

# Executive Summary

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## About the Project

The Green Line Extension Project is an initiative of the Executive Office of Transportation and Public Works (EOT) and the Massachusetts Bay Transportation Authority (MBTA) to enhance transit services in order to improve mobility and regional access for residents in the communities of Cambridge, Somerville, and Medford. The Project is required by the State Implementation Plan (SIP) and fulfills a longstanding commitment of the Central Artery/Tunnel Project to increase public transit.

The Green Line Extension Project will finally provide light rail transit beyond Lechmere Station, serving the region's most densely populated communities of Cambridge, Somerville and Medford that today are surrounded by, but are not directly served by, fixed-guideway transit. With approximately 18,870 people per square mile in Somerville, 15,760 in Cambridge, and 6,850 in Medford, the study area neighborhoods are among the densest in the Boston region<sup>1</sup> and Somerville is recognized as one of the most densely populated municipalities in United States. In addition, approximately 60 percent of the residents of Cambridge, Somerville, and Medford live in state-defined environmental justice areas, which take up approximately 42.8 percent of the cities' combined area.<sup>2</sup>

The Project Area is currently under-served by transit, and U.S. Census data (2000) indicate that approximately 21 percent of study area households do not own a vehicle, which can create a need for reliable and efficient transit service. Although MBTA commuter rail lines pass through the study area corridor, there are no rail transit stops within these communities. In addition, roadway congestion in the study area affects the reliability of current on-street transit services and results in long travel times (approximately 30 minutes) from Lechmere Station to the Mystic Valley Parkway/Route 16 area despite the relatively short distance (approximately four miles).

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<sup>1</sup> U.S. Census Bureau, Census 2000.

<sup>2</sup> Environmental justice areas are defined by thresholds for income, minority populations, foreign-born populations, and English proficiency. Therefore, most environmental justice areas contain a mix of environmental justice and non-environmental justice residents.

The purpose of the Green Line Extension Project is to improve corridor mobility, boost transit ridership, improve air quality, ensure equitable distribution of transit services, and support opportunities for smart growth initiatives and sustainable development in the Project area of Cambridge, Somerville, and Medford.

The proposed Green Line Extension Project evaluated in this Draft Environmental Impact Report/Environmental Assessment (DEIR/EA) includes:

- ▶ Extending Green Line service to Medford within the existing MBTA Lowell Line commuter railroad right-of-way (the Medford Branch), from a newly relocated Lechmere Station terminating at either Medford Hillside in the vicinity of College Avenue with intermediate stations at Brickbottom, Lowell Street, Gilman Square, and Ball Square; or at Mystic Valley Parkway/Route 16.
- ▶ Extending Green Line service to Union Square in Somerville (the Union Square Branch), either within the existing MBTA Fitchburg Line commuter railroad right-of-way, or using an in-street running option (a new at-grade alignment along Somerville Avenue), with a station near Union Square;

The Green Line Extension Project offers tremendous benefits to the area, in that the Proposed Project will:

- ▶ Be fully grade separated, constructed along existing MBTA railroad rights-of-way, which will enable light rail service to serve pedestrian-oriented centers with minimal disruption to the surrounding community and without significant property or neighborhood impacts.
- ▶ Focus regional transportation investment funds into established environmental justice communities, connecting residents to jobs and services in Boston and Cambridge and strengthening business and residential districts in the corridor.
- ▶ Maintain existing railroad operations while reducing net noise and vibration impacts and provide mitigation measures in areas that will substantially reduce existing noise levels.
- ▶ Offer a one-seat ride from the Project Area into downtown Boston, eliminating the forced bus/rail transfer that occurs at Lechmere Station or to the MBTA's other Orange and Red rapid transit lines.
- ▶ Improve transit travel times within the Project Area by 13 to 19 minutes compared to the No-Build Alternative to Union Square or Medford Hillside, respectively.
- ▶ Increase the MBTA's anticipated daily ridership at the Proposed Project's seven stations (boardings and alightings) by approximately 52,000 by 2030, with approximately 90% of these trips to take place in the Project's opening year of 2014. The Green Line will also see an increase of 30,700 boardings and the entire MBTA system will see an increase of 7,900 new daily linked transit trips as a result of the extension of Green Line service. Of these new transit trips,

approximately 70 percent of these riders are projected to switch from using their automobiles to using transit.

- Substantially improve mobility and service quality for transit-dependent riders, with improved access to jobs, schools and care facilities and provide universal access, meeting American with Disabilities Act (ADA) standards at all stations.
- Reduce daily Vehicle Miles Traveled (VMT) by 25,018, improving air quality and providing zero-emission transportation capacity for anticipated growth.

The Green Line Extension is urgently needed to improve corridor mobility and livability, particularly in transit-dependent and Environmental Justice communities. The No-Build Alternative provides insufficient mobility improvements for Project area residents and fails to improve environmental conditions and promote smart growth and economic development in the corridor.

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## The Proposed Project

Alternative 1, Green Line Extension to Medford Hillside and Union Square (using commuter rail rights-of-way), has been selected as the “Proposed Project” for the Green Line Extension Project, as it provides a balance of cost, ridership, and environmental impacts (Figure ES-1). EOT also believes that this alternative will help the Commonwealth achieve its goal of providing expanded transportation services and improve regional air quality. This alternative extends to Union Square via the MBTA Fitchburg Line right-of-way, which would require fewer acquisitions of private property, have more operational reliability, and have a lower capital cost than the Somerville Avenue option. Alternative 1 would meet all Project goals, would be operationally practical, and would generate a high number of new systemwide transit trips. This is the Project for which EOT is currently seeking approval by the FTA.

A total of seven stations are included in the Proposed Project: Lechmere, Brickbottom, Gilman Square, Lowell Street, Ball Square, College Avenue and Union Square. The route length would be about three miles to Medford Hillside with an approximately one-mile spur to Union Square. The primary infrastructure improvements of the Proposed Project would include relocating existing commuter rail lines, and constructing approximately four miles of new light rail track and systems, four multi-span viaducts, a maintenance facility, and reconstructing 11 bridge structures to support the extended service. The Proposed Project is expected to generate new systemwide transit ridership of 7,900 boardings per day and a reduction of 25,018 VMTs per day (projected to the year 2030).

Although the FTA action that is the subject of this EA is the Proposed Project described above, EOT has selected as its Preferred Alternative, Alternative 2, Green Line Extension to Mystic Valley Parkway/Route 16, with no parking at Mystic Valley Parkway/Route 16 Station, and Union Square (using commuter rail rights-of-way).

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This alternative also meets all of the Project goals and provides additional regional benefits. However, because of the constraints placed on EOT by federal funding requirements and the economic crisis facing the Commonwealth, at this time EOT is not able to identify sufficient funding to support the construction of the Medford Hillside to Mystic Valley Parkway/Route 16 segment within the 2014 timeframe mandated by the State Implementation Plan.

As of the filing of this document, the Boston Region Metropolitan Planning Organization has voted to ‘flex’ funding dedicated to the construction of highways to fund the construction of the Medford Hillside to Mystic Valley Parkway/Route 16 segment. These funds will be available sometime between 2016 and 2020 and may allow this portion of the Green Line Extension to be constructed shortly after the 2014 schedule for the Proposed Project has been completed.

Therefore, EOT’s Preferred Alternative is proposed to be built in two phases with an initial operating segment (or the “Proposed Project”) being constructed to Medford Hillside in the vicinity of College Avenue on the Medford Branch and a spur to Union Square, which is described and evaluated in this DEIR/EA as Alternative 1. The second phase of this Project, the “Future Full-Build Alternative” will include extending the Project from College Avenue Station to Mystic Valley Parkway/Route 16 Station in the future and has been described and evaluated in the DEIR/EA as Alternative 2.

The environmental impacts of both the Proposed Project, referred to as Alternative 1, and of the Future Full-Build Alternative, referred to as Alternative 2, have been fully evaluated and are described in detail in this DEIR/EA. For federal action, the Proposed Project to Medford Hillside is the subject of this DEIR/EA, as the extension to Mystic Valley Parkway/Route 16 is not envisioned to be constructed within the three-year MEPA or NEPA time frame and would, therefore, require re-assessment at a future date. However, constructing the initial operating segment of the Project will not preclude a future extension of the Preferred Alternative or Future Full-Build Alternative to Mystic Valley Parkway/Route 16, should funding become available in the future.

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## About the MEPA/NEPA Process

The Green Line Extension Project, as a major action of a state agency, requires public review under the Massachusetts Environmental Policy Act (MEPA). As required by MEPA, an Expanded Environmental Notification Form (EENF) was submitted to the Executive Office of Environmental Affairs (EEA) on October 10, 2006. The Secretary of EEA issued a Certificate on the EENF on December 1, 2006, requiring a Draft Environmental Impact Report (DEIR) for the proposed Project. This DEIR provides the information and analyses required by the Secretary’s Certificate, and responds to the substantive comment letters on the EENF.

Because EOT is seeking funding through the FTA, the Project also requires review under the National Environmental Policy Act (NEPA). This document also serves as the Environmental Assessment (EA) for the proposed Project.

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## Public Involvement

The Green Line Extension Project has received significant public input throughout the planning process. As noted in the Secretary's Certificate, the approximately 90 comment letters on the EENF reflect a substantial interest in the future of the 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.

To plan and develop the Green Line Extension Project in coordination with this wide range of interests, EOT established a public involvement process that included an Advisory Group, open public meetings, and coordination with the staff and elected officials of Cambridge, Somerville, and Medford, as well as other stakeholders and neighborhood interest groups along the corridor. This process continued the public involvement that began in 2004, during the *Beyond Lechmere Major Investment Study/Alternatives Analysis* study.

Eleven Advisory Group meetings were held during preparation of this DEIR/EA, between September 2007 and March 2009. One round of public meetings, attended by 226 people, was held in January 2008, in two different locations. Station workshops were held to obtain neighborhood input on station locations, access, and potential impacts and mitigation measures. Five station workshops were held in January and February 2008. A second round of public meetings was held in March 2009, in two different locations, which over 600 people attended. In addition to these meetings, the Project Team also attended numerous community and neighborhood briefings.

During the course of the public involvement process for the Project, a number of key issues were raised involving technical analysis and Project outreach including, but not limited to:

- **Ridership Modeling** – Based on requests for additional information by Advisory Group members, EOT held technical tutorials on ridership modeling.
- **Maintenance Facility** – Based on requests for additional information by Advisory Group members, EOT held a site tour of the Green Line Riverside facility and conducted a technical tutorial. Due to concerns about the proposed location of the support facility, EOT and the Project team also produced a full study of the site selection process and evaluated numerous additional



alternatives based on feedback and suggestions by members of the public.

- **Station Siting** –Early in the Project, members of the Advisory Group and the public expressed interest in the siting of stations in the Project area neighborhoods. As a result, EOT held a series of five station workshops where members of the public could discuss their concerns in small groups with the Project team about station siting, including locations of drop-off and pick-up areas, platform locations, bicycle/pedestrian access, and ADA accessibility. Based on the feedback received at these meetings, some station locations received additional analysis and/or were reconfigured to address concerns raised by the public.
- **Tunnel Alignment Alternatives** – Several members of the public suggested constructing tunnels for segments of the Green Line Extension. Based upon this interest, EOT and the Project team performed an extensive analysis of tunneling as an alternative to at-grade construction. Ultimately, the report found tunneling to be cost-prohibitive for this Project.
- **Construction Impacts** –Members of the public expressed concerns with regard to impacts during construction. EOT developed a detailed construction staging plan to help minimize the impacts to neighborhoods, including vehicular traffic, pedestrian traffic, on-street parking, public access, and emergency access to local businesses and residences.

With regard to public outreach, EOT responded to requests for meeting materials in alternative formats, including audio tapes and large-print. These requests were in addition to the standard outreach approaches, including translating materials and meeting notices into multiple languages and other formats. Based on feedback from the public, EOT also expanded the Project database by sending notices of the March 2009 public meetings to all property owners in Medford, Somerville and East Cambridge.

