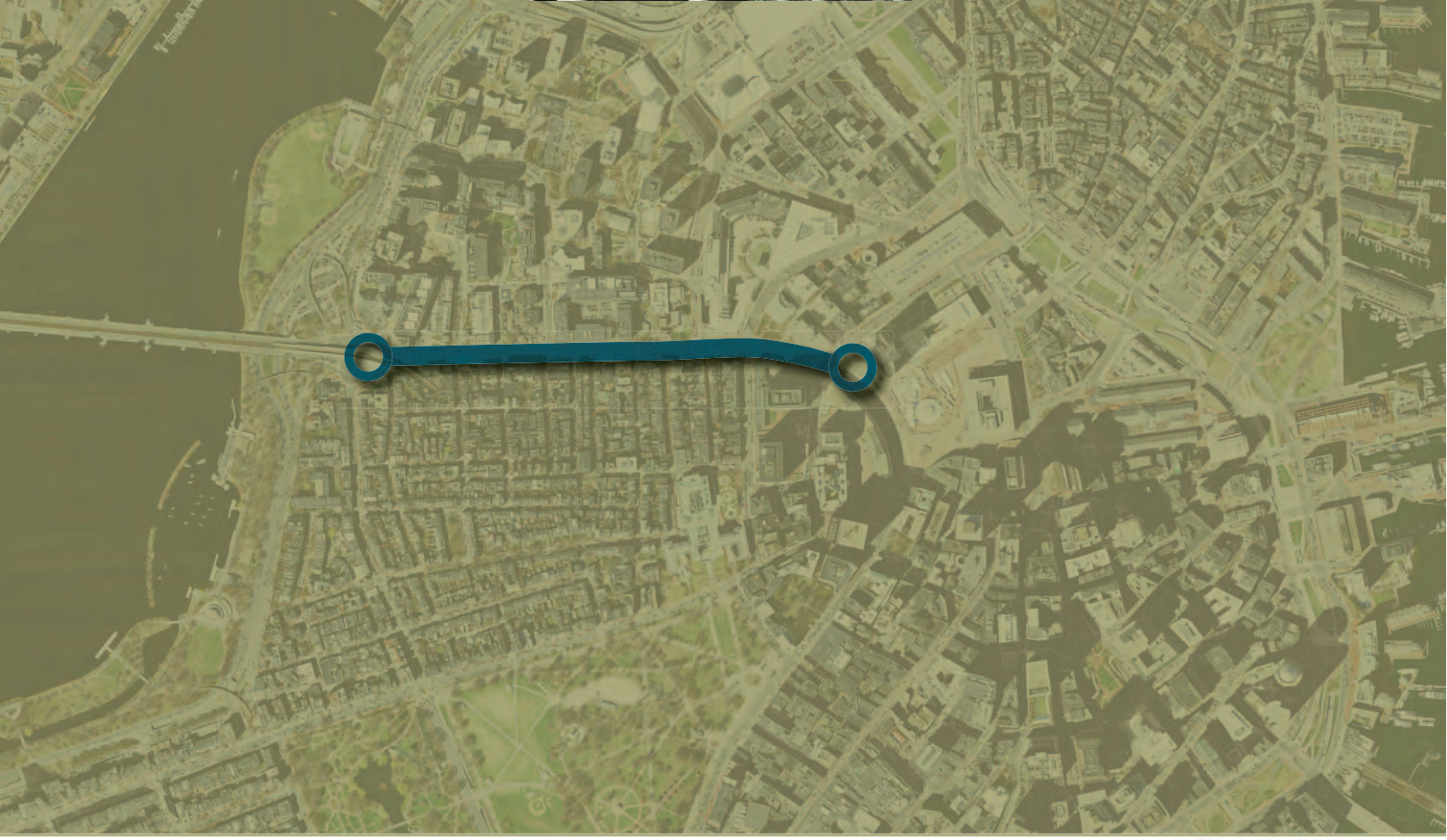
Draft Environmental Impact Report

EEA #14101

March 2010

RED LINE/BLUE LINE CONNECTOR PROJECT



Moving Massachusetts Forward.
massDOT
Massachusetts Department of Transportation

Red Line
Blue Line
CONNECTOR

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JEFFREY B. MULLAN
SECRETARY & CEO

Moving Massachusetts Forward.
massDOT
Massachusetts Department of Transportation

March 31, 2010

Re: **Draft Environmental Impact Report, Red Line/Blue Line Connector Project**
EEA #14101

Dear Reviewer:

The Massachusetts Department of Transportation (MassDOT) is pleased to submit the attached Draft Environmental Impact Report (DEIR) for the Red Line/Blue Line Connector Project, to allow public review of this important project under the Commonwealth's Massachusetts Environmental Policy Act (MEPA) process. MassDOT will hold an open house at 5:30 PM, followed by a public meeting at 6:00 PM, on May 3, 2010, at Shriners Hospital Auditorium (51 Blossom Street, Boston).

We have requested that the MEPA comment period on this DEIR be extended for a 45-day period to allow full public review and comment. Written comments should be provided by May 21, 2010 to:

Secretary Ian Bowles
Executive Office of Energy and Environmental Affairs
MEPA Office, Attn: Holly Johnson, MEPA Analyst
EEA # 14101
100 Cambridge Street, Suite 900
Boston MA 02114

Comment letters may be submitted by U.S. mail to the above address, by fax to Holly Johnson at (617) 626-1181, or by email to holly.s.johnson@state.ma.us. Copies of comments may also be sent to Scott Hamwey, Massachusetts Department of Transportation, 10 Park Plaza, Room 4150, Boston, MA 02116. Written comments should reference the project name and MEPA file number: **Draft Environmental Impact Report, Red Line/Blue Line Connector Project, EEA #14101**

As was contemplated in the MEPA Certificate on the EENF, we have requested that the Secretary accept this DEIR as the Final Environmental Impact Report following the public comment period. We believe that it complies with all of the requirements of the Scope, and that the extensive public coordination that has taken place since the EENF has addressed all of the public concerns about this important public transit project.

Sincerely,

Massachusetts Department of Transportation

Jeffrey B. Mullan
Secretary and Chief Executive Officer

cc: See Distribution List

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Executive Summary

ES.1 Overview

The Red Line/ Blue Line Connector Project is an initiative of the Massachusetts Department of Transportation (MassDOT, formerly Executive Office of Transportation and Public Works, EOT) and the Massachusetts Bay Transportation Authority (MBTA) to improve air quality and increase public transit ridership and system capacity. Enhancing transit services would improve mobility and regional access for residents of East Boston and North Shore communities as well as residents of Cambridge and other communities northwest or south of Boston. The Project will also improve access to Massachusetts General Hospital (MGH), the Massachusetts Eye and Ear Infirmary (MEEI), and other nearby medical facilities.

The MBTA's Red and Blue Lines are the only two of Boston's rapid transit lines that do not intersect. Current transit riders traveling from points along the Blue Line to the Red Line must transfer using the MBTA's Green or Orange Lines. A direct connection between the Blue and Red lines would boost transit ridership, reduce automobile travel through downtown Boston, improve air quality, reduce pedestrian congestion in the existing downtown transfer stations, and improve mobility and access to jobs, education, and health care, in particular for Blue Line riders.

The Project fulfills a longstanding commitment of the Central Artery/ Tunnel Project to increase public transit ridership and system capacity. The Massachusetts Department of Environmental Protection (DEP) Air Pollution Control Regulations, appended to the State Implementation Plan (SIP) for ozone, require that MassDOT complete the design of this Project by December 31, 2011.[1] At this time, MassDOT has not identified funding for the construction of the Project. Should additional resources for MBTA expansion projects become available, the Red Line/ Blue Line Connector

1 DEP. 2009. Code of Massachusetts Regulations (CMR), Chapter 310 Department of Environmental Protection, Part 7.00 Air Pollution Control, Section 7.36 (Universal) Transit System Improvements. (310 CMR 7.36 (2)(h)(i)).

will be one of the projects considered for implementation. When such a priority setting effort takes place, it would be informed by the level of environmental review, and design and engineering work conducted between now and the end of 2011 in order to satisfy the SIP commitment.

The Project is being reviewed under the Massachusetts Environmental Policy Act (MEPA). An Expanded Environmental Notification Form (EENF) was made available for public review in September 2007, and the Secretary of Energy and Environmental Affairs (EEA) issued a Certificate on November 15, 2007, which established the scope and other requirements for this Draft Environmental Impact Report (DEIR). This DEIR has been prepared to meet the requirements of the Secretary's Certificate on the EENF, and documents the Project design as well as potential impacts to the environment. The Secretary's Certificate on the EENF indicated that the MEPA review of the Project could be streamlined if the DEIR resolves the substantive issues identified in the Secretary's Certificate on the EENF. This DEIR has been prepared to meet these goals and MassDOT anticipates that the Secretary will be able to determine that the DEIR, after public review and comment, will serve as the Final EIR. This DEIR has been circulated for public review, and comments should be submitted to the Secretary by May 21, 2010.

ES.2 Project Description

The Red Line/ Blue Line Connector Project consists of extending the Blue Line from Bowdoin Station to Charles/ MGH Station on the Red Line. The Project location is shown in Figure ES-1. The Project would use realigned tracks from just west of the Government Center Station to Bowdoin Station and new tracks from Bowdoin Station to Charles/ MGH Station. The Project would also require constructing a new subsurface platform for the Blue Line east of and below the Charles/ MGH Station headhouse, with pedestrian connections to the elevated platforms for the Red Line. Bowdoin Station would be eliminated to allow for faster travel times (by eliminating a stop) or relocated to provide better transit access.

The key goals of the Red Line/ Blue Line Connector Project are to:

- Link residents in East Boston and the North Shore with jobs, services, and educational opportunities in Boston's West End and the Cities of Cambridge and Somerville;
- Enhance regional access to MGH, MEEI, and surrounding medical facilities;
- Expand transportation options for residents in Boston's West End and Beacon Hill neighborhoods; and

- Improve access from Cambridge, Somerville, and northwestern suburbs to jobs, services, and attractions in Downtown Boston, East Boston, the North Shore, and to Logan International Airport.

As required by the Secretary's Certificate on the EENF, two Build Alternatives and a No-Build Alternative are evaluated in this DEIR. The No-Build Alternative is evaluated as a baseline condition to which the Build Alternatives may be compared. The two Build Alternatives evaluated in this DEIR, described in Chapter 3, Alternatives, are:

- Alternative 1: Blue Line Extension to Charles/ MGH Station with Eliminated Bowdoin Station, and
- Alternative 2: Blue Line Extension to Charles/ MGH Station with Relocated Bowdoin Station.

Alternative 1 has been identified as the Preferred Alternative. This alternative provides the best balance of cost, ridership, and environmental impacts. This alternative would have more operational reliability and have a lower capital cost than Alternative 2. Alternative 1 would meet all Project goals, would be operationally practical, and would generate a high number of new system-wide transit trips. MassDOT also believes that this alternative will help the Commonwealth achieve its goal of improving regional air quality and providing expanded transportation services.

ES.3 Purpose and Need

The purpose of the Red Line/ Blue Line Connector Project is to boost transit ridership, reduce automobile travel through Downtown Boston, improve air quality, reduce congestion in the existing Downtown transfer stations, and improve mobility and access to jobs and health care for residents of Boston, East Boston, Cambridge, Somerville, Revere, Winthrop, and Chelsea.

As identified in the SIP, final design of the Project (to be completed by December 31, 2011) is needed to comply with the DEP Air Pollution Control Regulations. Transit enhancements are also needed to address:

- Poor transit connectivity;
- Limited transit capacity;
- Poor regional air quality; and
- Congestion in existing downtown subway stations.

Existing transit service in Boston and Cambridge is currently offered by MBTA subway lines and numerous bus routes. However, the Red Line and Blue Line do not connect anywhere in the MBTA system. As a result, riders connecting between points on the Blue Line (the Boston waterfront, East Boston, Logan Airport, Revere) and points on the Red Line (Boston, Cambridge, Somerville, Quincy) must transfer to the Green or Orange Lines in order to complete their trip. This transfer penalty reduces ridership and increases congestion at other Downtown Boston stations.

The Project is needed to relieve congestion pressure at other subway stations in the Downtown Boston area. Boardings at the four existing Downtown Boston Blue Line stations vary substantively. There are relatively few daily boardings at Bowdoin Station (1,330), more than three times that many at Aquarium Station (4,400), and an order of magnitude higher boardings at Government Center and State Stations (15,110 and 11,980, respectively). These counts indicate that Blue Line boardings are highest at transfer points to other subway lines.

The Project area is located within a US Environmental Protection Agency-designated non-attainment air quality area for ozone, with a classification of "moderate." Motor vehicles are the predominant sources of ozone precursor emissions. Reducing vehicle miles traveled and cutting consequent emissions of volatile organic compounds and carbon monoxide may result from improved transit options and shifting travel mode from automobiles to transit services. As noted above, design of the Project is a requirement of the DEP Air Pollution Control Regulations specifically for these purposes.

ES.4 DEIR Alternatives

Three alternatives are evaluated in this DEIR:

- No-Build Alternative;
- Alternative 1: Red Line/ Blue Line Connector with Eliminated Bowdoin Station; and
- Alternative 2: Red Line/ Blue Line Connector with Relocated Bowdoin Station.

Alternatives 1 and 2 are collectively referred to as the Build Alternatices. Other alternatives were considered and eliminated early in the Project, as documented in the EENF. As suggested by some commentors, MassDOT evaluated other transit modes for the Red Line/ Blue Line connector, such as "people-mover" technology, but found that these would provide little transportation benefit and did not meet the requirements of the Air Pollution Control Regulations. MassDOT evaluated constructing both Alternative 1 and Alternative 2 using cut-and-cover, mined tunnel, and sequential excavation mining construction methods. The cut-and-cover method, which if used for the entire alignment would have required that Cambridge Street be

excavated and that a substantial number of utilities be relocated, would have substantially higher cost and would disrupt traffic and neighborhoods to a much greater extent than a mined tunnel. The Build Alternatives described in this DEIR would use a combination of the three techniques, based on physical constraints, construction requirements, impacts to the community and environment, and cost.

ES.4.1 No-Build Alternative

Under the No-Build Alternative, Red Line and Blue Line operations would remain similar to today's operations with the exception of the infrastructure improvements proposed in the Boston Region Metropolitan Planning Organization's long range transportation plan, *Journey to 2030*.[2] These improvements are collectively known as the Blue Line Modernization Project and consist of capacity enhancements (increase to six-car trains) and station accessibility improvements. The two stations in the Project area, Bowdoin and Charles/ MGH, are serviced by the Blue Line and the Red Line, respectively.

Bowdoin Station is located in Downtown Boston just west of Government Center. The station is the southern terminus of the Blue Line. It was constructed as part of the East Boston Tunnel Extension project in 1916 and used for streetcar service.[3] The Blue Line was converted to electric rapid transit service by 1924, and the platforms were raised to accommodate the new trains. The station was renovated in 1968 as part of a systemwide modernization program. Inbound Blue Line trains use a loop track at Bowdoin Station to reverse direction and begin the outbound trip. However, the tight radius of the curve does not allow for safe emergency evacuations while in the loop. Prior to entering the loop, all westbound passengers are required to exit the train. Once the train travels through the loop, eastbound passengers are able to board on the south side of the platform.

Charles/ MGH Station is located along the Boston side of the Charles River, between the historic Longfellow Bridge and the Red Line tunnel under Beacon Hill. Constructed in 1931, Charles/ MGH Station was designed to accommodate the Red Line elevated track, which was built in 1912. The original station was built on a traffic island with a below-grade passageway that allowed pedestrian access from the sidewalk rather than through the traffic circle. In 1961, the underground passageway was replaced with overhead walkways that connected the elevated platforms on both the north and south sides in a three-story structure. Charles/ MGH Station was renovated again in 2007 as a fully Americans with Disabilities Act (ADA) accessible station. The new two-story building replaced the elevated pedestrian footbridges and three-story headhouse. The station currently consists of a street-level headhouse entrance and fare collection lobby

2 Boston Region Metropolitan Planning Organization. 2007. *Journey to 2030*. Available on the MPO website: http://www.ctps.org/bostonmpo/3_programs/1_transportation_plan/plan.html. Accessed 11 December 2009.

3 STV. 2009. *Red Line/Blue Line Connector Historic Resources Reconnaissance Survey and Archaeological Resources Assessment*. Prepared by STV, Inc. in association with the Public Archaeology Laboratory. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue.

located in Charles Circle, and two semi-enclosed side platforms above the lobby area. Stairs, upward escalators, and elevators allow patrons to access the platforms.

Under the No-Build Alternative, no improvements would be made to the Blue Line except for already programmed ADA access improvements at each station with the exception of Bowdoin Station.

ES.4.2 Alternative 1: Red Line/Blue Line Connector with Elimination of Bowdoin Station

Alternative 1 would extend the Blue Line from Bowdoin Station to Charles/ MGH Station, eliminating the existing Bowdoin Station. The station would be deactivated, although a passageway would be retained to allow for emergency egress. A new underground Blue Line platform would be constructed east of and below the existing Charles/ MGH Station. The Blue Line platform at Charles/ MGH Station would connect to the existing elevated Red Line platforms by stairways, escalators, and elevators allowing passengers to easily transfer between the two lines. Figures ES-2a and ES-2b show a conceptual plan of Alternative 1; a cross-section view is provided in Figure ES-3.

Reconstructing the track through Bowdoin Station would bypass the loop track for a straighter alignment to Charles/ MGH Station. The current conceptual design specifies two tracks throughout the length of the Project, as compared to up to four tracks in some sections as previously envisioned in the EENF. For the majority of the length of the Blue Line extension, between Bowdoin Station and Charles/ MGH Station, two parallel tunnels would be constructed by a tunnel boring machine beneath existing street and buried utility infrastructure. Except at access points at either end of the alignment, all tunnel boring work would be completed below grade, and surface disturbance would be limited. A staging area, tentatively established as a portion of the MEEI parking lot immediately north of Charles/ MGH Station, would be the main access point for construction.

Three portions of the Project would be constructed with cut-and-cover or sequential excavation mining methods, and decking would be installed over the excavations to minimize disruption of surface traffic:

- The segment east of Bowdoin Station, approximately 550 feet long, would be constructed using the cut-and-cover method to allow the existing tracks to be realigned and the tunnel boring machine to be removed.
- A segment east of Charles/ MGH Station, approximately 100 feet long, would be constructed with the cut-and-cover method to allow a ventilation room to be constructed in the area of the track crossover.

- Short tail tracks west of Charles/ MGH Station would be constructed with the sequential excavation mining method because the sharp bend in the tunnel alignment doesn't allow the tunnel boring machine to be used. The eastern ends of these two tail tracks would be connected to the main tunnel immediately east of Charles/ MGH Station. This area, about 150 feet long, would be excavated by cut-and-cover methods to allow the tunnel boring machine to be inserted.

Grates and protective bollards for ventilation shafts and emergency exits in the Cambridge Street median would be the only tunnel elements visible from the street when the Project is completed.

For either Build Alternative, the new platform for the Blue Line at Charles/ MGH Station would be constructed immediately east of, and below, the existing headhouse. Two new elevator shafts would be constructed to provide access to the Blue Line level, as would a stairway and two escalators from the existing street level headhouse down to the Blue Line platform. A single 320-foot long center platform would be constructed. The two tail tracks, for train storage, would extend west beyond the station.

There will be no new parking facilities, facilities for passenger drop-off and pick-up, or bus stops. No additional station staff is expected since fares will be paid at the existing fare gates in the Charles/ MGH Station headhouse.

Based on a 10-percent conceptual level of design, the current estimated cost to construct Alternative 1 is $621 million, in 2009 dollars. The escalated cost based on mid-point of construction dollars is approximately $748 million. This alternative would take approximately 6 years to construct.

ES.4.3 Alternative 2: Red Line/Blue Line Connector with Relocation of Bowdoin Station

Alternative 2 would similarly extend the Blue Line from Bowdoin Station to Charles/ MGH Station, but the platform of Bowdoin Station would be relocated while maintaining the existing mezzanine and headhouse. The new platform at Bowdoin Station would be able to accommodate six-car trains. Access to the platform would be made via escalators, elevators, and stairway connections. The new platform would be approximately 22 feet below the existing platform elevation to accommodate the appropriate slope for the tunnel extension to Charles/ MGH Station. As with Alternative 1, the loop track would be eliminated. A new underground Blue Line platform would be constructed east of and below the existing Charles/ MGH Station, and connections between the two stations would be made via ADA-accessible stairways, escalators, and elevators. Figures ES-4a and ES-4b shows conceptual plans of Alternative 2; a cross-section view is provided in Figure ES-5.

Based on a 10-percent conceptual level of design, the current estimated cost to construct Alternative 2 is $718 million, in 2009 dollars. The escalated cost based on mid-point of construction dollars is approximately $867 million. Alternative 2 would take approximately 6 years to construct.

ES.5 Environmental Consequences

Chapter 5 of this DEIR, Environmental Consequences, and Chapter 6, Construction Period Impacts, describe the permanent and temporary impacts, respectively, of each alternative considered (No-Build Alternative, Alternative 1, and Alternative 2). The evaluation of environmental consequences includes the environmental impacts of the alternatives and any adverse environmental effects that cannot be avoided. Information provided under each impact category in this DEIS includes consideration of direct and indirect effects and their significance, and applicable permit or regulatory requirements. The resource evaluations respond to the requirements of the Secretary's Certificate on the EENF. The analyses were developed in compliance with the MEPA regulations.

ES.5.1 Permanent Impacts and Mitigation Measures

The proposed Project would have beneficial impacts to users of the MBTA system, and would have regional air quality benefits. There are no differences between Alternative 1 and Alternative 2 with respect to either beneficial or adverse effects. Beneficial effects of the Project, in addition to improved transit access, include:

- Traffic - The Project is anticipated to result in a general decrease in traffic in Downtown Boston, and along Cambridge Street in particular, compared to the No-Build Alternative. Regionally, either alternative would reduce weekday vehicle-miles traveled by approximately 5,250 (in 2030).
- Air Quality - There were no major differences identified in the local (microscale) analysis of carbon monoxide (CO) emissions in 2030 between the two Build Alternatives, and both showed improvements when compared to the No-Build Alternative. Emission levels for each alternative would be below the National Ambient Air Quality Standards (NAAQS) for CO of 35 parts per million (ppm) for a 1-hour period and 9 ppm for an 8-hour period. A regional (mesoscale) analysis estimated the area wide emissions of volatile organic compounds (VOCs), oxides of nitrogen (NO_x), carbon dioxide (CO_2), CO, and particulate matter (PM) emissions in 2030. All alternatives would result in reductions of these pollutants as compared to 2009 levels, and all parameters would be below the current NAAQS. Minor differences were found in CO_2 emissions between the two Build Alternatives, but both are lower than under the No-Build Alternative.

The Build Alternatives would provide CO_2 emission reductions on the order of 1,236 tons per year in 2030.

- Environmental Justice - Environmental justice populations would benefit from the Project from increased access to transit and decreased travel times for these populations. No adverse permanent impacts to air quality, noise levels, access to parks, traffic, or neighborhood fragmentation are anticipated to result from the Project. Accordingly, no disproportionate impacts to environmental justice populations would occur from either Build Alternative.

Because the proposed Project is entirely below ground, there would be no permanent changes to Cambridge Street or the surrounding area except for vent grates, emergency egress hatches, and protective bollards. The Project has the potential to cause permanent adverse noise and affect groundwater levels in some areas. These impacts would be addressed through construction methods, as summarized below and described in greater detail in the following sections, and no long-term adverse effects are anticipated. Potential permanent impacts resulting from the proposed Project include:

- Noise (ground-borne) generated by vibration when the trains pass over track joints at the crossovers, which would be mitigated using special track structures at crossover locations; and
- Groundwater seepage due to the location of the tunnel invert intersecting with the water table in proposed station areas. This seepage would be mitigated through permeation grouting within the tunnel and underpinning piers and foundations, as necessary. Groundwater levels would be monitored during and after construction to ensure that drawdown required for constructing the relocated Bowdoin Station under Alternative 2 is temporary.

There would be no permanent impacts to the following conditions/ resources:

- Stormwater – The Project would not create new impervious surfaces or new stormwater discharges, and therefore would not increase stormwater runoff or increase the pollutants in runoff.
- Existing Transportation Systems – Local bus and shuttle services provided by MBTA and others would be unaffected by the Project.
- Hazardous Materials - The Project would not generate hazardous or solid waste. Exposure to residual hazardous materials is not expected to present a risk to public health. There is no different risk of exposure between the Alternatives.
- Land Use and Parks - The Project does not require land acquisition of any kind. It would not permanently impact Cardinal Cushing Park or City Hall Plaza. Although the footprint of Charles/ MGH Station would be expanded slightly to the northeast to accommodate internal structural changes, use of this section of

the Charles River Reservation (owned by the Department of Conservation and Recreation and protected under the Massachusetts Constitution Article 97) has been granted to MassDOT under an occupancy permit. There would be no permanent adverse impacts to Landlocked Tidelands, protected under Massachusetts General Law Chapter 91, from either Build Alternative other than subsurface transit facilities.

- Historic and Archeological Resources - No historic properties or known archaeological resources would be permanently impacted by the Project. There would be no difference in permanent impacts to historic or archaeological resources between the Build Alternatives.

Noise

Since the Project is an underground tunnel, airborne noise generated by the trains would not propagate into the surrounding community. Airborne noise sources from transit operations are limited to a traction power substation near Charles/ MGH Station and fans for ventilation shafts at the end of the northern and southern tail tracks, in the median of Cambridge Street at North Anderson Street and near Bowdoin Station.

Day-night noise levels (Ldn) from the traction power substation are projected to be less than 50 decibels (dBA) at sensitive receptor sites and no impact is expected. Similarly, Ldn levels from ventilation shafts are projected to be less than 42 dBA and no impact is expected. There would be no difference between the Build Alternatives in airborne noise levels.

Ground-borne vibration and ground-borne noise, which is produced when ground-borne vibrations propagate into a building and radiate noise from the motion of the room surfaces, have been assessed at sensitive locations along the Project corridor. Potential ground-borne noise impact from transit operations is projected at four multi-family residences (224 to 238 Cambridge Street, 250 Cambridge Street, 284 Cambridge Street, and 1 Garden Street) near the track crossover, where increases in ground-borne noise and vibration levels would be expected due to the gaps in the rail running surface. Ground-borne noise is projected to be between 35 and 41 dBA at these locations (the Federal Transit Administration's residential criterion for impacts requiring mitigation is 35 dBA). Using special track structures (spring-rail frogs, moveable-point frogs, or flange-bearing frogs) would mitigate potential ground-borne noise impacts from transit operations at these residences. With these mitigation measures, there would be no permanent impacts from noise or vibration for either Build Alternative.

Groundwater

Because the proposed tunnels and stations are below the groundwater level, it will be necessary to de-water certain sections of the Project during construction. Once completed, the tunnels and stations are anticipated to be water-tight and would not affect groundwater levels or flows.

The proposed mined tunnel, access shafts, cut-and-cover tunnel, and associated structures would be designed to be as watertight as practicable, through the use of grouting and pre-cast concrete liners, such that seepage and related water-level drawdown locally and regionally will be minimal. Any seepage that occurs would be addressed by sealing visible leaks and recharging the collected groundwater in infiltration basins and/ or recharge wells. No permanent impacts to groundwater flow or quality from the Build Alternatives are expected.

ES.5.2 Construction Impacts and Mitigation Measures

Most impacts associated with the Project would be temporary and associated with construction. Resources that may be affected during construction include traffic, air quality, noise and vibration, groundwater, hazardous materials, stormwater, historic and archeological properties, and environmental justice communities. Anticipated short-term Project-related impacts during construction and proposed mitigation measures are summarized below. The two Build Alternatives would have the same temporary construction impacts primarily associated with the open cut-and-cover excavations between Bowdoin Station and Government Center, and near Charles/ MGH Station.

Temporary construction-period impacts would be mitigated to the extent practicable (see Chapter 7, Draft Section 61 Findings and Mitigation Commitments, of this DEIR).

The following paragraphs describe construction-period impacts and mitigation measures for the evaluated resources.

Traffic

Existing station access to Charles/ MGH Station would be maintained throughout construction. While Bowdoin Station would be closed during the majority of construction (either permanently or for reconstruction) there may be a need to provide access during early stages via temporary sidewalks connecting to the existing headhouse. Additionally, subway riders may need to be bused from Maverick Station to Government Center Station (with stops at Aquarium and State Stations) for three weekend days when the track between State Station and Government Center Station is temporarily closed to construct a new crossover east of Government Center.

Impacts to traffic operations are anticipated to be identical during the construction of either alternative. The Project would be constructed along Cambridge Street, a busy thoroughfare in Downtown Boston with a variety of residential, commercial, and institutional land uses along its length. Open excavations would be required for segments constructed by the cut-and-cover method; vehicle traffic detours would be required to route traffic around these construction areas until temporary decking can be installed. Certain lanes of Cambridge Street may be temporarily closed to allow for surface work such as jet grouting for sequential excavation mining and installing traffic decks over open excavations. These closures would be scheduled for overnight or weekends to minimize traffic flow disruption during peak travel times. Vehicle parking and pedestrian or bicycle access would be restricted temporarily at each construction zone. Once the traffic decking had been removed and final utility installation has been completed, roadway configurations would be returned to their respective pre-construction alignments and the surface would be restored using temporary lane closures or detours during off-peak traffic periods.

Air Quality

Temporary air quality impacts from equipment emissions and dust could result from construction activities such as relocating utilities, grading, excavating, trackwork, and installing systems components. These impacts, if unmitigated, may occur in residential areas and at other sensitive land uses located within several hundred feet of the alignment.

Construction contractors would be required to adhere to all applicable regulations regarding control of construction vehicles emissions. This would include, but not be limited to, maintaining all motor vehicles, machinery, and equipment associated with construction activities and proper fitting of equipment with regulatory-required emissions control devices. Also, excessive idling of construction equipment engines would be prohibited, as required by DEP regulations in 310 CMR 7.11, *Regulations for the Control of Air Pollution*.

Contract specifications would require that all diesel-powered construction equipment used on-site be fitted with after-engine emission controls such as diesel oxidation catalysts or diesel particulate filters.[4] Construction contractors would be required to use ultra-low sulfur diesel fuel for all off-road construction vehicles as an additional measure to reduce air emissions from construction activities. The contractor would also be responsible for protective measures around the construction and demolition work to protect pedestrians and prevent dust and debris from leaving the site and entering the surrounding community.

4 This is consistent with the Certificate of Construction Equipment Standard Compliance Form required for all bids to the MBTA.

Noise and Vibration

For short-term construction activities, a preliminary "worst-case" scenario of potential noise impact indicates that 26 residential properties and 26 institutional and commercial properties may be exposed to construction noise. The MEEI building at 325 Cambridge Street and the multi-family residential building at 315 Cambridge Street may be exposed to vibration from construction activities that, if unmitigated, could cause damage to building foundations, annoy humans within the buildings, and affect vibration-sensitive equipment.

Construction noise mitigation would include preparing a Noise Control Plan in conjunction with the contractor's specific equipment, schedule, and methods of construction, specifying maximum noise limits for each piece of equipment, prohibiting certain types of equipment during the nighttime hours, and engineering noise control measures. Building foundations potentially impacted by vibration would be monitored in conjunction with the settlement monitoring described in Sections 5.9 and 6.9 of this DEIR. To mitigate the potential impacts, the contractor would need to use specific construction methods and equipment to minimize the potential for damage, annoyance, and effects to sensitive equipment. Such methods may involve using alternatives to clam shovels for excavation or typical drill rigs prior to jet grouting, or using methods which generate lower vibrations. Given the close proximity of the construction activities to these buildings, other mitigation measures such as trenches or wave barriers are not likely to be feasible.

Soils and Groundwater

The soil profile within the Project area includes fill, organic silt, marine clay, marine sand, glacial till, possible glacial moraine deposits, and bedrock. Construction techniques have been selected based upon the geotechnical properties of the soils, taking into consideration the presence of groundwater. Both of the Build Alternatives involve a predominantly mined tunnel (using a tunnel boring machine) in combination with relatively short sections of tunnel constructed using the cut-and-cover construction technique. Excavation for the Charles/ MGH Station and Bowdoin Station (for Alternative 2 only) platforms and tail track tunnel segments would be constructed using the sequential excavation method after the two tunnels were completed.

The estimated volume of soil that would be excavated by either Build Alternative is 175,000 cubic yards. The soil removed from the tunnels would be stockpiled at the staging area, trucked off-site and disposed of at an appropriate, approved site. Soil removed from the cut-and-cover excavation between Bowdoin Station and Government Center would be loaded directly onto trucks and transported off-site.

For both Build Alternatives, the tunnels would be designed and constructed such that groundwater levels would not be lowered along the alignment. The construction contractor would be required to take remedial measures if the groundwater drops

below current background levels during construction. Some ground settlement may occur as a result of dewatering along the tunnel alignment and in the area of Bowdoin Station during construction. Settlement may affect some adjacent structures, depending upon the extent of dewatering and type of building foundation. Underpinning may be required to prevent permanent damage to some structures. Other buildings or structures (such as sidewalks or retaining walls) may be monitored for settlement during construction, and repaired if damaged. There are no historic buildings in this area. There is no difference in risk of permanent settlement damage between the Build Alternatives.

The Bowdoin Station area would likely be the only place where temporary groundwater drawdown would be considered to allow for construction, under Alternative 2. However, the dewatering is unlikely to affect neighboring structures, as shallow wood-pile foundations are not anticipated in this area. Groundwater would be monitored prior to, during, and after construction to ensure that the groundwater level in the vicinity of the Project is not lowered in any area to a degree that would cause harm to existing structures. Some groundwater may have been contaminated by historical releases of regulated materials; contaminated groundwater would be treated and discharged in accordance with appropriate regulatory requirements.

Hazardous Materials

Contaminated soil or groundwater may be encountered during Project construction activities. Excavations to 65 feet below ground surface would likely be through contaminated soil, and dewatering activities (specifically in the vicinity of Bowdoin Station) may encounter contaminated groundwater. Exposure to residual hazardous materials in soil and/ or groundwater may present a risk to worker health, and any materials with concentrations of chemicals in excess of regulatory standards must be treated and/ or disposed of properly. A soil and groundwater management plan, describing testing protocols, on-site management, and eventual treatment or disposal would be developed before construction.

Suspected lead-, mercury-, or asbestos-containing building materials, as well as polychlorinated biphenyl products and petroleum products, are present within Bowdoin Station and the existing tunnels. Construction or demolition activities may result in worker exposure to these regulated materials. The nature and extent of the exposure risk may vary between the alternatives, depending upon the extent of building material disturbance at Bowdoin Station. It is not possible, at this phase of the design, to determine the full extent of materials that would be disrupted for either Build Alternative. A hazardous materials management plan, describing testing protocols, on-site management, and eventual treatment or disposal, would be developed before construction, based upon the final design.

Land Use

Temporary construction easements to facilitate construction would be required at the following locations for both Build Alternatives:

- Parking lot west of Charles Street (MEEI);
- Parking lot under elevated Red Line adjacent to West Cedar Street (Eye Research Institute);
- Charles Circle (DCR); and
- John F. Kennedy Federal Building - handicapped parking area in front of the building (Boston Redevelopment Authority).

Impacts to these properties would include temporary restrictions on access during cut-and-cover excavation and underpinning Red Line Pier No. 7. The MEEI parking lot would be used as a staging area throughout construction. Public use of the parking lot under the elevated Red Line east of Charles/ MGH Station would be temporarily restricted for underpinning Pier No. 7. An easement from DCR would be required for construction activities within and underneath Charles/ MGH Station, within the footprint of Charles Circle. Vehicle access to the John F. Kennedy Federal Building/ City Hall Plaza at the eastern end of the Project area would be temporarily restricted during cut-and-cover excavation for this segment.

Pedestrian access to the Cardinal Cushing Park at Bowdoin Station, John F. Kennedy Federal Building/ City Hall Plaza, and Charles Circle in the Charles River Reservation at the Charles/ MGH Station would be modified during construction. There would likely be temporary access constraints to the pedestrian walkways through the Park, Plaza, and the easternmost boundary of the Reservation, adjacent to Charles Circle. Vehicular and pedestrian access to Charles Circle would be affected during construction of the subway tunnel, which would require a temporary occupancy permit from DCR.

Impacts to filled Landlocked Tidelands from both Build Alternatives would include excavating fill and placing below-ground structures along Cambridge Street during the tunnel boring phase of the Project. Impacts to these tideland areas would be limited to temporary traffic detouring and potentially limited public access along adjacent sidewalks during construction.

Stormwater

Constructing the open cut-and-cover sections would require temporary relocation of portions of the storm drain system. MassDOT intends to restore all elements of Cambridge Street, including stormwater infrastructure, to pre-construction conditions. There is no difference between the Build Alternatives' construction period impacts to stormwater.

Construction would require coverage under the U.S. Environmental Protection Agency National Pollutant Discharge Elimination System (NPDES) Construction General Permit because the Project would disturb over one acre of land. A Stormwater Pollution Prevention Plan (SWPPP) would be required to identify potential sources of stormwater pollution during construction and describe practices to reduce pollutants in stormwater discharges.

Historic and Archaeological Resources

No impacts to historical structures or archaeological resources from either of the Build Alternatives are anticipated as a result of construction-period vibration or dewatering activities. Subsurface work (excavation and tunneling) may encounter buried archaeological resources, most likely within filled tidelands west of Anderson Street. Additional archaeological investigations would be needed in high sensitivity areas to locate, identify, evaluate, and record significant cultural deposits. Such investigations would be coordinated with the Massachusetts Historical Commission.

Environmental Justice

Temporary impacts to air quality, noise levels, access to parks, and traffic may result during the construction period, as described above. Residents of designated environmental justice neighborhoods adjoining the Project area (on the north side of Cambridge Street) could be affected by these impacts. However, the effects would not be disproportionate, as adjoining neighborhoods not designated as environmental justice neighborhoods (on the south side of Cambridge Street) would be similarly affected. There would be no neighborhood fragmentation impacts from either Build Alternative.

Summary

Temporary impacts to the resources described above would result from constructing the Red Line/ Blue Line Connector Project. Mitigation measures would eliminate or reduce the effects of the construction activities. MassDOT and MBTA are committed to mitigating the impacts to the extent practical. Table ES-1 summarizes the construction period mitigation and management protocols associated with the proposed Project.

Table ES-1 Cosntruction Period Mitigation and Management Protocols

Traffic
Establish temporary detours to minimize traffic disruption due to construction.
Adjust traffic signal timing at five intersections.
Coordinate with emergency response and hospitals to insure unimpeded access.
Construct temporary pedestrian walkways.
Construct temporary parking structure for MEEI visitors.

Air Quality
Apply water to dry soil and construction vehicles to prevent dust production.
Use ultra-low sulfur diesel in construction equipment to reduce air emissions.
Regular street/pavement sweeping to control dust.
Follow existing MBTA retrofit procedures for construction equipment to reduce emissions.
Prohibit excessive idling (per 310 CMR 7.11) to reduce air emissions.

Noise
Use specially quieted equipment with enclosed engines and/or high-performance mufflers.
Provide spring frogs at crossover location to mitigate ground-borne noise.
Avoid nighttime construction in residential neighborhoods.
Keep truck idling to a minimum.
Route construction equipment and vehicles through areas that would cause the least disturbance to nearby receptors where possible.
Fit any air-powered equipment with pneumatic exhaust silencers.
Locate stationary construction equipment as far as possible from noise-sensitive sites.

Vibration
Avoid nighttime construction in residential neighborhoods.
Use alternative construction methods to minimize the use of impact and vibratory equipment (e.g., pile drivers and compactors).
Monitor sensitive buildings for vibration damage to foundations and inspect sidewalks and retaining walls; repair as necessary.

Water Quality/Stormwater
Develop and implement a Stormwater Pollution Prevention Plan in accordance with National Pollutant Discharge Elimination System and Department of Environmental Protection standards.
Use dewatering controls, if necessary.
Treat dewatered groundwater prior to discharge.

Hazardous Materials and Solid Waste
Implement special management procedures for any hazardous, contaminated or special wastes generated during construction, including special handling, dust control, and management and disposal of contaminated soil. Procedures should protect both workers and nearby receptors.
Perform subsurface investigations to test for possible soil or groundwater contamination; develop Soil and Groundwater Management Plan as necessary.
Treat and dispose of contaminated soil or groundwater dewatering effluent in accordance with DEP requirements.
Prepare a site-specific Health and Safety Plan.
Conduct pre-demolition inspections to identify any hazardous materials such as asbestos and lead-based paint in Bowdoin Station.
Follow City rodent control guidelines based on the state sanitary code as it relates to trash and rats. Place and maintain bait boxes throughout the Project area.

Soils/Groundwater
Recharge dewatered groundwater where possible.
Conduct monitoring program to identify and remedy water drawdown issues.
Restore groundwater through leak sealing and additional grouting.
Install groundwater cut-off wall to reduce dewatering requirements in addition to a large-scale jet grouting effort, if necessary.
Underpin piers and foundations and repair damage as necessary.

ES.6 Public Involvement

The Red Line/ Blue Line Connector Project has received public input throughout the planning process. As noted in the Secretary's Certificate on the EENF, the comment letters on the EENF reflect a substantial interest in the future of the Project corridor from elected officials and municipal representatives; city, state, and regional agencies; environmental, bicycle, and pedestrian advocacy groups; neighborhood groups; groups that represent the disabled; businesses; residents; and the general public.

MassDOT has established a Red Line/ Blue Line Connector Working Group with neighborhood, civic, business, and community representation in general. The Working Group has met bi-monthly and provides important guidance and input to MassDOT and the consultant team on a range of issues relating to the Project. The team has also met with several Project abutters and agencies to gather information on engineering concepts and to assess potential impacts.

MassDOT has met with agencies having jurisdiction over resources within the Project corridor, and has consulted about temporary and permanent impacts. This coordination has included the Boston Water and Sewer Commission (BWSC), Boston Traffic Department (BTD), DCR, DEP Waterways, and the Massachusetts Historical Commission (MHC).

MassDOT has created a Project website where Working Group members and the public can read and download reports, presentations, and summary notes. The website (www.mass.gov/ massdot/ redblue) is promoted in all Project emails and publications, and is updated regularly.

A public meeting will next take place in the community on May 3, 2010 when there are Project milestones for review and comment. In addition, MassDOT plans to make presentations to local and regional groups to introduce the Project, gather comments and consider suggestions and ideas for the Project.

Figures

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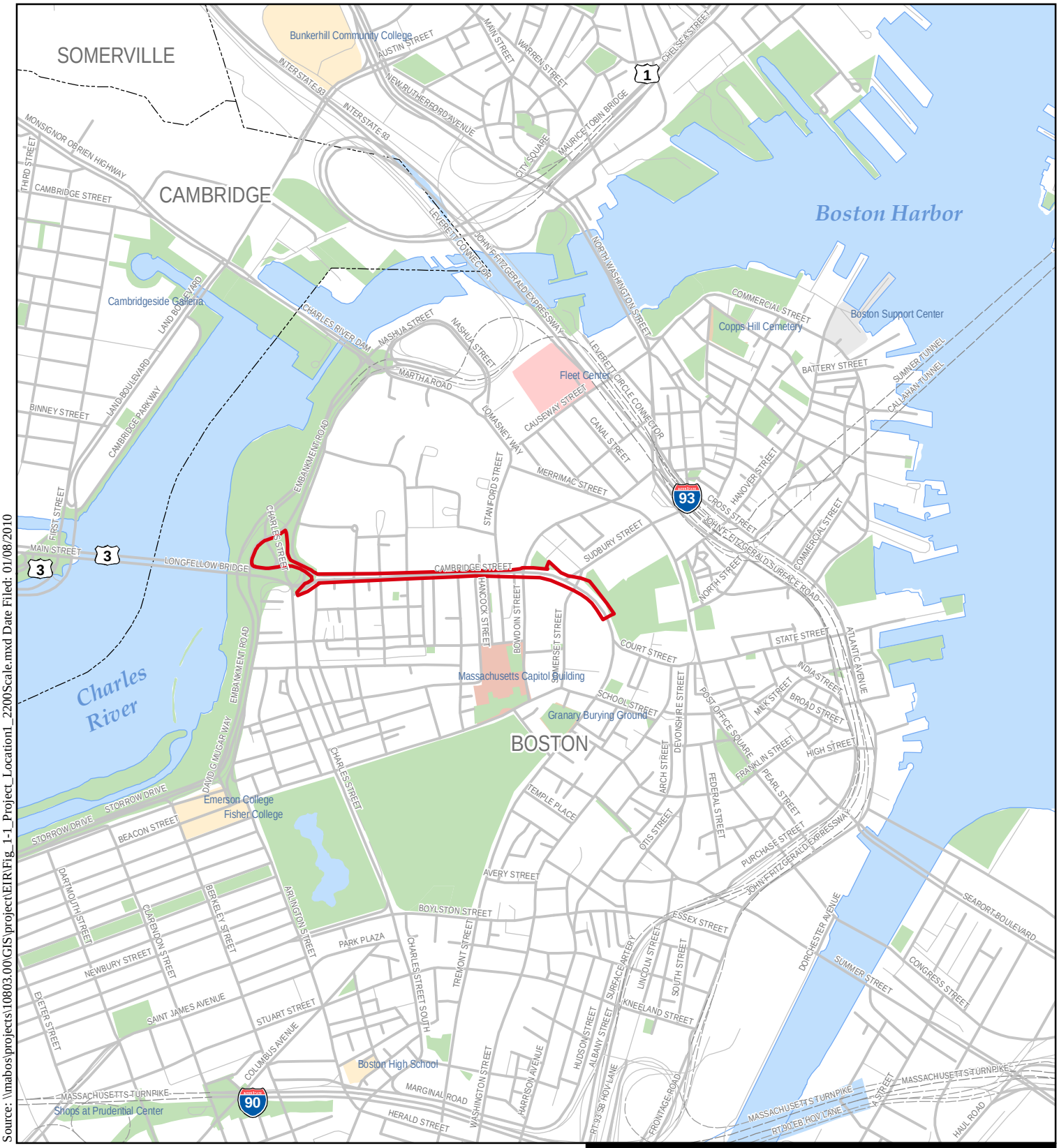

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Red Line/ Blue Line Connector Project

Figure ES-1

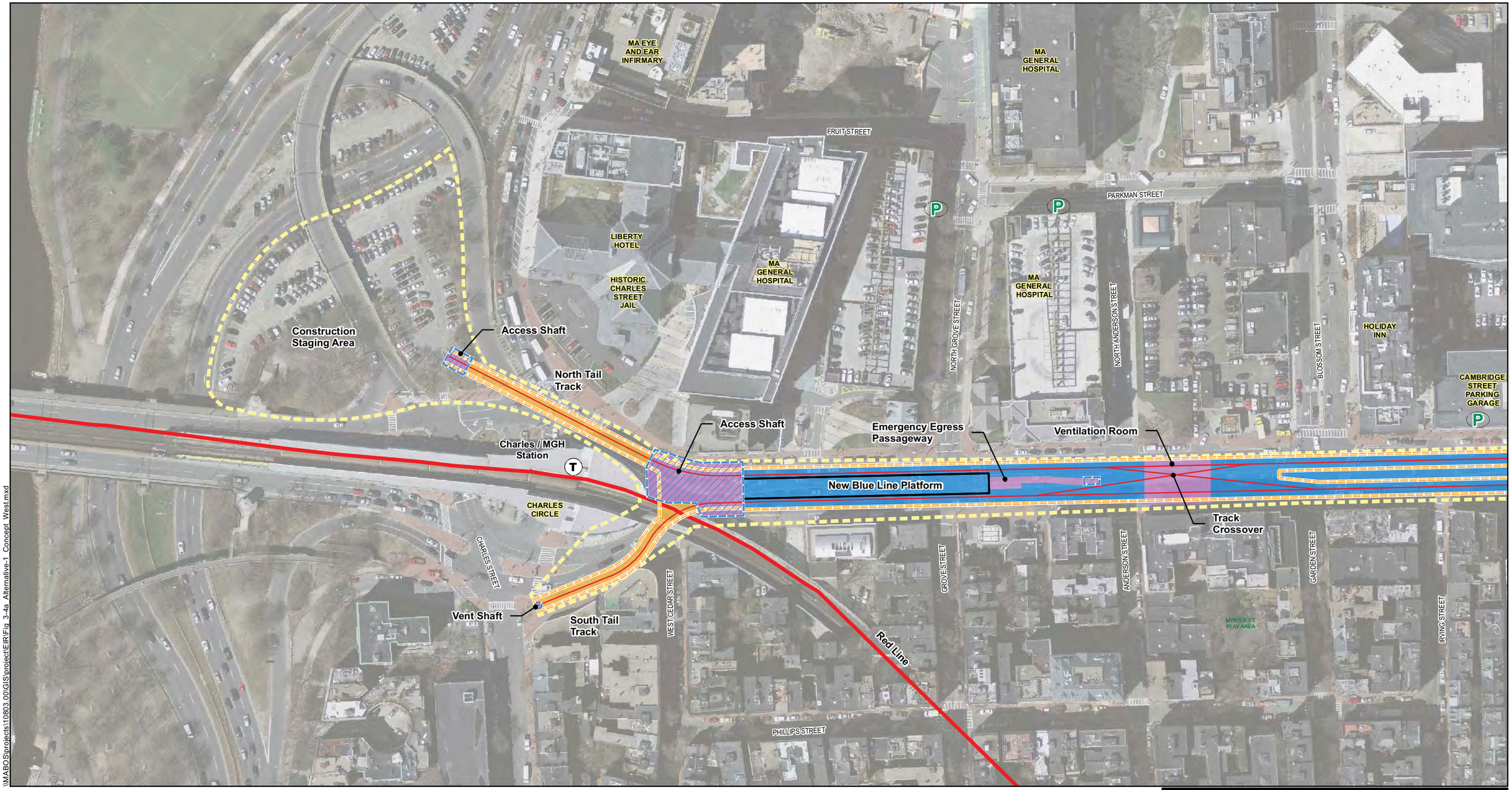
Project Location

Legend

Project Location

0 0.1 0.2 0.3 Miles

Sources: MassGIS & BWSC



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Legend

- Project Area
- Proposed Open Mined Shaft
- Track Alignment
- Proposed Tunnel
- Proposed Platform
- Existing Blue Line Track Alignment
- Cut and Cover
- Sequential Excavation Mining
- Tunnel Boring Machine

