FARRAGUT NORTH-FARRAGUT WEST STATION CAPACITY STUDY

Final Report

Farragut North and Farragut West Metrorail Stations
District of Columbia
February 2015

Washington Metropolitan Area Transit Authority

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FARRAGUT NORTH-FARRAGUT WEST

Station Capacity Study

Washington Metropolitan Area Transit Authority
Office of Real Estate and Station Planning

February 2015

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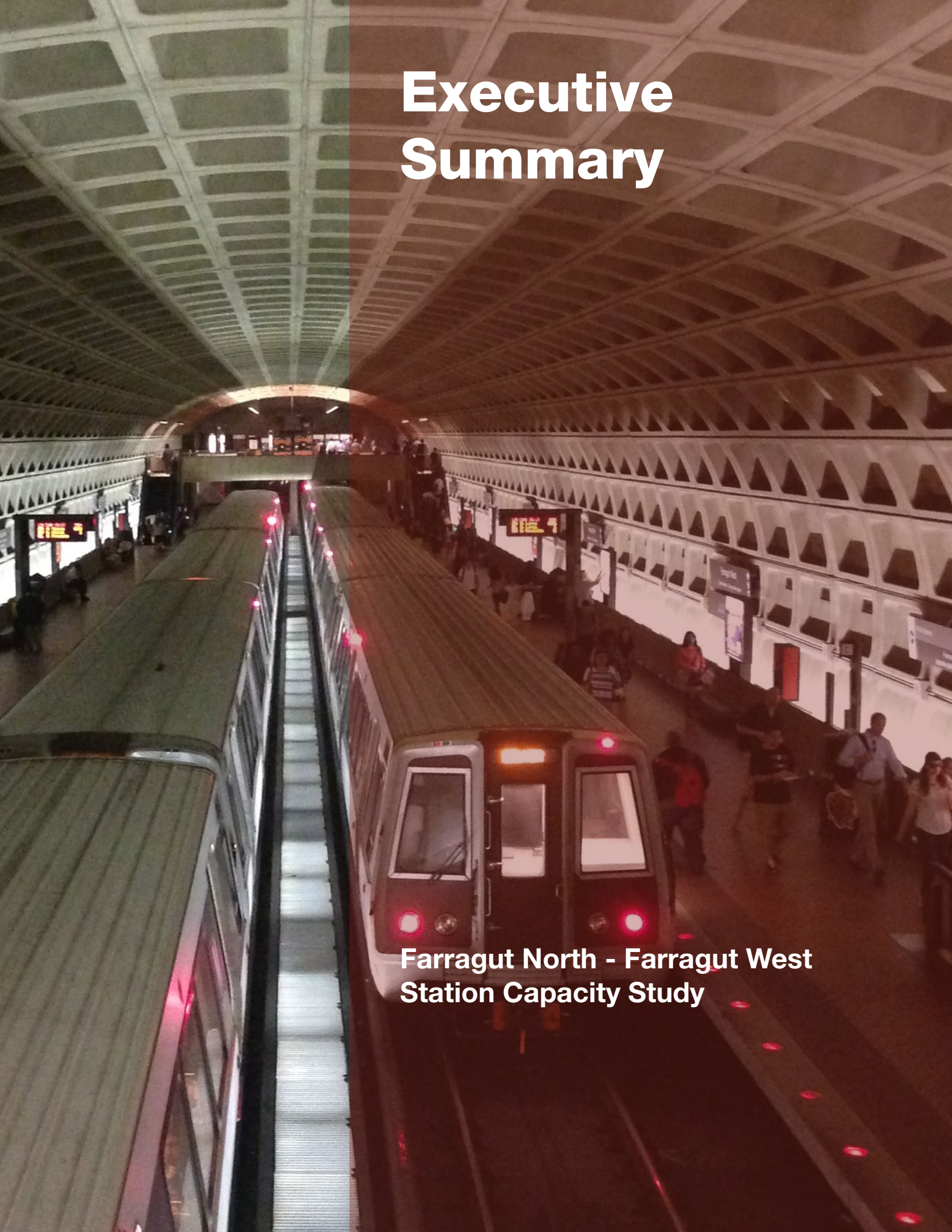

Executive Summary

Farragut North - Farragut West Station Capacity Study

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EXECUTIVE SUMMARY

Introduction

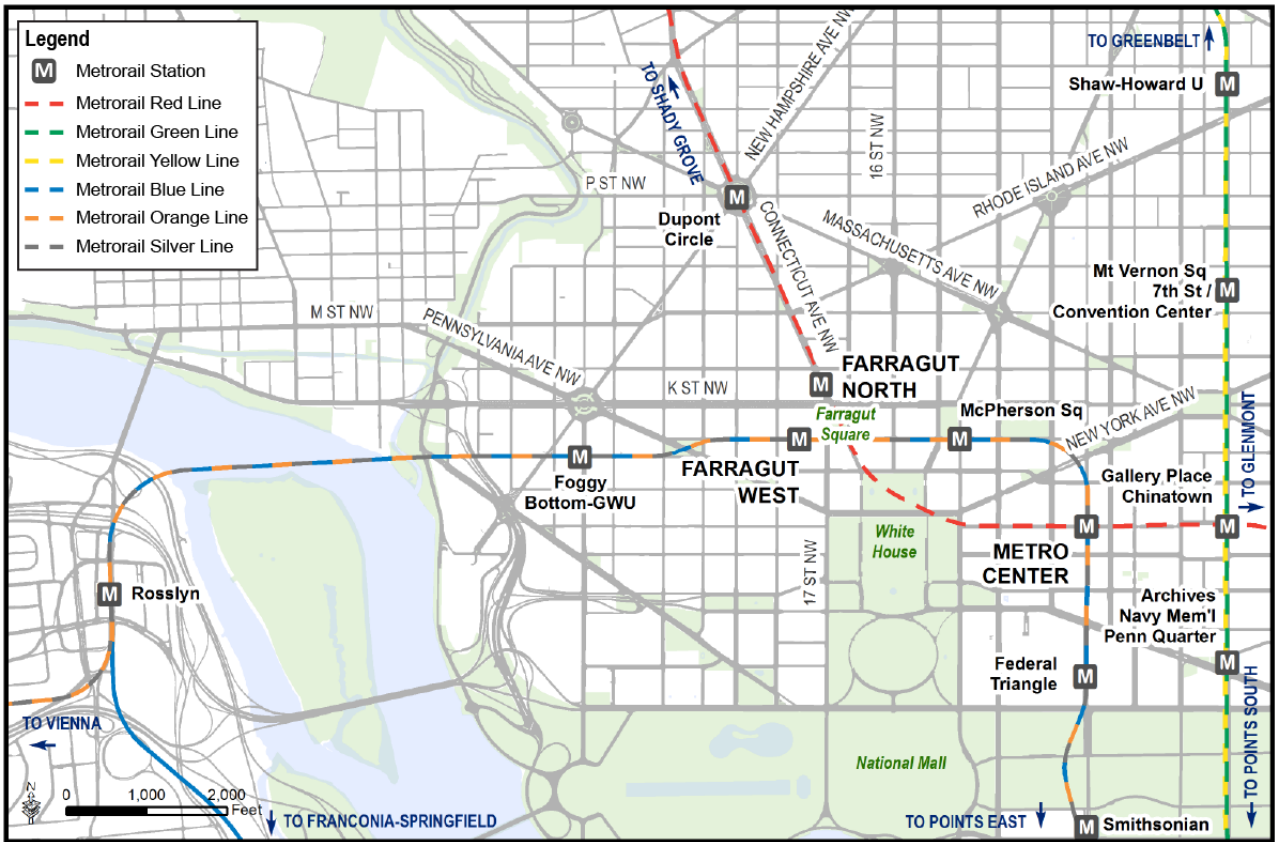
This report summarizes the findings and conclusions of the Farragut North-Farragut West Station Capacity Analysis Study ("the study") conducted by the Washington Metropolitan Area Transit Authority (WMATA or "Metro").

Background

Farragut North, Farragut West, and Metro Center Metrorail Stations (see **Figure ES-1**) are among the top five busiest stations in the Metrorail system in terms of daily passenger entries (ranging from 22,000 to 28,000). Metro Center also serves a high volume of transfers between Metrorail lines, currently the highest in the system (almost 85,000 per day). Ridership growth over the years has resulted in passenger crowding on various areas of the platforms, mezzanines, and escalators at the three stations.

Farragut Square between Farragut North and Farragut West Stations

Figure ES-1 Farragut North, Farragut West, and Metro Center Stations within Downtown DC



Metro has previously studied capacity improvements at the Farragut stations, as well as investigated the Farragut pedestrian tunnel as a way to partly relieve the high transfer demand at Metro Center. The platforms of the two Farragut Stations are approximately 400 feet apart, while the transfer point between the lines served at the two stations is at Metro Center Station, which is approximately 3,500 feet (2/3 mile) southeast of the two stations. The current study builds on the previous studies, which include the *Farragut North-Farragut West Passageway Study* (2004) and the *100% Eight-Car Train Implementation Plan* (2013).

Future Station Conditions

2030 Forecast Station Ridership and Pedestrian Tunnel Usage

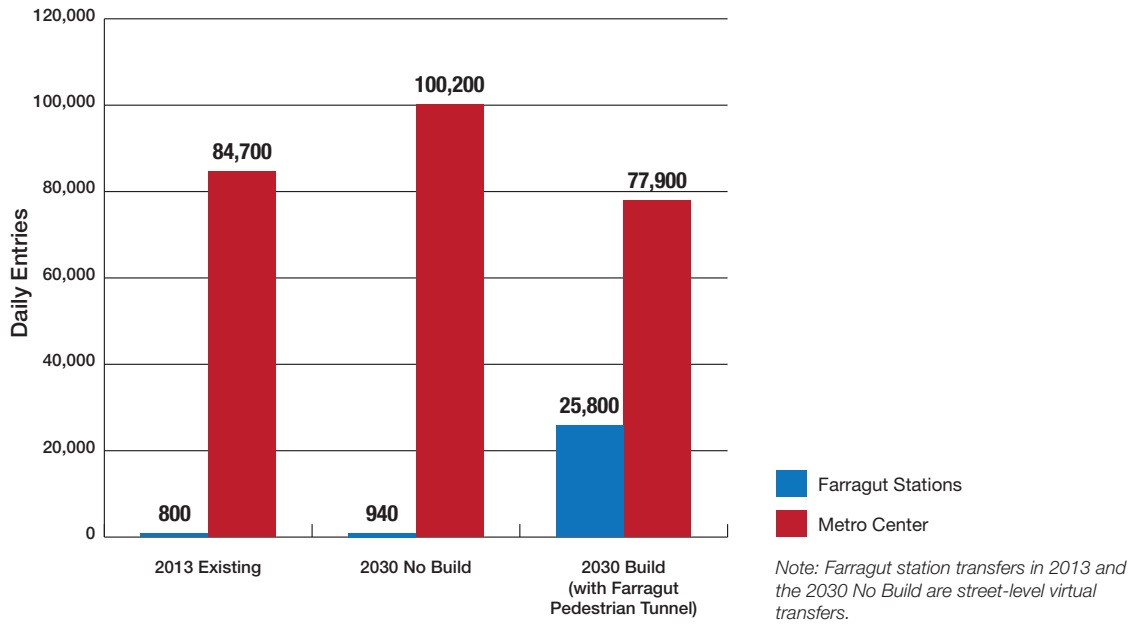
Forecast Methodology – 2030 station ridership was forecast using Metro's Regional Transit System Plan (RTSP) Model with LineLoad application and the Metropolitan Washington Council of Governments (MWCOG) Round 8.2 Cooperative Land Use Forecast. Planned Metrorail train operations include Silver Line Phase 2, 100-percent eight-car trains in peak periods, and other changes. The travel demand forecast was conducted for two scenarios:

- *2030 No Build Conditions* – assumes planned 2030 Metrorail train operations but without the Farragut pedestrian tunnel; and
- *2030 Build Conditions* – assumes implementation of the Farragut pedestrian tunnel.

Forecast Results – Between 2013 and 2030, daily passenger entries at each of the three stations are forecast to grow between 20 and 27 percent, and daily transfers at Metro Center are forecast to grow by over 18 percent. The Farragut pedestrian tunnel would attract 25,800 daily transfers between Metrorail lines and over 6,000 daily passengers using the tunnel to enter or exit the Metrorail system from the opposite station.

Figure ES-2 shows the significant effect of the tunnel on transfer activity at Metro Center, as well as the significant new volume of transfer passengers who would transit through the Farragut stations.

Figure ES-2 Average Weekday Transfers - 2013, 2030 No Build, and 2030 Build



Note: Farragut station transfers in 2013 and the 2030 No Build are street-level virtual transfers.

2030 No Build Station Conditions

Pedestrian Simulation Modeling - 2030 station conditions at Farragut North, Farragut West, and Metro Center Stations were assessed using pedestrian simulation modeling of forecast passenger volumes within current station facilities (referred to as "2030 No Build" conditions). The simulation results were used to estimate future changes in pedestrian crowding, escalator queue clearance times, and passenger journey times in 2030, and to identify potential areas of safety concern.

Summary of 2030 Station Conditions - Figures ES-3 and **ES-4** summarize 2030 No Build conditions at the two Farragut stations and at Metro Center Station.

Farragut Stations

Farragut North congestion between Center and South Mezzanine Escalators

Passengers waiting at Farragut West westsbound platform in the PM peak

Metro Center

Congestion on lower platform, between escalator and platform edge

Crowding on lower platform, between center escalators leading to Red Line platforms

Figure ES-3 2030 No Build Peak Period Conditions - Farragut North and Farragut West

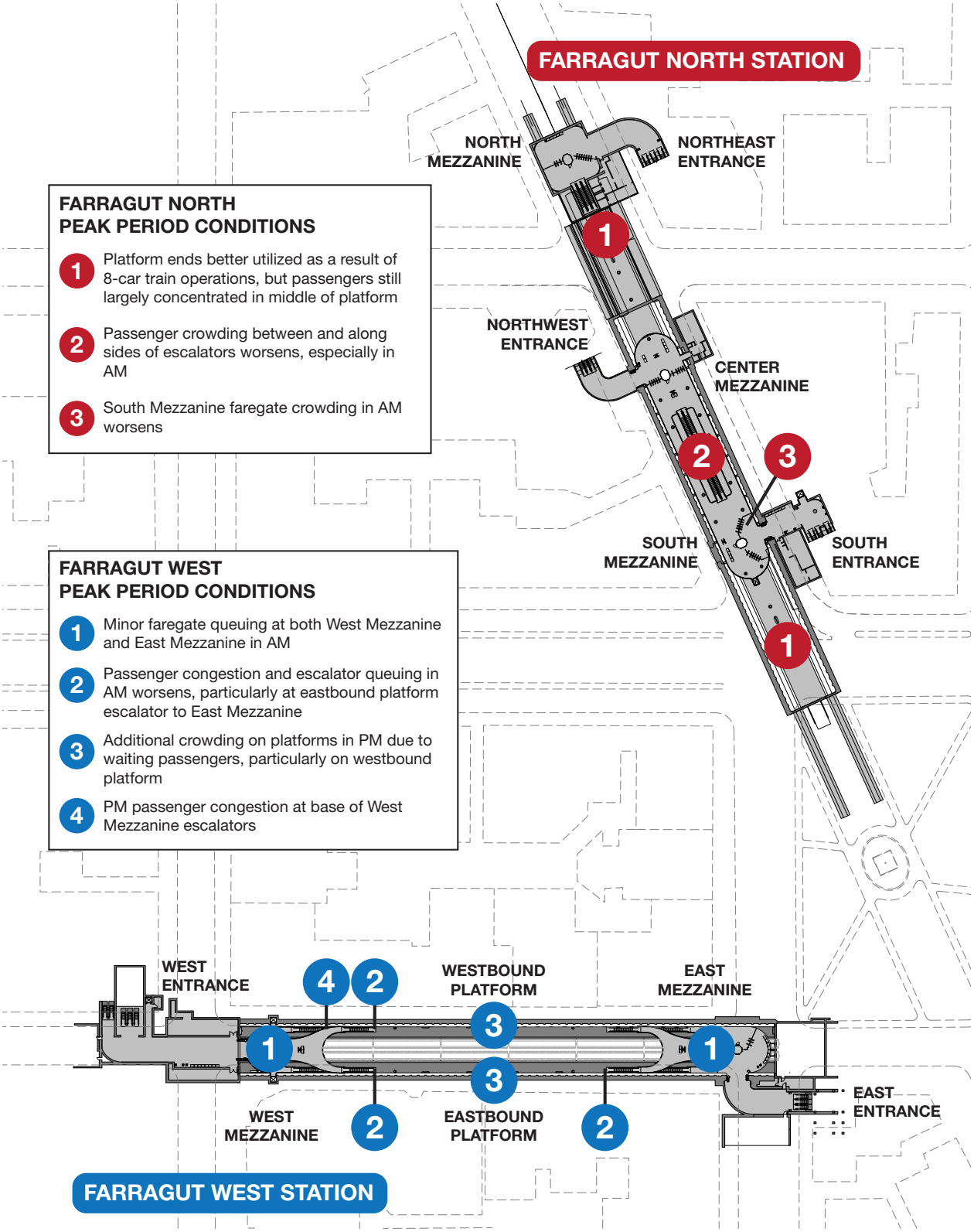
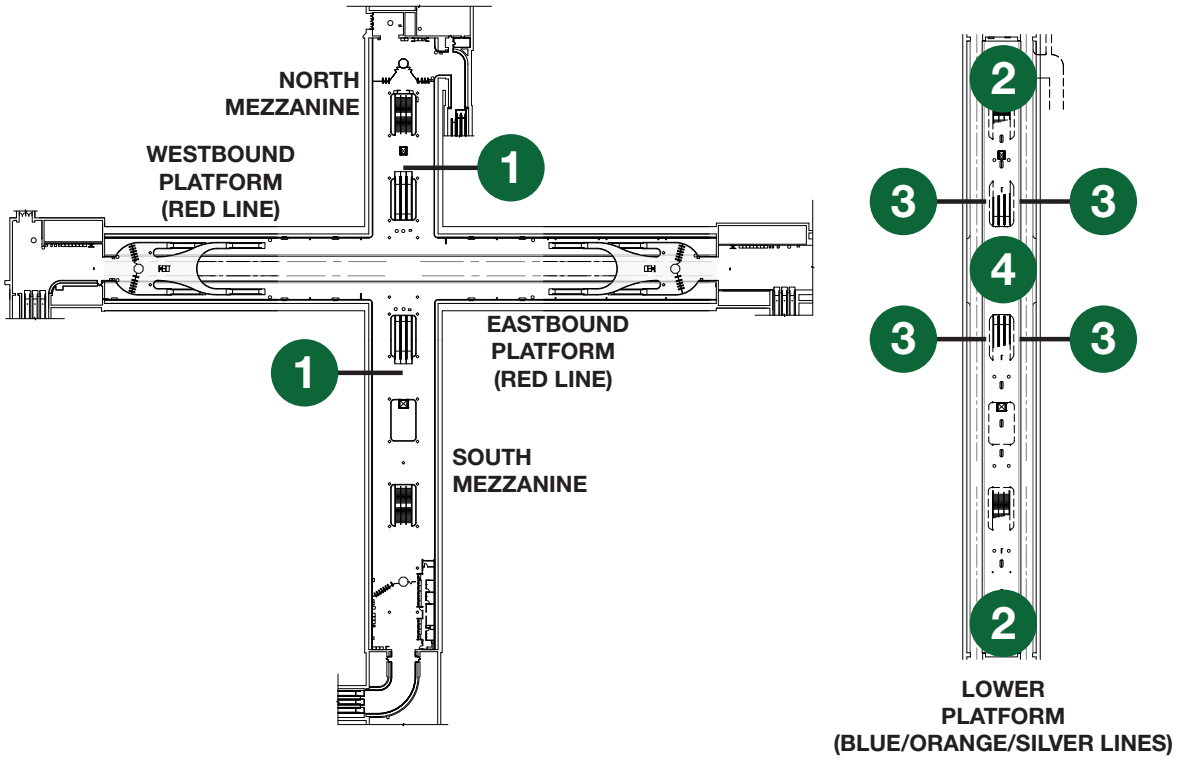


Figure ES-4 2030 No Build Peak Period Conditions - Metro Center

METRO CENTER STATION



METRO CENTER
PEAK PERIOD CONDITIONS

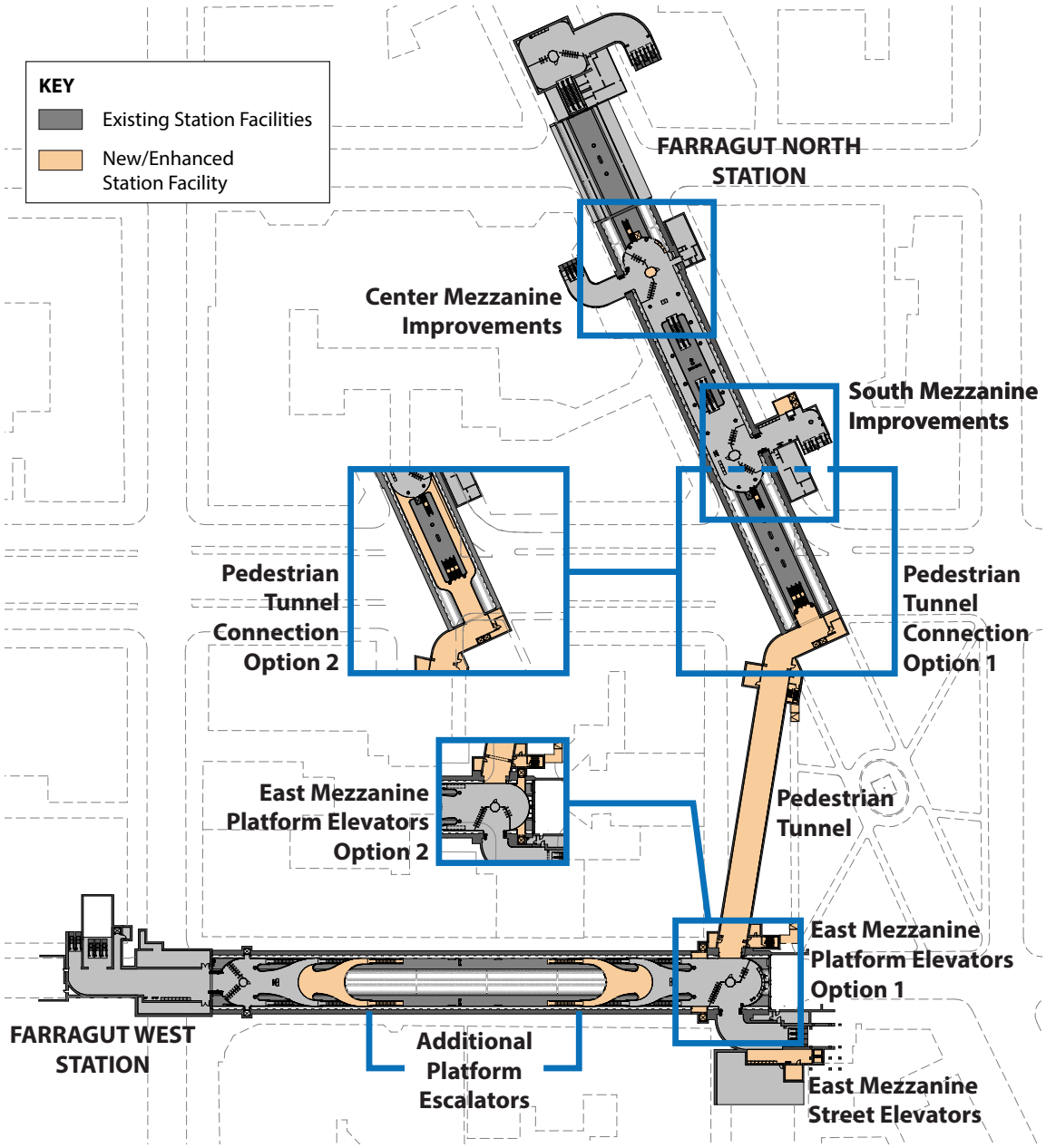
1. Congestion, cross-flow conflicts, and escalator queuing by transferring passengers
2. Platform ends underutilized by waiting passengers
3. Congestion between escalators and platform edges
4. Congestion and cross-flow conflicts

Station Improvement Concepts

The set of improvement concepts shown in **Figure ES-5** was further developed from previous studies to address the current station deficiencies and address forecast future conditions.

Coordination with Metro's ADA Policy and Planning (ADAP) office was an integral part of the design process with regard to station accessibility and design requirements. In addition, the draft design concepts were shared and discussed with the National Park Service (NPS) and the District Department of Transportation (DDOT) to review and address any potential impacts to NPS property and DC streets and public spaces.

Figure ES-5 Overview of Farragut Station Improvement Concepts

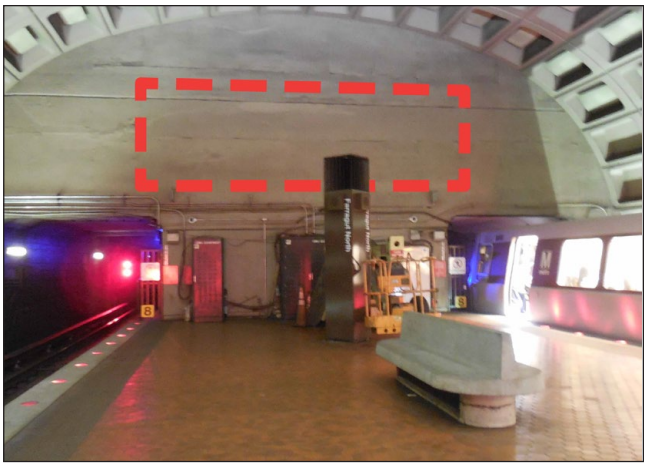


Farragut North-West Pedestrian Tunnel

The pedestrian tunnel concept retains the design developed by the 2004 Farragut North-Farragut West Passageway Study. Specific refinements made to the 2004 design were:

- **Farragut North pedestrian tunnel connection –** The refined concept design incorporates a wider stair to accommodate passenger demand and includes an option for an extension of the South Mezzanine (Option 2) to connect directly to the tunnel entrance; and
- **Farragut West, East Mezzanine platform elevators –** A design option was developed to place the elevators at the back of the mezzanine (Option 2) away from the heavily trafficked circulation areas by the escalators and tunnel entrance.

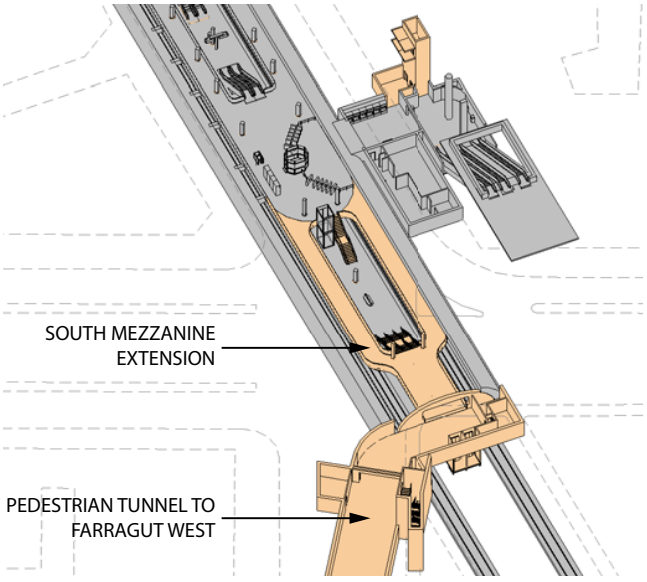
Figure ES-6 illustrates both of these design concepts at Farragut North and Farragut West.



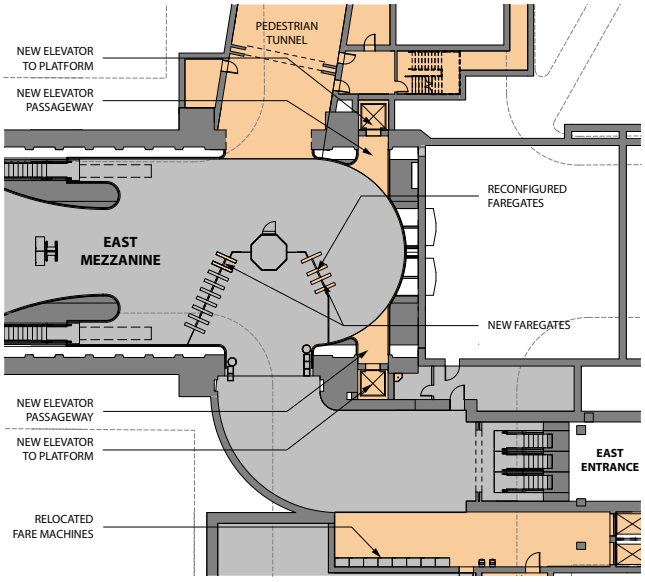
Farragut North Station, southern end of platform, location of pedestrian tunnel connection

Figure ES-6 Farragut Pedestrian Tunnel Design Options

Farragut North, Pedestrian Tunnel Connection, Option 2



Farragut West, East Mezzanine, Platform Elevators, Option 2



Farragut North and West Capacity Improvements

Capacity improvements for the Farragut Stations are proposed at the locations shown in the images below:

Farragut North Station, Center Mezzanine proposed location of new stair and elevator

Farragut North Station, South Mezzanine proposed location of new stair; a second street elevator is also proposed at the South Entrance

Farragut West Station, additional platform escalators are proposed at each mezzanine

Modeling and Evaluation of Future Improvement Concepts

The Farragut North and Farragut West Station improvement concepts were modeled using pedestrian simulations of 2030 station conditions. Variations of the design concepts were tested to compare their performance: with and without the pedestrian tunnel, with and without the additional platform escalators at Farragut West, and other design options. No changes were made to the Metro Center Station layout or facilities; however, passenger volumes were modeled using the 2030 Build condition forecast for the Farragut pedestrian tunnel.

The key simulation results are shown in the following pages using color-coded pedestrian density maps that depict level of service (LOS) for station passengers. The yellow areas of LOS D generally represent the maximum acceptable levels of passenger crowding, depicting station areas that have reached their maximum capacity to accommodate passenger levels. The orange and red areas of LOS E and F represent significant crowding.

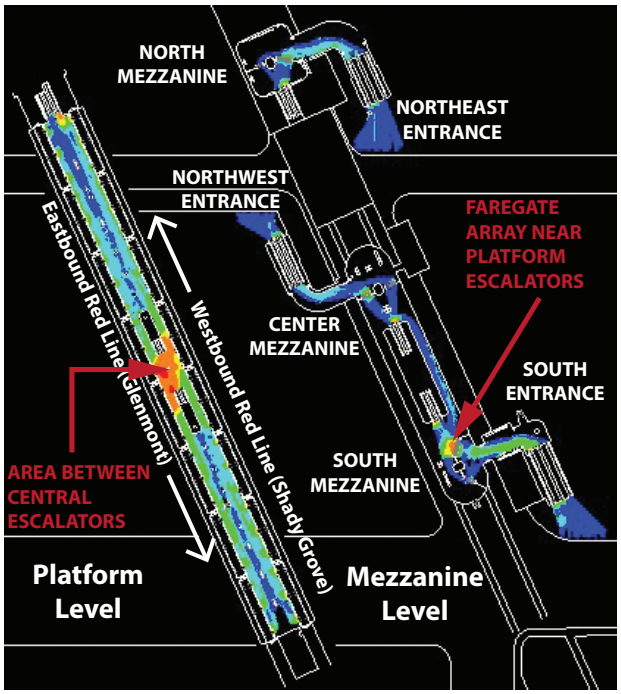
Farragut North – Effect of Capacity Improvements and Pedestrian Tunnel

Figures ES-7 and **ES-8** compare density maps of 2030 No Build conditions and 2030 conditions with station capacity improvements and the pedestrian tunnel at Farragut North.

AM peak platform crowding is dispersed from the middle and is lower overall in the AM peak as a result of the new stairs at the platform ends. PM peak platform passenger volumes are higher (although without adding significant crowding) as a result of the pedestrian tunnel transfers. The South Mezzanine extension helps diffuse passenger circulation at the south end of the station, and the wide stair better accommodates passenger flows from the pedestrian tunnel than a single escalator pair (modeled in separate alternative not shown).

Figure ES-7 Farragut North No Build Conditions - 2030 Passenger Density, AM/PM Peak 15 Minutes

AM Peak 15 Minutes



PM Peak 15 Minutes

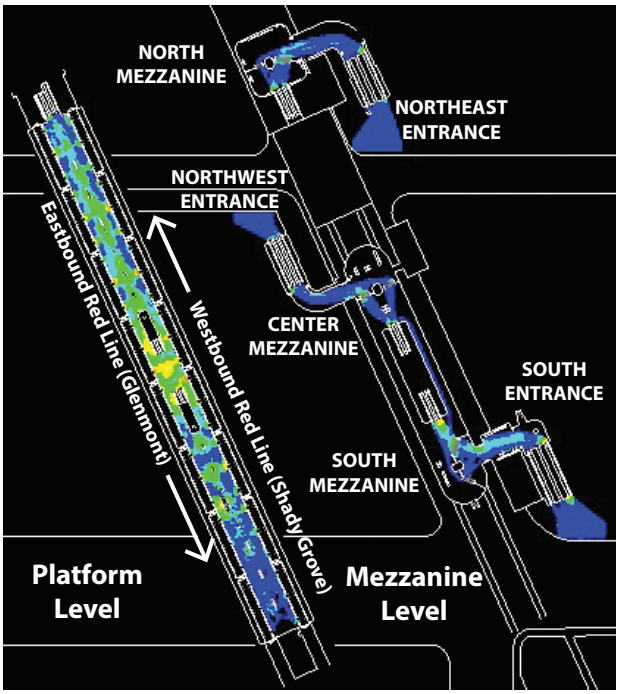
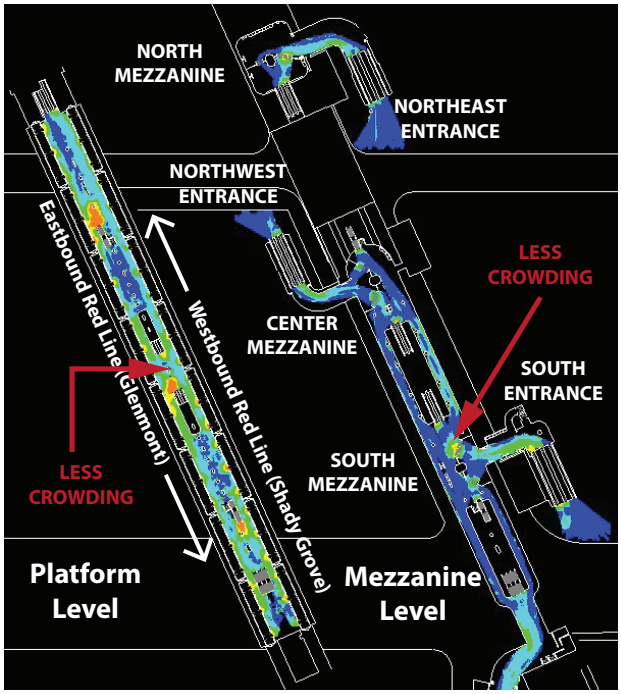
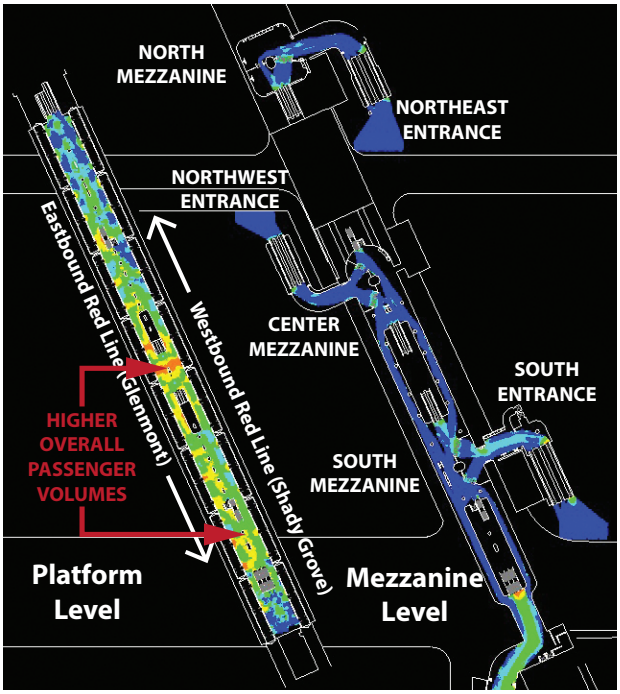


Figure ES-8 Farragut North with Capacity Improvements and Pedestrian Tunnel - 2030 Passenger Density, AM/PM Peak 15 Minutes

AM Peak 15 Minutes



PM Peak 15 Minutes



Farragut West - Effect of Farragut Pedestrian Tunnel

Figure ES-9 illustrates the significant increase in passenger volumes forecast at the Farragut West, East Mezzanine, particularly from the eastbound platform, as a result of the Farragut pedestrian tunnel.

Figures ES-10 and **ES-11** show the effect of the increased passenger volumes on station conditions. With the additional passengers transferring to Farragut North, the eastbound platform has significant crowding and the escalator queues to the East Mezzanine do not clear between trains (red areas of LOS F).

The simulations show that additional platform vertical circulation is needed at Farragut West to accommodate the increase in demand due to the pedestrian tunnel, as well as to address 2030 No Build conditions.

Farragut West queuing at escalator from eastbound platform to East Mezzanine in the AM peak; the pedestrian tunnel would exacerbate congestion without additional vertical circulation capacity

Figure ES-9 Comparison of 2030 Passenger Volumes at Farragut West - No Build and Build Forecasts

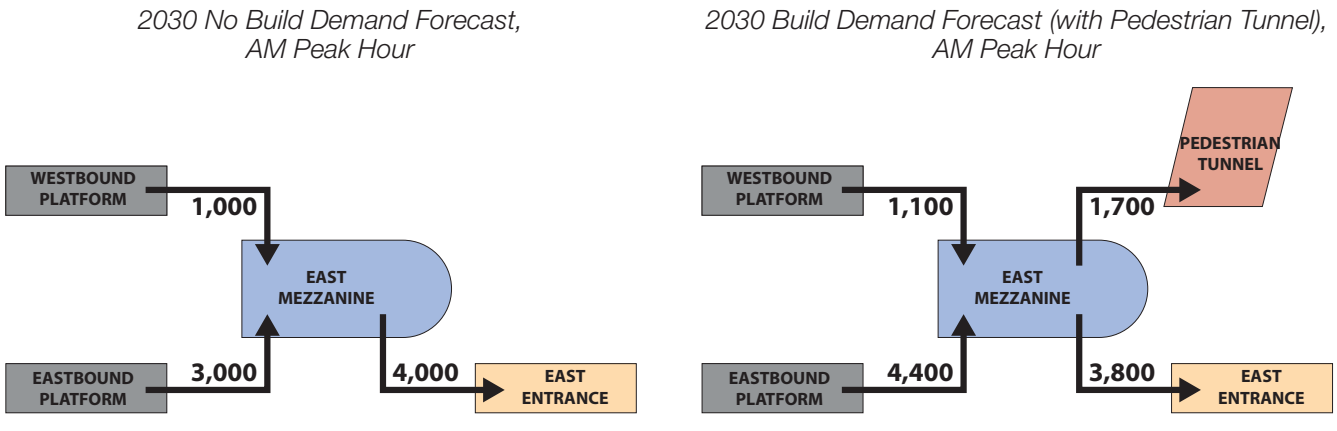


Figure ES-10 Farragut West No Build Conditions - 2030 Mean Passenger Density, AM Peak 15 Minutes

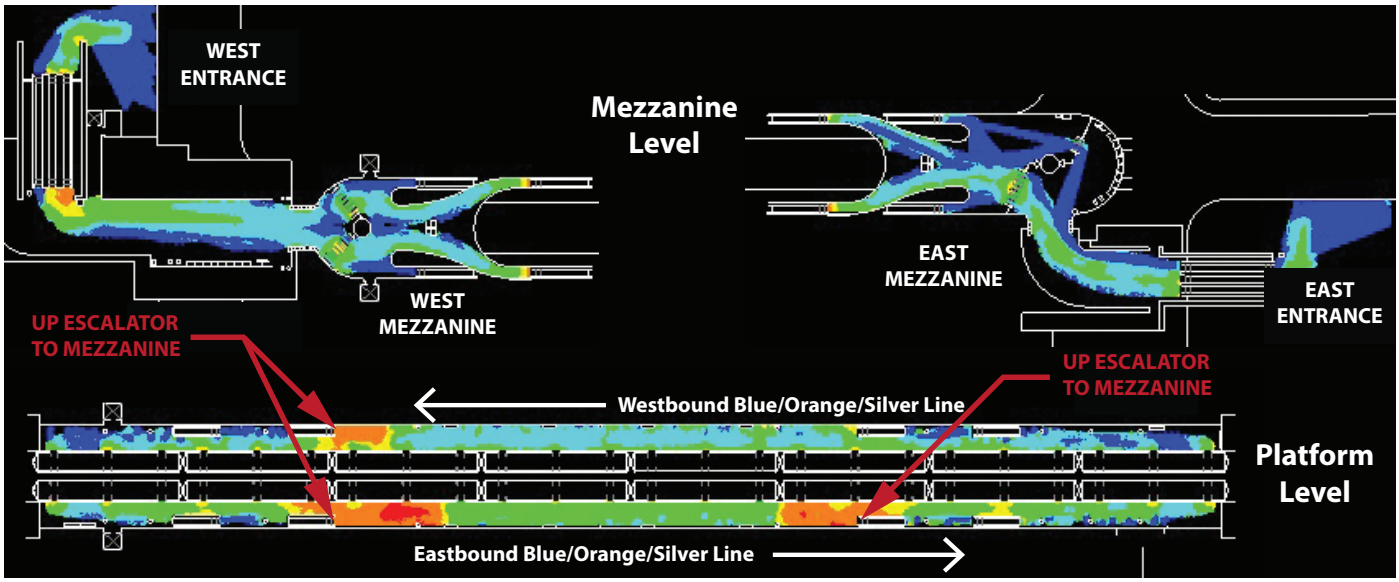
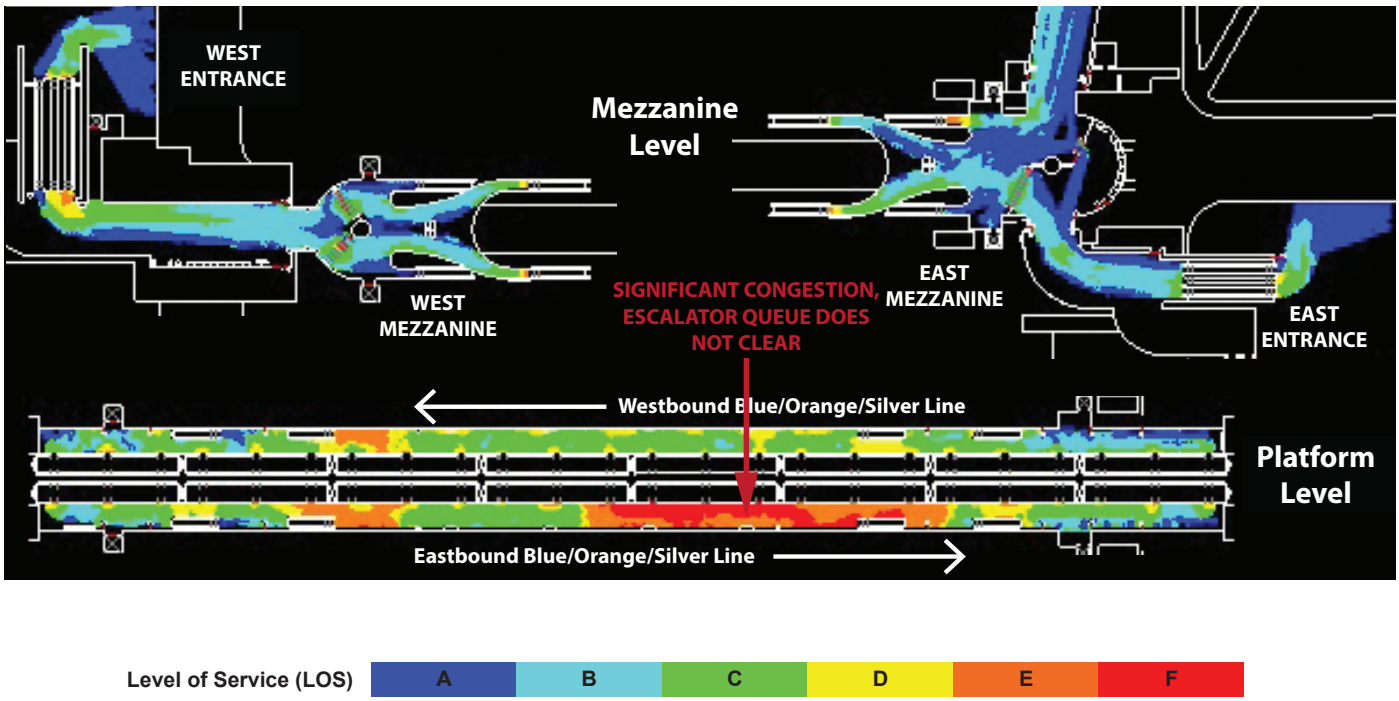


Figure ES-11 Farragut West with Pedestrian Tunnel - 2030 Mean Passenger Density, AM Peak 15 Minutes

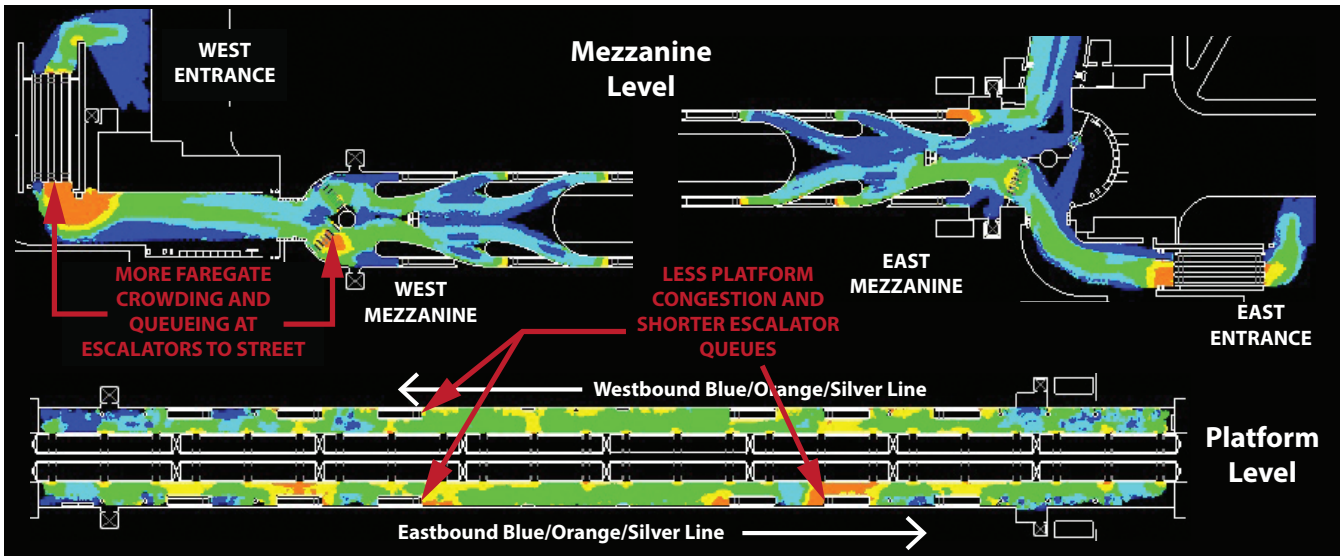


Effects of Additional Platform Escalators at Farragut West

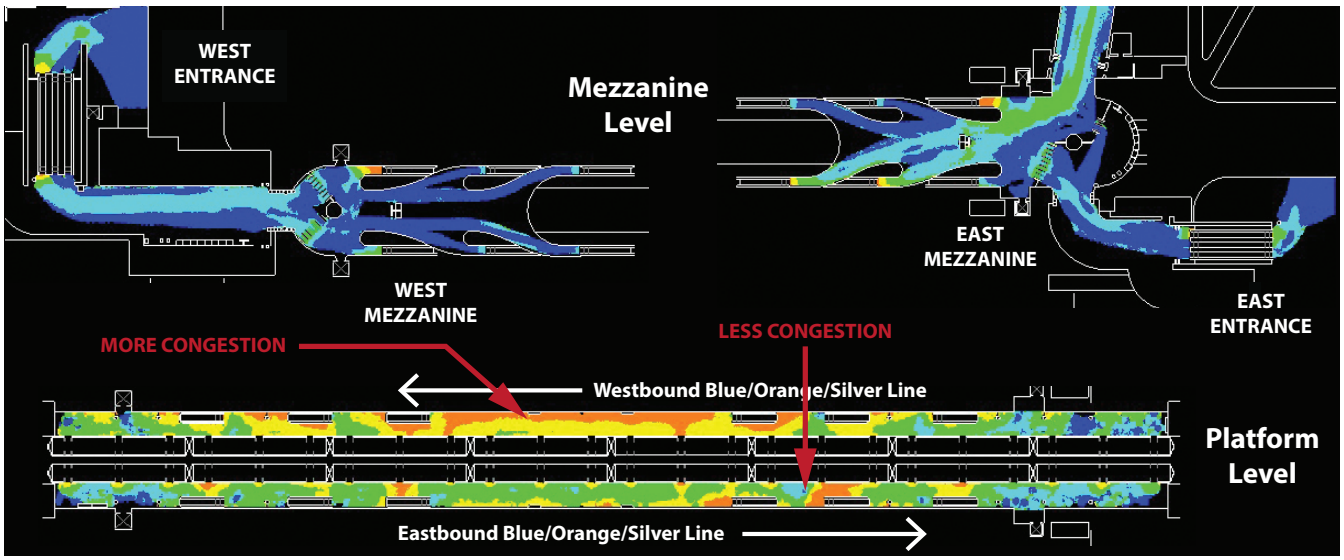
Figure ES-12 shows the effect of additional platform escalators on station conditions with the pedestrian tunnel. In the AM peak, the additional escalators significantly reduce platform congestion but shift crowding to the mezzanine level as a result of the faster platform egress. In the PM peak, the additional escalators relieve eastbound platform congestion from transfers to Farragut North but exacerbate westbound platform crowding by reducing the space available for waiting passengers.

Figure ES-12 Farragut West with Additional Platform Escalators and Pedestrian Tunnel - 2030 Mean Passenger Density

AM Peak 15 Minutes



PM Peak 15 Minutes



Level of Service (LOS) A B C D E F

Metro Center - Effect of Farragut Pedestrian Tunnel

Figure ES-13 illustrates the decrease in forecast passenger volumes for some transfer movements at Metro Center as a result of the Farragut pedestrian tunnel.

On the following pages**, Figure ES-14** shows the reduced congestion on the South Mezzanine and Red Line platforms, and **Figure ES-15** shows the reduced congestion on the Lower Platform as a result of the Farragut pedestrian tunnel. The effects are similar in the PM peak, but also with reduced Red Line platform crowding.

Metro Center transfer-related congestion (shown here) is reduced in some key areas of the station by the shift in transfer demand to the Farragut pedestrian tunnel

Figure ES-13 Comparison of 2030 Passenger Volumes at Metro Center - No Build and Build Forecasts

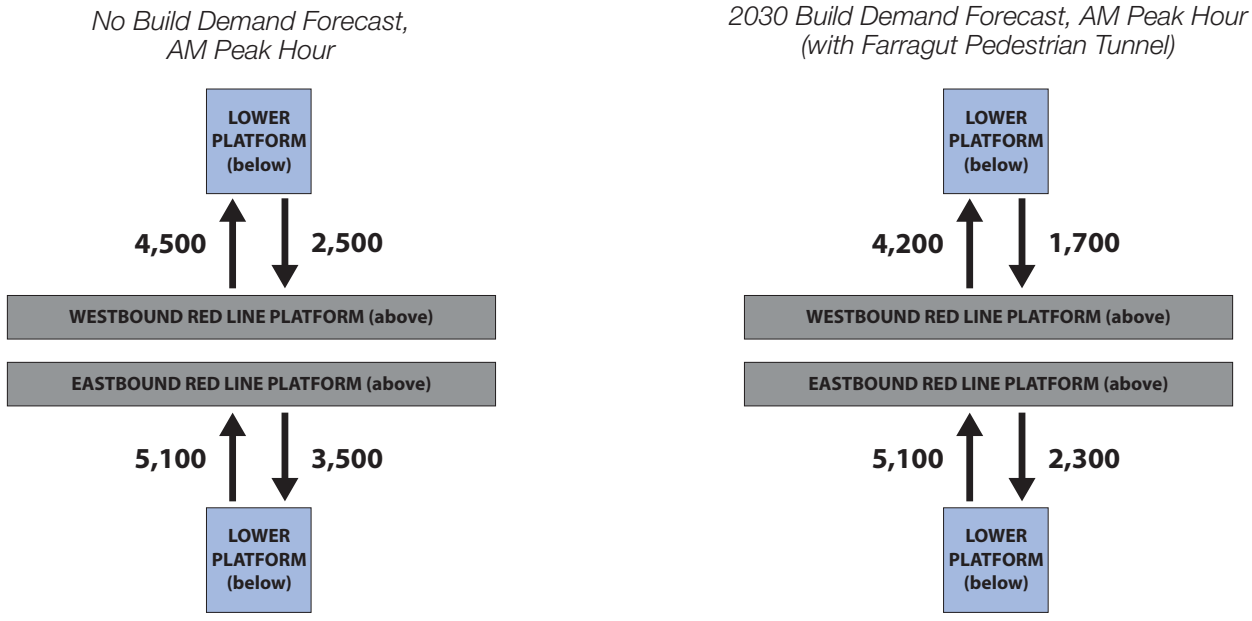
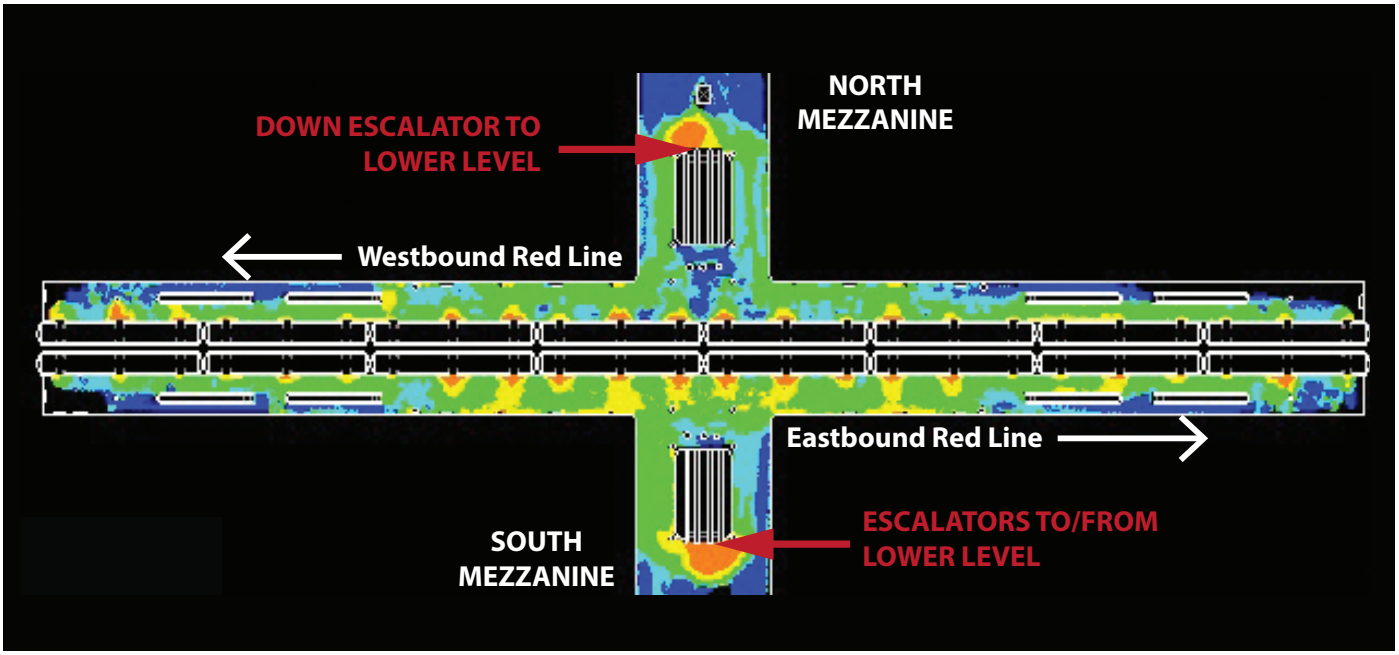


Figure ES-14 Metro Center Upper Level Platforms and Transfer Areas - 2030 Mean Passenger Density, AM Peak 15 Minutes

2030 No Build Condition



2030 Build Condition (with Farragut Pedestrian Tunnel)

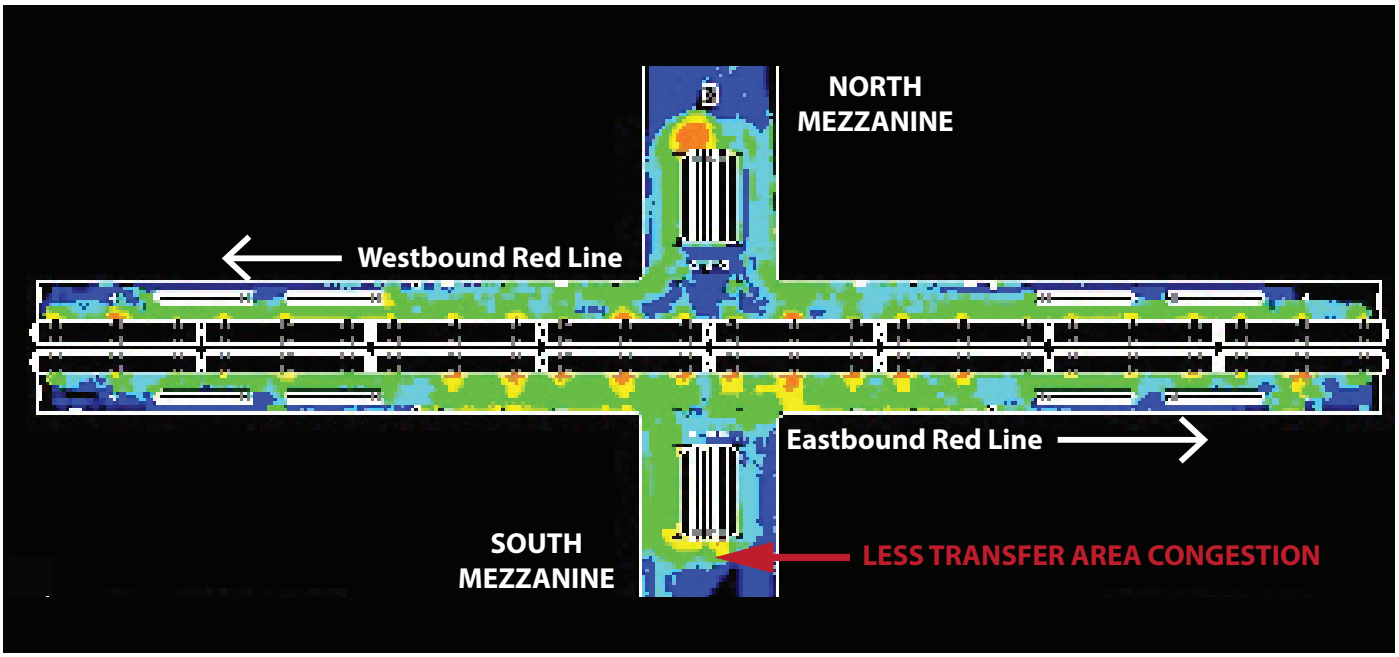
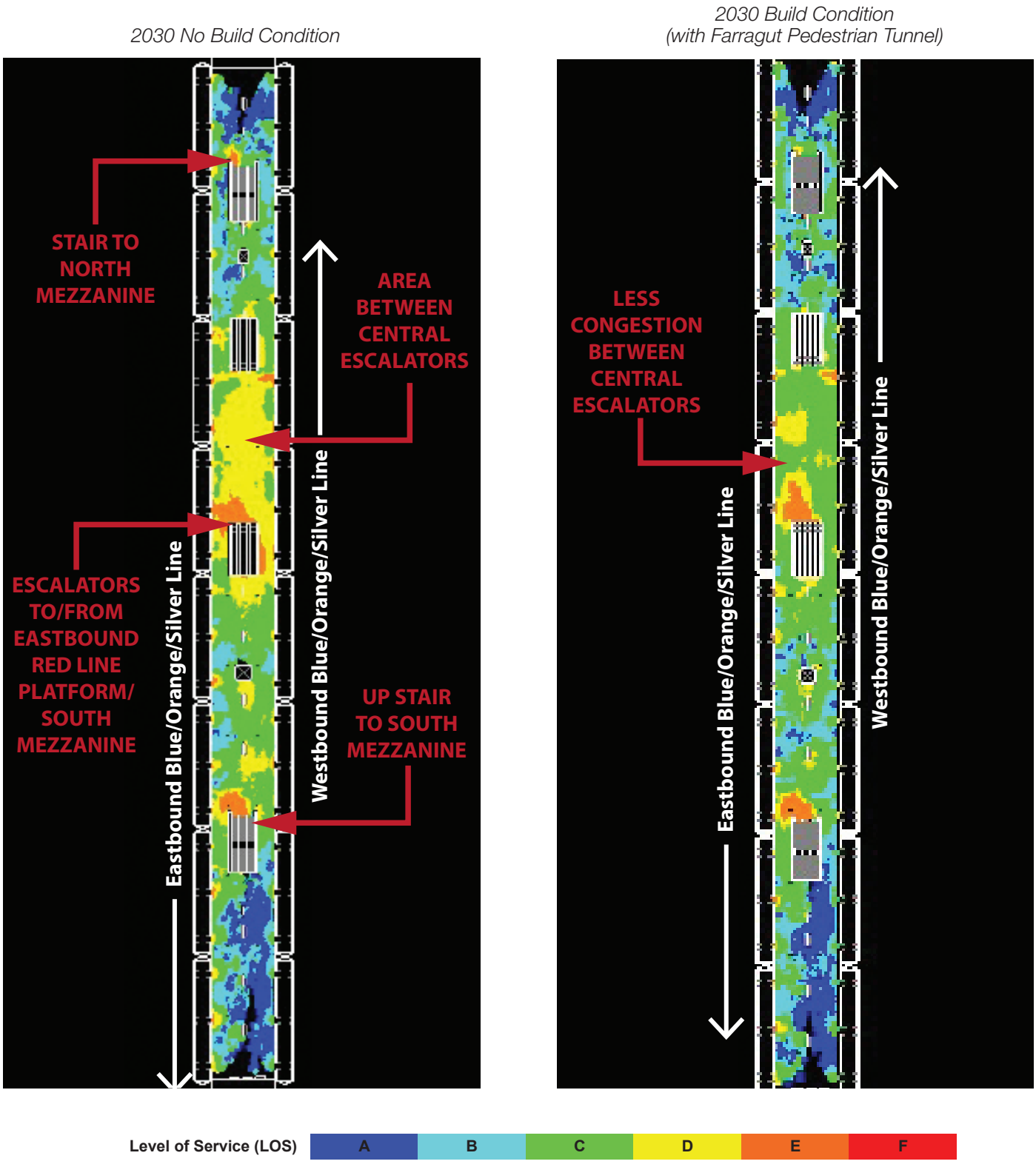


Figure ES-15 Metro Center Lower Level Platform – 2030 Mean Passenger Density, AM Peak 15 Minutes



Travel Time Savings

The primary market for the pedestrian tunnel is the transfer between the Shady Grove to Downtown DC segment of the Red Line and the Virginia to Foggy Bottom segments of the Blue, Orange, and Silver Lines. This transfer movement would have significant time savings as a result of the Farragut pedestrian tunnel. **Table ES-1** compares the average transfer times (under congested conditions) and minimum transfer times (under relatively uncongested conditions) for the different routes.

Comparison of Total Numbers of Passengers Experiencing Significant Crowding – with and without the Farragut Pedestrian Tunnel

Table ES-2 compares passenger density at the station level, showing that without additional capacity improvements, the Farragut pedestrian tunnel shifts crowding from Metro Center to the Farragut stations, but that additional capacity improvements at the Farragut stations can provide a net decrease in crowded conditions.

Table ES-1 Metrorail Transfer Times - 2030 No Build/Build Average Combined AM/PM Peak Hours

Red Line to/from Blue/Orange/Silver Lines	No Build (Metrorail via Metro Center)	No Build (via street level virtual transfer)	Build (via Pedestrian Tunnel)
Average Time per Passenger (mm:ss)	6:14	7:51	3:19
Minimum Time per Passenger (mm:ss)	5:35	6:17	1:39

Note: Metrorail journey time is 5 minutes on train between Farragut North and Farragut West stations via Metro Center based on schedule, plus pedestrian simulation transfer time within Metro Center. All times exclude train waiting time on the transfer and destination platforms.