EOT has maintained an informative and up-to-date interactive Project website, [www.mass.gov/greenlineextension](http://www.mass.gov/greenlineextension). Between November 2007 and March 2009, the site attracted more than 23,000 new visitors and had a total of more than 145,775 page views. Along with a brief overview of the Project's history and current phase, the website provides access to various reference materials, including documents from previous phases of the Project as well as the most up-to-date Project materials. Interested individuals are able to sign up to be part of the Project mailing list. Individuals are also able to post comments about the Project publicly, as well as use the website to ask questions of EOT and the Project team. The Project website contains all of the materials used at the Advisory Group and public meetings, including comments and responses to comments, fact sheets, Project updates, maps, and graphics. Materials from the Project website have been converted into audio tapes upon request from members of the public.

Regular coordination has occurred with the officials of Cambridge, Somerville, and Medford throughout the Project. In addition to the outreach at a local level, there was also a significant amount of coordination with the various state and Federal agencies to discuss potential Project impacts and other Project details. Agency coordination during the development of this DEIR/EA included, but was not limited to, the following: FTA, MBTA, Massachusetts Department of Environmental Protection (MassDEP), the Massachusetts Department of Conservation and Recreation (DCR), the Metropolitan Area Planning Council (MAPC), the Massachusetts Highway Department (MassHighway), the Massachusetts Historical Commission (MHC), and the Central Transportation Planning Staff (CTPS).

## What Alternatives did EOT/FTA Evaluate?

Six “Build” Alternatives and a Baseline Alternative are evaluated in this DEIR/EA. The Baseline Alternative is evaluated, as required by FTA, to identify the best option for meeting the transportation needs of the study area with smaller capital investments than are proposed in the Build Alternatives. The Baseline Alternative evaluated in this document includes enhanced MBTA bus service within the study area, including enhancing the existing Route 80 between existing Lechmere Station and Mystic Valley Parkway/Route 16 parallel to the MBTA Lowell Line commuter rail right-of-way, and a new shuttle bus service between existing Lechmere Station and Union Square.

**Table ES-1 Comparison of DEIR/EA Build Alternatives**

Alternative	Medford Branch	Union Square Branch	Daily Boardings (2030)	Capital Cost (\$M) <sup>1</sup>
1	Medford Hillside	Commuter Rail ROW	7,900	\$804.8
2	Mystic Valley Parkway/Route 16	Commuter Rail ROW	8,900 <sup>2</sup>	\$959.3 <sup>2</sup>
3	Medford Hillside	In-street	7,700	\$829.8
4	Mystic Valley Parkway/Route 16	In-street	8,700	\$984.3
5	Mystic Valley Parkway/Route 16	None	10,500	\$870.0
6	None	Commuter Rail ROW	3,900	\$370.6

<sup>1</sup> 2008 dollars

<sup>2</sup> These results include 300 parking spaces at Mystic Valley Parkway/Route 16 Station. With no parking at this station, the ridership would be 8,600 new systemwide boardings daily, and the capital cost would be \$951.8 million.

The six Build Alternatives evaluated in this DEIR/EA are summarized in Table ES-1. All of these alternatives include relocating Lechmere Station and include a new layover/maintenance facility.

In addition to the Green Line Extension Alternatives, EOT was also scoped with the conceptual design of the Somerville Community Path. Design of the proposed Community Path was developed in order to determine its feasibility. However, construction of the Community Path is not included as part of the Green Line Extension Proposed Project. The design plans for the Somerville Community Path are shown in Appendix E.

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## Project Description

The Green Line Extension Proposed Project is envisioned to provide service to Medford Hillside and Union Square using a two-branch operation, both in existing commuter rail rights-of-way. One branch would operate from Relocated Lechmere Station to Medford Hillside along the MBTA Lowell Line. This branch would begin at Relocated Lechmere Station and head northwest, meeting the MBTA Lowell Line just south of Washington Street in Somerville. From Washington Street, the alignment would run parallel to the MBTA Lowell Line to Medford, terminating its route at Medford Hillside in the vicinity of College Avenue. The second branch would operate along the MBTA Fitchburg Line from new Lechmere Station into a terminus at Union Square in Somerville. The Union Square Branch would begin at Relocated Lechmere Station and head northwest to Red Bridge, then follow the MBTA Fitchburg Line to the Union Square area.

The Proposed Project is expected to increase the MBTA's anticipated daily ridership at the Project's seven stations (boardings and alightings) by approximately 52,000 by 2030 (and by 56,000 in the Future Full-Build Alternative by 2030), with approximately 90% of these trips to take place in the Project's opening year of 2014. The Proposed Project will generate new systemwide transit ridership of 7,900 boardings per day and a reduction of 25,018 VMTs per day (projected to the year 2030). In the Future Full-Build Alternative, new systemwide transit ridership will increase by 8,600 boardings per day and will result in a reduction of 26,647 VMTs per day (projected to the year 2030).

The Green Line Extension Project has been designed to minimize impacts to the communities by reducing the footprint of the Project and maximizing the use of existing transportation corridors. The Project would use existing railroad rights-of-way for most of its approximately four-mile length. This is possible because the MBTA Fitchburg Line and the MBTA Lowell Line had sufficient width to accommodate additional tracks for freight rail lines dating back to the late 19th century that have since been abandoned. The footprint of the abandoned tracks provides space for new tracks for this proposed Project. The existing right-of-way ranges from 55 to 110 feet in width. In places where space is limited by steep slopes, retaining walls have been proposed to maximize usable space in the railroad rights-of-way. The proposed retaining walls will include a "green" design component, which means that efforts will be made to use recycled and recyclable

materials and to incorporate vegetation as part of the wall system, which will provide a more natural aesthetic for the retaining structure. Landscape treatments will also be proposed on the slopes above the walls and to the greatest extent possible at each of the stations.

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## The Green Line Branches

The Proposed Project includes extending the Green Line along two branches – the Medford Branch (from Lechmere Station to Medford Hillside in the vicinity of College Avenue, extending to Mystic Valley Parkway/Route 16 in the Future Full-Build) and the Union Square Branch (from Lechmere Station to Union Square).

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### Medford Branch

The 3.4-mile Medford Branch of the Green Line Extension Proposed Project would be constructed within the existing MBTA Lowell Line right-of-way, owned by the MBTA. The existing commuter rail tracks would be shifted approximately 13 feet toward the east side of the right-of-way, using retaining walls where necessary to avoid property impacts. The new light rail track and overhead catenary would be added within the western half of the right-of-way. For the Proposed Project, five stations would be constructed on this branch:

- south of Washington Street (Brickbottom Station);
- at Gilman Square;
- at Lowell Street;
- at Ball Square, north of Broadway; and
- at College Avenue.

In the Future Full-Build Alternative, there will be one additional station located just south of Mystic Valley Parkway/Route 16.

Although all of the Medford Branch alternatives would be constructed within the existing MBTA right-of-way, several existing roadway and rail bridges would need to be reconstructed to accommodate the new light rail tracks. These include:

- former Red Bridge (rail) (Somerville);
- Washington Street (rail) (Somerville);
- Walnut Street (roadway) (Somerville);
- Medford Street (roadway) (Somerville);
- School Street (roadway) (Somerville);
- Lowell Street (roadway) (Somerville);
- Cedar Street (roadway) (Somerville);
- Broadway (roadway) (Somerville);
- Harvard Street (rail) (Medford); and

- College Avenue (roadway) (Medford).

Two additional bridges would be reconstructed for the Future Full-Build Alternative:

- Winthrop Street (roadway) (Medford); and
- North Street (roadway) (Medford).

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## Union Square Branch

The 0.9-mile Union Square Branch of the Green Line Extension Project would be constructed within the existing MBTA Fitchburg Line right-of-way, owned by the MBTA. The existing commuter rail tracks would be shifted approximately 10 to 14 feet toward the south side of the right-of-way, using retaining walls where necessary to avoid property impacts. The new light rail track and overhead catenary would be added within the north half of the right-of-way. A station would be constructed along the rail corridor at Prospect Street near Union Square. The Union Square Branch would require reconstructing the Medford Street rail bridge in Somerville.

Other alternatives also evaluated the Union Square Branch of the Green Line Extension as a single-track loop alignment, starting its outbound service at Relocated Lechmere Station and travelling on a new alignment and connect into Somerville Avenue, where embedded tracks would allow in-street running in the roadway. From Union Square, the tracks would turn south towards the MBTA Fitchburg Line using private property along Prospect Street. This option was not selected as part of the Proposed Project because of its substantially higher environmental impacts.

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## Construction

Construction staging and sequencing strategies are critical to achieving the balance of an efficient construction project while minimizing the impacts to vehicular traffic, pedestrian traffic, on-street parking, public access, and emergency access to local businesses and residences. This corridor presents several construction challenges including narrow roadways, urban traffic volumes, and a variety of commercial, industrial, and residential land uses that require continuous access, limited space for construction zones and lay down areas within or near the rail corridor, and existing rail service that must be maintained throughout construction.

The Green Line Extension Proposed Project has been designed to minimize impacts to the communities by reducing the footprint of the Project and maximizing the use of existing transportation corridors. The Project would use existing railroad rights-of-way for most of its approximately four-mile length. The use of the existing MBTA commuter rail right-of-way for the proposed Green Line tracks greatly reduces the complexity of construction as well as construction impacts. Figures ES-2 and ES-3

show the existing right-of-way and the proposed right-of-way. The existing cut would be widened by installing retaining walls on either side and excavating the slopes. On the MBTA Lowell Line, the commuter rail tracks would be shifted to the east side of the widened cut, and the new Green Line tracks would be built along the west side. Most of the right-of-way is located below the surrounding land surface, reducing potential land acquisitions as well as environmental impacts such as noise and visual changes.

Bridge reconstruction will be staged whenever possible to maintain traffic over the respective bridges during construction. Construction staging will be required for roadway traffic as well as rail traffic beneath the bridge. In some cases, the existing bridge structure, the extent of reconstruction required on the bridge, and/or the proposed bridge structure are such that staged construction is not feasible and the bridge will have to be closed during construction. A detour will be required to provide alternative traffic routes during construction. Based on analysis of the existing bridges and a conceptual level design, two bridges will require traffic detours during construction.

The current level of construction staging and sequencing developed for the Project address the constraints of the corridor, impacts to abutters, and other construction issues. More detailed evaluation and staging recommendations will be developed as design progresses and through coordination with the City of Cambridge, City of Somerville, and City of Medford, and the respective Fire and Police Departments. This coordination will define restrictions that will be placed on the contractor, such as time of construction and construction zone set-up requirements, as well as maintenance of traffic and access to abutting properties. Blasting is not anticipated for construction of the Project. Rodent control policies will be included in construction management plans to prevent increased pest populations during the construction period. Likely measures would include good waste management (sealed trash containers, closed drains on dumpsters, etc.), fencing around long-term construction sites, and traps and/or baits as needed for any observed rodent problems. Construction procedures will comply with MassDEP's solid waste and air quality control regulations to prevent the spread of contaminated material or air quality impacts during construction.

Close coordination with MBTA, City of Cambridge, City of Somerville, City of Medford, and the respective Fire and Police Departments will address specific construction issues. The preliminary analysis of construction staging and sequencing shows that it is feasible to construct the Project while maintaining railroad operations, access to abutters, and traffic and pedestrian paths. As the design progresses, the traffic management details will be refined to better identify specific measures in specific areas, including detours. A comprehensive construction staging and sequencing plan will be developed and included in the final construction contract documents and communicated to the public.