0 30 60 120 Feet

Moving Massachusetts Forward. massDOT Massachusetts Department of Transportation

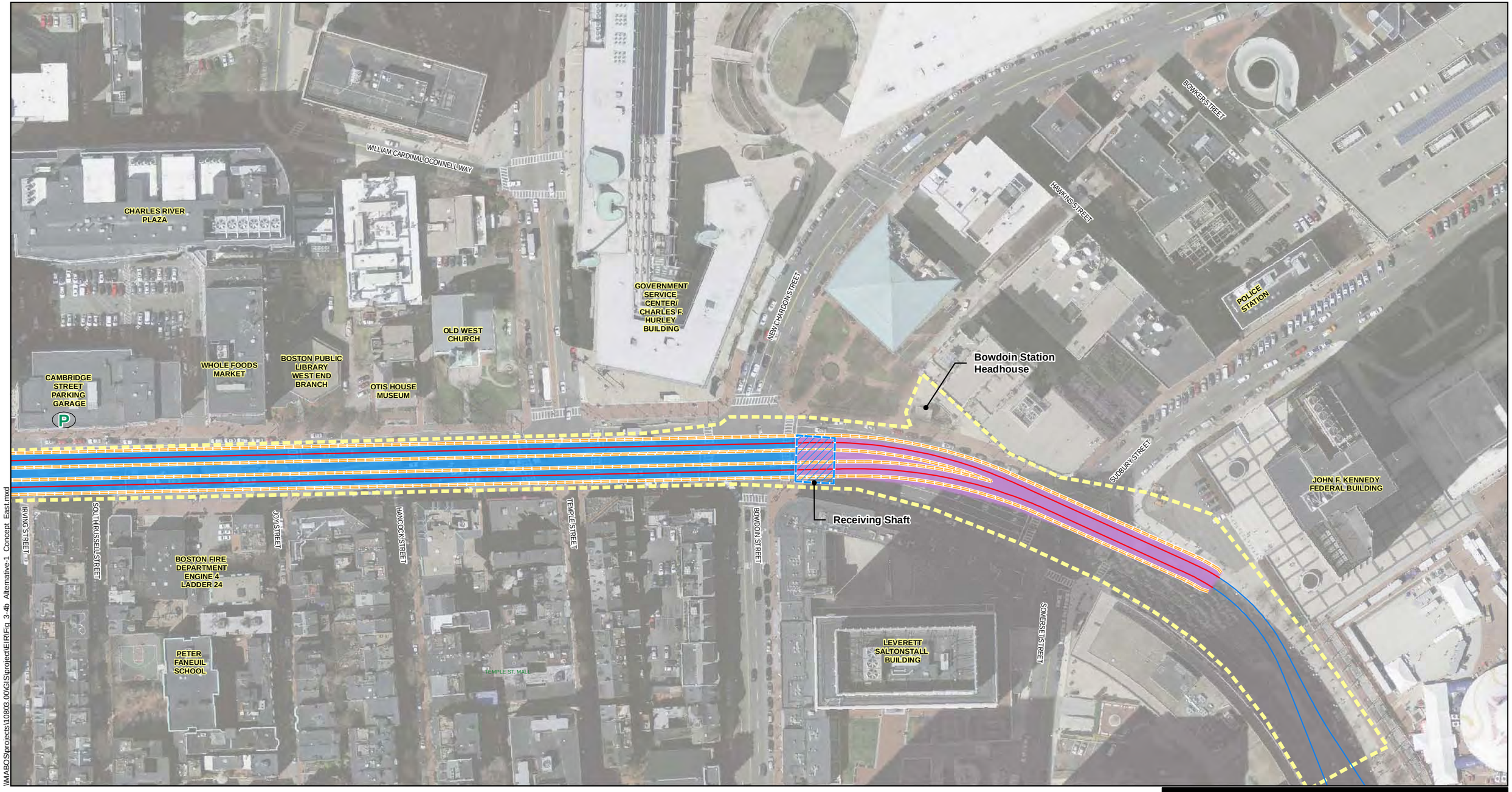
Red Line Blue Line CONNECTOR

Red Line/ Blue Line Connector Project

Figure ES-2a

Alternative 1: Bowdoin Station Eliminated Conceptual Layout (West)

Sources: MassGIS & BWSC



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Legend

- Project Area
- Proposed Open Mined Shaft
- Track Alignment
- Proposed Tunnel
- Proposed Platform
- Existing Blue Line Track Alignment
- Cut and Cover
- Sequential Excavation Mining
- Tunnel Boring Machine

0 30 60 120 Feet

Moving Massachusetts Forward. massDOT Massachusetts Department of Transportation

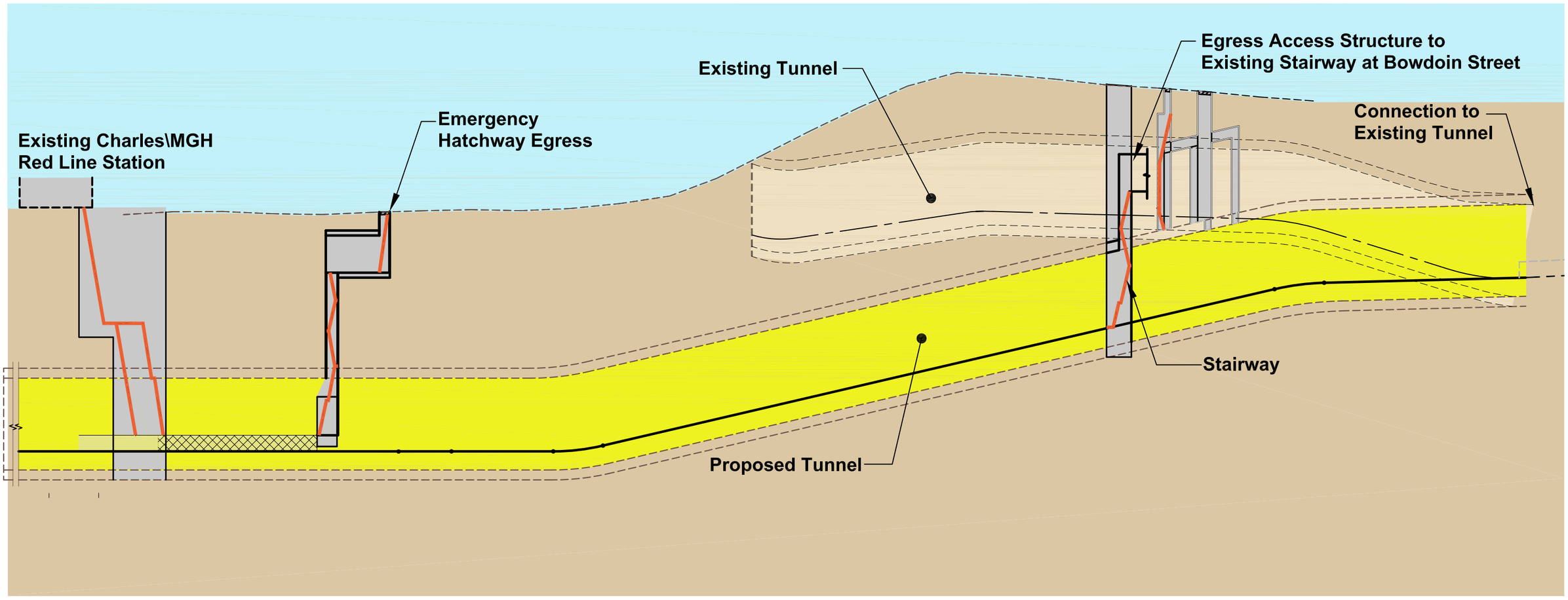
Red Line Blue Line CONNECTOR

Red Line/ Blue Line Connector Project

Figure ES-2b

Alternative 1: Bowdoin Station Eliminated Conceptual Layout (East)

Sources: MassGIS & BWSC



Existing Grade
Existing Top of Rail
Proposed Top of Rail
Platform
Stairs

0 100 200 Feet

Red Line/Blue Line Connector Project

Figure ES-3

Alternative 1
Tunnel Cross-Section

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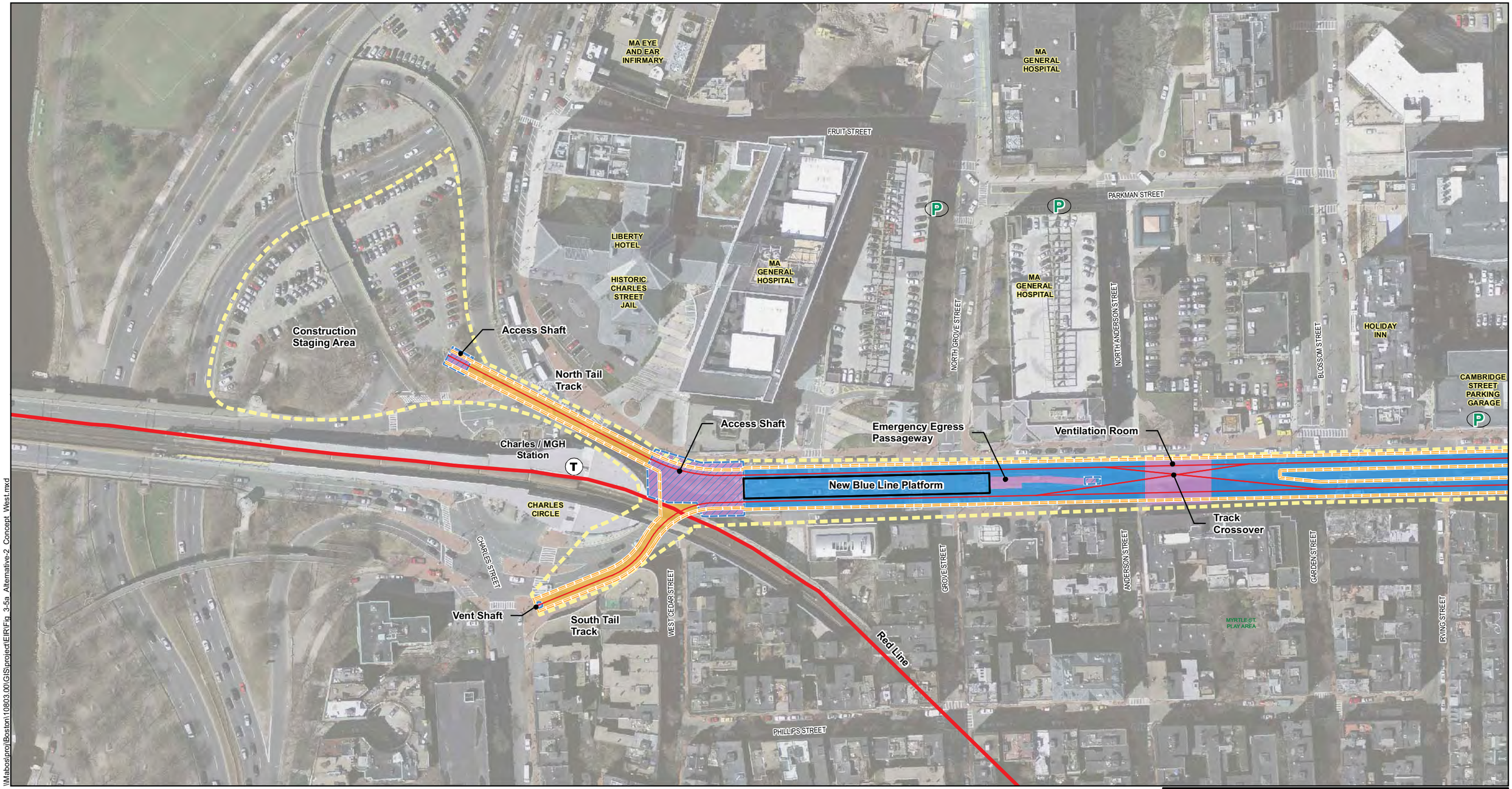


\\Mabos\proj\Boston\10803.00\GIS\projectEIR\Fig. 3-5a Alternative-2 Concept West.mxd

Legend

- Project Area
- Proposed Open Mined Shaft
- Track Alignment
- Proposed Tunnel
- Proposed Platform
- Existing Blue Line Track Alignment
- Cut and Cover
- Sequential Excavation Mining
- Tunnel Boring Machine

0 30 60 120 Feet

Moving Massachusetts Forward. massDOT Massachusetts Department of Transportation

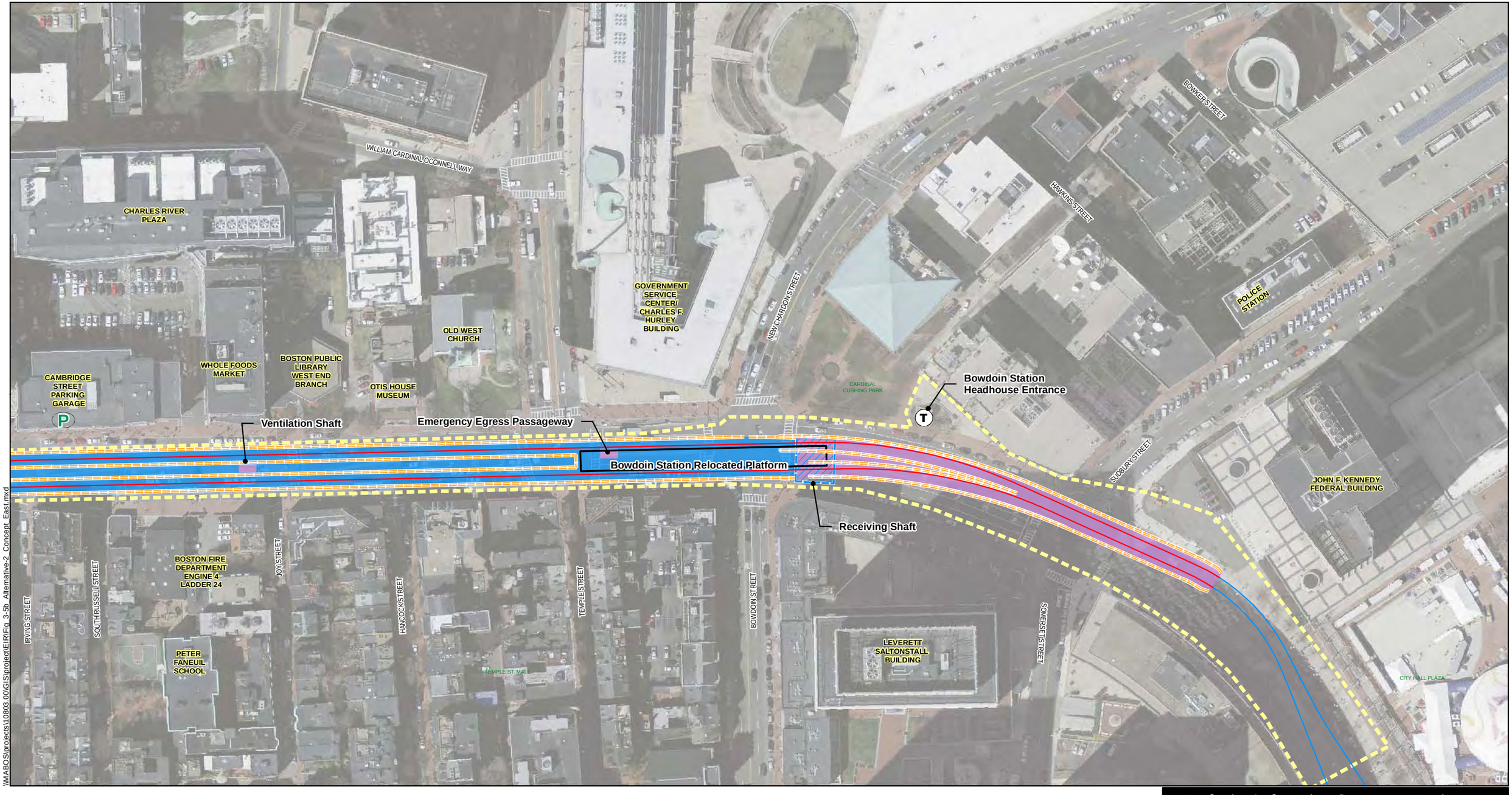
Red Line Blue Line CONNECTOR

Red Line/ Blue Line Connector Project

Figure ES-4a

Alternative 2: Bowdoin Station Relocated Conceptual Layout (West)

Sources: MassGIS & BWSC



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Legend

- Project Area
- Proposed Open Mined Shaft
- Track Alignment
- Proposed Tunnel
- Proposed Platform
- Existing Blue Line Track Alignment
- Cut and Cover
- Sequential Excavation Mining
- Tunnel Boring Machine

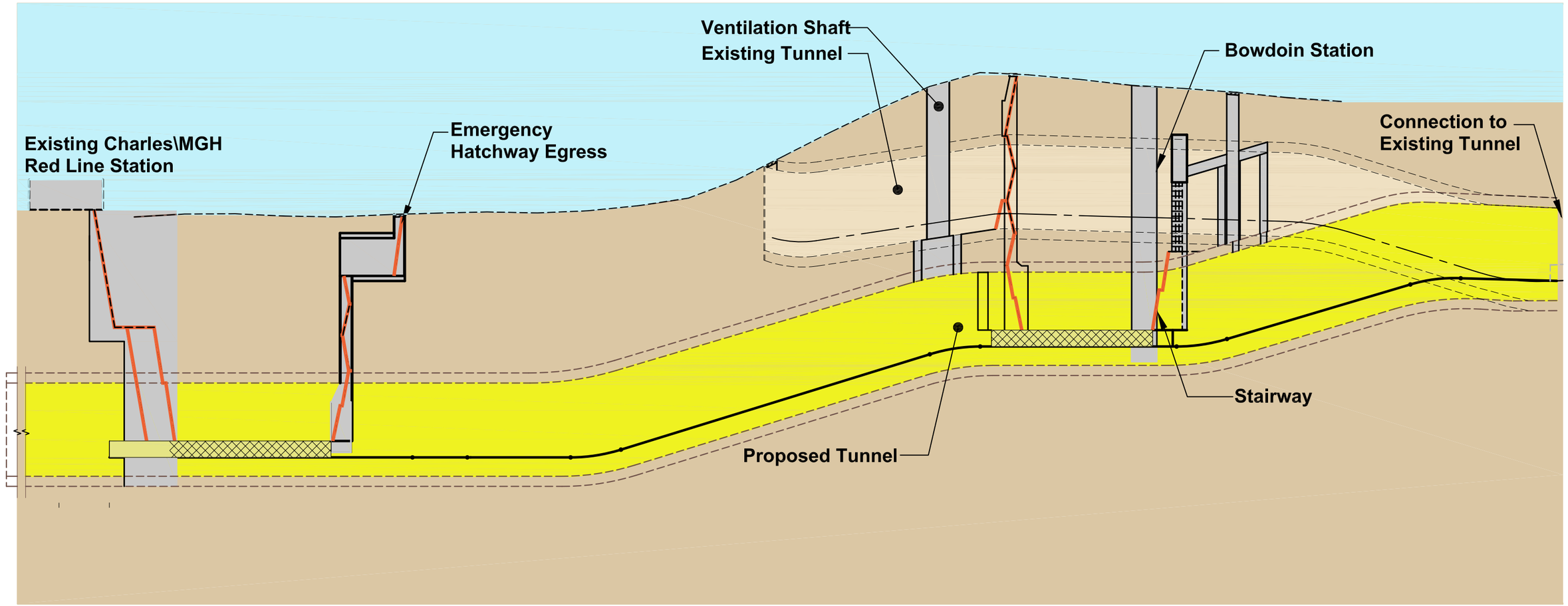
0 30 60 120 Feet

Red Line/ Blue Line Connector Project

Figure ES-4b

Alternative 2: Bowdoin Station Relocated Conceptual Layout (East)

Sources: MassGIS & BWSC



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Existing Grade
Existing Top of Rail
Proposed Top of Rail
Platform
Stairs

0 100 200 Feet

Moving Massachusetts Forward. massDOT Massachusetts Department of Transportation

Red Line Blue Line CONNECTOR

Red Line/Blue Line Connector Project

Figure ES-5

Alternative 2
Tunnel Cross-Section

1 Introduction

1.1 Introduction

The Red Line/ Blue Line Connector Project is an initiative of the Massachusetts Department of Transportation (MassDOT, formerly Executive Office of Transportation and Public Works, EOT) and the Massachusetts Bay Transportation Authority (MBTA) to improve air quality by increasing public transit. Enhancing transit services would improve mobility and regional access for residents of East Boston and North Shore communities as well as residents of Cambridge and other communities northwest or south of Boston. The Project will also improve access to Massachusetts General Hospital (MGH), the Massachusetts Eye and Ear Infirmary (MEEI), and other nearby medical facilities.

The Red Line and the Blue Line are the only two of Boston's rapid transit lines that do not intersect. Current transit riders traveling to points along the Red Line or Blue Line requiring transfer between the two lines must use the Green Line or the Orange Line for one segment to complete their trip. A direct connection between those two lines would boost transit ridership, reduce automobile travel through downtown Boston, improve air quality, reduce pedestrian congestion in the existing downtown transfer stations, and improve mobility and access to jobs, education, and health care, in particular for Blue Line riders.

The Project fulfills a longstanding commitment of the Central Artery/ Tunnel Project to increase public transit. The Massachusetts Department of Environmental Protection (DEP) Air Pollution Control Regulations, appended to the State Implementation Plan (SIP) for ozone, require that MassDOT complete the design of this Project by December 31, 2011.[1] At this time, MassDOT has not identified funding for the construction of the Project. Should additional resources for MBTA expansion projects become available, the Red Line/ Blue Line Connector Project will be one of the projects considered for implementation.

1 DEP. 2009. Code of Massachusetts Regulations (CMR), Chapter 310 Department of Environmental Protection, Part 7.00 Air Pollution Control, Section 7.36 (Universal) Transit System Improvements. (310 CMR 7.36 (2)(h)(i)).

When such a priority setting takes place, it would be informed by the level of environmental review, and design and engineering work conducted between now and the end of 2011 in order to satisfy the SIP commitment.

In anticipation of the 2011 final design deadline, an Expanded Environmental Notification Form[2] (EENF) for the Red Line/ Blue Line Connector Project was submitted by EOT to the Executive Office of Environmental Affairs (EEA) on September 6, 2007. The Secretary of the EEA issued a Certificate[3] on the EENF on November 15, 2007, requiring a Draft Environmental Impact Report (DEIR) for the proposed Project. A copy of the Secretary's Certificate on the EENF is provided in Appendix A. This DEIR has been prepared to meet the requirements of the Secretary's Certificate on the EENF, and documents the Project design as well as potential impacts to the environment. The Secretary's Certificate on the EENF indicated that the Massachusetts Environmental Policy Act (MEPA) review of the Project could be streamlined if the DEIR resolves the substantive issues identified in the Secretary's Certificate on the EENF. This DEIR has been prepared to meet these goals and MassDOT anticipates that the Secretary will be able to determine that the DEIR, after public review and comment, will serve as the Final EIR.

1.2 Background

Historically, transit services in this area of Boston were connected. When Bowdoin and Scollay Square (now Government Center) Stations were constructed in 1916, streetcars from East Boston traveled under the harbor and served those stations before surfacing in Cambridge Street, at a portal west of Joy Street. The streetcars continued on the Longfellow Bridge over the Charles River to Cambridge. In 1924, the connection between East Boston and Cambridge was severed and a loop track, enabling street cars to turn around at Bowdoin Station, became the end of the service line.

The rapid transit alignment now known as the Red Line was constructed in 1912. Charles Station (now Charles/ MGH) was opened in 1932 and serves the Red Line in Boston's West End, on the south shore of the Charles River. The station was recently renovated and a new street-level headhouse was constructed. The street-level entrance and fare collection lobby was designed to also serve as an entrance to a future subsurface Blue Line platform.

2 EOT. 2007. *Red Line/Blue Line Connector Expanded Environmental Notification Form.* Commonwealth of Massachusetts, Executive Office of Transportation and Public Works. Prepared by TranSystems Corporation: Medford MA.

3 EEA. 2007. *Certificate of the Secretary of Energy and Environmental Affairs on the Expanded Environmental Notification Form.* Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs: Boston.

1.3 Project Summary

The Red Line/ Blue Line Connector Project consists of extending the Blue Line service from Bowdoin Station to Charles/ MGH Station. The Project location is shown in Figure 1-1. The Project would use realigned tracks from 250 feet west of the Government Center Station to Bowdoin Station and new tracks from Bowdoin Station to Charles/ MGH Station. The Project would also include constructing a new subsurface platform for the Blue Line east and below the Charles/ MGH Station headhouse, with pedestrian connections to the elevated platforms for the Red Line. Bowdoin Station would be eliminated to allow for faster travel times (by eliminating a stop) or relocated to provide greater transit access (by retaining the station but relocating both platforms to accommodate six-car trains).

As required by the Secretary's Certificate on the EENF, two Build Alternatives and a No-Build Alternative are evaluated in this DEIR. The No-Build Alternative is evaluated as a baseline condition to which the Build Alternatives may be compared. The two Build Alternatives evaluated in this DEIR, described in Chapter 3, are:

- Alternative 1: Blue Line Extension to Charles/ MGH Station with Elimination of Bowdoin Station, and

- Alternative 2: Blue Line Extension to Charles/ MGH Station with Relocated Bowdoin Station.

For either Build Alternative, reconstructing the track through Bowdoin Station would include bypassing the loop track for a straighter alignment to Charles/ MGH Station. The current conceptual design specifies two tracks throughout the length of the Project, as compared to up to four tracks in some sections as previously envisioned. The majority of the Project length would have two separate tunnels; at the station platforms and crossover, one broad tunnel would be constructed.

For the majority of the length of the Blue Line extension, between Bowdoin Station and Charles/ MGH Station, the tunnels would be constructed by a horizontal tunnel boring machine (TBM) beneath existing infrastructure. Except at access points at either end of the alignment, all boring work would be completed below grade and surface disturbance would be limited. A staging area, tentatively established as a portion of the MEEI parking lot immediately north of Charles/ MGH Station, would be the main access point. A second access point would be at Bowdoin Station to allow the boring machine to be removed.

Three portions of the Project would be constructed with cut-and-cover or sequential excavation mining methods, and decking would be installed over the excavations to minimize disruption of surface traffic:

- The segment east of Bowdoin Station, approximately 550 feet long, would be constructed using the cut-and-cover method to allow the existing tracks to be realigned.

- A segment east of Charles/ MGH Station, approximately 86 feet long, would be constructed with the cut-and-cover method to allow a ventilation room to be installed in the area of the track crossover.

- The TBM access shaft east of Charles/ MGH Station would also be constructed with the cut-and-cover method (and to accommodate constructing the elevator, escalators and stairs).

Short portions of the tail tracks west of Charles/ MGH Station would be constructed with the sequential excavation mining method (because the sharp bend in the tunnel alignment does not allow the boring machine to be used).

Ventilation shaft grates and emergency egress hatches with protective bollards in the Cambridge Street median would be the only tunnel elements visible from the street when the Project is completed.

For Alternative 1, Bowdoin Station would be deactivated, although passageway through the station and headhouse would be retained for emergency egress. For Alternative 2, the platform at Bowdoin Station would be relocated. The new platform would be west of, and about 22 feet below, the current platform location to accommodate the necessary slope to reach the new Blue Line platform at Charles/ MGH Station. The new platform would be on a straight segment of track, allowing full use of the six-car trains.

For either Build Alternative, the new platform for the Blue Line at Charles/ MGH Station would be constructed immediately east of, and below, the existing headhouse. New elevator shafts would be constructed to the Blue Line platform level, as would a stairway and escalators from the existing street level headhouse down to the Blue Line platform level. A single 320-foot long center platform would be constructed. There would be two tail tracks, for train storage, extending west beyond the station.

There would be no new parking facilities, facilities for passenger drop-off and pick-up, or bus stops. No additional station staff is expected since fares would be paid at the existing fare gates in the headhouse.

The key goals of the Red Line/ Blue Line Connector Project are to:

- Link residents in East Boston and the North Shore with jobs, services, and educational opportunities in Boston's West End and the Cities of Cambridge and Somerville;
- Enhance regional access to MGH, MEEI, and surrounding medical facilities;
- Expand transportation options for residents in Boston's West End and Beacon Hill neighborhoods; and
- Improve access from Cambridge, Somerville, and northwestern suburbs to jobs, services, and attractions in Downtown Boston, East Boston, the North Shore, and to General Edward Lawrence Logan International (Logan) Airport.

Based on the analyses presented in this DEIR, Alternative 1: Blue Line Extension to Charles/ MGH Station with Eliminated Bowdoin Station has been selected as the Preferred Alternative for the Red Line/ Blue Line Connector Project. This alternative provides the best balance of cost, ridership, and environmental impacts. MassDOT also believes that this alternative will help the Commonwealth achieve its goal of improving regional air quality and providing expanded transportation services. This alternative would have more operational reliability and have a lower capital cost than Alternative 2. Alternative 1 would meet all Project goals, would be operationally practical, and would generate a higher number of new system-wide transit trips.

1.4 Permits and Approvals

The Red Line/ Blue Line Connector Project requires an EIR under the Massachusetts Environmental Protection Act (MEPA) because the Project would be undertaken by a state agency (MassDOT) and consists of constructing a new rail or rapid transit line along a new, unused, or abandoned right-of-way for transportation of passengers or freight. The Project may be financed by funds issued by the Commonwealth; MEPA jurisdiction for the Project is therefore broad and extends to all aspects of the Project that are likely, directly or indirectly, to cause damage to the environment. The MBTA would own and operate the Project, and is generally exempt from the requirements of municipal permitting programs. The Red Line/ Blue Line Connector Project would require several state and federal permits and approvals, as listed in Table 1-1. MassDOT will initiate these permit applications when the appropriate designs are available and the MEPA process has been satisfied.

Table 1-1 Possible Permits or Approvals

Agency	Approval or Permit
Federal Transit Administration (if federal funding is used)	Finding of No Significant Impact
	Section 4(f) Determination
	Section 106 Finding
	Federal funding approval
U.S. Environmental Protection Agency Region I	NPDES Permit for stormwater discharges and construction period
	Remediation General Permit (EPA, Federal Register, September 9, 2005)
Massachusetts Department of Environmental Protection	Compliance with Massachusetts Stormwater Management Standards and Regulations
	Section 61 Finding
MassDOT/MBTA	State funding approval
	Section 61 Finding
Massachusetts Department of Conservation and Recreation	Access permits
	Section 61 Finding
Massachusetts Historical Commission	Approval of archaeological monitoring plan
Massachusetts Water Resource Authority	Compliance with MWRA NPDES permit No. MA0103284 for discharges through the Combined Sewer Overflow system
	Sewer Use Discharge Permit (issued jointly with MWRA)
City of Boston	Approval for temporary road closings/detours for construction
	Building permits as needed for construction
Boston Conservation Commission	Order of Conditions for work in Bordering Land Subject to Flooding
Boston Water & Sewer Commission	Approval for temporary relocation of stormwater and sewer infrastructure (NPDES Permit No. MA0101192)
	Drainage Discharge Permit and/or Dewatering Discharge Permit
	Sewer Use Discharge Permit (issued jointly with MWRA)

1.5 Public Involvement and Agency Coordination

The Red Line/ Blue Line Connector Project has received public input throughout the planning process. As noted in the Secretary's Certificate on the EENF (Appendix A), the comment letters on the EENF reflect a substantial interest in the future of the Project corridor from elected officials and municipal representatives; city, state, and regional agencies; environmental, bicycle, and pedestrian advocacy groups; neighborhood groups; groups that represent the disabled; businesses; residents; and the general public. Comments received on the EENF, and responses to those comments, are provided in Appendix B.

MassDOT has established a Red Line/ Blue Line Connector Working Group with neighborhood, civic, business, and community representation in general. The Working Group has met bi-monthly and provides important guidance and input to MassDOT and the consultant team on a range of issues relating to the Project.

The team has also met with several Project abutters and agencies to gather information on engineering concepts and to assess potential impacts.

MassDOT has created a Project website where Working Group members and the public can read and download reports, presentations and summary notes. The website is promoted in all Project emails and publications, and is updated regularly. The website address is www.mass.gov/massdot/redblue.

A public meeting in the community was held on October 26, 2009. A public meeting will next take place in the community on May 3, 2010 when there are Project milestones for review and comment. In addition, MassDOT plans to make presentations to local and regional groups to introduce the Project, gather comments and consider suggestions and ideas for the Project.

MassDOT has met with agencies having jurisdiction over resources within the Project corridor, and has consulted about temporary and permanent impacts. This coordination has included the Boston Water and Sewer Commission (BWSC), Boston Traffic Department (BTD), DCR, DEP Waterways and the Massachusetts Historical Commission (MHC).

1.6 Requirements of the Secretary's Certificate on the EENF

The Secretary's Certificate on the EENF identified the general issues to be addressed in the DEIR, as well as specific requirements for the scope of the DEIR. The general issues included:

- The Project should be designed to maximize benefits for local residents while preserving the integrity and character of existing neighborhoods.
- Additional analysis, information and commitment to mitigation measures is necessary to ensure the success of the Project, specifically with regard to:
  - Enhanced land use planning;
  - Station locations;
  - Land takings;
  - Mitigation of noise and vibration impacts;
  - Stormwater;
  - Good access for pedestrians, bicyclists, and disabled persons;
  - Coordination of bridge design and reconstruction; and
  - Traffic management and parking.

The specific requirements of the Secretary's Certificate on the EENF, and the sections of this DEIR that address these requirements, are provided in Table 1-2. As noted above, a copy of the Secretary's Certificate on the EENF and responses to the requirements are provided in Appendix A.

Table 1-2 Requirements of the Secretary's Certificate on the EENF

Category	Requirement	Addressed In
Project Description & Permitting	Include a detailed Project description, phasing schedule, Project costs, and funding sources.	Sections 3.3 and 3.4
	Describe the history of rapid transit use in the corridor	Section 1.2
	Show consistency of the Project with the SIP, and correlation of the proposed improvements with other MBTA projects	Sections 2.1, 3.3, and 3.5
	Include existing conditions plan with supporting narrative	Section 3.3.1 (Figures 3-1 to 3-3) and Chapter 4.
	Include proposed conditions plan with plans, designs, renderings, and illustrations/photos	Section 3.4 and Figure 3-4
	Provide detailed information on station locations, designs, lighting and access, including circulation plans	Sections 3.3.1, 3.3.2, and 3.3.3
	Provide descriptions of storage track locations and train storage	Sections 3.3.1 , 3.3.2, and 3.3.3
	Provide descriptions of electrical systems, substations, and signal/communication systems	Sections 3.3.1, 3.3.2, and 3.3.3
	Identify temporary and permanent land takings	Sections 5.2 and 6.2
	Provide list of required permits and approvals, with status of each	Section 1.4 (Table 1-1)
Alternatives	Evaluate the No-Build Alternative, the Blue Line Extension to Charles/MGH Station with Elimination of Bowdoin Station Alternative, and the Blue Line Extension to Charles/MGH Station with Relocated Bowdoin Station Alternative.	Sections 3.3.1, 3.3.2, and 3.3.3
	Describe the benefits and drawbacks of each alternative, including the impact of a decommissioned Bowdoin Station	Section 3.3.4
	Consider other alternatives that could meet the SIP and regulatory requirements	Section 3.2.1
	Evaluate feasible alternatives to cut-and-cover construction method	Section 3.2.3
Transit Ridership	Propose a design and operating plan that generates the highest level of ridership possible while balancing the use of MBTA resources and community impacts	Sections 3.3.2 and 3.3.3 (Tables 3-1, 3-2, and 3-3)
	Update transit ridership data to incorporate anticipated growth in the area and changes in trip distribution.	Sections 3.3.2 and 3.3.3 (Tables 3-1, 3-2 and 3-3)
	Re-evaluate increased ridership and reduced vehicle miles traveled (VMT) for each alternative; specify whether VMT reductions are based on new or diverted trips.	Sections 3.3.2 and 3.3.3 (Tables 3-2 and 3-3); Section 4.6 and 5.6
	Describe the assumptions used to generate ridership numbers, and the operating parameters necessary to achieve them.	Sections 3.3.2 and 3.3.3

Table 1-2 Requirements of the Secretary's Certificate on the EENF (Continued)

Category	Requirement	Addressed In
Transit Ridership (Cont'd.)	Discuss the impacts and benefits associated with various ridership levels and impacts on existing service at Charles/MGH, Bowdoin, and Government Center Stations, including whether shutdowns or reductions in service will be required.	Sections 3.3.2 and 3.3.3
	Discuss if any existing alternative transportation modes will be negatively impacted during the construction period.	Sections 6.4 and 6.5
Traffic and Transportation	Include a detailed traffic study with data for existing and proposed conditions along with an analysis of impact on vehicle trips within the Project area for each Project alternative, to demonstrate that the anticipated reduction in vehicle trips along the Project corridor are reasonably achievable.	Sections 4.5 and 5.5
	Analyze traffic for existing, build and no-build conditions with respect to intersection level of service (LOS), pedestrian and bicycle circulation	Sections 4.5 and 5.5
	Address traffic circulation on all roadways adjacent to the proposed Project area	Sections 5.5 and 6.5
	State assumptions incorporated in modeling process, and consider background growth and new developments in the model.	Sections 4.5 and 5.5
	Include strategies for mitigating traffic, pedestrian, or bicycle operations	Sections 4.5, 5.5, and 6.5
	Work with DCR, MassHighway, and City of Boston to determine the scope of the study area commensurate with anticipated Project impact; jurisdictional areas of studied intersections and roadway segments should be clarified.	Sections 4.5, 5.5, and 6.5
	Summarize the integration of the Project into the overall transit system and the anticipated benefits (or drawbacks) of constructing the Project.	Sections 4.4 and 5.4
	Discuss how adding additional length to the Blue Line may affect headways, operating costs, and system efficiencies.	Sections 3.3.2 and 3.3.3
	Evaluate the consistency of this Project with various regional and state transportation plans	Section 3.5
Air Quality	Describe air quality benefits of the Project and its consistency with the SIP and DEP's Transit Regulations	Sections 2.3.3 and 5.6
	Clarify if air quality permits are required from state or federal agencies in association with construction or operation of the Project.	Section 1.4 (Table 1-1) and Section 6.6
	Include modeling data to support claims that the Project will result in reductions of emissions of VOCs, NOx, carbon monoxide (CO)	Section 5.6
	Address potential air quality impacts during the construction phase and propose sufficient mitigation to offset increases in localized construction period air quality.	Section 6.6
	Conduct mesoscale and microscale analyses to assess emissions of VOCs, NOx, greenhouse gases, CO, particulate matter (PM), and air toxics.	Section 5.6

Table 1-2 Requirements of the Secretary's Certificate on the EENF (Continued)

Category	Requirement	Addressed In
Noise/Vibration	Include an analysis of noise and vibration for existing and proposed conditions, identify sensitive receptors	Sections 4.7, 4.8, 5.7, 5.8, 6.7, and 6.8
	Include a detailed analysis consistent with the FTA guidelines, and an assessment of the impact of service on the surrounding community.	Sections 4.7, 4.8, 5.7, 5.8, 6.7, and 6.8
	Outline a noise and vibration monitoring program, indicate areas where mitigation for noise and vibration is needed, and identify specific mitigation measures that will be proposed. Specifically address the unique conditions that will be experienced during the construction period and outline construction-related noise and vibration mitigation measures.	Sections 6.7 and 6.8
Land	Clarify jurisdictional areas with regard to right-of-way ownership and specifically identify those areas of the Project area that may be controlled by the DCR or subject to EEA's Article 97 Policy. Address how the Project will be completed in accordance with applicable DCR construction requirements for work affecting DCR roadways.	Sections 4.2, 4.11, 5.2, 5.11, 6.2, and 6.11
	Conceptually quantify the volume of earth to be excavated and removed, and discuss how the soil will be excavated and removed from the Project area. Stockpile areas awaiting transport should be identified.	Sections 5.9 and 6.9
	Include a geotechnical analysis that characterizes soil types and provides supporting geotechnical data for both existing and proposed conditions. Confirm that the proposed construction methodologies are suitable for use in the soil types found along the Project corridor.	Section 4.9
	Clarify ownership of the park at the intersection of Cambridge Street and New Chardon Street; confirm that it is or is not Article 97 land, and identify what direct impacts to this park may occur as a result of the Project alternatives. Identify if public shade trees may be lost and outline mitigation measures to offset impacts upon completion of construction.	Sections 4.11, 5.11, and 6.11
Groundwater	Include data that depicts the existing levels of groundwater in the Project area and the anticipated groundwater levels upon completion of construction.	Section 4.9
	Address how groundwater impacts will be avoided, minimized, or mitigated associated with the Project; investigate opportunities to maintain or increase groundwater levels beyond existing conditions.	Sections 5.9 and 6.9
	Consider how groundwater level changes may impact adjacent historic structures and the overall structural integrity of existing infrastructure.	Section 6.9
	Outline a groundwater monitoring plan to ensure the effectiveness of proposed mitigation measures.	Sections 6.9 and 6.13
Open Space and Historic Resources	Consult with Massachusetts Historical Commission (MHC) to evaluate impacts and develop appropriate mitigation	Sections 5.13 and 6.13
	Provide a Historic and Cultural Resources map, confirming the location of state and local historic districts and individual properties, and a resource summary to identify historic resources and open spaces adjacent to the corridor and likely to be impacted by air quality, noise, vibration, and stormwater impacts associated with the Project. Include detailed descriptions of registered properties immediately adjacent to the Project corridor.	Section 4.13 (Table 4.13-2 and Figure 4.13-1)

Table 1-2 Requirements of the Secretary's Certificate on the EENF (Continued)

Category	Requirement	Addressed In
Open Space and Historic Resources (Cont'd.)	Describe measures that will be employed to avoid, minimize and mitigate impacts to historic and cultural resources.	Section 6.13
	Include a commitment to provide field survey, research, analysis, and documentation services in order to comply with appropriate federal and state regulations, including the NHPA.	Section 6.13
Stormwater	Provide a proposed stormwater management plan, prepared in compliance with the DEP Stormwater Management Policy (SMP) and the NPDES General Permit.	Section 6.10
	Evaluate drainage in the new tunnel during the construction period.	Section 6.10
	Include supplemental graphics that depict the existing drainage patterns and areas used for storage or treatment of contaminated soils, groundwater, or stormwater, and the location of major control or treatment structures to be utilized during the construction period.	Sections 4.9, 4.10, 6.9, 6.10, 6.14
	Address comments regarding retaining stormwater and dewatering drainage on-site or directing discharges to the Charles River prior to considering discharge to the Boston Water and Sewer Commission system. Confirm that stormwater will not be discharged to the sanitary sewer. Analyze stormwater discharges to the Charles River, if applicable.	Sections 5.10 and 6.10
	Demonstrate that source controls, pollution prevention measures, erosion and sediment controls during construction, and the post-development drainage system are consistent with the SMP for water quality and quantity impacts and the NPDES General Permit.	Section 5.10
Hazardous Waste/ Contaminated Soils	Describe how contaminated soils will be evaluated, managed and disposed.	Section 6.14
	Include an updated list of hazardous waste sites, consisted with DEP comments. Add database and Release Tracking Numbers to the list.	Section 4.14
	Include a summary of the contaminated sites immediately adjacent to the Project site, characterizing the nature of contamination, status of clean-up, and the potential relationship of existing environmental conditions to Project construction impacts.	Sections 4.14 and 6.14
	Consult with DEP to ensure that demolition and management of contaminated soils are consistent with applicable regulations	Section 6.14
Water/Wastewater	Identify any water or wastewater flows required in conjunction with the construction or operation of the Project.	Sections 5.10 and 6.10
	Identify any new sanitary facilities that may be constructed under each Project alternative and estimate new water or wastewater demand.	Sections 3.3.2 and 3.3.3
Construction Period Impacts	Include a discussion of construction phasing, potential impacts associated with construction activities, and feasible measures to avoid or eliminate these impacts.	Section 3.4, Chapter 6
	Identify temporary and permanent construction easements	Sections 5.2 and 6.2
	Discuss compliance with DEP's Solid Waste and Air Quality Control regulations during construction, including implementation of measures to alleviate dust, noise, and odor nuisance conditions.	Sections 6.6 and 6.14
	Include a construction staging plan with the goal of maintaining four lanes of traffic on Cambridge Street during construction, maintaining pedestrian access to businesses and public transportation, and limiting the temporary removal of parking and loading zones. Focus on maintaining full and efficient access along the Project corridor for emergency vehicles. Develop mitigation measures to ensure access.	Sections 3.4 and 6.5

Table 1-2 Requirements of the Secretary's Certificate on the EENF (Continued)

Category	Requirement	Addressed In
Construction Period Impacts (Cont'd.)	Develop a traffic management plan to discourage cut-through traffic along residential streets in Beacon Hill and the West End.	Section 6.5
	Require contractors to retrofit construction equipment to reduce diesel exhaust.	Section 6.6
	Include a current inventory of all affected utilities, identify the utility owners, and outline a plan to maintain continuous service or replacement of infrastructure if necessary. Discuss which major utilities will require temporary or permanent relocation to accommodate the Project.	Section 6.1
	Commit to mitigation measures for repair or replacement of disturbed landscape and streetscape improvements. Measures should include timetables to ensure timely replacement.	Section 6.12 and 7.4 (Table 7-1)
	Provide a characterization of how the proposed Project will be integrated into the larger scheme of nearby development and infrastructure projects. Outline how applicable plans can be modified or altered if other nearby projects commence during a similar time period. Describe how a coordinated approach can be implemented amongst the numerous major proposed transportation projects.	Sections 3.5 and 5.2
	Establish a Project advisory committee to allow for an ongoing forum of public input during the final design phase and during the construction period. Outline goals and a conceptual structure for this committee, and commit to its implementation.	Section 1.5
Mitigation	Include a separate chapter on mitigation measures, including a proposed Section 61 findings for all state permits, and a schedule for implementation	Chapter 7
	Include clear commitments to implement mitigation measures, estimate the individual cost of each proposed measure, identify the parties responsible for implementation, and include a schedule for implementation.	Chapter 7
Comments	Include a copy of each comment received and respond to the substantive comments received to the extent that it is within MEPA jurisdiction. Present additional technical analyses and/or narrative as necessary to respond to the concern raised.	Appendix B

2

Purpose and Need

2.1 Overview

The Commonwealth of Massachusetts, in obtaining environmental permits for the Central Artery/ Tunnel Project in the early 1990s, committed to implement a number of transit improvement projects in the Boston region as mitigation measures. The transit project commitments included extending the MBTA Blue Line from its current southern endpoint, at Bowdoin Station, approximately 0.4 miles west to Charles/ MGH Station to connect to the Red Line. Final design of the Project is required by the Massachusetts DEP Air Pollution Control Regulations (310 CMR 7.36(2)(i)), which are appended to the ozone State Implementation Plan (SIP).

This Chapter defines the purpose of, and need for, the Red Line/ Blue Line Connector Project and identifies a number of related Project goals. The Purpose and Need statement is a simple method for outlining both the reasons for proposing a project and the underlying need for the project.

2.2 Project Purpose

The Purpose of the Red Line/ Blue Line Connector Project is to boost transit ridership, reduce automobile travel through Downtown Boston, improve air quality, reduce congestion in the existing Downtown transfer stations, and improve mobility and access to jobs and health care for residents of East Boston, Revere, Winthrop, and Chelsea.[4]

4 EOT. 2007. *Red Line/Blue Line Connector, Expanded Environmental Notification Form.*

2.3 Project Need

Final design of the Project is needed to comply with the Air Pollution Control Regulations cited above. Transit enhancements are also needed as a result of:

- Poor transit connectivity;
- Limited transit capacity;
- Poor regional air quality; and
- Congestion in existing downtown subway stations.

These needs are described in the following sections.

2.3.1 Transit Connectivity

Transit service in Boston and Cambridge is currently offered by all MBTA subway lines and numerous bus routes. However, the Red Line and Blue Line do not connect. As a result, riders connecting between points on the Blue Line (the Boston waterfront, East Boston, Logan Airport, Revere) and points on the Red Line (Boston, Cambridge, Somerville, Quincy) must first transfer to the Green or Orange Lines in order to complete their trip (Figure 2-1). This transfer penalty reduces ridership and increases congestion at other Downtown Boston stations.

The Blue Line connects to the Green Line at Government Center Station and the Orange Line at State Station. The Red Line connects to the Green Line at Park Street Station and the Orange Line at Downtown Crossing Station. The average number of weekday riders transferring between the Blue or Red and Green or Orange Lines is provided in Table 2-1. On an average weekday in 2007, an average of 15,800 riders transferred between either the Blue or Red and the Green or Orange Lines at any one of the four major downtown transit stations. These data indicate a high degree of transit interconnectivity.

Table 2-1 Average Weekday Subway Transfers (2007)

Transferring from/to	Station	Number of Riders
Blue to Green	Government Center	11,665
Green to Blue		10,515
Blue to Orange	State	6,400
Orange to Blue		7,250
Red to Green	Park Street	27,080
Green to Red		28,920
Red to Orange	Downtown Crossing	16,675
Orange to Red		17,650

Source: MBTA. 2007. Ridership and Service Statistics.

2.3.2 Transit Capacity

The Blue Line operates under restricted capacity due to the physical constraints at Bowdoin Station, as well as operational constraints (limited hours). The Blue Line uses six-car trains, but the eastbound platform at Bowdoin Station is only able to accommodate a four-car train. Six-car trains stop with two cars in the tunnel, restricting passenger access. Each car has 34 seats and a total capacity of 145 riders.[5]

The Blue Line operates between 5:00 AM and 1:00 AM with weekday peak headways every 4 minutes and off peak headways of every 9 minutes. However, Bowdoin Station, the southern terminus of the Blue Line, is only open on weekdays between 5:15 AM and 6:30 PM. At other times, Government Center Station is the southern terminus.

The Red Line connects the City of Boston with suburbs northwest and southeast, extending to Alewife, Ashmont (with an extension to Mattapan), and Braintree Stations. The Red Line system also operates between 5:00 AM and 1:00 AM. The Red Line uses predominately six-car trains with large, high-capacity passenger cars. Depending upon the particular car, seat capacity ranges from 50 to 64, or with standing only (no seats), holding up to 200 riders.

2.3.3 Air Quality

The Project area is located within an US Environmental Protection Agency-(EPA) designated non-attainment area for ozone, with a classification of "moderate." Motor vehicles are the predominant sources of ozone precursor emissions. Reducing vehicle miles traveled and cutting consequent emissions of volatile organic compounds and carbon monoxide may result from improved transit options and shifting travel mode from automobiles to transit services. As noted above, design of the Project is a requirement of the DEP Air Pollution Control Regulations specifically for these purposes.

2.3.4 Station Congestion

The Project is needed to relieve congestion pressure at other subway stations in the Downtown Boston area. Boardings at the four existing downtown Blue Line stations vary substantively between the stations. Table 2-2 shows relatively few daily boardings at Bowdoin Station (1,330), more than three times that many at Aquarium Station (4,400), and an order of magnitude more boardings at

5 Siemens. 2009. *Metro System, Blue Line, Married Pairs, Boston, USA*. Siemens website: http://www.mobility.siemens.com/mobility/en/pub/references/details.cfm?do=app.detail&referenceID=233&lID=1 Accessed 16 November 2009.