Table ES-2 2030 Peak Hour Passengers Experiencing Significant Crowding (LOS E and F)

Station	2030 No Build Conditions		2030 Pedestrian Tunnel, with Basic Station Improvements[1]		2030 Pedestrian Tunnel, with Basic Station Improvements, Additional Farragut West Platform Escalators, and Improved Farragut North Tunnel Entrance[2]	
	# LOS E/F	% LOS E/F	# LOS E/F	% LOS E/F	# LOS E/F	% LOS E/F
Farragut North	4,400	7%	7,700	11%	4,400	4%
Farragut West	5,300	12%	11,600	21%	7,300	14%
Metro Center	18,500	16%	8,200	9%	8,200	9%
Combined Total: Farragut Stations + Metro Center	**28,300**	**13%**	**27,600**	**13%**	**19,900**	**8%**

Note: Totals may not add due to rounding.

1. Pedestrian simulation Build Alternative 1: includes Farragut Pedestrian Tunnel, Farragut North additional platform stairs, and single escalator pair connecting the pedestrian tunnel to the Farragut North platform.

2. Pedestrian simulation Build Alternative 3 (complete set of recommended improvement concepts): includes Farragut Pedestrian Tunnel, Farragut North additional platform stairs, additional Farragut West platform escalators, and Farragut North South Mezzanine extension and wide stair from tunnel entrance to platform.

The pedestrian tunnel with basic improvements at the Farragut stations results in no net decrease in passengers experiencing significant crowding among the three stations compared to the 2030 No Build condition. However, additional capacity improvements at Farragut North and Farragut West, combined with the pedestrian tunnel, provide a measurable net decrease in peak hour passengers experiencing significant crowding at the three stations, from 13 percent to 8 percent.

Capital Cost Estimates

Conceptual capital cost estimates for the station improvement concepts were developed based on WMATA specifications and industry practices (see **Table ES-3**). Construction costs are based on 2014 dollars and contract costs are escalated to the mid-point of construction (assumed to be mid-2021).

Summary of 2030 Station Conditions with the Farragut Improvement Concepts

Figures ES-16 and **ES-17** on the following pages provide an overview of station conditions at Farragut North and Farragut West Stations and at Metro Center Station, respectively, with the improvements and shift in passenger demand to the Farragut pedestrian tunnel.

Table ES-3 Conceptual Capital Cost Estimates

Cost Subtotal/ Total	Farragut North-West Pedestrian Tunnel*		Farragut North, Center Mezzanine Improvements	Farragut North, South Mezzanine Improvements	Farragut West, East Mezzanine Street Elevators	Farragut West, Additional Platform Escalators
	Option 1 (without Farragut North, South Mezzanine Extension)	Option 2 (with Farragut North, South Mezzanine Extension)				
Total Contract Cost (Hard + Soft Costs)	**$70.1 M**	**$73.2 M**	**$8.8 M**	**$14.2 M**	**$19.0 M**	**$16.9 M**

** Farragut North-West Pedestrian Tunnel costs include Farragut West, East Mezzanine platform elevators.*

Note: Costs are in 2014 dollars escalated to the mid-point of construction, 3rd quarter of 2021.

Figure ES-16 2030 Peak Period Conditions with Improvement Concepts - Farragut North and Farragut West

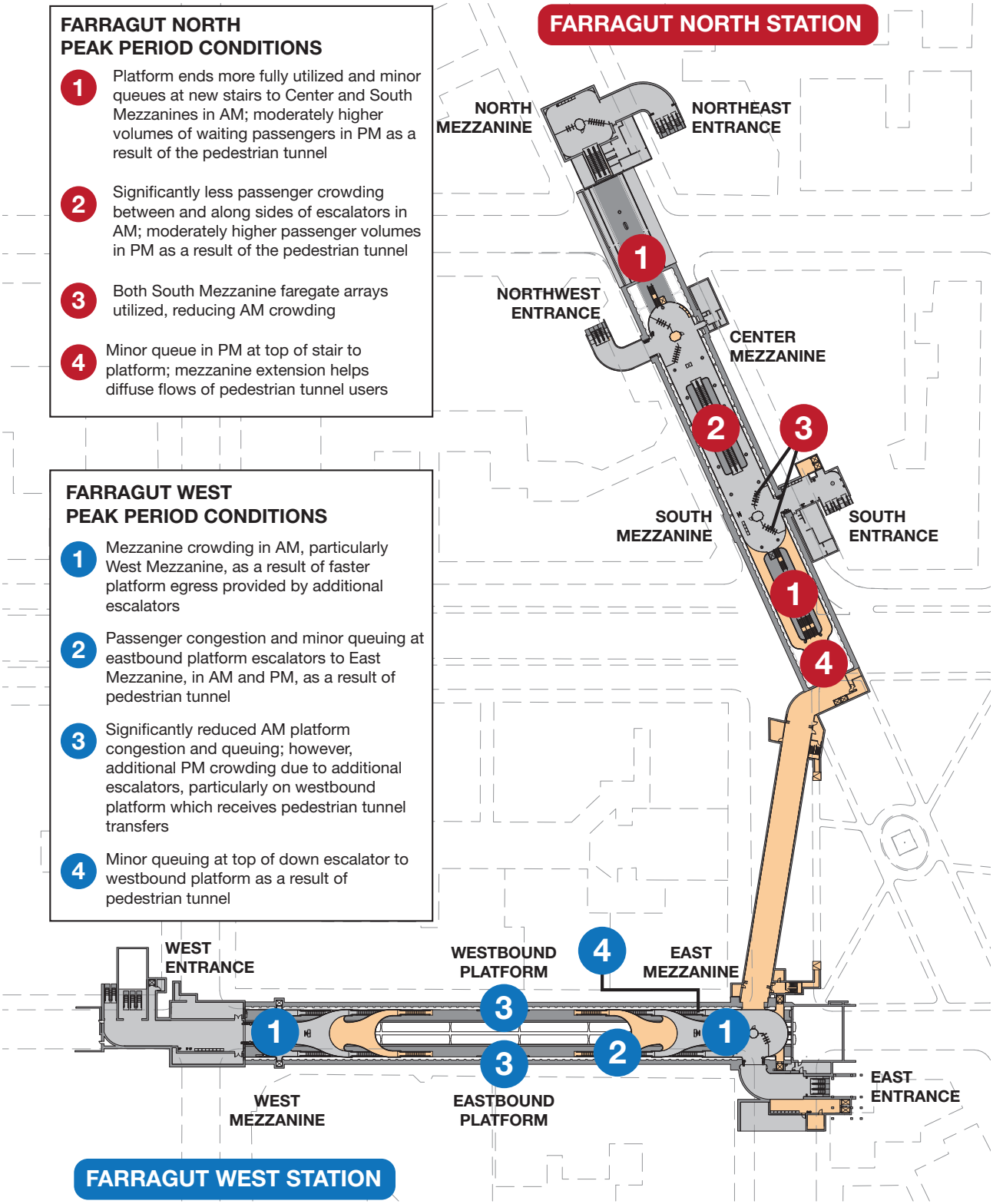
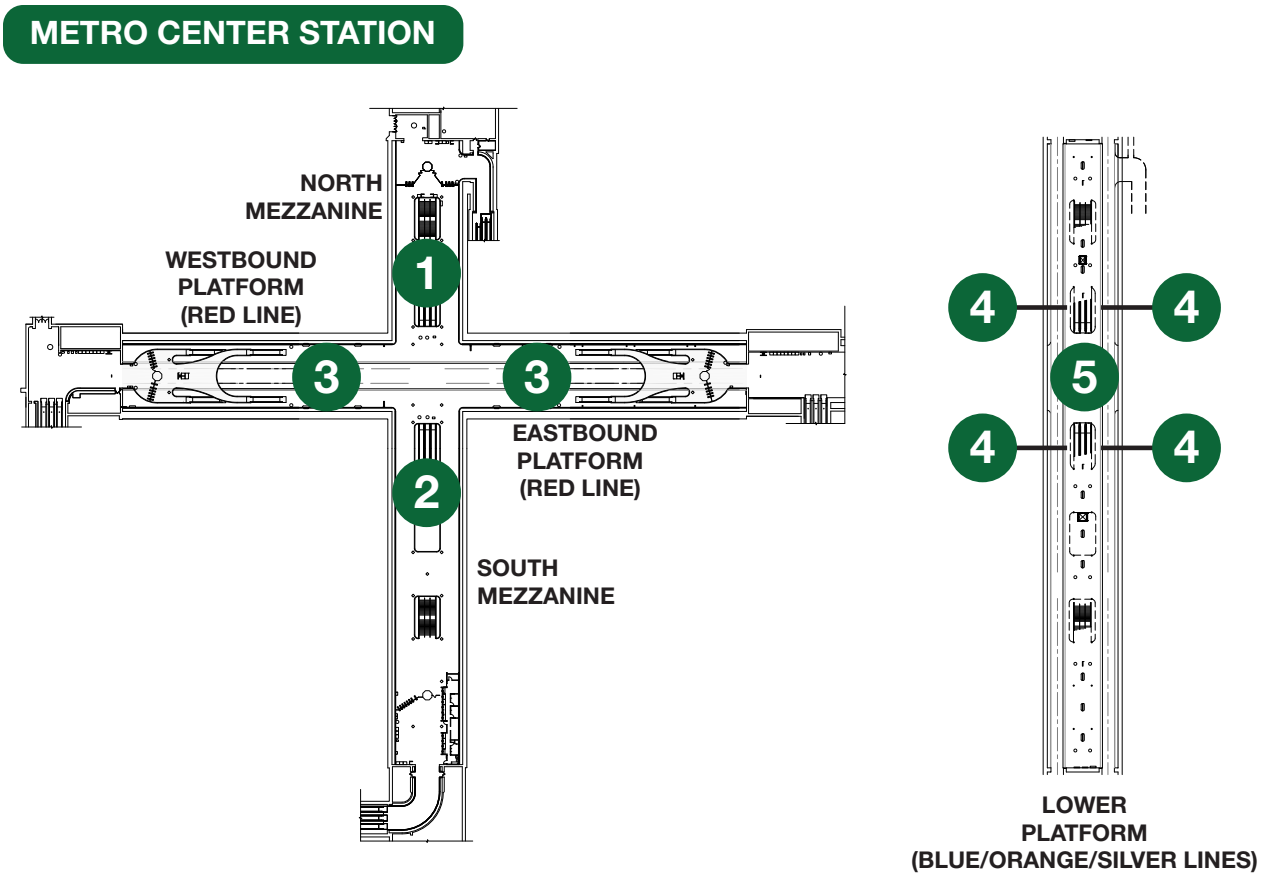


Figure ES-17 2030 Peak Period Conditions with Farragut Pedestrian Tunnel - Metro Center



METRO CENTER PEAK PERIOD CONDITIONS

1. North Mezzanine transfer area congestion, cross-flow conflicts, and escalator queuing largely unchanged
2. Significantly less South Mezzanine transfer area congestion, cross-flow conflicts, and escalator queuing
3. Reduced PM platform crowding
4. Less congestion between escalators and platform edges
5. Less congestion and cross-flow conflicts

Conclusions

By 2030, Farragut North, Farragut West, and Metro Center Stations will experience significant areas of passenger congestion based on Metrorail passenger forecasts and pedestrian model simulations. Implementation of the recommended capacity improvements at Farragut North and Farragut West along with the pedestrian tunnel will improve passenger conditions at both Farragut stations and at Metro Center. However, the set of improvement concepts identified by the current study does not address all pedestrian circulation deficiencies at the stations, and further study is needed.

Short-Term Improvements

Potential low-cost and operational improvements can be implemented in the short-term to help address existing deficiencies, in advance of more detailed structural analysis and design development required for the more in-depth improvement concepts. These proposed short-term improvements include:

- **Farragut North –** New stair from platform to southern end of South Mezzanine, taking advantage of existing pit in platform structure, and other station facility enhancements; and
- **Farragut West –** Additional standard faregate at East Mezzanine and shifting ADA faregate to less used array at West Mezzanine and swapping with a standard faregate.

Further Structural Analysis and Design

The current study's findings are not conclusive and do not provide an optimal solution for Farragut North, Farragut West, and Metro Center Stations. Proposed improvements that require further structural analysis or design in subsequent studies include:

- **Farragut Pedestrian Tunnel –** More detailed assessment of construction impacts.
- **Farragut North Station –** Further design of structural support of proposed South Mezzanine extension and assessment of adjacent building basement where new street elevator is proposed.
- **Farragut West Station –** Further design refinements to address PM platform crowding resulting from the additional platform escalators, structural analysis of new platform elevator location between East Entrance passageway and vault wall, assessment of basement of adjacent building where new street level elevators proposed as well as impact to street level circulation. Potential additional design concept ideas include a mezzanine bridge to provide additional circulation routes and help relieve congestion.
- **Metro Center Station –** Development of improvement concepts for the station that address congested areas not affected by the shift in transfer demand to the Farragut pedestrian tunnel, such as the North Mezzanine transfer area.

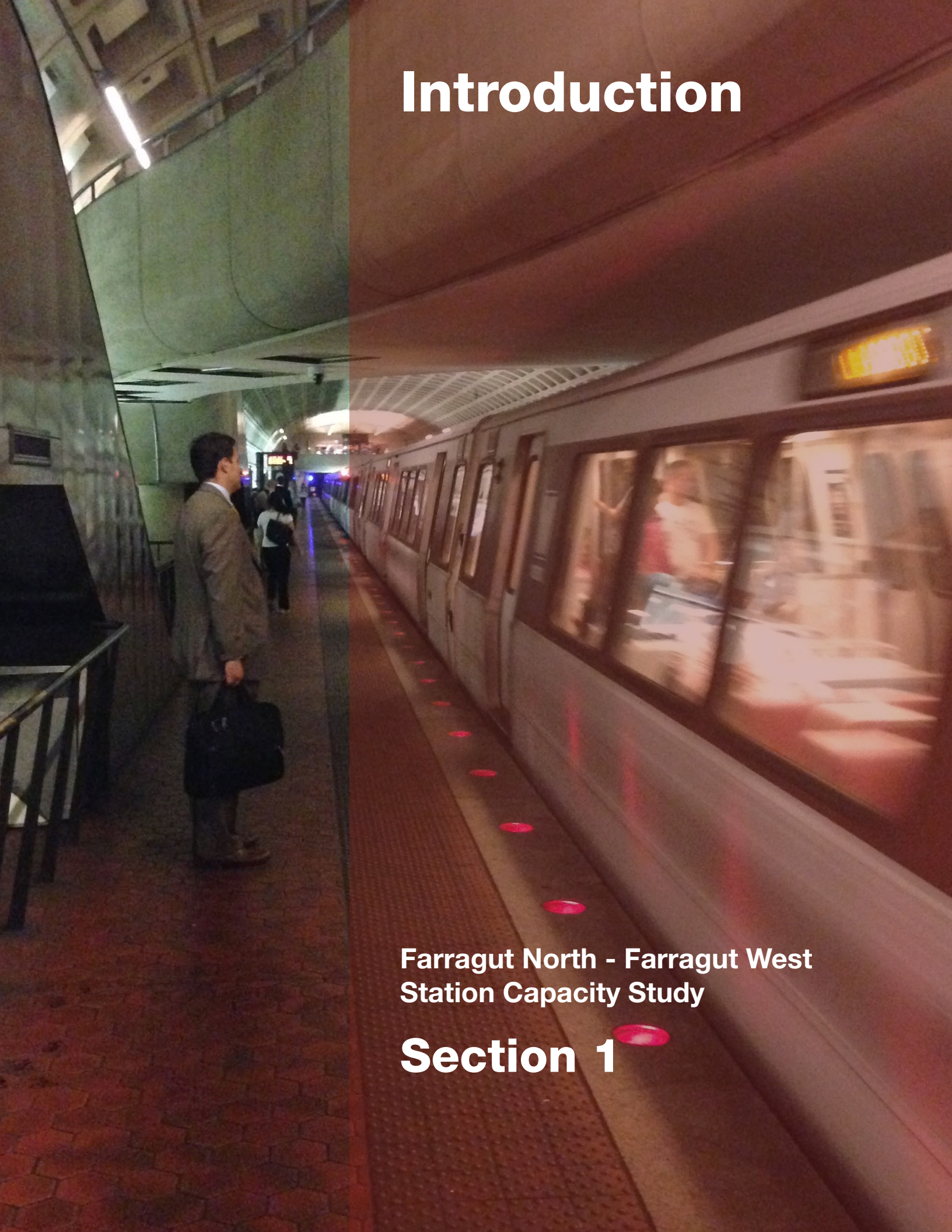
Long-Term Considerations

New Entrances

New entrances at Farragut West should be further explored to address the mezzanine crowding that results from adding platform escalators and providing faster egress following train arrivals, especially on the West Mezzanine. Additional entrances for both mezzanines, pending redevelopment of the adjacent buildings, could be investigated to help relieve the mezzanine level congestion. Alternatively, an east entrance for Foggy Bottom-GWU Station could be investigated as a way to help relieve demand at the Farragut West, West Mezzanine.

2040 New Metrorail M Street, NW Line

Farragut North Station would require additional study, particularly at the North Mezzanine, as plans for a new Metrorail line along M Street, NW are further developed as part of the *ConnectGreaterWashington 2040 Plan*. In current conceptual plans, a pedestrian tunnel would connect a new station at M Street, NW and Connecticut Avenue with Farragut North.



Introduction

Farragut North - Farragut West
Station Capacity Study

Section 1

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1.0 INTRODUCTION

This report summarizes the findings and conclusions of the Farragut North-Farragut West Station Capacity Analysis Study ("the study") conducted by the Washington Metropolitan Area Transit Authority (WMATA or "Metro").

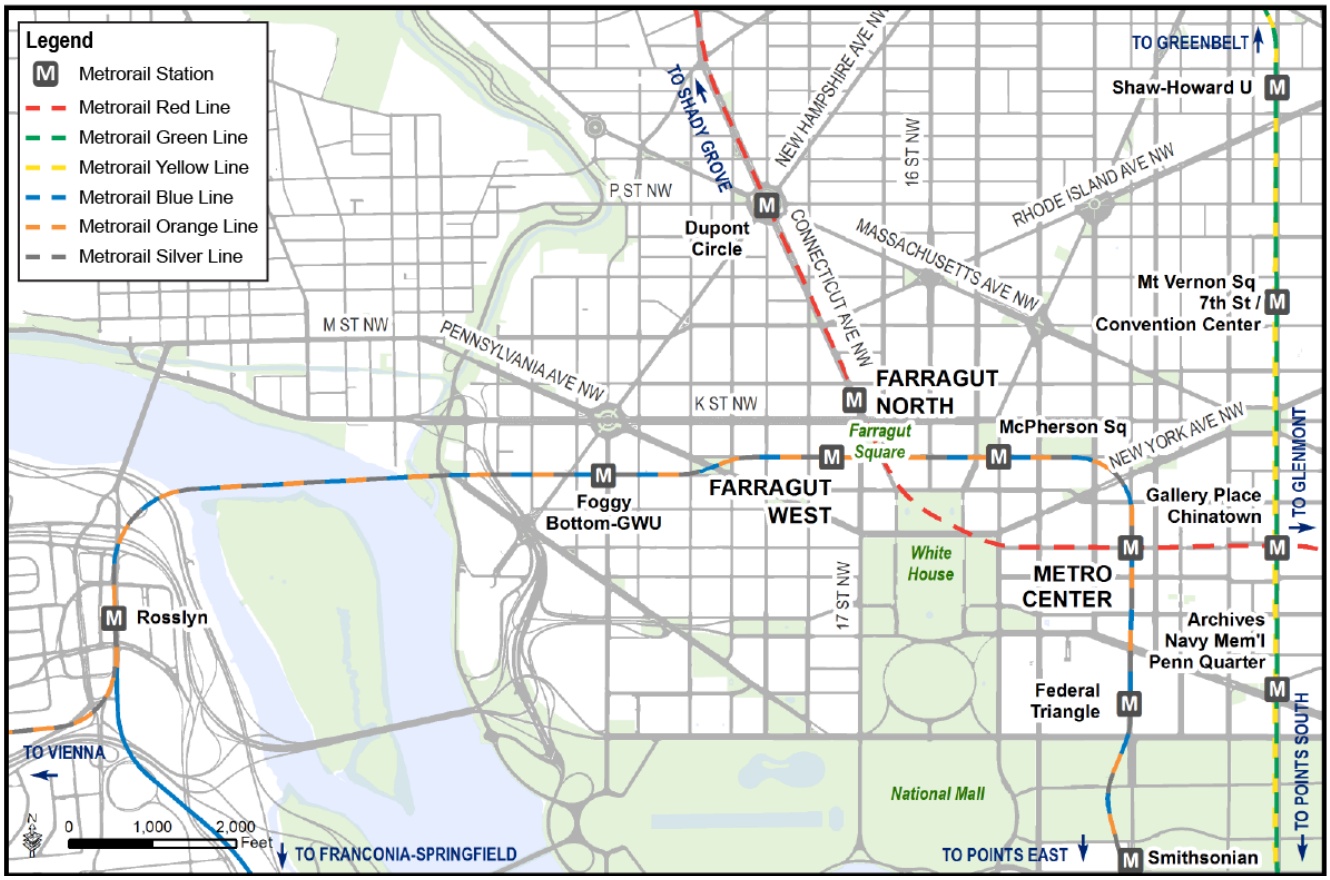
1.1 Study Purpose and Overview

The purpose of the study was to assess current and future station conditions, review previously developed improvement concepts, including the Farragut North-Farragut West pedestrian tunnel, and develop refined or new improvement concepts. The study had the following design objectives:

- Address current passenger circulation deficiencies within Farragut North and Farragut West stations;
- Accommodate future travel demand at Farragut North and Farragut West stations;
- Relieve current and future transfer demand at Metro Center station;
- Improve station accessibility at Farragut North and Farragut West stations; and
- Develop improvement concepts for Farragut North and Farragut West that are feasible to implement and enhance the user's experience.

The study assessed existing station conditions and future station conditions in 2030 at Farragut North, Farragut West, and Metro Center Stations using up-to-date travel demand forecasts and pedestrian simulation modeling. The assessment of future conditions also analyzed the effects of the planned

Figure 1-1 Farragut North, Farragut West, and Metro Center Stations within Downtown DC



pedestrian tunnel to accommodate transfers between the Farragut stations, including the effects on transfer activity and pedestrian circulation at Metro Center Station. Additional internal capacity improvements at the Farragut Stations were modeled and their designs refined based on the pedestrian simulation results. The study also developed accessibility improvements for Farragut North and Farragut West Stations.

1.2 Background

The Farragut Stations are located in Downtown District of Columbia (DC), at Farragut Square. Farragut North serves the Red Line, and Farragut West serves the Blue, Orange, and Silver Lines. The platforms of the two Farragut Stations are approximately 400 feet apart, while the transfer point between the lines served at the two stations is at Metro Center Station, which is approximately 3,500 feet (2/3 mile) southeast of the two stations (see **Figure 1-1**).

Planned Farragut Pedestrian Tunnel Connection

A connection between the Farragut North and Farragut West Stations has been envisioned since the early phases of construction of the Metrorail system. The stations are located on either side of Farragut Square, within a block of each other in the busy core of the Metrorail system. An underground pedestrian connection would conveniently accommodate transfers between the Red Line and the Blue, Orange, and Silver Lines. A "knock-out" panel was included in the vault wall of each station when the stations were constructed, allowing for easier construction of an entrance for the planned pedestrian tunnel at some point in the future. Previous studies for the pedestrian tunnel are summarized in **Section 1.3.**

Ridership Growth and Station Crowding

Farragut North, Farragut West, and Metro Center Stations are among the top five busiest stations in the Metrorail system in terms of daily passenger entries and exits. Metro Center also serves a high volume of transfers between Metrorail lines, currently the highest in the system. Ridership growth over the years has resulted in passenger crowding on various areas of the platforms, mezzanines, and escalators at the three stations. Metro has previously studied capacity improvements at the stations, as well as investigated the Farragut pedestrian tunnel as a way to partly relieve the high transfer demand at Metro Center.

1.3 Previous Studies

The current study builds on the following previous studies conducted by Metro.

Farragut North-Farragut West Passageway Study (Metro, 2004)

The *Farragut North-Farragut West Passageway Study* analyzed the design, construction feasibility, and travel demand for a pedestrian tunnel between Farragut North and Farragut West stations. The study developed three design options that included a pedestrian tunnel along with options that included a moving walkway and retail opportunities.

The tunnel concepts also included new street-level and platform-level elevator access at the Farragut West East Mezzanine. The current study's design concept for the pedestrian tunnel is based on the 2004 design and incorporates some refinements to the tunnel entrances and elevator improvements at each station.

100% Eight-Car Train Implementation Plan (Metro, 2013)

The *100% Eight-Car Train Implementation Plan Final Report* identified the necessary short- and long-term capital improvements necessary to operate 100-percent eight-car trains across the Metrorail system. The plan also identified secondary improvements needed to accommodate increased customer demand resulting from the expanded Metrorail service. For the Farragut stations, these recommended capacity improvements included the pedestrian tunnel and the following internal improvements:

Farragut North

- New escalators and stairs from the Center Mezzanine and South Mezzanine to the platform;
- Extension of the South Mezzanine to accommodate additional escalators; and
- Additional faregates at the Center and South Mezzanines.

Farragut West

- Additional sets of platform escalators and expanded East and West Mezzanines;
- East Mezzanine elevator improvements; and
- Additional faregates at the East Mezzanine.

The current study used these recommended capacity improvements from the Eight-Car Train study as the initial basis for the design concepts and made refinements based on more detailed concept designs and the findings of the pedestrian model simulations.

Momentum (Metro, 2013)

Momentum, Metro's strategic plan, looked at the necessary medium-range capital improvements necessary for Metro to respond to the current and future ridership demand on the Metrorail, Metrobus, and MetroAccess systems, with a horizon year of 2025. These improvements included all eight-car train operations and station capacity enhancements in Downtown DC.

At the Farragut stations, Momentum recommended the following improvements:

- Farragut North-Farragut West pedestrian tunnel;
- Additional internal vertical circulation and faregate capacity at both Farragut Stations; and
- Farragut West increased platform capacity.

Other Metro Core Capacity Plans

The *Metrorail Station Access and Capacity Study* (2008) assessed future capacity needs, recommending a Farragut North-Farragut West pedestrian tunnel and new escalators at Farragut North and Metro Center Stations. The *Metrorail Core Capacity Study* (2001) analyzed ridership growth and identified necessary operating strategies and capital investments necessary for Downtown DC, including the Farragut North-Farragut West pedestrian tunnel.

1.4 Report Organization

The final report for the study is organized as follows:

Section 1: Introduction

Introduces the study and provides project background.

Section 2: Existing Conditions

Summarizes the layout, facilities, operations, and pedestrian circulation conditions within Farragut North, Farragut West, and Metro Center Stations.

Section 3: Future Travel Demand and Station Conditions

Forecasts 2030 Metrorail ridership at the stations and summarizes internal station conditions based on pedestrian simulation modeling.

Section 4: Station Improvement Concepts

Depicts the design process and recommended improvement concepts at Farragut North and Farragut West Stations.

Section 5: Simulation Modeling of Future Improvement Concepts

Summarizes the results of pedestrian simulation modeling of the improvement concepts with regard to 2030 conditions at Farragut North, Farragut West, and Metro Center Stations.

Section 6: Summary Evaluation and Conclusion

Evaluates the improvement concepts and reports the key findings of the study and next steps.

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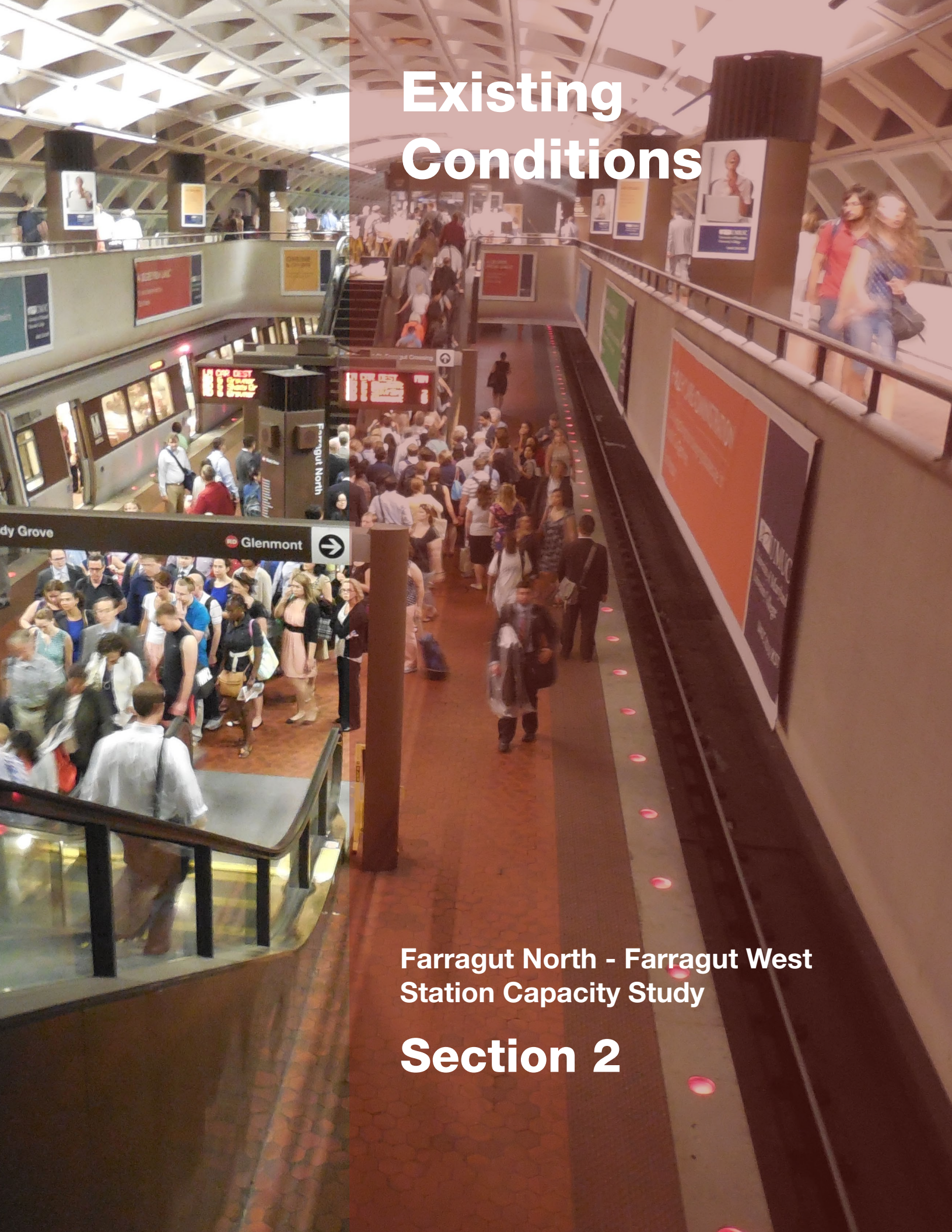

Existing Conditions

Farragut North - Farragut West Station Capacity Study

Section 2

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2.0 EXISTING CONDITIONS

This section summarizes existing conditions at Farragut North, Farragut West, and Metro Center Metrorail Stations, including facilities and layouts, operations, planning context, and pedestrian circulation conditions. The description of Metro Center Station focuses on the internal facilities and conditions.

2.1 Station Overview

Figure 2-1 shows the Farragut stations, their entrance locations and the surrounding Farragut Square area.

Station Characteristics

Farragut North, Farragut West, and Metro Center are urban stations accessed primarily by pedestrians and served by on-street bus stops. The stations do not have dedicated Kiss & Ride or Park & Ride facilities. **Table 2-1** summarizes the lines served by each station, number of entrances, and ridership.

Due to the surrounding high-density employment center with comparatively little residential use, the stations experience a surge of exits during the AM peak period and a surge of entries during the PM peak period, during which 8:00 am to 9:00 am and 5:00 pm to 6:00 pm are the peak hours. In addition, Metro Center serves a high volume of transfers between Metrorail lines.

Farragut Square between Farragut North and Farragut West Stations

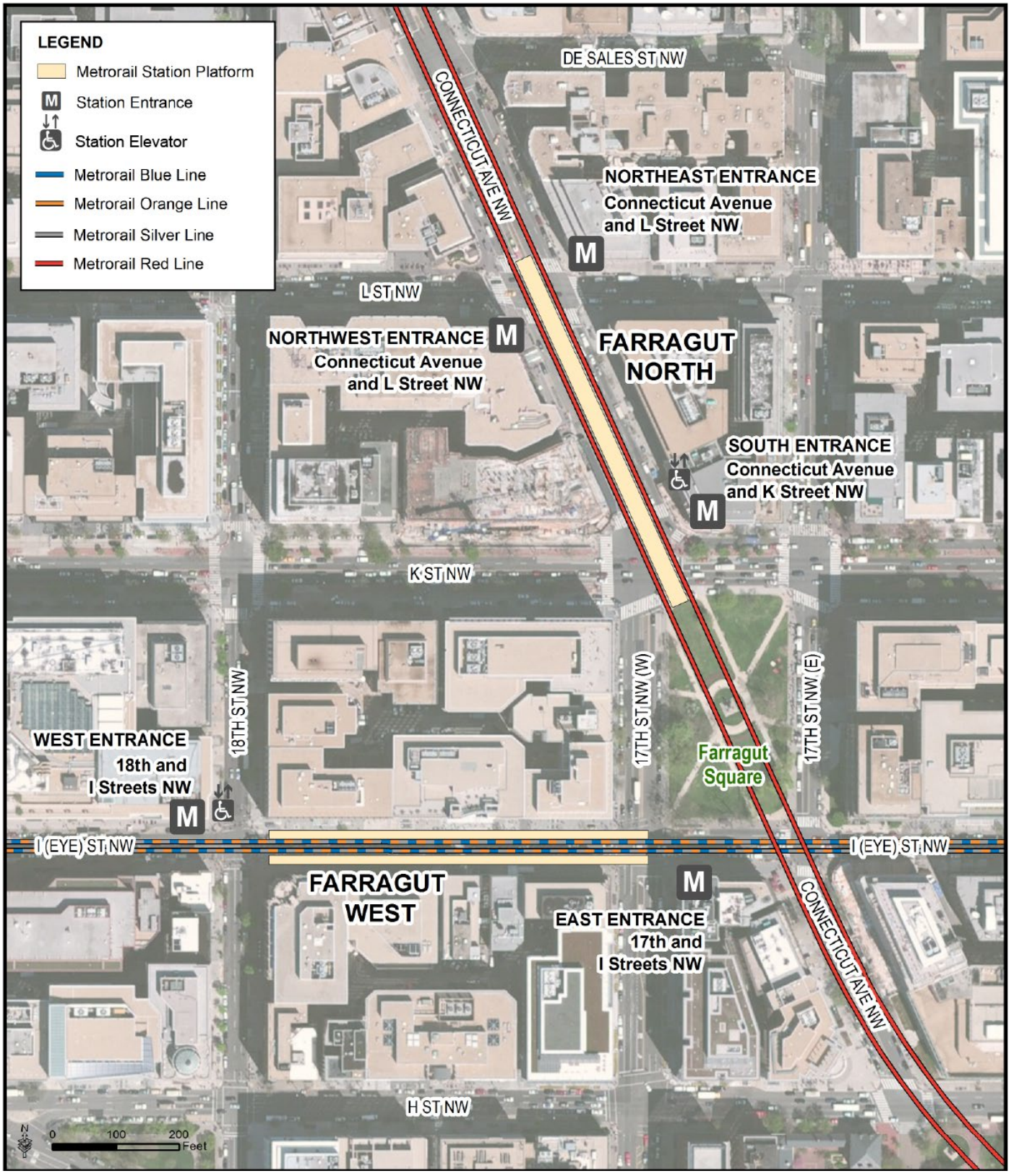
Table 2-1 Farragut North, Farragut West, and Metro Center Station Overview

Station	Lines Served	Number of Entrances	2013 Weekday Entries	2013 Weekday Transfers
Farragut North	Red	3	26,500	800*
Farragut West	Blue, Orange, Silver	2	22,800	
Metro Center	Blue, Orange, Red, Silver	4	28,300	84,700

Sources: 2013 weekday boardings from WMATA October 2012 Faregate data; 2013 Metro Center transfers from WMATA RTSP model line load application (March 2014); Farragut transfers from WMATA NCS Rail-to-Rail Transfer Analysis (March 2014)

**Street-level transfers between Farragut stations (free exit and entry at opposite Farragut station with SmarTrip card within 30 minutes)*

Figure 2-1 Farragut Square Area with Farragut Stations



Metrorail Operations

Currently, the Orange, Blue, Silver, and Red, Lines use a mix of 6-car and 8-car trains during peak periods. **Table 2-2** lists peak headways of trains serving the Farragut Stations and Metro Center both prior to and after commencement of Silver Line Phase 1 Operations.

Table 2-2 Comparative Train Headways at Farragut and Metro Center Stations with Rush + and Silver Line Phase 1 Operations

Line	Pre-August 2014 Operations (Rush+ Service) (minutes)	Current Operations with Silver Line Phase 1 (minutes)
Red	3	3
Blue	6/6/12*	12
Orange	3	6
Silver	--	6

**Blue Line Train headways represent AM Peak/PM Peak/Off-Peak Configuration*

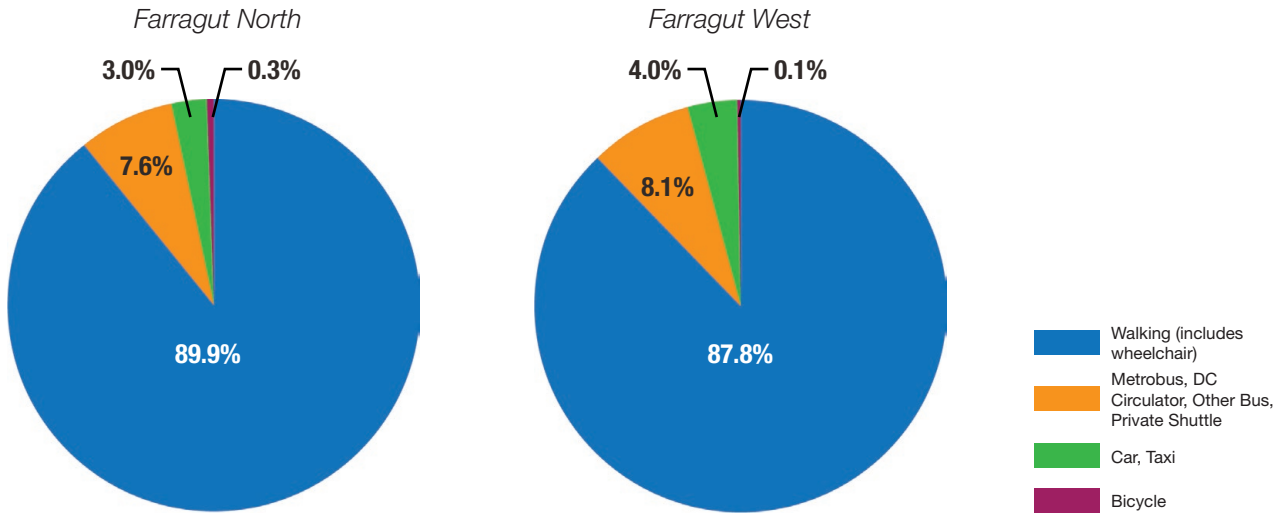
Farragut North and Farragut West Station Access

The Farragut Stations are primarily pedestrian-oriented stations, with bus access being their next most significant access mode. **Figure 2-2** shows the relative shares of access modes at each station based on the 2012 Metrorail Passenger Survey.

Pedestrians access the two Farragut stations from all directions in their immediate vicinity, given the evenly spread office blocks and fine-grained street network in Downtown DC. In addition, pedestrians coming from north of Farragut Square use Farragut West Station to access the Blue, Orange, and Silver Lines, bypassing Farragut North Station to avoid the transfer at Metro Center. Likewise, pedestrians coming from south and west of Farragut West Station walk directly to Farragut North to access the Red Line.

As a result, Farragut Square walkways are important links for Metrorail passengers entering and exiting the system. Although the SmarTrip Card system allows free street-level transfers between the Farragut stations, a relatively small number of Metrorail passengers use this "virtual" transfer option between the two stations (approximately 800 per day).

Figure 2-2 Farragut Stations Access Mode



Source: WMATA Metrorail Passenger Survey, 2012

2.2 Station Facilities and Layout

Farragut North

Farragut North Metrorail Station has three entrance mezzanines and a center platform. **Table 2-3** summarizes the faregate and vertical circulation capacity provided at each mezzanine.

Figures 2-3 and **2-4** on the following pages depict the mezzanine and platform level layouts and escalator operations.

Table 2-3 Farragut North Mezzanines - Faregate and Vertical Circulation Capacity

Mezzanine	Faregates		Vertical Circulation Elements			
	Standard	ADA	Escalator		Elevator	
			Street to Mezzanine	Mezzanine to Platform	Street to Mezzanine	Mezzanine to Platform
North	7	1	3	3	0	0
Center	7	1	3	2	0	0
South	8	2	3	2	1	1

Center Mezzanine with faregates and station kiosk, the Northwest Entrance is on the left

South end of platform looking towards the South Mezzanine

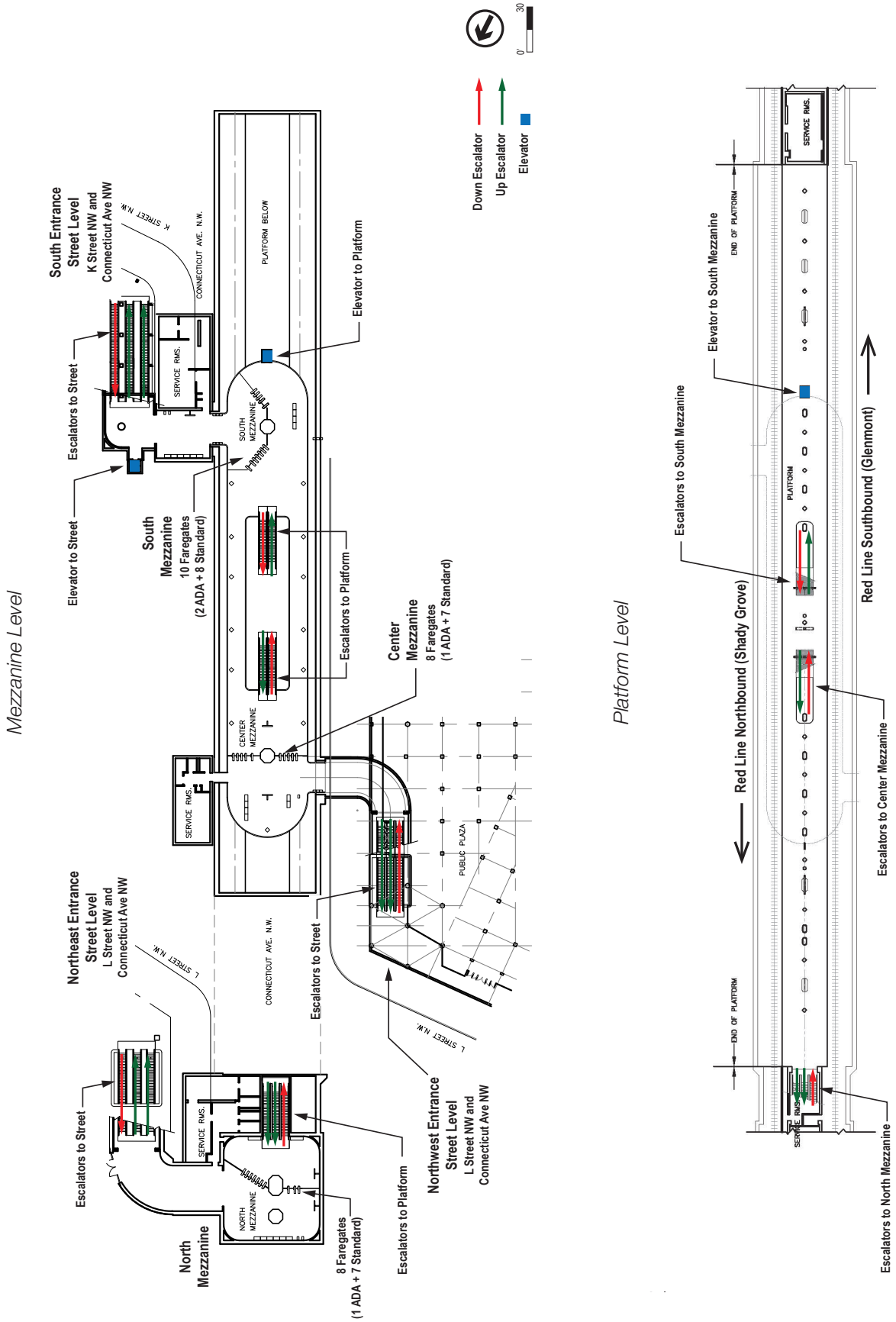


Figure 2-3 Farragut North Station Layout (Plan View)

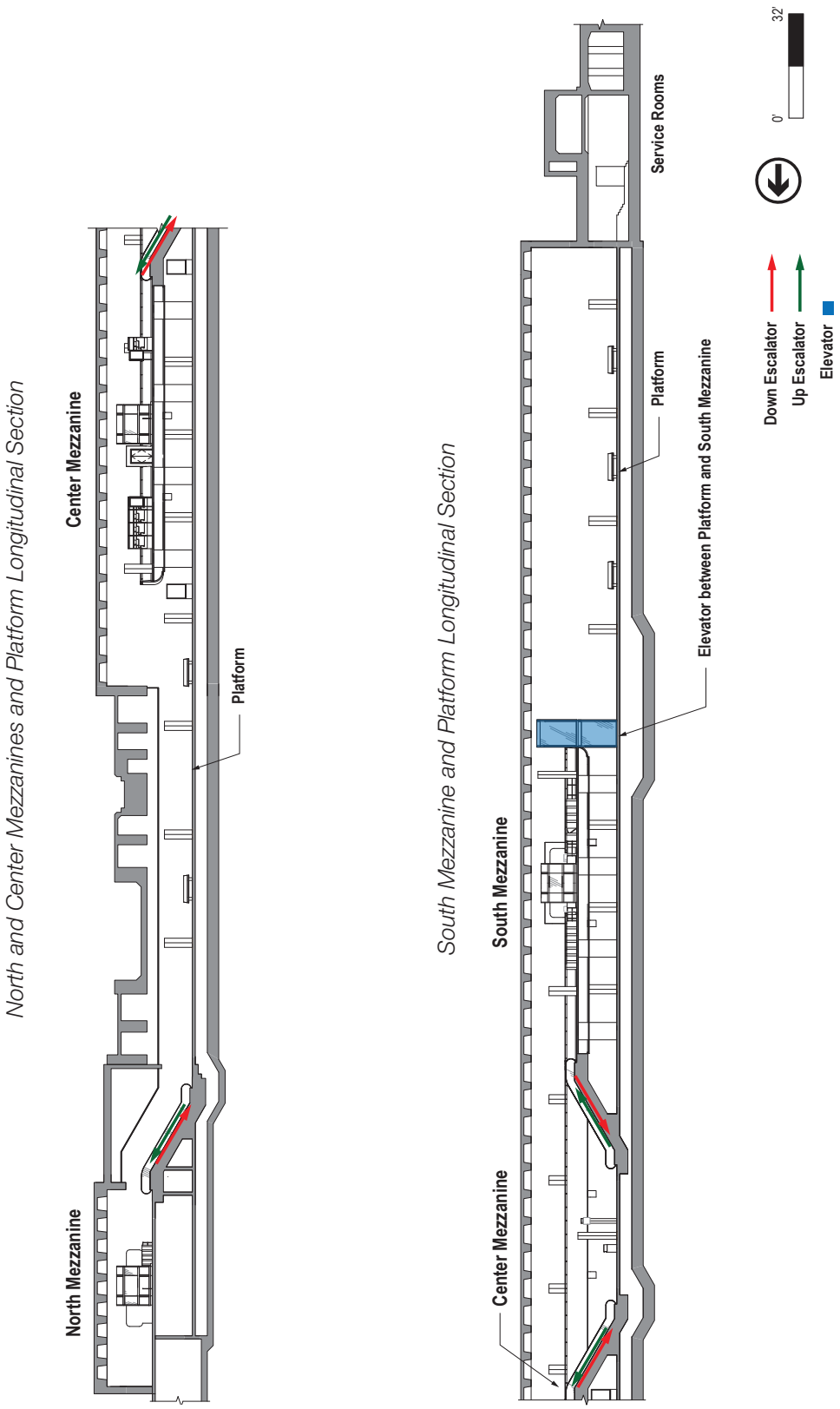


Figure 2-4 Farragut North Station Layout (Section View)

Farragut West

Farragut West Metrorail Station has two entrance mezzanines and two side platforms. **Table 2-4** summarizes the faregate and vertical circulation capacity provided at each mezzanine.

Figures 2-5 and **2-6** on the following pages depict the mezzanine and platform level layout and escalator operations.

Table 2-4 Farragut West Mezzanines - Faregate and Vertical Circulation Capacity

Mezzanine	Faregates		Vertical Circulation Elements			
	Standard	ADA	Escalator		Elevator	
			Street to Mezzanine	Mezzanine to Platform	Street to Mezzanine	Mezzanine to Platform
East	8	1	3	4	0	0
West	11	1	3	4	1	2

Westbound platform, looking towards the East Mezzanine

East Mezzanine Faregates (array on south side of kiosk), looking towards the East Entrance passageway

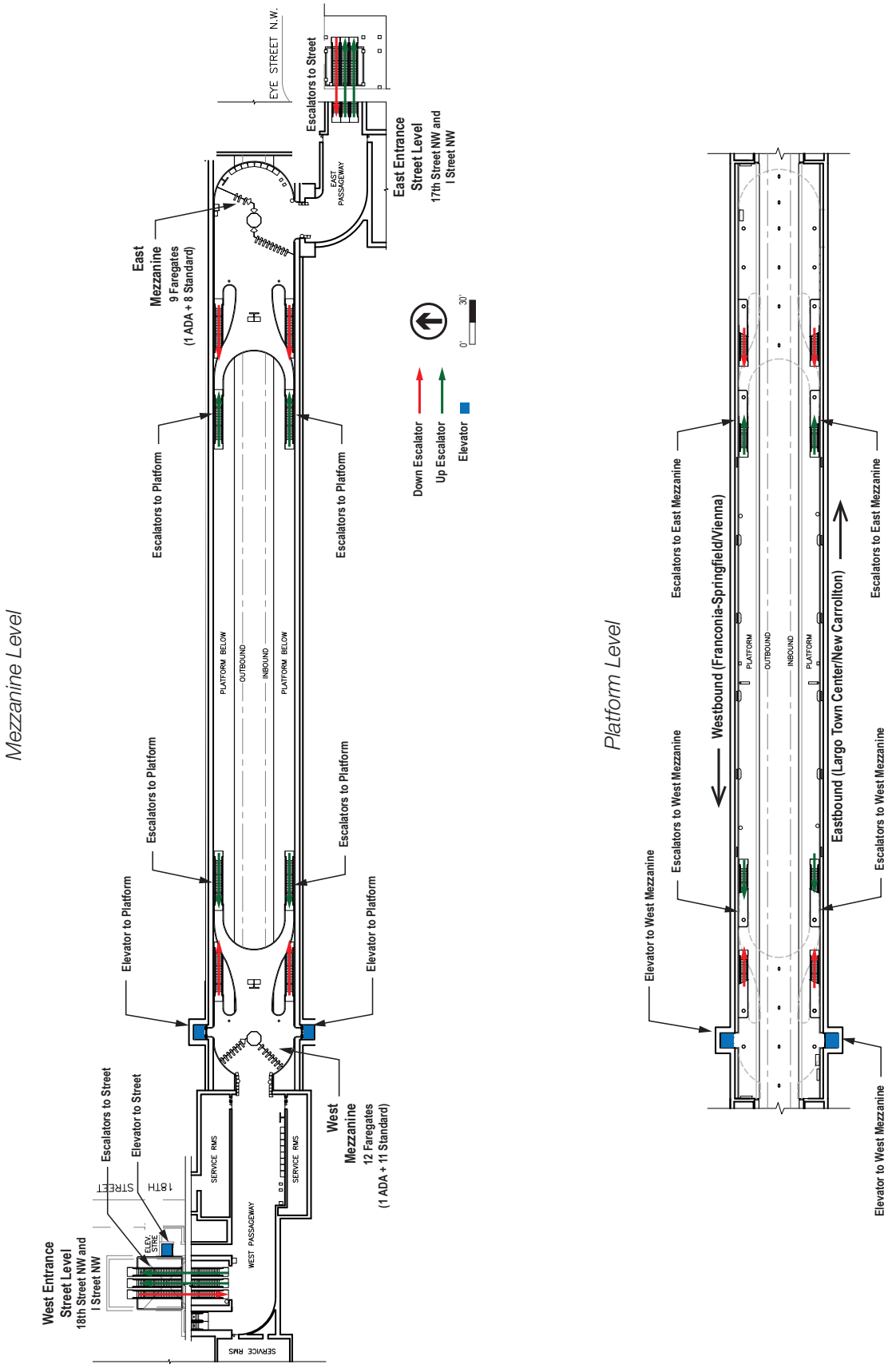


Figure 2-5 Farragut West Station Layout (Plan View)

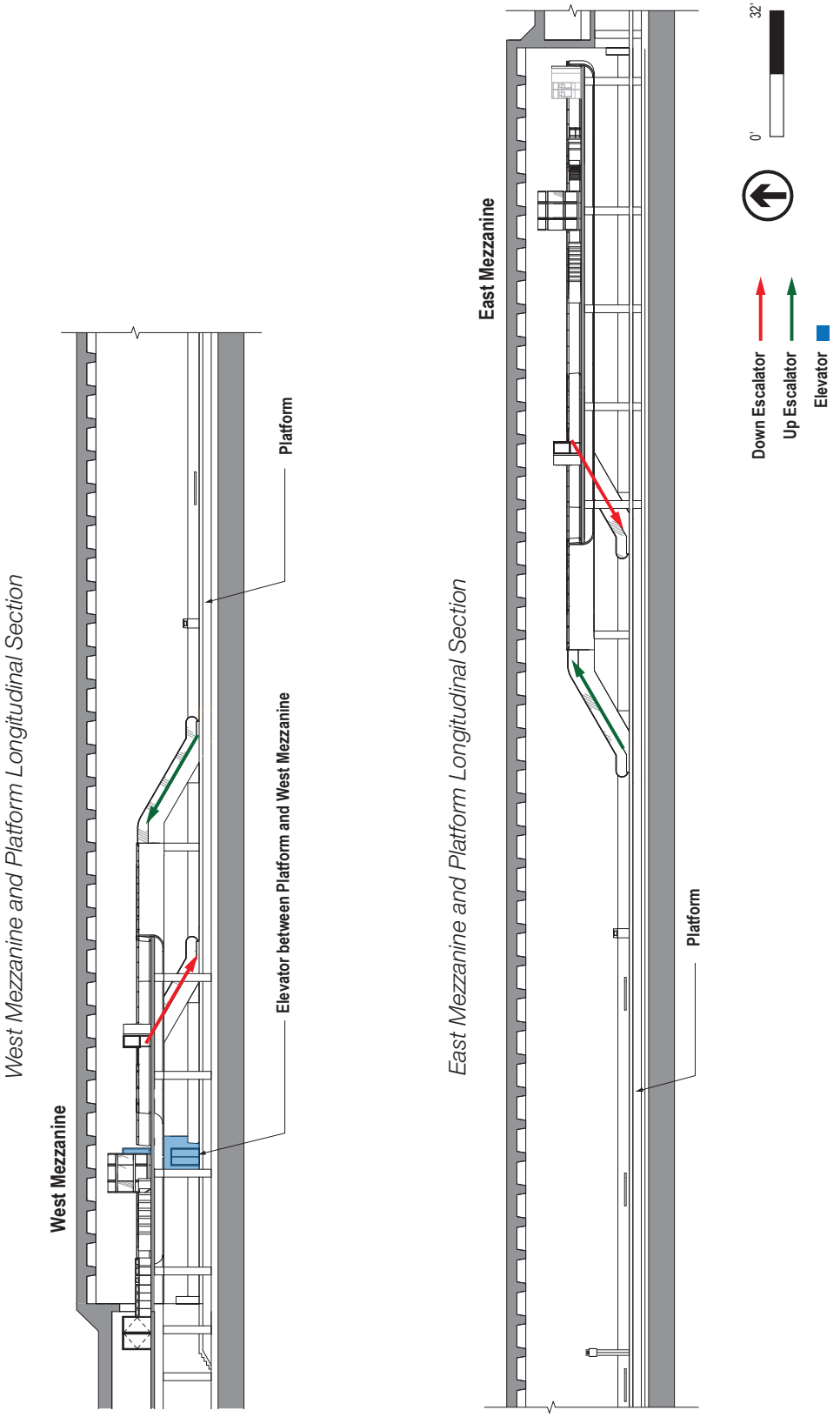


Figure 2-6 Farragut West Station Layout (Section View)

Metro Center (Transfer Areas)

Metro Center Metrorail station has four entrance mezzanines and two platform levels: the upper platform level for the Red Line and the lower platform level for the Blue, Orange, and Silver Lines. The north and south mezzanines are located at the upper platform level and serve as transfer areas between the two platform levels.

Table 2-5 summarizes the station's vertical circulation capacity between platform levels. **Figure 2-7** on the following page depicts the upper and lower platform levels, focusing on the main transfer areas, and escalator operations.

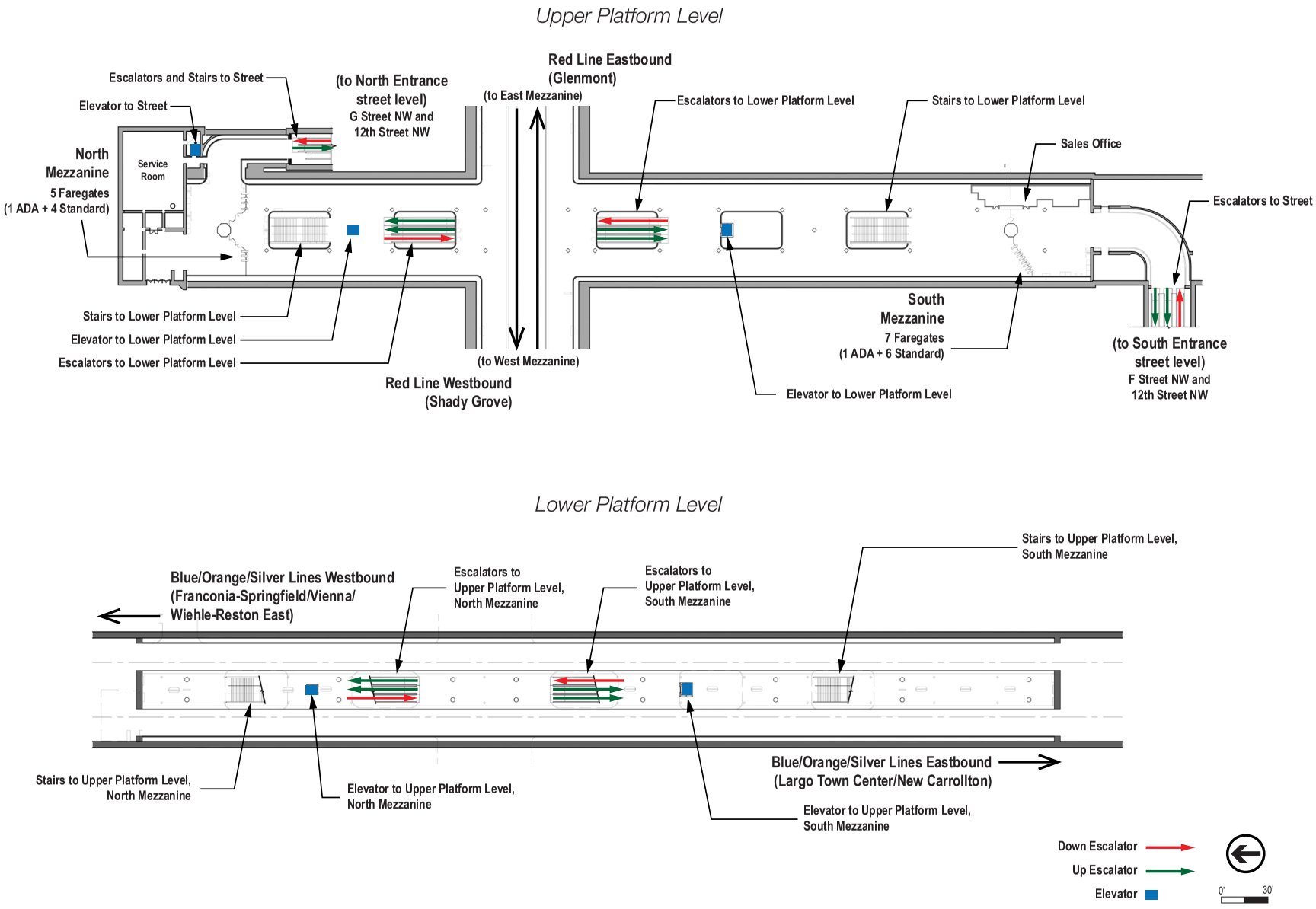
Table 2-5 Metro Center Transfer Areas - Vertical Circulation Capacity

Transfer Area	Vertical Circulation Elements - Between Platform Levels		
	Escalators	Stairs	Elevator
North Mezzanine Westbound Red Line Platform)	3	3 (single bay)	1
South Mezzanine (Eastbound Red Line Platform)	3	3 (single bay)	1

Upper platform level (North Mezzanine): passengers transferring to the lower platform level

Lower platform level: passengers exiting to the South Mezzanine

Figure 2-7 Metro Center Station Layout (Plan View, Transfer Areas)



2.3 Station Area and Planning Context

The Farragut stations are located in downtown District of Columbia, a dense commercial district that includes mostly office buildings with some retail uses, government buildings, and limited residential properties. **Figure 2-8** shows the existing land use within the Farragut Square area. The District of Columbia Comprehensive Plan (2006) recommends that the area's land use and zoning continue to remain largely the same.

The Farragut Square area is mostly built out, and no major redevelopment projects are underway or planned.

Pedestrians walking between Farragut North and Farragut West Stations

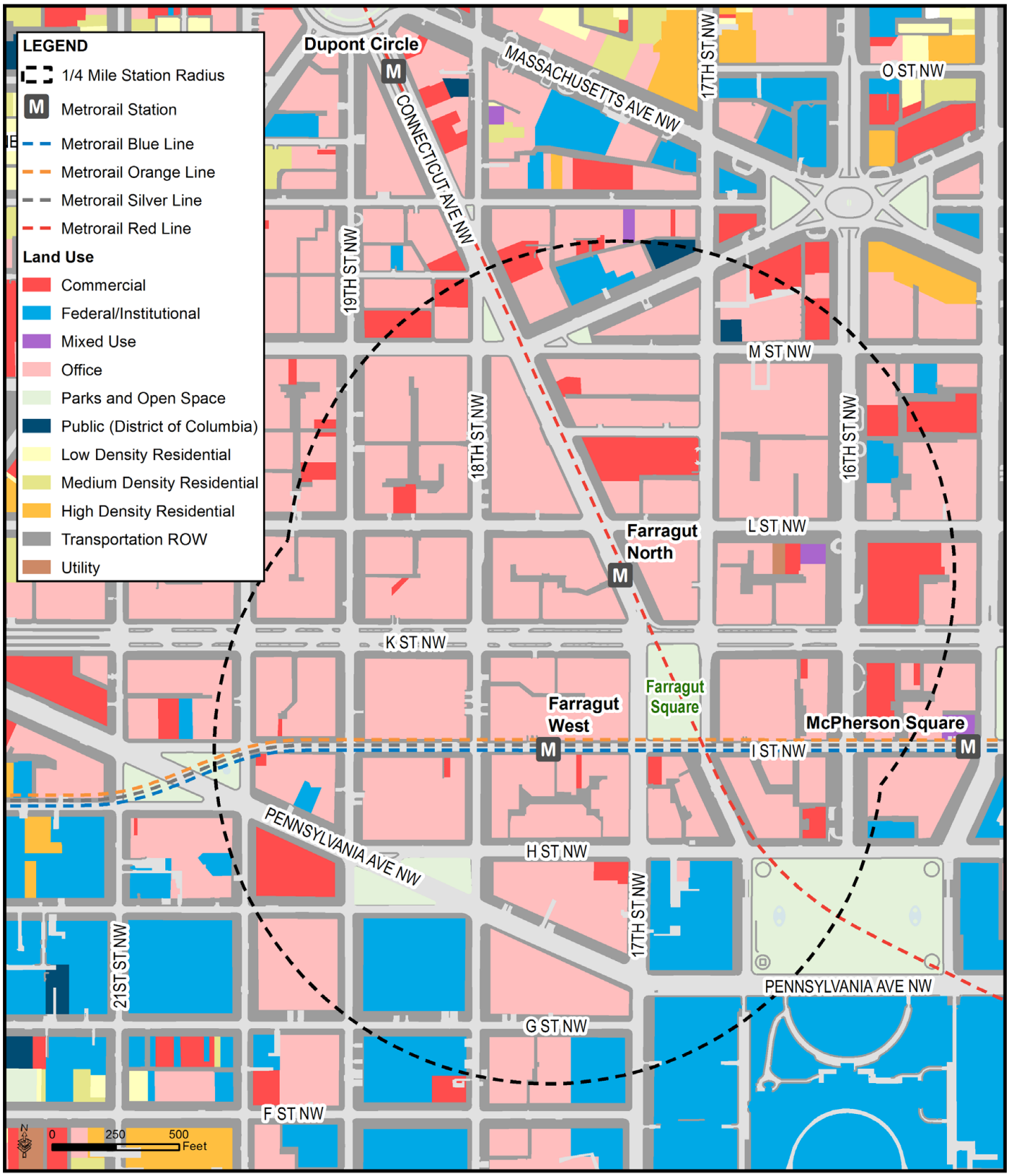
Station Area Surface Transportation

The Farragut stations are well served by multiple surface transit modes, including Metrobus, DC Circulator, commuter buses, private shuttles, and bicycles.

