Appendix 3.3-A

Northeast Corridor Fourth Track Construction Assessment

Northeast Corridor Fourth Track Construction Assessment

Prepared for

Massachusetts Depart of Transportation
Boston, Massachusetts

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1 Introduction

This memorandum examines the construction impacts and associated costs of adding a fourth track on the Northeast Corridor (NEC) from Readville Station to Back Bay Station. The fourth track was analyzed to address capacity issues related to the Attleboro Alternatives of the South Coast Rail (SCR) project.

As part of the SCR project, Systra Consulting Inc. (Systra) completed a report entitled, "Massachusetts Executive Office of Transportation, MBTA South Coast Rail (SCR) Project, Technical Memorandum, Network Simulation Analysis of Proposed MBTA/Amtrak Operation," Rev. 1.1, dated August 28, 2009. Systra's memorandum concluded that the Attleboro Alternatives of the SCR were infeasible due to the capacity issue of Tower 1 Interlocking at South Station in Boston.

Systra provided a follow-up memorandum on October 29, 2009, entitled "Analysis of South Coast Rail Attleboro Alternative PM Peak Period, Using Back Bay as Northerly Terminal (Tower I and South Station Effects Removed)". This subsequent memorandum analyzed the Attleboro Alternatives' PM Peak Period, stopping trains at Back Bay in lieu of continuing trains on to South Station. Systra concluded that unacceptable delays south of Back Bay Station would be encountered after implementation of the SCR Attleboro Alternatives, independent of any South Station constraints.

MassDOT prepared a memorandum to the US Army Corps of Engineers on May 5, 2010, describing the independent utility of South Station from the SCR project. This memorandum also provides a preliminary discussion of adding a fourth track between Forrest Hills Station and Back Bay Station. MassDOT concluded that adding the fourth track was infeasible due to property acquisitions, infrastructure challenges, and cost. MassDOT further indicated that the infeasibility of adding a fourth track is a conclusion that the Federal Railroad

Administration and Amtrak also reached. A copy of the MassDOT memorandum is attached in Appendix B.

Members of the Interagency Coordinating Group requested additional analysis to assess the infeasibility of constructing a fourth track. This construction assessment memorandum responds to the Interagency Group's request by quantifying construction impacts and costs associated with adding the fourth track to the NEC.

1.1 Project Description

The South Coast Rail Attleboro Alternatives, as shown by Systra's simulations in the above referenced technical memorandums, require the addition of a third track on the NEC south of Readville Station to support the increased train volumes which would result from the new commuter rail service to Fall River and New Bedford. East of Readville Station, the additional trains of the Attleboro Alternatives add considerable congestion on the NEC, reducing reliability of all services to unacceptable limits. In order to increase the capacity on the NEC that would be consumed by the South Coast Rail Attleboro Alternatives, a plan for a new fourth track was analyzed and is presented in this memorandum.

A large portion of the NEC in this area is constrained by the MBTA Orange Line, abutting properties, buildings, utilities, parks and retaining walls. This technical memorandum reviews the issues and constraints. It also identifies the anticipated impacts, develops an order of magnitude cost estimate, and a preliminary construction schedule.

Figure 1-1 shows a locus map of the area analyzed.

1.2 Existing Conditions

This memorandum focuses on the NEC from Readville Station to Back Bay Station, which is approximately 8.7 miles in length, with the MBTA's Orange Line running adjacent to the Commuter Rail for approximately 4.2 miles.

The NEC in this area consists of three tracks. It supports mixed corridor operations, including MBTA Commuter Rail service, Amtrak for service to Providence, New York City and Washington DC and CSX freight trains. In addition to these operations, the MBTA's Orange Line operates on two tracks that share the Right-of-Way (ROW) from Forest Hills Station to Back Bay Station, then proceeds underground to service the downtown area.

Three branches of the MBTA Commuter Rail system operate within this ROW: the Franklin Line from just east of Readville, the Needham Line from just east of Forest Hills and the Providence/Stoughton Lines. The railroad ROW expands to five tracks at Back Bay Station and enters "Tower 1" interlocking at South Station. At Back Bay Station, there are 146 MBTA Commuter Rail and 38 Amtrak Regional and ACELA trains currently operating on the NEC during regular weekday hours, per posted schedules by MBTA and AMTRAK. The maximum authorized speed (MAS) of the existing service along this section of the NEC is 120 mph from Readville Station up to the curve approaching Back Bay Station where the MAS is decreased to 30 mph.

There are currently five stations that service the Commuter Rail on the NEC in this area: Readville, Hyde Park, Forest Hills, Ruggles and Back Bay. Three of these are also serviced by the Orange Line: Forest Hills, Ruggles and Back Bay. Additionally, there are four subway stations served solely by the Orange Line: Green Street Station, Stony Brook Station, Jackson Square Station, and Roxbury Crossing Station. The existing Commuter Rail track layout is shown in Figures A-1 in Appendix A.

At Forest Hills Station, the NEC enters a cut section that extends through Back Bay Station. This area is very constrained, prohibiting expansion of the ROW without expanding the existing cut section. The Southwest Corridor Park is located on both sides of this cut as far as Massachusetts Avenue. There are also several locations where the park spans the ROW. North of Massachusetts Avenue, the park spans the ROW entirely along the top of the tunnel.

In addition to the restrictions noted here in, there are currently forty-two undergrade and overhead bridge crossings (including pedestrian overpasses) as well as eleven cut-and-cover tunnel sections with parks above them.

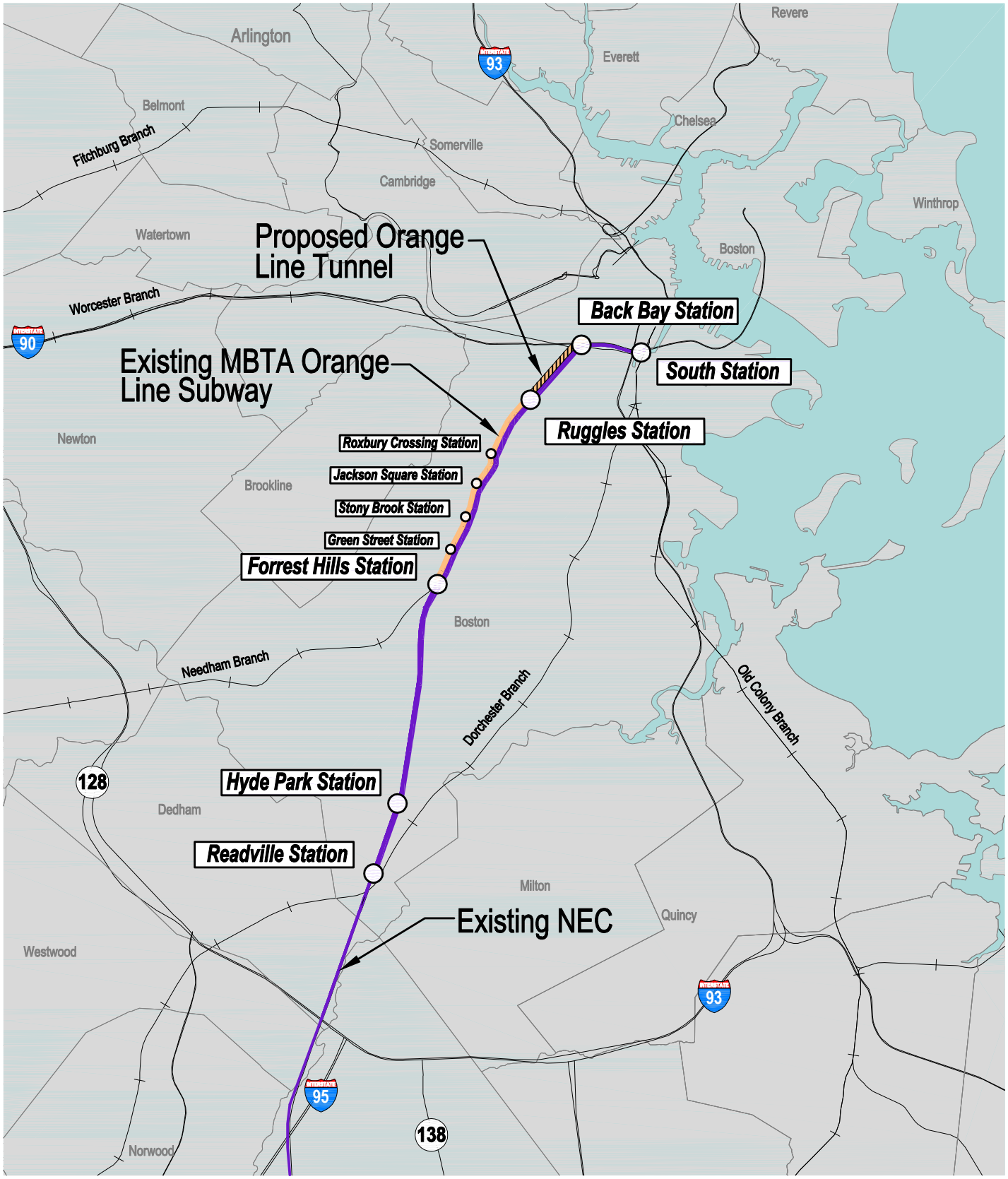

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Figure 1-1
Locus Map
Fourth Track Construction Assessment - Readville Station to Back Bay Station

Prepared by: VHB

2

Proposed Layout

Adding of a fourth track to the NEC was analyzed between Readville Station and Back Bay Station. By utilizing the existing track charts and aerial photographs to minimize impacts to the maximum extent practicable, the location of the fourth track was determined to be on either the north side of the tracks or the south side of the tracks, where inbound to Boston is considered east as per Amtrak's standard naming conventions.

East of Readville Station, the NEC has space for expansion on the north side of the existing tracks as far as Forest Hills. Physical space for the track construction exists, existing overhead catenary portals are large enough to accommodate an additional track, and the majority of existing bridges appear to have sufficient space.

At Forest Hills, the MBTA's Orange Line joins the NEC ROW on the south side of the tracks and continues along this alignment through Back Bay Station. This portion of the NEC and Orange Line exist in a cut section that is below existing grade. No structural cap exists over the cut section. The majority of the cut sections are open-top sections with no cover.

At Massachusetts Avenue, the NEC and Orange Line enter a cut section with a structural cap. Adjacent to this cut section are residential and commercial buildings, many of them high rises, that constrain expansion of the NEC to the north and south.

Due to the severity of constraints through different sections along the corridor, this memorandum analyzed an addition of a fourth track through this portion of the NEC in three sections:

- Section 1 – Between Readville Station and Forest Hills Station

- Placement of the fourth track on the north side of the NEC within existing real estate.

- Section 2 – Between Forrest Hills Station and Ruggles Station/Massachusetts Avenue
  - Placement of the fourth track on the south side of the NEC by demolishing the existing southern retaining wall and expanding the existing cut section.

- Section 3 – Between Ruggles Station/Massachusetts Avenue and Back Bay Station
  - Placement of the fourth track on the north side of the NEC, along the existing MBTA Orange Line alignment. The MBTA Orange Line would be replaced by extending a tunnel under the NEC approximately two miles from just east of Back Bay to just east of Ruggles Station.

Figure A-1 shows the line diagram for the proposed track alignment for the full length of the corridor analyzed.

2.1 Section 1 (Readville to Forest Hills)

The first section of the additional fourth track would begin immediately east of Readville Station and extend east to Forest Hills. For this portion of the alignment, there is space available for the addition of a fourth track on the north side of the existing tracks, as shown in Figure 2-1.

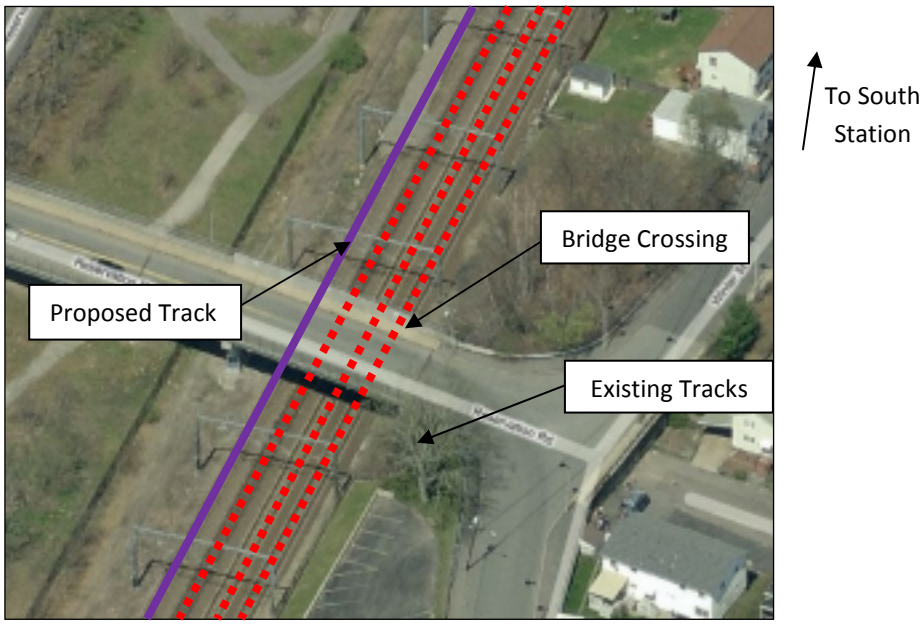


Figure 2-1 – Existing Tracks East of Readville Station

2.1.1 Track Alignment

The fourth track would begin east of Readville Station, approximately where the MBTA's Franklin Branch merges with the NEC. It would continue along the north side of the corridor to Forest Hills. Figures A-2 and A-3 in Appendix A show the existing track layout after Readville Station and a plan view of the proposed location of the turnout for the fourth track. Figure A-4 shows a typical existing and proposed section view of this area indicating the existing physical space that is available.

2.1.2 Impacts

Impacts in this section would include reconstruction of bridge structures, reconstruction of stations and acquisition of residential or commercial properties. These impacts are described in more detail in the following sections.

2.1.2.1 Bridge Impacts

With the proposed fourth track constructed on the north side of the existing tracks, the majority of bridges have space to accommodate the construction, similar to the Reservation Road Bridge, shown above in Figure 2-1.

Of the eight overhead and undergrade bridges through this section, only two would be affected by the construction of the fourth track on the north side. The first, River Street, is located in Hyde Park. This bridge would need to be reconstructed in order to fit both the fourth track and the new platform beneath it. The second bridge is located at Mother Brook. Currently this bridge is wide enough to accommodate four tracks; however the bay for the fourth track is in disrepair and would need to be replaced before new track could be constructed.

Table 2-1 lists detailed information regarding bridges in Section 1 of the corridor.

Table 2-1 Bridge Crossing Summary (Section 1)

No.	Description	Type	Impacted (Y/N)	MP
1	Reservation Road	OH	N	220.18
2	*Mother Brook*	*UG*	*Y*	*220.42*
3	*River Street*	*OH*	*Y*	*220.74*
4	West Street	OH	N	221.20
5	Pedestrian Overpass	OH	N	221.85
6	Canterbury Street	OH	N	222.86
7	Cummins Highway	OH	N	222.46
8	Blakemore Street	OH	N	222.82

2.1.2.2 Station Impacts

One MBTA commuter rail station falls within this section of the corridor: Hyde Park Station. There are currently three tracks that pass through the station; low level and mini-high level platforms are located adjacent to the outside tracks.

Since the existing platform at the station would be removed to accommodate a fourth track, routing the track north of the station and adding a new center platform would provide greater operation flexibility for the NEC. Figure A-5 and A-6 in Appendix A show a proposed layout of Hyde Park as well as existing and proposed cross sections at Hyde Park.

New platforms that would be installed at existing stations on tangent portions of track would need to be high-level platforms to accommodate the American's with Disabilities Act (ADA) compliance. Since the platform shown on Figure A-5 on the outbound (north) side of Hyde Park would be a high-level platform, the inbound platform (south) would need to upgrade to a high-level, as well.

