HARVARD
UNIVERSITY

SCIENCE AND ENGINEERING COMPLEX

INSTITUTIONAL MASTER PLAN NOTIFICATION FORM / NOTICE OF PROJECT CHANGE

NOVEMBER 2015

Institutional Master Plan Notification Form / Notice of Project Change

For the First Amendment to
Harvard University's Campus in Allston
Institutional Master Plan

SCIENCE AND ENGINEERING COMPLEX

Submitted to:

Boston Redevelopment Authority

Submitted by:

Harvard University, through:

Harvard Planning & Project Management

Smith Campus Center

1350 Massachusetts Avenue

Cambridge, MA 02138

In conjunction with:

Behnisch Architekten

&

Epsilon Associates Inc.

Vanasse Hangen Brustin Inc.

Stephen Stimson Associates

Nitsch Engineering Inc.

Transolar

Van Zelm Engineers

Turner Construction

CPP Wind Engineering

November 2015

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EXECUTIVE SUMMARY

This Institutional Master Plan Notification Form (IMPNF) and Notice of Project Change (NPC) is being submitted to the Boston Redevelopment Authority in order to advance the review and construction of the Science and Engineering Complex (SEC). This project will provide laboratories, classrooms, and related teaching and research facilities for Harvard's John A. Paulson School of Engineering and Applied Sciences (SEAS). In addition to creating new facilities for SEAS, the SEC will include significant accessible open space, new streets, a broad range of streetscape improvements, infrastructure upgrades, and various transportation improvements including parking, transit accommodations, bike facilities, and pedestrian amenities.

Designed by the firm of Behnisch Architekten and located along Western Avenue, the SEC will comprise approximately 496,850 square feet[1], including the renovation and re-use of the existing 114 Western Avenue building and will be surrounded by approximately 70,000 square feet of green space. The project will house faculty, scientists, researchers, students, and staff from SEAS—including undergraduate concentrators and graduate students who are studying applied mathematics, applied physics, computational science and engineering, bioengineering, computer science, electrical engineering, environmental science and engineering, material science, and mechanical engineering.

The SEC has been designed to strengthen and complement the area's public realm by raising most of the secure laboratory space above a two-story glassy "pedestal" space that will infuse Western Avenue with transparency and activity. Within this glassy space will be an atrium extending the full height of the building and including two levels below grade, a first floor dining facility with extensive open seating available to building occupants and the public, retail space, and visible activity spaces to be used for classes and engineering student projects. The ground floor space will have multiple entrances generally open to the public during business hours and generous circulation space connecting the north and south sides of the building. On the south side of the building, the existing concrete foundation platform will be transformed into a large landscaped open space, accessible to all.

In comparison with the previously approved project for this site, the SEC will result in a reduction in square footage and will be a comparable height. Due to the demographics of the SEAS community, the project will require significantly fewer parking spaces and will generate less vehicular traffic. The SEC building will utilize just the north side of the site. A permanent open space central to the site will be created similar to that in the original project. The southern portion of the site is being preserved for future as yet to be determined institutional development and will be fully landscaped until future development decisions are reached.

The SEC will provide a living laboratory for the University's scientists and engineers— both in physical spaces for research and teaching and in enhancing the existing community of entrepreneurs and innovators. The SEC will serve as a hub for partnerships with new

1 All square footage numbers in this document refer to gross floor area as defined by the Boston Zoning Code.

neighbors at Harvard Business School and the Harvard Innovation Lab. Uniting these strengths of the University will establish the planning framework for creating the planned Enterprise Research Campus, which promotes the translation of research ideas into successful products and services as well as attracts entities interested in proximity to the emerging innovation and entrepreneurial hub. Harvard's expansion into Allston is an integral part of Boston's innovation portfolio, a key link between the University and its surrounding community as well as an intellectual and entrepreneurial ecosystem that enables the most talented scholars, scientists, and engineers to advance scientific discovery, shape the future, and improve the world.

In the past few years, SEAS enrollment has tripled, with more than half of all Harvard undergraduates now electing to take at least one course in computer science. Harvard's open environment enables collaborations in the arts, sciences, mathematics, design, medicine, government, law, and industry—with partnerships that draw on the best ideas across disciplines. From building a swarm of robots that can arrange themselves into complex shapes to 3D printing an organ using biomimetic materials, the SEAS faculty and students are pioneering technological advances that cross boundaries to advance human life and its place in the world.

In terms of teaching, SEAS is a leader in active teaching amongst its peers. Some of the University's most exciting and popular courses are taught through SEAS, including: Introduction to Computer Science, Harvard's introduction to the intellectual enterprises of computer science and the art of programming; Science and Cooking, which brings in chefs from around the world and includes a very popular public lecture series; and Engineering Problem Solving and Design, a design engineering course where students have worked on real problems from the nuclear waste in Japan after the tsunami to retrofitting Harvard University Dining Services dishwashers to make them more energy efficient. SEAS faculty are also involved in science fairs every year where students showcase their class projects, including robots, electronics, and computer apps.

In terms of research, in the past eight years, teams at SEAS and their affiliates such as the Wyss Institute have developed an organ-on-a-chip that is suitable for drug testing, regenerated musculoskeletal tissues, and created a robot that can assemble itself from a single sheet of paper—in just four minutes—and moves without human intervention. They've designed a soft exosuit that fits under clothing to help soldiers walk farther, tire less easily, and carry heavy loads more safely. Inspired by the biology of a bee, they've even built a "RoboBee" that could have applications in environmental monitoring, search-and rescue operations, and crop pollination. Researchers at SEAS have recently demonstrated a flying, swimming insect-like robot, easing the way to create future aerial-aquatic robotic vehicles. Harvard's engineering students have teamed up with a surgeon to design the gentle grasper, a surgical tool equipped with rubberized pressure sensors that can slip through a small incision and manipulate delicate tissues; it has the potential to reduce hemorrhaging, and thus, save lives. With broad faculty expertise and cohorts of exceptional students, SEAS is translating discoveries in the classroom and laboratory into real-world applications.

Encompassing a broad range of research areas—from robotics to computer science to 3D printing—the SEC will accommodate research, teaching, and social spaces. The design of the building balances the demands of varied disciplines and specialties; areas for focused retreat mixed with spaces for integrated communication and collaboration. The SEC will span up to six floors above-grade, with two additional levels below ground at the courtyard level. The interior of the Complex will open to the courtyard landscape to the south, featuring recessed gardens that provide light into the lower floors of the building and accessible terraces with plantings and seating.

1.0 INTRODUCTION AND REGULATORY FRAMEWORK

This Institutional Master Plan Notification Form/Notice of Project Change (IMPNF/NPC) is being submitted to the Boston Redevelopment Authority (BRA) by the President and Fellows of Harvard College (Harvard or Harvard University). This document is being submitted in accordance with both Section 80D-5 of the Boston Zoning Code (the Zoning Code), for purposes of amending the current Institutional Master Plan (IMP) for Harvard University's Allston Campus and Section 80B-2 of the Zoning Code to revise Large Project Review.

This IMPNF/NPC considers one project: the Science and Engineering Complex (SEC or the Project) which was originally permitted and approved in 2007 as the Harvard Allston Science Complex.

This IMPNF/NPC does not propose to add any land to the existing Harvard IMP area in Allston. The site of the proposed Project is already part of the Harvard IMP area; the proposed institutional use requires approval under the IMP requirements of Section 80-D of the Zoning Code.

This IMPNF/NPC filing is intended to start the formal review of the revised Project under Articles 80B (Large Project Review) and 80D (IMP Review). Following the public comment period, the BRA will issue a Scoping Determination outlining issues to be addressed in more detail in an IMP Amendment filing and in any further Article 80B filing deemed necessary by the BRA.

2.0 PROJECT DESCRIPTION

2.1 Previously Approved Project

In 2007, the University received approval to construct the Harvard Allston Science Complex (2007 Science Project).

- That approved project consisted of approximately 589,000 square feet of space in four interconnected buildings on an 8.5 acre site.
- Of this, approximately 532,000 square feet was located above-ground and approximately 57,000 square feet was located below-grade.
- The project was to be constructed in a single phase.
- The project was to be the home of the Harvard Stem Cell Institute and others, and included primarily research space, but also included an atrium, ground floor retail space, a daycare facility, an auditorium, a district energy facility, and parking, both below-grade and off-site.
- The project included a large central green open space as well as new streets and pathways around its perimeter.

Construction of the 2007 Science Project started in late 2007 and resulted in the completion of the foundation and elements of the subsurface component of the project, but in 2009, due to the global financial downturn and its severely constraining effects, the University announced that work on the project would be paused.

2.2 Planning for Current Project

In 2010, Harvard convened an internal Work Team comprised of senior faculty and administrators to advise the University on how the University might proceed in planning for its properties in Allston. In addition, Harvard developed a series of internal planning principles to guide redevelopment of the science site. These include:

- Maintain the University's leadership in science teaching and research
- Develop a project that is consistent with the recently approved Institutional Master Plan
- Design a project that continues to include significant permeability both through the site and the building itself
- Design a project that maintains significant transparency at the street
- Develop a vibrant public realm
- Provide significant landscaped open space within the project
- Comply with City and Harvard's own sustainability guidelines
- Develop area-wide connectivity with courtyard connections to open space including the future Greenway, Rena Park and Path, as well as adjacent streets

- Establish building density, massing, and scale consistent with the IMP, with higher density closer to Western Avenue and lower density to the south
- Connect with the area's intermodal transportation network

2.3 Changes to the Project

Following the Work Team recommendations and the development of the planning principles, the University undertook a planning and reprogramming effort that built on the previously approved project but which also included changes. The primary changes to the 2007 Science Project include:

- The primary building occupant will be the John A. Paulson School of Engineering and Applied Sciences (SEAS) rather than the Harvard Stem Cell Institute.
- The existing Harvard-owned building at 114 Western Avenue has been added to the project site. The building will be renovated and used for administrative space for SEAS.
- The building program on the existing building foundation has been reduced from 589,000 SF to 445,350 SF and the overall project square footage has been reduced from 589,000 square feet to 496,850 square feet.
- The project will consist of a single building on the northern portion of the site rather than four separate but connected buildings.
- The southern portion of the site is being preserved for future as yet to be determined institutional development and will be landscaped in the interim.
- The western edge of the site – referred to as "Academic Way"- will be a street running between Western Avenue and "Science Drive" rather than a pedestrian path.
- "Science Drive" will connect Rotterdam Street with "Academic Way" rather than end with a turn-around on its western edge.
- Parking will be located in two surface lots - the existing lot that serves the building at 114 Western Avenue and a new lot to be constructed south of Rotterdam Street – rather than in the basement of the building.

Table 1 depicts the comparison of the previously approved 2007 Science Project and the currently proposed project.

Table 1: Comparison of 2007 Project with Current Project

Area	2007 Project	Current Project
Site Size	8.5 acres	12.5 acres
Project Square Footage	589,000 SF	496,850 SF
Foundation	589,000 SF	445,350 SF
Above-ground	537,000 SF	363,550 SF
Below-grade	52,000 SF	81,800 SF
114 Western Ave.	N/A	51,500 SF
Building Height (zoning)	107 feet	Comparable
Parking Spaces	350 on site, 150 off-site	275 on site
LEED Target	Gold	Gold

Note: All square footage numbers in this document refer to gross floor area as defined by the Boston Zoning Code.

2.4 Project Description

Project Site

As shown in Figure 1, the Project will be located in North Allston on the southerly side of Western Avenue, east of the intersection of Western Avenue and North Harvard Street, and east of Travis Street.

Since the original project was approved in 2007, the size of the Project site has increased from approximately 8.5 acres to approximately 12.5 acres. The increase in size is attributable to the inclusion of the existing Harvard-owned building at 114 Western Avenue into the Project.

Project Context

Since the original project was approved in 2007, there have been two important changes in the context of this project.

First, there have been significant changes in the built environment in the area around the site. Commercial activities have increased through the renovation of existing Harvard-owned buildings for use as Stone Hearth Pizza (182 Western Avenue) and SwissBakers (168 Western Avenue). Additional institutional uses have been added through the creation of the Harvard Innovation Lab at 125 Western Avenue and the renovation of 28 Travis Street for Harvard activities. Harvard-related community-oriented uses such as the Ed Portal and the Ceramics Program have been expanded and relocated to 224 Western Avenue from 175 North Harvard Street. The residential nature of the immediate area has changed with the construction of the Continuum Project in Barry's Corner and the relocation of the Charlesview Apartments to a new site further west on Western Avenue and the demolition of the former Charlesview buildings. In addition, both Continuum and Charlesview include ground floor retail space. And finally, the open space character has changed with Harvard's development of Ray Mellone Park to the southwest and the opening of the grove of trees on the former Charlesview site. As a result of these activities, the site of the SEC is no longer carrying the responsibility of a single project, but instead will be a contributor to a range of activities and uses along Western Avenue.

Second, at the time of the permitting of the 2007 Science Project, the University was in the early stages of developing its Institutional Master Plan for its Allston campus. That master planning effort was included in an IMPNF, filed in early 2007. The 2007 IMPNF presented a master plan that included both a 20-year plan and a 50-year vision. In response to the 2007 IMPNF, the BRA issued a Scoping Determination outlining the issues to be addressed in the new IMP. Due to the global financial downturn and its severely constraining effects, the University slowed its long-term master planning process and did not then file a new IMP. Following a period of internal review and external outreach, the University withdrew its 2007 IMPNF and filed a new IMPNF in the Fall of 2012 and a new IMP in 2013.

The 2013 IMP, which was approved by the BRA Board in October 2013 and the Boston Zoning Commission in November 2013, provides a Ten-Year Plan and Long-Term Vision for a broader Science and Enterprise district that includes the site of the SEC. Although the SEC was not technically a Proposed Institutional Project in the 2013 IMP, it was included in the discussion of planning districts, as well as a background project in the technical analyses. As a result of the development of this planning framework, the SEC can be seen in the context of future development and institutional activities rather than as a stand-alone project as it was in the 2007 permitting process.

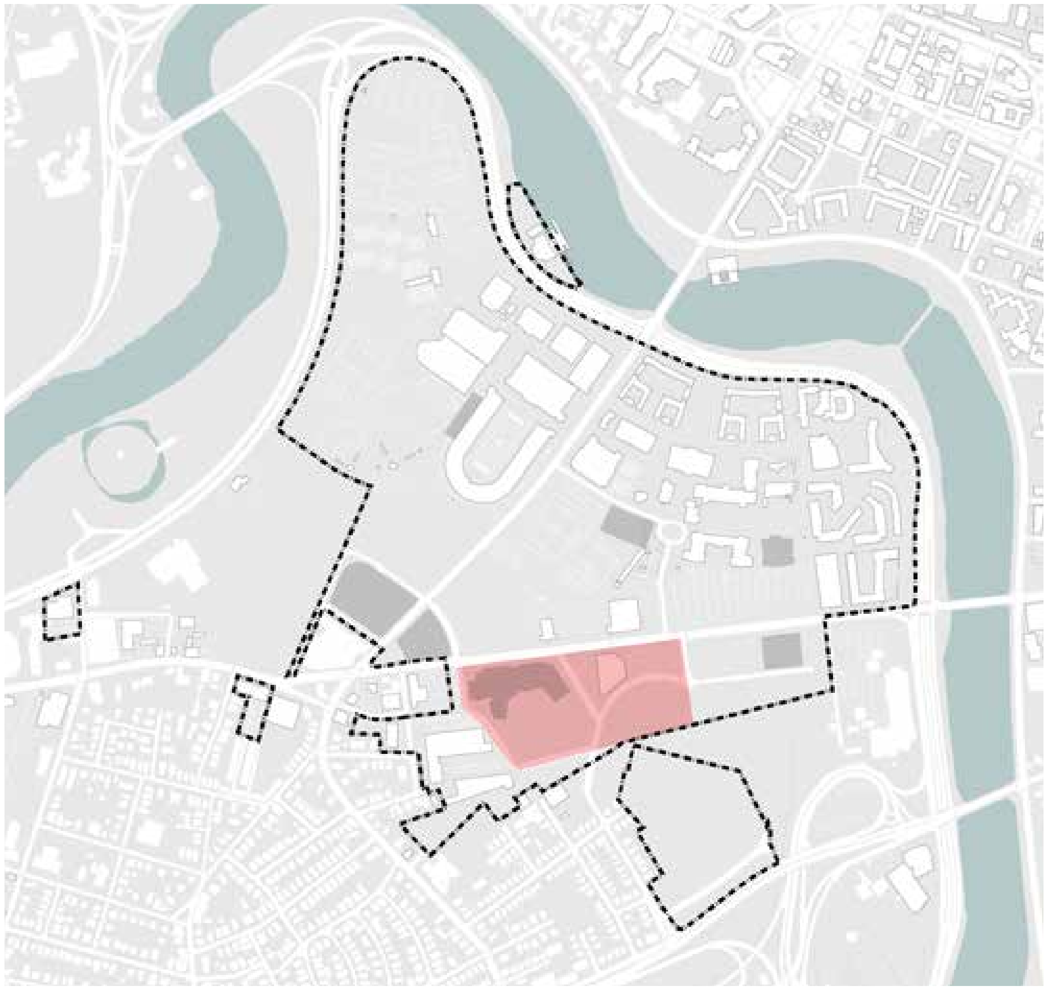


Figure 1: Project Area within the IMP Area

Building Program and Dimensions

The Science and Engineering Complex as a whole is comprised of two components: a single building fronting on Western Avenue and the renovation and reuse of an existing building at 114 Western Avenue.   Table 2 provides area calculations of uses within each building.