- **Farragut Square bus terminus –** 17 Metrobus routes currently terminate at Farragut Square, while several private shuttles use Farragut Square to collect and drop off passengers.
- **H & I Street bus routes –** 33 bus routes (Metrobus, DC Circulator, and commuter bus) serve H & I Streets near Farragut Square, including 24 Metrobus routes that carry 63,000 daily riders (about 14 percent of the daily Metrobus ridership).
- **Planned K Street Transitway –** The proposed dedicated transitway includes a streetcar that would run along K Street NW, including a stop between 17th and 18th Streets NW near the Farragut Stations.
- **Bicycle Facilities –** Two Capital Bikeshare stations are located at Farragut Square. In addition, the two Farragut Metrorail stations have bike racks with total parking capacity for 150 bicycles.

Bicycle racks outside the Farragut North South Entrance

Figure 2-8 Farragut Square Area Existing Land Use



Transportation Plans

Table 2-6 summarizes recent transportation plans and studies in the station vicinity.

Table 2-6 Transportation Plans and Studies

Plan	Relevant Recommendations
Metro Plans	
ConnectGreaterWashington 2040 Regional Transit System Plan (Metro, Draft 2014)	Proposes new Metrorail line by 2040 to address core capacity constraints: • M Street, NW line to relieve crowding on Blue/Orange/Silver Lines and Rosslyn tunnel • Pedestrian tunnel connection to Farragut North from new station at M Street/ Connecticut Avenue, NW
On-Street Bus Terminal Study (Metro, 2013)	Recommended consolidation of several bus stops at Farragut Square to separate bus and private shuttle operations
H/I Bus Lane Study (Metro, 2013)	Recommended vehicle turning restrictions on Eye Street, NW and rerouting some bus routes away from Farragut Square to improve operations
Other Plans	
Pedestrian Safety and Accessibility at Farragut Square Study (Golden Triangle Business Improvement District, 2012)	Assessed street level pedestrian circulation needs, recommending: • Widening sidewalks on the west side of Farragut Square • Closing the slip lane on westbound K Street, NW at Connecticut Avenue in front of the Farragut North station South Entrance • Rerouting select bus lines to reduce right-turn conflicts with pedestrians around Farragut Square
Union Station to Georgetown Premium Transit Alternative Analysis Study (DDOT, 2013)	Recommended a dedicated right-of-way for streetcar, as well as station locations, for the K Street NW corridor between Union Station and Georgetown

2.4 Existing Station Pedestrian Circulation Conditions

Existing conditions within Farragut North, Farragut West, and Metro Center Stations were assessed based on field observations conducted during November and December 2013. Areas of passenger crowding and movement conflicts during peak periods are depicted in **Figure 2-9** for Farragut North and Farragut West Stations and in **Figure 2-10** for Metro Center Station on the following pages.

Farragut North congestion between Center and South Mezzanine escalators

Farragut West queuing at escalator from eastbound platform to West Mezzanine in the AM peak

Crowds on both the westbound and eastbound platforms of Farragut West station in the PM peak

Congestion at Metro Center lower platform, between center escalators leading to the Red Line platforms

Figure 2-9 Existing Peak Period Conditions - Farragut North and Farragut West

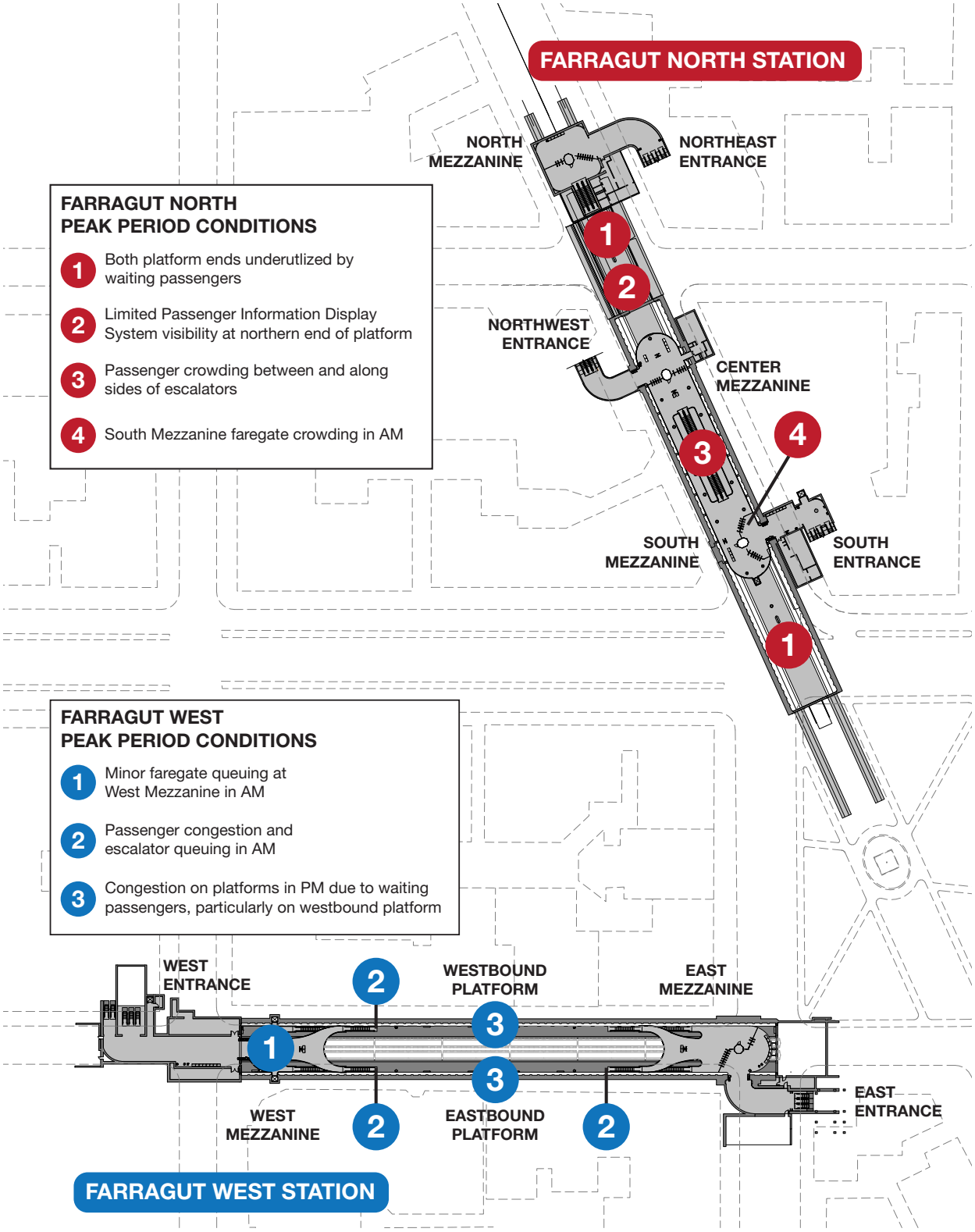
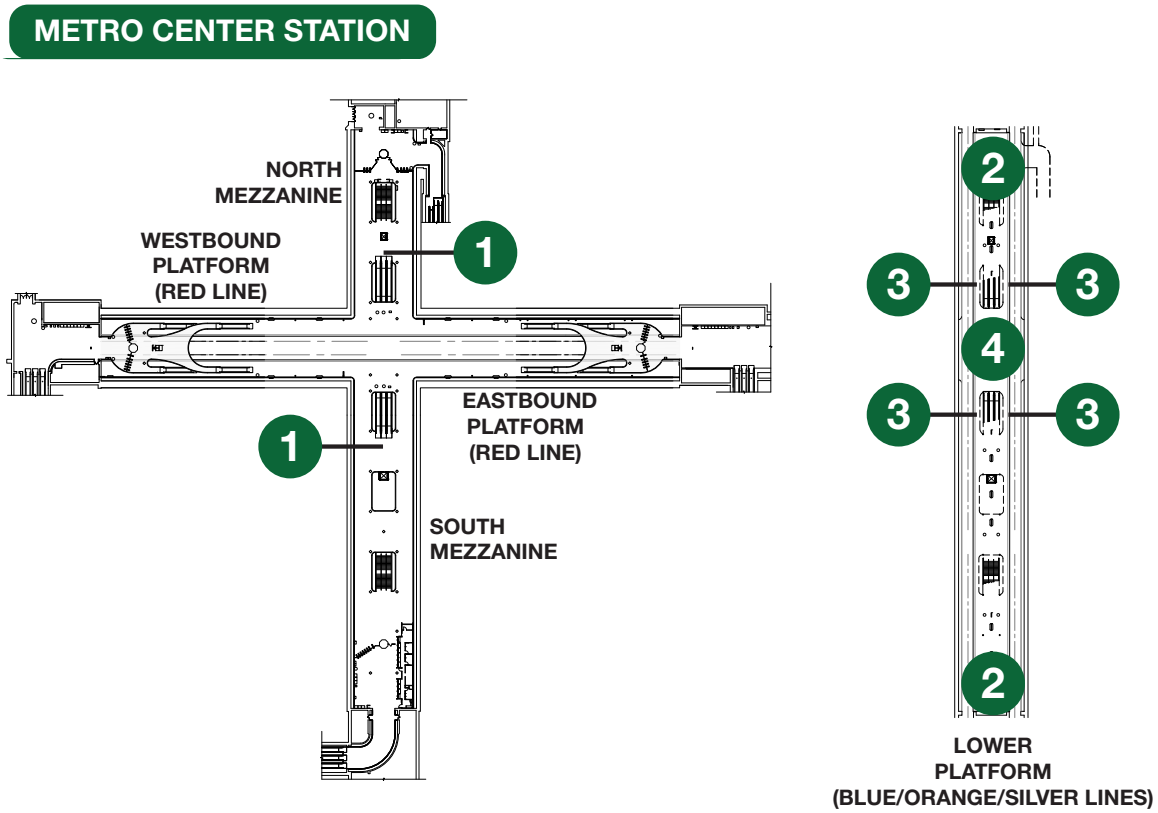


Figure 2-10 Existing Peak Period Conditions - Metro Center



METRO CENTER PEAK PERIOD CONDITIONS

1. Congestion, cross-flow conflicts, and escalator queuing by transferring passengers
2. Platform ends underutilized by waiting passengers
3. Congestion between escalators and platform edges
4. Congestion and cross-flow conflicts

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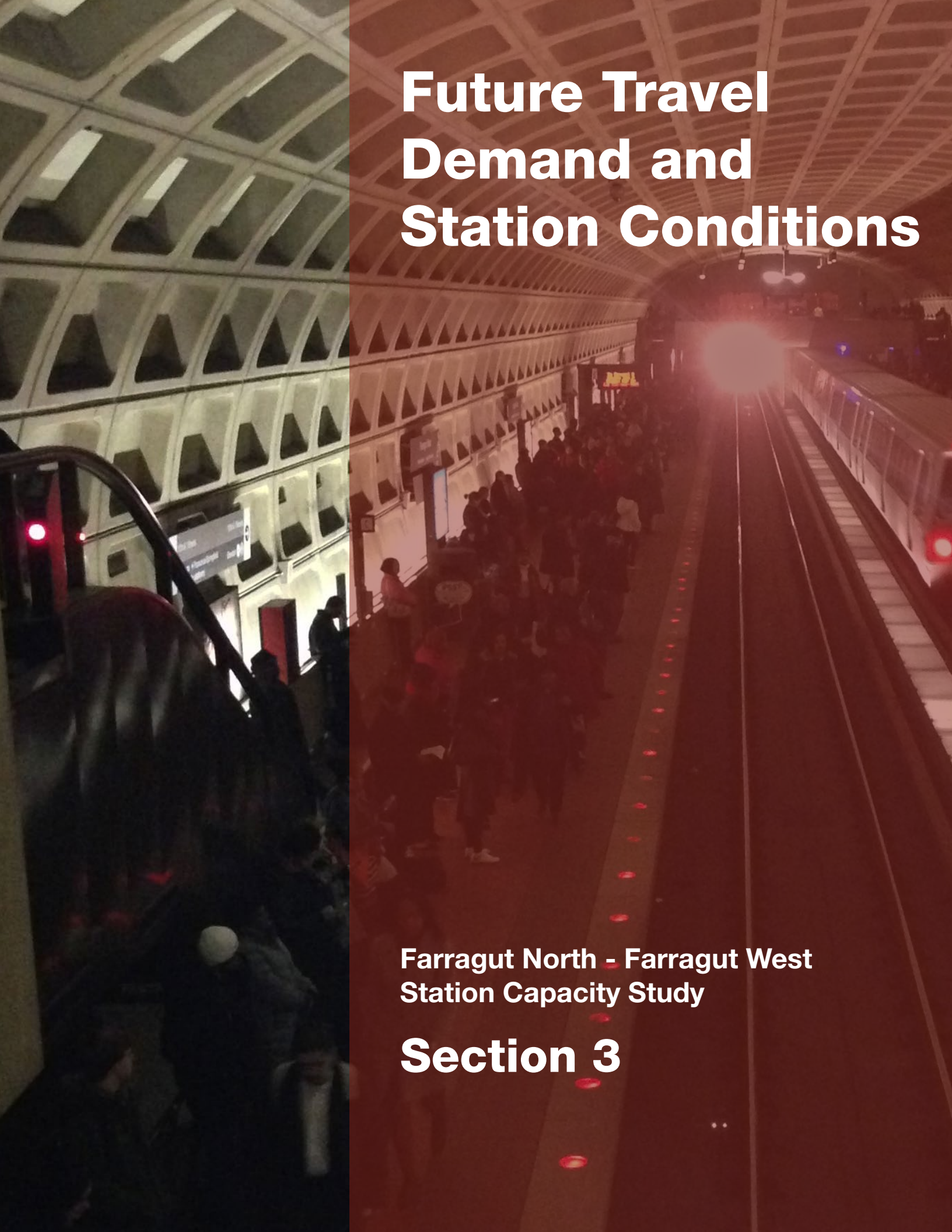

Future Travel Demand and Station Conditions

Farragut North - Farragut West Station Capacity Study

Section 3

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3.0 FUTURE TRAVEL DEMAND AND STATION CONDITIONS

This section summarizes:

- 2030 forecast travel demand (numbers of passengers entering, exiting and transferring) at Farragut North, Farragut West and Metro Center Stations; and
- 2030 station conditions based on pedestrian simulation modeling of forecast passenger volumes within current station facilities (referred to as "2030 No Build" conditions).

3.1 Forecast Travel Demand

Future Station Area Land Use

Downtown DC in the vicinity of the Farragut stations is largely built out, but some incremental residential and commercial growth is anticipated. Within ¼ mile of the Farragut stations, population and employment are forecast to increase slightly between 2010 and 2030, with most growth occurring by 2020, and then leveling off between 2020 and 2030 (see **Table 3-1**).

Future Metrorail Operations

Planned changes in Metrorail operations that are anticipated to attract additional riders include the extension of the Silver Line and the introduction of eight-car train operations in peak periods.

Table 3-2 provides an overview of 2030 Metrorail operations assumed in the travel demand forecast and pedestrian simulation modeling (described in Section 3.2) for lines serving Farragut North, Farragut West, and Metro Center Stations.

Silver Line Phase 2 (Anticipated 2018)

Phase 2 of the Metrorail Silver Line, currently under construction, will extend its western terminus to Route 772 in Loudoun County, Virginia. The extension will add six stations to the line, including one at Dulles International Airport. The Phase 2 extension is anticipated to open in 2018. Metrorail train headways at Farragut West and Metro Center along the Blue, Orange and Silver Lines are planned to remain the same as under current Silver Line Phase 1 operations.

100 Percent Eight-Car Train Operations (Planned by 2025)

Metro plans to run 100 percent eight-car trains during peak periods by 2025. System-wide, peak period trains will run at a combined average 3-minute headway, and off-peak trains will run at a combined average 6-minute headway. Red Line trains will no longer turn back at either Silver Spring or Grosvenor-Strathmore. Orange Line trains will travel between Vienna and New Carrollton at all times.

Forecast Station Ridership and Pedestrian Tunnel Usage

Travel Demand Forecast Methodology

2030 station entries, exits, and transfers were forecast for Farragut North, Farragut West, and Metro Center Stations as part of this study. The travel demand forecast used Metro's Regional Transit System Plan (RTSP) Model with the Metropolitan Washington Council of Governments (MWCOG) Round 8.2 Cooperative Land Use Forecast for 2030 population and employment. Adjustments to the travel demand model outputs were made using Metro's LineLoad application, which further refines the forecast pathways of passengers through the Metrorail system, including their transfer points and station mezzanine entries and exits by time of day.

Table 3-1 Current and Forecast Population and Employment within ¼ Mile of the Farragut Stations

Demographic Measure	2010	2020	Percent Change (2010 - 2020)	2030	Percent Change (2020 - 2030)	Net Percent Change (2010 - 2030)
Population	779	867	+11%	893	+3%	+15%
Employment	87,526	89,336	+2%	89,369	0%	+2%

Source: MWCOG Round 8.2 Cooperative Land Use Forecast.

Table 3-2 Assumed 2030 Metrorail Operations at Farragut North, Farragut West, and Metro Center Stations

Metrorail Line	Origin-Destination	Headway (minutes)	
		Peak	Off-Peak
Red	Shady Grove – Glenmont	3	6
Blue	Franconia – Largo Town Center	12	12
Orange	Vienna – New Carrollton	6	12
Silver	VA 772 – Largo Town Center	6	12

Source: Metro RTSP Model, 2030 Metrorail Operating Plan.

Farragut Pedestrian Tunnel Usage Forecast: 2030 No Build and Build Conditions

The travel demand forecast was conducted for two scenarios:

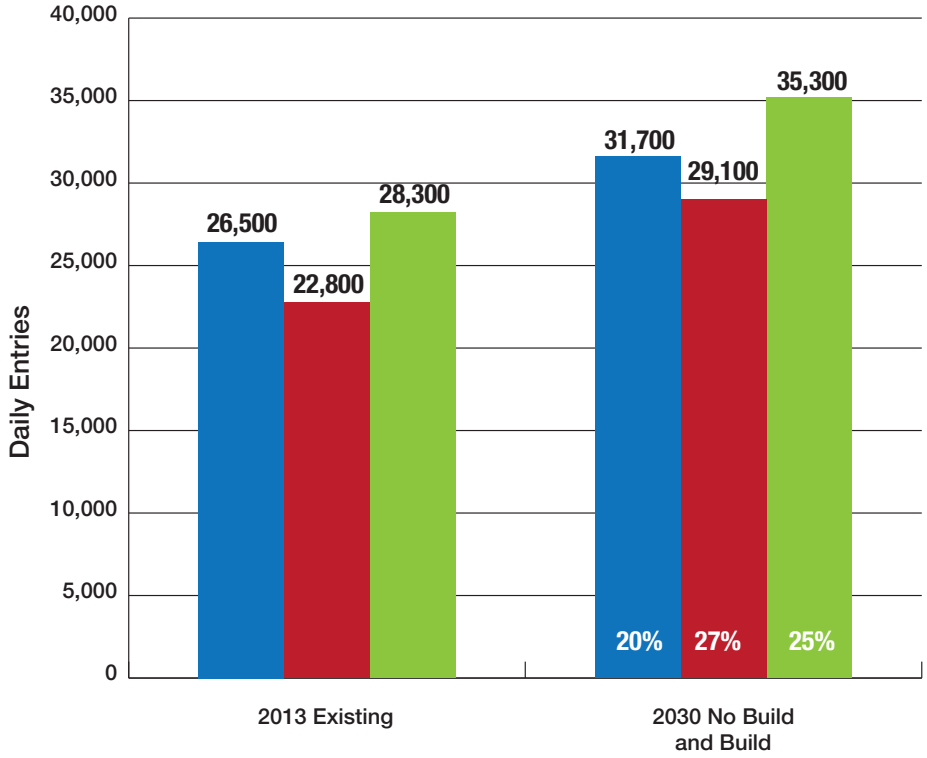
- **2030 No Build conditions (without the Farragut pedestrian tunnel) –** Metrorail system ridership is forecast without a Farragut pedestrian tunnel. The relatively small number of street-level "virtual" transfers between the two Farragut stations are assumed to grow from 2013 to 2030 at the same rate as forecast transfers between the Red Line and Blue/Orange/Silver Lines at Metro Center.
- **2030 Build conditions (with the Farragut pedestrian tunnel) –** The Metrorail network includes the Farragut pedestrian tunnel as a link between the stations that allows for transfers between Metrorail lines and entries and exits at the opposite station. Usage of the tunnel was forecast similar to other Metrorail system transfer movements and mezzanine entry/exit movements using the LineLoad application's assignment of passenger trips based on the shortest modeled travel time. The Build condition forecast scenario assumed the same overall demand for station entries and exits at the Farragut stations and Metro Center as the No Build condition.

Travel Demand Forecast Results

The average weekday station entries and transfers for the Farragut Stations and Metro Center Station are summarized in **Figure 3-1** and **3-2**, comparing 2013 and 2030 for the No Build and Build conditions.

Daily entries increase at the three stations between 2013 and 2030, ranging from 20 to 27 percent increases. Daily transfers at Metro Center increase 18 percent in the 2030 No Build condition compared to 2013, but decrease 8 percent in the 2030 Build condition compared to 2013 as a result in the shift in transfer demand to the Farragut pedestrian tunnel.

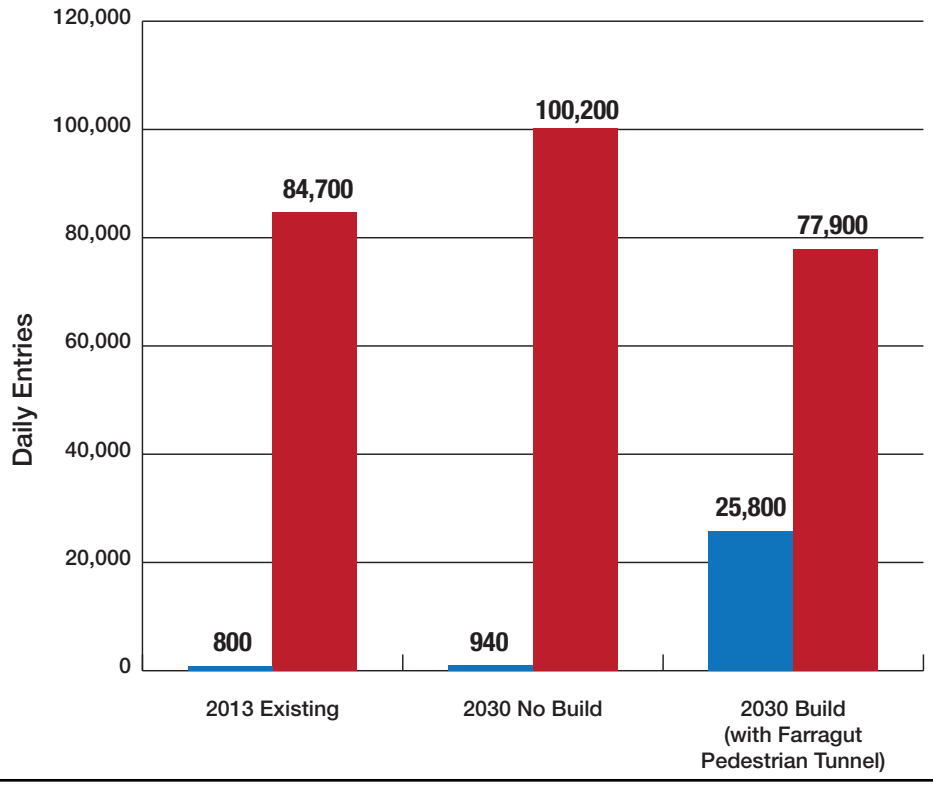
Figure 3-1 Average Weekday Station Entries - 2013, 2030 No Build, and 2030 Build



Note: Percentages represent change from 2013 to 2030. No change between 2030 No Build and 2030 Build.

Source: Existing entries from Metro faregate data; 2030 forecast entries from Metro RTSP travel demand model and LineLoad application.

Figure 3-2 Average Weekday Transfers - 2013, 2030 No Build, and 2030 Build



Note: Farragut station transfers in 2013 and the 2030 No Build are street-level virtual transfers.

Source: 2013 Farragut transfers from Metro faregate data; 2013 Metro Center 2030 forecast transfers from Metro RTSP travel demand model and LineLoad application.

Of the 32,100 daily pedestrian tunnel users:

- 25,800 daily passengers use the pedestrian tunnel to transfer between Metrorail lines; and
- 6,300 daily passengers use the pedestrian tunnel to enter/exit the Metrorail system from the other station.

Table 3-3 summarizes the pedestrian tunnel users by period of day; these include transfers between Metrorail lines and passengers using the tunnel to enter or exit the Metrorail system from the opposite station. **Figures 3-3** and **3-4** compares the AM and PM peak hour entries, exits, and transfers for the Farragut Stations and Metro Center Station.

Travel Demand Forecast Summary

By 2030, daily entries are forecast to increase at the Farragut stations and Metro Center between 20 and 27 percent, and transfers are forecast to increase at Metro Center by 18 percent.

The Farragut pedestrian tunnel would have significant effects on both Metro Center Station and the Farragut Stations:

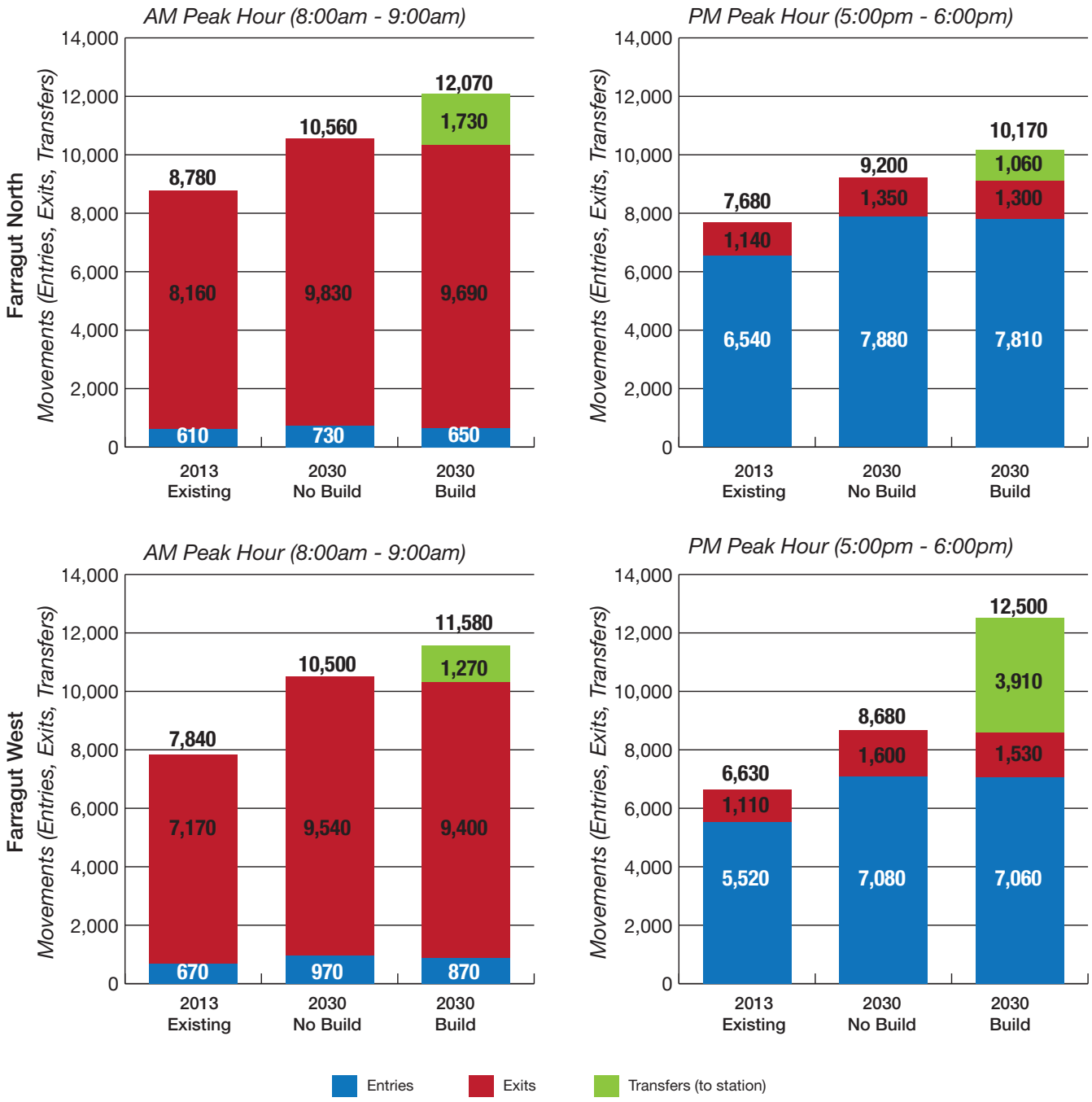
- Daily transfers at Metro Center would be reduced by 33 percent, compared to the 2030 No Build condition; and
- The number of daily passengers using the Farragut stations in 2030 would increase by 41 percent with the addition of transfers between Metrorail lines.

Table 3-3 2030 Pedestrian Tunnel Users by Period

Peak Hour		Peak Period			Off-Peak Period	Daily Total
AM	PM	AM	PM	Subtotal		
3,800	5,900	8,900	11,900	20,800	11,400	32,100

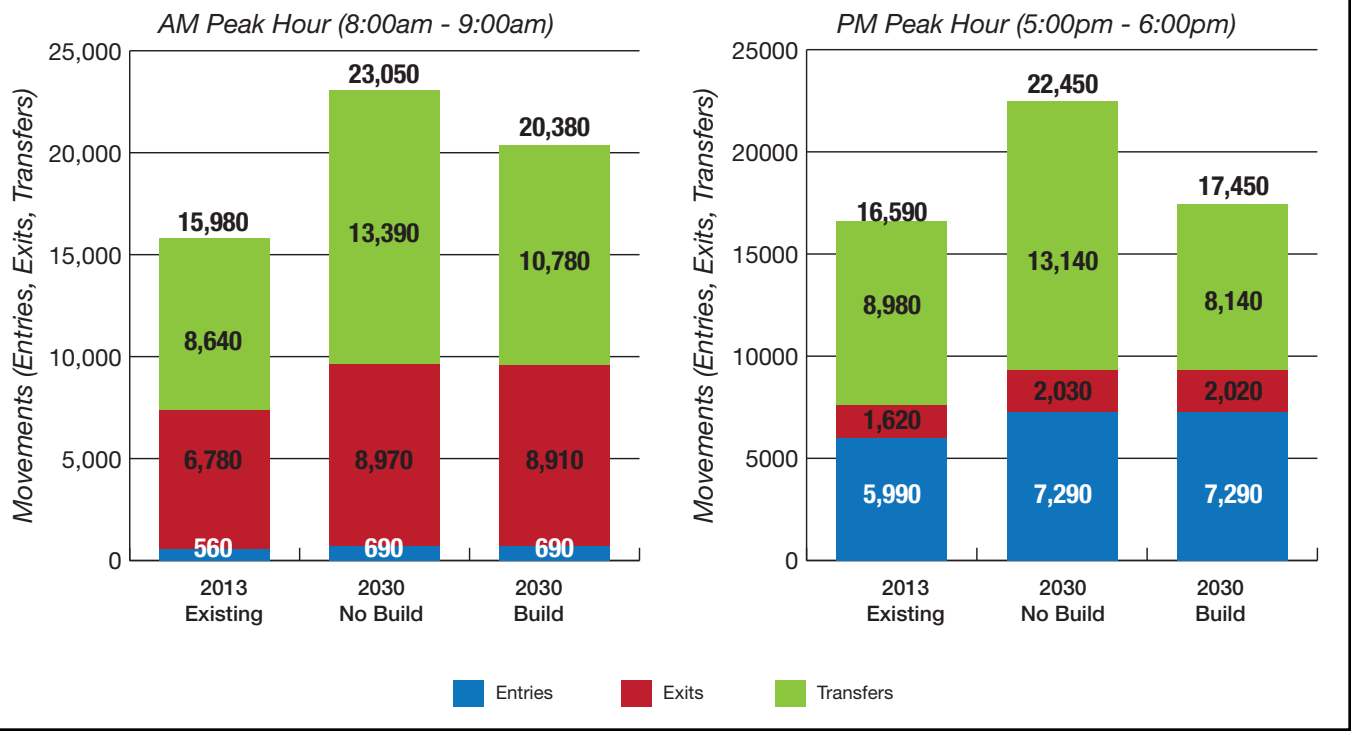
Note: Peak Hours are 8:00am-9:00am and 5:00pm-6:00pm; Peak Periods are 6:30am-9:30am and 3:30pm-6:30pm.

Figure 3-3 Farragut North and Farragut West Peak Hour Entries, Exits, and Transfers - 2013, 2030 No Build and 2030 Build



Note: Street-level virtual transfers between the Farragut stations in 2013 and 2030 No Build are included in the entries and exits. 2030 Build entries and exits include passengers using the pedestrian tunnel to access the opposite station.

Figure 3-4 Metro Center Peak Hour Entries, Exits, and Transfers - 2013, 2030 No Build, and 2030 Build



3.2 2030 No Build Pedestrian Simulation Model

Simulation Methodology

The pedestrian simulations were conducted using Legion SpaceWorks software, modeling conditions during the AM and PM peak hours (8:00 am - 9:00 am and 5:00 pm - 6:00 pm) for 2013 and 2030 using the observed and forecast passenger volumes described in the previous section. The 2030 No Build simulations model the existing station facilities and layouts without design or capacity improvements.

Modeled Pedestrian Movements

The 2013 and 2030 models analyze most passenger movements inside the stations, including simulated station entries and exits at faregates, boarding and alighting of trains, escalator operations, and circulation between origin and destination points. Elevator operations are generally not included in the simulation models due to their marginal effect on overall pedestrian circulation patterns and conditions. For transfers between the Farragut stations at street level, the 2013 Existing and 2030 No Build models account for transferring passengers entering and exiting the stations but do not model street level conditions.

Metrorail Operations

The 2030 simulations use planned future Metrorail train operations, as described in the previous section (100-percent eight-car train operations, full Silver Line service to Dulles). The 2013 simulation model is based on Metrorail operations prior to the July 2014 introduction of Silver Line service. The models incorporate the average train headway variability (difference between scheduled and actual train arrival times) that occurs over the course of typical Metrorail operations.

Pedestrian Measures of Effectiveness (MOEs)

The following measures of effectiveness (MOEs) are used to assess pedestrian circulation conditions within the stations based on the simulation results:

- **Mean Density** – Pedestrian density is calculated as the number of people within a 5-foot radius of each passenger and measured on a Level of Service (LOS) scale of "A" to "F." LOS A represents the least dense or uncrowded conditions, and LOS F represents the most dense or significantly crowded conditions. Maps of passenger cumulative mean densities during the most heavily traveled times (the peak 15 minutes in each peak hour) are used to depict potential areas of acute congestion.
- **Escalator/Stair Clearance Time** – The average times for escalator and stair queues to clear after a train arrival are measured at key locations within each station. A queue is considered to occur when the volume of passengers attempting to board an escalator or stair exceeds its capacity by greater than 20 percent, as measured by the passenger flow over a one-minute period. The queue clearance time is calculated as the additional time beyond 12 seconds that passengers are slowed or stopped.
- **Pedestrian Zone Density** – The percentage of passengers experiencing LOS E or F conditions is used to characterize the degree of station crowding in key pedestrian circulation zones (platforms, heavily used mezzanine areas) identified within each of the stations.
- **Journey Time** – The average time required for passengers to travel between origin and destination points within the station (for example, from train platform to station exit) are measured for the key passenger movements. The average journey times account for movement that is slowed or stopped due to passenger crowding. Minimum journey times, which reflect relatively uncongested station conditions, are reported for comparison.

A New Carrollton-bound Orange Line Train arrives at Farragut West

- **Safety Analysis –** Specific areas of potential safety concern within each station (for example, crowding near a platform edge or along a main egress route) are discussed qualitatively in the summary of 2030 No Build conditions at the end of the section.

3.3 Detailed No Build Simulation Results by Measure of Effectiveness (MOE)

Mean Density

Figures 3-5 through **3-10** depict cumulative mean densities in the stations during the peak 15 minutes, comparing 2013 and 2030 No Build conditions. The maps use the following LOS color key (see below).

LOS A-C (blue and green) represent areas where passengers can move about the station freely. The yellow areas of LOS D generally represent the maximum acceptable levels of passenger crowding, depicting station areas that have reached their maximum capacity to accommodate passenger levels. The orange and red areas of LOS E and F represent significant crowding. Sites of notable congestion and significant changes from existing conditions are called out in the figures.

Farragut North

The platform area near the central escalator banks will experience even more significant congestion during the AM peak by 2030; during the PM peak, this area will become moderately more congested by 2030, though still without any areas of LOS E and F. At the South Mezzanine, additional congestion will occur during the AM peak at the faregate array near the escalators.

Farragut West

During the AM peak, the significant platform crowding that occurs at three of the four up escalators will increase by 2030. During the PM peak, the moderate congestion from the high volume of waiting passengers on the westbound platform will increase by 2030, with notable crowding along the escalators from the West Mezzanine.

Metro Center

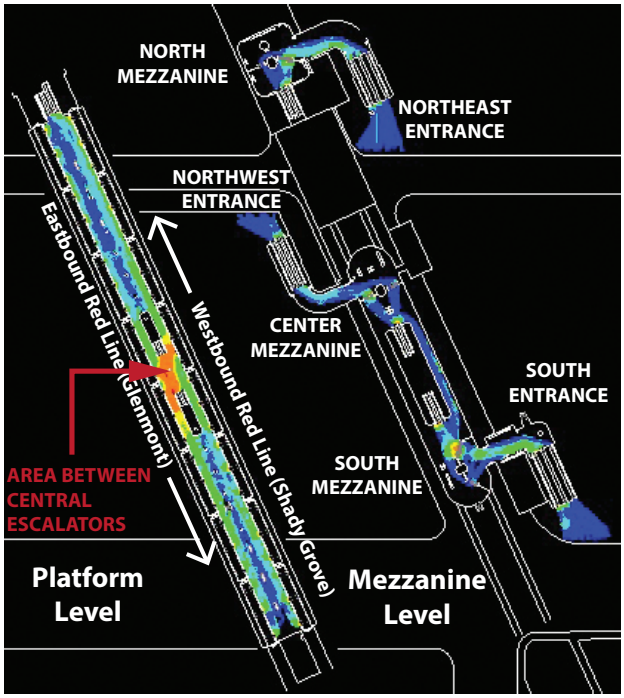
Congestion related to transfers will increase by 2030 during both the AM and PM peaks. On the upper platform level, the areas at the top of the escalators closest to the Red Line platforms will experience more crowding, particularly by the down escalators. Lower platform level crowding in the area between the central escalator banks will worsen, with areas of LOS E between the platform edge and escalator bank to the eastbound Red Line platform and South Mezzanine, a potential safety concern.

Mean Density Map LOS Key

Level of Service (LOS)	A	B	C	D	E	F
	<35 sq ft per person	25-35 sq ft per person	15-25 sq ft per person	10-15 sq ft per person	5-10 sq ft per person	<5 sq ft per person

Figure 3-5 Farragut North Mean Density - 2013/2030 No Build, AM Peak 15 Minutes

2013 Existing



2030 No Build

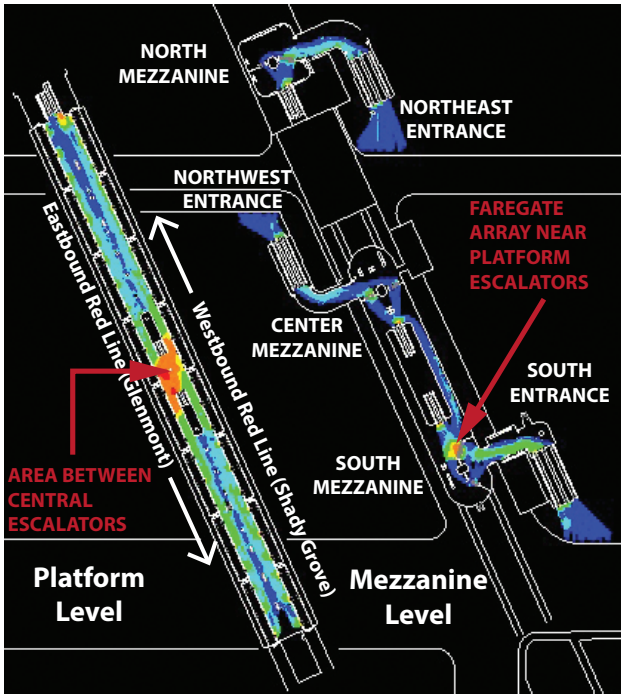
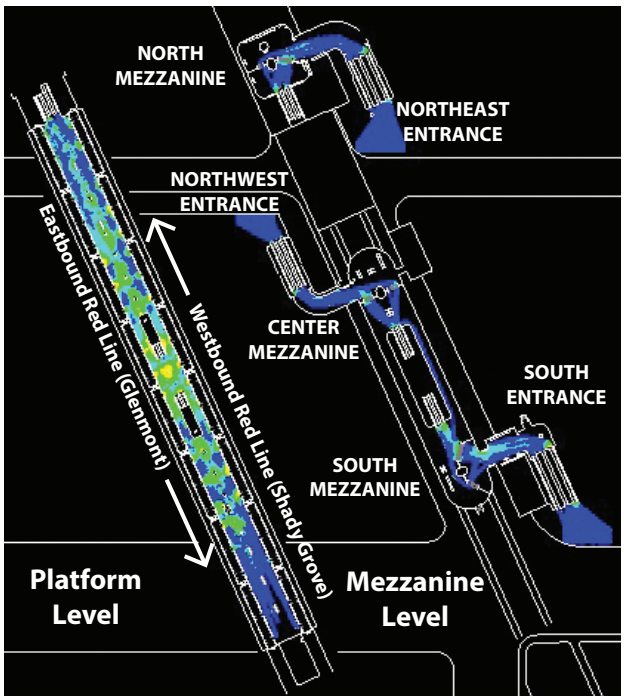


Figure 3-6 Farragut North Mean Density - 2013/2030 No Build, PM Peak 15 Minutes

2013 Existing



2030 No Build

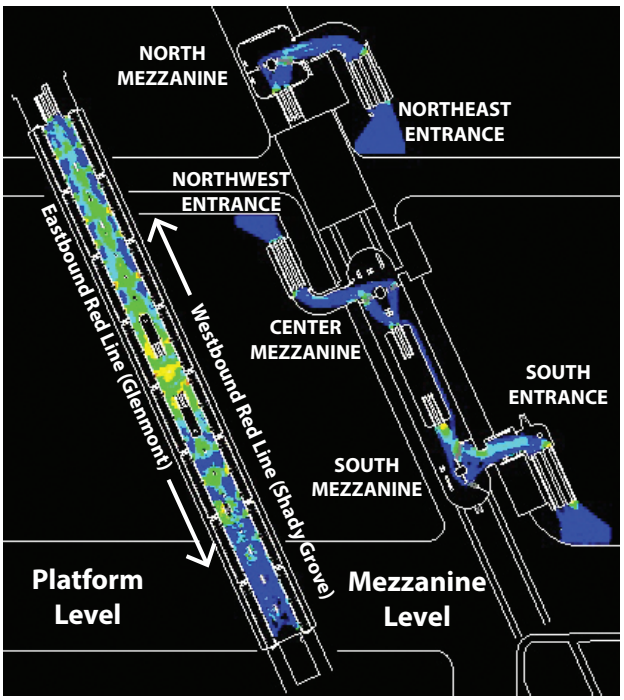
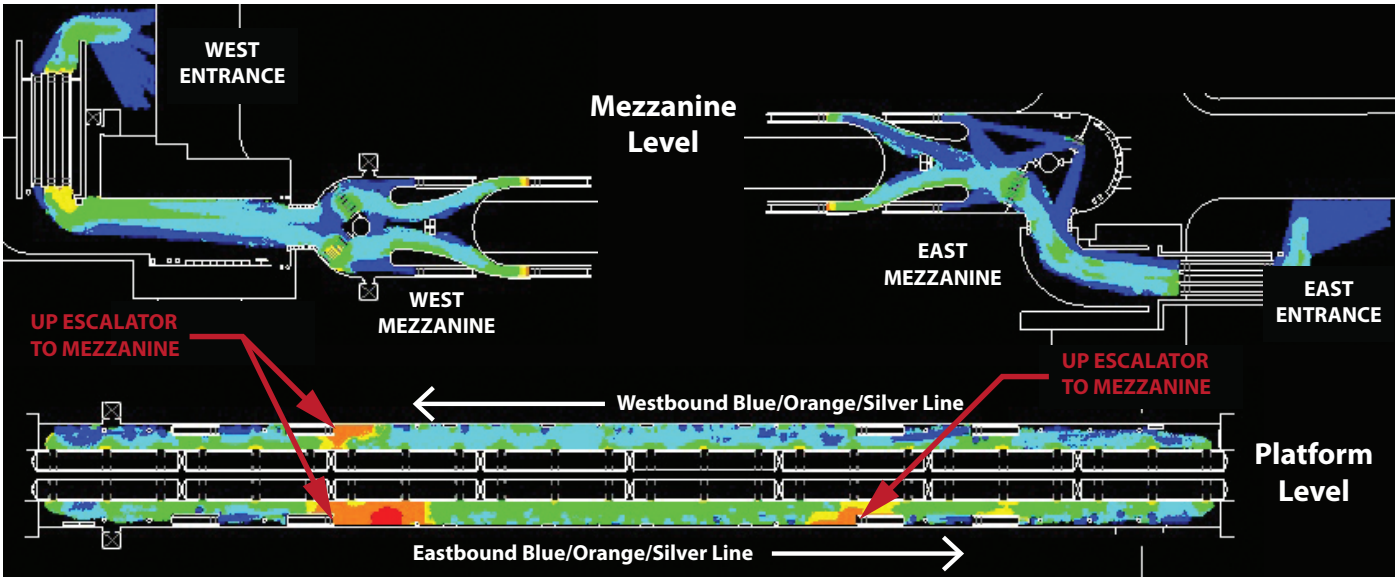


Figure 3-7 Farragut West Mean Density - 2013/2030 No Build, AM Peak 15 Minutes

2013 Existing



2030 No Build

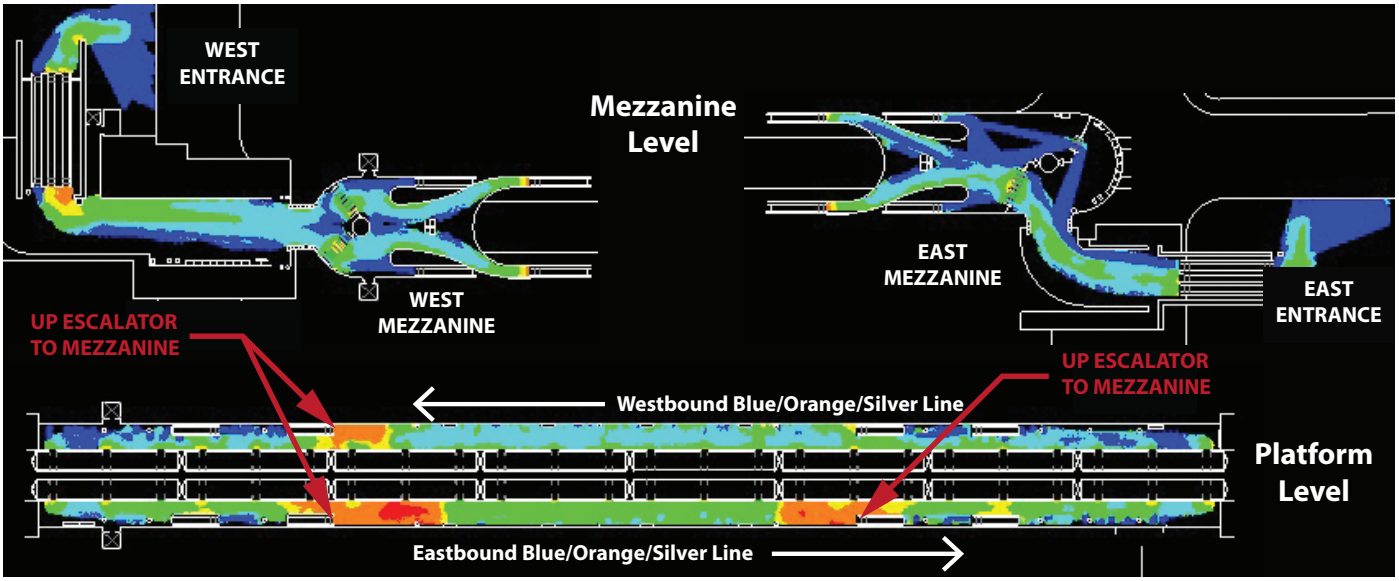
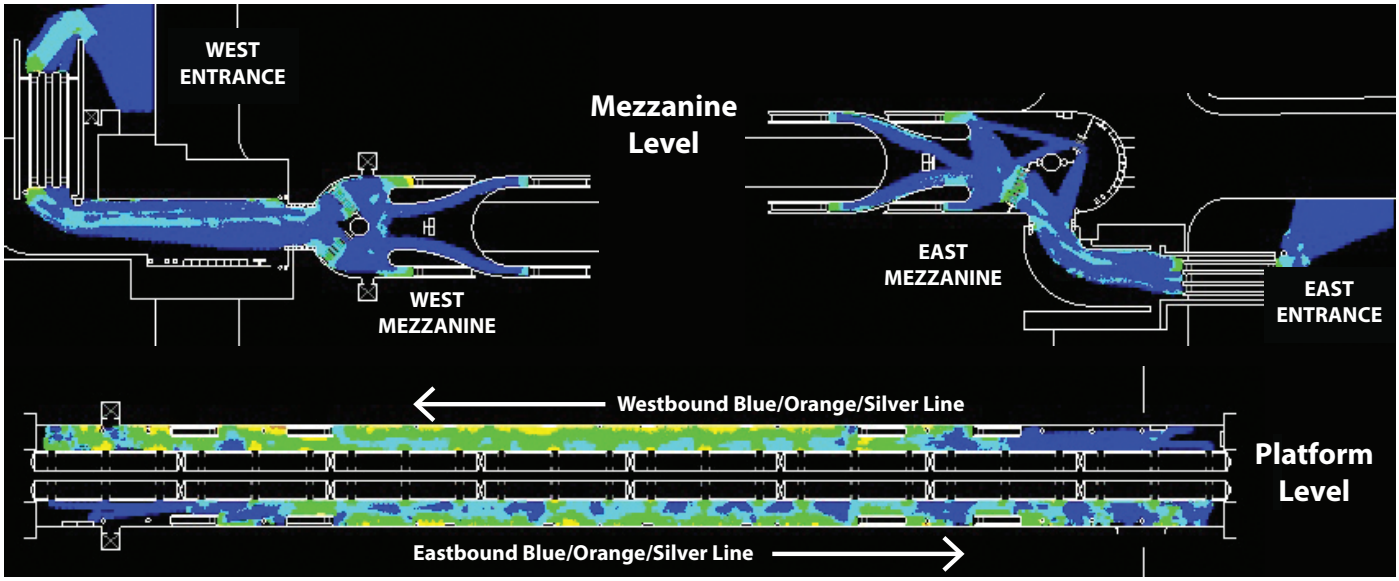


Figure 3-8 Farragut West Mean Density - 2013/2030 No Build, PM Peak 15 Minutes

2013 Existing



2030 No Build

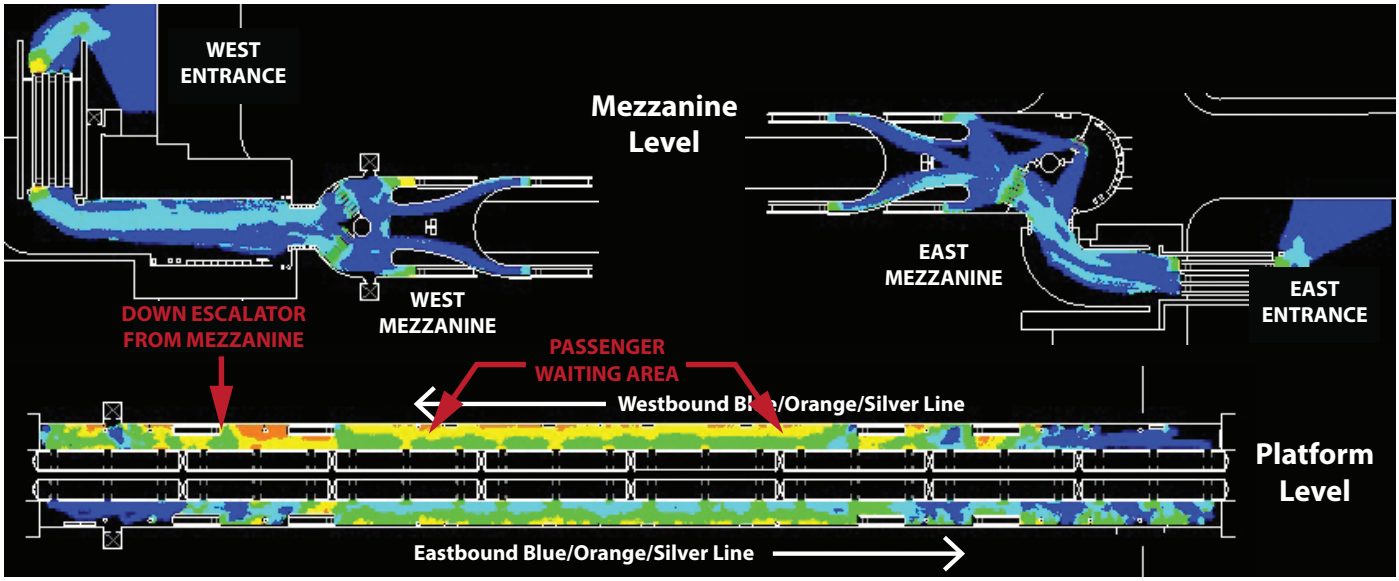
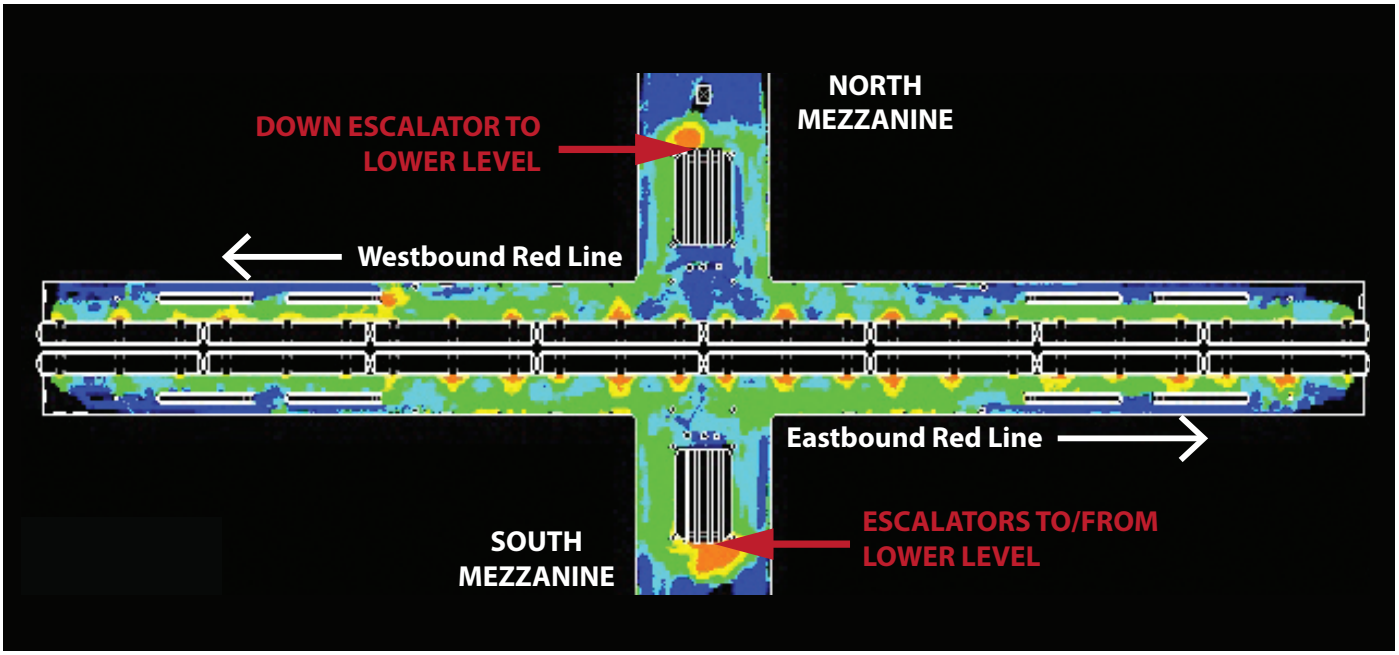


Figure 3-9 Metro Center Upper Level Mean Density - 2013/2030 No Build, AM Peak 15 Minutes

2013 Existing



2030 No Build

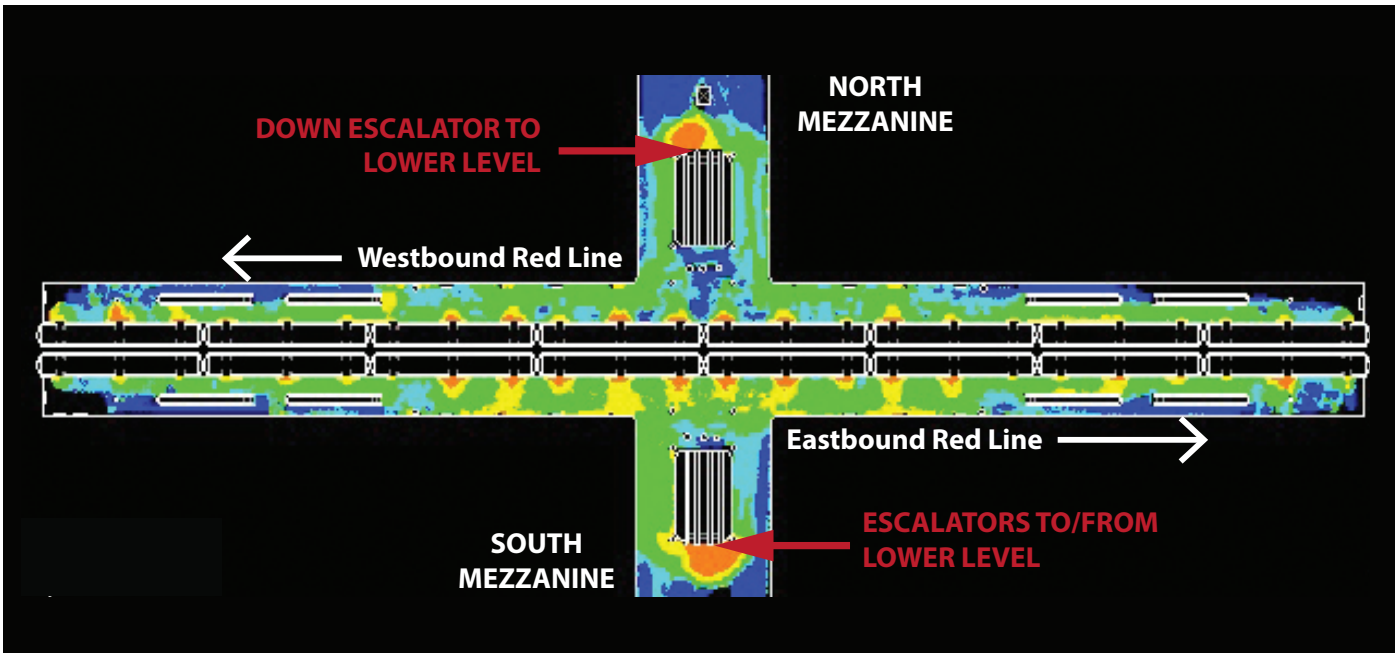


Figure 3-10 Metro Center Lower Level Mean Density - 2013/2030 No Build, AM Peak 15 Minutes

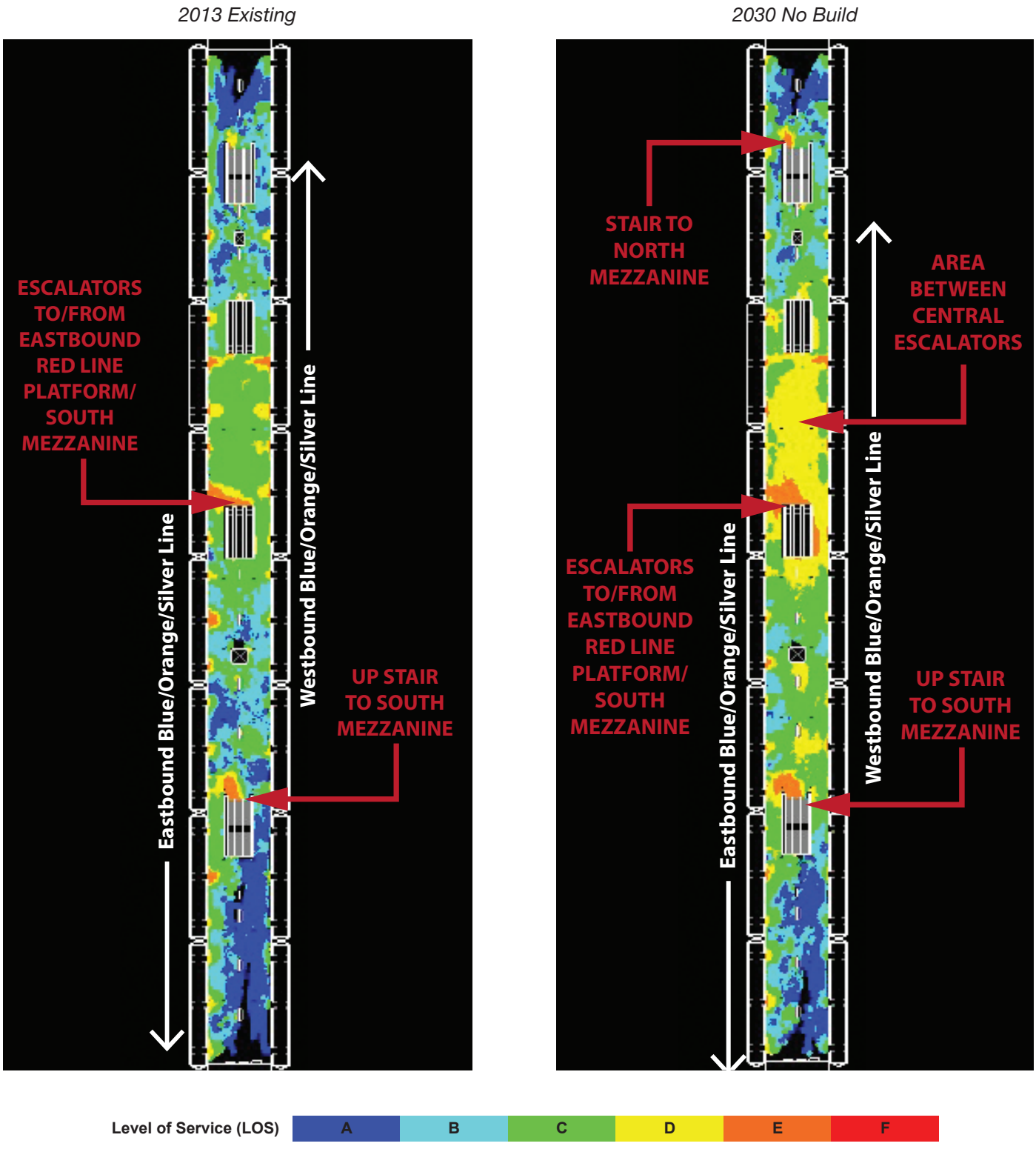
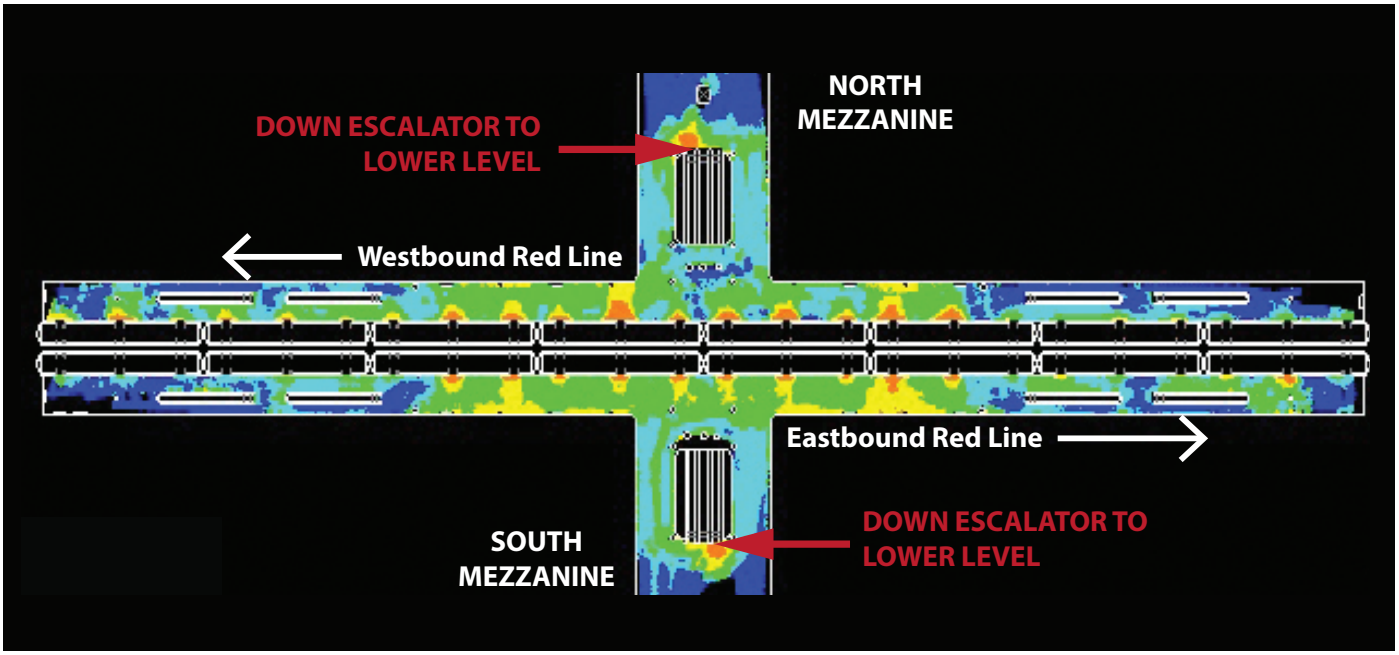