2.1.2.3 Property Impacts

Because there is space available on the north side of the track in this section of the corridor, there will be fewer properties that need to be acquired in order to install the fourth track. The majority of the land needed to install the fourth track and provide the proper amount of clearance between the track and the adjacent walls or fences is within the MBTA right-of-way (ROW). Near Hyde Park Station, there would be four residential properties acquired, three of which would be partial takings and only one a full acquisition with a building demolished. Table 2-2 describes in more detail the properties that would need to be acquired.

Table 2-2 Property Impacts Summary (Section 1)

No.	Type	Description	MP
1	Residential	West of Hyde Park - Existing building would need to be demolished in order to install a fourth track and a new high level platform.	220.58
2	Residential	West of Hyde Park - Partial taking at the edge of the property, no buildings to demolish	220.60
3	Residential	West of Hyde Park - Partial taking at the edge of the property, no buildings to demolish	220.62
4	Residential	East of Hyde Park and River Street – Partial taking at the edge of the property, no buildings to demolish	220.75

Adjacent to Hyde Park Station, Business Street runs parallel to the existing platform. By installing the fourth track north of the existing platform, Business Street would have some temporary construction impacts.

2.2 Section 2 (Forest Hills to Ruggles)

The second analyzed section of the corridor runs from immediately west of Forest Hills, where the tracks enter a cut section, to just east of Ruggles. This

section of the corridor is where the Orange Line meets the NEC. The Orange Line, which runs on the north side of the commuter rail tracks, adds another layer of complexity due to the fact that there are many Orange Line stations which would need to be reconstructed to accommodate the addition of the fourth track on the north side of the NEC.

2.2.1 Track Alignment

As the tracks approach inbound at Forest Hills Station, they enter a cut section. The existing ROW available for the addition of a fourth track slowly begins to transition away once the tracks enter the cut section. Figure A-7 shows a typical existing and proposed cross section throughout this portion of the corridor.

Since the Orange Line runs parallel to the Commuter Rail tracks from Forest Hills to Back Bay along the north side of the NEC, it would be preferable to install the fourth track on the south side of the existing tracks. Figures A-8 and A-9 in Appendix A shows a plan view of the proposed track shift before Forest Hills and the track layout at Forest Hills, respectively. Figure A-10 in Appendix A shows an existing and proposed cross section at Forest Hills.

2.2.2 Impacts

The existing NEC and MBTA Orange Line tracks are in a cut section through this portion of the corridor. The cut section is only wide enough to accommodate the existing track layout. Expansion of this section will cause significant amounts of impact to the surrounding areas. These impacts are described in more detail in the following sections.

2.2.2.1 Bridge Impacts

There are 19 bridges which cross the alignment within this section. Each bridge would need to be demolished and reconstructed in order to expand the cut section to accommodate an additional track. Additionally, new earth support must be constructed, as the existing retaining wall would need to be taken down and replaced by a new retaining wall approximately 10'-14' south of the existing retaining wall.

There are 19 overhead bridges which would need to be reconstructed. Table 2-2 lists detailed information on the bridges.

Table 2-3 Bridge Crossing Summary (Section 2)

No.	Description	Type	MP
1	Pedestrian Overpass	OH	223.30
2	Ukraine Way	OH	223.52
3	Arborway (Elevated)	OH	223.75
4	New Washington Street (Arborway Lower)	OH	223.77
5	McBride Street	OH	224.07
6	Williams Street	OH	224.19
7	Gordon Street	OH	224.38
8	Green Street	OH	224.43
9	New Minton Street	OH	224.70
10	Boylston Street	OH	224.90
11	Atherton Street	OH	225.05
12	Centre Street	OH	225.30
13	Heath Street	OH	225.40
14	New Cedar Street	OH	225.76
15	Tremont Street	OH	226.00
16	Prentiss Street	OH	226.17
17	Ruggles Street	OH	226.39
18	Bus Overpass	OH	226.54
19	Pedestrian Overpass	OH	226.66

One of the more complicated bridge crossings would be Arborway, located just east of Forest Hills, where the Arborway crosses over the tracks. Arborway is a major arterial, and includes an elevated highway with one of its supports sitting adjacent to the location of the Commuter Rail and Orange Line tracks.

In addition to the 19 overhead bridge crossings, this section of the corridor contains a large amount of area where the existing track cut section is covered with parks or other recreational spaces. In these sections, the existing parks on the roofs would be removed and then replaced after the cut section has been widened. Table 2-4 includes more detailed information about these sections.

Table 2-4 Cut Section Roof Summary (Section 2)

No.	Description	Type	MP #
1	North of Forest Hills (Under Rt. 203)	OH	223.80
2	North of Arborway	OH	223.80
3	Between McBride & Williams Street	OH	224.10
4	North of Green Street	OH	224.45
5	South of New Minton Street	OH	224.70
6	South of Boylston Street	OH	224.70
7	North of Atherton Street	OH	225.05
8	South of Centre Street	OH	225.28
9	North of Jackson Square Station	OH	225.40
10	East of Roxbury Crossing Station	OH	225.60
11	Between Prentiss and Ruggles Street	OH	226.30

An example of one of the cut sections roofs can be seen in Figure 2-2. Between McBride Street and Williams Street, the Southwest Corridor Park alternates from running along the south side of the cut section to the north side.

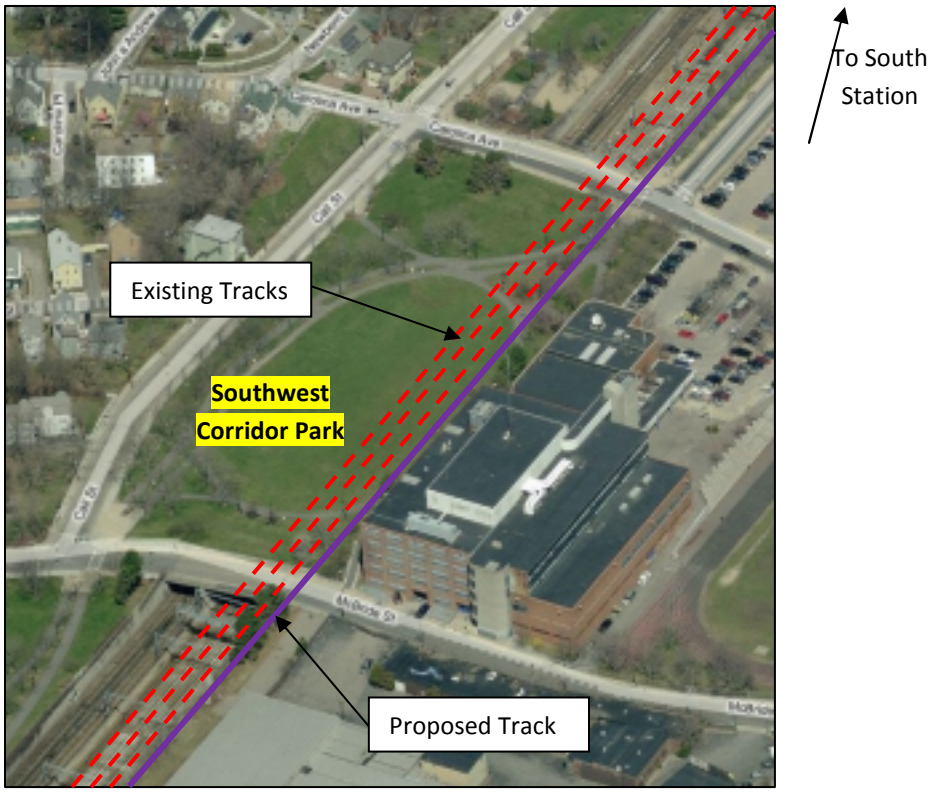


Figure 2-2 Southwest Corridor Park between McBride St. and Williams St.

There are retaining walls on both sides of the cut section that are greater than fifteen feet high for the entire length. In order to add the fourth track through this section, the eastern retaining wall would need to be reconstructed approximately 14' south of its current location. This would require approximately 3.6 miles of new retaining walls.

2.2.2.2 Station Impacts

With the Orange Line running adjacent to the NEC in this section, there would also be impact to Orange Line subway stations. There are only two stations that service the Commuter Rail and the Orange Line in this section, Forest Hills and Ruggles; however there are four additional stations which only service the Orange Line that would be impacted by the fourth track construction. These stations are Green Street, Stony Brook, Jackson Square and Roxbury Crossing. Although the stations are independent from the NEC, the headhouse structures are integral to the south retaining wall. Therefore the Orange Line station headhouses would be impacted by the construction of the fourth track. Figure 2-3 depicts a typical aerial view at one of the Orange Line stations, which would need to be reconstructed due to the installation of the fourth track.

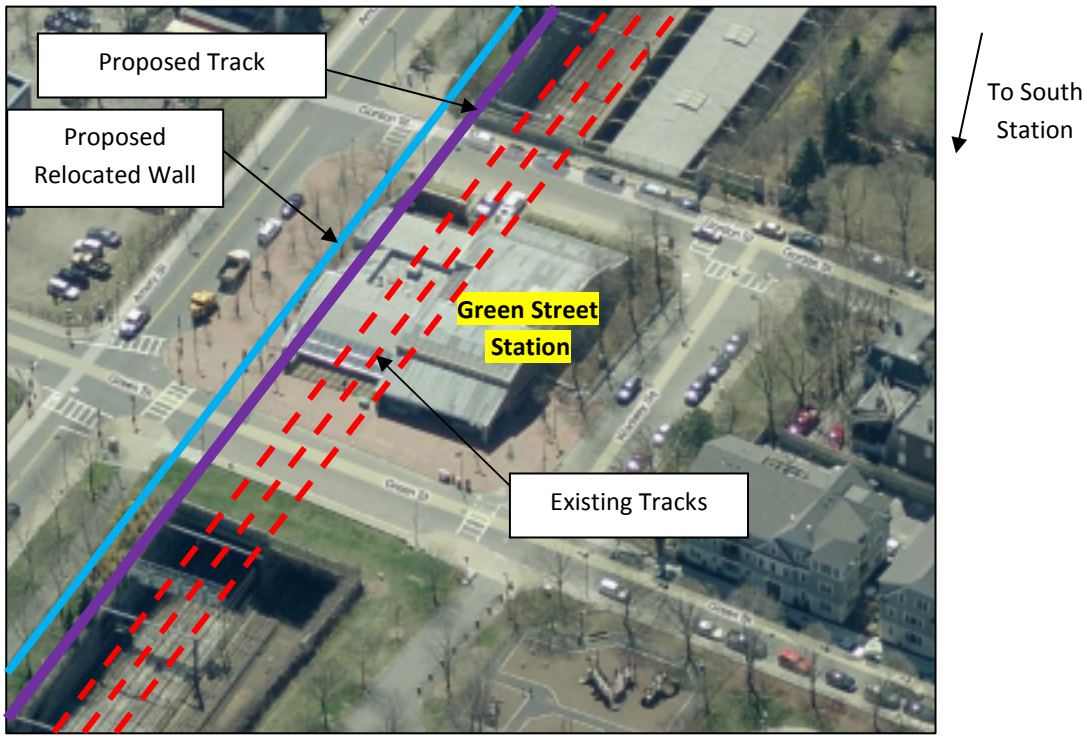


Figure 2-3 Aerial View of Green Street Station

2.2.2.2.1 Forest Hills

Impacts to Forest Hills Station would include eliminating of parking areas, relocating an existing bus terminal, and reconstructing numerous station elements and the headhouse. There is an MBTA parking lot southeast of the station. Reconstruction of the eastern retaining wall approximately 14' south of its current location would eliminate all of the parking spaces which abut the existing retaining wall. In addition to the MBTA parking lot, there is an existing parking lot directly south of the existing station, located above the Orange Line and NEC tracks. This lot would need to be removed in order to extend the width of the cut section and reconstruct the retaining wall, but it could be rebuilt in the same location once the new track and retaining wall are installed. Depending on the amount of space provided, this lot could be extended to meet the new retaining wall and would then provide the necessary space to relocate the parking spots eliminated in the eastern parking lot. Figure 2-4 shows an aerial view at Forest Hills, which highlights some of these impacts.

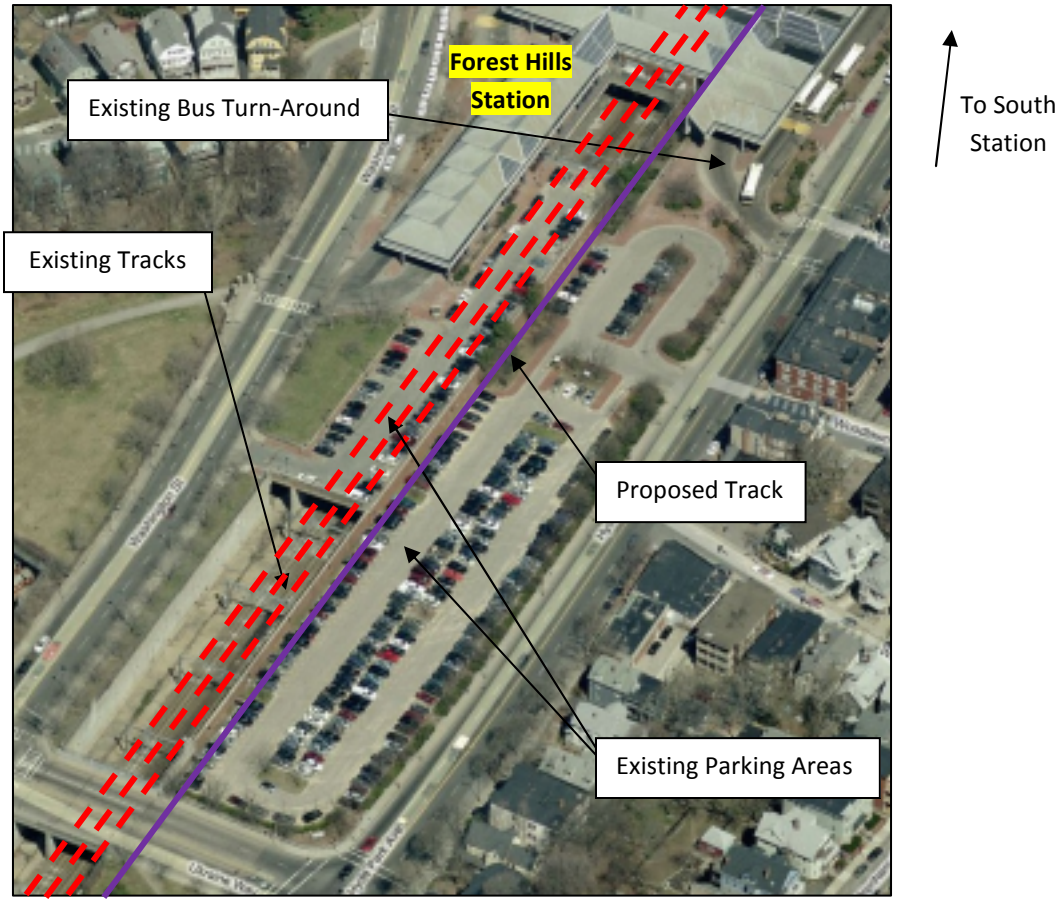


Figure 2-4 Aerial View of Forest Hills Station

Another aspect of the Forest Hills station that would be impacted is the bus turn-around loop and terminal. The proposed fourth track location would encroach on the bus turn-around area and the station headhouse/bus terminal, as shown in Figure A-10 in Appendix A. Adding the fourth track would require the bus terminal to be redesigned and/or relocated.

East of Forest Hills, there is another bus roadway which sits underneath the Rt. 203 overpass. This bus facility would also need to be relocated temporarily during construction and replaced once construction is complete.

Currently there is only one platform that services one of the three existing tracks at the Forest Hills Station. Adding the fourth track to the south side of the existing tracks allows for the construction of a new platform that would provide service to both the tracks on the south side. This approach allows platform access to three of the four tracks.

2.2.2.2.2 Ruggles

Ruggles is the other station in this section of the corridor which services the Orange Line and the NEC tracks, as well as provides bus service. Figure 2-5 shows the existing commuter rail platform servicing two of the existing three tracks and the bus turn-around area south of the existing tracks and retaining wall.