Table 2: Building Program (Gross Floor Area)

	SEC	**114 Western**	**TOTAL**
Dedicated Laboratory	209,000	0	**209,000**
Admin	8,400	12,200	**20,600**
Amenities / Retail	31,000	1,700	**32,700**
Atrium / Circulation	122,250	20,800	**143,050**
Teaching Environments	58,200	14,300	**72,500**
Core Layout	16,500	2,500	**19,000**
TOTAL	**445,350**	**51,500**	**496,850**

Note: All square footage numbers in this document refer to gross floor area as defined by the Boston Zoning Code.

The SEC is designed to have ground floor functions that open strategically onto Western Avenue and the central courtyard, two areas that will attract lively pedestrian activities. In addition to the entrance in the center of the building on Western Avenue, there will be building entrances located at the northwest corner (towards Barry's Corner) and northeast corner (facing Harvard Business School).

Consisting of three laboratory "blocks" and an exterior quadrangle, the SEC will span up to six floors above-grade, with two additional levels below ground at the courtyard level. The interior of the SEC will open to the courtyard, featuring recessed gardens that provide light into the lower floors of the building and accessible terraces with ample greenery and seating.

Research labs will comprise a mix of wet and dry spaces with both open lab research areas and enclosed specialty and core facilities. Research will range from robotics prototyping to materials synthesis. Core facilities may include soft lithography, rheology, motion capture, biological characterization, and machine fabrication shops.

Teaching environments will be focused on active learning spaces and will be located on the lower floors of the building. Program spaces include maker space, design studios, fabrication garages, clubhouse plaza rooms, as well as traditional flat and sloped floor classrooms.

The communal areas in the atrium and the cafeteria/lounges will promote an innovative and interactive educational environment that reinterprets the spatial and social characteristics of Harvard Yard while reflecting Harvard's rich intellectual traditions. Throughout, they are complemented and supported by highly sustainable systems that will continue to inspire and, in turn, attract the best scientists and students to Harvard.

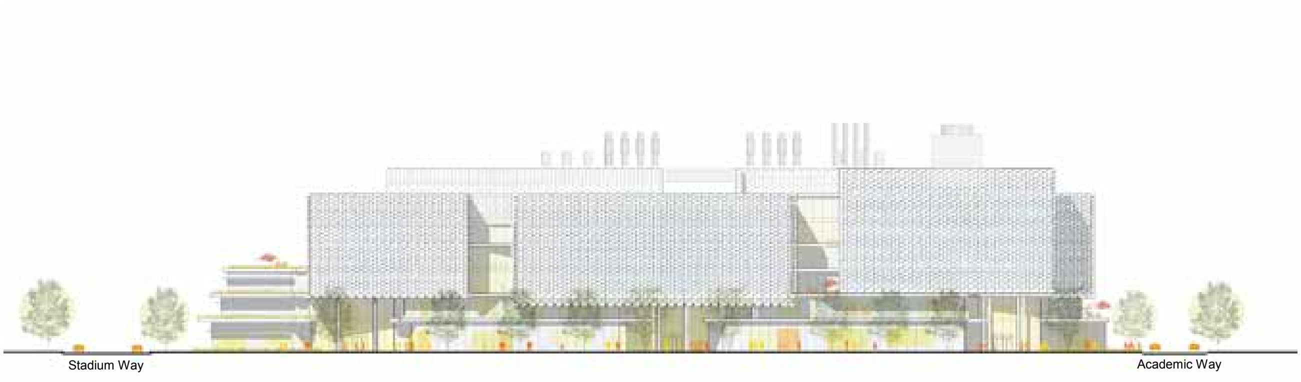
The figures on the following pages depict floor plans, elevations, and the central atrium.

Figure 2: Site Plan and Ground Floor

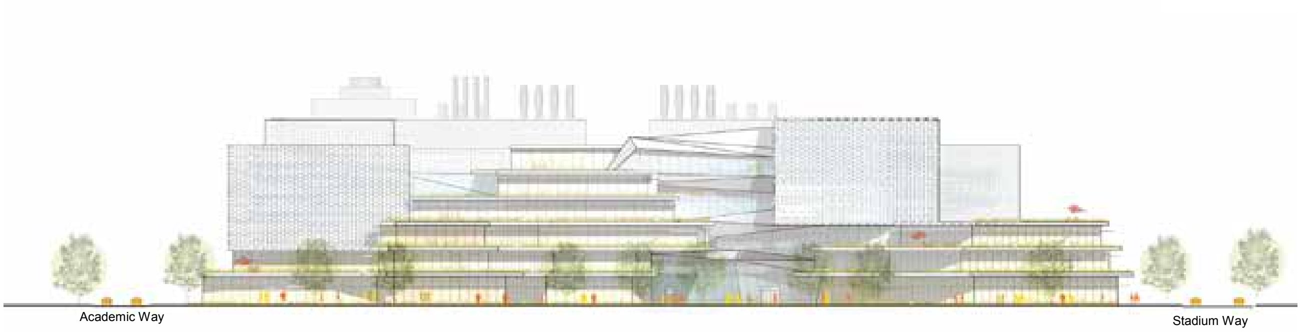
0 50 100

Figure 3: Second Floor Plan

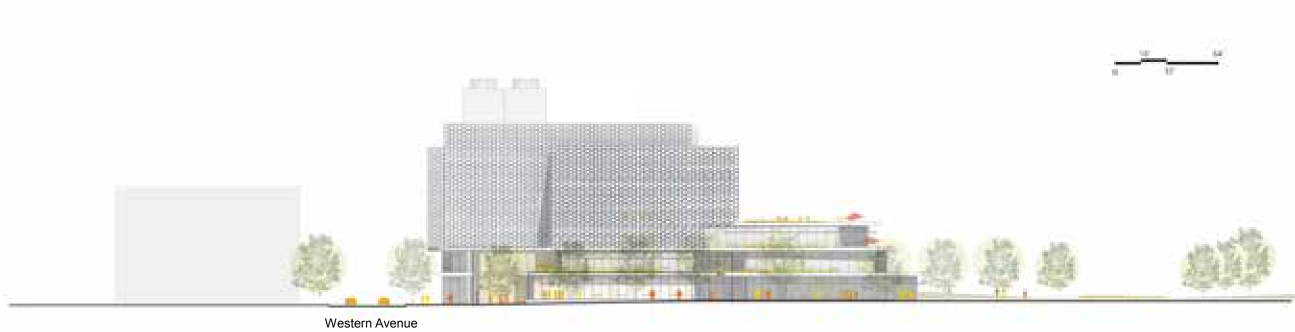
Figure 4: Upper Floor Plan (Typical)



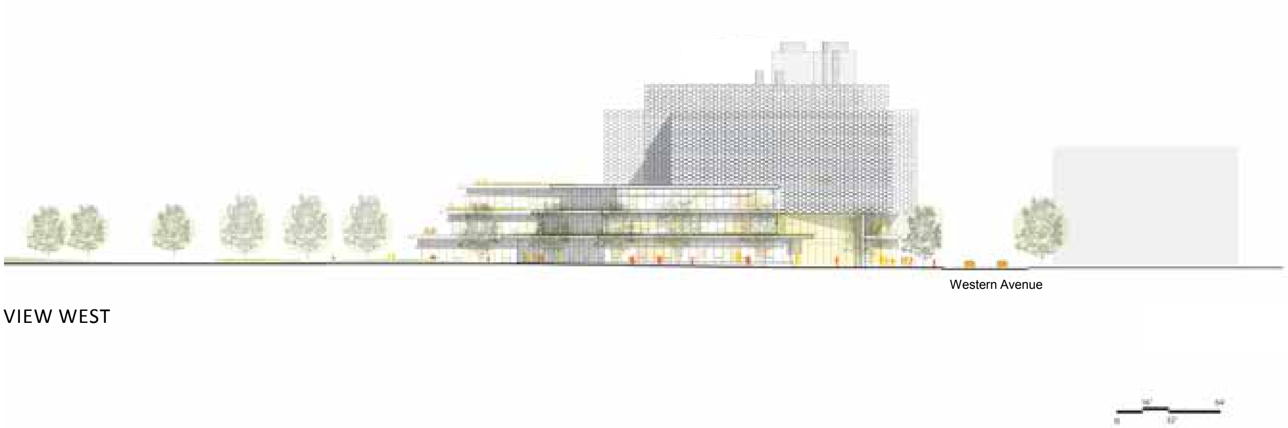
VIEW SOUTH



VIEW NORTH



VIEW EAST



VIEW WEST

Figure 5: Elevations

Figure 6: Section

Figure 7: Central Atrium

Public Access to Science Complex Buildings

As indicated in Table 3 and illustrated by Figure 8, approximately 20,000 square feet of the SEC building programming (including circulation areas on the ground floor) will be accessible to the general public. Table 3 provides a more detailed breakdown of the uses associated with areas of the building that will be publicly-accessible. This will include the large interior atrium, which will allow public passage from the entrances on Western Avenue into the central courtyard and the retail and food uses. The atrium, which will rise from the basement level, will be used as an active area for the public, as well as for students, faculty members, and researchers to showcase the ongoing research conducted by SEAS, such as robotics, innovative materials, and nanoengineering projects. Beyond these zones, persons with Harvard identification or persons with business within the building will be allowed to access other areas of the SEC. As discussed on the following page, the outdoor open space associated with the SEC will also be open to the public.

Table 3: Public Areas

	SEC	114 Western	TOTAL
Retail	3,000 SF	1,000 SF	**4,000 SF**
Cafeteria	5,900 SF	0	**5,900 SF**
Atrium	5,000 SF	0	**5,000 SF**
Auditorium[1]	4,500 SF	0	**4,500 SF**
Exhibit Space	600 SF	0	**600 SF**
TOTAL	**19,000 SF**	**1,000 SF**	**20,000 SF**

Note: All square footage numbers in this document refer to gross floor area as defined by the Boston Zoning Code.

1. Scheduled use.

Figure 8: Level 1 Program

Landscape and Public Realm Improvements

The central courtyard of the Science and Engineering Complex site will comprise landscaped green space open to the public. Further, the landscape plan has been designed to complement the series of green corridors and open spaces proposed as part of the IMP, including connections to Rena Park and Ray Mellone Park to the southwest.

The landscape approach provides an opportunity to define a major new outdoor space. It will coordinate with the overall open space master plan for Allston by reinforcing connections from the future Greenway and the SEC open space. There will be a strong pedestrian connection through the SEC building at grade, linking the pedestrian realm along Western Avenue with the courtyard space.

The landscape design will accommodate a variety of outdoor seating options. The approach will allow for casual gathering as well as larger formal events. Overall site strategies include study of the potential for future flooding as a result of climate change. The outcomes of this study will be used to support the project's comprehensive climate resiliency strategy.

Figure 9 depicts a rendering of the courtyard and Figure 10 shows the below-grade connections to the exterior.

Other Project Elements

Beyond those programmatic elements described previously, the Project includes the following elements:

Parking and Loading

The Project includes approximately 275 parking spaces to be located in two surface parking lots: 1) the existing parking lot that services 114 Western Avenue; and 2) a new parking lot to be located south of Rotterdam Street. More information on parking, including a discussion of supply and demand, is included in Section 3.1.

The Project contains a below grade, 6-bay enclosed loading dock that will serve the various functions of the building. Among other purposes, the loading dock will be used to receive food, furniture, and other regular deliveries, including hazardous materials as well as ship out all waste, including hazardous waste in support of the building's laboratory users.

Energy Facility

It has been Harvard's intention to develop a strategy to provide hot water for heating, chilled water for cooling, and electricity for building power for the projects associated with the Ten-Year IMP along with the Science and Engineering Complex through the installation of district energy facilities located in the IMP Area. This strategy aggregates heating, cooling, and electric loads from multiple buildings and supplies them from district systems.

This IMPNF/NPC assumes that the SEC includes a district energy facility and the relevant technical analyses in this document (such as the noise impacts analysis) evaluate the impacts of such a facility. The University is currently undertaking an evaluation of climate resiliency and identifying specific risks for the buildings to be constructed within Harvard's campus in Allston. As part of this analysis, the cost of resiliency, including the replacement cost of equipment that could potentially be damaged and the downtime of facilities interrupted by mechanical failure, is being considered.

Figure 9: South Courtyard, Looking Northwest

Figure 10: Below Grade Connection to Exterior

Simultaneously, the University is taking a broader look at the strategy of district energy in light of future growth associated not only with the institutional projects in the IMP Area but with the future development of the enterprise research campus to the east of the SEC. This evaluation includes options for optimizing the location of a district energy facility that could potentially serve additional future growth.

If the results of the resiliency evaluation and the broader look at district energy indicate that a different approach to providing energy to the SEC is appropriate, these analyses will be updated in the IMP Amendment.

Project Schedule

The project schedule calls for modifications to the existing below-grade structure to begin in the summer of 2016 and construction of the above-grade steel framework to begin in the fall of 2016. Based on the current schedule, the building will be occupied in the fall of 2020.

Project Sustainability

The Science and Engineering Complex will be an exemplary project of integrated sustainability, in both quantitative as well as qualitative terms. In quantitative terms, the SEC project aspires to achieve at a minimum LEED for Building Design and Construction (LEED-BD&C) Version 4 Gold certification, a significant achievement for an energy intensive laboratory building. The SEC project is being designed to comply with the Harvard Green Building Standards, which is a set of process oriented requirements that go above and beyond those of LEED certification.

More information on the sustainability aspects of the project is included in Section 3.12 and a LEED checklist is included as Appendix D. In addition, Appendix E includes Climate Change Resiliency Checklists.

2.5 Relationship to the Institutional Master Plan and Existing Zoning

Harvard has been filing Institutional Master Plans for its Allston campus since 1989, including a full IMP in 1997. In 2007, the University amended the 1997 IMP to add the site of the 2007 Science Project on Western Avenue to the IMP Area. The 2007 IMP Amendment was approved by the BRA on October 3, 2007 and the Boston Zoning Commission on December 5, 2007.