Government Center and State Stations (15,110 and 11,980 respectively). These counts indicate that Blue Line boardings are highest at transfer points to other subway lines.

Table 2-2 Typical Weekday Blue Line Boardings at Downtown Stations

	Downtown Stations			
Direction	Bowdoin	Government Center	State	Aquarium
Eastbound	1,330	14,790	11,360	2,730
Westbound	0	320	620	1,670
Total	**1,330**	**15,110**	**11,980**	**4,400**

Source: Central Transportation Planning Staff, 2009.

2.4 Goals and Objectives

The Red Line/ Blue Line Connector Project would allow Blue Line passengers to more efficiently access Downtown Boston and medical facilities along Cambridge Street in the West End area. In addition, Red Line passengers from the northwestern suburbs of Boston would have direct access to the Blue Line without making intermediate transfers on the Orange or Green Lines. Implementing the Red Line/ Blue Line Connector could also:

- Increase transit ridership, especially by providing hospital workers and visitors with a direct Red Line/ Blue Line connection;
- Improve mobility and regional access, especially for residents of East Boston, the North Shore, Cambridge, and suburbs to the northwest of Boston, benefitting both environmental justice and non-environmental justice populations;
- Reduce congestion in downtown transfer stations; and
- Improve regional air quality by reducing automobile traffic.

3 Alternatives

This Chapter describes the alternatives considered for the Project and addresses the requirements of the Secretary's Certificate on the EENF for the alternatives analysis.

3.1 Introduction

The EENF presented the history of alternatives analysis for the Project, and proposed a preferred project alignment. Comments on the EENF suggested further analysis and consideration of other alternatives. Based on the legal commitment requiring design of this specific connection between the Red Line and the Blue Line, and the general support for the alignment and proposed technology, the Secretary's Certificate on the EENF requires that this DEIR consider three alternatives:

- No-Build Alternative;
- Alternative 1 – Red Line/ Blue Line Connector with Eliminated Bowdoin Station; and
- Alternative 2 – Red Line/ Blue Line Connector with Relocated Bowdoin Station.

The Secretary's Certificate on the EENF also requires a description of the benefits and drawbacks of each alternative (including the impact of a decommissioned Bowdoin Station), consideration of other alternatives that could meet the SIP and regulatory requirements, and evaluation of feasible alternatives to the cut-and-cover construction method. The following sections provide the alternatives analysis completed by MassDOT for the Project.

3.2 Alternatives Considered

This section summarizes the alternatives analysis contained in the EENF, subsequent evaluation and screening analyses, and the tunnel construction methods considered.

3.2.1 Summary of Past Alternatives Analysis

A connection between the Red Line and Blue Line has been under consideration since at least the mid-1980s. In 1986, a feasibility study evaluated a "Bowdoin-Charles Connector"[6] and a subsequent design and environmental status report was published in November 1987.[7] The feasibility study and status report both identified a subway extension of the Blue Line and an underground Blue Line platform with a pedestrian connection to the elevated Red Line platform at Charles/ MGH Station as the preferred option.

The 2006 amendments to the SIP[8] for ambient ozone concentrations, and implementing Massachusetts Department of Environmental Protection (DEP) transit regulations,[9] call for the Red Line/ Blue Line Connector Project's final design to be completed by December 31, 2011[10] as part of an overall strategy to improve air quality. The limits of the Project are defined by 310 CMR 7.36(2)(i) to be the Blue Line at Government Center to the Red Line at Charles/ MGH Station. The transportation mode to be employed is also clear. There are no practical build alternatives employing a mode other than Blue Line rapid transit. The only design alternatives to be considered are the track and platform configurations for both Charles/ MGH Station and the possible Bowdoin Station replacement. Accordingly, the EENF evaluated two Build Alternatives:

- Blue Line Extension to Charles/ MGH Station with Elimination of Bowdoin Station; and
- Blue Line Extension to Charles/ MGH Station with Relocated Bowdoin Station.

As described in the EENF, the Project consists of three major components: 1) realigning the westbound Blue Line track through Bowdoin Station including

6 STV/Seelye Stevenson Value & Knecht. 1986. *Bowdoin Station & Charles Station Connector Project, Feasibility Study and Final Report.* December 1986.
7 Howard Needles Tammen & Bergendoff / Thomas K. Dyer Inc. 1987. *Bowdoin / Charles Connector Project, Preliminary Design and Environmental Studies, Status Report.* November 1987.
8 DEP. 2008. *Final Massachusetts State Implementation Plan To Demonstrate Attainment of the National Ambient Air Quality Standard for Ozone*. Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs, Department of Environmental Protection: Boston.
9 DEP. 2009. Air Pollution Control Regulations, (Universal) Transit System Improvements, Transit System Improvement Projects.310 CMR 7.36(2)(i).
10 MassDOT. 2009. *Red Line/Blue Line Connector Project* website: www.mass.gov/massdot/redblue Accessed 1 October 2009.

widening the existing tunnel and closing the existing Bowdoin Station, 2) a new 1,400-foot long rapid transit tunnel extending the Blue Line under Cambridge Street, and 3) a new underground Blue Line platform connected to the existing Charles/ MGH Station headhouse. The EENF also considered an alternative consisting of constructing a new Bowdoin Station accompanied by additional modifications to existing tunnels. The configurations of both the new Blue Line platform at Charles/ MGH Station and the potentially relocated platform at Bowdoin Station were not determined in the EENF.

The need to eliminate the Bowdoin Loop, due to safety and operational constraints, impacts the MBTA's ability to keep Bowdoin Station open. According to the EENF, a larger radius curve cannot be constructed due to physical constraints (the curve cannot be below existing buildings in the area). The only alternative appears to be to close the existing Bowdoin Station center platform and to re-align the westbound track through the current platform location. Bowdoin Station would either be completely eliminated or would need to be reconstructed with new side platforms alongside the existing eastbound and re-aligned westbound track.

West of Bowdoin Station, the extended Blue Line tunnel would be relatively shallow, close to the street level. The early engineering studies placed the top of rail between 27 and 35 feet below street level. The tunnel width was expected to be approximately 30 feet at the eastern end (where it would meet the existing tunnel), expanding to as much as 55 feet west of Garden Street (where additional storage tracks would be included). At the new Blue Line platform at Charles/ MGH Station, the tunnel was expected to vary between 50 and 60 feet wide. The alternatives considered in the 1986 feasibility study ended the tunnel just before encountering the piers supporting the Red Line. The conceptual design developed for the 1987 engineering study moved the tracks and platform to pass directly under three Red Line support piers.

The tunnel would contain at least two tracks throughout its length. Additional storage tracks were recommended by both the feasibility and the engineering studies. The exact track configuration was not determined in the EENF but it was suggested that some sections of the tunnel could have as many as four tracks.

The EENF described one new Blue Line platform at Charles/ MGH Station. New construction would include extending the existing elevator shafts to the Blue Line platform level, a passageway from the elevators to the Blue Line platform under the existing headhouse floor, a stairway and escalator from the existing street-level headhouse down to the Blue Line platform level, and one 320-foot long center platform in the tunnel. The stairways/ escalators would require an eastward extension of the exterior of the headhouse and the reconfiguration or relocation of the "event entrance" to the headhouse. There would be no new parking facilities, facilities for passenger drop-off and pick-up, or bus stops.

The EENF anticipated a 4-year construction schedule. Although deep bore tunneling methods were not ruled out, the proximity of the existing Blue Line tunnel to the surface, the topography of the Project area, and the sub-surface conditions led to the recommendation that cut-and-cover tunneling methods be used from Joy Street to Charles/ MGH Station. This would result in temporary construction impacts along Cambridge Street.

In summary, the main components of the Project as described in the EENF were:

- Extending rapid transit from Bowdoin Station to Charles/ MGH Station;
- Constructing two tunnels with a cut-and-cover method;
- Installing two tracks for subway service, and up to four tracks for train storage;
- Eliminating or retaining the Bowdoin Station; and
- Constructing a new subsurface Blue Line platform at Charles/ MGH Station.

Based on the Secretary's Certificate on the EENF requirements, a wide range of alternative concepts that met or exceeded the Project evaluation criteria was identified. This range was then narrowed to a reasonable number of practicable options that could be carried forward to a more detailed level of analysis. The goal of this effort was to then select the two Build Alternatives to be used as the basis for the DEIR analysis. The following sections explain how the alternatives were identified, evaluated, and dismissed or advanced for further evaluation in a two-tiered approach.

It should be noted that some alternatives suggested by commenters, such as an underground conveyor ("people mover") from Government Center Station or Bowdoin Station to Charles/ MGH Station, do not meet the regulatory requirement of extending rapid transit service to connect the Red Line and Blue Line. An underground conveyor would result in a "three- or four-seat" trip for Blue Line riders who travel to destinations on the Red Line. These riders already endure a "three-seat" trip. Therefore, this option would not constitute an improvement in transit. Alternatives of this nature were, therefore, eliminated from consideration.

3.2.2 Tier 1 Alternatives Evaluation and Screening

MassDOT developed an initial set of 32 alternatives for consideration in the first tier of evaluation and screening. These Tier 1 alternatives were evaluated for general feasibility, constructability, relative cost, transportation benefit, and environmental impact. The alternatives were divided into four groups:

- Closing the Existing Bowdoin Station
- Blue Line Realignment with Elimination of Bowdoin Station
- Blue Line Realignment with a Relocated Bowdoin Station
- Alignment and Track Configuration from Joy Street to Charles/ MGH Station

Summaries of the Tier 1 evaluation and screening process for these four groups are provided below.

3.2.2.1 Closing the Existing Bowdoin Station

An MBTA operational analysis of six-car trains at Bowdoin Station determined that the existing station configuration cannot meet current MBTA turning radius and safety standards. The tight curve of the Bowdoin Loop cannot permit safe evacuation of the six-car trains. In addition, it is not possible to safely accommodate six-car trains in both directions. Based on this conclusion, any alternatives that included the current Bowdoin Station configuration or the Bowdoin Loop were dismissed from further consideration.

3.2.2.2 Blue Line Realignment with Elimination of Bowdoin Station

Four alternative schemes were developed in order to identify the most appropriate Blue Line track and tunnel realignment between Government Center Station and Joy Street that would permit an extension of the Blue Line to Charles/ MGH Station while eliminating Bowdoin Station. The preliminary track and tunnel design determined the horizontal and vertical modifications required, as well as the construction type and surface impacts during construction. Securing and abandoning underground facilities and station entrances were also considered in the screening process.

3.2.2.3 Blue Line Realignment with Relocated Bowdoin Station

Nine alternatives were developed to accommodate a relocated track configuration and relocated platform at Bowdoin Station. The criteria used to design and evaluate the schemes for a relocated platform included the need to provide safe operations within the MBTA's standards to accommodate six-car trains. Increasing the potential ridership, while balancing financial resources and community impacts, were factors used in evaluating the relocated Bowdoin Station platform alternatives. The horizontal and vertical modifications, storage capacity, platform locations and type, headhouse locations, and emergency egress routes were factors in the alternative refinement process.

3.2.2.4 Alignment and Track Configuration from Joy Street to Charles/ MGH Station

Six alternatives were developed to identify the necessary track and tunnel alignment that would permit an extension of the Blue Line from Joy Street to Charles/ MGH Station. In addition, thirteen schemes were combined to cover the entire alignment from Government Center Station to Charles/ MGH Station. The criteria used to design and evaluate the schemes for the new Blue Line platform at Charles/ MGH Station required a pedestrian connection into the existing at-grade mezzanine and fare collection area. The schemes were designed to support MBTA operations and security needs and allow for the highest possible ridership opportunities.

Balancing financial resources and community impacts were factors in evaluating these schemes. The platform type, depth of excavation, construction type, horizontal alignment, vertical alignment, surface impacts during construction and right-of-way were also considered in defining the best alignment and location for the new platform. The new Blue Line platform at Charles/ MGH Station would accommodate six-car trains, provide storage for a minimum of two trains at the platform, and enough track to store two additional trains.

3.2.3 Tier 2 Alternatives Evaluation and Screening

The Tier 1 evaluation resulted in the selection of four Tier 2 Alternatives for further evaluation. The four Tier 2 Alternatives consisted of one Cut-and-Cover Alternative and one Mined Tunnel Alternative for each Build Alternative. The following paragraphs briefly describe the tunnel construction methods that would be used for the Project, and a relative cost evaluation.

Subsurface excavation methods vary according to the geotechnical properties of the subsurface materials, the dimensions of the excavation, physical constraints (such as surface topography and adjacent structures), and the purpose for which the excavation is made. Cost and social or environmental impacts are also considerations.

Cut-and-cover construction involves excavating a trench for the subsurface infrastructure, constructing sidewalls and roofs, and covering the structure with fill material back to surface level. This method would be used primarily at the eastern end of the Project area, for the segment from Bowdoin Station toward Government Station. Short sections for ventilation shafts and a tunnel boring machine access point would also be constructed using cut-and-cover techniques.

A mined tunnel is constructed by a tunnel boring machine, which advances horizontally from an entrance point (access shaft) to the destination. A precast concrete ring beam liner would be installed as the tunnel is advanced. Two parallel tunnels, extending from Charles/ MGH Station to Bowdoin Station, would be constructed with this method.

The sequential excavation mining method allows progressive construction of a tunnel opening by excavating areas only as large as the soil can support prior to installing structural supports and shotcrete. This method would be used at the Blue Line platform at Charles/ MGH Station and the tail tracks.

A relative cost evaluation of the Tier 2 Alternatives was conducted to compare the cost of constructing a tunnel by two methods: mining versus cut-and-cover. The evaluation is not an estimate of total construction costs. The evaluation considered the scope and cost of offsets necessary to enable the direct construction work, and determined that:

- The geographic area and cost of surface disruption and utility relocations along Cambridge Street would be far greater in the cut-and-cover scheme than in the mining scheme. As modeled, this was the primary cost driver that differentiates the cost of the two schemes.

- The mining scheme would require a large staging area at grade, anticipated to be situated at an existing parking lot. The model carried costs to provide replacement parking via construction of a temporary multi-story parking garage. The model also carried a lump sum allowance for anticipated, but undefined, modifications to the surface grades and to adjacent roadways and traffic controls.

The resulting total cost (direct plus offsets) to construct a cut-and-cover tunnel shell is about 1.2 times the cost of the mined tunnel method. This differential may slightly decrease when the balance of construction scope (e.g., station components common to both Build Alternatives) is considered. Based on this relative cost differential and the associated environmental and social impacts, schemes utilizing mining methods were selected for further development and evaluation.

The four Tier 2 alternatives were refined to ensure the feasibility of the final profiles based on constructability, architectural station components, impacts during construction, cost of construction, and Project schedule. A set of evaluation criteria were developed, organized in six general categories:

- Transit Service/ Operations,
- Construction Impacts,
- Community Impacts,

- Environment,
- Order-of-Magnitude Relative Cost, and
- Coordination.

The four Tier 2 Alternatives were evaluated again each criterion and, based on this analysis, it has been determined that the mined tunnel options were more advantageous in terms of cost, schedule, and construction impacts for all alternatives.

Throughout the public outreach process, the Working Group members reiterated the importance of minimizing street impacts along the Cambridge Street corridor. Through the conceptual design process it became apparent that extensive impacts along the corridor would be associated with utility relocations for the cut-and-cover construction. Based on this determination, the mined tunnel approach for some portion of the alignment became a realistic construction methodology for the Project. An explanation of the tunnel construction methods is provided in the following section.

3.3 DEIR Alternatives

This section provides the analysis of the three alternatives (No-Build, Eliminating Bowdoin Station, and Retaining Bowdoin Station) required by the Secretary's Certificate on the EENF, using the mined tunnel construction method for the Build Alternatives.

3.3.1 No-Build Alternative

The No-Build Alternative provides a baseline against which the Build Alternatives are compared. Under the No-Build Alternative, it is assumed that Red Line and Blue Line operations would remain similar to today's operations with the exception of the infrastructure improvements proposed in the Boston Region Metropolitan Planning Organization's long range transportation plan, *Journey to 2030*.[11] The existing stations and tunnels within the Project area are described below.

3.3.1.1 Stations

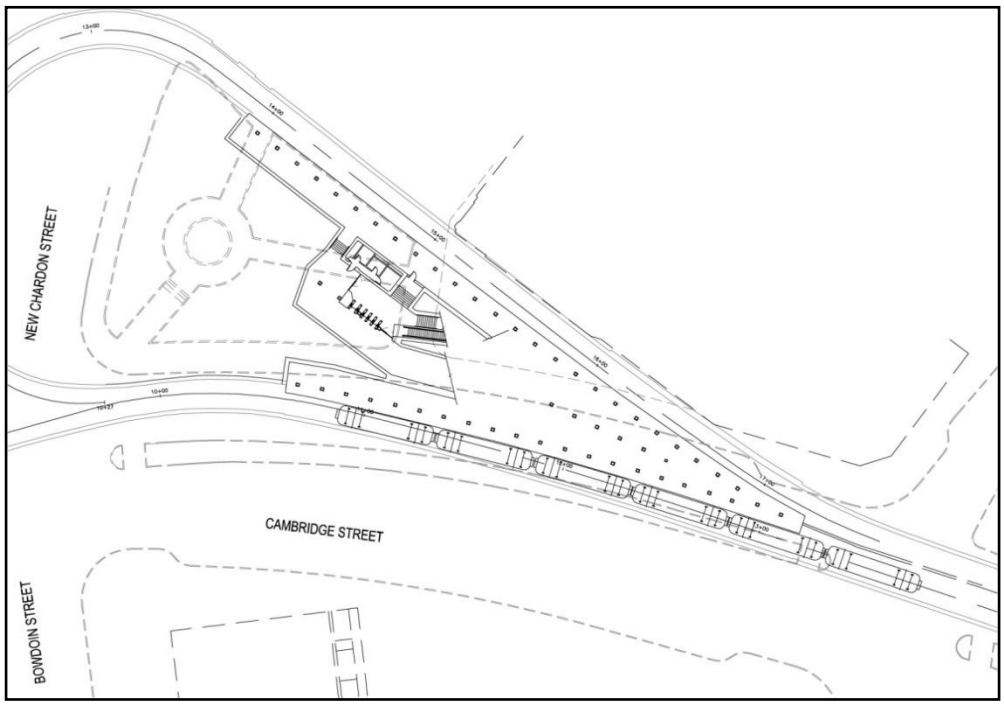
Two stations, Bowdoin and Charles/ MGH, are serviced by the Blue Line and the Red Line, respectively. These stations are described in the following paragraphs.

[11] Boston Region Metropolitan Planning Organization. 2007. *Journey to 2030*. Available on the MPO website: http://www.ctps.org/bostonmpo/3_programs/1_transportation_plan/plan.html. Accessed 11 December 2009.

Bowdoin Station

Bowdoin Station is located in Downtown Boston just west of Government Center. The station is the southern terminus of the Blue Line. It was constructed as part of the East Boston Tunnel Extension project in 1916 and initially used for streetcar service.[12] The line was converted to electric rapid transit service by 1924, and the station platform was raised to accommodate the new trains. The station was renovated in 1968 as part of a system-wide modernization program. The existing Bowdoin Station platform configuration is shown in Figure 3-1.

Figure 3-1 Existing Bowdoin Station (Platform Configuration)



At this station, six-car trains can only be accommodated on the westbound platform. The platform is not long enough in the eastbound direction to fit all six cars: two cars stop within the tunnel while the last four cars are accessible at the platform, as shown in Figure 3-1. Support staff on the platform, and motormen using television monitors, must observe door operations while passengers board.

12 STV. 2009. *Red Line/Blue Line Connector Historic Resources Reconnaissance Survey and Archaeological Resources Assessment*. Prepared by STV, Inc. in association with Public Archaeology Laboratory: Pawtucket, RI. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

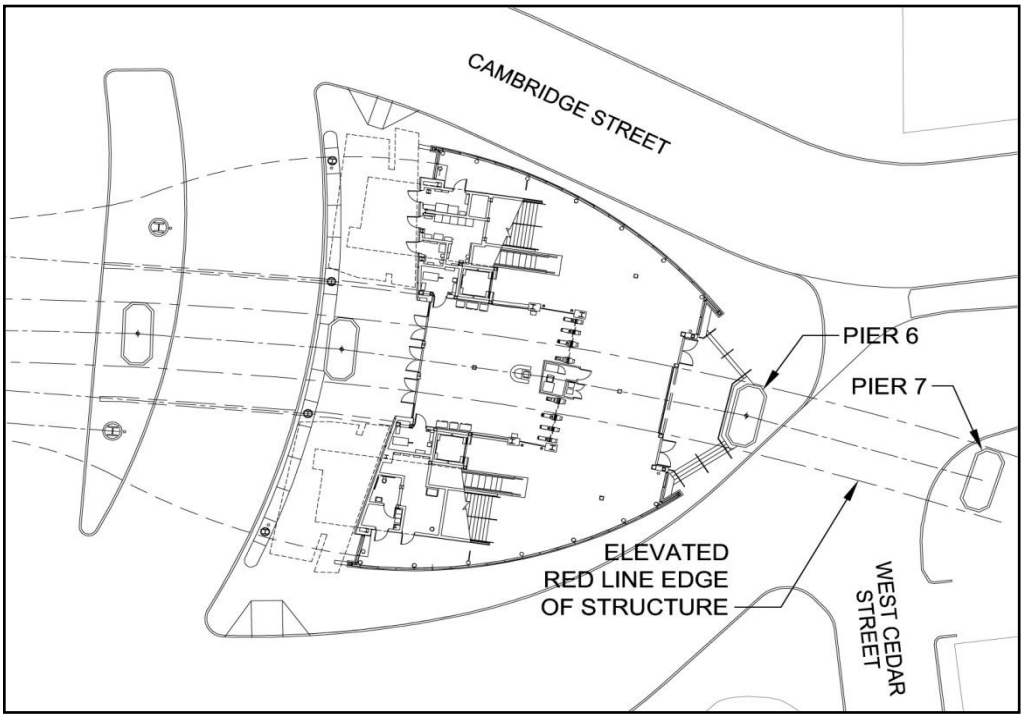
Charles/MGH Station

Charles/ MGH Station is located along the Boston side of the Charles River; the historic Longfellow Bridge is at the station's west end. East of the station, the trains make their descent into the Red Line tunnel under Beacon Hill.

Charles/ MGH Station was constructed in 1931 to accommodate the Red Line elevated track, which was built in 1912. The original station was built on a traffic island (Charles Circle) with a below-grade passageway that allowed pedestrian access from the sidewalk. In 1961, the underground passageway was replaced with overhead walkways that connected the elevated platforms on both the north and south sides in a three-story structure.

Charles/ MGH Station was again renovated in 2007 as a fully Americans with Disabilities Act (ADA) accessible station. A new two-story building replaced the 1961 elevated pedestrian footbridges and three-story headhouse. The station currently consists of a street level headhouse entrance and fare collection lobby located in Charles Circle, and two semi-enclosed side platforms elevated above the lobby area. The platforms are accessible to patrons via stairs, upward escalators, and elevators. Figure 3-2 shows the existing Charles/ MGH Station mezzanine.

Figure 3-2 Existing Charles/MGH Station (Mezzanine)

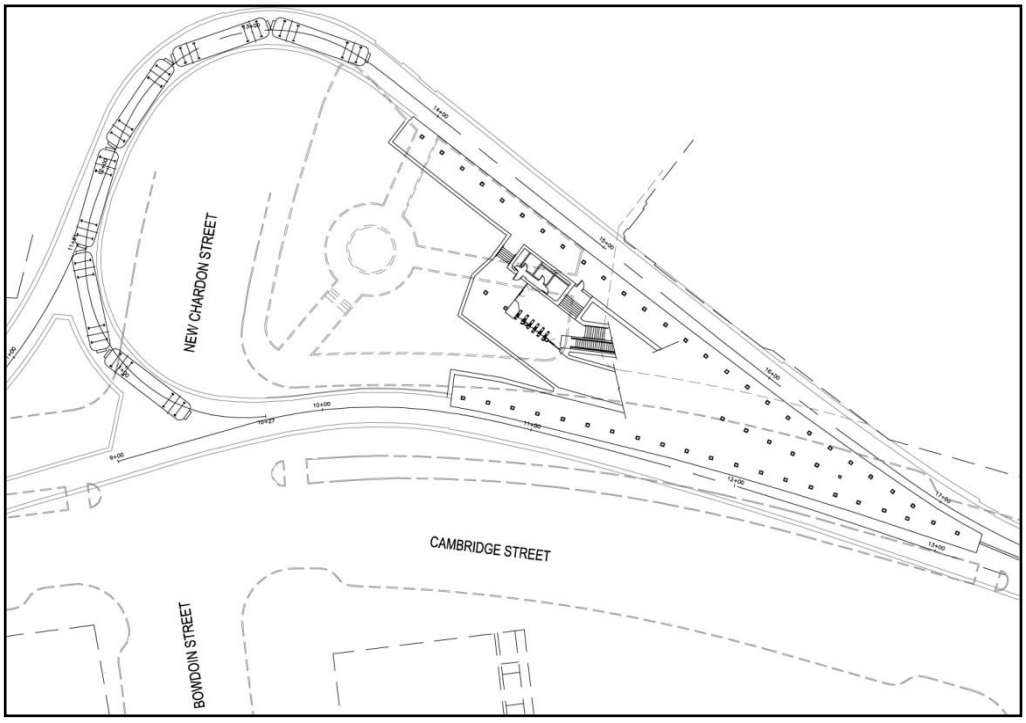


3.3.1.2 Blue Line Tunnel and Bowdoin Station Loop

When Bowdoin Station was constructed in 1916, streetcars from East Boston surfaced onto Cambridge Street at the portal near Joy Street, and continued over the Charles River on the Longfellow Bridge into Cambridge. In 1924, the streetcars were replaced by rapid transit cars and the connection between East Boston and Cambridge was eliminated. Bowdoin Station became the end of the Blue Line. In 1952, the Cambridge Street portal was closed and backfilled, leaving dead end tail tracks extending off the loop track at Bowdoin Station. The 600- to 700-foot length of tail track is referred to as the Bowdoin Yard and is used for train storage during the winter months.

Currently, inbound Blue Line trains use the loop track to reverse direction and begin the outbound trip. However, the tight radius of the curve does not allow for safe emergency evacuations while in the loop. Prior to entering the loop, all westbound passengers are required to exit the train. Once the train travels through the loop, eastbound passengers are able to board on the south side of the platform. Figure 3-3 shows the existing Bowdoin Station platform and loop track configuration.

Figure 3-3 Existing Bowdoin Station Loop Configuration



3.3.1.3 Capital Improvements

Three MBTA capital improvement projects for the Blue Line have been or will be completed in the No-Build Alternative, regardless of whether or not the Red Line/ Blue Line Connector Project is implemented.

Accessibility Enhancements

All stations on the Blue Line will eventually be ADA-accessible,[13] except for Bowdoin Station. In general, accessibility improvements to the stations will consist of installing elevators to transport passengers between the platform levels and the street level, and eliminating obstacles to wheelchair circulation within the stations. Stations on the Blue Line have high level platforms, meaning platforms are at the same height as vehicle floors and do not require further improvement for ADA compliance. At stations with parking facilities, some modifications will be made to provide ADA-accessible spaces.

Blue Line Railway Car Upgrades

As part of the Blue Line Modernization Project, the MBTA ordered 94 new cars to replace the existing 70-car fleet.[14] Additionally, the train length was expanded to six cars, concurrent with other station renovation projects which lengthen the platforms. Until 2008, the Blue Line operated with four-car trains due to the short platforms, which were originally designed to accommodate streetcars, at several Blue Line stations (including the Bowdoin Station). The operation of six-car trains increased the line's peak passenger carrying capacity by 50 percent.

Government Center Modernization

As noted above, several Blue Line stations are being renovated and expanded to accommodate six-car trains.[15] The Blue Line platform modifications at Government Center Station will enhance the station's ability to accommodate six-car trains, allowing the Blue Line trains to carry more passengers and meet an environmental commitment made as part of the Central Artery/ Tunnel Project.[16] The station will be outfitted with new elevators, escalators, stairs, lights, and communication systems. These improvements will bring the station into compliance with the ADA. MBTA is also reviewing options for constructing a second headhouse at Government Center Station along Cambridge Street for the Blue Line.

13 MBTA, 2009. *T-Projects and Accessibility*. Website: http://www.mbta.com/about_the_mbta/t_projects/projects_accessibility/. Accessed 14 December 2009.
14 MBTA. 2009. *T-Projects and Accessibility* website: http://www.mbta.com/about_the_mbta/t_projects/projects_accessibility/. Accessed 13 November 2009.
15 MBTA. 2002. *North Shore Transit Improvement Project- Major Investment Study*. Massachusetts Bay Transportation Authority: Boston. Prepared by PB/DMJM + Harris.
16 MBTA. 2009. *Government Center Modernization* website: http://www.mbta.com/about_the_mbta/t_projects/default.asp?id=1004. Accessed 26 October 2009.

Operations

The Blue Line is one of the four rapid transit lines operated by the MBTA. The Blue Line currently operates between Wonderland Station in Revere and Bowdoin Station in Boston. The Blue Line connects to Green Line at Government Center Station and the Orange Line at State Station. Today there is no direct connection between the Red Line and the Blue Line; passengers wishing to do so must transfer to either the Orange or Green Lines to make this connection.

In September of 2008, MBTA began operating six-car trains on the Blue Line. All Blue Line stations can accommodate the six-car trains except for eastbound platform at Bowdoin Station. Currently, at this platform, two cars on eastbound trains must stop in the tunnel and passengers must use door controls on the four cars on the platform. Television monitors are used by motormen to observe door operations.

Blue Line service operates from 5:00 AM to 1:00 AM, weekdays and Saturdays; and 6:00 AM to 1:00 AM on Sundays. Presently, Bowdoin Station is closed weekday evenings, after the 6:00 PM departure, and all day Saturday and Sunday the service begins and ends at Government Center.

Frequencies on the Blue Line are presented below.

Weekdays

- Rush Hours: every 5 minutes
- Midday: every 9 minutes
- Evening: every 10 minutes
- Late Night: every 13 minutes

Saturdays

- AM and PM Peak: every 9 minutes
- Evening: every 9 minutes
- Late Night: every 13 minutes

Sundays

- AM Peak: every 13 minutes
- PM Peak: every 9 minutes
- Evening: every 9 minutes
- Late Night: every 13 minutes.

Ridership

Based on the most current running times and headways that appear on the September 5, 2009 version of the Blue Line headway report, 13 trains (12 scheduled and one run-as-directed train) are required to provide peak period service. In 2030, weekday ridership on the Blue Line under the No-Build Alternative is projected to increase from 2008 levels by 12.85 percent to 73,000 daily boardings. For the MBTA subway system as a whole, weekday ridership under the No-Build Alternative is expected to increase from 2008 levels by 9.7 percent to 868,200 daily boardings.

3.3.1.4 Cost

There is no cost associated with the No-Build Alternative other than the capital improvements already programmed.

3.3.2 Alternative 1: Red/Blue Line Connector with Elimination of Bowdoin Station

Operations at Bowdoin Station are constrained by the platform length and loop track configuration. Eliminating the station and loop track would allow for relatively faster travel with little transit access penalty to passengers, who could board at either the Government Center or Charles/ MGH Stations.

Alternative 1 would extend the Blue Line from Bowdoin Station to Charles/ MGH Station and eliminate the existing Bowdoin Station. The station would be deactivated, although passageway would be retained to allow for emergency egress. A new underground Blue Line platform would be constructed east of, and below, the existing Charles/ MGH Station. The Blue Line platform at Charles/ MGH Station would connect to the existing elevated Red Line platforms via stairways, escalators, and elevators allowing passengers to transfer between the two lines. There would not be any restrooms for patrons, but there would be two new staff restrooms (male and female). Figures 3-4a and 3-4b show the conceptual layout for the western and eastern, respectively, portions of the Project area for Alternative 1. Figure 3-4c shows plan and cross-sectional views of Alternative 1: Red Line/ Blue Line Connector with Elimination of Bowdoin Station, including both horizontal and vertical alignments. Specific components of Alternative 1 are outlined in the following paragraphs.

3.3.2.1 Stations

Bowdoin Station would be eliminated for this alternative, but the headhouse would be retained. The existing subsurface structures would be deactivated,

although portions of the station would be used for emergency egress through the headhouse. The existing headhouse structure may be retained in its current configuration for this purpose or, alternatively, may be replaced by a flush grate/ panel to improve the appearance of the area in the vicinity of Cardinal Cushing Park. During Project construction, Blue Line service would terminate at Government Center. A new subsurface platform would be constructed at Charles/ MGH Station to service the Blue Line.

3.3.2.2 Tunnel

A two-track tunnel, with crossovers[17] and two tail tracks,[18] would extend the Blue Line from its current endpoint at Bowdoin Station to Charles/ MGH Station. The maximum tunnel slope would reach 4.2 percent from Government Center Station down to the new platform at Charles/ MGH Station. The Bowdoin Loop would be eliminated. The construction methodology for Alternative 1 would be a combination of cut-and-cover, mined tunnel, and the sequential excavation method.[19] As shown in Figures 3-4a and 3-4b, the tunnel would be constructed by the cut-and-cover method for a distance of about 550 feet from Bowdoin Station southeast toward Government Center Station, and for a distance of about 120 feet east of Charles/ MGH Station. Open excavations would also be required for vents and emergency egress points, as identified in Figures 3-4a and 3-4b. Sequential excavation method would be used for the tail tracks, and mined tunnel for the balance of the tunnel work.

3.3.2.3 Track Alignment

The new track would be laid within side-by-side driven tunnels. All track work would remain within the Cambridge Street right-of-way. The track would be installed by direct fixation to absorb vibration and reduce noise transmission. The top-of-track depth at its lowest elevation (at Staniford Street) would be approximately 50 feet below surface grade. Lengths of track sections would be:

- North Tail Track – Approximately 400 feet from the west end of the proposed Charles/ MGH Station Blue Line platform to beneath the MEEI parking lot.

17 Crossovers are train track intersections that would allow trains to move from the westbound to the eastbound track, or vice versa.
18 Tail tracks are dead-end track segments that, in this case, would extend past Charles/MGH Station and be used for train storage.
19 STV. 2009. *Geotechnical Interpretive Report*. Prepared by STV, Inc. in association with HMMH. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

- South Tail Track – Approximately 300 feet from the west end of the proposed Charles/ MGH Station Blue Line platform to beneath the eastern sidewalk of Charles Street on the south side of Charles Circle.

- Blue Line Extension (Government Center Station to Charles/ MGH Station)
  - Inbound Track – 2,480 feet
  - Outbound Track – 2,490 feet
- Total Proposed New Track Length (both directions, including tail tracks) – 5,710 feet.

Two crossovers would be provided:

- Full Crossover – east of Charles/ MGH Station Blue Line platform
- Left Hand Crossover - east of Government Center Station.

3.3.2.4 Station Locations and Conceptual Design

The Blue Line platform at Charles/ MGH Station would be a center platform configuration with tangent track[20] on both sides. Dimensions of the platform would be:

- Length – 320 feet
- Width – 26 feet

There would be no Bowdoin Station for this alternative.

3.3.2.5 Location of Emergency Exits and Vent Structures

Emergency egress would be provided at two locations:

- Charles/ MGH Station Blue Line Platform Emergency Egress – access would be provided via stairs at the east end of the platform. The stairs would lead to an access hatch located in the Cambridge Street median between Strong Place and Anderson Street.
- Tunnel Emergency Egress below Cambridge Street/ Bowdoin Street –access would be provided via stairs at track level, which would lead up through the deactivated Bowdoin Station mezzanine. The Bowdoin Station headhouse, which reaches grade level, would be used for emergency egress only.

20 Tangent track would exactly parallel the station platform, with no gap between the platform and the car floor.

Ventilation would be provided for passenger comfort and help to mitigate the piston effects caused by air being pushed and pulled through the tunnel by the trains. It would also be used to provide smoke control within the tunnels and at the platform.

- Ventilation Room No. 1 would be located within the westbound tunnel wall, 250 feet east of the proposed platform at Charles/ MGH Station. The ventilation grate would be located within the Cambridge Street median.
- The existing Joy Street Ventilation Room No. 2 would be abandoned in place, as ventilation for Bowdoin Station would no longer be required.
- Ventilation Room No. 3 would be located just east of the Cambridge Street/ Bowdoin Street egress shaft, approximately 560 feet west of the existing Government Center Station platform. The access hatch and grate would be located within the Cambridge Street median.
- Passive ventilation shafts would also be provided at the ends of the two tail tracks west of Charles/ MGH Station.

3.3.2.6 Station Access and Circulation

Entrance and exit into the Blue Line platform at Charles/ MGH Station at this level of conceptual design would be provided through the existing mezzanine level via stairs, up/ down escalators, and an elevator. The existing northeast exterior wall of the headhouse would need to be relocated outward slightly to accommodate new ground floor structures. At the platform level, these primary entrance/ exits would be located at the west end of the platform. Stairs, escalators, and an elevator at Charles/ MGH Station would be located where they are most visible and easily identified as a means of accessing the various levels.

- Stairs – 8-foot wide stairs would provide access from the Red Line mezzanine to a new Blue Line mezzanine and then down to the Blue Line platform.
- Escalators – Two escalators (each 3 feet, 7 inches wide) would travel in both up and down directions from the Red Line mezzanine to a new Blue Line mezzanine and then down to the platform.
- Elevator – At this level of design one elevator would provide vertical circulation from the existing Red Line mezzanine directly to the Blue Line platform. The elevator would be located at the west end of the platform. During later stages of design the need for redundant elevators would be further evaluated with the MBTA.

  During a December 10, 2009 meeting with MassDOT and MBTA, the MBTA requested the Project include a redundant elevator from the existing Red

Line mezzanine to the new Blue Line platform. During subsequent discussions with MBTA it was determined that the location of the second elevator would be developed during the next design phase.

3.3.2.7 Disposition of Abandoned Tunnels and Station Entrances

The Bowdoin Loop tunnels would be abandoned. The entrances to the abandoned tunnels will be blocked off with gate-equipped chain link fences. The chain link fences will allow for air movements in the blocked-off areas. The Bowdoin Station headhouse would be retained solely for emergency egress, as described above.

3.3.2.8 Landscape and Streetscape Improvements

Portions of the recently completed Cambridge Street landscape and streetscape improvements would be impacted by the construction activities. All disturbed areas would be restored to pre-construction conditions when construction is complete.

3.3.2.9 Power, Signal, and Communication Systems

Electrical infrastructure for Alternative 1 would consist of:

- Traction Power Substation – located within the Charles/ MGH Station Blue Line mezzanine.
- Electric Power Substation – located within the Charles/ MGH Station Blue Line mezzanine.
- Communication and Cellular Carriers Room – located at the Charles/ MGH Station Blue Line platform level.
- Main Emergency Electrical Room – located at the Charles/ MGH Station Blue Line platform level.
- Signal Bungalow – located adjacent to the eastern end of the Charles/ MGH Station Blue Line platform at track level. Access would be provided through the emergency egress stair corridor.
- Electric Power Substation - located in Ventilation Room No. 1 area near North Anderson Street.

- Electric Power Substation - located in Ventilation Room No. 3 east of the Cambridge Street/ Bowdoin Street egress shaft.

3.3.2.10 Stormwater Management Systems

Portions of the existing storm drain system within the Project area would need to be temporarily relocated to accommodate construction activities. The system would be returned to at or near its current location when construction is completed. Operation of the Red Line/ Blue Line Connector would not require any new stormwater management system.

3.3.2.11 Groundwater Management Systems

Groundwater pumping is likely to be required, specifically in the vicinity of Bowdoin Station, to dewater the excavation area to accommodate construction activities. The subsurface structures would be constructed with impervious materials and sealed to prevent any groundwater seepage into the tunnels or underground portions of the station. Groundwater quality and flow characteristics would not be altered by the Project. No groundwater management systems would be required.

3.3.2.12 Blue Line Operations

The operating plan for the Blue Line under Alternative 1 would take into consideration hours of operation, train frequency, and ridership. Closing Bowdoin Station and constructing the Blue Line extension to Charles/ MGH Station would create temporary impacts to the Blue Line operations during certain construction activities:

- Installing a revised turnout east of the Government Center Station;
- Installing a new signal bungalow at the Government Center Station;
- Installing a third rail at the new turnout location (between Government and State Stations);
- Final testing and cutover of the new signal bungalow at Government Center Station; and
- Final testing and cutover of the Government Center Station to Charles/ MGH Station extension.

All of these temporary impacts would be mitigated by busing between Maverick Station and Government Center with stops at Aquarium and State Stations during the revenue hours, and possibly during two weekends to be determined

when the construction schedule is developed. The Blue Line Operations Memorandum[21] analyzes the operations of the Blue Line for Alternative 1 as compared to the No-Build Alternative and Alternative 2. It is assumed that the span of service and frequencies on the Blue Line would remain unchanged under this Alternative.

Alternative 1 assumes the elimination of Bowdoin Station. The impact on travel time resulting from the extension of Blue Line service to Charles/ MGH is 2.5 minutes of additional travel time (assuming the layover at Charles/ MGH is 4.0 minutes and the layover at Wonderland is 8.0 minutes)[22]. Therefore, 14 trains (84 cars) running in both directions, including one "Run-As-Directed" train, would be required to provide service under 4.5 minute peak headways.

The operational capacity for the Blue Line with Alternative 1 was analyzed to determine if the number of trains required to maintain 4.5 minute headways provides sufficient capacity to meet the maximum ridership demand in the future or if changes to headways or additional trains would be needed.

The Supplemental Analyses of Ridership and Rapid Transit Operations[23] evaluated the ability of the Blue Line to accommodate the projected increase in ridership forecast under within Alternative 1. Alternative 1 is projected to have a weekday ridership of 77,200 in 2030. This is an increase of 19.34 percent over the 2003 level (64,668 weekday riders). Applying this growth percentage to the 2003 AM peak 15-minute ridership results in a peak 15-minute ridership of 1,703 in the AM rush period.

Using MBTA vehicle loading standards for the number of passengers per car and per train, the total capacity provided by operating six-car trains on a 4.5-minute headway was calculated to be 1,900 passengers. Therefore, it appears that the current peak period schedule of six-car trains will provide sufficient capacity to carry the projected 2030 ridership under Alternative 1 consistent with MBTA service standards for the Blue Line.

3.3.2.13 Ridership

Table 3-1 presents the expected daily Red Line and Blue Line ridership under Alternative 1 (as compared to the No-Build Alternative) in 2030. A detailed

21 STV. 2009. *Blue Line Operations Memorandum*. Prepared by STV, Inc. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

22 It should be noted that the net increase in round trip running time takes into account the time savings accrued from the elimination of the Bowdoin Loop. That is, under both alternatives, westbound trains would no longer have to travel around the loop to get into position to travel eastbound. This move currently takes four minutes, according to the July 29, 2009 STV Incorporated Signaling Report.

23 STV. 2009 *Supplemental Analyses of Ridership and Rapid Transit Operations*. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

ridership discussion and analysis is provided in the Ridership Technical Memorandum.[24]

Table 3-1 Alternative 1 Trip Summary

	No-Build (2030)			Alternative 1 (2030)		
	Daily Boardings	Walk-Ins	Transfers	Daily Boardings	Walk-Ins	Transfers
Bowdoin Station	1,450	1,450	0	No Service	No Service	No Service
Charles/MGH Station	10,050	10,050	0	22,390	11,170	5,610
Red Line	10,050	10,050	0	12,920	7,310	-
Blue Line	No Service	No Service	No Service	9,470	3,860	-

Source: CTPS 2009. Red-Blue Connector Study: Charles/MGH Transfer Activity (12/28/2009)

Under Alternative 1, Bowdoin Station would not be serviced. However, Charles/ MGH Station would experience 22,390 daily boardings, including 5,610 transfers between the Red and Blue Lines, as compared to 10,500 daily boardings under the No-Build Alternative.

3.3.2.14 Cost

Based on a 10-percent conceptual level of design, the current estimated cost to construct Alternative 1 is $621 million, in 2009 dollars. The escalated cost based on mid-point of construction dollars is approximately $748 million. This alternative would take approximately six years to construct, including utilities relocations and project testing and close-out. Table 3-2 shows the estimated order of magnitude costs for the major components of Alternative 1, escalated from 2009 dollars.

Table 3-2 Alternative 1 Order-of-Magnitude Cost Estimate

Component	Estimated Cost
Design	$ 81M
Construction	$643M
Equipment	$ 17M
Mitigation	$ 7M
Total	**$748M**

24 STV. 2009. *Ridership Technical Memorandum*. Prepared by STV, Inc. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

3.3.3 Alternative 2: Red/Blue Line Connector with Relocated Bowdoin Station

Alternative 2 would similarly extend the Blue Line from Bowdoin Station to Charles/ MGH Station, but the platform of Bowdoin Station would be relocated while maintaining the existing mezzanine and headhouse. Under this scheme, Bowdoin Station would be able to accommodate six-car trains. As noted above, operations at Bowdoin Station are constrained by the platform length and loop track configuration. As an alternative to eliminating Bowdoin Station, relocating the platform and eliminating the loop track would allow relatively easier transit access with little travel time penalty to passengers. Access to the platform would be made via escalators, elevators, and stairway connections. As with Alternative 1, the loop track would be eliminated. A new underground Blue Line platform would be constructed east and below the existing Charles/ MGH Station, and connections between the two stations would be made ADA-accessible via stairways, escalators, and elevators. There would not be any restrooms for patrons, but there would be two staff restrooms (male and female). Figures 3-5a and 3-5b show the conceptual layout of the western and eastern, respectively, portions of the Project area for Alternative 2. Figure 3-5c shows plan and cross-sectional views of Alternative 2: Red Line/ Blue Line Connector with Relocated Bowdoin Station, including both horizontal and vertical alignments. Specific components of Alternative 2 that differ from Alternative 1 are outlined in the following paragraphs.

3.3.3.1 Stations

This alternative would include Bowdoin and Charles/ MGH Stations. The platform at Bowdoin Station would be relocated to the west, away from a track curve, to accommodate six-car trains. The new center platform would be approximately 22 feet below the existing platform elevation to accommodate the appropriate slope for the tunnel extension to Charles/ MGH Station. During Project construction, Blue Line service would terminate at Government Center Station. A crossover would be constructed east of Government Center to allow the trains to reverse direction. As with Alternative 1, a new subsurface platform would be constructed at Charles/ MGH Station to service the Blue Line.

3.3.3.2 Tunnel

Similar to Alternative 1, a two-track tunnel, with crossovers and two tail tracks, would extend the Blue Line from its current endpoint at Bowdoin Station to Charles/ MGH Station, and the Bowdoin Loop track would be eliminated. The alignment would be the same as for Alternative 1, but the slope would differ to accommodate the new platform at Bowdoin Station. The slope from Government

Center Station to the new Bowdoin Station platform would be 5.0 percent, flatten through the Bowdoin Station, and continue at 5.0 percent from the Bowdoin Station platform to the new Charles/ MGH Station Blue Line platform. The construction methodology for Alternative 2 would also be a combination of cut-and-cover, mined tunnel, and the sequential excavation method.[25] As shown in Figures 3-5a and 3-5b, the tunnel would be constructed by the cut-and-cover method for a distance of about 550 feet from Bowdoin Station southeast toward Government Center Station, and for a distance of about 250 feet east of Charles/ MGH Station. Open excavations would also be required for vents and emergency egress points, as identified in Figures 3-5a and 3-5b. Sequential excavation would be used for the tail tracks, and mined tunnel for the balance of the tunnel work.

3.3.3.3 Track Alignment

The track work associated with Alternative 2 would be the same as in Alternative 1 with the exception of the slope to accommodate the relocated Bowdoin Station platform. Top-of-track depth at its lowest elevation (at Staniford Street) would be approximately 51 feet below surface grade. Lengths of track would be:

- North Tail Track – Approximately 400 feet from the west end of the Charles/ MGH Station Blue Line platform to beneath the MEEI parking lot.
- South Tail Track – Approximately 300 feet from the west end of the Charles/ MGH Station Blue Line platform to beneath the eastern sidewalk of Charles Street on the south side of Charles Circle.
- Blue Line Extension (Government Center Station to Bowdoin Station) –
  - Inbound Track – 680 feet
  - Outbound Track – 690 feet
- Blue Line Extension (Bowdoin Station to Charles/ MGH Station) –
  - Inbound Track – 1,800 feet
  - Outbound Track – 1,800 feet
- Total Proposed New Track Length (both directions, including tail tracks) – 5,710 feet

Crossovers for Alternative 2 would be the same as for Alternative 1.

25 STV. 2009. Geotechnical Interpretive Report. Prepared by STV, Inc. in association with HMMH. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

3.3.3.4 Station Locations and Conceptual Design

The Blue Line platform at Charles/ MGH Station for Alternative 2 would be the same as for Alternative 1. The relocated Bowdoin Station platform would be a center platform configuration with 214 feet of tangent track on the outbound side and 231 feet of tangent track on the inbound side of the platform. The track on either side would have a curvature of 1,000-foot radius to accommodate the bend along the right-of-way. The dimensions of the platform would be:

- Length – 320 feet
- Width – 26 feet

3.3.3.5 Location of Emergency Exits and Vent Structures

Emergency egress from the Blue Line platform at Charles/ MGH Station and along the tunnel for Alternative 2 would be the same as for Alternative 1. At Bowdoin Station, platform emergency egress would be provided via stairs from the platform level. The stairs would lead up to an emergency hatchway located in the median at the Cambridge Street/ Staniford Street intersection.

Ventilation provisions for Alternative 2 would be the same as for Alternative 1 except for Ventilation Room No. 2. The addition of Ventilation Room No. 2 is required for the new Bowdoin Station platform ventilation. This ventilation room would allow reconfiguration of the existing tail track and upgrades to the existing ventilation to accommodate the relocated Bowdoin Station. The existing exhaust vent grate would be replaced in the Cambridge Street median; however, the ventilation system would be located below the Cambridge Street and Ridgeway Lane intersection.

3.3.3.6 Station Access and Circulation

Entrance and exit into the Blue Line platform at Charles/ MGH Station would be the same as for Alternative 1. Entrance to Bowdoin Station is through the existing headhouse on the north side of Cambridge Street, adjacent to Cardinal Cushing Park. Internal circulation at Bowdoin Station would be unchanged except for rerouting to the new platform location and the ADA-accessibility improvements. The vertical circulation elements for the relocated Bowdoin Station platform would be:

- Stairs – provide access from the existing headhouse down to the mezzanine, then to the relocated platform.

