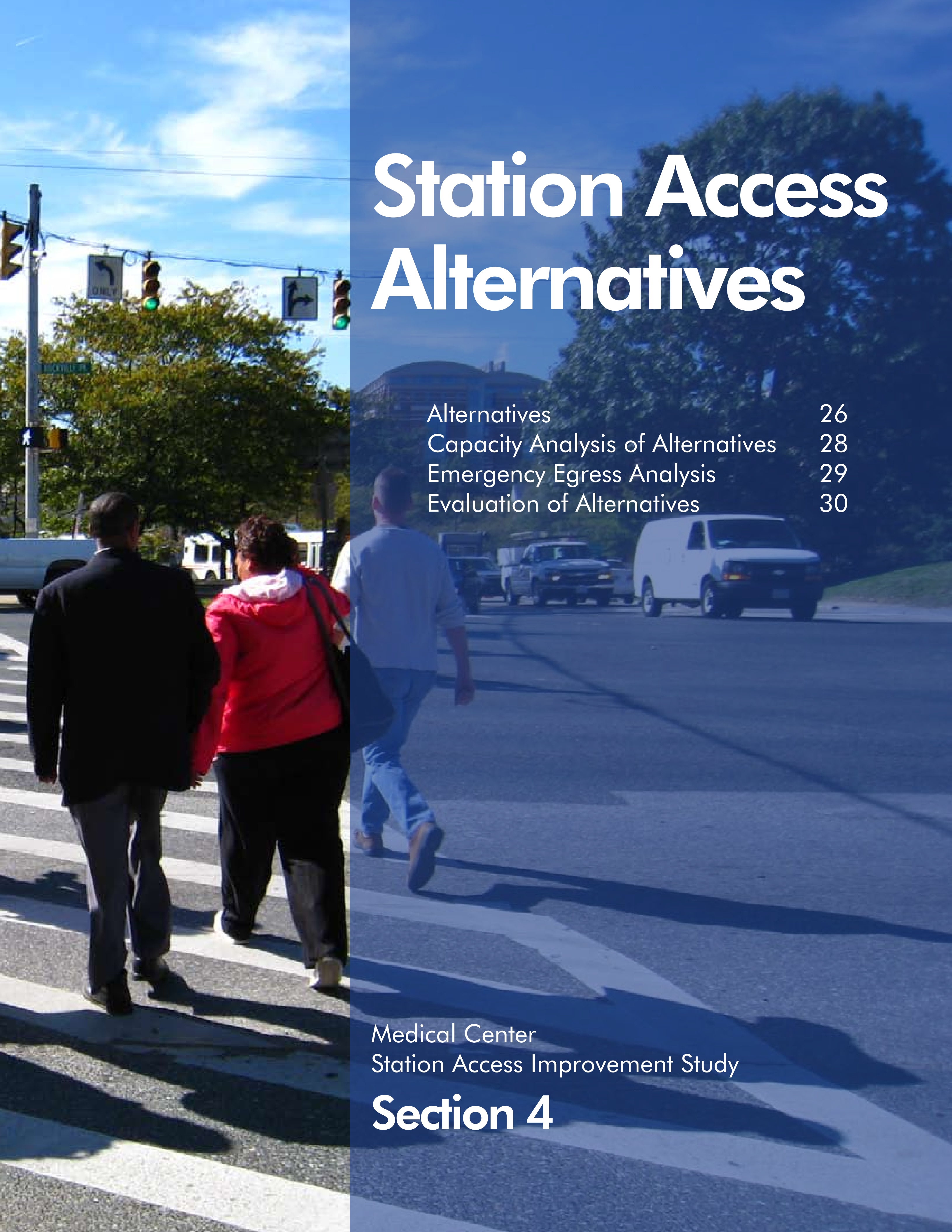


Station Access Alternatives

Medical Center
Station Access Improvement Study

Section 4

Station Access Alternatives

Using the study goals, the guidance of the DAR Needs Report, and stakeholder feedback, WMATA explored several new or upgraded station access alternatives. A passenger capacity analysis established the required infrastructure for additional and improved station access and allowed for a comparison between different alternatives.

Alternatives

The study analyzed five alternatives, each of which would address the study goals to varying degrees. Because of the focus on the Rockville Pike crossing due to NNMC growth, the location of the existing entrance and station mezzanine, and the security constraints at NNMC, all alternatives are limited to the same general area around the existing crosswalk. Some alternatives share common improvements, which are delineated in Table 6 for clarity. The following sections describe each alternative in more detail. In addition, the architectural, structural, mechanical, electrical, and system components of each alternative are discussed in Section 5.

Alternative 1: No Build with Improved At-Grade Crossing

Alternative 1 would not incorporate any station modifications or significant construction. This alternative would include an upgraded crosswalk on Rockville Pike as well as a new curbside Kiss & Ride drop-off area on the east side of Rockville Pike. The upgraded crosswalk would feature a staggered pedestrian refuge, similar to what is used throughout the United Kingdom, which would increase pedestrian safety for those that may not be able to make it across in a single walk phase. Incorporating a staggered refuge would require a median width of 10 to 12 feet to ensure adequate accessibility, storage space, and room for a railing. The refuge would include

Table 6: Components of Alternatives

	Alternative				
Components	1	2	3	4	5
Upgraded crosswalk	X	X			
East-side Kiss & Ride	X	X	X	X	X
New platform stairway and escalator		X		X	
East-side elevators		X		X	
Shallow pedestrian tunnel			X	X	
Pedestrian bridge					X

its own signal pole and head. Signal timing modifications may be required to allow a two-stage crossing. While enhancing pedestrian safety, this alternative would not reduce the number of pedestrians crossing the intersection.

Alternative 2: Elevator Entrance on East Side of Rockville Pike

Alternative 2 would include the elements in Alternative 1 with the addition of three high-speed elevators on the east side of Rockville Pike. These elevators would provide direct access to the station mezzanine below via a short pedestrian passageway, reducing the average travel time by half for Metrorail passengers accessing NNMC and removing the need for Metrorail passengers to cross Rockville Pike. An emergency stairway would be constructed in tandem with and adjacent to the new elevators.

In addition, Alternative 2 would include a new platform-to-mezzanine stairway and elevator, greatly lowering emergency egress time. This alternative includes crosswalk upgrades, as described in Alternative 1, because bus patrons and others would still need to cross Rockville Pike at-grade.

This alternative would serve Metrorail passengers that would otherwise cross Rockville Pike to reach NNMC, reducing the pedestrian crossings by 80 percent.

Alternative 3: Shallow Pedestrian Tunnel Underneath Rockville Pike

A shallow pedestrian tunnel, which could be 30 feet deep if using mining methods or 19 feet deep if using cut-and-cover methods, is the main component of Alternative 3. Such a tunnel would benefit the safety and travel time reliability for all pedestrians crossing the intersection, though Metrorail passengers who work at NNMC would not see any time savings. At each end of the tunnel would be a stairway with a bicycle ramp, one escalator in the up direction, and two elevators for ADA compliance. The elevators would only connect the tunnel to the sidewalks and would not connect to the station mezzanine. To lower the cost of this alternative, it might be possible to eliminate one of the elevators and the escalator at each end, but this would need further consideration. Alternative 3 would not upgrade the Rockville Pike crosswalk, but it would include the east-side Kiss & Ride drop-off. This alternative does not include any station modifications.

Alternative 4: Shallow Pedestrian Tunnel Plus Elevator Entrance on East Side of Rockville Pike

Alternative 4 is a combination of Alternatives 2 and 3, without the upgraded crosswalk. This alternative is comprised of the Kiss & Ride drop-off, three east-side high-speed elevators, the shallow pedestrian tunnel, and the new platform-to-mezzanine stairway and elevator. The pedestrian tunnel would directly connect to the east-side high-speed elevators. Alternative 4 provides the same time savings for Metrorail passengers as Alternative 2, and the same degree of safety improvements as Alternative 3. It is also the costliest alternative.

Figure 18: Medical Center Station Entrance
Source: Schumin Web Transit Center

Alternative 5: Pedestrian Bridge Over Rockville Pike

Alternative 5 is similar to Alternative 3, except that pedestrians would cross Rockville Pike on a bridge rather than in a tunnel. Such a bridge would benefit the safety of all pedestrians, although MDSHA has expressed concern that the bridge may impact aerial structures along the roadway. Metrorail passengers who work at NNMC would not see any time savings. Each end of the bridge would have a stairway and two elevators, for ADA compliance. To lower the cost of this alternative, it might be possible to eliminate one of the elevators at each end, but this would need further consideration. The elevators would only connect the bridge to the sidewalks and would not extend down to the station mezzanine. Alternative 5 would not upgrade the Rockville Pike crosswalk, but it would include the east-side Kiss & Ride drop-off. This alternative does not include any station modifications.

Alternatives Considered but Dismissed

Early on in the project, WMATA considered a modified version of Alternative 4 where new high-speed elevators would be located on the west side of Rockville Pike instead of the east side. These elevators would have connected the mezzanine, the pedestrian tunnel, and the surface. This alternative was eliminated from consideration because its impacts on the existing underground substation would have been cost prohibitive.

Capacity Analysis of Alternatives

Infrastructure requirements at the Medical Center station were evaluated based on existing and estimated ridership levels, requirements set by WMATA and standards in the Transit Capacity and Quality of Service Manual. The capacity analyses of the vertical and horizontal elements of the station were performed for the following scenarios:

- **2007 Existing**: The existing station facilities were evaluated using the current (2007) ridership data.
- **2020 No Build**: The existing station facilities were evaluated using the estimated 2020 ridership data.
- **2020 Internal Station Improvements**: The proposed internal station improvements were evaluated using the estimated 2020 ridership. Only Alternatives 2 and 4 propose interior station improvements in the form of an additional platform-to-mezzanine stairway and elevator.

The capacity analyses of the entrances were performed focusing on farecard vendors, faregate aisles, elevators, escalators, and stairways. All station elements were analyzed for the peak 15-minute passenger volume.

Analysis Assumptions

The existing station elements are shown in Table 7, and the design criteria used in the capacity analyses are presented in Table 8. Other general assumptions used throughout the analysis include:

- Design year: 2020
- Future Metrorail service at station: 2.5-minute headways
- Future Metrorail train: eight-car trains

Table 7: Summary of Existing Station Elements

Regular faregates	3
ADA faregates	1
Exitfare	2
Fare vendors	2
Platform width (feet)	30
Platform length (feet)	600
Platform elevators	1
Mezzanine elevators	1
Platform escalators	2
Mezzanine escalators	3
Platform stairs	0
Mezzanine stairs	0

Source: Metro Station Access & Capacity Study, 2007

Table 8: Assumed Metrorail Station Capacity Criteria

Item	Value	Units	*Source*
Peaking factor for alighting passengers	1.28		WMATA
Escalator flow rate	90	p/min	WMATA, Station Access and Capacity Study
Stairway flow rate per width	10	p/ft/min	Transit Capacity and Quality of Service Manual
Passengers using farecard vendor	2	%	PB, field measurements
Farecard vendor transactions rate	2.5	p/min	Bi-County Transitway, Bethesda Station Access Dem. Analysis
Faregate aisle flow rate	35	p/min	WMATA, field measurements
Standard elevator speed	1.79	ft/sec	WMATA, Rosslyn Elevator Capacity Analysis
High-speed elevator	5.77	ft/sec	WMATA, Rosslyn Elevator Capacity Analysis
Passengers using east-side elevators, AM peak (entries/exits)	10/40	%	PB, ridership analysis
Passengers using east-side elevators, PM peak (entries/exits)	40/25	%	PB, ridership analysis

Analysis Results

Table 9 summarizes the station infrastructure requirements for the existing and future scenarios analyzed. This is based on the capacity criteria and WMATA standards previously cited. Because identical station modifications are present in Alternatives 2 and 4 only, a single build scenario is analyzed for 2020. All other station access alternatives would not directly modify the Medical Center station, thus their infrastructure requirements would be aligned with the 2020 No Build column. According to the capacity analysis, Medical Center station is not expected to become capacity constrained in either of the 2020 scenarios. However, to accommodate NNMC-bound passengers in Alternatives 2 and 4, which include direct elevator access east of Rockville Pike, two high-speed elevators would be required, though three elevators are proposed to reduce queuing.

Table 9: Infrastructure Requirements Summary

<table>
<tr><th colspan="3" rowspan="3">Infrastructure Element</th><th colspan="3">Number of Elements Required</th></tr>
<tr><th rowspan="2">No Build 2020</th><th colspan="2">Build 2020</th></tr>
<tr><th>West</th><th>New East</th></tr>
<tr><td rowspan="4">Vertical circulation</td><td rowspan="2">Street to mezzanine</td><td>Escalators</td><td>2</td><td>2</td><td>N/A</td></tr>
<tr><td>Elevators</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td rowspan="2">Mezzanine to platform</td><td>Escalators</td><td>2</td><td colspan="2">2</td></tr>
<tr><td>Elevators</td><td>1</td><td colspan="2">1</td></tr>
<tr><td colspan="3">Farecard vendors</td><td>1</td><td colspan="2">1</td></tr>
<tr><td colspan="2" rowspan="3">Faregate aisles</td><td>Standard</td><td>3</td><td colspan="2">3</td></tr>
<tr><td>ADA</td><td>1</td><td colspan="2">1</td></tr>
<tr><td>Total</td><td>4</td><td colspan="2">4</td></tr>
</table>

Source: Metro Station Access & Capacity Study, 2007

Number of elements required is greater than the number of existing elements.

Emergency Egress Analysis

The egress capacity of the station, for both the existing and future conditions, was analyzed based on the requirements set by the National Fire Protection Association (NFPA) Standard for Fixed Guideway Transit and Passenger Rail Systems 2007 (NFPA 130). For new transit facilities, NFPA 130 requires the platform to be evacuated in four minutes and allow people to reach a point of safety in six minutes. Evacuation time analysis is based on a worst-case-scenario with full trains arriving in both directions and needing to evacuate, per NFPA 130 standards. Because the Medical Center station predates NFPA requirements, WMATA is not required to meet NFPA 130 existing times, but can use them as design goals. In addition, the analysis can ensure that station exiting times for future ridership do not exceed the exiting times of current ridership by comparing NFPA 130 egress times.

As shown in Table 10, both the time to clear the platform and the time to evacuate the station is lowest for Alternatives 2 and 4. Although the addition of a platform-to-mezzanine stairway and a mezzanine-to-sidewalk emergency stairway would not make the station compliant with NFPA 130 requirements, it would nearly meet the platform clearing standard for both morning and evening peaks and substantially improve the emergency egress time during other periods.

NFPA 130 also sets requirements for station elements and their configuration. Section 5.5.6.3.2 of NFPA 130 allows escalators to account for more than one-half of egress capacity if a portion of the egress capacity at each station level is provided by stairs. This is the case with Alternatives 2 and 4, in which a stairway would connect the platform to the mezzanine and an emergency stairway would connect the mezzanine to the surface.

WMATA should address other emergency evacuation details, such as coordination with emergency responders, as this project progresses through the design stage.

Evaluation of Alternatives

This study is in response to the Department of the Navy's DAR Needs Report that identifies new east-side elevator access for Medical Center station as a necessity and top priority in addressing future access road congestion at NNMC, as well as interest from MDOT and Montgomery County. One of WMATA's roles as a regional agency is to study station access alternatives and evaluate their effectiveness. This report is intended to provide information and sound analysis to support decision-making, but does not recommend a specific alternative. The decision on what entity would build the project will be made as part of a follow-on phase, and that entity, along with stakeholders, would determine which alternative is most desirable and feasible.

Table 11 shows a comparison of alternatives with respect to performance measures derived from study goals. Performance measures in the areas of traffic/ pedestrian conflict, vehicular delay, and construction traffic impacts are reported on a relative scale that rates each alternative according to the performance measure as High, Medium, or Low. The estimated cost of each alternative is discussed more in Section 5

Alternatives 3, 4, and 5 would have the lowest likelihood of conflict between traffic and pedestrians due to their grade-separated crossings of Rockville Pike that can be used by Metrorail passengers, bus patrons, and general pedestrians alike. Alternative 2 includes a grade-separated crossing as well. While this alternative would primarily serve Metrorail passengers, these passengers are estimated to account for about 80 percent of all NNMC-bound pedestrians crossing Rockville Pike. The No Build alternative would have the highest likelihood of vehicle and pedestrian conflict since all pedestrians would cross Rockville Pike at-grade, though the median refuge would help increase pedestrian safety.

Grade-separated Alternatives 3, 4, and 5 would potentially have the largest effect on reducing vehicular delay. Alternative 2 would also lower vehicular delay, but bus passengers and other pedestrians, about 20 percent of all NNMC-bound pedestrians, would still cross at-grade. Average travel time for Metrorail passengers would be halved from 6.7 minutes to 3.3 minutes with Alternative 2 or 4. The pedestrian

Table 10: Emergency Egress Analysis Results

	AM Peak			
NFPA 130 Measure	NFPA 130 Standard	Existing (2007)	Alts. 1, 3, 5 (2020)	Alts. 2, 4 (2020)
Time to clear platform (minutes)	4.0	12.4	17.9	5.1
Evacuation time (minutes)	6.0	21.9	30.2	13.4
	PM Peak			
Time to clear platform (minutes)	4.0	11.8	16.9	4.8
Evacuation time (minutes)	6.0	21.1	28.7	12.8

Source: PB, 2009

Table 11: Evaluation of Alternatives

Performance Measure	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
			Pedestrian Safety		
Number of traffic and pedestrian conflicts*	High	Medium	Low	Low	Low
			Trip Time		
Vehicular delay	High	Medium	Low	Low	Low
Metrorail passenger travel time** (minutes)	6.7	3.3	6.7	3.3	6.7
Bus passenger travel time*** (minutes)	3.8	3.8	3.8	3.8	3.8
			Cost Effectiveness		
Estimated project cost**** FY09$ (M)	0.7	30.5	31.5	59.4	14.6
Construction traffic impacts	Low	Low	Low	Low	Medium

* Assumes average pedestrian wait time is 1.25 minutes to cross Rockville Pike; maximum wait is 2.5 minutes.
** Travel time from faregates to the NNMC security checkpoint. Assumes 3.5 feet per second walking speed.
*** Travel time from first bus bay to the NNMC security checkpoint. Assumes 3.5 feet per second walking speed.
**** Estimates include construction, planning, engineering, construction management, and administrative costs.
Alternatives 3 and 4 utilize a mining construction method for pedestrian tunnel.

tunnel or bridge would not reduce average travel time from the No Build alternative because the time spent walking up and down stairs is equivalent to the average wait time of 1.25 minutes for the pedestrian "walk" signal.