More recently, Harvard filed an IMPNF in October 2012 to start the process of the review and approval of a new Ten Year Institutional Master Plan for Harvard's campus in Allston. Harvard submitted its new IMP on July 26, 2013 [revised in October 2013] in response to the BRA's Scoping Determination on the IMPNF. The IMP was approved by the BRA Board on October 17, 2013 and by the Boston Zoning Commission on November 20, 2013.

The 2013 approved IMP included an update on the status of the Science and Engineering Complex and also included the development of the SEC site as a background project as part of the technical analyses included in the IMP.

Figure 11 shows the SEC as it was depicted in the 2013 IMP and Figure 12 shows the current design of the SEC on the context of the IMP's Ten-Year Plan.

As depicted on Figure 1 earlier in this chapter, the Project site is located within the Harvard University Institutional Sub-district of the Allston Neighborhood District and also within Harvard's IMP Area. "College or University" uses are allowed uses within this subdistrict.

Prior to the issuance of a building permit, the BRA must issue both a Certificate of Compliance pursuant to Section 80B-6 of the Zoning Code and a Certification of Consistency pursuant to Section 80D-10 of the Zoning Code stating that the Project is consistent with the University's IMP.

Figure 11: Institutional Master Plan (October 2013) Aerial View Toward Northeast

Figure 12: Updated Aerial View Toward Northeast

2.6 Community Benefits

As part of the approval of the 2007 Science Project, the University entered into a Cooperation Agreement with the City of Boston. The 2008 Cooperation Agreement outlined an extensive package of benefits in five areas: public realm, education, housing, workforce development and jobs, and the establishment of the Partnership Fund. Following the decision to pause the 2007 Science Project, the University maintained the commitment to the 2008 Cooperation Agreement. Among the highlights of those continued commitments, Harvard:

- Designed, constructed, and continues to maintain Ray Mellone Park, a 1.74-acre public park located behind the Honan Branch Library;
- Developed, constructed, programmed, and continues to operate the Education Portal (which recently relocated from 175 North Harvard Street to 224 Western Avenue);
- Completed the jobs linkage payments and continues to pay the annual housing linkage payments to the City;
- Worked with the City's Office of Jobs and Community Service to fund the operation the Resource Center and offer workforce development classes; and
- Funded the Partnership Fund, which provides financial resources to neighborhood organizations.

Since the 2008 Cooperation Agreement, Harvard has signed two additional Cooperation Agreements: one for the 28 Travis Street project and one for the 2013 IMP. Collectively, these three agreements build upon each other's commitments and each one was informed by extensive interactions with the community, the City of Boston, and the Harvard-Allston Task Force to ensure an evolution that best serves the entire Allston-Brighton Community.

A full report on the status of the 2008 Cooperation Agreement – and two subsequent Cooperation Agreements – is on the BRA website (http://www.bostonredevelopmentauthority.org/getattachment/298fdb88-d6a4-457b-9eaf-1899131ba982) and an excerpt is included in Appendix A.

2.7 List of Permits

Table 4 presents a preliminary list of local, state, and federal permits and approvals that may be required for the Project. The list is based on current information about the Project and is subject to change as the design of the Project advances. Some of the permits listed may not be required, while there may be others not listed that will be needed.

Table 4: Preliminary List of Permits and Approvals

Agency	Approval
City	
Boston Redevelopment Authority	Article 80B Large Project Review Article 80D IMP Review
Boston Civic Design Commission	Design Review
Boston Inspectional Services Department	Demolition/Building Permits
Boston Public Improvement Commission	Review and Approval of Streets
Boston Public Works Department	Curb Cut Permit
Boston Transportation Department	Construction Management Plan/ Transportation Access Plan Agreement
Boston Water and Sewer Commission	Site Plan Review/ General Service Application/ Water and Sewer Connector Self-Certification
State	
Executive Office of Environmental Affairs	Massachusetts Environmental Policy Act – Notice of Project Change
Department of Environmental Protection	Air Permits (as required)
Massachusetts Water Resources Authority	8M Permit
Federal	
Environmental Protection Agency	NPDES Stormwater Construction General Permit (if required)

2.8 Project Team

Project Name:	Science and Engineering Complex
Address/Location:	Western Avenue, Allston
Proponent:	President and Fellows of Harvard College *through the* Office of the Executive Vice President Massachusetts Hall Harvard Yard Cambridge MA 02138 Katherine N. Lapp, Executive Vice President
	Harvard Planning and Project Management Smith Campus Center 1350 Massachusetts Avenue Cambridge, MA 02138 Elizabeth Sisam
	Harvard Public Affairs and Communication Smith Campus Center, Room 1060 1350 Massachusetts Avenue Cambridge, MA 02138 Kevin Casey
	Harvard Office of the General Counsel Smith Campus Center, Room 980 1350 Massachusetts Avenue Cambridge, MA 02138 Daniel Rabinovitz
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Landscape Architect:	Stephen Stimson Associates 288 Norfolk Street Cambridge, MA 02139 Stephen Stimson

Transportation Consultant:	Vanasse Hangen Brustin Inc. 101 Walnut Street Watertown, MA 02471 Mike Regan
Stormwater Engineer:	Nitsch Engineering Inc. 2 Center Plaza Boston, MA 02108 John Schmid
Climate Engineer:	Transolar 220 East 23rd Street New York, NY 10010 Erik Olsen
Mechanical Engineer:	Van Zelm Engineers 10 Talcott Notch Farmington, CT 06032 John Coyle
Construction Consultant:	Turner Construction Two Seaport Lane, Suite 200 Boston, MA 02210 Maureen Kirkpatrick
Daylight, Air Quality, and Noise Consultants:	Epsilon Associates Three Clock Tower Place Maynard, MA 01754 Cindy Schlessinger
Wind Engineer:	CPP Wind Engineering 2400 Midpoint Drive, Suite 190 Fort Collins, CO 80525 John Carter
Legal Counsel:	Goulston & Storrs 400 Atlantic Avenue Boston, MA 02110 Doug Husid Matt Kiefer

3.0 ANTICIPATED IMPACTS

3.1 Transportation and Access

The Science and Engineering Complex will replace the previously approved uses that are described in the 2007 Science Project Draft Project Impact Report (DPIR). The SEC includes 496,850 square feet of space: 445,350 on the northern portion of the foundation and 51,500 square feet in a repurposed 114 Western Avenue. The analysis assumes that the SEC program will accommodate approximately 360 faculty/staff, 1,000 graduate students/researchers, and 600 of the 1,000 SEAS undergraduate students on a daily basis. It also assumes the remaining floor space in 114 Western Avenue will be occupied by an institutional use. The SEC program will provide temporary landscaping on the southern portion of the site.

The 2007 Science Project evaluated the transportation impacts of 589,000 square feet of scientific research and educational space on the foundation that will be occupied by 1,000 employees. At that time, 114 Western Avenue was assumed to function as a fully occupied commercial space. The 2013 IMP evaluated the transportation impacts of approximately 733,000 square feet of institutional uses on the full foundation site and in a repurposed 114 Western Avenue. The analysis included a preliminary SEC program with approximately 300 faculty/staff and 900 graduate students/researchers affiliated with SEAS as well as the transportation demands associated with 390,000 square feet of research and development (R&D) uses on the remainder of the site.

The transportation evaluation presented in this chapter compares the transportation impacts of the SEC to the 2007 Science Project; the 2007 conditions also include 114 Western Avenue as a fully tenanted commercial building. Comparisons are also made to the SEC program that was evaluated in the 2013 IMP analysis.

Project Characteristics

The academic nature of the Science and Engineering Complex results in a fundamentally different type of transportation profile as compared to the previously approved 2007 Science Project. In the SEC, faculty/staff and office employees will have similar commuting patterns as the proposed occupants of the 2007 Science Project, but they will be fewer in numbers: approximately 420 as compared to 1,000 in the 2007 Science Project. The addition of the academic component will bring graduate students/researchers and undergraduates to the site. Graduate students/researchers are non-auto oriented and more heavily reliant on transit, Harvard shuttle buses, bicycles and walking as modes of travel. Undergraduates are restricted from purchasing parking permits and instead use Harvard shuttle buses, bike or walk to travel on campus. As a result, the SEC will have lower auto use and higher non-auto use as compared to the 2007 Science Project.

The presence of undergraduates at the SEC will generate new pedestrian, bicycle and shuttle bus trips throughout the day as students move between Cambridge and Allston.

Harvard's residential house philosophy strongly encourages on-campus housing for undergraduates for all four years and restricts undergraduates from purchasing a parking permit. In 2015, approximately 98 percent of undergraduates live in Harvard residences and approximately one-quarter of one percent have a parking permit. Therefore, undergraduate transportation demands will be limited to pedestrian, bicycle and shuttle bus trips. These connections were anticipated by the 2013 IMP, which provided a planning context to improve pedestrian, bicycle and shuttle bus systems to accommodate SEC travel demands.

Auto use and parking requirements for the commuting population of the SEC will be lower than the previously approved 2007 Science Project because the SEC commuting population is not as auto-oriented as the population of the 2007 Science Project. As a result, fewer parking spaces will be needed by the SEC. The 2013 IMP also anticipated this change and indicated that the building program for SEAS could be accommodated by expanding the existing surface parking at 114 Western Avenue and that no below grade parking would be required for the initial program.

Site circulation has also changed significantly since the 2007 Science Project. Figure 13 presents the street typologies that were developed for the 2013 IMP. These typologies are based on Boston's Complete Streets Guidelines and provide a framework for future street improvements. The SEC includes streets on all four sides of the site while 2007 Science Project had streets on three sides. Other key differences include the recent implementation of a bike network in the study area and other transportation infrastructure upgrades such as improvements to Barry's Corner and the planned construction of "Academic Way" between North Harvard Street and Western Avenue.

In combination, the reduced reliance on auto use by building users and the planned and implemented transportation network improvements indicate that the traffic impacts of the SEC will be less than the impacts of the previously approved 2007 Science Project. In addition, the analysis indicates that recent, ongoing, planned and proposed improvements to the transit, shuttle, bicycle and pedestrian systems can accommodate the new SEC demands.

The SEC contains a below grade, six-bay enclosed loading dock that will serve the various functions of the building. Like the 2007 Science Project, the loading dock is a drive-in/drive-out facility. It will use the same driveway on Science Drive that was included in the 2007 Science Project.

Table 5 summarizes key elements of the previously approved 2007 Science Project and the currently proposed 2015 SEC project

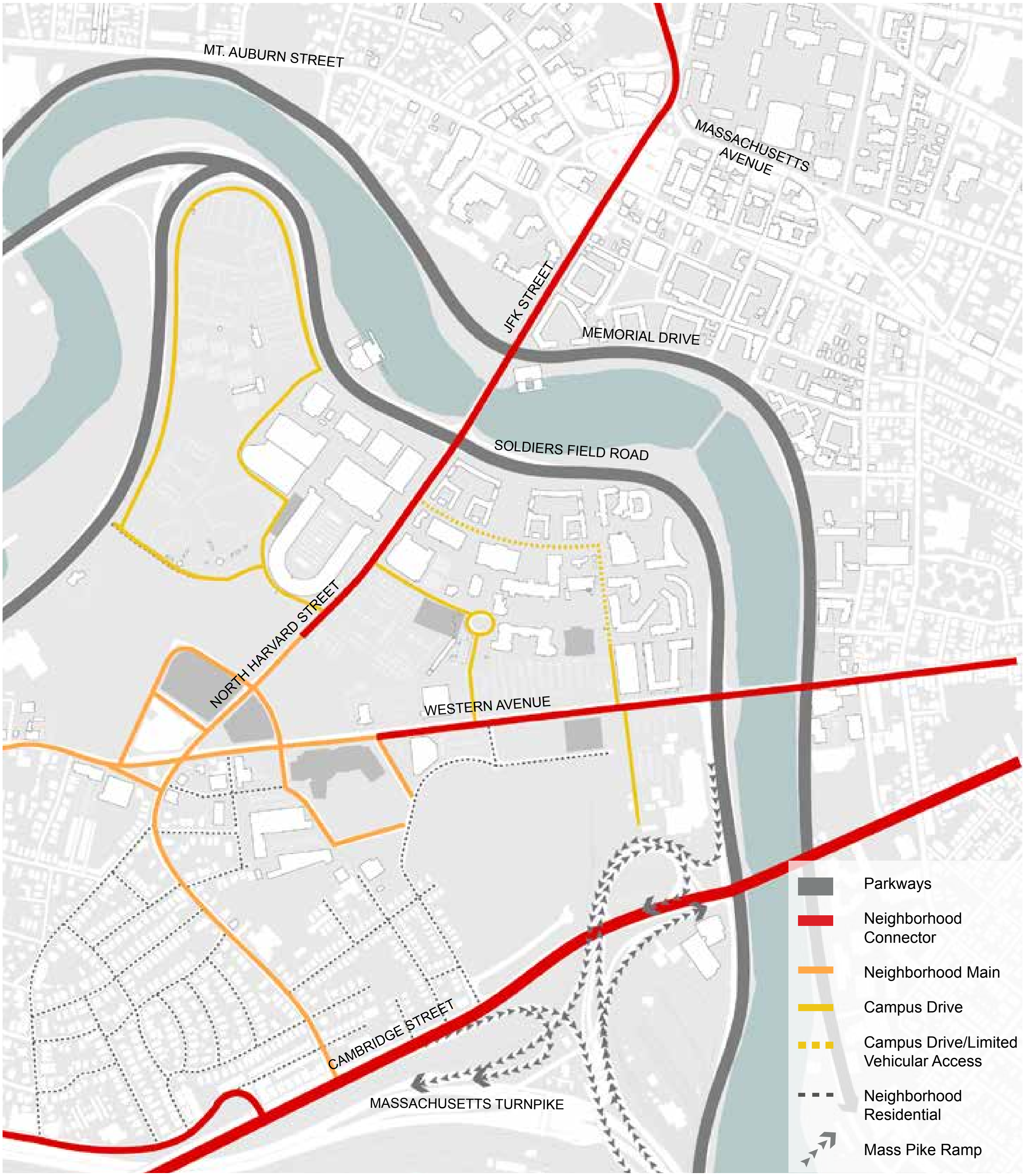


Figure 13: Future Street Typologies

Figure 14: Site Area Circulation

Table 5: Comparison of Key Transportation Elements

	2007 Science Project	2015 SEC Project
BUILDING SQUARE FEET		
Science/SEC Program	589,000 SF	496,850 SF[1]
Office / Other Institutional[2]	79,000 SF[3]	27,500 SF
TOTAL	**668,000 SF**	**524,350 SF**
COMMUTING POPULATION (Approximate Numbers)		
Faculty/Staff	N/A	360
Graduate Students[4]	N/A	1,000
R&D	1,000	N/A
Office[2]	240	N/A
Other Institutional[2]	N/A	60
TOTAL[5]	**1,240**	**1,420**
PARKING		
Existing Surface Spaces	178	178
New Surface Spaces	150 (off-site)	97 (on-site)
New Garage Spaces	350	N/A
TOTAL	**678 TOTAL SPACES**	**275 TOTAL SPACES**
PARKING ACCESS	Parking garage driveways on "Science Drive"	Parking driveways on Rotterdam Street
LOADING	Drive-in/drive-out underground loading docks Driveway on "Science Drive"	Drive-in/drive-out underground loading docks Driveway on "Science Drive"
Site Roadways		
"Stadium Way"	Two-way to "Science Drive" intersection Interim connection to Rotterdam and Windom Streets Long-term connections undetermined	Two-way to "Science Drive" intersection with bike path Interim connection to Rotterdam and Windom Streets Long-term connection to the future reconfigured Allston inter-change area (by MassDOT)
"Science Drive"	Two-way with cul-de-sac	Two-way from "Stadium Way" to "Academic Way"
"Academic Way"	Multi-Use pedestrian/bicycle path	Two-way from "Science Drive" to N. Harvard St. with 28 Travis Street driveway

Notes:

All square footage numbers in this document refer to gross floor area as defined by the Boston Zoning Code.