- Escalators – one escalator (3 feet, 7 inches wide) traveling in the up direction would lead patrons from the mezzanine to grade. Two escalators (each 3 feet, 7 inches wide) that travel in both directions would lead from the mezzanine to a landing where there is one escalator providing service up from platform level. The platform-level escalator would align with the relocated platform.
- Elevator – one elevator would lead patrons from the street level to the mezzanine. An additional elevator would provide vertical circulation from the mezzanine directly to the platform level. The elevator would be located at the east end of the platform, beyond the escalators and stairs.

  Redundant elevators, as required for ADA accessibility, will be evaluated at the next phase of design.

3.3.3.7 Disposition of Abandoned Tunnels and Station Entrances

The Bowdoin Loop tunnels would be abandoned as described above for Alternative 1. The Bowdoin Station entrance would be retained for normal use.

3.3.3.8 Landscape and Streetscape Improvements

As with Alternative 1, disturbed landscape and streetscape improvements along Cambridge Street would be restored to pre-construction conditions when construction is complete.

3.3.3.9 Power, Signal, and Communication Systems

Electrical infrastructure requirements for Alternative 2 would be the same as for Alternative 1 except for an additional electric power substation, located west of the new Bowdoin Station platform (Ventilation Room No. 2, in the reconfigured space which is currently the tail track).

3.3.3.10 Stormwater Management Systems

As with Alternative 1, no permanent changes in the storm drain system would be required for Alternative 2. Temporary system relocations for construction would be required.

3.3.3.11 Groundwater Management Systems

As with Alternative 1, permanent groundwater management systems would not be required for Alternative 2. Temporary dewatering to accommodate construction activities, especially in the vicinity of Bowdoin Station, would be required.

3.3.3.12 Blue Line Operations

A new operating plan for the Blue Line under Alternative 2 would take into consideration hours of operation, train frequency, and ridership.

It is assumed that the span of service and train frequencies on the Blue Line would also remain unchanged under this Alternative, except the hours of operation at Bowdoin Station would be expanded to match the other Blue Line stations.

For Alternative 2, the net increase in the round trip running time for the Blue Line extension from Government Center Station to Charles/ MGH Station, including a stop at Bowdoin Station, would be approximately 4 minutes and 8 seconds, as compared to existing operations (assuming the layover at Charles/ MGH Station is 4.0 minutes and the layover at Wonderland is 8.0 minutes).[26] This increase in travel time would require the addition of two trains, or 15 trains/ 108 cars per hour, to maintain currently scheduled peak headways on the Blue Line. This total includes one "Run-As-Directed" train.

3.3.3.13 Ridership

Table 3-3 presents the expected daily Red Line and Blue Line ridership under Alternative 2 (as compared to the No-Build) in 2030.

Table 3-3 Alternative 2 Trip Summary

	No-Build (2030)			Alternative 2 (2030)		
	Daily Boardings	Walk-Ins	Transfers	Daily Boardings	Walk-Ins	Transfers
Bowdoin Station	1,450	1,450	0	2,170	2,170	0
Charles/MGH Station	10,050	10,050	0	21,200	9,700	5,750
Red Line	10,050	10,050	0	13,650	7,900	-
Blue Line	No Service	No Service	No Service	7,550	1,800	-

Source: CTPS, 2009. Red-Blue Connector Study: Charles/MGH Transfer Activity (12/28/09)

26 It should be noted that the net increase in round trip running time takes into account the time savings accrued from the elimination of the Bowdoin Loop. That is, under both Build Alternatives, westbound trains would no longer have to travel around the loop to get into position to travel eastbound. This move currently takes four minutes, according to the July 29, 2009 STV Incorporated Signaling Report.

Under Alternative 2, Bowdoin Station would have 2,160 daily boardings compared to the 1,450 boardings under the No-Build Alternative. Total daily boardings at Charles/ MGH Station would be 21,200, including 5,750 transfers between the Red and Blue Lines, as compared to 10,050 under the No-Build Alternative. The combined daily boardings at Bowdoin and Charles/ MGH Stations under Alternative 2 would be 23,360, slightly more than the 22,390 daily boardings at just Charles/ MGH Station under Alternative 1. This difference translates into a negligible effect on transportation operations.

3.3.3.14 Cost

Based on a 10-percent conceptual level of design, the current estimated cost to construct Alternative 2 is $718 million, in 2009 dollars. The escalated cost based on mid-point of construction dollars is approximately $867 million. Alternative 2 would take approximately six years to construct, including utilities relocations and project testing and close-out, similar to Alternative 1. Table 3-4 shows the estimated order of magnitude costs for the major components of Alternative 2, escalated from 2009 dollars.

Table 3-4 Alternative 2 Order-of-Magnitude Cost Estimate

Component	Estimated Cost
Design	$ 92M
Construction	$733M
Equipment	$ 35M
Mitigation	$ 7M
Total	**$867M**

3.3.4 Summary and Comparison

The two Build Alternatives are alike in many respects. The track alignments and the Blue Line platform at Charles/ MGH Station would be the same. The type, extent, and duration of construction would also be the same. Temporary traffic disruptions during the construction period would result from both Build Alternatives. There are differences between the two Build Alternatives based upon eliminating or relocating the platform at Bowdoin Station. The total project cost of Alternative 2, about $119 million more than Alternative 1, is due to the additional cost of designing and constructing the relocated Bowdoin Station. There are minor differences between the two Build Alternatives in ridership and trip times. Table 3-5 compares the alternatives.

Table 3-5 Comparison of the Alternatives

Alternative	Blue Line Ridership Increase[1]	Cost[2]	Round Trip Travel Time Increase
No-Build	0	0	0
Alternative 1: Eliminated Bowdoin Station	4,400	$748 million	2 minutes, 29 seconds
Alternative 2: Retained Bowdoin Station	4,200	$867 million	4 minutes, 8 seconds

1 Based on projected 2030 ridership.
2 Based on escalated mid-year of construction dollars.

3.3.4.1 Comparison of Boardings

Projected 2030 daily boardings for the Red Line and Blue Line at major downtown transfer stations are provided in Table 3-6.

Table 3-6 Red Line and Blue Line Boardings[1] at Selected Downtown Transfer Stations in 2030

	No-Build	Alternative 1: Eliminate Bowdoin Station		Alternative 2: Relocate Bowdoin Station	
Station	Boardings	Boardings	Change from No-Build	Boardings	Change from No-Build
Red Line					
Charles/MGH	10,050	13,650	+3,600	12,920	+2,870
Park Street	39,580	35,230	-4,350	35,040	-4,540
Downtown Crossing	29,940	29,660	-280	29,580	-360
Blue Line					
Charles/MGH	0	9,470	+9,470	7,550	+7,550
Bowdoin	1,450	0	-1,450	2,170	+720
Government Center	18,280	13,660	-4,620	13,120	-5,160
State	12,220	12,360	+140	12,410	+210

Source: CTPS, Red-Blue Connector Balanced Blue Line Boardings and Alightings, 11/9/2009 and Red-Blue Connector Balanced Red Line Boardings and Alightings, 11/30/2009.

1 Total boardings, inbound and outbound, on a daily balanced, 18-hour basis.

These data indicate that daily boardings at Charles/ MGH Station would increase under both Build Alternatives for both the Red Line and the Blue Line as compared to the No-Build Alternative. Bowdoin Station would be eliminated under Alternative 1, so all boardings there would be lost; it is assumed that the majority of those riders would board the Blue Line at either Charles/ MGH or Government Center Stations. Substantive changes in daily boardings would be observed at Park Street Station for the Red Line and Government Center Station for the Blue Line, where these two lines intersect the Green Line. Less substantive changes would be realized at the Downtown Crossing and State Stations, where these two lines intersect the Orange Line. As compared to the No-Build Alternative, between 4,350 and 4,540 fewer riders would board the Red Line at Park Street Station each day. Similarly, between 4,620 and 5,160 fewer riders would board the Blue Line at Government Center Station each day. These reductions would be realized because transfers at these stations to the Green or Orange Lines would not be necessary when the Red Line and Blue Line are connected. Congestion at these stations would be reduced by approximately 11 and 27 percent, respectively. Slightly increased boardings at State Station may result from Orange Line riders transferring to the Blue Line at this location to access medical facilities near Charles/ MGH Station rather than transferring to the Red Line at Downtown Crossing Station (where slightly decreased boardings would be observed) for this purpose.

3.3.4.2 Comparison of Benefits

The benefits and drawbacks of the No-Build Alternative and the two Build Alternatives, based on the Project description provided above, the environmental

consequences evaluation provided in Chapter 5, and the construction period impacts described in Chapter 6, are summarized below.

The benefits of the No-Build Alternative are:

- No construction costs; and
- No traffic disruption or noise level increases during construction.

The drawbacks of the No-Build Alternative are:

- No potential for improvement in air quality;
- No improvement in transit connectivity;
- No improvement in access to jobs and health care facilities;
- No reduction in congestion at Downtown transfer stations; and
- No reduction in Downtown automobile traffic.

The benefits of Alternative 1 are:

- Potential for improvement in air quality;
- Improvement in transit connectivity;
- Improvement in access to jobs and health care facilities;
- Reduction in congestion at Downtown transfer stations;
- Reduction in Downtown automobile traffic;
- Faster transit travel times than Alternative 2; and
- Lower construction cost ($748 million) than Alternative 2.

The drawbacks of Alternative 1 are:

- Slight reduction in transit access as compared to Alternative 2; and
- Traffic disruption and increased noise levels during construction.

The benefits of Alternative 2 are:

- Potential for improvement in air quality;
- Improvement in transit connectivity;
- Improvement in access to jobs and health care facilities;
- Reduction in congestion at Downtown transfer stations;
- Reduction in Downtown automobile traffic; and
- Better transit access than Alternative 1.

The drawbacks of Alternative 2 are:

- Traffic disruption and increased noise levels during construction;
- Increase in transit travel times as compared to Alternative 1; and
- Higher construction cost ($867 million) than Alternative 1 ($748 million).

3.4 Preferred Alternative

Alternative 1, Blue Line Extension with Eliminated Bowdoin Station, has been selected as the Preferred Alternative for the Red Line/ Blue Line Connector Project, as it provides the best balance of cost, ridership, and environmental impacts. MassDOT also believes that this alternative would help the Commonwealth achieve its goal of providing expanded transportation services and improving regional air quality. This alternative extends the Blue Line to Charles/ MGH Station under the Cambridge Street right-of-way has environmental benefits, has faster transit travel time and have a lower capital cost than Alternative 2. Alternative 1 would meet all Project goals, would be operationally practical, and would generate a high number of new system-wide transit trips.

Although MassDOT has committed to funding the design, no funding source has been identified for the construction of the Project. Should additional resources for MBTA expansion projects become available, the Red Line/ Blue Line Connector Project will be one of the projects considered for implementation. When such a priority setting takes place, it would be informed by the level of environmental review, and design and engineering work conducted between now and the end of 2011 in order to satisfy the SIP commitment.

A general Construction Phasing Plan has been developed. The Construction Phasing Plan identifies the general phases, tasks, and construction methodologies. In chronological order (with some task overlap), the major phases of construction would include:

- Phase 1 - Initial utility relocation and other initial activities including installing a reverse crossover in the tracks east of Government Center Station and necessary track signal modifications.
- Phase 2 - Northerly (westbound) tunnel construction and excavation of the cut-and-cover tunnel east of Bowdoin Station.
- Phase 3 - Southerly (eastbound) tunnel construction.
- Phase 4 - Construction of station, center arch (combining the two bored tunnels into one wider tunnel), platform, followed by the cut-and–cover excavation at the crossover and ventilation area east of Charles/ MGH Station.
- Phase 5 - Systems installation.
- Phase 6 - Testing and close out.

The anticipated duration of constructing the Preferred Alternative is 6 years, 3 months. Assuming a starting time at the beginning of the third quarter of 2012, the Project would be completed by the end of the third quarter of 2018.

3.5 Consistency with Regional Projects and Planning

The Preferred Alternative is consistent with and supportive of local, regional, state, and federal policies related to transportation infrastructure improvements including transit, pedestrian, and bicycle facilities and services. Design of the Project is required by the ozone SIP, and the Project is supportive of local, regional, state, and federal policies related to transportation infrastructure improvements including transit, pedestrian, and bicycle facilities and services. The Project also complements other MBTA, Massachusetts Department of Conservation and Recreation (DCR), and MassDOT projects in the immediate vicinity, and is consistent with municipal land use planning by the City of Boston, the Metropolitan Area Planning Council (MAPC), and the Commonwealth.

The Charles River Basin Infrastructure Synchronization Project[27] report describes twelve major road and/ or bridge projects along the river that are scheduled in the next 5 to 20 years. Completing these projects will require substantial coordination to minimize traffic disruptions and environmental impacts. Three of these projects are within 0.25 mile of the Red Line/ Blue Line Connector Project area: the Longfellow Bridge, Craigie Dam Bridge and Drawbridge, and Storrow Drive Tunnel.

The Project's consistency with the ozone SIP, other related or nearby transportation projects, and local and regional land use planning is summarized in the following paragraphs.

3.5.1 State Implementation Plan

The ozone SIP, amended with the Air Pollution Control Regulations, requires MassDOT to complete design of the Red Line/ Blue Line Connector Project by December 31, 2011. The Project, along with several other transit projects, is intended to, in part, offset increased air pollutant emissions resulting from increased automobile traffic using the recently completed Central Artery/ Tunnel highway system through downtown Boston. By improving transit access to jobs, education, and medical facilities, the Project is anticipated to reduce automobile use and, thereby, air pollution.

27 EOT. 2008. *Charles River Basin Infrastructure Synchronization Project Final Report*. Commonwealth of Massachusetts, Executive Office of Transportation and Public Works. Prepared by BETA Group, Inc.: South Norwood, MA, in association with Simpson Gumpertz & Heger, and CDW.

3.5.2 Blue Line Extension to Lynn

The MBTA has studied extending the Blue Line from its current northernmost stop, at Wonderland Station in Revere, into Lynn. This project would improve transit access for residents of northeastern suburbs, and has been identified as a high-priority project by the MBTA.[28]

The Red Line/ Blue Line Connector Project is consistent with extending the Blue Line to Lynn. One of the key goals of the Project is to improve transit access to the Red Line for patrons in northeastern suburbs, improving access to jobs, education, and medical services. Extending the Blue Line to Lynn would further this goal.

3.5.3 Urban Ring

The Urban Ring is a three-phased, circumferential transit improvement project within a corridor approximately two miles outside of Downtown Boston. The project includes segments within Boston, Cambridge, Somerville, Brookline, Everett, Medford, and Chelsea; these areas include some of the fastest growing locations around Boston.[29] The Urban Ring would provide new rapid bus transit services that would connect to existing radial transit lines (subway, commuter rail, and bus) to create shorter transit trips and fewer transfers. The Urban Ring would connect with the Red Line in Boston at Broadway Station and in Cambridge at the Kendall/ MIT and Harvard Square Stations, and with the Blue Line at Airport Station.[30]

The Red Line/ Blue Line Connector Project is consistent with the Urban Ring project in furthering downtown connections between the radially oriented transit lines.

3.5.4 Longfellow Bridge

MassDOT and DCR are undertaking a project to rehabilitate the Longfellow Bridge across the Charles River between Boston and Cambridge.[31] Longfellow Bridge carries Cambridge Street and the Red Line. The main goals of this project

28 Boston Metropolitan Planning Organization. 2009. *Transportation Improvement Plan*. See in particular Appendix A, page 27.
29 EOT. 2009. *The Urban Ring* website: http://www.theurbanring.com/. Accessed 26 October 2009.
30 EOT. 2009. *Notice of Project Change: Circumferential Transportation Improvements in the Urban Ring Corridor; Urban Ring Phase 2*. Commonwealth of Massachusetts, Executive Office of Transportation and Public Works: Boston. The Notice of Project Change was withdrawn on October 15, 2009, and withdrawn from MEPA evaluation on January 22, 2010 due to financial constraints. Letter from James Aloisi, Secretary of EOT, on October 15, 2009 to Ian Bowles, Secretary of EEA and letter from Jeffrey B. Mullan. Secretary and Chief Executive Officer of MassDOT on January 22, 2010 to Ian Bowles.
31 MassHighway. 2009. *Restoration of the Longfellow Bridge* website: http://www.mhd.state.ma.us/default.asp?pgid=longfellowbridge/longfellow&sid=level2. Accessed 26 October 2009.

are to address the bridge's current structural deficiencies, upgrade its structural capacity, and bring the bridge up to modern code. This project must restore a sidewalk across the bridge while satisfying ADA accessibility requirements and MassDOT Highway Division (formerly, MassHighway) design standards and maintaining the historical character of the bridge.[32] The preliminary design phase was completed in May 2009. Final design will be completed in July 2010. Construction is scheduled to begin in 2011 and be completed in 2014.

The Red Line/ Blue Line Connector Project is consistent with the Longfellow Bridge Restoration Project in providing ADA-compliant access to pedestrians using the bridge and Charles/ MGH Station. The Longfellow Bridge Restoration Project will abut Charles/ MGH Station, but would not encroach into the Red Line/ Blue Line Connector Project construction area. The Longfellow Bridge Restoration Project will not directly impact Charles/ MGH Station, and impacts to DCR parkland along the Charles River will be separated from the Red Line/ Blue Line Connector Project impacts to Charles Circle by Charles Street, Charlesbank Road, and Embankment Road (the latter two of which are also commonly referred to as Storrow Drive).

3.5.5 Craigie Dam Bridge and Drawbridge

The Craigie Dam bridge and drawbridge are located about 0.25 mile north of the Red Line/ Blue Line Connector Project area, and cross Charles River as Highway 28, the Monsignor O'Brien Highway. The Craigie Dam bridge project will renovate the aging structure and widen the pedestrian walkway.[33] The Craigie drawbridge project will replace the existing superstructure to provide better weathering protection for machinery and comfort of vehicular and pedestrian traffic.[34] The two projects are closely related and will be completed in phases, from 2009 through 2011, to minimize traffic disruptions.[35]

The Red Line/ Blue Line Connector Project complements the Craigie Dam bridge and drawbridge projects in improving infrastructure including transit, pedestrian, and bicycle facilities and services across the lower Charles River.

32 MassHighway and DCR. 2009. *Environmental Notification Form: Longfellow Bridge Rehabilitation Project.* Commonwealth of Massachusetts, Executive Office of Transportation and Public Works, Massachusetts Highway Department and Department of Conservation and Recreation: Boston.
33 DCR. 2009. *Craigie Drawbridge and Craigie Dam Bridge Rehabilitation Project* website: http://www.mass.gov/dcr/projects/craigie.htm. Accessed 27 October 2009.
34 Ibid.
35 EOT. 2008. *Charles River Basin Infrastructure Synchronization Project Final Report*. Commonwealth of Massachusetts, Executive Office of Transportation and Public Works. Prepared by BETA Group, Inc.: South Norwood, MA, in association with Simpson Gumpertz & Heger, and CDW. See Figure H-2, Traffic Reassignment Routes, Craigie Dam Bridge and Craigie Drawbridge, in Appendix H.

3.5.6 Storrow Drive Tunnel

The Storrow Drive Tunnel, between Arlington and Clarendon Streets about 0.25 mile southwest of Charles Circle, carries eastbound traffic. Westbound traffic travels atop the tunnel. The tunnel was constructed in 1951 and needs to be replaced due to deterioration, leaks, and design deficiencies that prevent tall emergency vehicles from entering the low-level structure.[36] Interim repairs to address immediate concerns and extend the tunnel life by 5 years were completed in 2009.[37] Design work for the rehabilitation project is ongoing and the construction project is expected to begin prior to the expiration of the 5-year extended life.[38]

The Red Line/ Blue Line Connector Project complements the Storrow Drive Tunnel Reconstruction Project. Both projects enhance safety and mobility for travelers in the lower Charles River basin.

3.5.7 City of Boston Land Use Planning

The City of Boston has enacted several land use plans, area plans, and open space plans, and conducted several planning efforts in recent years that are relevant to the Project. MGH, which is directly adjacent to the project corridor, recently completed an Institutional Master Plan. The City of Boston has also worked with developers on several major development projects to revitalize the Cambridge Street corridor in recent years. Municipal land use plans, open space plans, institutional plans, and other planning relevant to the Red Line/ Blue Line Connector Project include:

- *A Framework for Planning and Development of the West End Area*, prepared by the Boston Redevelopment Authority in cooperation with the West End Area Planning Group and the Boston Transportation Department, 2003.
- *Boston 400: Connecting the City and Its People*, a comprehensive, long-term planning effort for all of the city's neighborhoods carried out by the Boston Redevelopment Authority. Began in 1997 and entailed community meetings and extensive discussion about the future of the neighborhoods and the city.
- *Open Space Plan 2002-2006*, Boston Parks and Recreation Department, 2002.

36 DCR. 2006. *Environmental Notification Form: Storrow Drive Tunnel Reconstruction Project*. Commonwealth of Massachusetts, Department of Conservation and Recreation. Prepared by Epsilon Associates, Inc.: Maynard, MA.
37 DCR. 2009. *Q&A Storrow Drive Tunnel Interim Repair Project* website: http://www.cambridgema.gov/TheWorks/contents/constrdocs/pdffiles/StorrowTunnelQA.pdf. Accessed on 26 October 2009.
38 EOT. 2008. *Charles River Basin Infrastructure Synchronization Project* Final Report. Commonwealth of Massachusetts, Executive Office of Transportation and Public Works. Prepared by BETA Group, Inc.: South Norwood, MA, in association with Simpson Gumpertz & Heger, and CDW.

- *Fostering Transit-Oriented Development in Boston*, ongoing planning initiative by the Boston Redevelopment Authority begun in 2003.

- *Massachusetts General Hospital Institutional Master Plan*, developed by MGH, approved by the Boston Redevelopment Authority in 2006.

The land use plans developed by the City of Boston encourage compact, mixed-use development and revitalization of lands around the Project area, as well as transit-oriented development and linkages between open space and mass transit. In addition to these plans and efforts, recent developments in which the City of Boston has worked with project proponents to contribute to the revitalization of the Cambridge Street corridor have included:

- Redevelopment of Charles River Plaza, on Cambridge Street near Staniford Street, including redeveloping 650,000 square feet of existing space, constructing more than 400,000 square feet of new space in two buildings, and adding 10,000 square feet of retail space including a new supermarket.

- Revitalization of the Saltonstall Building, at 100 Cambridge Street, including constructing 75 new units of housing and 35,000 square feet of retail space.

- Redevelopment of the former Charles Street Jail into a 305-room hotel.

The City's recent efforts with developers in the Project corridor have worked toward the land use plan goals, and the MGH Master Plan promotes compact development on its West End Campus, including a new 10-story building that would be located behind the Yawkey Center for Outpatient Care.

The Red Line/ Blue Line Connector project is consistent with the land use plans of the City of Boston as well as the MGH Master Plan. The Red Line/ Blue Line Connector Project would be beneficial in terms of transportation access and mobility, air quality and the environment, and land use and economic development, consistent with these municipal and institutional plans and policies.

3.5.8 MAPC Regional Policy Plan

The most recent regional policy plan for the Boston region is MetroFuture,[39] completed in 2009 by MAPC. The basic tenet of the plan is that concentrating development in previously developed areas is economically and environmentally more practical than the current model of scattered growth. MetroFuture emphasized that concentrated development encourages and enhances transit use, ride sharing and pedestrian traffic with a resultant

39 MAPC. 2009. MetroFuture: Making a Greater Boston Region.

reduction in automobile travel, traffic congestion, air pollution and fuel consumption, and in addition, reduces the pressure to develop open space and environmentally sensitive lands.

In developing MetroFuture, participants developed four scenarios for growth in the Boston region, including one that would extend current growth trends and three alternate scenarios that would direct growth in a more compact way (with differences in the degree and pace of change). The recommended growth plan envisions a future in which growth is focused in areas that can meet the needs of new residents. It envisions more urban "starter homes" in the Inner Core and Regional Urban Centers; suburban growth steered to town centers and villages on previously developed land; and clustering of housing in rural areas to protect open space. In the Inner Core and Regional Urban Centers, the plan also envisions increased transit, more parks and shops, revitalized main streets, and new pathways opening up access to recreational and natural areas.

The Red Line/ Blue Line Connector project is consistent with the MetroFuture plan, as it would provide enhanced transit to improve residents' transportation access and mobility.

3.5.9 Massachusetts Sustainable Development Principles

The Commonwealth of Massachusetts has adopted a set of Sustainable Development Principles which are intended to promote sustainable development through integrated energy and environment, housing and economic development, transportation and other policies, programs, investments, and regulations.[40] Several of these principles are particularly relevant to the Red Line/ Blue Line Connector Project: 1. Concentrate Development and Mix Uses; 2. Advance Equity; 7. Provide Transportation Choice; 8.Increase Job and Business Opportunities; and 10. Plan Regionally. The Red Line/ Blue Line Connector Project is consistent with the Commonwealth's Sustainable Development Principles.

40 Massachusetts. 2009. *Sustainable Development Principles.* Website: http://www.mass.gov/Agov3/docs/smart_growth/patrick-principles.pdf. Accessed 14 December 2009.

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4

Affected Environment

4.1 Introduction

This Chapter describes the existing conditions and the environment resources that may be affected by the Red Line/ Blue Line Connector Project. Based upon the requirements of the Secretary's Certificate[41] on the EENF and MEPA regulations, the environmental resources evaluated are:

- Land Use
- Environmental Justice
- Existing Transportation Systems
- Traffic
- Air Quality
- Noise
- Vibration
- Soils and Groundwater
- Stormwater
- Parks and Recreation
- Visual Environment
- Historic and Archaeological Resources
- Hazardous Materials

The potential permanent impacts of the Project on the resources and conditions described in this Chapter are discussed in Chapter 5, Environmental Consequences. Temporary (construction period) impacts are discussed in Chapter 6, Construction Period Impacts.

41 EEA. 2007. *Certificate of the Secretary of Energy and Environmental Affairs on the Expanded Environmental Notification Form.* Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs: Boston.

4.2 Land Use

This section provides an overview of the existing land uses in the Project area, population and employment data that help to characterize these uses, and existing or proposed land use plans or projects in the vicinity of the Project area. A more detailed description of the existing land uses is provided in the Land Use Technical Report.[42] This section also identifies lands protected under the Public Waterfront Act. Recreational land uses are separately described in Section 4.11, Parks and Recreation.

4.2.1 Introduction

The Cambridge Street corridor is a dense urban sector of Downtown Boston. There are approximately 560 individual properties along the corridor that are primarily commercial/ retail and institutional, mixed-use, and a few residential properties bordering the corridor. The corridor streetscape was recently improved, including repaving and repairing the street, landscaping, installing traffic calming measures, improving pedestrian walkways, and widening sidewalks. There are standard city sidewalks located on either side of Cambridge Street. Due in part to the lack of subway and bus service along this corridor, it is heavily utilized by pedestrians walking to or from Government Center, Beacon Hill, or the West End.

The following Secretary's Certificate on the EENF requirements are addressed in this section:

- Right-of-way ownership; and
- Massachusetts General Law Chapter 91 (Public Waterfront Act) jurisdiction.

4.2.2 Regulatory Context

The primary regulatory restrictions on land use within the Project area come from Massachusetts General Law Chapter 91 and the City of Boston Zoning Code. Additional regulatory requirements protecting recreational land uses are described in Section 4.11.2.

42 STV. 2009. Red Line/Blue Line Connector Project Technical Report: Land Uses. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston, MA. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

4.2.1.1 Massachusetts Public Waterfront Act

The *Massachusetts Public Waterfront Act*, Massachusetts General Law Chapter 91, protects the public's rights in Commonwealth Tidelands. These rights include fishing, fowling, and navigation. Commonwealth Tidelands are defined as filled tidelands (under tidal waters seaward of the present mean high water [MHW] shoreline) and flowed tidelands. The Act authorizes the Waterways Regulations (310 CMR 9.00) which protect the public's access to, and use of, Commonwealth Tidelands.

4.2.1.2 Zoning

The City of Boston zoning regulations that are most applicable to the Project are within Article 8, Regulation of Uses. This article specifies the baseline of allowable and conditional uses within the City, including the Project area. Railroad facilities are allowed in Local and General Business, and Restricted and General Industrial use zones within the Project area.

The Cambridge Street North District includes zoning subdistricts, height, and Floor Area Ratio (FAR) restrictions. The Charles Street Jail North and South Protection Areas are both Planned Development Areas (PDA) under the Boston Zoning Code Article 47A. The Charles Street PDAs were established to ensure proper redevelopment of these historic properties. A PDA is an overlay district that establishes special zoning controls for large or complex projects. The purpose of a PDA is to establish a more flexible zoning law, to allow for the diversification and expansion of Boston's economy, and to encourage development that knits together the surrounding neighborhoods through a new urban design for the area.

4.2.2 Existing Conditions

The primary land use within the Project area is transportation, along Cambridge Street and intersecting roads (Figure 4.2-1). The Cambridge Street right-of-way is owned by the City of Boston, with a MassDOT easement for transportation use. The westernmost extent of the Project area, Charles/ MGH Station and the two proposed tail track alignments extend underground into the Charles River Reservation. The existing Charles/ MGH headhouse occupies Charles Circle, which is within the reservation. This public open space is owned by DCR and includes both park land and public roads such as Charles Street, Embankment Road, and Charlesbank Road (Storrow Drive).

Commercial and medical facility (exempt institutions) land uses dominate the development on the north side of Cambridge Street, while residential land uses

are common on the south side, as shown in Figure 4.2-1. Major activity centers along the Cambridge Street corridor (Figures 4.2-2a-b) include the Massachusetts General Hospital (MGH); the Charles River Plaza retail center (Whole Foods, CVS/ Pharmacy, etc.); high density housing to the north (Charles River Park and West End Apartments); and hotels (Holiday Inn, Liberty Hotel, and Extended Stay). Farther east is the Government Center area and City Hall Plaza with a number of government buildings (Government Service Center Charles Hurley Building, Massachusetts Department of Mental Health, Suffolk County Courthouses, Boston City Hall, and John F. Kennedy Federal Building). The Beacon Hill neighborhood, a prominent historic residential area, is south of the corridor.

Out of approximately 560 properties within 500 feet of the Cambridge Street corridor, 27 are owned by local, state or federal government entities. These properties are some of the largest along the corridor, ranging in size up to 285 acres at the Government Center/ City Hall Plaza that is owned by the City of Boston. The remaining properties are owned by private companies. Some of these companies are nonprofit organizations and institutions such as Suffolk University and Partners HealthCare System Inc., which owns all MGH properties. Established in 1811, MGH is one of the corridor's primary landholders. A number of MGH buildings along the corridor are historic structures, as described in Section 4.13. The largest cluster of hospital buildings is at the western terminus of Cambridge Street where the MGH Yawkey Center for Outpatient Care and the MGH main entrance are located.

Residential uses along Cambridge Street are interspersed in various structural types but are typically largely brick frame condominiums with first floor retail. Dense high-rise apartment complexes are located to the north within the West End neighborhood.

Commonwealth Tidelands protected under Chapter 91 are present at the western end of the Project area, as depicted in Figure 4.2-3, based on the historic high water line (shoreline).

4.2.2.1 Population and Employment

The Project area is densely populated and fully built-out with little to no vacant land. The combined population of the four U.S. Census Tracts along the Cambridge Street corridor was 17,747 people in 2000, and the combined land area is 0.76 square miles, as shown in Table 4.2-2.

Table 4.2-2 Population in the Project Area

Census Tract	Neighborhood	Area (square miles)	Population	Pop. Density (persons/sq mi)	Households	Housing Density (units/sq mi)
20100	Back Bay South	0.12	3,635	30,292	2,666	22,217
20200	Back Bay North	0.03	4,157	138,567	2,352	78,400
20300	West End	0.32	5,881	18,378	3,059	9,559
30300	Government Center	0.28	4,074	14,550	2,353	8,404
		0.75	**17,747**	**23,663**	**10,430**	**13,907**

Source: U.S. Census 2000

The Project area has a population density of 23,663 persons per square mile, which is projected to increase by approximately 951 persons by 2030 (Table 4.2-3). Comparatively, population density for the entire City of Boston in 2006 was 12,772 persons per square mile. The high population density is primarily due to the dense residential neighborhood of the Back Bay south of Cambridge Street.

Table 4.2-3 Population, Housing, and Employment in the Project Area

	Existing	Projected			
	2000	2010	% Change	2030	% Change
Population	17,747	18,205	2.58	18,707 [2]	2.76
Population density (persons/sq mi.)	23,663	23,954	1.23	24,614	2.76
Households	10,430	10,630	1.92	11,051 [3]	3.96
Housing density (units/sq mi.)	13,907	13,987	0.58	14,541	3.96
Employment	14,757 [1]	NA	--	15,639	5.98

Source: U.S. Census 2000

1 Percentage of total Boston employment (2.89%).

2 Derived from Metropolitan Area Planning Council Population, Housing and Employment Projections 2010-2030, January 2006; percentage of total Boston population (2.89%).

3 Derived from Metropolitan Area Planning Council Population, Housing, and Employment Projections 2010-2030, January 2006; based on percentage of total Boston households (4.3%).

Table 4.2-3 shows that there were 10,430 households within the Project area in 2000. The number of households is projected to remain fairly constant over the next two decades, increasing by approximately 200 households from 2000 to 2010 and by 400 households by 2030. Housing density is projected to grow by approximately four percent between 2010 and 2030. As with the high population density, this high housing unit density (13,724 units per square mile compared to 5,314 units per square mile for the entire City) is attributed to the highly urbanized sector that includes both the Beacon Hill neighborhood and the apartment buildings within the West End neighborhood.

Approximately 14,757 people in the Project area were employed in 2000; the number of employed residents is expected to rise to 15,639 people (an approximately six percent increase) by 2030. It is expected that this area of Boston will have a steady increase in employment because it includes one of the largest hospital systems in the northeastern U.S. (MGH), along with supporting commercial businesses and services (e.g., hotels and restaurants).

4.2.2.2 Land Use and Transportation Plans

Several land use and transportation plans apply to the Cambridge Street corridor:

- *Access Boston 2000 – 2010*, Boston Transportation Department (2000): Boston's first comprehensive transportation plan calls for decongestion of local-business main streets, district-based restrictions on new parking, traffic calming on residential streets, investment in a next generation of transit projects, amenities for bus riders, and transit-oriented development.
- *Journey to 2030*, Boston Metropolitan Planning Organization (MPO) (2007, amended 2009): This is the latest regional transportation plan completed by the MPO, outlining a regional transportation vision through the year 2030. The plan builds on Boston's role as the transportation and commercial hub of New England while planning for greater lateral connectivity across communities in the region.
- *Framework for Planning and Development of the West End Area*, BRA (2003): This document is a framework to offer insight into the values, priorities, and expectations of the West End community. The framework offers guidance to prospective developers, criteria to be considered by public officials in planning and development, and stands as a written record of community concerns and issues.
- *Cambridge Street Plan*, BRA (1991): This plan was developed to ensure that urban planners and developers create a grand promenade for pedestrians and to maintain Cambridge Street as a major traffic connector to downtown. The plan also called for the creation of a "cohesive identity" between the West End and Beacon Hill neighborhoods, which are segmented by the corridor.

4.2.2.3 Proposed Development and Transportation Projects

One development project is proposed along the Cambridge Street corridor. Other transportation projects in the vicinity, but not within the Project area, are described in Section 3.5.

The Government Center Garage project would redevelop approximately 30 acres of urban land approximately 300 to 400 feet north of the Cambridge Street corridor. The project includes replacing the Government Center Parking Garage building and the city-owned buildings west of Bowker Street with approximately 3.8 million square feet of mixed use development divided among five major buildings, ranging in height from approximately 60 to 710 feet. It will include space for office, residential, hotel, and retail use, as well as space for the Haymarket Station and the District A-1 Police Station.

4.3 Environmental Justice

This section discusses the environmental justice populations within and surrounding the Project area. A more detailed description of the environmental justice populations is provided in the Environmental Justice Technical Report.[43]

4.3.1 Introduction

Environmental justice is an important element of policy-making in transportation planning. It is based on the principle that all people have the right to be protected from environmental pollution and to live in and enjoy a clean and healthful environment. Environmental justice policies focus on improving the natural environment in disadvantaged communities, addressing disproportionate adverse environmental impacts that exist in those communities, and providing opportunities for residents to participate in the decision-making processes that may affect them.

4.3.2 Regulatory Context

The EEA's Environmental Justice Policy[44] is an effort to protect the environment and public health in the Commonwealth. The Environmental Justice Policy makes environmental justice an integral consideration in the implementation of all state environmental programs including, but not limited to, granting financial resources, implementing and enforcing laws, regulations, and policies, and providing access to both active and passive open space. The policy focuses attention on the high-minority/ low-income neighborhoods in Massachusetts where residents are likely to be unaware of or unable to participate in

43 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Environmental Justice*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston, MA. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

44 EEA. 2002. *Environmental Justice Policy of the Massachusetts Office of Energy and Environmental Affairs*. Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs: Boston.

environmental decision-making or to gain access to state environmental resources.

The EEA's Environmental Justice Policy characterizes environmental justice populations as neighborhoods, comprised of block groups defined by the U.S. Census Bureau, which meet one or more of the following criteria:

- Median annual household incomes are at or below 65 percent of the statewide median ($30,515 in 2000);
- Minority residents are 25 percent or more of the population;
- Foreign-born residents are 25 percent or more of the population; or
- Residents lacking English language proficiency comprise 25 percent or more of the population.

A different set of criteria to define environmental justice areas is used by the Boston MPO. The MPO assigns environmental justice status to transportation analysis zones (TAZs) rather than U.S. Census blocks, and differentiates between two types of analyses.

Environmental justice areas for outreach and accessibility analyses have a total minority (non-white or Hispanic) population of over 200 residents and meet one or both of the following criteria:

- Median annual household incomes are at or below 60 percent of the 2000 MPO region median household income of $55,800 ($33,480); or
- Minority (non-white or Hispanic) residents are 50 percent or more of the population.

Environmental justice areas for mobility, congestion, and environmental analyses have a total minority (non-white or Hispanic) population of over 200 residents and meet one or both of the following criteria:

- Median annual household incomes are at or below 80 percent of the 2000 MPO region median household income of $55,800 ($44,640); or
- Minority (non-white or Hispanic) residents are 21.4 percent or more of the population.

This section describes both the EEA- and the MPO-defined environmental justice communities potentially affected by the Project.

Relevant federal statutes, regulations, and guidance documents are:

- Executive Order 12898[45] states "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority and low-income populations."
- U.S. Department of Transportation (DOT) Order 5610.2[46] requires all DOT agencies to determine whether activities will have an adverse impact on minority and low-income populations. DOT agencies must determine if adverse effects are predominantly borne by a low-income or minority population and if adverse effects are appreciably more severe than the adverse effect that would be suffered by the non-minority or non-low-income population.
- The U.S. Environmental Protection Agency (EPA) defines environmental justice as "The fair treatment and meaningful involvement of all people, regardless of race, color, national origin or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. Fair treatment means that no group of people, including racial, ethnic, or socio-economic groups should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal and commercial operations or the execution of federal, state, local and tribal programs and policies."[47] EPA has responsibility for the consideration of environmental justice in Clean Air Act reviews.

4.3.3 Existing Conditions

The Project study area for environmental justice populations is the Cambridge Street corridor in which the Red Line-Blue Line Connector would be constructed plus a 0.5-mile radius around the corridor. One-half mile is generally considered the maximum distance that an average person would walk to access transit services. Benefits to environmental justice populations distant from the Project area may result from improved access to transit. Revere, at the northern extent of the Blue Line, was included in the analysis of beneficial impacts as representative of outlying communities served by the Blue Line.

The general demographic characteristics of Boston are included here for reference. Based on U.S. Census Bureau data from 2000, the City of Boston

45 Clinton, President William J. 1994. *Executive Order: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.* The White House: Washington, DC.
46 US Department of Transportation. 1997. *Department of Transportation (DOT) Order to Address Environmental Justice in Minority Populations and Low-Income Populations.* Federal Register, Vol. 62, No. 72, pages 18377-18381. Washington, DC.
47 Environmental Protection Agency. 1998. *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analysis.* EPA, Office of Federal Activities. Washington, DC.

exhibits the following demographic characteristics in relationship to environmental justice criteria:

- The median annual household income was $39,629, which is 129 percent of the statewide median ($30,515 in 2000). Boston does not meet the environmental justice criteria of less than or equal to 65 percent of the statewide median income.
- Minority residents are 55.5 percent of the population. Boston meets the environmental justice criteria of greater than or equal to 25 percent minority population.
- Foreign-born residents are 25.8 percent of the population. Boston meets the environmental justice criteria of greater than or equal to 25 percent foreign-born population.
- Residents lacking English language proficiency are 16.3 percent of the population. Boston does not meet the environmental justice criteria of greater than or equal to 25 percent of the population lacking English language proficiency.

The Red Line provides transit service from northwestern suburbs through downtown Boston to southern and southeastern suburbs. The Blue Line provides transit service between downtown Boston and northeastern suburbs. The Red Line and the Blue Line are the only two subway services in the MBTA system that are not directly connected. Neighborhoods in Boston and the suburbs meeting one or more of the environmental justice criteria are present along the lengths of the Red Line and the Blue Line, shown in Figure 4.3-1.

The MPO has mapped the TAZs meeting environmental justice criteria for the entire MPO region and the urban core of the Boston metropolitan area. Boston and 15 other municipalities in the MPO region include TAZs meeting the MPO's low income, minority, or low income and minority criteria.[48] Figure 4.3-2 shows the TAZs meeting the MPO's low income, minority, or low income and minority criteria in the urban core. None of the TAZs in the central Boston area are identified as meeting any MPO environmental justice criterion. Large areas north and south of central Boston, and selected areas to the west, do meet these criteria. Within the TAZs meeting any MPO environmental justice criteria, 66 percent of the population is minority and the median household income is between 27 and 88 percent of the region's median household income.[49]

48 MPO. 2007. *Journey to 2030- Amendment; Transportation Plan of the Boston Region Metropolitan Planning Organization*. See Chapter 14. Available on-line at http://www.bostonmpo.org/bostonmpo/3_programs/1_transportation_plan/plan.html. Accessed on 2 November 2009.

49 MPO. 2007. *Environmental Justice Area Demographics*. MPO website: http://www.bostonmpo.org/bostonmpo/3_programs/4_regional_equity/EJ_Demographics.pdf. Accessed on 2 November 2009.

The Red Line/ Blue Line Connector Project is located in the West End of Downtown Boston, a densely populated, multi-use area with residential, commercial, and institutional land uses. A 0.5-mile radius around the Project area extends into other areas of the city, such as Downtown, the North End, and Beacon Hill, and across the Charles River into Cambridge. Figure 4.3-3 shows several neighborhoods meeting EEA environmental justice criteria that lie within a 0.5-mile radius of the corridor:

- The neighborhood north of Cambridge Street meets the low income and minority criteria, with an inset neighborhood meeting foreign-born and minority criteria;
- The eastern end of Cambridge Street, including the Bowdoin Station, is in a neighborhood meeting minority criteria;
- Three neighborhoods to the southeast and south meet some or all criteria; and
- Four neighborhoods to the west meet some or all criteria.

Table 4.3-1 lists the fraction of the population in each environmental justice U.S. Census block meeting the EEA environmental justice criteria. All of the environmental justice neighborhoods within a 0.5-mile radius of the Project area meet minority criteria, all but two meet foreign-born criteria, three meet low-income criteria, and four meet English language proficiency criteria. These data reflect the cosmopolitan nature of the Boston metropolitan area, with relatively high percentages of minority and foreign-born residents. However, most residents are not low income and are proficient in speaking English.

Table 4.3-1 State-listed Environmental Justice Populations within 0.5 mile of the Project Area

	Project Area	Fraction of Population Meeting Criteria Within Each Designated Environmental Justice Neighborhood			
Block Group	Geographic Location and Neighborhood(s)	Foreign-Born	Low Income	Minority	Lacking English Language Proficiency
0250203001	North of Cambridge Street; West End, North End, and Downtown	8.1	25.7	**48.8**	5.1
0250203002	Inset north of Cambridge Street; West End and Downtown	**28.8**	7.8	**28.0**	7.6
0250303003	East end of Project area; Downtown	16.6	34.4	**32.9**	6.5
0250701001	Southeast of Project area; Downtown	**52.7**	36.9	**62.7**	**38.7**
0250701002	Southeast of Project area; Downtown and Chinatown/Leather District	**50.8**	43.8	**63.4**	**29.2**
0250701003	South of Project area; Beacon Hill, Downtown, and Chinatown/Leather District	**27.7**	24.0	**37.8**	**28.1**
0250703001	South of Project area; Beacon Hill	**28.7**	26.6	**33.0**	20.7
0173531001	West of Project area; MIT (Cambridge)	**36.9**	12.4	**41.7**	7.4
0173524002	West of Project area; East Cambridge	**42.7**	34.1	**88.6**	**25.3**
0173523001	Northwest of Project area; East Cambridge	**27.4**	15.1	**28.4**	7.6
0173521001	Northwest of Project area; East Cambridge	**29.2**	20.0	**31.4**	5.0

Source: US Census data (2000), MassGIS.
Bold denotes values meeting environmental justice neighborhood criteria. Does not apply to Low Income neighborhoods, the designation for which is based on median household income (as a percentage of state-wide average) rather than the fraction of the population meeting the criteria.

4.4 Existing Transportation Services

This section describes existing transportation services within the immediate vicinity of the Project area.

4.4.1 Introduction

The Secretary's Certificate on the EENF requires a description of the overall transit system in order to determine how the Project would integrate with the system. Transportation services, in terms of transit systems, within the Project area are limited to the Red Line and Blue Line subway systems at either end of the alignment, and local shuttle services. There is no bus service along Cambridge Street.

4.4.2 Existing Conditions

The following paragraphs describe existing public transit and private shuttle services within the Project area.

4.4.2.1 Public Transit

Public transit in the immediate Project area includes the Blue Line and Red Line rapid transit services. These are both heavy rail transit (HRT) lines that are fully separated from other rail traffic. No public bus routes serve the immediate area.

MBTA Blue Line

The Blue Line is a medium-capacity rail transit line following a 6-mile long corridor between the City of Revere and Downtown Boston. Intermediate destinations include Logan Airport and East Boston. The Blue Line operates between approximately 5:00 AM and 1:00 AM with weekday peak headways averaging 4.5 minutes and off peak headways of 9 minutes. In 2006, the Blue Line carried nearly 61,000 daily riders.

The Blue Line's western terminus is Bowdoin Station in Downtown Boston. This station includes platforms at either end of a track loop that enables trains to reverse direction (reversing loop). While the reversing loop is active during all Blue Line operating hours, Bowdoin Station is only open on weekdays between 5:15 AM and 6:30 PM. At other times, Government Center Station is the western terminus of the line. The walking distance between the Bowdoin and Government Center Station headhouses is about 350 yards. Bowdoin Station is also constrained by its ADA inaccessibility.

Blue Line headways are currently constrained by the reversing capabilities at the line's northern terminus near Wonderland Station. The northern terminus contains no reversing loop, and thus train drivers must switch tracks and walk to a cab at the opposite end of the train in order to reverse direction. At the opposite end of the Blue Line, the Bowdoin Station reversing loop enables the Blue Line to maintain 4-minute peak period headways and is capable of reversing trains in less than four minutes. Passengers are not permitted to travel through the loop as no emergency egress is available in that segment.

The Blue Line uses six-car train consists almost exclusively, but the eastbound (inbound) platform at Bowdoin Station is only able to accommodate a four-car train. Its passenger cars are shorter and narrower than many heavy rail transit cars. Downtown and in the line's Boston Harbor tunnel, the trains operate using a third-rail power source. East of the Boston Harbor tunnel, the cars operate with an overhead power source.

MBTA Red Line

The Red Line is a high-capacity service connecting the Cities of Boston, Cambridge, and Quincy, and the Town of Braintree. The Red Line network is 21 miles long and includes 22 stations. In 2006, the Red Line carried nearly 214,000 daily riders.[50] In 2007, there were more than 9,000 average weekday boardings at Charles/ MGH Station.[51] The Red Line operates between approximately 5:00 AM and 1:00 AM. During the weekday peak period, trains travel along the trunk line, including Charles/ MGH Station, with headways every 4.5 minutes. The Red Line uses predominately six-car trainsets with large, high-capacity passenger cars.

Two branches connect the northern cities of Cambridge and Somerville to Braintree and other communities south of Boston. These are the Alewife-Braintree and Alewife-Ashmont lines, respectively. The two Red Line branches are joined south of Downtown Boston in the City's Dorchester neighborhood. The shared trunk line segment, from Dorchester north to Alewife, is approximately 8.75 miles long. All trains on the Red Line serve stations in Downtown Boston, including Charles/ MGH Station.

The Alewife-Braintree Line extends from Alewife Station in Cambridge though Somerville, Boston, and Quincy to Braintree. This corridor is just under 18 miles long. The end-to-end travel time is about 50 minutes. Most stations on the line are in urban neighborhoods with high-density development.

The Alewife-Ashmont Line shares the northern trunk line corridor with the Alewife-Braintree Line. The lines split in eastern Dorchester, with the Alewife-Ashmont Line extending to southern Dorchester's Peabody Square neighborhood (Ashmont Station). The Alewife-Ashmont Line provides a direct connection to the Ashmont-Mattapan High-Speed Line (also marketed as the Red Line). The High-Speed Line is a streetcar corridor with an exclusive right-of-way extending three miles to Boston's Mattapan neighborhood. The High-Speed Line operates vintage PCC streetcars (not ADA-accessible) at peak headways every four minutes. The Alewife-Ashmont Line travel distance is approximately 12 miles. The end-to-end travel time is about 40 minutes. When the Mattapan High-Speed Line is included, the combined line distance is just under 15 miles, with an end-to-end travel time of about one hour.

Transit Connections to the Blue and Red Lines

Both the Blue Line and the Red Line connect to the Green and Orange Lines at Downtown Boston stations. The Green Line is a light rail transit network and the most heavily utilized light rail service in the United States. It has four lines with stations in Boston, Brookline, Cambridge, and Newton. A grade-separated

50 MBTA 2006 statistics.
51 MBTA 2007 statistics.

extension through Cambridge, Somerville and Medford is included in the State's Transportation Improvements Program and is currently under MEPA review. All Green Line service branches share the Green Line Central Subway, which intersects with the Blue and Red Lines at Government Center Station and Park Station, respectively. In 2006, over 202,000 weekday riders boarded Green Line trains.

The Orange Line is an HRT service operating between Malden and southern Boston. Service cities include Malden, Medford, and Boston. An additional station at Assembly Square in Somerville is included in the State's Transportation Improvements Program. In 2006, over 161,000 weekday passengers boarded the Orange Line.

The Red Line connects with Boston's primary commuter and intercity rail and bus terminal at South Station. The Blue Line connects with Logan Airport via a shuttle to all terminals.