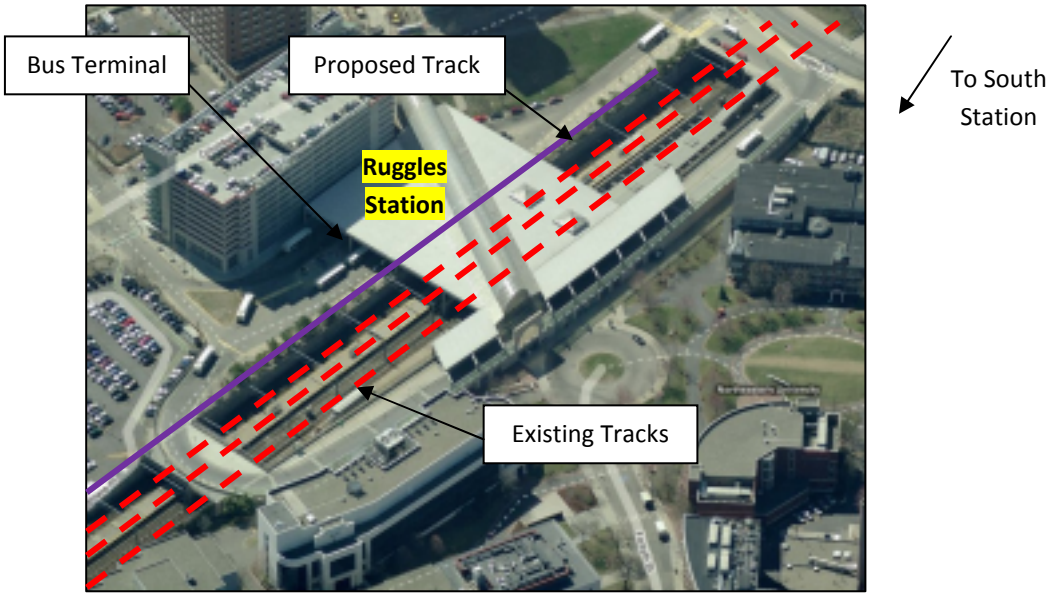


Figure 2-5 Aerial View at Ruggles Station

The fourth track would be installed on the south side of the existing tracks at Ruggles Station. In order to provide better service, an additional platform would be installed in between the existing third track and the proposed fourth track, as shown in Figure A-11 in Appendix A.

The bus terminal on the south side is at the same elevation as the existing tracks. The proposed fourth NEC track location would encroach on the bus turn-around area and the station headhouse/bus terminal, as shown in Figure A-12 in Appendix A. Adding the fourth track would require the redesign and/or relocation of the bus terminal.

A major impact to Ruggles would be to the walkway that runs the length of the station and passes overhead of the existing tracks. The structural supports for this section of the building fall directly on top of the existing retaining wall on the east side of the existing tracks. Removing and reconstructing this retaining wall approximately 12'-15' south of its current location, would require the building to be reconstructed.

2.2.2.3 Property Impacts

The expansion of the cut section to the south would impact abutting properties, which run along the edge of the cut section. Most of these properties are private commercial properties. Table 2-5 provides more detailed information on the properties that need be acquired. An example of one of these property takings is shown in Figure 2-6.

Table 2-5 Property Impacts Summary (Section 2)

No.	Type	Description	MP#
1	Residential	West of Forest Hills and Ukraine Way - Partial taking only, eliminates open space area east of residential buildings, no buildings demolished.	223.30
2	Commercial	East of New Minton Street - Partial taking only eliminates parking space along the existing retaining wall and would limit the access to the rear of the existing building.	244.75
3	Commercial	Between Boylston Street and Atherton Street - One small structure in the corner of the property against the retaining wall to be demolished; one large rink structure against the retaining wall to be demolished or relocated; parking spaces along the retaining wall to be eliminated.	245.00
4	Commercial	Columbus Avenue Parking Lot for Northeastern University - Partial taking only, eliminates parking space along the retaining wall; reconstruct or demolish parking lot on Columbus Avenue opposite Burke Street.	226.55
5	Public - Park	Southwest Corridor Park - Section to be removed and replaced in their original location; sections to be removed and replaced by the proposed fourth track and retaining wall.	223.70 - 226.55

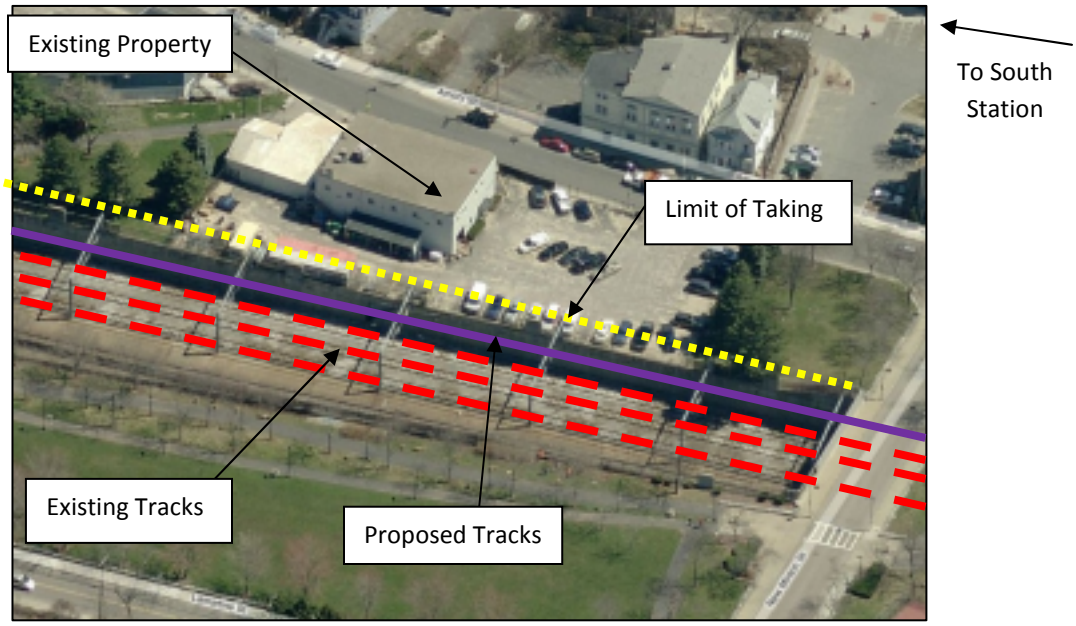


Figure 2-6 Property Impact Example (No. 2 from Table 2-5)

The largest property acquisition would be the Southwest Corridor Park, which is owned by the City of Boston and maintained by the Department of Conservation and Recreation (DCR). In many of the locations along this section of the corridor, overbuilt sections of the park would need to be removed/relocated in order to install the fourth NEC track. These sections are described as the cut section roofs in Section 2.2.2.1. In areas where the park runs along the south side of the tracks, the park would need to be removed in order to install the fourth track and the new retaining wall. The park could either be replaced above the new track on a cantilevered roof section, or would have to be permanently removed. Figure 2-7 shows an example of one of these sections.

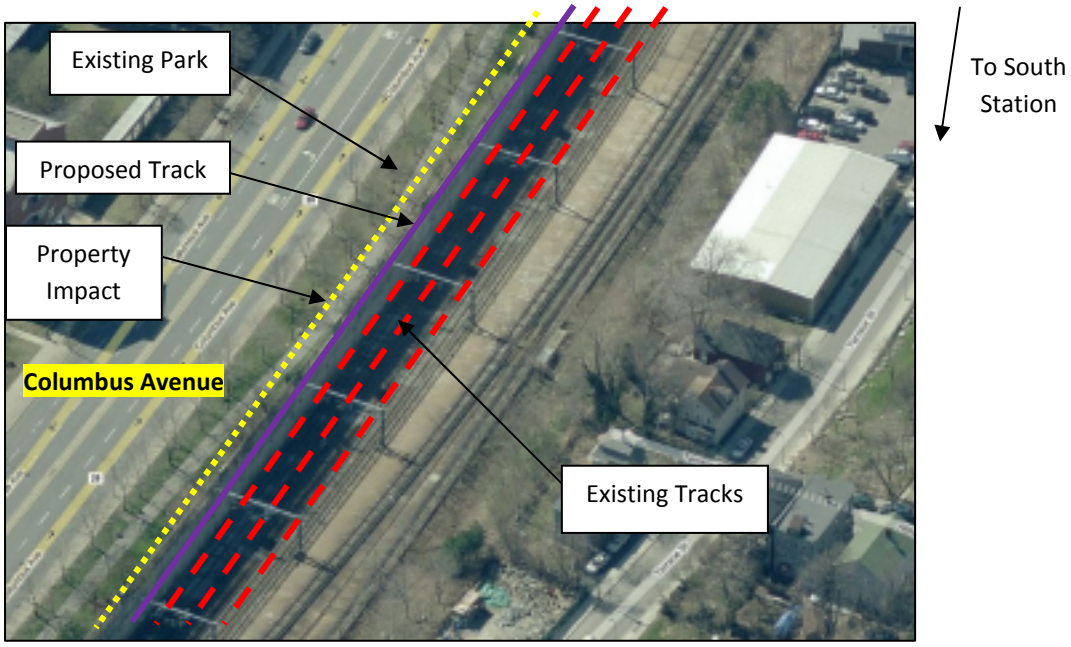


Figure 2-7 Southwest Corridor Park Impact

2.2.2.3.1 Southwest Corridor Park Impacts

Opened in 1987, Southwest Corridor Park is a 4.7 mile, 52 acre linear park stretching from Forest Hills Station to Back Bay Station owned and maintained by the Massachusetts Department of Conservation and Recreation. As the park is protected by the Department of Transportation's Section 4(f) requirements for publicly held land, a 4(f) evaluation would be required.

In addition to the impacts described above, there are other impacts more difficult to quantify at this conceptual level that would potentially affect the project. There are existing utilities, as shown in Figure 2-8, which run along the corridor, including Southwest Corridor Park, on the south side of the existing tracks that would need to be relocated in order to extend the cut section to the south.

Impacts to Southwest Corridor Park are defined by two parameters: permanent impacts due to construction resulting in loss of parkland, or temporary impacts to parkland requiring removal and replacement. Temporary impacts would result in loss of parkland throughout construction, for approximately 3-6 years at each section.

Figure 2-8 Utility Structures along Southwest Corridor Park

Table 2-6 provides more detailed information on the impacts to Southwest Corridor Park.

Table 2-6 Summary of Impacts to Southwest Corridor Park

No.	Type	Description	Acres
1	Temporary	Temporary impacts to the parkland that would result from removal of the park during construction and replacement of park elements post-construction.	8.54
2	Permanent	Permanent impacts to the parkland that would result from removal of the park along the track alignment and not replaced.	2.85

2.3 Section 3 (Ruggles to Back Bay)

The third section of the corridor begins east of Ruggles Stations (at Massachusetts Avenue) and extends to Back Bay Station. Major constraints in this section of the corridor include that the NEC and the Orange Line enter a cut section with a structural cap that runs under the Southwest Corridor Park north towards Back Bay and along a dense urban setting with many residential and commercial buildings in the South Bay abutting the ROW.

2.3.1 Track Alignment

Widening this section through the South Bay would be problematic and costly. Many high rise buildings adjacent to the NEC would be impacted, with a large number of business owners and residents displaced (see Figure 2-9). Adding the proposed fourth track adjacent to the existing alignment would involve acquisition of and demolition of the many business owners and residents.

In order to avoid the need to widen the existing cut/capped section, which runs under the South Bay, the Orange Line would be relocated into a new tunnel section beginning east of Ruggles Station and in to the existing Orange Line east of Back Bay Station. This would free up the space currently used by the Orange Line for use by the fourth NEC track, with some necessary upgrades. Figure A-13 in Appendix A shows the proposed track shift after Ruggles Station. Figure A-14 shows the line diagram of the proposed track layout at Back Bay Station.

2.3.1.1 Orange Line Alignment

MBTA's Orange Line would begin to descend to meet the new tunnel entrance just east of the Ruggles Station platforms. From this location, just west of Massachusetts Avenue, the Orange Line would utilize a new tunnel through Back Bay Station (approximately 2 miles), and connect with the existing Orange Line tunnel. Refer to Figures A-15 and A-16 for a concept of the tunnel section.

2.3.1.2 Commuter Rail Alignment

With the Orange Line relocated into the new tunnel from Ruggles Station eastward, the NEC tracks would be the only service operating in the existing cut section in this portion of the corridor. The fourth NEC track would then utilize the space vacated by the existing Orange Line through this section of the corridor.

2.3.2 Impacts

The number of impacts through this section of the corridor would be different than the impacts described for the previous section due to the addition of a new tunnel for the Orange Line. Reconstructing two Orange Line stations (Massachusetts Avenue and Back Bay) and providing an alternative busing service for Orange Line passengers while the construction of the tunnel is

underway would cause significant impact. These impacts are described in greater detail in the following sections.

2.3.2.1 Structural Impacts

West of Massachusetts Avenue Station, the existing tracks enter a cut section with a structural cap, which runs through the South End, as shown in Figure 2-9 below.

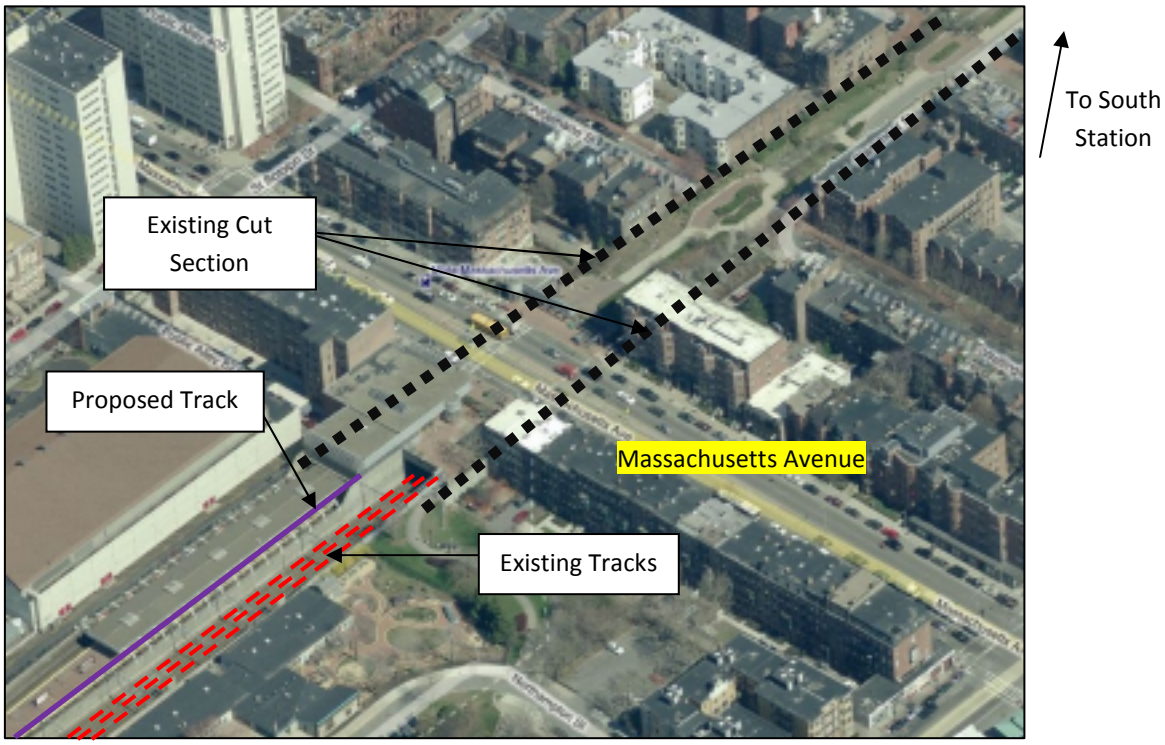


Figure 2-9 Tunnel Section after Massachusetts Avenue Station

MBTA Commuter Rail trains require a higher vertical clearance than the Orange Line trains. In order for the fourth track to be placed in the Orange Line track space, the existing elevation would need to be lowered in order to provide the proper vertical clearance for the Commuter Rail tracks entering the existing Orange Line tunnel. This option is preferable to widening the existing tunnel because it potentially eliminates the need to dig up Southwest Corridor Park to widen the existing tunnel, eliminates the need to close and reconstruct bridges such as Massachusetts Avenue and West Newton Street, and eliminates the need to acquire abutting properties.

