WASHINGTON UNION STATION
STATION EXPANSION

Draft Environmental Impact Statement for Washington Union Station Expansion Project

Appendix A3e – Final Concept Development and Evaluation Report Appendix E: *Supporting Pedestrian Flow Information for Concept Development*

U.S. Department of Transportation
Federal Railroad Administration

July 13, 2016

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WASHINGTON
UNION STATION
STATION EXPANSION

Appendix E

Supporting Pedestrian Flow Information for Concept Development

Task 4.2C

July 13, 2016

Contents

INTRODUCTION

PASSENGER FLOW

Introduction

This section of the report discusses the flow of passengers through the Washington Union Station (WUS) Station Expansion Plan (SEP). This report addresses the issues that impact passenger flow, which are common to all proposed Concepts, and describes any resultant issues.

A brief review of existing WUS conditions for pedestrians is included to establish context, and previous passenger flow studies are described to highlight the impact of other station improvements as they relate to and inform SEP.

Although no longer considered to be required on operational grounds, the structural and systems implications of this potential program element were evaluated during concept design.

Existing Conditions

Existing WUS conditions were assessed to understand key pedestrian flows during the peak AM and PM periods, route choices from the MARC and VRE commuter trains and Amtrak trains to the WMATA Metrorail station and other destinations around the station, as well as the overall spatial composition of the Amtrak concourse.

The main findings from site observations include:

- The primary AM peak pedestrian flow is from the MARC/VRE trains to the Metrorail platforms. The main flow of passengers is to the north end of the Metrorail station although passengers also use the central and south escalators to reach the platforms via the south mezzanine.
- During the AM peak, congestion occurs at the top of the escalators leading to the WMATA station north mezzanine entrance. During the PM peak, queuing forms at the base of both the platform and mezzanine escalators.
- The primary PM peak pedestrian flow is from the Metrorail station directly towards MARC and VRE platforms through the north mezzanine and the corridor linking the two, not through Concourse A.
- Departing MARC commuters who arrive at Concourse A before their track has been called wait to receive departure gate information inside the Concourse adjacent to the men's restroom. VRE commuters who arrive early tend to wait inside the North Hangar.
- Most daily commuters do not wait in the Starlight or Stardust waiting rooms. MARC/VRE commuters tend to know their departure times and arrive at the Concourse just prior to departure; they do not wait for long periods and do not require much seating.
- Similarly many Amtrak passengers do not use seating areas because of Amtrak's first-come, first-served boarding process. With unassigned seating, passengers prefer to queue for their train departure rather than sit down and risk getting seated late in the boarding process.
- The main concourse is not wide enough for all functions that need to occur in the space including circulation, queuing for Amtrak departures, viewing train arrival/departure boards, retail store access, window shopping, waiting for others, pausing for navigation, and station furniture (see images 1-3 below).

AM PEAK QUEUING AT THE TOP OF THE ESCALATOR TO THE WMATA NORTH MEZZANINE

PASSENGERS WAITING FOR MARC DEPARTURE TRAIN ANNOUNCEMENTS

CONGESTION DUE TO MANY DIFFERENT ACTIVITIES OTHER THAN CIRCULATION

AMTRAK QUEUING AND OTHER ACITIVITIES AND OBSTRUCTIONS IN MAIN CONCOURSE

Previous Passenger Flow Studies

Amtrak Concourse A Phase 1a Improvements

A dynamic pedestrian simulation model was created to assess the preferred Amtrak Concourse A design alternative. The model was used primarily to inform design of the vestibule walls and door arrangements and to help organize seating and circulation around the inherent passenger paths.

An AM peak period from 6:45-8:15 AM was simulated to capture numerous peak train arrivals from MARC and VRE, including some simultaneous and near-simultaneous arrivals which put significant pressure on the Concourse circulation areas.

The model incorporated key inputs from the following areas to simulate realistic conditions:

- **Geometry:** features of the physical space, including walls, columns, stairs, escalators and any areas that pedestrians might use for circulation
- **People:** the number of Amtrak, MARC, VRE and WMATA passengers and the rate at which they arrive and depart
- **Operations:** activities such as ticketing as well as functional features of WUS including one-way doors or zones dedicated to seating and/or waiting

Model Findings

In terms of pedestrian circulation, the benefits of the Phase 1a Concourse Renovation include:

- New vestibule walls with several sliding doors provide more points of access and greater permeability between the Block and existing Concourse A (Claytor Concourse). Passengers would be able to use any available doors that suit their journey. As a result, the Phase 1a model did not exhibit any queuing or congestion on the Block during the AM peak period.
- Circulation paths are clearer and wider within the Concourse.
- New waiting spaces are allocated and organized around specific rail services and circulatory patterns within WUS.

Claytor Concourse will be reconstructed in the future as a consequence of the SEP. The findings of this initial modelling have been taken in to account in the architectural design of the revised Concourse A, removing the queuing and pinch points currently experienced.