1. Includes 51,500 SF of SEC program in 114 Western Avenue.

2. Assumes three commercial office employees per 1,000 square feet and assumes two employees per 1,000 square feet for "Other Institutional" space in 114 Western Avenue.

3. 114 Western Avenue included as an existing condition that was carried into the analysis of future conditions.

4. Includes SEAS researchers.

5. Does not include undergraduate students.

Commuting Characteristics

The Science and Engineering Complex is significantly smaller in terms of square feet, trip generation and parking needs than the site conditions that were previously evaluated as part of the 2007 Science Project and the 2013 IMP. Both the 2007 Science Project and the 2013 IMP included significant R&D space which has greater trip generation and parking impacts than the SEC, which is primarily academic in nature. The 2007 Science Project and 2013 IMP also included the full use of the foundation site, while the SEC uses the northern portion of the site and proposes temporary landscaping on the southern portion of the site.

Trip Generation

To assess the impacts of the SEC, person-trip estimates were based on Harvard empirical data regarding peak hour arrival/departure patterns for existing faculty/staff and graduate students on the Allston campus. As shown in Table 6, the SEC generates fewer person-trips than the analysis from the previously approved 2007 Science Project and the 2013 IMP. This difference is primarily associated with the removal of the R&D component from the SEC. It should be noted that to present comparable scenarios, trip generation estimates for a fully occupied 114 Western Avenue have been added to the 2007 Science Project. Detailed trip generation calculations are presented in the Appendix B.

Table 6: Person Trips

	2007 Science Project[1]	**2013 IMP**[2]	**2015 SEC Project**[2]
Weekday Daily	3,680	4,820	2,690
Weekday AM Peak Hour			
Enter	475	770	545
Exit	100	80	40
TOTAL	**575**	**850**	**585**
Weekday PM Peak Hour			
Enter	65	65	40
Exit	445	560	295
TOTAL	**510**	**625**	**335**

Notes:

1. Includes trip generation estimates for a fully occupied 114 Western Avenue based on peak hour driveway counts.

2. Not including undergraduate trips.

Mode Choice

Table 7 presents the peak hour/peak direction mode share estimates that were used in the traffic analysis for the 2007 Science Project, the 2013 IMP and the SEC. The Boston Transportation Department's (BTD's) Access Boston mode shares were used for the 2007 Science Project mode shares and the research and development and office uses in the 2013 IMP and 2015 SEC project. Academic mode shares for faculty/staff and graduate students/ researchers in the 2013 IMP and the SEC are based on empirical data that was available at the time of the analysis. The mode shares in Table 7 were determined by weighting each group's mode share by the percent of the total commuting population represented by that group.

Table 7: Mode Choice

	2007 Science Project[1]	**2013 IMP[2]**	**2015 SEC Project[3]**
Vehicle	59%	37%	21%
Transit	18%	30%	40%
Bike	23%	33%	29%
Walk			10%
TOTAL	**100%**	**100%**	**100%**

Notes:

1.2007 Science Project mode share is based on BTD's Access Boston mode shares for Area 17. Walk and bike modes were combined for this analysis.

2.Academic is based on empirical data and R&D is based on BTD's Access Boston mode shares. Walk and bike modes were combined for this analysis.

3. Academic is based on empirical data and non-SEAS institutional ("Institutional Other") is based on BTD's Access Boston mode shares for office uses. Undergraduates, who are restricted from purchasing a parking permit, are not included in these estimates.

The vehicle mode choice for the SEC will be significantly lower than the previously approved 2007 Science Project. This reflects the academic nature of the project and, in particular, the low level of auto use by graduate student/researchers, who represent 70 percent of the commuting population. As discussed later in this chapter, the lower auto mode share will reduce traffic and parking demands as compared to the 2007 Science project. In addition, the anticipated SEC auto mode share of 21 percent will support Harvard's commitment to achieve a mode share of 40 percent or less for commuters traveling to the Allston Campus by car, as described in the 2013 IMP. This is below the 50 percent auto mode share goal for commuters that was established for the 2007 Science Project.

Table 8 provides a breakdown of the mode shares by group for the SEC. The mode shares for the faculty/staff and graduate student/researchers are based on survey data from 2014. This data indicated that the SEAS faculty/staff, which represent 25 percent of the overall commuting population, have an auto mode share of approximately 25-35 percent in Cambridge. To be conservative for this IMPNF analysis, it was assumed that the auto mode share for faculty/staff would increase to 60 percent. In contrast, the 2013 IMP used a 75 percent auto mode share for faculty/staff, based on mode share data from 2006.

Table 8: Mode Choice by Group

	Faculty/ Staff[1]	Graduate Students/ Researchers[1]	Institutional Other[2]	"Blended" Mode Shares[3]
Vehicle	60%	5%	59%	21%
Transit	20%	48%	18%	40%
Bike	15%	35%	17%	29%
Walk	5%	12%	6%	10%
Total	100%	100%	100%	**100%**

Notes:

1. Based on 2014 SEAS survey.

2. Based on BTD's Access Boston mode shares for Area 17.

3. Based on 25% faculty/staff; 70% graduate student/researchers; and, 5% "institutional other."

Graduate student/researchers, who represent 70 percent of the overall commuting population, have an auto mode share of three to four percent in Cambridge. This population is strongly oriented towards non-auto use, so the auto mode share was increased slightly to five percent. "Institutional other" would make up five percent of the overall population and would have mode shares based on BTD's Access Boston mode shares for office workers. Additional information is provided in Appendix B.

Vehicle Trips

Table 9 presents the vehicle trip estimates for the 2007 Science Project, 2013 IMP and the SEC. This analysis indicates that the SEC will generate less than half the number of peak hour trips and less than one-third the daily vehicle trips as both the 2007 Science Project and the assumptions that were included in the detailed traffic analysis of the 2013 IMP. As a result, the SEC will have less impact on intersection operations and level of service than the 2007 Science Project and the 2013 IMP. Mitigation for the SEC will draw upon recommendations from the 2013 IMP.

Table 9: Vehicle Trips

	2007 Science Project[1]	2013 IMP	2015 SEC Project[2]
Weekday Daily	2,050	2,110	570
Weekday AM Peak Hour			
Enter	255	270	115
Exit	55	40	10
Total	310	310	125
Weekday PM Peak Hour			
Enter	35	30	10
Exit	240	280	115
Total	275	310	125

Notes:

1. Includes trip generation estimates for a fully occupied 114 Western Avenue based on peak hour driveway counts.

2. Not including undergraduate trips

Vehicular Trip Distribution

Regional vehicular trip distribution estimates for the 2013 IMP were developed for Harvard-affiliated uses based on 2012 employee zip code data for the Allston Campus provided by Harvard, adjusted for mode to derive automobile trips by town of origin. Each town of origin was assigned to a regional roadway and then to one of the campus gateways serving the study area. Employees assigned to each route were then aggregated to develop a vehicle trip distribution. The more localized trip distribution (i.e., site access) was developed based on the anticipated parking and driveway access locations.

These regional trip distribution patterns are applicable to the SEC and are generally consistent with trip distribution patterns utilized as part of the 2007 Science Project, as shown in Table 10.

Table 10: Vehicle Trip Distribution Comparison

	Trip Distribution	
Roadway (from/to)	**2007 Science Project[1]**	**2013 IMP and 2015 SEC[2]**
Western Ave (from west)	7%	7%
Everett Street (from south)	3%	5%
Cambridge Street (from west)	4%	4%
Harvard Ave (from south)	2%	3%
I-90 East	43%	22%
I-90 West		16%
Soldiers Field Rd (from east)	13%	15%
Western Ave (from east)	5%	4%
North Harvard St (from north)	5%	5%
Route 2 (from west)	18%	19%
TOTAL	**100%**	**100%**

Notes:

1. As presented in Harvard University Allston Science Complex DPIR; June 25, 2007.

2. Based on Harvard 2012 Employee Zip Code Data for the Allston Campus and 2007-2011 American Community Survey 5-Year Estimate Means of Transportation (Mode Share) for home-based work trips; Allston & Cambridge Mode Shares adjusted (2010 DEP Rideshare Survey & 2012 PTDM Survey data used, respectively).

Corridor Traffic Volumes

Vehicular trip generation estimates for the SEC were applied to the roadway network using the trip distribution developed as part of the 2013 IMP. A cordon-level volume comparison of the projected peak hour vehicular traffic along area roadways between the 2007 Science Project, the 2013 IMP, and the SEC is presented in Table 11. As shown in Table 11, the SEC is projected to generate significantly fewer or the same number of vehicle trips on the primary corridors serving the site when compared to 2007 Science Project and the 2013 IMP estimates.

Table 11: Cordon-level Peak Hour Vehicular Volume Comparison

	Bi-directional Vehicle Trips		
Roadway Link	**2007 Science Project[1]**	**2013 IMP**	**2015 SEC Project**
N. Harvard Street south of Soldiers Field Road			
Weekday Morning	30	75	30
Weekday Evening	35	75	30
Western Avenue west of Spurr Street			
Weekday Morning	60	40	15
Weekday Evening	50	35	15
Western Avenue west of Soldiers Field Road			
Weekday Morning	140	120	50
Weekday Evening	115	115	65
Cambridge Street west of N. Harvard Street			
Weekday Morning	20	20	10
Weekday Evening	20	25	10

Note:
1. Includes trip generation estimates for a fully occupied 114 Western Avenue based on peak hour driveway counts

Windom Street Traffic Volumes

In addition to the cordon-level analysis, projected vehicle trips along Windom Street were compared for the 2007 Science Project, 2013 IMP, and the SEC as shown in Table 12. As shown in Table 12, the SEC trips along Windom Street are less than half of what was projected for the 2007 Science Project and the 2013 IMP.

Table 12: Windom Street Peak Hour Vehicle Trip Comparison

	2007 Science Project[1]	**2013 IMP**	**2015 SEC**
Weekday AM Peak Hour			
Enter	70	70	30
Exit	10	10	(0-5) [2]
TOTAL	**80**	**80**	**30**
Weekday PM Peak Hour			
Enter	15	10	5
Exit	60	75	10
TOTAL	**75**	**85**	**15**

Note:
1. Includes trip generation estimates for a fully occupied 114 Western Avenue based on peak hour driveway counts.
2. Negligible amount (less than 5 vehicles)

Driveway counts at 114 Western Avenue conducted in June 2013 indicate that approximately twenty and ten vehicles currently use Windom Street during the weekday morning and evening peak hours, respectively. The SEC will replace the commercial uses in the existing 114 Western Avenue building with institutional uses. As compared to existing conditions, the SEC is projected to increase traffic volumes on Windom Street by approximately ten vehicles during the weekday morning peak hour and five vehicles during the weekday evening peak hour

"Stadium Way"

As part of the 2013 IMP, Harvard agreed to undertake a 25-percent design of "Stadium Way" between Western Avenue and Cambridge Street. Harvard and the City would then work together to determine when the design should be advanced further and constructed based on traffic conditions related to the build-out of the IMP Ten-Year Plan and the status of ongoing environmental remediation within the Enterprise Research Campus. At the time of the 2013 IMP, the location of the "Stadium Way" corridor presented the only opportunity to build a north-south connection through the Enterprise Research Campus, connecting Western Avenue and Cambridge Street. The elevated section of Cambridge Street and the location of turnpike ramps prevented the possibility of other connections.

Since the completion of the 2013 IMP, MassDOT has initiated the Allston Interchange project that will reconstruct the existing I-90 viaduct along the Charles River; replace and relocate the current interchange with an urban interchange; construct a new local street grid between Cambridge Street and the relocated interchange; build a new West Station transit and commuter rail facility; and construct a layover yard for commuter rail. This project will also put Cambridge Street at ground level and relocate the existing ramps further to the south and adjacent to the highway, removing a significant obstruction to north-south circulation between Cambridge Street and Western Avenue.

Harvard is working with the City of Boston to review its commitment to the 25 percent design for "Stadium Way" and make appropriate revisions that reflect current conditions and planning initiatives. This includes the development of concept plans in the near-term and a schedule to prepare more detailed engineering plans in the future in coordination with the MassDOT's Allston Interchange project. Harvard is considering a concept that would allow for "Stadium Way" to become a narrow, transit-oriented corridor with local circulation opportunities for general traffic. Other streets, such as "Cattle Drive" and "East Drive," would provide vehicular access and circulation. These designs of these three streets will be developed and implemented in coordination with the future build-out of the Enterprise Research Campus and the Allston Interchange project.

The SEC project does include the construction of the portion of "Stadium Way" that is within the project site. The design will be consistent with the City's Complete Streets Guidelines and will retain sufficient flexibility to address the potential for increased transit service on the corridor as the area is developed in the future. The proposed configuration, which is illustrated in Figure 14, would provide one travel lane and a lane for shuttle bus drop-off/pick-up or on-street parking in each direction with curb extensions and crosswalks at the Western Avenue intersection. An off-road two-way cycle track is proposed along the eastern side of the street. This path would eventually extend to the south to connect with proposed bicycle improvements in the interchange area.

Transit

Transit service is provided by the MBTA within the study area as shown in Figure 15. The MBTA operates two bus routes (86 and 66) along North Harvard Street, two bus routes (70 and 70A) along Western Avenue and one bus route (64) along Cambridge Street. In addition to the bus routes, the Harvard Square Station, which is one mile from Barry's Corner, is the most significant regional transit facility near the study area. Red Line service provides access to both local and regional connections. In addition to the Red Line, Harvard Square is a major bus facility that accommodates ten surface bus routes and four trolley-bus services. The Harvard Shuttle complements MBTA transit service by providing a connection between Harvard Square and the Allston Campus.

The Science and Engineering Complex is expected to generate approximately 235 transit trips during the morning peak hour and 110 transit trips during the evening peak hour. These morning and evening peak hour trips are made primarily by faculty, staff, graduate students and researchers. The first and last undergraduate classes of the day are anticipated to be scheduled outside commuter peak hours, so the majority of trips made by undergraduates occur during non-peak commuting hours. Additionally, undergraduate students are anticipated to predominantly use the Harvard Shuttle to travel between the Cambridge Campus and Allston Campus.

The 2013 IMP indicated that the Science project, the Continuum Project and the Ten-Year Plan IMP projects would generate 415 new MBTA transit trips (370 entering and 40 exiting) during the morning peak hour and 330 new transit trips (65 entering and 265 exiting) during the evening peak hour. The new transit trips in the 2013 IMP analysis included transit trips for the Science project that were comparable to the 2015 SEC project: 250 (235 entering and 15 existing) during the morning peak hour and 140 new transit trips (15 entering and 125 exiting) during the evening peak hour. The 2013 IMP analysis also indicated that there was sufficient capacity for these trips on the existing bus services. Therefore, it is anticipated that there will be sufficient transit capacity for the SEC peak hour transit trips.