Figure ES-2 Existing Section Looking North

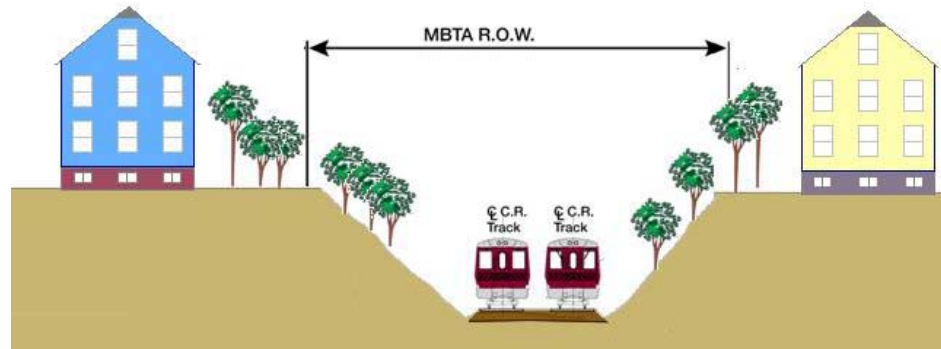
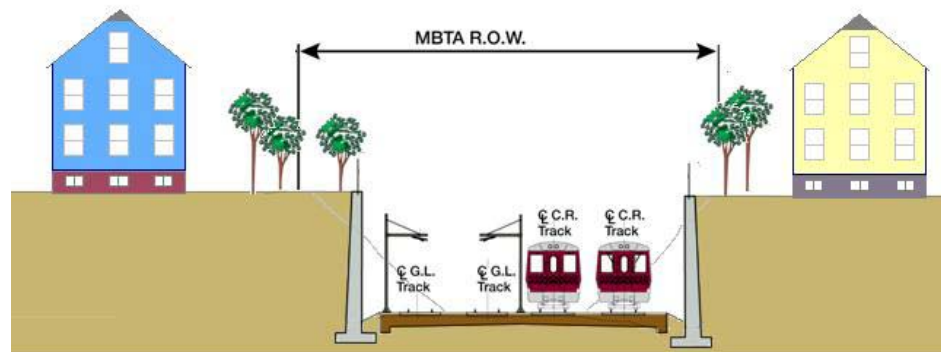


Figure ES-3 Proposed Section Looking North




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## Stations

Station locations for the Green Line Extension were identified through an evaluation process and in working with the public and local officials. Important considerations in station siting and configuration included operations and access, as well as impacts to area properties. Stations are intended to function as neighborhood stations with no provisions for parking. The Future Full-Build Alternative could include parking at the terminal location at Mystic Valley Parkway/Route 16 Station although none is currently proposed.

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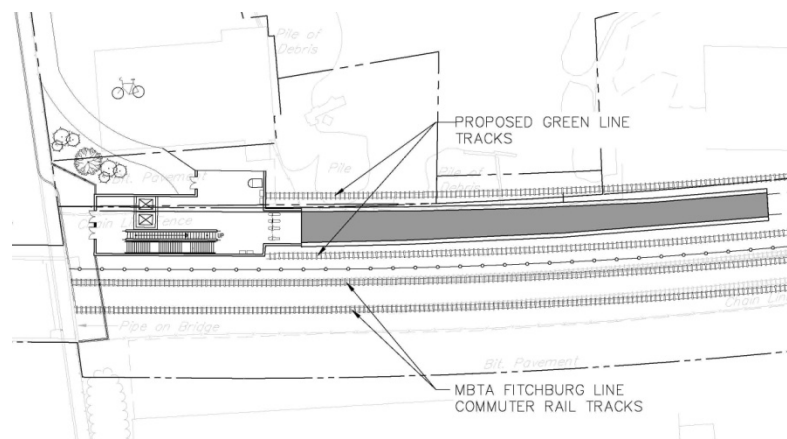
### What a Typical Station Will Look Like

Stations were designed to meet the Project's goals of improved transit access and accessibility, and to minimize impacts to the community associated with land acquisition, traffic, and loss of parking. The design for each station is envisioned to

provide a headhouse with automated fare lines, vending machines, an information booth, and restrooms. Figures ES-4 and ES-5 show a typical station layout and elevation. In addition to these design elements, the stations are also envisioned to provide:

- Bike racks at all stations, which will encourage the use of bicycles to access the station and reduce vehicular access;
- MBTA Direction Maps showing inbound and outbound stations as well as the MBTA Spider Maps showing all rapid transit lines;
- Uniformly lit platforms at a level that enhances a feeling of safety;
- Tactile/Braille Station Identification signs; and
- Trash receptacles.

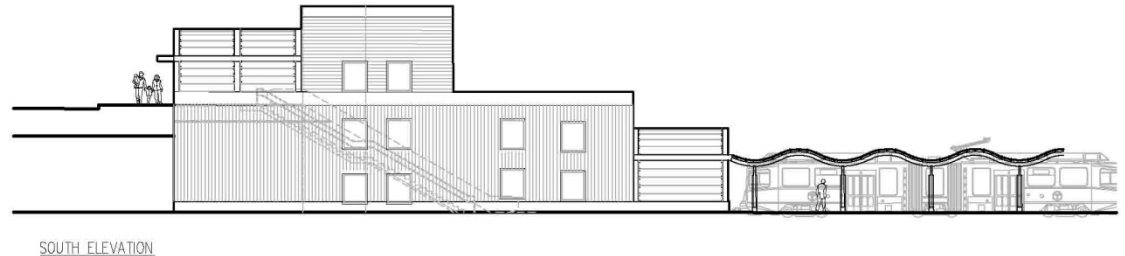
Figure ES-4 Typical Station Plan



Many station platforms would be located at a different elevation than the station access points. Entry to and exit from the platforms will be by elevators, escalators, and stairs. The design of the platform was based on projected peak hour passenger volume. Station access and platform design were based on requirements and guidance provided by the Americans with Disabilities Act (1990) and the Commonwealth of Massachusetts Architectural Access Board (AAB), as well as requirements of the MBTA.



Figure ES-5 Typical Station Elevation



In addition to station amenities and access requirements, station criteria also considered “green” or high performance design. Green design opportunities for the Green Line Extension Project include:

- **Access** - Stations will offer safe and convenient pedestrian access to encourage walking and transit-oriented development in the nearby vicinity. This includes providing secure bicycle racks and/or storage within 200 yards of each station entrance.
- **Lighting** - Station design will minimize unnecessary light pollution at each station site, while ensuring that adequate safety lighting measures are provided.
- **Stormwater** - Station design will minimize the amount of impervious cover, increase on-site infiltration, reduce or eliminate pollution from stormwater runoff, and eliminate contaminants.
- **Recycling** - Stations will provide easily accessible bins for recycling, including paper, corrugated cardboard, glass, plastics, and metals.
- **Site and Building Materials** - Where possible, station design and construction will use materials that incorporate recycled content materials; are extracted and manufactured locally; reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials, such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheat-board, strawboard, and cork; use Forest Stewardship Council (FSC) Certified Wood; and reduce the heat island effect at each station by utilizing high-reflectance (high-albedo) materials for hardscape.
- **Water Efficiency** - Where possible, station design will eliminate the use of potable water for landscape irrigation at each station site; and will reduce the generation of wastewater and potable water demand at each station by specifying high-efficiency fixtures and dry fixtures, such as waterless urinals and low-flow toilets.

- **Energy Performance** - Where possible, station design will include the building envelope, heating, ventilation, and air conditioning (HVAC), lighting, and other systems to maximize energy performance; utilize non-polluting and renewable energy sources, including solar, wind, geothermal, low-impact hydro, biomass, and bio-gas strategies; avoid or minimize the use of mechanical cooling and refrigeration equipment; and use ENERGY STAR compliant products throughout all buildings.
- **Indoor Air Quality** - Where possible, station design will include an indoor air quality management plan to address moisture and mold damage including the design of surface grades, drainage systems and heating, ventilating, and air conditioning systems, ductwork transport, storage, and installation and filtration media in air handlers. Effective air management systems will be employed to minimize the exposure of station occupants and ventilation air distribution systems to environmental tobacco smoke; provide additional outdoor ventilation to improve air quality within the station building; provide capacity for ventilation system monitoring to help sustain station occupant comfort; and reduce the quantity of indoor air contaminants that are odorous, irritating, or harmful to station occupants.
- **Demolition and Construction** - Where possible, construction management during demolition of existing buildings on the station sites will divert debris from disposal in landfills and incinerators. Station design will include Erosion and Sediment Control Plans and will consider additional methods to control dust and particulate matter during construction.

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## Station Selection Process

Beginning in late January 2008 and continuing throughout February, residents of Cambridge, Somerville, and Medford came in the hundreds to a series of five station workshops for the Green Line Extension Project. As the alternatives analysis phase began, EOT reached out to communities early in the process to help incorporate residents' everyday knowledge of the corridor into the analysis. The meetings began with a half-hour open house for participants to review maps of the corridor and talk with Project team members. After a brief overview of the Project and its current phase, the meetings broke into workshop style sessions with participants surrounding tables of maps and providing input regarding station locations; station access; traffic trends at nearby intersections; pedestrian, bus, and bike path connections; and desired station amenities. With attendance reaching 100 or more at some workshops, this series of meetings allowed residents to express both their excitement and their concerns about the Green Line Extension Project.

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## Station Locations

All of the Proposed Project stations have been designed to serve the local neighborhood, and allow residents to access the station by foot, bicycle, or vehicular pick-up/drop-off. Station boardings are estimated for the 2030 analysis year.

### Lechmere Station

Relocated Lechmere Station and associated roadway and busway improvements have long been intended to be constructed as part of the NorthPoint development project. However, due to the uncertainty surrounding the NorthPoint project, the Commonwealth has included the planning for the relocation of Lechmere Station and area roadway improvements into the Green Line Extension Project. The new Lechmere Station will be relocated and elevated on a new and realigned viaduct on the east side of Monsignor O'Brien Highway/Route 28. Once the relocation is complete, the existing Lechmere Station would be demolished and cleared, and the existing station site would be made available for potential future redevelopment. There will be approximately 234 parking spaces provided in two separate parking lots within MBTA property at the station to replace the parking that currently exists on the same MBTA property for Lechmere Station patrons.

Vehicular access to the south parking lot would be provided from East Street. Vehicular access to the north lot will be provided primarily from Water Street. An access road will be provided to connect Water Street, North First Street, and East Street, allowing vehicular access between the two lots as well as providing busway connections to O'Brien Highway/Route 28 and Cambridge Street. Pedestrian access will be provided across O'Brien Highway/Route 28. A busway with one-way, southbound circulation will accommodate local bus service, including MBTA Bus Routes 69, 80, 87, and 88, with access from O'Brien Highway/Route 28 via Water Street and egress to O'Brien Highway/Route 28 via a new North First Street connection. Curbside drop-offs for taxis, corporate shuttles, and station patrons will be provided across New North First Street and the access road. Due to its location on the viaduct, the station proper would be accessed using elevators, escalators, and stairs. Bike racks will be provided to encourage use of this mode. Daily ridership at this station is anticipated to be 10,900 boardings.

### Brickbottom Station

The proposed Brickbottom Station site is on two private parcels on the east side of Joy Street and approximately 220 feet south of the intersection with Washington Street. The area around the proposed station is categorized as light industrial with shops and automobile related businesses. There are residential homes located north of Washington Street and on the south end of Joy Street at the Brickbottom Artists Lofts. Access to the station will be provided for both pedestrian and vehicular traffic along Joy Street. At this location, the Green Line tracks will be at a higher elevation than Joy Street. Consequently, access to the platform will occur from below via

elevators, escalators, and stairs. Bus Routes 86, 91, and CT2 provide service along Washington Street, with a bus stop 200 feet north of the proposed station. A pick-up/drop-off for automobiles will be provided. Bike racks will also be provided to encourage use of this mode. Connections to the proposed Somerville Community Path are possible. Daily ridership at this station is anticipated to be 2,730 boardings.

### Gilman Square Station

Gilman Square Station is proposed to be located along Medford Street directly behind Somerville High School. The neighborhood is home to municipal facilities (Somerville City Hall, Somerville Public Library, Somerville High School), commercial enterprises along Highland Avenue and Medford Street, and residential areas. Access to the station will occur on the east side of the rail right-of-way from Medford Street through a City-owned parcel and at a second location directly from the Medford Street bridge structure. Access to the platform level will be via elevators, escalators, and stairs. These access points are being provided in order to provide access in accordance with ADA requirements, as the Medford Street Bridge has an approximately eight percent grade. Connections to the proposed Somerville Community Path are also possible in the future. The station's placement on the north side of Medford Street provides the opportunity for bicycle and pedestrian access with minimal property impacts. Connections to MBTA Bus Routes 80, 88, and 90 are located within ¼ mile of the station. Bike racks will also be provided. Daily ridership at this station is anticipated to be 4,410 boardings.