Figure 3-11 Metro Center Upper Level Mean Density - 2013/2030 No Build, PM Peak 15 Minutes

2013 Existing



2030 No Build

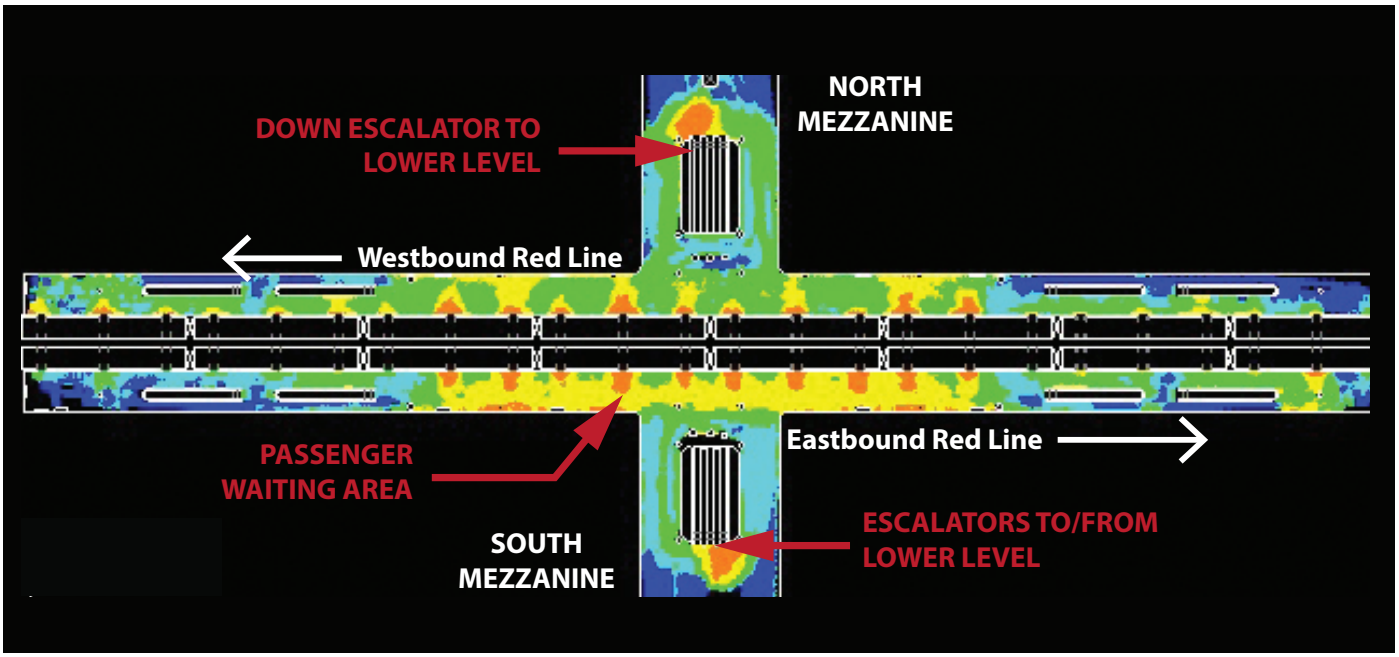
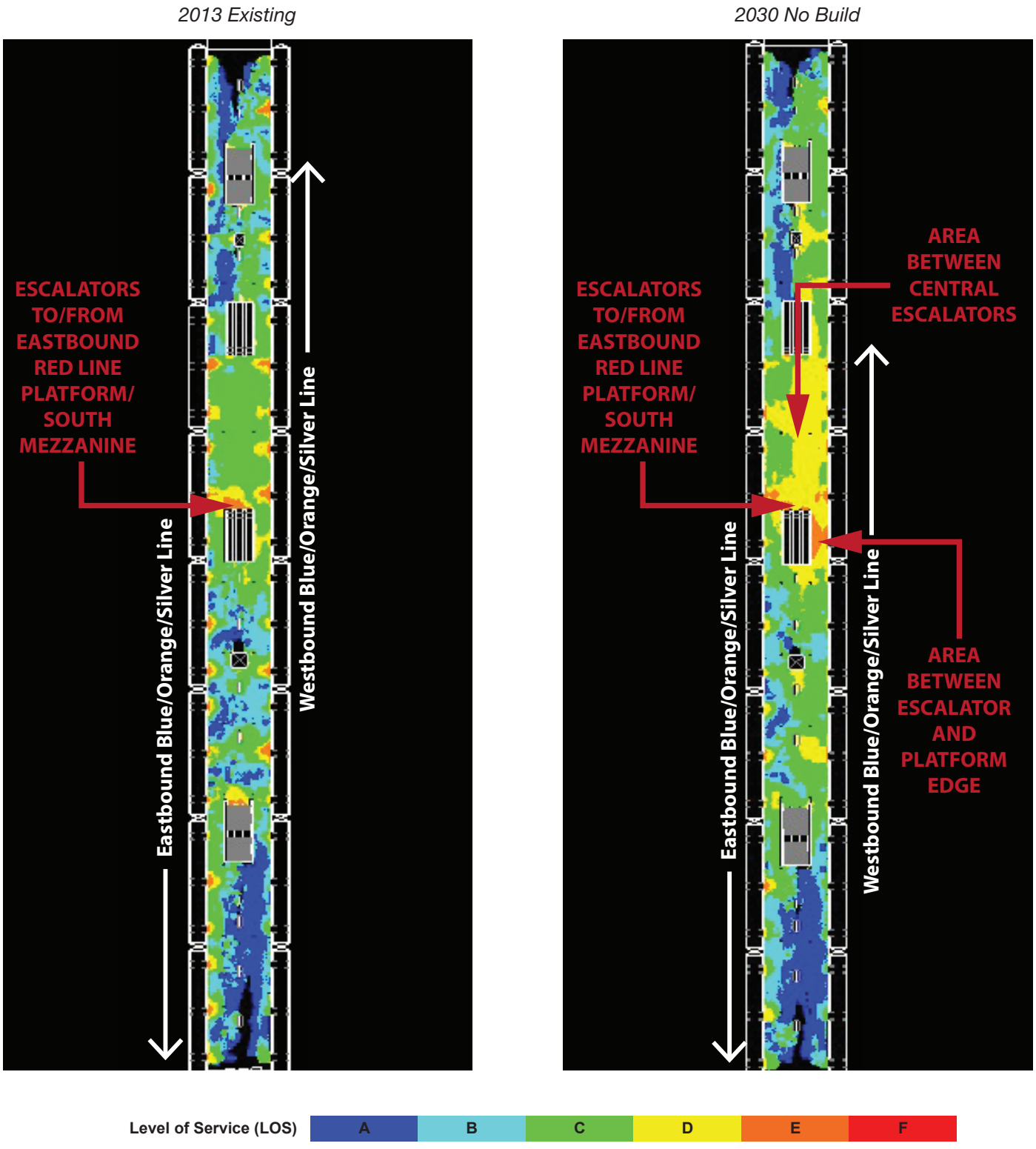


Figure 3-12 Metro Center Lower Level Mean Density - 2013/2030 No Build, PM Peak 15 Minutes



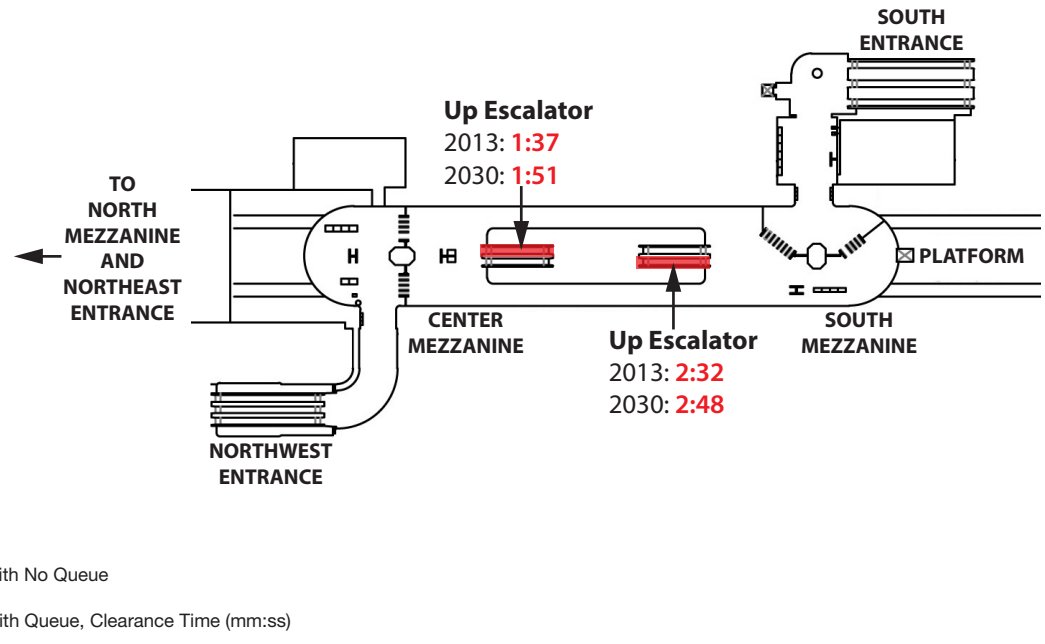
Escalator/Stair Clearance Time

Figures 3-13 and **3-14** show 2013 and 2030 escalator queue clearance times for the AM peak hour, when high volumes of passengers are alighting trains to exit Farragut North and Farragut West Stations. All platform escalators with queues will experience longer clearance times by 2030. The Farragut West eastbound platform in particular will have long escalator clearance times.

Figure 3-15 shows 2013 and 2030 escalator and stair queue clearance times for Metro Center transfer areas in both the AM and PM peak hours. The longest clearance times are experienced by the down escalators closest to the Red Line platforms (each escalator bank has only one down escalator compared to two up escalators). All escalator queues increase by 2030, except for the up escalator from the lower platform to the eastbound Red Line platform during the PM peak, as a result of the increase in the number of trains during the peak hour and the resulting decrease in each train's passenger volume.

The up escalator from the platform to the South Mezzanine at Farragut North is one of the most congested escalators at the Farragut Stations

Figure 3-13 Farragut North Escalator/Stair Queue Clearance - 2013/2030 No Build, AM Peak Hour



Note: North Mezzanine platform escalators do not experience queues and are not shown

Figure 3-14 Farragut West Escalator/Stair Queue Clearance - 2013/2030 No Build, AM Peak Hour

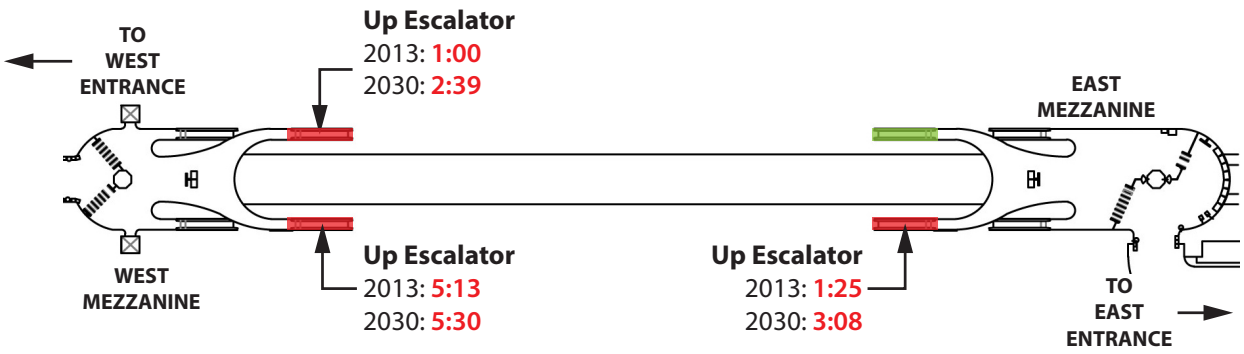
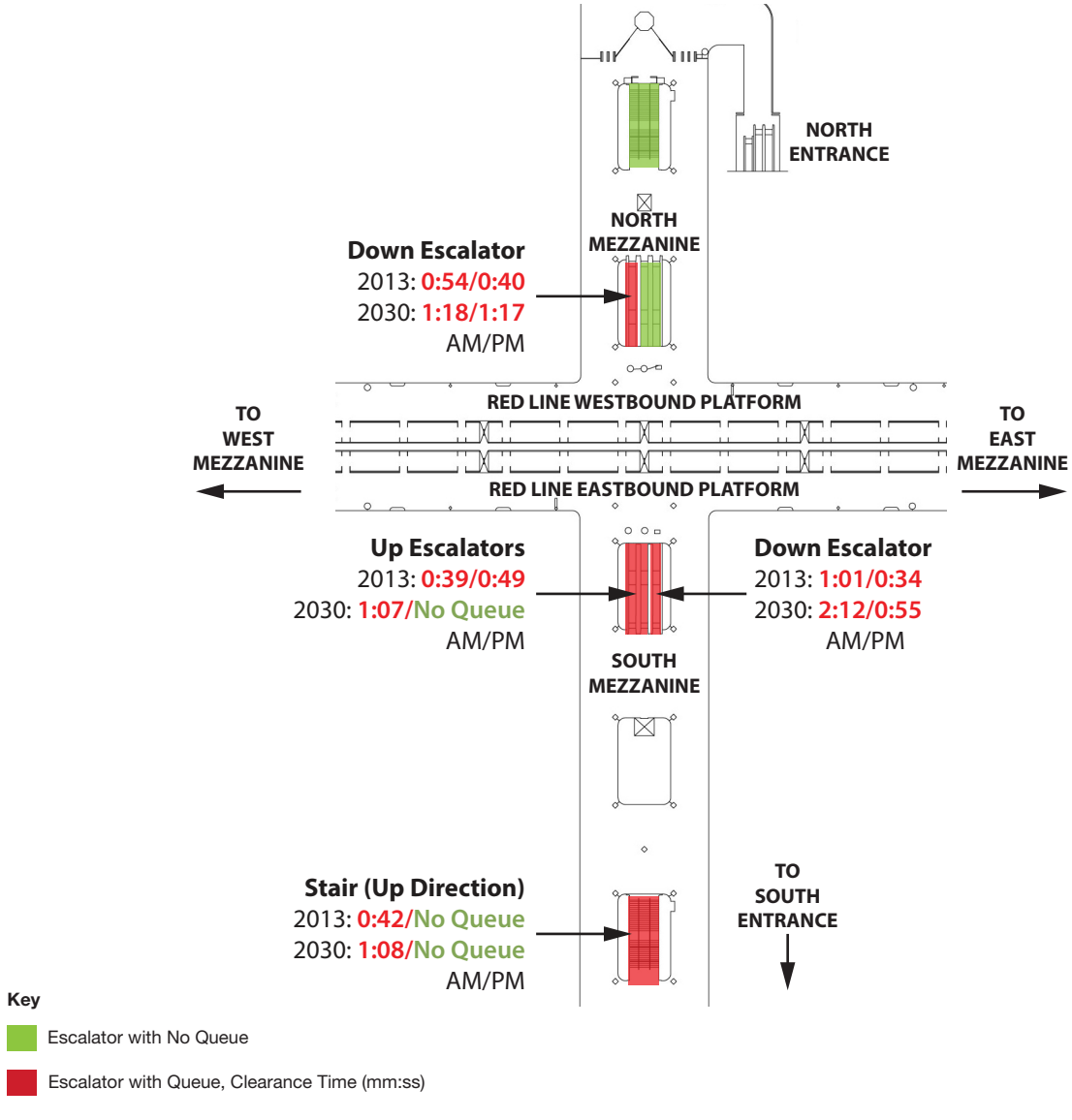


Figure 3-15 Metro Center Escalator/Stair Queue Clearance - 2013/2030 No Build, AM/PM Peak Hours



Pedestrian Zone Density

Figures 3-16 through **3-18** depict pedestrian density analysis zones for key circulation areas at Farragut North, Farragut West, and Metro Center Stations, respectively. **Tables 3-4** through **3-6** report the combined percentages of passengers in LOS E and F for each peak hour, using the colors in the diagram below.

The pedestrian zone densities at all three stations generally increase between 2013 and 2030. The Farragut West eastbound platform (Zone G) during the AM peak hour has the most significant crowding, with almost 50 percent combined LOS E and F by 2030. Other areas expected to have significant crowding by 2030 include the Farragut North platform (Zone D) during the AM peak, the Farragut West westbound platform (Zone H) during the PM peak, and the Metro Center North and South Mezzanine transfer areas (Zones I and J) during the AM peak.

The eastbound platform at Farragut West (Analysis Zone G) is particularly congested during the AM peak hour at the escalators to each mezzanine

Density Analysis Zone Table Key

COMBINED LOS E & F	5% or less	6 - 9%	10 - 19%	20 - 39%	above 40%
	(no crowding)	(occasional minor crowding)	(approaching significant crowding)	(significant crowding)	(very significant crowding)

Figure 3-16 Farragut North Station Pedestrian Analysis Zones

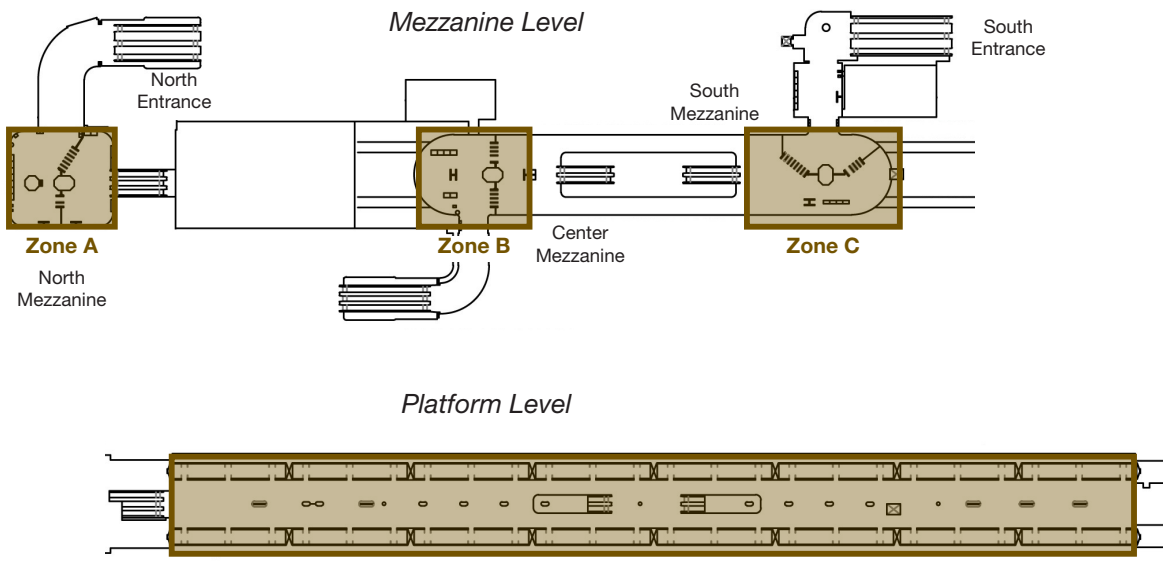


Table 3-4 Farragut North Station % LOS E & F - 2013/2030 No Build, AM/PM Peak Hours

Analysis Zone	AM Peak Hour		PM Peak Hour	
	2013 Existing	2030 No Build	2013 Existing	2030 No Build
Zone A North Mezzanine	2%	2%	0%	0%
Zone B Center Mezzanine	3%	3%	0%	0%
Zone C South Mezzanine	7%	14%	0%	3%
Zone D Platform	22%	29%	3%	5%

Figure 3-17 Farragut West Station Pedestrian Analysis Zones

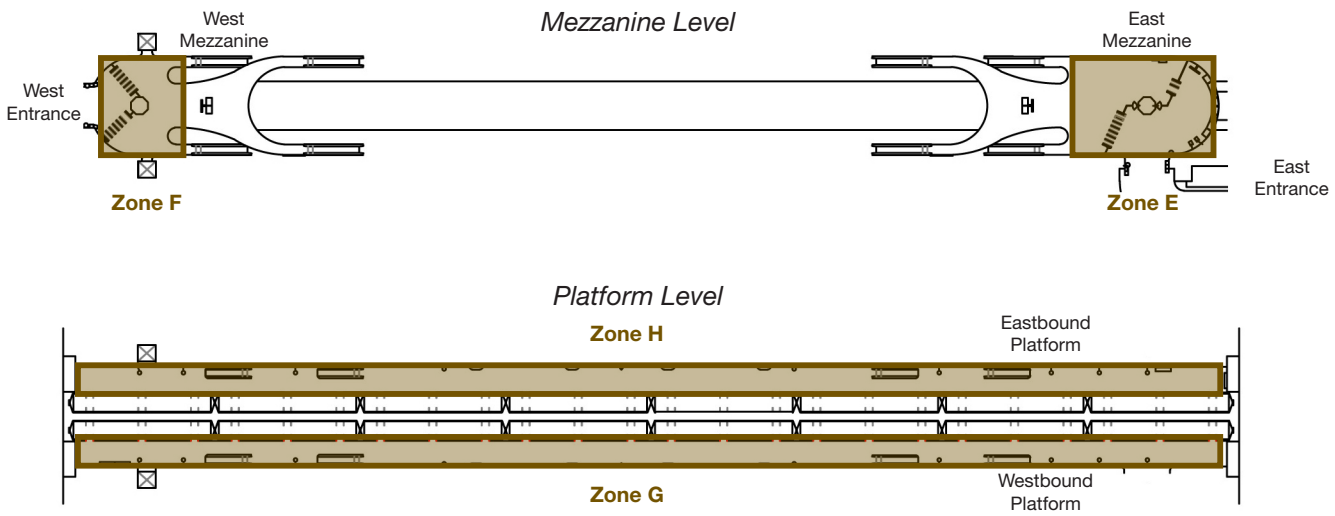


Table 3-5 Farragut West Station % LOS E & F - 2013/2030 No Build, AM/PM Peak Hours

Analysis Zone	AM Peak Hour		PM Peak Hour	
	2013 Existing	2030 No Build	2013 Existing	2030 No Build
Zone E East Mezzanine	1%	2%	0%	0%
Zone F West Mezzanine	1%	1%	0%	0%
Zone G Eastbound Platform	29%	48%	2%	4%
Zone H Westbound Platform	8%	15%	14%	26%

Figure 3-18 Metro Center Station Pedestrian Analysis Zones

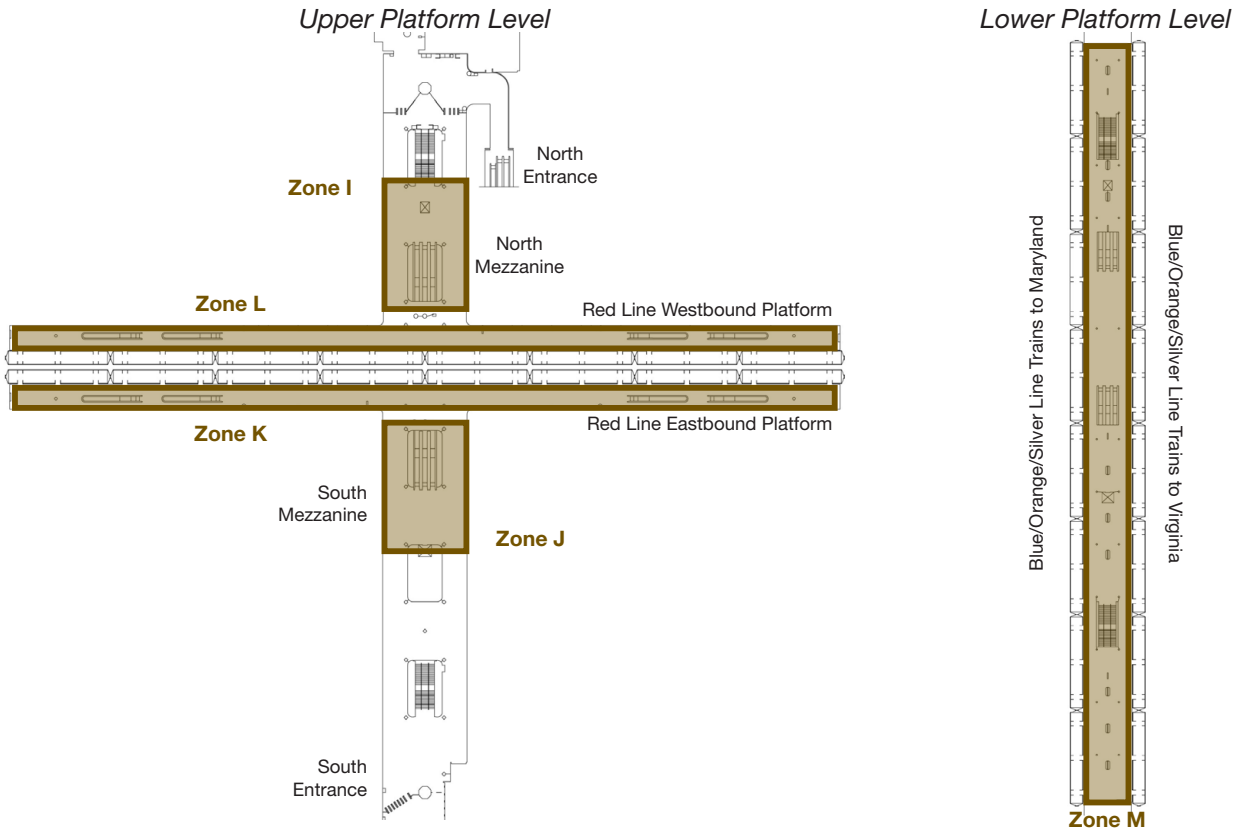


Table 3-6 Metro Center Station % LOS E & F - 2013/2030 No Build, AM/PM Peak Hours

Analysis Zone	AM Peak Hour		PM Peak Hour	
	2013 Existing	2030 No Build	2013 Existing	2030 No Build
Zone I North Mezzanine	9%	20%	5%	19%
Zone J South Mezzanine	15%	29%	7%	15%
Zone K Red Line Eastbound Platform	8%	15%	7%	17%
Zone L Red Line Westbound Platform	6%	7%	9%	13%
Zone M Lower Platform	4%	14%	6%	15%

Journey Times

Figures 3-19 and **3-20** show journey times for alighting passengers (from train to station exit) at Farragut North and Farragut West, respectively, during the AM peak hour. Journey times for PM peak hour alighting passengers and both AM and PM peak hour boarding passengers are less affected by passenger congestion and show little change between 2013 and 2030.

Farragut North

Average journey times for alighting passengers are approximately one minute greater than minimum journey times due to passenger congestion, and by 2030 alighting passenger journey times further increase by 13 to 18 seconds.

Farragut West

Average journey times for exiting passengers are as much as two minutes greater than uncongested minimum journey times and increase significantly by 2030 (25 to 36 seconds), except for westbound platform exits to the East Mezzanine, which experience little to no congestion.

Metro Center

Figure 3-21 shows the transfer journey times at Metro Center Station for combined AM and PM peak hours. Transfer passengers will experience moderate increases in average journey times between 2013 and 2030, and the difference between average and relatively uncongested minimum journey times by 2030 will be approximately one minute.

In the 2030 No Build condition, it would take the average passenger nearly four minutes to travel from Blue/Orange/Silver Line trains to the Farragut West, West Exit (above)

Figure 3-19 Farragut North Alighting Journey Times - 2013/2030 No Build, AM Peak Hour

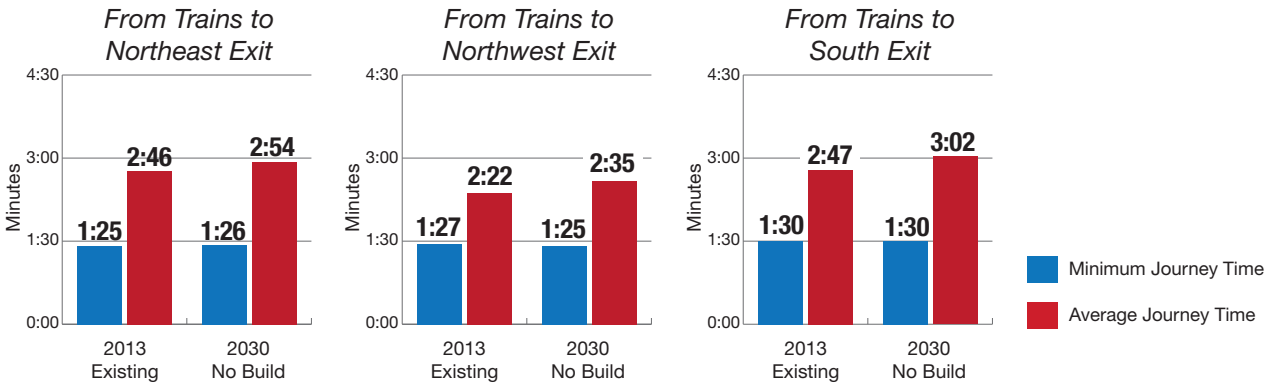


Figure 3-20 Farragut West Alighting Journey Times - 2013/2030 No Build, AM Peak Hour

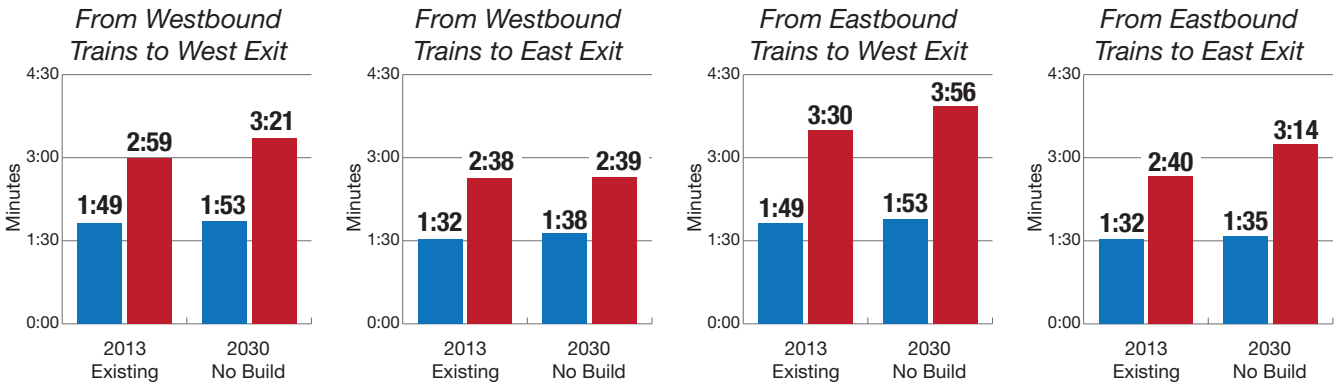
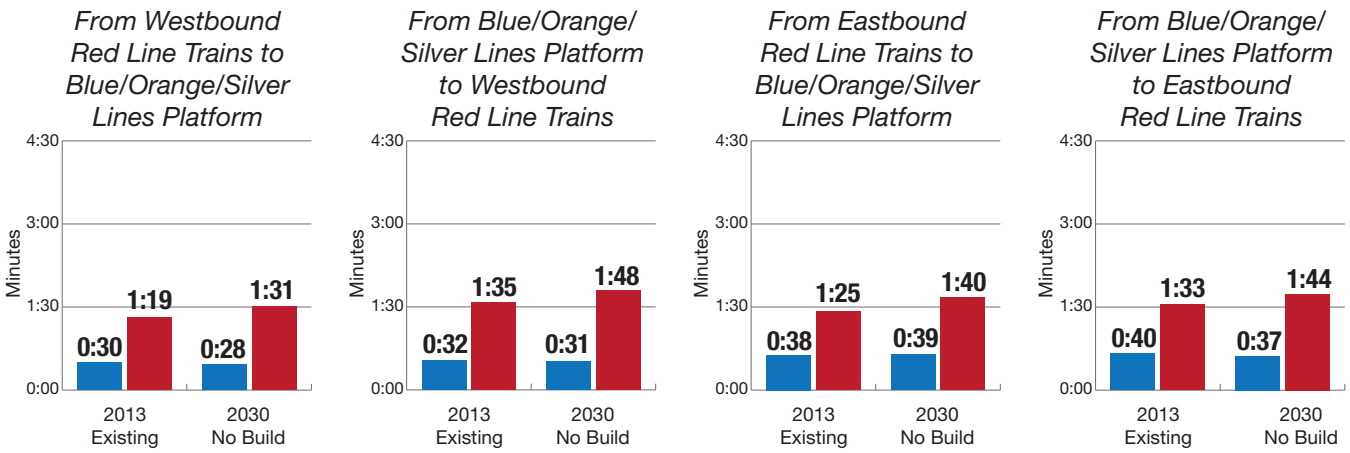


Figure 3-21 Metro Center Transfer Journey Times - 2013/2030 No Build, AM Peak Hour



3.4 Summary of 2030 No Build Conditions

Figure 3-22 provides a summary of the 2030 No Build conditions at both Farragut North and Farragut West Stations.

Farragut North Station

AM Peak Hour

Platform crowding and queues between the two central escalator banks will worsen by 2030, by which time the platform will have 29 percent of passengers in LOS E and F. The escalator queues and faregate crowding are most significant for passengers exiting to the South Mezzanine. Journey times for alighting passengers are approximately one minute greater than during uncongested times, due to passenger congestion, and by 2030 further increase by 13 to 18 seconds.

PM Peak Hour

PM peak hour conditions will become moderately more crowded, but no station areas show severe crowding or escalator queues.

Safety Analysis

Platform crowding between the central escalator banks impedes the only means of station egress for passengers on the southern half of the platform. During the AM peak, this crowding also spills over into the areas between the escalator banks and platform edge.

Farragut West Station

AM Peak Hour

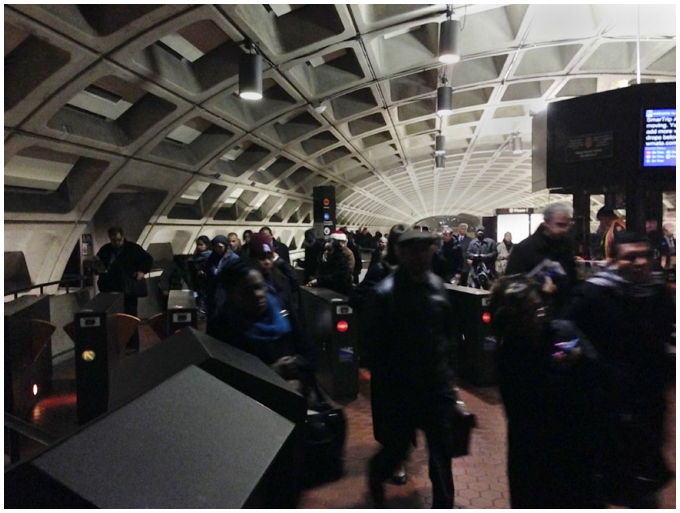
During the AM peak hour, three out of four of the platform up escalators have significant queues and platform level congestion at their boarding areas. The eastbound platform, in particular, in 2013 has 29 percent of passengers in LOS E and F, growing to 48 percent by 2030. Average Journey Times for exiting passengers are as much as two minutes greater than uncongested Minimum Journey Times and increase significantly by 2030 (25 to 36 seconds), except for westbound platform exits to the East Mezzanine, which experience little to no congestion.

PM Peak Hour

During the PM peak hour, westbound platform congestion worsens, growing from 14 to 26 percent of passengers in LOS E and F.

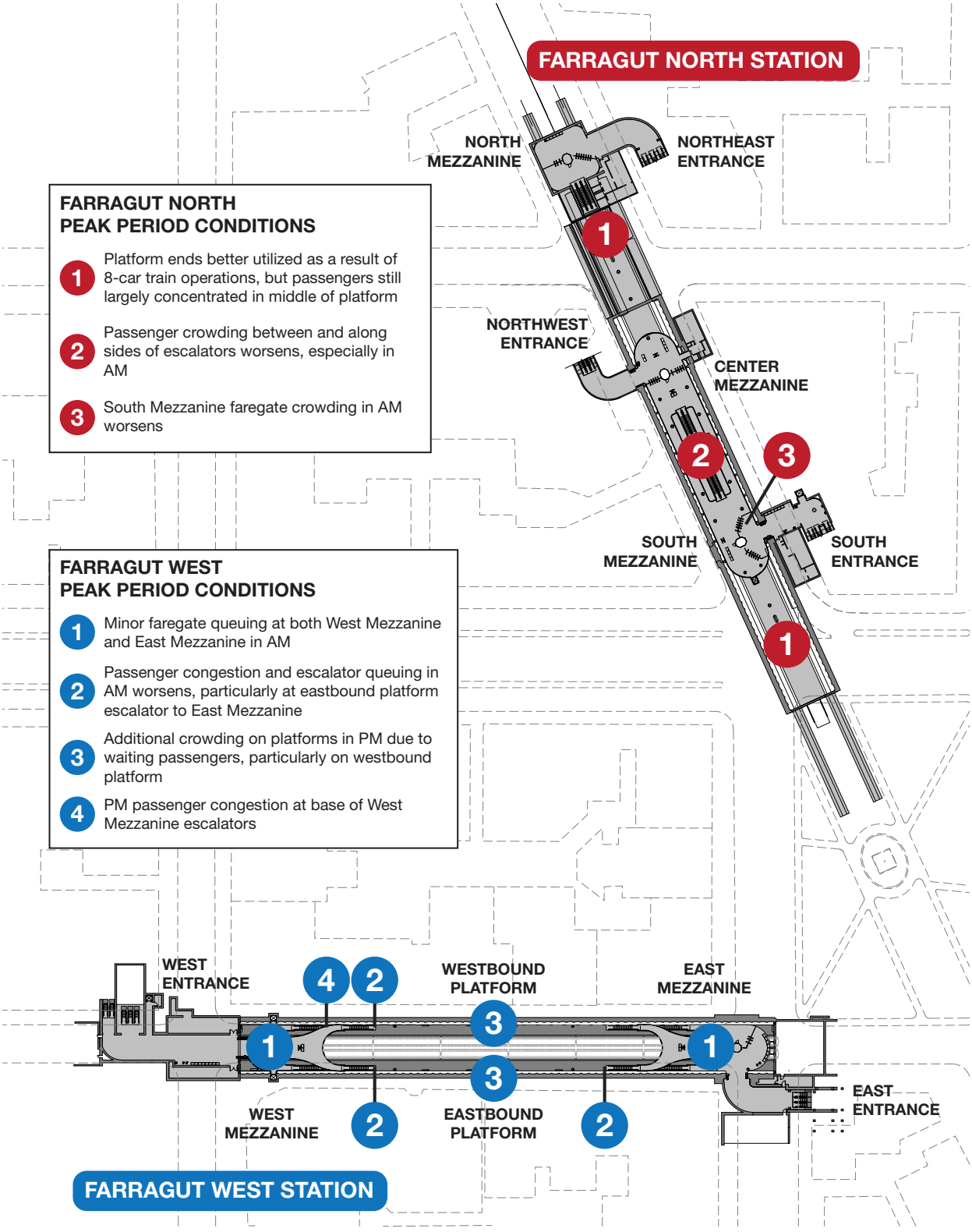
Safety Analysis

The platform congestion between the escalators and the platform edge, especially on the eastbound platform during the AM peak period, is a safety concern given the relatively narrow width of the side platforms. During the PM peak period, this crowding is also a potential concern on the westbound platform near the escalators to/from the West Mezzanine.



Congestion will worsen at both Farragut North and Farragut West (above) if no capacity improvements are implemented within the stations.

Figure 3-22 2030 No Build Peak Period Conditions - Farragut North and Farragut West



Metro Center Station

Figure 3-23 provides a summary of the 2030 No Build conditions at Metro Center Station.

Crowding on the lower platform level in the area between the escalators to upper platforms at Metro Center is a key issue affecting passenger circulation and also a safety issue between the escalators and platform edge.

AM Peak Hour

By 2030, the lower platform will experience more significant congestion in the central area between the escalators. The down escalators from the Red Line platforms will continue to have queues. The North and South Mezzanine transfer areas will have 20 and 29 percent of passengers, respectively, experiencing LOS E and F. Blue, Orange, and Silver Lines (Lower Platform) alighting passengers and transfer passengers will experience increased journey times, and the difference between average and relatively uncongested minimum journey times will be approximately one minute.

PM Peak Hour

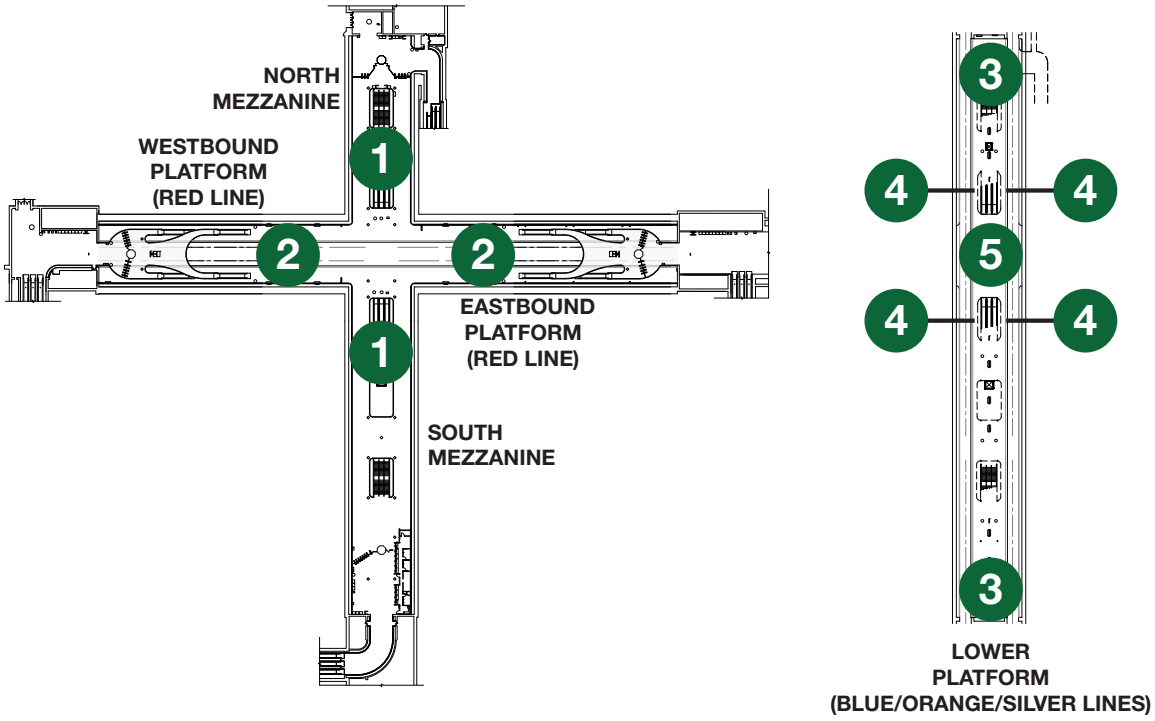
The lower platform will experience more significant congestion in the central area between the escalators, similar to the AM peak. The down escalators from the eastbound and westbound Red Line platforms to the lower platform will continue to experience queues. All areas of the station will have higher percentages of passengers experiencing LOS E and F by 2030, although none are above 20 percent. Transfer journey times will increase moderately by 2030.

Safety Analysis

Lower platform crowding between the central escalator banks extends into the space between the South Mezzanine escalators and the platform edge during the AM and PM peaks.

Figure 3-23 2030 No Build Peak Period Conditions - Metro Center

METRO CENTER STATION



METRO CENTER PEAK PERIOD CONDITIONS

1. Moderately higher congestion, cross-flow conflicts, and escalator queuing by transferring passengers, particularly higher at down escalator from eastbound platform
2. Crowding in PM due to waiting passengers
3. Platform ends better utilized as a result of 8-car train operations, but passengers still largely concentrated in middle of platform
4. Congestion between escalators and platform edges worsens
5. Higher congestion and cross-flow conflicts

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Station Improvement Concepts

Farragut North - Farragut West Station Capacity Study

Section 4

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4.0 STATION IMPROVEMENT CONCEPTS

This section summarizes the individual station improvement concepts proposed for Farragut North and Farragut West Stations. These concepts comprise:

- Farragut North-Farragut West pedestrian tunnel
- Farragut North Station capacity and access improvements
- Farragut West Station capacity and access improvements

Figure 4-1 provides an overview of the improvement concepts.

4.1 Design Process

The improvement concepts build upon recommendations from the previous studies discussed in **Section 1** and the assessments of existing and future No Build conditions, discussed in **Section 2** and **3**. As initial concepts were developed, they were tested using the pedestrian simulation models of Build Alternatives described in **Section 5**, and some of the improvement concepts were refined based on the results.

Accessibility

Coordination with Metro's ADA Policy and Planning (ADAP) office was an integral part of the design process. ADAP provided specific guidance on station accessibility and design requirements related to elevators, locations of stairs and escalators, accessible pathways, emergency egress facilities, and other station elements.

Agency Coordination

The draft design concepts were shared and discussed with the National Park Service (NPS) and the District Department of Transportation (DDOT) to review and address any potential impacts to NPS property and DC streets and public spaces.

4.2 Design Objectives

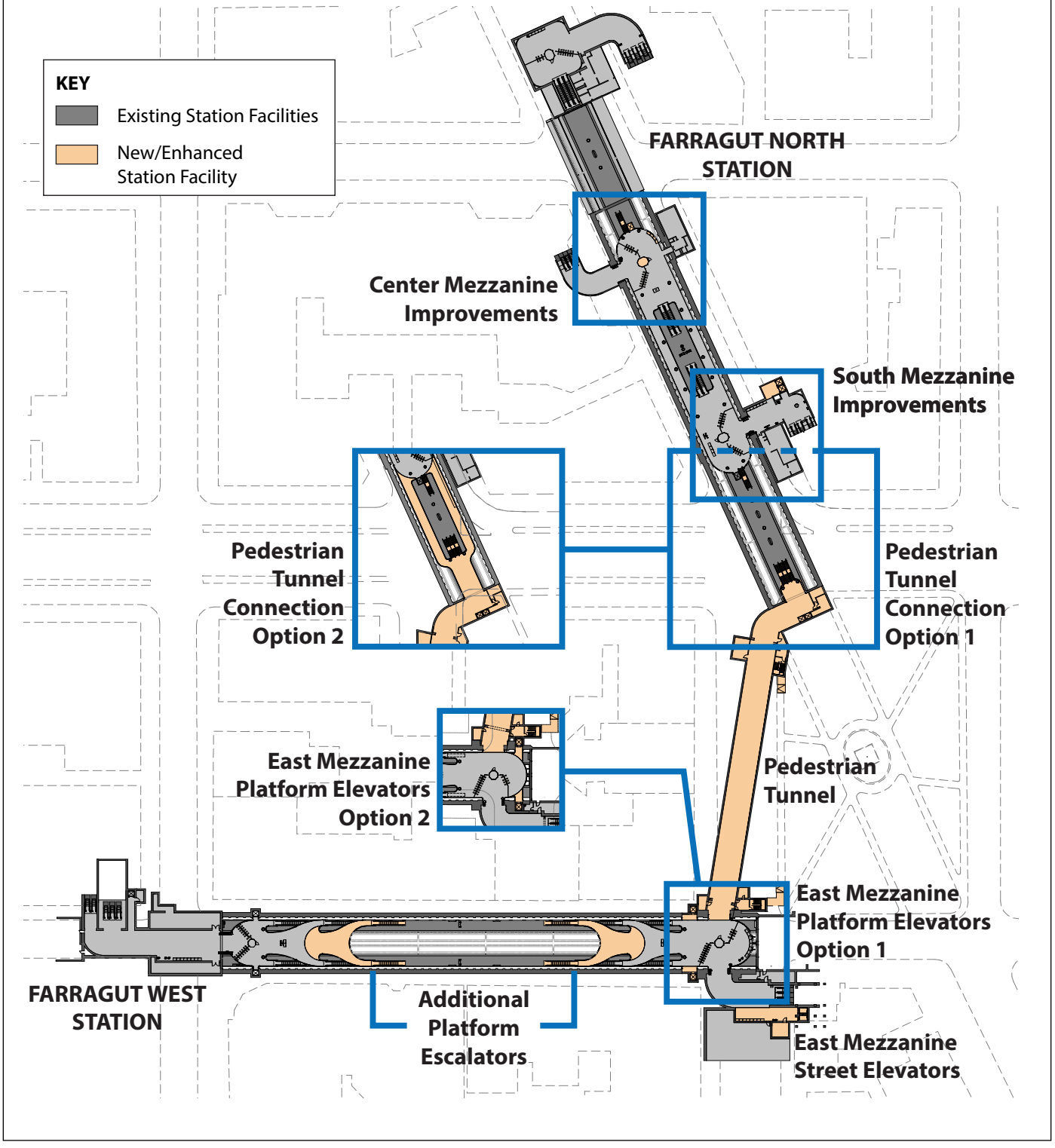
The following general design objectives were developed for the station improvement concepts:

- Address current passenger circulation deficiencies within Farragut North and Farragut West stations;
- Accommodate future travel demand at Farragut North and Farragut West stations;
- Relieve current and future transfer demand at Metro Center station;
- Improve station accessibility at Farragut North and Farragut West stations; and
- Develop improvement concepts for Farragut North and Farragut West that are feasible to implement and enhance the user's experience.

The following sections describe the recommended station improvement concepts developed for the Farragut stations.

The detailed drawing set of the improvement concepts is provided in a separate volume to this report.

Figure 4-1 Overview of Farragut Station Improvement Concepts



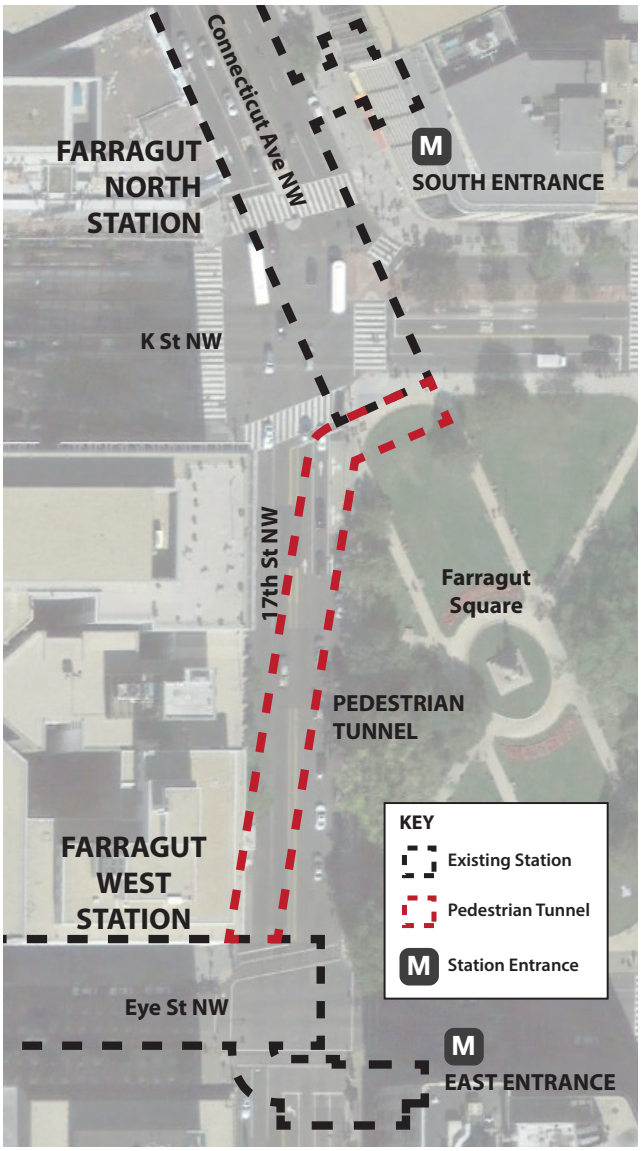
4.3 Farragut North-West Pedestrian Tunnel

The pedestrian tunnel concept (see **Figure 4-2**) retains the design developed by the 2004 *Farragut North-Farragut West Passageway Study*. Specific refinements made to the 2004 design were:

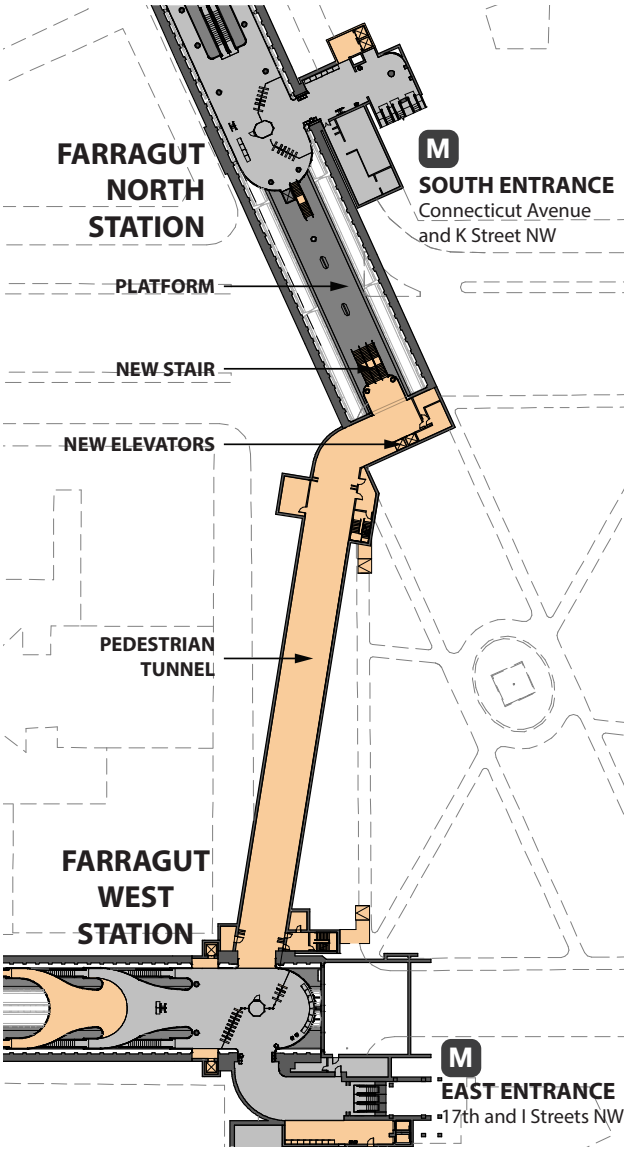
- Farragut North pedestrian tunnel entrance connection (two options described below); and
- Farragut West, East Mezzanine platform elevators (two options described in **Section 4.5**).

Figure 4-2 Overview of Pedestrian Tunnel Design

Farragut North-West Pedestrian Tunnel Aerial View

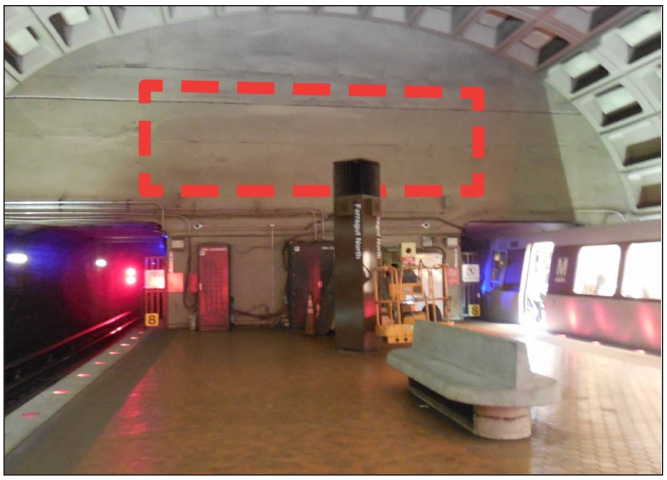


Farragut North-West Pedestrian Tunnel Plan



Farragut North Tunnel Entrance Options

The pedestrian tunnel connects to Farragut North at the southern end of the platform through the end wall of the vault. **Option 1** provides a wide stair to link the tunnel entrance down to the platform, as well as two elevators located in a platform vestibule within part of the existing service rooms at the end of the platform (see **Figure 4-3**). **Option 2** also extends the South Mezzanine to the pedestrian tunnel entrance; allowing passengers to access the tunnel without descending to the platform and then ascending back up (see **Figures 4-4** and **4-5**).



Farragut North Station, southern end of platform, location of pedestrian tunnel connection

Figure 4-3 Farragut North Pedestrian Tunnel Connection - Option 1

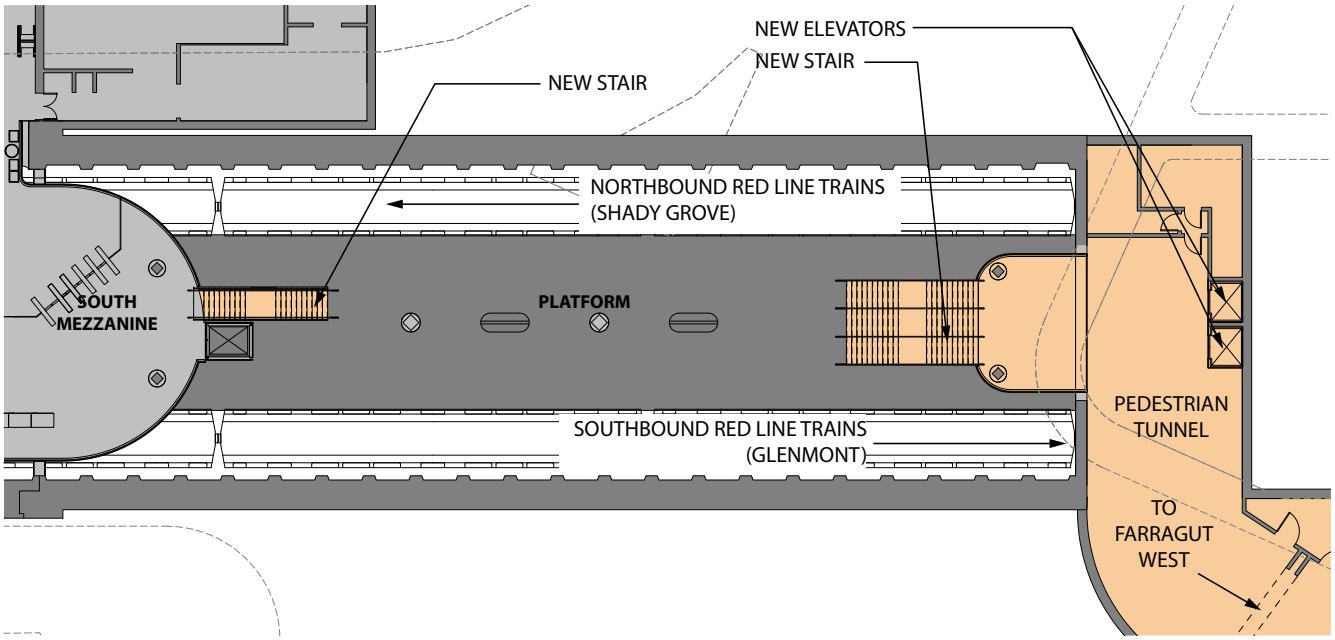


Figure 4-4 Farragut North Pedestrian Tunnel Connection - Option 2, Plan View

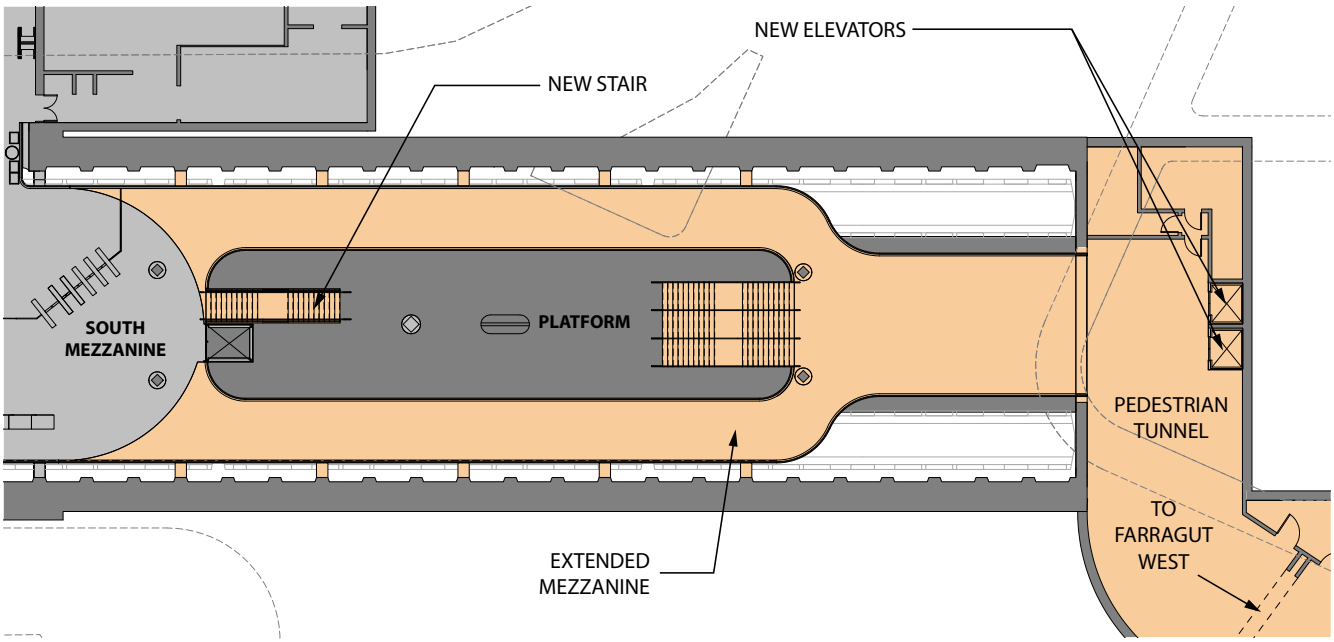
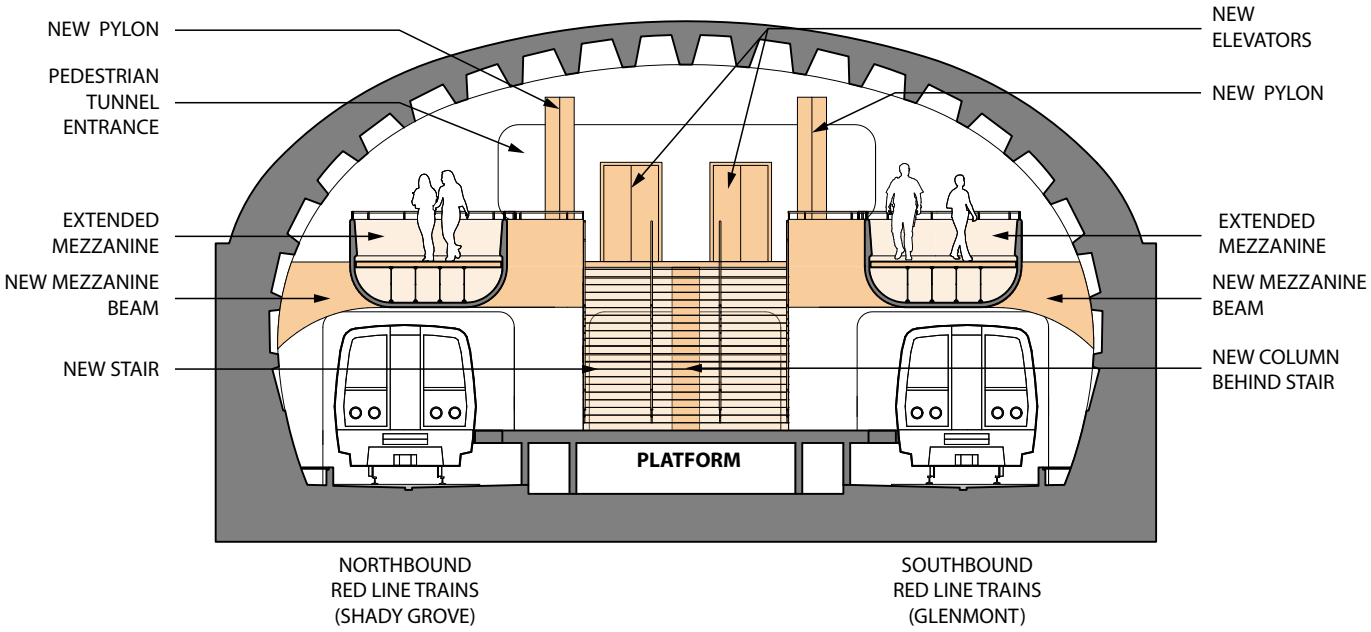


Figure 4-5 Farragut North Pedestrian Tunnel Connection - Option 2, Section View (Looking South)



4.4 Farragut North Station Improvements

The proposed design improvements for Farragut North address limited vertical circulation capacity, relatively low utilization of the platform ends, and limited elevator access. Proposed improvements are focused at the Center and South Mezzanines. No improvements are proposed for the North Mezzanine, which does not experience significant passenger crowding or escalator queues.