Traffic during construction would be disrupted the least in alternatives that do not require extensive ground construction over or under Rockville Pike. The pedestrian tunnel would likely have the greatest impact on maintenance of traffic (MOT), especially if a cut-and-cover construction method is employed versus a mining method. Mining for new east-side elevator access would likely not disturb traffic to a great degree since most construction would occur well below the surface.

Estimated project costs are the highest for alternatives featuring east-side elevators due to shaft construction and station modifications, including an extended mezzanine and a new platform-to-mezzanine stairway and elevator. Cost estimates are reported as a range for Alternatives 3 and 4 because of differing construction methods for the pedestrian tunnel. Cost estimates shown for Alternatives 3 and 4 assume a mined construction method. Section 5 provides more details on project cost estimates.

Overall, Alternative 4 provides the most benefits but is also the costliest. Alternative 2 provides significant benefit given that 80 percent of all NNMC-bound pedestrians are Metrorail passengers. Alternatives 3 and 5 provide some benefit, with Alternative 3 being more costly. Though Alternative 1 does not provide the benefits of the other alternatives, it would improve pedestrian safety by adding a new pedestrian refuge while limiting construction costs. However, it would not reduce the overall number of pedestrians crossing Rockville Pike. In short, all alternatives would address the study goals to varying degrees, with only Alternatives 2 through 5 reducing the number of pedestrians crossing the intersection.

Figure 19: Medical Center Pylon
Source: Schumin Web Transit Center

Figure 20: Medical Center Station Platform
Source: ChrisDag/Flickr CC

Additional Considerations

In addition to the evaluation factors previously discussed, there are other functional considerations, particularly for the grade-separated pedestrian crossings proposed in Alternatives 3, 4, and 5.

Pedestrian bridges or tunnels are typically built where there are high pedestrian accident rates, high vehicular delays, or destinations either above or below grade to which the crossing would connect. Though current transportation and demographic trends favor pedestrian-friendly streets, active land uses, and at-grade crossings, there are instances where grade-separations are appropriate. At the intersection of Rockville Pike and South Wood Road/South Drive, high pedestrian volumes, vehicular delays, and active land uses nearby prompted the development of Alternatives 3, 4, and 5.

Many pedestrian bridges or tunnels built in previous decades were done for the primary benefit of automobiles and were not always convenient for pedestrians. As a result, these crossings go largely unused. An example is the pedestrian bridge at the Prince George's Plaza station. Though utilization of this bridge is presently high, it is because Prince George's County recently installed a barrier along the median of the roadway below to prevent illegal crossings. Before the barrier, the bridge was underutilized in part because it does not directly connect to retail across the street.

Pedestrians, like all travel modes, choose the path of least resistance. When a tunnel or bridge is convenient, safe, and offers a better alternative to crossing at-grade, it tends to be heavily used. The pedestrian tunnel at the White Flint station, for example, directly aligns with pedestrians exiting the station destined for the other side of Rockville Pike. Given the long traffic signal cycle length of the at-grade crossing, many pedestrians use the tunnel to save time. Additionally, the tunnel is clean, bright, and matches the design of the Metro station.

The shallow tunnel proposed in Alternatives 3 and 4 is envisioned to have similar attributes as the pedestrian tunnel at White Flint by enhancing the safety of the Rockville Pike crossing and by reducing vehicular delay for drivers exiting NNMC to the south. In Alternative 3, Metrorail passengers would need to exit the station via the existing escalator or elevator, walk to the tunnel entrance, and go down to the tunnel. Alternative 4 would be more convenient for Metrorail passengers because it would directly connect to elevators from the mezzanine, eliminating the need to come up and then go back down.

Like a tunnel, the bridge proposed in Alternative 5 would enhance the safety of the crossing and reduce vehicular delay. However, the bridge's impact on the historic NNMC viewshed should be studied. Additionally, MDSHA has expressed concern over the bridge's height and its impact on aerial structures along the roadway, such as signal heads and advanced overhead signing.

Alternatives 3, 4, and 5 would all enhance the safety of the Rockville Pike crossing for bus passengers.

Alternative 2 would avoid any utilization concerns associated with the pedestrian bridge or tunnel by providing a direct connection from the Medical Center station mezzanine to the east side of Rockville Pike. However, the direct connection would only apply to Metrorail passengers, or approximately 80 percent of all NNMC-bound pedestrians crossing Rockville Pike.


CLARK
HKS

Image: thisisbossi/Flickr CC

Implementation

Medical Center
Station Access Improvement Study

Section 5

Implementation

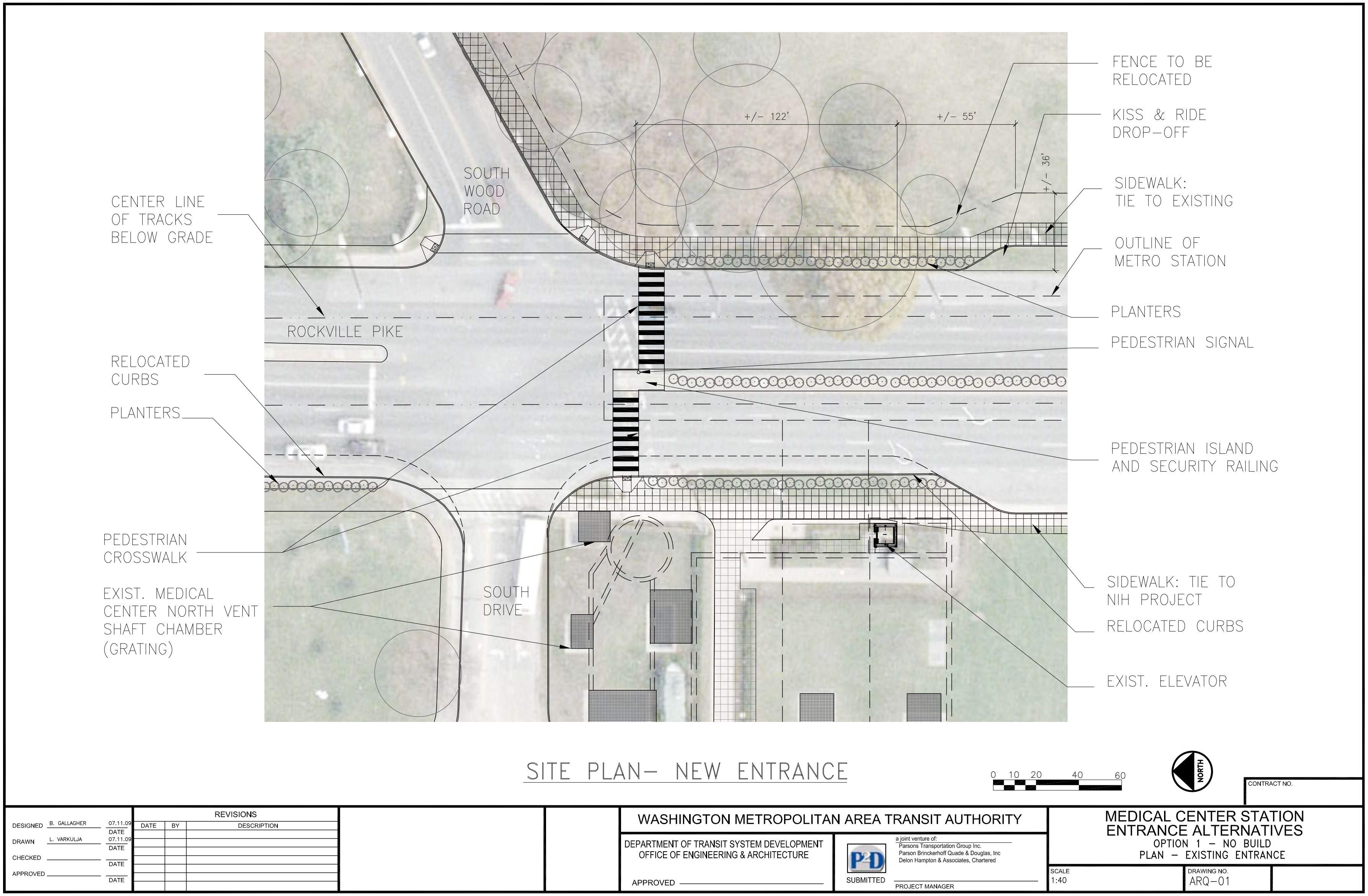
Access improvements to the Medical Center station could be built by a variety of parties. The project sponsor(s) and the alternative chosen would likely depend on funding sources and levels. Each alternative has physical requirements and considerations regarding architecture, structures, and mechanical, electrical, and system components.

Alternative 1: No Build with Improved At-Grade Crossing

Alternative 1 (page 37) would not incorporate any station access modifications or significant construction. The sidewalks on the east and west sides of Rockville Pike would be widened and landscaping would be installed between the sidewalks and the roadway. The sidewalk area just west of the intersection would be enlarged to allow more pedestrians to gather and move more quickly across the street. The crosswalk itself would be widened and modified to include high visibility pavement markings. In the center of Rockville Pike, the median would be widened to 10 to 12 feet to provide a refuge for pedestrians in a staggered crossing, as shown on page 37. To facilitate this refuge area, the west curb line would be shifted westward, tapering back to the existing roadway as it extends from the intersection. This would require additional right-of-way from NIH and the Navy to ensure proper alignment of the intersection approaches. This work would need to be coordinated with nearby planned MDSHA projects and, in particular, the new southbound left-turn-lane from Rockville Pike to eastbound Jones Bridge Road.

A staggered crossing would create an opportunity for a two-stage pedestrian crossing in the future. MDSHA has indicated that they might be willing to consider a leading pedestrian interval (LPI) at this intersection, depending on pedestrian volumes. This would enable pedestrians to cross Rockville Pike prior to the westbound left-turning motorists. Such an arrangement would complement a staggered crossing.

If a two-stage pedestrian crossing of Rockville Pike was added, a railing would be needed to channelize pedestrians and provide a protected storage area. ADA requires a six-foot pedestrian pathway that is also clear of obstacles. Based on that requirement as well as design standards from other jurisdictions, a 10- to 12-foot wide median is needed. A more specific median width would be identified later during the design process. A pedestrian signal would be installed on the median that could someday allow permitted partial crossing to the refuge area.


FENCE TO BE RELOCATED
KISS & RIDE DROP-OFF
SIDEWALK: TIE TO EXISTING
OUTLINE OF METRO STATION
PLANTERS
PEDESTRIAN SIGNAL
PEDESTRIAN ISLAND AND SECURITY RAILING
SIDEWALK: TIE TO NIH PROJECT
RELOCATED CURBS
EXIST. ELEVATOR
+/- 122'
+/- 55'
+/- 36'
SOUTH WOOD ROAD
ROCKVILLE PIKE
SOUTH DRIVE
CENTER LINE OF TRACKS BELOW GRADE
RELOCATED CURBS
PLANTERS
PEDESTRIAN CROSSWALK
EXIST. MEDICAL CENTER NORTH VENT SHAFT CHAMBER (GRATING)
SITE PLAN- NEW ENTRANCE
0 10 20 40 60
NORTH
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
DATE BY DESCRIPTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DEPARTMENT OF TRANSIT SYSTEM DEVELOPMENT
OFFICE OF ENGINEERING & ARCHITECTURE
APPROVED
SUBMITTED
a joint venture of:
Parsons Transportation Group Inc.
Parson Brinckerhoff Quade & Douglas, Inc
Delon Hampton & Associates, Chartered
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 1 - NO BUILD
PLAN - EXISTING ENTRANCE
SCALE 1:40
DRAWING NO. ARQ-01

On the east side of Rockville Pike just south of the South Wood Road intersection, a Kiss & Ride drop-off would be created by relocating the curb approximately eight feet to the east. This would require moving the NNMC fence and adding a new sidewalk segment. The exact location of the Kiss & Ride would be determined during the design phase while considering the pros and cons of potential locations. For instance, the nearer it is to the intersection, the more difficulty motorists may have merging back into traffic, thereby potentially reducing usage. However, the farther it is from the intersection, the more likely pedestrians are to cross outside of the crosswalk.

Alternative 2: Elevator Entrance on East Side of Rockville Pike

Architectural Features

Alternative 2 (pages 39 - 42) would consist of the upgrades found in Alternative 1 with the addition of three high-speed elevators on the east side of Rockville Pike connecting directly to the mezzanine level of Medical Center station via a short pedestrian passageway. These elevators would be set back from Rockville Pike about 25 feet into the NNMC property and would include an emergency stairway from the station below, per NFPA 130. A new sidewalk would connect the elevators to the intersection and the new Kiss & Ride drop-off. The NNMC fence would be moved behind the elevators and stairway hatch to allow WMATA access to service the facility without going on NNMC property. A new Metro pylon would also be added on the east side of the street.

The new east-side shaft would extend downward approximately 105 feet, and would contain three elevators, a 10-foot-wide stairway, and a vent shaft. At the bottom of the shaft, a horizontal tunnel would be mined to the station, which would become the pedestrian passageway. Once the shaft and tunnel are complete, an opening would be made into the station structure for the connection.

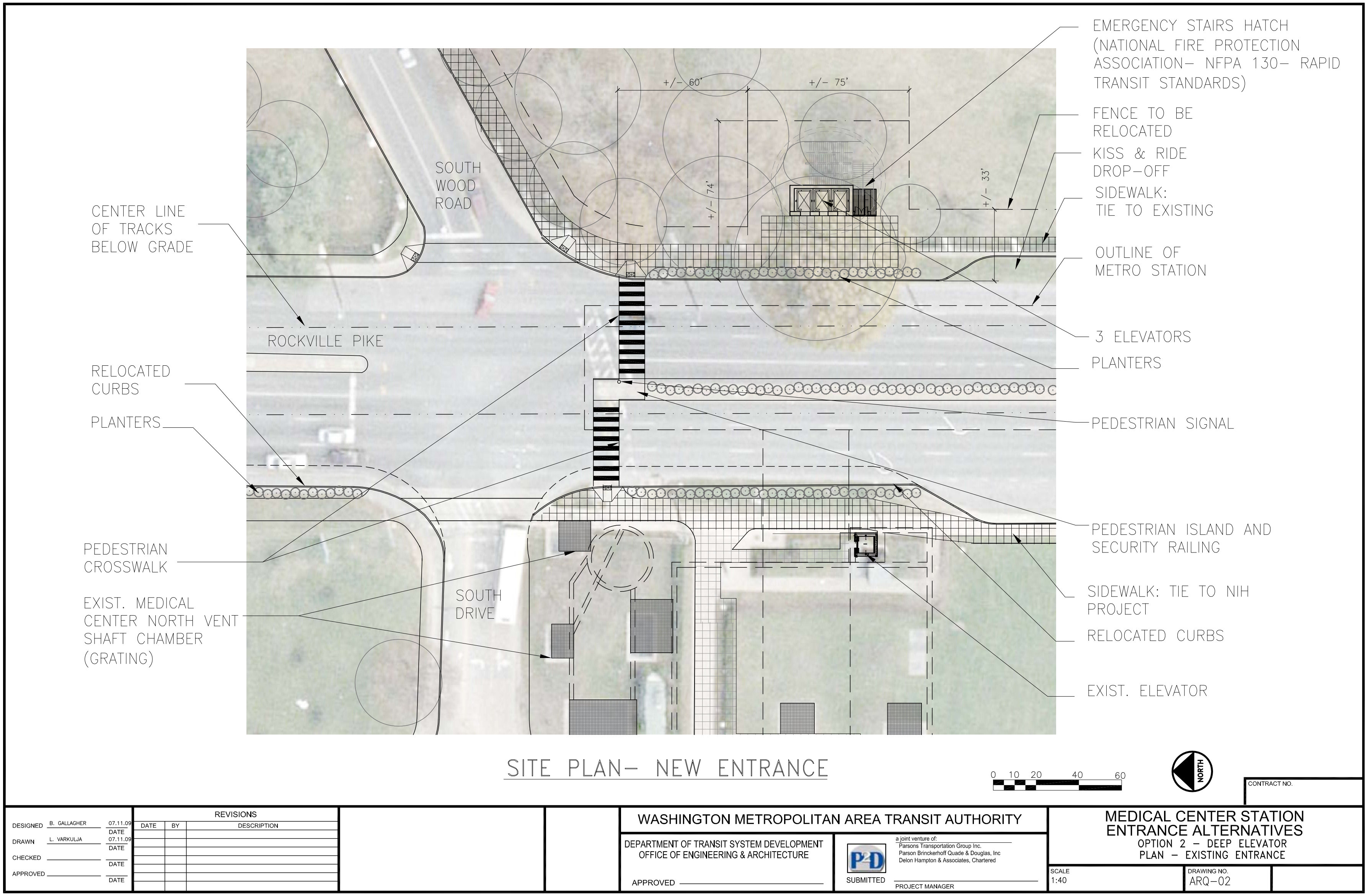
At the mezzanine level, a new passageway would be created by removing a section of the existing curved passage just north of the train room. The area would take a small section of the existing mechanical room, which is not occupied with equipment but does contain some piping and conduits. This location allows the creation of a new "portal" through the station structure without going through the station vault, which is more difficult due to the existing architectural finish. The wall would be penetrated with two 10 foot openings (or doorways) separated by an approximately four foot pillar to keep the structural work to a minimum. These doorways would each have a pair of five-foot-wide doors that would be held open with an electronic switch. If there is an emergency, the doors would close automatically, although patrons could push them open by hand to enter the elevator passageway.

This new passageway would function as an ADA AORA (Area of Rescue Assistance) for the patrons of the station, and would be designed per ADA regulations. ADA requires a "safe area" to be sized to hold one person in a wheelchair for every 200 people in the station. One wheelchair is defined as 36 inches by 48 inches or 12 square feet. This room would be approximately 1,000 square feet, which would hold approximately 82 wheelchairs. This number is well above what is required for the station capacity.