### Lowell Street Station

Lowell Street Station is proposed to be located at Lowell Street, adjacent to an abandoned industrial building. Lowell Street Station is in a primarily residential area of two, three, and four-story structures. There is a nursing home nearby and an abandoned industrial building, which is scheduled for redevelopment for residential use. Accessibility at this station is a challenge due to the existing roadway grades. To better accommodate access, a vehicular pick-up/drop-off area will be provided on Lowell Street. At this location, the Green Line tracks and platform will be at a lower elevation than Lowell Street. Consequently, access to the platform will occur from street level via elevators, escalators, and stairs. The station will be constructed along with a new bridge to accept automobile pick-ups /drop-offs and bicycle traffic from the neighborhood. Bike racks will be provided. Pedestrian access will be provided using sidewalks along Lowell Street. Local MBTA Bus Routes 80, 88, and 90 are within ¼ mile of the station. Connections from the proposed Somerville Community Path to the station headhouse would be possible via Lowell Street. Daily ridership at this station is anticipated to be 1,260 boardings.

### Ball Square Station

Ball Square Station is proposed to be located on the north side of the Broadway Bridge in the vicinity of the Somerville and Medford city line near the corner of Broadway and Boston Avenue. The area adjacent to the station is of mixed use with automobile shops along Boston Avenue, commercial uses on Broadway, and residential neighborhoods beyond. Residential structures are generally three to four stories. Due to Broadway's steep grade, the station provides two points of access. One access point will be provided at the intersection of Boston Avenue and Broadway. The other access point is envisioned directly from the Broadway Bridge. At this station, the Green Line tracks and platform will be at a lower elevation than Broadway, consequently, access to the platform from street level will be via elevators, escalators, and stairs. Local MBTA Bus Routes 80 and 89 have stops located adjacent to Ball Square Station. Bike racks will also be provided at the station. Daily ridership at this station is anticipated to be 1,890 boardings.

### College Avenue Station

College Avenue Station is proposed to be located at the corner of College Avenue and Boston Avenue, which primarily serves the residential neighborhoods adjacent to the station and the Tufts University community. In order to meet accessibility requirements, the station provides two points of access due to the eight percent grade along the College Avenue Bridge. One access point will be provided from the College Avenue Bridge; the second access point will be provided from Boston Avenue. Vehicular pick-up/drop-off will be available along Boston Avenue. Bicycle parking will also be provided at this station. Local MBTA Bus Routes 80, 94, and 96 provide service adjacent to the station with a bus stop located on College Avenue, approximately 600 feet from the station. Daily ridership at this station is anticipated to be 2,420 boardings.

### Mystic Valley Parkway/Route 16 Station (Future Full-Build Alternative Only)

The Mystic Valley Parkway/Route 16 Station, included in the Future Full-Build Alternative only, is proposed to be located south of the intersection of Boston Avenue and Mystic Valley Parkway/Route 16 in the vicinity of the Somerville and Medford city line. The neighborhood surrounding the proposed station is generally residential. There is a shopping center nearby as well as recreational facilities. This station has been considered both with and without 300 parking spaces in a multi-level parking garage. However, the Preferred Alternative does not include any parking at this station. Vehicular pick-up/drop-off is proposed with access primarily via Boston Avenue, with a possible curb cut onto Mystic Valley Parkway/Route 16. Pedestrian access will be provided from walkways along Boston Avenue and Mystic Valley Parkway/Route 16. Access to the platform will occur via elevators, escalators, and stairs. Local MBTA Bus Routes 80 and 94 provide service adjacent to the station

with a bus stop at the corner of Boston Avenue and Mystic Valley Parkway/Route 16. Bike parking will be provided at this station. In the Full-Build Alternative, daily ridership at this station is anticipated to be 2,000 boardings (in year 2030).

### Union Square Station

Union Square Station is the only station proposed on the Union Square Branch, proposed to be located at the intersection of the MBTA Fitchburg Line and Prospect Street. The area adjacent to the station is of mixed use with light industrial, residential, and commercial uses. Due to the eight percent grade along Prospect Street, the station is envisioned to provide access via two levels, including the lower grades along Prospect Street as well as directly from the bridge structure. Access to the platform will also occur via elevators, escalators, and stairs. Vehicular pick-up/drop-off will be accommodated along Prospect Street. Local MBTA Bus Routes 85, 86, and 87 provide service adjacent to the station. Bike parking will be provided at the station. Daily ridership at this station is anticipated to be 2,310 boardings.

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### The Layover and Maintenance Facility

The Build Alternatives also include a layover/maintenance facility. A separate alternatives analysis (described in Chapter 3) was developed to evaluate sites for this facility. The analysis determined that the most practicable location was the area known as “Yard 8,” a six-acre former railroad yard located adjacent to the proposed Green Line alignment and accessed from Inner Belt Road in Somerville. This site, combined with the adjacent grassy parcel along Inner Belt Road, could accommodate the necessary maintenance facility components. In general, the requirements include four storage tracks (providing storage capacity for approximately 80 cars), an approximate 100-vehicle employee parking lot, equipment for the various types of vehicle maintenance required, and a support facility building that includes maintenance bays, storage room, loading docks, administrative offices, and employee facilities and amenities. Figure ES-6 shows the proposed maintenance facility layout.

As described above, Yard 8 has been the preferred option for the construction of a Green Line vehicle storage and maintenance facility, given its combination of size, configuration, and adjacency to the Green Line Extension tracks. However, the Yard 8 site has elicited local opposition from some municipal officials, elected representatives, and abutting residents and businesses. To endeavor to address and resolve these concerns, EOT has initiated analysis of two additional possible sites for the facility: (1) the so-called “Mirror H” site, proposed by the City of Somerville; and (2) a site, newly conceived by EOT and termed “Option L.” The “Mirror H” site straddles the Inner Belt area of Somerville and the NorthPoint area of Cambridge.

The “Option L” site is located immediately adjacent to BET, outside the current BET fence line. Both locations are shown on Figure ES-6.

Preliminary analysis indicates that both alternative sites have impacts above and beyond that of the Yard 8 alternative (e.g., Mirror H – renegotiation of MBTA-NorthPoint agreement and Option L – relocation of active businesses). However, to sufficiently compare the sites to the preferred Yard 8 location, a complete analysis of both alternatives - including environmental impacts, schedule implications, community benefits, property acquisition needs, regulatory issues, and costs to the municipalities and the Commonwealth - will be performed over the next few weeks. Results will be made available to the public for input and discussion once underway. The outcome of the analyses will determine whether EOT chooses to pursue a Notice of Project Change for the Green Line Extension Project, to formally substitute one of the alternative options for Yard 8 as the preferred site for the storage and maintenance facility.

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### Why a Layover and Maintenance Facility is Needed

The existing Green Line fleet is currently stored at the Reservoir, Riverside, Lake Street, and Lechmere facilities, and within the central subway. It will be essential to store a number of cars on the north side of the proposed Green Line Extension to provide cars for start-up in the morning, provide a convenient location for overnight and off-peak storage as cars come out of service, and minimize the distance a disabled train has to travel to reach a maintenance facility. A north side facility would also eliminate much of the need to move cars to the west-side facilities each night and back to the north side in the early morning, a move that would interfere with critical overnight maintenance work for Green Line track, signal, and power systems. Car storage is not only required for the overnight storage of cars but also for the day-time lay-up of cars.

Maintenance support is only available at the Reservoir, Riverside, and Lake Street facilities; all are located on the west end of the Green Line system. The existing facilities are operating beyond their planned capacity and expansion of these facilities to accommodate the proposed Green Line Extension is impractical in terms of logistics, service reliability, and operating costs. There are currently no maintenance facilities located on the north side of the system, in the proximity of the proposed Green Line Extension. When a Green Line car becomes disabled, it is essential that the car be moved to the closest maintenance facility to get it out of the way of revenue service trains and to a location where it can be serviced. In order to provide a service that is reliable, cost-efficient, and does not adversely impact the remainder of the Green Line system, it is necessary that a maintenance facility be provided on the north side of the system. The Green Line Extension Project will therefore require a new maintenance facility on the north side of the Green Line

system to store, inspect, maintain, and repair cars and to provide a base for the maintenance and repair of the track, power, and signal systems.

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## Layover Site Selection Process

Several sites were considered for the new Green Line maintenance facility including the Boston Engine Terminal (BET), Yard 8 and Option L. Additional sites or variations of these sites were suggested by representatives of the Cities of Medford and Somerville, by Project Advisory Group members, and by the public. Due to the density of development in the Project study area, there were limited potential sites to evaluate. However, in working with the Project stakeholders, 11 sites were identified for evaluation as potential maintenance facility locations.

These sites were put through a two-tier screening process to determine which site(s) best met the program requirements, which included size and configuration of the site(s) and proximity to the proposed extension. Those sites that were determined to be too small to accommodate the program and/or required a crossing of the MBTA Lowell Line in order to access the sites were eliminated from further consideration. Sites unable to meet the program because of inadequate size or configuration or because they were unable to make direct track connections to the proposed extension lines were also disqualified.

At the request of the Advisory Group and other Project stakeholders, the analysis considered 10 additional possible configurations for the maintenance facility, focusing on the MBTA BET Commuter Rail Maintenance Facility and on Yard 7 near the NorthPoint development. Additionally, the City of Somerville requested an evaluation of a modified scheme that would use the BET and NorthPoint development.

The results of the analysis showed that none of the areas within the MBTA BET Commuter Rail Maintenance Facility property are available or suitable for use as a Green Line support facility. The existing BET facility is barely adequate for current commuter rail needs. Most of the site is already in use for train operations. The parking lot is too far from the Green Line, and would require long bridges over the existing tracks for access. The configuration is not well suited for train storage. The existing open storage area is important for current and future commuter rail operations. Even if it were available for Green Line use, it is too long and narrow and not well-suited for a Green Line storage facility. Combining the BET site with Yard 7 does not offer a large enough site in the required configuration to accommodate a Green Line facility. Federal Railroad Administration (FRA) regulations also state that use of both commuter rail and light rail within the same facility is incompatible.<sup>3</sup>

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<sup>3</sup> Federal Railroad Administration, 49 CFR Parts 209 and 211, *Shared Use of the Tracks of the General Railroad System by Conventional Railroad and Light Rail Transit Systems; Notice and Final Rule*, Federal Register, Vol. 65, No. 132, Monday, July 10, 2000, Notices.



Therefore, the MBTA BET Commuter Rail Maintenance Facility was determined to be unsuitable to support the program.

Of the numerous sites considered in the screening process, only Yard 8 with the Adjacent Parcel is of a sufficient size and configuration to effectively store the required cars and house a support facility while providing the operational flexibility that is needed for such a facility without additional environmental impacts. Yard 8 is a former railroad property located in an industrial area that is currently zoned for this type of a facility.

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## Estimated Cost

During the development of this DEIR/EA, 10-percent concept plans for the Proposed Project and Future Full-Build Alternative alignments were designed and detailed capital cost estimates were developed. The capital improvements described in previous sections include, but are not limited to, construction of track, stations, structures, systems, drainage, utilities, and the maintenance facility. Additional costs include property acquisitions and relocations as well as the cost for vehicle acquisitions. The cost of the Proposed Project (Alternative 1 - Extension to Medford Hillside with a spur to Union Square using the MBTA Fitchburg Line) includes the cost to reconstruct Lechmere Station and is estimated to be approximately \$805 million in 2008 dollars, including \$76.0 million for vehicles. Annual operating and maintenance costs would be approximately \$21.3 million in 2008 dollars. The total costs for the Proposed Project were increased to include inflation for the time period in which the Project is to be implemented. Therefore, the "Year-of-Expenditure (YOE)" costs for the Proposed Project were calculated to be approximately \$932.4 million in YOE dollars, with operating and maintenance costs of \$25.9 million in YOE dollars.