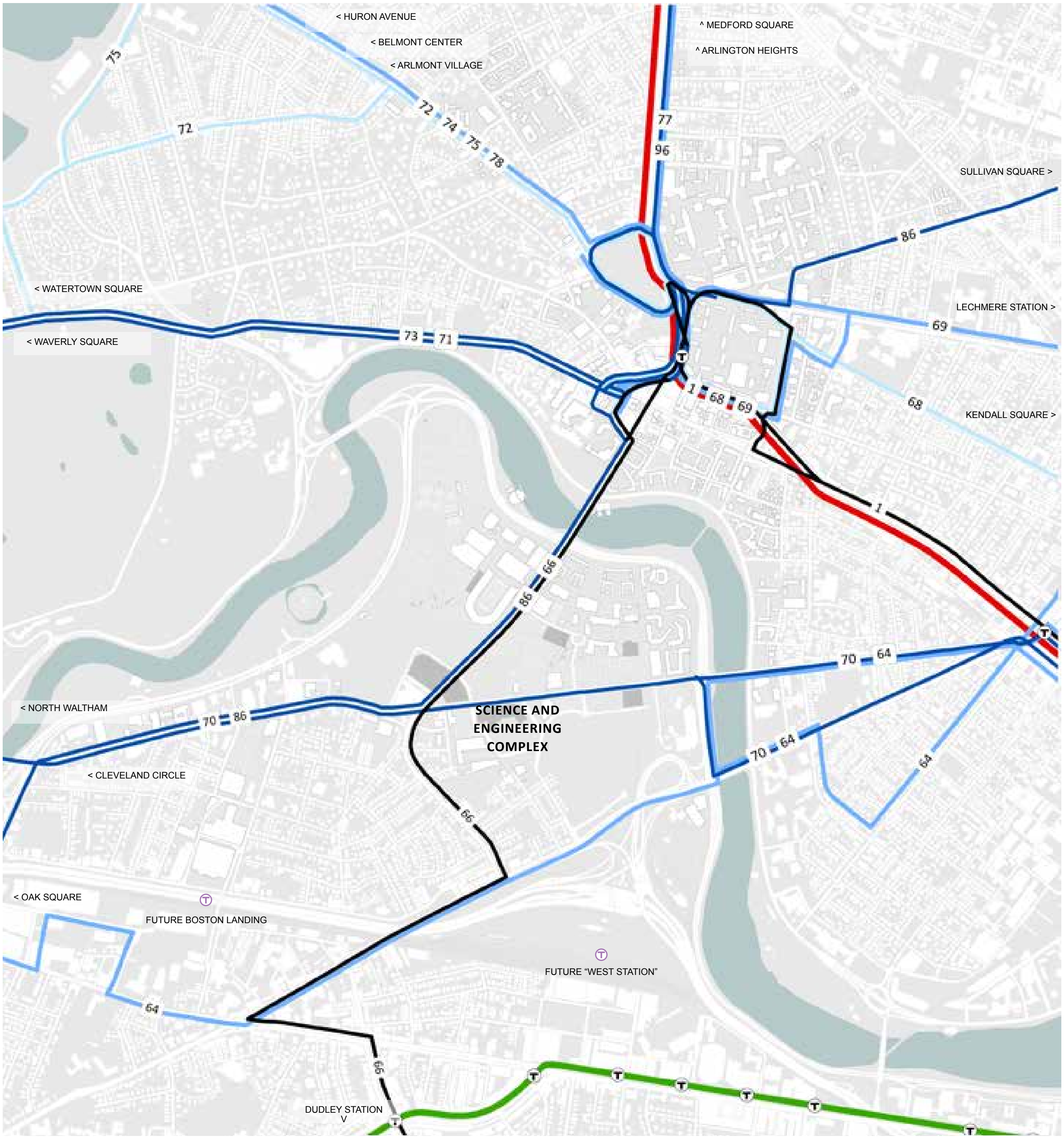


Figure 15: Area Transit

MBTA Bus Routes Weekday Boardings

- More than 10,000 (Routes 1,66)
- 5,000-10,000 (Routes 70, 71, 33, 77)
- 1,000-5,000 (Routes 64, 69, 74, 78)
- Less than 1,000 (Routes 68, 72, 75)

- MBTA Subway Station
- MBTA Subway Line
- Planned MBTA Commuter Rail Station

Shuttle Buses

Harvard University provides shuttle services to enhance connectivity between its Allston and Cambridge campuses. The Allston Express shuttle provides students and staff transportation throughout the year. Buses depart from the Cambridge Campus approximately every 15 minutes on weekdays with connections at Harvard Square, Harvard Kennedy School, Harvard Stadium, Harvard Business School (HBS), and Soldiers Field Park Garage. Headways are adjusted during other times of the year to reflect changes in demand.

In November 2014, the Allston Express service will be supplemented by a new shuttle bus route, the Harvard Square Express which will travel along North Harvard Street and stop at Barry's Corner and Cotting Hall in Allston and Eliot Street and Harvard Square in Cambridge. The shuttle runs will initially make three trips per hour from 7:00-10:00 a.m. and 3:00-6:00 p.m., terminating in the parking lot behind 175 North Harvard Street until Academic Way is constructed between North Harvard Street and Western Avenue. In the future, as demand warrants, Harvard anticipates that the service will operate at approximately ten-minute headways. This route provides convenient travel between the Cambridge and Allston campuses and connects to additional transit routes in Harvard Square and adds transit capacity at a time when new transit trips are being generated on the Allston Campus. Neighborhood residents and employees of the Continuum project are able to use the shuttles.

Harvard is committed to providing high quality transit services to Harvard affiliates including undergraduates, graduate student, staff and faculty. The construction of "Academic Way", "Science Drive" and "Stadium Way" create an opportunity to reevaluate shuttle bus routing to more effectively serve the SEC project. As plans for the SEC project progress, Harvard anticipates refining and/or supplementing shuttle service to/from and within the Allston campus to accommodate the anticipated increase in demand.

Harvard also proposes to create a shuttle bus stop/hub on "Stadium Way," next to the SEC. This location would allow buses to drop-off/pick-up passengers and stage off Western Avenue. The Harvard Square Express could be extended to this location and loop around 114 Western Avenue or the SEC to return to North Harvard Street via "Academic Way." Similarly the Allston Express could use these streets to access the Stadium Way stop. A waiting area would be created in SEC as part of a Mobility Hub at this location.

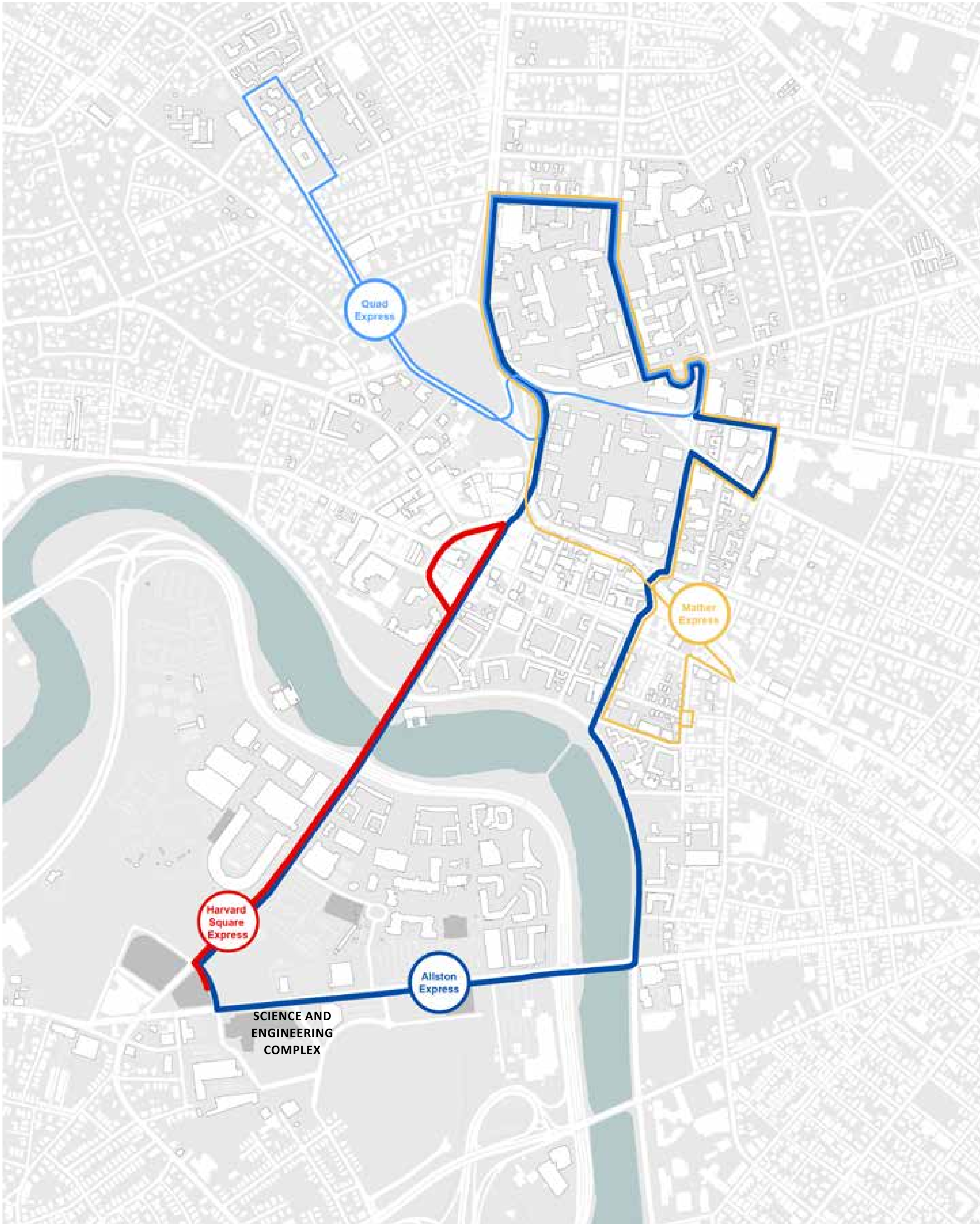


Figure 16: Future Harvard Shuttle Network

Bikes

Bicycles are an important component of the transportation system at Harvard. Harvard provides both covered and uncovered bicycle parking for its employees, students, and visitors on its Allston Campus and is committed to providing covered off-street bike parking and accessible public spaces that are convenient to the SEC building entrance. Harvard has also worked with the City of Boston and the City of Cambridge to sponsor and install four 15-dock Hubway regional bike-share stations in Allston. As demand increases, Harvard is committed to exploring the expansion of the Hubway stations.

In recent years, there has been a significant increase in the number of bike lanes serving Allston. Harvard has collaborated with the City of Boston to install bicycle lanes on North Harvard Street from Soldiers Field Road to Cambridge Street and on Western Avenue from Barry's Corner east to Soldiers Field Road, including a westbound cycle track as shown below. The Paul Dudley White Bicycle Paths along the Charles River provide off-road east-west mobility for bicycles and pedestrians from Watertown Square to Museum of Science passing by the study area. Bicycle accommodations on the Anderson Memorial Bridge, the Weeks Bridge, and at Barry's Corner are currently being improved and MassDOT has proposed improvements to the bicycle network serving the area as part of the Allston Interchange project. Figure 17 illustrates the future bicycle network with the SEC.

The mode share analysis indicates that as many as 390 faculty, staff, graduate students and researchers will commute by bicycle to the SEC on a daily basis. An additional 90-100 undergraduates (approximately 15 percent of the daily population) may also bike to the SEC on a daily basis. This is significantly greater than the potential numbers of bicycle commuters for the 2007 Science project,but less than the 2013 IMP estimate of 1,740 total daily bicycle commuters for the Ten-Year plan including Science.

The SEC includes the accommodation of approximately 400 secure/covered bike parking spaces and approximately 100 outdoor bike parking spaces per Boston's Bike Parking Guidelines. Harvard will also continue to work with the City and the State to upgrade and enhance bicycle facilities that serve Allston. In addition to the bike parking and Hubway station improvements discussed above, improvements will be made to the cycle track on the northern side of Western Avenue as part of the SEC. Figure 17 illustrates the proposed improvements that would formalize the existing eastbound cycle track and create a new westbound cycle track in front of the site. The eastbound track will be relocated onto the space currently occupied by the existing sidewalk. This will create additional street width to restore a parking lane on the north side of the street.

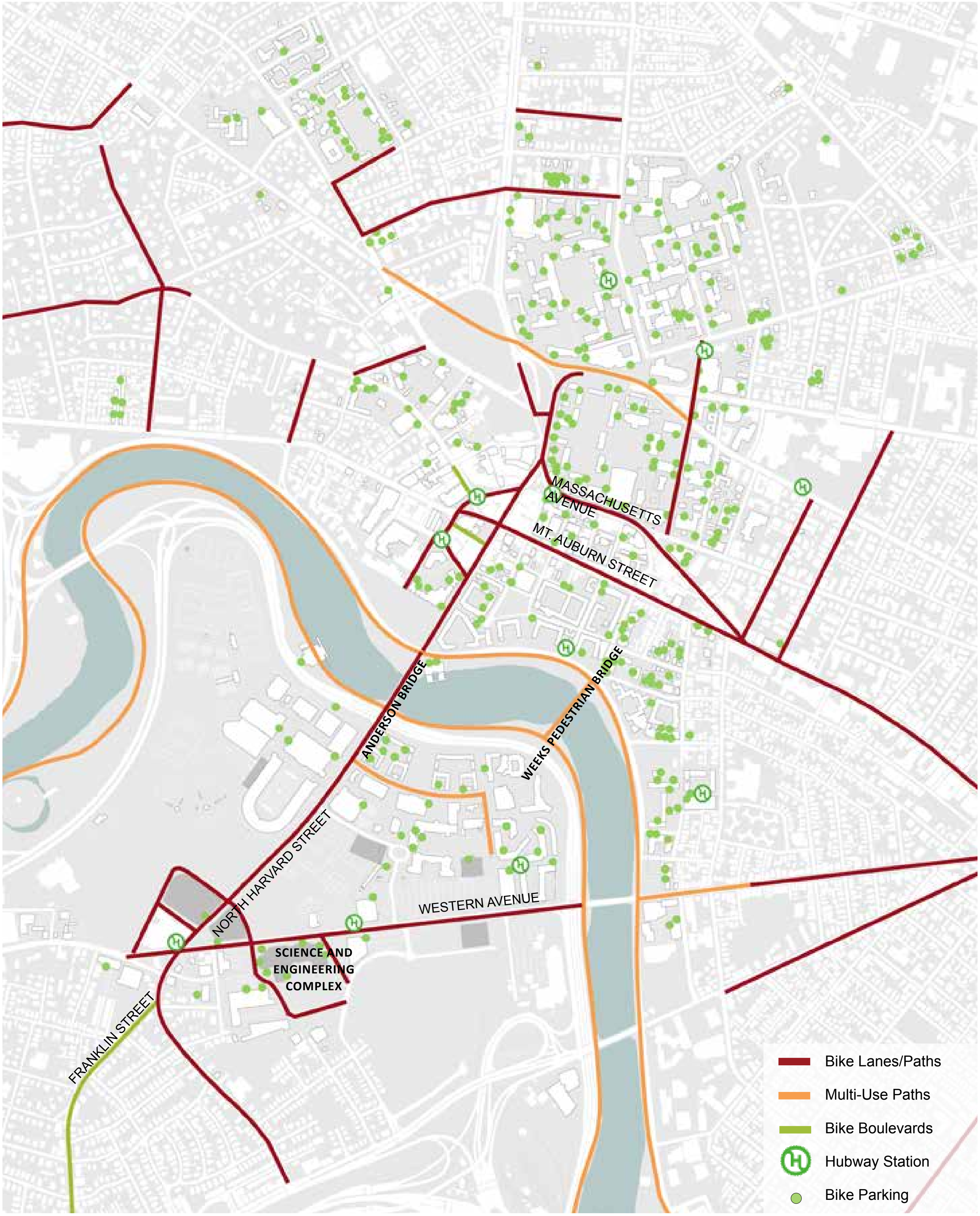


Figure 17: Future Bicycle Network

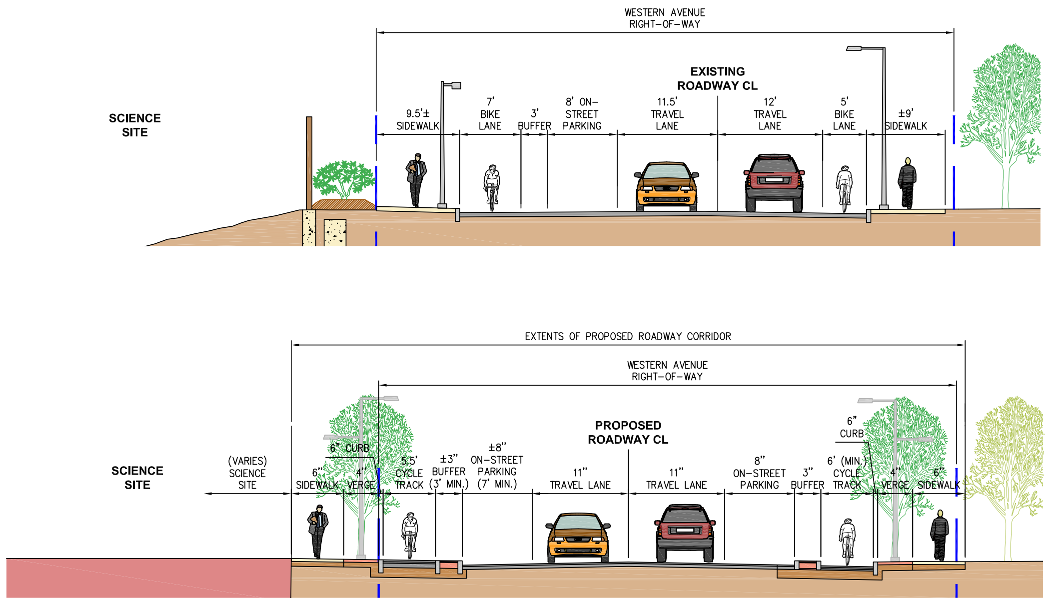


Figure 18: Existing (Top) and Proposed (Bottom) Western Avenue Sectional Conditions

Pedestrians

The shift to academic uses will also increase pedestrian activity as compared to the 2007 Science project. This will include commuters that will walk to the site and students that will walk to and from the Science and Engineering Complex for class and other academic activities. This level of pedestrian activity was anticipated by the 2013 IMP and is reflected in the design guidelines for streets and paths in the IMP area.