2.3.2.2 Station Impacts

Massachusetts Avenue Station and Back Bay Station would be affected by placing the Orange Line in a tunnel and utilizing the Orange Line track space for the MBTA Commuter Rail. Back Bay Station is the only one of the two that services the MBTA Commuter Rail.

At Massachusetts Avenue Station, the existing building would be able to remain unaffected and improvements to be made to the building would include providing a connection to the new Orange Line Tunnel beneath the station. It was assumed that the existing station foundations would not be affected.

Back Bay Station services all MBTA's and Amtrak operations on the NEC. In addition to providing access to the new Orange Line tunnel, the existing Orange Line platform layout and track location would need to be demolished in order to accommodate the fourth NEC track. Figure A-17 is a typical section between Massachusetts Avenue and Ruggles showing the location of the Commuter Rail track in place of the existing Orange Line tracks. A new high-level platform would be constructed where the existing Orange Line platform is located. This would require reconstructing a large portion of Back Bay Station. See Figures A-15 and A-16 for existing and proposed cross section view at Back Bay Station. Figure A-18 shows the plan view of the proposed track layout at Back Bay Station.

In order to construct the new tunnel underneath the existing Orange Line tracks and connect in to the existing tracks at the ends, Orange Line service from Tufts Medical Center to Forest Hills would need to be suspended and replaced with bus service for the duration of the construction. Table 2-5 describes this bus service in greater detail.

Table 2-7 Bus/Shuttle Service Summary

ID	Bus/Shuttle Service		Formula
A	Total Peak Riders Services =	26,195	
B	Riders per Bus =	50	
C	Total Bus Trips Needed during the Peak Hours =	524	A/B
D	Round trip per bus (hr)=	1.25	
E	Operating Time (hr) =	19	
F	Total Peak Period Time (hr) =	4	
G	Trips per Bus during the Peak Hours =	3	F/D
H	Total Busses Needed =	175	C/G
I	Provide Bus Service for 2 years (2yrs x 365.25=)	730	
J	***Total Bus Days =***	***127,750***	H*I

Total number of riders at these stations was determined by the total typical weekday entries at each of the Orange Line stations that would be closed during construction. Peak riders were determined by multiplying 40% times the total weekday entries. An additional 20% is added to the total peak hour entries to account for existing riders that get on before Back Bay Station and continue south towards Forest Hills, as well as to account for the number of weekday entries at these stations during the midday hours. It was conservatively assumed that the South Station through Back Bay Station Commuter Rail trains would accommodate the remainder of the ridership. The bus service would only be required to run during the time the Orange Line is shut down, which would be approximately 2 years. Total bus days is the product of the number of busses used and the number of days the service is running (H times I, from above).

2.3.2.3 Property Impacts

Figure 2-11 shows the location of the existing cut section with the structural cap running under the Southwest Corridor Park with residential and commercial properties abutting the park on the south and north side. The Orange Line tunnel avoids acquisition and demolition of properties directly abutting the south side of Southwest Corridor Park.

3 Summary

3.1 Impact Summary

Nine properties would be impacted by the proposed construction: three commercial properties, five residential properties, and the Southwest Corridor Park property. Six of the private properties, along with the Southwest Corridor Park parcel, would only be partial acquisitions. Two abutting properties would require full acquisition and a total of four private buildings would be demolished.

Approximately three miles of Orange Line subway would be relocated, and approximately nine miles of new commuter rail track would be installed. Six stations would require major renovation, defined as reconstruction of headhouses, vertical circulation, and platforms. Three stations would require minor renovations to platforms and other appurtenances.

Construction of the fourth track would require a new Orange Line tunnel that was approximately 1.5 miles long. Rehab and replacement of almost one mile of existing subway tunnel would be retrofit to allow for commuter rail trains.

Table 3-1 summarizes the infrastructure and ROW acquisition needs for construction of the fourth track.

Table 3-1 Infrastructure Needs/Impacts

Description	Unit	Quantity
Trackwork		
Commuter Rail Track	LF	45,868
Orange Line Track	LF	14,470
Crossover (#20)	EA	2
Turnout (#20)	EA	1
Structural		
Overhead Bridges	EA	21
Cut Section Roofs	EA	11
Undergrade Crossing	EA	1
Pedestrian Overpass	EA	2
Retaining Walls	LF	19,008
Tunnel		
Orange Line Tunnel	LF	7,235
Back Bay Station Tunnel Upgrades	LF	4,400
Station Tunnel Upgrades	EA	2
Signals and Communication	LF	53,103
Power		
Traction Power	LF	31,864
Overhead Contact System Wiring	LF	19,671
Main Substation	EA	1
Wayside Power/Interlocking (Needham)	EA	1
Wayside Power/Interlocking (Franklin)	EA	1
Stations		
Major Renovations	EA	6
Minor Renovations	EA	3
New Platforms	EA	4
Right-of-Way Acquisition		
Private Commercial	EA	3
Private Residential	EA	5
Public Park	EA	1
Alternative Transportation	BUS-DAY	127,750

3.2 Schedule Summary

Figure 3-1 provides a schedule summary of the critical construction items.

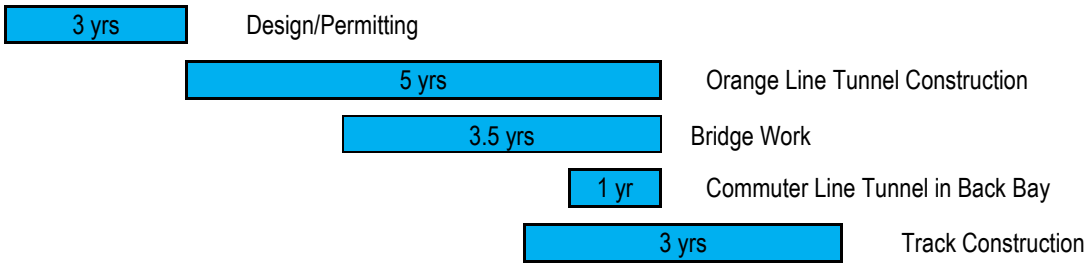


Figure 3-1 – Schedule Summary

The critical construction item that must be completed before other work can proceed is the rerouting of the Orange Line into a new tunnel from Ruggles to Tufts Medical Center. The tunnel work is assumed to take approximately five years, after which the construction of the fourth track in that area could begin. It is assumed that the contractor would be able to construct the majority of the tunnel beneath the existing Orange Line tracks before having to shut down the Orange Line to connect to the existing track sections. Due to the proximity to the Commuter Rail tracks and existing catenary structures, the connections at both ends of the proposed Orange Line tunnel would be constrained to construction during the night when train service is not running and the catenary system could be de-energized. Because of these constraints, construction of the tie-in points would take approximately 2 years.

It is assumed that adjacent bridges would serve as detour routes during the construction of a bridge. A conservative assumption would be that approximately six overhead bridges could be completed per year. The reconstruction of these bridges must be complete prior to construction of the new track in order to provide adequate space for the new track.

As with all construction work which needs to occur on operating tracks, the length of time allotted for construction over the portions that could foul the catenary system is approximately three hours during the night when train service is not running and the catenary system could be de-energized. This would add considerable construction time to the schedule.

Considering all of these factors, the length of time it would take to complete this project would be approximately 10-12 years.

3.3 Order of Magnitude Cost Summary

There are several major cost items associated with this project. One of the primary items would be placing the Orange Line in a tunnel from Ruggles Station to Massachusetts Avenue, approximately 1.4 miles. This is assumed to occur while maintaining service on the Orange Line. Total cost of implementing a new Orange Line tunnel and retrofitting the existing tunnel to accommodate Commuter Rail trains (with new ventilation) is approximately $621 Million.

Shuttle service would need to be provided to continue servicing the riders of the Orange Line during construction of the connections to the tunnel on either end. The cost of the shuttle would be the total bus-days and the operating cost, at approximately $2,200 per bus per day. This results in a total cost of approximately $281 Million.

Another major cost item associated with the installation of the fourth NEC track would be the structural items, such as bridges, pedestrian overpasses, cut section roofs and retaining walls. The approximately 21 overhead bridge crossings would cost $67 million. Adding in the undergrade crossings, the cut section roofs, the pedestrian overpasses and the retaining walls, the total cost for the structural items would be approximately $284 Million.

Table 3-2 summarizes the Order of Magnitude Cost Summary for the items listed above as well as for other items conceptually identified for this project.

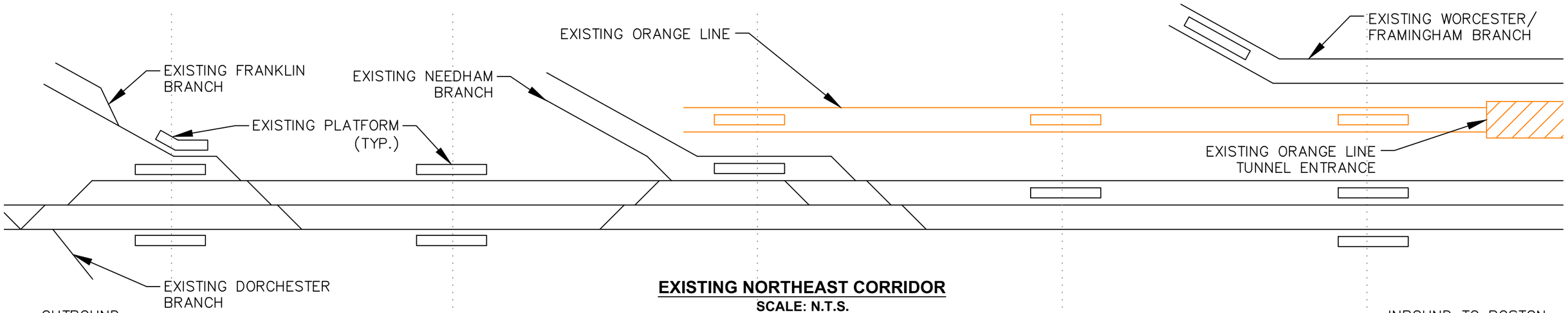
Table 3-2 Cost Summary ($2011)

Description	Unit	Quantity	Cost
Trackwork			
Commuter Rail Track	LF	45,900	$23,300,000
Orange Line Track	LF	14,500	$5,400,000
Crossover (#20)	EA	2	$4,900,000
Turnout (#20)	EA	1	$900,000
Structural			
Overhead Bridges	EA	21	$66,400,000
Cut Section Roofs	EA	11	$180,500,000
Undergrade Crossing	EA	1	$900,000
Pedestrian Overpass	EA	2	$1,100,000
Retaining Walls	LF	19,000	$40,300,000
Tunnel			
Orange Line Tunnel	LF	7,200	$401,300,000
Back Bay Station Tunnel Upgrades	LF	4,400	$220,000,000
Station Tunnel Upgrades	EA	2	$109,000,000
Signals and Communication	LF	53,100	$14,200,000
Power			
Traction Power	LF	31,900	$6,900,000
Overhead Contact System Wiring	LF	19,700	$3,200,000
Main Substation	EA	1	$14,000,000
Wayside Power/Interlocking (Needham)	EA	1	$800,000
Wayside Power/Interlocking (Franklin)	EA	1	$600,000
Stations			
Major Renovations	EA	6	$120,000,000
Minor Renovations	EA	3	$9,000,000
New Platforms	EA	4	$8,000,000
Right-of-Way Acquisition			
Private Commercial	EA	3	$6,800,000
Private Residential	EA	5	$5,600,000
Public Park	EA	1	$22,500,000
Contingency (Construction Items)	PERCENT	30%	$379,680,000
		Subtotal (Construction Items)=	***$1,645,300,000***
Alternative Transportation	BUS-DAY	127,750	$281,400,000
Contingency (Alt. Transportation)	PERCENT	20%	$56,300,000
		Subtotal (Alt. Transportation)=	***$337,700,000***
		Subtotal (Alt. Transportation and Construction Items)=	***$1,983,000,000***
Professional Services/Soft Costs	PERCENT	25.00%	$495,800,000
		Total Cost =	***$2,478,800,000***

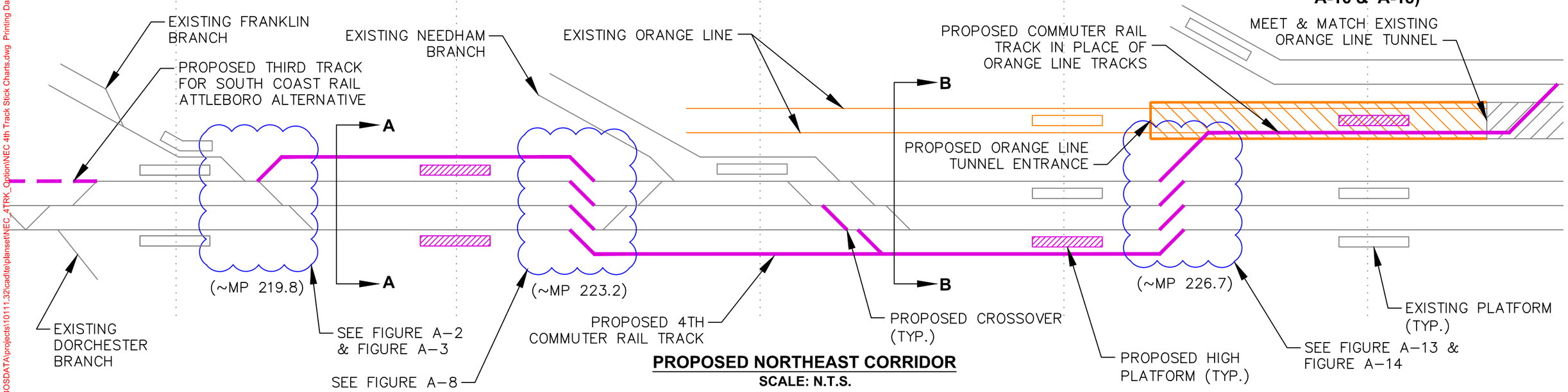
Note: LF = Linear Foot
EA = Each

Appendix A

Figures



EXISTING NORTHEAST CORRIDOR
SCALE: N.T.S.

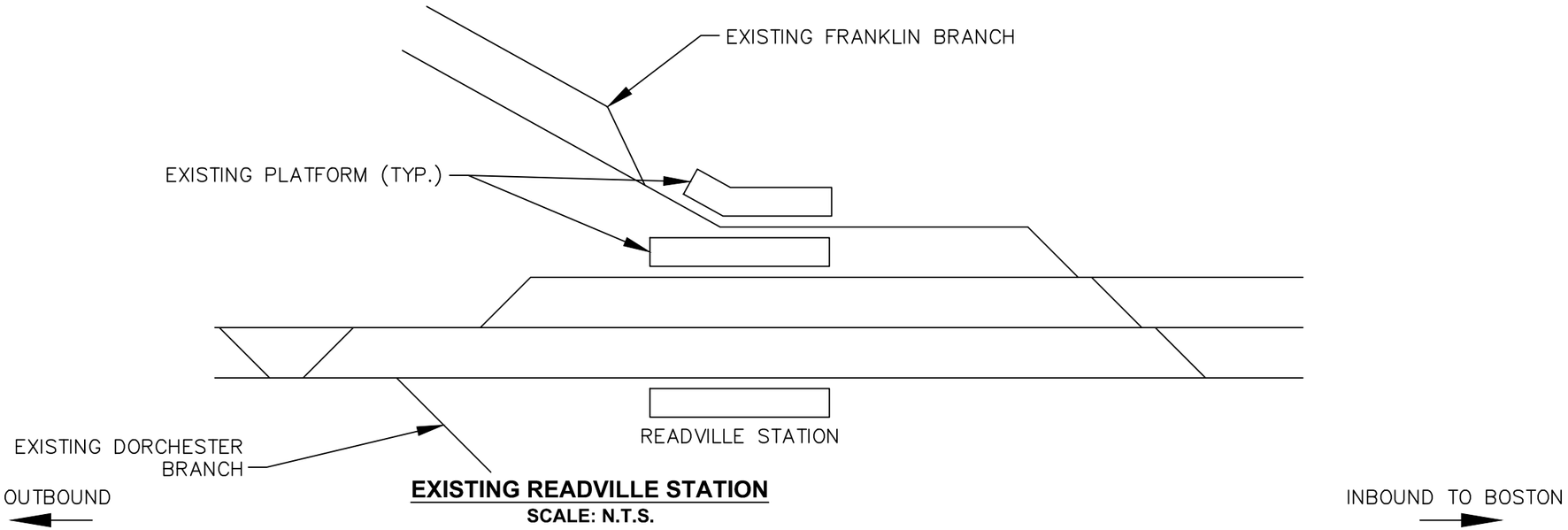


PROPOSED NORTHEAST CORRIDOR
SCALE: N.T.S.