Tables 4-1 and **4-2** summarize the existing and proposed vertical circulation and faregate capacity for Farragut North Station.

Adding two additional faregates to the Center Mezzanine is part of the station improvements proposed for Farragut North Station

Table 4-1 Farragut North Station Existing and Proposed Vertical Circulation Capacity

Mezzanine	Escalator/Stair		Elevator			
	Mezzanine to Platform		Street to Mezzanine		Mezzanine to Platform	
	Existing #	Proposed #	Existing #	Proposed #	Existing #	Proposed #
North	3	3	0	0	0	0
Center	2	**3**	0	0	0	**1**
South	2	**3**	1	**2**	1	1

Table 4-2 Farragut North Station Existing and Proposed Faregate Capacity

Mezzanine	Standard Faregate		ADA Faregate	
	Existing #	Proposed #	Existing #	Proposed #
North	7	7	1	1
Center	7	**9**	1	1
South	8	8	2	2

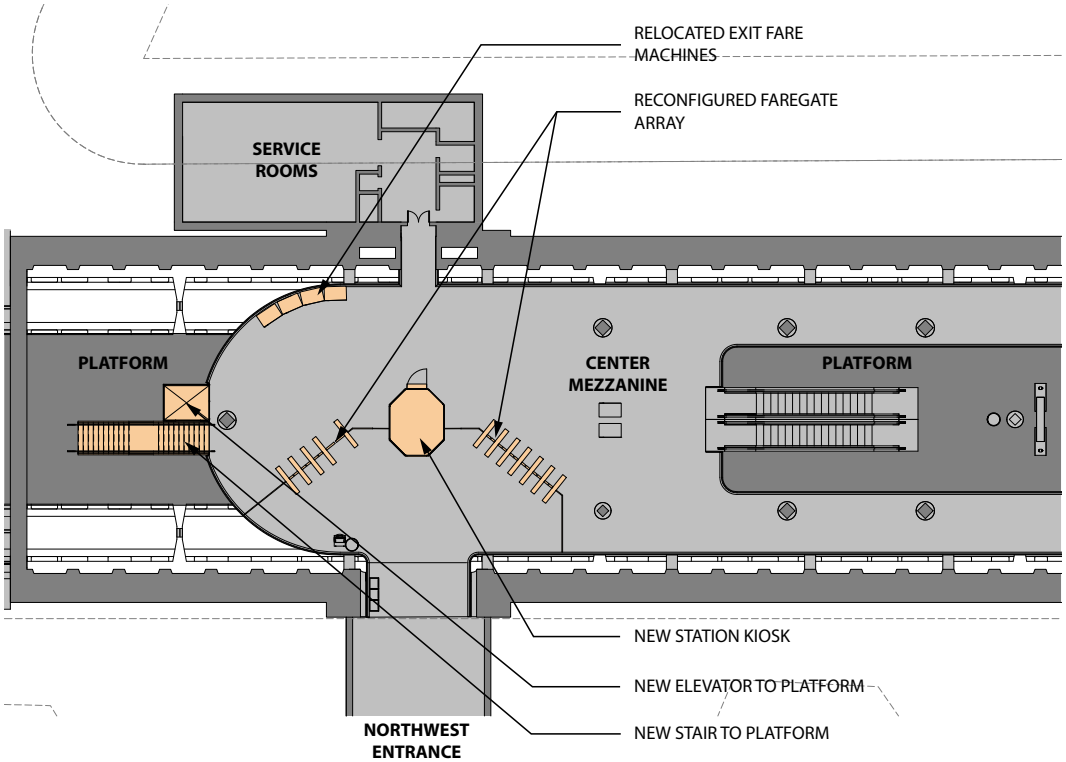
Center Mezzanine Improvements

The proposed improvements for the Farragut North Center Mezzanine (see **Figure 4-6**) provide the following:

- **Expanded Vertical Circulation Capacity** – A new stair and elevator are proposed to connect the northern end of the platform to the Center Mezzanine and to help relieve the crowded central platform area.
- **Expanded Faregate Capacity** – To accommodate the new stair and elevator, the faregates and station kiosk need to be re-oriented. Two additional standard faregates are proposed to accommodate future passenger demand.
- **New Accessible Pathway between Northern End of Platform and Mezzanine Level** – The new elevator will provide an accessible pathway that allows passengers to access the street level elevator at the South Mezzanine while avoiding the congested central platform area.

Farragut North Station, Center Mezzanine proposed location of new stair and elevator

Figure 4-6 Farragut North Station Capacity Improvements - Center Mezzanine



South Mezzanine Improvements

The proposed improvements for the Farragut North South Mezzanine (see **Figures 4-7** and **4-8**) provide the following:

- **Expanded Vertical Circulation Capacity –** A new stair at the southern end of the South Mezzanine takes advantage of the existing stair pit incorporated in the platform structure.
- **Better Utilization of Existing Faregates –** The pathway provided by the new stair allows passengers to better utilize the lesser used faregate array on the southern side of the station manager kiosk, relieving crowding at the northern faregate array by the escalators.
- **Second Street Level Elevator –** A second elevator is proposed at the South Entrance, adjacent to the existing elevator. A new passageway would be required to connect the street elevator to the South Mezzanine but would allow for the existing elevator to be reconfigured to face the same direction as the new elevator.

Farragut North Station, South Mezzanine proposed location of new stair

Farragut North Station, South Entrance existing elevator and proposed location of new elevator on Connecticut Ave, NW

Figure 4-7 Farragut North Station Capacity Improvements - South Mezzanine

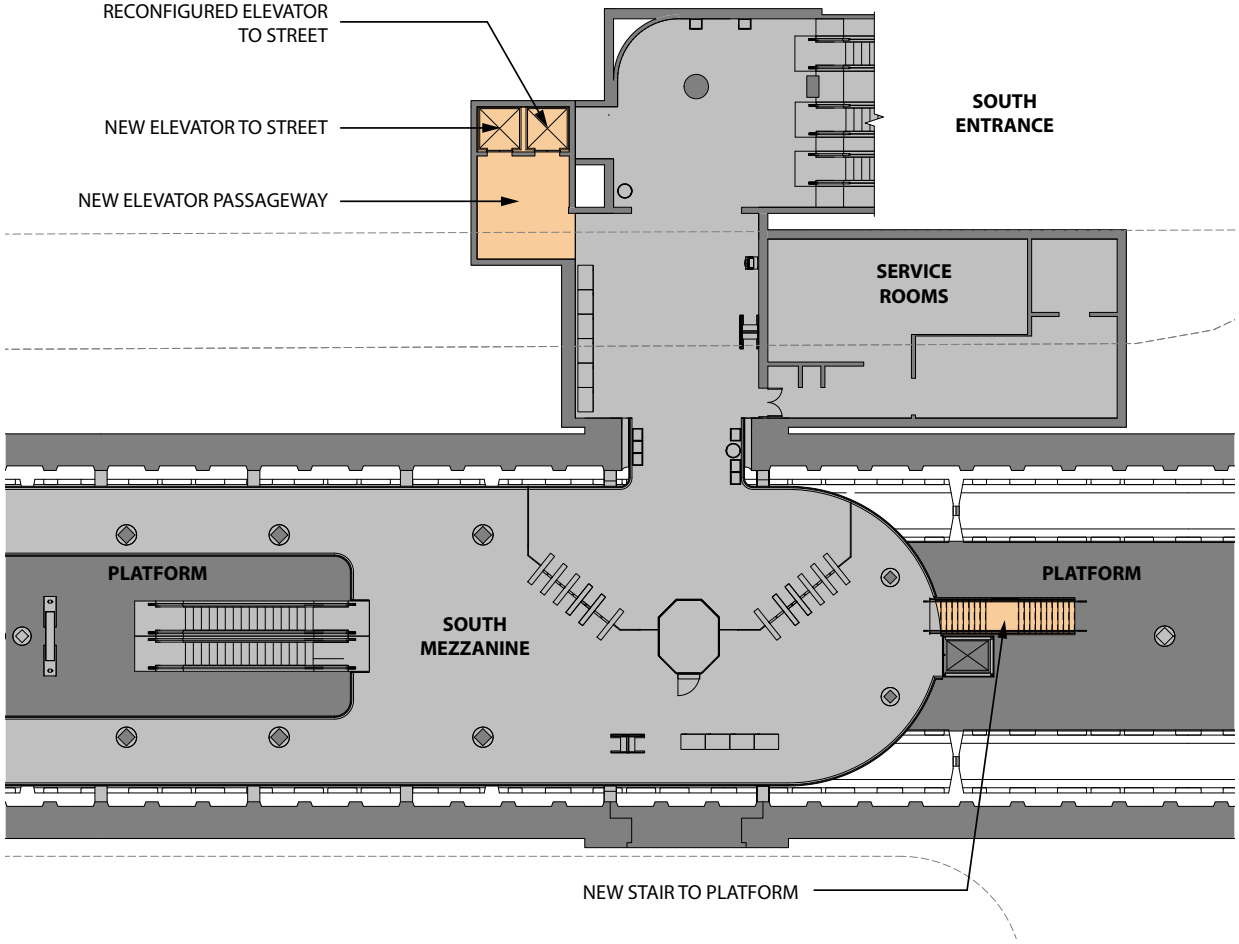
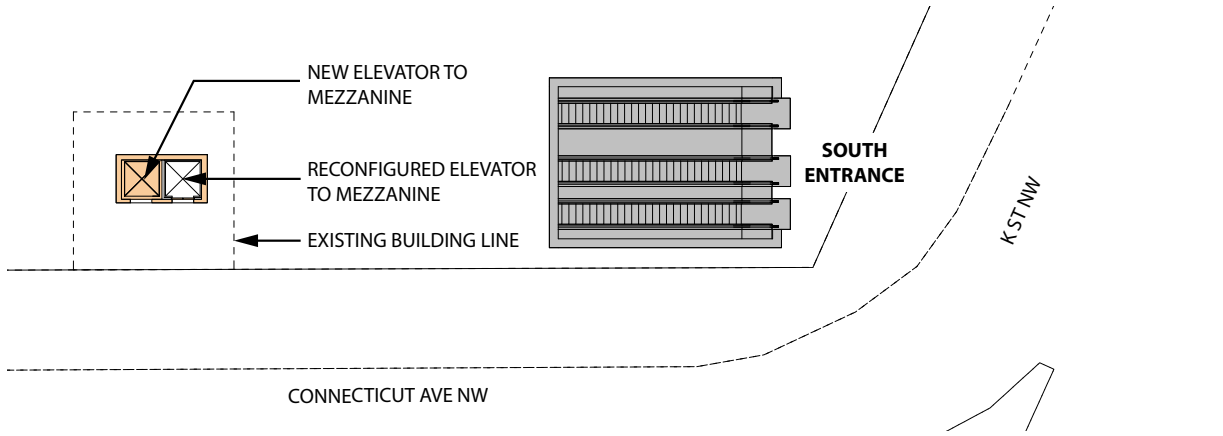


Figure 4-8 South Mezzanine Street Elevators - Street Level



4.5 Farragut West Improvements

Proposed improvements comprise new platform and street elevators at the East Mezzanine, additional escalators connecting both platforms to the two mezzanines, and additional or reconfigured faregates.

Tables 4-3 and **4-4** summarize the existing and proposed vertical circulation and faregate capacity for Farragut West station.

Station improvements proposed for Farragut West are designed to increase platform vertical circulation capacity and provide more accessible pathways throughout the station.

Table 4-3 Farragut West Station Existing and Proposed Vertical Circulation Capacity

Mezzanine	Escalator/Stair		Elevator			
	Mezzanine to Platform		Street to Mezzanine		Mezzanine to Platform	
	Existing #	Proposed #	Existing #	Proposed #	Existing #	Proposed #
East	4	**6**	0	**2**	0	**2**
West	4	**6**	1	1	2	2

Table 4-4 Farragut West Station Existing and Proposed Faregate Capacity

Mezzanine	Standard Faregate		ADA Faregate	
	Existing #	Proposed #	Existing #	Proposed #
East	8	**10**	1	1
West	11	11	1	1

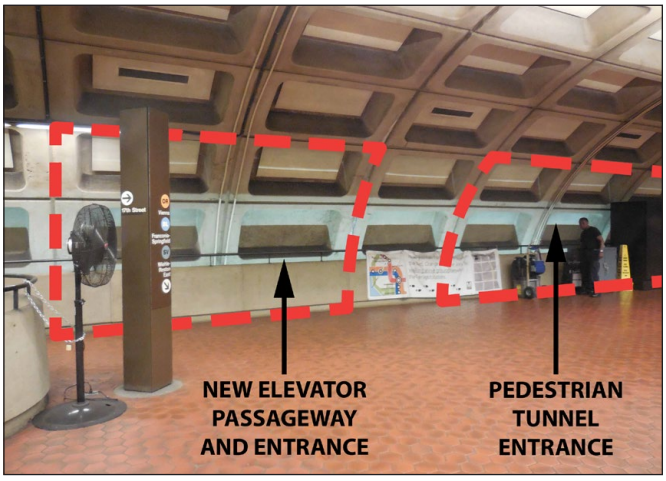
East Mezzanine Elevator Improvements

New Platform Elevators

Two options were developed for the new elevators connecting the East Mezzanine to the eastbound and westbound platforms:

- **Option 1 – Elevators Located near Escalators:** Similar to the 2004 study design, elevators are located near the tops of the platform escalators. The current design incorporates the passageway to create a 15-foot wide vestibule, providing sufficient queuing area to avoid passenger circulation issues, consistent with WMATA design guidelines. The passageway design requires a vault opening of two coffers in width.
- **Option 2 – Elevators Located at Back of Mezzanine:** Elevators are located out of the main pedestrian circulation pathways near the vault end wall. A single-coffer vault passageway opening is proposed, because the 15-foot wide elevator queuing area can be accommodated within the extended mezzanine area required to connect to the vault wall. The option would require a reconfiguration of the faregate array and relocation of the fare vending machines to the entrance passageway. Utility and service rooms would also need to be reconfigured.

Figure 4-9 on the following page shows the two proposed elevator options for the Farragut West East Mezzanine.

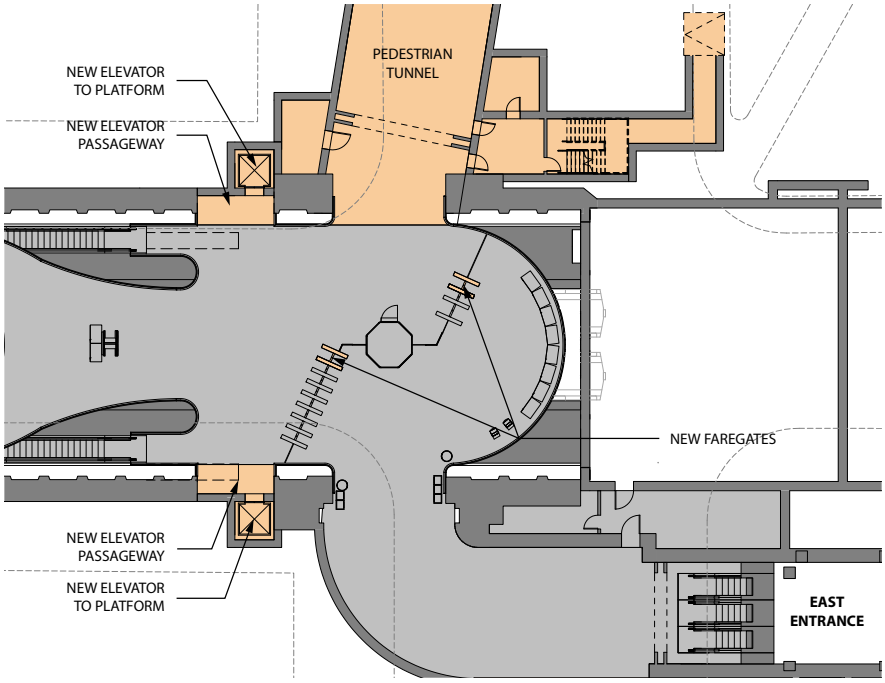


Farragut West Station, East Mezzanine, Option 1 proposed location of new platform elevator (westbound platform side shown)

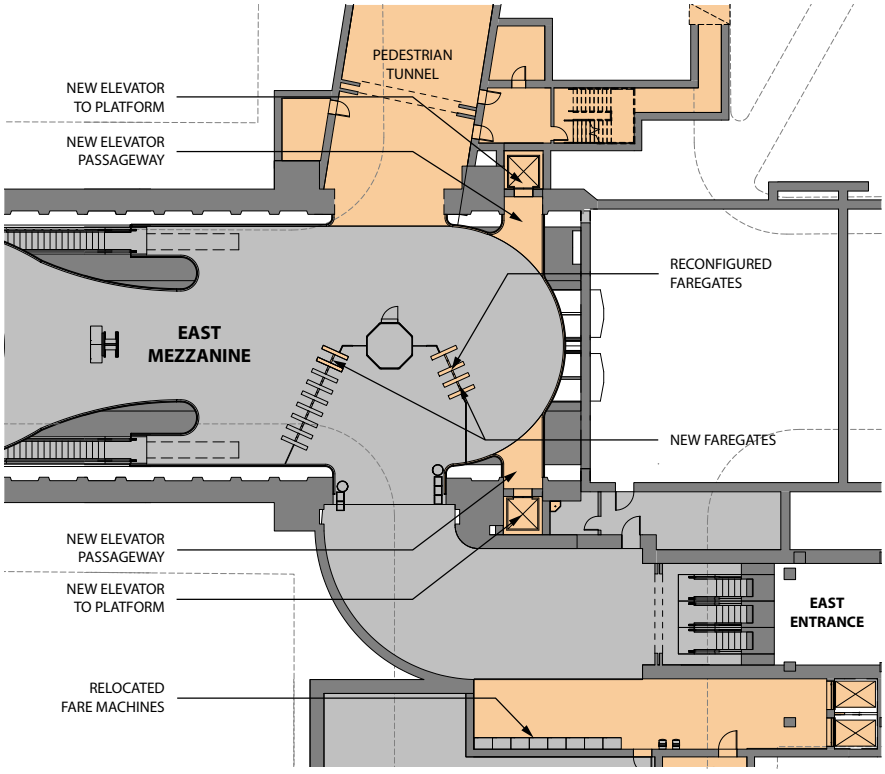
Farragut West Station, East Mezzanine, Option 2 proposed location of new platform elevator passageway (eastbound platform side shown)

Figure 4-9 Farragut West Station East Mezzanine Platform Elevators Design Options

Option 1 - Elevators Located near Escalators

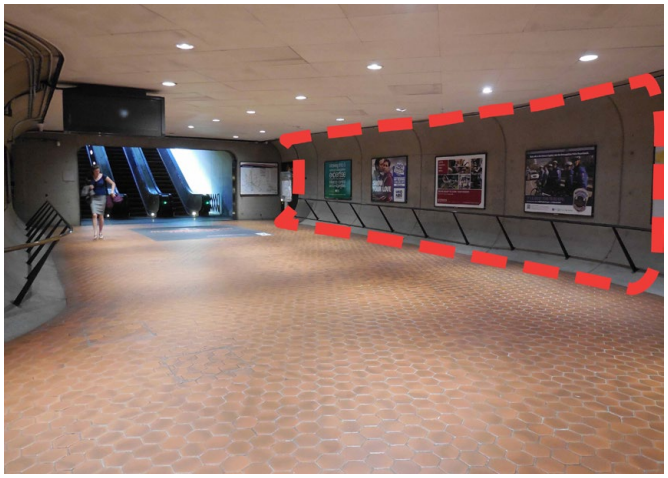


Option 2 - Elevators Located at Back of Mezzanine

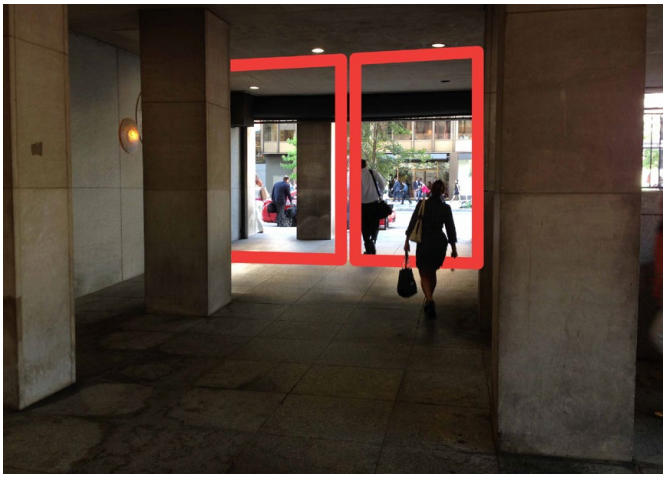


East Mezzanine Street Elevators

Two new elevators are proposed to connect the East Mezzanine to the street level entrance. A new mezzanine passageway is required (see **Figure 4-10**). At the street level, the elevator design utilizes the space of the current 17th Street, NW entrance. The elevators have separate doors for the mezzanine and street levels. The design provides a queuing area for the elevator inside the existing station entrance and out of the way of busy pedestrian circulation areas; however, the location would require closing the 17th Street side of the entrance, leaving only the Eye Street, NW side open (see **Figure 4-10**).

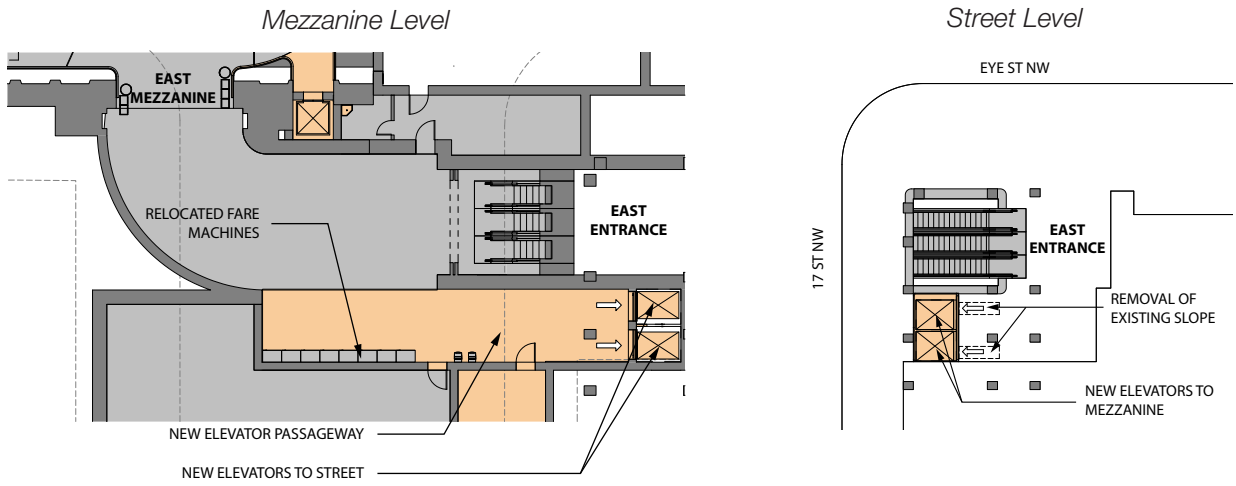


Farragut West Station, East Entrance, location of proposed passageway to new street level elevators



Farragut West Station, East Entrance, (17th St NW), street level location of proposed elevators

Figure 4-10 East Mezzanine to Street Elevators



Additional Platform Escalators

Additional platform escalators for both mezzanines are proposed. The current design replicates the existing escalator and mezzanine design, with symmetrical extensions of the mezzanines over the tracks and an additional escalator on each platform end.

Although the additional escalators would alleviate AM peak period congestion and escalator queues, as modeled in the pedestrian simulations, the additional platform space occupied by the escalators would exacerbate PM peak period crowding by limiting the space available for waiting passengers.

Further study is needed to developed additional alternative design concepts for expanded vertical circulation capacity for the Farragut West platforms.

Farragut West Station, platform escalators, existing condition

Expanded Faregate Capacity

East Mezzanine

Two additional faregates are proposed at the East Mezzanine to accommodate future demand. The array on the west side of the kiosk, towards the escalators, receives most of the pedestrian traffic, thus one additional standard faregate is needed to accommodate future demand. The array on the east side of the kiosk would receive more pedestrian traffic as a result of the tunnel, thus one additional standard faregate would better accommodate two-way passenger flows and higher anticipated demand.

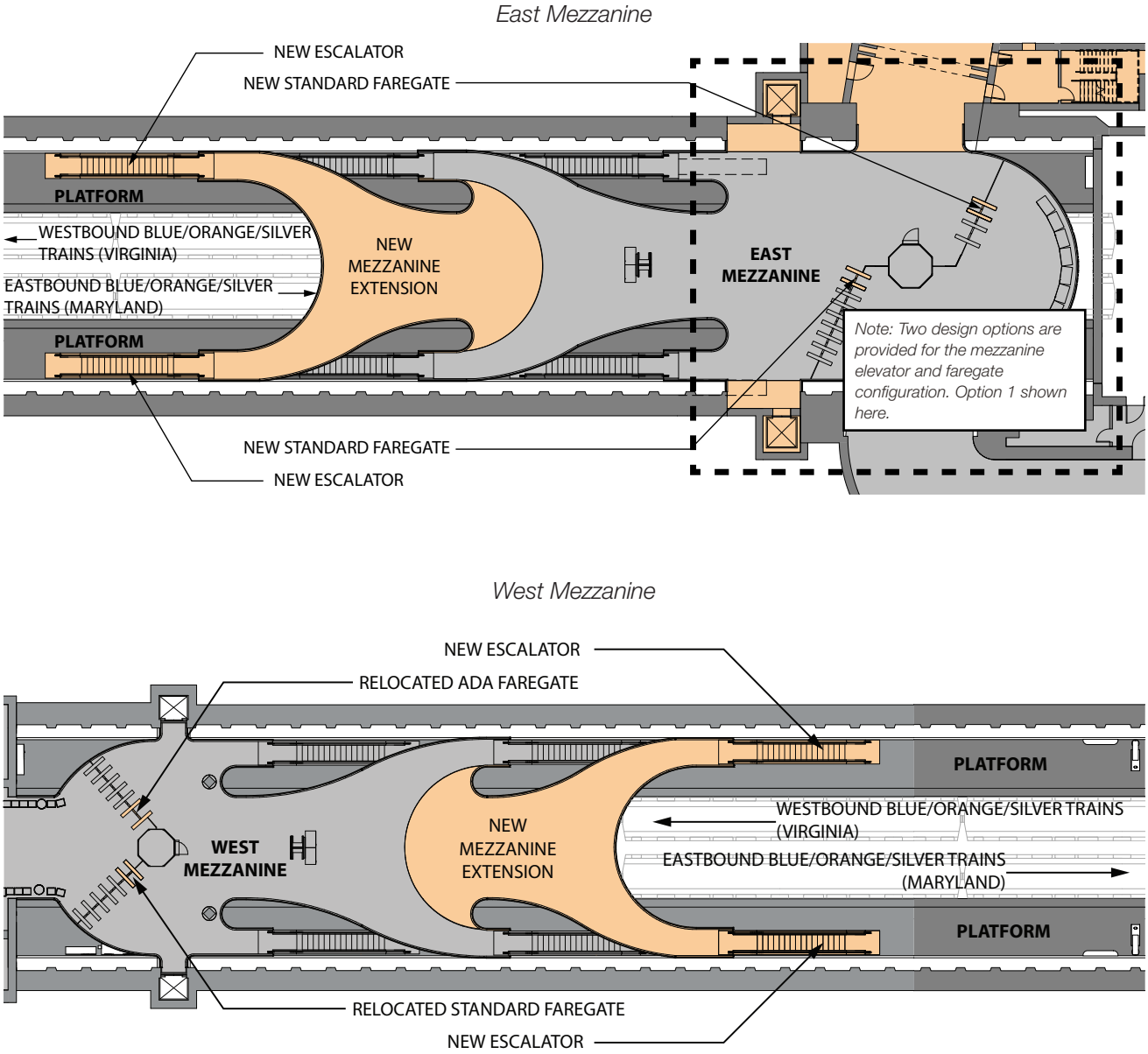
Farragut West Station, West Mezzanine, current location of ADA faregate proposed to be relocated to opposite side of station kiosk and replaced with a standard faregate to better accommodate passenger flow

West Mezzanine

The West Mezzanine cannot accommodate additional faregates without restructuring the faregate arrays in a way that would constrict the pedestrian circulation space at the top of the escalators. To help improve faregate capacity given this constraint, it is proposed to shift the ADA faregate from the more heavily used southern array to the northern faregate array and swap it with a standard faregate (which can accommodate a higher rate of passenger flow) from the northern array. The relocated ADA gate would still be in a convenient and accessible location for all passengers.

Figure 4-11 shows the additional platform escalators, extended East and West Mezzanines, and improved faregate arrays at Farragut West station.

Figure 4-11 Farragut West Station Additional Platform Escalators and Expanded Faregate Capacity



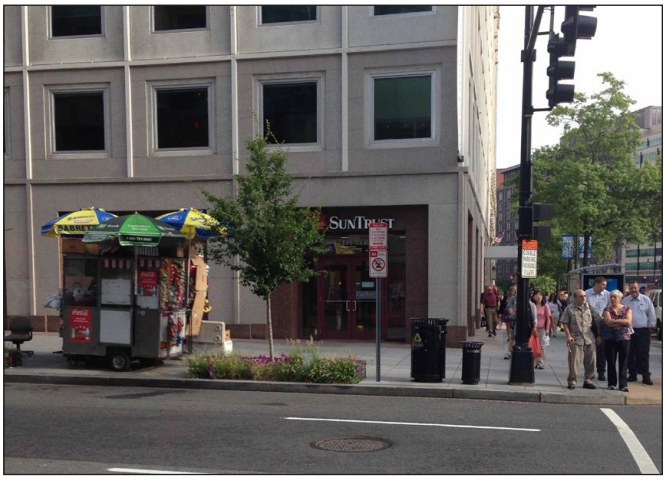
4.6 Potential Future Station Improvements

Farragut West, East Mezzanine Second Entrance

To improve accessibility of the Farragut West East Mezzanine, a second entrance from the northwest corner of 17th Street, NW and Eye Street, NW could be beneficial (see **Figure 4-12**). A second entrance point would allow passengers from the north and west to avoid street crossings and would also compensate for the closure of one of the two entry points to the existing East Entrance if needed for new street elevators. Transfers from bus and streetcar services along the planned K Street Transitway could utilize the second entrance to Farragut West, and, because the second entrance would connect into the pedestrian tunnel (see **Figure 4-13**), Farragut North passengers could use it as an alternative to the sometimes congested South Entrance.

A new entrance at this location would depend on redevelopment of the existing office building (900 17th Street, NW). A mid-block entrance along 17th Street, NW, closer to K Street, could also be considered as a way to serve Farragut North as well as Farragut West. However, even if redevelopment of the building block occurs, the limited space at street level and underground would still pose a challenge for the design and construction of a new entrance.

Design options explored for the potential new entrance include locating the faregates at street level versus at mezzanine level and providing elevator-only access or both escalators and elevators.



Potential future entrance location for Farragut West, East Mezzanine, northwest corner of 17th St, NW and Eye St, NW

Figure 4-12 Farragut West Potential Future Entrance Location (Street Level)

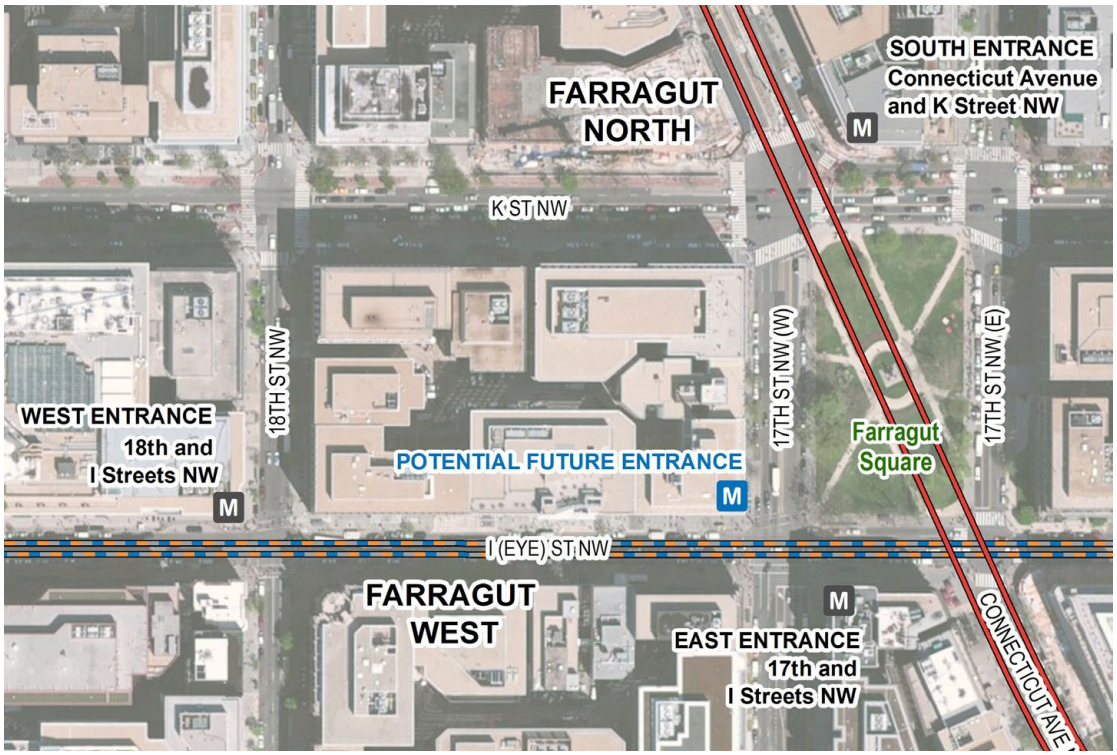
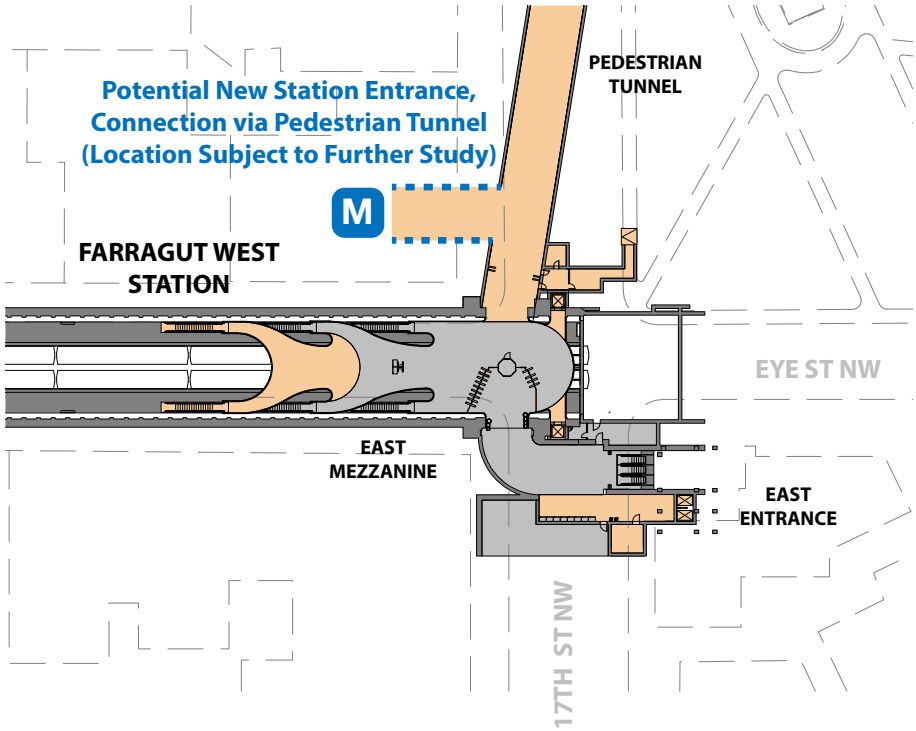


Figure 4-13 Farragut West Potential Future Entrance Location (Mezzanine Level)



4.7 Conceptual Capital Cost Estimates

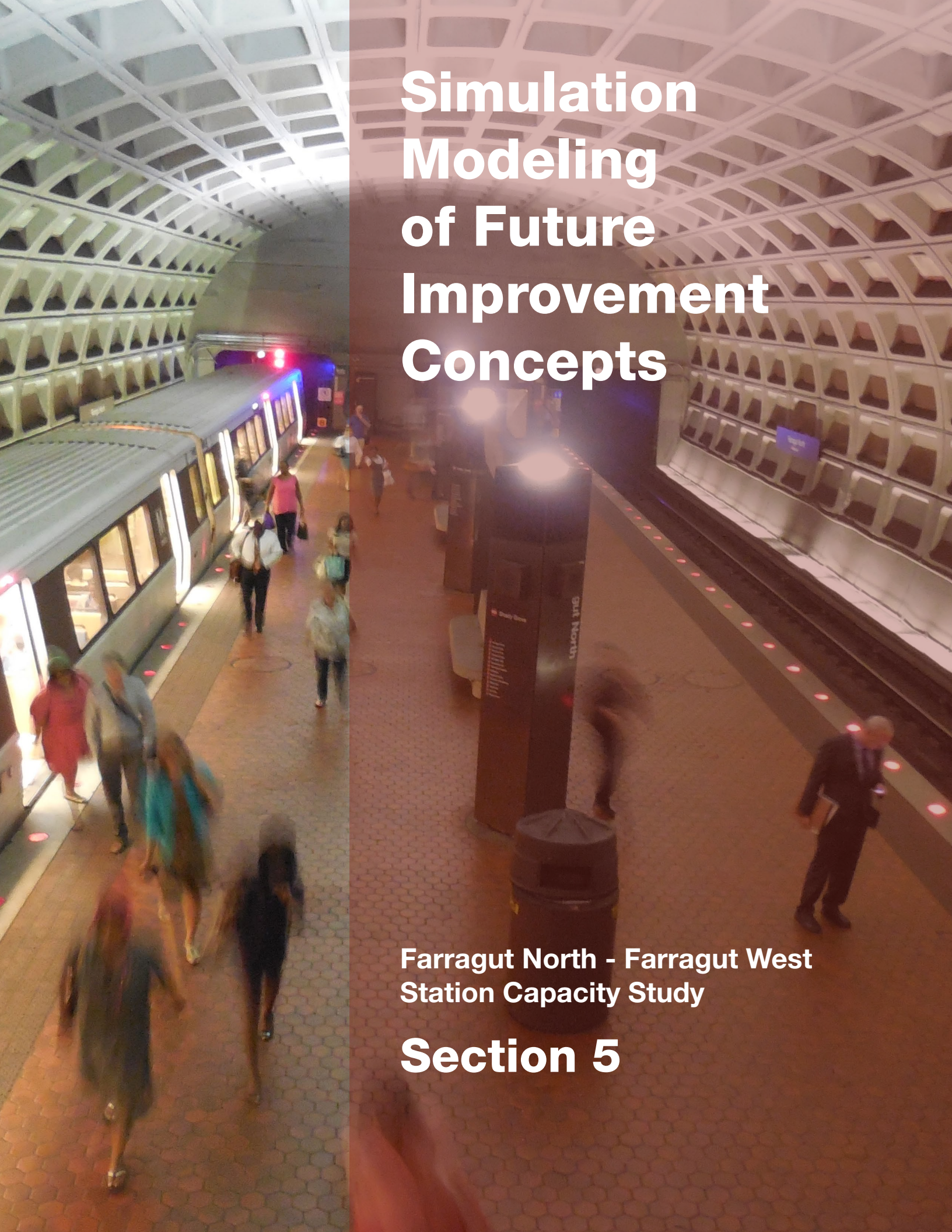
Conceptual capital cost estimates for the station improvement concepts were developed based on WMATA specifications and industry practices. Construction costs are based on current year dollars and contract costs are escalated to the mid-point of construction (assumed to be mid-2021). **Table 4-5** summarizes the estimated construction and total project costs.

Appendix A contains the detailed cost estimates.

Table 4-5 Conceptual Capital Cost Estimates

Cost Subtotal/ Total	Farragut North-West Pedestrian Tunnel*		Farragut North, Center Mezzanine Improvements	Farragut North, South Mezzanine Improvements	Farragut West, East Mezzanine Street Elevators	Farragut West, Additional Platform Escalators
	Option 1 (without Farragut North, South Mezzanine Extension)	Option 2 (with Farragut North, South Mezzanine Extension)				
Construction Subtotal (2014 dollars)	$25.0 M	$26.1 M	$3.1 M	$5.1 M	$6.8 M	$6.0 M
Construction Cost (2014 dollars; incl. Markups for general conditions & project requirements, bond, insurance, building permit)	$30.1 M	$31.4 M	$3.8 M	$6.1 M	$8.2 M	$7.3 M
Contract Cost (Hard Costs only) (incl. Contingency & Escalation to mid-point of construction in 3rd Quarter 2021)	$46.8 M	$48.8 M	$5.9 M	$9.5 M	$12.7 M	$11.3 M
Total Contract Cost (Hard + Soft Costs) (incl. Design, Engineering, Design Mgmt., Constr. Support)	**$70.1 M**	**$73.2 M**	**$8.8 M**	**$14.2 M**	**$19.0 M**	**$16.9 M**

** Farragut North-West Pedestrian Tunnel costs include Farragut West, East Mezzanine platform elevators.*



Simulation Modeling of Future Improvement Concepts

Farragut North - Farragut West Station Capacity Study

Section 5

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5.0 SIMULATION MODELING OF FUTURE IMPROVEMENT CONCEPTS

This section describes how the improvement concepts were packaged into Build Alternatives for comparative modeling using pedestrian simulations. The performance of the improvement concepts under 2030 station conditions is summarized, comparing the Build alternatives with each other and against the 2030 No Build conditions.

5.1 Design Alternatives Selected for Simulation

Three Build Alternatives were developed to test the different design improvements described in **Section 4** at Farragut North and Farragut West Stations. While some design options not shown in the previous chapter were tested in these alternatives, designs were subsequently refined based on the simulation results or architectural design considerations.

Table 5-1 lists the specific elements in each alternative. **Figures 5-1** through **5-3** illustrate the design alternatives, highlighting the proposed station improvements at Farragut North and Farragut West for each alternative.

Table 5-1 Improvement Concepts Included in Each Build Alternative

Design Improvement Concept	Build Alt. 1	Build Alt. 2	Build Alt. 3
Farragut North-West Pedestrian Tunnel			
Farragut Pedestrian Tunnel	✓		✓
Farragut North Station Improvements			
Center Mezzanine Improvements – new stair and elevator to platform, additional faregates	✓	✓	✓
South Mezzanine Improvements – new stair to platform, new street elevator	✓	✓	✓
Pedestrian Tunnel Connection Option 1 – with escalator pair from platform to tunnel entrance instead of stair	✓		
Pedestrian Tunnel Connection Option 2 – with South Mezzanine extension and wide stair to tunnel entrance			✓
Farragut West Station Improvements			
Additional platform escalators		✓	✓
Additional standard faregates at East Mezzanine	✓ (1 faregate)	✓ (2 faregates)	✓ (1 faregate)
East Mezzanine platform elevators Option 1, located near escalators	✓		✓
East Mezzanine platform elevators Option 2, at back of Mezzanine		✓	
East Mezzanine street elevators	✓	✓	✓

Figure 5-1 2030 Pedestrian Simulation Build Alternative 1
Pedestrian Tunnel with Basic Station Improvements

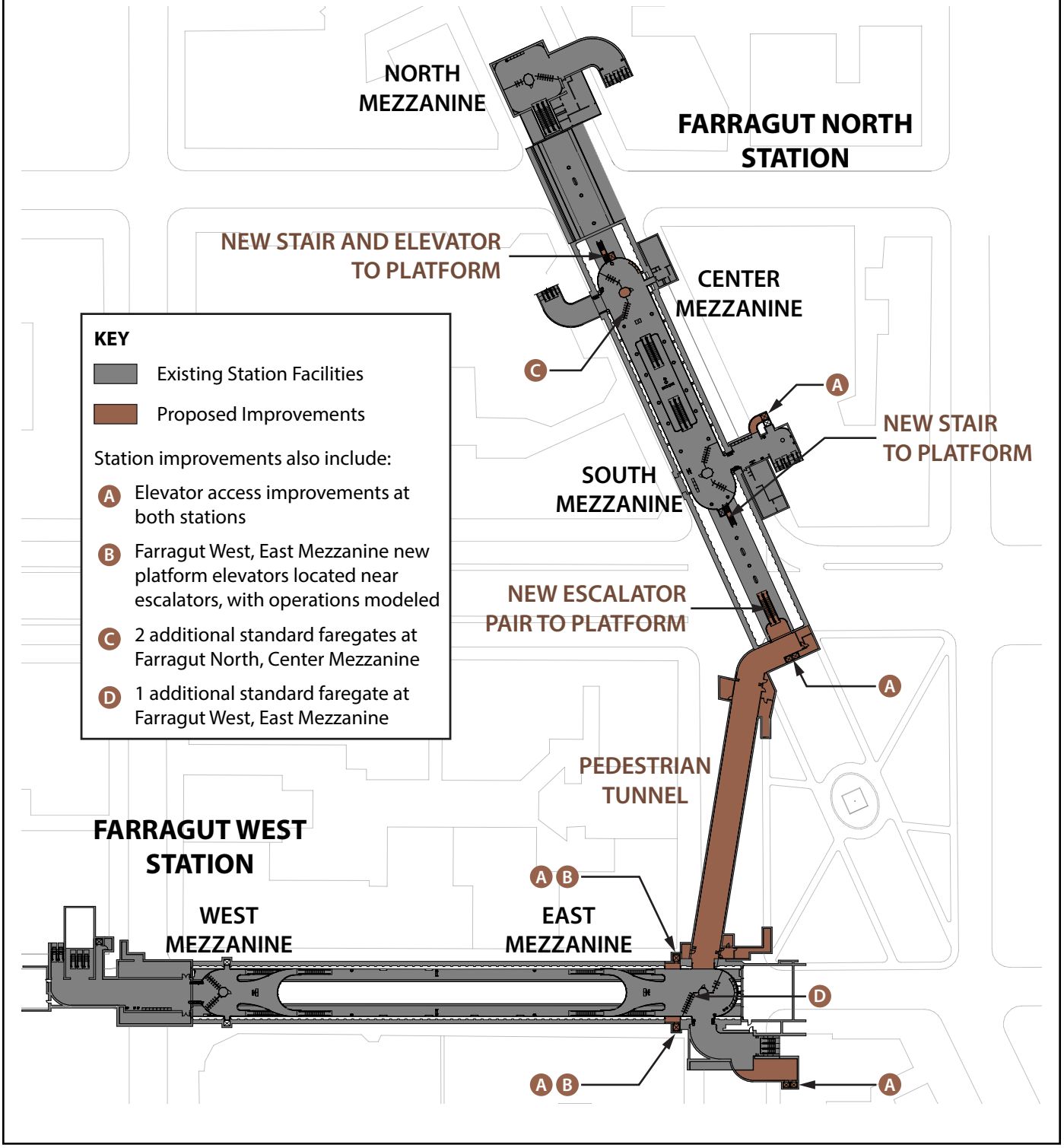


Figure 5-2 2030 Pedestrian Simulation Build Alternative 2
Basic Station Improvements and Farragut West Additional Platform Escalators (No Pedestrian Tunnel)

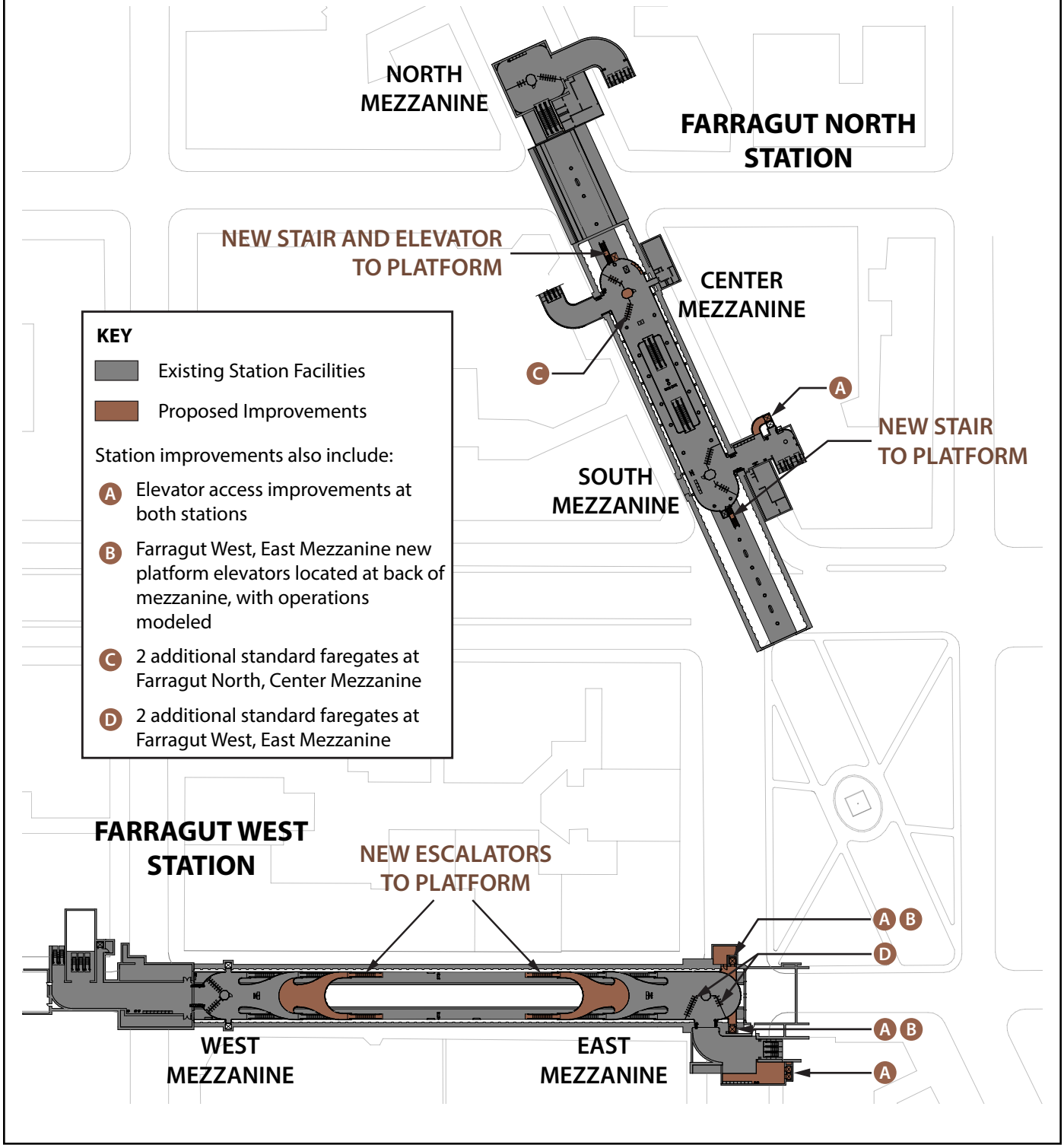
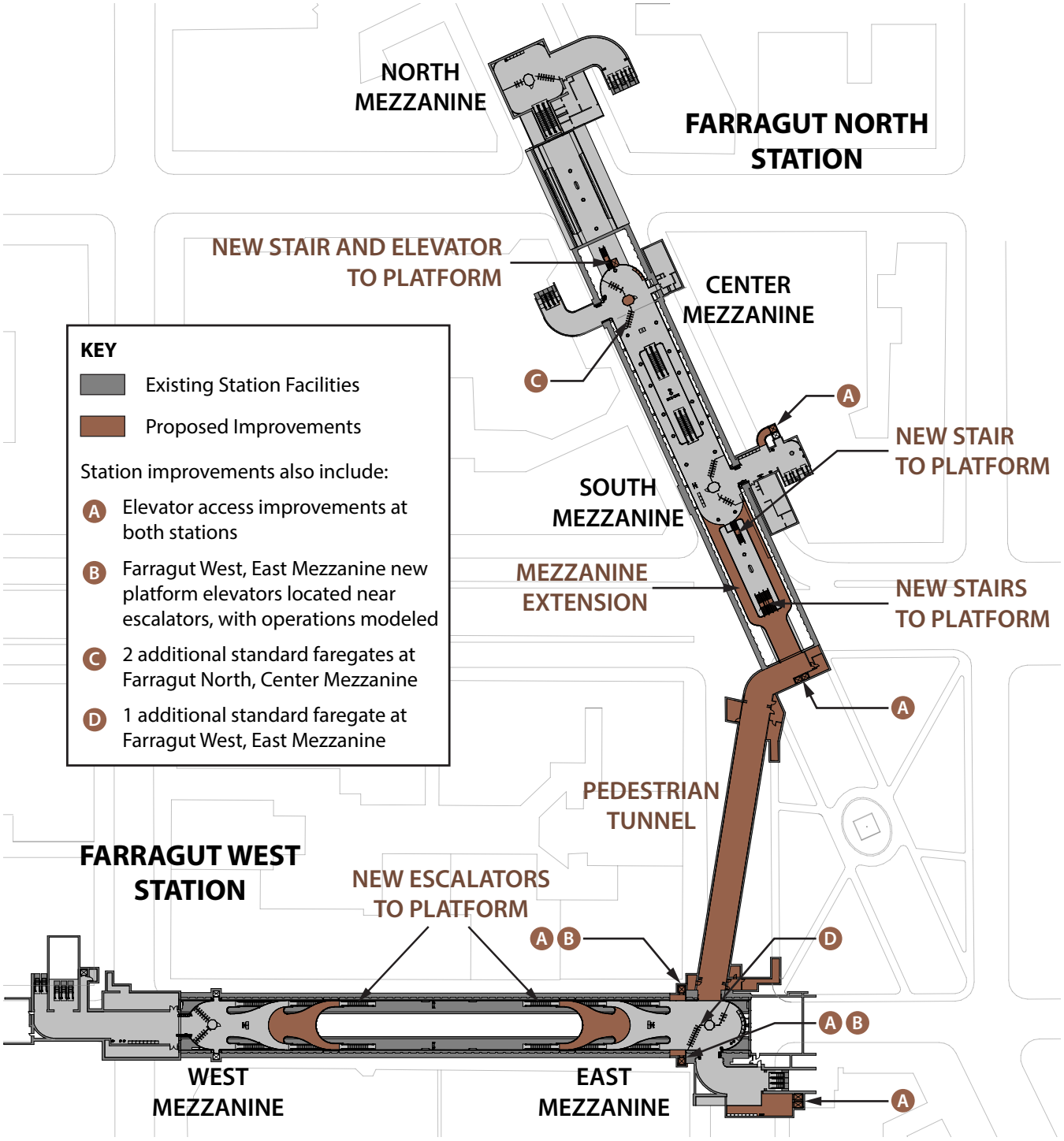


Figure 5-3 2030 Pedestrian Simulation Build Alternative 3
Pedestrian Tunnel with Basic Station Improvements, Farragut West Additional Platform Escalators, and Farragut North, South Mezzanine Extension



Methodology

The 2030 Build Alternative pedestrian model simulations use the same methodology and Metrorail train operations as described in **Section 3.2** for the 2030 No Build conditions. Specific components of the Build Alternative pedestrian models are:

- **Modified Station Layouts and New Facilities –** The Farragut North and Farragut West Station pedestrian models incorporate the modified station layouts and new facilities described in **Section 5.1**.
- **Build Alternatives 1 and 3 (with Pedestrian Tunnel) –** The Build models for Alternatives 1 and 3 include pedestrian tunnel users between the two Farragut stations, modeling the entire journey of users, with passenger volumes and movements based on the 2030 Build conditions demand forecast described in **Section 3.1**.
- **Farragut West, East Mezzanine Platform Elevator Simulation –** The Build Alternatives simulated the elevator operations for the Farragut West, East Mezzanine new platform elevators. These elevator operations were specifically included to test two different design options with regard to potential pedestrian movement conflicts.
- **Metro Center Station –** No changes were made to the Metro Center Station layout or facilities in the Build simulations. However, as a result of the Farragut pedestrian tunnel, the Metro Center passenger volumes in Build Alternatives 1 and 3 are based on the 2030 Build conditions demand forecast described in **Section 3.1**.

5.2 2030 Passenger Volumes with Pedestrian Tunnel

As described in **Section 3.1**, the Farragut pedestrian tunnel would alter passenger volumes at the Farragut stations and at Metro Center. These volumes are reflected in Build Alternatives 1 and 3 at Farragut North and Farragut West and in the 2030 Build forecast for Metro Center.

Figure 5-4 illustrates passenger volumes at the south end of Farragut North and the effect of the pedestrian tunnel in the AM peak hour.

Figure 5-5 on the following page illustrates the particularly significant impact on passenger volumes at Farragut West Station in the AM peak hour, where additional the pedestrian tunnel users would be alighting from the platform along with passengers exiting to the East Mezzanine.

Figure 5-6 on the following page illustrates the impact on passenger volumes at Metro Center Station transfer. areas in the AM peak hour. Similar changes occur in the PM peak hour.

Figure 5-4 Comparison of 2030 Passenger Volumes at Farragut North - No Build and Build Forecasts

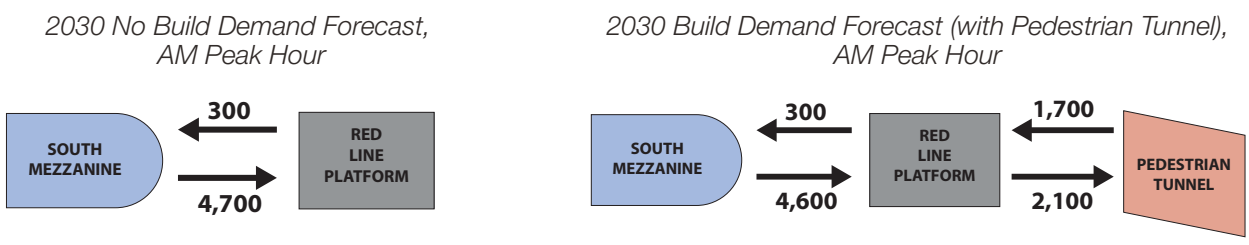


Figure 5-5 Comparison of 2030 Passenger Volumes at Farragut West - No Build and Build Forecasts

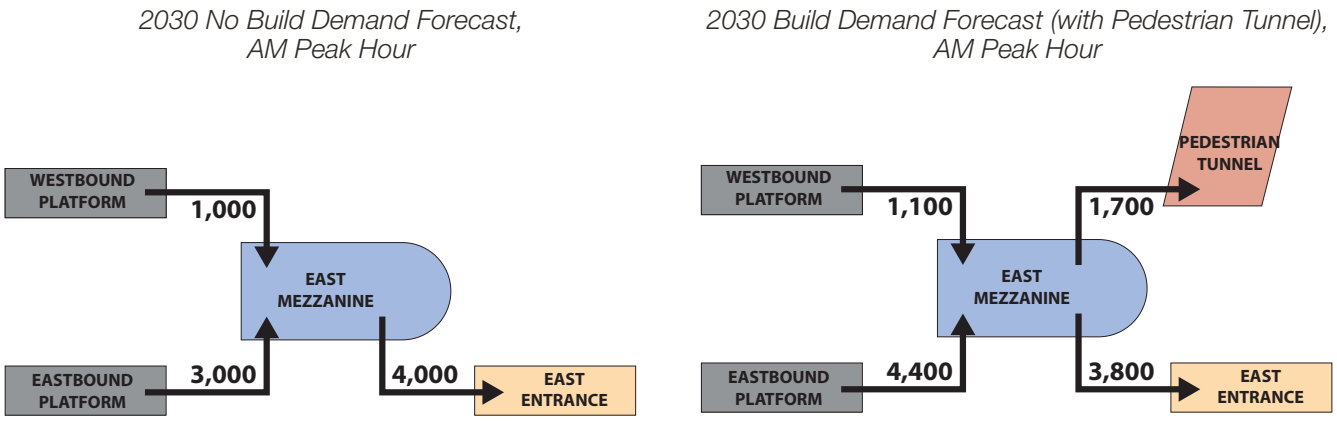
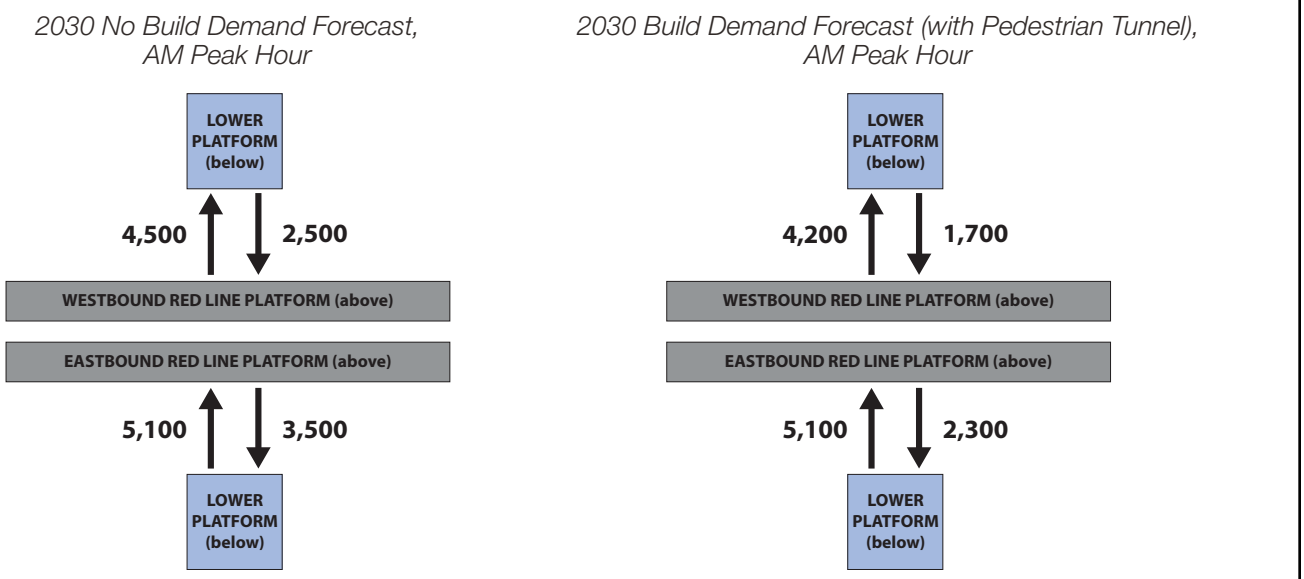


Figure 5-6 Comparison of 2030 Passenger Volumes at Metro Center - No Build and Build Forecasts



5.3 Build Alternative Simulation Results Summary

Overall, the simulations of the Build Alternatives show some clear benefits of station congestion relief and reduced travel times but also display the following trade-offs:

- The Farragut pedestrian tunnel (Build Alternatives 1 and 3) relieves transfer-related congestion at Metro Center and shortens transfer times but adds passenger demand and crowding at the Farragut stations, especially at Farragut West;
- Additional platform escalators at Farragut West (Build Alternatives 2 and 3) relieve significant AM peak platform crowding and escalator queues but shift crowding and queues to the mezzanine level (especially the West Mezzanine) and contribute to PM peak crowding on the westbound platform.

Build Alternative 3, which contains the full slate of proposed improvements from the current study, performed the best of the alternatives in improving passenger conditions at all three stations. **Figures 5-7** and **5-8** on the following pages provide an overview of station conditions at Farragut North and Farragut West Stations and at Metro Center Station, respectively, with the improvements and shift in passenger demand to the Farragut pedestrian tunnel.