In 2008, the FTA engaged a Project Management Oversight Consultant (PMOC) to undertake a review of the preliminary cost estimate for the Green Line Extension Project. The PMOC review identified a number of issues that introduce risk into this preliminary cost estimate. The most significant issues relate to construction methodology and schedule. As a result, FTA is not able to endorse these cost estimates at this time. EOT recognizes these issues, which are principally related to the current state of conceptual engineering for the Project, as appropriate to a draft environmental document. EOT will continue to work with FTA and the PMOC process to address these issues and ensure FTA endorsement of the Green Line Extension Project cost estimates as the Project develops through preliminary engineering and final design.

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## What are the Project Benefits and Impacts?

The DEIR/EA evaluates the Project's impacts – both beneficial and adverse – on natural and human resources. These impacts were compared to the effects of the No-Build Alternative, in the year 2030. The Green Line Extension Project offers tremendous benefits with minimal impact to the Project area by virtue of the fact that it is being constructed along existing MBTA railroad rights-of-way, which will enable light rail service to serve pedestrian-oriented centers with minimal disruption to the surrounding community and without significant property or neighborhood impacts. Other benefits related to the Project's environmental impacts include:

- **Land Use, Social and Economic Resources** – The Proposed Project is expected to decrease low intensity commercial and light industrial uses in the Project corridor and increase mixed-use, high-density transit-oriented development, particularly at Union Square, Brickbottom Station, and Ball Square Station. Impacts to land, businesses and residences have been minimized as much as possible through the use of existing transportation corridors. The Proposed Project would provide socioeconomic benefits due to increased transit access, which increases both the potential for local commerce and the potential for area residents to commute to jobs elsewhere.
- **Environmental Justice** – According to the transit modeling performed on the Project, the Proposed Project would substantially increase transit access to environmental justice and disability populations. The Proposed Project will focus regional transportation investment funds into established environmental justice communities, connecting residents to jobs and services in Boston and Cambridge and strengthening business and residential districts in the corridor. There would be no disproportionate impacts to environmental justice areas from the Proposed Project.
- **Traffic** – The Proposed Project does not have an adverse impact on traffic operations throughout the study area and, in fact, makes improvements to many intersections for traffic and pedestrian movements. The Project would not physically alter designated bicycle facilities nor disrupt plans for future on-road or off-road facilities. When the opportunity is available, connections from bicycle facilities directly to proposed stations can be made. Ample bicycle parking would be provided at the Proposed Project station locations to accommodate and encourage commuting by bicycle. Minimal impacts to parking and recommendations for parking enforcement plans are expected for the Proposed Project.
- **Air Quality** – The Proposed Project is a significant investment in urban mass transit which will provide important transportation, air quality, and urban redevelopment benefits and will fulfill a longstanding commitment to incorporate transit projects as an integral element of the Central Artery/Tunnel project (CA/T). The air quality study demonstrates that the Proposed Project for

the Green Line Extension Project complies with the Clean Air Act Amendments (CAAA) and the State Implementation Plan (SIP). The Proposed Project will reduce daily Vehicle Miles Traveled (VMT) by 25,018, improving air quality and providing zero-emission transportation capacity for anticipated growth.

- **Noise** – Although the Proposed Project will introduce a new noise source into the Project study area, proposed noise barriers, potential sound insulation, and rail lubrication would be effective in mitigating all potential noise impacts from the Proposed Project and no residual impacts would be expected. In fact, for locations along the existing commuter rail lines, the future noise levels would be substantially lower than the existing noise levels due to the noise barriers. Therefore, with mitigation, there would be no severe noise impacts from the Project.
- **Vibration** – The proposed vibration mitigation for the Proposed Project including ballast mats or resilient fasteners on the proposed Green Line tracks and the relocated commuter rail tracks and the relocation or use of specially-engineered trackwork would be effective in keeping future vibration levels at or below existing levels for commuter trains and in reducing future vibration from Green Line trains below the impact criteria (72 VdB for commuter rail and 75 VdB for Green Line trains).
- **Visual** – The Proposed Project would not have a significant effect on the local visual environment. The changes proposed would occur in urbanized areas within and adjacent to the existing right-of-way and would have little overall visual impact on the public. The most significant change would be the loss of forested areas along the right-of-way, reducing the green space visible from local residential areas. The addition of landscaping at the stations and both on and above the retaining walls will reduce the overall visual effect of vegetation losses. The proposed noise barriers would block the view of the right-of-way for adjacent homes and prevent any further visual impacts by obscuring the trains and rails that would otherwise be visible from residential back yards.
- **Historic Resources** – The Proposed Project has impacts on a minimal number of historic or archeological resources, including existing Lechmere Station, which is recommended as potential National Register-eligible, several domestic properties and the industrial areas surrounding Yard 8. However, the Project has developed a Memorandum of Agreement that specifies the measure to be implemented to mitigate adverse effects resulting from the Project.
- **Hazardous Materials** – The Proposed Project would have an environmental benefit by remediating several sites that contain contaminated soils. Mitigation measures during construction include special handling, dust control, and management and disposal of contaminated soil and groundwater in order to prevent construction delays and to provide adequate protection to workers and any nearby sensitive receptors. All response actions must ensure that any nearby or adjacent receptors are adequately protected.

- **Indirect and Cumulative Impacts** – The Green Line Extension Project is proposed for an area that is already densely developed. The extension of rail service through this area provides opportunities for the cities to modify their zoning and create infill development. The Proposed Project would support a number of major redevelopment projects that are currently planned and underway near the proposed station sites. It is not expected that the Green Line Extension would lead to an increase in the overall level of growth in the region. Rather, it would focus the growth into patterns that would increase the number of viable travel options available to corridor residents and employees, including transit, walking, and bicycling. The Proposed Project is also not likely to generate additional regional growth in jobs or population. However, it may affect where that growth occurs, the form of the growth, and the pace of redevelopment.

The following sections provide additional detail on the Project's impacts and benefits.

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### "No Effect" Categories

The DEIR/EA evaluated impacts to a wide range of resources, and found that the proposed alternatives would have no adverse effect, or only a minor effect, on water quality, wetlands, threatened and endangered species, wildlife habitat, open space, and parks and recreation areas.

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### Land Use, Social, and Economic Resources

This group of categories evaluates the impacts on properties, types of land uses, jobs, neighborhoods, and property tax revenues. The increased transit access and ridership has the potential to increase commerce and encourage greater economic development along the Green Line Extension, which would increase property values and offset decreases in municipal property tax revenue.

Acquiring buildings and properties for the Project is unavoidable due to the dense urban character of the Project Area. Despite the relative abundance of commercial and industrial properties in the affected cities, the acquisition and demolition of existing businesses could result in temporary reductions in local commerce as the affected businesses relocate or permanent reductions if the businesses do not reopen locally or at all. The use of the existing right-of-way minimizes the property acquisitions, which would be much higher for an extension that involved establishing a new right-of-way through these cities.

The use of the existing right-of-way for most of the tracks also avoids dividing and segmenting any neighborhoods, which could otherwise cause significant changes to the local character. The proposed property acquisitions would not cut off access

within any existing neighborhoods or block access from one neighborhood to another.

The Proposed Project is expected to decrease low intensity commercial and light industrial uses in the Project corridor and increase mixed-use, high-density transit-oriented development, particularly at Union Square, Brickbottom Station, and Ball Square Station. Impacts to land, businesses and residences have been minimized as much as possible through the use of existing transportation corridors.

Constructing the Proposed Project as currently designed would require 11.5 acres of land acquisition from approximately 38 properties, and would require relocating five businesses. The largest area acquisitions are for the Project's maintenance and storage facility at Yard 8 in Somerville (two parcels totaling 5.8 acres). In terms of impact, the most substantial acquisitions are those that require the displacement and relocation of residences and active businesses. These are located at Ball Square (three businesses), and in Union Square (two businesses). No residences would be displaced. The Future Full-Build Alternative (extending to Mystic Valley Parkway/Route 16 Station (one business and two office/R&D buildings with multiple businesses).

The Proposed Project would have the lowest amount of property acquisition and displacement of the alternatives evaluated. Alternative 4, Green Line Extension to Mystic Valley Parkway/Route 16 (via commuter rail right-of-way) and Union Square (in-street running), would have the greatest impacts (52 acquisitions, 21.1 acres of land, seven business relocations and four residential relocations), largely associated with the Union Square extension.

The Proposed Project would provide socioeconomic benefits due to increased transit access, which increases both the potential for local commerce and the potential for area residents to commute to jobs elsewhere. As a result of the land acquisition, the Proposed Project would result in a total decrease of \$228,239 in municipal property taxes (the least adverse impact of the four alternatives that include extending both to Medford and Union Square). The Future Full-Build Alternative would result in an additional \$269,608 decrease in property taxes. Tax losses would be primarily in Medford (\$205,935) with a small amount (\$6,527) in Somerville for the Proposed Project.

The Proposed Project would displace an estimated 18 jobs in Somerville. The Future Full-Build Alternative could result in the displacement of an additional 13 jobs in Somerville and 224 jobs in Medford, largely as a result of constructing the Mystic Valley Parkway/Route 16 Station. These displacements do not represent a significant fraction of the jobs in these three cities. By comparison, the 2000 U.S. Census estimated the workforces of Cambridge, Medford, and Somerville at 59,965 workers, 30,133 workers, and 47,656 workers, respectively. Although it is uncertain how many



of the jobs displaced are held by local residents rather than commuters, the small scale of the job losses relative to the workforce makes it clear that the jobs at stake represent at most a minor economic impact.

Many of the jobs displaced would likely be relocated or replaced within the affected cities. There is an inherent economic advantage to being located close to public transit and to educational and social centers such as Tufts University and Union Square. Therefore, many of the jobs affected — particularly the office positions displaced in Medford — would not actually be eliminated but only relocated locally.

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## Environmental Justice

According to the transit modeling performed on the Project, the Proposed Project would increase transit access to environmental justice and disability populations. The Project connects low-income and environmental justice communities to the region's fixed-guideway network, thus improving access to jobs and services. The Project is designed to provide fair access to stations and economic development opportunities and avoid any disproportionate share of impacts." The Project complies with federal DOT requirements for environmental justice as developed through Executive Order 12898 and DOT Order 5610.2 (DOT Order on Environmental Justice, April 15, 1997).

The primary benefit of the Project for local residents and workers is improved access to transit. Improved access was evaluated only for the Full Build Alternative, which provides similar benefits to the currently proposed Project. As this analysis demonstrates, the Green Line Extension would improve transit access to jobs, on average, by 6.1 percent; access to colleges by 7.6 percent, and access to hospital beds by 9.8 percent. While there are impacts of building acquisitions and noise on environmental justice populations, these impacts are unavoidable due to the proximity of the existing rail corridors to environmental justice areas. These impacts are neither severe nor disproportionate, and the impacts would be balanced by the transit benefits to environmental justice populations. While the exact economic benefits cannot be determined, providing increased transit access and economic opportunities to the same neighborhoods affected by the Project would offset any economic impacts to these neighborhoods.

The Proposed Project would result in the acquisition of five commercial buildings and displace approximately 18 jobs in environmental justice areas. The Future Full-Build Alternative would not increase these impacts. There would be no disproportionate noise impacts to environmental justice areas from the Proposed Project or the Future Full-Build Alternative. Noise mitigation would be required for the residences affected, resulting in no residual adverse impacts due to noise.

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## Traffic

This section discusses the direct, indirect, and cumulative effects of the Preferred Alternative with respect to intersection, pedestrian, bicycle, public bus transportation, and parking systems in the Study Area. For the year 2030, the DEIR/EA analyzes future traffic volumes throughout the Study Area (both with and without the Project), the impacts of the Project on the transportation system in the surrounding communities, and any measures that would mitigate Project impacts.