This passage would continue to the elevators and would have a "vaulted ceiling" with the standard curved base and handrails. Quarry tile would be used on the floor to match the existing station flooring. The walls would be exposed concrete and standard WMATA acoustic tiles would be placed on the ceiling. Recessed lighting would be located in the acoustic panels and an up and down "cove" light would be used along the walls to illuminate the surfaces of the space. The passage leads to the elevator doors, to an emergency stair exit, and to a mechanical room located under the stairs.

The mechanical room is needed to provide outdoor air in the passage and create positive pressure to keep smoke from passing from the train room into the space. The emergency stairs would be ten feet wide with a center handrail to meet International Building Code and NFPA 130 requirements. The stair would also be pressurized to provide positive pressure and keep smoke from entering.

A new 12 foot by 12 foot elevator machine room would be created in the existing mezzanine and would be adjacent to the existing mechanical room. The entry door would be directly off the new passageway. This room is


EMERGENCY STAIRS HATCH (NATIONAL FIRE PROTECTION ASSOCIATION– NFPA 130– RAPID TRANSIT STANDARDS)
FENCE TO BE RELOCATED
KISS & RIDE DROP–OFF
SIDEWALK: TIE TO EXISTING
OUTLINE OF METRO STATION
3 ELEVATORS
PLANTERS
PEDESTRIAN SIGNAL
PEDESTRIAN ISLAND AND SECURITY RAILING
SIDEWALK: TIE TO NIH PROJECT
RELOCATED CURBS
EXIST. ELEVATOR
CENTER LINE OF TRACKS BELOW GRADE
RELOCATED CURBS
PLANTERS
PEDESTRIAN CROSSWALK
EXIST. MEDICAL CENTER NORTH VENT SHAFT CHAMBER (GRATING)
SOUTH WOOD ROAD
ROCKVILLE PIKE
SOUTH DRIVE
+/– 60'
+/– 75'
+/– 74'
+/– 33'
SITE PLAN– NEW ENTRANCE
0 10 20 40 60
NORTH
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09
DRAWN L. VARKULJA 07.11.09
CHECKED
APPROVED
DATE
REVISIONS
DATE BY DESCRIPTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DEPARTMENT OF TRANSIT SYSTEM DEVELOPMENT
OFFICE OF ENGINEERING & ARCHITECTURE
APPROVED
a joint venture of:
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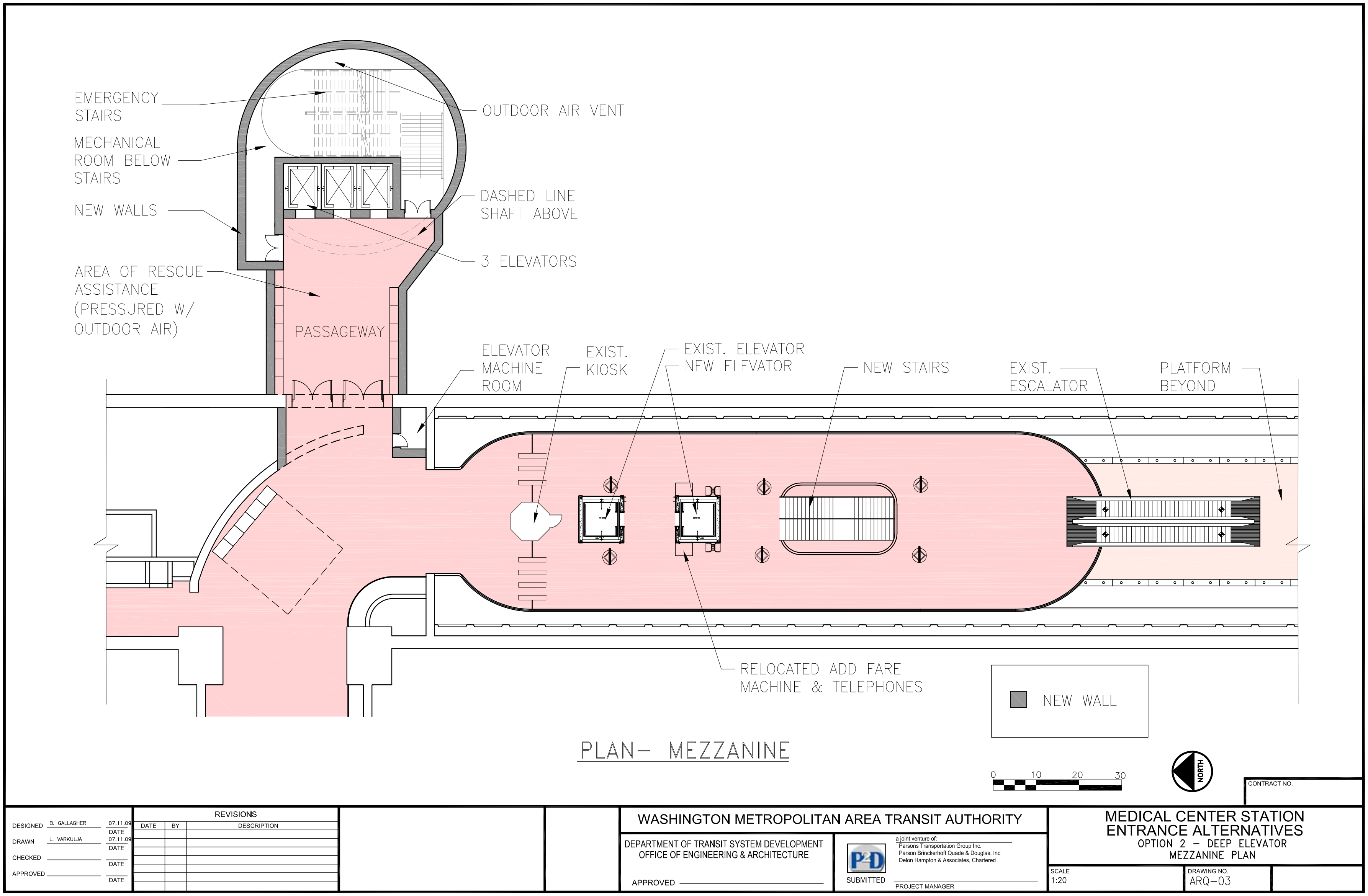
Delon Hampton & Associates, Chartered
SUBMITTED
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 2 – DEEP ELEVATOR
PLAN – EXISTING ENTRANCE
SCALE 1:40
DRAWING NO. ARQ–02


EMERGENCY STAIRS
MECHANICAL ROOM BELOW STAIRS
NEW WALLS
AREA OF RESCUE ASSISTANCE (PRESSURED W/ OUTDOOR AIR)
OUTDOOR AIR VENT
DASHED LINE SHAFT ABOVE
3 ELEVATORS
PASSAGEWAY
ELEVATOR MACHINE ROOM
EXIST. KIOSK
EXIST. ELEVATOR
NEW ELEVATOR
NEW STAIRS
EXIST. ESCALATOR
PLATFORM BEYOND
RELOCATED ADD FARE MACHINE & TELEPHONES
NEW WALL
PLAN- MEZZANINE
0
10
20
30
NORTH
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
DATE
BY
DESCRIPTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DEPARTMENT OF TRANSIT SYSTEM DEVELOPMENT
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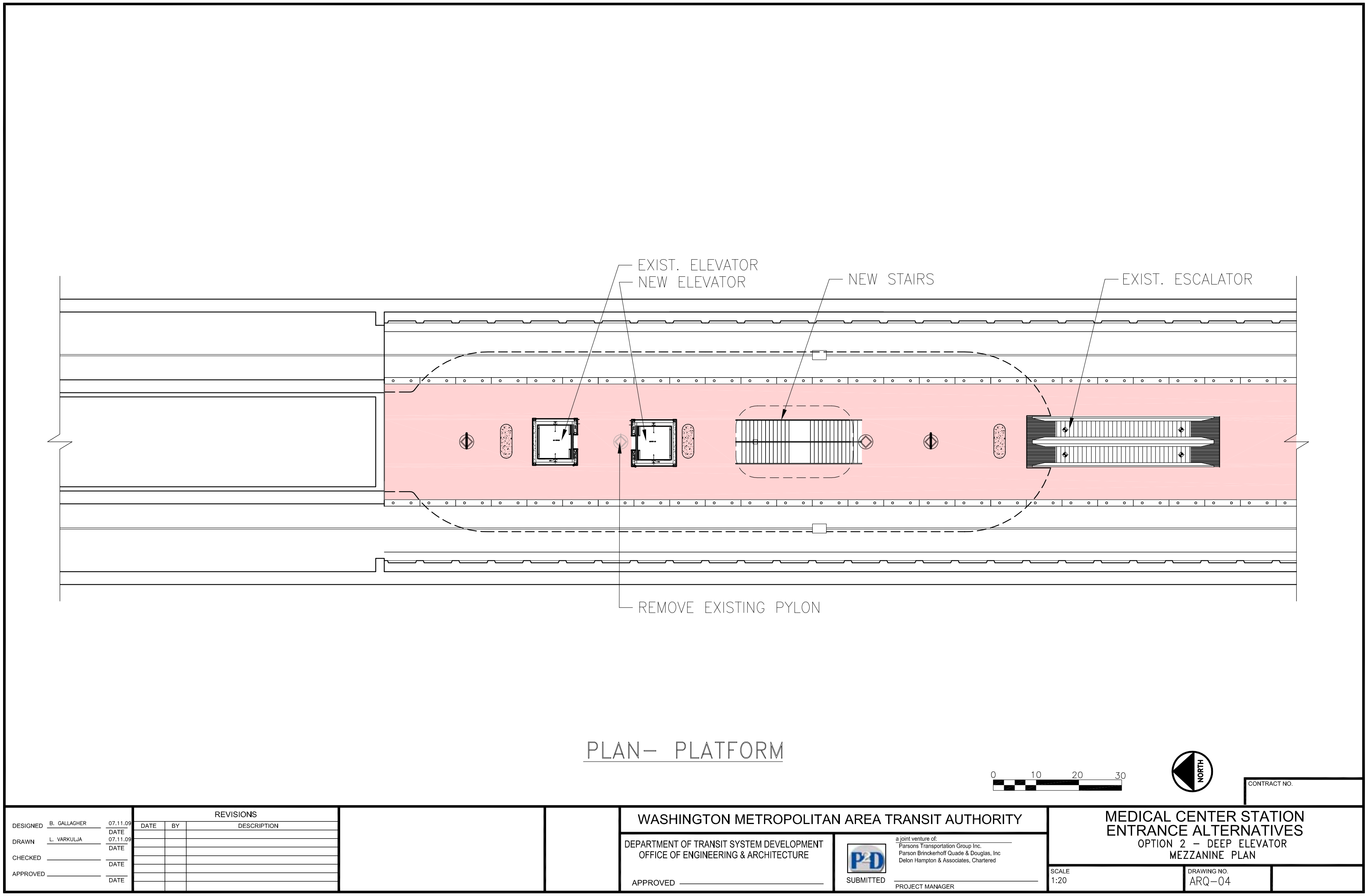
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 2 – DEEP ELEVATOR
MEZZANINE PLAN
SCALE
1:20
DRAWING NO.
ARQ-03


EXIST. ELEVATOR
NEW ELEVATOR
NEW STAIRS
EXIST. ESCALATOR
REMOVE EXISTING PYLON
PLAN– PLATFORM
0 10 20 30
NORTH
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
DATE BY DESCRIPTION
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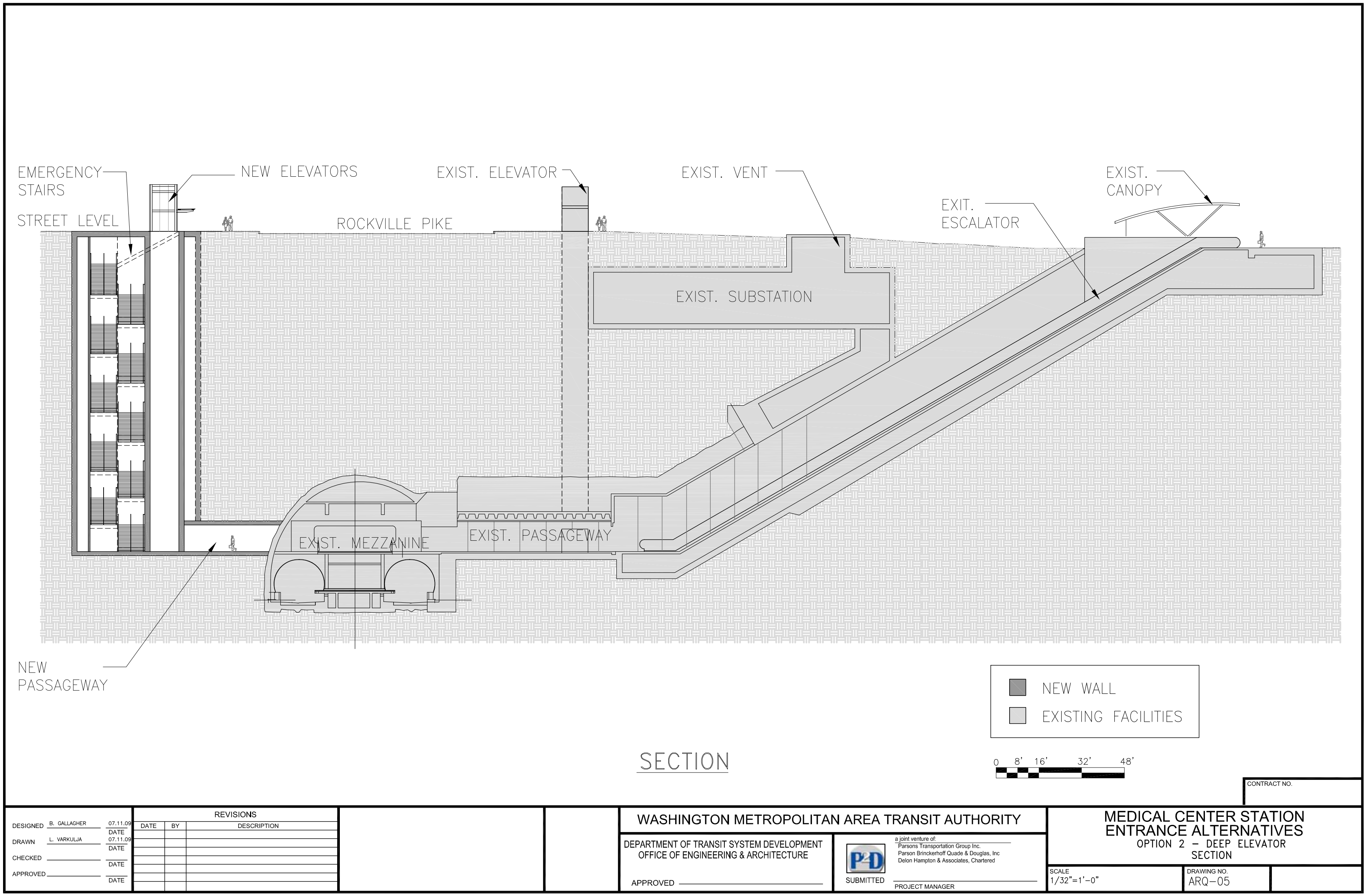
SUBMITTED
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 2 – DEEP ELEVATOR
MEZZANINE PLAN
SCALE
1:20
DRAWING NO.
ARQ–04


EMERGENCY STAIRS
NEW ELEVATORS
EXIST. ELEVATOR
EXIST. VENT
EXIT. ESCALATOR
EXIST. CANOPY
STREET LEVEL
ROCKVILLE PIKE
EXIST. SUBSTATION
EXIST. MEZZANINE
EXIST. PASSAGEWAY
NEW PASSAGEWAY
NEW WALL
EXISTING FACILITIES
SECTION
0 8' 16' 32' 48'
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
DATE BY DESCRIPTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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SUBMITTED
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 2 – DEEP ELEVATOR
SECTION
SCALE 1/32"=1'-0"
DRAWING NO. ARQ-05

required for the new mezzanine-platform elevator.

In the train room a new elevator would be added connecting the mezzanine and the platform. This is located near the existing elevator and the two would face each other as this is best for patrons waiting for the elevator. The new elevator would require moving the add fare machines, telephones, and map case. They would be located along the side of the new elevator – one on each side. A new 10-foot-wide stair with an intermediate handrail would be inserted into the existing opening between the mezzanine and platform. The stairway would be the standard granite steps and handrails. This helps egress calculations from the station along with the new emergency stairs in the elevator shaft.

The new elevator on the platform would require the removal of one platform pylon next to the elevator door opening. This may result in a loss of air conditioning; the equipment could be relocated to the ceiling under the mezzanine where there are existing air-conditioning ducts.

Structural Features

General Construction
Construction of the new east entrance would require the excavation of a vertical access shaft located on the east side of Rockville Pike and excavation of a horizontal tunnel from the bottom of the shaft to the existing north service area tunnel structure. Demolition of the existing east wall of the north service area tunnel structure would provide access from the new tunnel to the existing mezzanine level of the station. A shaft approximately 40 feet by 50 feet wide is required to accommodate the proposed elevators, stairway, and vents. The tunnel excavation would be approximately 14 feet high, 30 feet wide, and 30 feet long.

The top 20 to 35 feet of excavation would be in sandy soil materials or weathered rock. The lower 80 feet of excavation would be in sound rock (quartz diorite-gneiss). If blasting is required while excavating the lower portion of the shaft, vibrations would be monitored to ensure that the structural integrity of the existing facilities is maintained. An existing condition survey of local structures and utilities would be performed prior to any construction activities to set a baseline for determining any potential damage to surrounding structures or facilities.

Figure 21: Passengers Exiting Medical Center Station
Source: ChrisDag/Flickr CC

Although groundwater should not pose a problem during construction activities, runoff of stormwater would need to be addressed during design and construction. In addition, depending on the season, frost heave of the surficial soils would also be a concern.

North Service Area
At the mezzanine level, access for the new passageway would require structure demolition of a 22 foot wide by 10 foot high opening in the east exterior wall of the north service area tunnel. The exterior tunnel wall consists of W14x61 steel ribs spaced at 5 foot on-center encased in shotcrete. The new wall opening would require the design of a structural frame to support the load in the steel ribs that would be cut.

