CHAPTER 2.0 Evolution of the Silver Line Phase III Alternatives

2.1 Introduction

This chapter summarizes the Massachusetts Bay Transportation Authority's (MBTA's) extensive process of developing and screening alternative alignments and portal options for the Silver Line Phase III project. The chapter begins with a summary discussion of the original project alignment presented in the 1993 South Boston Piers/Fort Point Channel Transit Project Final Environmental Impact Statement/Final Environmental Impact Report (FEIS/FEIR). This chapter then describes the subsequent evolution of the Silver Line Phase III alignment, including a discussion of the screening criteria that led to the elimination of certain alternatives and the selection of the alternatives currently described and analyzed in this Silver Line Phase III Supplemental Draft Environmental Impact Statement/Environmental Impact Report (SDEIS/EIR). A complete summary of the history of the environmental review process for the overall Silver Line project and its predecessor projects, the South Boston Piers/Fort Point Channel Transitway and the Washington Street Replacement Service, was presented in the 4th Annual Update Pursuant to M.G.L. Section 61 in February 2005. A copy of the Annual Update can be reviewed via the MBTA website at http://www.allaboutsilverline.com/annualtext.asp.

Phase III of the Silver Line incorporates what had originally been the second phase of the South Boston Piers Transitway: a tunnel connection between South Station and Boylston Station, providing transit connections to the Red, Orange and Green Lines. The original alignment for this phase, extending from South Station along Essex Street, Avenue de Lafayette and Avery/Tremont Streets to Boylston Station terminating in a loop underneath the Boston Common in the Vicinity of the Central Burying Ground, was reviewed and approved as part of the 1993 FEIS/FEIR. The Secretary of the Massachusetts Executive Office of Environmental Affairs (EOEA) issued its FEIR Certificate on February 16, 1994, which completed state-level Massachusetts Environmental Policy Act (MEPA) review, and the Federal Transit Administration (FTA) issued its Record of Decision (ROD) for the Full Build Transitway Project on May 12, 1994, which completed federal National Environmental Policy Act (NEPA) review. A Process Memorandum of Agreement (MOA) was also executed with the Massachusetts Historical Commission (MHC), containing the MBTA's commitments to mitigate impacts to historic and archaeological resources.

In 1997, the Massachusetts Port Authority (Massport) modified their ground access plans, dropping the previously proposed People Mover and Logan Terminal to South Station shuttle, and substituting the Airport Intermodal Transit Connector (AITC), permitting a one-seat ride from Logan terminals to the South Boston waterfront, South Station, Chinatown Station on the Orange Line, and Boylston Street on the Green Line via the South Boston Transitway (now called Silver Line). FTA approved the Massport document in 1997.

The MBTA subsequently proposed the integration of the Washington Street Replacement Service (now Silver Line Phase I) and Transitway projects (now Silver Line Phases II and III) into the combined Silver Line in the Washington Street/Silver Line Transit Service Environmental Notification Form (ENF), filed with EOEA for review under MEPA in July 1998. On August 21, 1998, the Secretary of EOEA issued a Certificate that allowed the MBTA to prepare a Notice of Project Change (NPC) to address issues raised in both the Certificate and the ENF comment letters relating to the full Silver Line project. In response, the 1999 Notice of Project Change, Washington Street/Silver Line Transit Service and Roadway Improvements; Response to Comments, South Boston Piers Transitway formally presented a description of the combined
Silver Line Phase III

2.2 Criteria Used in the Screening Evaluation of Alternatives

Since completion of the 1993 FEIS/FEIR for the South Boston Piers Transitway, the Silver Line Phase III alignment has been modified to minimize impacts to important cultural and community resources; respond to design, construction, and operational considerations; meet ridership demand related to the project purpose and need; and reduce the overall cost of the project to make it more competitive for Federal funds. This section provides a discussion of the criteria that were considered in the evolution and screening of alignment alternatives, which led to the selection of alternatives to be considered in the SDEIS/EIR. These are the same criteria that must be applied under Section 4(f) of the Transportation Act of 1966 review, to determine if an alternative is infeasible (for technical or economic reasons, or because it fails to satisfy project purpose and need) or imprudent (because it involves unacceptably high impacts on parklands, historic resources, community facilities, or other resources). (See Section 5.10 for additional discussion of Section 4(f).)

As indicated in Table 2.3-1 at the end of this chapter, common elements of the alternatives emerged as design solutions to these criteria were developed, leading to the development of the Core Tunnel Segment for much of the Phase III alignment. This segment extends along Essex and Boylston Streets between South Station and the turnaround loop beneath the intersection of Boylston and Charles Streets. As a result of this extensive evaluation and screening process, the issues that remain to be considered within the context of this SDEIS/EIR relate primarily to the consideration of a limited number of alternatives for the Silver Line Phase III alignment from the turnaround loop to the portal, providing the connection to Phase I service.

2.2.1 Impacts on Community, Parkland, and Cultural Resources

One important criterion influencing the development of alignment alternatives has been the potential for adverse impacts on community, parkland, or cultural (historic and archaeological) resources. Specific resources considered under this criterion include the Chinatown YMCA,
Boston Common, and Elliot Norton Park, based on community and agency comments. (See Chapter 4 for more information on these resources.)

As discussed in Section 2.3.3, the Silver Line Phase III alignment presented in the 2002 2nd Annual Update Pursuant to M.G.L. Section 61 would have provided an operational connection to the Silver Line Phase I service via a tunnel portal and ramp to the surface at Washington Street within the site of the Chinatown YMCA. The YMCA would have needed to be demolished and relocated to a new off-site location under this alternative alignment. As described in Section 2.3.4.1, this portal location has been eliminated in favor of an alternate location between the New England Medical Center (NEMC) garage and the Doubletree Hotel which is currently occupied by surface parking (the “NEMC” portal, which is associated with the Tremont Street, Charles Street, and Stuart Street alignment alternatives evaluated in this SDEIS/EIR). The NEMC portal provides a similar operational connection to Phase I service without the adverse impact associated with demolition of a community center.