The DEIR/EA analyzes traffic for the No-Build and Build Alternatives in order to evaluate the effects of the Project on intersection levels of service and pedestrian and bicycle circulation. The DEIR/EA provides a detailed assessment of the impacts on the transportation system associated with the Build Alternatives. The following conclusions were reached:

- **Traffic Operations** – With mitigation at four intersections, the Proposed Project would improve operations at eight intersections. The Future Full-Build Alternative would improve operations at five intersections.
- **Pedestrians** – Pedestrian improvements would be implemented at 29 locations throughout the Study Area to accommodate the expected number of pedestrians accessing proposed stations. Pedestrian delays throughout the Study Area would be improved and signals would be timed to ensure pedestrians have adequate time to cross the street. The Future Full-Build Alternative would improve pedestrian operations at 33 intersections.
- **Bicycles** – The Project would not physically alter designated bicycle facilities nor disrupt plans for future on-road or off-road facilities. When the opportunity is available, connections from bicycle facilities directly to proposed stations can be made. Ample bicycle parking (270 spaces) would be provided at the Proposed Project station locations to accommodate and encourage commuting by bicycle. The Future Full-Build Alternative would provide an additional 50 bicycle parking spaces at Mystic Valley Parkway/Route 16 Station.
- **Parking** – Minimal impacts to parking are expected for the Proposed Project. A total of 12 parking spaces would be removed to accommodate the station entrances and enhance pedestrian access. The Future Full-Build Alternative extension to Mystic Valley Parkway/Route 16 would require removing and additional 16 parking spaces and demolishing an existing parking structure near Mystic Valley Parkway/Route 16. However, this alternative would also remove the commercial building associated with the parking structure thereby resulting in no parking impacts to the neighborhood. Enforcement would be necessary to ensure that on-street parking is being used appropriately.
- **Bus Transportation** – Slight operational changes to bus service would occur at Relocated Lechmere Station to facilitate the station relocation. No other bus routes or services would be impacted.

- **Construction Impacts** – Construction impacts would be related to construction and traffic detours and would be temporary. In the vicinity of the stations and bridges, available parking may be temporarily displaced. Construction staging would limit the number of temporary bridge closures and ensure that adjacent bridges are not closed at the same time.

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## Air Quality

The Proposed Project is a significant investment in urban mass transit which will provide important transportation, air quality, and urban redevelopment benefits and will fulfill a longstanding commitment to incorporate transit projects as an integral element of the Central Artery/Tunnel project (CA/T). The DEIR/EA describes the air quality benefits associated with the Green Line Extension Project and describes its consistency with the State Implementation Plan (SIP) and DEP's Transit Regulations. The DEIR/EA includes a mesoscale and microscale air quality analysis that evaluates emissions of volatile organic compounds (VOCs), oxides of nitrogen (NO<sub>x</sub>), greenhouse gas carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), and particulate matter (PM). The microscale (local or hotspot) analysis evaluated carbon monoxide (CO) and particulate matter (PM). The regional (mesoscale) analysis evaluated ozone precursors (VOCs, NO<sub>x</sub>, CO<sub>2</sub>, CO, and PM).

### Microscale Analysis

The microscale analysis indicates that reductions in CO concentrations are expected to occur over time when compared to 2007 existing conditions. All of the calculated future CO concentrations are equal to or less than the 2007 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. The Proposed Project would not exceed the CO National Ambient Air Quality Standards (NAAQS).

The microscale analysis also calculated the 24-hour PM<sub>10</sub> concentrations and the 24-hour and annual PM<sub>2.5</sub> concentrations for 2030. The 24-hour PM<sub>10</sub> concentrations were calculated using EPA's CAL3QHC model. The 24-hour PM<sub>10</sub> concentrations for the Proposed Project ranged from a minimum of 66 ug/m<sup>3</sup> to a maximum of 83 ug/m<sup>3</sup>. All of the 24-hour PM<sub>10</sub> concentrations are well below the PM NAAQS of 150 ug/m<sup>3</sup>. The 24-hour PM<sub>2.5</sub> concentrations for the Proposed Project ranged from a minimum of 30.5 ug/m<sup>3</sup> to a maximum of 32.1 ug/m<sup>3</sup>, and the annual PM<sub>2.5</sub> concentrations ranged from a minimum of 11.9 ug/m<sup>3</sup> to a maximum of 12.2 ug/m<sup>3</sup>. All of the annual PM<sub>2.5</sub> concentrations are well below the PM<sub>2.5</sub> NAAQS of 15 ug/m<sup>3</sup>, and all of the 24-hour PM<sub>2.5</sub> concentrations are below the PM<sub>2.5</sub> NAAQS of 35 ug/m<sup>3</sup>.

## Mesoscale Analysis

The air quality study included a mesoscale analysis that estimates the area-wide emissions of VOCs, NO<sub>x</sub>, CO<sub>2</sub>, 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 mesoscale analysis calculated the 2030 mobile source emissions from the major roadways in the study area. These emissions, estimated to be 22,687.5 kilograms per day (kg/day) of VOCs, 19,186.2 kilograms per day of NO<sub>x</sub>, and 3,385.7 kg/day of PM<sub>10</sub>, establish a baseline to which future emissions can be compared.

The results of the mesoscale analysis demonstrate that the Proposed Project would reduce emissions of VOC, NO<sub>x</sub>, and PM<sub>10</sub> as compared to the No-Build Alternative, as shown in Figure ES-7. The Future Full-Build Alternative (extension to Mystic Valley Parkway/Route 16) would provide a small additional decrease in air quality emissions.

The air quality study demonstrates that the Proposed Project for the Green Line Extension Project complies with the Clean Air Act Amendments (CAAA) and the State Implementation Plan (SIP). The ozone mesoscale analysis demonstrates that all Build Alternatives will result in a decrease of VOC, NO<sub>x</sub>, and PM<sub>10</sub> emissions, as compared to the No-Build Alternative.

## Greenhouse Gas (CO<sub>2</sub>) Analysis

The Executive Office of Energy and Environmental Affairs (EEA) has developed a policy that requires a proposed project to evaluate Greenhouse Gas (GHG) emissions. The air quality study calculated the GHG emissions from mobile sources related to the proposed Green Line Extension Project. While GHG emissions include several gases, CO<sub>2</sub> (carbon dioxide) was selected for evaluation because it is the most significant component of transportation-related GHG emissions. The year 2030 was selected as the future year of analysis to be consistent with the regional long-range transportation plan. The Proposed Project would reduce CO<sub>2</sub> by 17.115 kg/day in comparison to the No-Build Alternative. The Future Full-Build Alternative extension to Mystic Valley Parkway/Route 16 would provide an additional 928 kg/day reduction.

Figure ES-7 Mesoscale 2030 Mobile Source Analysis Results (kilograms per day)

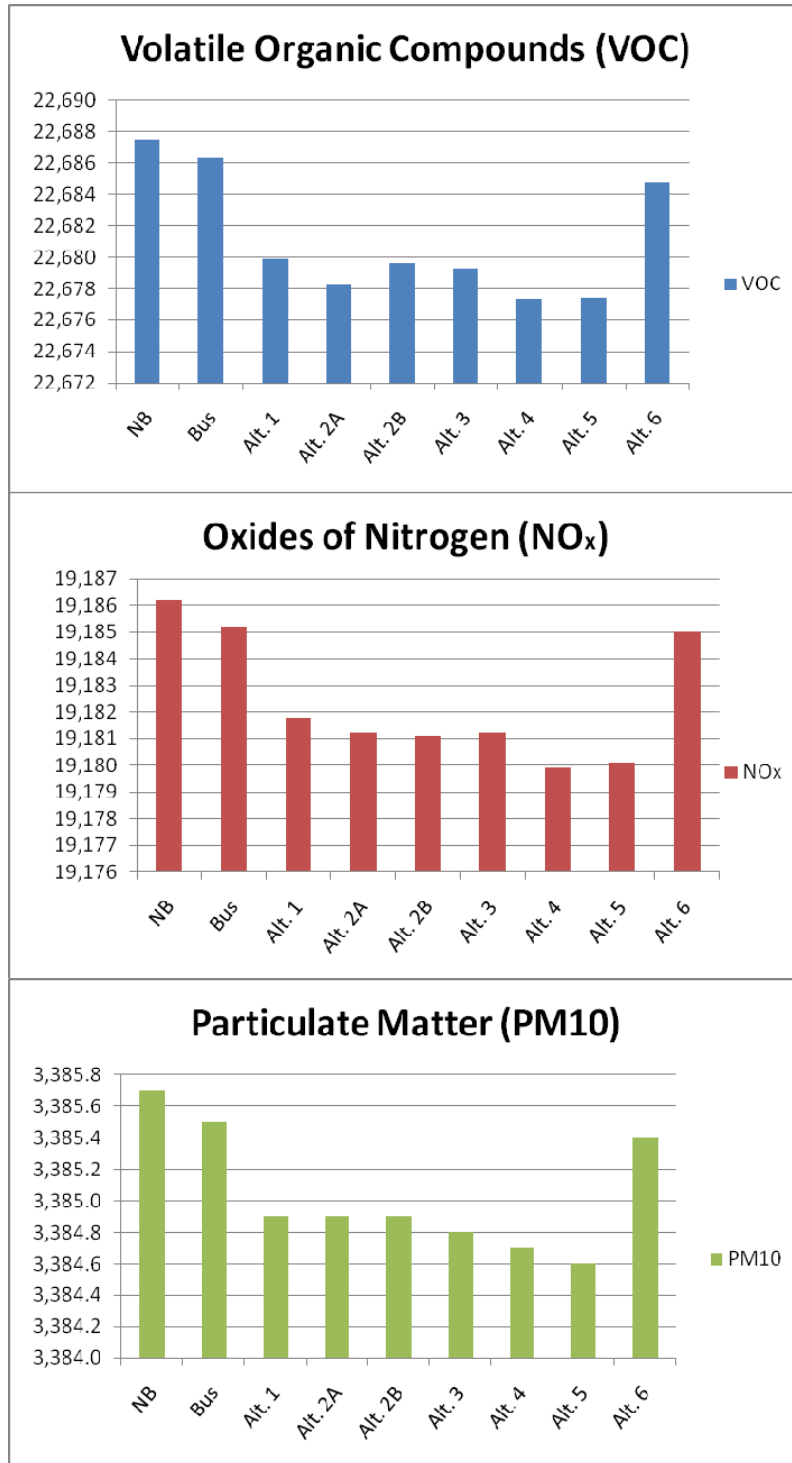


Table ES-2 – Comparison of Air Quality Benefits

	Carbon Monoxide (CO)	Nitrogen Oxides (NO <sub>x</sub> )	Volatile Organic Compounds (VOC)
2006 Approved Package of Projects (Arborway; Green Line Extension to Ball Square/Tufts; Blue Line/Red Line Connection)	292	8	11
2008 Federal Register SIP Approved Projects + 10%	321.2	8.8	12.1
2009 Package (Green Line Extension - College Avenue with Union Square Spur; Fairmount; Parking)	520	9.5	16
2009 Analysis – Green Line Extension Only Benefits	443	8.5	13
% of Green Line Extension Benefits as compared to Total Package	85%	89%	81%

## Noise

The Green Line Extension would add a new noise source to the environment along the proposed corridor. While there is existing noise exposure from sources such as commuter trains and automobiles, introducing an additional noise source and relocating the commuter rail lines have the potential to increase future noise at some noise-sensitive receptors. The Proposed Project involves relocating the commuter rail lines up to 18 feet along some portions of the corridor and introducing the proposed Green Line tracks on the west side of the corridor along the Medford Branch and on the south side on the Union Square Branch.

Potential noise impact on the west side of the Lowell Line alignment is due primarily to the proximity of noise-sensitive receptors to the Green Line trains. At close distances (within approximately 50 feet) the contribution of noise from Green Line trains is more significant than from commuter trains. Future noise levels on the west side are projected to generally increase one to two decibels due to the close proximity of noise-sensitive receptors to the Green Line trains. At a few specific locations (Alston Street and Piggott Road) the increase in noise levels is higher (five to seven decibels) due to the close proximity (16 to 25 feet) to the near track centerline of the proposed Green Line trains.

Because existing noise levels are relatively high at locations along the existing commuter rail line, even small increases in future noise levels are considered to have the potential for moderate or severe noise impact. Moving the commuter rail closer to residences on the east side of the Lowell Line right-of-way would therefore have moderate to severe impacts in some locations.

Temporary noise impacts could result from construction activities associated with utility relocation, grading, excavation, track work, and installation of systems components. Such impacts may occur in residential areas and at other noise-sensitive land uses located within several hundred feet of the alignment. The potential for noise impact would be greatest at locations near pile driving operations for bridges and other structures, and at locations close to any nighttime construction activities.