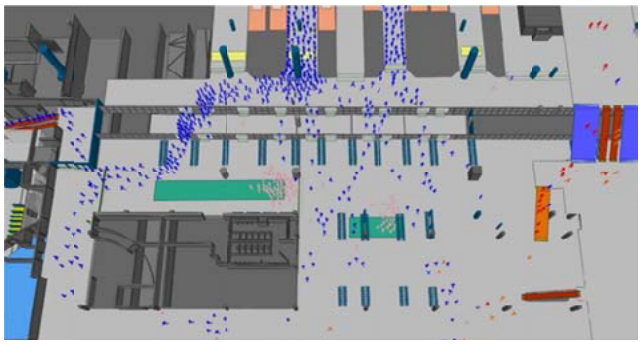

Figure 1 Phase 1a conditions on the Block during peak train arrivals

WMATA Phase 0 and 1st Street Entrance Options

The Concourse A model was expanded upon to assess impacts to the Metrorail station north mezzanine and platform if both the Amtrak Phase 1b and WMATA Phase 0 plans were completed.

Proposed Phase 0 improvements include:

1. Stair added to north escalators (Phase 0)
2. Concourse Vertical transportation is relocated (Phase 1b)
3. New Lower Level Concourse connection to north mezzanine
4. New central mezzanine with two (2) elevators and one (1) staircase
5. Street access scenarios

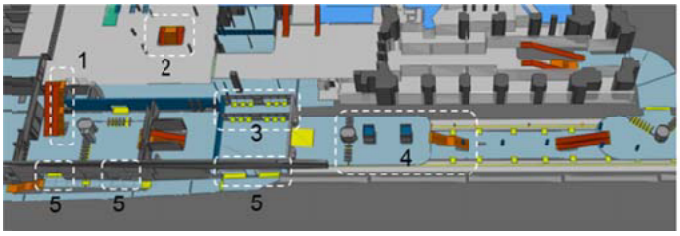

Figure 2 Phase 0 additional vertical circulation, mezzanine and First Street entrance

Model Findings

The Phase 0 model included passenger demand and rail timetabling for a future year 2030. Outputs indicated that, given the increase in Metro and WUS passengers expected in the year 2030, additional connections between the two stations would be needed to maintain consistent flow to and from Metro platforms.

Phase 0 includes a new central mezzanine off of the Metro platform, joining with a combination of new First Street entrances, including through the loading dock. The new mezzanine and associated vertical circulation provide new opportunities to spread passenger volumes across the length of the platform and exit the platform quickly.

Key to the SEP, this modeling exercise also reinforced the Metro station as a key WUS destination in the future.

Analysis of Lower Level Concourse Utility in TI Options 14 and 16

Specific to the TI Options 14 and 16 were assessed to understand utility and passenger benefit of the Lower Level Concourses.

Both Options contain the following features:

- Platforms that are widened to provide more circulation space for passengers, and lengthened to allow double berthing of trains (in most cases)
- A new east-west H Street Concourse under the tracks/platforms, providing connections with the urban street network and the First Street and Central Concourses
- A new north-south First Street Concourse providing connections between the H Street Concourse, the Metrorail Station and Concourse A.
- A new north-south Central Concourse providing connections between the H Street Concourse and the Concourse A
- New vertical connections between the platforms and the H Street Concourse below
- New vertical connections (escalators, stairs, elevators) between the Concourse A upper and lower levels, parking, bus deck, and BP
- New vertical connections (escalators and stairs) at the intersection of the Central Concourse and H Street Concourse, providing connections with BP and the H Street Streetcar above
- New vertical connections (escalators, stairs, elevators) at the intersection of First Street and H Street Concourse and Second Street and H Street Concourse, providing connections to the H Street Bridge, Streetcar and BP above.

The combination of these new circulation areas would provide new, expansive access between neighborhood streets, WUS platforms and the Metrorail station.

Option 14 and Option 16 Comparison

In terms of access and circulation there is no substantive difference between Options 14 and 16. Option 16 features a larger platform above and wider Central Concourse below, but this should have limited impact on pedestrian use of and flows through the Concourse. For this reason only Design Option TI-14 was modeled in MassMotion.

Flow Diagramming

Equipped with knowledge of SEP performance and passenger behaviors gleaned through the aforementioned modeling exercises, flow diagrams were created to map anticipated flows from the rail platforms to key destinations within and without WUS. These diagrams show one MARC train arrival on Track 12, with rough orders of magnitude of volume of pedestrian flow represented by the arrow thicknesses. (See Figures 3 – 6.)

The diagrams reveal that the Central Concourse, without Below Grade Tracks, in either Option 14 or 16 would likely be underutilized for the following reasons:

- The shortest path for passengers on arriving trains – particularly for those passengers towards the front or southern end of the trains – Is to remain on the platforms and walk to Concourse A. Passengers towards the rear of the trains may also remain on the platforms, particularly if the escalators to the H Street Concourse are behind them. Under a “herd” mentality, passengers towards the rear of the trains may also remain on the platforms if they are following other passengers.
- In terms of utility, passengers who are frequent users of WUS would likely take the shortest path from point to point. This assumes that passengers stay at the same level unless a level change is required. They are not likely to travel up to go down, or down to go up, because any movement away from the shortest route to their destination would require more time and less efficiency. First-time or infrequent station users may also take the shortest path but are more likely to take any number of routes given knowledge of their surroundings.
- The physical layout of the Metrorail Station, the WUS platforms and the at-grade connections plays a large role in passenger movement choices. The platforms, being end-loaded, provide relatively direct access to points south. Passengers traveling to or from the south would be unlikely to descend to the new lower concourses only to journey back up to reach street level (See Figures 8 and 10).
- Of the two north-south lower concourses, the First Street Concourse would likely be the preferred route choice for passengers traveling from the rail platforms south to the Metrorail Station because it offers a shorter route than the Central Concourse. (See Figure 11.)