Multiple MBTA bus lines connect to the Red and Blue Line networks, extending the reach of these lines, but do not pass through the Cambridge Street corridor. Major Blue Line bus connecting points include the Wonderland, Maverick, and Airport Stations. Major Red Line bus connecting points include the Cambridge stations (particularly Harvard Square), Davis Square in Somerville, South Station in Boston (Silver Line guideway bus and intercity carriers), and several other Boston stations.

Foot ferry services, including the MBTA Inner Harbor and Harbor Express routes, connect with the Blue Line at Aquarium Station on the Downtown Boston waterfront. In 2006, MBTA water transit services carried over 4,600 daily riders.

4.4.2.2 Private Shuttles

Partners HealthCare provides weekday shuttles between MGH and the Longwood Medical Area, Cambridge, Charlestown, North Station, and other locations. These shuttles include:

- MGH to Charlestown (MGH Main Campus, North Station, One Constitution Road, Charlestown Navy Yard), with service every 15 minutes during the day;
- MGH to Prudential Center and Longwood Medical Area (MGH, Prudential Center, Brigham and Women's Hospital), with service every 15 minutes during the day;
- Shuttles to satellite parking at Spaulding Rehabilitation Hospital and the Museum of Science. Two routes each operate every 20 to 30 minutes during the day;
- MGH to Massachusetts Institute of Technology (MIT) in Cambridge, operating every 30 minutes during the day;

- Infrequent shuttles between MGH, North End medical facilities, and Bunker Hill Health Center in Charlestown;
- Infrequent shuttles between MGH and the Winthrop Senior Center, serving the East Boston Health Center; and
- Other infrequent shuttles to the MGH Revere Health Center, the Chelsea Health Center, and the Everett Health Center.

4.5 Traffic

This section summarizes the existing traffic conditions in the Project area. A more detailed description of the existing traffic conditions is provided in the Traffic Technical Report.[52]

4.5.1 Introduction

The existing transportation system in the Project area was evaluated as a baseline to determine the transportation impacts of the Red Line/ Blue Line Connector Project. The existing conditions evaluation focuses on morning and evening peak hour traffic; pedestrian and bicycle volumes; recent crash history along the Cambridge Street corridor; traffic operations; and pedestrian operations. Bicycle operations are qualitatively discussed. A parking evaluation was performed to support a future conditions assessment of potential parking impacts associated with construction of the Red Line/ Blue Line Connector Project.

The following Secretary's Certificate on the EENF requirements are addressed in this section:

- Existing vehicle trips,
- Intersection level of service (LOS),
- Pedestrian and bicycle circulation, and
- Jurisdictional areas of studied intersections and roadway segments.

As required by the Secretary's Certificate on the EENF, a meeting was convened between representatives of the Department of Conservation and Recreation (DCR), MassDOT, and the City of Boston Transportation Department (BTD) to discuss Study Area roadways and intersections. At that meeting, ten intersections were selected for the existing conditions evaluation:

- Charles Circle - Longfellow Bridge outbound/ Storrow Drive westbound off-ramp (unsignalized with flashing red and yellow signals);

52 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Land Uses*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston, MA. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

- Charles Circle - Charles Street/ Storrow Drive eastbound off-ramp/ Longfellow Bridge inbound (signalized);
- Charles Circle - Charles Street northbound/ Storrow Drive westbound on-ramp (signalized);
- North Grove Street/ Grove Street (signalized);
- North Anderson Street/ Anderson Street (unsignalized);
- Blossom Street/ Garden Street (signalized);
- Joy Street (signalized with fire pre-emption);
- Staniford Street/ Temple Street (signalized);
- New Chardon Street/ Bowdoin Street (signalized); and
- New Sudbury Street/ Somerset Street (signalized).

4.5.2 Existing Conditions

The existing traffic volume, safety, traffic operations, emergency vehicle and truck access, pedestrian and bicycle, and parking conditions are described below.

4.5.2.1 Traffic Volume

Daily morning and evening peak hour traffic volume data were collected at 15 locations (Figure 4.5-1) on April 29, 2009. Observed traffic volumes are summarized in Table 4.5-1.

The role of Cambridge Street as a major commuter route is demonstrated by the traffic flow patterns. The majority of the morning peak hour traffic travels eastbound towards Government Center, and the majority of the evening peak hour traffic travels westbound away from Government Center. Conversely, the majority of the traffic on the Longfellow Bridge travels westbound into Cambridge during the morning peak hour and eastbound toward Boston during the evening peak hour. The difference in peak travel direction between the Longfellow Bridge and Cambridge Street may reflect the role of Storrow Drive as a major commuter route for people traveling to and from the City of Cambridge. The Storrow Drive on-ramp and Charles Street northbound have their highest traffic volume during the evening peak hour as commuters leave Boston and Cambridge. The Storrow Drive eastbound and westbound off-ramps have their highest volumes during the morning peak hour as commuters enter the area.

Table 4.5-1 2009 Daily Traffic Volumes on Project Area Roadways

Location	Direction	Weekday ADT[1]	Weekday Morning Peak Hour Volume (vph)[2]	Weekday Morning Peak Hour "k" Factor[3] (%)	Weekday Morning Peak Hour Directional Flow (%)	Weekday Evening Peak Hour Volume (vph)	Weekday Evening Peak Hour "k" Factor (%)	Weekday Evening Peak Hour Directional Flow (%)
Cambridge Street over Storrow Drive(Longfellow Bridge)	Eastbound	13,038	707	5.4	39	1,290	9.9	65
	Westbound	11,472	1,125	9.8	61	697	6.1	35
	Total	24,510	1,832	7.5		1,987	8.1	
Cambridge Street between Joy Street and Blossom Street	Eastbound	12,083	862	7.1	52	892	7.4	47
	Westbound	13,402	787	5.9	48	991	7.4	53
	Total	25,485	1,649	6.5		1,883	7.4	
Cambridge Street East of Somerset Street	Eastbound	9,590	641	2.7	59	499	5.2	43
	Westbound	6,489	441	4.0	41	662	10.2	57
	Total	16,079	1,082	6.7		1,161	4.0	
Charles Street South of Cambridge Street	Southbound	7,224	489	6.8	100	535	7.4	100
Charles Street North of Cambridge Street	Northbound	8,887	401	4.5	100	560	6.3	100
Storrow Drive EB Off-Ramp to Charles Circle	Eastbound	13,055	1,325	10.1	100	741	5.7	100
Storrow Drive WB On-Ramp from Charles Circles	Westbound	8,408	360	4.3	100	959	11.4	100
Storrow Drive WB Off-Ramp to Charles Circle	Westbound	13,381	1,016	7.6	100	555	4.1	100
Grove Street South of Cambridge Street	Southbound	891	59	6.6	100	56	6.3	100
Joy Street South of Cambridge Street	Northbound	793	30	3.8	100	57	7.2	100
Staniford Street North of Cambridge Street	Northbound	5,885	396	6.7	43	477	8.1	52
	Southbound	7,000	521	7.4	57	432	6.2	48
	Total	12,885	917	7.1		909	7.1	
Temple Street South of Cambridge Street	Northbound	315	24	7.6	100	3	1.0	100
New Chardon Street North of Cambridge Street	Northbound	3,958	195	4.9	25	357	9.0	48
	Southbound	7,525	580	7.7	75	384	5.1	52
	Total	11,483	775	6.7		741	6.5	
Bowdoin Street South of Cambridge Street	Northbound	8,873	318	3.6	40	232	2.6	27
	Southbound	3,288	486	14.8	60	629	19.1	73
	Total	12,161	804	6.6		861	7.1	
New Sudbury Street North of Cambridge Street	Northbound	9,108	557	6.1	100	739	8.1	100
Somerset Street South of Cambridge Street	Northbound	1,501	370	24.7	86	234	15.6	56
	Southbound	3,401	60	1.8	14	181	5.3	44
	Total	4,902	430	8.8		415	8.5	

Source: 24-hour Automatic Traffic Recorder (ATR) counts conducted by Precision Data Industries, LLC in April 2009.

1 Average daily traffic expressed in vehicles per day.

2 Peak hour volumes expressed in vehicles per hour.

3 Percent of daily traffic that occurs during the peak hour.

4.5.2.2 Safety

A safety assessment was conducted for Project area intersections using MassDOT crash records for 2005 through 2007 (the most recent three years for which data are readily available). These data include all reported crashes with property damage greater than $1,000 or that involved personal injuries or fatalities.

Six Project area intersections experience, on average, five or fewer crashes per year. These include Cambridge Street at Joy Street and Cambridge Street at Anderson Street where no crashes were reported over the three-year period studied. Charles Circle and the intersection of Cambridge Street at New Chardon Street/ Bowdoin Street are the only locations that experience an average of greater than five crashes per year. The New Chardon Street/ Bowdoin Street intersection had 19 reported crashes over the 3-year period. Charles Circle experienced 55 crashes, or an average of more than 18 per year. This is likely a result of the heavy traffic volume that Charles Circle processes and the geometry of the Circle, which can be confusing to drivers not familiar with the area.

As part of the safety assessment, crash rates were calculated for all Project area intersections to determine whether intersections in the Project area experience greater than average crash occurrences. The calculated crash rates were compared to the current statewide average crash rates (0.87 for signalized intersections and 0.66 for unsignalized intersections) and MassDOT District 4 average crash rates (0.88 for signalized intersections and 0.63 for unsignalized intersections). Only Charles Circle exceeds the MassDOT statewide and District average crash rates. Since it is not possible to disaggregate the data, it cannot be determined whether any specific location within Charles Circle has a disproportionately high number of crashes.

The safety assessment also included a review of the statewide High Crash Location list.[53] One of the Project area intersections (Embankment Road and Charles Circle) is ranked at 43 out of 100. However, no fatalities were reported at the intersections within Charles Circle during the 3-year period analyzed.

4.5.2.3 Traffic Operations

Intersection capacity analyses were based on the existing traffic volumes and traffic control. Capacity analyses provide an indication of how well the intersections accommodate the traffic demands placed upon them. Intersection operating conditions are classified by calculated level of service (LOS). LOS provides an index to the operational qualities of an intersection. LOS designations range from A to F, with LOS A representing the optimal operating conditions with little or no

53 MassHighway. 2005. *Top 1,000 High Crash Location Report* (1999-2001), MassDOT, Highway Division.

delay and LOS F representing the worst operating conditions with high congestion and long delays. LOS D or better is generally considered an acceptable operating condition. In urban areas however, LOS E may sometimes be considered an acceptable condition. The results of the traffic operations analysis for existing signalized intersections are presented in Table 4.5-2.

Table 4.5-2 Existing Signalized Intersection Traffic Operations

	Morning Peak Hour			Evening Peak Hour		
Intersection	**V/C[1]**	**Delay[2]**	**LOS[3]**	**V/C**	**Delay**	**LOS**
Charles Circle - Charles Street/Storrow Drive Westbound On-Ramp	0.60	22	C	0.75	18	B
Charles Circle - Charles Street/Storrow Drive Eastbound Off-Ramp/Longfellow Bridge Inbound	1.11	80	F	1.00	72	E
Cambridge Street and North Grove Street/Grove Street	1.05	26	C	0.89	12	B
Cambridge Street and Blossom Street/Garden Street	0.66	15	B	0.65	14	B
Cambridge Street and Joy Street	0.48	8	A	0.48	8	A
Cambridge Street and Staniford Street/Temple Street	0.82	37	D	0.70	35	C
Cambridge Street and New Chardon Street/Bowdoin Street	0.73	57	E	0.78	48	D
Cambridge Street and New Sudbury Street/Somerset Street	0.80	110	F	0.82	54	D

1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
3 Level of Service

As shown in Table 4.5-2, three signalized intersections currently operate at an unacceptable LOS E or LOS F during one or both peak hours:

- Charles Circle -- Charles Street/ Storrow Drive eastbound off-ramp;
- Cambridge Street and New Chardon Street/ Bowdoin Street; and
- Cambridge Street and New Sudbury Street/ Somerset Street.

The results of the traffic operations analysis for existing unsignalized intersections are presented in Table 4.5-3. Notably, Cambridge Street at the Storrow Drive westbound off-ramp operates as a stop-controlled intersection (flashing traffic signal) and each approach carries one-way traffic only. The Storrow Drive westbound off-ramp traffic is stop-controlled with a flashing red indication and Cambridge Street westbound is given a flashing yellow indication. Both Charles Circle at Cambridge Street/ Storrow Drive westbound off-ramp and Cambridge Street at North Anderson Street/ Anderson Street currently operate at an unacceptable LOS F during one of the peak hours.

Table 4.5-3 Existing Unsignalized Traffic Operations

Intersection	Critical Movement	Morning Peak Hour			Evening Peak Hour		
		v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS
Charles Circle – Cambridge Street/ Storrow Drive Westbound Off-Ramp	SB T	0.86	62	F	0.52	23	C
Cambridge Street and North Anderson Street/ Anderson Street	SB R	0.28	25	C	>1.20	>120	F

1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
3 Level of Service

4.5.2.4 Emergency Vehicles and Truck Access

Major roadway access for emergency vehicles and heavy trucks traveling to, from, and through the Project area were identified in order to determine the nature and magnitude of potential construction impacts. The emergency vehicle parking areas and the loading docks, for the buildings within the Project area, are shown in Figure 4.5-2.

Major roadways for emergency vehicle access to and from the Cambridge Street corridor include Interstate 93/ Route 1/ Route 3, Route 28, Longfellow Bridge, and Storrow Drive. With the exception of Storrow Drive, these roadways also provide access for trucks. Storrow Drive is designated as a parkway by DCR, and buses and trucks are prohibited. On the local roadway system, emergency vehicles and trucks can access any roads within the Project area except Bowdoin Street and Hancock Street, where trucks over 2.5 tons and buses are prohibited. Trucks are also prohibited from Cedar Street and South Russell Street.[54] All state numbered routes, including those within the City of Boston but excluding any portions that are owned by DCR, are designated truck routes.

4.5.2.5 Pedestrians and Bicycles

Pedestrian volumes and bicycle turning movements were observed at each of the Project area intersections during one weekday's morning and evening peak hours. Approximately 200 to 700 pedestrians were noted along Cambridge Street during each peak hour. The number of pedestrians traveling to and from Charles/ MGH Station was observed to be 1,574 during the morning peak hour and 1,883 during the evening peak hour.

54 City of Cambridge Truck Routes. http://www.cambridgema.gov/CityOfCambridge_Content/documents/trucks-day.pdf

Crosswalk analyses were conducted at all Project area intersections. Pedestrian Level of Service (PLOS) provides an index to quantify pedestrian delay similar to that of vehicles, with PLOS A representing excellent pedestrian operations and PLOS F representing an unacceptable delay for pedestrians waiting to cross the roadway. Table 4.5-4 presents the results of the PLOS analysis. Ten crosswalks at five signalized intersections operate at PLOS E or PLOS F during at least one peak hour. This poor PLOS is the result of the long traffic signal cycle lengths needed to process vehicular traffic and a relatively short pedestrian crossing phase.

Table 4.5-4 Existing Pedestrian Level of Service (PLOS)

		Morning Peak Hour		Evening Peak Hour	
Intersection	Crosswalk	Average Pedestrian Delay (sec)	PLOS	Average Pedestrian Delay (sec)	PLOS
Cambridge Street at Storrow Drive Westbound On-Ramp	East	19	B	8	A
Cambridge Street at Charles Street/ Storrow Drive Eastbound Off-Ramp and Longfellow Bridge Inbound	South	33	D	25	C
	West (North)	14	B	21	C
	West (South)	31	D	24	C
	East (North)	13	B	19	B
	East (South)	32	D	25	C
Cambridge Street at North Grove Street/ Grove Street	North	11	B	4	A
	South	27	C	32	D
	East	36	D	41	E
	West	38	D	43	E
Cambridge Street at Blossom Street/ Garden Street	North	21	C	21	C
	South	34	D	36	D
	East	38	D	43	E
	West	37	D	42	E
Cambridge Street at Joy Street	South	33	D	33	D
Cambridge Street at Staniford Street/ Temple Street	North	27	C	25	C
	South	17	B	15	B
	East	41	E	46	E
	West (north)	28	C	33	D
	West (south)	30	C	34	D
Cambridge Street at New Chardon Street/ Bowdoin Street	North	17	B	22	C
	South	42	E	41	E
	East	35	D	47	E
	West	41	E	44	E
Cambridge Street at New Sudbury Street/ Somerset Street	North	38	D	37	D
	South	19	B	21	C
	East	46	E	52	E
	West	44	E	50	E

The largest volume of bicycles was observed along Cambridge Street. Observed bicycle volumes along Cambridge Street varied between 30 and 100 bicycles traveling eastbound during the morning peak hour and between 40 and 95 bicycles traveling westbound during the evening peak hour along Cambridge Street.

A safety assessment was also conducted for the Project area intersections for pedestrians and bicycle safety. There were no reported crashes involving pedestrians or bicycles during the 3-year period analyzed.

4.5.2.6 Parking

Figure 4.5-3 shows the available parking supply and commercial loading zones in the Project area. The parking inventory along either side of Cambridge Street, and along intersecting streets within 500 feet of Cambridge Street, is summarized in Table 4.5-5.

Table 4.5-5 Parking Inventory – Cambridge Street and Intersecting Streets

Location	Metered Parking	Commercial Loading	Pick-up/ Drop-off	Unrestricted Parking	Handicap Parking	Visitor Parking	Resident Permit	Reserved Parking	Total
Cambridge Street Westbound Total	38	0	2	0	15	0	0	0	55
Cambridge Street Eastbound Total	26	16	8	15	0	0	0	0	65
Intersecting Streets Total	145	11	14	20	21	14	354	91	670

4.6 Air Quality

This section discusses the existing air quality within the Project area and vicinity. A more detailed description of the existing air quality is provided in the Air Quality Technical Report.[55]

55 STV. 2009. *Red Line/Blue Line Connector Project Air Quality Technical Report*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc..: Boston, MA. Appended to the *Alternatives Analysis Technical Report*, provided in the Project website at www.mass.gov/massdot/redblue.

4.6.1 Introduction

As described in Chapter 2, design of the Red Line/ Blue Line Connector Project is required by state air quality regulations for compliance with the State Implementation Plan (SIP) for ozone. The Secretary's Certificate on the EENF required an analysis of air quality impacts associated with the Project, as described in Section 5.6.

4.6.2 Regulatory Context

The Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA), in cooperation with the Environmental Protection Agency (EPA) have established procedures for Transportation Conformity requirements of the Clean Air Act Amendments (CAAA) of 1990. The Transportation Conformity provisions of the CAAA are intended to integrate transportation and air quality planning in areas that are designated by the EPA as not meeting the National Ambient Air Quality Standards (NAAQS). Transit projects are an important part of improving air quality. The air quality study for the Red Line/ Blue Line Connector Project included a local and regional air quality analysis that demonstrates compliance with SIP and Transportation Conformity. The local or hotspot analysis evaluated carbon monoxide (CO) and particulate matter (PM). The regional or mesoscale analysis evaluated ozone precursors, volatile organic compounds (VOCs), oxides of nitrogen (NO_x), the greenhouse gas carbon dioxide (CO_2), CO, and PM.

Guidance from both the EPA and DEP define the air quality modeling and review criteria for analyses prepared pursuant to the CAAA and SIP. The CAAA and the SIP require that a proposed project not:

- Cause any new violation of the NAAQS;
- Increase the frequency or severity of any existing violations; or
- Delay attainment of any NAAQS.

4.6.1.1 Pollutants of Concern and Attainment Status

Air pollution is of concern because of its demonstrated effects on human health. Of special concern are the respiratory effects of the pollutants and their potential toxic effects. The transportation air pollutants of concern include:

- Carbon monoxide (CO)
- Particulate matter (PM)
- Ozone (O_2)
- Volatile organic compounds (VOCs)

- Nitrogen oxides (NO_X)
- Carbon dioxide (CO_2)

The CAAA resulted in states being divided into attainment and non-attainment areas with classifications based upon the severity of their air quality problem. A non-attainment area is an area that has had measured pollutant levels that exceed the NAAQS and that has not been re-designated to attainment status. The CAAA established emission reduction requirements that vary by an area's classification. SIPs describe how a state intends to meet NAAQS and re-designate areas as in attainment.

Massachusetts has been determined to be a non-attainment area, statewide, for ozone. The state has been divided into two non-attainment areas, Eastern and Western Massachusetts. The Project is in the Eastern Massachusetts 8-hour ozone non-attainment area, which has been classified as "Moderate." A "Moderate" area has a design value of 0.092 parts per million (ppm) up to but not including 0.107 ppm. The other pollutants CO and PM are in attainment status for the study area.

Additionally, EEA has issued a policy and protocol for evaluating greenhouse gas (GHG) emissions from proposed projects with particular emphasis on CO_2 emissions. This policy requires that certain projects quantify greenhouse gas emissions generated by the project and identify measures to reduce or minimize these impacts.

4.6.1.2 Air Quality Modeling Methodology

The air quality study for the Project evaluated the 2009 existing conditions for local and regional emissions, against which future emissions could be compared. The existing 2009 conditions included the existing traffic conditions in the Project area, and accounted for the existing roadway geometrics and observations of traffic flow. The microscale analysis calculated maximum 1-hour and 8-hour CO and the 24-hour PM concentrations for congested intersections in the Project area. The mesoscale analysis calculated VOCs, NO_x, CO_2, CO, and PM emissions.

Intersections in the Project area were ranked based on traffic volumes and LOS. As shown in Figure 4.6-1, eight intersections were selected for analysis because they were the most congested intersections in the Project area:

- Cambridge Street at Longfellow Bridge outbound/ Storrow Drive westbound off-Ramp (Charles Circle);
- Cambridge Street at Charles Street/ Storrow Drive westbound on-Ramp/ Charles Street northbound (Charles Circle);

- Cambridge Street at Charles Street/ Storrow Drive eastbound off-Ramp/ Longfellow Bridge inbound (Charles Circle);
- Cambridge Street at North Grove Street and Grove Street;
- Cambridge Street at Blossom Street/ Garden Street
- Cambridge Street at Staniford Street and Temple Street;
- Cambridge Street at New Chardon Street and Bowdoin Street; and
- Cambridge Street at New Sudbury Street and Somerset Street.

The predominant sources of regional pollution impacts anticipated from the Red Line/ Blue Line Connector Project are emissions reductions resulting from modal travel shifts from private automobiles to rail service. The mesoscale analysis uses traffic and emissions data for existing and future conditions. The mesoscale analysis estimated the future regional VOCs, NO_x, CO_2, CO, and PM emissions due to the changes in average daily traffic volume, roadway characteristics, and vehicle emissions.

The air quality study used traffic data (volumes, delays, and speeds) developed for each analysis condition. The microscale analysis used the evening peak hour traffic conditions during the CO season (winter). The mesoscale analysis for VOC and NO_x emissions used typical daily peak and off-peak traffic volumes for the ozone season (summer). Vehicle speeds are developed based upon traffic volumes, observed traffic flow characteristics, and roadway capacity. The detailed traffic analysis is presented in Section 4.5, Traffic.

4.6.2 Existing Conditions

The results of the microscale and mesoscale analyses are provided in the following paragraphs.

4.6.2.1 Microscale Analysis

All the 1-hour and 8-hour concentrations are below the CO NAAQS of 35 and 9 ppm, respectively. These values are consistent with the area's designation as a CO attainment area. The 2009 existing conditions results of the microscale analysis for the 1-hour CO concentrations ranged from 4.8 ppm to 7.4 ppm, which is well below the 1-hour CO NAAQS of 35 ppm. The minimum 4.8 ppm value occurred at the intersection of Cambridge Street at Blossom Street/ Garden Street and the maximum at the intersection of Cambridge Street and Charles Circle.[56] The corresponding 8-hour CO concentrations for 2009 ranged from a

56 Charles Circle includes the intersections of Cambridge Street at Longfellow Bridge Outbound/Storrow Drive Westbound Off-Ramp, Cambridge Street at Charles Street/Storrow Drive Westbound On-Ramp/ Charles Street Northbound and Cambridge Street at Charles Street/Storrow Drive Eastbound Off-Ramp/ Longfellow Bridge inbound. The concentration presented herein represents the highest concentration found at these three intersections.

minimum of 3.3 ppm to a maximum of 5.2 ppm, which is well below the 8-hour CO NAAQS of 9.0 ppm. The minimum 3.3 ppm value occurred at the intersection of Cambridge Street at New Sudbury Street/ Somerset Street and the maximum at the intersection of Cambridge Street and Charles Circle.

All of the 24-hour PM_{10} concentrations are below the PM_{10} NAAQS of 150 micrograms per cubic meter (ug/ m^3). These values are consistent with the area's designation as a PM attainment area. The microscale analysis determined that the predicted maximum 24-Hour PM_{10} concentrations ranged from 41.3 ug/ m^3 to 44.5 ug/ m^3. The minimum 41.3 ug/ m^3 value occurred at the intersections of Cambridge Street at Blossom Street and Garden Street, Cambridge Street at Staniford Street/ Temple Street, and Cambridge Street at New Sudbury Street and Somerset Street and the maximum at the intersection of Charles Circle.

All of the annual and 24-hour $PM_{2.5}$ concentrations are below the $PM_{2.5}$ NAAQS of 5 ug/ m^3 and 35 ug/ m^3, respectively. These values are consistent with the area's designation as a PM attainment area. The microscale analysis determined that the predicted maximum annual $PM_{2.5}$ ranged from 11.4 to 11.8 ug/ m^3. The minimum 11.4 ug/ m^3 value occurred at the intersections of Cambridge Street at Blossom Street and Garden Street, Cambridge Street at Staniford Street and Temple Street, Cambridge Street at New Chardon Street and Bowdoin Street, and Cambridge Street at New Sudbury Street and Somerset Street and the maximum at the intersection of Charles Circle.

The microscale analysis determined that the predicted maximum 24-hour $PM_{2.5}$ ranged from 29.9 to 31.9 ug/ m^3. The minimum 29.9 ug/ m^3 value occurred at the intersections of Cambridge Street at Blossom Street and Garden Street, Cambridge Street at Staniford Street and Temple Street, Cambridge Street at New Chardon Street and Bowdoin Street, and Cambridge Street at New Sudbury Street and Somerset Street and the maximum at the intersection of Charles Circle.

4.6.2.2 Mesoscale Analysis

Under existing conditions, VOC emissions are estimated to be 17,156 kg/ day, the NO_X emissions are estimated to be 41,183.1 kg/ day. The $PM_{2.5}$ emissions are estimated to be 954 kg/ day and the PM_{10} emissions are estimated to be 1,510 kg/ day. The CO emissions are estimated to be 515,608 kg/ day and the CO_2 emissions are estimated to be 1,930,224 kg/ day or 7,772,085 (short) tons/ year. The corresponding vehicles miles traveled for the study area is 34,474,957 vehicles per day.[57]

57 The Central Transportation Planning Staff (CTPS) Eastern Massachusetts study area contains 164 communities.

4.7 Noise

This section describes the noise-sensitive receptors and existing noise conditions present within the Project area. A more detailed description of the existing noise environment is provided in the Noise and Vibration Technical Report.[58]

4.7.1 Introduction

Noise is typically defined as unwanted or undesirable sound, where sound is characterized by small air pressure fluctuations above and below the atmospheric pressure. The basic parameters of environmental noise that affect human subjective response are intensity or level, frequency content, and variation with time. Because environmental noise fluctuates from moment to moment, it is common practice to condense these three factors into a single number, called the "equivalent" sound level (Leq).

Leq can be thought of as the steady sound level that represents the same sound energy as the varying sound levels over a specified time period (typically one hour or 24 hours). Often the Leq values over a 24-hour period are used to calculate cumulative noise exposure in terms of the Day-Night Sound Level (Ldn). Many surveys have shown that Ldn and Leq are well correlated with human annoyance, and therefore these descriptors are widely used for environmental noise impact assessment from permanent noise sources such as transit operations. Another metric used to describe noise is the statistical percentile L10, which is defined as the noise level which is exceeded 10 percent of the time over a specified measuring period. While the L10 is not the maximum noise level, it describes the higher noise levels that are present in the community.

The Secretary's Certificate on the EENF required an analysis of noise level impacts associated with the Project, as presented in Section 5.7.

4.7.2 Regulatory Context

The FTA classifies land uses sensitive to noise from transit operations into three categories.

- Category 1: Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and

58 STV. 2009. *Red Line/Blue Line Connector Project Noise and Vibration Technical Report*. Prepared by STV, Inc. in association with Harris Miller Miller & Hanson.: Boston, MA. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue.

quiet, as well as outdoor amphitheaters, National Historic Landmarks with significant outdoor use, and recording studios and concert halls.

- Category 2: Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity is assumed to be of utmost importance.
- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters and churches. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds, and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

The FTA noise impact criteria are based on change in noise exposure using a sliding scale. Lower levels of transit noise are allowed in areas where existing noise levels are relatively low, and higher levels are allowed in neighborhoods where existing noise levels are higher since the existing noise will tend to mask the new source. The Ldn is used to characterize noise exposure for residential areas (Category 2). For other noise sensitive land uses (Categories 1 and 3), the peak-transit hour Leq is used.

There are two levels of airborne noise impact included in the FTA criteria:

- Severe Impact: Project-generated noise in the severe impact range can be expected to cause a significant percentage of people to be highly annoyed by the new noise and represents the most compelling need for mitigation.
- Moderate Impact: The change in the cumulative noise level is noticeable to most people but may not be sufficient to cause strong, adverse reactions from the community. Other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation.

4.7.3 Existing Conditions

Land use in the Project area that is sensitive to noise from transit operations and construction activities includes multi-family residential properties, hotels, hospitals, schools, parks, a television studio, a library, a church, a museum, and a fire department with housing. In addition, there are commercial areas (businesses, offices, stores) that are sensitive to daytime construction noise. Many of the closest residential buildings along the Cambridge Street corridor are four to six stories tall with commercial land use on the first floor.

Two long-term (48-hour) and four short-term (1-hour) measurements were conducted within the Project area (Figure 4.7-1). Long-term measurements were conducted on an elevated balcony area at the (First) Harrison Gray Otis House Museum and on a second-story roof on top of 316 Cambridge Street. The average

24-hour Ldn over both days were calculated from these 48-hour measurements, as well as peak-transit hour Leq and hourly L10 values. These measurement sites accurately represent the location of most first-row noise-sensitive receptors in the Project area.

Short-term measurements were conducted at Cardinal Cushing Park, Boston Fire Department District 3 Ladder 24, North Anderson Street Park at MGH, and the Liberty Hotel.

Table 4.7-1 presents the noise measurement results. The dominant noise source is vehicular traffic on Cambridge Street including a relatively high level of horn use and emergency sirens from ambulances accessing MGH and MEEI, and fire engines. Ldn values in the Project area range from 67 to 76 dBA. Peak-transit hour Leq values in the Project area range from 65 to 74 dBA. L10 values in the Project area range from 63 to 71 dBA during the daytime, 65 to 73 dBA during the evening and 58 to 70 dBA during the nighttime.

Table 4.7-1 Existing Ambient Noise Measurement Results

Location	Distance to Cambridge St. Center Lane of Travel (feet)	Existing Day-Night Level (Ldn)[a]	Existing Peak-Transit Hour Level (Leq)	Existing Daytime 7AM - 6PM (L10)	Existing Evening 6PM - 10PM (L10)	Existing Nighttime 10PM - 7AM (L10)	Duration (hours)
Cardinal Cushing Park	50	71	66	67 [b]	65 b	64 [b]	1
Otis House Museum[b]	30	75 [a]	70	70	69	67	48
Boston Fire Department	40	77	72	73 [b]	71 [b]	70 [b]	1
North Anderson Street Park	60	68	66	64[c]	65 [c]	58 [c]	1
316 Cambridge Street[c]	30	76 [a]	74	72	73	67	48
Liberty Hotel	40	67	65	63 [c]	65 [c]	58 [c]	1

a Ldn is average of two 24-hour measurements.
b Ldn and L10 estimated based on same hourly measurement at the Otis House Museum long-term site.
c Ldn and L10 estimated based on same hourly measurement at the 316 Cambridge Street long-term site.

4.8 Vibration

This section describes the vibration-sensitive receptors and existing vibration conditions present within the Project area. A more detailed description of the existing vibration conditions is provided in the Noise and Vibration Technical Report.[59]

59 STV. 2009. *Red Line/Blue Line Connector Project Noise and Vibration Technical Report*. Prepared by STV, Inc. in association with Harris Miller Miller & Hanson.: Boston, MA. Appended to the *Alternatives Analysis Technical Report*, provided in the Project website at www.mass.gov/massdot/redblue

4.8.1 Introduction

Ground-borne vibration is the oscillatory motion of the ground about some equilibrium position that can be described in terms of displacement, velocity, or acceleration. Because sensitivity to vibration typically corresponds to the vibration velocity amplitude in the low-frequency range (roughly 4 to 80 Hz), velocity is the preferred measure for evaluating ground-borne vibration from transit projects.

The Secretary's Certificate on the EENF required an analysis of vibration impacts associated with the Project.

4.8.2 Regulatory Context

The FTA generally classifies vibration-sensitive land uses into the same three categories as noise (Section 4.7). Although commercial and industrial land uses are sensitive to daytime construction noise, they are not considered to be sensitive to potential annoyance from vibrations generated during construction or transit operations. All structures, including those specified by FTA as vibration-sensitive commercial and industrial buildings are assessed for potential damage due to transit operations and construction activities, using the following vibration categories:

- Vibration Category 1 – High Sensitivity: Included in this category are buildings where vibration would interfere with operations, such as buildings with vibration-sensitive research and manufacturing facilities, hospitals with sensitive equipment, and university research operations.
- Vibration Category 2 - Residential: Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels.
- Vibration Category 3 - Institutional: This category includes buildings with primarily daytime and evening use, such as schools, libraries, and churches.
- Special Buildings: Special-use buildings such as television studios, concert halls, recording studios, auditoriums, and theatres warrant special consideration.

The FTA vibration impact criteria for transit operations are based on land use and train frequency. There are separate FTA criteria for ground-borne noise, the "rumble" that can be radiated from the motion of room surfaces in buildings due to ground-borne vibration. Such criteria are particularly important for underground transit operations when airborne noise paths are not dominant.

For special buildings that can be very sensitive to vibration, special ground-borne vibration criteria apply. In addition, FTA has established criteria for use in

assessing potential ground-borne vibration impact to sensitive equipment. For residential buildings with nighttime occupancy, the applicable ground-borne vibration criterion for Blue Line trains or construction activities is a maximum velocity level of 72 VdB. For institutional buildings such as schools, libraries, museums and churches, the applicable ground-borne vibration criterion for Blue Line trains or construction activities is 75 VdB.

4.8.3 Existing Conditions

Reference vibration measurements of the Blue Line trains were conducted in 2009 near the John F. Kennedy Federal Building at 15 New Sudbury Street. Blue Line trains were traveling at approximately 15 mph at this location and measurements were conducted of trains on both the near track and far track locations. Accelerometers were located approximately 35 feet, 38 feet, and 55 feet (slant distance) from the nearest proposed track centerline.

Ambient vibration measurements were conducted in 2009 at nine locations throughout MGH and MEEI at vibration-sensitive equipment locations closest to the proposed track alignment (Figure 4.7-1). A summary of all vibration measurement results is shown in Table 4.8-1.

Table 4.8-1 Vibration Measurement Results

Location	Type of Measurement	Results
John F. Kennedy Federal Building	Reference Vibration Levels of Blue Line Trains	Maximum Vibration Velocity at 50 feet (slant distance) 60 to 70 VdB primarily between 40 and 80 Hz
MGH (Simches 8th floor Room 8151 Laser-Based Systems)	Ambient	Meets VC-C Criterion
MGH (Simches 7th floor Room 7502 NMR)	Ambient	Meets VC-B Criterion
MGH (Barlett Extension 6th floor Room 620 Imaging Equipment)	Ambient	Meets VC-B Criterion
MGH (Ellison 2nd floor Room 230 MRI Suite)	Ambient	Meets VC-C Criterion
MGH (Yawkey 10th floor Room 10.748 Embryology Lab)	Ambient	Meets VC-B Criterion
MEEI (325 Cambridge Street Outside Building)	Ambient	Meets VC-E Criterion
MGH (Yawkey 6th floor Room 6.428 MRI Suite)	Ambient	Meets VC-C Criterion
MEEI (1st floor MRI Suite)	Ambient	Meets VC-E Criterion
MEEI (12th floor Ophthalmic Surgery Equipment)	Ambient	Meets VC-C Criterion

Source: HMMH 2009
Note: Average ambient vibration levels are compared to VC criteria.

4.9 Soils and Groundwater

This section describes the subsurface soil conditions and ground water resources within and surrounding the Project area. This section also provides information on applicable groundwater resource protection regulations. Full accounts of soils and groundwater evaluations are provided in the Soils and Groundwater Technical Reports.[60]

4.9.1 Introduction

The Secretary's Certificate on the EENF requires characterization of the existing soils and groundwater within the Project area to establish the basis for evaluating impacts, provided in Section 5.9 (for permanent impacts) and Section 6.9 (for construction-period impacts). Information on the existing quality and use of these resources are based on existing publicly accessible data.

4.9.2 Regulatory Context

Groundwater resources are regulated under the Massachusetts Groundwater Discharge Permit Regulations (314 CMR 5.00), authorized by the Massachusetts Clean Waters Act (MGL Chapter 21, § 26 through 53), and the City of Boston Zoning Code (Article 32), described below. The Project does not include drinking water or source water resources; therefore, groundwater resources within the Project area are not protected under the federal Safe Drinking Water Act.

4.9.2.1 Massachusetts Groundwater Discharge Permit Regulations

DEP controls the discharge of pollutants to groundwater through the Massachusetts Groundwater Discharge Permit Regulations (314 CMR 5.00). These regulations are designed to assure that groundwater is protected for its potential use as a source of potable water, that surface waters are protected for their existing and designated uses, and to assure the attainment and maintenance of the Massachusetts Surface Water Quality Standards (314 CMR 4.00). The term "discharge" or "discharge of pollutants" is defined in the regulations as "any addition of any pollutant or combination of pollutants to waters of the Commonwealth from any source." The regulations also include groundwater quality standards (314 CMR 5.11) that set forth effluent limitations for discharge to groundwater.

60 STV. 2009. *Geotechnical Data Report, Geotechnical Interpretive Report*, and *Preliminary Groundwater Management Plan*. Prepared by STV, Inc. in association with Haley & Aldrich, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

4.9.2.2 City of Boston Groundwater Conservation Overlay District

The City of Boston's Groundwater Conservation Overlay District (Article 32 of the Boston Zoning Code) ordinance calls for the infiltration of no less than 1.0 inches of rainfall across impervious surfaces and the use of "groundwater-retaining paving" for projects that require a building permit from the City. The recharge requirement is slightly more stringent than the Massachusetts Stormwater Standards for recharge, which vary by soil type.

4.9.3 Existing Conditions

The Project is located in the West End of Downtown Boston. Although there are groundwater resources present, there are no drinking water resources within the Project area and therefore, no natural water supply protection areas exist within the Project area.

4.9.3.1 Soils

The ground surface elevation at the west end of the alignment in the Charles Circle area is at approximately 107 feet above sea level while the ground surface in the area of Bowdoin Station is 143 feet above sea level. The original colonial shoreline crosses Cambridge Street at approximately North Anderson Street. The area west of North Anderson along Cambridge Street is filled land that was once below the tide level.

The Project area is at the northern edge of Beacon Hill, primarily a glacial moraine. Beacon Hill is "a complexly faulted mass of well-bedded sand, interbedded sand and clay, gravel, and till." [61] Marine and estuarine deposits, mostly consisting of silty clays and organic silts, cover the low-lying areas around Beacon Hill and the original Shawmut Peninsula. General characteristics of each soil stratum that occur within the Project area are described below.

- **Fill** - Miscellaneous fill is characteristically variable in density from loose to medium dense and is heterogeneous and intermixed but predominantly granular. In addition to sand, gravel, silt, and clay soil particles, the fill contains miscellaneous materials such as brick, ash, wood, cinders, coal, paving stones, and concrete rubble.

61 Skehan, James W. 2001. *Roadside Geology of Massachusetts*. Mountain Press Publishing Company; 1st edition.

- **Organic Silt** - The organic silt stratum is of tidal marsh origin and generally consists of loose to very loose organic silt, silty fine sand and fibrous peat. It may also contain shells, little to trace clay, and/ or coarse sand and gravel.
- **Marine Clay** - Commonly referred to as the Boston Blue Clay, the marine clay encountered at the site is predominantly very soft to very stiff silty clay with interbedded sand and gravel. This deposit typically exhibits an upper desiccated yellow silty clay layer containing a higher proportion of sand and gravel lenses grading into a blue-green silty clay below.
- **Marine Sand** - The marine sand is predominantly medium dense to dense, fine or fine to coarse sands and gravel with between 0 and 35 percent silt.
- **Glacial Till** - The glacial till stratum consists of medium dense to very dense silt and clay to silt with varying amounts of fine to coarse sand and gravel. The till is more granular in the eastern part of the Project area than in the western.[62]
- **Possible Glacial Moraine Deposits** - This stratum consists of glacially up-thrust soil layers that are typical geologic features of Beacon Hill. These deposits are medium dense to very dense or medium stiff to very stiff and should be considered potentially high permeability zones, although thick layers of silty clay exist within the stratum in some locations. Glacial moraine deposits are highly variable in gradation, ranging from clay to sand with cobbles and boulders. The contacts/ strata breaks within this unit are expected to be chaotic, exhibiting evidence of deformation, including folding and faulting.
- **Bedrock** – Bedrock at the Project area is predominantly argillite and sandstone. The upper bedrock is often moderately to severely weathered. The proposed tunnel is expected to be above the top of bedrock. However, there are a few areas where the top of bedrock elevation approaches the bottom of the proposed tunnels. Further investigation of the top of bedrock elevation will be required for final design.

4.9.3.2 Groundwater

Groundwater elevations within Shawmut Peninsula are altered from natural conditions. According to the Boston Groundwater Trust (BGT), the cause of groundwater drawdown within the Shawmut Peninsula, including the Project area, is the local sewer system.[63] The West Side Interceptor and the Boston Marginal Conduit are part of the Boston Main Drainage System (BMDS), the purpose of which is to intercept local sewers and carry the sanitary waste and rainwater runoff to an offshore disposal point. Seepage of groundwater into

62 GZA Geotechnical Data Report. 1987.
63 Boston Groundwater Trust website: http://www.bostongroundwater.org/, November, 2009

these structures and their associated underdrains is the likely cause of localized lower groundwater levels in this area. Excess stormwater flow and sewage could still overflow into the Charles River at numerous overflow outlets.

Shallow groundwater has been measured in the vicinity of the Boston Marginal Conduit and the West Side Interceptor sewers. The current shallow groundwater flow regime in the Project area shows groundwater flowing from beneath Beacon Hill generally toward the Charles River, roughly mimicking the ground surface topography. Existing hydrogeologic data indicates that the water table elevations and groundwater levels in deeper strata generally decline from east to west along Cambridge Street. Some groundwater observations include:

- Water table elevations in observation wells near Joy Street, which were measured from March to October 1987, ranged from approximately 114 to 117 feet above sea level;
- During this same time period, groundwater elevations in shallow water table wells near Charles Circle ranged from 105.5 to 111 feet above sea level;
- The water table elevation in the Bowdoin Station area is expected to range from 118 to 122 feet above sea level; and
- Groundwater elevations measured in deeper confined strata, glacial till, and glacial moraine deposits, ranged from 107.6 to 108.8 feet above sea level in the Charles Circle area, to 110.3 to 122.0 feet above sea level in the Bowdoin Station area.

Many buildings in the Charles Circle area are supported on timber piles. This area is not on the original Shawmut Peninsula and consists of filled material in tidelands (see Figure 4.2-3). The water table in this area is currently depressed and many of the timber pile-supported buildings which have not already been underpinned are at risk of subsidence. BGT wells indicate that the groundwater elevation is very close to top of pile cutoff elevations in this area under current conditions. Some of the MGH and Liberty Hotel buildings are also supported by wood piles or concrete foundations bearing in the clay, which could settle if loading on the clay is increased by lowering the water table. Buildings east of North Anderson Street are most likely not supported on wood piles as they are built on the original Shawmut Peninsula and not filled tidelands.

4.10 Surface Water and Stormwater

This section discusses the surface water resources within and adjacent to the Project area and the existing stormwater management system along the Cambridge Street corridor. This section also provides information on applicable surface water resources and stormwater management regulations, and defines the regulatory

categories for water resources. A more detailed description of the existing stormwater conditions is provided in the Stormwater Management Plan.[64]

4.10.1 Introduction

There are no natural surface water resources or water supply protection areas within the Project area, although the Charles River is immediately west of the western extent. Stormwater runoff is managed through a storm sewer system. Groundwater is present, but there are no drinking water resources within the Project area; groundwater resources are discussed in Section 4.9.

Surface waters are important natural resources that have a variety of uses including public drinking water supply, irrigation, industrial supply, and wildlife habitat. Water quality is determined by the amount and type of dissolved or suspended material that the water may contain. The quality of a surface water body is largely determined by the terrain and condition of its contributing watershed. Pollutant sources can include point sources, such as industrial discharges with high concentrations of chemicals, as well as non-point sources, such as stormwater runoff from farmland containing fertilizers and pesticides. This section describes existing conditions of the receiving waters and stormwater management system and establishes the basis for evaluating impacts.

The Secretary's Certificate on the EENF required a characterization of existing drainage patterns and wetland resources within the Project area to establish a baseline against which Project impacts may be compared.

4.10.2 Regulatory Context

Surface water resources are protected under several state and federal laws and regulatory programs, including the federal Clean Water Act and the Massachusetts Clean Waters Act (MGL Chapter 21, §26-53). Other applicable rules, regulations, and guidance include the Massachusetts Wetlands Protection Act (MGL Chapter 131, §40) and Wetlands Protection Act Regulations (310 CMR 10.00), Massachusetts Public Waterfront Act (MGL Chapter 91) and Waterways Regulations (310 CMR 9.00), the Surface Water Quality Standards (314 CMR 4.00), the Waterways Regulations, the proposed Stormwater Management Regulations (314 CMR 21.00), and the Massachusetts Stormwater Management Handbook.[65] Each of the applicable statutes and regulations is summarized below. The Charles

64 STV. 2009. *Red Line/Blue Line Connector Project Stormwater Management Plan*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc..: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

65 DEP. 2008. *Massachusetts Stormwater Handbook*. February 2008.

River is also regulated under MGL Chapter 91, which protects the public interest in non-tidal rivers such as the Charles River, as described in Section 4.2.

4.10.2.1 Clean Water Act

Water quality must be addressed for compliance with the Federal Water Pollution Control Act, also known as the Clean Water Act (CWA), which provides the authority to the EPA to establish water quality standards (or to states to establish standards equal to or more stringent than EPA standards), to control discharges into surface and subsurface waters, to develop waste treatment management plans and practices, and to issue permits for dredging, filling, or discharging to a waterbody. It requires states to monitor and classify waterbodies, establish goals, and publish lists of monitoring and classification results. The CWA gives states the authority and responsibility to publish water quality standards.[66] Applicable programs of the CWA are described in the following paragraphs.

National Pollutant Discharge Elimination System Permit

The National Pollutant Discharge Elimination System (NPDES) permit program, authorized by the CWA Section 402, controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Industrial, municipal, and other facilities must obtain permits if their discharges report directly to surface waters.

The proposed Project would be subject to the NPDES individual permit for the Boston Water and Sewer Commission (BWSC) discharges to the Charles River from Combined Sewer Overflows (CSO). The proposed Project must also meet the provisions listed in the NPDES Massachusetts General Permit for stormwater discharges from Small Municipal Separate Storm Sewer Systems, as it pertains to the City of Boston system.

NPDES regulations also require a Construction General Permit (CGP) when construction activities would disturb over one acre of land. The CGP regulates erosion control, pollution prevention, and other stormwater management issues at construction sites over 1 acre. This permit requires a Stormwater Pollution Prevention Plan that would specify proper stormwater management procedures for any disturbed areas.

The NPDES permit program in Massachusetts is administrated by EPA Region 1.

66 U.S. Code. Title 33, Chapter 26 – *Water Pollution Prevention and Control*. November 27, 2002.

Section 303(d) of the CWA

Section 303(d) of the CWA establishes the Total Maximum Daily Load (TMDL) program, which is managed by DEP. A TMDL is the allowable concentration (load) of a single pollutant within a designated portion of a waterbody, from all point and non-point sources discharging to the waterbody. Under the TMDL program, states establish priority rankings for their waterbodies and identify the uses for these waterbodies (e.g., drinking water supply, recreation, etc.). TMDLs can then be set for individual pollutants to ensure that the water quality is adequate for the designated uses.

DEP is also mandated by Section 303(d) to maintain the Massachusetts Integrated List of Waters. The Massachusetts Integrated List of Waters identifies what designated uses are attained, what impairments have been reported, and whether or not a TMDL has been prepared, if required.

4.10.2.2 Massachusetts Surface Water Quality Standards

The Massachusetts Surface Water Quality Standards (314 CMR 4.00) designate the most sensitive uses for the state's surface waterbodies in order to enhance, maintain, and protect water quality in these waters. The standards stipulate minimum water quality criteria required to sustain designated uses, and contain regulations necessary to achieve these uses and maintain existing water quality. The standards assign class designations to inland and coastal waters. These classes specify water quality standards based on the intended uses of the waterbodies. The standards for each class can address characteristics such as temperature, dissolved oxygen (DO), pH, bacteria, solids, color and turbidity, oil and grease, and taste and odor.

4.10.2.3 Massachusetts Wetlands Protection Act and Stormwater Management Standards

Stormwater from the Project area would likely discharge to resource areas regulated under the Massachusetts Wetlands Protection Act (WPA; 310 CMR 10.5(6)(k)). Projects that fall under the jurisdiction of the WPA must comply with the 2008 Massachusetts Stormwater Management Standards. The Stormwater Management Standards define the requirements for proper stormwater management for new or re-development sites in the Commonwealth. The water quality issues addressed by the standards include erosion control, peak discharge rates, ground water recharge, total suspended solids (TSS) removal, wellhead protection, construction management, long-term maintenance, and illicit (non-stormwater) discharges to the stormwater management system. Additional stormwater regulations (314 CMR 21.00) proposed by the DEP are

currently under review. The new regulations apply treatment requirements to projects in TMDL areas, impose restrictions on discharges to water supply protection areas, require infiltration to offset the effects of impervious surfaces on runoff and ground water recharge, and create a statewide permit program administered by DEP.