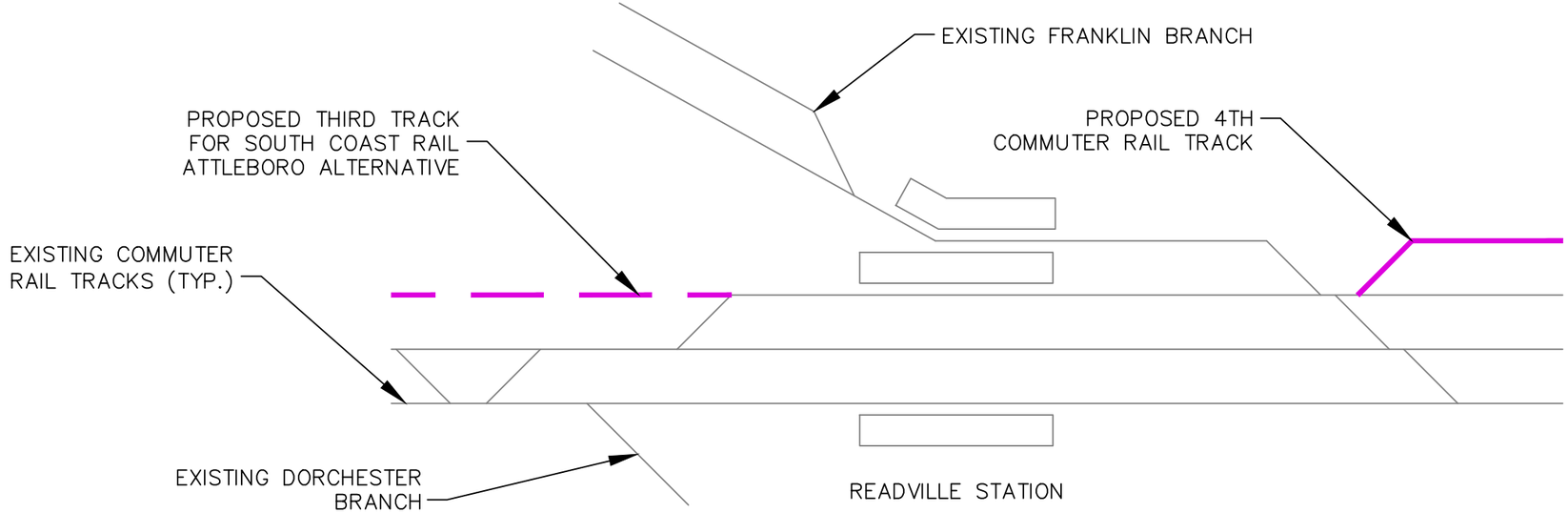
NOTE:
1. EXISTING TRACK GEOMETRY OBTAINED FROM "AMTRAK HIGH SPEED RAIL CONFIGURATION" CHARTS PREPARED BY AMTRAK DATED JANUARY 9, 1998.
2. SEE FIGURE A–4 FOR SECTION A
3. SEE FIGURE A–7 FOR SECTION B

Figure A-1
Northeast Corridor 4th Track Option
Full Corridor Stick Chart
January 14, 2011

Prepared by: VHB



EXISTING READVILLE STATION
SCALE: N.T.S.



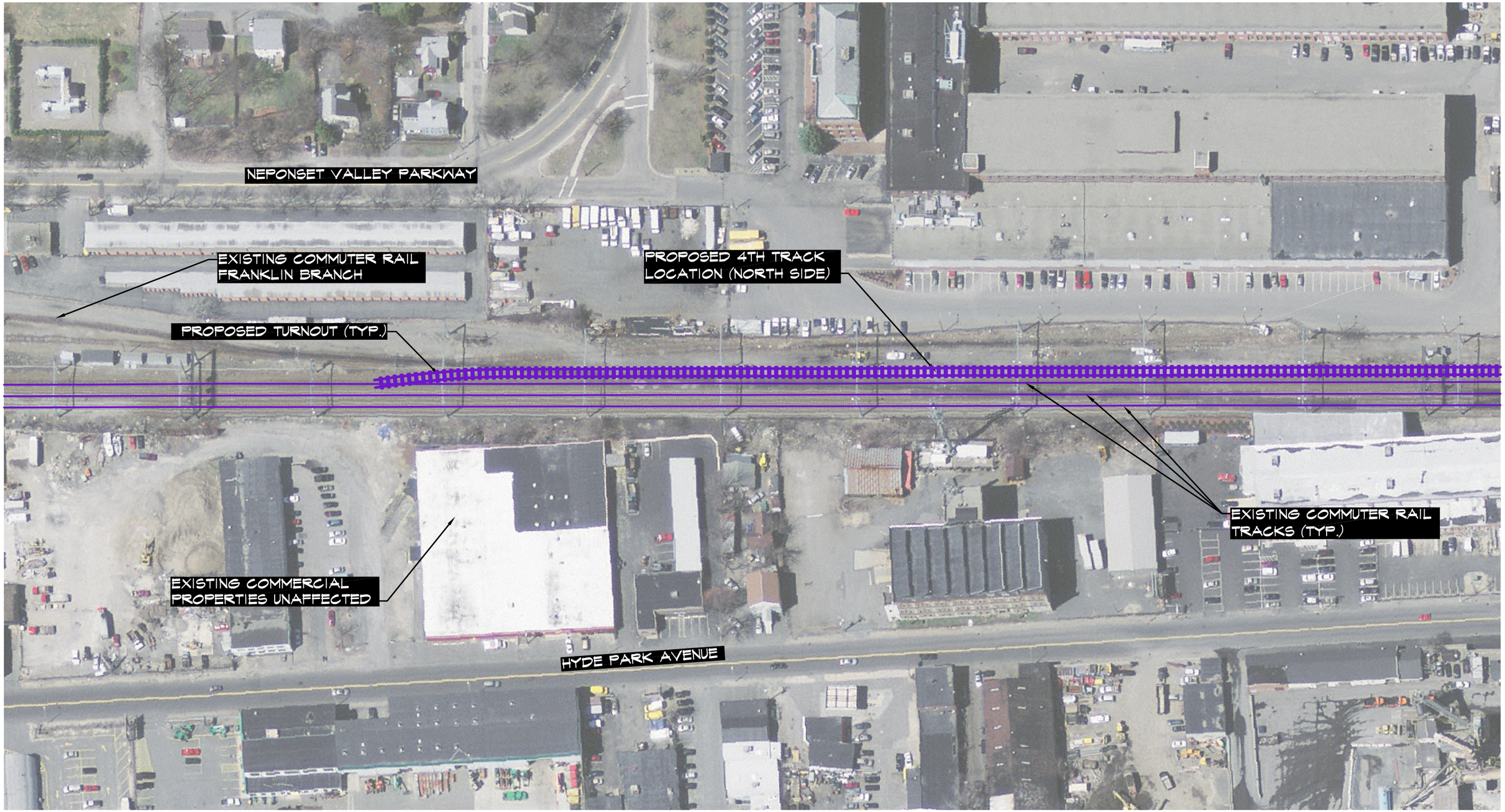
PROPOSED READVILLE STATION
SCALE: N.T.S.

NOTE:
1. EXISTING TRACK GEOMETRY OBTAINED FROM "AMTRAK HIGH SPEED RAIL CONFIGURATION" CHARTS PREPARED BY AMTRAK DATED JANUARY 9, 1998.

2. REFER TO PLAN VIEW ON FIGURE A–4.

Figure A-2
Northeast Corridor 4th Track Option
Readville Station Stick Chart
(~MP 219.5)
January 14, 2011

Prepared by: VHB



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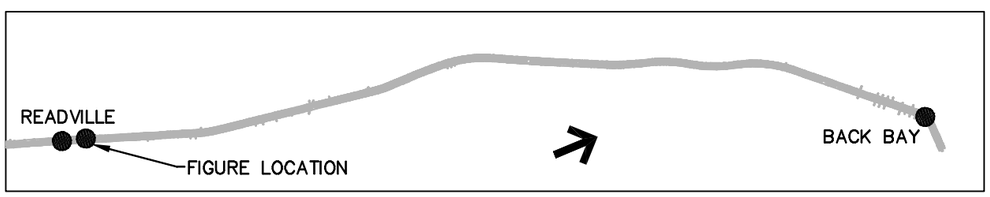


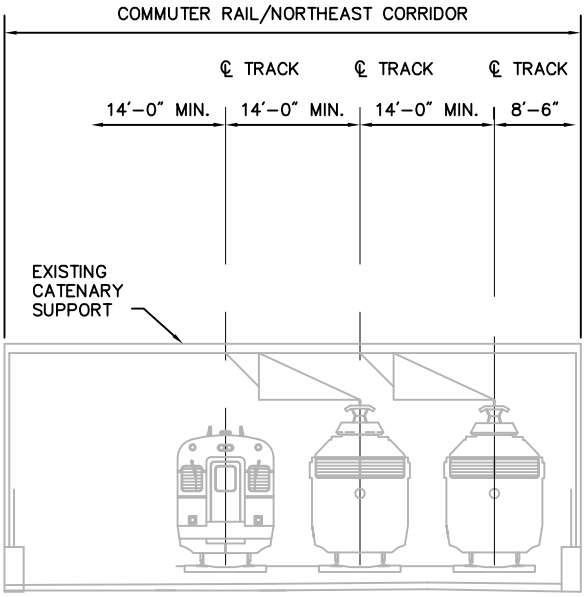
LOCUS MAP
SCALE: 1"=7500'

Moving Massachusetts Forward. massDOT

SOUTH COAST RAIL

Figure A-3
Northeast Corridor 4th Track Option
Turnout after Readville Station
(~MP 219.80)
January 14, 2011

Prepared by: VHB



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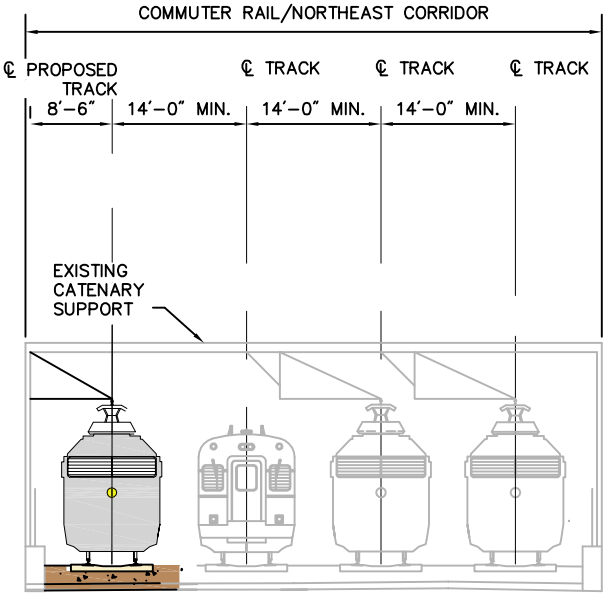

PROPOSED SECTION (LOOKING INBOUND)

0 10 20 Feet

Figure A-4
Northeast Corridor 4th Track Option
Typical Section - Readville to Forest Hills
January 14, 2010

Prepared by: VHB

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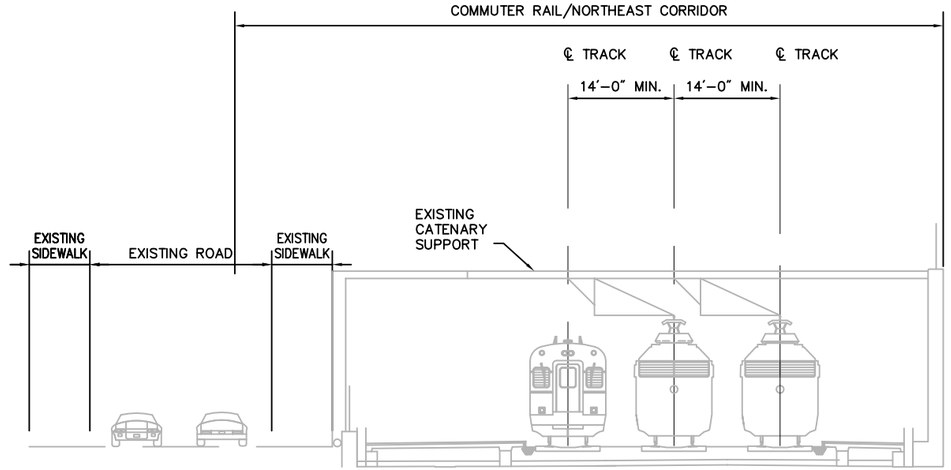
Moving Massachusetts Forward. massDOT

SOUTH COAST RAIL

Figure A-5
Northeast Corridor 4th Track Option
Hyde Park Station - Plan View
(~MP 220.6)
January 14, 2011

Prepared by: VHB



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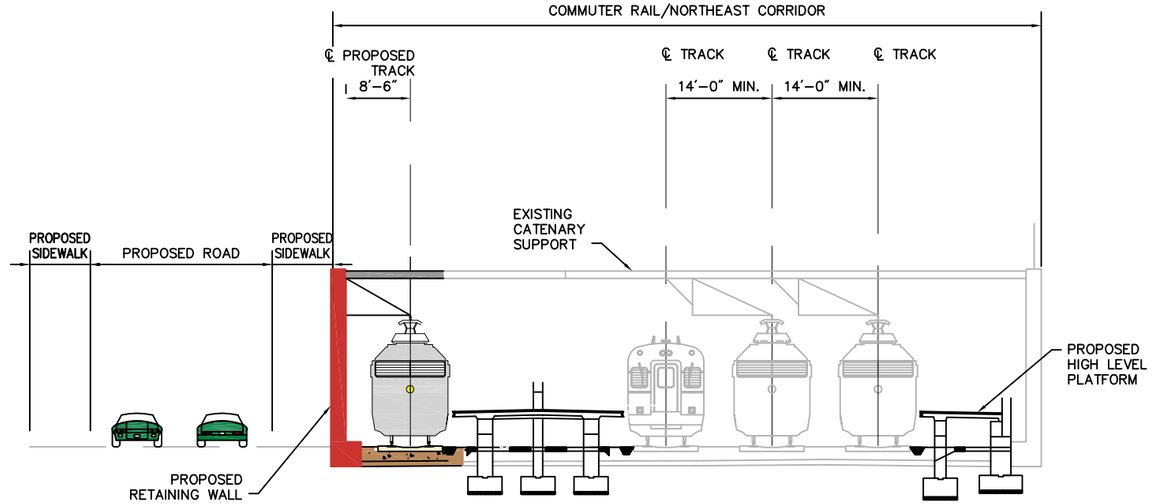


PROPOSED SECTION (LOOKING INBOUND)