When considering the additional passenger flow as a consequence of the future Below Grade Tracks (BGT), the predominant passenger flow will be from BGT directly to Concourse A from the new boarding concourse at Level B2, with additional flow to Concourse at H-Street and up to Burnham Place. The passengers alighting from BGT are unlikely to significantly use the Central Concourse.

Inexperienced and first time travelers may access northern destinations from the southern escalator set, thus using the central concourse, yet this would be a small percentage of passengers.

Refer to (See Figure 7).

Flow diagramming has been used in lieu of spreadsheet type modelling / calculations, this will be done once the future ridership data is provided by FRA and Amtrak.

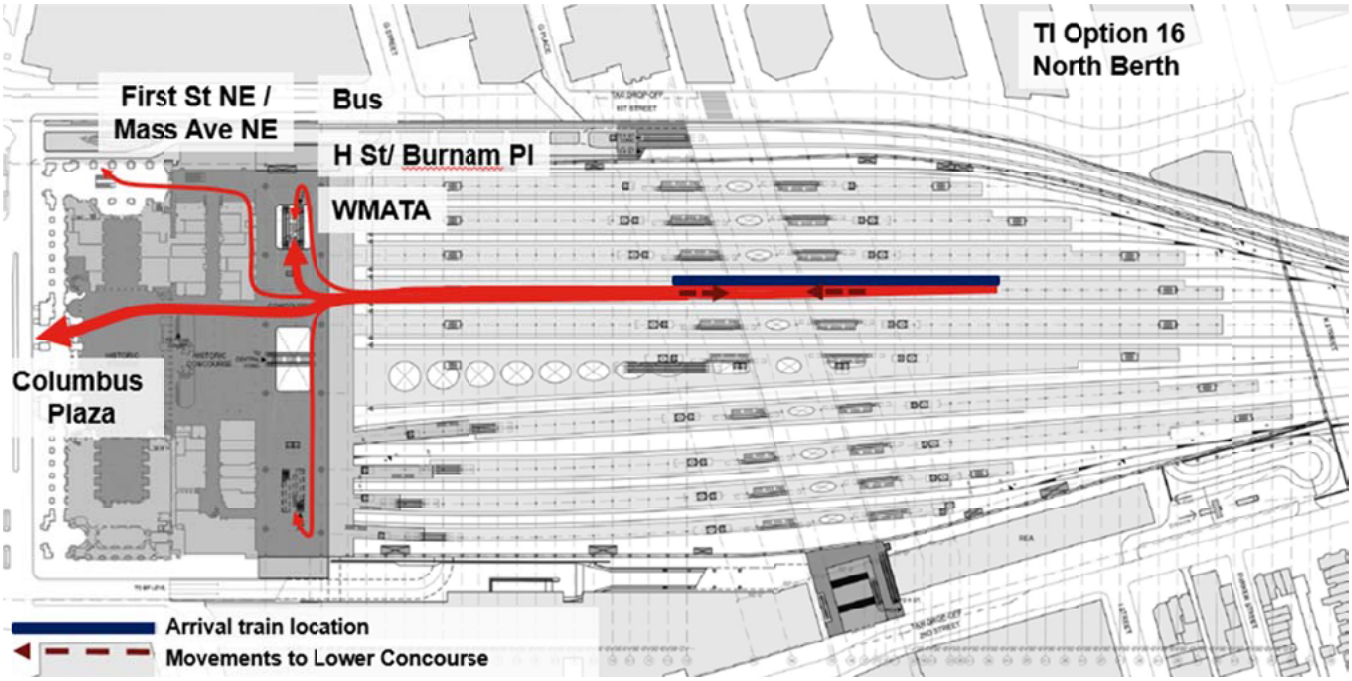

Figure 3 Design Option TI-16, North Berth Train Arrival Destinations, Platform Level