The interior curved eight-inch thick concrete wall frames into the mezzanine ceiling concrete beam/slab. Final design should confirm the construction sequence for the demolition and construction of mezzanine passageway walls. Existing utilities penetrate the top of the wall and should be supported or relocated. New passageway walls may be located as shown for the proposed mezzanine layout. The top of slab elevation between the exterior wall and the interior curved wall is a few inches higher than the top of slab elevation in the mezzanine passageway and may require milling to make room for the tile flooring.

Figure 22: Medical Center Arrival Display
Source: Schumin Web Transit Center

New Elevator and Stair Shaft
Support of excavation for the new vertical shaft would be required for the sand and weathered rock located within approximately the top 30 feet of the proposed shaft. Excavation below this level into sound rock (quartz diorite-gneiss) would require an initial liner consisting of shotcrete and rock bolts to support construction loads. An interior final concrete liner would be designed to support the final loading. The interior elevator shaft and vent walls may be cast-in-place concrete. Stair landings and stairways may be either cast-in-place or precast concrete. Construction activities on the east side of Rockville Pike would require an adjacent construction staging area. Its dimensions would be identified during the engineering and design phase.

At the mezzanine level, the 14 foot high by 30 foot wide by 30 foot long tunnel from the bottom of the shaft to the north service room would also consist of a rock bolt and shotcrete initial liner and a final cast-in-place concrete liner. This tunnel would be constructed using typical blasting and pre-splitting excavation methods. Stability of the rock at this depth should not be an issue during construction.

Mechanical Features
Machine rooms for the mezzanine to surface traction elevators would be located above the hoistway. The resulting hoistway structure would extend above the surface to a height of approximately 25 feet. In addition, the machine room footprint would need to accommodate an access stairway as required by code. Air conditioning and heating would be provided for the elevator machine room. WMATA criteria do not discuss machine room air conditioning and continue to require machine room ventilation. Air conditioning provides a more suitable environment for electronic components and a variance to criteria is warranted in this case.

Based on past practice, platform to mezzanine hydraulic elevators were served by a machine room located below the platform. However, this configuration is discouraged by WMATA criteria and would result in extensive modifications to the existing station structure beyond those required to accommodate the new elevator pit. Another option involves the use of a remote machine room. In this case, a minimum 12 foot by 12 foot by 9 foot space is necessary to house elevator equipment. As previously described, this would be located in the existing mezzanine. Hydraulic piping would need to be routed between the elevator pit and the selected machine room location. Existing platform and mezzanine air conditioning system ducts would also require reconfiguration in either case.

Providing access to the new mezzanine level elevator lobby would require modifications to the existing station mezzanine air conditioning system. These modifications consist of relocating existing mezzanine air conditioning unit ACU-3 and reconfiguring the associated ductwork. Due to the apparent age and condition of this equipment item, a new unit should be provided per current WMATA criteria.

The elevator lobby would also serve as an ADA required AORA. Per WMATA criteria, this space requires a pressurization system with an outside air intake. Mechanical equipment room space and a shaft terminating at the surface are required. Area drains would be provided for shafts. Elevator and escalator pit drainage would be provided in accordance with local building codes and environmental regulations. Due to potential problems associated with connecting to the existing station drainage systems, sump pumps may be necessary if gravity drainage is not feasible.

Electrical Features
New electrical circuits to provide power to lights, emergency lights and mechanical equipment would be required. Electrical distribution equipment would be required in each of the elevator machine rooms. Electrical circuits installed in conduits would

run from the nearest source of power in the existing passenger station AC switchgear rooms. Some modifications would be required in the AC switchgear rooms such as adding new circuit breakers, evaluating the impact of adding new loads on the existing equipment and increasing the size of the uninterruptible power supply (UPS) where necessary. Conduits would be concealed or embedded wherever feasible.

Existing conduits that either stub up or pass through the area affected by the new passageway would have to be rerouted. These are shown on the existing station drawings.

System Features

Closed-Circuit Television (CCTV) cameras to monitor elevator access would be required. Existing mezzanine CCTV cameras may need to be relocated to coordinate with the new fare machine layout. Conduits/cables would be required between these cameras and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the station kiosk.

Intrusion devices on all elevator machine room access doors would be required. Conduits/cables would be required between these devices and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the station kiosk.

Fire alarm devices associated with elevator equipment would be required. Conduits/cables would be required between these devices and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the station kiosk. New passageway doors would be held open in normal operating mode, but released during fire mode.

Existing Passenger Information Display System (PIDS) may need to be relocated to coordinate with the new passageway. Conduits/cables would be required between these displays and the corresponding communication room. Public address speakers would be required in the new passageway. Conduits/cables would be required between the speakers and the corresponding communication room.

A two-way communication system would be required in the AORA. Conduits/cables would be required between this system and the corresponding communication room. Additional conduits/cable may be required to go from the communication room to the passenger station kiosk.

Modifications to the existing station kiosk to accommodate additional elevators, CCTV cameras, intrusion, fire and communication equipment would be required.

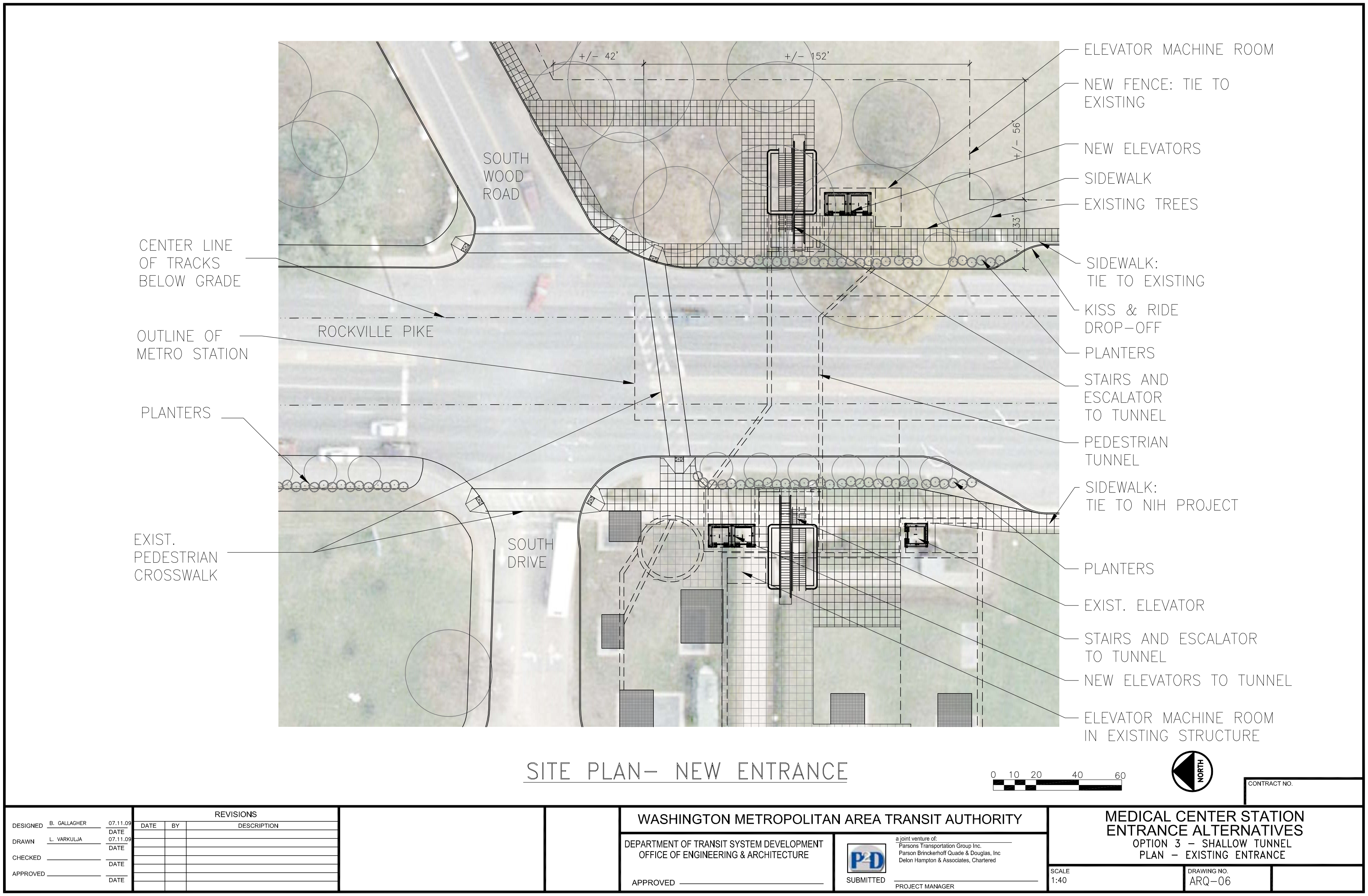
Alternative 3: Shallow Pedestrian Tunnel Underneath Rockville Pike

Architectural Features

Alternative 3 (pages 46 and 47) would not incorporate any elements of Alternative 1 or 2 except the addition of the Kiss & Ride Drop-Off on the east side of Rockville Pike and the new sidewalk leading from there to the intersection. Alternative 3 is a shallow tunnel connecting both sides of Rockville Pike with an up escalator, a ten foot wide stair with center handrail, a bicycle ramp, and two elevators on each side. The stairway would be WMATA standard granite with stainless steel handrails and would include a narrow bicycle ramp along the side. A standard entry canopy would be located over both entrances. A Metro pylon would be added to the east side of the street. To lower the cost of this alternative, it might be possible to eliminate one of the elevators and the escalator at each end, but this would need further consideration. Additionally, if the escalator was eliminated, an entry canopy would no longer be required per WMATA standards.

Project stakeholders have suggested adding amenities to the tunnel such as a moving walkway, a Public Information Display System (PIDS) showing train arrival times, and retail kiosks. While these elements are not included in the design or cost at this time, if desired, they could be added as the project progresses. Other future tunnel considerations include adequate lighting and proper maintenance to ensure cleanliness.

On the east side of Rockville Pike the escalator and stairs would come up in the existing NNMC site facing away from the road. This requires a new sidewalk in front of the stairway/escalator that extends north through the NNMC site to the existing gate house. The elevators would face the roadway since there would be people coming from all directions to circulate near the road. The


ELEVATOR MACHINE ROOM
NEW FENCE: TIE TO EXISTING
NEW ELEVATORS
SIDEWALK
EXISTING TREES
SIDEWALK: TIE TO EXISTING
KISS & RIDE DROP–OFF
PLANTERS
STAIRS AND ESCALATOR TO TUNNEL
PEDESTRIAN TUNNEL
SIDEWALK: TIE TO NIH PROJECT
PLANTERS
EXIST. ELEVATOR
STAIRS AND ESCALATOR TO TUNNEL
NEW ELEVATORS TO TUNNEL
ELEVATOR MACHINE ROOM IN EXISTING STRUCTURE
CENTER LINE OF TRACKS BELOW GRADE
OUTLINE OF METRO STATION
PLANTERS
EXIST. PEDESTRIAN CROSSWALK
SOUTH WOOD ROAD
ROCKVILLE PIKE
SOUTH DRIVE
+/- 42'
+/- 152'
+/- 56'
+/- 33'
SITE PLAN– NEW ENTRANCE
0 10 20 40 60
NORTH
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
DATE BY DESCRIPTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DEPARTMENT OF TRANSIT SYSTEM DEVELOPMENT
OFFICE OF ENGINEERING & ARCHITECTURE
APPROVED
a joint venture of:
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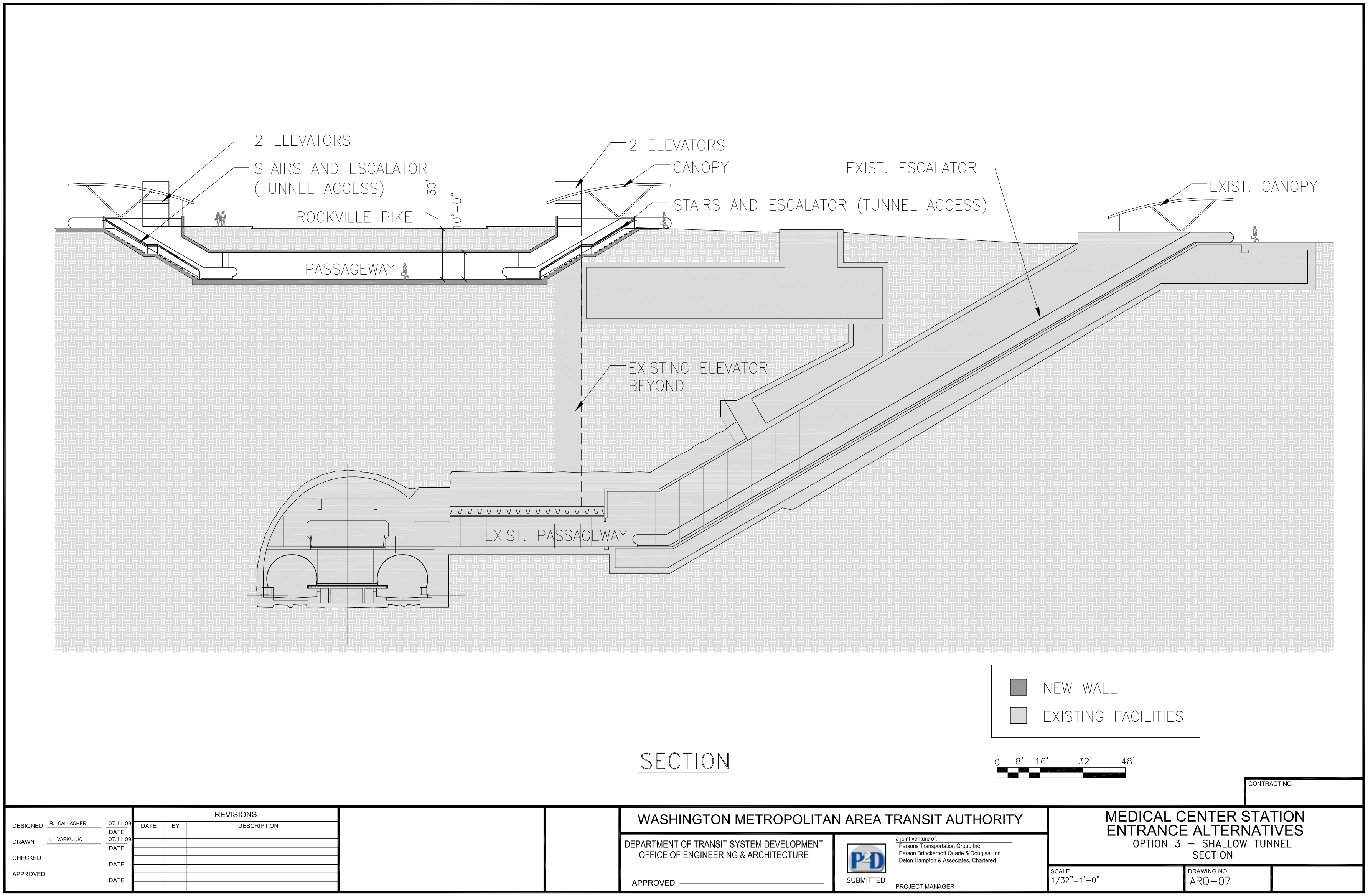
Delon Hampton & Associates, Chartered
SUBMITTED
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 3 – SHALLOW TUNNEL
PLAN – EXISTING ENTRANCE
SCALE 1:40
DRAWING NO. ARQ–06


2 ELEVATORS
STAIRS AND ESCALATOR (TUNNEL ACCESS)
ROCKVILLE PIKE
+/- 30'
10'-0"
PASSAGEWAY
2 ELEVATORS
CANOPY
STAIRS AND ESCALATOR (TUNNEL ACCESS)
EXIST. ESCALATOR
EXIST. CANOPY
EXISTING ELEVATOR BEYOND
EXIST. PASSAGEWAY
NEW WALL
EXISTING FACILITIES
SECTION
0 8' 16' 32' 48'
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
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DATE BY DESCRIPTION
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PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 3 - SHALLOW TUNNEL
SECTION
SCALE
1/32"=1'-0"
DRAWING NO.
ARQ-07

portal for the stairway/escalator and the elevators are all set back approximately 25 feet from Rockville Pike. The entire area would require moving the NNMC fence to the east and extending around to the gate house. The existing sidewalk, south of the pedestrian tunnel entrance, on the east side of Rockville Pike would be maintained but not improved.

The west side of the street is more complicated due to the existing underground structures including a substation, the station vent shaft and the escalator passage from the station. The new stairway and escalator are situated to fit just east of the substation and the stair/escalator portal and the elevators are located approximately 25 feet back from Rockville Pike. The elevators are tucked in between the vent shaft and the substation. There may be services in this area that would have to be relocated to fit in the elevators, although these are not visible on the existing plans.

The tunnel can be constructed by two methods—cut-and-cover or mined. The cut-and-cover tunnel could be approximately 19 feet deep and would be a box shape with exposed concrete structure and have a standard WMATA curved base with handrails and curved ceiling cove approximately 22 feet wide. A flat ceiling would be covered with acoustic panels and recessed lighting. Quarry tiles would be used for the flooring with drains at each end to prevent flooding during heavy rains. The mined tunnel, shown on pages 47 and 52, would be deeper, up to 30 feet deep, and have a natural curved ceiling with curved acoustic panels. The base would be a rounded cove base with the standard handrails and a quarry tile floors with the same drains at the ends. Cove lighting is directed both up and down continuously along the length of the tunnel. The lighting is located between the ceiling tiles and the concrete lining used as the finish wall surface.

The pedestrian tunnel is a stand alone solution and does not connect to the existing Metrorail station.

Structural Features

The new pedestrian tunnel would be located between 70 to 80 feet above the existing trainroom and escalatorway depending on the construction method. The west end of the new pedestrian tunnel would be constructed directly over and supported by the east end of the existing cast-in-place concrete substation. The stairway loading on the existing substation structure should be less than the existing earth overburden.

If the pedestrian tunnel under Rockville Pike was constructed using a cut-and-cover method, staged construction and temporary roadway bridging to minimize lane closures would be utilized. If this method was used, it may be prudent to include additional duct banks or utility chases for future build outs or improvements to the facility.