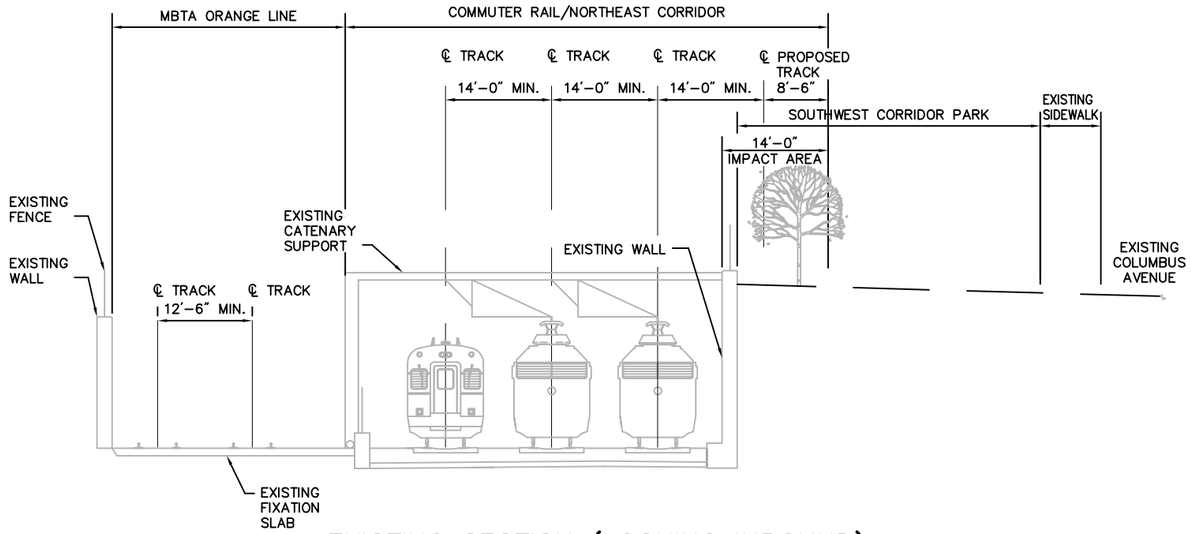
0 10 20 Feet

Moving Massachusetts Forward. massDOT

SOUTH COAST RAIL

Figure A-6
Northeast Corridor 4th Track Option
Typical Section - Hyde Park Station
January 14, 2010

Prepared by: VHB



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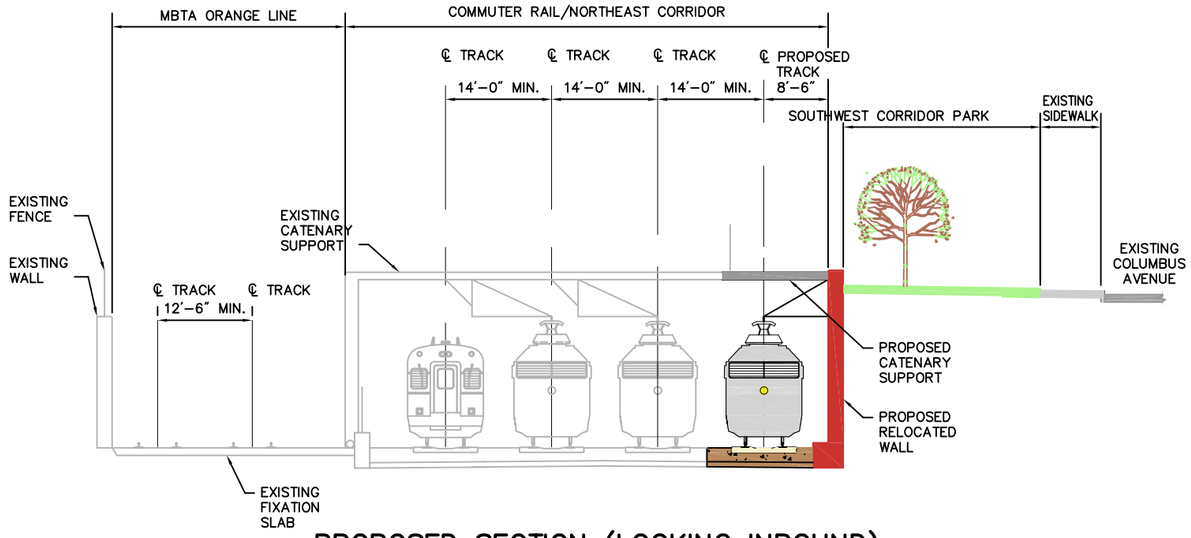
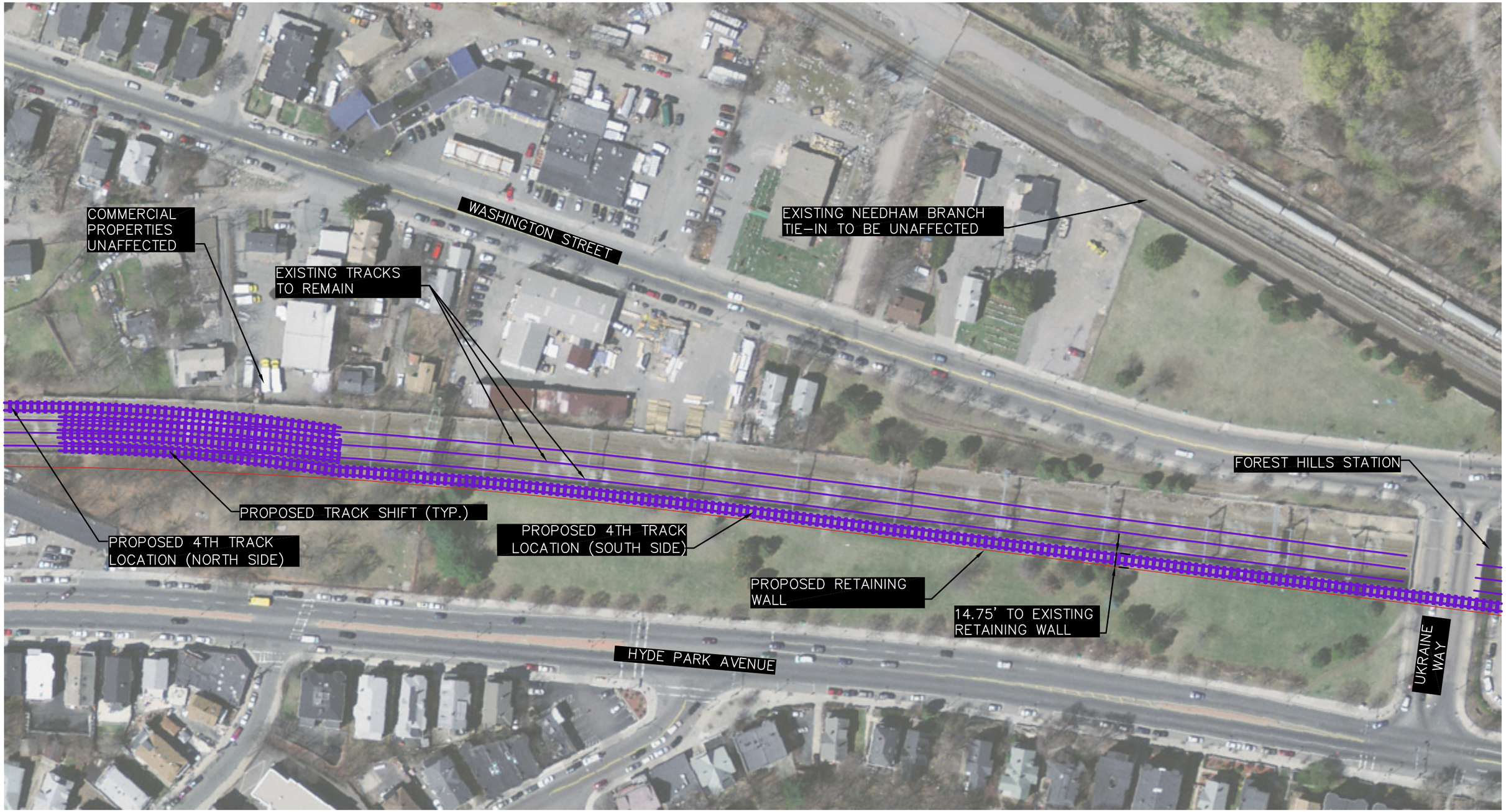


PROPOSED SECTION (LOOKING INBOUND)

0 10 20 Feet

Figure A-7
Northeast Corridor 4th Track Option
Typical Section - Forest Hills to Ruggles
January 14, 2010

Prepared by: VHB



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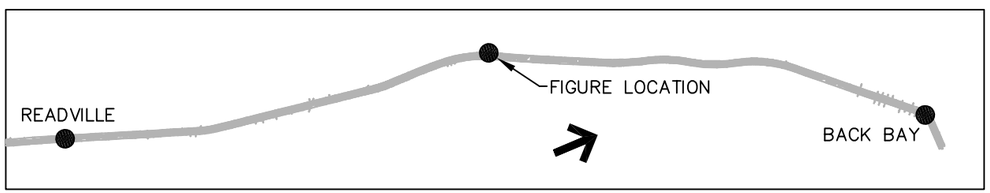


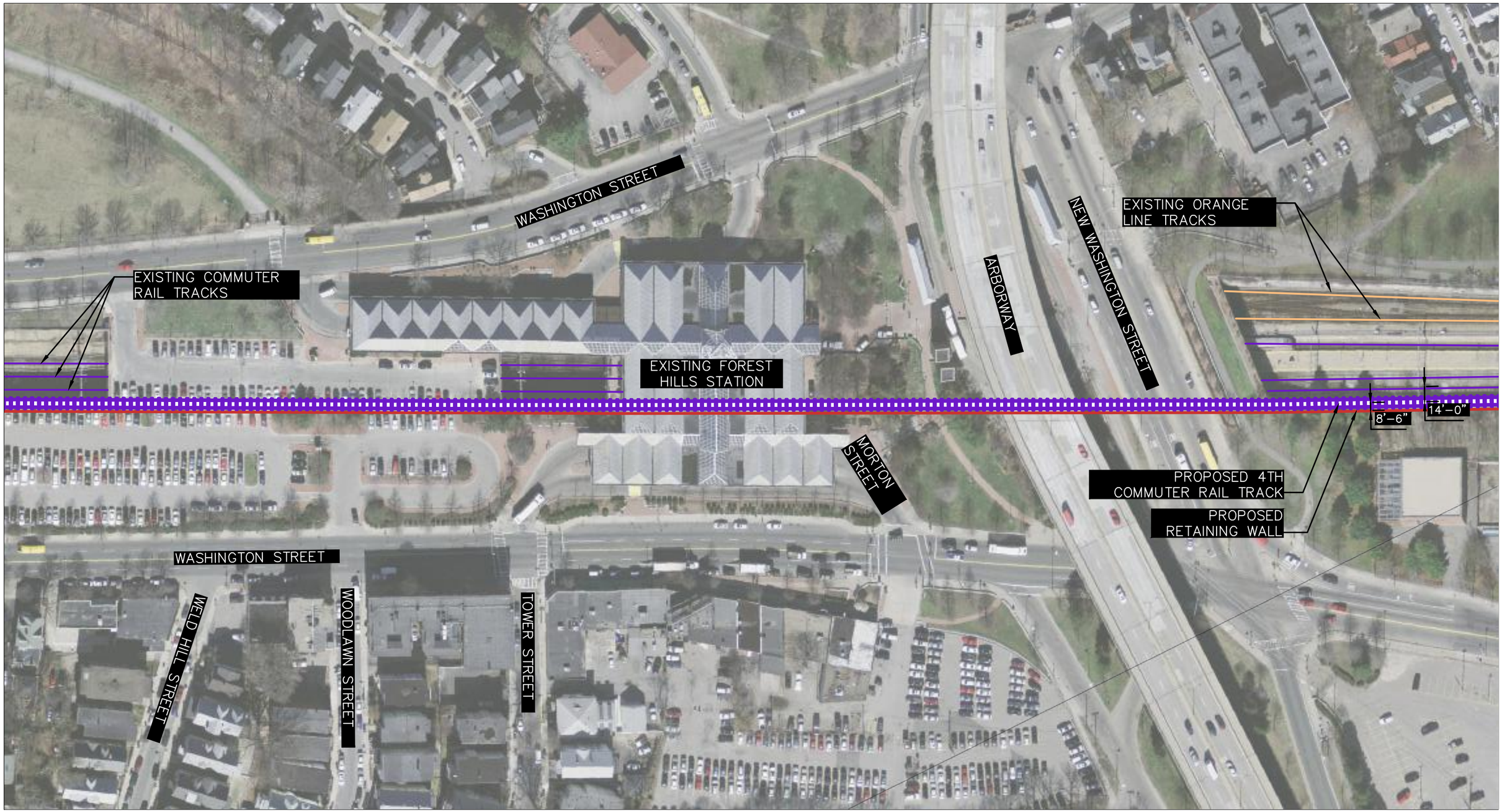
LOCUS MAP
SCALE: 1"=7500'

Moving Massachusetts Forward. massDOT

SOUTH COAST RAIL

Figure A-8
Northeast Corridor 4th Track Option
Track Shift before Forest Hills Station
(~MP 223.2)
January 14, 2011

Prepared by: VHB



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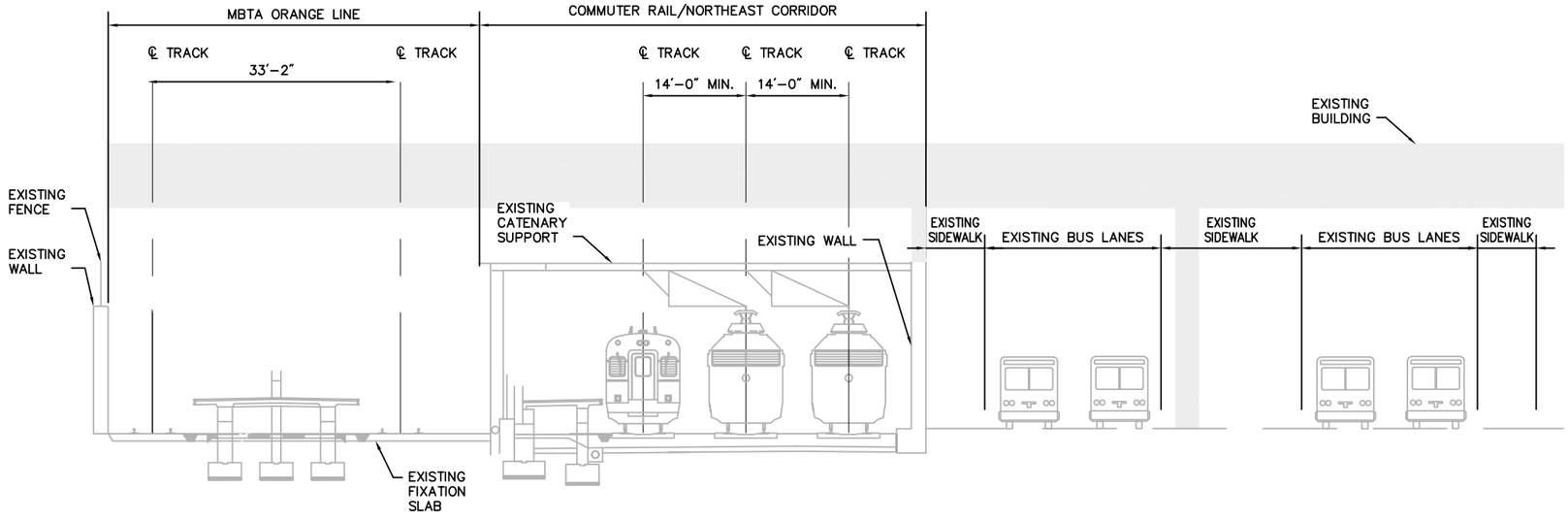
Moving Massachusetts Forward. massDOT

SOUTH COAST RAIL

Figure A-9
Northeast Corridor 4th Track Option
Forest Hills Station - Plan View
(~MP 223.7)
January 14, 2011