4.10.3 Existing Conditions

The Project area is located within the West End of Downtown Boston, an urban sector of the City. There are no surface water resources within the Project area but regulated wetlands are present at the western extreme, in the construction staging area, as shown in Figure 4.10-1a. The Charles River is west of the western terminus of the Project and receives stormwater discharges from the Cambridge Street corridor. Boston Harbor is approximately 0.4 mile east of the existing Bowdoin Station and there are no existing stormwater discharges to the harbor from Cambridge Street.

4.10.3.1 Surface Water Resources

The Charles River watershed is the most urbanized in Massachusetts, with 20 percent of the state's population, and highly impervious land cover. The segment of the river to which the Cambridge Street corridor discharges stormwater is known as the Lower Charles River Basin.

Discharges to the Charles River from the existing stormwater management system are primarily managed by the BWSC. However, some of the stormwater drainage infrastructure is combined with the sanitary sewer system, managed by the Massachusetts Water Resources Authority (MWRA). Both these entities have received separate NPDES permits (No. MA0103284 and MA 0101192, respectively), covering CSOs. CSOs occur during large storm events when the combined stormwater and sanitary sewer drainage system reaches capacity and discharges its flow into a receiving water (the Charles River) instead of a wastewater treatment plant. The MWRA and BWSC have also received variances from the NPDES requirements to eliminate CSO discharges. The variances authorize limited CSO discharges during wet weather events under a series of conditions including the completion of design, construction, and subsequent monitoring of CSO controls proposed in the MWRA's revised Long-Term Control Plan. Alterations to the stormwater system must meet the standards of these existing permits and variance requirements.

The Lower Charles River Basin, between the Watertown Dam and the New Charles River Dam at Boston Harbor, is listed on the Massachusetts Integrated List as a Category 5 water. Specifically, it is identified as an impaired or threatened waterbody for one or more uses, and requires TMDLs for nutrients

and pathogens. Stormwater discharges must be treated in accordance with the proposed Massachusetts Stormwater Regulations regarding TMDL pollutant reductions.

According to the Massachusetts Surface Water Standards, the Lower Charles River Basin is classified as a warm water fishery, Class B inland water that is impacted by the discharge of CSOs. When CSO discharges occur, the Massachusetts Water Quality Standards for swimming and contact recreation are violated. Class B waters are designated as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth, and other critical functions, and for primary and secondary contact recreation.[67] Many of these impairments to the Charles River are attributable to stormwater pollution and remain the main impediment to realizing a fishable, swimmable river.

According to the *Final Total Maximum Daily Load for Nutrients in the Lower Charles River Basin, Massachusetts,*[68] the Lower Charles River is impaired due to the overabundance of pathogens and phosphorous in the watershed. Most of the watershed area surrounding the Lower Charles River is highly urbanized with extensive piped drainage systems. The major source categories of phosphorus to the Lower Charles River include end-of-pipe stormwater, illicit sanitary sewage discharges, and CSOs. There are few overland sources of nutrient pollution that discharge directly to the Lower Charles River from the Cambridge Street corridor.

A portion of the westernmost extreme of the Project area lies within Bordering Land Subject to Flooding (BLSF), protected by the Wetlands Protection Act. This area is on fill material west of the colonial-era Shawmut Peninsula shoreline, and is identified by the Federal Emergency Management Agency (FEMA) as within the 100-year floodplain (Figure 4.10-1a).

4.10.3.2 Stormwater Management System

The stormwater management system along the Cambridge Street corridor is an engineered system that collects stormwater runoff from impervious surfaces (city streets, sidewalks and often rooftops) and discharges it into the Charles River. The BWSC controls most of the stormwater system; however, some storm drains and outfalls are privately owned or are owned by agencies such as MassDOT, Massport, or DCR.

In the City of Boston, including the Cambridge Street corridor, a piped system carrying both sewage and stormwater flows to the MWRA Deer Island

67 Division of Water Pollution Control. 314 CMR 4.00 Massachusetts Surface Water Standards. January 2007.
68 Massachusetts Department of Environmental Protection & United States Environmental Protection Agency, New England Region. *Final Total Maximum Daily Load for Nutrients in the Lower Charles River Basin, Massachusetts, CN301.1.* June 2007

Wastewater treatment plant. Treated water is discharged to Massachusetts Bay. According to studies conducted by the MWRA, the potential for a CSO discharge increases when the amount of rainfall exceeds 0.5 inches. The Cambridge Street corridor is comprised of one drainage area that discharges to one CSO outfall along the Charles River (MWR 022). This is the location where stormwater flows from the Project area enter the Charles River in large storm events. This outfall is within the Esplanade Park, along the east bank of the Charles River approximately 370 feet north of the Longfellow Bridge (Figure 4.10-1a).

According to current Massachusetts Geographic Information Systems (MassGIS) and BWSC data, there is no stormwater infrastructure at the Bowdoin Station or adjacent Cardinal Cushing Park. However, there is stormwater infrastructure along Cambridge Street corridor that may be altered by the Project. Figures 4.10-1a and 4.10-1b depict the existing stormwater system.

4.10.3.3 Water Quality

BWSC monitored stormwater quality in drainage areas representative of high density residential and mixed land uses between spring 2001 and fall 2004.[69] The following general conclusions were made by BWSC:

- Bacterial levels in stormwater consistently exceed applicable water quality standards, particularly those based on fecal coliform concentration, even in areas known to have no illegal sanitary connections.
- Levels of copper and zinc in runoff from the Boston area consistently exceed applicable water quality criteria. The metals occur primarily in dissolved form, suggesting that conventional stormwater best management practices aimed at solids control would be ineffective at addressing dissolved metals concentrations.
- Drainage areas with more pavement and associated automobile traffic (e.g., commercial, high-density residential and mixed use areas such as Cambridge Street) generally had higher levels of solids, heavy metals, oil & grease, and/ or total petroleum hydrocarbons.

Only minor changes to the BWSC system along Cambridge Street have been made in the past decade; therefore, these assumptions made regarding pollutants in Boston stormwater are still valid. Bacteria and phosphorous standards exceedances have also been confirmed by water quality studies conducted by the Charles River Watershed Association (CRWA).[70] In 2008, monitoring at the Longfellow Bridge CSO area identified phosphorus levels of 0.06 milligrams per

69 Boston Water and Sewer Commission, *2008 Stormwater Management Report.*
70 Charles River Watershed Association, *Charles River Monthly Monitoring Program; 2008 Year-End Report*, August, 2009.

liter (mg/ L), well above the EPA-recommended criterion of 0.0238 mg/ L. The CRWA 2008 water quality report showed that samples taken at this CSO met bacteria standards only 27 percent of the time during wet weather (e.g., during CSO events).

4.11 Parks and Recreation Areas

This section provides an overview of the existing public parks and recreation areas in the Project area. A more detailed description of the existing recreational land uses is provided in the Land Use Technical Report.[71]

The Project area is within the highly developed Cambridge Street corridor, with few parks or recreational areas. The Secretary's Certificate on the EENF required the following documentation regarding parks and recreation sites:

- Inventory of public parks, recreation areas, and conservation lands within 100 feet of the Cambridge Street corridor; and
- Clarification of right-of-way ownership and DCR-controlled land areas and roadways.

4.11.1 Regulatory Context

The primary regulatory restrictions on recreational land use within the Project area come from the 97th Amendment to the Massachusetts Constitution protecting conservation and recreation use. With respect to open space preservation, the Article includes the following provision:

> "The people shall have the right to clean air and water, freedom from excessive and unnecessary noise, and the natural, scenic, historic, and esthetic qualities of their environment; and the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources is hereby declared to be a public purpose…Lands and easements taken or acquired for such purposes shall not be used for other purposes or otherwise disposed of except by laws enacted by a two thirds vote, taken by yeas and nays, of each branch of the general court."

71 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Land Uses*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

4.11.2 Existing Conditions

The Cambridge Street corridor is a very urbanized sector of Downtown Boston. There are only two Article 97 protected parks located within the Project area: Cardinal Cushing Park and the Charles River Reservation.

Cardinal Cushing Park, owned by the Boston Redevelopment Authority (BRA), is in the eastern portion of the corridor between the New Chardon and Sudbury Street intersections with Cambridge Street (see Figure 4.2-2b). This site is a small urban park with a brick surface, park benches, a central flower bed, and some grassy areas. The existing Bowdoin Station headhouse is immediately adjacent to, but does not encroach into, the park. It is primarily used as a brief resting place for pedestrians and for local employees to eat lunch. The property is designated as a park in the City of Boston's 2008-2012 Open Space Plan. The Open Space Plan asserts that the park is permanently protected from land uses other than conservation or recreation purposes under Article 97.

The Charles River Reservation is a linear park stretching from Boston Harbor up the river for 20 miles. The lower half of the reservation, from downtown Boston to the Watertown Dam, is known as the Lower Charles River Basin, which includes the Esplanade on the Boston side. The western portion of the Project area falls within the reservation. According to the City of Boston's 2008-2012 Open Space Plan, the Charles River Basin (including Charles Circle) is protected open space under Article 97.

In addition to these protected parks, there is a small grassy area on the corner of Cambridge and North Anderson Street, privately owned by MGH. This 1-acre parcel is not classified as a park by the City of Boston; however, it includes green space and shaded benches for public use. There is also a small open space area in front of the John F. Kennedy Federal Building on 15 New Chardon Street within the Project area. This paved plaza is owned by the Boston Redevelopment Authority as part of City Hall Plaza, but is not deemed as a protected park by the City, as noted in the 2008-2012 Open Space Plan.

4.12 Visual Environment

This section provides an overview of the existing visual environment in the Project area. The visual environment is defined as the physically observable, from the ground level perspective, features of the Project area. The Secretary's Certificate on the EENF does not include any requirements for characterization of the visual environment.

The Cambridge Street corridor is a highly developed urban setting, with a variety of building sizes, ages, and styles (as described in Section 4.2, Land Use,

and Section 4.13, Historic and Archaeological Resources). Cambridge Street itself is a busy transportation thoroughfare, functioning as an arterial road to deliver commuters to and from the Downtown Boston area and surrounding communities, as well as providing local access to businesses and neighborhoods. Cambridge Street was recently reconstructed and contains a raised brick median with granite curbs and landscaping (trees and perennial plants) in wider sections, with brick sidewalks and antique-style street lights.

Open spaces within or near the Project area are limited to Cardinal Cushing Park and a privately owned park on MGH property, as described in Section 4.11, Parks and Recreation Areas. Although the Project area extends into the Charles River Reservation, the footprint of the Project is within the developed portion (public roadways and Charles/ MGH Station) that do not function visually as open space. Immediately west of the Project area, the Charles River Reservation Esplanade along the south bank of the Charles River does provide an aesthetically pleasing open space.

4.13 Historic and Archaeological Resources

This section discusses the previously known and documented historic and archaeological resources and those newly identified for the Red Line/ Blue Line Connector Project that are listed, determined eligible for listing, or recommended eligible for listing in the Massachusetts State Register (State Register) and the National Register of Historic Places (National Register). A more detailed description of the existing historic and archaeological resources is provided in the Historic and Archaeological Technical Report.[72]

4.13.1 Introduction

The purpose of the cultural resources reconnaissance survey was to identify known historic and archaeological resources within the Red Line/ Blue Line Connector Project "Area of Potential Effect" (APE). The survey was also designed to provide recommendations regarding the locations of potential sensitivity for archaeological resources and identified potentially significant historic resources requiring additional intensive survey and/ or significance evaluation. To achieve these goals, archival research in the study area, field survey of the APE, and analysis were completed. As shown in Figure 4.13-1, the APE for historic resources

72 STV. 2009. *Red Line/Blue Line Connector Historic Resources Reconnaissance Survey and Archaeological Resources Assessment*. Prepared by STV, Inc. in association with Public Archaeology Laboratory: Pawtucket, RI. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

extends 150 feet, or one building lot, on either side of Cambridge Street, underneath which the subway tunnel will be constructed or widened.

The Secretary's Certificate on the EENF included the following requirements for characterization of existing historic and archaeological resources:

- Provide a historic and cultural resources map confirming the location of state and local historic districts and individual properties, and a resource summary to identify historic resources adjacent to the corridor and likely to be impacted by air quality, noise, vibration, and stormwater impacts associated with the Project.
- Include detailed descriptions of registered properties immediately adjacent to the Project corridor.

4.13.2 Regulatory Context

The historic and archaeological resources reconnaissance survey for the Red Line/ Blue Line Connector Project was undertaken as the first step in fulfilling compliance responsibilities regarding cultural resources. MassDOT serves as the lead state agency and is responsible for identifying and evaluating properties through archaeological and historic architectural surveys in accordance with MGL Chapter 9 Sections 26-27C, as amended, 950 CMR 71.00, 950 CMR 70.00, and MEPA.

The National Register Criteria for Evaluation established by the National Park Service (NPS) state that, "the quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

- That are associated with events that have made a significant contribution to the broad patterns of our history; or
- That are associated with the lives of persons significant in our past; or
- That embody the distinctive characteristics of a type, period or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose component may lack individual distinction; or
- That have yielded, or may be likely to yield information important in prehistory or history."

National Historic Landmarks (NHLs) are properties of national level significance.

4.13.3 Existing Conditions

Historic resources are known to exist, and archaeological resources may exist, within the Project area, as described below.

4.13.3.1 Historic Resources

A total of 48 resources (2 districts and 46 individual properties) listed with the Massachusetts Historical Commission (MHC) were identified within the APE. Fifteen of these resources are known NHLs, National Register-listed or have been determined to be eligible for listing, or have been evaluated as potential (National Register recommended eligible) historic properties. Of these, one district and two individual properties are NHLs, and one district and two individual properties are listed in the National Register. An additional five individual properties have been previously determined eligible for listing in the National Register. One of these properties has lost architectural integrity through recent demolition and new construction, and is now recommended as not eligible. Four of the individual properties surveyed are recommended as potentially eligible for National Register listing. All of the 15 resources within the APE identified as historic properties are listed in Table 4.13-2 and shown on Figure 4.13-1.

4.13.3.2 Archaeological Resources

The Project area overlaps the MBTA Bowdoin/ Charles Connector Project and the Blue Line Modernization Project work areas studied in 1987 and 1993. A review of these projects and the data they used to analyze and assess the Project work areas confirms that the majority of the current Project has no to low archaeological sensitivity. There are no recorded archaeological sites in these areas. However, the historic shoreline extended as far east as Cambridge and Anderson streets. Therefore, the high archaeological sensitive area of pre-contact/ contact period potential for Native American fish weir and shell-midden resources extends from Anderson Street west to and including Charles Circle (Figure 4.13-1).

A small park located at the east corner of Cambridge and North Anderson streets was previously identified as a sensitive area from the ground surface down to subsoils for historic period resources. There could also be deeply buried pre-contact/ contact (Native American) resources. This area is assigned a high archaeological sensitivity.

Table 4.13-2 List of Historic Properties Identified within the Red Line/Blue Line Connector Project APE

Map No.[1]	Street No.	Street Name	District/Property Name	Style/Type	Est. Date	MHC Area No.	MHC No.	NR Status[2]
Areas/Districts								
A		Cambridge, Bowdoin, Hancock, and Beacon streets, and Embankment Road	Beacon Hill Historic District	Multiple	1790-1955	BOS.BY (for NHL, NRDIS) BOS.BE (for LHD)	Multiple	NHL, NRDIS, LHD
B		Charles River; Memorial Drive, Cambridge Parkway, Embankment Road, Storrow Drive, Soldier's Field Road	Charles River Basin Historic District	Multiple	1880-1955	BOS.CA, CAM.AJ	Multiple	NRDIS
Individual Properties								
003	1	City Hall Plaza	Boston City Hall and Plaza	Expressionist	1961-1969	n/a	BOS.1657	MHC-DOE
004	15 15	New Sudbury St Cambridge St	John F. Kennedy Federal Building	Modern	1966	n/a	BOS.1617	RNRE
008	65 6	Cambridge St Bowdoin Square	New England Telegraph and Telephone Company	Art Deco	1930, Late 20th c. add.	n/a	BOS.1575	RNRE
011	115 19	Cambridge St Staniford St	Massachusetts Health, Welfare, and Education Building/State Service Center	Expressionist	1965-1970	n/a	BOS.1618 BOS.4208	MHC-DOE
013	131	Cambridge St	Old West Church	Federal	1806	n/a	BOS.4182	NHL, NRIND
014	141	Cambridge St	(First) Harrison Gray Otis House	Federal	1796	n/a	BOS.4183	NHL, NRIND
021	30	South Russell St	Peter Faneuil School	Classical Revival	1910	BOS.BY, BOS.BE	BOS.4090	NRIND (within NHL district)
028	24	Parkman St at Blossom St	Winchell Elementary School	Renaissance Revival	1884-1885	n/a	BOS.4159	MHC-DOE
029	16-18	Blossom St	West End House	Classical Revival	1929	n/a	BOS.4158	RNRE
038	4	North Grove St at Cambridge St	Resident Physician's House	Italianate/ Colonial Revival	1892	n/a	BOS.4190	RNRE
043	32 215	Fruit St Charles St	Suffolk County/Charles Street Jail	Renaissance Revival	1851	n/a	BOS.4200	NRIND
045		Charles Circle	Charles/MGH Station (Charles Station), Red Line	Rapid Transit Station	1932/ 2003	n/a	BOS.4198	MHC-DOE, RNE
046		Cambridge Street	Longfellow Bridge	Beaux Arts, NeoClassical	1907	n/a	BOS.9034, CAM.912	NRDIS-C MHC-DOE
003	1	City Hall Plaza	Boston City Hall and Plaza	Expressionist	1961-1969	n/a	BOS.1657	MHC-DOE

Table 4.13-2 List of Historic Properties Identified within the Red Line/Blue Line Connector Project APE (Continued)

Map No.[1]	Street No.	Street Name	District/Property Name	Style/Type	Est. Date	MHC Area No.	MHC No.	N NNR Status[2]
004	15 15	New Sudbury St Cambridge St	John F. Kennedy Federal Building	Modern	1966	n/a	BOS.1617	RNRE
008	65 6	Cambridge St Bowdoin Square	New England Telegraph and Telephone Company	Art Deco	1930, Late 20th c. addition	n/a	BOS.1575	RNRE
011	115 19	Cambridge St Staniford St	Massachusetts Health, Welfare, and Education Building/State Service Center	Expressionist	1965-1970	n/a	BOS.1618 BOS.4208	RNRE
013	131	Cambridge St	Old West Church	Federal	1806	n/a	BOS.4182	NHL, NRIND
014	141	Cambridge St	(First) Harrison Gray Otis House	Federal	1796	n/a	BOS.4183	NHL, NRIND
021	30	South Russell St	Peter Faneuil School	Classical Revival	1910	BOS.BY, BOS.BE	BOS.4090	NRIND, (within NHL district)
028	24	Parkman St at Blossom St	Winchell Elementary School	Renaissance Revival	1884-1885	n/a	BOS.4159	MHC-DOE
029	16-18	Blossom St	West End House	Classical Revival	1929	n/a	BOS.4158	RNRE
038	4	North Grove St at Cambridge St	Resident Physician's House	Italianate/Colonial Revival	1892	n/a	BOS.4190	RNRE
043	32 215	Fruit St Charles St	Suffolk County/Charles Street Jail	Renaissance Revival	1851	n/a	BOS.4200	NRIND
045		Charles Circle	Charles/MGH Station (Charles Station), Red Line	Rapid Transit Station	1932/2003	n/a	BOS.4198	MHC-DOE, NE
046		Cambridge Street	Longfellow Bridge	Beaux Arts, NeoClassical	1907	n/a	BOS.9034, CAM.912	NRDIS-C MHC-DOE

1 See Figure 4.13-1. Resources are generally sequenced north to south and east to west along the Project corridor.

2 National Register Status Key

NHL	National Historic Landmark
NRIND	Property individually listed in the National Register
NRDIS	Property listed in the National Register as a historic district
NRDIS-C	Property listed in the National Register as a contributing building in a historic district
NRMPS	Property individually listed in the National Register as part of a NRMPS
NRDOE	Property formally determined eligible by Keeper of the National Register
MHC-DOE	Property evaluated as eligible by MHC
RNRE	Property recommended as eligible
LHD	Property located within a State Register listed local historic district
MHC-NE	Property evaluated as not eligible by MHC
NE	Property evaluated as not eligible for National Register Listing

4.14 Hazardous Materials and Solid Wastes

This section describes the hazardous materials (including special wastes) and solid wastes present or potentially present within and surrounding the Project area. A more detailed description of the hazardous materials and solid wastes present or potentially present within the Project Area is provided in the Hazardous Materials Technical Reports.[73]

4.14.1 Introduction

Hazardous materials are used and hazardous wastes generated by many common commercial and industrial activities. Hazardous materials and hazardous wastes above certain concentrations present a risk to human health or the environment, and are therefore regulated by several federal and state laws. These regulated substances are here collectively referred to as hazardous materials. Owners and operators of facilities and/ or landowners of property contaminated by releases of these hazardous materials are typically liable for remediating contaminated sites unless it can be determined that another entity is responsible for the release.

Special wastes, such as petroleum-contaminated soil or asbestos-containing building materials, present less of a health risk to the general public, but disposal of these wastes is also regulated. Solid wastes (including construction or demolition debris), while presenting a yet lower human health or environmental risk, must also be managed properly.

The Secretary's Certificate on the EENF included the following requirements for characterization of existing hazardous materials conditions:

- Include an updated list of hazardous waste sites, consistent with DEP comments. Add database and Release Tracking Numbers to the list; and
- Include a summary of the contaminated sites immediately adjacent to the Project site, characterizing the nature of the contamination and status of clean-up.

73 STV. 2009. *Limited Environmental Site Assessment Report* and *Hazardous Materials Inspection Report*. Prepared by STV, Inc. in association with TRC, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

The list of hazardous waste sites is provided in the *Limited Environmental Site Assessment Report*.[74] A summary of the adjacent contaminated sites is provided in Section 4.14.3, below.

4.14.2 Regulatory Context

The Massachusetts Contingency Plan[75] (MCP) is the primary law that regulates the remediation of hazardous material releases in the Commonwealth. The DEP administrates the MCP regulatory program, which provides incentives to private parties to clean up contamination and allows the DEP to focus on sites requiring government action.[76] Under certain conditions, responsible parties can clean up sites under the direction of a Licensed Site Professional (LSP) with little or no direct oversight by the DEP. Alternatively, DEP oversees the cleanup of spills and situations presenting imminent hazards, and those where cleanup is not completed within one year of notification. In any case, responsible parties must fund cleanup and proper disposal of contaminated materials.

Special and solid wastes are regulated by the federal Resource Conservation and Recovery Act (RCRA). These wastes must be managed properly from the point of generation until disposal at an appropriately permitted facility.

4.14.3 Existing Conditions

A site assessment evaluated current and historical records to identify land uses with a potential for hazardous material use or generation. As part of the MCP program, the DEP maintains a database listing disposal, spill, and leak sites throughout the Commonwealth. The database was reviewed for information about known or possible releases of regulated substances within or near the Project area. Other historical records (such as aerial photographs and city atlases) were reviewed for indications of land use with a high probability of hazardous material use or generation. A site reconnaissance was conducted to confirm existing land uses along the corridor. Separately, a site inspection was completed to identify potential hazardous materials within the existing MBTA facilities in the Project area.

Over 400 hazardous material disposal sites within, adjacent to, or in the vicinity of the Red Line/ Blue Line Connector Project area are recorded in the MCP

74 STV. 2009. *Red Line/Blue Line Connector Project: Limited Phase I Environmental Site Assessment*. Prepared by STV, Inc. in association with TRC Corporation. Appended to the *Alternatives Analysis Technical Report, provided on* the Project website at: www.mass.gov/massdot/redblue

75 DEP. 2008. *Massachusetts Contingency Plan*. 310 CMR 40.0000.

76 DEP. 2009. *Cleanup of Sites & Spills, About the Waste Site Cleanup Program*. DEP website: http://www.mass.gov/dep/cleanup/oview.htm. Accessed on 28 October 2009.

database.[77] The majority of the 400 sites are not considered to represent a significant concern to the Project due to distance, hydrogeologic conditions, the type and extent of contamination, and/ or current regulatory status. A subset of 34 MCP-listed sites was determined to have some potential to impact soils or groundwater within the Project corridor. With further analysis, these 34 sites were categorized as having a low, moderate, or high potential of impacting subsurface conditions. MCP records for the three sites determined to have a high potential for impact were evaluated in detail. These three sites, shown in Figures 4.14-1a and 4.14-1b, are:

- Charles/ MGH Station (RTN 3-21624). A release of an unspecified quantity of extractable petroleum hydrocarbons was reported to the DEP in 2002. Available information indicates that an area comprising approximately 95,480 square feet of contaminated soil remains within the Project area. Residual extractable petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and lead remains above background concentrations. The depth of the contaminated area is not specified; the volume of contaminated material is therefore unknown.
- 19 Staniford Street (RTN 3-15720). A release of diesel fuel from a 550-gallon underground storage tank was reported to the DEP in 1997. The site has been remediated such that residual contamination is equivalent to background levels. The impacted area comprises approximately 876 square feet within the Project area.
- 1, 2, 4 Strong Place (RTN 3-12300). Evidence of No. 2 fuel oil in groundwater, from an unidentified source, was reported to the DEP in 1995. DEP was also notified of a release of No. 2 fuel oil at this site in 1998. Light non-aqueous phase liquids in soil and groundwater are still present at this site, adjacent to and hydrogeologically upgradient of the Project area. The area and/ or volume of contaminated material are not known.

In addition, historical data (city atlases dating from 1890, and aerial photographs dating from 1938) visually document the land use development history of the area over the last 119 years. Land use activities in the late 19th century included residential, commercial, and institutional functions along the Cambridge Street corridor, with little or no industrial functions. The 1938 city atlas and aerial photograph both show multiple facilities of potential environmental concern, including heating oil companies and automobile repair garages, occupying many sites along Cambridge Street. Aerial photographs in each decade from the 1940s through the 1990s document evolving land use in the Project area. The historical data review and site reconnaissance concluded that there are numerous historical releases of petroleum products along Cambridge Street between Lindall Place

77 STV. 2009. *Red Line/Blue Line Connector Project: Limited Phase I Environmental Site Assessment*. Prepared by STV, Inc. in association with TRC Corporation. Appended to the *Alternatives Analysis Technical Report, provided on* the Project website at: www.mass.gov/massdot/redblue.

and Joy Street, and that undocumented releases are likely to have occurred in this same area prior to the current regulatory regime.

A site inspection was conducted in accessible areas where modifying or demolishing existing MBTA infrastructure and/ or structures have been proposed (i.e., tunnels and stations).[78] The current location, condition, and type of hazardous materials or suspect hazardous materials were identified in the approximately 383,000 square feet of space, comprised of railway stations, tunnels, mechanical rooms, and electrical closets. Suspected lead-based paint (including dust), mercury-containing lamps, asbestos-containing materials, and polychlorinated biphenyls in electrical equipment were found in various locations. Additionally, petroleum products and various types of out-of-service electrical equipment were observed. No hazardous wastes or biological hazards (mold, fungi, rodent or guano) were observed.

78 STV. 2009. *Hazardous Materials Inspection Report*. Prepared by STV, Inc. in association with TRC Corporation. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

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5 Environmental Consequences

5.1 Introduction

This Chapter describes the permanent impacts that each Red Line/ Blue Line Connector Project alternative may have on the environmental resources described in Chapter 4, Affected Environment. Permanent impacts from the two Build Alternatives are considered and compared to the No-Build Alternative. Secondary and cumulative impacts to these resources are also described. Temporary impacts are described in Chapter 6, Construction Period Impacts.

The resource evaluations in this Chapter respond to the requirements of the Secretary's Certificate on the EENF and consider the comment letters received on the EENF. The analyses were developed in compliance with the MEPA regulations.

5.2 Land Use

The Project's permanent impacts to land uses along the Cambridge Street corridor are described below. Recreational land use impacts are separately discussed in Section 5.11. A more detailed description of impacts to land use is provided in the Land Use Technical Report.[79]

79 STV. 2009. *Red Line/Blue Line Connector Project Technical Memorandum: Land Use*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

The Secretary's Certificate on the EENF specifically required that the DEIR:

- Describe impacts to each property as a result in change of access or construction impacts;
- Describe impacts to Cardinal Cushing Park from excavation and possible expansion of the park under the Bowdoin eliminated alternative;
- Discuss impacts to shade trees and mitigation;
- Describe impacts to Chapter 91 riverfront and floodplain areas, if any; and
- Identify temporary easements for construction or permanent alterations.

This section summarizes permanent impacts to land uses from the No-Build and Build Alternatives. Temporary (construction period) impacts are discussed in Section 6.2, and impacts to parks and recreational sites are discussed in Section 5.11.

5.2.1 Environmental Consequences

The Project area lies principally within the City of Boston right-of-way along Cambridge Street. The Cambridge Street corridor is highly developed with commercial, institutional (medical facilities), and residential land uses. A portion of the Blue Line platform at Charles/ MGH Station would occupy Charles Circle, which is part of the Charles River Reservation, owned by DCR. The two tail tracks also extend underground into the Charles River Reservation. Permanent, passive vent shafts will be constructed within the MEEI parking lot and within the sidewalk on the southern tail track. However, only a vent cover would be visible from the surface and sidewalk. A portion of the Project area includes Landlocked Tidelands (Figure 4.2-3), subject to the Massachusetts Public Waterfront Act. Cambridge Street east to North Anderson Street, and adjacent land uses and public walkways, are presumed to be included in this jurisdictional area. Impacts to these land uses and the Landlocked Tidelands that would result from the Project alternatives are described below.

5.2.1.1 No-Build Alternative

There are no direct impacts to land uses associated with the No-Build Alternative because there would be no substantive changes to the MBTA subway system and therefore no land acquisitions or changes in land use would be necessary.

5.2.1.2 Alternative 1

Alternative 1 would extend the Blue Line to Charles/ MGH Station, eliminating the existing Bowdoin Station and constructing a new underground platform for

the Blue Line east and below the existing Charles/ MGH Station. The headhouse at Bowdoin Station would remain for use as emergency egress only.

Alternative 1 would not:

- Result in change of access to any property;
- Require any permanent land acquisition;
- Displace any land use; or
- Affect any planned development.

Extending the Blue Line and closing Bowdoin Station would not directly or indirectly affect land uses. There would be no permanent impacts to land uses from Alternative 1.

5.2.1.3 Alternative 2

Alternative 2 would extend the Blue Line to Charles/ MGH Station, relocating the platform of Bowdoin Station while maintaining the existing mezzanine and headhouse. In addition, the two tail tracks and a new Blue Line platform would be constructed below Charles/ MGH Station, as described above for Alternative 1. There would not be any new stations and therefore no induced growth or land use change.

As with Alternative 1, there would be no land acquisitions or land use displacements for Alternative 2. There are no direct or indirect permanent impacts to land uses from Alternative 2.

5.2.2 Regulatory Compliance

As noted above, the Project would be subject to the Massachusetts Public Waterfront Act; Massachusetts General Law Chapter 91, and its accompanying Waterways Regulations (310 CMR 9.00). The portion of the Project area along Cambridge Street east to North Anderson Street, and adjacent land uses and public walkways, are presumed to be Landlocked Tidelands. As discussed in Section 6.2, temporary (construction) effects to filled Landlocked Tidelands from both Build Alternatives include excavating fill and placing structures along Cambridge Street during the tunnel boring phase of the Project. Impacts to these tidelands are limited to temporary traffic detouring and limited public access along adjacent walkways during construction. There would be no permanent impacts to the tidelands from either Build Alternative.

However, and although alterations to Landlocked Tidelands do not require a Waterways License, they are subject to a Public Benefit Determination per the MEPA regulations (310 CMR 13). It is likely that the Project would be classified

as a Nonwater-Dependent Project since it does not meet the Water-Dependent criteria under 310 CMR 9.12. In making the Public Benefit Determination for Nonwater-Dependent Projects, the Secretary of EEA will consider the following Project elements:

- Purpose and effect of the project;
- Impact on abutters and the surrounding community;
- Enhancement to the property;
- Benefits to the public trust rights in tidelands or other associated rights, including benefits provided through previously obtained municipal permits;
- Community activities on the site;
- Environmental protection and preservation; and
- Public health and safety, and the general welfare.

Primary public benefits of the Project for both Build Alternatives within Landlocked Tidelands would include increased transit accessibility, equitable distribution of transit services, increased transit ridership, and improved regional air quality. Impacts to abutters would be temporary from construction activities, as discussed previously. The Project protects and preserves environmental resources by utilizing an underground rail corridor rather than creating an above ground, light-rail corridor that would require additional land resources and potentially result in impacts to adjacent natural resources. In addition, public health goals of the Commonwealth would be met by improving regional air quality, reducing regional emissions of greenhouse gases, and reducing the region's dependence on petroleum.

5.3 Environmental Justice

This section describes the permanent direct and indirect impacts to environmental justice populations that would result from the Red Line/ Blue Line Connector Project. A more detailed description of the impacts to environmental justice populations is provided in the Environmental Justice Technical Report.[80] Temporary (construction period) impacts are discussed in Section 6.3.

Environmental justice populations are considered to be disproportionately impacted if significant impacts to relevant resources result from a project and the

80 STV. 2009. *Red Line/Blue Line Connector Project Technical Memorandum: Environmental Justice*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

effect to environmental justice populations is disproportionate as compared to the effect to non-environmental justice populations.

5.3.1 Environmental Consequences

The following paragraphs outline the potential permanent impacts to environmental justice populations from each alternative.

5.3.1.1 No-Build Alternative

Under the No-Build Alternative, it is assumed that Blue Line operations would remain similar to currents operations with the exception of implementing infrastructure improvements proposed in the MBTA's long range transportation plan, including Americans with Disabilities Act (ADA) accessibility enhancements.[81]

The Red Line operations would be unchanged. Under the No-Build Alternative, the Red Line and Blue Line would not be directly connected. Riders transferring between the two lines would use a short segment of the Green Line or the Orange Line. The transfer penalty reduces the transit mode share for these trips.

There would be no adverse impacts to either environmental justice or non-environmental justice populations from the No-Build Alternative. There would be no increases in noise or air pollution, traffic disruption, decreases in access to parks, or changes to the social environment.

The impact to environmental justice populations from the No-Build Alternative would be continued indirect connections between the Red Line and the Blue Line, with resulting poor access to transit to jobs, educational opportunities, and hospitals along either line. Capacity and accessibility enhancements would improve system performance and accessibility for disabled persons.

5.3.1.2 Alternative 1: Eliminate Bowdoin Station

As described in other sections in this Chapter, there would be no permanent increases in air pollution, noise, or vibration levels; decreases in access to parks; traffic disruptions; or changes to the social environment. Consequently, there would be no adverse permanent impacts to either environmental justice or non-environmental justice populations from Alternative 1.

81 MBTA. 2009. *Capital Investment Program, FY 2010-2014*. Available on-line at: http://www.mbta.com/uploadedfiles/About_the_T/Financials/MBTA%20FY10-FY14%20CIP.pdf. Accessed 2 November 2009.

The beneficial impacts to the public, including environmental justice populations, of eliminating Bowdoin Station under Alternative 1, as compared to Alternative 2, are potentially higher system ridership because of slightly faster travel times: there would be an approximately 3.5-minute round trip travel time savings under this Alternative. The adverse impact of eliminating the Bowdoin Station would be decreased access to transit. Air quality is expected to improve if more people use transit service rather than drive personal cars; this benefit would occur for both Alternatives.

Environmental justice populations in outlying areas would also benefit from Alternative 1 by improved access to transit, and transit travel times, to educational institutions, hospitals, and jobs. Tables 5.3-1 and 5.3-2 show the relative improvements, as compared to the No-Build Alternative, for environmental justice and non-environmental justice populations in East Boston, Charlestown, and Revere.

There would be no changes in transit access or transit time to colleges and universities for environmental justice populations under Alternative 1, but no change in transit time. Transit access to hospitals for environmental justice populations would also not improve under this Alternative, but there would be small improvements in transit times, up to 0.4 percent for Revere residents under Alternative 1. Improvements in access to jobs would be realized for East Boston and Revere environmental justice populations, at up to 1.6 percent for access to service jobs for Revere residents. There would be no measurable improvement in transit times for environmental justice populations in these communities.

There would be no improvements in mobility for residents of Boston, Cambridge, or Revere under Alternative 1.

Table 5.3-1 Improvements in Accessibility to Colleges, Universities, and Hospitals

	Accessibility to Colleges, Universities, and Hospitals							
	Colleges/Universities				Hospitals			
	Access		Time		Access		Time	
Alternative	EJ	Non-EJ	EJ	Non-EJ	EJ	Non-EJ	EJ	Non-EJ
East Boston Residents								
1-Bowdoin Station Eliminated	0%	0%	0%	0%	0%	0%	0.3%	0.7%
2-Bowdoin Station Relocated	1%	0.1%	0%	0%	5.1%	0.6%	0.2%	0.5%
Charlestown Residents								
1-Bowdoin Station Eliminated	0%	0%	0%	0%	0%	0%	0.1%	0.1%
2-Bowdoin Station Relocated	0%	0%	0%	0%	0.2%	0.1%	0.1%	0.1%
Revere Residents								
1-Bowdoin Station Eliminated	0%	0%	0%	0%	0%	0%	0.4%	0.7%
2-Bowdoin Station Relocated	1.1%	0.1%	0%	0%	6.2%	0.7%	0.2%	0.5%

Source: CTPS. 2010. Red-Blue Connector Study. March 11,2010.

Table 5.3-2 Improvements in Accessibility to Employment

	Accessibility to Employment											
	Basic Jobs				Retail Jobs				Service Jobs			
	Access		Time		Access		Time		Access		Time	
Alternative	EJ	Non-EJ	EJ	Non-EJ	EJ	Non-EJ	EJ	Non-EJ	EJ	Non-EJ	EJ	Non-EJ
East Boston Residents												
1- Bowdoin Station Eliminated	0.5%	0.2%	0%	0%	0.4%	0.1%	0%	0%	1.1%	0.3%	0%	0%
2- Bowdoin Station Relocated	0.7%	0.2%	0%	0%	0.7%	0.1%	0%	0%	1.3%	0.5%	0%	0%
Charlestown Residents												
1- Bowdoin Station Eliminated	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2- Bowdoin Station Relocated	0.1%	0.1%	0%	0%	0.1%	0.1%	0%	0%	0.4%	0.3%	0%	0%
Revere Residents												
1- Bowdoin Station Eliminated	0.9%	0.1%	0%	0%	0.8%	0%	0%	0%	1.6%	0.5%	0%	0%
2- Bowdoin Station Relocated	0.9%	0.1%	0%	0%	0.9%	0.1%	0%	0%	1.7%	0.5%	0%	0%

Source: CTPS. 2010. Red-Blue Connector Study. March 11,2010.

5.3.1.3 Alternative 2: Relocate Bowdoin Station

As described in other sections in this Chapter, there would be no permanent increases in air pollution, noise, or vibration levels; decreases in access to parks; traffic disruptions; or changes to the social environment. Consequently, there would be no adverse permanent impacts to either environmental justice or non-environmental justice populations from Alternative 2.

The beneficial impacts to the public of retaining the Bowdoin Station, with a relocated inbound platform, are continued access to transit and improved

ridership capacity. The adverse impact of retaining the Bowdoin Station is increased travel time, as compared to Alternative 1, due to an extra stop on the Blue Line. As noted above, air quality is expected to improve if more people use transit service rather than drive personal cars; this benefit would occur for both Alternatives.

The benefits for residents of Cambridge, Boston, and Revere would be similar to those for Alternative 1, as shown in Tables 5.3-1 and 5.3-2. As with Alternative 1, environmental justice and non-environmental justice populations would realize slight improvements in some, but not all, access and travel time scenarios to employment opportunities, colleges and universities, and hospitals for Alternative 2. There would be no improvements in mobility (changes in weighted average travel times) under this Alternative.

5.3.2 Regulatory Compliance

There are no applicable regulations for impacts to environmental justice populations. Federal and state agency policy requires analysis to determine if impacts are disproportionate. Because there would be no permanent substantive adverse impacts to air quality, noise or vibration levels, access to parks, traffic disruptions, or neighborhood fragmentation for any populations from either Build Alternative, environmental justice populations would not be disproportionately impacted. Beneficial impacts from both Alternatives are small improvements in access to some job categories and hospitals for environmental justice and non-environmental justice populations. Improvements in transit time to hospitals would also benefit both populations; other transit time improvements are relatively small on a percentage basis, at about 4 minutes.

5.4 Existing Transportation Systems

This section outlines the Project's permanent impacts to existing transportation systems. The Secretary's Certificate on the EENF required that the environmental consequences evaluation for impacts to existing transportation systems summarize the integration of the Project into the overall transit system and the anticipated benefits or drawbacks of constructing the Project.

Existing transportation systems consist of the Red Line and Blue Line subways with the Charles/ MGH and Bowdoin Station at either end of the Project area, the greater MBTA system, and local shuttles. Permanent impacts to these systems are described in the following paragraphs.

5.4.1.1 No-Build Alternative

The No-Build Alternative would not impact existing transportation systems. The Red Line and the Blue Line would remain unconnected, and local shuttle services would continue to operate in the area.

5.4.1.2 Alternative 1

Alternative 1 would beneficially impact the MBTA subway system by connecting the Red Line and the Blue Line, improving transit connectivity and decreasing congestion at other Downtown Boston stations. Eliminating Bowdoin Station would result in improved transit times along the Blue Line between Charles/ MGH Station and Government Center Station as compared to Alternative 2, but decreased accessibility to transit for passengers. There would be no adverse impacts to the Red Line or the Blue Line operations. Alternative 1 would also not preclude operation of local shuttle services.

5.4.1.3 Alternative 2

Alternative 2 would also beneficially impact the MBTA subway system by connecting the Red Line and the Blue Line, improving transit connectivity and decreasing congestion at other Downtown Boston stations. Retaining Bowdoin Station would result in improved access to transit for passengers as compared to Alternative 1, but decreased transit times along the Blue Line between Charles/ MGH Station and Government Center Station. There would be no adverse impacts to the Red Line or the Blue Line operations. Alternative 2 would also not preclude operation of local shuttle services.

5.5 Traffic

This section describes the permanent impacts to traffic that would result from the Project alternatives. A detailed account is provided in the Traffic Technical Report.[82] The Secretary's Certificate on the EENF included a number of requirements for analysis of the Project's impacts to traffic:

- A traffic impact study for three conditions: No Build, Blue Line Extension to Charles/ MGH Station with elimination of Bowdoin Station, and Blue Line Extension to Charles/ MGH Station with relocated Bowdoin Station.

82 STV. 2009. *Red Line/Blue Line Connector Project Technical Memorandum: Traffic*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

- An evaluation of the Project's potential impact for intersection Level of Service (LOS) and pedestrian and bicycle circulation.
- Proposed mitigation for areas where the Project will have significant impact on traffic, pedestrian or bicycle operations.
- Proposed temporary mitigation and detours to address construction-related impacts.

The following sections address permanent impacts to traffic that would result from the Project alternatives. Temporary (construction period) impacts are addressed in Section 6.5.

5.5.1 Environmental Consequences

This section discusses the physical changes, operational changes, other transportation projects, traffic operations, emergency access and truck routes, pedestrians and bicycles, and parking that would impact or be impacted by the Project alternatives.

5.5.1.1 No-Build Alternative

Physical and operational changes would occur under the No-Build Alternative as a result of ongoing development of the public transit system and road construction or reconstruction in the surrounding area. The No-Build Alternative includes planned or on-going physical and operational transportation changes that would occur between 2009 and 2030.

Results of the traffic operations analyses are presented in Table 5.5-1 for signalized intersections and Table 5.5-2 for unsignalized intersections. Three signalized intersections and two unsignalized intersections operate at an unacceptable level of service (LOS F) during at least one peak hour in 2009. By 2030, the intersection of Cambridge Street at New Chardon Street/ Bowdoin Street is expected to decline from LOS D to LOS E during the evening peak hour under No-Build conditions. No other deficiencies are expected.

5.5.1.2 Alternative 1

Alternative 1 includes extending the Blue Line to Charles/ MGH Station with the elimination of Bowdoin Station. Eliminating Bowdoin Station allows for faster travel time on the Blue Line between Government Center and Charles/ MGH than if the station was maintained.

Traffic Operations

The majority of intersections along Cambridge Street would see minor improvements to overall average intersection delay under Alternative 1 as compared to the No-Build Alternative. Table 5.5-3 presents the signalized traffic operations results for Alternative 1.

Table 5.5-1 2030 No-Build Condition Signalized Intersection Traffic Operations

		Existing Conditions			Future No-Build Conditions		
Intersection	Time of Day	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS
Charles Circle - Charles Street/Storrow Drive	Morning	0.60	22	C	0.64	22	C
Westbound On-Ramp	Evening	0.75	18	B	0.77	18	B
Charles Circle - Charles Street/Storrow Drive	Morning	1.11	81	F	1.11	81	F
Eastbound Off-Ramp/Longfellow Bridge Inbound	Evening	1.00	72	E	1.03	85	F
Cambridge Street and	Morning	1.10	26	C	1.05	26	C
North Grove Street/Grove Street	Evening	0.89	12	B	0.89	13	B
Cambridge Street and	Morning	0.66	15	B	0.66	15	B
Blossom Street/Garden Street	Evening	0.65	14	B	0.75	18	B
Cambridge Street and Joy Street	Morning	0.48	8	A	0.48	8	A
	Evening	0.48	8	A	0.57	8	A
Cambridge Street and	Morning	0.82	37	D	0.83	38	D
Staniford Street/Temple Street	Evening	0.70	35	C	0.84	48	D
Cambridge Street and	Morning	0.73	57	E	0.73	72	E
New Chardon Street/Bowdoin Street	Evening	0.78	48	D	0.98	56	E
Cambridge Street and	Morning	0.80	110	F	0.80	114	F
New Sudbury Street/Somerset Street	Evening	0.82	53	D	0.87	55	D

1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
3 Level of Service

Table 5.5-2 2030 No-Build Condition Unsignalized Traffic Operations

Intersection	Time of Day	Critical Movement	Existing Conditions V/C[1]	Existing Conditions Delay[2]	Existing Conditions LOS[3]	Future No-Build Conditions V/C	Future No-Build Conditions Delay	Future No-Build Conditions LOS
Charles Circle – Cambridge Street/	Morning	SB T	0.86	62	F	0.88	67	F
Storrow Drive Westbound Off-Ramp	Evening	SB T	0.52	23	C	0.68	33	D
Cambridge Street and	Morning	SB R	0.28	25	C	0.28	25	C
North Anderson Street/ Anderson Street	Evening	SB R	>1.20	>120	F	>1.20	>120	F

1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
4 Level of Service

Table 5.5-3 Alternative 1 Signalized Intersection Traffic Operations in 2030

Intersection	Time of Day	No-Build Conditions V/C[1]	No-Build Conditions Delay[2]	No-Build Conditions LOS[3]	Alternative 1 V/C	Alternative 1 Delay	Alternative 1 LOS
Charles Circle - Charles Street/Storrow Drive	Morning	0.64	22	C	0.62	22	C
Westbound On-Ramp	Evening	0.77	18	B	0.75	17	B
Charles Circle - Charles Street/Storrow Drive	Morning	1.11	81	F	1.10	79	E
Eastbound Off-Ramp/Longfellow Bridge Inbound	Evening	1.03	85	F	1.02	83	F
Cambridge Street and	Morning	1.05	26	C	1.07	25	C
North Grove Street/Grove Street	Evening	0.89	13	B	0.89	12	B
Cambridge Street and	Morning	0.66	15	B	0.65	15	B
Blossom Street/Garden Street	Evening	0.75	18	B	0.70	15	B
Cambridge Street and Joy Street	Morning	0.48	8	A	.047	8	A
	Evening	0.57	8	A	0.55	8	A
Cambridge Street and	Morning	0.83	38	D	0.80	35	D
Staniford Street/Temple Street	Evening	0.84	48	D	.081	43	D
Cambridge Street and	Morning	0.73	72	E	0.70	70	E
New Chardon Street/Bowdoin Street	Evening	0.98	56	E	0.81	50	D
Cambridge Street and	Morning	0.80	114	F	0.78	116	F
New Sudbury Street/Somerset Street	Evening	0.87	55	D	0.85	55	D

1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
3 Level of Service

Table 5.5-4 presents the results of the unsignalized intersection analysis. Each of the unsignalized study area intersections is expected to see a slight improvement in delay when compared to the No-Build condition. This is a direct reflection of decreased through traffic volumes along Cambridge Street.

Table 5.5-4 Alternative 1 Unsignalized Traffic Operations in 2030

Intersection	Time of Day	Critical Movement	No Build Conditions			Alternative 1		
			V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS
Charles Circle – Cambridge Street/	Morning	SB T	0.88	67	F	0.77	45	E
Storrow Drive Westbound Off-Ramp	Evening	SB T	0.68	33	D	0.67	31	D
Cambridge Street and	Morning	SB R	0.28	25	C	0.30	23	C
North Anderson Street/ Anderson Street	Evening	SB R	>1.20	>50	F	>1.20	>50	F

1 Volume-to-capacity ratio
2 Average delay expressed in seconds per vehicle
5 Level of Service

Emergency Access and Truck Routes

There would be no long-term impacts to emergency access or truck routes in the Project area. Construction-related impacts to traffic are discussed in Section 6.5. There would be no long term impacts to the Partners Shuttle operation.

Pedestrians and Bicycles

The changes to pedestrian travel patterns that may be caused by the Project were estimated using the CTPS travel demand model. Alternative 1 would modify pedestrian activity slightly in the vicinity of the Bowdoin Station because the station would be closed. Pedestrians destined to Government Center and the immediate vicinity of existing Bowdoin Station would exit the system at Government Center Station under this alternative. Riders currently boarding or alighting at Bowdoin Station would instead use Government Center or Charles/ MGH.

Since pedestrian LOS at crosswalks are a function of traffic signal timing and phasing and not of pedestrian volumes, pedestrian levels of service are expected to remain unchanged from the No-Build Alternative. However, there could be potential impacts to sidewalk capacity from the increase in pedestrians crossing Cambridge Street to Charles/ MGH Station. The traffic study determined that adequate sidewalk space exists to accommodate the additional pedestrians who will cross Cambridge Street to/ from Charles/ MGH Station.

No additional analysis was required at Government Center because the travel demand model shows that redistribution of pedestrian patterns would not

include a higher number of pedestrians crossing Cambridge Street in this location.

Alternative 1 would not physically alter designated bicycle facilities nor disrupt future plans for either on-road or off-road facilities in the Project area. Since Charles/ MGH Station is primarily accessed by foot, Alternative 1 is not expected to draw a substantial amount of new bicycle traffic to the area.

Parking

Alternative 1 would not physically alter the existing public parking supply or the City's ability to modify parking or change enforcement on a permanent basis. Construction impacts to parking supply are discussed in Section 6.5.