The tunnel would be 20 foot wide at the center, expanding to over 50 foot wide at each end, and would be located at a depth of nine feet below the existing roadway. Temporary shoring would be required to limit the extent of the excavation. In addition, a temporary abutment would be constructed to provide support for temporary roadway bridging. The box tunnel structure may be cast-in-place concrete. The use of precast concrete box sections assembled on site may reduce the construction duration considerably. Since Rockville Pike is a major traffic corridor, construction would be sequenced to minimize the impact to traffic.

An alternate means of constructing the pedestrian tunnel would be mined using either traditional TBMs or a series of smaller diameter horizontal shafts installed in a secant wall type configuration around the perimeter of the excavation with a TBM. The excavation for the 12 foot high by 25 foot wide pedestrian tunnel would be located completely in the sand layer. Construction utilizing a tunneling method may require injection grouting of the sandy soil and weathered rock layers beneath Rockville Pike to improve the existing soil and prevent settlement of the existing roadway during construction of the proposed tunnel.

Although the cost of this method is greater than the cut-and-cover operation, there would be minimal disturbance to the existing traffic pattern and the surrounding businesses Temporary support of utilities would be required during construction of the pedestrian tunnel under Rockville Pike. A study should be performed to determine the location of all underground and overhead utilities, including abandoned utilities that may conflict the new construction.

Mechanical Features

Machine room space sized to serve two elevators would be required at each end of the tunnel. Air conditioning and heating would be provided for the elevator machine rooms. The east one would be underground next to the elevators and accessed from the pedestrian tunnel. The west machine room could be located at the edge of the existing substation and accessed from the air intake vent shaft next to the substation.

Space is required to house the escalator control panels. The required space must be sized to provide electrical code mandated clearances and be located behind a lockable door.

A dry standpipe system would be provided in the pedestrian tunnel with angle hose valves located in the vicinity of each exit and an additional angle hose valve located at the approximate center of the walkway. This system would consist of an entirely separate dry standpipe system.

Elevator pit, escalator pit, and pedestrian tunnel drainage would be provided in accordance with local building codes and environmental regulations. Sump pumps may be necessary to complete connections to the existing drainage system.

Electrical Features

As described for Alternative 2, new electrical circuits and distribution equipment would be required for the elevators and escalators, and modifications would be required in the AC switchgear rooms.

System Features

This alternative would have the same system requirements as Alternative 2, without the PIDS relocation, public address speakers, or two-way communication system in the AORA.

Alternative 4: Shallow Pedestrian Tunnel and Deep Elevator Entrance on East Side of Rockville Pike

Architectural Features

Alternative 4 (pages 50 - 52) is a combination of Alternatives 2 and 3 without the upgraded crosswalk. This alternative is comprised of the east-side Kiss & Ride, three east-side high-speed elevators connecting the station mezzanine to the pedestrian tunnel and to the surface, and a pedestrian tunnel.

To make Alternative 4 convenient for pedestrians, the pedestrian tunnel would shift south on the east side of Rockville Pike to line up with the high speed elevators coming up from the station mezzanine. The elevators would have an additional stop at the pedestrian tunnel level. The tunnel would angle across the street, slightly extending the length but reducing the overall costs due to sharing the elevators on the east side. The west side of the pedestrian tunnel would remain the same as Alternative 3. The deep elevator features of Alternative 2 would be the same for this alternative, with the exception of an additional elevator stop at the pedestrian tunnel level.

Structural Features

This alternative would have the same structural requirements as Alternatives 2 and 3 combined.

Mechanical Features

This alternative would have the same mechanical requirements as Alternatives 2 and 3 combined.

Electrical Features

This alternative would have the same electrical requirements as Alternatives 2 and 3 combined.

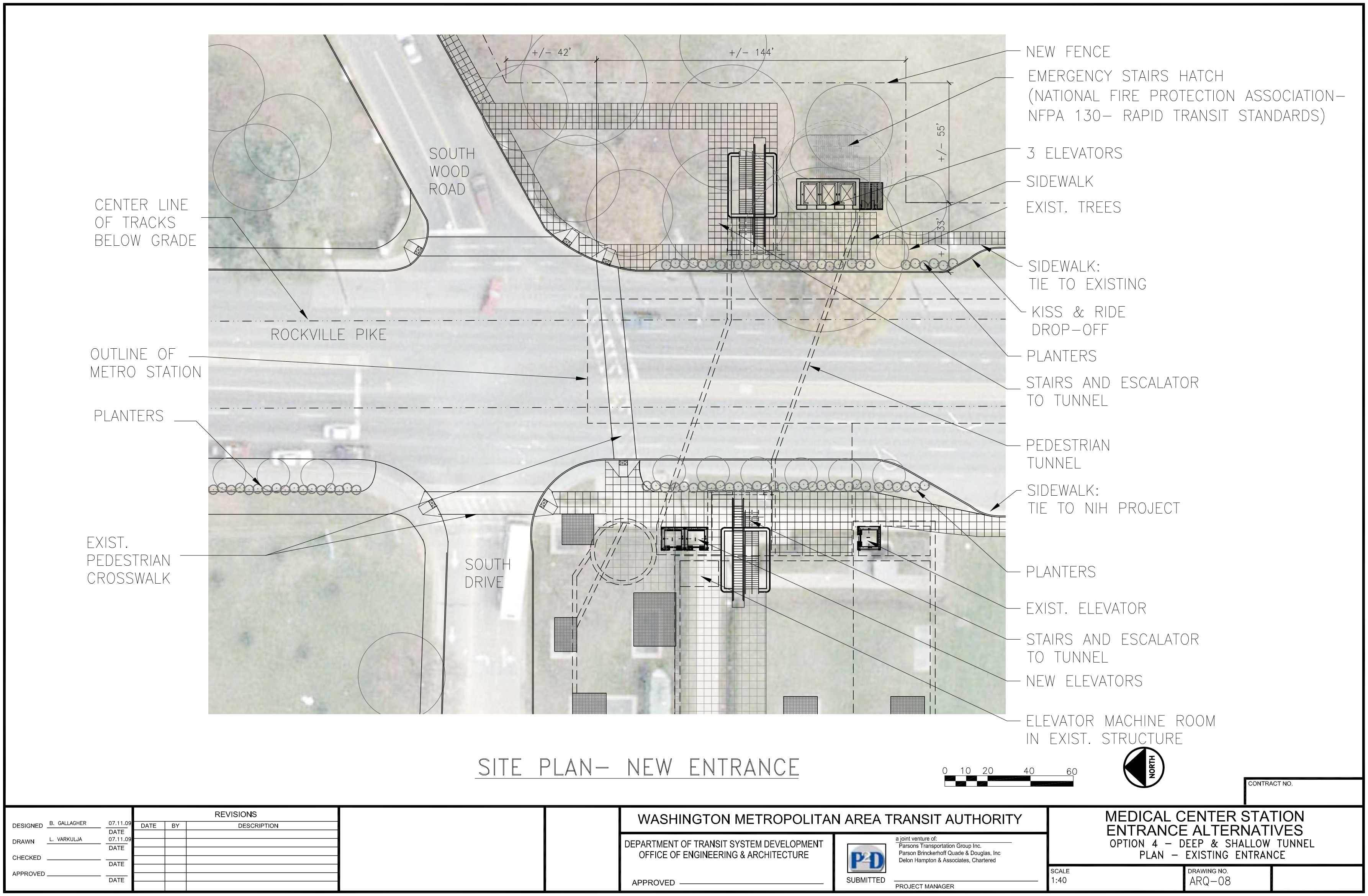
System Features

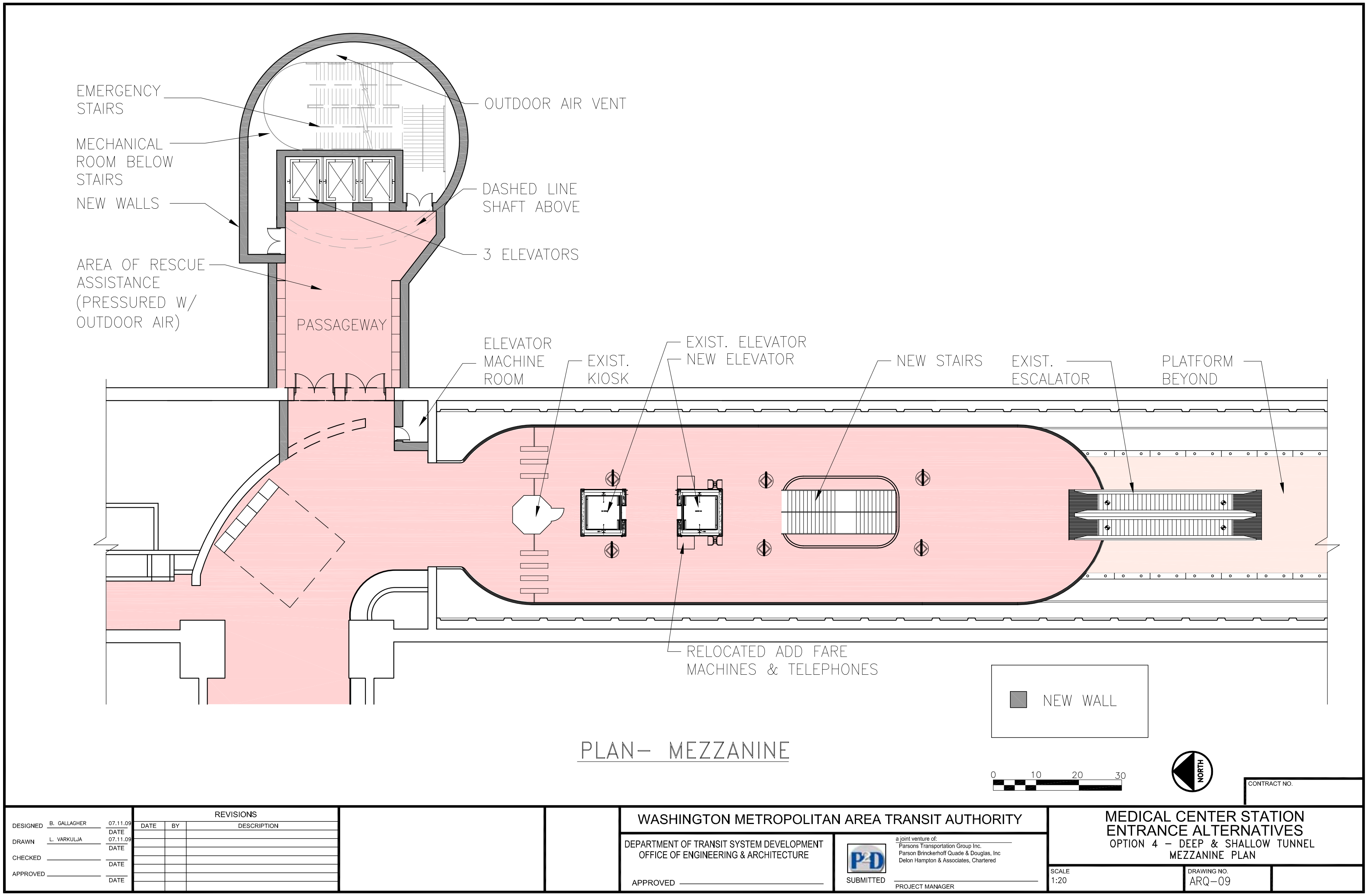
This alternative would have the same system requirements as Alternative 2.

Alternative 5: Pedestrian Bridge over Rockville Pike

Architectural Features

The pedestrian bridge of Alternative 5 (pages 53 and 54) would consist of a stair/escalator and two elevators on each side of the street. The stairway would be 10 feet wide with a center handrail. The existing Rockville Pike crosswalk would remain but without improvement. On the east side, the stair/escalator extends toward the entrance gate to NNMC inside the existing fenced area. The fence would be moved to the east to keep all pedestrian circulation in the public area. The elevators would be located to the south and new sidewalks would connect to the Kiss & Ride and to the NNMC entrance near the gate house. Landscaping would be planted between the new sidewalk and the roadway.


NEW FENCE
EMERGENCY STAIRS HATCH (NATIONAL FIRE PROTECTION ASSOCIATION– NFPA 130– RAPID TRANSIT STANDARDS)
3 ELEVATORS
SIDEWALK
EXIST. TREES
SIDEWALK: TIE TO EXISTING
KISS & RIDE DROP–OFF
PLANTERS
STAIRS AND ESCALATOR TO TUNNEL
PEDESTRIAN TUNNEL
SIDEWALK: TIE TO NIH PROJECT
PLANTERS
EXIST. ELEVATOR
STAIRS AND ESCALATOR TO TUNNEL
NEW ELEVATORS
ELEVATOR MACHINE ROOM IN EXIST. STRUCTURE
CENTER LINE OF TRACKS BELOW GRADE
OUTLINE OF METRO STATION
PLANTERS
EXIST. PEDESTRIAN CROSSWALK
SOUTH WOOD ROAD
ROCKVILLE PIKE
SOUTH DRIVE
+/– 42'
+/– 144'
+/– 55'
+/– 33'
SITE PLAN– NEW ENTRANCE
0 10 20 40 60
NORTH
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
DATE BY DESCRIPTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
DEPARTMENT OF TRANSIT SYSTEM DEVELOPMENT
OFFICE OF ENGINEERING & ARCHITECTURE
APPROVED
a joint venture of:
Parsons Transportation Group Inc.
Parson Brinckerhoff Quade & Douglas, Inc
Delon Hampton & Associates, Chartered
SUBMITTED
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 4 – DEEP & SHALLOW TUNNEL
PLAN – EXISTING ENTRANCE
SCALE 1:40
DRAWING NO. ARQ–08


EMERGENCY STAIRS
MECHANICAL ROOM BELOW STAIRS
NEW WALLS
AREA OF RESCUE ASSISTANCE (PRESSURED W/ OUTDOOR AIR)
OUTDOOR AIR VENT
DASHED LINE SHAFT ABOVE
3 ELEVATORS
PASSAGEWAY
ELEVATOR MACHINE ROOM
EXIST. KIOSK
EXIST. ELEVATOR
NEW ELEVATOR
NEW STAIRS
EXIST. ESCALATOR
PLATFORM BEYOND
RELOCATED ADD FARE MACHINES & TELEPHONES
NEW WALL
PLAN– MEZZANINE
0 10 20 30
NORTH
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
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WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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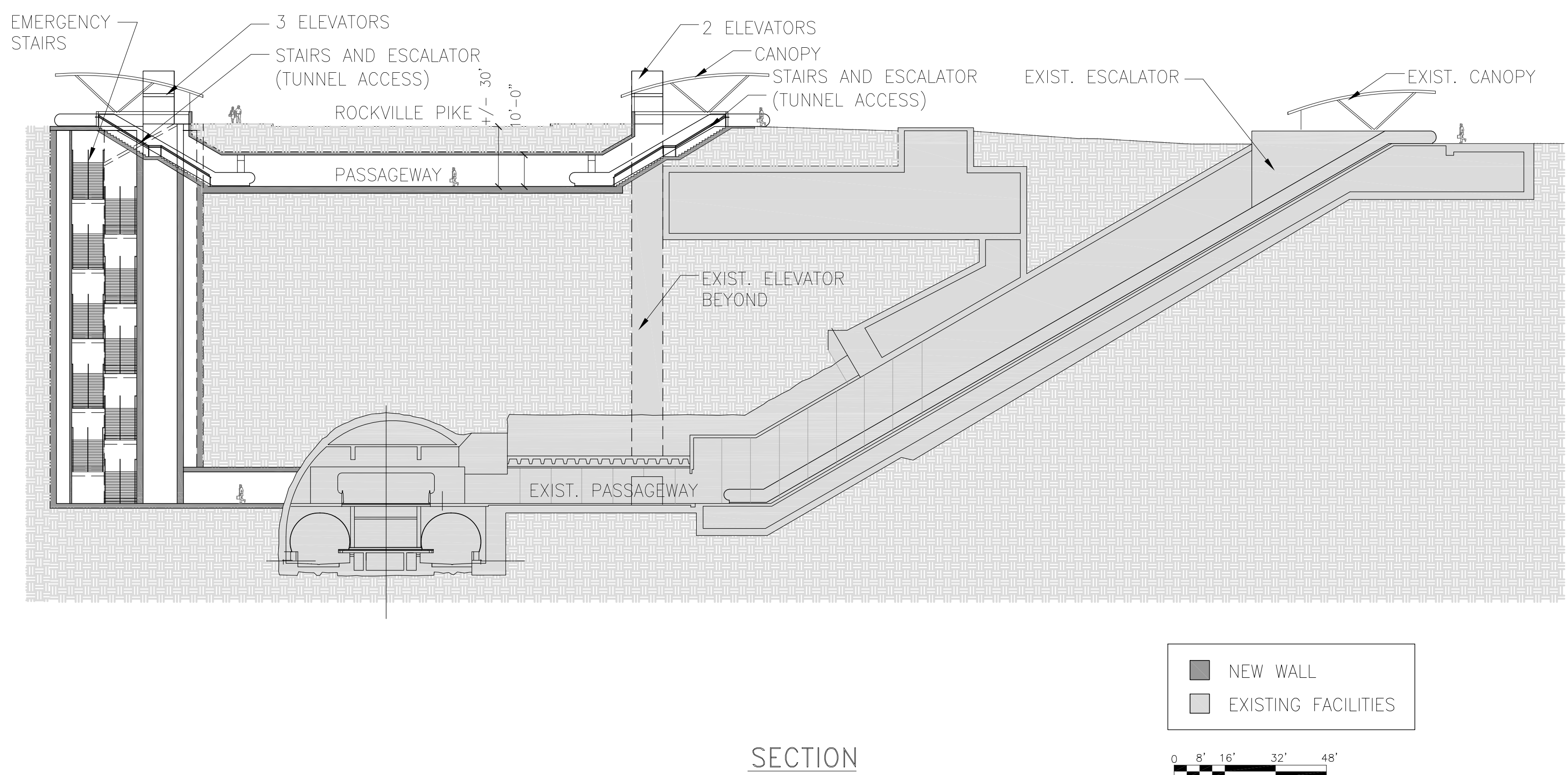
SUBMITTED
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 4 – DEEP & SHALLOW TUNNEL
MEZZANINE PLAN
SCALE 1:20
DRAWING NO. ARQ–09



SECTION

DESIGNED	B. GALLAGHER	07.11.09	DATE
DRAWN	L. VARKULJA	07.11.09	DATE
CHECKED			DATE
APPROVED			DATE

REVISIONS

DATE	BY	DESCRIPTION

CONTRACT NO.