Prepared by: VHB



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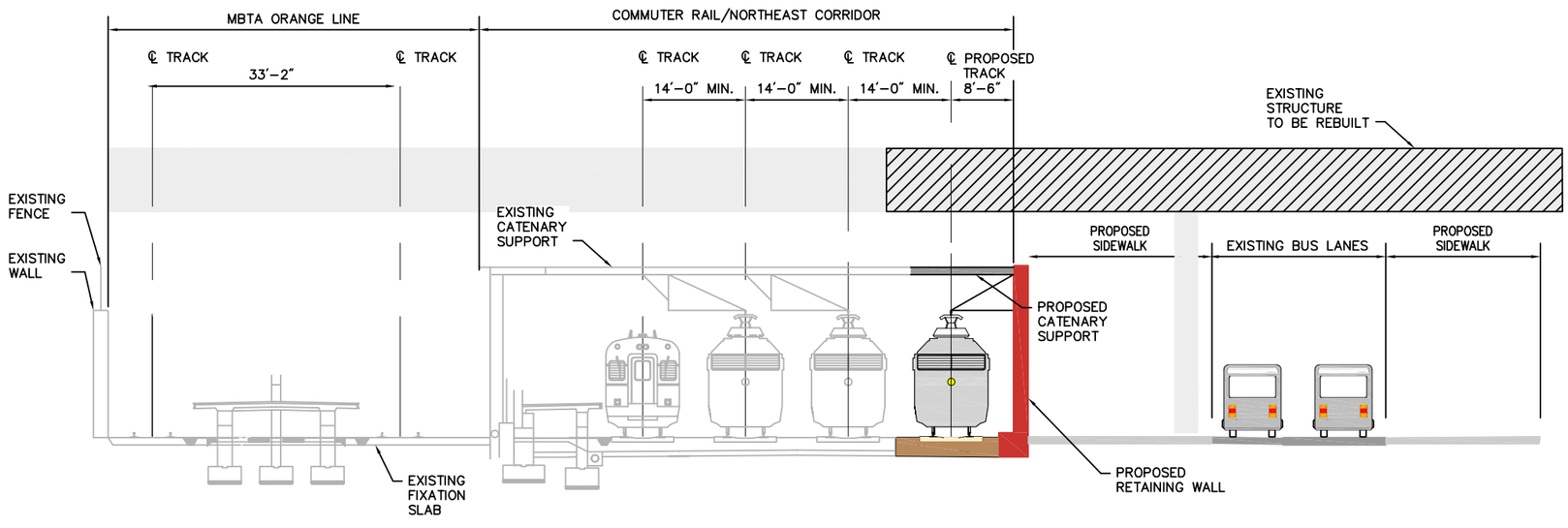

PROPOSED SECTION (LOOKING INBOUND)

0 10 20 Feet

Figure A-10
Northeast Corridor 4th Track Option
Typical Section - Forest Hills Station
January 14, 2010

Prepared by: VHB

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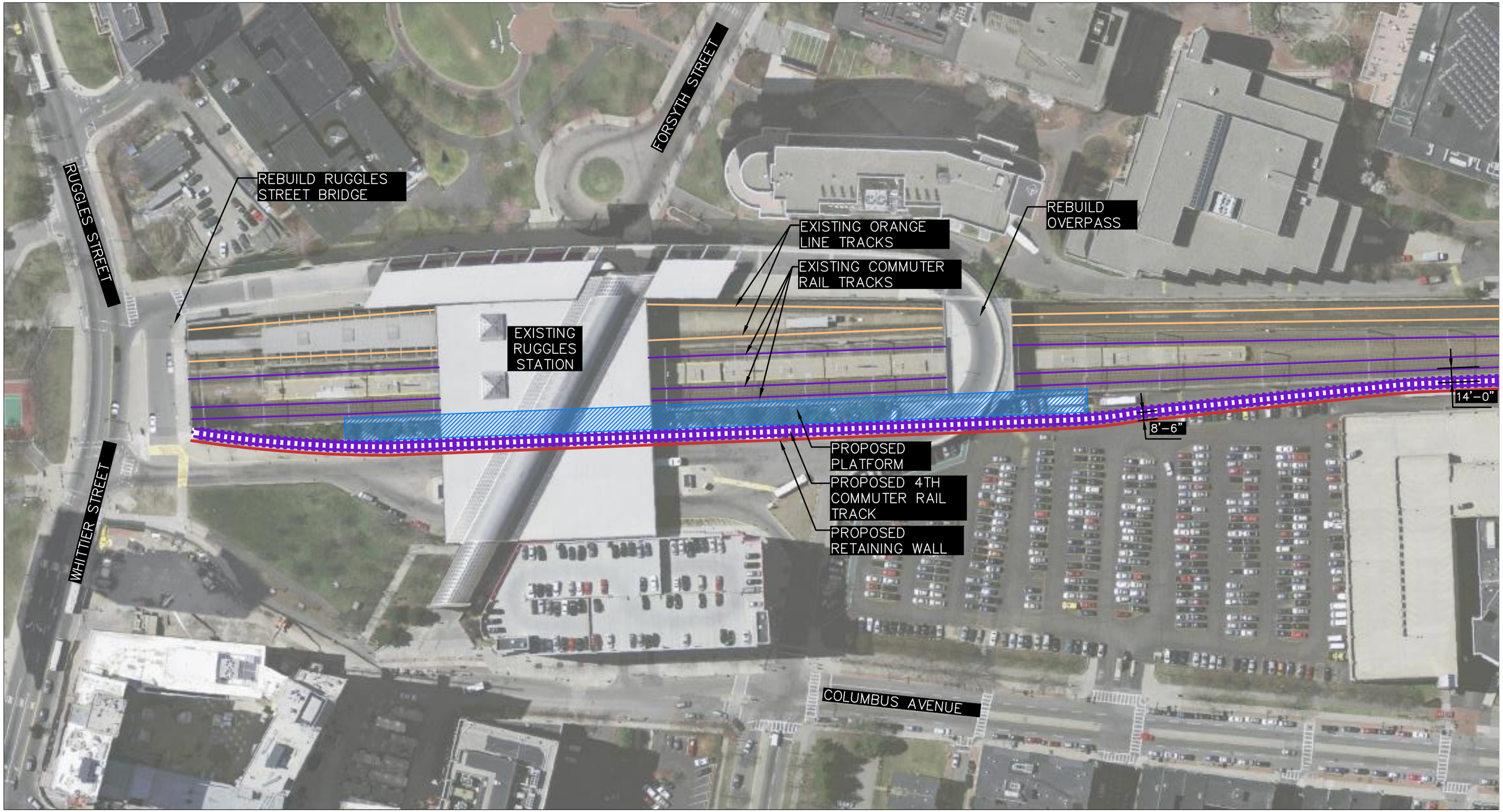


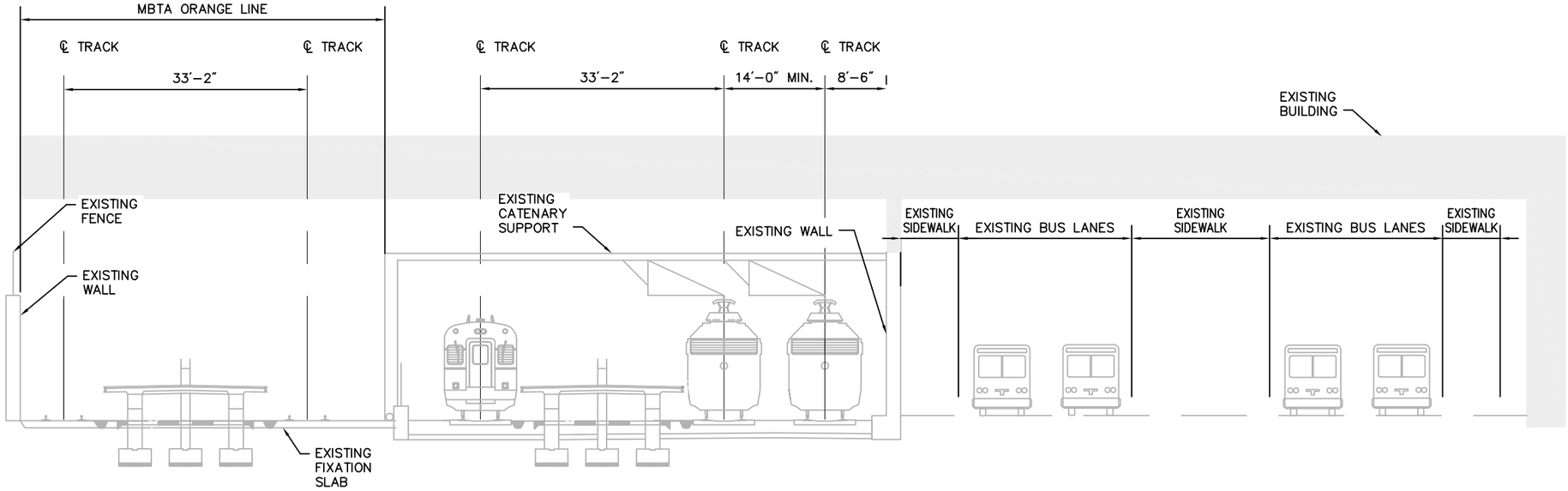
0 50 100 Feet

Moving Massachusetts Forward massDOT

SOUTH COAST RAIL

Figure A-11
Northeast Corridor 4th Track Option
Ruggles Station - Plan View
(~MP 226.5)
January 14, 2011

Prepared by: VHB



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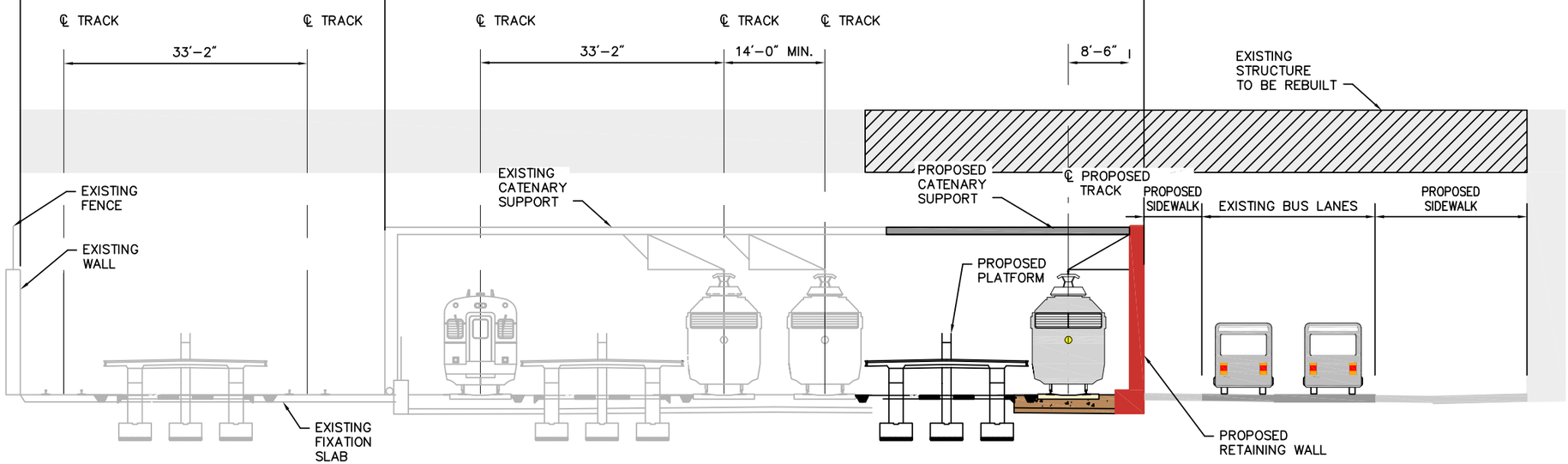
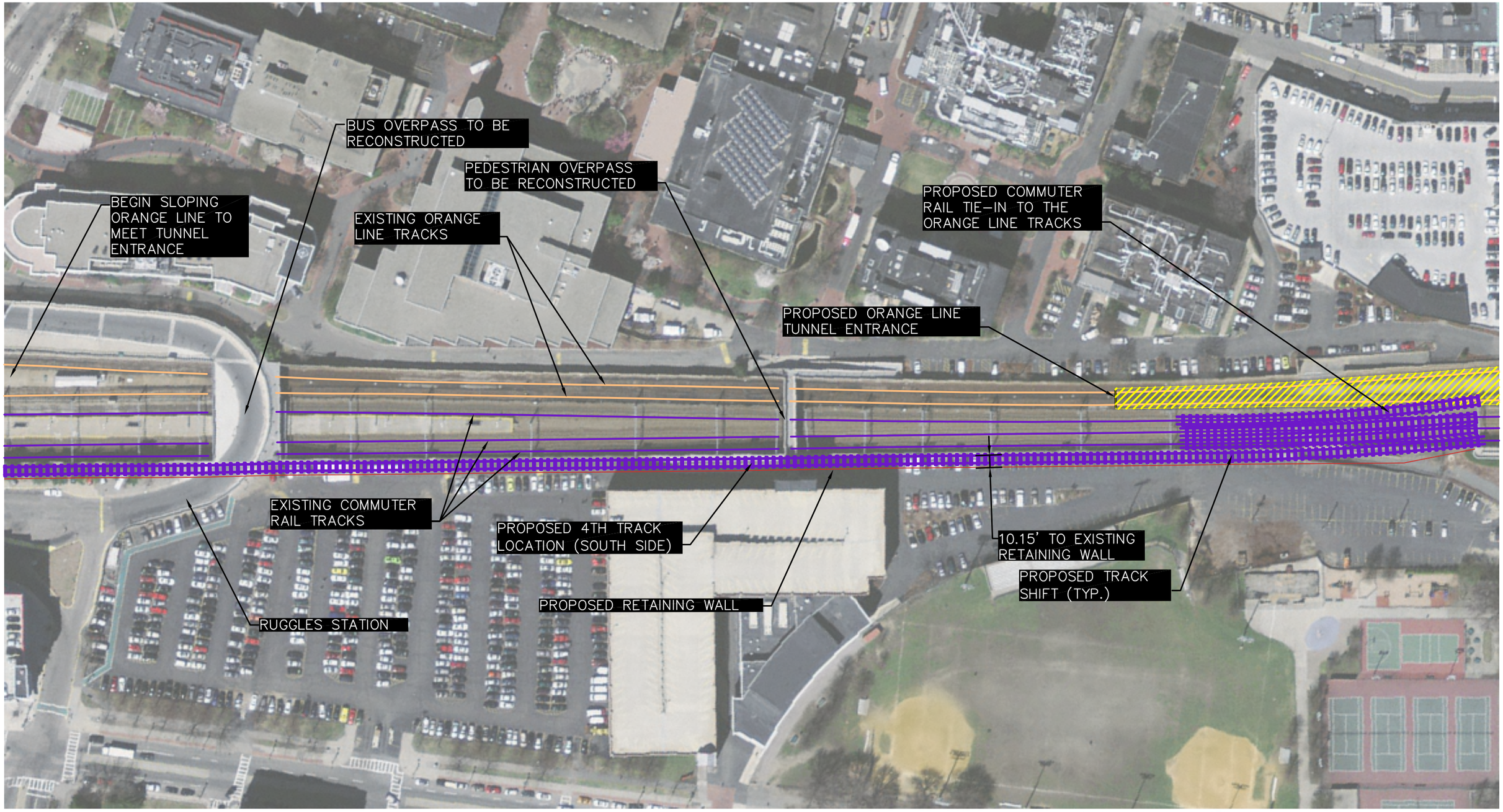


PROPOSED SECTION (LOOKING INBOUND)

0 10 20 Feet

Figure A-12
Northeast Corridor 4th Track Option
Typical Section - Ruggles Station
January 14, 2010

Prepared by: VHB



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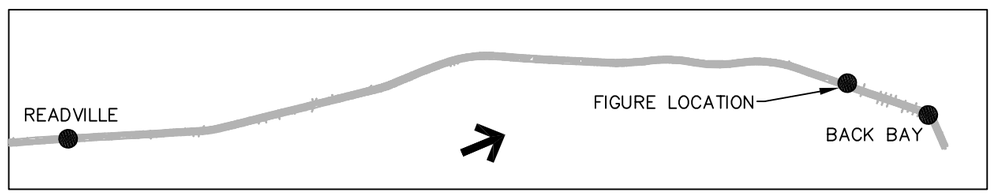