The Allston campus benefits from an extensive network of sidewalks and pedestrian paths that extend across the Charles River and into the Cambridge campus. Recent improvements have been made along these routes. The Department of Conservation and Recreation recently completed improvements to the John Weeks Bridge, making it more accessible and better lit at night. MassDOT is in the process of completing improvements to the Anderson Bridge that will provide better pedestrian crossings at the Memorial Drive and Soldiers Field Road intersections and improved sidewalks on the bridge.

Harvard owns and maintains a network of campus paths within its campus in Allston. These pathways provide internal connections and access to parking facilities as well as links to the system of public sidewalks and paths that are on the periphery of the campus. As part of the SEC, Harvard will continue to invest in pedestrian facilities to connect the project site to existing and planned facilities. As part of the project, new sidewalks will be constructed on roadways around the perimeter of the site, using Boston's Complete Streets Guidelines. New pedestrian crossings are envisioned at the future intersections of Western Avenue and Academic Way and Western Avenue at Stadium Way as part of the SEC. Harvard will work with BTD to design and implement appropriate pedestrian crossings at these locations.

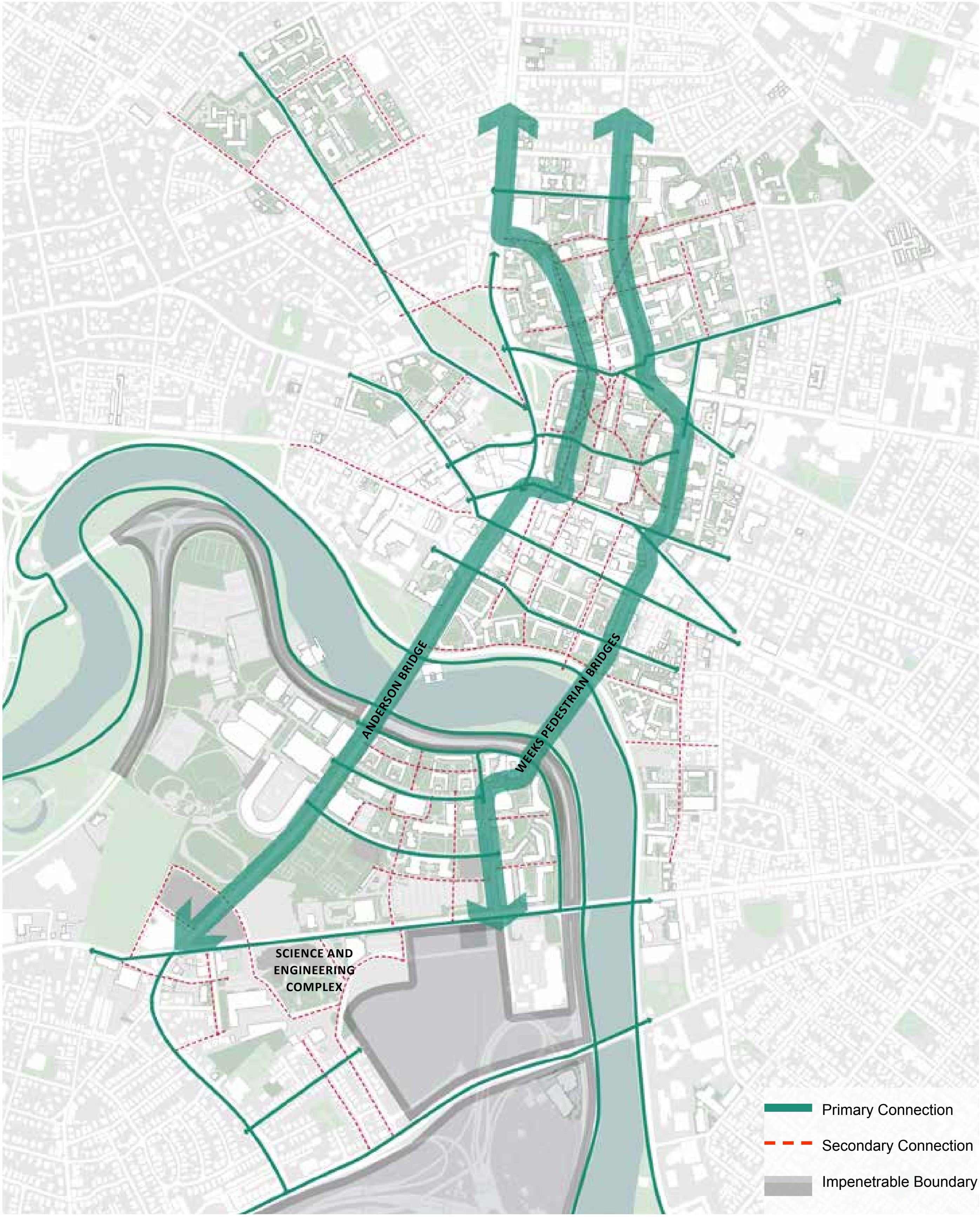


Figure 19: Pedestrian Network

Parking Management

All University parking is controlled and administered by the Harvard University Parking Office as a University-wide resource with a permitting system and specific parking lot/ garage assignments. Unreserved commuter parking (i.e., valid from 5:00 a.m. to 3:00 a.m. Monday through Friday, and all day on weekends) is available for eligible staff and faculty and costs $1,896 per year for surface parking and $2,028 per year for garage parking. Students or other Harvard affiliates living on-campus can obtain Reserved Parking permits (i.e., valid at all times for use by the permit holder) to park for $3,792 per year in garages and $3,576 in surface lots. These parking rates are for FY16. In addition, Harvard provides visitor parking in the Spangler Lot on Western Avenue and at designated multi-space meter locations. Appendix B provides further detail about Harvard's parking management programs.

The 2013 IMP explicitly stated that "No below grade parking is required for the initial program" (i.e. SEC). To accommodate the SEC parking demand, the IMP proposed to expand the 178 non-institutional surface spaces at 114 Western Avenue to 210 surface spaces by increasing the size of the lot to the west of the 114 Western Avenue building. As shown in Figure 14, the surface parking at 114 Western Avenue will be reconfigured to the south of 114 Western Avenue to accommodate the Stadium Way alignment and increased from 210 spaces to 275 spaces. As the design of the lot advances, Harvard will investigate the provision of electric charging stations and determine the need to designate other spaces for car-sharing services (e.g., ZipCar), high occupancy vehicles and low emission vehicles.

The new institutional parking supply will support the anticipated demand of 1,420 commuters to the building at a 21 percent auto mode share. Harvard's institutional parking supply was reduced by 90 spaces from 2,642 to 2,552 to construct Klarman Hall. The addition of 275 new institutional spaces for the SEC will increase the institutional parking supply to 2,827 spaces.

Transportation Demand Management

Harvard has an extensive Transportation Demand Management (TDM) program that is an important tool in managing vehicular travel to the campus. Harvard maintains an extensive CommuterChoice website (www.commuterchoice.harvard.edu) which provides information about these programs. Table 13 provides an overview of Harvard's TDM program.

Table 13: Overview of CommuterChoice (TDM) Program

Category	TDM Measure
Transit Passes	50 percent subsidy for MBTA monthly passes Pre-tax savings on the purchase of private transit passes and commuter checks is offered as an added bonus for eligible faculty and staff On-line monthly pass sales Participation of 6,700 Harvard affiliates in monthly pass program Eligible affiliates must be a full time benefits eligible employee paid directly through the University and not having a parking pass
Marketing	Transit pass program Public transportation options and Harvard shuttle services Bicycling services such as safe cycling classes, repair clinic, the Hubway bike share, and the departmental bike program Ridesharing options Walking and bicycle maps Links to other references and resources
Bicycle Program	$50 discounted annual membership in the Hubway bike sharing program (normally $85 per year) Reimbursements for bicycle safety training and repair classes for fulltime employees Discounted bike helmets Harvard affiliates bike registration program in conjunction with the Harvard University Police Department Participation in the Bicycle Benefit Act providing bicyclists up to $240/year for bicycle expenses.
Rideshare Programs	Discounted and preferential carpool and vanpool parking in the largest garages and several surface lots 50 percent discount on annual parking permits for carpoolers if they carpool with one other employee, and a 75 percent discount on the cost of their annual parking permit if they travel with three or more people. Carpool partner matching and registration Emergency ride home assistance Zimride, an online ride sharing program that helps Harvard affiliates locate other people with similar commuting patterns or travel needs and facilitates ridesharing. RelayRides program to match people who are willing to lend or borrow vehicles from one another
ZipCar	Discounted annual Zipcar membership ($25/year) to employees. Memberships for an 18+ age group. Parking for 34 ZipCars including 15 in Allston Participation of 10,000+ Harvard affiliates in the program
LEV and Electric Vehicles	Approximately 26 preferred parking spaces are available, with the appropriate permit, for Low Emission Vehicles (LEV) at ten locations on the Cambridge and Allston campuses. Two Electric Vehicle Charging Stations on the Allston Campus at 125 Western Avenue (i-lab)

Harvard is also a member of A Better City Transportation Management Association, which provides TDM services to employees at commercial properties. In addition to its extensive TDM program, Harvard also accommodates transportation demands related to athletic, commencement, and Business School events through police detail traffic control/ management, parking demand management and temporary signage.

Mitigation

The 2013 IMP identified a menu of enhancements to address the transportation impacts of the various IMP projects. Harvard will implement the following measures that were identified in the 2013 IMP as part of the 2015 SEC project:

- Construction of “Academic Way” from Science Drive to North Harvard Street to relieve traffic congestion in Barry’s Corner and provide new pedestrian and bike connections to SEAS/SEC.
- Signal monitoring improvements at Barry’s Corner and along N. Harvard Street to improve management of the traffic signal system along this corridor.
- Enhancements to the Harvard Shuttle system to extend the Allston Express to Barry’s Corner
- Upgrades to Western Avenue to create separated cycle tracks on both sides of the street in front of the new SEC buildings.
- Creation of Mobility Hubs at Barry’s Corner and SEAS/SEC with Hubway stations, bike parking, ZipCars, MBTA bus stops, and Harvard shuttle stops.
- Consolidation of MBTA bus stops on Western Avenue and North Harvard Street (north of Barry’s Corner) to reduce delay, bus bunching and improve service reliability.

In addition to these measures, Harvard will initiate the Harvard Square Express between Barry’s Corner and Harvard Square in November 2015. This bus currently stops in the 175 North Harvard Street parking lot, but will be moved to the former Charlesview site once “Academic Way” is constructed. Neighborhood residents and employees of the Continuum project are able to use the shuttles.

Harvard has also worked cooperatively with the Massachusetts Department of Transportation (MassDOT) to facilitate traffic signal improvements at the intersection of Cambridge Street, River Street Bridge, and Soldiers Field Road. These improvements, which require the use of a portion of Harvard property, will upgrade the signal equipment, improve vehicular channelization, add new bike lanes and cycle tracks and enhance pedestrian crossings with improved equipment and signal timing plans.

3.2 Pedestrian Level Wind

The project team - led by CPP Wind Engineering - has conducted an initial review of the pedestrian level wind impacts that will result from the development of the new construction portion of the Project. (There are no changes proposed to the exterior of 114 Western Avenue so the renovation of that building will not result in any changes to the pedestrian level wind environment.) As the design of the project advances, the project team will conduct additional analysis of the wind environment – including a wind tunnel test – to confirm the conclusions and recommendations described below.

In terms of building heights, the existing surrounding environment is homogeneous to the southwest, a mix of heights within the institutional development to the north, and largely vacant to the east.

The Science and Engineering Complex will initially be taller than the immediate existing surrounding environment. Therefore, until surrounding development occurs, there will be minimal shielding available from the wind along the external boundaries of the site, particularly from the east and east-southeast.

Wind Speeds and Directions

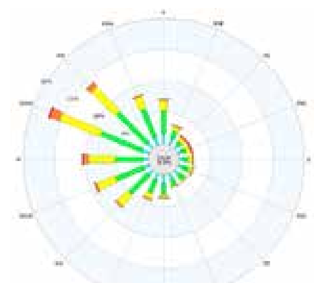
The primary winds of concern for pedestrian comfort are those in the yellow, orange, and red wind speed ranges. The wind rose indicates that the most frequent occurrences of these speeds are from the south-southwest through the northwest, clockwise. However, these ranges of wind speeds also occur for many of the easterly directions.

In winter (December-February) the winds of concern are primarily from the northwesterly directions.

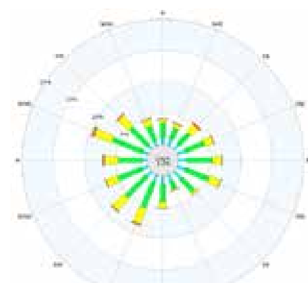
In spring (March-May) both westerly and easterly winds are of concern.

In summer (June-August) the winds are generally more mild with directions of concern mostly from the southwest.

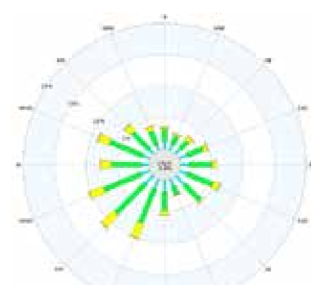
In autumn (September-November) winds of concern are generally from the west, with contributions also from the northeast.