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

DEPARTMENT OF TRANSIT SYSTEM DEVELOPMENT
OFFICE OF ENGINEERING & ARCHITECTURE

APPROVED

P2D

SUBMITTED

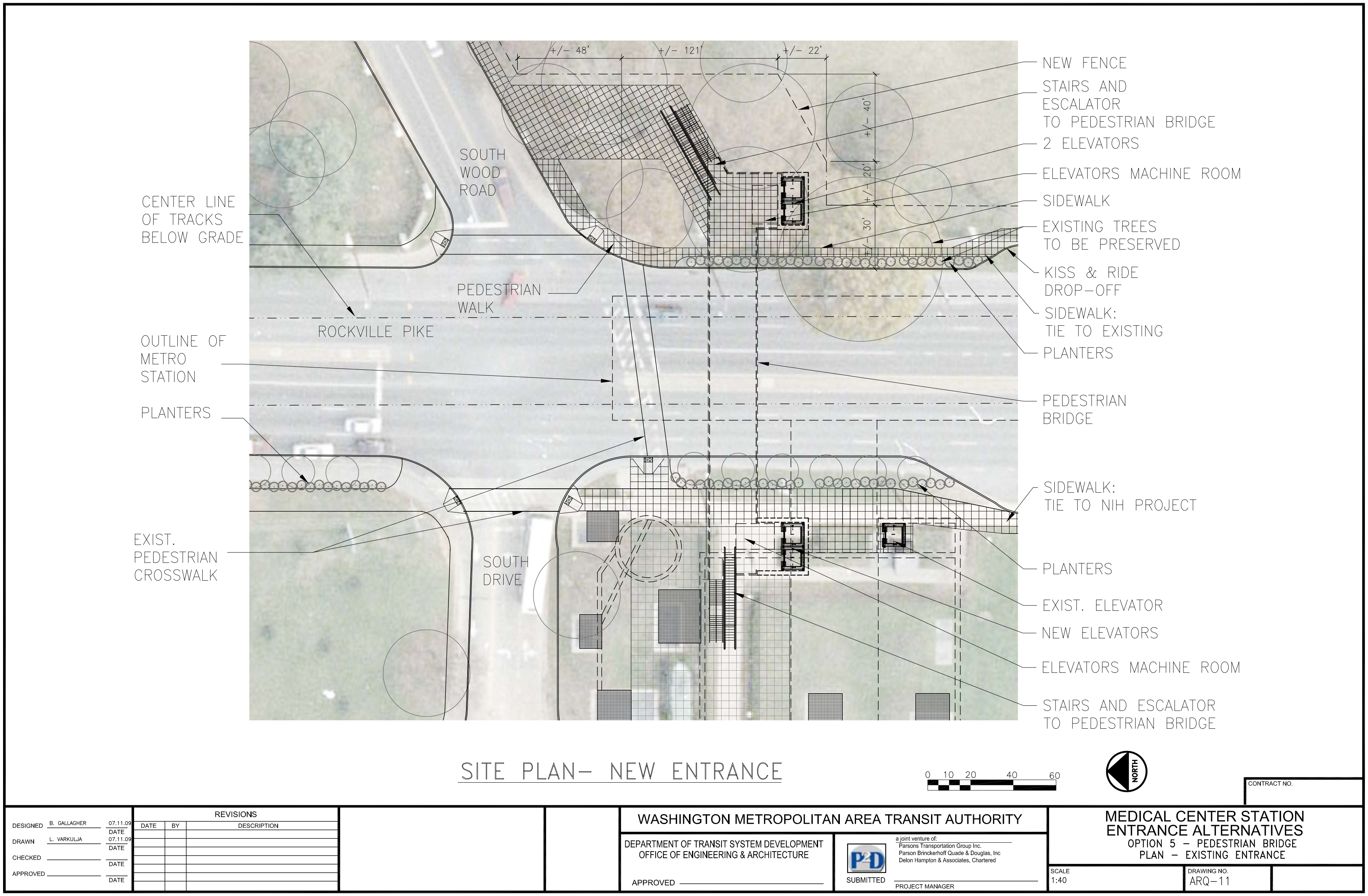
a joint venture of:
Parsons Transportation Group Inc.
Parson Brinckerhoff Quade & Douglas, Inc
Delon Hampton & Associates, Chartered

PROJECT MANAGER

MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 4 – DEEP & SHALLOW TUNNEL
SECTION

SCALE 1/32"=1'-0"

DRAWING NO. ARQ-10


+/- 48'
+/- 121'
+/- 22'
+/- 40'
+/- 20'
+/- 30'
NEW FENCE
STAIRS AND ESCALATOR TO PEDESTRIAN BRIDGE
2 ELEVATORS
ELEVATORS MACHINE ROOM
SIDEWALK
EXISTING TREES TO BE PRESERVED
KISS & RIDE DROP-OFF
SIDEWALK: TIE TO EXISTING
PLANTERS
PEDESTRIAN BRIDGE
SIDEWALK: TIE TO NIH PROJECT
PLANTERS
EXIST. ELEVATOR
NEW ELEVATORS
ELEVATORS MACHINE ROOM
STAIRS AND ESCALATOR TO PEDESTRIAN BRIDGE
CENTER LINE OF TRACKS BELOW GRADE
SOUTH WOOD ROAD
PEDESTRIAN WALK
ROCKVILLE PIKE
OUTLINE OF METRO STATION
PLANTERS
EXIST. PEDESTRIAN CROSSWALK
SOUTH DRIVE
SITE PLAN– NEW ENTRANCE
0 10 20 40 60
NORTH
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
DATE BY DESCRIPTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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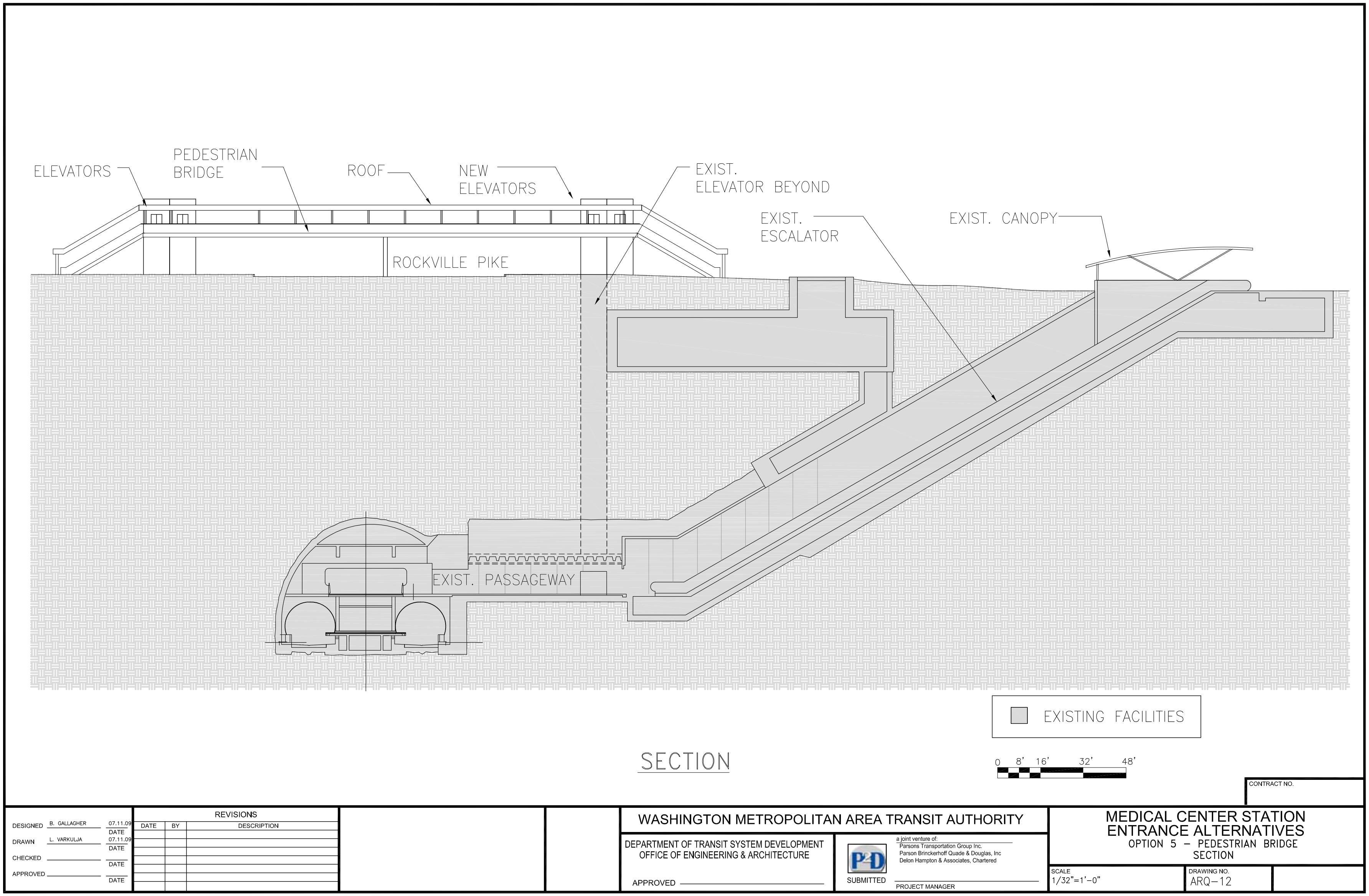
Delon Hampton & Associates, Chartered
SUBMITTED
PROJECT MANAGER
MEDICAL CENTER STATION ENTRANCE ALTERNATIVES
OPTION 5 – PEDESTRIAN BRIDGE
PLAN – EXISTING ENTRANCE
SCALE 1:40
DRAWING NO. ARQ–11


ELEVATORS
PEDESTRIAN BRIDGE
ROOF
NEW ELEVATORS
EXIST. ELEVATOR BEYOND
EXIST. ESCALATOR
EXIST. CANOPY
ROCKVILLE PIKE
EXIST. PASSAGEWAY
EXISTING FACILITIES
SECTION
0 8' 16' 32' 48'
CONTRACT NO.
DESIGNED B. GALLAGHER 07.11.09 DATE
DRAWN L. VARKULJA 07.11.09 DATE
CHECKED DATE
APPROVED DATE
REVISIONS
DATE BY DESCRIPTION
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
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SUBMITTED
PROJECT MANAGER
MEDICAL CENTER STATION
ENTRANCE ALTERNATIVES
OPTION 5 – PEDESTRIAN BRIDGE
SECTION
SCALE
1/32"=1'-0"
DRAWING NO.
ARQ-12

The west-side stair/escalator is located on top of the existing substation and the foundations must be coordinated with the existing structure. The elevators are to the south with one just off the substation structure and the other on the structure. There are new sidewalks connecting the bridge to the existing Metrorail entrance and to the sidewalk along Rockville Pike.

There would be elevator machine rooms located at both bridge entrances. The east elevators would have a machine room below grade and below the bridge next to the base of the elevators. This would be accessed by a hatch and stairway in the pavement. The west elevator machine room would be located below grade between the existing station vent shaft and the substation, accessed by a hatch in the pavement. The pedestrian bridge is a stand alone solution and does not connect to the existing station.

Mechanical Features

Elevator machine rooms sized to house equipment for two elevators are required at each end of the bridge. Per WMATA criteria, minimum dimensions are 12 feet by 18 feet by 9 feet high. Air conditioning and heating would be provided for the elevator machine rooms. Additional space, which must be sized to provide electrical code mandated clearances and be located behind a lockable door, is required to house the escalator control panels. Elevator and escalator pit drainage would be provided in accordance with local building codes and environmental regulations. Sump pumps may be necessary to complete connections to the existing drainage system.

Electrical Features

This alternative would have the same electrical requirements as Alternative 3.

System Features

This alternative would have the same system requirements as Alternative 2, without the PIDS relocation, public address speakers, or two-way communication system in the AORA.

Potential Project Schedule

The estimated timeframe for project implementation of Alternatives 2, 3, 4 and 5 would vary between 36 to 42 months. This schedule is dependent on availability of sufficient funds at the outset of the project for project initiation, environmental clearance, preliminary engineering, and development of design build documents. This phase would be followed by issuance of a request for proposal (RFP) for project delivery. Construction funding would need to be available prior to issuance of the RFP. It is estimated that the duration of project initiation through issuance of the RFP would be approximately 18 months. It is anticipated that the duration of the construction phase would be approximately 18 months for Alternatives 2, 3, and 5 and approximately 24 months for Alternative 4. These timeframes are based on WMATA experience with similar scale projects. A detailed schedule would need to be developed as part of the next phase of project development.

Cost Estimates

Order-of-magnitude costs were estimated for the five station access alternatives for Medical Center station. Table 12 summarizes these costs. The construction costs include:

A 25 percent design contingency, composed of a 15 percent design contingency for structural, utilities, and maintenance of pedestrians and traffic, and a 10 percent design contingency for sitework, architectural, mechanical, electrical, plumbing, and system conveyance. This allowance is included to cover the continuing refinements to the design as the project evolves. This contingency does not cover the owner's risk in changes, claims, and personnel costs for the project which are referred to as project delivery costs in this study.

An 18 percent temporary facilities overhead, which are the costs of mobilizing and establishing the contractor's equipment and facilities necessary to complete the work of the project. They include purchase, lease, shipping, site erection of the construction equipment, work site preparation, and establishing temporary utilities, among others.

A 10 percent contractor profit and overhead allowance, which is factored on the basis of the total project labor costs and reflects a judgment of the possible risk in this project.

A seven percent fee for costs related to design engineering for a design-build solicitation.

A 10 percent fee for bonding.

Construction costs for Alternatives 1 and 2 do not include any electrical work for the new pedestrian signal at the median refuge. Cost escalation beyond year 2009 is not included.

The costs shown in Table 12 include elements that reflect a comprehensive definition of the design alternatives. It is possible that as the project progresses, some elements such as elevators, escalators, and canopies could be reduced or eliminated.

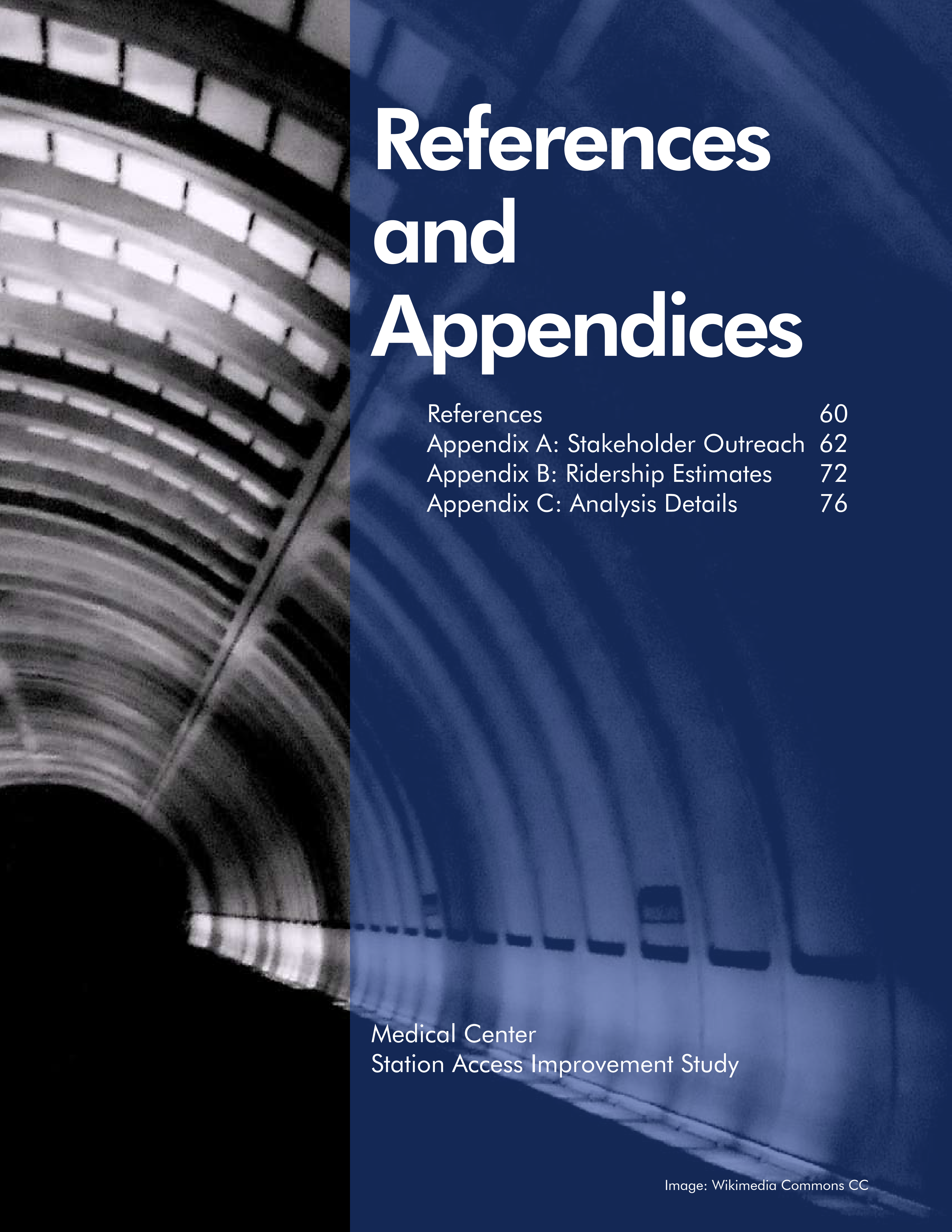
WMATA adds an allowance of 35 percent to construction costs for project delivery. This includes additional planning, engineering, architectural, construction management, and administrative costs.

The range of accuracy of this estimate at this conceptual level of development is -10 percent to +30 percent. These cost estimates will be further refined during design.