The Boston Common, established in 1634, is the oldest public park in the United States and is listed on the National Register of Historic Places as a National Historic Landmark. It has also been designated as having high sensitivity for both contact and pre-contact archaeological resources. (See Chapter 4 for additional information.) While the MBTA received approval for the 1993 Transitway alignment (See Section 2.3.1), which included a turnaround loop and Boylston Station under the Boston Common, more recent discussions with the City of Boston Parks and Recreation Department, the Boston Landmarks Commission, and the Massachusetts Historical Commission indicated a concern regarding the potential for adverse impacts to the Boston Common from installation of an access shaft to support construction of the underground tunnel loop and station beneath the Common. As described in Section 2.3.4.3, an alternate design concept was developed that avoided these impacts by placing Boylston Station beneath the right-of-way of Boylston Street and providing a turnaround loop beneath the intersection of Boylston and Charles Streets. All alternatives that included a station and turnaround loop under the Boston Common were eliminated in favor of this alternate design concept, which is now part of the Core Tunnel Segment.

Finally, Elliot Norton Park has been identified as a parkland resource, with particular significance for the Bay Village neighborhood. As described in Section 2.4, the Charles Street alignment with a portal at Elliot Norton Park, was among the alternatives presented in the June 2004 Notice of Project Change submitted to the EOEA proposing modifications to the Phase III segment of the Silver Line. It has been eliminated from further consideration as a SDEIS/EIR alternative because it would have required the permanent taking of the park. The Charles Street alignment with a NEMC portal would create temporary construction phase impacts at the park and is under consideration as a SDEIS/EIR alternative. The park would be fully restored after construction. (See Chapter 6.)

### 2.2.2 Technical Feasibility: Design, Engineering, and Construction Standards

Since the early stages of planning and design of the Transitway project (the predecessor to the Silver Line), the MBTA has maintained a standard for Bus Rapid Transit (BRT) design, construction and operation (see Section 7.3 for a more detailed description of Silver Line BRT performance characteristics). The standards require, among other criteria, that the project must be designed to allow future potential conversion to light rail. These design standards affect such areas as grade, elevation, radii of curves, etc. The MBTA is planning to maintain this standard throughout Phase III. All alternatives considered must comply with these design standards.

One issue of particular significance to the evaluation of Silver Line alignment alternatives is the maximum grade of the travel way. The steeper the grade, the greater is the power demand and the wear and tear on the vehicle, and the higher the likelihood that the vehicle will fail and cause delays in the system. Steeper grades also result in higher capital costs for traction power...
infrastructure and for vehicles built to cope with more demanding operating conditions. As a result, the MBTA established a maximum preferred grade of 5 percent for the Silver Line in 1993, with an absolute maximum of 6 percent under specific circumstances. These design criteria were established to allow for a future conversion to light rail. In addition, the Silver Line Bus Rapid Transit (BRT) dual mode vehicle has been designed to operate at a maximum grade of 6 percent. As further described in Section 2.3.4.3, Tremont Street alignment alternatives that include a single mid-block station between Chinatown and Boylston Station instead of separate Boylston and Chinatown Silver Line stations fail to satisfy this criterion of technical feasibility.

2.2.3 Operational Considerations and Ridership Demand

Transportation modeling for Silver Line Phase III indicates very high passenger demand in the Core Tunnel Segment between South Station and Boylston Station. This is an important segment of the Silver Line, providing connections to the MBTA’s Red, Orange, and Green Lines. The service plan for Silver Line Phase III (see Chapter 3) provides a high service frequency and passenger capacity within the Core Tunnel Segment to serve the high passenger demand between the downtown core and the South Boston Waterfront, consistent with the project purpose and need described in Chapter 1. The service plan operates eight of the Silver Line’s nine routes within the Core Tunnel Segment, with peak headways of less than a minute to serve this demand.

To adequately meet this demand approximately three out of four vehicles will be “short-turned” after the Boylston Station for a return inbound trip towards the waterfront. The Boylston Loop allows short-turning vehicles to complete this movement in the quickest possible fashion, so that vehicles may be re-entered into revenue service in the opposite direction of travel, thereby minimizing operating costs and vehicle fleet requirements. The Boylston Loop also allows the movement to be completed within a dedicated right-of-way free of non-transit traffic, and without requiring a mode change, which is required at the surface. Due to its physical location in the midsection of the high passenger demand segment between Boylston Station and the South Boston Waterfront, rather than at the end, a retrofit of the existing Phase II turnaround loop at South Station would be of no operational use to the short-turned vehicles serving the high demand stations between Boylston Street and the South Boston Waterfront. As further described in Section 2.3.4.3, alternatives that exclude a turnaround loop fail to satisfy this key criterion.

Travel demand and ridership levels for the Silver Line Phase III are significantly affected by access time to stations, passenger travel times within the system, and the ability to maintain vehicle headways. As further described in Section 2.3.4.3, Tremont Street alignment alternatives with a single mid-block station fail to satisfy the criterion of maintaining ridership levels because of longer access times, longer trip times, and longer dwell times that would exceed the vehicle headways, resulting in unacceptable service delays and vehicle queues throughout the system.

2.2.4 Cost Effectiveness and Eligibility for Federal Funding

The cost effectiveness of the Silver Line Phase III project alternatives is key to obtaining federal funding under FTA’s Section 5309 New Starts program. Projects seeking New Starts funding must make annual submittals to FTA detailing the proposed project’s justification and costs. Project justification is determined by equal weights placed by FTA on cost effectiveness and transit-supportive land use. Cost effectiveness is calculated according to FTA guidance by

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1 The MBTA has consistently received a high rating from FTA on its transit-supportive land use. In addition to the two key New Starts criteria, there are other project justification criteria reported to FTA: mobility, operating efficiencies, and environmental benefits. These other criteria are typically considered in a project justification rating only in cases where an overall project justification is on the cusp of two rating categories.
dividing the annualized capital and operating costs of each alternative by the annual travel time savings enjoyed by new and existing riders of the transit system; these travel time savings are referred to as "user benefits". In March 2005, FTA determined that projects must receive a cost effectiveness rating of medium or better to be eligible for New Starts funding. Because federal funds are needed to implement the Phase III project, the alternatives must be evaluated on both overall costs as well as user benefits. Any alternative that cannot achieve a cost effectiveness rating of medium or higher will not be considered by the MBTA.