5.4 Detailed Build Simulation Results by Measure of Effectiveness (MOE)

Detailed MOE results for the Build Alternatives are reported below for the following:

- Mean Density Maps
- Escalator/Stair Clearance Times
- Pedestrian Zone Density
- Journey Times (within stations)
- Transfer Time Comparison
- Station Access Journey Times at Farragut Square

Figure 5-7 2030 Build Alternative 3 Peak Period Conditions - Farragut North and West

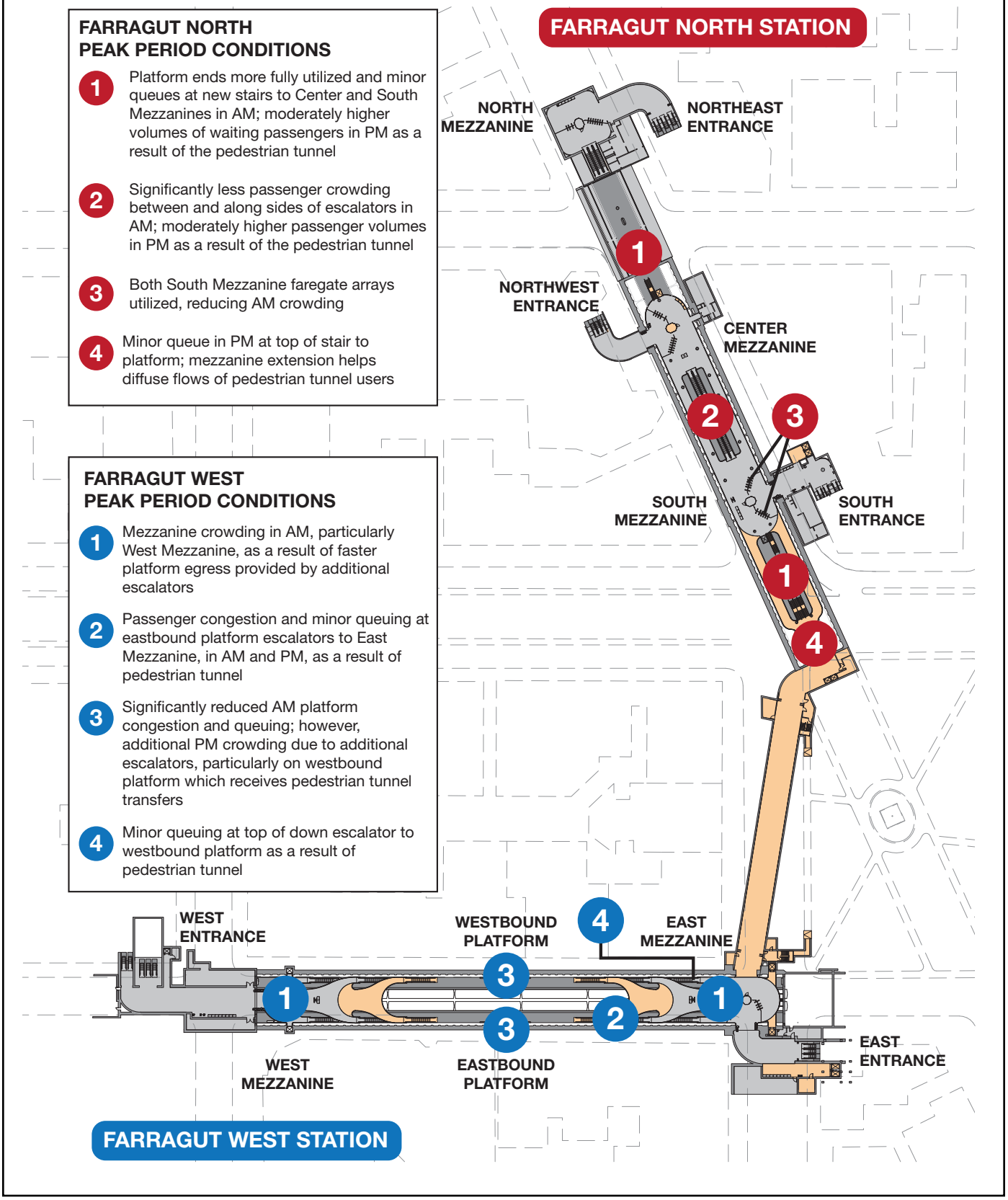
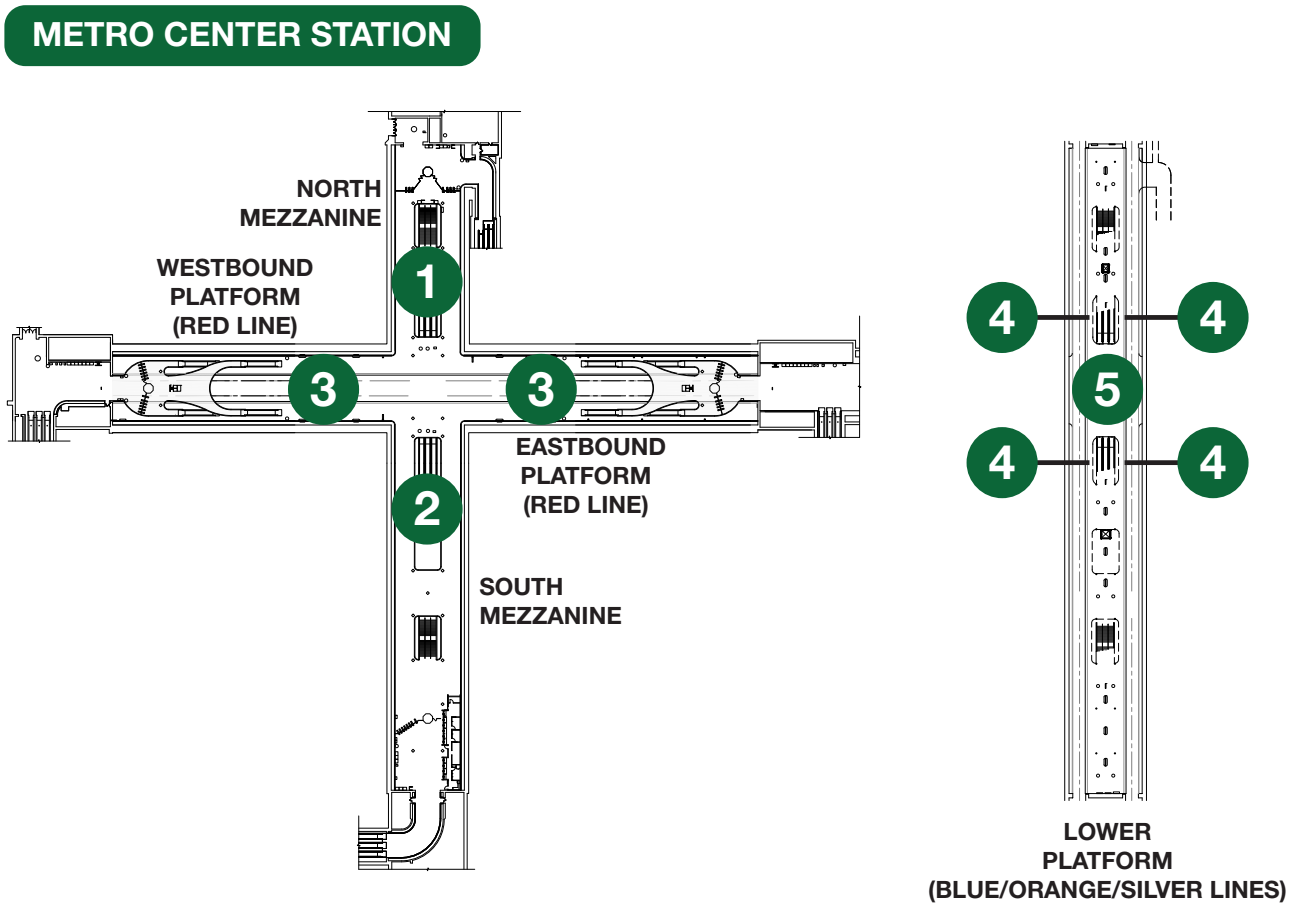


Figure 5-8 2030 Build Alternative 3 Peak Period Conditions - Metro Center



Mean Density Maps

The figures on the following pages depict cumulative mean passenger densities in the stations during the peak 15 minutes, comparing 2030 No Build conditions with the Build Alternatives.

Farragut North – AM Peak

Figure 5-9 shows that the additional platform stairs in the Build Alternatives reduce the congestion in the middle of the platform and crowding at the South Mezzanine array faregate closest to the escalator. The South Mezzanine extension in Build Alternative 3 helps disperse the congestion at the south end of the station related to the pedestrian tunnel compared to Build Alternative 1.

Farragut North – PM Peak

Figure 5-10 shows that the pedestrian tunnel (Build Alternatives 1 and 3) results in overall higher volumes of passengers on the platform in the PM compared to the 2030 No Build condition. The pedestrian tunnel entrance handles the passenger flow better with the wide stair in Build Alternative 3 than the single escalator pair in Build Alternative 1.

Farragut West – AM Peak

Figure 5-11 compares the Farragut West AM peak period maps for the 2030 No Build and 2030 Build Alternative conditions. Significant congestion along the eastbound platform sharply increases in Build Alternative 1 compared to the No Build, occurring in the passenger waiting area and at the base of the escalator connecting the platform to the East Mezzanine. This congestion is greatly reduced in Build Alternatives 2 and 3. In both alternatives, passenger crowding is reduced along the platforms, while significant congestion at the West Mezzanine faregates and escalators connecting the West Mezzanine to the West Entrance increases sharply.

Farragut North faregate congestion at the South Mezzanine (shown here) is relieved by the new stair from the south end of the platform, which helps shift passenger traffic to the underutilized faregate array

Farragut North platform congestion and escalator queues (shown here) are relieved by the new stairs added at the platform ends

Farragut West – PM Peak

Figure 5-12 compares the Farragut West PM peak period maps for the 2030 No Build and 2030 Build Alternative conditions. Significant congestion also increases sharply on the eastbound platform in Build Alternative 1 compared to the No Build, both in the passenger waiting area and at the base of the escalator connecting to the East Mezzanine. In Build Alternatives 2 and 3, there is less significant congestion along the eastbound platform, but more significant congestion along the westbound platform, occurring mostly in the passenger waiting area and at the base of the new escalators connecting to both mezzanines.

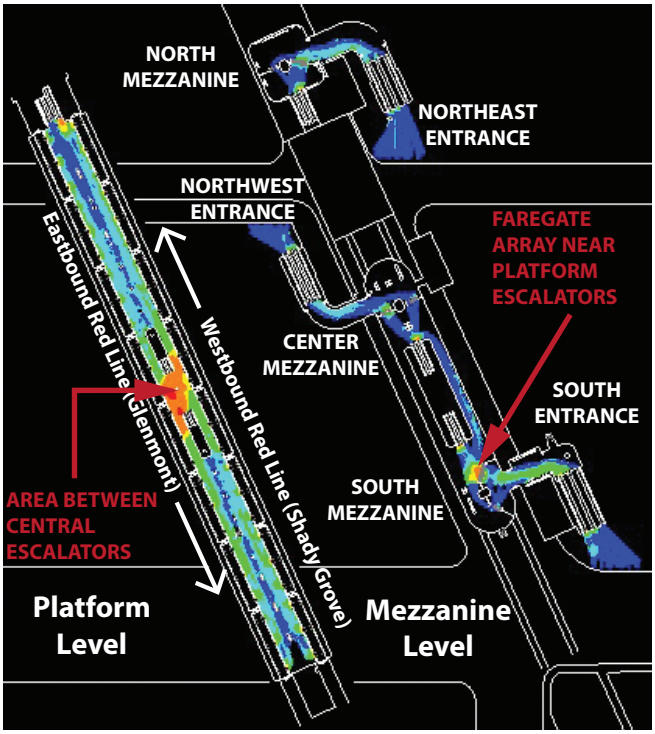
Metro Center transfer-related congestion (shown here) is reduced in some key areas of the station by the shift in transfer demand to the Farragut pedestrian tunnel

Metro Center

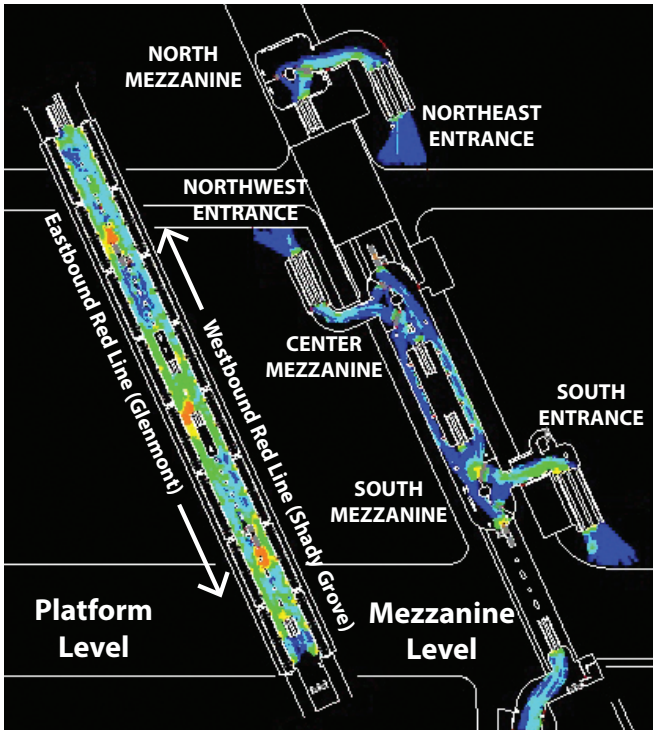
Figures 5-13 through **5-16** depict Metro Center density maps for the 2030 No Build condition and 2030 Build Alternatives 1 and 3 (shift in transfer demand due to Farragut pedestrian tunnel). During both the AM and PM peak, the Build Alternatives have less congestion in the South Mezzanine transfer area and on the lower platform between the central escalator banks. In the PM peak there is less congestion in the middle of the eastbound Red Line platform in the Build Alternatives. There is less PM peak congestion on the lower level platform between the platform edge and the South Mezzanine escalators.

Figure 5-9 Farragut North Mean Density - 2030 No Build/Build, AM Peak 15 Minutes

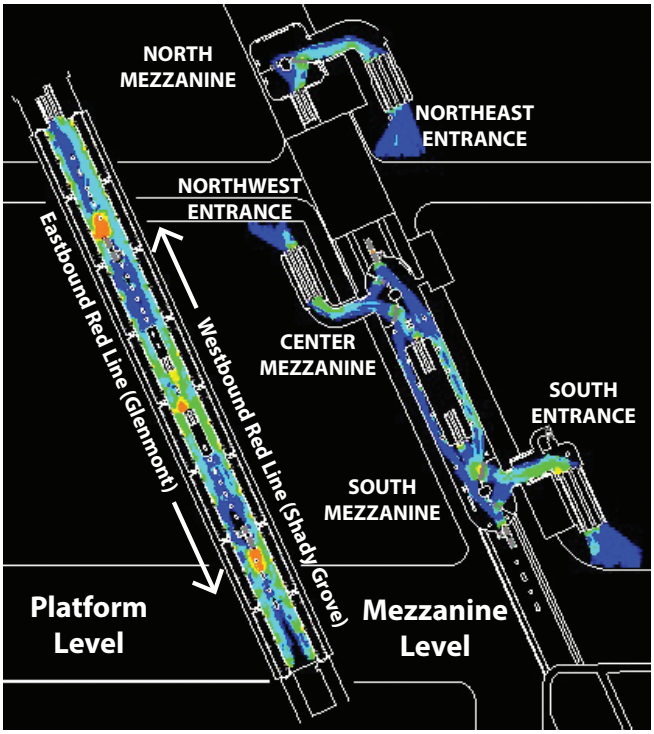
2030 No Build



2030 Build Alternative 1



2030 Build Alternative 2



2030 Build Alternative 3

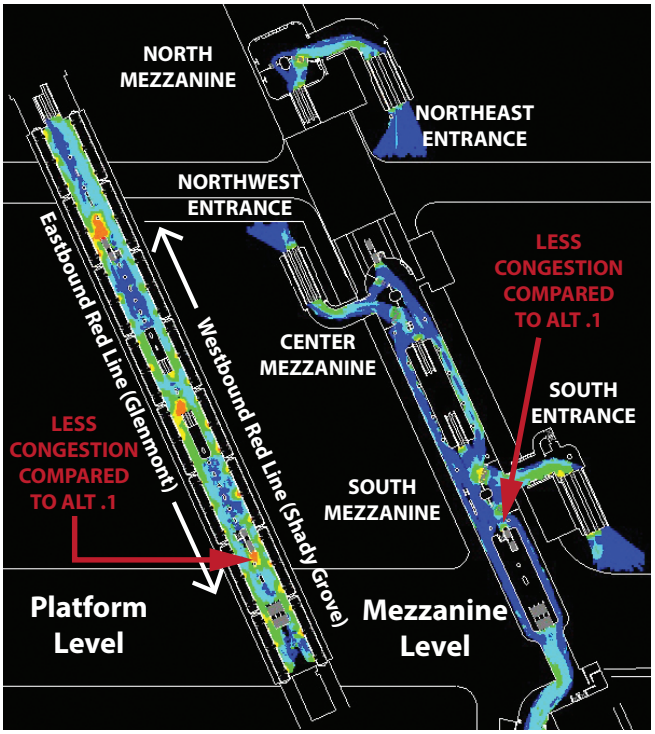
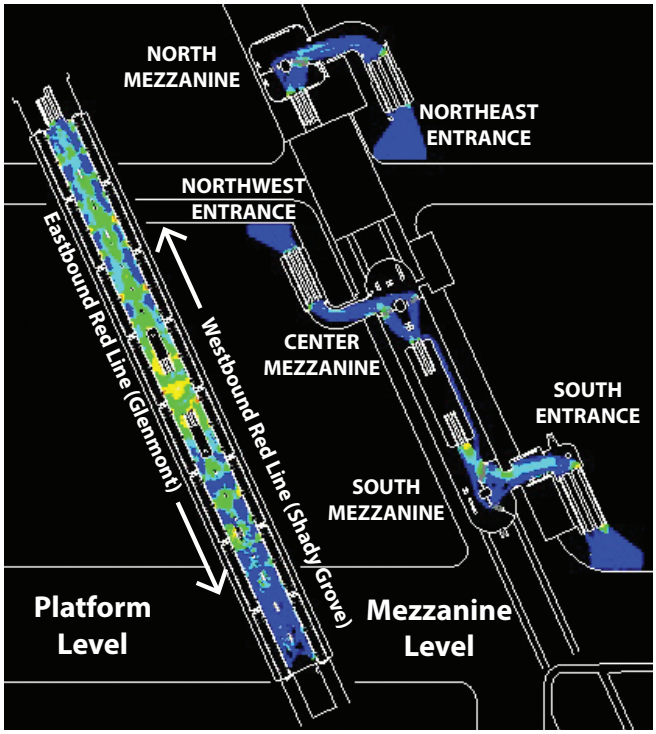
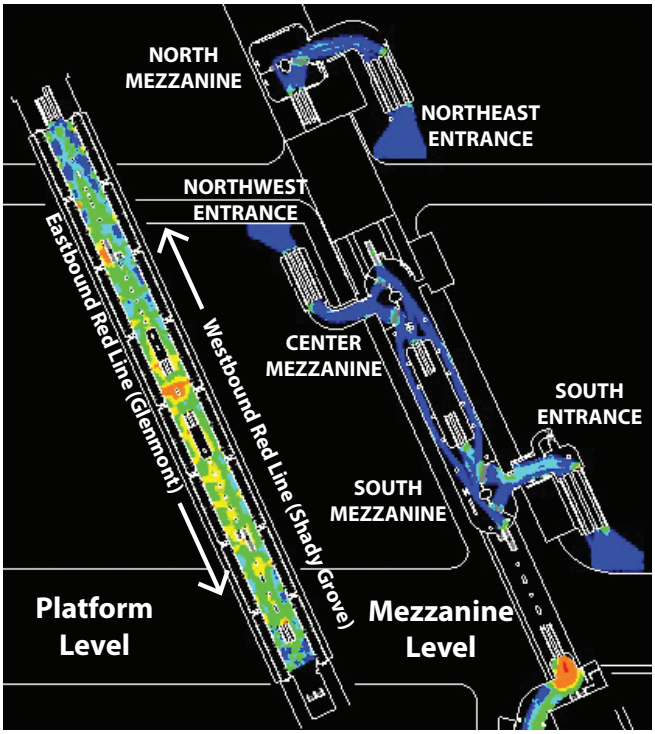


Figure 5-10 Farragut North Mean Density - 2030 No Build/Build, PM Peak 15 Minutes

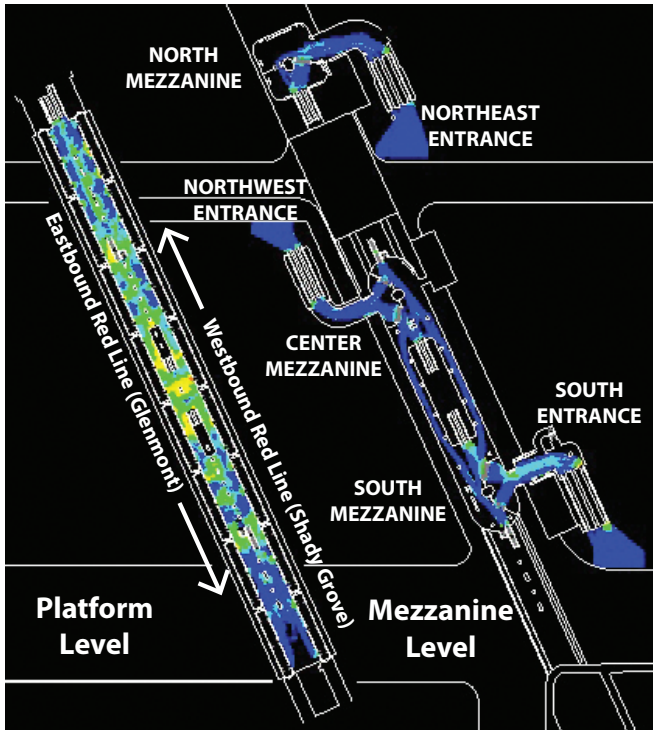
2030 No Build



2030 Build Alternative 1



2030 Build Alternative 2



2030 Build Alternative 3

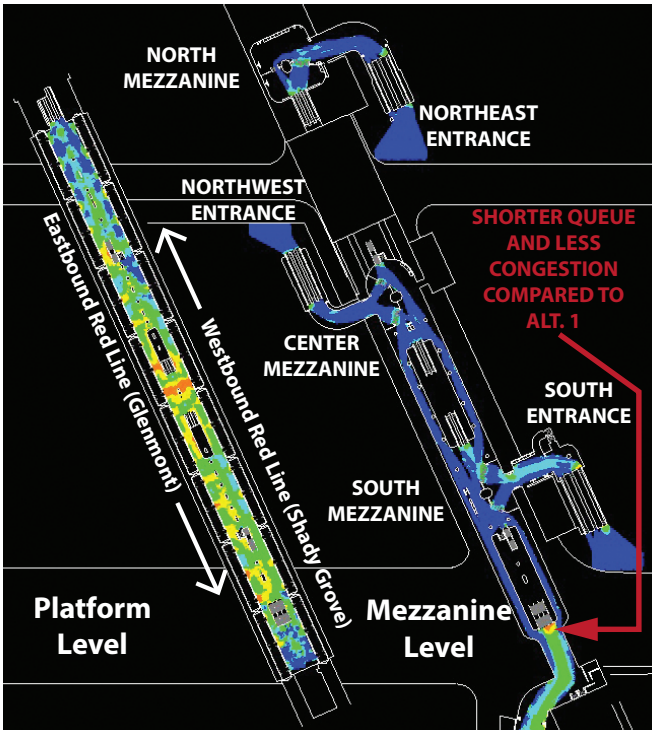
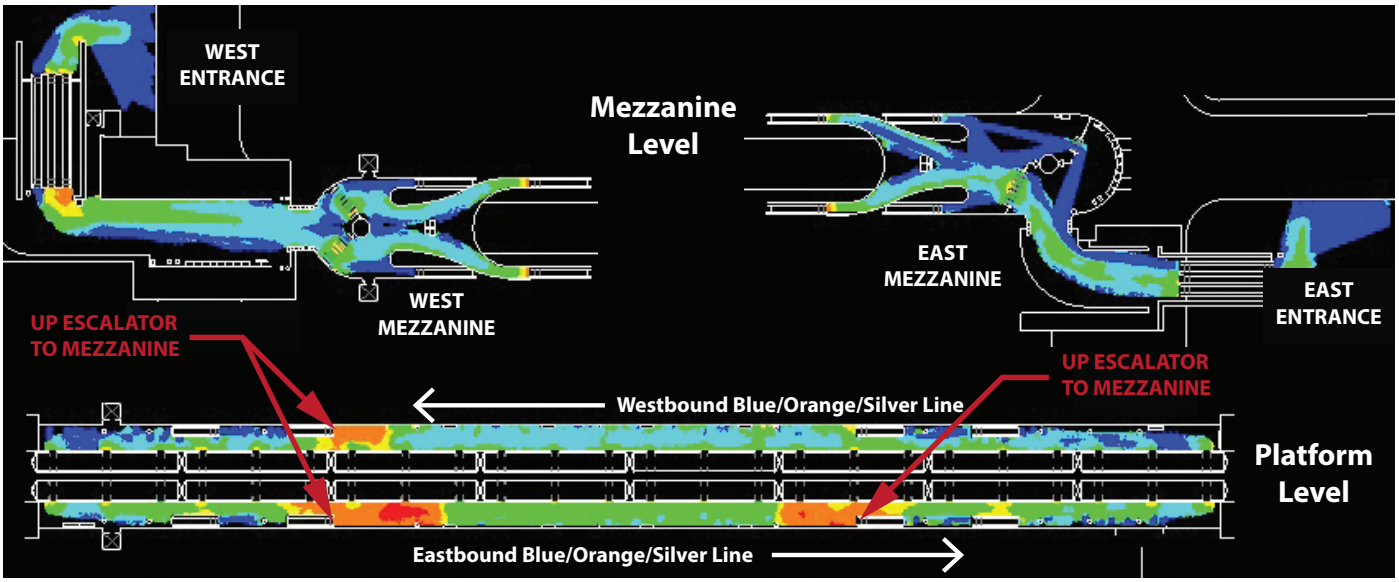
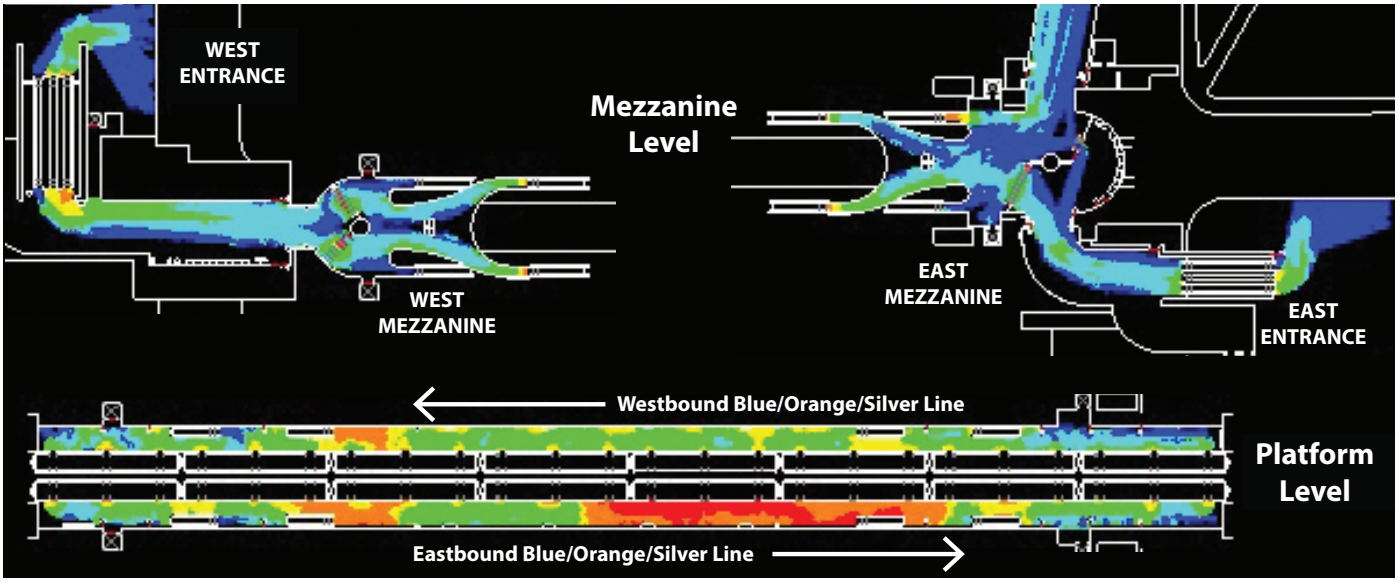


Figure 5-11 Farragut West Mean Density - 2030 No Build/Build, AM Peak 15 Minutes

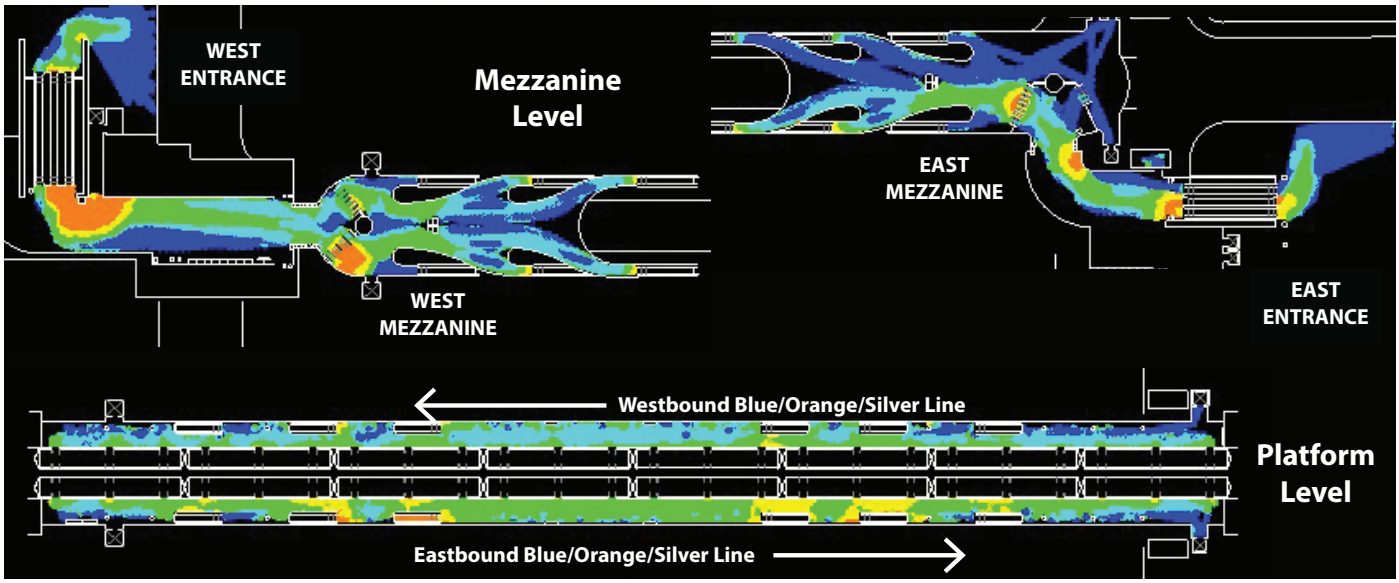
2030 No Build



2030 Build Alternative 1



2030 Build Alternative 2



2030 Build Alternative 3

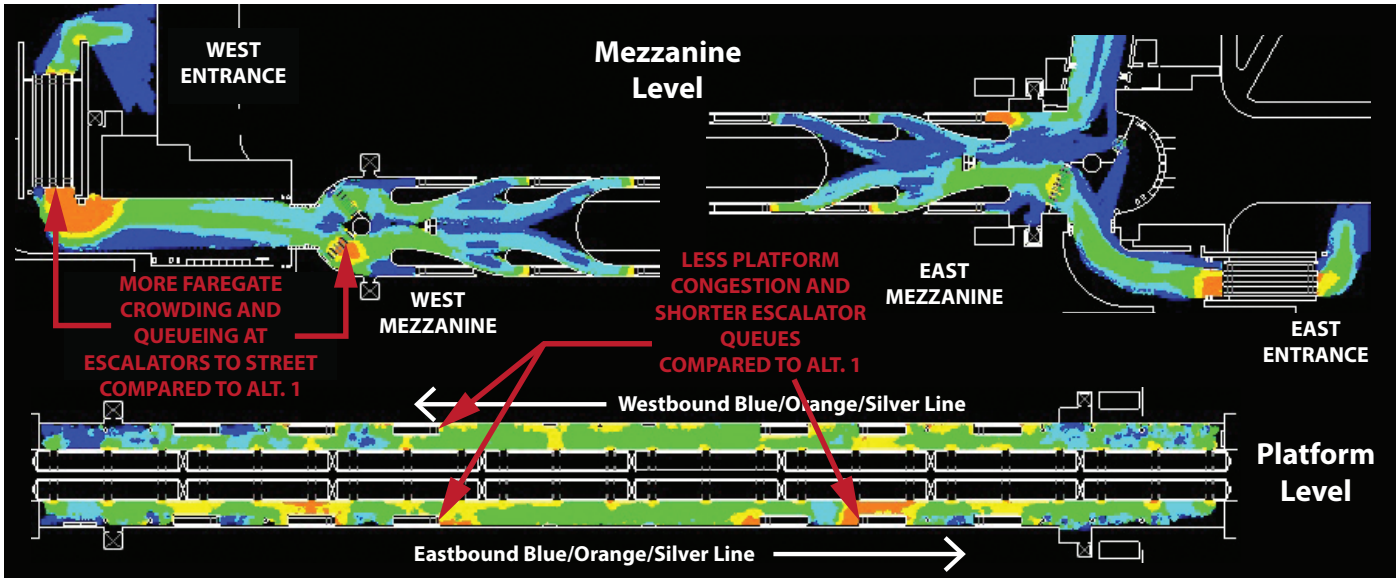
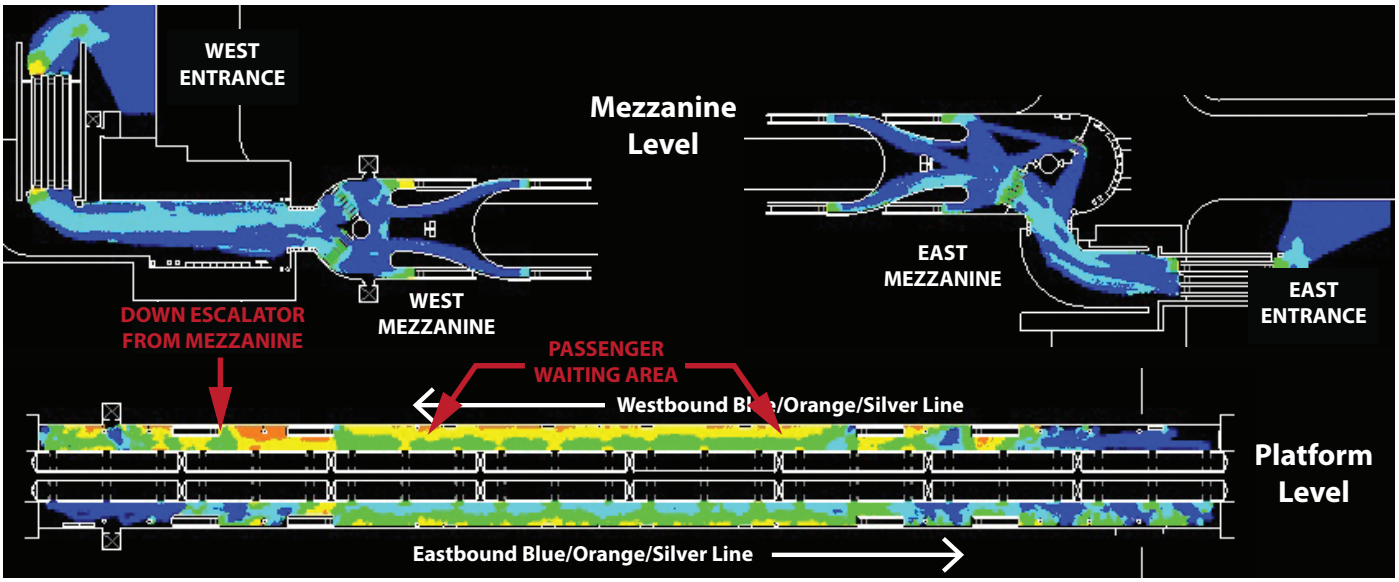
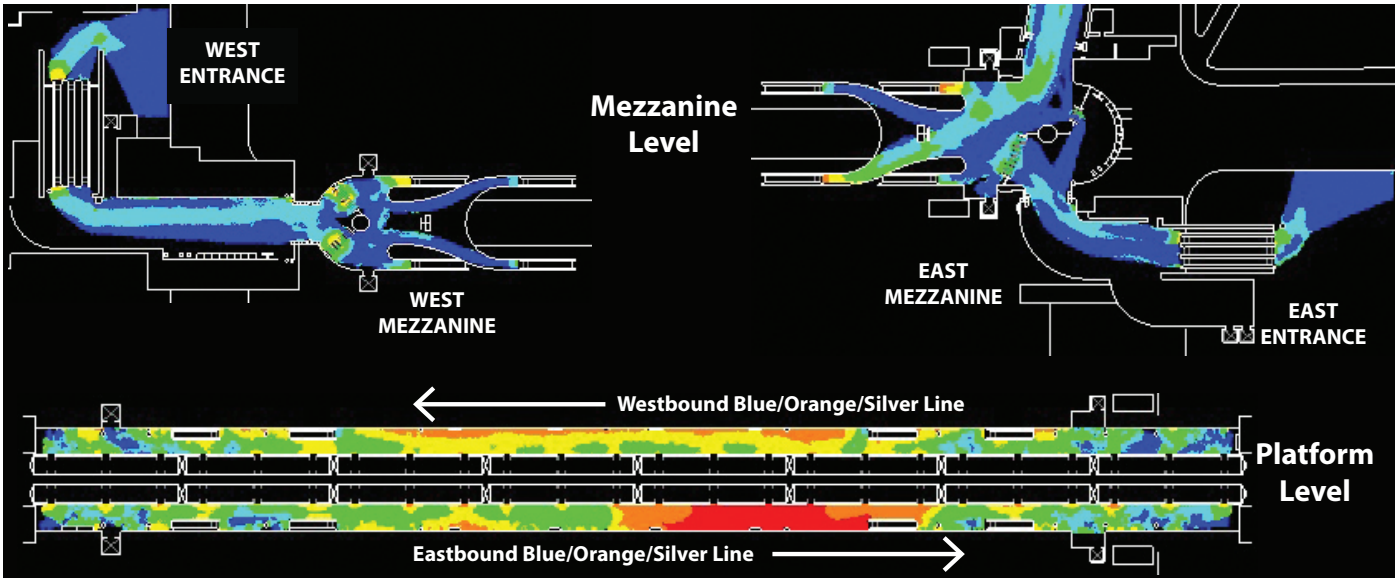


Figure 5-12 Farragut West Mean Density - 2030 No Build/Build, PM Peak 15 Minutes

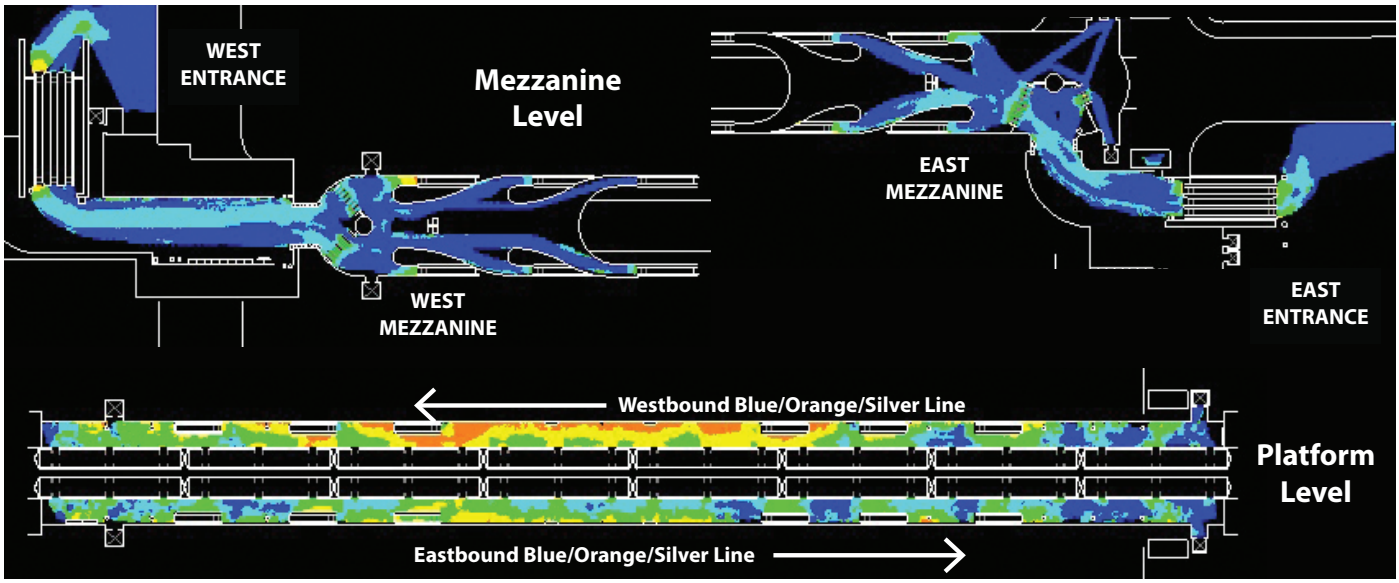
2030 No Build



2030 Build Alternative 1



2030 Build Alternative 2



2030 Build Alternative 3

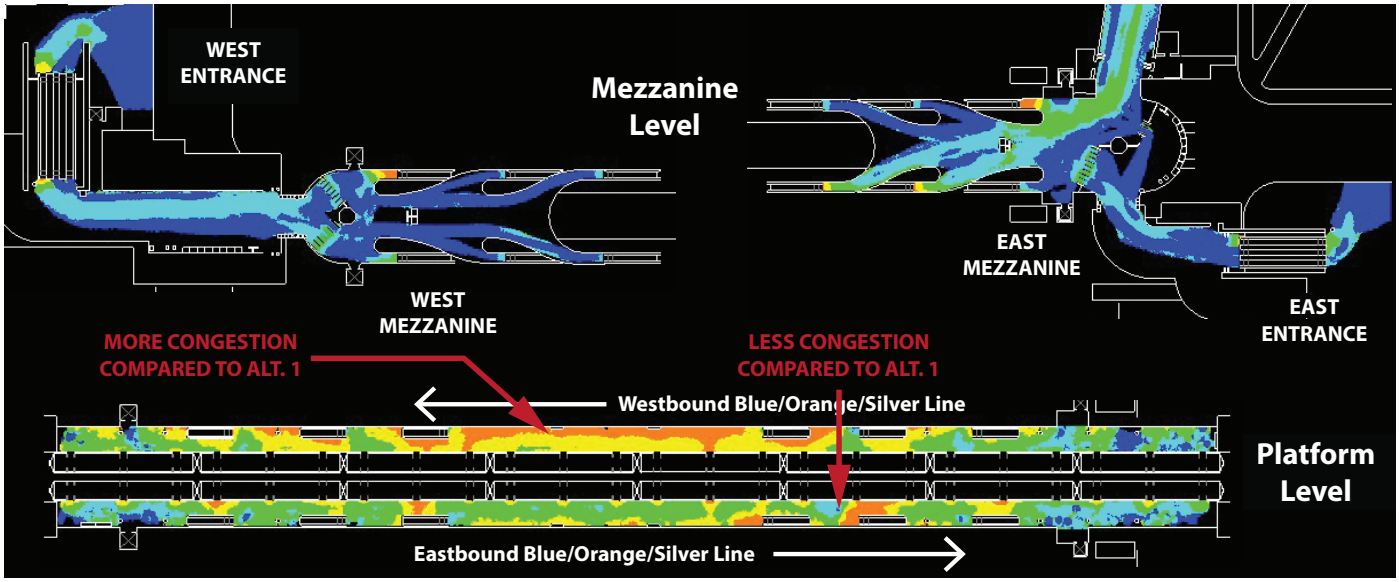
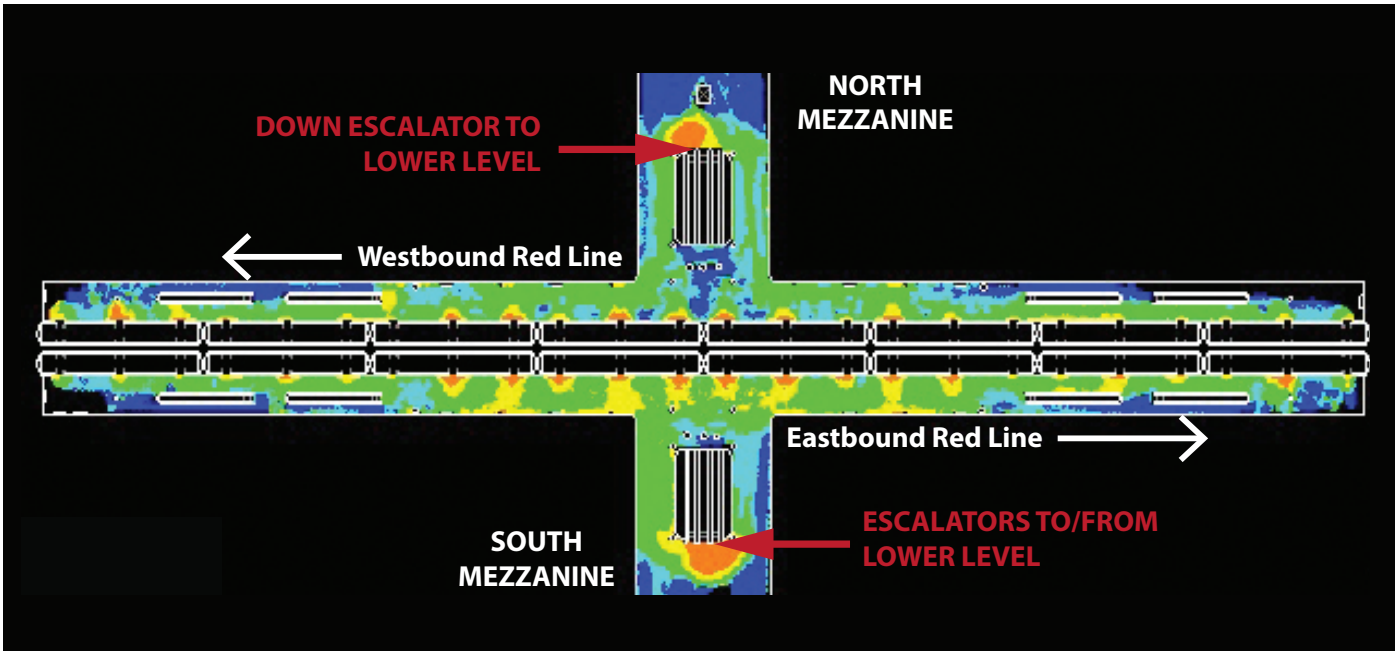


Figure 5-13 Metro Center Upper Level Mean Density - 2030 No Build/Build, AM Peak 15 Minutes

2030 No Build



2030 Build Alternatives 1 and 3

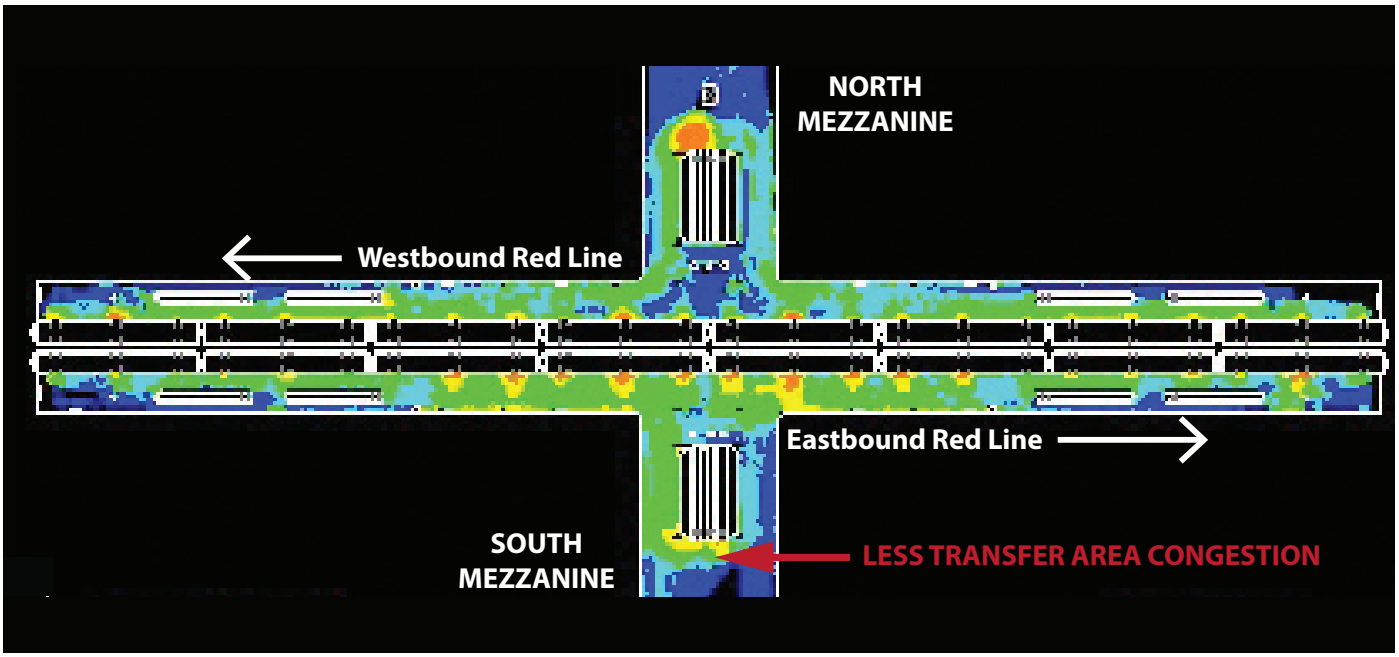


Figure 5-14 Metro Center Lower Level Mean Density - 2030 No Build/Build, AM Peak 15 Minutes

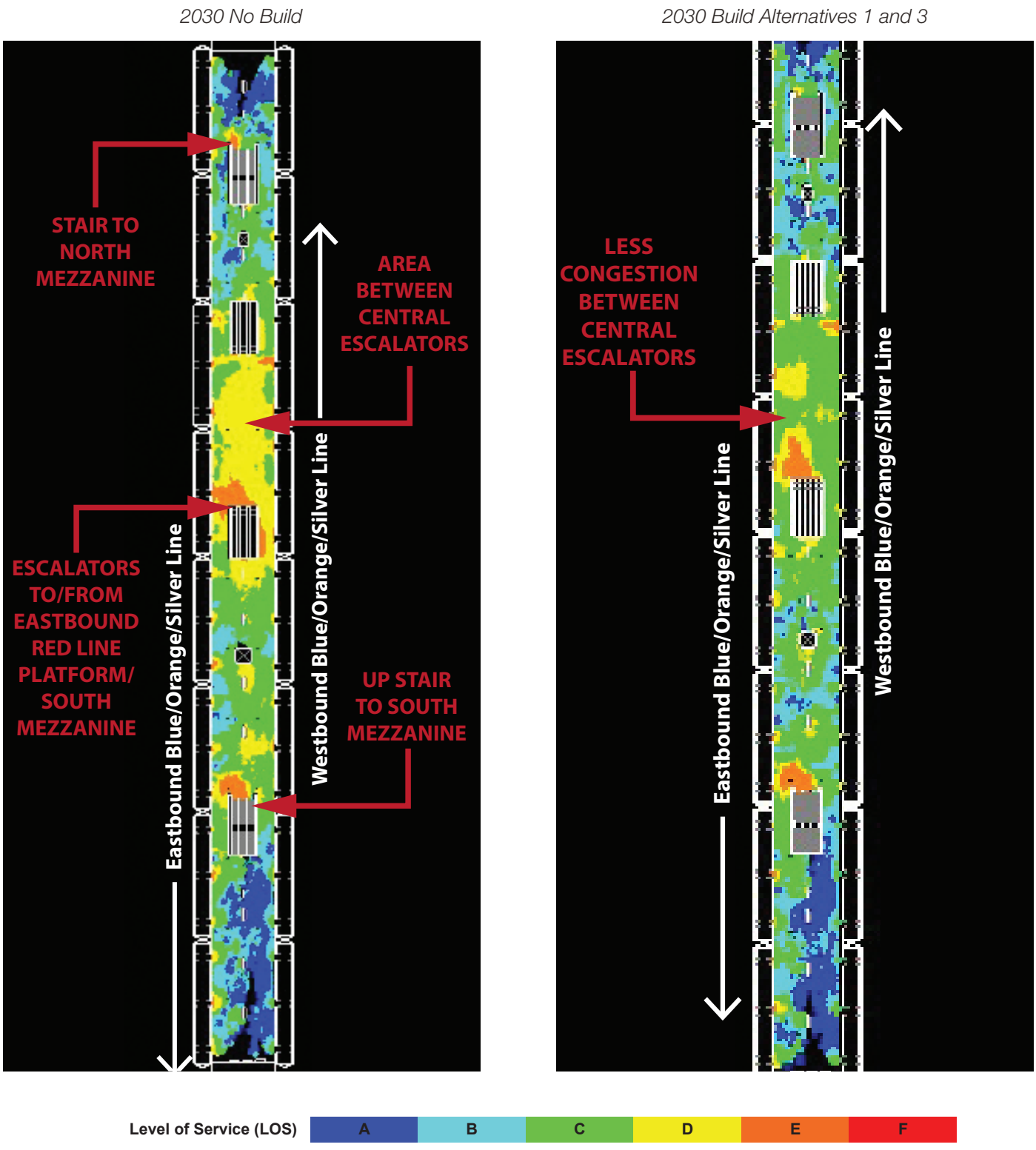
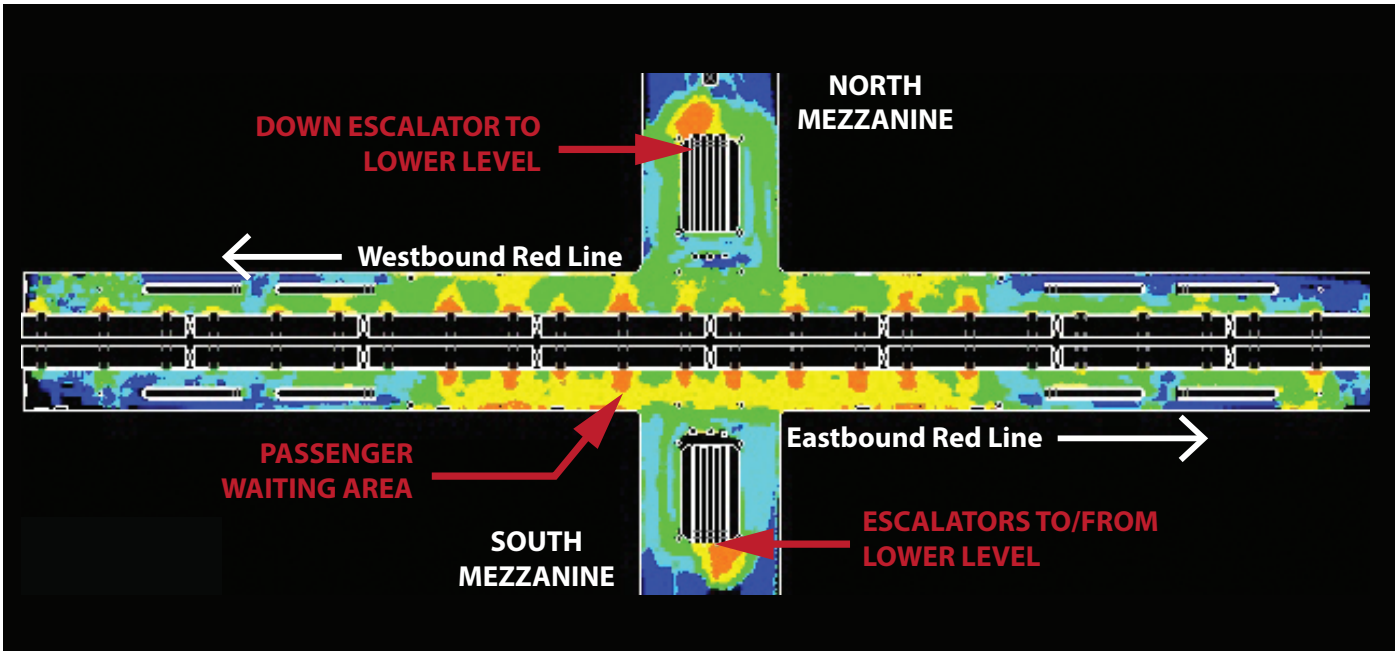


Figure 5-15 Metro Center Upper Level Mean Density - 2030 No Build/Build, PM Peak 15 Minutes

2030 No Build



2030 Build Alternatives 1 and 3

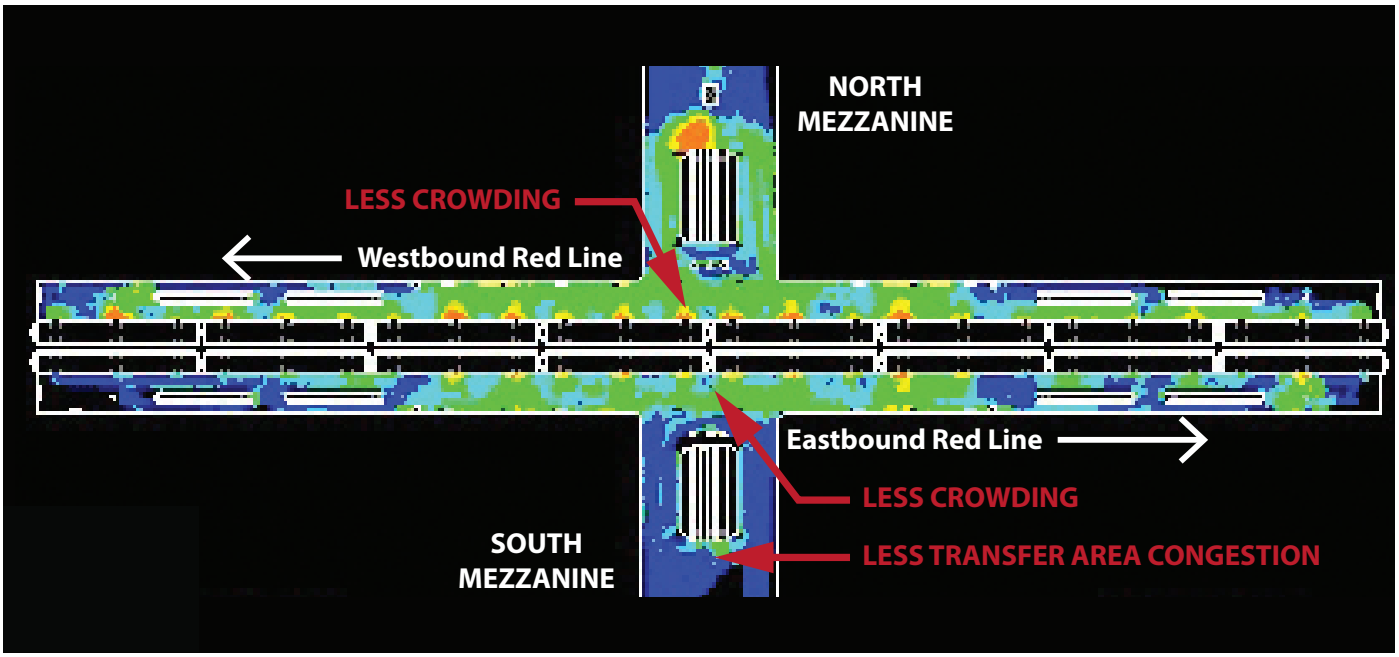
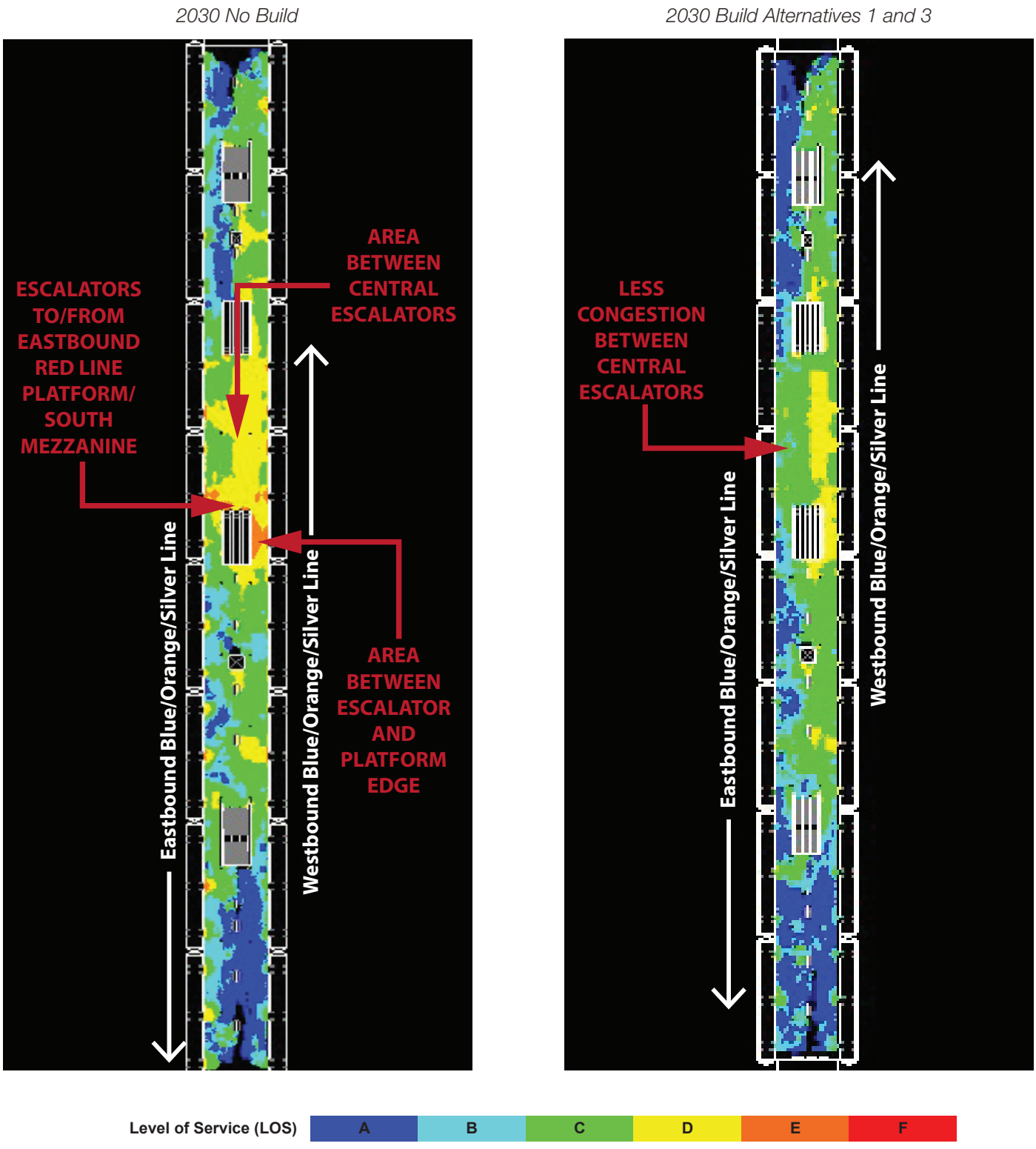


Figure 5-16 Metro Center Lower Level Mean Density - 2030 No Build/Build, PM Peak 15 Minutes



Escalator/Stair Clearance Times

Figures 5-17 through **5-19** show escalators and stairs with queues and their clearance times at Farragut North, Farragut West, and Metro Center for the 2030 No Build condition and 2030 Build Alternatives.

Farragut North

Queues for up escalators at the central escalator banks decrease significantly in the AM peak as a result of the new platform stairs; these new stairs have queues as a result of the high volumes of alighting passengers. In the PM peak, the pedestrian tunnel connection has high passenger volumes that cannot be accommodated by the single down escalator in Build Alternative 1; the wide stair provided in Build Alternative 3 significantly reduces the queue.

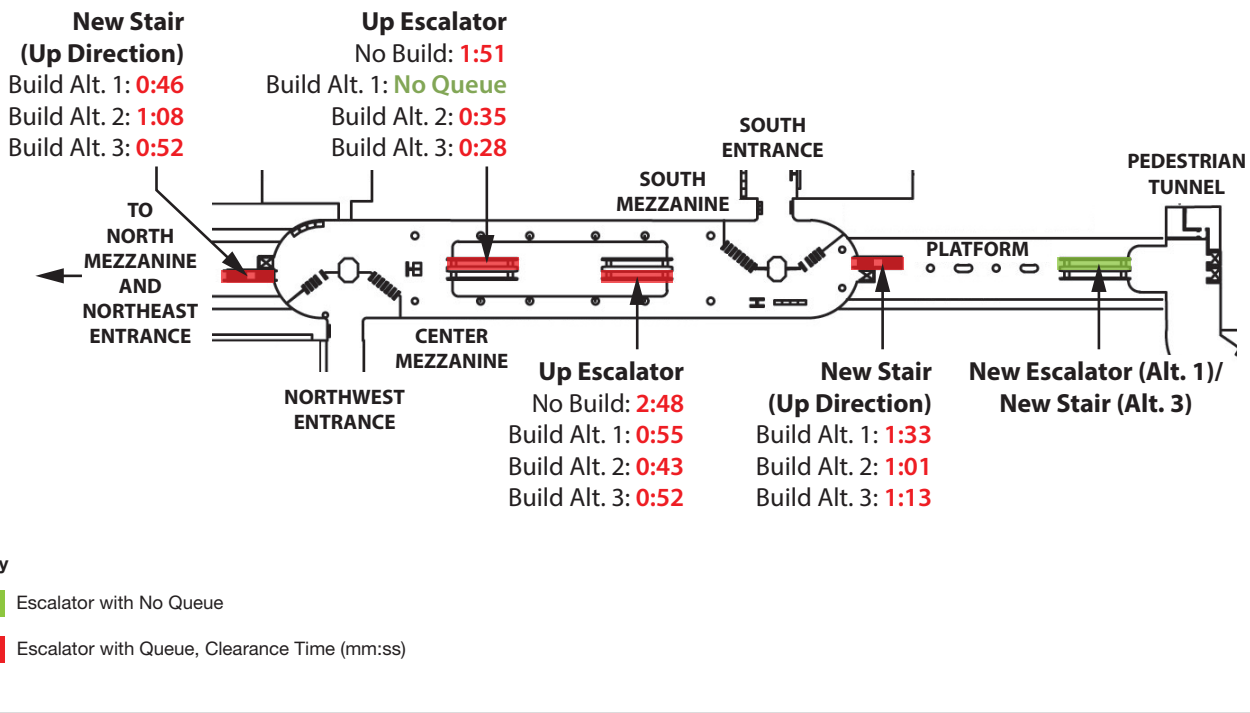
Farragut West

The higher passenger volumes in Build Alternative 1 overwhelm the eastbound platform single up escalator to the East Mezzanine. The additional platform escalators provided by Build Alternatives 2 and 3 significantly reduce queues. In Build Alternative 3, the down escalator to the westbound platform has queues as a result of the pedestrian tunnel transfers.