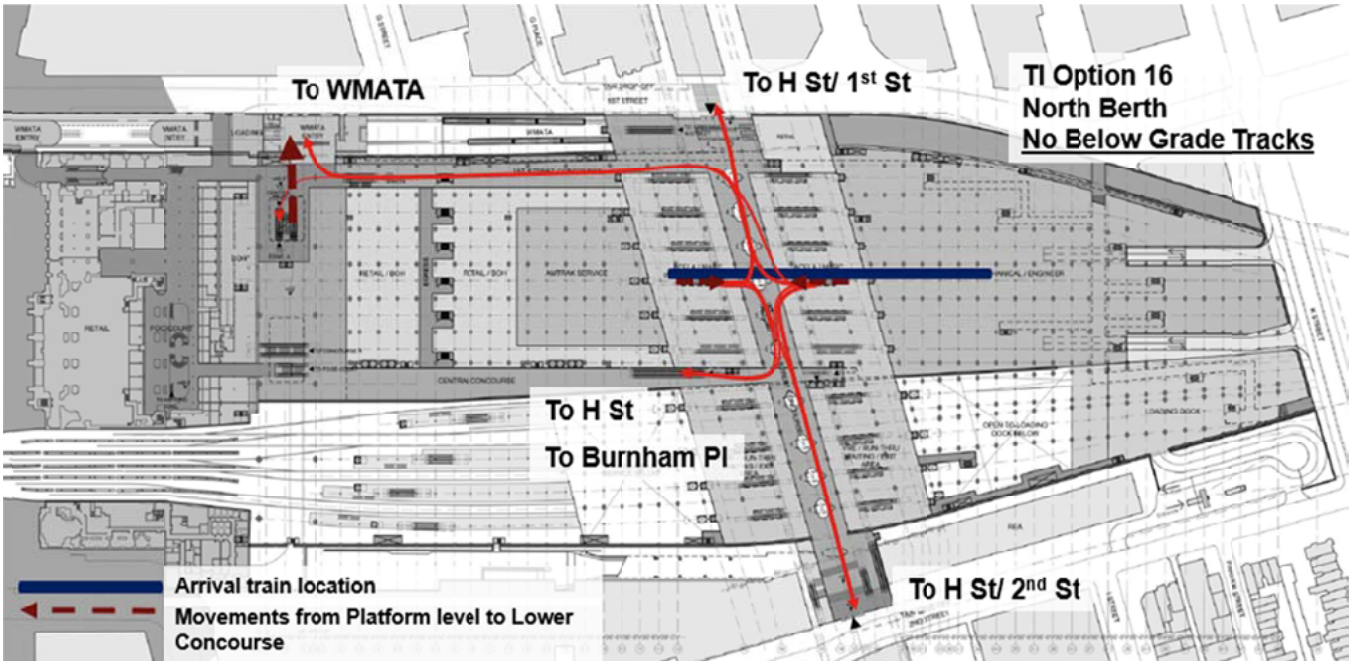

Figure 4 Design Option TI-16, North Berth Train Arrival Destinations, Lower Concourse Level, No Below Grade Tracks