2.3 Chronology and Description of Alternatives

The following section summarizes the evolution and screening of the alignment alternatives for Phase III of the Silver Line, beginning with a summary discussion of the original project alignment presented in the 1993 FEIS/FEIR. Table 2.3-1, at the end of the chapter, provides a comparative summary of the alternatives considered. A more detailed discussion of these alternatives was presented in the 3rd Annual Update Pursuant to M.G.L. Section 61 filed with EOEA in December 2003. The 2003 3rd Annual Update is hereby incorporated by reference.

2.3.1 1993 FEIS/FEIR Alignment

The tunnel alignment for the Silver Line from South Station to Boylston Street was originally proposed along Essex and Avery Streets, documented in the 1993 FEIS/FEIR for the South Boston Piers Transitway. (This alignment is shown in Figure 2.3-1.) The 1993 FEIS/FEIR alignment, which was designed to provide direct connections to the Green and Orange Lines, extended in a tunnel from South Station west along Essex Street, Avenue de Lafayette, Hayward Place, and Avery Street. A new underground station was proposed near the intersection of Washington Street and Hayward Place at which transfers could be made to Chinatown Station on the Orange Line via a pedestrian tunnel. From there, the alignment continued west along Avery Street to a new station and platform one level below the existing Green Line Boylston Station platforms. A tunnel loop was proposed in the vicinity of the Central Burying Ground on the Boston Common to allow the vehicles to reverse direction to South Station. There was no portal to surface proposed as part of this alternative; the entire alignment was in a tunnel.

The FEIS/FEIR alignment received a ROD from FTA under NEPA, and a final Certificate from EOEA under MEPA, concluding environmental review and approving this alignment in 1994. Furthermore, the MBTA negotiated and executed an MOA with the MHC and the FTA pursuant to Section 106 of the National Historic Preservation Act for the FEIS/FEIR tunnel loop under Boston Common in the vicinity of the Central Burying Ground.

2.3.2 1999 Notice of Project Change Alignment

The 1999 NPC established Phase III of the Silver Line, allowing a connection between Phase I, with service on Washington Street between Dudley and Downtown, and Phase II, providing service between South Station, the South Boston Waterfront area, and Logan Airport. The NPC alignment included the approved Avery Street alignment, as documented in the 1993 FEIS/FEIR, serving as the core tunnel segment of Phase III. Phase III then continued in a tunnel alignment extending south along Tremont Street to the Chinatown YMCA, where the tunnel turned east to a portal on Washington Street, just north of the intersection with Oak Street. A new underground Silver Line Station connecting to the Orange Line NEMC Station was proposed, in addition to the Silver Line Boylston and Chinatown Stations proposed along the 1993 FEIS/FEIR alignment. (See Figure 2.3-2)
Figure 2.3-1
1993 FEIS/FEIR Alignment

1993 FEIS/FEIR Alignment

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

AVERY STREET ALIGNMENT

SILVER LINE PLATFORMS AT BOYLSTON STATION

EXISTING SILVER LINE PHASE II (SOUTH BOSTON PIERS TRANSITWAY)

SILVER LINE PLATFORMS AT CHINATOWN STATION

EXISTING SILVER LINE PHASE II (SOUTH BOSTON PIERS TRANSITWAY)

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Figure 2.3-1
1993 FEIS/FEIR Alignment
Figure 2.3-2
1999 Notice of Project Change
Alignment
2.3.3 Preliminary Engineering (PE) Request/2nd Annual Update Alignment

In April 2000, the alignment for a portion of the core tunnel segment was modified and relocated one block south, from Avenue de Lafayette and Avery Street to an Essex/Boylston Street alignment, as initially presented in the Essex/Boylston Street Alignment Conceptual Design Report. (See Figure 2.3-3.) The Essex/Boylston Street alignment has formed the basis for all subsequent alignments of the Core Tunnel Segment described in this document. This modified alignment was found preferable to the previous Avery Street alignment because of subsequent changes that had occurred in actual and planned development along the Avery Street corridor following completion of the 1993 FEIS/FEIR, along with the modified alignment’s reduced impacts on historic resources and parklands.

The MBTA presented the modified Silver Line Phase III conceptual design in its request to the FTA to initiate preliminary engineering (January 2002), and in the 2nd Annual Update Pursuant to M.G.L. Section 61 submitted to EOEA (October 2002). The Silver Line Phase III alignment as presented in the 2002 documents was comprised of a tunnel following alignments along Essex, Boylston, and Tremont Streets, with a turnaround loop tunnel under the southeastern corner of the Boston Common. The Essex/Boylston Street alignment followed Essex and Boylston Streets between South Station and Boylston Station, with Silver Line Stations provided in the core tunnel segment at the existing Chinatown (Orange Line) and Boylston (Green Line) Stations. FTA approved initiation of preliminary engineering in July 2002.

The Essex/Boylston Street alignment reduced impacts on private property. (By contrast, the 1993 FEIS/FEIR Avery Street alignment would have passed completely beneath both the Millennium Place Development and the Textile Building, and through the future development parcel at Hayward Place.) At the time of the 1993 FEIS/FEIR, the Hayward Place/Avery Street Station location had been considered a preferred direct connection to the existing Orange Line Station. Due to the proposed large-scale mixed-use development then planned for the Hayward Place parcel, the MBTA and the Boston Redevelopment Authority (BRA) considered that location as a better opportunity to encourage transit oriented development. That development project, however, has not progressed; in the meantime, the large Millennium Place project has been completed one block south, obstructing the original Avery Street alignment. Therefore, the currently proposed Essex/Boylston Street alignment and Chinatown Station location presents a better design in terms of relative impacts and coordination of transit investments with development patterns.

The Essex/Boylston Street alignment provides a straighter alignment better suited to transit operations. This is a safer and more operationally efficient tunnel configuration than the Avery Street alignment, which used an at-grade tunnel crossing entering and exiting the station. The new alignment also eliminated the need for a 290-foot long pedestrian tunnel connecting the proposed Silver Line Chinatown Station with the existing Orange Line Chinatown Station, by locating the new Silver Line Station beneath the Orange Line Station, which provides for more convenient passenger transfers. Finally, the Essex/Boylston alignment reduced the impact to historic and culturally sensitive areas of the Boston Common, by relocating the Boylston Station turnaround loop from the vicinity of the Central Burying Ground (as had been proposed by the Avery Street alignment) to a location under the Boston Common north of the proposed station.