The Proposed Project would expose 145 residential buildings to moderate (115) or severe (30) noise levels, and would expose three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio, and Bacon Hall at Tufts University) to moderate noise levels and one severe institutional impact. (the Walnut Street Center, a non-profit support center for adults with developmental disabilities near Union Square). The Future Full-Build Alternative extension to Mystic Valley Parkway/Route 16 would add 55 moderate and 35 severe residential impacts.

With mitigation, there would be no severe noise impacts from the Project. Noise mitigation including noise barriers, potential sound insulation treatments, and rail lubrication would be feasible, reasonable, and effective in mitigating all potential noise impact due to the proposed Project for all alternatives. During the preliminary engineering phase of the Project, the existing outdoor-to-indoor noise reduction of the buildings will be measured. An analysis will be made as to whether the noise reduction of the building could be improved by five decibels or more with sound insulation treatments. The effectiveness of potential noise barriers to reduce interior noise levels at these locations will also be assessed.

The noise barriers (examples are shown in Figure ES-8) would be effective in reducing noise levels from transit sources generally 7 to 11 decibels and would result in substantial reduction in future noise levels in comparison to existing noise levels. The proposed noise barriers, potential sound insulation, and rail lubrication would be effective in mitigating all potential noise impacts from the Proposed Project and no residual impacts would be expected. In fact, for locations along the existing commuter rail lines, the future noise levels would be substantially lower than the existing noise levels due to the noise barriers. Therefore, with mitigation, there would be no severe noise impacts from the Project and noise improvements would be made along the corridor.

Figure ES-8 Examples of Noise Barrier Materials



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## Vibration

The Green Line Extension Project would add a new vibration source to the environment along the proposed corridor. While there is existing vibration exposure from sources such as commuter trains and automobiles, introducing an additional vibration source and relocating the commuter rail lines have the potential to increase future vibration at some sensitive receptors. The Project involves relocating the commuter rail lines up to 18 feet to the east along some portions of the corridor and adding the proposed Green Line tracks on the west side of the corridor.

Vibration impact from the commuter trains generally occurs within 60 feet of the future commuter rail near-track centerline and within 40 feet of the proposed Green Line near-track centerline. Most receptors projected to be exposed to vibration impact from commuter train activity are on the east side of the Lowell Line or the south side of the Fitchburg Line where the proposed commuter rail near track is planned to shift



up to 18 feet closer than its current location. Shifting the existing commuter rail lines closer to sensitive receptors is generally expected to increase vibration levels 10 to 13 VdB. Most receptors projected to be exposed to vibration impact from Green Line train activity are located on the west side of the MBTA Lowell Line.

Temporary vibration impacts could result from construction activities associated with the Green Line Extension Project. The potential for vibration impact would be greatest at locations near pile driving and vibratory compactor operations.

The Proposed Project may potentially expose 93 vibration-sensitive buildings to impact without vibration mitigation. This includes 90 single-family and multi-family residential buildings and three institutional buildings (Science and Technology Center, Outside the Line Artist's Studio, and Bacon Hall at Tufts University). The Future Full-Build Alternative extension to Mystic Valley Parkway/Route 16 would expose an additional 9 residential buildings to vibration impacts.

The proposed vibration mitigation including 19,700 track-feet of vibration mitigation such as ballast mats or resilient fasteners on the proposed Green Line tracks and the relocated commuter rail tracks and the relocation or use of specially-engineered trackwork (flange-bearing or moveable-point frogs) for 12 crossovers and turnouts would be effective in keeping future vibration levels at or below existing levels for commuter trains and in reducing future vibration from Green Line trains below the impact criteria of 72 VdB (commuter rail) or 75 VdB (Green Line trains).

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## Visual

The Proposed Project would require acquiring property, demolishing buildings, constructing new Green Line track and stations, and relocating the commuter rail track within the existing right-of-way. Some existing vegetation would be removed, and new retaining walls and noise barriers would be built. Fences, trees, and steep slopes on each side of the right-of-way minimize the rail corridor's visibility. The right-of-way is only visible to the public from certain locations, such as from bridges or through fences. With the exception of the Lechmere Station area, which will be on an elevated structure, there will be minimal visual impact on the area. Because the changes would occur in urbanized areas within and adjacent to the existing right-of-way, they would have little overall visual impact on the public. New planting and screening efforts along the right-of-way and atop the retaining walls would be done in coordination with abutting residents and businesses to ensure that no undue visual impacts are imposed on local neighborhoods. The Project will incorporate vegetation in and above these walls and at the stations in order to maximize the amount of vegetation along the expanded right-of-way. These will reduce the net loss of vegetation and reduce the visual impact of any tree removal on the neighborhoods.

The stations themselves have generally small footprints and are located along and within the right-of-way to the greatest extent possible, minimizing the overall visual impact. The major materials used in the station buildings will be masonry, steel, and glass. Landscaping will be designed to provide protection from the elements without obscuring visibility. Landscaping will be inviting both to the users of the stations and to the passers-by, using small trees and low shrubs, which are easily maintained and of a design that encompasses lighting and defensible space for safety. The new stations would be visible from their street access points and from nearby bridges.

The Proposed Project would require noise mitigation, usually consisting of noise barriers, to protect sensitive receptors such as residences from increases in train noise. Noise barriers would range from six to 12 feet tall and would block the view of the right-of-way for adjacent homes. While this would reduce the visibility of the green space surrounding the right-of-way, it would also prevent any further visual impacts by obscuring the trains and rails that would otherwise be visible from residential back yards.

The Proposed Project would not have a significant effect on the local visual environment. The changes proposed would occur in urbanized areas within and adjacent to the existing right-of-way and would have little overall visual impact on the public. The most significant change would be the loss of forested areas along the right-of-way, reducing the green space visible from local residential areas. The addition of landscaping at the stations and both on and above the retaining walls will reduce the overall visual effect of vegetation losses. The proposed noise barriers would block the view of the right-of-way for adjacent homes and prevent any further visual impacts by obscuring the trains and rails that would otherwise be visible from residential back yards.

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## Historic Resources

The FTA is the lead federal agency for the Green Line Extension Project with responsibility for compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 and other federal statutes. The Environmental Assessment filed under NEPA addresses compliance with Section 106 of the NHPA and Section 4(f) of the Department of Transportation Act of 1966.

The Proposed Project would impact historic resources by relocating the existing Lechmere Station, which is recommended as potentially eligible for the National Register-of Historic Places, to the north side of the O'Brien Highway in Somerville. This impact would occur for all of the alternatives considered in this DEIR/EA. This constitutes an "adverse effect" under Section 106 and a "use" under Section 4(f). The DEIR/EA documents that there are no feasible and prudent alternatives to the use of the Lechmere Station, and that adverse effects cannot be avoided.

Relocated Lechmere Station and associated roadway and busway improvements have long been intended to be constructed as part of the NorthPoint development project. However, due to the uncertainty surrounding the NorthPoint project, the Commonwealth has included the planning for the relocation of Lechmere Station and area roadway improvements into the Green Line Extension Project. The new Lechmere Station will be relocated and elevated, situated on a new and realigned viaduct on the east side of Monsignor O'Brien Highway/Route 28. Once the relocation is complete, the existing Lechmere Station would be demolished and cleared, and the area would be made available for potential future redevelopment.

A Memorandum of Agreement (MOA) has been developed that specifies the measures that will be implemented by FTA to mitigate the adverse effects. Mitigation measures include archival photographic documentation and historical interpretation.

Due to their location primarily within the existing right-of-way and their design, the proposed stations will have no effect or no adverse effect on historic properties in the surrounding Area of Potential Effect (APE).

The Proposed Project would potentially affect one archaeological sensitive area needed for the proposed Brickbottom Station (pickup/dropoff and access). This sensitive area is documented as having the potential to contain significant belowground remains associated with mid-late nineteenth-century worker housing that characterized the Joy Street section of Somerville during the late industrial period.

Yard 8, the proposed layover facility, may also contain deeply buried archaeologically sensitive strata that could be impacted by construction associated with the proposed new vehicle maintenance building. Mitigation measures for archaeological sites that will be adversely affected by construction activities will include an archaeological data recovery program designed in accordance with state and federal guidelines and standards for the excavation of National Register-eligible archaeological sites. Should any significant and National Register-eligible archaeological resources be identified during the intensive survey or subsequent site evaluation testing, then measures to avoid, minimize, or mitigate any adverse effects of the Project on the National Register-eligible resource(s) will need to be determined by the FTA and EOT, in consultation with the MHC and other consulting and interested parties.

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## Hazardous Materials

The Proposed Project would require construction in areas where contaminated soils or groundwater are likely to be present in the vicinity of the rail right-of-way or proposed stations and where soil and/or groundwater remediation may be required as the Project design progresses. The remediation includes removing contaminated soil and pumping contaminated groundwater in accordance with the provisions of

the Massachusetts Contingency Plan (MCP), Massachusetts General Law (MGL) Chapter 21E and 21C, and the federal Resource Conservation and Recovery Act (RCRA).

The Proposed Project requires construction in seven areas which collectively contain 18 “Recognized Environmental Conditions” or RECs. These include off-site properties where releases have occurred but have been cleaned up or where there are underground storage tanks that are unlikely to have leaked; properties such as those with potential sources of oil and hazardous material with limited or inconclusive information; and sites such as those with confirmed soil, groundwater, and/or indoor air impacts that were reported to MassDEP and have undergone some type of cleanup or remain an active case. The Future Full-Build Alternative extension to Mystic Valley Parkway/Route 16 would require construction in an additional three sites with RECs.

The Proposed Project would have an environmental benefit by remediating sites that contain “high impact” RECs. One high-potential site would be cleaned as part of the proposed Green Line Extension Project.

Mitigation measures during construction on sites with RECs include special handling, dust control, and management and disposal of contaminated soil and groundwater in order to prevent construction delays and to provide adequate protection to workers and any nearby sensitive receptors. All response actions must ensure that any nearby or adjacent receptors are adequately protected.

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## Indirect and Cumulative Impacts

The DEIR/EA evaluates the consistency of the Project with ongoing and planned projects, evaluates the indirect and cumulative effects of the Project by topic and highlights how the effects would differ among alternatives.

Indirect impacts are defined as “effects which are caused by the [proposed] action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to changes in the pattern of land use, population density, or growth rate...” For this analysis indirect effects are defined as potential land use impacts of the Proposed Project. In comparison, direct land use impacts are displacements of properties required for the Project.

Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of

time.” Cumulative impacts include the direct and indirect impacts of a project together with the reasonably foreseeable future actions of others.

The Proposed Project is not likely to generate additional regional growth in jobs or population. However, it may affect where that growth occurs, the form of the growth, and the pace of redevelopment.

The Green Line Extension Project is proposed for an area that is already densely developed. The extension of rail service through this area provides opportunities for the cities’ to modify their zoning and create infill development, with opportunities for more housing and other changes that Somerville is already contemplating. The Proposed Project would support a number of major redevelopment projects that are currently planned and underway near the proposed station sites, particularly in the NorthPoint area of Cambridge. Improved mobility, access to a wider range of transportation options, and less traffic congestion would make these projects particularly appealing.

Within the Station areas, the Green Line Extension combined with supportive public policies could attract transit-supportive development that would otherwise locate outside Station areas in less transit-supportive forms. It is likely that Cambridge, Somerville, and Medford would adopt zoning rules that would allow for more dense development around transit stations relative to existing conditions and surrounding areas. Cambridge and Somerville have already taken steps in this direction. The NorthPoint, Union Square, and the developing Brickbottom and Inner Belt area plans in particular emphasize development in concert with the proposed transit Project.

Although the addition of transit does not directly cause development to occur, plans and policies that provide incentives for new development to be located near transit stations can significantly influence where development takes place and the form of the development. These policies and the presence of a transit system can also have an indirect positive effect on property values near station sites, as has been demonstrated in other cities with transit systems.

It is not expected that the Green Line Extension would lead to an increase in the overall level of growth in the region. Rather, it would focus the growth into patterns that would increase the number of viable travel options available to corridor residents and employees, including transit, walking, and bicycling. As an additional benefit, compact transit-oriented development (TOD) reduces the cost of providing utilities, facilities, and services to new residential and commercial developments.