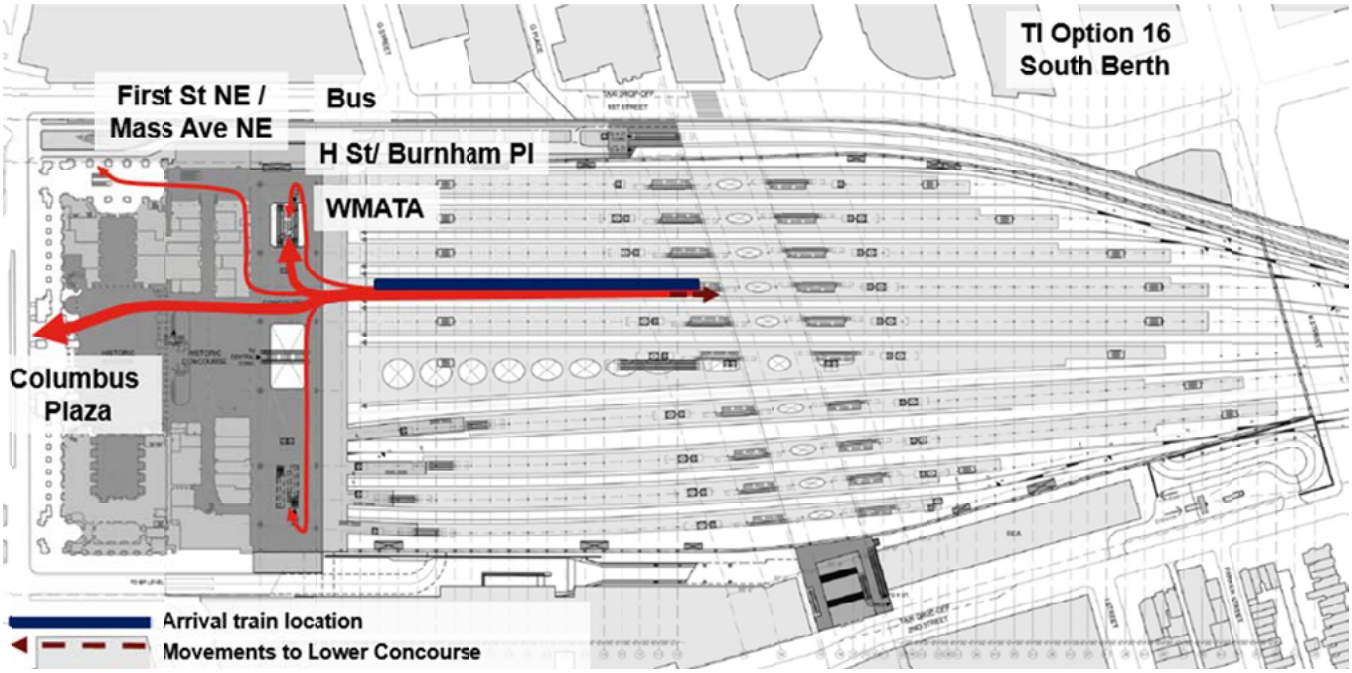

Figure 5 Design Option TI-16, South Berth Train Arrival Destinations

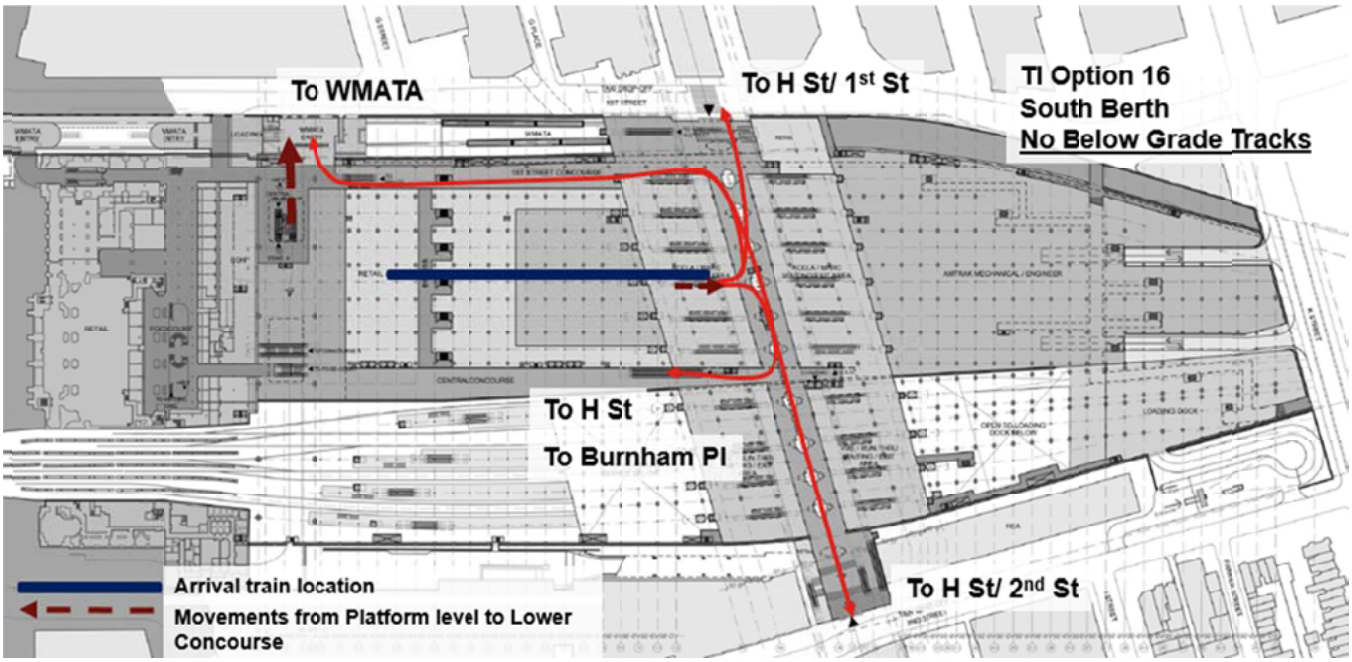

Figure 6 Design Option TI-16, South Berth Train Arrival Destinations, Lower Concourse Level, No Below Grade Tracks