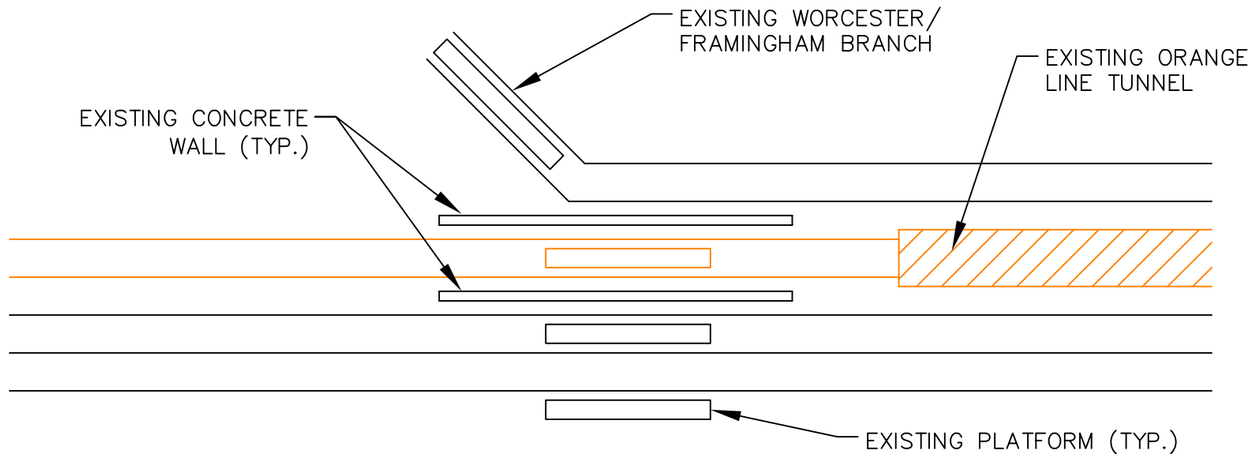
LOCUS MAP
SCALE: 1"=7500'

Moving Massachusetts Forward. massDOT

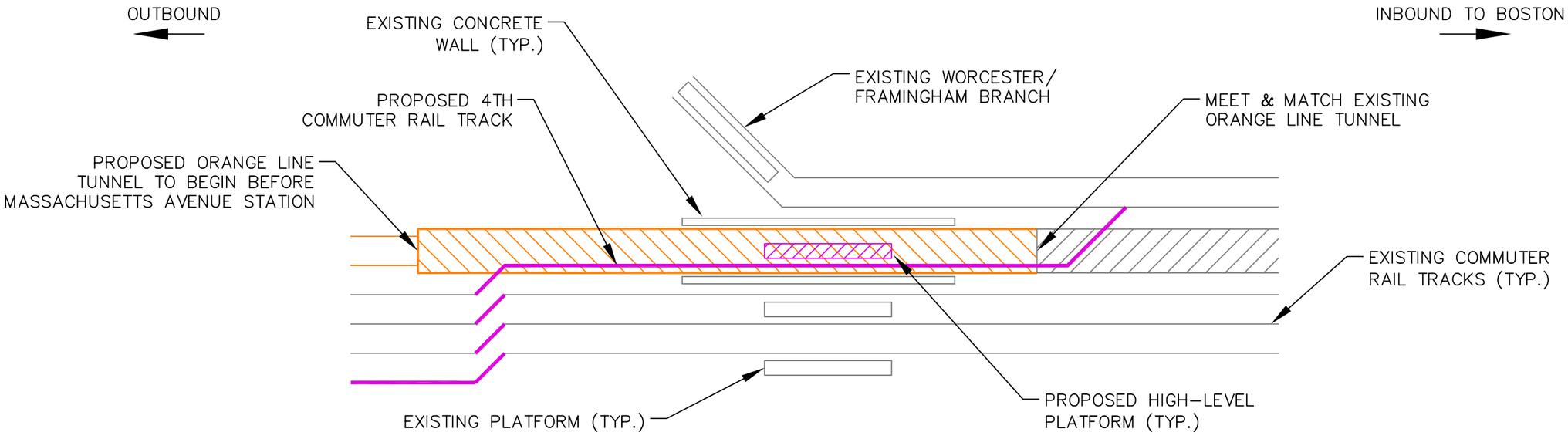
SOUTH COAST RAIL

Figure A-13
Northeast Corridor 4th Track Option
Track Shift after Ruggles Station
(~MP 226.7)
January 14, 2011

Prepared by: VHB



EXISTING BACK BAY STATION
SCALE: N.T.S.



PROPOSED BACK BAY STATION
SCALE: N.T.S.

NOTE:
1. EXISTING TRACK GEOMETRY OBTAINED FROM "AMTRAK HIGH SPEED RAIL CONFIGURATION" CHARTS PREPARED BY AMTRAK DATED JANUARY 9, 1998.

Figure A-14
Northeast Corridor 4th Track Option
Back Bay Station Stick Chart
(~MP 227.50)
January 14, 2011

Prepared by: VHB

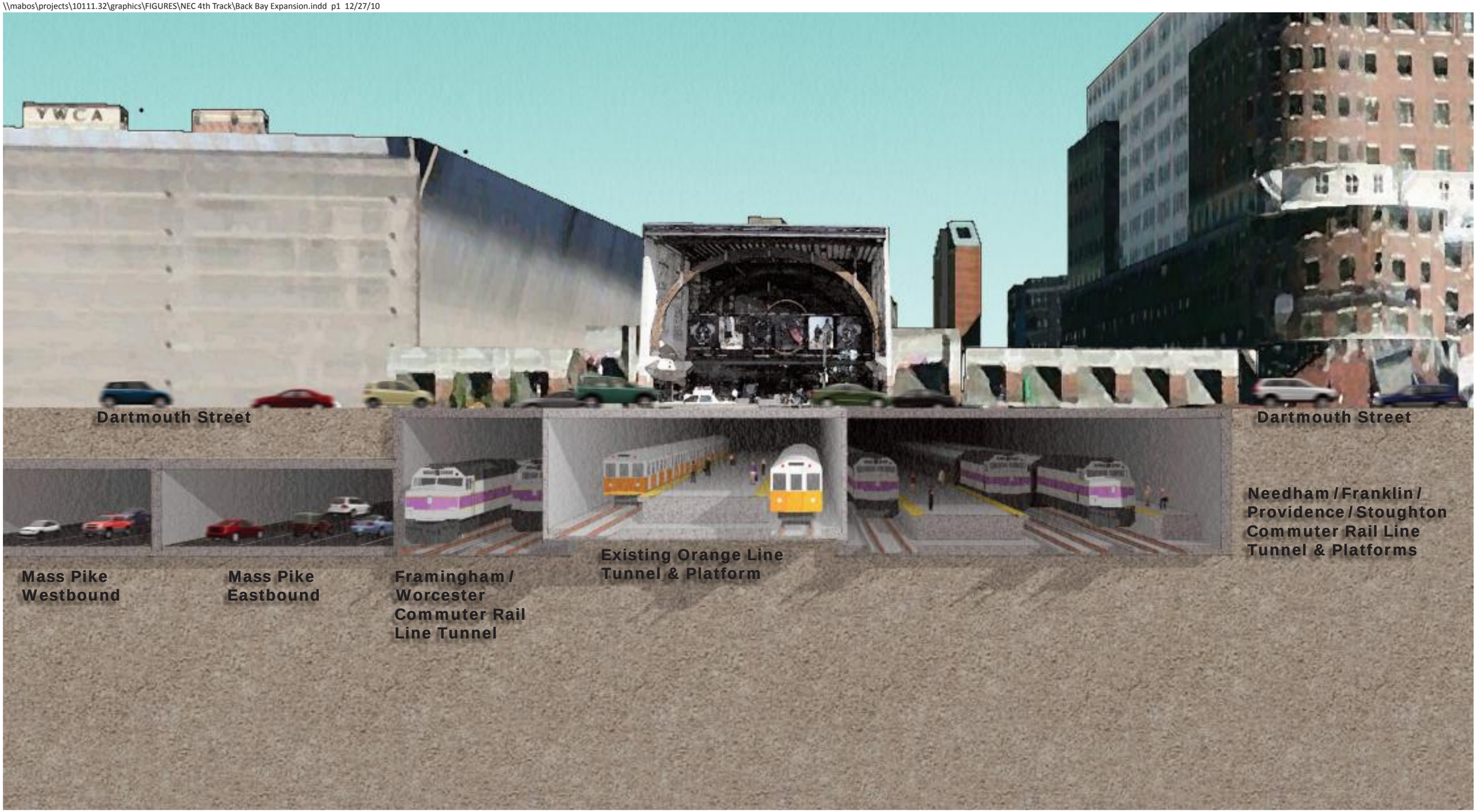


Figure A-15
Northeast Corridor 4th Track Option
Existing Section - Back Bay Station
January 14, 2011

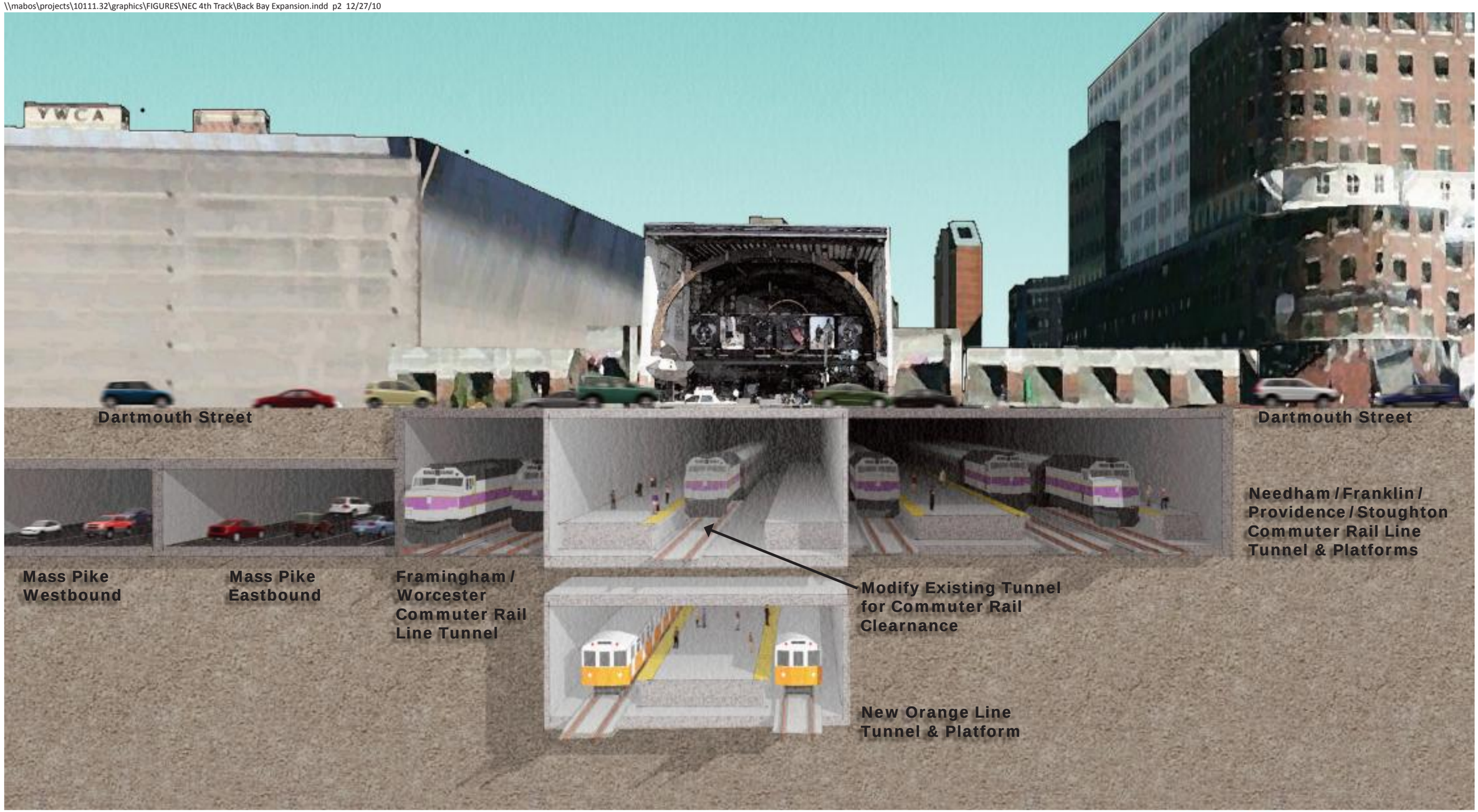
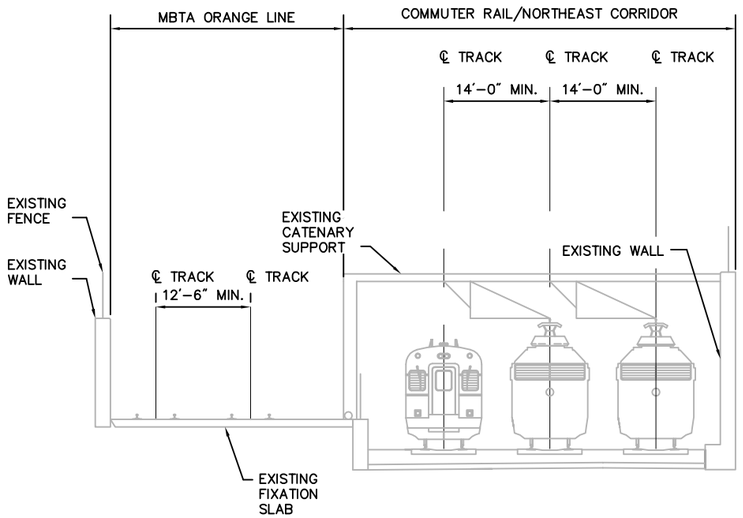
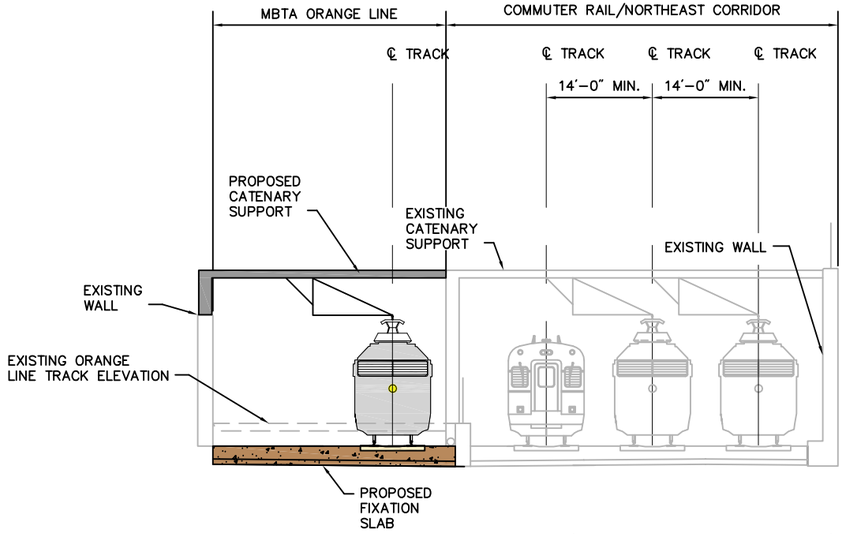


Figure A-16
Northeast Corridor 4th Track Option
Proposed Section - Back Bay Station
January 14, 2011



EXISTING SECTION (LOOKING INBOUND)



PROPOSED SECTION (LOOKING INBOUND)

0 10 20 Feet

Moving Massachusetts Forward. massDOT

SOUTH COAST RAIL

Figure A-17
Northeast Corridor 4th Track Option
Typical Section
Ruggles to Massachusetts Avenue
January 14, 2011

Prepared by: VHB

EXISTING BACK BAY STATION

MASSACHUSETTS TURNPIKE

STANHOLPE STREET

CAHNERS PLACE

COLUMBUS AVENUE

CLARENDON STREET

CAZENOVE STREET

ST. CHARLES STREET

CHANDLER STREET

BERKELEY STREET

CORTES STREET

ARLINGTON STREET

EXISTING ORANGE LINE TRACKS

PROPOSED ORANGE LINE TUNNEL

PROPOSED COMMUTER RAIL TRACK IN PLACE OF ORANGE LINE TRACKS

14'–0"

MEET AND MATCH EXISTING ORANGE LINE TUNNEL

0 50 100 Feet

Moving Massachusetts Forward. massDOT

SOUTH COAST RAIL

Figure A-18
Northeast Corridor 4th Track Option
Back Bay Station - Plan View
(~MP 227.5)
January 14, 2011

Prepared by: VHB

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