5.5.1.3 Alternative 2

Alternative 2 includes extending the Blue Line to Charles/ MGH Station with the relocation of Bowdoin Station. Bowdoin Station would be reconstructed under Alternative 2 to allow for greater transit access and would require the relocation of the both east and westbound platforms to accommodate six-car trains. There would be slight changes in ridership patterns.

Traffic Operations

The traffic impacts and benefits realized under Alternative 2 are identical to those of Alternative 1, as described above.

Emergency Access and Truck Routes

As with Alternative 1, there would be no long-term impacts to emergency access or truck routes to/ from the Project area. Construction-related impacts are discussed in Section 6.5.

Pedestrians and Bicycles

Alternative 2 would increase pedestrian activity slightly in the vicinity of the Bowdoin Station due to the increased boardings. No other changes would be expected in the vicinity of Bowdoin or Government Center Stations.

Pedestrian LOS are expected to remain unchanged from the No-Build Alternative. However, there could be potential impacts to sidewalk capacity from the increase in pedestrians crossing Cambridge Street to Charles/ MGH Station. The traffic study determined that adequate sidewalk space exists to accommodate the additional pedestrians who will cross Cambridge Street to/ from the Charles/ MGH Station.

Alternative 2 would not physically alter designated bicycle facilities nor disrupt future plans for either on-road or off-road facilities in the Project area. Since both stations are within the central subway system and primarily accessed by foot, Alternative 2 is not expected to draw new bicycle traffic to the area.

Parking

Alternative 2 would not physically alter existing public parking supply or the community's ability to modify parking or change enforcement on a permanent basis. Construction impacts to parking supply are discussed in Section 6.5.

5.5.2 Regulatory Context

The traffic impacts analysis was conducted in compliance with FTA and FHWA requirements, and determined that no permanent impacts to traffic operations would result from the Project.

5.6 Air Quality

This section describes the permanent impacts to air quality that would result from the Project. A detailed description of these impacts is provided in the Air Quality Technical Report.[83] Temporary impacts to air quality as a result of construction activities are described in Section 6.6.

The Secretary's Certificate on the EENF required a description of the air quality benefits of the Project and its consistency with the SIP and DEP's transit regulations, the modeling data to support claims that the Project will result in reductions of emissions of volatile organic compounds (VOCs), oxides of nitrogen (NO_x), and carbon monoxide (CO), and an assessment of emissions of VOCs, NO_x, greenhouse gases (e.g., carbon dioxide [CO_2]), particulate matter (PM), and air toxics.

5.6.1 Environmental Consequences

Future estimates of Project-related emissions of CO and PM at the local (microscale) level are based upon changes in traffic and emission factor data. The data include traffic volume, vehicle miles traveled (VMT), signal cycle timing, and physical roadway improvements. The emission factor data include years of analysis and roadway speeds. The following paragraphs summarize the results

83 STV. 2010. *Red Line/Blue Line Connector Project Technical Memorandum: Air Quality*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

of these analyses; each of the Project alternatives' impacts to air quality is described in the subsequent subsections.

The microscale analysis calculated CO concentrations for the existing conditions, future No-Build Alternative, and the two Build Alternatives. The concentrations are expressed in parts per million (ppm) and include a 1-hour background concentration of 3.0 ppm. The 1-hour CO concentrations were calculated using EPA's CAL3QHC model, with evening peak hour traffic and emission data. The 8-hour CO concentrations were derived by applying a persistence factor of 0.70 to the 1-hour CO concentrations. This persistence factor represents the average ratio of second highest 8-hour to second highest 1-hour CO reading. Similar to the 8-hour CO emissions, the concentrations are expressed in ppm and include an 8-hour background concentration of 2.1 ppm. The EPA has set the NAAQS for CO to protect the public health. The NAAQS for CO sets maximum concentrations of 35 ppm for a 1-hour period and 9 ppm for an 8-hour period, each not to be exceeded more than once per year.

The microscale analysis indicates that reductions in CO concentrations are expected to occur over time when compared to the 2009 existing conditions. All of the calculated future CO concentrations (both 1- and 8-hour) are equal to or less than the 2009 existing conditions concentrations. These reductions can be attributed to more efficient vehicles with enhanced emissions control technologies and the benefits of the Massachusetts' vehicle inspection and maintenance program. None of the existing conditions or future No-Build and Build Alternatives concentrations approaches the 1-hour or 8-hour CO NAAQS.

A regional (mesoscale) analysis estimated the area-wide emissions of VOCs, NO_X, CO_2, CO, and PM emissions. The mesoscale analysis evaluated the changes in emissions based upon changes in the average daily traffic volumes, roadway lengths, and vehicle emission rates. The analysis calculated the 2018 and 2030 mobile source emissions from the major roadways in the study area. Table 5.6-1 provides the results of the mesoscale analysis.

The results of the greenhouse gas (CO_2) analysis are provided in Table 5.6-2. There are minor differences in CO_2 emissions between the two Build Alternatives, but both are lower than under the No-Build Alternative.

Table 5.6-1 Mesoscale Analysis Results

Parameter	2009 Existing	2018 No-Build	2018 Alt. 1	2018 Alt. 2	2030 No-Build	2030 Alt. 1	2030 Alt. 2
Vehicle Miles Traveled (VMT) [1]	34,474,957	35,675,241	35,669,992	35,669,992	37,340,874	37,335,625	37,335,625
Pollutant			**Emissions (kilograms per day)**				
Volatile Organic Compounds (VOCs)	17,155.9	12,404.0	12,402.1	12,402.1	8,049.2	8,047.9	8,047.9
Emissons							
Build/No-Build Difference			(1.8)	(1.8)		(1.4)	(1.4)
Nitrogen Oxides (NO_x)	41.183.1	18.534.9	18.532.2	18.532.2	6.392.7	6.391.9	6.391.9
Emissons							
Build/No-Build Difference			(2.7)	(2.7)		(0.8)	(0.8)
Particulate Matter 2.5 ($PM_{2.5}$)	954.1	709.7	709.6	709.6	478.3	478.2	478.2
Emissons							
Build / No-Build Difference			(0.1)	(0.1)		(0.1)	(0.1)
Particulate Matter 10 (PM_{10})	1,509.5	1,280.8	1,280.6	1,280.6	1,028.9	1,028.7	1,028.7
Emissons							
Build/No-Build Difference			(0.2)	(0.2)		(0.1)	(0.1)
Carbon Monoxide (CO-Winter)	515,607.5	427,680.9	427,618.0	427,618.0	333,314.4	333,271.7	333,271.7
Emissons							
Build / No-Build Difference			(62.9)	(62.9)		(42.7)	(42.7)

1 VMT represents the vehicle miles traveled on an average weekday in 2030.

2 The Build Alternatives used for the air quality analysis includes improved traffic operations.

Table 5.6-2 Greenhouse Gas Analysis Results

Year	Alternative	CO_2 Emissions in kg/day: Emissions	CO_2 Emissions in kg/day: Change from No-Build	CO_2 Emissions in tons/year: Emissions	CO_2 Emissions in tons/year: Change from No-Build
2009	Existing	19,304,224		7,772,085	
2018	No-Build	20,147,313		8,111,522	
	Alternative 1	20,144,349	-2,964	8,110,329	-1,193
	Alternative 2	20,144,349	-2,964	8,110,329	-1,193
2030	No-Build	21,328,985		8,587,275	
	Alternative 1	21,325,913	-2,964	8,586,039	-1,236
	Alternative 2	21,325,913	-2,964	8,586,039	-1,236

In regard to air toxics, the Red Line/ Blue Line Connector Project is not expected to generate any substantial amount of air toxics in the study area because the

train engines are electric and would not result in the combustion of fuels and the Project would also reduce VMT.

5.6.1.1 No-Build Alternative

The 2018 and 2030 No-Build Alternative 1-hour CO emissions range from a minimum of 4.1 ppm and 4.0 ppm to a maximum of 5.9 ppm and 5.7 ppm, respectively. Similarly, the No-Build Alternative 8-hour CO emissions range from a minimum of 2.9 ppm for 2018 and 2.8 ppm for 2030 to a maximum of 4.1 ppm in 2018 and 4.0 ppm in 2030.

The 2018 and 2030 No-Build Alternative 24-hour PM_{10} emissions would range from a minimum of 40.9 and 40.5 micrograms per cubic meter (ug/ m^3), respectively to a maximum of 42.9 ug/ m^3. The No-Build Alternative annual $PM_{2.5}$ emissions range from a minimum of 11.4 ug/ m^3 to a maximum of 11.5 ug/ m^3 for both 2018 and 2030 conditions. Similarly, the No-Build 24-hour $PM_{2.5}$ emissions range from a minimum of 29.5 ug/ m^3 to a maximum of 30.3 ug/ m^3 for both 2018 and 2030 conditions.

The No-Build Alternative regional VOC and NO_X emissions in 2018 and 2030 would be typically lower than the existing conditions emissions in 2009 due to the implementation of state and Federal emission control programs.

5.6.1.2 Build Alternatives

The highest 1-hour Build CO emissions under the Project's 2018 and 2030 Build Alternatives would occur at Charles Circle (5.9 and 5.7 ppm, respectively). All of these concentrations are well below the 1-hour CO NAAQS of 35.0 ppm. The highest 8-hour Build CO emissions under the Project's 2018 and 2030 Build Alternatives would occur at the Charles Circle (4.1 and 4.0 ppm, respectively). All of these concentrations are well below the 8-hour CO NAAQS of 9.0 ppm.

The 2018 and 2030 24-hour PM_{10} concentrations for the Build Alternatives ranged from a minimum of 40.5 ug/ m^3 to a maximum of 42.9 ug/ m^3. All of the 24-hour PM_{10} concentrations would be well below the PM NAAQS of 150 ug/ m^3. The 2018 and 2030 Build Alternatives annual $PM_{2.5}$ concentrations for the Build Alternatives would range from a minimum of 11.3 ug/ m^3 to a maximum of 11.5 ug/ m^3. All of the modeled annual $PM_{2.5}$ concentrations are well below the $PM_{2.5}$ NAAQS of 15 ug/ m^3. The 2018 Build Alternatives 24-hour $PM_{2.5}$ concentrations would range from a minimum of 29.5 ug/ m^3 to a maximum of 30.3 ug/ m^3. The 2030 Build 24-hour $PM_{2.5}$ concentrations for the Build Alternatives would range from a minimum of 29.1 ug/ m^3 to a maximum of 30.3 ug/ m^3. All of the modeled 24-hour $PM_{2.5}$ concentrations are below the $PM_{2.5}$ NAAQS of 35 ug/ m^3.

The Build Alternatives would result in minor reductions in emissions of VOCs, NO_x, and PM_{10} as compared to the No-Build Alternative. This is consistent with the reduction of approximately 5,000 VMT between the No-Build and Build Alternatives. The air quality study demonstrates that all alternatives for the proposed Red Line/ Blue Line Connector Project comply with the CAAA and the SIP. The ozone mesoscale analysis demonstrates that all Build Alternatives would result in a decrease of VOC, NO_x and PM_{10} emissions, as compared to the No-Build Alternative. Alternatives 1 and 2 would provide CO_2 emission reductions on the order of 1,194 tons/ year in the year 2018 and 1,236 tons/ year under 2030 conditions.

5.6.2 Regulatory Compliance

Design of the Project would fulfill the requirements of the SIP. Air quality would be beneficially impacted following construction. The Project would contribute to continued improvements in air quality in compliance with the Clean Air Act Amendments.

5.7 Noise

This section describes the permanent changes in noise levels that would result from the Project. A more detailed description of these impacts is provided in the Noise and Vibration Technical Report.[84]

The Secretary's Certificate on the EENF required that the environmental consequences evaluation for noise levels:

- Include an analysis of noise for existing and proposed conditions;
- Include a detailed analysis consistent with the FTA guidelines, and an assessment of the impact of service on the surrounding community; and
- Outline a noise monitoring program, indicate areas where mitigation for noise is needed, and identify specific mitigation measures that will be proposed. Specifically address the unique conditions that will be experienced during the construction period and outline construction-related noise mitigation measures.

The noise monitoring methodology is described in Section 4.7; in summary, representative monitoring points along the Cambridge Street corridor were

84 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Noise and Vibration*. Prepared by STV, Inc. in association with Harris Miller Miller Hanson, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at: www.mass.gov/massdot/redblue

selected and monitored for ambient noise levels. Changes in noise levels from operation of the proposed trains were modeled, and any incremental increases in noise levels above FTA guidelines were identified to determine significant impacts. Temporary (construction period) impacts are evaluated in Section 6.7.

5.7.1 Environmental Consequences

Outdoor locations with frequent use such as balconies or park areas where passive recreation occurs may be affected by increased noise levels from the Project. For receptors with no outdoor locations, impact may occur at the nearest building façade. Potential noise impact from transit operations is considered only at locations specified as sensitive by the FTA, and does not include commercial or industrial land uses. The permanent noise impacts that would result from each alternative are described below.

5.7.1.1 No-Build Alternative

There would be no change to noise levels under the No-Build Alternative. Infrastructure improvements to the Blue Line proposed in the MBTA's long range transportation plan are not expected to change ambient noise levels.[85]

5.7.1.2 Alternative 1: Eliminate Bowdoin Station

Since the Project is a subway in an underground tunnel, airborne noise generated by the trains would not propagate significantly into the community. Airborne noise sources from transit operations are limited to a traction power substation near Charles/ MGH Station and fans in ventilation shafts in the median of Cambridge Street at North Anderson Street and near the eliminated Bowdoin Station (as shown in Figures 3-4a and 3-4b).

Day-night noise levels (Ldn) from the traction power substation are projected to be less than 50 dBA at sensitive receptors and no impact is expected. Similarly, Ldn levels from ventilation shafts are projected to be less than 42 dBA and no impact is expected.

There is no potential airborne noise impact from transit operations and no mitigation is required. There is no need for a noise monitoring program during operations.

85 MBTA. 2009. *Capital Investment Program, FY 2010-2014*. Available on-line at: http://www.mbta.com/uploadedfiles/About_the_T/Financials/MBTA%20FY10-FY14%20CIP.pdf. Accessed 2 November 2009.

Ground-borne noise, which is produced when ground-borne vibration propagates into a building and radiates noise from the motion of the room surfaces, has been assessed at sensitive locations along the Cambridge Street corridor for transit operations. Ground-borne noise levels are projected to be 35 dBA or less at sensitive receptors that are further than 100 feet (slant distance) from the crossover just east of Charles/ MGH Station (see Figure 3-4); no impact is projected. At locations within 100 feet of this double crossover, ground-borne vibration levels and ground-borne noise levels are 10 decibels higher than on straight tangent track due to the gaps in the rail running surface at the crossover points and frogs. Ground-borne noise levels are between 35 and 41 dBA (residential criterion is 35 dBA) at four multi-family residences within 100 feet of the crossover. Mitigation measures for vibration, as described in Section 6.8, would address the ground-borne noise levels. Specifically, installing spring-rail frogs, moveable-point frogs, or flange-bearing frogs would eliminate the impact at these locations.

5.7.1.3 Alternative 2: Relocate Bowdoin Station

There would be no difference in noise levels between Alternative 2 and Alternative 1.

5.7.2 Regulatory Compliance

No permanent impacts to noise levels are anticipated from either Build Alternative. The Project would be developed in compliance with FTA noise guidelines.

5.8 Vibration

Vibration levels may increase while operating the Red Line/ Blue Line Connector. Potential ground-borne vibration impact has been assessed for sensitive receptors. This section describes the direct and indirect impacts from vibration that would result from the Red Line/ Blue Line Connector Project. A full account is provided in the Noise and Vibration Technical Report.[86]

The Secretary's Certificate on the EENF required that the environmental consequences evaluation for vibration levels:

- Include an analysis of vibration for existing and proposed conditions;

86 STV. 2009. Red Line/Blue Line Connector Project Noise and Vibration Technical Report. Prepared by STV, Inc. in association with Harris Miller Miller & Hanson, Inc.: Boston. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue.

- Include a detailed analysis consistent with the FTA guidelines, and an assessment of the impact of service on the surrounding community; and
- Outline a vibration monitoring program, indicate areas where mitigation for vibration is needed, and identify specific mitigation measures that will be proposed. Specifically address the unique conditions that will be experienced during the construction period and outline construction-related vibration mitigation measures.

The vibration monitoring methodology is described in Section 4.8; in summary, monitoring points along the Cambridge Street corridor were selected and monitored for ambient vibration levels. Vibration impact criteria were based on FTA guidance, which includes a usage ranking (workshop to residential night/ operating room) scale within the "feelable" range, and an alphabetical scale (VC-A through VC-E) denoting decreasing maximum vibration levels (increasing sensitivity) for equipment. Changes in vibration levels from operation of the proposed subway were modeled, and any incremental increases in vibration levels above FTA guidelines were identified to determine significant impacts.

In addition to ground-borne vibration criteria for humans in residential, institutional, and special buildings and vibration-sensitive equipment, there are ground-borne vibration criteria for potential damage to structures. The limits of vibration that structures can withstand are substantially higher than those for humans and for sensitive equipment. Since buildings in the Project area are typically engineered concrete and masonry or reinforced-concrete, steel, or timber construction, a vibration damage criterion of 98 VdB was used.

Temporary (construction period) impacts are evaluated in Section 6.8. The following paragraphs outline the permanent vibration impacts from each alternative.

5.8.1 Environmental Consequences

Vibration levels may increase while operating the Red Line/ Blue Line Connector. Potential ground-borne vibration impact has been assessed for sensitive receptors.

5.8.1.1 No-Build Alternative

There would be no change to vibration levels under the No-Build Alternative. Infrastructure improvements to the Blue Line proposed in the MBTA's long range transportation plan[87] are not expected to change ambient vibration levels.

5.8.1.2 Alternative 1: Eliminate Bowdoin Station

There would be no ground-borne vibration impact from transit operations to residences, hotels, hospital beds, or institutional land uses. Table 5.8-1 shows the projected ground-borne vibration levels from transit operations at vibration-sensitive equipment at MGH and MEEI. All receptors are expected to be below the VC-E criterion[88] at all locations except for the MEEI Angiogenesis Lab at 325 Cambridge Street where vibrations from transit operations are projected to be below the VC-C criterion.[89]

Since existing vibration levels at sensitive equipment is typically at VC-B[90] or VC-C levels, transit operations are not expected to cause any adverse effect. The sensitive equipment at the MEEI Angiogenesis Lab is a 100x magnification microscope, which typically will only require vibration levels to be below the residential nighttime/ operating room criterion (72 VdB) to avoid impact. Interior vibration levels at the 3rd floor of this building are projected to be 54 VdB, well below this impact criterion. Accordingly, there is no need to mitigate vibration impacts to sensitive equipment.

As mentioned in Section 5.7 above, ground-borne vibration may cause ground-borne noise at four multi-family residences near the crossover by Charles/ MGH Station. The vibration source could be eliminated by using spring-rail frogs, moveable-point frogs or flange-bearing frogs at this location. There is no need for a vibration monitoring plan during operations.

87 MBTA. 2009. *Capital Investment Program, FY 2010-2014*. Available on-line at: http://www.mbta.com/uploadedfiles/About_the_T/Financials/MBTA%20FY10-FY14%20CIP.pdf. Accessed 2 November 2009.
88 VC-E criterion is the most demanding criterion for extremely vibration-sensitive equipment.
89 VC-C criterion is appropriate for most inspection and lithography equipment to 1 micron detail size
90 VC-B criterion is adequate for high-power optical microscopes, and inspection and lithography equipment to 3 micron line widths.

Table 5.8-1 Projected Ground-Borne Vibration Levels at Sensitive Equipment from Transit Operations

Receptor Number	Location	Side of Tracks	Slant Distance to Near Track Tunnel Centerline (feet)	Train Speed (mph)	Maximum Vibration Velocity Level (VdB)	Meets General Vibration Criterion
1	MEEI (325 Cambridge St. 3rd Floor Angiogenesis Lab)	North	57	10	54	VC-C
3	MEEI (1st floor MRI Suite)	North	477	10	32	VC-E
4	MEEI (12th floor Opthalmic Laser Equipment)	North	502	10	24	VC-E
5	MGH (MRI Trailer Outside Founders Building)	North	502	10	31	VC-E
20	MGH (Yawkey 6th floor MRI Suite)	North	120	10	42	VC-E
21	MGH (Northeast Proton Therapy Center 1st floor)	North	324	10	35	VC-E
22	MGH (Ellison 2nd floor MRI Suite)	North	702	10	33	VC-E
23	MGH (Yawkey 10th floor Embryology Lab)	North	393	10	27	VC-E
26	MGH (Wang Building 1st floor)	North	403	10	33	VC-E
40	MGH (Barlett Extension 6th floor Imaging Equipment)	North	433	12	31	VC-E
46	MGH (Simches 7th floor NMR Spectrometer)	North	254	15	38	VC-E

5.8.1.3 Alternative 2: Relocate Bowdoin Station

The vibration levels that would result from Alternative 2 are the same as those that would result from Alternative 1.

5.8.2 Regulatory Compliance

No permanent impacts from vibration are anticipated from either Build Alternative. The Project would be developed in compliance with FTA vibration guidelines.

5.9 Soils and Groundwater

This section describes the permanent impacts to soils and groundwater resources that would result from the Red Line/ Blue Line Connector Project. Temporary (construction period) impacts are discussed in Section 6.9.

5.9.1 Introduction

In accordance with the Secretary's Certificate on the EENF, this section addresses the following issues with regard to the Project's potential impacts to soils and groundwater:

- Anticipated groundwater levels upon the completion of construction;
- Methods to avoid, minimize or mitigate groundwater impacts;
- Opportunities to maintain or increase groundwater levels beyond existing conditions;
- Impact of groundwater level changes on the overall structural integrity of existing foundations and infrastructure; and
- Groundwater monitoring methods to ensure the effectiveness of proposed mitigation measures.

5.9.2 Environmental Consequences

The Project would be an underground subway system, permanently placed within the subsurface soils and, to some degree, groundwater. Permanent impacts to these resources are described below.

5.9.2.1 No-Build Alternative

Under the No-Build Alternative, no changes to the MBTA subway system would occur; therefore, there would be no direct impacts to soils or groundwater.

5.9.2.2 Alternative 1: Eliminate Bowdoin Station

Approximately 175,000 cubic yards (cy) of soil[91] would be permanently removed to construct Alternative 1, as described in Section 6.9. The North Tail Track Tunnel would be constructed in soft, to very stiff, marine clay. The South Tail Track Tunnel would be constructed in both marine clay and glacial till. The Blue Line platform at Charles/ MGH Station would be primarily in marine clay with some marine sand and glacial till at the base of the tunnel. Both the inbound and outbound (south and north) tunnel tubes would be in the "possible glacial moraine deposits" stratum. In this area, this stratum is typically dense sand with layers of silty clay.

91 Keville. 2009. Soils Report. Provided to STV, Incorporated via e-mail on 12 January 2010.

The permanent tunnels, stations, and auxiliary underground structures required for the Project would be designed to be as waterproof as practicable to avoid the issues associated with permanently lowering the groundwater table. It is assumed that anticipated leakage rate of the tunnel will be in the range of 5 gallons per minute (gpm) per 1,000 linear feet of each running tunnel tube. The leakage rate of the SEM tunnel segments will be slightly higher. Shaft leakage is anticipated to be less than 15 gpm, based on the underdrain design for a deep excavation north of Charles Circle. At this preliminary design stage, it is anticipated that the leakage to the permanent structures will be less than aquifer recharge.

The existing Charles/ MGH Station is within the expected zone of settlement. Several buildings between Charles Street and West Cedar Street to the south and east of the South Tail Track are also within the zone of expected settlement. Any potential dewatering within the Charles Circle area could expose the tops of the piles, causing them to rot and the buildings to settle. A monitoring program would be developed to identify and remedy problem situations. Groundwater monitoring is recommended to continue after construction to ensure that adverse long-term impacts to the water table do not occur.

5.9.2.3 Alternative 2: Relocate Bowdoin Station

Permanent impacts to soils and groundwater from Alternative 2 are anticipated to be the same as Alternative 1.

5.10 Surface Water and Stormwater

This section describes the permanent impacts to surface water and stormwater resources that would result from the Project. The Secretary's Certificate on the EENF specified that the DEIR should include a Stormwater Management Plan prepared in accordance with the Massachusetts Stormwater Management Standards and the Massachusetts National Pollutant Discharge Elimination System (NPDES) General Permit. The Secretary's Certificate on the EENF also called for a depiction of areas that will be used for storage or treatment of contaminated soils, groundwater or stormwater, and the location of major control or treatment structures to be utilized during the construction period. Temporary impacts to surface water and stormwater are described in Section 6.10.

5.10.1 Environmental Consequences

Given the urban character of the Project area, proposed changes under the Build Alternatives would occur on developed land rather than undisturbed sites. In fact, the proposed Build Alternatives would occur underground since this is a subway rail improvement project. No new impervious surfaces are proposed, which eliminates the potential for new stormwater-related impacts to the Charles

River. There would be no permanent impacts to wetlands. Temporary impacts to the existing stormwater system from construction would include use of temporary alterations to the stormwater infrastructure and dewatering discharges to the stormdrain system. Section 6.10 evaluates these construction-period impacts.

5.10.1.1 No-Build Alternative

No changes to the existing MBTA subway system are proposed and no new structures would be built under the No-Build Alternative. Therefore, this alternative would require no permanent or temporary changes to the existing stormwater management system.

5.10.1.2 Alternative 1

Alternative 1 would not create any additional impervious surfaces or require any permanent modifications to the stormwater management system in Cambridge Street. No additional drainage to the stormwater or sanitary sewer system would occur, therefore; there will be no additional stormwater flows to the Charles River or Deer Island Treatment Plant.

5.10.1.3 Alternative 2

Impacts to the drainage system from Alternative 2 would be identical to Alternative 1.

5.10.2 Post-construction Management

Post-construction stormwater management infrastructure will mirror the existing system. The preliminary design of the Build Alternatives does not include any long-term alterations to the Boston Water and Sewer Commission (BWSC) drainage system or increased impervious surfaces.

Groundwater dewatering on a permanent basis may be required depending on the permeability of the tunnel walls. Groundwater monitoring would be conducted throughout the construction period to determine this need and the potential volume of groundwater to be treated and either discharged or infiltrated.

The BWSC stormwater drainage system currently combines with the MWRA sanitary sewer system for treatment at the Deer Island Treatment Plant. Therefore, there would not be any on-site stormwater treatment facilities.

Existing stormwater management practices conducted by BWSC will continue, including:

- Regular street sweeping;
- Inspecting and maintaining outfall structures;
- Inspecting and cleaning catch basins;
- Removing snow and ice; and
- Routinely cleaning up trash and litter.

5.10.3 Regulatory Compliance

Both Build Alternatives meet the Massachusetts Stormwater Management Standards because there would be no additional impervious surfaces and no additional stormwater discharges to the receiving water (Charles River). Any relocated or replaced storm drains would be separated, in accordance with BWSC requirements.

5.11 Parks and Recreation Areas

This section describes the permanent impacts to parks and recreation lands that would result from the Project. A detailed account is provided in the Land Use Technical Report.[92]

The Secretary's Certificate on the EENF required that the environmental consequences evaluation clarify ownership of the park at the intersection of Cambridge Street and New Chardon Street (Cardinal Cushing Park, as described in Section 4.11), confirm that it is or is not Article 97 land, and identify what direct impacts to this park may occur as a result of the Project alternatives.

Temporary (construction period) impacts to parks and recreation sites are discussed in Section 6.11. Permanent impacts to these resources are discussed in the following paragraphs.

5.11.1 Environmental Consequences

Two public parks (Cardinal Cushing Park and the Charles River Reservation, including Charles Circle) and one privately owned park (on MGH property) are within the Project area. The potential permanent impacts to these parks and recreation sites are described below.

92 STV. 2009. *Red Line/Blue Line Connector Project Technical Memorandum: Land Use.* Prepared for MassDOT by STV, Incorporated in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue.

5.11.1.1 No-Build Alternative

The No-Build Alternative would not impact any parks or recreation sites.

5.11.1.2 Alternative 1

Alternative 1 would not permanently impact Cardinal Cushing Park or the MGH park. The headhouse at Bowdoin Station, adjacent to Cardinal Cushing Park, would be decommissioned except for use as emergency egress; the physical structure would not be changed. No work would occur at the MGH park. The northeastern wall of Charles/ MGH Station would be relocated outward slightly to accommodate interior reconfiguration. The relocated wall would impact the exterior walkway around the station, which occupies Charles Circle.

The new Blue Line platform that would be constructed at Charles/ MGH Station, and the two tail tracks, would extend underground into the Charles River Reservation. However, these structures would not change the recreational use of the reservation because they would be below the ground surface, under the roadway.

5.11.1.3 Alternative 2

Alternative 2 would have the same surface structures as Alternative 1, although the Bowdoin Station headhouse would be retained for active use. Alternative 2 would not impact parks or recreation sites.

5.11.2 Regulatory Compliance

The Project is primarily located within the City of Boston right-of-way of Cambridge Street, extending into the Charles River Reservation at Charles/ MGH Station. A temporary occupancy permit for work within the Charles River Reservation, issued by DCR, would be required. Neither Build Alternative would permanently impact Article 97-protected land.

5.12 Visual Environment

This section describes the permanent impacts to the visual environment that would result from the Project. The Secretary's Certificate on the EENF did not include any requirements for evaluation of the Project's impacts to the visual environment.

5.12.1 Environmental Consequences

The Project area is a highly developed urban environment, and the majority of the Project would be under ground. Surface elements of the Project would be limited to ventilation grates, emergency egress points, and a minor alteration to the exterior of Charles/ MGH Station.

5.12.1.1 No-Build Alternative

There would be no changes to surface components of Bowdoin Station or Charles/ MGH Station under the No-Build Alternative. Accordingly, the visual environment would not be impacted.

5.12.1.2 Alternative 1

The only surface structure that would be visibly altered under Alternative 1 is Charles/ MGH Station. The northeastern outer wall of the station would be relocated slightly to accommodate interior modifications (see Figure 3-4a). The reconstructed wall would be identical in appearance to the existing wall, with no impact to the visual environment.

New ventilation grates and emergency egress points with protective bollards would be installed in the center median of Cambridge Street at several locations (Figure 5.12.1). The grates would be flush with the ground surface; they would be visible but not readily apparent and would not change the visual environment.

5.12.1.3 Alternative 2

The impacts to the visual environment under Alternative 2 would be identical to those described above for Alternative 1. In addition, there will be an exhaust ventilation grate placed in the Cambridge Street Median (adjacent to the Charles River Plaza development) and an emergency hatchway egress grate in the roadway at the Staniford Street intersection. These grates would be flush with the ground surface; they would be visible but not readily apparent and would not change the visual environment (Figure 5.12-2). Although the Bowdoin Station headhouse would be used for regular access instead of just emergency egress, its outward appearance would not be changed.

5.12.2 Regulatory Compliance

There are no applicable regulatory requirements for impacts to the visual environment from the subsurface structures of the Project.

5.13 Historic and Archaeological Resources

This section outlines the direct permanent impacts to historic and archaeological resources that would result from the Project. A detailed account of these resources is provided in the Historical and Archaeological Resources Technical Report.[93] The Secretary's Certificate on the EENF required that the environmental consequences evaluation for historic resources include:

- Consultation with the Massachusetts Historical Commission (MHC) to evaluate impacts and develop appropriate mitigation;
- Describe measures that will be employed to avoid, minimize, and mitigate impacts to historic and cultural resources; and
- Include a commitment to provide field survey, research, analysis, and documentation services in order to comply with appropriate federal and state regulations, including the NHPA.

Temporary (construction period) impacts are evaluated in Section 6.13. The following paragraphs outline the permanent impacts to historic and archaeological resources from each alternative.

5.13.1 Environmental Consequences

Several historic structures and one historic district are within the Project area. No archaeological resources are known to exist but are likely within the western end of the Project area. Permanent impacts to historic resources, and a management program to identify archaeological resources, are described in the following paragraphs.

5.13.1.1 No-Build Alternative

The No-Build Alternative would not impact any historic or archaeological resources.

5.13.1.2 Alternative 1

Alternative 1 would not impact any historic resources because there would be no operational noise, vibration, or land acquisition requirements. There are no

93 STV. 2009. *Red Line/Blue Line Connector Historic Resources Reconnaissance Survey and Archaeological Resources Assessment*. Prepared by STV, Inc. in association with Public Archaeology Laboratory: Pawtucket, RI. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue.

known archaeological resources within the Project area, but portions of the subsurface along the historic Shawmut Peninsula shoreline have been identified as high sensitivity for archaeological resources. As described in Section 6.13, a monitoring program would be developed to describe archaeological resource management requirements if any such resources are encountered during construction.

5.13.1.3 Alternative 2

Alternative 2 would also not impact historic resources, and would be subject to the same construction-phase monitoring for archaeological resources as Alternative 1.

5.13.2 Regulatory Compliance

There would be no permanent impacts to historic resources and, accordingly, both Build Alternatives for the Project would be in compliance with regulatory requirements. It is not known if impacts to archaeological resources would occur. As described in Section 6.13, a monitoring program would be developed for the construction phase and, if any archaeological resources are encountered, they would be managed in accordance with applicable MHC requirements. Consultation with MHC has been initiated to develop the monitoring plan.

5.14 Hazardous Materials and Solid Waste

The Secretary's Certificate on the EENF required that the environmental consequences evaluation of hazardous wastes and contaminated soils:

- Describe how contaminated soils will be evaluated, managed, and disposed;
- Summarize the potential relationship between existing conditions and the Project construction impacts; and
- Ensure, through consultation with DEP, that demolition and management of contaminated soils are consistent with applicable regulations.

These issues are evaluated in Section 6.14. There would be no permanent impacts from either Build Alternative.

5.15 Secondary and Cumulative Impacts

Based on the environmental consequences evaluations provided for each resource above, permanent adverse impacts would not result from either Build

Alternative. There would be no induced growth or land use change from the Project because there would be no new stations and no substantial increase in new transit ridership. Accordingly, there would be no substantive secondary or cumulative permanent impacts from the Project.

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6

Construction Period Impacts

6.1 Introduction

This Chapter describes the temporary impacts that constructing either of the Red Line/ Blue Line Connector Project alternatives may have on the environmental resources described in Chapter 4, Affected Environment. The temporary, construction-period impacts from the two Build Alternatives are considered here separately from the permanent impacts described in Chapter 5, Environmental Consequences. Regulatory compliance issues for adverse impacts to these resources are also described.

The temporary impact resource evaluations respond to the requirements of the Secretary's Certificate on the EENF and consider the comment letters received on the EENF. The analyses were developed in compliance with the MEPA regulations.

The following paragraphs summarize the construction activities for the Project, much of which are common between the two Build Alternatives. For the resources considered in this Chapter, impacts from construction activities to close or relocate Bowdoin Station do not vary substantively.

The tunnels for the Blue Line extension under Cambridge Street west of the Bowdoin Station would be constructed by a horizontal boring machine. This machine would bore the two (in-bound and out-bound) tunnels beneath existing infrastructure. Except at access points at either end of the alignment, all work along this segment would be completed below grade. Surface disturbance on Cambridge Street would be limited; any required traffic detours would be scheduled at night or on weekends, rather than during weekday work hours. East of Bowdoin Station, for approximately 550 feet, cut-and-cover construction would be used to realign the existing tracks from Government Station. Traffic

would be detoured along this section of Cambridge Street during the construction period. Open excavation would also be used to construct the ventilation shafts at the terminus of both tail tracks immediately west of Charles/ MGH Station, the tunnel boring machine access shaft east of Charles/ MGH Station, and the nearby Anderson Street vent shaft; these cut and cover excavations total approximately 250 feet in length. The open excavation areas are shown in Figures 3-4a and 3-4b, and 3-5a and 3-5b, for Alternatives 1 and 2, respectively. The open trenches would be covered with decking when possible to minimize impacts to traffic.

Buried utilities within the Cambridge Street corridor would be temporarily relocated to accommodate the open excavations. A complete inventory of buried utilities would be conducted as part of final design; coordination with service providers would be necessary. The numerous utilities known to be present include water, stormwater, and sewer pipelines; electrical ductbanks; natural gas pipelines, and telecommunications lines.

A staging area, tentatively established as a portion of the MEEI parking lot immediately northwest of Charles/ MGH Station, would be the main access point to the excavation area. A second access point would be established near Bowdoin Station to allow the boring machine to be removed.

A project requirement is that four lanes of automobile traffic, and unimpeded pedestrian traffic, be retained at all times except during night-time and weekend work periods. Traffic patterns would be altered by the temporary detours during these periods.

6.2 Land Use

The Project's temporary impacts to non-recreational land uses along the Cambridge Street corridor are described below. Recreational land use impacts are separately discussed in Section 6.11. A more detailed description of impacts to land use is provided in the Land Use Technical Report.[94]

The Secretary's Certificate on the EENF for the Red Line/ Blue Line Connector Project specifically required evaluation of construction period impacts to land use for:

- Each property;
- Chapter 91 riverfront and floodplain areas, if any; and

94 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Land Use*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue.

- Temporary easements.

The Project area lies principally within the City of Boston right-of-way along Cambridge Street. The Cambridge Street corridor is highly developed with commercial, institutional (medical facilities), and residential land uses. A portion of Charles/ MGH Station, as well as the two tail tracks, extends underground into the Charles River Reservation, owned by DCR. This section summarizes construction period impacts to general land uses from the two Build Alternatives.

Rerouting traffic along the moving work zones for the cut-and-cover excavations described above could temporarily impair access to some businesses and residences along the Cambridge Street corridor. Some pedestrian traffic may also be impacted along Cambridge Street due to work zone locations affecting sidewalks (e.g., rerouting of pedestrian crossings and alterations to pedestrian routes).

Access to the MEEI parking lot north of the Charles/ MGH Station, leased from DCR to MEEI, would be eliminated during construction while this area is used for staging and a temporary parking structure. A temporary occupancy permit from DCR during construction within the Charles River Reservation boundary is anticipated to be required.

Temporary construction easements would be required at the following locations:

- Parking lot under the elevated Red Line (east of Charles/ MGH Station, adjacent to West Cedar Street) – Eye Research Institute; and
- John F. Kennedy Federal Building Plaza (plaza/ handicapped parking area in front of the building) – Boston Redevelopment Authority.

The use of the parking lot under the elevated Red Line would be temporarily restricted due to underpinning of the Red Line Pier No. 7. Vehicle access to the John F. Kennedy Federal Building Plaza would be temporarily restricted while constructing the eastern end of the tunnel in the cut-and-cover excavation section.

6.3 Environmental Justice

This section describes the temporary impacts to environmental justice populations that would result from the Red Line/ Blue Line Connector Project.

A more detailed description of the impacts to environmental justice populations is provided in the Environmental Justice Technical Report.[95]

Environmental justice populations could be adversely impacted during construction activities due to increases in noise, vibration, or air pollution, traffic (pedestrian and automobile) disruption, decreases in access to parks, and neighborhood fragmentation during operation of the Red Line/ Blue Line Connector.

As documented in other sections in this Chapter, the construction phase activities for the tunnels would:

- Disturb traffic temporarily, with detours and nighttime or weekend work periods, constricting business hours.
- Not result in noise impacts to sensitive receptors, given the predominant subsurface nature of the work and existing background noise levels within this highly developed area of the city, as well as regulatory requirements.
- Not result in air quality impacts, also given the predominant subsurface nature of the work and regulatory controls on emission sources.
- Disturb, but not restrict, access to parks; and
- Not result in neighborhood fragmentation.

Construction activities would be conducted in accordance with regulatory requirements and management practices (e.g., noise and dust controls). Environmental justice populations would not be disproportionately impacted by the Red Line/ Blue Line Connector Project construction activities.

There are no applicable regulations for impacts to environmental justice populations. Federal and state agency policy requires analysis to determine if impacts are disproportionate. Because there would be no substantive temporary adverse impacts to air quality, noise or vibration levels, access to parks, traffic disruptions, or neighborhood fragmentation for any populations from either Build Alternative, environmental justice populations would not be disproportionately impacted.

95 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Environmental Justice*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue.

6.4 Existing Transportation Systems

This section outlines the Project's temporary impacts to existing transportation systems. The Secretary's Certificate on the EENF required that the construction-period evaluation for impacts to existing transportation systems summarize the integration of the Project into the overall transit system and the anticipated benefits or drawbacks of constructing the Project.

Existing transportation systems consist of the Red Line and Blue Line subways with the Charles/ MGH and Bowdoin Station at either end of the Project area, the greater MBTA system, and local shuttles. Constructing either Build Alternative would temporarily impact the MBTA subway system by closing Bowdoin Station; Government Station would be the terminus of the Blue Line until construction is complete. Passengers that would otherwise access the Blue Line trains at Bowdoin Station would be required to use Government Station instead. It is assumed that the majority of the passengers boarding or alighting at Bowdoin Station walk from or to Charles/ MGH Station, or businesses or residences along or near the Cambridge Street corridor. During construction, these patrons would be required to walk the extra 350 yards to or from Government Center Station. Local shuttle service may be impacted by the traffic detours as described in Section 6.5.

6.5 Traffic

This section describes the construction-period impacts to traffic for both Build Alternatives. A more detailed description of the impacts to traffic is provided in the Traffic Technical Report.[96]

The Secretary's Certificate on the EENF required:

- A construction staging plan with the goal of maintaining four lanes of traffic on Cambridge Street during construction and limiting the temporary removal of parking and loading zones. The plan should focus on maintaining full and efficient access along the Project corridor for emergency vehicles. Mitigation measures should be developed to ensure access.

- A traffic management plan to discourage cut-through traffic along residential streets in Beacon Hill and the West End.

96 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Traffic.* Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue

These plans will be developed prior to the construction period, and will be based upon the impacts described below. Constructing either Build Alternative would temporarily impact traffic operations, emergency access and truck routes, pedestrians and bicycles, and parking.

Traffic Operations

During construction of Alternative 1, the geometry and/ or signal timings at five intersections would be altered:

- Charles Circle – Charles Street/ Storrow Drive westbound off-ramp;
- Cambridge Street at Joy Street;
- Cambridge Street at Staniford/ Temple Street;
- Cambridge Street at New Chardon/ Bowdoin Street; and
- Cambridge Street at New Sudbury/ Somerset Street.

Modifications at Charles Circle would be in effect throughout the entire construction period and include a reduction in the number of lanes provided in the northbound direction (under Charles/ MGH Station) from six lanes to three lanes.

Minor signal modifications would be implemented at the intersection of Cambridge Street at Joy Street during certain phases of construction. The crosswalk on the east side of this intersection would be moved approximately 35 feet east. To accommodate this shift, the clearance times (yellow and red signal indications) would be increased. The overall signal operations would not change and therefore no change in level of service is expected.

The traffic signal cycle length at the intersection of Cambridge Street at Staniford/ Temple Street would be modified during the morning peak hour so that this intersection can remain part of a coordinated signal system with New Chardon and New Sudbury Streets. No other changes are proposed and this intersection would not see degradation in LOS due to this change.

The Cambridge Street intersections at New Chardon/ Bowdoin Street and New Sudbury/ Somerset Street would be altered for a large portion of the construction period. During this phase of construction, Cambridge Street would be reduced to two travel lanes plus a turning lane in both directions of travel between New Chardon Street and Court Street. Signal timing and phasing adjustments at the intersections of Cambridge Street and New Chardon/ Bowdoin Street and Cambridge Street at New Sudbury/ Somerset Street would be modified to accommodate this temporary traffic condition. Overall existing LOS would be maintained at these intersections; however, some movements would experience an increase in delay due to construction. Traffic control would be managed through the use of police detail when necessary.

Other temporary lane closures and detours would be required on occasion to facilitate moving equipment into and out of work zones and to support other construction measures. Proposed detour routes are shown in Figure 6.5-1. These lane closures and detours would occur at night and on weekends and are expected to have a limited impact on off-peak traffic operations. There would also be temporary closure of New Sudbury Street at nights and on weekends. Access to New Sudbury Street would be maintained from Congress Street.

Emergency Access and Truck Routes

Emergency access would be maintained at all times throughout the area. Temporary disruptions to existing emergency vehicle, the Partners Shuttle, and truck routes would occur during the closure and detour of Cambridge and Sudbury Streets on nights and weekends over the course of the project. Close coordination with emergency response officials and area hospitals would be ongoing throughout construction to ensure all emergency responders have unimpeded access as needed. Routing for trucks for removal of soil excavated from the Project area is described in Section 6.9.

Pedestrians and Bicycles

Maintaining traffic through construction includes accommodating pedestrian and bicycle flow along the Cambridge Street corridor. Pedestrians may be directed along temporary walkways when work is occurring at certain areas, such as between MGH and Charles/ MGH Station.

There is one location where minor impacts to pedestrian accommodations would be unavoidable. At the intersection of Cambridge Street at Joy Street, the pedestrian crosswalk across Cambridge Street would be moved to the east about 35 feet during a portion of the construction period. The current pedestrian signal crossing and traffic control would be maintained and the delay to pedestrians waiting to cross the street would not change. For pedestrians heading to/ from Charles River Plaza from Joy Street, the walk trip would increase by less than 10 seconds.

Minor signal timing adjustments at Staniford/ Temple Street and New Chardon/ Bowdoin Street would be needed throughout the duration of construction. These minor timing changes would have a negligible effect on pedestrian levels of service at the intersection crosswalks.

Parking

Eighty-nine parking spaces along Cambridge Street would be impacted at some point during construction. All but five of these spaces would only be impacted during specific phases of construction. The five metered spaces at Cambridge Street westbound near Charles Circle would be impacted for the entire duration

of the construction period, but would be restored to service when construction is completed. There would be no loss of residential parking. Table 6.5-1 presents the type and location of the parking impacts. The duration of impact would be further refined as the design for the Project is progressed.

In addition to the above-noted spaces, for the duration of construction, the existing MEEI parking lot on Charles Street (under the Storrow Drive ramps) would be used as a construction staging area. To accommodate MEEI patients and visitors who use this parking lot, a temporary multi-story parking structure would be constructed on the portion of the lot that would not used for construction staging.

Table 6.5-1 Construction-related Parking Impacts

Location	Number and Type	Associated with
Cambridge Street Westbound near Charles Circle	5 metered	Mobilization/Staging, utility relocation, subsurface grouting and decking support construction
Cambridge Street Eastbound near Charles Circle	4 metered 2 commercial	Mobilization/Staging, utility relocation, subsurface grouting and decking support construction
Cambridge Street Eastbound near North Anderson Street	9 metered 1 loading zone	Vent room & egress hatch construction
Cambridge Street Westbound near North Anderson Street	3 metered	Vent room & egress hatch construction
Cambridge Street Eastbound between Blossom Street and Hancock Street	1 commercial	Median element construction
Cambridge Street Westbound between Hancock Street and Blossom Street	7 metered	Median element construction
Cambridge Street Eastbound between Bowdoin Street and Court Street	3 loading zone 21 metered 10 unrestricted	Slurry wall/utility relocation and decking construction
Cambridge Street Westbound between Bowdoin Street and Court Street	14 metered 9 Handicapped[1]	Slurry wall/utility relocation and decking construction
TOTAL	63 metered 3 commercial 4 loading zone 10 unrestricted 9 handicapped	

1 An additional six handicapped parking spaces would be temporarily relocated from Cambridge Street to New Chardon Street.

6.6 Air Quality

This section describes the temporary impacts to air quality that would result from constructing the Project. A detailed evaluation is provided in the Air Quality Technical Report.[97]

The Secretary's Certificate on the EENF required an assessment of potential air quality impacts during the construction phase, and a proposal for sufficient mitigation to offset increases in localized construction period air quality.

Construction activities associated with utility relocation, grading, excavation, track and tunnel work, and the installation of systems components could result in temporary air quality impacts. Air quality in the study area is not expected to be substantially affected by project construction because of the temporary nature of the construction and the confined construction area. Emissions from the operation of construction machinery could include nitrogen oxides, sulfur oxides, carbon monoxide, and particulate matter.

In an effort to reduce air quality emissions from temporary construction activities, the Project will contractually require the construction contractors to adhere to all applicable regulations regarding control of construction vehicles emissions. This will include, but not be limited to, maintenance of all motor vehicles, machinery, and equipment associated with construction activities and proper fitting of equipment with mufflers or other regulatory-required emissions control devices. Also, the prohibition of excessive idling of construction equipment engines will be implemented, as required by MA DEP regulations in 310 CMR 7.11.

Additionally, construction specifications will require that all diesel construction equipment used on-site will be fitted with after-engine emission controls, such as diesel oxidation catalysts (DOCs) or diesel particulate filters (DPFs).[98] The Project will also contractually require the construction contractors to utilize ultra-low sulfur diesel fuel for all off-road construction vehicles as an additional measure to reduce air emissions from construction activities. The Project will put idling restriction signs on the premises to remind drivers and construction personnel of the state's idling regulation.

The contractor will also be responsible for protective measures around the construction and demolition work to protect pedestrians and prevent dust and debris from leaving the site or entering the surrounding community. Dust generated

97 STV. 2010. *Air Quality Technical Report*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the *Alternatives Analysis Technical Report,* provided on the Project website at www.mass.gov/massdot/redblue

98 This is consistent with the Certificate of Construction Equipment Standard Compliance Form required for all bids to the MBTA.

from earthwork and other construction activities like stockpiled soils will be controlled by spraying with water to mitigate wind erosion on open soil areas. Other dust suppression methods will be implemented to ensure minimization of the off-site transport of dust. There will be regular sweeping of the pavement of adjacent roadway surfaces during the construction period to minimize the potential for vehicular traffic to create airborne dust and particulate matter.

6.7 Noise

This section describes the temporary impacts to noise levels that would occur during construction. A more detailed description of the impacts to noise levels is provided in the Noise and Vibration Technical Report.[99]

The Secretary's Certificate on the EENF required that the evaluation for construction period noise levels outline a noise monitoring program, indicating areas where mitigation for noise is needed, and identifying specific mitigation measures that will be proposed. The evaluation should specifically address the unique conditions that will be experienced during the construction period and outline construction-related noise mitigation measures.

Above-ground construction methods assessed for potential noise impact include pier reconstruction and ventilation shaft drilling, jet grouting, utility relocation, cut and cover excavation, and ventilation structure and building construction. Construction noise is dependent on the specific equipment used, the location of equipment and the duration of use. Noise-generating construction equipment expected for this Project include air compressors, generators, jack hammers, auger drill rigs, soil mix drill rig (for jet grouting), back hoes, dump trucks, cranes, clam shovels, excavators, hoe rams (hydraulically powered impact device), concrete mixer trucks, and concrete pumps.