As in the 1999 NPC alignment, the Tremont Street portal route alignment provided an extension of the Silver Line tunnel from Boylston Station to a new Silver Line NEMC Station, providing an operational connection to the Silver Line Phase I service via a tunnel portal and ramp to the surface at Washington Street. The Chinatown YMCA occupies the location of the Silver Line portal to Washington Street that was proposed in the 2002 alignments. The Chinatown YMCA would have needed to be demolished and relocated to a new off-site location under this portal route alignment.
2.3.4 Alignment Alternatives Presented in the 3rd Annual Update

Approval to initiate preliminary engineering was received from FTA in July 2002. Following selection of the consulting team, the MBTA then initiated Preliminary Engineering in 2003. As part of that engineering process, the MBTA undertook a further analysis and screening of portal route alternatives. These alternatives, which were discussed in detail in the 2003 3rd Annual Update Pursuant to M.G. L. Section 61, and are summarized below, were developed in response to comments from the FTA encouraging the MBTA to improve the cost effectiveness of the project, as well as in response to comments from the community regarding the proposed taking and relocation of the Chinatown YMCA. Out of this process emerged the basis for the Tremont Street/NEMC Portal alternative and the Charles Street/NEMC Portal alternative that are analyzed in this SDEIS/EIR. In addition, a wide range of other portal route alignments were screened and eliminated as infeasible or imprudent.

2.3.4.1 Screening of Initial Portal Options

As discussed in the 3rd Annual Update, a series of alternatives to the original portal location were initially developed (part of the 2003 Group 1 Alternatives) that responded to community concerns regarding the taking of the Chinatown YMCA. A total of nine alternative inbound and outbound portal location options that avoided the Chinatown YMCA were evaluated through a screening process, with particular attention on technical feasibility and impacts on the local environment, including vehicular and pedestrian traffic and parking.

All of the portal location options avoided impacts to the Chinatown YMCA. These preliminary portal locations are indicated on Figures 2.3-4 through 2.3-6 and are described below. Each figure indicates the portal location options relative to the Chinatown YMCA portal, which has been eliminated. In addition, each option eliminated the underground NEMC Silver Line Station in favor of an at-grade station. Based on the preliminary portal location screening study, Portal Location Option 3, which calls for a dual inbound and outbound portal located between the Doubletree Hotel and the NEMC parking garage, was selected as the portal location for each of the subsequently developed Group 1 alignment alternatives. All other portal locations were eliminated from further consideration based on flaws identified in the portal location study and summarized for each location below.

**Tremont Street – Portal Location Option 1**

This option calls for the inbound portal to be located between the Doubletree Hotel and the NEMC parking garage and the outbound Portal to be located on the far (west) side of Tremont Street just north of the intersection with Oak Street to provide room for a bus stop location. Three one-way travel lanes would be retained on Tremont Street, but 25 parking spaces along Tremont Street would be lost for the length of the portal ramp. This option was eliminated because of excessive impacts.

**Tremont Street – Portal Location Option 2**

This option calls for the inbound portal to be located on Oak Street and the outbound portal to be located on the far (west) side of Tremont. Ramping down to the portal on Oak Street would reduce Oak Street to a one-way street. As a result, 25 parking spaces would be lost on Tremont Street, and sidewalk and pedestrian routing conflicts would be created at the northwest corner of the Oak and Tremont Street intersection. This option was eliminated because of excessive impacts.
Figure 2.3-4
Preliminary Portal Options
Figure 2.3-5
Preliminary Portal Options

TREMONT STREET - PORTAL LOCATION OPTION 4

TREMONT STREET - PORTAL LOCATION OPTION 5

TREMONT STREET - PORTAL LOCATION OPTION 6

TREMONT STREET - PORTAL LOCATION OPTION 7
Figure 2.3-6
Preliminary Portal Options
Tremont Street – Portal Location Option 3

This option calls for a dual inbound – outbound Portal located between the Doubletree Hotel and the NEMC parking garage. Off-street parking at the Auto Parks lot and Doubletree Hotel would be affected, but there would be no loss of parking on Tremont Street. However, some on-street parking spaces would be lost on Washington Street to accommodate the portal ramp to grade. Development rights over the portal ramp (boat section) would be retained.

Tremont Street – Portal Location Option 4

This option calls for two portals, inbound and outbound, both located on Tremont Street. The Inbound portal would be located on the east side of Tremont and buses would enter from Oak Street. This parallel dual alignment of portals along Tremont Street would significantly restrict traffic operations by reducing the number of travel lanes to two lanes and sidewalk widths to a maximum of eight feet. In addition, 25 on-street parking spaces would be lost. Excavation of both portal ramps would require an extended construction schedule, thus extending the period of construction impacts on Tremont Street. This option was eliminated because of excessive impacts.

Tremont Street – Portal Location Option 5

This is a variation of Option 4. The outbound portal on Tremont Street would be pushed back to the north, offsetting it from the inbound portal and thereby avoiding the restriction of traffic lanes associated with Option 4. However, pushing the portal further north moves the ramp section to an area of unfavorable surface road profile; it would require a significantly longer open ramp (boat section) to the portal along Tremont Street, which would extend back to Stuart Street through the area of the Wang and Shubert Theatres. Operationally, three travel lanes would be retained, but all on-street parking along Tremont Street from Oak Street to Stuart Street would be lost. In addition, all mid-block street pedestrian access and crossing would be blocked. This option was eliminated because of excessive impacts.

Shawmut Avenue – Portal Locations Option 6 and Option 7

These two options are variants of one another; they would locate one portal in the Shawmut Avenue block between Oak Street and Marginal Road, and the other portal on Tremont Street north of Oak Street. The options only vary as to the placement of the inbound or outbound portal on Shawmut Avenue. The problem with these two options is the limited length of Shawmut Avenue and its unfavorable grading. The boat section ramping up or down on Shawmut Avenue would have to be completed with the face of portal or tunnel entrance set just before the Oak Street intersection. This could only be accomplished by raising the intersection elevation approximately seven feet which is clearly problematic given the abutting properties and proximity of other roadway intersections. These options were eliminated because of excessive impacts and technical infeasibility.