Table 12: Cost Estimates (FY09, $ million)

	Alternative				
Costs*	1	2	3	4	5
Construction	0.5	22.6	23.3	44.0	10.8
Project delivery	0.2	7.9	8.2	15.4	3.8
Total	0.7	30.5	31.5	59.4	14.6

* Accuracy range of -10 to +30 percent.



References and Appendices

Medical Center
Station Access Improvement Study

Image: Wikimedia Commons CC

References

Department of the Navy, Access Road Needs Report for Implementation of the 2005 Base Realignment and Closure Actions at National Naval Medical Center, Bethesda, Maryland, May 2008.

Department of the Navy, Final Environmental Impact Statement For Activities to Implement 2005 Base Realignment and Closure Actions at National Naval Medical Center, Bethesda, Maryland, March 2008.

NFPA, NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems, 2007.

NIH, Master Plan 2003 Update, March 2005.

NNMC, Master Plan Update, November 2008.

TRB, TCRP Report 100: Transit Capacity and Quality of Service Manual 2nd Edition, 2003.

WMATA, Manual of Design Criteria For Maintaining and Continued Operation of Facilities, May 2007.

WMATA, Metrorail Passenger Survey, 2007.

WMATA, Metrorail Station Access & Capacity Study, October 2007.

Appendix A Stakeholder Outreach

The study team coordinated with a multiagency stakeholder group composed of representatives from NNMC, Montgomery County, Maryland Transit Administration (MTA), MDOT, and WMATA. In addition, the study team coordinated with the Maryland State Highway Administration (SHA) in regard to roadway operations and Onyx Group with respect to a potential emergency vehicle/pedestrian tunnel between NNMC and NIH.

The study team presented project goals, analysis findings, and station access alternatives at three separate stakeholder meetings held in October 2008, February 2009, and June 2009. Public meetings were officiated by the BRAC Implementation Committee, which consists of various state and local agency representatives and neighborhood association leaders. The attendees, which also included the general public, commented and provided feedback on station access alternatives and other elements of the study process. This appendix summarizes each meeting.

First Stakeholder Meeting

WMATA presented to the BRAC Implementation Committee on October 21, 2008. Highlights of the meeting include:

- The DAR request is still pending and that approval is expected in February 2009.
- 2020 ridership estimates were discussed. Some committee members suggested a deeper investigation into the effects of larger patient and visitor loads on future ridership.
- WMATA's only role is to study and present the alternatives. The agency does not control the funding for any alternative that may be recommended.

Suggestions by the BRAC Implementation Committee include:

- For Alternative 3, consider a covered walkway from the entrance of the shallow tunnel to the entrance of the Metro station since this option includes exposure to the elements (assuming one is taking the escalator/stair path and not the existing deep elevator).
- Consider including a shuttle bus stop on the east side of Rockville Pike to serve nearby residents and future Kiss & Ride passengers without having to cross the street.
- What is WMATA's preference between stairs and escalators for the station alternatives? WMATA explained that Alternatives 3 and 4 were shown with stairs as a

measure to reduce cost. Escalators remain an option.

- Consider the development of a Kiss & Ride facility on the east side of Rockville Pike.
- Add a second deep elevator shaft to Alternative 3.

The meeting ended with several general conclusions from the committee:

- Alternative 2 is the best for time savings for Metrorail passengers only.
- The committee member representing NIH commented that Alternative 3 is the most viable solution because it would accommodate NIH to NNMC traffic well.
- Some committee members expressed that Alternative 3 is good for pedestrian safety and beneficial to those carpooling and utilizing the Kiss & Ride facility.

Second Stakeholder Meeting

WMATA presented at the BRAC Implementation Committee Meeting on February 24, 2009. Highlights of the meeting include:

- The Department of Navy is waiting for this report to make any decisions concerning the DAR funding request.
- East-side elevator access would be the most appealing alternative for Metrorail passengers due to significant time savings. The pedestrian tunnel or bridge alternatives would create a relatively circuitous path for crossing Rockville Pike, thereby eliminating potential time savings for Metrorail passengers but maintaining the safety of a grade separated crossing.
- The study is not researching how ridership would vary between each alternative because it is the nearby land use that is attracting riders, not the minor shift in the station entrance.
- The scope of this study is Medical Center station only, and does not include surrounding intersections.
- Metrorail ridership estimates for 2020 are based upon current ridership, goals and strategies of the NNMC TMP, proximity of future BRAC employees to the station, and parking conditions described in the NIH Master Plan Update.
- The number of "area residents" displayed on the pedestrian circulation visuals appears high because they were not broken down by mode (bus or walking).

Suggestions Committee included:

- Consider conducting a cost/benefit analysis to help determine which is the best alternative.
- Consider investigating how different station access alternatives affect the pedestrian walkshed surrounding the station.

Third Stakeholder Meeting

WMATA presented at the BRAC Implementation Committee Meeting on June 16, 2009. Highlights of the meeting include:

- Presented the draft report.
- Presented the alternatives and discussed what each alternative would do and wouldn't do.
- Presented the refined cost estimates.
- Discussed the next steps for the project, regarding DAR Certification and various funding options.
- DOD budget includes the DAR Metro Access project at NNMC for FY2011.
- Suggestion for a project timeline to be included in the final report.
- Reiterated that this is the first of its kind for DAR Certification because it is a transit project and not a roadway improvement.
- Montgomery County said that they would build the project if the State of Maryland didn't want to, according to Phil Alperson.
- NNMC stated that they would transfer land to the County, if necessary.

MDSHA Comments

The State Highway Administration District 3 provided an analysis on the project. The remainder of Appendix A is a letter from MDSHA dated June 9, 2009.

WMATA Bethesda BRAC Crossings Comments

In light of these tough economic times, all projects need to be scrutinized to maximize Maryland's investment. The State Highway Administration has concern over the cost of Alternatives 2, 3, 4, and 5 based on the stated fact that only 635-760 people will use the new passageways. The State Highway Administration would prefer to look more closely at the at-grade options. District 3 traffic has provided an analysis on low, medium, and high investment options at this intersection keeping the following issues in mind:

- Any pedestrian improvements may result in an increase to transit's modal split.
- Countdown Pedestrian Signals (CPS) activated 10/28/2005
- No Turn On Red (NTOR) exists for EB approach. Shared through/right lane on WB approach.
- Tight turning radii on west leg.
  - Damage to NW corner from R-turning buses onto South Drive.
  - EB L-turning buses regularly stop prior to stop bar so provide turning radii for inbound buses.
  - WMATA is reclaiming NIH inspection facility along South Drive to expand Kiss and Ride service.
- Soldiers wear camouflage, including new digital designs:
  - Navy to introduce new uniforms in 2009
  - Air Force (also present at facility) has new uniforms
  - Army (note Walter Reed merger) has new uniforms
  - In general, personnel use non-camos, but some do use camos; and potential exists that they may be required to use camos in the future.

OPTIONS (LOW-COST SIGNAL MODS)

Review pedestrian timing
PRO Ensures pedestrians have adequate time to cross.
CON May impact vehicular splits.
NOTES MCDOT already acting upon this for 3.5 fps. CPS provided since 2005.
FINAL Pursuing – Already being pursued by MCDOT

Pushbutton extends crossing time
PRO May provide slower pedestrians with additional time to cross (in addition to standard 3.5 fps).
CON May impact vehicular splits. May impact vehicular coordination.
NOTES CPS provided since 2005. Pedestrians generally observed capable of crossing within 3.5 fps.
FINAL Declined – Lack of significant justification, though it could certainly be reconsidered in the future.

Leading Pedestrian Interval (LPI)
PRO May enable pedestrians to occupy intersection prior to turning motorists.
CON Will impact vehicular splits.
NOTES Considered a 3-second LPI.
FINAL Declined – Lack of significant justification, though it could certainly be reconsidered in the future.

All-Red Pedestrian Interval (ARPI)
PRO May enable pedestrians to occupy intersection prior to turning motorists
CON Will impact vehicular splits.
NOTES None
FINAL Declined – Per cons: impacts would be too excessive.

OPTIONS (LOW-COST MARKING)

Refresh crosswalk markings
PRO Improves awareness of motorists toward pedestrians.
CON None of significance.
NOTES None
FINAL Consider – If OOTS is willing.

Stagger W leg stop bar
PRO Improves inbound turning radii for buses. Easing transit entry may enable the operator to give greater attention to rest of the environment.
CON Possibility for motorists to overrun left stop bar.
NOTES OOTS does not prefer to stagger stop bars.
FINAL Consider – If OOTS is willing.

Pull back W leg stop bar
PRO Improves inbound turning radii for buses. Easing transit entry may enable the operator to give greater attention to rest of the environment.
CON Motorists – particularly R-turns – may regularly overrun stop bar.
NOTES Note impacts to loop detection.
FINAL Consider – If staggering is not pursued, this may be a consideration.

OPTIONS (LOW-COST SIGNING)

Yield to Ped (YTP) signing
PRO May improve yield compliance between turning motorists and pedestrians.
CON Reiterates existing regulation; does not enact any new regulations. May increase signing clutter. Potential for setting a precedent.
NOTES MCDOT has indicated favorable results at select locations. MCDOT indicates a willingness to try YTP signing here, noting that they have a select list of locations they would like to use YTP signing at.
FINAL Declined – At this time SHA does not wish to use YTP signing.

Stop for Ped (SFP) signing
PRO May improve yield compliance between turning motorists and pedestrians.
CON Established a more restrictive regulation over default YTP. New regulation violates expectancy without significant difference.
NOTES YTP is preferable to SFP signing.
FINAL Declined – At this time SHA does not wish to use SFP signing.

Do Not Block Intersection (DNBI) signing
PRO May reduce frequency with which vehicles queue through intersection, which can block crosswalks as well as prohibit side-street movements.
CON Reiterates existing regulation; does not enact any new regulations. May increase signing clutter. Potential for setting precedent.
NOTES Specifically requested by Navy and MCDOT. SHA is pursuing: maintenance request to install signs submitted March 2009.
FINAL Pursuing – Already being pursued by SHA District 3.

NB U-turn restriction
PRO Reduces conflict between last U-turn movement (after occupying intersection) and peds that have occupied crosswalk. Reduces U-turn / EB R-turn conflicts.

CON Impacts NIH visitor's access. Potentially high violation rate. Diverted motorists would become a NB and a SB through movement as well as a U-turn movement at Wilson Drive.
NOTES Requested by Navy.
FINAL Decline – Per cons and lack of significant justification.

OPTIONS (EDUCATION / ENFORCEMENT)

Encourage reflective vest or flashlight use for military personnel
PRO May counter effects of camouflage.
CON Cost of equipment.
NOTES Particularly relevant for overnight crossings. Program would be run by Navy.
FINAL Pursue – Recommend to Navy

Spot enforcement
PRO May improve compliance with existing traffic regulations.
CON Limited manpower at MCPD District 2 of Bethesda. May have limited and temporary effect.
NOTES Navy has contacted MCPD regarding spot enforcement.
FINAL Pursuing – Already being pursued by Navy

Continuous enforcement
PRO May improve compliance with existing traffic regulations.
CON Cost of hiring overtime police officers.
NOTES Program would be run by Navy and/or NIH. Consider feasibility of an MOU between MCPD and NIH / Navy police to permit enforcement by NIH or Navy. Consider if it is permissible for federal and/or non-civilian police agencies to enforce traffic regulations in State-maintained right-of-way.
FINAL Consider – Recommend to Navy and/or NIH.

Crossing guard
PRO May improve the awareness of motorists with regard to pedestrians, which may be particularly relevant given camouflage. May improve control of pedestrian movements.
CON Cost of hiring personnel.
NOTES A crossing guard would operate per the traffic signal and would not be permitted to override it. Program would be run by the Navy.
FINAL Consider – Recommend to Navy.

Manual traffic control
PRO May improve time given for pedestrian crossings as well as awareness between motorists and pedestrians. May improve operations for motorists exiting side streets.
CON Manual control fully disrupts signal splits and coordination. Personnel would likely give inappropriate bias toward pedestrian and side-street traffic at cost to mainline.
NOTES Navy previously requested and was declined by SHA and MCDOT.
FINAL Declined – Per cons: impacts would be too excessive.

OPTIONS (MEDIUM-COST)

Sidewalk realignment (More direct alignment from Metro station to S leg crossing)
PRO Directs pedestrians to crosswalk rather than midblock. Removes two 90-degree turns for pedestrians: one at crosswalk onto trail; another at trail to Metro access.
CON Landscaping impacts.

NOTES Likely fairly low cost: removal/replanting of bushes and concrete sidewalk. Should be feasible without impacting trees. Most pedestrians generally cross at crosswalk; not midblock. Hence: limited justification. Note presence of MetroRail ventilation shafts.
FINAL Consider – If cost can be justified.

Crosswalk realignment (to remove diagonal)
PRO Reduces crossing distance. Improves pedestrian sight lines toward oncoming traffic.
CON Cost of ramps. Potentially necessitates signal reconstruct.
NOTES Recommended concurrent with resurfacing in order to remove existing markings.
FINAL Consider – If performing other pedestrian modifications, it should be considered; but this is not justified to be a lone modification.

Resurfacing
PRO May reduce crashes attributed to poor weather. Repairs damage to corners arising from turning buses. Repairs damage to pavement arising from decelerating heavy vehicles.
CON Cost of resurfacing.
NOTES Friction ratings in high 20's to low 30's, considered poor. Previously recommended for resurfacing in May 2007.
FINAL Pursue – Justified for both vehicular and pedestrian benefits.

Drainage
PRO Reduces disincentives for pedestrian / transit travel. Reduces risks to motorists traveling in adverse weather.
CON Cost of drainage modifications.
NOTES Ponding occurs on southeast corner, impacting crosswalk: ADA issues, splashing on peds, potential safety impacts to motorists.
FINAL Pursue – Justified for both vehicular and pedestrian benefits.

OPTIONS (HIGHER-COST)

Signal reconstruct
PRO May improve pedestrian accommodation. May improve vehicular accommodation. Improves ADA-compliance of intersection.
CON Cost
NOTES Includes mast arms, blackface signal heads, LED signal indications, APS, ADA-compliant ped ramps, DWS. Pedestrian MOT may be difficult as there are only 3 crossings rather than more typical 4.
FINAL Pursue – Justified for both vehicular and pedestrian benefits.

Median refuge
PRO May improve pedestrian accommodation. Reduces apparent crossing distances.
CON May encourage pedestrians to cross against pedestrian signals.
NOTES Without buttons in refuge, pedestrian timing must still be for the full crossing – therefore refuge only serves those crossing against pedestrian signals or whom are unable to cross within allotted time.
FINAL Consider – Should be included with signal reconstruct; may be considered as combination with offset two-stage pedestrian crossing.

Offset two-stage pedestrian crossing
PRO May improve pedestrian accommodation. Halves crossing distance.
CON Rare configuration in Maryland. May encourage pedestrians to cross against signals. Minimal effect to signal splits.

NOTES Such configurations are particularly well-suited for split-phased intersections or intersections with wide pavement and/or wide medians. Storage within median must be capable of providing for a typical peak load of pedestrians. Side-streets have enough vehicular traffic such that vehicular splits already accommodate pedestrian crossing time, hence halving crossing time may have minimal effect on vehicular operations. Therefore, this should only be pursued if it can result in a concurrent reduction in vehicular splits and allotment to mainline; otherwise pedestrians will still receive two WALK signals but are delayed by the offset. While rare in Maryland, these may become more frequent with Purple Line and could be worth testing in advance, if feasible.

FINAL Consider – If it results in improved vehicular and/or pedestrian accommodation.

OPTIONS (GRADE-SEPARATION)

Pedestrian Bridge (without direct elevator connection to MetroRail)

PRO Provides safe pedestrian accommodation.

CON Cost. May be too out-of-the-way for some peds, potentially still results in at-grade crossings. Elevators do not provide direct station access, meaning users must change grade multiple times. People approach up stairs first, discouraging use. Impacts to protected viewshed. Impacts to NB signal head sight distance. At-grade accommodations likely still necessary.

FINAL Declined – Minimal benefit anticipated.

Shallow Tunnel (without direct elevator connection to MetroRail)

PRO Removes conflicts. Could permit removal of at-grade treatments.

CON Cost. May be too out-of-the-way for some peds, potentially still resulting in at-grade crossings (particularly for peds arriving from along SB 355). Lack of direct elevator connection to Metrorail may also reduce usage in lieu of at-grade crossings.

NOTES If at-grade amenities are removed, realign sidewalks and trails to provide greater buffer from roadway. Note connections between MetroRail station, bus loop, Kiss and Ride, and/or hiker/biker trail with grade-separated structure.

FINAL Consider – If cost can be justified.

Shallow Tunnel (with direct elevator connection to MetroRail)

PRO Removes conflicts. Direct MetroRail connection may improve rail's modal split. WMATA estimates 90% of transit trips to NNMC come by rail. Could permit removal of at-grade treatments.

CON Cost. May be too out-of-the-way for some peds, potentially still resulting in at-grade crossings (particularly for peds arriving from along SB 355).

NOTES If at-grade amenities are removed, realign sidewalks and trails to provide greater buffer from roadway. Note connections between MetroRail station, bus loop, Kiss and Ride, and/or hiker/biker trail with grade-separated structure.

FINAL Consider – If cost can be justified. Of grade-separated options, this is my preferred option (not considering cost or feasibility).

Shallow Tunnel (without direct elevators) + Deep Tunnel (high-speed elevators on east side)

PRO Removes conflicts. Direct MetroRail connection may improve rail's modal split. WMATA estimates 90% of transit trips to NNMC come by rail. Could permit removal of at-grade treatments.

CON Cost. May be too out-of-the-way for some peds, potentially still resulting in at-grade crossings (particularly for peds arriving from along SB 355).

NOTES If at-grade amenities are removed, realign sidewalks and trails to provide greater buffer from roadway. Note connections between MetroRail station, bus loop, Kiss and Ride, and/or hiker/biker trail with grade-separated structure.

FINAL Consider – If cost can be justified.

Deep Tunnel (high speed elevators on east side)

PRO Reduces conflicts. Direct MetroRail connection may improve rail's modal split. WMATA estimates 90% of transit trips to NNMC come by rail.

CON Cost. Pedestrians traveling along MD 355 unlikely to use, especially if turnstiles block direct travel between east/west station accesses. At-grade accommodations are still necessary.