Potential noise impact from construction activities has been assessed at FTA Category 2 (residential, hotels, hospital beds) receptors for daytime, evening and nighttime periods and at institutional and commercial receptors for the daytime period. For short-term construction activities, a preliminary "worst-case" scenario of potential noise impact without mitigation indicates that 26 residential properties and 26 institutional and commercial properties may be exposed to construction noise impact. L10 construction noise levels (those that exceed 10 percent of the time over a specified measuring period) are generally 80 to 90 dBA at these closest receptors.The typical daytime criterion is 75 dBA for residences and 80 dBA for commercial land uses, typical evening criterion is

99 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Noise and Vibration*. Prepared by STV, Inc. in association with Harris Miller Miller Hanson, Inc.: Boston. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue

65 to 78 dBA at residences and typical nighttime criterion is 65 to 70 dBA at residences. These properties are shown in Figure 6.7-1.

Construction noise mitigation would include preparing a Noise Control Plan in conjunction with the contractor's specific equipment, schedule, and methods of construction, specifying maximum noise limits for each piece of equipment, prohibiting certain types of equipment during the nighttime hours, and engineering noise control measures.

6.8 Vibration

This section describes the temporary impacts to vibration levels that would occur during construction of the Red Line/ Blue Line Connector Project. A detailed evaluation is provided in the Noise and Vibration Technical Report.[100]

The Secretary's Certificate on the EENF required that the construction-period evaluation for vibration levels outline a vibration monitoring program, indicate areas where mitigation for vibration is needed, and identify specific mitigation measures that will be proposed. The evaluation should also specifically address the unique conditions that will be experienced during the construction period and outline construction-related vibration mitigation measures.

Vibration levels may increase while constructing the Red Line/ Blue Line Connector. The MEEI building at 325 Cambridge Street and the multi-family residential building at 315 Cambridge Street may be exposed to vibration from construction activities which could cause damage to building foundations, annoy humans within the buildings, and affect vibration-sensitive equipment. These locations are shown in Figure 6.7-1.

There are no regulatory requirements for managing vibration during construction activities. To mitigate the potential impacts, the contractor will need to use specific construction methods and equipment to minimize the potential for damage, annoyance or adverse effects on noise-sensitive equipment. Such methods may involve not using a clam shovel for excavation, not using a typical drill rig prior to jet grouting, or using a particular drill rig which generates lower vibrations. Given the close proximity of the construction activities to these buildings, other mitigation measures such as trenches or wave barriers are likely infeasible.

100 STV. 2009. *Red Line/Blue Line Connector Project Technical Report: Noise and Vibration*. Prepared by STV, Inc. in association with Harris Miller Miller Hanson, Inc.: Boston. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue

6.9 Soils and Groundwater

This section describes the construction-period impacts to soils and groundwater that would result from the Project.

6.9.1 Temporary Impacts

Both Build Alternatives would involve excavations for the subsurface construction activities, and management (dewatering) of groundwater that would seep in to the excavations. Soil and groundwater management is described below.

6.9.1.1 Soils

Excavating the tunnels and other subsurface features, whether by tunneling or open excavations, will generate some 175,000 cy of soil. Due to the urban nature of the construction site, on-site stockpiling excavated materials will not be possible. As described in Section 5.14, some contaminated soil is likely to be encountered, requiring special management for appropriate disposal. Pre-characterization of soil would be completed to allow direct loading of trucks for off-site disposal. Trucks would be routed to and from the Project area as shown in Figure 6.9-1.

Soil excavation and disposal will be completed following MCP rules and regulations, as well as the state Hazardous Waste Management Rule and the federal Resource Conservation and Recovery Act (RCRA) regulations. A management plan for disposal of regulated materials, including contaminated soils if needed, is described in Section 6.14, Hazardous Materials and Solid Waste.

6.9.1.2 Groundwater

Shallow groundwater is present in the construction area, as described in Section 4.9. Groundwater monitoring wells and piezometers would be installed and in-situ permeability testing conducted in the excavation and tunneling areas. The piezometers and wells would allow water level monitoring. Particular attention will be placed in the areas in and around the Groundwater Conservation Overlay District (GCOD) area and in areas where SEM excavation would occur.

The piezometers and wells would be installed during the final investigation stage to allow for an extended monitoring period, ideally at least 1 year, prior to the start of construction. Monitoring water levels in the wells for an extended period prior

to construction would establish a baseline of groundwater elevations that would allow an assessment of seasonal and diurnal variations in groundwater level. Threshold and Limiting groundwater elevations would be set for each of the wells used to monitor the construction. If the groundwater level were to decline below the Threshold value, the Contractor would be required to take measures to restore it, as described below. If the groundwater drops below the Limiting value, the contractor would be required to stop all work until the appropriate level is restored. Groundwater monitoring would continue after construction is complete to ensure that adverse impacts to the water table do not occur.

Dewatering would likely be required when mining the Bowdoin Station platform area between the two tunnels, and possibly from other construction areas. The volume or quality of groundwater that would be dewatered would be calculated in later stages of design. It is anticipated that the groundwater would have to be lowered temporarily as much as 40 feet to the tunnel invert in the Bowdoin Station platform area and 20 feet to the tunnel invert in the Charles/ MGH Station platform area.[101] Greater drawdown is anticipated outside of the Project limits, as groundwater flows toward the construction area, in response to drawdown to the tunnel invert. However, shallow wood-pile building foundations are not anticipated in this area, so drawdown is not expected to impact any adjacent structures. If further analysis during final design concludes that the groundwater drawdown would have detrimental effects on adjacent structures, a grout curtain cutoff may be installed at the crown of the two TBM tube tunnels in the platform area.

Alternative No. 1 does not require additional excavation at Bowdoin Station platform between the two TBM tubes to accommodate the relocated platform of Alternative 2. Therefore, if Alternative 1 is chosen, there would not be a need to lower the groundwater level in this area. Alternative 2 would require dewatering and drainage of the soil above the roof of the Bowdoin Station and at the station/ tunnels face to allow the use of the SEM to mine the area for the new Bowdoin Station platform. Groundwater levels would need to be lowered to the tunnel subgrade elevation.

The construction specifications for the Project would require that if drawdown to the water table is found during construction, the Contractor would take the following actions to restore groundwater levels:

- Seal any visible leaks in the excavation support system by grouting or other means;
- Add additional grouting to the mined areas to reduce seepage; and

101 Personal Communication with John Kastrinos, Haley and Aldrich, Groundwater Drainage Meeting, VHB, Boston, November 19, 2009.

- Recharge the groundwater by installing infiltration basins or recharge wells in the affected areas; or
- A combination of the above three methods.

After completing these actions and allowing the water table to respond, an assessment of the effectiveness of the remedial measures on the water table would be made. If the resulting water table has not reached the pre-determined baseline elevation, additional mitigation efforts would be required.

A groundwater cutoff wall on the western end of the Project area will be explored during final design and construction planning to reduce dewatering requirements. Alternatively, a large-scale, jet grout, ground improvement program could be undertaken to create a strong arch of low permeability soil over the Blue Line platform area at Charles/ MGH Station.

As discussed in Sections 5.9 and 5.14, contaminated shallow groundwater is likely to be found in the Charles Circle area, Bowdoin Station area, and along the alignment of the cut-and-cover excavation at the east end of the Project area. The shallow groundwater pumped from these areas would likely need to be treated before discharge.

Permeation grouting of the glacial till from within the tunnel as the tunnel advances will likely be required to reduce groundwater inflow and to prevent softening of exposed glacial till surfaces associated with excessive seepage or heave of a clay subgrade due to hydrostatic uplift pressures in the underlying glacial till.

Dewatered groundwater from the Project would not be discharged without proper pre-treatment and permitting from DEP, MWRA, and/ or EPA. A typical water treatment method would be used to settle out solids in groundwater in a fractionation (frac) tank, then route the water (by pumping) through activated carbon before releasing it. The western end of the North Tail Track area may be well-suited for siting a temporary water treatment facility. Groundwater would be pumped from excavation areas and recharged back to the ground only in an area approved by DEP and/ or EPA.

For small, short-term excavations where only limited dewatering is anticipated, treated groundwater extracted during dewatering would be pumped from one side of the Project area to another trench. This option would apply only when a very small volume of water is collected and where such return to groundwater would not result in flooding over the ground surface or within nearby subsurface utilities or other structures. If a larger volume of groundwater is removed, excess groundwater may be pumped into drums or frac tanks for temporary containment during construction activities. The drums or tank(s) would collect and store the water until subsurface work is complete. In some cases, it may be

possible to return the collected water into the opened excavation once the subsurface work is complete. If groundwater is dewatered from an MCP site, then the water can only be replaced into the ground within the MCP site boundaries (as long as there is no oil on the water).

Off-site disposal would be considered in areas where treatment and recharge is not possible. Groundwater would be pumped into a container or tank truck and then shipped to an off-site treatment and disposal facility, using a Bill Of Lading or hazardous waste manifest.

6.9.2 Regulatory Context

State and federal regulations and guidelines applicable to management of soil and groundwater during construction include the following:

- NPDES Remediation General Permit Regulations (40 CFR 122) -untreated discharges to remediation sites; and/ or
- NPDES Construction General Permit Regulations (40 CFR 122) - treated discharges to stormwater system;
- RCRA Regulations, 40 CFR Part 261.310- hazardous materials, hazardous waste, and solid waste;
- Massachusetts Hazardous Waste Management Rules (CMR 30.000); and
- MCP (310 CMR 40.0000).

Coverage under the Remediation General Permit (RGP) is required for authorization to discharge contaminated, dewatered groundwater from construction sites to waters designated in the Massachusetts Surface Water Quality Standards (SWQS). In the event of a CSO discharge, the receiving water, Charles River, is designated under the SWQS as a Class B water, as described in Section 4.10. The RGP would be required if dewatered groundwater is infiltrated to MCP-identified remediation sites within the Project area. Coverage under the Massachusetts National NPDES Construction General Permit (CGP) would be required for the discharge of uncontaminated, dewatered groundwater at the Project site, whether infiltrated or discharged through the BWSC stormwater system.

The Massachusetts Hazardous Waste Management Rules implements RCRA by regulating the storage, collection, transport, treatment, disposal, use, reuse, and recycling of contaminated soils. The MCP is a body of regulations designed to streamline and accelerate the assessment and cleanup of releases of oil and hazardous materials to the environment, as outlined in Section 4.14.2.

6.10 Surface Water and Stormwater

This section describes the construction-period impacts to surface water and stormwater that would result from the Project. A detailed account is provided in the Stormwater Management Plan.[102] Also included in this section is a discussion of groundwater discharges, as collected groundwater may be discharged through the with stormwater drain system.

The Secretary's Certificate on the EENF required:

- A proposed Stormwater Management Plan, prepared in compliance with the DEP Stormwater Management Policy (SMP) and the NPDES CGP.
- An evaluation of drainage in the new tunnel during the construction period.
- Supplemental graphics that depict the existing drainage patterns and areas used for storage or treatment of contaminated soils, groundwater, or stormwater, and the location of major control or treatment structures to be utilized during the construction period.
- Demonstration that source controls, pollution prevention measures, erosion and sediment controls during construction, and post-development drainages system are consistent with the SMP for water quality and quantity impacts and the NPDES CGP.

6.10.1 Temporary Impacts

Temporary impacts to the existing stormwater system would occur during construction, which would temporarily alter the stormwater infrastructure and discharge to the storm drain system. This analysis focuses on evaluating these temporary construction impacts to the existing stormwater system. This section describes the proposed sedimentation and erosion control measures for both Build Alternatives during construction as well as groundwater treatment and dewatering methods.

Temporary impacts to an area regulated under the Wetlands Protection Act would also occur during construction. A portion of the staging area in the MEEI parking lot is within Bordering Land Subject to Flooding (BLSF), protected under the Massachusetts Wetlands Protection Act. The area subject to flooding (see Figure 4.10-1a) were identified and mapped according to existing Flood Insurance Rate Map (FIRM) issued by the Federal Emergency Management Agency (FEMA). The MEEI staging area is included on the City of Boston

102 STV. 2009. *Stormwater Management Plan*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue

Community FIRM Panel No. 25025C0077G, revised September 25, 2009. Base flood elevations were not available for this portion of the City however, according to the FIRM, a portion of the staging area coincides with a B Zone: an area of moderate flood hazard, which is usually the area between the limits of the 100-year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.

As discussed in Section 6.9, groundwater dewatering would be necessary during construction due to the high water table. As described in the Limited Phase I Environmental Site Assessment[103] and Groundwater Management Plan,[104] groundwater in much of the Project area is expected to be contaminated from leaks and seepage of hazardous materials, and will need to be treated prior to discharge and/ or infiltration.

6.10.1.1 Stormwater Generation

The existing stormwater management system would be temporarily altered during construction to accommodate the excavation activities. Some of the stormwater drainage piping (see Figures 4.10-1a and b) would be temporarily relocated during construction. The drainage system would be reconstructed to its original alignment upon completion of each phase of construction and any altered CSO infrastructure would be separated into stormwater and sanitary sewer infrastructure as required under BWSC Sanitary Sewer regulations.

6.10.1.2 Stormwater Pollutant Sources

Sedimentation associated with exposed soils during the cut-and-cover construction phase, if untreated, could negatively impact the environment:

- A decrease in visibility and increase in turbidity for aquatic organisms, making it difficult for these organisms to capture prey;
- A decrease in light availability for photosynthetic organisms;
- Closing of gills in fish and aquatic species;
- Reduction in spawning of fish and general survival;

103 STV. 2009. *Limited Phase I Environmental Site Assessment*. Prepared by STV, Inc. in association with TRC Corporation: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue

104 STV. 2009. *Groundwater Management Plan*. Prepared by STV, Inc. in association with Haley & Aldrich: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue

- Increase in the transport of heavy metals, phosphorous and other pollutants through waterways as they attach to the sediment particles and harm water quality.

6.10.1.3 Stormwater Management

In order to comply with the Massachusetts Stormwater Standard 8 (control of construction-related impacts) and the NPDES CGP, MassDOT would develop a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP would describe the sediment and erosion control measures that would be put in place during construction. Key elements of the SWPPP are briefly described below.

Erosion Control Measures

Soils in the Project area generally consist of miscellaneous fill, organic (tidal) silt, marine clay, marine sand, and glacial till (see Section 4.9). Due to the highly urbanized nature of the Project area and proposed construction methodology, there would not be any excavations requiring sloped soils. Exposed soils would be located within the cut-and-cover construction areas, which would serve as detention basins during rainfall events. Furthermore, exposed soils would be stabilized where necessary throughout the Project area using permeation grouting. For example, the South Tail Track Tunnel would be advanced through both marine clay and glacial till. Permeation grouting of the glacial till from within the tunnel as the tunnel advances would likely be required to reduce groundwater inflow and to prevent softening of exposed glacial till surfaces associated with excessive seepage or heave of a clay subgrade due to hydrostatic uplift pressures in the underlying glacial till.

Although discharges to the Charles River are not planned, CSO situations could result in a release to the Charles River. Outlet protective/ velocity dissipation devices would be required by the CGP to be placed at existing discharge locations (Outfall MWR022 to the Charles River; see Figure 4.10-1a) to provide a non-erosive flow velocity from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected. A joint agreement between MassDOT, BWCS, and MWRA must be initiated to implement this measure due to the joint ownership of drainage infrastructure. Outlet protection devices to be considered include rock, grouted riprap, or concrete rubble placed at the MWR 022 outfall to prevent scour of the soil caused by high flow velocities during construction and to absorb flow energy to produce non-erosive velocities.

Sediment Control Measures

Although unlikely, sedimentation from construction operations may be possible, primarily within the proposed cut-and-cover construction locations adjacent to

Bowdoin and Charles/ MGH Stations. Sediment control measures during construction of the Build Alternatives would include storm drain inlet protection, street sweeping, perimeter controls, stabilized construction entrances/ exits, temporary sediment basins, and staging area management.

Storm Drain Inlet Protection

Storm drain inlet protection measures prevent soil and debris from entering storm drain drop inlets. These measures are temporary and would be implemented before the Project site is disturbed. The type of filter used depends on the inlet type (for example, curb inlet, drop inlet), slope, and volume of flow. Inlet types under consideration include fabric barriers around inlet entrances, block and gravel protection, and proprietary inlet filters.

Street Sweeping

The City of Boston currently maintains a daily street sweeping schedule for long-term pollutant and sediment control. Pollutants, including sediment, debris, trash, road salt, and trace metals, can be minimized by street sweeping. The City's cleaning occurs daily (a bi-monthly schedule covers each neighborhood) from April through November by contracted and City-owned mechanical sweepers. Nightly street sweeping along Cambridge Street during Project construction could be negotiated through an agreement with MassDOT and the City of Boston.

Perimeter Controls

Silt fences to stop sediment from leaving the site would be considered in locations where the use of these devices would not impair pedestrian or vehicle access to businesses and residences. These control measures may be useful adjacent to cut-and-cover construction locations to ensure that sediment transport does not occur. They would also create an appropriate pedestrian safety barrier.

Stabilized Construction Entrances/Exits

The purpose of stabilizing entrances to/ exits from a construction site is to minimize the amount of sediment leaving the area as mud and sediment attached to vehicles.[105] Stabilizing the entrance/ exit can improve both the appearance and the public perception of the construction project. Stabilized construction entrances/ exits are commonly made of large crushed rock. Due to the highly urbanized nature of the Cambridge Street corridor, it may not be possible to utilize these materials. However, MassDOT would consider using concrete pads or corrugated steel panels (rumble pads), if possible.

105 U.S. Environmental Protection Agency's Construction Site Stormwater Runoff Control Best Management Practices List (http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=4).

Sediment Basins and Rock Dams

A single temporary sediment basin or equivalent controls is not feasible due to the urbanized site area; however, smaller sediment basins and/ or sediment traps are acceptable. Cut-and-cover excavations would serve as temporary sediment basins during rainfall events.

Staging Area Management

The proposed construction staging area at the MEEI parking lot is located within the Charles River Reservation, owned by the DCR. Construction equipment and maintenance materials would be stored at the combined staging area and materials storage areas.

A small portion of the staging area would be located within the BLSF (see Figure 4.10-1a); therefore, flood hazard protection is also required within this area. Gravel bag berms would be installed around the perimeter to designate the staging and materials storage area and protect the area from potential flooding. A watertight shipping container would be used to store smaller construction materials and tools.

6.10.1.4 Groundwater Discharge

As described in Section 6.9, groundwater that seeps into the excavated areas, and accumulated rain water, would be collected and discharged. The following discharge options are being explored:

- Recharge to the MCP-allowed areas (100 feet of the regulated contaminated site; see Figures 4.14-1a and 4.14-1b);
- Discharge to the BWSC/ MWRA Sanitary Sewer System, if possible;
- Discharge to the storm drain system or infiltrate in on-site trenches, as covered under the NPDES RGP for treatment of the groundwater; and/ or
- Dispose off-site.

All options depend on dewatering flow calculations that are not yet available. The NPDES RGP would require treatment based on the quality of groundwater during the time of construction. A sampling and analysis program just prior to and during construction, to determine and monitor water quality during construction, would be developed. Treatment and infiltration options are described in further detail below.

Treatment

According to the Limited Phase I Environmental Site Assessment,[106] multiple releases of many different contaminants have occurred within the Project area. Pollutants found in the groundwater would likely include metals, petroleum products, and polycyclic aromatic hydrocarbons. Based on the close proximity of the release sites to proposed excavation areas, shallow groundwater pumped from the excavation areas would likely need to be treated before it can be released. A typical treatment method would be to settle out solids in a frac tank, then pump the water through activated carbon before releasing it. Treatment options will be limited by siting constraints. The western end of the North Tail Track area may be well-suited for siting a temporary water treatment facility.

Infiltration

As described in the Groundwater Management Plan,[107] many buildings in the Charles Circle area are supported on timber piles. The water table in this area is currently depressed and many of the timber pile-supported buildings in this area, which have not already been underpinned, are at risk of subsidence under the No-Build Alternative.

The most feasible infiltration option to be explored during construction and post-construction includes the use of infiltration trenches. A trench would be excavated, lined, and backfilled with stone to form a subsurface basin. Collected groundwater and stormwater would be pumped into the trench and stored until it can infiltrate into the soil. Infiltration trenches are adaptable Best Management Practices (BMPs), and the availability of many practical configurations make them ideal for small urban drainage areas, such as along the Cambridge Street corridor.[108]

6.10.2 Regulatory Compliance

Coverage under the NPDES CGP would be required because the Project disturbs over one acre of land. As described above, a SWPPP would be required to identify potential sources of stormwater pollution during construction and describe practices to reduce pollutants in stormwater discharges. The SWPPP will be developed and implemented in accordance with NPDES and DEP standards.

106 STV. 2009. *Hazardous Materials Inspection Technical Memorandum.* Prepared by STV, Inc. in association with TRC Corporation. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue

107 STV. 2009. *Groundwater Management Plan*. Prepared by STV, Inc. in association with Haley & Aldrich: Boston. Appended to the *Alternatives Analysis Technical Report*, provided on the Project website at www.mass.gov/massdot/redblue

108 U.S. Department of Transportation Federal Highway Administration. *Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring.* (http://www.fhwa.dot.gov/environment/ultraurb/index.htm)

A portion of the Project is within the City of Boston Groundwater Conservation Overlay District (GCOD). A Massachusetts Licensed Professional Engineer would certify that the proposed construction would not lower groundwater levels at properties within the GCOD. Although the GCOD recharge requirements are primarily targeted towards impervious surfaces, the Project may be subject to these requirements due to the need for dewatering during construction.

A portion of the staging area in the MEEI parking lot is within BLSF. It is likely that an Order of Conditions from the Boston Conservation Commission would be required for alterations made and/ or work done within this resource area.

Dewatered groundwater from the Project would not be discharged to nearby storm drains and/ or surface water bodies without proper pre-treatment and permitting from DEP, MWRA, and/ or EPA. Groundwater would be pumped from excavation areas and recharged back to the ground only in an area approved by DEP and/ or EPA.

If Combined Sewer Overflow infrastructure is altered, the CSO infrastructure would be replaced with separated stormwater and sanitary sewer infrastructure, as required by BWSC sewer regulations.

6.11 Parks and Recreation Areas

This section describes the temporary impacts to parks and recreation lands that would result from the Project. A detailed account is provided in the Land Use Technical Report.[109]

Two public parks (Cardinal Cushing Park and the Charles River Reservation, including Charles Circle) and one privately owned park (on MGH property) could be impacted by the Project. Both Build Alternatives would temporarily impact Charles Circle, Cardinal Cushing Park, and the MGH park by restricting access. Pedestrians would be detoured around work zones when construction activities were underway. Pedestrian access through Cardinal Cushing Park would be temporarily rerouted to a walkway on the northern side of the park, immediately in front of the One Bowdoin Square building.

A temporary construction work zone would be located within the Charles River Reservation adjacent to the Charles/ MGH Station. Traffic would be temporarily rerouted during night and weekend construction. A temporary occupancy

109 STV. 2009. *Land Use Technical Report*. Prepared by STV, Inc. in association with Vanasse Hangen Brustlin, Inc.: Boston. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue

permit during construction within the Reservation boundary is anticipated to be required.

6.12 Visual Environment

This section describes the temporary impacts to the visual environment that would result from the Project. The Secretary's Certificate on the EENF did not include any requirements for evaluating the Project's impacts to the visual environment during construction.

Constructing either Build Alternative would include open excavations at the eastern and western ends of the Project area, relocating the northeastern exterior wall of Charles/ MGH Station with scaffolding, a construction staging area and temporary parking structure at the MEEI parking lot, and traffic detours. Each of these elements would be highly visible to passers-by and occupants of adjacent buildings. The existing landscape and streetscape elements of the recently completed Cambridge Street renovation project would be restored at the conclusion of the Project. Any trees damaged by construction would be replaced.

6.13 Historic and Archaeological Resources

This section outlines the temporary impacts to historic and archaeological resources that would result from the Project. A detailed account of these resources is provided in the Historical and Archaeological Resources Technical Report.[110] The Secretary's Certificate on the EENF required that the construction-period evaluation for historic resources include a commitment to provide field survey, research, analysis, and documentation services in order to comply with appropriate federal and state regulations, including the NHPA. The following paragraphs outline the temporary impacts to historic and archaeological resources from each alternative and these mitigation commitments.

Several historic structures and one historic district are within the Project area. No archaeological resources are known to exist. Temporary impacts to historic resources, and a management program to identify archaeological resources, are described in the following paragraphs.

Constructing either Build Alternative would not result in temporary impacts to any historic structures. No historic properties would be acquired or buildings

110 STV. 2009. *Red Line/Blue Line Connector Historic Resources Reconnaissance Survey and Archaeological Resources Assessment.* Prepared by STV, Inc. in association with Public Archaeology Laboratory: Pawtucket, RI. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue

demolished, and no impacts from increased noise or vibration are expected. Access to historic sites may be temporarily altered during certain phases of construction, but would not be significantly constrained.

Subsurface work (excavation and tunneling) may encounter buried archaeological resources, most likely within filled tidelands west of the historic shoreline. Additional archaeological investigations would be needed in high sensitivity areas to locate, identify, evaluate, and record significant cultural deposits. A monitoring program would be developed to describe archaeological resource management requirements if any such resources are encountered during construction. The monitoring program would be developed in consultation with MHC and, if any archaeological resources are encountered, they would be managed in accordance with applicable MHC requirements. Consultation with MHC has been initiated to develop the monitoring plan.

6.14 Hazardous Materials and Solid Waste

This section describes how hazardous materials and solid wastes would be managed during the construction period. A preliminary management plan for soils and groundwater, which may be contaminated, is presented in the Soil and Groundwater Management Plan.[111]

The Secretary's Certificate on the EENF required that the construction-period evaluation of hazardous wastes and contaminated soils:

- Describe how contaminated soils will be evaluated, managed, and disposed;
- Summarize the potential relationship between existing conditions and the Project construction impacts; and
- Ensure, through consultation with DEP, that demolition and management of contaminated soils are consistent with applicable regulations.

As described in Section 6.9, contaminated soil or groundwater may be encountered while constructing either Build Alternative. Excavations to 50 feet below ground surface would likely be through contaminated soil, and dewatering activities (specifically in the vicinity of Bowdoin Station) may involve impacted groundwater. Exposure to residual hazardous materials in soil and/ or groundwater may present a risk to worker health, and any materials with concentrations of chemicals in excess of regulatory standards must be treated and/ or disposed of properly. A soil and groundwater management plan,

111 STV. 2009. *Soil and Groundwater Management Plan*. Prepared by STV, Inc. in association with TRC Environmental Corporation. Appended to the Alternatives Analysis Technical Report, provided on the Project website at www.mass.gov/massdot/redblue

describing testing protocols, on-site management, and eventual treatment or disposal, would be developed prior to construction.

Construction and demolition in Bowdoin Station would generate solid waste; preliminary estimates determined that approximately 7,500 cy of construction and demolition debris may be generated. Some of this debris may be special waste, requiring special management for worker exposure and waste disposal. Suspected lead-, mercury-, or asbestos-containing building materials, as well as polychlorinated biphenyl products and petroleum products, are present within Bowdoin Station and the existing tunnels. Construction or demolition activities in the Bowdoin Station or Bowdoin Loop tunnels may result in worker exposure to these regulated materials. The nature and extent of the exposure risk is not possible, at this phase of the design, to determine. A hazardous materials and/ or special waste management plan, describing testing protocols, on-site management, and eventual treatment or disposal would be developed to the extent necessary, based upon the final design, prior to construction.

Hazardous waste materials such as oil filters, petroleum products, paint, and equipment maintenance fluids would be stored in structurally sound and sealed shipping containers, within the hazardous materials storage area. Hazardous waste materials would be stored in appropriate and clearly marked containers and segregated from other non-waste materials. Secondary containment would be provided for all waste materials in the hazardous materials storage area and would consist of commercially available spill pallets. Additionally, all hazardous waste materials would be disposed of in accordance with federal, state, and municipal regulations. All waste materials would be collected and disposed of into two metal trash dumpsters in the materials storage area. Dumpsters would have a secure watertight lid, be placed away from stormwater conveyances and drains, and meet all federal, state, and municipal regulations. Further details regarding these methods would be included in the SWPPP.

Any hazardous materials (hazardous wastes, hazardous materials, or contaminated soil or groundwater) would be managed in accordance with relevant regulatory requirements for treatment, storage, and disposal. The management plans described above would be developed with and approved by the DEP prior to implementation.

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7

Draft Section 61 Findings and Mitigation Commitments

7.1 Introduction

As required by the Secretary's Certificate on the EENF, this Chapter identifies all proposed mitigation commitments and provides draft Section 61 Findings for the proposed Project.

7.2 Project Benefits

The proposed Project (Preferred Alternative) is expected to generate 8,800 new daily boardings and alightings at the Blue Line's twelve stations and reduce transfers by 4,200 per day. It would also reduce VMT by 5,249 per day (projected to the year 2030). The increased transit access and ridership will improve corridor mobility, improve traffic conditions, improve regional air quality, increase services to environmental justice populations, and support future smart growth initiatives and sustainable development.

7.3 Project Mitigation

Potential permanent impacts resulting from constructing the proposed Project would be mitigated by design measures, as summarized in Table 7-1.

Table 7-1 Project Mitigation Commitments

Environmental Categories	Mitigation Measure	Implementation Schedule	Implementation Responsibility
Noise	Provide spring frogs at crossover location to mitigate ground-borne noise.	Completion of construction	MassDOT/MBTA
Soils and Groundwater	Permeation grout the glacial till from within the tunnel, underpin piers and foundations as necessary prior to construction; monitor during and after construction. Repair damage as necessary.	Prior to and during construction	MassDOT/MBTA

7.4 Construction Period Mitigation

Temporary, short-term impacts from construction activities would be mitigated to the extent practicable. MBTA and MassDOT are responsible for these construction mitigation measures, and would insure that appropriate action items are incorporated into the contract documents. Specifications governing the activities of contractors and subcontractors constructing elements of the Project would also be included. On-site resident engineers and inspectors will monitor all construction activities to ensure that mitigation measures are properly implemented. The cost of the construction-period mitigation measures is included in the overall construction cost estimate. The construction mitigation measures and management protocols are summarized in Table 7-2 and described in detail in Chapter 6 of this DEIR.

Table 7-2 Construction Period Mitigation and Management Protocols

Traffic

Establish temporary detours to minimize traffic disruption.
Adjust traffic signal timing at five intersections.
Coordinate with emergency response and hospitals to ensure unimpeded access.
Install temporary pedestrian walkways.
Construct temporary parking structure for MEEI visitors.

Air Quality

Apply water to dry soil and construction vehicles to prevent dust production.
Follow existing MBTA retrofit procedures for construction equipment to reduce emissions.
Prohibite excessive idiling (per 310 CMR 7.11) to reduce air emissions.
Use ultra-low sulfur diesel to reduce air emissions.
Sweep street/pavement regularly to control dust.

Noise

Use specially quieted equipment with enclosed engines and/or high-performance mufflers.
Keep truck idling to a minimum.
Route construction equipment and vehicles through areas that would cause the least disturbance to nearby receptors where possible.
Fit any air-powered equipment with pneumatic exhaust silencers.
Locate stationary construction equipment as far as possible from noise-sensitive sites.

Vibration

Use alternative construction methods to minimize the use of impact and vibratory equipment (e.g., pile drivers and compactors).
Monitor sensitive buildings for vibration damage to foundations and inspect sidewalks and retaining walls; repair as necessary

Surface Water/Stormwater

Develop and implement a SWPPP in accordance with NPDES and DEP standards.
Use dewatering controls, if necessary.
Maintain construction equipment to prevent oil and fuel leaks.
Treat dewatered groundwater prior to discharge.
Replace altered CSOs with separated stormwater and sanitary sewer infrastructure, as required by BWSC sewer regulations.
Implement special management procedures for any hazardous, contaminated or special wastes generated during construction, including special handling, dust control, and management and disposal of contaminated soil. Procedures should protect both workers and nearby receptors.
Perform subsurface investigations to test for possible soil or groundwater contamination; develop Soil and Groundwater Management Plan as necessary.
Treat and dispose of contaminated soil or groundwater dewatering effluent in accordance with DEP requirements.
Prepare a site-specific Health and Safety Plan.
Conduct pre-demolition inspections to identify any hazardous materials such as asbestos and lead-based paint in Bowdoin Station.

Soils/Groundwater

Recharge dewatered groundwater where possible.
Conduct monitoring program to identify and remedy water drawdown issues.
Restore groundwater through leak sealing and additional grouting.
Construct groundwater cut-off wall to reduce dewatering requirements in addition to a large-scale jet grouting effort.

7.5 Proposed Section 61 Findings

These Proposed Section 61 Findings for the Project have been prepared to comply with the requirements of Massachusetts General Laws, Chapter 30, Section 61, and in accordance with the MEPA regulations at 301 CMR 11.07(6)(k). The MEPA regulations require state agencies and authorities to review, evaluate, and determine the impacts on the natural environment of all projects or activities requiring permits issued by the state, and to issue findings describing the environmental impacts, if any, and certifying that all feasible measures have been taken by the Project proponent to avoid or minimize these impacts. Each state agency that issues a permit for the project shall issue a Section 61 Finding in connection with permit issuance, identifying mitigation that is relied on to satisfy the Section 61 requirement. The following agencies are anticipated to issue a Section 61 Finding:

- MBTA; and
- Department of Conservation and Recreation.

7.5.1 Project Description

The Red Line/ Blue Line Connector Project consists of extending the Blue Line service from Bowdoin Station to Charles/ MGH Station. The Project location is shown in Figure 1-1. The Project would use realigned tracks 250 feet west from the Government Center Station to the relocated Bowdoin Station and new tracks from relocated Bowdoin Station to Charles/ MGH Station. The Project would also require constructing a new subsurface platform for the Blue Line east and beneath the Charles/ MGH Station headhouse, with pedestrian connections to the elevated platforms for the Red Line. Bowdoin Station would be eliminated to allow for faster travel times (by eliminating a stop) under Alternative 1 or relocated to provide greater transit access (by retaining the headhouse but relocating both east and westbound platforms to accommodate six-car trains) under Alternative 2.

As required by the Secretary's Certificate on the EENF, these two Build Alternatives and a No-Build Alternative are evaluated in this DEIR. The No-Build Alternative is evaluated as a baseline condition to which the Build Alternatives may be compared. For either Build Alternative, reconstructing the track through Bowdoin Station would include bypassing the loop track for a straighter alignment to Charles/ MGH Station. The current conceptual design specifies two tracks throughout the length of the Project, as compared to up to four tracks in some sections as previously envisioned. The majority of the Project length would have two separate tunnels.

For the majority of the length of the Blue Line extension, between Bowdoin Station and Charles/ MGH Station, the tunnels would be constructed by a horizontal boring machine beneath existing infrastructure. Except at access points at either end of the alignment, all boring work would be completed below grade, and surface disturbance would be limited. A staging area, tentatively established as a portion of the MEEI parking lot immediately north of Charles/ MGH Station, would be the main access point. A second access point would be at Bowdoin Station to allow the boring machine to be removed. Three portions of the Project would be constructed with cut-and-cover excavation, and decking would be installed over the excavations to minimize disruption of surface traffic.

For Alternative 1, Bowdoin Station would be deactivated, although passageway through the station and headhouse would be retained for emergency egress. For Alternative 2, the platform at Bowdoin Station would be relocated. The new platform would be west of, and about 22 feet below, the current platform location to accommodate the necessary slope to reach the new Blue Line platform at Charles/ MGH Station. The platform would be on a straight segment of track, allowing full use of the six-car trains.

For either Build Alternative, the new platform for the Blue Line at Charles/ MGH Station would be constructed immediately east of, and below, the existing headhouse. Two new elevator shafts would be constructed to the Blue Line level, as would a stairway and two escalators from the existing street level headhouse down to the Blue Line platform level. A single 320-foot long center platform would be constructed. There would be two tail tracks, for train storage, extending west beyond the station.

There will be no new parking facilities, facilities for passenger drop-off and pick-up, or bus stops. No additional station staff is expected since fares will be paid at the existing fare gates in the headhouse.

Alternative 1: Blue Line Extension to Charles/ MGH Station with Eliminated Bowdoin Station has been selected as the Preferred Alternative for the Red Line/ Blue Line Connector Project. This alternative provides the best balance of cost, ridership, and environmental impacts. MassDOT also believes that this alternative will help the Commonwealth achieve its goal of improving regional air quality and providing expanded transportation services. This alternative would have more operational reliability and have a lower capital cost than Alternative 2. Alternative 1 would meet all Project goals, would be operationally practical, and would generate a higher number of new system-wide transit trips.

7.5.2 History of MEPA Review

An EENF was submitted to the EEA on September 14, 2007. The Secretary of EEA issued a Certificate on the EENF on November 15, 2007, requiring a DEIR for the Project.

7.5.3 Related Permits and Approvals

The Project will require permits and approvals from several local, state and Federal agencies. Table 7-3 below lists the permits and approvals that are anticipated for the Project.

Table 7-3 Possible Permits or Approvals

Agency	Approval or Permit
Federal Transit Administration (if federal funding is used)	Finding of No Significant Impact Section 4(f) Determination Section 106 Finding Federal funding approval
U.S. Environmental Protection Agency Region I	NPDES Permit for stormwater discharges and construction period Remediation General Permit (EPA, Federal Register, September 9, 2005) Section 61 Finding
Massachusetts Department of Environmental Protection	Compliance with Massachusetts Stormwater Management Standards and Regulations
MassDOT/MBTA	State funding approval Section 61 Finding
Massachusetts Department of Conservation and Recreation	Access permits Section 61 Finding
Massachusetts Historical Commission	Approval of archaeological monitoring plan
Massachusetts Water Resource Authority	Compliance with MWRA NPDES permit No. MA0103284 for discharges through the Combined Sewer Overflow system Sewer Use Discharge Permit (issued jointly with MWRA)
City of Boston	Approval for temporary road closings/detours for construction Building permits as needed for construction
Boston Conservation Commission	Order of Conditions for work in Bordering Land Subject to Flooding
Boston Water & Sewer Commission	Approval for temporary relocation of stormwater and sewer infrastructure (NPDES Permit No. MA0101192) Drainage Discharge Permit and/or Dewatering Discharge Permit Sewer Use Discharge Permit (issued jointly with MWRA)

7.5.4 Overview of Project Impacts and Mitigation Measures

This section summarizes the impacts to environmental resources and the mitigation measures proposed to prevent or reduce these impacts that would result from the preferred alternative.

7.5.4.1 Noise

Ground-borne vibration may cause ground-borne noise at four multi-family residences near the crossover by Charles/ MGH Station. The vibration source could be eliminated by using spring-rail frogs, moveable-point frogs, or flange-bearing frogs at this location. There is no need for a vibration monitoring plan during operations.

7.5.4.2 Soils and Groundwater

Permeation grouting of the glacial till from within the tunnel as the tunnel advances will likely be required to reduce groundwater inflow and to prevent softening of exposed glacial till surfaces associated with excessive seepage or heave of a clay subgrade due to hydrostatic uplift pressures in the in the underlying glacial till.

The existing Charles/ MGH Station is within the expected zone of settlement. Several buildings between Charles Street and West Cedar Street to the south and east of the South Tail Track are also within the zone of expected settlement. Any potential dewatering within the Charles Circle area could expose the tops of the piles, causing them to rot and the buildings to settle. A monitoring program would be developed to identify and remedy problem situations. Groundwater monitoring is recommended to continue after construction to ensure that adverse impacts to the water table do not occur.

The construction specifications for the Project would require that if drawdown to the water table is found during construction, the Contractor would take the following actions to restore groundwater levels:

- Seal any visible leaks in the excavation support system by grouting or other means;
- Add additional grouting to the SEM mined areas to reduce seepage;
- Recharge the groundwater by installing infiltration basins or recharge wells in the affected areas; or
- A combination of the above three methods.

After completing the repair and allowing the water table to respond, an assessment of the effectiveness of the remedial measures on the water table would be made. If the resulting water table has not reached the pre-determined baseline elevation, additional mitigation efforts would be required.

Dewatering would likely be required during the SEM construction. At the current design stage, there is no information on the volume or quality of groundwater that would be dewatered. It is anticipated that the groundwater would have to be lowered temporarily as much as 20 feet to the tunnel invert in the Charles/ MGH Station platform area.[112] Greater drawdown is anticipated outside of the Project limits, as groundwater flows toward the construction area, in response to drawdown to the tunnel invert. However, shallow wood-pile building foundations are not anticipated in this area, so drawdown is not expected to impact any adjacent structures. If further analysis during final design concludes that the groundwater drawdown would have detrimental effects on adjacent structures, a grout curtain cutoff may be installed at the crown of the two TBM tube tunnels in the platform area.

Alternative No. 1 does not require additional excavation at Bowdoin Station platform between the two TBM tubes to accommodate the relocated platform of Alternative 2. Therefore, there would not be a need to lower the groundwater level in this area.

A groundwater cutoff wall on the western end of the Project area will be explored during final design and construction planning to reduce dewatering requirements. Alternatively, a large-scale, jet grout, ground improvement program could be undertaken to create a strong arch of low permeability soil over the Blue Line platform area at Charles/ MGH Station.

Dewatered groundwater from the Project would not be discharged to nearby storm drains and/ or surface water bodies without proper pre-treatment and permitting from DEP, MWRA, and/ or EPA. A typical water treatment method would be used to settle out solids in groundwater in a frac tank, then route the water (by pumping) through activated carbon before releasing it. The western end of the North Tail Track area may be well-suited for siting a temporary water treatment facility. Groundwater would be pumped from excavation areas and recharged back to the ground only in an area approved by DEP and/ or EPA.

For small, short-term excavations where only limited dewatering is anticipated, treated groundwater extracted during dewatering would be pumped from one side of the Project area to another trench. This option would apply only when a very small volume of water is collected and where such return to groundwater

112 Personal Communication with John Kastrinos, Haley and Aldrich, Groundwater Drainage Meeting, VHB, Boston, November 19, 2009.

would not result in flooding over the ground surface or within nearby subsurface utilities or other structures. If a larger volume of groundwater is removed, excess groundwater may be pumped into drums or frac tanks for temporary containment during construction activities. The drums or tank(s) would collect and store the water until subsurface work is complete. In some cases, it may be possible to return the collected water into the opened excavation once the subsurface work is complete. If groundwater is dewatered from an MCP site, then the water can only be replaced into the ground within the MCP site boundaries (as long as there is no oil on the water).

Off-site disposal would be considered in areas where treatment and recharge is not possible. Groundwater would be pumped into a container or tank truck and then shipped to an off-site treatment and disposal facility, using a Bill Of Lading or hazardous waste manifest.

7.5.4.3 Traffic

During construction of the Project, geometry and/ or signal timings at five intersections would be altered:

- Charles Circle – Charles Street/ Storrow Drive westbound off-ramp;
- Cambridge Street at Joy Street;
- Cambridge Street at Staniford/ Temple Street;
- Cambridge Street at New Chardon/ Bowdoin Street; and
- Cambridge Street at New Sudbury/ Somerset Street.

Traffic detours would be established during construction to minimize traffic disruption and ensure access to this area is maintained. Emergency access would be maintained at all times throughout the area. Temporary disruptions to existing emergency vehicle, the Partners Shuttle, and truck routes would occur during the closure and detour of Cambridge and Sudbury Streets on nights and weekends over the course of the project. Close coordination with emergency response officials and area hospitals would be ongoing throughout construction to ensure all emergency responders have unimpeded access as needed.

Maintaining traffic through construction includes accommodating pedestrian and bicycle flow along the Cambridge Street corridor. Temporary walkways would be installed where necessary to direct pedestrians around work zones. There is one location where minor impacts to pedestrian accommodations would be unavoidable. At the intersection of Cambridge Street at Joy Street, the pedestrian crosswalk across Cambridge Street would be moved to the east about 35 feet during a portion of the construction period. The current pedestrian signal crossing and traffic control would be maintained by temporarily relocating the traffic signal equipment. The delay to pedestrians waiting to cross the street would not change.

For pedestrians heading to/ from Charles River Plaza from Joy Street, the walk trip would increase by less than 10 seconds.

Minor signal timing adjustments at Staniford/ Temple Street and New Chardon/ Bowdoin Street would be needed throughout the duration of construction. These minor timing changes would have a negligible effect on pedestrian levels of service at the intersection crosswalks.

There would be no permanent or temporary loss of residential parking and no mitigation is required. However, there would be temporary losses of commercial and metered parking during construction. The MEEI parking lot on Charles Street (under the Storrow Drive ramps) would be used as a construction staging area. To accommodate MEEI patients and visitors who use this parking lot, a temporary multi-story parking structure would be constructed on the portion of the lot that would not used for construction staging.

7.5.4.4 Air Quality

Construction activities associated with utility relocation, grading, excavation, track and tunnel work, and the installation of systems components could result in temporary air quality impacts. Air quality in the study area is not expected to be substantially affected because of the temporary nature of the construction and the confined construction area. Emissions from the operation of construction machinery could include nitrogen oxides, sulfur oxides, carbon monoxide, and particulate matter.

In an effort to reduce air quality emissions from construction activities, the Project will contractually require the construction contractors to adhere to all applicable regulations regarding control of construction vehicles emissions. This would include, but not be limited to, maintaining all motor vehicles, machinery, and equipment associated with construction activities and proper fitting of equipment with mufflers or other regulatory-required emissions control devices. Also, excessive idling of construction equipment engines would be prohibited, as required by MA DEP regulations in 310 CMR 7.11.

Additionally, construction specifications would require that all diesel construction equipment used on-site will be fitted with after-engine emission controls, such as diesel oxidation catalysts or diesel particulate filters.[113] Additionally, the Project would contractually require the construction contractors to utilize ultra-low sulfur diesel fuel for all off-road construction vehicles as an additional measure to reduce air emissions from construction

113 This is consistent with the Certificate of Construction Equipment Standard Compliance Form required for all bids to the MBTA.

activities. The Project would put idling restriction signs on the premises to remind drivers and construction personnel of the state's idling regulation.

The contractor would also be responsible for protective measures around the construction and demolition work to protect pedestrians and prevent dust and debris from leaving the site or entering the surrounding community. Dust generated from earthwork and other construction activities like stockpiled soils would be controlled by spraying with water to mitigate wind erosion on open soil areas. Other dust suppression methods would be implemented to ensure minimization of the off-site transport of dust. Pavement of adjacent roadway surfaces would be swept regularly during the construction period to minimize the potential for vehicular traffic to create airborne dust and particulate matter.

7.5.4.5 Stormwater

A SWPPP would be developed and implemented in accordance with NPDES and DEP standards. Dewatering controls will be used, if necessary. Construction equipment would be maintained to prevent oil and fuel leaks.

Dewatered groundwater from the Project would not be discharged to nearby storm drains and/ or surface water bodies without proper pre-treatment and permitting from DEP, MWRA, and/ or EPA. A typical water treatment method would be used to settle out solids in groundwater in a frac tank, then route the water (by pumping) through activated carbon before releasing it. The western end of the North Tail Track area may be well-suited for siting a temporary water treatment facility. Groundwater would be pumped from excavation areas and recharged back to the ground only in an area approved by DEP and/ or EPA. If the CSO infrastructure is altered, the CSO infrastructure would be replaced with separated stormwater and sanitary sewer infrastructure, as required by BWSC.

7.5.4.6 Hazardous Materials and Solid Waste

Contaminated soil or groundwater may be encountered while constructing either Build Alternative. Excavations to 50 feet below ground surface would likely be through contaminated soil, and dewatering activities may involve impacted groundwater. Exposure to residual hazardous materials in soil and/ or groundwater may present a risk to worker health, and any materials with concentrations of chemicals in excess of regulatory standards must be treated and/ or disposed of properly. A soil and groundwater management plan, describing testing protocols, on-site management, and eventual treatment or disposal would be developed prior to construction.

Construction and demolition in Bowdoin Station would generate solid waste; preliminary estimates determined that approximately 7,500 cy of construction

and demolition debris may be generated. Some of this debris may be special waste, requiring special management for worker exposure and waste disposal. Suspected lead-, mercury-, or asbestos-containing building materials, as well as polychlorinated biphenyl products and petroleum products, are present within Bowdoin Station and the existing tunnels. Construction or demolition activities in the Bowdoin Station or Bowdoin Loop tunnels may result in worker exposure to these regulated materials. The nature and extent of the exposure risk is not possible, at this phase of the design, to determine. A hazardous materials and/ or special waste management plan, describing testing protocols, on-site management, and eventual treatment or disposal would be developed to the extent necessary, based upon the final design, prior to construction.

Any hazardous materials (hazardous wastes, hazardous materials, or contaminated soil or groundwater) would be managed in accordance with relevant regulatory requirements for treatment, storage, and disposal. The management plans described above would be developed with and approved by the DEP prior to implementation.

7.5.5 Proposed Section 61 Findings

The language in the following paragraphs is a proposed Section 61 Finding that extends to cover all potential impacts of the project and could be adopted by the MBTA, MassDOT, DCR, or other state agency.

Project Name: Red Line/ Blue Line Connector Project
Project Location: Boston, Massachusetts
Project Proponent: Massachusetts Department of Transportation
EEA Number: 14101

The potential environmental impacts of the project have been characterized and quantified in the EENF and DEIR, which are incorporated by reference into this Section 61 Finding. Throughout the planning and environmental review process, the proponent has been working to develop measures to mitigate significant impacts of the proposed action. With the mitigation proposed and carried out in cooperation with state agencies, the agency finds that there are no significant unmitigated impacts.

The proponent has prepared Construction Period Mitigation and Management Protocols (Table 7-2 of the DEIR) that specify the mitigation measures that the proponent will provide.

Therefore, (agency), having reviewed the MEPA filings for the Red Line/ Blue Line Connector Project, including the mitigation measures summarized in Chapters 6 and7 of the DEIR, finds pursuant to M.G.L. C. 30, S. 61 that, with the

implementation of these mitigation measures, all practicable and feasible means and measures will have been taken to avoid or minimize potential damage from the project to the environment.

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8

Distribution List

In accordance with Section 11.16 of the Massachusetts Environmental Policy Act (MEPA) regulations at 301 CMR 11.00 and the Secretary's Certificate on the EENF, this Draft Environmental Impact Report (DEIR) is being distributed to the following governmental agencies and other parties.

It is expected that notice of the availability of this DEIR will be published in *The Environmental Monitor* on or about April 7, 2010. Per Section 11.06(1) of the MEPA regulations, the public review period for a DEIR lasts 30 days. However, MassDOT is requesting an extended public review period of 45 days. Written comments are due to the MEPA office by May 21, 2010.

Copies of this report will also be posted on the Project website (http://www.eot.state.ma.us/redblue/) and also made available at the listed libraries. To request a copy of this document, please contact Regan Checchio at (617) 357-5772 or rchecchio@reginavilla.com.

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