Washington Street – Portal Location Option 8 and Option 9

These two options are variants of one another; they would locate the portal on Washington Street beyond the MBTA Orange Line Station entrance and prior to Stuart Street, either as two portals (inbound and outbound) located to the outsides of the travelway, or as a common dual portal down the middle of the street. Parking on both sides of Washington Street would be lost, and pedestrian street-crossing movements would be blocked under either of these options. In addition, the shallow cover depth over
the existing Orange Line Tunnel makes Options 8 and 9 infeasible to construct. These options were eliminated because of excessive impacts and technical infeasibility.

2.3.4.2 2003 New Starts Alternative

The alignment identified as the 2003 New Starts Alternative, which was presented to FTA in the annual New Starts submittal on August 29, 2003, was similar to the 2nd Annual Update Pursuant to M.G. L. Section 61 alignment described in Section 2.3.3 above, with the following changes. The 2003 New Starts Alternative eliminated the underground Silver Line NEMC Station, and it relocated the Washington Street tunnel portal to a parcel located between the Doubletree Hotel and the NEMC Garage (portal location Option 3 above). Under this alternative, the Silver Line Station at the NEMC would be on the surface. The NEMC portal was selected since, in addition to eliminating the need to take and relocate the Chinatown YMCA, it did not require the taking of existing travel lanes, and it resulted in the least impact to vehicular and pedestrian traffic and parking of the nine alternatives evaluated. (See Section 2 of the 3rd Annual Update for additional discussion of this screening process. The 2003 New Starts Alternative is one of the Group 1 Alternatives discussed in the 3rd Annual Update.)

In addition to the NEMC portal relocation, this stage of the alternatives analysis also examined ways in which the capital costs of Silver Line Phase III could be reduced, while maintaining ridership and other project benefits. Eliminating the cost of taking and relocating the Chinatown YMCA supported this objective, as did elimination of the underground NEMC Station. Additionally, three additional Group 1 alternatives (all of which incorporated the NEMC portal location as proposed in the 2003 New Starts Alternative) looked at the cost savings and ridership impacts of replacing the separate Silver Line Stations at Boylston and Chinatown Stations with a single mid-block station on Essex Street. These alternatives were examined to determine the cost savings that would be afforded by one combined station and, in two cases, elimination of the Boylston Loop as well.

All four of the 2003 Group 1 Alternatives (2003 New Starts, plus three mid-block alternatives; Mid-Block/No Loop; Mid-Block/Bidirectional South Station Loop, and Mid-Block/Non-revenue Loop) utilized a Tremont Street alignment and avoided taking and relocating the Chinatown YMCA. (See Figures 2.3-7, 2.3-8, 2.3-9, and 2.3-10.) However, as discussed previously and in Section 2.3.4.3 following, the Mid-block and No-loop alternatives presented operational deficiencies and reduced ridership, when compared to the 2003 New Starts Alternative, which provides Silver Line platforms at both the existing Green and Orange Line Stations at Boylston Station and Chinatown. The 2003 New Starts Alternative was the only one of the Group 1 alternatives found to be feasible, because it alone could meet the critical cost effectiveness threshold according to FTA requirements. In addition, each of the Mid-block alternatives failed to satisfy design and/or operational criteria established for Silver Line Phase III. Thus, the three mid-block station alternatives were eliminated from further consideration.

2.3.4.3 Screening of Mid-block and No-loop Alternatives

Three of the Group 1 alternatives presented in the 3rd Annual Update and then eliminated from further consideration proposed a mid-block station concept (instead of a separate Chinatown and Boylston Silver Line stations) and/or eliminated a Boylston turnaround loop. This section discusses why the mid-block and no loop alternatives were eliminated because of failure to satisfy the design, operational, and/or cost-effectiveness criteria for Silver Line Phase III.
Figure 2.3-9
Midblock Bi-directional
South Station Loop Alternative
Boylston Loop

As described in Section 2.2.3, the Silver Line service plan provides a high service frequency and person-capacity within the “Core” Tunnel Segment to serve the high passenger demand between the downtown core and the South Boston Waterfront. To adequately meet this demand, approximately three out of four vehicles are “short-turned” after the Boylston Station for a return inbound trip towards the waterfront. The Boylston Loop allows short-turning vehicles to complete this movement in the quickest possible fashion, so that vehicles may be re-entered into revenue service in the opposite direction of travel, thereby minimizing operating costs and vehicle requirements.

An existing unidirectional turnaround loop, located just beyond South Station at the terminus of the Phase II alignment is currently used to reverse Phase II vehicles at the end of their inbound trips. Under Phase III operations, this turnaround loop would be located in the midsection of the high passenger demand segment between Boylston Station and the South Boston Waterfront, rather than at the end. Due to its physical location in the “center” of the Phase III high demand segment, a turnaround loop at South Station would be of no operational use in meeting this goal.

In the full build scenario with the Boylston Loop, approximately 18 vehicles/hour in each direction would pass through the NEMC or Columbus portals. If the Boylston Loop were removed from the Phase III alignment, the “short-turning” movement would have to be completed outside of the Silver Line portal on surface streets and all 74 vehicles/hour would pass through the portal in each direction, taxing the capacity of the portal and surrounding streets. This situation would result in increased travel time and operating costs, unpredictable service delays due to traffic congestion, and added vehicle delays related to inbound and outbound mode changes. (See Technical Appendix A for a more detailed discussion of the Boylston Loop.)

The Boylston Loop ensures that the physical infrastructure of the Phase III tunnel meets the operational requirements of the full build service plan and the forecasted ridership patterns. Therefore, those alternatives that did not include an underground turnaround loop, or provided for a loop at South Station, were eliminated from further consideration because of failure to satisfy these criteria.