The potential for TOD differs at each station site. Factors that could spur TOD development, beyond the addition of a transit station, include available and vacant land, adoption of TOD zoning and policies, other real estate investment in the area, and market demand for new and additional floor space.

Of the seven station sites being considered in the Proposed Project, only one, Lechmere, is in an area that can be characterized as already having TOD. Three stations with high potential for TOD are Lechmere, Brickbottom, and Union Square. In the Future Full-Build Alternative, Mystic Valley Parkway/Route 16 is also a station with TOD opportunities. Two station sites have moderate potential for TOD, and two have low potential due to a lack of available developable land. Those stations with moderate potential have strong public planning support for TOD and in some cases have redevelopment plans for the future. Table ES-3 summarizes the TOD potential for each station site.

Changes in property values that result from construction of a rail transit system are also considered indirect effects. Research based on rail transit systems in U.S. cities has shown that residential property values can increase close to a transit station. While most studies of rail transit's impact on real estate value show increases, they cannot explicitly isolate transit benefits from other market forces.

Housing affordability has been an ongoing concern in the Project corridor and throughout the Project region. The region has many characteristics that make it attractive and expensive - its dense, walkable cities and squares; a vibrant economy and proximity to jobs in downtown Boston and Kendall Square; a high concentration of universities and institutions; and its networks of parks and waterways.

Housing prices in the Project corridor have increased significantly over the last 20 years. The extension of the Red Line to Davis Square made an already desirable location even more desirable and increased real estate values in the neighborhood, including Ball Square. Student demand for housing near Tufts University has helped to keep rents and housing prices high near College Avenue. The NorthPoint development is geared toward high-end residential. The areas with the greatest potential for transit-related price increases are the areas with the greatest potential for high-end redevelopment - Union Square, with the potential redevelopment of Boynton Yards, and Brickbottom, with the potential redevelopment of the Brickbottom and Inner Belt industrial areas. To avoid potential displacement of current residents and middle-income individuals and families, the cities should make housing affordability a central theme in the planning for these areas.

Table ES-3 TOD Potentials at Proposed Station Sites

Station Site	TOD Potential			Comments
	High	Moderate	Low	
Lechmere, Cambridge (relocated)	X			Existing and planned future high density, mixed-use development is transit-oriented. Much vacant land exists in the NorthPoint Planned Unit Development zone. Surrounding area is already TOD.
Brickbottom, Somerville	X			City plans that are under development for Brickbottom and Inner Belt districts are transit-oriented. The area has much vacant and underused land.
Gilman Square, Somerville		X		The City could redevelop its adjacent parcel for high-density, mixed uses and include cross-track air rights development.
Lowell Street, Somerville			X	Planned housing development is transit supportive but not mixed-use TOD. No other space is available for TOD.
Ball Square, Medford		X		TOD would require redevelopment of occupied parcels and/or air rights development. New signs of increased activity and economic vitality may support redevelopment.
College Avenue, Medford			X	Tufts University controls most nearby land. TOD potential would require redevelopment of institutional properties to more public uses. Tufts could redevelop some of its properties to higher density.
Mystic Valley Parkway/Route 16, Medford (Future Full-Build Alternative Only)	X			Redevelopment of U-Haul site, 200 Boston Avenue, and 196 Boston Avenue for mixed uses in conjunction with the station presents an opportunity for TOD.
Union Square, Somerville	X			City plans for Union Square and Boynton Yards and related zoning initiatives promote TOD.
<b>Total</b>	<b>4</b>	<b>2</b>	<b>2</b>	

This section describes the potential indirect effects on land use within a ½-mile radius of each proposed station site. This represents the maximum distance riders are willing to walk. If TOD were to be approved, it would likely be sited within ¼-mile from a station.

**Land Use** – The Proposed Project is likely to result in higher density redevelopment, more TOD, and lower on-site parking requirements in areas that are within walking distance of the stations. The following station areas have the greatest potential for higher density redevelopment and TOD: Relocated Lechmere; Brickbottom; Mystic Valley Parkway/Route 16; and Union Square.

**Transportation and Traffic** – The Green Line Extension Project would provide a new transit option northwest of NorthPoint that would mitigate potential traffic increases from continued growth and redevelopment in the Project corridor. Combined with the Urban Ring, the Community Path, and the Alewife Brook Parkway to Mystic

Valley Path, the Green Line Extension would improve the regional transportation network and reduce regional traffic and congestion.

**Property Values** – Property values are likely to increase in areas within walking distance of the stations. However, the increases are likely to be modest, as the Project corridor is already highly desirable, and housing affordability is already a concern. The greatest increases are likely to occur in areas that are planned for significant redevelopment: Union Square, Boynton Yards, the Brickbottom District, and the Inner Belt District. Public policy to preserve affordability for moderate-income residents and small businesses should be implemented to mitigate transit-related increases in land values.

**Economy** – Continued transition away from the industrial and trade sectors toward the services, knowledge-based industries, life sciences, technology, and the arts is anticipated and is supported by public policy. Planned and proposed projects that would expand employment centers in the corridor (redevelopments in East Cambridge, Brickbottom and Inner Belt districts, Union Square, and Boynton Yards) would support this trend and are more likely to proceed under the Build Alternatives.

**Neighborhoods** – Redevelopment of underused land in the Project corridor would be enhanced by the addition of a new and improved transit alternative. The greatest changes would likely occur in the Brickbottom and Inner Belt districts and in Boynton Yards, where planning is underway for potential redevelopment of these lower rent, commercial/industrial neighborhoods as mixed-use employment centers. Public policy to preserve affordability for moderate-income residents and small businesses should be implemented to minimize impacts of redevelopment on existing neighborhoods.

**Environmental Justice** – Environmental justice populations would benefit from the addition of a reliable transit alternative that would provide more opportunities to live and work in places throughout the region. However, increases in land values near new stations, particularly around Brickbottom and Union Square, may impact small businesses and limit affordable housing opportunities. Public policy to help preserve small businesses and maintain housing affordability should be implemented to help maintain diverse communities in the corridor.

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## EOT's Mitigation Commitments

Potential permanent impacts resulting from constructing the Proposed Project would be mitigated to the extent practicable, as described in Chapter 5 of this DEIR/EA and summarized in Table ES-4.



Temporary, short-term impacts from construction activities would be mitigated to the extent practicable. Appropriate construction mitigation measures would be incorporated into the contract documents and specifications governing the activities of contractors and subcontractors constructing elements of the Proposed Project. On-site resident engineers and inspectors will monitor all construction activities to ensure that mitigation measures are properly implemented. The construction mitigation measures are summarized in Table ES-5.

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## What Permits and Approvals are Required?

In addition to review under MEPA and NEPA, the Green Line Extension Proposed Project will require the state and federal permits and approvals listed below.

- Determination of Adverse Effect to Historic or Archaeological Resources [Section 106 of the National Historic Preservation Act] (FTA);
- Section 4(f) Determination (FTA);
- National Pollutant Discharge Elimination System General Permit, Section 402, Federal Clean Water Act (U.S. Environmental Protection Agency); and
- Massachusetts Highway Department access permit(s).

Table ES-4 Project Mitigation Commitments

Environmental Categories	Mitigation Measure	Implementation Schedule	Implementation Responsibility
Traffic	Provide roadway and signal modifications at six specific intersections in order to prevent adverse traffic impacts from the Project.	Completion of construction	EOT/MBTA
	Provide pedestrian improvements at 29 specific locations to improve pedestrian flow and safety.	Completion of construction	EOT/MBTA
	Work with cities to develop station-area parking enforcement plans.	Completion of construction	EOT/MBTA
Noise	Provide noise mitigation in the form of noise barriers, home sound insulation, and rail lubrication to mitigate all moderate and severe noise impacts.	Completion of construction	EOT/MBTA
	Install continuously welded rail for light rail tracks.	Completion of construction	EOT/MBTA
Vibration	Provide vibration mitigation in the form of ballast mats and special trackwork to mitigate vibration impacts.	Completion of construction	EOT/MBTA
Water Quality/ Stormwater	Prepare a Stormwater Pollution Prevention Plan (SWPPP).	Prior to construction	EOT/MBTA
	Implement all aspects of the SWPPP including recommendations in annual updates based on new or improved procedures or changes to operations.	Ongoing	EOT/MBTA
	Update the Operation and Maintenance (O&M) plan in the SWPPP to include a detailed outline of inspection and cleaning schedules for stormwater management practices, including detention areas and deep sump catch basins.	Ongoing	EOT/MBTA
	Install detention and infiltration systems to prevent any increase in peak flows to municipal stormwater drainage systems and to remove TSS from stormwater runoff prior to discharge.	During construction	EOT/MBTA
Visual Environment	Provide vegetation on and/or above retaining walls to minimize visual changes.	Completion of construction	EOT/MBTA
	Work with affected communities on design of noise barriers and vegetated walls.	Prior to construction	EOT/MBTA
Historical and Cultural Resources	Perform archival documentation of historic structures to be removed or altered.	Prior to demolition	EOT/MBTA
	Construct noise barriers with materials and colors compatible with adjacent historic properties.	Completion of construction	EOT/MBTA
	Provide noise mitigation (sound insulation) for sensitive historic structures that cannot be protected using noise barriers.	Completion of construction	EOT/MBTA
	Perform intensive archaeological survey before disturbing any archaeologically-sensitive areas.	Prior to construction	EOT/MBTA

**Table ES-5 Summary of Construction Mitigation Measures**

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Mitigation Measures
<b>Traffic</b> <ul style="list-style-type: none"><li>■ Temporary detours would be established to minimize traffic disruption due to construction.</li><li>■ Bridge reconstruction would be timed so as to minimize temporary bridge closures and to ensure that adjacent bridges were not closed simultaneously.</li></ul>
<b>Air Quality</b> <ul style="list-style-type: none"><li>■ Use water trucks to disperse water on exposed soil to reduce dust.</li><li>■ Use water for compaction in the fill areas and as a dust retardant in both the soil cut areas and haul roads.</li><li>■ Follow existing MBTA retrofit procedures for construction equipment to reduce emissions.</li></ul>
<b>Noise</b> <ul style="list-style-type: none"><li>■ Use specially quieted equipment with enclosed engines and/or high-performance mufflers.</li><li>■ Avoid nighttime construction in residential neighborhoods.</li><li>■ Keep truck idling to a minimum.</li><li>■ Route construction equipment and vehicles through areas that would cause the least disturbance to nearby receptors where possible.</li><li>■ Fit any air-powered equipment with pneumatic exhaust silencers.</li><li>■ Locate stationary construction equipment as far as possible from noise-sensitive sites.</li><li>■ Construct noise barriers, such as temporary walls or piles of excavated material, between noisy activities and noise-sensitive receivers.</li></ul>
<b>Vibration</b> <ul style="list-style-type: none"><li>■ Avoid nighttime construction in residential neighborhoods.</li><li>■ Use alternative construction methods to minimize the use of impact and vibratory equipment (e.g. pile drivers and compactors).</li></ul>
<b>Water Quality/Stormwater</b> <ul style="list-style-type: none"><li>■ Develop and implement a SWPPP in accordance with NPDES and MA DEP standards.</li><li>■ Stabilize any highly erosive soils with erosion control blankets and other stabilization methods, as necessary.</li><li>■ Reinforce slopes using a hydroseed mix with a resin base, native vegetation, or other approved methods.</li><li>■ Use dewatering controls, if necessary.</li><li>■ Install a gravel entrance to prevent sediment from being tracked onto roadways and potentially discharged to surface waters.</li><li>■ Maintain construction equipment to prevent oil and fuel leaks.</li></ul>
<b>Hazardous Materials and Solid Waste</b> <ul style="list-style-type: none"><li>■ 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.</li><li>■ Perform subsurface investigations for any planned excavation to test for possible contamination.</li><li>■ Prepare a site-specific Health and Safety Plan.</li><li>■ Conduct pre-demolition inspections to identify any hazardous materials such as asbestos and lead-based paint.</li></ul>

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