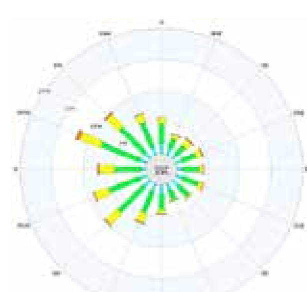
Winter



Spring



Summer



Fall

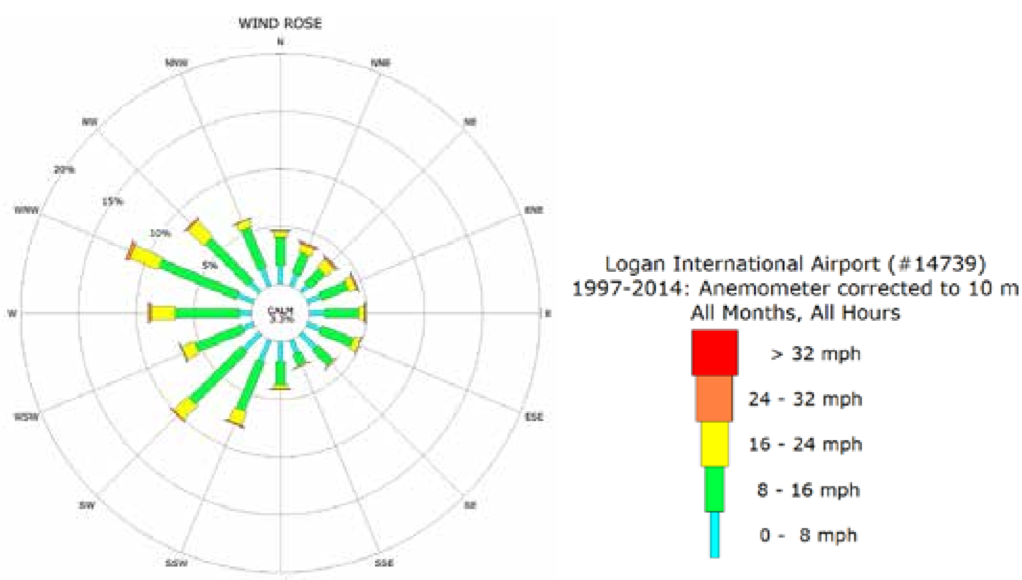


Figure 20: Wind Rose for Boston (Logan Airport Station, 1997-2014, All Months, All Hours)

Building Entrances

The building entrances at the northwest and northeast corners of the building will be exposed to the northwesterly and northeasterly winds of concern. However, the irregular shape of the building may limit the effect of down-washed winds being accelerated at these locations.

The central entrance on Western Avenue, the entrance on the southwest corner, and the central entrance from the courtyard will all be set back into the building massing and are likely to be well protected most of the time.

The building entrance at the southwest corner may be exposed to easterly winds down-washing on the east elevation and accelerating around the corner. However, the irregular building shape may also serve to protect this location.

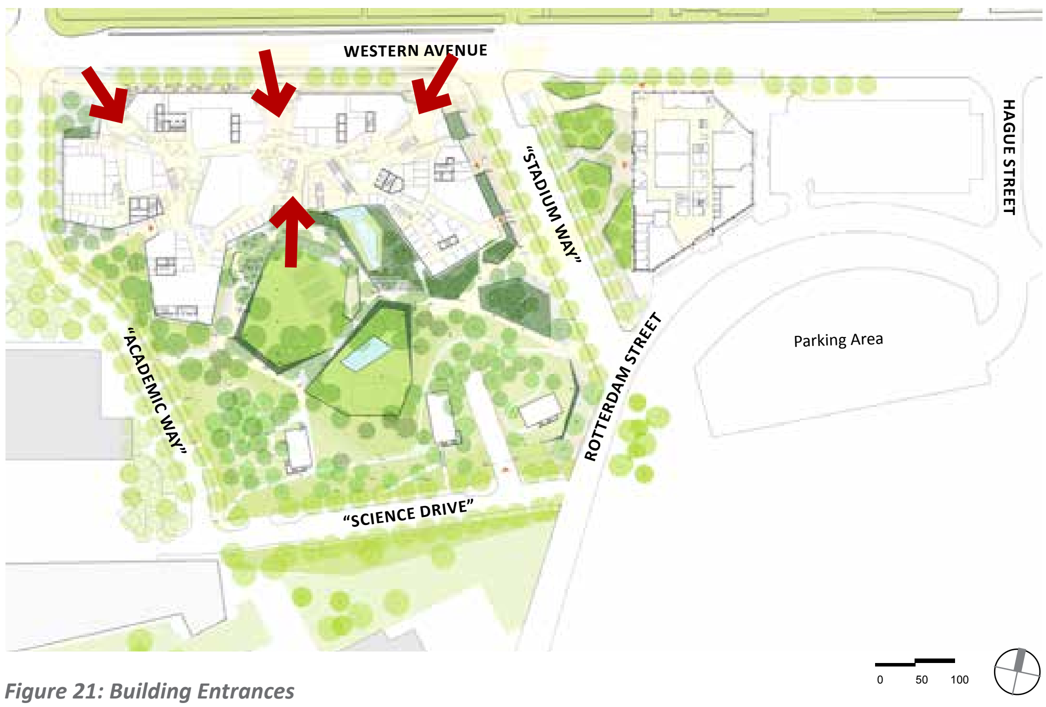


Figure 21: Building Entrances

Outdoor Spaces

With the project in place, the grade level central courtyard space will be sheltered from the northwesterly and northeasterly winds, but exposed to southeasterly through southwesterly winds. For events held during the spring in the courtyard, temporary shelter may be needed to provide protection from these wind directions.

With the project in place, the west terrace will be sheltered only from the northeasterly winds. The east terrace will be sheltered only from northwesterly winds.

Local interventions such as screen walls may be needed to provide shelter from the westerly winds (west terrace) and from northeasterly and southwesterly winds (east terrace).

Sidewalks

The sidewalk along Western Avenue has the potential to be exposed to northwesterly and northeasterly winds being down-washed and accelerating around the building corners. If present, these accelerated flow areas may be small and limited to the extreme east and west ends due to the setback/break in the façade near the building center.

The sidewalk along Western Avenue has the potential to be exposed to northwesterly and northeasterly winds. Only the western most door would likely be affected (by the northeasterly winds). The trees proposed for the project's landscape plan, if large enough, are likely to provide adequate protection.

The winds of concern for the west elevation are primarily northwesterly and southwesterly winds being down-washed and accelerating around the building corners. Only the northern most door, would likely be affected (by the southwesterly winds), though accelerated flows at the southern corner sidewalk may also occur. The large trees proposed for the landscape plan will provide significant protection.

The south elevation doors may be exposed to unobstructed southwesterly winds. However, the setback in the building will reduce potential for door damage from these winds.

Figure 22: Sidewalk Pedestrian Wind Areas of Concern

3.3 Shadow

Introduction and Methodology

As typically required by the BRA, a shadow impact analysis was conducted to investigate shadow impacts from the Project during three time periods (9:00 a.m., 12:00 noon, and 3:00 p.m.) during the summer solstice (June 21), autumnal equinox (September 21), vernal equinox (March 21), and the winter solstice (December 21). In addition, shadow studies were conducted for the 6:00 p.m. time period during the summer solstice and autumnal equinox.

The shadow analysis presents the existing shadow as well as the net new shadow from the building, and illustrates the incremental impact of the Project's new building. The analysis focuses on open spaces and major pedestrian areas in the vicinity of the Project site. Shadows have been determined using the applicable Altitude and Azimuth data for Boston. The analysis focuses on impacts from the new construction. There are no changes proposed to the exterior of 114 Western Avenue so the renovation of that building will not result in any changes to the shadows in the project area.

Vernal Equinox (March 21)

At 9:00 a.m., new shadow will be cast to the west and northwest of the Project, crossing Western Avenue and Academic Way (Figure 23). At 12:00 p.m., new shadow will be cast to the north of the Project and onto a portion of Western Avenue (Figure 24). At 3:00 p.m., new shadow will be cast to the north and northeast of the Project, onto Western Avenue and its intersection with Stadium Way (Figure 25). During all three time periods, the central courtyard will be free of shadow.

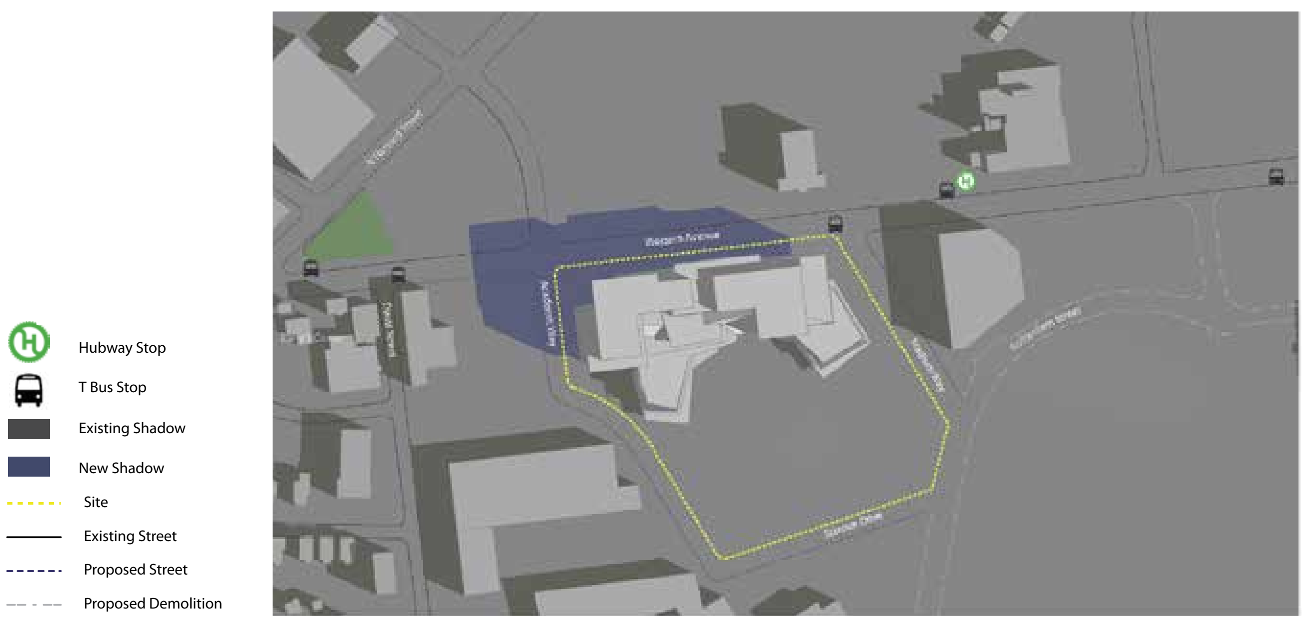


Figure 23: Shadow Study, Vernal Equinox (March 21, 9:00am)

Hubway Stop
T Bus Stop
Existing Shadow
New Shadow
Site
Existing Street
Proposed Street
Proposed Demolition

Figure 24: Shadow Study, Vernal Equinox (March 21, 12:00pm)

N 0 50 100 200 feet

Hubway Stop
T Bus Stop
Existing Shadow
New Shadow
Site
Existing Street
Proposed Street
Proposed Demolition

Figure 25: Shadow Study, Vernal Equinox (March 21, 3:00pm)

N 0 50 100 200 feet

Summer Solstice (June 21)

During the summer solstice, new shadow will be limited to the areas immediately surrounding the Project. At 9:00 a.m., new shadow will be cast to the west of the Project, crossing Academic Way (Figure 26). At 12:00 p.m., new shadow will be cast onto the sidewalk immediately adjacent to the Projects on the north side (Figure 27). At 3:00 p.m., new shadow will be cast to the northeast across small areas immediately adjacent to the Project and into a portion of Academic Way (Figure 28). At 6:00 p.m., new shadow will be cast to the east of the Project onto a portion of the central courtyard and across Stadium Way (Figure 29).

Figure 26: Shadow Study, Summer Solstice (June 21, 9:00am)

Figure 27: Shadow Study, Summer Solstice (June 21, 12:00pm)

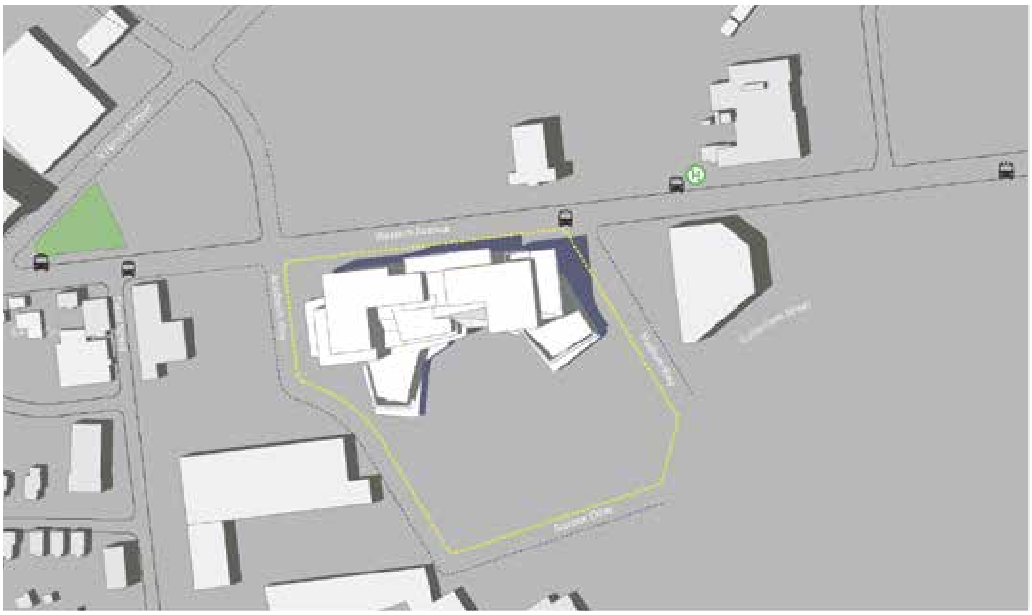


Figure 28: Shadow Study, Summer Solstice (June 21, 3:00pm)

Figure 29: Shadow Study, Summer Solstice (June 21, 6:00pm)

Autumnal Equinox (September 21)

At 9:00 a.m., new shadow will be cast to the west and northwest of the Project, across Western Avenue and its intersection with Academic Way (Figure 30). At 12:00 p.m., new shadow will be cast to the north of the Project onto the sidewalks on the north side of the building (Figure 31). At 3:00 p.m., new shadow will be cast to the north and northeast of the Project, across Western Avenue and its intersection with Academic Way (Figure 32). At 6:00 p.m., new shadow will be cast to the east of the Project onto a portion of the central courtyard, as well as the western façade of 114 Western Avenue (Figure 33).