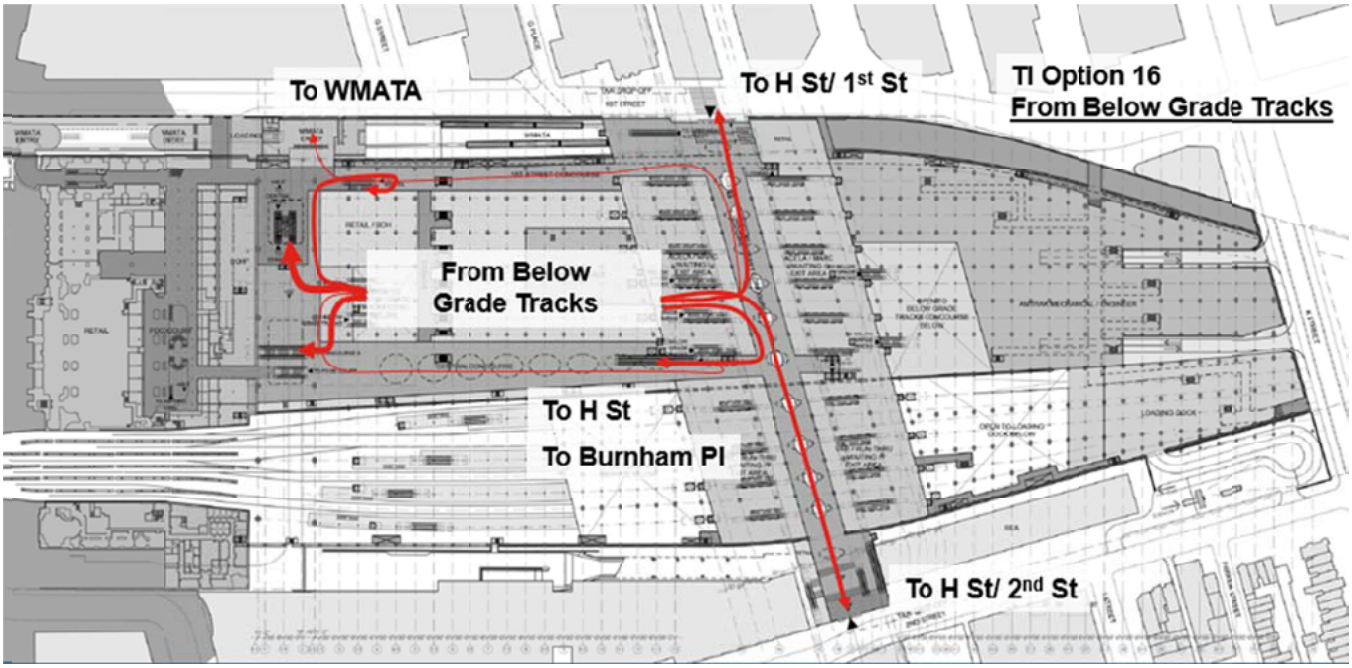

Figure 7 Design Option TI-16, Below Grade Train Arrivals to Various Destinations

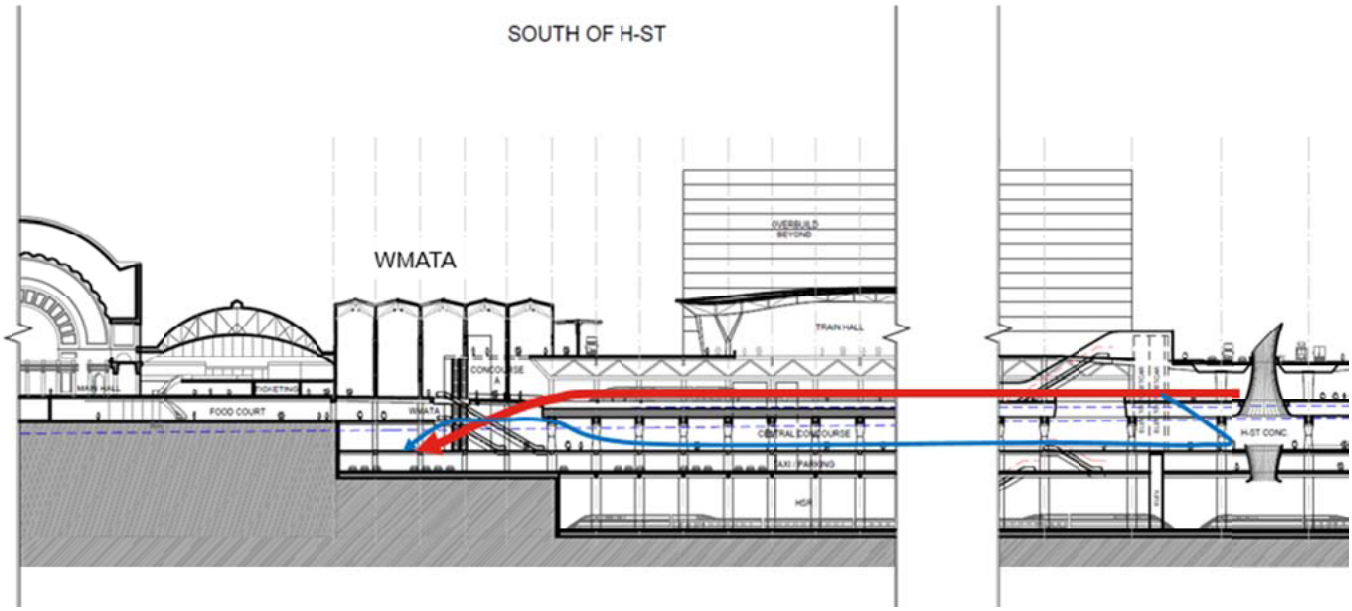

Figure 8 Long Section: Two passenger routes to WMATA

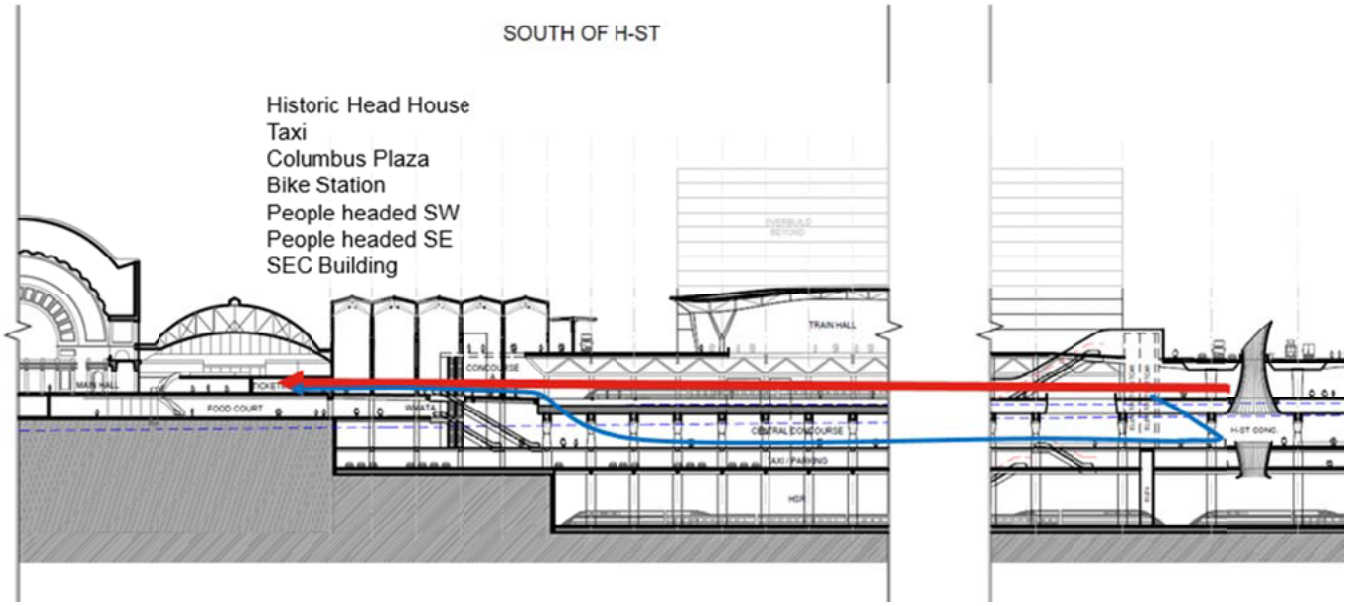