Mid-Block Station

Instead of individual Chinatown and Boylston Stations as part of the Core Tunnel Segment, the “mid-block” station concept would provide only one station located along Boylston Street between Washington and Tremont Streets, with pedestrian connections to both the Orange Line (at Chinatown Station) and the Green Line (at Boylston Station). One presumed benefit of this concept was that by building one station instead of two, the MBTA could reduce the capital cost of the project, thereby making it more competitive from a financial point of view. The Mid-Block concept was initially studied in 2003, and presented in the 3rd Annual Update among the Group 1 alternatives utilizing a Tremont Street alignment. It was then reevaluated in response to comments on the 3rd Annual Update, assuming a Tremont Street alignment, with a portal at NEMC and a turnaround loop at Stuart Street. The following provides a summary of the reasons why this concept was eliminated from consideration. A more detailed discussion may be found in Technical Appendix A.

The MBTA evaluated the concept of a mid-block station with regard to three Silver Line Phase III criteria:

1. Technical Feasibility: Conformance to MBTA Design, Engineering and Construction Standards;

2. Station Functionality and Transit Operations; and,
3. Financial Feasibility: Capital and Operating Costs, and Cost-Effectiveness as defined by the FTA.

MBTA Design, Engineering and Construction Standards

As described in Section 2.2.2, the MBTA established a maximum preferred grade of 5 percent for the Silver Line in 1993, with an absolute maximum of 6 percent under specific circumstances. The Silver Line Phase Bus Rapid Transit (BRT) dual mode vehicle is constrained to operate at a maximum grade of 6 percent. The Mid-Block alignment utilizing Tremont Street would require a grade of 6.4 percent along Tremont Street between the NEMC portal and Boylston Street. This grade exceeds both the 5 percent maximum preferred grade and the 6 percent absolute maximum grade criteria.

Station Functionality and Transit Operations

As described in Section 2.2.4, one of the major determinants for a successful transit station or system is its ability to function under the proposed service plan. Access time, passenger travel time and vehicle headways are significant factors affecting travel demand for the service. A single mid-block station would on average, be further away from a group of trip origins and destinations than two stations. The longer access time to a mid-block station would increase the overall passenger travel time, which in turn would make the trip less attractive to potential users, thereby reducing ridership. Transfer time is another important factor. The longer it takes to transfer (for example between the Orange Line and the Silver Line), or the more cumbersome that transfer is, the less likely a person is to make the trip and therefore, ridership would be reduced.

A mid-block station would serve the same passenger catchment area as the two individual Boylston and Chinatown Stations, and therefore the passenger demand at the mid-block station would be higher than at either of the two individual stations. However, there is less platform capacity at the mid-block station to meet this demand. The two stations provide a total of two platforms with six vehicle berths per direction. The mid-block station on the other hand provides a single three-berth platform per direction to service essentially the same demand, in spite of the longer vehicle dwell times at the mid-block station. The longer dwell times are needed to accommodate the higher levels of passenger boarding and alighting which then translate into vehicle delays, reduced system capacity, longer passenger travel times, and reduced ridership.

More importantly, during peak periods the dwell time at a mid-block station could quite often exceed the vehicle arrival headways (approximately 49 seconds), resulting in unacceptable service delays throughout the system. With only three berths per direction at the mid-block station as opposed to a combined six berths at Boylston Station and Chinatown, the system will be less adept at absorbing these operational “shocks” without impacting service elsewhere in the system.

Lengthening of the mid-block platform to include four or more vehicle berths would have little, if any, operational benefit. In the absence of a passing lane, which is infeasible due to right-
of-way and cost considerations (discussed below), having more than three “in line” berths in this station yields virtually no additional platform capacity—yet it would result in a significant capital cost increase.

Capital and Operating Cost and Cost Effectiveness

As described in Section 2.2.4, the financial feasibility criterion reflects upon eligibility for federal New Starts funding. Funding eligibility requires satisfying the FTA’s cost effectiveness standards. The mid-block station alternative would have a capital cost similar to the two-station alternatives (Boylston and Chinatown), due to additional elements associated with the station design and the turn around loop. A mid-block station would need to be larger to accommodate a higher passenger volume and emergency egress at a single station, as compared to each of the two individual stations. Boylston Street at the proposed Mid-block station location has a narrow right-of-way, so a wider station would encroach on private property for most of its length. Abutting structures (many of which are historic) would need to be underpinned to accommodate the mid-block station, resulting in higher real estate acquisition and building mitigation costs than the two-station alternatives, which would be subject to greater risk of increase over time.

In addition, a turnaround loop at the Boylston and Charles Streets intersection would not be practical with a mid-block station, as a turnaround loop at this location would require longer non-revenue travel time. An alternate location for the loop was identified at the southwest corner of Tremont and Stuart Streets. The site, currently used as a parking lot, is proposed for the construction of a new, fully permitted, 25-story Loews Hotel. The turnaround loop would occupy parking and other service areas of the hotel that the MBTA would need to mitigate in their design and construction, resulting in significantly higher acquisition and building mitigation costs for this turnaround loop option.

In summary, while the capital cost of the mid-block alternative is similar to the other alternatives with two stations, it results in a drop in ridership and user benefits, thus giving the mid–block alternative a poor cost-effectiveness ratio when compared to the two-station alternatives. As a result, the MBTA determined that a mid-block alternative is neither prudent nor feasible, based on the Silver Line Phase III screening criteria, and it was eliminated from further consideration.

As part of an on-going effort, the MBTA will continue to review design alternatives that reduce cost and minimize disruption to abutters without sacrificing adequate service to the ridership including a mid-block station alternative.

2.3.4.4 Revised Group 2 Alternatives

The Group 2 Alternatives, which were also described in the 3rd Annual Update, evolved from the 2003 New Starts Alternative in response to two issues. First, the ridership forecasting conducted in support of the New Starts submittal to FTA indicated that the passenger demand for the Silver Line would exceed the vehicle berthing capacity of the single Silver Line platform proposed for Boylston Station under the 2003 New Starts Alternative. Second, the MBTA held meetings with representatives from the City of Boston Parks and Recreation Department, the Boston Landmarks Commission, and the Massachusetts Historical Commission at which concern was expressed regarding the impacts of constructing the Silver Line Boylston Station and turnaround loop alignment beneath the southeast corner of the Boston Common.