Metro Center

The shift in transfer demand to the Farragut stations under the Build condition (Build Alternatives 1 and 3) eliminates the AM and PM peak queues at the down escalator from eastbound Red Line platform to the lower platform. Queues at other escalators and stairs do not change measurably.

Figure 5-17 Farragut North Escalator/Stair Queue Clearance - 2030 No Build/Build AM Peak Hour



Note: North Mezzanine platform escalators do not experience queues and are not shown

Figure 5-18 Farragut West Escalator/Stair Queue Clearance - 2030 No Build/Build, AM Peak Hour

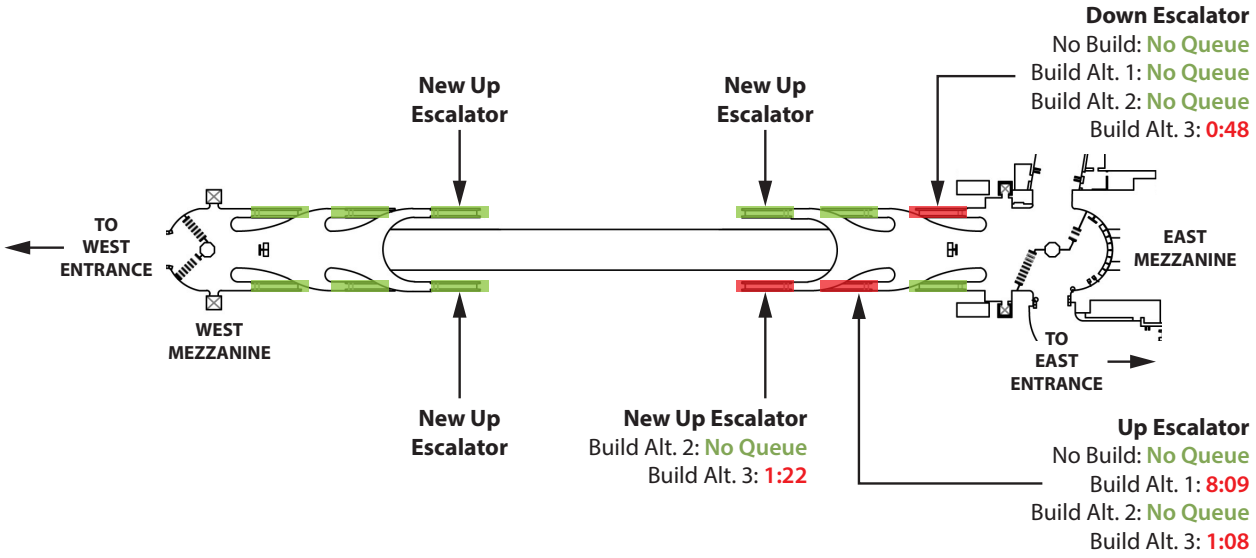
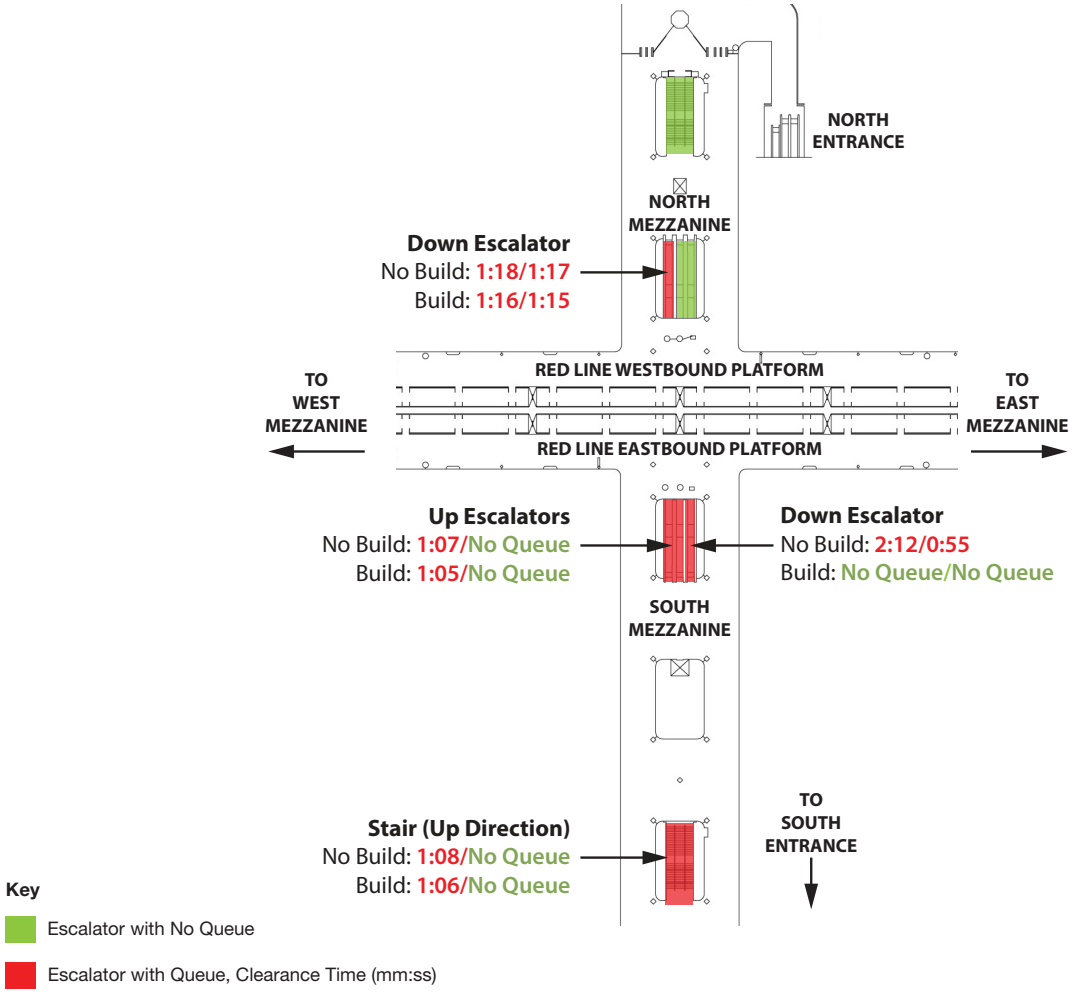


Figure 5-19 Metro Center Escalator/Stair Queue Clearance - 2030 No Build/Build, AM/PM Peak Hours



Pedestrian Zone Density

The amount of significant crowding in each alternative is summarized by the percentages of passengers in LOS E and F in key pedestrian analysis zones. **Figures 5-20** through **5-22** depict pedestrian density analysis zones for key circulation areas at Farragut North, Farragut West, and Metro Center Stations, respectively. **Tables 5-2** through **Table 5-6** report the combined percentages of passengers in level of service (LOS) E and F for each peak hour, using the colors in the diagram below.

Farragut North

The station experiences less crowding in the Build Alternatives compared to the 2030 No Build condition. The area at the pedestrian tunnel entrance (Zone C-1) experiences significant congestion during the PM peak hour in Build Alternative 1 due to the limited circulation capacity provided by the single escalator; however, the wide stair provided in Build Alternative 3 reduces most of this congestion.

Farragut West

The station experiences additional crowding in Build Alternative 1 (especially on the eastbound platform). The additional platform escalators in Build Alternative 3 help reduce the high levels of platform crowding below the 2030 No Build conditions, except on the westbound platform in the PM peak. The additional escalators in Build Alternatives 2 and 3 increase mezzanine level crowding in the AM peak by enabling faster platform egress after train arrivals.

Metro Center

The station has less overall crowding as a result of the Farragut pedestrian tunnel. The South Mezzanine transfer area particularly benefits from the shift in transfer demand to the Farragut stations. Other areas that have measurably less crowding in the 2030 Build condition are the lower platform in both peak hours and the Red Line platforms in the PM peak hour. The North Mezzanine transfer area crowding is not measurably affected.

Density Analysis Zone Table Key

COMBINED LOS E & F	5% or less	6 - 9%	10 - 19%	20 - 39%	above 40%
	(no crowding)	(occasional minor crowding)	(approaching significant crowding)	(significant crowding)	(very significant crowding)

Figure 5-20 Farragut North Station Pedestrian Analysis Zones

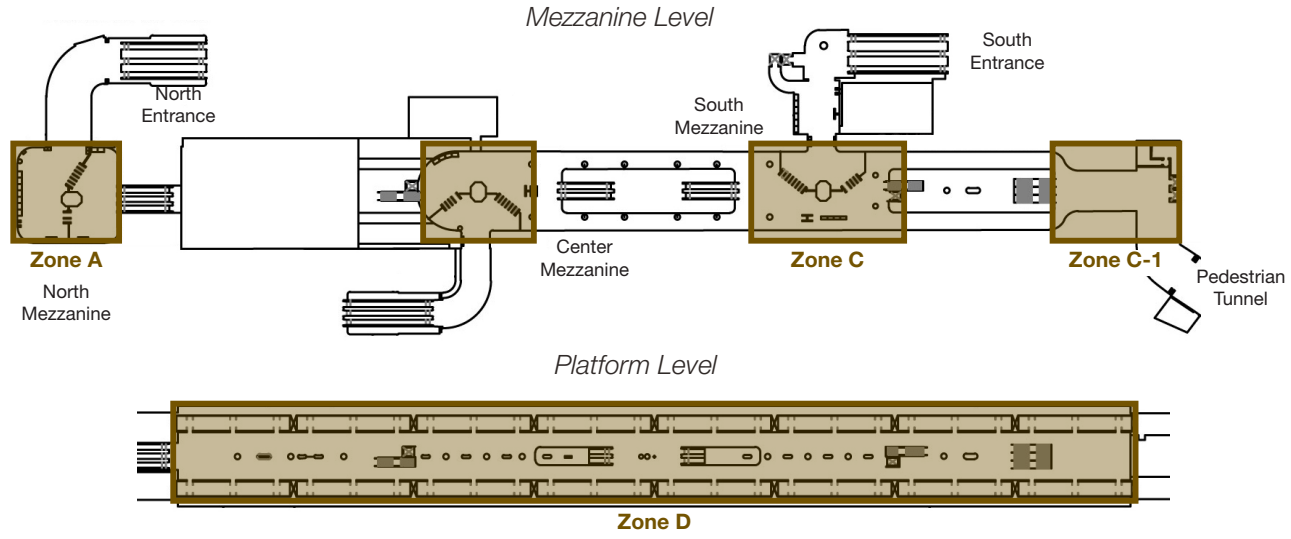


Table 5-2 Farragut North Station % LOS E & F - 2030 No Build/Build, AM Peak Hour

Analysis Zone	AM Peak Hour			
	2030 No Build	2030 Build Alternative 1	2030 Build Alternative 2	2030 Build Alternative 3
Zone A North Mezzanine	2%	2%	1%	2%
Zone B Center Mezzanine	3%	0%	0%	0%
Zone C South Mezzanine	14%	5%	3%	4%
Zone D Platform	29%	11%	18%	12%
Zone C-1 Tunnel Connection	--	1%	--	0%

Table 5-3 Farragut North Station % LOS E & F - 2030 No Build/Build, PM Peak Hour

Analysis Zone	PM Peak Hour			
	2030 No Build	2030 Build Alternative 1	2030 Build Alternative 2	2030 Build Alternative 3
Zone A North Mezzanine	0%	0%	0%	0%
Zone B Center Mezzanine	0%	0%	0%	0%
Zone C South Mezzanine	3%	0%	0%	0%
Zone D Platform	5%	13%	5%	13%
Zone C-1 Tunnel Connection	--	74%	--	12%

Figure 5-21 Farragut West Station Pedestrian Analysis Zones

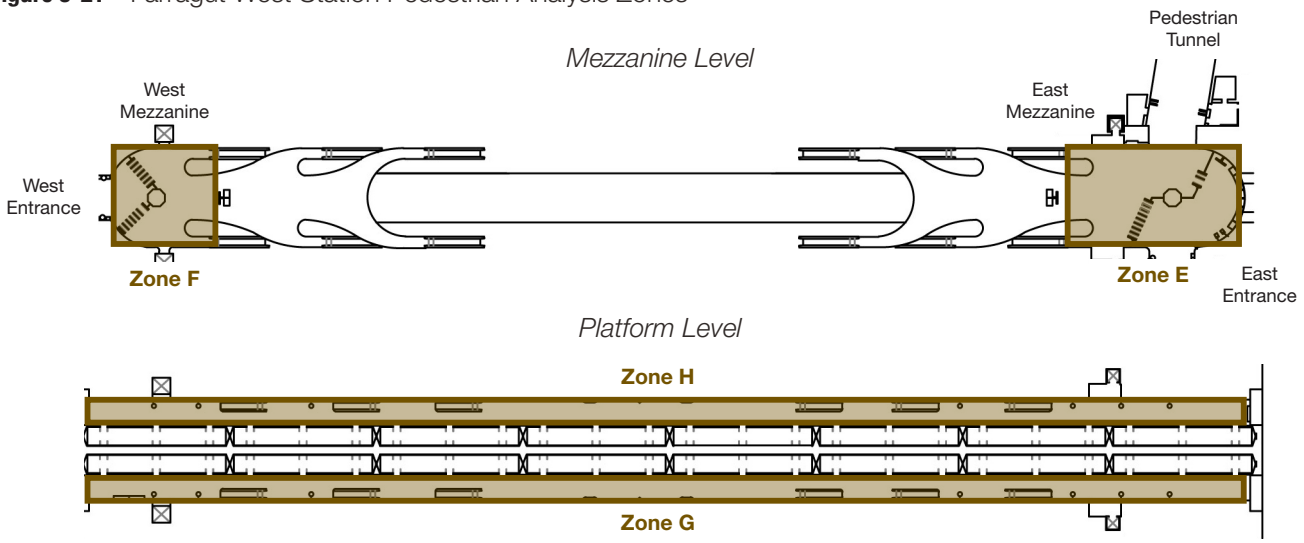


Table 5-4 Farragut West Station % LOS E & F - 2030 No Build/Build, AM Peak Hour

Analysis Zone	AM Peak Hour			
	2030 No Build	2030 Build Alternative 1	2030 Build Alternative 2	2030 Build Alternative 3
Zone E East Mezzanine	2%	0%	13%	5%
Zone F West Mezzanine	1%	1%	25%	25%
Zone G Eastbound Platform	48%	66%	11%	21%
Zone H Westbound Platform	15%	13%	2%	7%

Table 5-5 Farragut West Station % LOS E & F - 2030 No Build/Build, PM Peak Hour

Analysis Zone	AM Peak Hour			
	2030 No Build	2030 Build Alternative 1	2030 Build Alternative 2	2030 Build Alternative 3
Zone E East Mezzanine	0%	0%	0%	1%
Zone F West Mezzanine	0%	0%	0%	0%
Zone G Eastbound Platform	4%	56%	6%	17%
Zone H Westbound Platform	26%	31%	30%	35%

Figure 5-22 Metro Center Station Pedestrian Analysis Zones

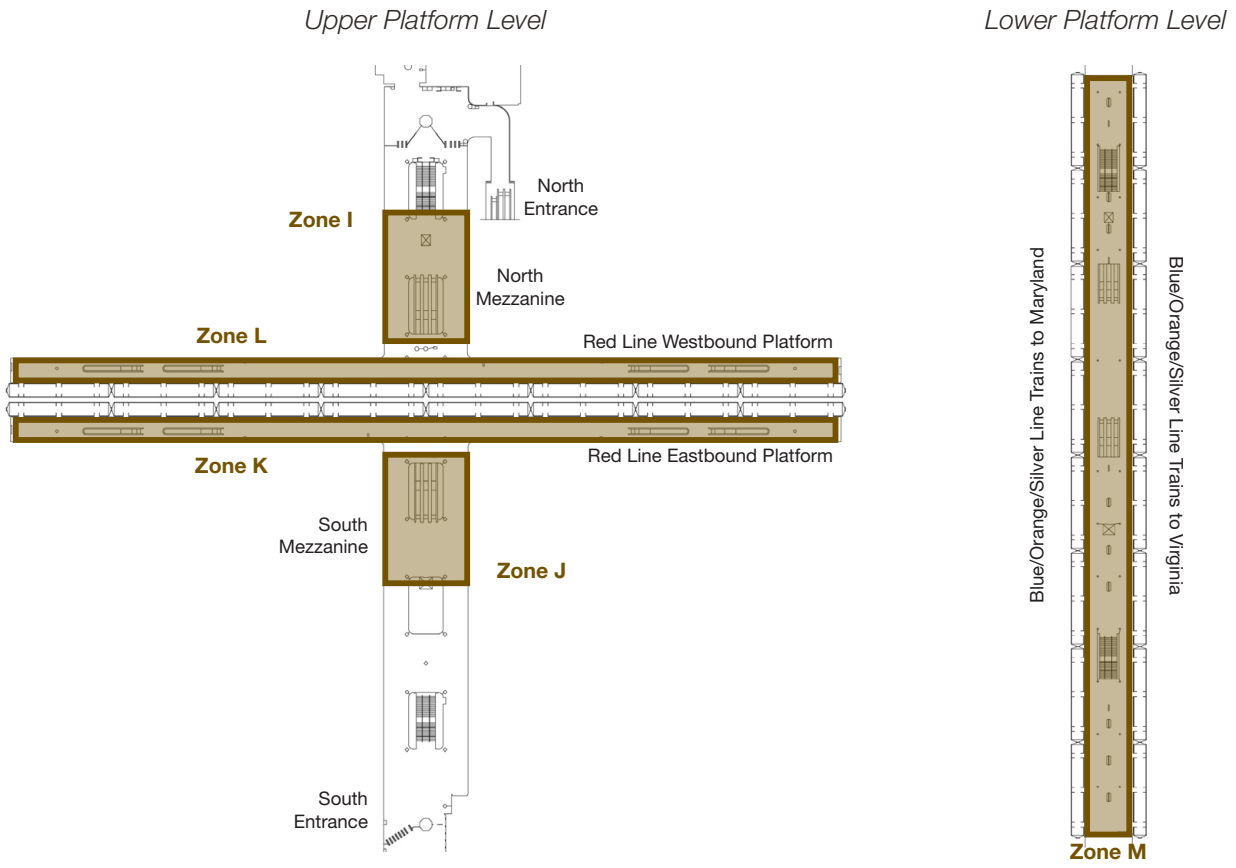


Table 5-6 Metro Center Station % LOS E & F - 2030 No Build/Build, AM/PM Peak Hours

Analysis Zone	AM Peak Hour		PM Peak Hour	
	2030 No Build	2030 Build Alternative 1	2030 No Build	2030 Build Alternative 1
Zone I North Mezzanine	20%	19%	19%	18%
Zone J South Mezzanine	29%	7%	15%	1%
Zone K Red Line Eastbound Platform	15%	14%	17%	2%
Zone K Red Line Westbound Platform	7%	4%	13%	8%
Zone M Lower Platform	14%	9%	15%	6%

Comparison of Total Numbers of Passengers Experiencing Significant Crowding – With and Without the Farragut Pedestrian Tunnel

Table 5-7 compares passenger density at the station level, showing that without additional capacity improvements, the Farragut pedestrian tunnel shifts crowding from Metro Center to the Farragut stations, but that additional capacity improvements at the Farragut stations can provide a net decrease in crowded conditions.

Build Alternative 1 results in no net decrease in passengers experiencing significant crowding among the three stations compared to the 2030 No Build condition. The additional capacity improvements in Build Alternative 3 provide a measurable net decrease in passengers experiencing significant crowding.

Table 5-7 2030 Peak Hour Passengers Experiencing Significant Crowding (LOS E and F)

Station	2030 No Build		2030 Build Alternative 1		2030 Build Alternative 3	
	# LOS E/F	% LOS E/F	# LOS E/F	% LOS E/F	# LOS E/F	% LOS E/F
Farragut North	4,400	7%	7,700	11%	4,400	4%
Farragut West	5,300	12%	11,600	21%	7,300	14%
Metro Center	18,500	16%	8,200	9%	8,200	9%
Combined Total: Farragut Stations + Metro Center	**28,300**	**13%**	**27,600**	**13%**	**19,900**	**8%**

Note: Totals may not add due to rounding. Build Alternative 2 is not included in the comparison because it does not include the pedestrian tunnel and resulting shift in travel demand.

Journey Times

Figures 5-23 and **5-24** show journey times for alighting passengers at Farragut North and Farragut West, respectively, during the AM peak hour, comparing the 2030 No Build and Build Alternatives for the most heavily used movements.

Farragut North

The average journey times decrease for passengers exiting to the Northwest and South Entrances as a result of the additional platform vertical circulation capacity provided in all three Build Alternatives.

Farragut West

The average journey times for passengers exiting from the more heavily used eastbound platform increase under Build Alternative 1 as a result of the higher volumes of passengers alighting to use the pedestrian tunnel. The additional platform escalators provided in Build Alternatives 2 and 3 decrease journey times for eastbound platform exiting passengers.

Figure 5-23 Farragut North Alighting Journey Times - 2030 No Build/Build AM Peak Hour

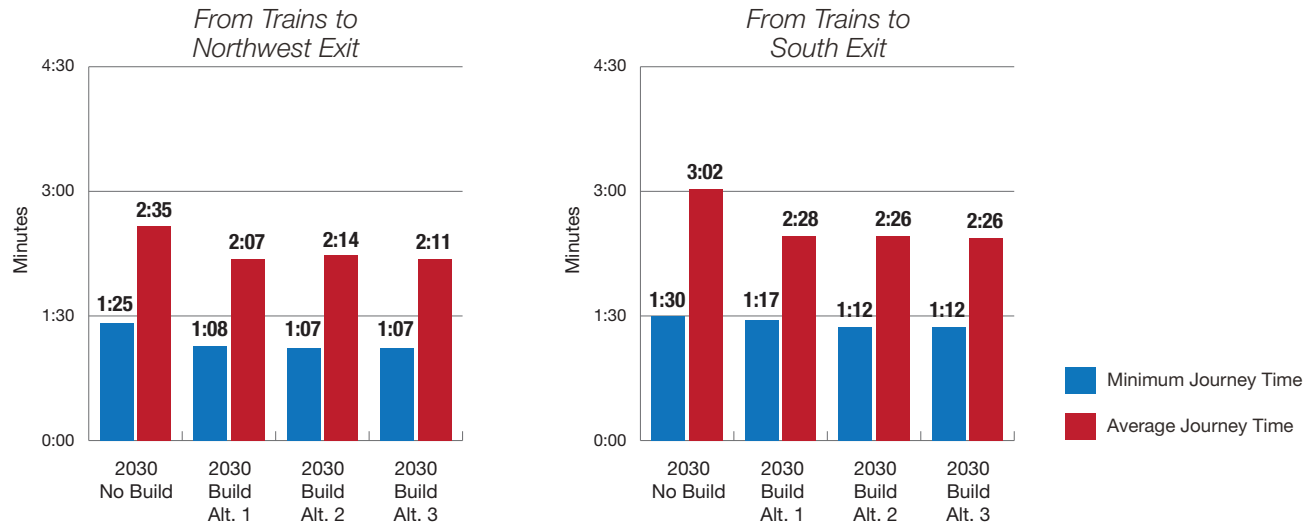
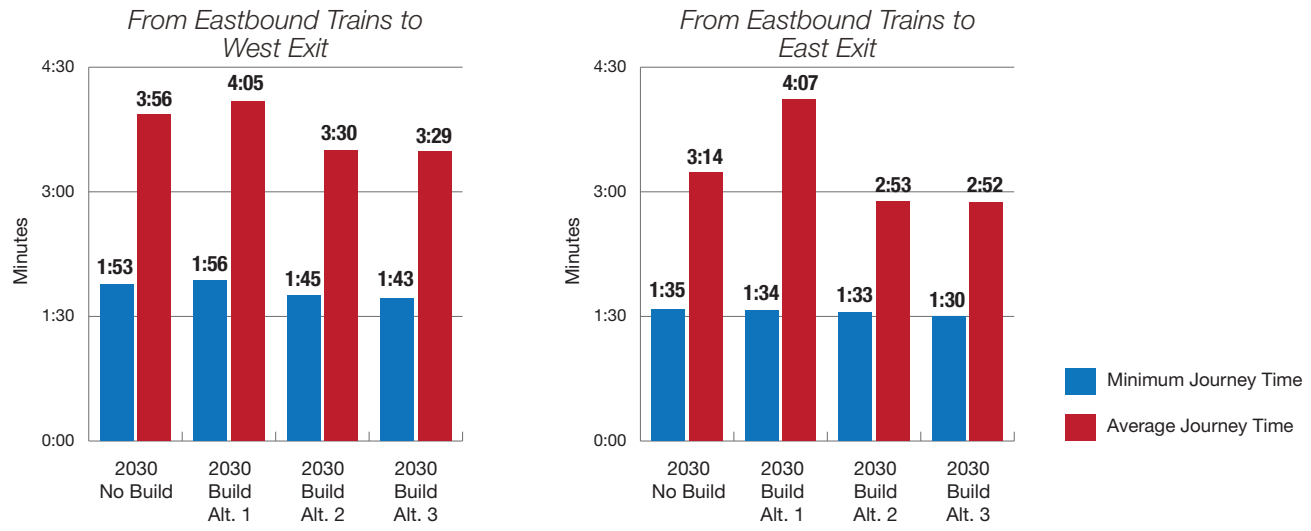


Figure 5-24 Farragut West Alighting Journey Times - 2030 No Build/Build AM Peak Hour

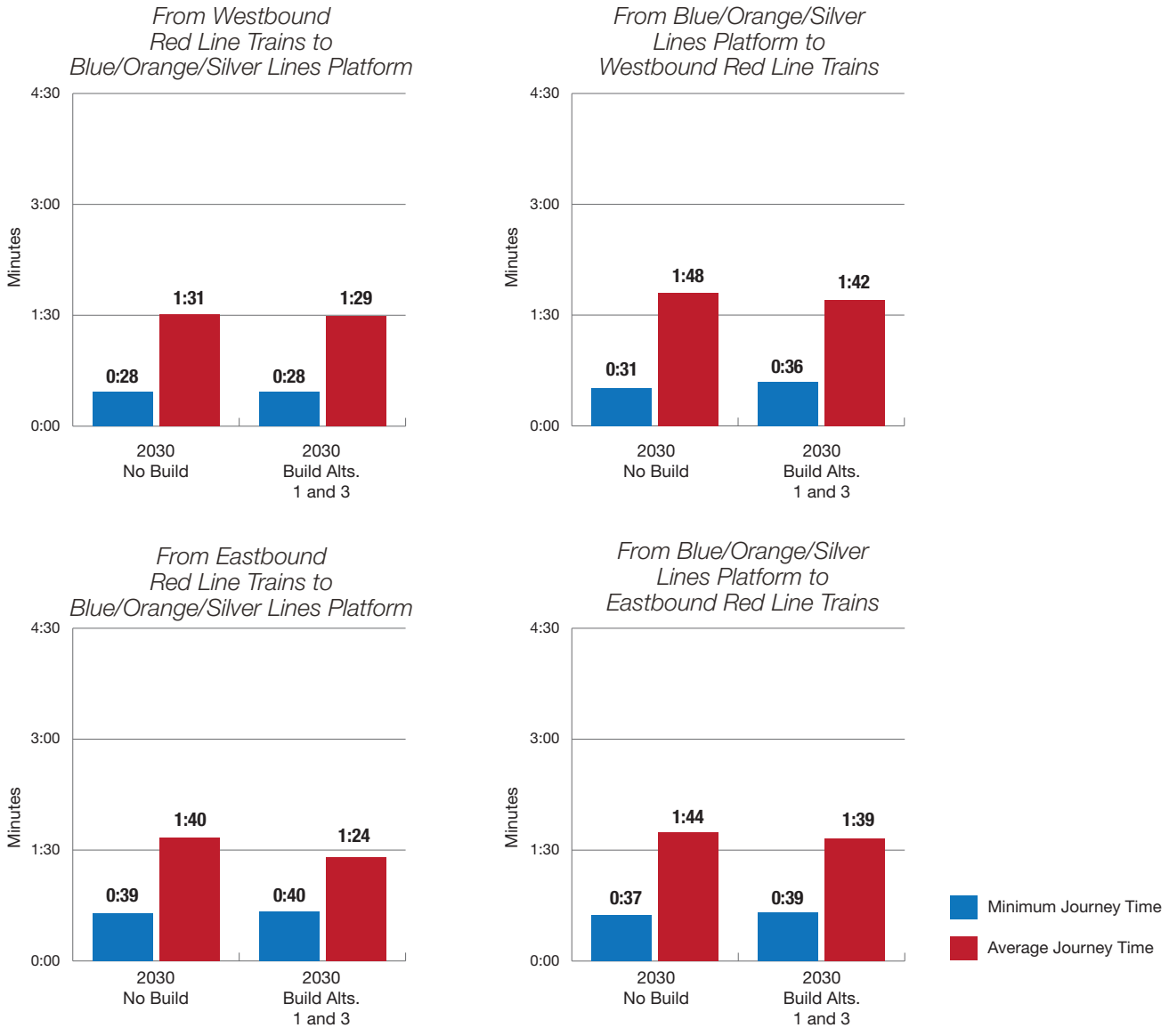


Metro Center

Figure 5-25 shows the transfer journey times at Metro Center Station for combined AM and PM peak hours. Transfers from the eastbound Red Line to the lower platform experience measurably shorter journey times as a result in the shift in transfer demand to the Farragut stations in the Build condition.

Other transfer movement journey times are not affected – the transfer movement from the westbound Red Line to the Blue/Orange/Silver Lines does not benefit from the Farragut pedestrian tunnel, and the movements from the Blue/Orange/Silver Lines to either Red Line platform generally have sufficient escalator capacity in the up direction (two up escalators versus one down escalator), so their journey times do not decrease significantly.

Figure 5-25 Metro Center Alighting Transfer Journey Times - 2030 No Build/Build Combined AM/PM Peak Hours



Transfer Time Comparison

The primary market for the pedestrian tunnel is the transfer between the Shady Grove to Downtown DC segment of the Red Line and the Virginia to Foggy Bottom segments of the Blue, Orange, and Silver Lines (see **Figure 5-26**). This transfer movement would have significant time savings as a result of the Farragut pedestrian tunnel compared to using Metrorail to transfer at Metro Center.

Table 5-8 compares the average transfer times (under congested conditions) and minimum transfer times (under relatively uncongested conditions) for the different routes. **Table 5-9** lists the total travel time savings for the forecast Metrorail transfer passengers using the Farragut pedestrian tunnel to transfer rather than continuing on Metrorail to transfer at Metro Center.

Table 5-8 Metrorail Transfer Times - 2030 No Build/Build, Average Combined AM/PM Peak Hours

Red Line to/from Blue/Orange/Silver Lines	No Build (Metrorail via Metro Center) (Orange Path in Figure)	No Build (via street level virtual transfer) (Green Path in Figure)	Build Alternative 1 (via Ped. Tunnel) (Blue Path in Figure)	Build Alternative 3 (via Ped. Tunnel) (Blue Path in Figure)
Average Time per Passenger (mm:ss)	6:14	7:51	4:09	3:19
Minimum Time per Passenger (mm:ss)	5:35	6:17	1:45	1:39

Note: Metrorail journey time is 5 minutes train travel time between Farragut North and Farragut West stations via Metro Center based on schedule plus pedestrian simulation transfer time within Metro Center. All times exclude train waiting time on the transfer and destination platforms.

Figure 5-26 Transfer Time Comparison - via Metro Center vs. Street Level vs. Pedestrian Tunnel

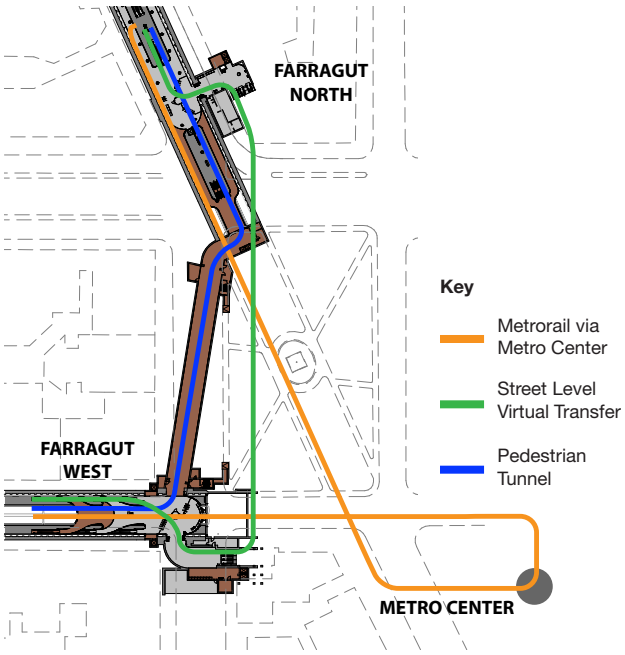


Table 5-9 Forecast 2030 Metrorail Transfer Time Savings from Farragut Pedestrian Tunnel

Time Period	Number of Transfers	Total Travel Time Savings
Peak Period (AM +PM)	11,000	543
Off-Peak Period	7,000	495
Daily (weekday)	18,000	1,040
Annual*	5,472,000	311,400

**Annual savings is estimated based on the daily (weekday) total multiplied by an annualization factor of 300.*

Station Access Journey Times at Farragut Square

Table 5-10 compares journey times for passengers crossing Farragut Square to access the opposite station (AM and PM averages) walking at street level versus using the proposed Farragut pedestrian tunnel to access the other station (see **Figure 5-27**).

Figure 5-27 Farragut North and Farragut West Station Entry Journey Time Comparison – Street Level vs. Pedestrian Tunnel

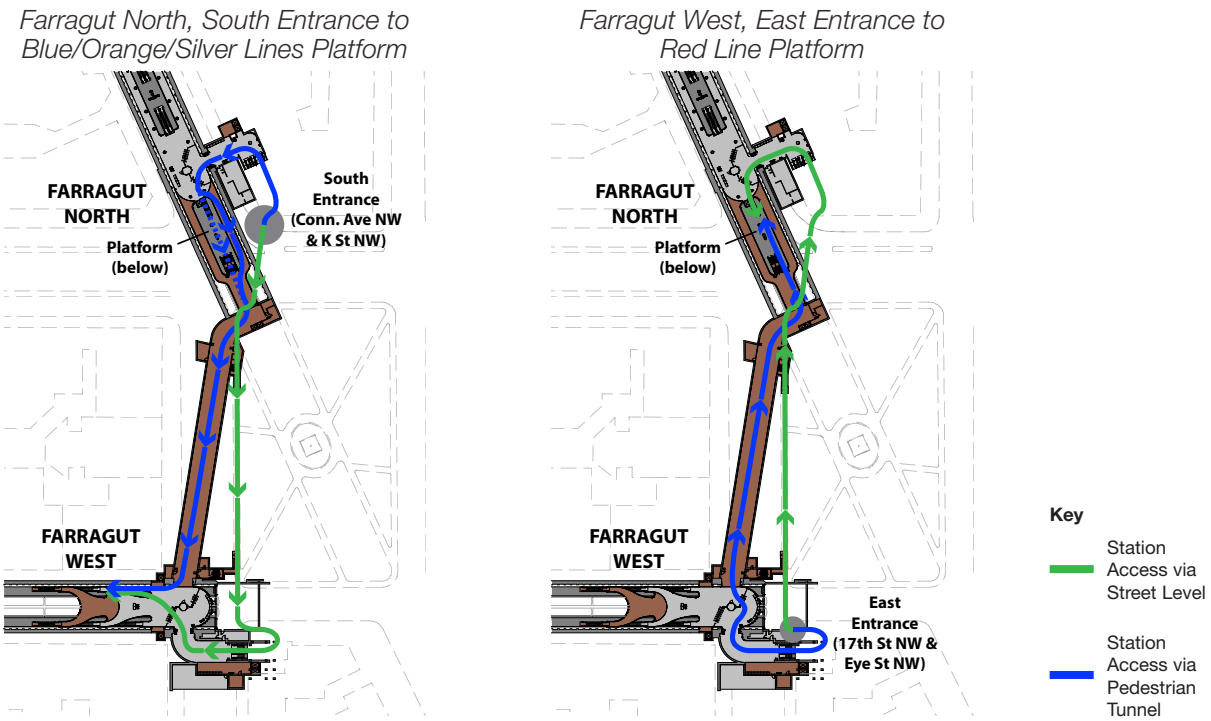


Table 5-10 Farragut West and Farragut North Station Entry Journey Time Comparison – 2030 Average Combined AM and PM Hours

Farragut North to/ from Farragut West	2030 No Build (via street level) (Green Arrows in Figure)	2030 Build Alt. 1 (via Ped. Tunnel)* (Blue Arrows in Figure)	Build Alternative 3 (via Ped. Tunnel)* (Blue Arrows in Figure)
Average Time per Passenger (mm:ss)	6:01	3:31	3:17
Minimum Time per Passenger (mm:ss)	5:42	2:43	2:49

Note: The difference in minimum journey times between Build Alternatives 1 and 3 should not be considered significant, due to simulation model variability and the relatively low sample sizes of passengers using the tunnel to enter the opposite station.

5.5 Summary of Build Alternative Simulation Findings

This section summarizes the performance of the improvement concepts based on the pedestrian model simulations of the Build Alternatives.

Farragut Pedestrian Tunnel

The Farragut pedestrian tunnel provides measurable relief to Metro Center crowding in some but not all areas of the station. Conversely, the tunnel results in additional passenger demand at both Farragut North and Farragut West (Build Alternative 1) that requires additional stair and escalator capacity improvements (Build Alternative 3). The tunnel itself is able to handle the forecast passenger volumes, which can be considered conservatively on the high side for some of the secondary transfer movements forecast.

The tunnel measurably reduces transfer times between the Red Line and the Blue/Orange/Silver Lines and also can save Metrorail passengers time crossing surface streets at Farragut Square.

Pedestrians waiting to cross K Street, NW at the Farragut North, South Entrance

Farragut West Additional Platform Escalators

The additional platform escalators at Farragut West are needed to handle the pedestrian tunnel's additional passenger volumes (Build Alternative 3). Further strategies should be explored to address the adverse effect of the additional escalators on waiting passengers on the westbound platform in the PM peak and to address the additional crowding at the West Mezzanine in the AM peak resulting from the faster platform egress.

Farragut North Platform Vertical Circulation Elements to Pedestrian Tunnel Entrance

The wide platform stair to the tunnel entrance is better able to handle the high volumes than a single escalator pair. The stair also provides more flexibility in serving flows from different directions after trains unload at Farragut North or Farragut West.

Farragut North, South Mezzanine Extension to Pedestrian Tunnel Entrance

The mezzanine extension helps diffuse some of the pedestrian circulation at the south end of the station. Based on the estimated travel time savings for passengers using the pedestrian tunnel to enter/exit one station and access the other Farragut station (rather than cross Farragut Square and surface streets), it can be expected that some passengers will choose this option, for which the mezzanine extension at Farragut North is particularly of benefit. The mezzanine extension allows tunnel users entering/exiting the Metrorail station at the Farragut stations to seamlessly travel between the South and Center Mezzanines and the pedestrian tunnel, versus descending to the crowded platform and then ascending to the pedestrian tunnel entrance.

Basic Station Improvements

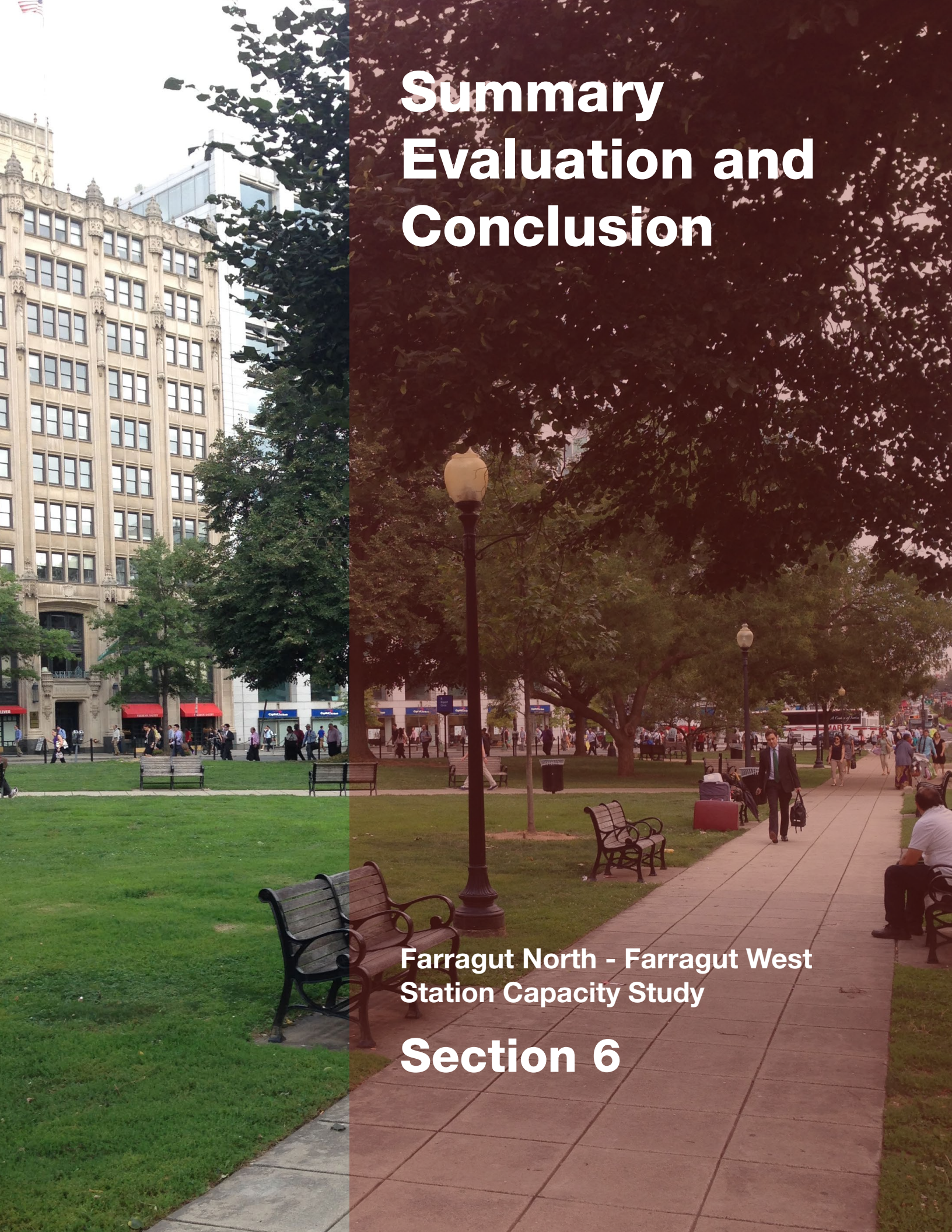
The package of basic station improvements assumed in all three build alternatives (new platform-mezzanine stairs at Farragut North, and additional faregates and elevators at both stations) provides various benefits:

- New stairs to the Center and South Mezzanines at Farragut North reduce platform crowding and South Mezzanine faregate crowding;
- Additional faregates at specific locations help accommodate the faster platform egress provided by the additional stairs, escalators, and elevators at both stations; and
- New platform and street level elevators provide additional ADA accessibility within the stations.

At Farragut West, the simulations show that the East Mezzanine new platform elevators are better located at the back of the mezzanine away from the heavy pedestrian volumes accessing the down escalators and the pedestrian tunnel.

Safety Analysis

The Build alternatives mitigate many of the potential safety concerns in the 2030 No Build conditions. Implementation of the Farragut pedestrian tunnel requires additional vertical circulation capacity at Farragut West Station; although Build Alternative 3 addresses the AM peak crowding, it does not resolve PM peak crowding, especially on the westbound platform. At Metro Center Station, the shift in transfer demand to the Farragut stations as a result of the pedestrian tunnel resolves certain areas of crowding, but on the lower platform there remain areas, particularly in the AM peak where crowding occurs between escalators and the platform edge.



Summary Evaluation and Conclusion

Farragut North - Farragut West
Station Capacity Study

Section 6

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6.0 CONCLUSION

6.1 Evaluation of Improvement Concepts

The station improvement concepts were evaluated based on the degree to which they would achieve the study's design objectives described in Section 4.2, informed by the results of the Build Alternative pedestrian model simulations summarized in the previous chapter. **Table 6-1** on the following page outlines the general evaluation criteria and specific evaluation measures (quantitative and qualitative) developed for the design objectives.

Tables 6-2 through **6-5** summarize the evaluation results for the improvement concepts:

- Farragut North-West Pedestrian Tunnel
- Farragut North, Center and South Mezzanine Improvements
- Farragut West Elevator Improvements
- Farragut West Additional Platform Escalators

The proposed improvement concepts for the Farragut Stations have the potential to greatly benefit Metrorail system users and to improve accessibility of the Farragut Square area

Table 6-1 Design Objectives and Corresponding Evaluation Criteria and Measures

Design Objectives	Evaluation Criteria	Evaluation Measures
1. Address current passenger circulation deficiencies within Farragut North and Farragut West Stations	Internal Station Performance (Farragut Stations and Metro Center Station	**Comparison of 2030 No Build and 2030 Build Alternatives pedestrian simulation modeling results (quantitative and qualitative):** • Farragut North Station • Farragut West Station **Farragut pedestrian tunnel measures also include:** • Metro Center Station • Metrorail transfers
2. Accommodate future travel demand at Farragut North and Farragut West Stations		
3. Relieve current and future transfer demand at Metro Center Station		
4. Improve station accessibility at Farragut North and Farragut West Stations	Station Access (Farragut Stations only)	**Entrance Accessibility (qualitative)** • Street level entrance access **ADA Accessibility (qualitative)** • ADA pathways from street level to mezzanine • ADA pathways from mezzanine to platform • Additional ADA pathways
5. Develop improvement concepts for Farragut North and Farragut West that are feasible to implement and enhance the user's experience	Visual Impact (Farragut Stations only)	**Sight Lines / Architectural Design (qualitative)** • Maintaining secure sight lines and openness of circulation areas • Compatibility of concepts with system architectural design
	Cost and Feasibility (Farragut Stations only)	**Conceptual Capital Cost (quantitative)** • Order-of-Magnitude capital costs • Constructability (quantitative) • Potential architectural/engineering constraints • Potential construction phasing constraints

Table 6-2 Farragut North-West Pedestrian Tunnel Evaluation

Evaluation Measures	Summary Findings
Internal Station Performance	
Metrorail Transfers	• Primarily serves transfers between Red Line Shady Grove-Downtown DC segment and Blue/Orange/Silver Lines Virginia segment. • Reduces average transfer times from approximately 6 minutes (Metrorail via Metro Center) to 3-4 minutes (Farragut pedestrian tunnel).
Metro Center	• Relieves some transfer-related congestion, particularly at South Mezzanine transfer area and on lower platform. • Reduces number of peak hour passengers experiencing significant crowding from 18,500 to 8,200.
Farragut North	• Moderately increases passenger volumes but without adding significant crowding. • FN Option 2 South Mezzanine extension helps diffuse passenger volumes at south end of station.
Farragut West	• Transfer demand for the pedestrian tunnel significantly exacerbates crowding at the eastbound platform escalators to the East Mezzanine. • Increases number of peak hour passengers experiencing significant crowding from 5,300 to 11,600 with no design improvements or to 7,300 with additional platform escalators.
Station Access	
Entrance Accessibility	• Provides additional street level access route for each station. • Farragut North Option 2 South Mezzanine extension would facilitate tunnel use for passengers entering/exiting at Farragut North.
ADA Accessibility	• Provides additional accessible pathways to/from each station. • Farragut North Option 2 South Mezzanine extension provides additional accessible pathways within Farragut North by connecting pedestrian tunnel elevators to the South and Center Mezzanines.
Visual Impact	
Sight Lines / Architectural Design	• No significant changes from tunnel entrances and associated facilities. • Farragut North Option 2 South Mezzanine extension would reduce sense of openness at south end of platform.
Cost and Feasibility	
Conceptual Capital Cost	$70.1 M - $73.2 M (with Farragut North Option 2 South Mezzanine Extension)
Constructability	• Construction impacts to NPS property and closures of streets. • New platform elevators at Farragut West East Mezzanine would require vault openings. • Farragut North Option 2 South Mezzanine extension requires development of structural support for portions of mezzanine extension over tracks.

Table 6-3 Farragut North, Center and South Mezzanine Improvements

Evaluation Measures	Summary Findings
Internal Station Performance	
Farragut North	• New stairs to the Center and South Mezzanines at Farragut North reduce platform crowding from 29% to 18% of passengers. • Reduce South Mezzanine crowding from 14% to 3% of passengers. • Improve passenger utilization of platform ends, reducing congestion in area between central escalator banks. • Platform escalators and stairs still have minor queues in AM peak hour due to high egress demand.
Station Access	
Entrance Accessibility	• Additional street level elevator at South Entrance enhances access.
ADA Accessibility	• New platform and street level elevators provide additional accessible pathways within station.
Visual Impact	
Sight Lines / Architectural Design	• No significant changes
Cost and Feasibility	
Conceptual Capital Cost	• Center Mezzanine Improvements: $8.8 M • South Mezzanine Improvements: $14.2 M
Constructability	• Impacts to adjacent building by new South Mezzanine street elevator. • New South Mezzanine platform stair can utilize existing platform structure pit designed to accommodate future installation.

Table 6-4 Farragut West, East Mezzanine Elevator Improvements

Evaluation Measures	Summary Findings
Internal Station Performance	
Farragut West	• Platform elevators Design Option 2 (near back of mezzanine) avoids pedestrian circulation conflicts of Design Option 1 near escalators and pedestrian tunnel entrance.
Station Access	
Entrance Accessibility	• Improves station elevator access but reduces street level access to East Entrance escalators by closing entry from 17th Street, NW (leaving only the entry from Eye Street, NW)
ADA Accessibility	• New platform and street level elevators provide accessible pathways within station East Mezzanine.
Visual Impact	
Sight Lines / Architectural Design	• No significant changes
Cost and Feasibility	
Conceptual Capital Cost	• New street elevators: $19.0 M • New platform elevators included in pedestrian tunnel cost estimate.
Constructability	• Potential impacts to adjacent building by new street elevator. • Vault openings required for new platform elevators. • Eastbound platform elevator Design Option 2 requires further structural analysis of area between vault and passageway walls.

Table 6-5 Farragut West Additional Platform Escalators

Evaluation Measures	Summary Findings
Internal Station Performance	
Farragut West	• Relieve significant AM peak platform congestion and escalator queues, especially with additional passenger volumes for the pedestrian tunnel. • Shift AM peak congestion and queues to the mezzanine level, especially West Mezzanine. • Contribute to PM peak crowding on the westbound platform.
Station Access	
Entrance Accessibility	• Faster platform egress causes additional AM peak congestion from mezzanine to street level. • New entrances may be required to address limited mezzanine-to-street level circulation capacity.
ADA Accessibility	(Not applicable)
Visual Impact	
Sight Lines / Architectural Design	• Reduce sense of openness at platform level.
Cost and Feasibility	
Conceptual Capital Cost	• $16.9 M
Constructability	• Require significant work above active tracks and on platforms. • Require additional concept designs to address the PM platform crowding and AM mezzanine level crowding.

6.2 Conclusions

By the year 2030, Farragut North, Farragut West, and Metro Center Stations will experience significant areas of passenger congestion based on Metrorail passenger forecasts and pedestrian model simulations of the stations. Implementation of the recommended capacity improvements at Farragut North and Farragut West along with the Farragut pedestrian tunnel (Build Alternative 3 in the pedestrian simulation modeling) will improve passenger conditions at both Farragut stations and at Metro Center. However, the set of improvement concepts identified by the current study does not address all pedestrian circulation deficiencies at the stations, and further study is needed to develop additional concept designs to address congestion at Farragut West and Metro Center Stations.

Farragut Pedestrian Tunnel

The pedestrian tunnel relieves transfer-related congestion at Metro Center and shortens transfer times but adds passenger demand and crowding at the Farragut stations, especially at Farragut West:

Capacity improvements at the Farragut stations are needed to provide a net decrease in station crowding – The pedestrian tunnel results in no meaningful net decrease in total passengers experiencing significant crowding at the three stations compared to the 2030 No Build condition, shifting congestion from Metro Center to the Farragut stations. However, with additional capacity improvements at the Farragut stations, the pedestrian tunnel provides a measurable net decrease in passengers experiencing significant crowding, from 28,300 in the 2030 No Build condition to 19,900 in Build Alternative 3.

The pedestrian tunnel's primary transfer market would receive significant travel time benefits from the tunnel, while other travel markets would not save time by using the tunnel – The Farragut pedestrian tunnel would primarily serve transfers between Red Line Shady Grove-Downtown DC segment and Blue/Orange/Silver Lines Virginia segment. For this transfer movement, the tunnel would reduce average travel times from approximately 6 minutes (Metrorail via Metro Center) to 3-4 minutes (Farragut pedestrian tunnel). Metrorail passengers using the Red Line Shady Grove-Downtown DC segment and entering or exiting at McPherson Square would receive smaller travel time savings. Other transfer groups would not experience travel time savings from using the pedestrian tunnel.

Farragut station entries and exits at Farragut Square also benefit from the tunnel – The pedestrian tunnel can shorten journey times for passengers with origins or destinations on the opposite side of Farragut Square from the station at which they alight or board.

Short-Term Improvements

Potential low-cost and operational improvements can be implemented in the short-term to help address existing deficiencies, in advance of more detailed structural analysis and design development required for the more in-depth improvement concepts. These proposed short-term improvements include:

Farragut North

- Improved Pedestrian Information Display System (PIDS) visibility at platform ends to help improve utilization of platform space;
- Relocation of South Mezzanine station furniture and ancillary storage areas that create blind spots; and
- New stair from platform to southern end of South Mezzanine, taking advantage of existing platform structure pit designed to accommodate future installation.

Farragut West

- Additional standard faregate at the East Mezzanine's heavily used array on the southwest side of the station manager kiosk; and
- Shifting the West Mezzanine ADA faregate to the less heavily used array by the westbound platform escalators and swapping with a standard faregate to increase throughput capacity for the more heavily used array by the eastbound platform escalators.

Further Structural Analysis and Design Development

Proposed improvement concepts that require further structural analysis or design development in subsequent studies include the following:

Farragut Pedestrian Tunnel

- **Construction Impacts to Farragut Square –** More detailed assessment will be needed of potential impacts to Farragut Square trees and development of minimization and mitigation measures.

Farragut North

- **Pedestrian Tunnel Connection, Option 2: South Mezzanine Extension –** structural support of the mezzanine extension over the Metrorail tracks (whether laterally from the vault wall or via overhead hanging connections to the vault, such as the Gallery Place proposed mezzanine bridge "earring" design) will need to be determined; and
- *New Street Level Elevator* – Further assessment of the basement area of the 1025 Connecticut Avenue building and ground level space within the existing CVS store is needed as part of a follow-up study to understand the constructability of this proposed location.

Farragut West

- **East Mezzanine Platform Elevators, Option 2: Elevators located at back of Mezzanine –** Further structural analysis is needed to assess the impact on the vault and passageway wall structures;
- **East Mezzanine Street Elevators –** Street level circulation will need to be evaluated to determine the impact of closing one of the two East Entrance openings. Future structural and property analysis will be needed to determine if there are potential conflicts with the basement level of the 839 17th Street, NW building; and
- **Additional Platform Escalators –** Further design refinements should be explored to address the PM crowding on the westbound platform resulting from the additional platform escalators. These escalators are necessary to resolve AM and PM peak period crowding on the eastbound platform and reduce AM escalator queues on both platforms, especially with implementation of the pedestrian tunnel. However, potential design refinements may be able to reduce the adverse impact on platform circulation space.
- **Alternative Design Solutions –** Additional alternative design concepts, such as a mezzanine bridge, can be developed and modeled to find ways to resolve the mezzanine level crowding resulting from the faster egress provided by additional platform stairs or escalators.

Metro Center

Development of improvement concepts is needed to address congested areas not affected by the shift in transfer demand to the Farragut pedestrian tunnel, such as the North Mezzanine transfer area.

Long-Term Considerations

The following considerations should also be studied as plans are implemented for the Farragut stations and Metro Center Station.

Potential New Farragut West Entrances

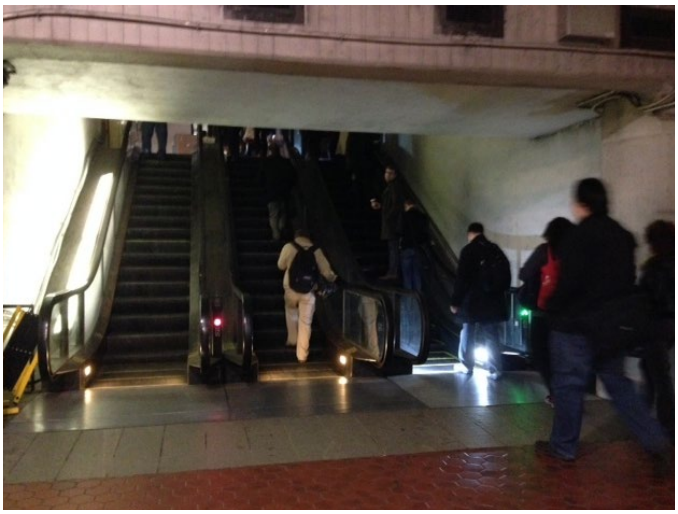
The current study reviewed potential configurations for a future new entrance to the East Mezzanine of Farragut West. If additional platform vertical circulation is implemented at Farragut West, both mezzanines would experience crowding as a result of the faster platform egress following train arrivals, especially the West Mezzanine. An additional entrance at the West Mezzanine, pending redevelopment of the adjacent buildings, could be investigated to help relieve the mezzanine level congestion. However, even if redevelopment of the building block occurs, the limited space at street level and underground would still pose a challenge for the design and construction of a new entrance.

2040 New Metrorail M Street, NW Line

Farragut North Station would require additional study, particularly at the North Mezzanine, as plans for a new Metrorail line along M Street, NW are further developed. In current conceptual plans, a pedestrian tunnel would connect the two stations, accommodating transfers between the Red Line and the new Metrorail line and adding passenger activity at Farragut North. None of the improvement concepts developed in the current study preclude a future pedestrian tunnel connection, but the effect of the additional passenger demand at the North Mezzanine would need to be assessed further.

Foggy Bottom-GWU Station Second Entrance

As an alternative to an additional entrance for the West Mezzanine of Farragut West, a new east entrance to Foggy Bottom-GWU Station could be studied as a way to relieve passenger demand.



Passengers exiting Farragut North via the North Mezzanine may one day be able to transfer to a new M Street, NW subway, one of Metro's long-term considerations

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Appendices

Farragut North - Farragut West
Station Capacity Study

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Appendix A:
CONCEPTUAL CAPITAL COST ESTIMATES

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November 26, 2014

FEASIBILITY STUDY
COST ESTIMATE
for
FARRAGUT NORTH/FARRAGUT WEST IMPROVEMENT CONCEPTS
WMATA

AECOM
3101 Wilson Blvd
Suite 900
Arlington, VA
22202

703.682.4900 tel
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November 26, 2014

Bill Pugh
AECOM Transportation
2101 Wilson Blvd
Suite 800
Arlington, VA 22201

FARRAGUT NORTH/FARRAGUT WEST IMPROVEMENT CONCEPTS - WMATA, Washington, DC

Dear Bill:

Please find enclosed our Construction Cost Estimate for the above referenced project based on Concept Design information.

	Const. Start	Estimated Cost
Farragut North/West Tunnel Connection		
I. Farragut North/West Connection, Option 1	Jan 1, 2020	**$70,146,463**
I. Farragut North/West Connection, Option 2	Jan 1, 2020	**$73,186,622**
Farragut North		
II. Farragut North, Center Mezzanine Improvements	Jan 1, 2020	**$8,772,204**
III. Farragut North, South Mezzanine Improvements	Jan 1, 2020	**$14,229,558**
Farragut West		
IV. Farragut West, East Mezzanine Street Elevators	Jan 1, 2020	**$19,046,932**
V. Farragut West, Additional Platform Escalators	Jan 1, 2020	**$16,924,980**

*I. Farragut North/West Tunnel Connection Option 1 and Option 2 costs include Farragut West 2# new elevators to the westbound and eastbound platform. The street level elevators and new passageway are included separately in IV. Farragut West, East Mezzanine Street Elevators.

This estimate includes all direct construction costs, contingency and soft costs. Cost escalation assumes start dates indicated above.

The estimate is based on union wage rates for construction in this market and represents a reasonable opinion of cost. It is not a prediction of the successful bid from a contractor as bids will vary due to fluctuating market conditions, errors and omissions, proprietary specifications, lack or surplus of bidders, perception of risk, etc. Consequently the estimate is expected to fall within the range of bids from a number of competitive contractors or subcontractors, however we do not warrant that bids or negotiated prices will not vary from the final construction cost estimate.

If you have any questions or require further analysis please do not hesitate to contact us.

Sincerely,

James Partridge
Associate

CONTENTS

BASIS OF COST ESTIMATE

Cost Estimate Prepared From	Dated	Received
Drawings issued for		
Concept Design Submission	07/31/14	07/31/14
Concept Design Submission, revised	09/16/14	09/24/14
Concept Design Submission, revised	10/01/14	10/24/14
Discussions and meetings with the Project Architect and Engineers		
Meeting with WMATA		
WMATA equipment pricing update		10/24/14

Conditions of Construction

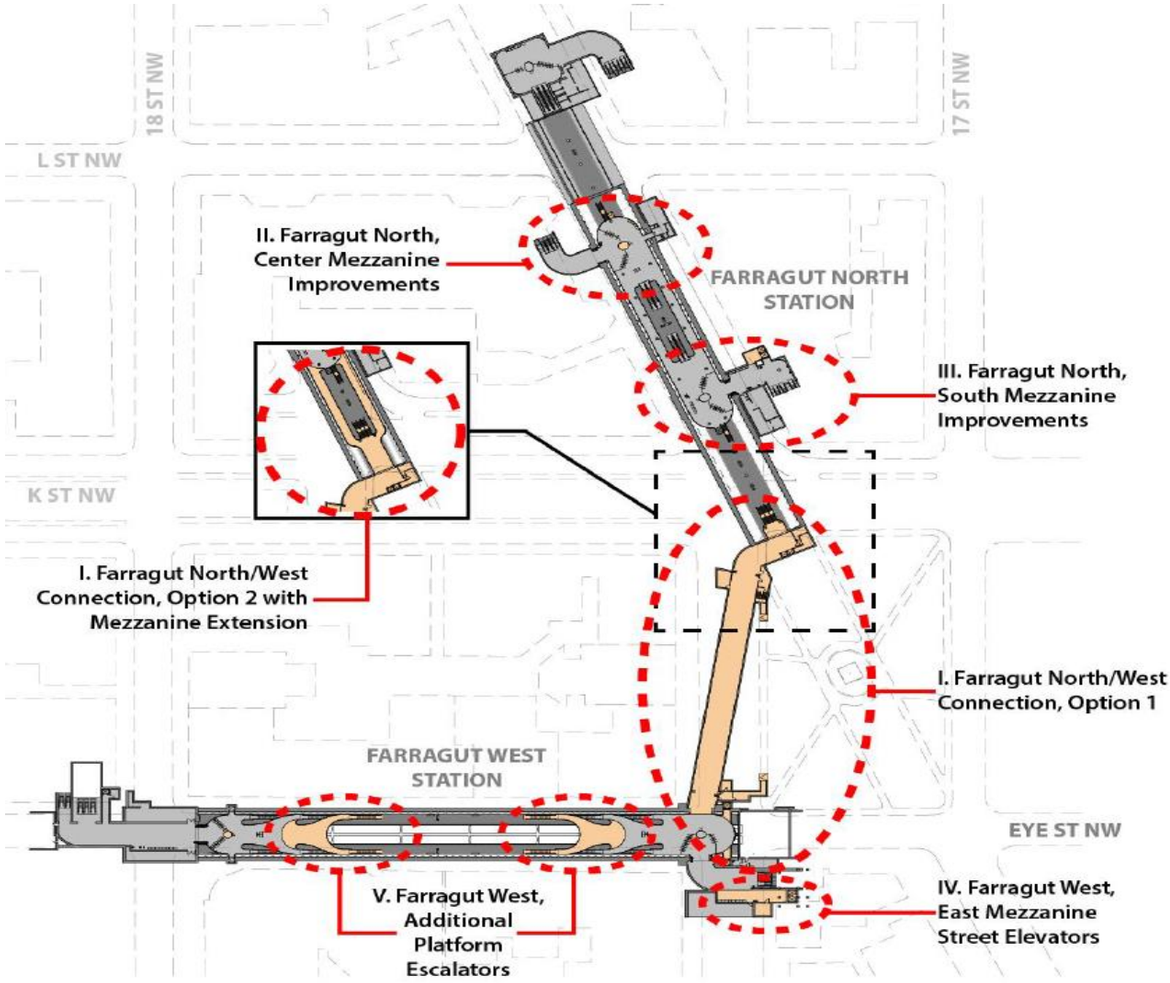
The pricing is based on the following general conditions of construction

- A start date of January 2020
- The unit pricing is based on 2014 dollars and then escalated to mid-point of construction (3Q2021).
- Construction Period:
  Tunnel Connection: Construction Period of approximately 36 months
  Farragut North & West improvement options to run concurrently with the tunnel connection.
- The general contract will be awarded to one construction manager and competitively bid to qualified subcontractors
- There will not be small business set aside requirements
- The contractor will be required to use union wage rates
- A 5% phasing allowance is included. (see estimate detail)
- The general contractor/construction manager will have full access to the site during normal business hours
- Compression of schedule, premium or shift work, and restrictions on the contractor's working hours - An allowance for 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half is included with each line item (see detailed estimate)

INCLUSIONS

This project in Washington, DC comprises the construction of a new pedestrian tunnel connecting the Farragut North and Farragut West Metro stations, as well as improvements to each of the stations due to the increase in pedestrian demand and need to improve ADA access. Five packages of improvements for the stations were examined under the feasibility study; one of the packages has two design options.