Figure 9 Long Section: Two passenger routes to south destinations

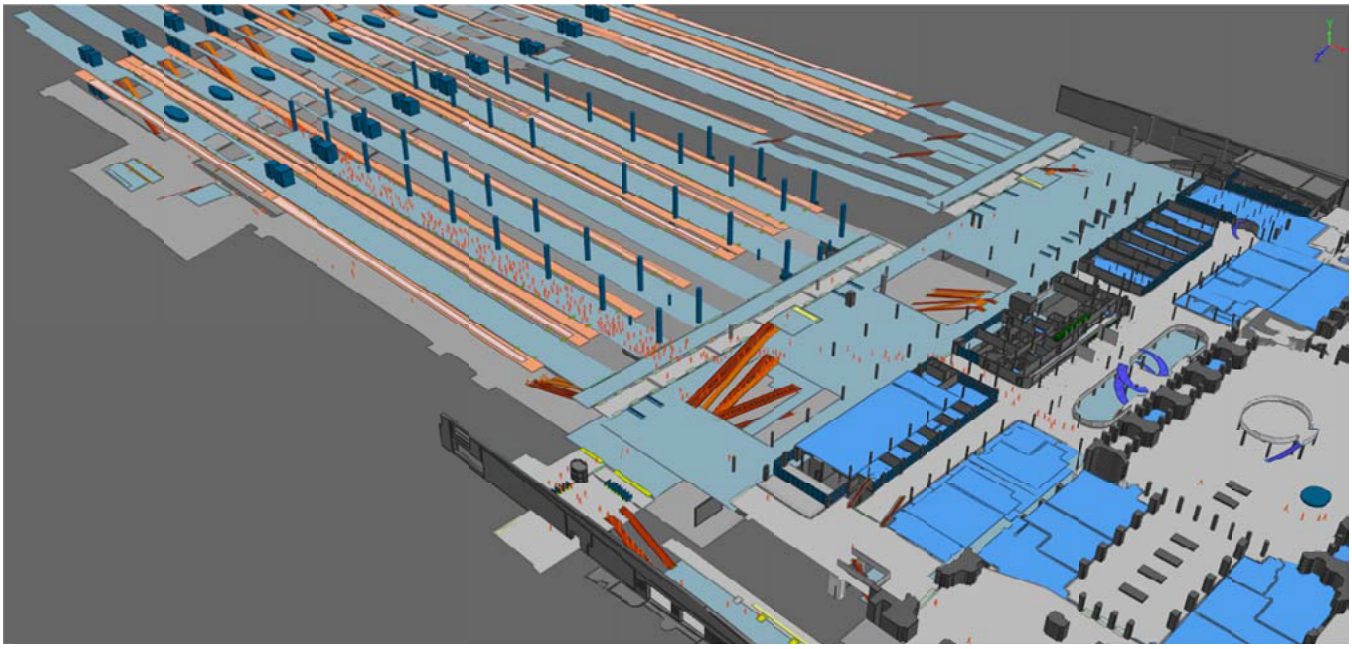

Figure 10 TI Option 14 MassMotion AM Peak Period model showing southbound passengers remaining on platform level