The MBTA undertook an additional alternatives analysis during the fall of 2003 to examine ways of addressing these two issues, while at the same time maintaining ridership levels and not exceeding the capital cost and user-benefits benchmark of the 2003 New Starts Alternative. All of the Revised Group 2 alternatives kept the same alignment along Essex and Boylston Streets as the 2003 New Starts Alternative.
One of the Revised Group 2 alternatives (Revised New Starts Alternative) proposed modifications to the Boylston Loop Silver Line Station platform to accommodate the projected ridership demand, thereby enlarging the size of the loop beneath the Boston Common. (See Figure 2.3-11.) The other three alternatives (Tremont Street (see Figure 2.3-12), Charles Street with NEMC Portal, and Charles Street with Elliot Norton Park Portal Alternatives) replaced the Boylston Loop with alternate Boylston Station and turn-around loop locations. This version of a Tremont Street alignment located Boylston Station within Tremont Street and the turnaround loop at Stuart Street. Both of the Charles Street alternatives located Boylston Station within Boylston Street and the turnaround loop entirely within the roadway intersection of Boylston and Charles Streets, thereby eliminating potential impacts of the turnaround loop to the Boston Common. (This turnaround loop location is now part of the Core Tunnel Segment.) In addition, an alternate to the NEMC portal location (Elliot Norton Park) was investigated for the Charles Street alignment alternatives.

As discussed in the 3rd Annual Update, each of the Group 2 alternatives met the MBTA’s cost effectiveness objective. Therefore, the key considerations for screening of the Group 2 alternatives were engineering design criteria relative to system operation and safety. While the Tremont Street/Stuart Street Loop Alternative had a slightly lower capital cost (primarily due to a shorter tunnel length), the grade constraints posed by the location of Boylston Station within the Tremont Street corridor and the geometry of the turn-around loop on Stuart Street resulted in a design that did not meet the MBTA’s design standards from an operational and safety perspective. This alternative would require a grade of 8.5% along Tremont Street between Boylston Station and the NEMC portal, which exceeds the maximum allowable grade of 6% as described in Section 2.2.2.

For these reasons, the design would not have been compatible with the design of the Silver Line Phase II portion of the tunnel, nor would the design have been compatible for future conversion to light rail, as described in Section 2.2.2. It also resulted in a shorter inbound platform at Boylston Station than the other alternatives. In addition, the Stuart Street loop would have required a permanent easement through the Loews Hotel development site, creating a significant impact to the hotel’s subsurface parking and other hotel functional areas (laundry, kitchen etc.) which would need to be financially mitigated and accommodated by joint development. (See the previous discussion in Section 2.3.4.3.) Therefore, the 2003 Tremont Street Alignment Alternative was eliminated from further consideration. (A more detailed discussion of the evaluation and screening process is provided in the 3rd Annual Update.)

The remaining three alternatives, the Revised New Starts Alternative, and the Charles Street alignment alternatives with a portal at either NEMC or Elliot Norton Park, were considered as viable candidates for Phase III of the Silver Line, and they were presented for public review and comment in the 3rd Annual Update.

Public comment on the alternatives presented in the 3rd Annual Update indicated that the new portal alignments defined by the Group 2 Alternatives extended the impacts of the project into areas and neighborhoods that had not previously been considered during the earlier MEPA and NEPA review procedures. As a result, several new issues arose from the communities that would now be affected by the project, among them:

- Concern over potential construction phase impacts to Elliot Norton Park associated with the Charles Street/NEMC Portal Alignment, and the potential for permanent impacts associated with the Charles Street/Elliot Norton Park Portal Alignment. The Bay Village neighborhood requested additional investigation of a Tremont Street alignment to avoid these park impacts. (See the Mid-block station discussion in Section 2.3.4.3.)
Figure 2.3-11
Revised New Starts
Alternative
Figure 2.3-12
Tremont Street Alternative with Stuart Street Loop
• Continued concern over the impacts of the Boylston turnaround loop associated with the Revised New Starts Alternative upon the Boston Common. The MBTA’s response to this concern led to development of a new Tremont Street alignment with a turnaround loop at Boylston and Charles, presented in the 2004 NPC (see Section 2.3.5).

• A request to consider alternate portal locations that would more directly facilitate service to the Back Bay, as well as to the Washington Street corridor. The MBTA’s response to this request led to development of the Columbus Avenue alignment alternative (see Section 2.3.5).

2.3.5 2004 Notice of Project Change Alignment Alternatives

Based on the comments received on the 3rd Annual Update, the MBTA determined that a SDEIS/EIR would provide an opportunity for full public review and comment on the alternative alignments under consideration for Silver Line Phase III. A Notice of Project Change (NPC) was submitted to EOEA in June 2004 to initiate this process. Each of the alignment alternatives submitted in the 2004 NPC had in common a Core Tunnel Segment from South Station that follows Essex and Boylston Streets to Boylston Station, with a turnaround loop at the intersection of Charles and Boylston Streets. The following alternative alignments from the loop to a portal were presented in the 2004 NPC:

• Tremont Street alignment to a NEMC Portal
• Charles Street alignment to a NEMC Portal
• Charles Street alignment to an Elliot Norton Park Portal

(See Figure 2.3-13.)

In addition to serving the Washington Street corridor as far as Dudley Station, the project will also provide service to the Back Bay, providing a much needed connection from both areas to Downtown, the South Boston Waterfront, and Logan Airport. Throughout the development of the project, individuals and stakeholders have raised the concept of shifting the portal to a location closer to the Back Bay, making this connection more direct. Under such an alignment, the MBTA would still connect to Phase I service in Washington Street, but via a portal in the Columbus Avenue area, as opposed to a portal on Washington Street. Because this suggested alignment had not yet been fully studied or made available for public comment, it was not proposed as a full-fledged alternative in this NPC. However, as part of the SDEIS/EIR scoping process, the MBTA requested public comment as whether the Columbus Avenue Alternative should be included for detailed impact analysis in the SDEIS/EIR.