Farragut North/Farragut West Improvement Concept Packages

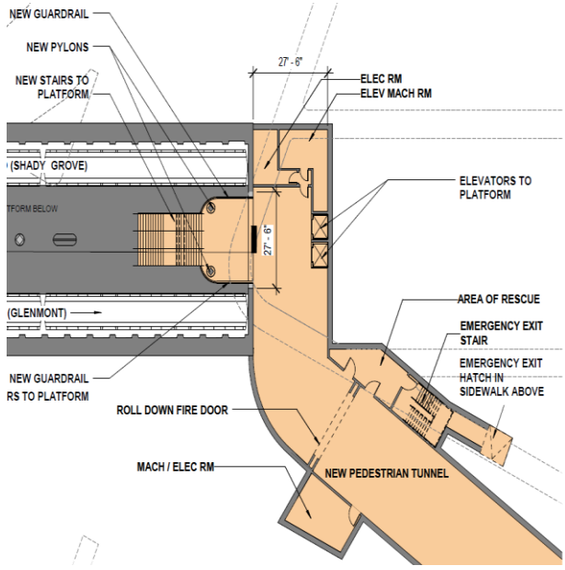


I. Farragut North/West Tunnel Connection

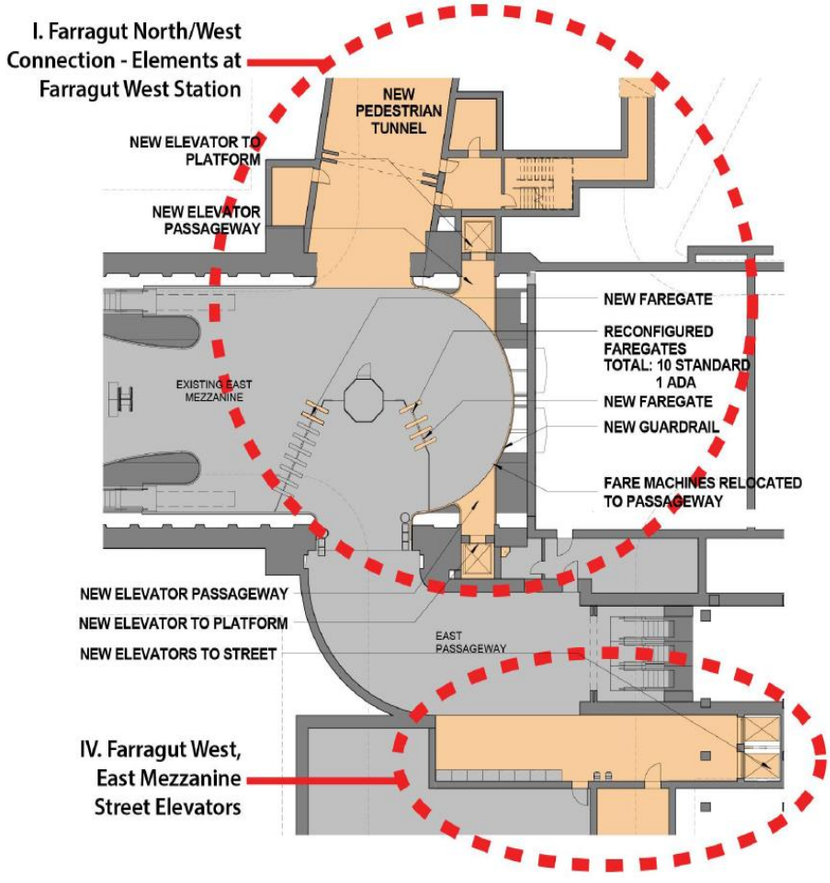
Farragut North Station- A small mezzanine level, 2# hydraulic elevators from mezzanine level to platform level including stairs, electric room & elevator machine room. Farragut West Station - 2# hydraulic elevator from mezzanine level to platform (both sides of mezzanine), new & reconfigured faregates, relocation of exit fare machines, guardrails, new water basin, relocated water service, and emergency egress stairs with hatch in the sidewalk. In this option a new pedestrian tunnel is required to connect the North Farragut Station to the West Farragut station. Included with the tunnel is new roll down fire door at each end, area of rescue, emergency exit stair with exit hatch in the sidewalk and associated MEP systems.

INCLUSIONS

Farragut North station with new platform stairs and two elevators to the partial pedestrian tunnel connection



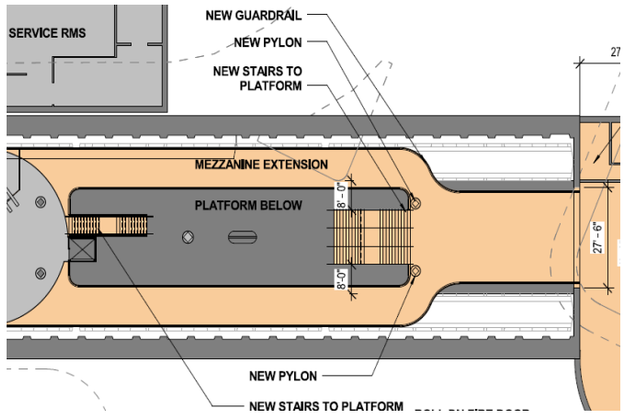
Farragut West station and partial pedestrian tunnel connection



INCLUSIONS

I. Farragut North/West Tunnel Connection - Option 2 Farragut North with Larger Mezzanine Extension

This is similar to Option 1 above except that at the Farragut North Station- A larger mezzanine extension connecting the tunnel entrance to the south mezzanine with stairs, guardrail & pylon is required.



II. Farragut North Center Mezzanine Improvements - New Stairs and Elevator from Center Mezzanine to platform

A relocation of an existing Kiosk, vending machines & fare gates (7# existing standard faregates, 1# existing ADA faregate and 2# new standard faregates) and associated infrastructure work.

III. Farragut North South Mezzanine Improvements - New Stairs from South Mezzanine

A new hydraulic elevator and relocated elevator form mezzanine level to street level and new elevator passageway. Also included is a new stair from the mezzanine level to the platform level.

IV. Farragut West East Mezzanine Street Elevators

2# hydraulic elevators from mezzanine level to street level including new elevator passageway & elevator machine room and associated infrastructure work.

V. Farragut West Additional Platform Escalators

A new West Mezzanine extension and two escalators to westbound and eastbound platforms. A new East Mezzanine extension and two escalators to westbound and eastbound platforms.

Bidding Process - Market Conditions

This document is based on the measurement and pricing of quantities wherever information is provided and/or reasonable assumptions for other work not covered in the drawings or specifications, as stated within this document. Unit rates have been obtained from historical records and/or discussion with contractors. The unit rates reflect current bid costs in the area. All unit rates relevant to subcontractor work include the subcontractors overhead and profit unless otherwise stated. The mark-ups cover the costs of field overhead, home office overhead and profit and range from 10% to 20% of the cost for a particular item of work.

Pricing reflects probable construction costs obtainable in the project locality on the date of this statement of probable costs. This estimate is a determination of fair market value for the construction of this project. It is not a prediction of low bid. Pricing assumes competitive bidding for every portion of the construction work for all subcontractors and general contractors, with a minimum of 5 bidders for all items of work. Experience and research indicates that a fewer number of bidders may result in higher bids, conversely an increased number of bidders may result in more competitive bids.

Since AECOM has no control over the cost of labor, material, equipment, or over the contractor's method of determining prices, or over the competitive bidding or market conditions at the time of bid, the statement of probable construction cost is based on industry practice, professional experience and qualifications, and represents AECOM's best judgment as professional construction consultant familiar with the construction industry. However, AECOM cannot and does not guarantee that the proposals, bids, or the construction cost will not vary from opinions of probable cost prepared by them.

EXCLUSIONS

- Owner supplied and installed furniture, fixtures and equipment - except as specifically identified
- Loose furniture and equipment except as specifically identified
- Security equipment and devices except as specifically identified
- Audio visual equipment
- Hazardous material handling, disposal and abatement
- Testing & inspection
- Assessments, taxes, finance, legal and development charges
- Environmental impact mitigation
- Builder's risk, project wrap-up and other owner provided insurance program
- Land and easement acquisition

CLARIFICATIONS and DEFINITIONS*

**It is anticipated that the project will be a Design & Build contract with a Construction Manager.*

Hard Construction

Design Contingency (item #22)

Design Contingency is an allowance for future design development, which alter the cost of the building as the design progresses, this percentage reduces as the design develops. It is based on a percentage of the sum of Sub-Total Construction, General Conditions and Requirements, Bond & Insurance and Building Permit.

Construction Management Fee (item #23)

Costs associated with general coordination of design reviews, meetings management, quality assurance, quality control, scheduling, financial close-out, and monitoring the project. Assume a 7% allocation.

Escalation (item #24)

Escalation is included to allow for market/price fluctuations and is escalated to the mid-point of construction @ 3% per annum.

Soft Costs

Design and Engineering (item #25)

The costs associated with the design and engineering services to include drawings, specifications, change orders and other design documentation. (Including A&E bridge documents and CM completion of design) Assume a 15% allocation.

Design Management (item #26)

Design support and oversight from WMATA to include review of all drawings, specifications and construction documents as they are developed by A/E during Schematic Design, Design Development, and Construction Documents design phases of the project, as well as meetings, town hall meetings, scheduling and overall general coordination of A/E. Assume a 15% allocation.

Construction Support (item #27)

A general term for construction coordination and support for WMATA during construction to include; project management, site inspector(s), safety, scheduling, operation & maintenance manuals, contract administration, etc. Assume a 20% allocation.

OVERALL SUMMARY COMPARISON - ORDER OF MAGNITUDE COSTS

Item	Description		*I. Farragut North/West Tunnel Connection		II. Farragut North, Center Mezzanine Improvements	III. Farragut North, South Mezzanine Improvements	IV. Farragut West, East Mezzanine Street Elevators	V. Farragut West, Additional Platform Escalators
			Option 1, no FN Mezzanine Extension	Option 2, with FN Mezzanine Extension				
1	*DEMOLITION/RE-ROUTING & RE-BUILDING - ALLOW*		$1,267,667	$1,299,057	$115,961	$360,899	$455,327	$290,852
2	*EARTHWORK & FOUNDATION*		$3,232,222	$3,329,364	$13,749	$532,301	$979,036	$97,738
3	*UTLILITY IMPACTS/REROUTING*		Included w/item 1	Included w/item 1	Included w/item 1	Included w/item 1	Included w/item 1	Included w/item 1
4	*ELEVATOR SHAFT*		$431,792	$425,676	$236,694	$268,858	$90,503	$133,213
5	*TUNNEL*		$6,302,653	$6,312,059	not required	$509,606	$595,133	not required
6	*MEZZANINE FLOOR CONSTRUCTION*		404,384	1,157,174	not required	not required	$0	$615,324
7	*NEW ENTRANCE ROOF STRUCTURE*		$0		not required	$43,409	$139,213	not required
8	*STANDARD WMATA ELEVATORS*		$2,200,000	$2,200,000	$550,000	$1,100,000	$1,100,000	not required
9	*STANDARD WMATA STANDARD ESCALATOR*		$0	$0	$0	$0	$0	$1,400,000
10	*INTERIOR BUILD-OUT*		$2,144,491	$2,313,706	$1,307,963	$146,216	$412,392	$303,903
11	*MECHANICAL*		4,945,000	4,945,000	$0	$1,048,125	$1,827,500	$1,935,000
12	*ELECTRICAL*		2,633,750	2,633,750	$752,500	$591,250	$645,000	$967,500
13	*COST TO REPLACE EXISTING ELEVATOR FOR NEW ELEVATOR*		not required	not required	not required	not required	not required	not required
14	*COST TO REFURBISH EXISTING ELEVATOR*		not required	not required	not required	not required	not required	not required
15	*ELEVATOR DOWN TIME (costs of WMATA bus-bridge)*		not required	not required	not required	not required	not required	not required
16	*EXTERIOR WORK*		$242,399	$242,399	not required	$228,169	$219,515	not required
17	*LABOR COSTS*		included above	included above	included above	included above	included above	included above
18	*PHASING REQUIREMENT*		$1,190,218	$1,219,659	$148,843	$241,442	$323,181	$287,177
SUB-TOTAL CONSTRUCTION			**$24,994,576**	**$26,077,845**	**$3,125,710**	**$5,070,274**	**$6,786,800**	**$6,030,707**
Markups								
	General Conditions							
19	General conditions and project requirements	15.0%	$3,749,186	$3,911,677	$468,857	$760,541	$1,018,020	$904,606
20	Bond and Insurance	3.0%	$862,313	$899,686	$107,837	$174,924	$234,145	$208,059
21	Building Permit	1.5%	$444,091	$463,338	$55,536	$90,086	$120,584	$107,151
PLANNED CONSTRUCTION COST			**$30,050,166**	**$31,352,546**	**$3,757,940**	**$6,095,826**	**$8,159,549**	**$7,250,522**
Contingencies/Escalation								
	Contingencies							
22	Design Contingency	20.0%	$6,010,033	$6,270,509	$751,588	$1,219,165	$1,631,910	$1,450,104
23	Construction Management Fee	7.0%	$2,524,214	$2,633,614	$315,667	$512,049	$685,402	$609,044
	Escalation							
24	Escalation to mid-point construction (3Q2021)	21.2%	$8,179,896	$8,534,414	$1,022,941	$1,659,332	$2,221,094	$1,973,650
ESTIMATED CONTRACT AWARD (Hard Costs)			**$46,764,309**	**$48,791,082**	**$5,848,136**	**$9,486,372**	**$12,697,955**	**$11,283,320**
Soft Costs								
25	*Design + Engineering*	15.0%	$7,014,646	$7,318,662	$877,220	$1,422,956	$1,904,693	$1,692,498
26	*Design Management*	15.0%	$7,014,646	$7,318,662	$877,220	$1,422,956	$1,904,693	$1,692,498
27	*Construction Support*	20.0%	$9,352,862	$9,758,216	$1,169,627	$1,897,274	$2,539,591	$2,256,664
ESTIMATED CONTRACT AWARD (Hard & Soft Costs)			**$70,146,463**	**$73,186,622**	**$8,772,204**	**$14,229,558**	**$19,046,932**	**$16,924,980**
28	*ESCORT ALLOWANCE included with Construction Support*		included above	included above	included above	included above	included above	included above
ESTIMATED CONTRACT AWARD (Hard, Soft and Escort Costs)			**$70,146,463**	**$73,186,622**	**$8,772,204**	**$14,229,558**	**$19,046,932**	**$16,924,980**

**I. Farragut North/West tunnel connection Options 1 and 2 costs listed above exclude IV. Farragut West east mezzanine street elevator costs.*

I. Tunnel connnection Option 1 and IV. Farragut West combined* **$89,193,394

I. Tunnel connection Option 2 and IV. Farragut West combined* **$92,233,554

I. Farragut North/West Connection, Option 1

	Quantity	Unit	Rate	Total
DEMOLITION/RE-ROUTING & RE-BUILDING - ALLOW				
Allow for the following:-				
Allow for re-routing of stormwater/sewer drainage, including piping, manholes, etc	1	LS	200,000.00	200,000
Allow for re-routing of electrical cabling, including conduit, electrical manholes, site lighting etc, complete	1	LS	150,000.00	150,000
Allow for re-routing of water utility piping, including piping, manholes, etc	1	LS	100,000.00	100,000
Demolition of hardscape/softscape at grade	1	LS	150,000.00	150,000
Rock exacavation, as need	1	LS	75,000.00	75,000
De-watering, allow	1	LS	75,000.00	75,000
Protection of existing utility runs, allow	1	LS	150,000.00	150,000
Miscellaneous demolition	1	LS	30,000.00	30,000
Knock out panel for future transfer tunnel - Allow for cutting and removal of existing rail tunnel wall (two locations North & West)	1	LS	100,000.00	100,000
Form new opening for new Elevator shaft @ North Farragut station - mezzanine level & platform level, complete	1	EA	58,440.00	58,440
Form new wall opening for new elevator @ Farragut West mezzanine & platform level, complete	2	EA	22,040.00	44,080
Remove existing parapet wall w/railing for new mezzanine elevator	20	LF	200.00	4,000
Allow for miscellaneous demolition @ North Farragut Station tunnel transition zone platform level & mezzanine level	2,847	SF	15.00	42,705
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	88,441.88	88,442
				$1,267,667
EARTHWORK & FOUNDATION				
New pedestrian tunnel - approximately 370' long				
Excavation (open cut)	10,874	CY	75.00	815,550
Backfill around tunnel walls with gravel	6,078	CY	50.00	303,885
Remove excavated material off site	4,796	CY	100.00	479,630
Support of excavation - soldier pile and lagging				not required
Support of excavation - shoring	18,078	SF	45.00	813,510
Allow for underpinning of adjacent structure	1	LS	250,000.00	250,000
North Farragut Expansion for new emergency egress stair/hatch				
Excavation (open cut)	717	CY	75.00	53,794
Backfill around tunnel walls with gravel	437	CY	50.00	21,830
Remove excavated material off site	281	CY	100.00	28,067
West Farragut Expansion for new emergency egress stair/hatch & machine room				
Excavation (open cut)	1,154	CY	75.00	86,569
Backfill around tunnel walls with gravel	703	CY	50.00	35,130
Remove excavated material off site	452	CY	100.00	45,167
Shaft wall earthwork - North Farragut				
Excavation	36	CY	75.00	2,689

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 1				
Backfill with gravel	27	CY	50.00	1,326
Remove excavated material off site	9	CY	100.00	933
Support of excavation - Shoring	264	SF	45.00	11,880
Shaft wall earthwork - West Farragut (2# locations)				
Excavation	76	CY	75.00	5,689
Backfill with gravel	55	CY	50.00	2,726
Remove excavated material off site	21	CY	100.00	2,133
Support of excavation - Shoring	512	SF	45.00	23,040
Escalator pit				not required
Excavation				
Backfill with gravel				
Remove excavated material off site				
Support of excavation - Shoring				
Column base earthwork - North Farragut				
Excavation	30	CY	75.00	2,222
Backfill with gravel	24	CY	50.00	1,215
Remove excavated material off site	5	CY	100.00	533
Support of excavation - Shoring	320	SF	60.00	19,200
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	225,503.85	225,504
				$3,232,222
UTLILITY IMPACTS/REROUTING				
Utility impacts/rerouting				incl w/Demolition/Re-routing section
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
ELEVATOR SHAFT				
Shaft - North Farragut				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	100	SF	40.00	4,000
Reinforcement in slab	1,867	LB	2.00	3,733
Concrete in slab	9	CY	320.75	2,994
Formwork to pit walls	400	SF	40.00	16,000
Reinforcement	5,185	LB	2.00	10,370
Concrete in pit walls	15	CY	320.75	4,752
Glazed aluminum framed walls	448	SF	200.00	89,600
18"CMU in shaft walls				not required
Cementitious waterproofing to elevator pit	326	SF	25.00	8,150
Shaft - West Farragut (2# locations)				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	192	SF	40.00	7,680
Reinforcement in slab	4,267	LB	2.00	8,533
Concrete in slab	21	CY	320.75	6,843
Formwork to pit walls	768	SF	40.00	30,720
Reinforcement	9,956	LB	2.00	19,911

	Quantity	Unit	Rate	Total
I. Farragut North/West Connection, Option 1				
Concrete in pit walls	28	CY	320.75	9,124
Glazed aluminum framed walls	672	SF	200.00	134,400
18"CMU in shaft walls - east bound elevator	336	SF	45.00	15,120
Cementitious waterproofing to elevator pit	672	SF	25.00	16,800
Miscellaneous concrete costs - premium for pump grade concrete mix and pump	74	CY	175.00	12,937
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	30,125.03	30,125
				$431,792
TUNNEL CONSTRUCTION				
Tunnel Size approximately 23'-2" W x 14' H x 370' L				
Matt Slab				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	2,023	SF	30.00	60,675
Reinforcement in slab	236,389	LBS	2.00	472,778
Concrete in slab, assume 30" thick	1,182	CY	320.75	379,109
Damproof membrane	12,765	SF	7.00	89,355
Concrete walls				
Concrete walls	671	CY	320.75	215,223
Reinforcements	201,300	LBS	2.00	402,600
Formwork	10,360	SF	40.00	414,400
Precast roof				
Steel beams and girders	137	TNS	4,500.00	616,050
Precast unit slabs with voids	13,690	SF	75.00	1,026,750
Waterproofing	13,690	SF	5.00	68,450
North Farragut Expansion for new emergency egress stair/hatch				
Matt Slab				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	418	SF	40.00	16,700
Reinforcement in slab	15,593	LBS	2.00	31,185
Concrete in slab, assume 30" thick	78	CY	320.75	25,007
Damproof membrane	842	SF	7.00	5,894
Concrete walls				
Concrete walls	130	CY	320.75	41,662
Reinforcements	38,967	LBS	2.00	77,933
Formwork	4,676	SF	40.00	187,040
Precast roof				
Steel beams and girders	9	TONS	4,500.00	40,921
Precast unit slabs with voids	842	SF	75.00	63,150
Waterproofing	842	SF	5.00	4,210
West Farragut Expansion for new emergency egress stair/hatch & machine room				
Matt Slab				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	730	SF	40.00	29,200

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 1				
Reinforcement in slab	25,093	LBS	2.00	50,185
Concrete in slab, assume 30" thick	125	CY	320.75	40,242
Damproof membrane	1,355	SF	7.00	9,485
Concrete walls				
Concrete walls	178	CY	320.75	57,129
Reinforcements	53,433	LBS	2.00	106,867
Formwork	6,412	SF	40.00	256,480
Precast roof				
Steel beams and girders	15	TONS	4,500.00	65,853
Precast unit slabs with voids	1,355	SF	75.00	101,625
Waterproofing	1,355	SF	5.00	6,775
Allowance for hoisting including rental, mobilization and demobilization	1	LS	500,000.00	500,000
Allow for tunnel connection to new mezzanine level @ North and West Farragut Station	2	EA	200,000.00	400,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	439,719.99	439,720
				$6,302,653
MEZZANINE FLOOR CONSTRUCTION				
Column - N Farragut				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to pad edge	192	SF	40.00	7,680
Reinforcement in pad	1,333	LB	2.00	2,667
Concrete in pad	5	CY	200.00	1,067
Steel Column	2	TON	4,500.00	10,157
Fire proofing	2	TON	200.00	451
Column - W Farragut				not required
Mezzanine Floor Slab - N Farragut				
Steel beams and girders	5	TON	4,500.00	22,599
Precast unit slab	465	SF	50.00	23,250
Parapet wall - 36" high w/railing @ cap	44	LF	300.00	13,200
Mezzanine Floor Slab - W Farragut @ new elevator passageway two levels (2# locations)				
Steel beams and girders	5	TON	4,500.00	21,967
Precast unit slab	452	SF	50.00	22,600
Parapet wall - 36" high w/railing @ cap		LF	150.00	not required
Allowance for hoisting including mobilization and demobilization	1	LS	250,000.00	250,000
Miscellaneous concrete costs - premium for pump grade concrete mix and pump	5	CY	100.00	533
Miscellaneous				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	28,212.84	28,213
				$404,384

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 1				
NEW ENTRANCE ROOF STRUCTURE				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				not required
				$0
STANDARD WMATA ELEVATORS				
Standard WMATA Elevators (Grade to mezzanine)		EA	550,000.00	not required
Standard WMATA Elevators (mezzanine to platform)				
N Farragut	2	EA	550,000.00	1,100,000
W Farragut	2	EA	550,000.00	1,100,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$2,200,000
STANDARD WMATA STANDARD ESCALATOR				
Standard WMATA Escalators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
INTERIOR BUILD-OUT				
Guardrail along tunnel both sides	740	LF	110.00	81,400
Roll down fire doors North & West entrances including power	2	EA	50,000.00	100,000
Finishing - ceiling/floor				
Tunnel	8,510	SF	45.00	382,950
Tunnel - North Farragut Expansion - Emergency hatch	842	SF	45.00	37,890
Tunnel - West Farragut Expansion - emergency hatch etc.	1,355	SF	45.00	60,975
N.Farragut New & Existing Mezzanine & Platform	3,312	SF	45.00	149,040
Mezzanine W.Farragut Elevator passageway	452	SF	45.00	20,340
Premium for work to new intake incl metal grate at grade level - allow	1	LS		not required
18" CMU wall				
Tunnel - West Farragut Expansion - emergency hatch etc.	196	SF	45.00	8,820
12" CMU wall				
Tunnel - North Farragut Expansion - Emergency hatch	1,414	SF	35.00	49,490
Tunnel - West Farragut Expansion - emergency hatch etc.	168	SF	35.00	5,880
N.Farragut existing mezzanine level	854	SF	35.00	29,890
18" Concrete walls		SF	65.00	not required
Specialized equipment provided by WMATA				
Fare gate (2# standard)	2	EA	75,000.00	150,000
Carefully remove, store & reinstall existing fare gate, complete - allow (1# ADA)	1	EA	25,000.00	25,000
Carefully remove, store & reinstall existing exit fare machines, complete - allow	4	EA	150,000.00	600,000

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 1				
Fare gate collection system		LS	1,300,000.00	not required
Kiosk including structure, electrical and mechanical and installation		EA	500,000.00	not required
Exit Stair North & West Tunnel	2	FLT	14,000.00	28,000
Emergency exit hatch in sidewalk North & west Tunnel including metal grate	2	EA	25,000.00	50,000
Mezzanine to platform stairs N.Farragut includes handrails complete -triple 15' wide	1	FLT	30,000.00	30,000
Mezzanine to platform stairs N.Farragut includes handrails complete - single	1	FLT	10,000.00	10,000
Pylon structure @ mezzanine level Farragut North includes ductwork & enclosure complete - confirm rate with WMATA	2	EA	25,000.00	50,000
Escalator stairs from grade to mezzanine		FLT	15,000.00	not required
Double leaf metal door		EA	2,800.00	not required
Single leaf metal door				
Tunnel N & W Expansion	9	EA	2,100.00	18,900
N.Farragut existing mezzanine level	3	EA	2,100.00	6,300
W.Farragut				not required
Allow for miscellaneous interior work	1	LS	100,000.00	100,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	149,615.63	149,616
				$2,144,491
MECHANICAL				
Plumbing and Drainage	1	LS	1,050,000.00	$1,050,000
Fire Protection	1	LS	750,000.00	$750,000
HVAC	1	LS	2,800,000.00	$2,800,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	345,000.00	345,000
				$4,945,000
ELECTRICAL				
Electrical - allow	1	LS	2,250,000.00	$2,250,000
500Kw generator allowance				not required
Security and communication allowance	1	LS	200,000.00	$200,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	183,750.00	183,750
				$2,633,750
COST TO REPLACE EXISTING ELEVATOR FOR NEW ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 1				
COST TO REFURBISH EXISTING ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	0.00	
				$0
ELEVATOR DOWN TIME (costs of WMATA bus-bridge)				
WMATA bus bridge - allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
EXTERIOR WORK				
Hard & soft scape work including site improvements above tunnel location - allow	1	LS	197,580.00	197,580
Carefully remove, store, remove off site and install new tree, complete	4	EA	7,500.00	30,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	14,818.50	14,819
				$242,399
SUB TOTAL				**23,804,358**
PHASING REQUIREMENT				
It is anticipated that phasing will be required to ensure that the metro station remains operational as much as possible. A 5% phasing allowance is	1	LS	1,190,217.92	1,190,218
SUB TOTAL Including phasing requirement				**24,994,576**

I. Farragut North/West Connection, Option 2

	Quantity	Unit	Rate	Total
DEMOLITION/RE-ROUTING & RE-BUILDING - ALLOW				
Allow for the following:-				
Allow for re-routing of stormwater/sewer drainage, including piping, manholes, etc	1	LS	200,000.00	200,000
Allow for re-routing of electrical cabling, including conduit, electrical manholes, site lighting etc, complete	1	LS	150,000.00	150,000
Allow for re-routing of water utility piping, including piping, manholes, etc	1	LS	100,000.00	100,000
Demolition of hardscape/softscape at grade	1	LS	150,000.00	150,000
Rock exacavation, as need	1	LS	75,000.00	75,000
De-watering, allow	1	LS	75,000.00	75,000
Protection of existing utility runs, allow	1	LS	150,000.00	150,000
Miscellaneous demolition	1	LS	30,000.00	30,000
Knock out panel for future transfer tunnel - Allow for cutting and removal of existing rail tunnel wall (two locations North & West)	1	LS	100,000.00	100,000
Form new opening for new Elevator shaft @ North Farragut station - mezzanine level & platform level, complete	1	EA	58,440.00	58,440
Form new wall opening for new elevator @ Farragut West mezzanine & platform level, complete	2	EA	22,040.00	44,080
Allow for miscellaneous demolition @ North Farragut Station tunnel transition zone platform level & mezzanine level	2,847	SF	15.00	42,705
Remove existing parapet wall w/railing @ existing mezzanine, level	71	LF	200.00	14,200
Remove existing parapet wall w/railing for new mezzanine elevator	20	LF	200.00	4,000
Protect existing elevator shaft from existing mezzanine to platform level, allow complete	1	LS	15,000.00	15,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	90,631.88	90,632
				$1,299,057
EARTHWORK & FOUNDATION				
New pedestrian tunnel - approximately 370' long				
Excavation (open cut)	10,874	CY	75.00	815,550
Backfill around tunnel walls with gravel	6,078	CY	50.00	303,885
Remove excavated material off site	4,796	CY	100.00	479,630
Support of excavation - soldier pile and lagging				not required
Support of excavation - shoring	18,078	SF	45.00	813,510
Allow for underpinning of adjacent structure	1	LS	250,000.00	250,000
North Farragut Expansion for new emergency egress stair/hatch				
Excavation (open cut)	717	CY	75.00	53,794
Backfill around tunnel walls with gravel	437	CY	50.00	21,830
Remove excavated material off site	281	CY	100.00	28,067
West Farragut Expansion for new emergency egress stair/hatch & machine room				
Excavation (open cut)	1,154	CY	75.00	86,569
Backfill around tunnel walls with gravel	703	CY	50.00	35,130

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 2				
Remove excavated material off site	452	CY	100.00	45,167
Shaft wall earthwork - North Farragut				
Excavation	36	CY	75.00	2,689
Backfill with gravel	27	CY	50.00	1,326
Remove excavated material off site	9	CY	100.00	933
Support of excavation - Shoring	264	SF	45.00	11,880
Shaft wall earthwork - West Farragut (2# locations)				
Excavation	76	CY	75.00	5,689
Backfill with gravel	55	CY	50.00	2,726
Remove excavated material off site	21	CY	100.00	2,133
Support of excavation - Shoring	512	SF	45.00	23,040
Escalator pit				not required
Excavation				
Backfill with gravel				
Remove excavated material off site				
Support of excavation - Shoring				
Column base earthwork - North Farragut				
Excavation	145	CY	75.00	10,889
Backfill with gravel	119	CY	50.00	5,953
Remove excavated material off site	26	CY	100.00	2,613
Support of excavation - Shoring	1,568	SF	60.00	94,080
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	232,281.23	232,281
				$3,329,364
UTLILITY IMPACTS/REROUTING				
Utility impacts/rerouting				incl w/Demolition/Re-routing section
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
ELEVATOR SHAFT				
Shaft - North Farragut				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	100	SF	40.00	4,000
Reinforcement in slab	1,867	LB	2.00	3,733
Concrete in slab	9	CY	320.75	2,994
Formwork to pit walls	400	SF	40.00	16,000
Reinforcement	5,185	LB	2.00	10,370
Concrete in pit walls	15	CY	320.75	4,752
Glazed aluminum framed walls	448	SF	200.00	89,600
18"CMU in shaft walls				not required
Cementitious waterproofing to elevator pit	326	SF	25.00	8,150
Shaft - West Farragut (2# locations)				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	192	SF	40.00	7,680
Reinforcement in slab	4,267	LB	2.00	8,533

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 2				
Concrete in slab	21	CY	320.75	6,843
Formwork to pit walls	768	SF	40.00	30,720
Reinforcement	9,956	LB	2.00	19,911
Concrete in pit walls	28	CY	120.75	3,435
Glazed aluminum framed walls	672	SF	200.00	134,400
18"CMU in shaft walls - east bound elevator	336	SF	45.00	15,120
Cementitious waterproofing to elevator pit	672	SF	25.00	16,800
Miscellaneous concrete costs - premium for pump grade concrete mix and pump	74	CY	175.00	12,937
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	29,698.35	29,698
				$425,676
TUNNEL CONSTRUCTION				
Tunnel Size approximately 23'-2" W x 14' H x 370' L				
Matt Slab				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	2,023	SF	40.00	80,900
Reinforcement in slab	236,389	LBS	2.00	472,778
Concrete in slab, assume 30" thick	1,182	CY	320.75	379,109
Damproof membrane	12,765	SF	7.00	89,355
Concrete walls				
Concrete walls	671	CY	320.75	215,223
Reinforcements	201,300	LBS	2.00	402,600
Formwork	10,360	SF	40.00	414,400
Precast roof				
Steel beams and girders	137	TNS	4,500.00	616,050
Precast unit slabs with voids	13,690	SF	75.00	1,026,750
Waterproofing	13,690	SF	5.00	68,450
North Farragut Expansion for new emergency egress stair/hatch				
Matt Slab				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	418	SF	30.00	12,525
Reinforcement in slab	15,593	LBS	2.00	31,185
Concrete in slab, assume 30" thick	78	CY	320.75	25,007
Damproof membrane	842	SF	7.00	5,894
Concrete walls				
Concrete walls	130	CY	320.75	41,662
Reinforcements	38,967	LBS	2.00	77,933
Formwork	4,676	SF	40.00	187,040
Precast roof				
Steel beams and girders	9	TONS	4,500.00	40,921
Precast unit slabs with voids	842	SF	75.00	63,150
Waterproofing	842	SF	5.00	4,210
West Farragut Expansion for new emergency egress stair/hatch & machine room				
Matt Slab				
Excavation				incl above

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 2				
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	730	SF	30.00	21,900
Reinforcement in slab	25,093	LBS	2.00	50,185
Concrete in slab, assume 30" thick	125	CY	320.75	40,242
Damproof membrane	1,355	SF	7.00	9,485
Concrete walls				
Concrete walls	178	CY	320.75	57,129
Reinforcements	53,433	LBS	2.00	106,867
Formwork	6,412	SF	40.00	256,480
Precast roof				
Steel beams and girders	15	TONS	4,500.00	65,853
Precast unit slabs with voids	1,355	SF	75.00	101,625
Waterproofing	1,355	SF	5.00	6,775
Allowance for hoisting including rental, mobilization and demobilization	1	LS	500,000.00	500,000
Allow for tunnel connection to new mezzanine level @ North and West Farragut Station	2	EA	200,000.00	400,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	440,376.24	440,376
				$6,312,059

MEZZANINE FLOOR CONSTRUCTION

Column - N Farragut				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to pad edge	941	SF	40.00	37,632
Reinforcement in pad	6,533	LB	2.00	13,067
Concrete in pad	26	CY	200.00	5,227
Steel Column	11	TON	4,500.00	49,771
Fire proofing	11	TON	200.00	2,212
Column - W Farragut				not required
Mezzanine Floor Slab - N Farragut				
Steel beams and girders	43	TON	4,500.00	192,602
Precast unit slab	3,963	SF	50.00	198,150
Parapet wall - 36" high w/railing @ cap	602	LF	300.00	180,600
Mezzanine Floor Slab - W Farragut @ new elevator passageway two levels				
Steel beams and girders	5	TON	4,500.00	21,967
Precast unit slab	452	SF	50.00	22,600
Parapet wall - 36" high w/railing @ cap		LF	150.00	not required
Allowance for hoisting including mobilization and demobilization	1	LS	350,000.00	350,000
Miscellaneous concrete costs - premium for pump grade concrete mix and pump	26	CY	100.00	2,613
Miscellaneous				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	80,733.08	80,733
				$1,157,174

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 2				
NEW ENTRANCE ROOF STRUCTURE				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
STANDARD WMATA ELEVATORS				
Standard WMATA Elevators (Grade to mezzanine)		EA	550,000.00	not required
Standard WMATA Elevators (mezzanine to platform)				
N Farragut	2	EA	550,000.00	1,100,000
W Farragut	2	EA	550,000.00	1,100,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$2,200,000
STANDARD WMATA STANDARD ESCALATOR				
Standard WMATA Escalators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
INTERIOR BUILD-OUT				
Guardrail along tunnel both sides	740	LF	110.00	81,400
Roll down fire doors North & West entrances including power	2	EA	50,000.00	100,000
Finishing - ceiling/floor				
Tunnel	8,510	SF	45.00	382,950
Tunnel - North Farragut Expansion - Emergency hatch	842	SF	45.00	37,890
Tunnel - West Farragut Expansion - emergency hatch etc.	1,355	SF	45.00	60,975
N.Farragut New & Existing Mezzanine & Platform	6,810	SF	45.00	306,450
Mezzanine W.Farragut Elevator passageway	452	SF	45.00	20,340
Premium for work to new intake incl metal grate at grade level - allow	1	LS		not required
18" CMU wall		SF	45.00	not required
Tunnel - West Farragut Expansion - emergency hatch etc.	196	SF	45.00	8,820
12" CMU wall				
Tunnel - North Farragut Expansion - Emergency hatch	1,414	SF	35.00	49,490
Tunnel - West Farragut Expansion - emergency hatch etc.	168	SF	35.00	5,880
N.Farragut existing mezzanine level	854	SF	35.00	29,890
18" Concrete walls		SF	65.00	not required
Specialized equipment provided by WMATA				
Fare gate (2# standard)	2	EA	75,000.00	150,000
Carefully remove, store & reinstall existing fare gate, complete - allow (1# ADA)	1	EA	25,000.00	25,000
Carefully remove, store & reinstall existing exit fare machines, complete - allow	4	EA	150,000.00	600,000

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 2				
Fare gate collection system		LS	1,300,000.00	not required
Kiosk including structure, electrical and mechanical and installation		EA	500,000.00	not required
Exit Stair North & West Tunnel	2	FLT	14,000.00	28,000
Emergency exit hatch in sidewalk North & west Tunnel including metal grate	2	EA	25,000.00	50,000
Mezzanine to platform stairs N.Farragut includes handrails complete -triple 15' wide	1	FLT	30,000.00	30,000
Mezzanine to platform stairs N.Farragut includes handrails complete - single	1	FLT	10,000.00	10,000
Pylon structure @ mezzanine level Farragut North includes ductwork & enclosure complete - confirm rate with WMATA	2	EA	25,000.00	50,000
Escalator stairs from grade to mezzanine		FLT	30,000.00	not required
Double leaf metal door		EA	2,800.00	not required
Single leaf metal door				
Tunnel N & W Expansion	9	EA	2,100.00	18,900
N.Farragut existing mezzanine level	3	EA	2,100.00	6,300
W.Farragut				not required
Allow for miscellaneous interior work	1	LS	100,000.00	100,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	161,421.38	161,421
				$2,313,706
MECHANICAL				
Plumbing and Drainage	1	LS	1,050,000.00	$1,050,000
Fire Protection	1	LS	750,000.00	$750,000
HVAC	1	LS	2,800,000.00	$2,800,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	345,000.00	345,000
				$4,945,000
ELECTRICAL				
Electrical - allow	1	LS	2,250,000.00	$2,250,000
500Kw generator allowance				not required
Security and communication allowance	1	LS	200,000.00	$200,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	183,750.00	183,750
				$2,633,750
COST TO REPLACE EXISTING ELEVATOR FOR NEW ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0

	Quantity	*Unit*	*Rate*	*Total*
I. Farragut North/West Connection, Option 2				
COST TO REFURBISH EXISTING ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	0.00	
				$0
ELEVATOR DOWN TIME (costs of WMATA bus-bridge)				
WMATA bus bridge - allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
EXTERIOR WORK				
Hard & soft scape work including site improvements above tunnel location - allow	1	LS	197,580.00	197,580
Carefully remove, store, remove off site and install new tree, complete	4	EA	7,500.00	30,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	14,818.50	14,819
				$242,399
SUB TOTAL				**24,393,185**
PHASING REQUIREMENT				
It is anticipated that phasing will be required to ensure that the metro station remains operational as much as possible. A 5% phasing allowance is	1	LS	1,219,659.27	1,219,659
SUB TOTAL Including phasing requirement				**25,612,845**

	Quantity	*Unit*	*Rate*	*Total*
II. Farragut North, Center Mezzanine Improvements				
DEMOLITION/RE-ROUTING & RE-BUILDING - ALLOW				
Allow for the following:-				
Allow for re-routing of stormwater/sewer drainage, including piping, manholes, etc	1	LS	15,000.00	15,000
Allow for re-routing of electrical cabling, including conduit, electrical manholes, site lighting etc, complete	1	LS	25,000.00	25,000
Allow for re-routing of water utility piping , including piping, manholes, etc	1	LS	10,000.00	10,000
Rock exacavation, as need				not required
De-watering, allow				not required
Protection of existing utility runs allow	1	LS	15,000.00	15,000
Miscellaneous demolition	1	LS	10,000.00	10,000
Form new opening for new Elevator shaft @ North Farragut station - mezzanine level & platform level, complete	1	EA	30,080.00	30,080
Remove existing parapet wall w/railing @ existing mezzanine, level	15	LF	200.00	3,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	7,881.00	7,881
				$115,961
EARTHWORK & FOUNDATION				
Shaft wall earthwork - North Farragut				
Excavation	25	CY	75.00	1,878
Backfill with gravel	19	CY	50.00	952
Remove excavated material off site	6	CY	100.00	600
Support of excavation - Shoring	208	SF	45.00	9,360
Escalator pit				not required
Excavation				
Backfill with gravel				
Remove excavated material off site				
Support of excavation - Shoring				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	959.25	959
				$13,749
UTLILITY IMPACTS/REROUTING				
Utility impacts/rerouting				incl w/Demolition/Re-routing section
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				
				$0
ELEVATOR SHAFT				
Shaft - North Farragut				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	72	SF	40.00	2,880

	Quantity	*Unit*	*Rate*	*Total*
II. Farragut North, Center Mezzanine Improvements				
Reinforcement in slab	1,200	LB	2.00	2,400
Concrete in slab	6	CY	320.75	1,925
Formwork to pit walls	288	SF	40.00	11,520
Reinforcement	3,733	LB	2.00	7,467
Concrete in pit walls	11	CY	320.75	3,421
Glazed aluminum framed walls	378	SF	200.00	75,600
18"CMU in shaft walls				not required
Cementitious waterproofing to elevator pit	225	SF	25.00	5,625
Glazed aluminum framed walls	504	SF	200.00	100,800
18"CMU in shaft walls				not required
Cementitious waterproofing to elevator pit	225	SF	25.00	5,625
Miscellaneous concrete costs - premium for pump grade concrete mix and pump	17	CY	175.00	2,917
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	16,513.50	16,514
				$236,694
TUNNEL CONSTRUCTION				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				
				$0
MEZZANINE FLOOR CONSTRUCTITON				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				
				$0
NEW ENTRANCE ROOF STRUCTURE				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				
				$0
STANDARD WMATA ELEVATORS				
Standard WMATA Elevators (Grade to mezzanine)		EA	550,000.00	not required
Standard WMATA Elevators (mezzanine to platform) N Farragut	1	EA	550,000.00	550,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$550,000

	Quantity	*Unit*	*Rate*	*Total*
II. Farragut North, Center Mezzanine Improvements				
STANDARD WMATA STANDARD ESCALATOR				
Standard WMATA Escalators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
INTERIOR BUILD-OUT				
Finishing - ceiling/floor				
N.Farragut existing Mezzanine & Platform level, allov	4,038	SF	45.00	181,710
18'' CMU wall				not required
12'' CMU wall				not required
18'' Concrete walls				not required
Carefully remove, store & reinstall existing exit fare machines, complete - allow	4	EA	150,000.00	600,000
Carefully remove, store & reinstall existing fare gate, complete - allow (7# standard & 1# ADA)	8	EA	25,000.00	200,000
Carefully remove, store & reinstall existing kiosk, complete - allow	1	EA	195,000.00	195,000
Mezzanine to platform stairs N.Farragut includes handrails complete - single	1	FLT	15,000.00	15,000
Allow for miscellaneous interior work	1	LS	25,000.00	25,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	91,253.25	91,253
				$1,307,963
MECHANICAL				
Plumbing and Drainage				assume not required
Fire Protection				assume not required
HVAC				assume not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	0.00	
				$0
ELECTRICAL				
Electrical - allow for adapting & amending	1	LS	600,000.00	$600,000
500Kw generator allowance				not required
Security and communication allowance adapting & amending	1	LS	100,000.00	$100,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	52,500.00	52,500
				$752,500
COST TO REPLACE EXISTING ELEVATOR FOR NEW ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0

	Quantity	*Unit*	*Rate*	*Total*
II. Farragut North, Center Mezzanine Improvements				
COST TO REFURBISH EXISTING ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	0.00	
				$0
ELEVATOR DOWN TIME (costs of WMATA bus-bridge)				
WMATA bus bridge - allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
EXTERIOR WORK				
Exterior work				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
SUB TOTAL				**2,976,867**
PHASING REQUIREMENT				
It is anticipated that phasing will be required to ensure that the metro station remains operational as much as possible. A 5% phasing allowance is included	1	LS	148,843.35	148,843
SUB TOTAL Including phasing requirement				**3,125,710**

III. Farragut North, South Mezzanine Improvements

	Quantity	Unit	Rate	Total
DEMOLITION/RE-ROUTING & RE-BUILDING - ALLOW				
Allow for the following:-				
Allow for re-routing of stormwater/sewer drainage, including piping, manholes, etc	1	LS	50,000.00	50,000
Allow for re-routing of electrical cabling, including conduit, electrical manholes, site lighting etc, complete	1	LS	50,000.00	50,000
Allow for re-routing of water utility piping , including piping, manholes, etc	1	LS	50,000.00	50,000
Demolition of hardscape/softscape at grade	1	LS	50,000.00	50,000
Rock exacavation, as need				assume not required
De-watering, allow	1	LS	15,000.00	15,000
Protection of existing utility runs allow	1	LS	75,000.00	75,000
Miscellaneous demolition	1	LS	25,000.00	25,000
Form new wall opening for new elevator passageway @ Farragut North mezzanine, complete	1	EA	20,720.00	20,720
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	25,179.00	25,179
				$360,899

EARTHWORK & FOUNDATION				
North Farragut Expansion for new elevator passageway & elevator shaft (confined area)				
Excavation (open cut)	398	CY	100.00	39,781
Remove excavated material off site	398	CY	50.00	19,891
Backfill around basement walls with gravel				not required
Support of excavation - sheet piling	2,866	SF	150.00	429,870
Shaft wall earthwork - North Farragut				
Excavation	40	CY	75.00	3,033
Backfill with gravel	29	CY	50.00	1,456
Remove excavated material off site	11	CY	100.00	1,133
Support of excavation - Shoring				included w/sheet piling above
Escalator pit				not required
Excavation				
Backfill with gravel				
Remove excavated material off site				
Support of excavation - Shoring				
Column base earthwork - North Farragut				assume not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	37,137.30	37,137
				$532,301

UTLILITY IMPACTS/REROUTING				
Utility impacts/rerouting				incl w/Demolition/Re-routing section
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				
				$0

	Quantity	*Unit*	*Rate*	*Total*

III. Farragut North, South Mezzanine Improvements

ELEVATOR SHAFT				
Shaft - North Farragut				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	104	SF	50.00	5,200
Reinforcement in slab	2,267	LB	2.00	4,533
Concrete in slab	11	CY	320.75	3,635
Formwork to pit walls	2,394	SF	50.00	119,700
Reinforcement	31,033	LB	2.00	62,067
Concrete in pit walls	89	CY	320.75	28,440
Glazed aluminum framed walls	490		assume at street level only	
Cementitious waterproofing to elevator pit	361	SF	25.00	9,025
Miscellaneous concrete costs - premium for pump grade concrete mix and pump	100	CY	175.00	17,500
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	18,757.50	18,758
				$268,858

TUNNEL CONSTRUCTION				
North Farragut Expansion for new elevator passageway & elevator shaft (confined area)				
Matt Slab				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	223	SF	50.00	11,125
Reinforcement in slab	6,381	LBS	2.00	12,763
Concrete in slab, assume 30" thick	32	CY	320.75	10,234
Damproof membrane	314	SF	7.00	2,198
Concrete walls				
Concrete walls	69	CY	320.75	22,132
Reinforcements	20,700	LBS	2.00	41,400
Formwork	2,484	SF	50.00	124,200
Allowance for hoisting including rental, mobilization and demobilization	1	LS	250,000.00	250,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	35,553.90	35,554
				$509,606

MEZZANINE FLOOR CONSTRUCTITON				
Miscellaneous				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	0.00	
				$0

	Quantity	*Unit*	*Rate*	*Total*
III. Farragut North, South Mezzanine Improvements				
NEW ENTRANCE ROOF STRUCTURE				
Roof to North Farragut Expansion for new elevator passageway & elevator shaft (confined area)				
Precast roof - excluding shaft opening				
Steel beams and girders	3	TNS	4,500.00	15,260
Precast unit slabs with voids	314	SF	75.00	23,550
Waterproofing	314	SF	5.00	1,570
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	3,028.53	3,029
				$43,409
STANDARD WMATA ELEVATORS				
Standard WMATA Elevators (Grade to mezzanine) assume 2# new elevators are required	2	EA	550,000.00	1,100,000
Standard WMATA Elevators (mezzanine to platform)			550,000.00	not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$1,100,000
STANDARD WMATA STANDARD ESCALATOR				
Standard WMATA Escalators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
INTERIOR BUILD-OUT				
Finishing - ceiling/floor				
North Farragut Expansion for new elevator passageway & elevator shaft	467	SF	45.00	21,015
Specialized equipment provided by WMATA				
Fare gate				not required
Fare gate collection system				not required
Kiosk including structure, electrical and mechanical and installation				not required
Mezzanine to platform stairs N.Farragut includes handrails complete - single	1	FLT	15,000.00	15,000
Double leaf metal door				not required
Single leaf metal door				not required
Allow for miscellaneous interior work	1	LS	100,000.00	100,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	10,201.13	10,201
				$146,216

	Quantity	*Unit*	*Rate*	*Total*
III. Farragut North, South Mezzanine Improvements				
MECHANICAL				
Plumbing and Drainage - adapt & amend	1	LS	300,000.00	$300,000
Fire Protection - adapt & amend	1	LS	175,000.00	$175,000
HVAC	1	LS	500,000.00	$500,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	73,125.00	73,125
				$1,048,125
ELECTRICAL				
Electrical - adapt & amend including new power for elevator, complete	1	LS	550,000.00	$550,000
500Kw generator allowance				not required
Security and communication allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	41,250.00	41,250
				$591,250
COST TO REPLACE EXISTING ELEVATOR FOR NEW ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
COST TO REFURBISH EXISTING ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	0.00	
				$0
ELEVATOR DOWN TIME (costs of WMATA bus-bridge)				
WMATA bus bridge - allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
EXTERIOR WORK				
Hard & soft scape work including site improvements - allow	1	LS	25,000.00	25,000
Elevator glazed enclosure at grade level, assume 14' high	728	SF	200.00	145,600
Roof finish including support to elevator shaft enclosure, complete	153	SF	50.00	7,650
Canopy - including lighting	136	SF	250.00	34,000

	Quantity	*Unit*	*Rate*	*Total*
III. Farragut North, South Mezzanine Improvements				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	15,918.75	15,919
				$228,169
SUB TOTAL				**4,828,833**
PHASING REQUIREMENT It is anticipated that phasing will be required to ensure that the metro station remains operational as much as possible. A 5% phasing allowance is	1	LS	241,441.64	241,442
SUB TOTAL Including phasing requirement				**5,070,274**

IV. Farragut West, East Mezzanine Street Elevators

	Quantity	Unit	Rate	Total
DEMOLITION/RE-ROUTING & RE-BUILDING - ALLOW				
Allow for the following:-				
Allow for re-routing of stormwater/sewer drainage, including piping, manholes, etc	1	LS	50,000.00	50,000
Allow for re-routing of electrical cabling, including conduit, electrical manholes, site lighting etc, complete	1	LS	50,000.00	50,000
Allow for re-routing of water utility piping , including piping, manholes, etc	1	LS	50,000.00	50,000
Demolition of hardscape/softscape at grade	1	LS	50,000.00	50,000
Rock exacavation, as need				assume not required
De-watering, allow	1	LS	15,000.00	15,000
Protection of existing utility runs allow	1	LS	75,000.00	75,000
Miscellaneous demolition	1	LS	25,000.00	25,000
Remove existing structural wall @ traction power substation, assume 12' high including temporary support, complete	1	LS	108,560.00	108,560
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	31,767.00	31,767
				$455,327
EARTHWORK & FOUNDATION				
West Farragut Expansion for new elevator passageway & elevator shaft (confined area)				
Excavation (open cut)	980	CY	100.00	98,048
Remove excavated material off site	980	CY	50.00	49,024
Backfill around basement walls with gravel				not required
Support of excavation - sheet piling	5,055	SF	150.00	758,310
Shaft wall earthwork -West Farragut from Mezzanine level to Street level				
Excavation	39	CY	75.00	2,889
Backfill with gravel	28	CY	50.00	1,393
Remove excavated material off site	11	CY	100.00	1,067
Support of excavation - Shoring			included w/sheet piling above	
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	68,304.83	68,305
				$979,036
UTLILITY IMPACTS/REROUTING				
Utility impacts/rerouting			incl w/Demolition/Re-routing section	
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
ELEVATOR SHAFT				
Shaft - West Farragut Mezzanine to Street Level				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	100	SF	40.00	4,000
Reinforcement in slab	2,133	LB	2.00	4,267

	Quantity	*Unit*	*Rate*	*Total*
IV. Farragut West, East Mezzanine Street Elevators				
Concrete in slab	11	CY	320.75	3,421
Formwork to pit walls	736	SF	40.00	29,440
Reinforcement	9,541	LB	2.00	19,081
Concrete in pit walls	27	CY	320.75	8,743
Glazed aluminum framed walls			assume at street level only	
Cementitious waterproofing to elevator pit	344	SF	25.00	8,600
18"CMU in shaft walls				not required
Miscellaneous concrete costs - premium for pump grade concrete mix and pump	38	CY	175.00	6,637
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	6,314.18	6,314
				$90,503
TUNNEL CONSTRUCTION				
West Farragut Expansion for new elevator passageway & elevator shaft (confined area)				
Matt Slab				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	203	SF	40.00	8,100
Reinforcement in slab	19,181	LBS	2.00	38,363
Concrete in slab, assume 30" thick	96	CY	320.75	30,762
Damproof membrane	1,007	SF	7.00	7,049
Concrete walls				
Concrete walls	104	CY	320.75	33,198
Reinforcements	31,050	LBS	2.00	62,100
Formwork	3,726	SF	40.00	149,040
Allowance for hoisting including rental, mobilization and demobilization	1	LS	225,000.00	225,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	41,520.90	41,521
				$595,133
MEZZANINE FLOOR CONSTRUCTION				
Miscellaneous				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
NEW ENTRANCE ROOF STRUCTURE				
Roof to West Farragut Expansion for new elevator passageway & elevator shaft (confined area)				
Precast roof - excluding shaft opening				
Steel beams and girders	11	TNS	4,500.00	48,940
Precast unit slabs with voids	1,007	SF	75.00	75,525
Waterproofing	1,007	SF	5.00	5,035
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	9,712.52	9,713
				$139,213

	Quantity	*Unit*	*Rate*	*Total*
IV. Farragut West, East Mezzanine Street Elevators				
STANDARD WMATA ELEVATORS				
Standard WMATA Elevators (Grade to mezzanine) assume 2# new elevators are required	2	EA	550,000.00	1,100,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$1,100,000
STANDARD WMATA STANDARD ESCALATOR				
Standard WMATA Escalators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
INTERIOR BUILD-OUT				
Finishing - ceiling/floor				
West Farragut Expansion for new elevator passageway, elevator shaft & mezzanine level	1,812	SF	45.00	81,540
Specialized equipment provided by WMATA				
Fare gate				not required
Fare gate collection system				not required
Kiosk including structure, electrical and mechanical and installation				not required
18'' CMU wall @ traction power/new elevator machine room, assume 14' high, complete	1,064	SF	45.00	47,880
Mezzanine to platform stairs W.Farragut includes handrails complete - single				not required
Double leaf metal door				not required
Single leaf metal door	2	EA	2,100.00	4,200
Allow for miscellaneous interior work	1	LS	250,000.00	250,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	28,771.50	28,772
				$412,392
MECHANICAL				
Plumbing and Drainage - adapt & amend	1	LS	600,000.00	$600,000
Fire Protection - adapt & amend	1	LS	300,000.00	$300,000
HVAC	1	LS	800,000.00	$800,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	127,500.00	127,500
				$1,827,500

	Quantity	*Unit*	*Rate*	*Total*
IV. Farragut West, East Mezzanine Street Elevators				
ELECTRICAL				
Electrical - adapt & amend including new power for elevator, complete	1	LS	600,000.00	$600,000
500Kw generator allowance				not required
Security and communication allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	45,000.00	45,000
				$645,000
COST TO REPLACE EXISTING ELEVATOR FOR NEW ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
COST TO REFURBISH EXISTING ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
ELEVATOR DOWN TIME (costs of WMATA bus-bridge)				
WMATA bus bridge - allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
EXTERIOR WORK				
Hard & soft scape work including site improvements - allow	1	LS	25,000.00	25,000
Elevator glazed enclosure at grade level, assume 14' high	700	SF	200.00	140,000
Roof finish including support to elevator shaft enclosure, complete	144	SF	50.00	7,200
Canopy - including lighting	128	SF	250.00	32,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	15,315.00	15,315
				$219,515
SUB TOTAL				**6,463,619**
PHASING REQUIREMENT				
It is anticipated that phasing will be required to ensure that the metro station remains operational as much as possible. A 5% phasing allowance is included	1	LS	323,180.93	323,181
SUB TOTAL Including phasing requirement				**6,786,800**

V. Farragut West, Additional Platform Escalators

	Quantity	Unit	Rate	Total
DEMOLITION/RE-ROUTING & RE-BUILDING - ALLOW				
Allow for the following:-				
Allow for re-routing of stormwater/sewer drainage, including piping, manholes, etc	1	LS	35,000.00	35,000
Allow for re-routing of electrical cabling, including conduit, electrical manholes, site lighting etc, complete	1	LS	50,000.00	50,000
Allow for re-routing of water utility piping , including piping, manholes, etc	1	LS	20,000.00	20,000
Rock exacavation, as need				assume not required
De-watering, allow				assume not required
Protection of existing utility runs allow	1	LS	30,000.00	30,000
Miscellaneous demolition	1	LS	25,000.00	25,000
Form new wall opening for new escalator @ Farragut West platform level only (2# locations), complete	2	EA	43,280.00	86,560
Remove existing parapet wall w/railing @ existing mezzanine, level	120	LF	200.00	24,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	20,292.00	20,292
				$290,852
EARTHWORK & FOUNDATION				
Escalator pit (4# locations)				
Excavation	89	CY	75.00	6,667
Backfill with gravel	68	CY	50.00	3,378
Remove excavated material off site	21	CY	100.00	2,133
Support of excavation - Shoring	720	SF	45.00	32,400
Column base earthwork - West Farragut				
Excavation	59	CY	75.00	4,444
Backfill with gravel	49	CY	50.00	2,430
Remove excavated material off site	11	CY	100.00	1,067
Support of excavation - Shoring	640	SF	60.00	38,400
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	6,818.93	6,819
				$97,738
UTLILITY IMPACTS/REROUTING				
Utility impacts/rerouting			incl w/Demolition/Re-routing section	
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				
				$0
ELEVATOR SHAFT				
Escalator pit (2# locations)				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to slab edge	264	SF	40.00	10,560
Reinforcement in slab	4,267	LB	2.00	8,533
Concrete in slab	21	CY	320.75	6,843

	Quantity	*Unit*	*Rate*	*Total*
V. Farragut West, Additional Platform Escalators				
Formwork to pit walls	1,056	SF	40.00	42,240
Reinforcement	7,333	LB	2.00	14,667
Concrete in pit walls	29	CY	320.75	9,409
Cementitious waterproofing to escalator pit	912	SF	25.00	22,800
Miscellaneous concrete costs - premium for pump grade concrete mix and pump	51	CY	175.00	8,867
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	9,293.93	9,294
				$133,213
TUNNEL CONSTRUCTION				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	0.00	
				$0
MEZZANINE FLOOR CONSTRUCTITON				
Column - N Farragut				
Excavation				incl above
Remove excavated material off site				incl above
Backfill with gravel				incl above
Formwork to pad edge	384	SF	40.00	15,360
Reinforcement in pad	2,667	LB	2.00	5,333
Concrete in pad	11	CY	200.00	2,133
Steel Column	11	TON	4,500.00	48,114
Fire proofing	11	TON	200.00	2,138
Mezzanine Floor Slab - W Farragut				
Steel beams and girders	44	TON	4,500.00	197,316
Precast unit slab	4,060	SF	50.00	203,000
Parapet wall - 36" high w/railing @ cap	330	LF	300.00	99,000
Miscellaneous				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	42,929.55	42,930
				$615,324
NEW ENTRANCE ROOF STRUCTURE				
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				
				$0
STANDARD WMATA ELEVATORS				
Standard WMATA Elevators (Grade to mezzanine) assume 2# new elevators are required				not required
Standard WMATA Elevators (mezzanine to platform)				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0

V. Farragut West, Additional Platform Escalators

	Quantity	Unit	Rate	Total
STANDARD WMATA STANDARD ESCALATOR				
Standard WMATA Escalators	4	EA	350,000.00	1,400,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$1,400,000
INTERIOR BUILD-OUT				
Finishing - ceiling/floor				
West Farragut Expansion for new elevator passageway, elevator shaft & mezzanine level	4,060	SF	45.00	182,700
Specialized equipment provided by WMATA				
Fare gate (2# standard)				not required
Fare gate collection system				not required
Kiosk including structure, electrical and mechanical and installation				not required
18" CMU wall @ traction power/new elevator machine room, assume 14' high, complete				not required
Mezzanine to platform stairs W.Farragut includes handrails complete - single				not required
Double leaf metal door				not required
Single leaf metal door				not required
Allow for miscellaneous interior work	1	LS	100,000.00	100,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	21,202.50	21,203
				$303,903
MECHANICAL				
Plumbing and Drainage - adapt & amend	1	LS	500,000.00	$500,000
Fire Protection - adapt & amend	1	LS	400,000.00	$400,000
HVAC	1	LS	900,000.00	$900,000
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	135,000.00	135,000
				$1,935,000
ELECTRICAL				
Electrical - adapt & amend including new power for elevator, complete	1	LS	900,000.00	$900,000
500Kw generator allowance				not required
Security and communication allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half	1	LS	67,500.00	67,500
				$967,500

	Quantity	*Unit*	*Rate*	*Total*

V. Farragut West, Additional Platform Escalators

COST TO REPLACE EXISTING ELEVATOR FOR NEW ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
COST TO REFURBISH EXISTING ELEVATOR				
Standard WMATA Elevators				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
ELEVATOR DOWN TIME (costs of WMATA bus-bridge)				
WMATA bus bridge - allowance				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
EXTERIOR WORK				
Exterior work				not required
* Assume 60% of Estimated Contract Award is labor; 25% of labor is premium time & is paid at time and a half				included above
				$0
SUB TOTAL				**5,743,530**
PHASING REQUIREMENT				
It is anticipated that phasing will be required to ensure that the metro station remains operational as much as possible. A 5% phasing allowance is	1	LS	287,176.50	287,177
SUB TOTAL Including phasing requirement				**6,030,707**