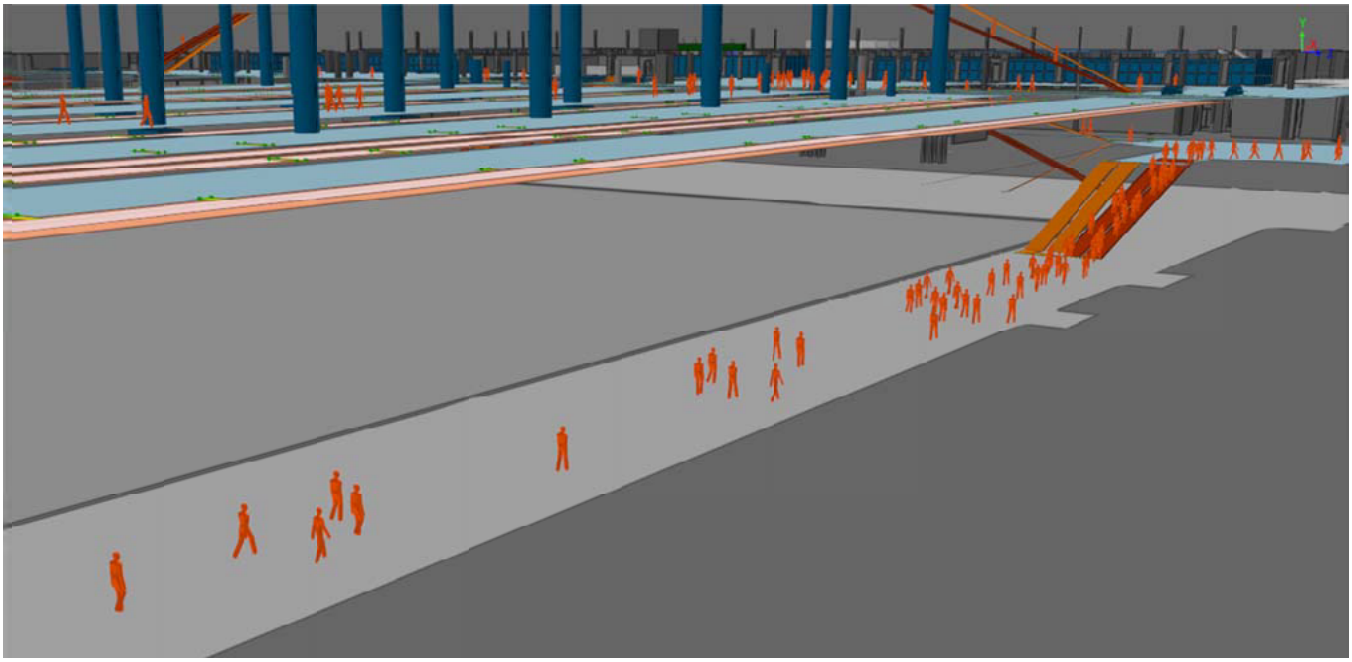

Figure 11 TI Option 14 MassMotion AM Peak Period model showing passengers utilizing 1st Street Concourse

Pedestrian Modeling

MassMotion was used to model Option TI-14 to understand use of the new lower concourses and validate the flow diagramming exercise previously described.

With limited inputs and knowledge of future train scheduling, origin-destination routes of passengers, or population forecasts, the model incorporated a set of assumptions. Train arrivals were assumed on every track, including double-berthed trains where track lengths allowed. The model assumed five (5)-minute arrivals. 2030 populations were used, which were calculated from baseline 2015 populations using a compound annual growth rate of 1.5%. These are not the future projections for the station, but simply a way to generate passengers in the model for the purposes of observing pedestrian flow and utility of the concourses.

The following table summarizes train arrivals by service with arrival times and the number of alighting passengers per arrival. This data was used in the Option 14 model.

Train Service	Time	Alighting Passenger Number	Track Number
MARC	6:46	504	7
MARC	6:51	224	8
MARC	6:56	224	9
MARC	7:02	704	10
MARC	7:07	604	11
MARC	7:12	224	12
Amtrak Regional	7:17	248	13
Amtrak	7:22	300	14
Amtrak	7:27	300	15
Amtrak	7:32	300	16
Amtrak	7:37	300	17
VRE	7:42	380	18
VRE	7:47	273	19
VRE	7:52	335	20
VRE	7:57	330	23
VRE	8:02	338	24

Train lengths were referenced from Page 6 of the TI Track Alignment Meeting document presented at DDOT on May 5, 2016 and positioned approximately 10 to 15 feet from the track termini. The following table summarizes assumed train lengths by service which were incorporated into the Option 14 model.

Train Service	Train Length
VRE	10 cars + locomotive = 925’
MARC	8 cars + locomotive = 755’
Amtrak	680’
Amtrak Regional	12 cars + locomotive = 1095’

Model Findings

Despite limited inputs, the model is an effective tool for determining passenger route preferences because model agents are programmed to find the shortest route between origin and destination.

The model confirmed the flow diagramming by showing that, during the AM peak period, the majority of passengers – particularly those originating from the front of the train sets – remain on the platforms to travel south to Concourse A and then west to the Metro station. Many passengers originating from the rear of the train sets follow this route as well. However, some rear-originating passengers utilize the escalators to the lower H Street Concourse and then proceed west to the First Street Concourse to access the Metro station. The Central Concourse is rarely used and has limited utility for passengers in the Option 14 and 16 schemes, with and without Below Grade Tracks.

Once future forecasts of ridership and mode-shares are better known, levels of service can be calculated to help assess concourse performance and design parameters (concourses, VCE’s and major arterial routes) in the alternatives that will be considered within the EIS process.