2.4 SDEIS/EIR Alternatives

The MBTA revised its candidate list of Silver Line Phase III alternatives for consideration in the SDEIS/EIR based on comments received on the 2004 NPC. The Charles Street alignment with a portal at Elliot Norton Park was eliminated from further consideration, due to its potential to create permanent adverse impacts to the park, and because of the availability of other alternatives that would meet the project’s purpose and need with lesser potential for impacts. The Columbus Avenue Alternative was added to the list of SDEIS/EIR alternatives.

In addition, the FTA requested that the MBTA consider an additional alternative that combined elements of the Charles Street and the Tremont Street alignments, while entirely avoiding Elliot Norton Park. This alternative alignment (known as the Stuart Street alignment) extends south from the Boylston/Charles Street turnaround loop along Charles Street, turning east on Stuart Street, and then south on Tremont Street to the NEMC portal.
The following lists the Build Alternative alignments and portals that are included for a detailed analysis in this SDEIS/EIR. Each of these alignment alternatives incorporates the Core Tunnel Segment.

- Tremont Street alignment to a NEMC Portal
- Charles Street alignment to a NEMC Portal
- Charles Street/Stuart Street/Tremont Street alignment to a NEMC Portal
- Columbus Avenue alignment to a Columbus Avenue Portal

A detailed description of each of the SDEIS/EIR alternatives is presented in Chapter 3.
### Table 2.3-1 — Comparative Summary of Alternatives Considered

<table>
<thead>
<tr>
<th>Alternative</th>
<th>South Station to Boylston Station* alignment</th>
<th>Chinatown Station</th>
<th>Boylston Station</th>
<th>Mid-Block Station</th>
<th>Turn around Loop</th>
<th>Boylston Station* to Portal Alignment</th>
<th>Portal Location</th>
<th>Comments/ Reasons For Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1993 ROD</strong></td>
<td>Alignment</td>
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<td></td>
<td>Essex Street, Avenue de Lafayette, Hayward Place, Avery Street</td>
<td>Under Avery Street</td>
<td>Under Boston Common</td>
<td>N/A</td>
<td>Under the Central Burying Ground, Boston Common</td>
<td>None</td>
<td>None</td>
<td>New development within ROW interferes with original alignment. Boston Common impacts.</td>
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<tr>
<td><strong>2002</strong></td>
<td>Preliminary Engineering Request Alignment</td>
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<td></td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Streets</td>
<td>Under Boston Common</td>
<td>N/A</td>
<td>Under Boston Common</td>
<td>Tremont Street</td>
<td>Chinatown YMCA</td>
<td>Community impacts from taking YMCA. Boston Common impacts. High cost with an underground NEMC station.</td>
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<tr>
<td><strong>2003 3rd Annual Update</strong></td>
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<tr>
<td>Group 1</td>
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<td></td>
<td>2003 New Starts</td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Streets</td>
<td>Under Boston Common, one platform</td>
<td>N/A</td>
<td>Under Boston Common</td>
<td></td>
<td>One platform at Boylston Station inadequate for ridership demand. Boston Common impacts.</td>
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<td></td>
<td>Mid-Block/No Loop</td>
<td>To Mid-Block Station - Essex Street, Boylston Street</td>
<td>N/A</td>
<td>N/A</td>
<td>Under Boylston Street w/ pedestrian connections to Green Line and Orange Line</td>
<td>None</td>
<td>* From Mid-Block Station - Tremont Street</td>
<td>Mid-Block Station insufficient to serve ridership projections and demand. No-Loop fails to meet operational demand between Boylston Station district and the South Boston Waterfront.</td>
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<td></td>
<td>Mid-Block/ Bidirectional South Station loop</td>
<td>To Mid-Block Station - Essex Street, Boylston Street</td>
<td>N/A</td>
<td>N/A</td>
<td>Under Boylston Street w/ pedestrian connections to Green Line and Orange Line</td>
<td>South Station</td>
<td>* From Mid-Block Station - Tremont Street</td>
<td>Mid-Block Station insufficient to serve ridership projections and demand. South Station bidirectional loop fails to meet operational demand between Boylston Station district and the South Boston Waterfront.</td>
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<td></td>
<td>Mid-Block/Non-Revenue loop</td>
<td>To Mid-Block Station - Essex Street, Boylston Street</td>
<td>N/A</td>
<td>N/A</td>
<td>Under Boylston Street w/ pedestrian connections to Green Line and Orange Line</td>
<td>Under Boston Common</td>
<td>* From Mid-Block Station - Tremont Street</td>
<td>Mid-Block Station insufficient to serve ridership projections and demand.</td>
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<tr>
<td>Group 2</td>
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<td></td>
<td>Revised 2003 New Starts</td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Street</td>
<td>Under Boston Common, two platforms</td>
<td>N/A</td>
<td>Under Boston Common</td>
<td>Tremont Street</td>
<td>Between NEMC garage and the Doubletree Hotel</td>
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<td></td>
<td>Tremont Street w/Stuart Street loop</td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Street</td>
<td>Under Tremont Street</td>
<td>N/A</td>
<td>Stuart Street</td>
<td>Tremont Street</td>
<td>Between NEMC garage and the Doubletree Hotel</td>
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<td></td>
<td>Charles Street/ Elliot Norton Park portal</td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Street</td>
<td>Under Boylston Street</td>
<td>N/A</td>
<td>Charles/Boylston Streets</td>
<td>Elliot Norton Park</td>
<td>Permanent, adverse impacts to Elliot Norton Park.</td>
</tr>
</tbody>
</table>

**SDEIS/EIR Alternatives**

<table>
<thead>
<tr>
<th>Core Tunnel Segment</th>
<th>Portal Alignments</th>
<th>SDEIS/EIR alternative</th>
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<tbody>
<tr>
<td>Charles Street/ NEMC Portal</td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Street</td>
</tr>
<tr>
<td>Tremont Street/NEMC Portal</td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Street</td>
</tr>
<tr>
<td>Stuart Street/NEMC Portal</td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Street</td>
</tr>
<tr>
<td>Columbus Avenue/Columbus Avenue Portal</td>
<td>Essex Street, Boylston Street</td>
<td>Under Essex/ Boylston Street</td>
</tr>
</tbody>
</table>

* Refers to mid-block station for those alternatives which propose a single mid-block station, since a separate Boylston Station would not be constructed.