NOTES Overall, unlikely to be used by pedestrians not traveling by MetroRail (bus riders, riders arriving from north or southward along MD 355, etc.).

FINAL Consider – If cost can be justified.

Recommendations

Pursuing

Improvement	Action
Pedestrian Timing	Already being pursued by MCDOT
DNBI Signing	Already being pursued by SHA District 3
Spot Enforcement	Already being pursued by Navy

To Pursue

Improvement	Action
Reflective Vests/Flashlight Use	Recommend to Navy
Resurfacing	Justified for both vehicular and pedestrian benefits
Signal Reconstruct	Justified for both vehicular and pedestrian benefits.
Drainage	Justified for both vehicular and pedestrian benefits.

Consider

Improvement	Action
Stagger W Leg Stop Bar	If OOTS is willing.
Pull Back W Leg Stop Bar	If staggering is not pursued, this may be a consideration.
Continuous Enforcement	Recommend to Navy and/or NIH.
Crossing Guard	Recommend to Navy.
Sidewalk Realignment	If cost can be justified.
Crosswalk Realignment	If performing other pedestrian modifications, but not justified to be a lone modification.
Median Refuge	Should be included with signal reconstruct; may be considered as combination with offset two-stage pedestrian crossing.
Offset Two-stage Pedestrian Crossing	If it results in improved vehicular and/or pedestrian accommodation.
Grade Separation	If cost can be justified.

Additional Comments

Table E-2 is not adequately described in the Executive Summary. It should be noted that the number of traffic and pedestrian conflicts for alternative 2 is medium because it doesn't serve non-Metro patrons. Also, it appears that the at-grade improvements don't take into account the time it would take if a patron would have to wait for the signals to change. I think that a range would be more accurate here, with 6.7 minutes being the lowest and 9.2 minutes being the high (if the patrons had to wait the whole 2.5 minutes between signals). The last comment on this table is a definition of what high, medium, or low. Are these relative to the other alternatives or compared to other sites?

On page 6, under Considerations, there are some discrepancies in the wording that SHA would like corrected. The sentence "The traffic volumes will increase by over 50 percent and the pedestrian volumes will triple" should be rewritten as "The traffic volumes entering and exiting NNMC are projected to increase by over 50 percent and the pedestrian volumes are expected to triple." The next sentence should also be reworded to say "The number of conflicts between crossing pedestrians and turning vehicles is also expected to increase due to the additional volume of both cars and people accessing NNMC following the BRAC action."

On page 31, second paragraph – This should make clear that 6,100 is the 2020 pedestrian count and not the existing. In order to provide a 12 foot wide median at the intersection of MD 355 and South Wood Drive, shifting of the vehicular movements approaching the intersection would be necessary to keep the intersection aligned appropriately. This will require additional ROW from both NIH and the Navy.

GLOSSARY

- APS Accessible Pedestrian Signals
- ARPI All-Red Pedestrian Intervals; "Barnes' Dance"
- CPS Countdown Pedestrian Signals
- DNBI Do Not Block Intersection
- DWS Detectable Warning Surface
- FPS Feet per second
- LED Light-Emitting Diode
- LPI Leading Pedestrian Intervals
- MCDOT Montgomery County Department of Transportation
- MCPD Montgomery County Police Department
- NIH National Institutes of Health
- NNMC National Naval Medical Center
- NTOR No Turn On Red
- OOTS Office of Traffic and Safety
- Ped Pedestrian
- SFP Stop for Pedestrians
- SHA State Highway Administration
- YTP Yield to Pedestrians

Appendix B
Ridership Estimates

Table B-1: Existing and Future NNMC Transit Mode Share

Employee Mode Share at NNMC		
	2007	2020
Metrorail	11.1%	24.0%
Bus	0.2%	6.0%

Source: NNMC TMP, 2008
* Estimated mode split based on NNMC TMP goals and strategies.

Table B-2: Existing and Future Station Trip Purpose

Trip Purpose	Percent of Daily Trips (2007)	Percent of Daily Trips (2020)
NNMC	15.2%	31.1%
NIH	50.8%	40.7%
Home	24.5%	19.3%
Patients and Visitors	4.0%	4.6%
Other*	5.5%	4.3%

Source: 2007 Metrorail Passenger Survey, WMATA
* "Other" category includes business trips, shopping, meals, school, and recreation.

Table B-3: Existing and Future NNMC Station Trips

Year	Total NNMC Employees	Percent of NNMC Employees Using Metrorail	Total NNMC Employees Using Metrorail	Total Medical Center Trips (Boarding and Alighting for each Employee)	Growth of NNMC Employee Medical Center Trips
2007	8,000	9.9%	792	1,584	-
2020	10,500	24.0%	2,520	5,040	218.2%

Source: NNMC TMP, 2008

Table B-4: Existing and Future NIH Station Trips

Year	Total NIH Employees	Metrorail Passenger to NIH Job Ratio	Metrorail Passenger Trips	Growth from 2007
2007	18,627	0.284	5,295	-
2020	22,000	0.300*	6,600	24.6%

*Assumed ratio based on future parking constraints.

Table B-5: Existing and Future Station Daily Boardings and Alightings by Purpose

Trip Purpose	2007	2020	Growth
NNMC	1,584	5,040	218.2%
NIH	5,295	6,600	24.6%
Home	2,554	3,135	22.7%
Patients and Visitors	417	750	79.9%
Other*	572	702	22.7%
Total	10,422	16,227	55.7%

* "Other" category includes business trips, shopping, meals, school, and recreation.

Table B-6: Existing and Future Split of Work-Related Station Trips

Facility	Percent of Work Trips (2007)	Percent of Work Trips (2020)
NNMC	23.0%	43.3%
NIH	77.0%	56.7%

Peak Hour Ridership

Table B-7: Existing Peaking at Station

	Percent of Average Daily Riders	
Period	Boardings	Alightings
AM Peak	4.0%	10.0%
PM Peak	8.0%	3.0%

Source: 2007 Metrorail Passenger Survey, WMATA

Table B-8: Future Station Peak Hour Ridership by Trip Purpose

Trip Purpose	AM Peak Alightings	PM Peak Boardings
NNMC	616	566
NIH	806	741
Home	79	0
Patients and Visitors	32	14
Other*	47	41
Total	1,580	1,361

* “Other” category includes business trips, shopping, meals, school, and recreation.

Appendix C
Analysis Details

Capacity Analysis

Table C-1: Input Data for All Alternatives

	Input	Value	
A	Peaking factor for alighting[1]	1.28	
B	Escalator flow rate	90	p/min
C	LOS C flow rate per stair width	10	p/ft/min
D	Peak analysis period	15	min
E	Faregate flow rate	35	p/min
F	Passengers using farecard vendor	2	%
G	Farecard vendor flow rate	2.5	p/min

1. Factor only applies to alighting volumes.

The capacity analysis used peak hour factors based on 2006 ridership data provided by WMATA.

Table C-2: Peak Hour Factors

	Factor	
Movement	AM	PM
Boarding	0.36	0.37
Alighting	0.26	0.26

Table C-3: Summary of 2007 Existing Capacity Analysis

	Category	AM			PM			Critical		Actual[2]		Formula
		Alighting[1]	Boarding	Total	Alighting[1]	Boarding	Total	Alighting	Boarding	Alighting	Boarding	
H	Passengers, 1-hour peak	1,299	455	1,470	394	874	1,182					
I	Passengers, 15-min. peak	338	164	428	103	323	403					H x PHF
J	Platform escalators required	1	1	2	1	1	2	1	1	1	1	(A x I) / (B x D)
K	Mezzanine escalators required	1	1	2	1	1	2	1	1	2(1)	1(2)	(A x I) / (B x D)
M	Faregate aisles required[3]	1	1	2	1	1	2	1	1	2	2	(A x I) / (D x E)
N	Farecard vendors required		1	1		1	1		1		4	(F x I) / (D x G)

Table C-4: Summary of 2020 No Build and Alternatives 1, 2, 3, 4, and 5 Capacity Analysis

	Category	AM			PM			Critical		Actual[2]		Formula
		Alighting[1]	Boarding	Total	Alighting[1]	Boarding	Total	Alighting	Boarding	Alighting	Boarding	
H	Passengers, 1-hour peak	2,022	708	2,730	614	1,361	1,975					
I	Passengers, 15-min. peak	526	255	781	160	540	664					H x PHF
J	Platform escalators required	1	1	2	1	1	2	1	1	1	1	(A x I) / (B x D)
K	Mezzanine escalators required	1	1	2	1	1	2	1	1	2(1)	1(2)	(A x I) / (B x D)
M	Faregate aisles required[3]	2	1	3	1	1	2	2	1	2	2	(A x I) / (D x E)
N	Farecard vendors required		1	1		1	1		1		4	(F x I) / (D x G)

1. Alighting factor applied
2. AM values (PM values) i.e. 2(1): two alighting escalators available in the AM and only one in the PM
3. In addition to standard faregate aisles, WMATA requires one ADA aisle that can accommodate passenger flow in both directions.

The 2020 station capacity analysis is applicable to a "no build" option as well as all five station access alternatives presented in this report. From the analysis presented in Table C-4, current station capacity remains adequate under the increased ridership scenario for 2020. Therefore, a capacity analysis for each station access alternative is unnecessary.

Elevator Analysis

Table C-5: High-Speed Elevator Analysis Assumptions

Elevator Cycle Assumptions (seconds)	
Boarding/alighting per passenger	1.05
Doors closing	2.50
High-speed elevator travel time	21.00
Leveling time	1.00
Doors opening	1.50
Doors closing	2.50
High-speed elevator travel time	21.00
Leveling time	1.00
Doors opening	1.50

Source: WMATA

Table C-6: Maximum Passenger Load per High-Speed Elevator

Passengers per elevator car (entering station)	15
Passengers per elevator car (exiting station)	15

Source: WMATA

Table C-7: Metrorail Arrivals

Trains per half hour	24

Source: WMATA

Table C-8: 2020 Queuing Assumptions

	Hourly Ridership	Half Hour Peak Factor	Half Hour Peak Ridership	Percent Using New Elevators
		AM		
Entries	708	55%	389	10%
Exits	1,580	52%	822	40%
		PM		
Entries	1,361	53%	821	40%
Exits	480	54%	259	25%

Source: WMATA

Table C-9: 2020 AM Peak Elevator Capacity Analysis

Number of Elevators	1	2	3
Volume to Capacity (2020)			
Interval between elevators (sec.)	115.00	57.50	38.33
Entering passenger capacity per 30 minutes	235	470	704
Exiting passenger capacity per 30 minutes	235	470	704
Total 30-minute capacity of elevators	470	939	1,409
2020 AM peak 30-minute passengers using elevators	368	368	368
Volume to capacity ratio	0.78	0.39	0.26
Maximum Queuing - Street (2020)			
Average arrival rate of entries (pass. per sec.)	0.02	0.02	0.02
Interval between elevators (sec.)	115.00	57.50	38.33
Average passengers per elevator cycle	2	1	1
Maximum passengers per elevator cycle	15	15	15
Remaining queue (passengers)	0	0	0
Maximum queue	2	1	1
Maximum Queuing - Mezzanine (2020)			
Average arrival rate of exits (pass. per train)	26.33	26.33	26.33
Interval between elevators (sec.)	115.00	57.50	38.33
Average interval between trains (sec.)	75	75	75
Elevator cycles per train	0.65	1.30	1.96
Maximum passengers per elevator cycle	15	15	15
Initial queue (passengers)	27	27	27
Remaining queue (passengers)	17	7	0
Maximum queue	43	33	26

Table C-10: 2020 PM Peak Elevator Capacity Analysis

Number of Elevators	1	2	3
Volume to Capacity (2020)			
Interval between elevators (sec.)	115.00	57.50	38.33
Entering passenger capacity per 30 minutes	235	470	704
Exiting passenger capacity per 30 minutes	235	470	704
Total 30-minute capacity of elevators	470	939	1,409
2020 AM peak 30-minute passengers using elevators	353	353	353
Volume to capacity ratio	0.75	0.38	0.25
Maximum Queuing - Street (2020)			
Average arrival rate of entries (pass. per sec.)	0.16	0.16	0.16
Interval between elevators (sec.)	115.00	57.50	38.33
Average passengers per elevator cycle	18	9	6
Maximum passengers per elevator cycle	15	15	15
Remaining queue (passengers)	3	0	0
Maximum queue	22	9	6
Maximum Queuing - Mezzanine (2020)			
Average arrival rate of exits (pass. per train)	2.70	2.70	2.70
Interval between elevators (sec.)	115.00	57.50	38.33
Average interval between trains (sec.)	75	75	75
Elevator cycles per train	0.65	1.30	1.96
Maximum passengers per elevator cycle	15	15	15
Initial queue (passengers)	3	3	3
Remaining queue (passengers)	0	0	0
Maximum queue	3	3	3

NFPA-130 Analysis

Table C-11: NFPA-130 Preliminary Analysis

	Existing Conditions				With Modified South Entrance					With New North Entrance				
	no.	width (in.)	pim	p/min		no.	width (in.)	pim	p/min		no.	width (in.)	pim	p/min
					Platform to Mezzanine Capacity									
Escalator	1	48	1.41	67.68	Escalator	1	48	1.41	67.68	Escalator	1	48	1.41	67.68
Stairs	0	60	1.41	0.00	Stairs	2	60	1.41	169.20	Stairs	2	60	1.41	169.20
Total				67.7	Total				236.88	Total				236.88
Escalator usage		100%			Escalator usage		29%			Escalator usage		29%		
					Faregate Capacity									
Faregates	3	21	50	150	Faregates	3	21	50	150	Faregates	3	21	50	150
ADA gate	1	36	75	75	ADA gate	1	36	75	75	ADA gate	1	36	75	75
Serv. gate	1	36	75	75	Serv. gate	1	36	75	75	Serv. gate	1	36	75	75
Total				300	Total				300	Total				300
					Mezzanine to Street Capacity									
Existing Entrance					Existing Entrance					Existing Entrance				
Escalator	2	48	1.41	135.36	Escalator	2	48	1.41	135.36	Escalator	2	48	1.41	135.36
Total				135.36	Total				135.36	New Elevator Entrance				
										Em. Stairs	1	108	1.41	152.28
										Total				287.64
										Escalator usage		55%		
					Walking Time for Longest Path									
	ft.	ft./min.	min.			ft.	ft./min.	min.			ft.	ft./min.	min.	
Platform	410	124	3.31		Platform	410	124	3.31		Platform	410	124	3.31	
Escalator	12	48	0.25		Escalator	12	48	0.25		Escalator	12	48	0.25	
Mezz.	265	124	2.14		Mezz.	265	124	2.14		Mezz.	265	124	2.14	
Escalator	101	48	2.10		Escalator	101	48	2.10		Escalator	101	48	2.10	
Total			7.80		Total			7.80		Total			7.80	

* One escalator is assumed to be out of service. Elevators are assumed to be out of service for evacuation purposes.

Table C-12: NFPA-130 Complete Analysis – AM

	Existing (2007)	No Build (2020)	Deep (2020)	Shallow + Deep (2020)	Bridge (2020)
Peak 1-hour period	455	708	708	708	708
Peak 15-min period	164	255	255	255	255
Headway (min.)	2.5	2.5	2.5	2.5	2.5
Entraining load	55	85	85	85	85
Cars per train	6	8	8	8	8
Car crush capacity	220	220	220	220	220
Crush capacity train load	1,320	1,760	1,760	1,760	1,760
Peak direction train load	709	1,000	1,000	1,000	1,000
Off-peak direction train load	75	126	126	126	126
Total occupant load	838	1,211	1,211	1,211	1,211
Time to clear platform (min.)	12.4	17.9	5.1	5.1	17.9

Wait Time at Platform Exit (min.)					
South entrance	9.1				
Modified south entrance		14.6		1.8	14.6
New north entrance			1.8		
Platform Flow Time (min.)					
South entrance	3.3				
Modified south entrance		3.3		3.3	3.3
New north entrance			3.3		
Platform to Faregate Flow Time (min.)					
South entrance	1.3				
Modified south entrance		1.3		1.3	1.3
New north entrance			1.3		
Mezzanine Flow Time (min.)					
South entrance	1.2				
Modified south entrance		1.2		1.2	1.2
New north entrance			1.2		
Wait Time at Escalator (min.)					
South entrance	5.0				
Modified south entrance		7.8		3.8	7.8
New north entrance			3.8		
Street Exit Flow Time (min.)					
South entrance	2.1				
Modified south entrance		2.1		2.1	2.1
New north entrance			2.1		
Evacuation Time (min.)	21.9	30.2	13.4	13.4	30.2

Table C-13: NFPA-130 Complete Analysis – PM

	Existing (2007)	No Build (2020)	Deep (2020)	Shallow + Deep (2020)	Bridge (2020)
Peak 1-hour period	874	1,361	1,361	1,361	1,361
Peak 15-min period	323	504	504	504	504
Headway (min.)	2.5	2.5	2.5	2.5	2.5
Entraining load	108	168	168	168	168
Cars per train	6	8	8	8	8
Car crush capacity	220	220	220	220	220
Crush capacity train load	1,320	1,760	1,760	1,760	1,760
Peak direction train load	613	854	854	854	854
Off-peak direction train load	81	125	125	125	125
Total occupant load	801	1,147	1,147	1,147	1,147
Time to clear platform (min.)	11.8	16.9	4.8	4.8	16.9

Wait Time at Platform Exit (min.)					
South entrance	8.5				
Modified south entrance		13.6		1.5	13.6
New north entrance			1.5		
Platform Flow Time (min.)					
South entrance	3.3				
Modified south entrance		3.3		3.3	3.3
New north entrance			3.3		
Platform to Faregate Flow Time (min.)					
South entrance	1.3				
Modified south entrance		1.3		1.3	1.3
New north entrance			1.3		
Mezzanine Flow Time (min.)					
South entrance	1.2				
Modified south entrance		1.2		1.2	1.2
New north entrance			1.2		
Wait Time at Escalator (min.)					
South entrance	4.7				
Modified south entrance		7.3		3.5	7.3
New north entrance			3.5		
Street Exit Flow Time (min.)					
South entrance	2.1				
Modified south entrance		2.1		2.1	2.1
New north entrance			2.1		
Evacuation Time (min.)	21.1	28.7	12.8	12.8	28.7