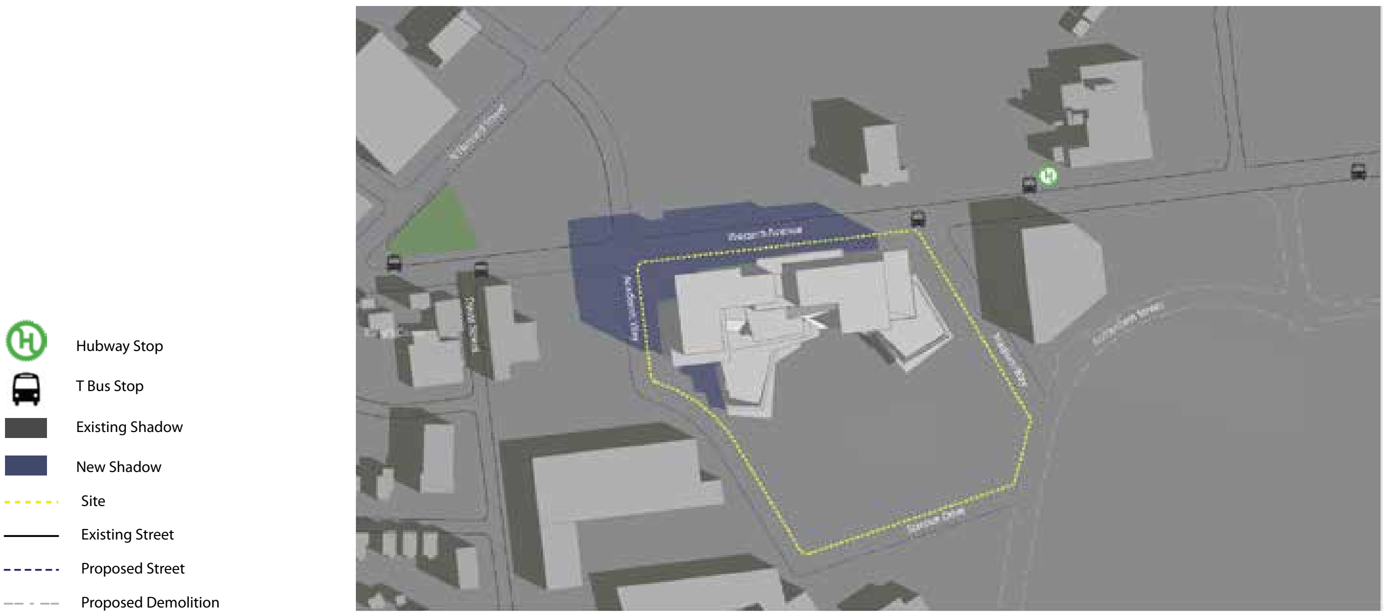


Figure 30: Shadow Study, Autumnal Equinox (September 21, 9:00am)

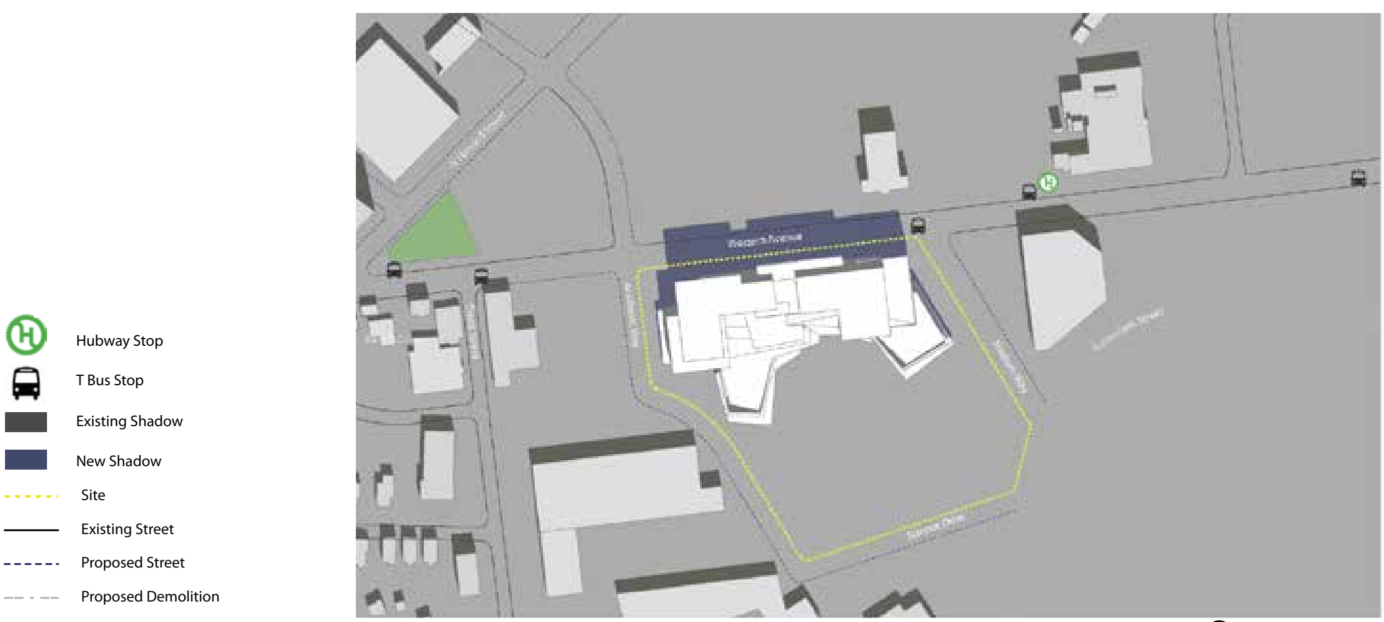


Figure 31: Shadow Study, Autumnal Equinox (September 21, 12:00pm)

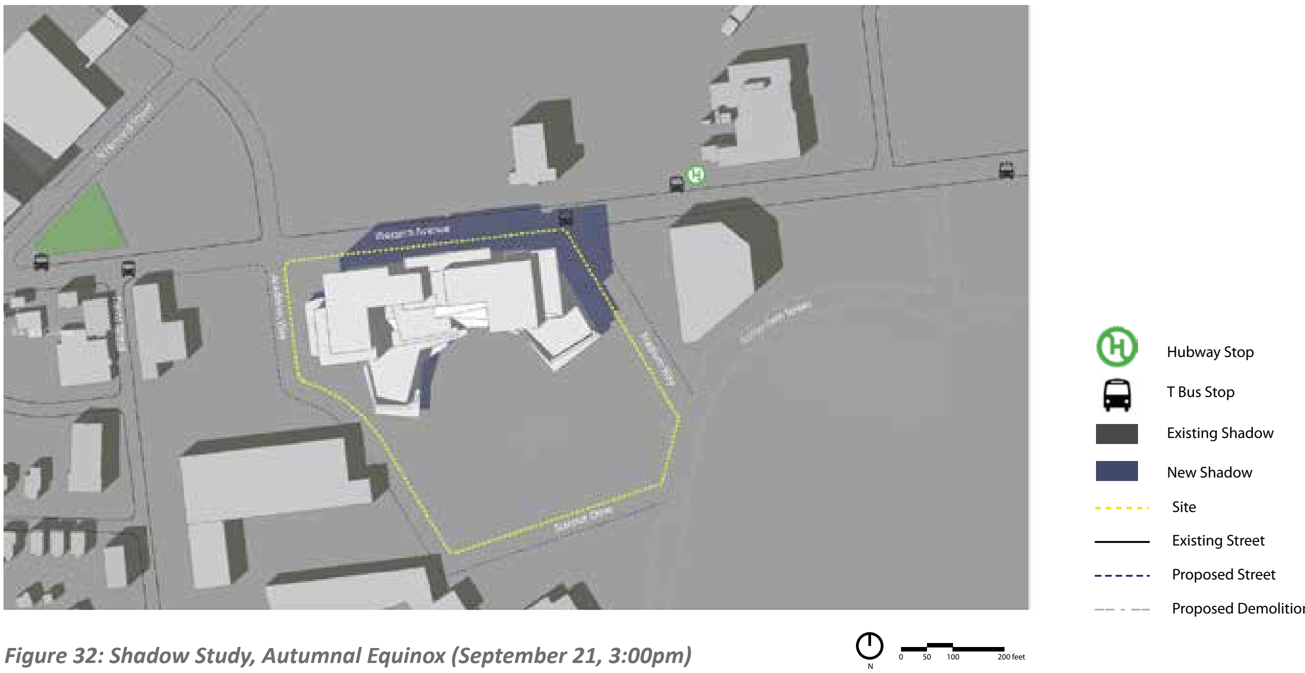


Figure 32: Shadow Study, Autumnal Equinox (September 21, 3:00pm)

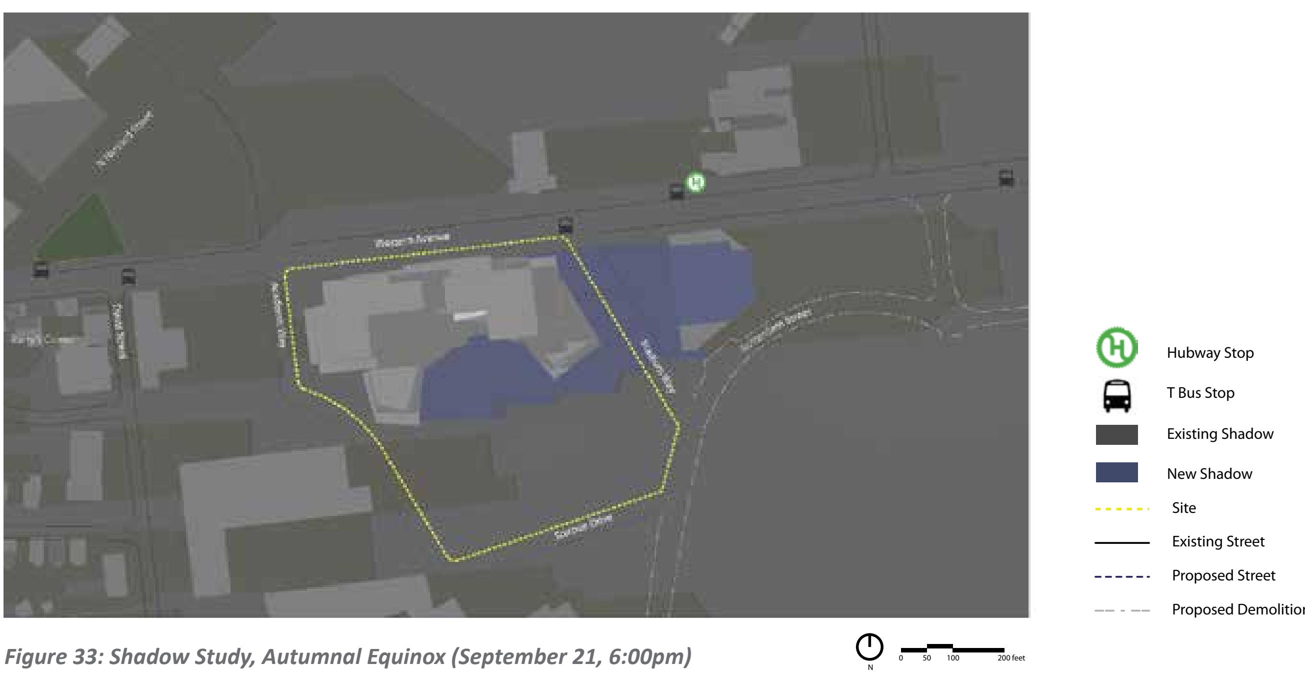


Figure 33: Shadow Study, Autumnal Equinox (September 21, 6:00pm)

Winter Solstice (December 21)

The winter solstice creates the least favorable conditions for sunlight in New England. The sun angle during the winter is lower than in any other season, causing the shadows to elongate and create considerable shadow in the area.

At 9:00 a.m., new shadow will be cast to the northwest of the Project, across Western Avenue (Figure 34). At 12:00 p.m., new shadow will be cast to the north of the Project, across Western Avenue and onto the NEDL Building (Figure 35). At 3:00 p.m., new shadow will be cast to the northeast of the Project, across Western Avenue and onto the parking lot for the i-Lab (Figure 36).

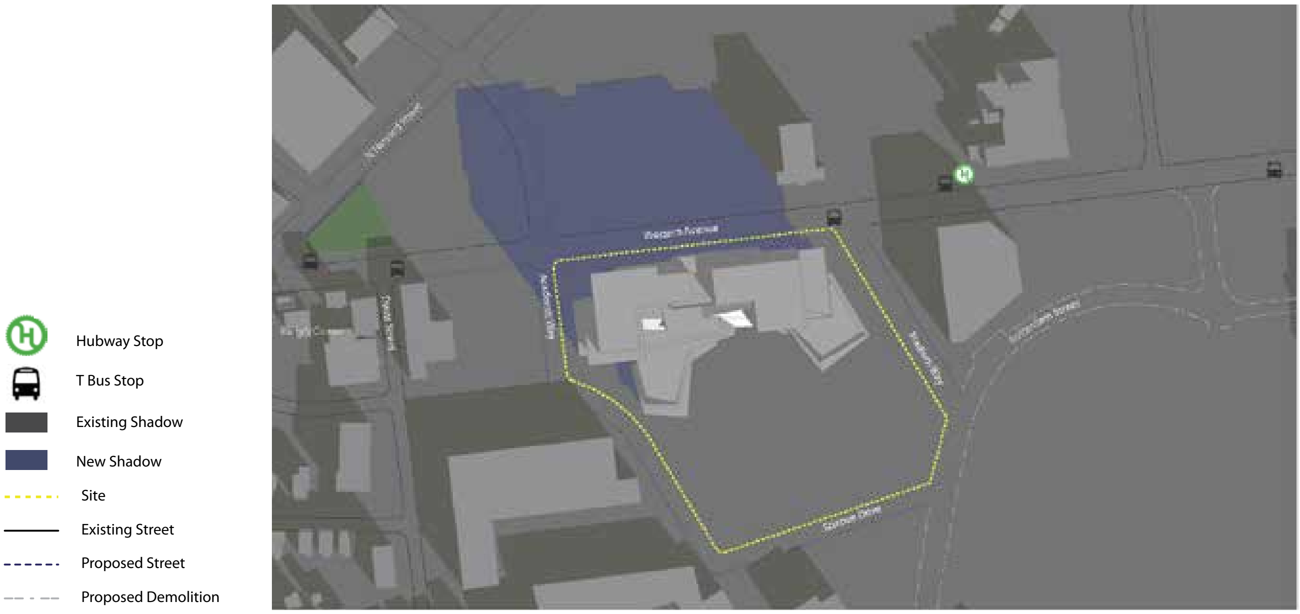


Figure 34: Shadow Study, Winter Solstice (December 21, 9:00am)

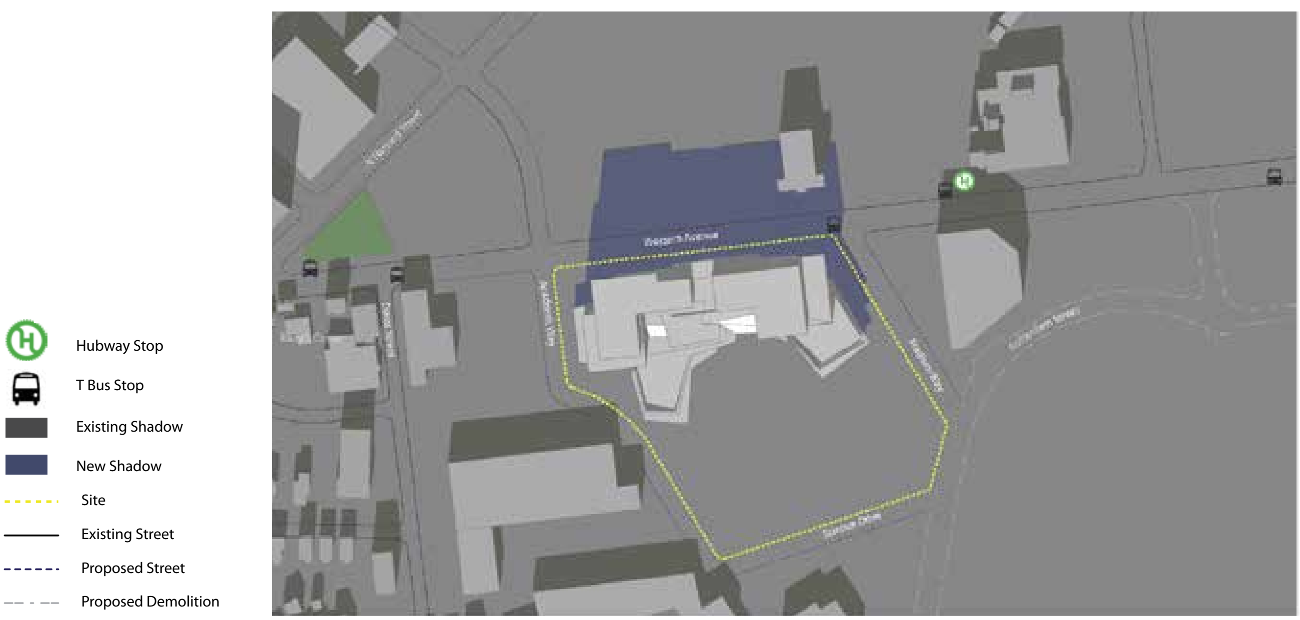


Figure 35: Shadow Study, Winter Solstice (December 21, 12:00pm)

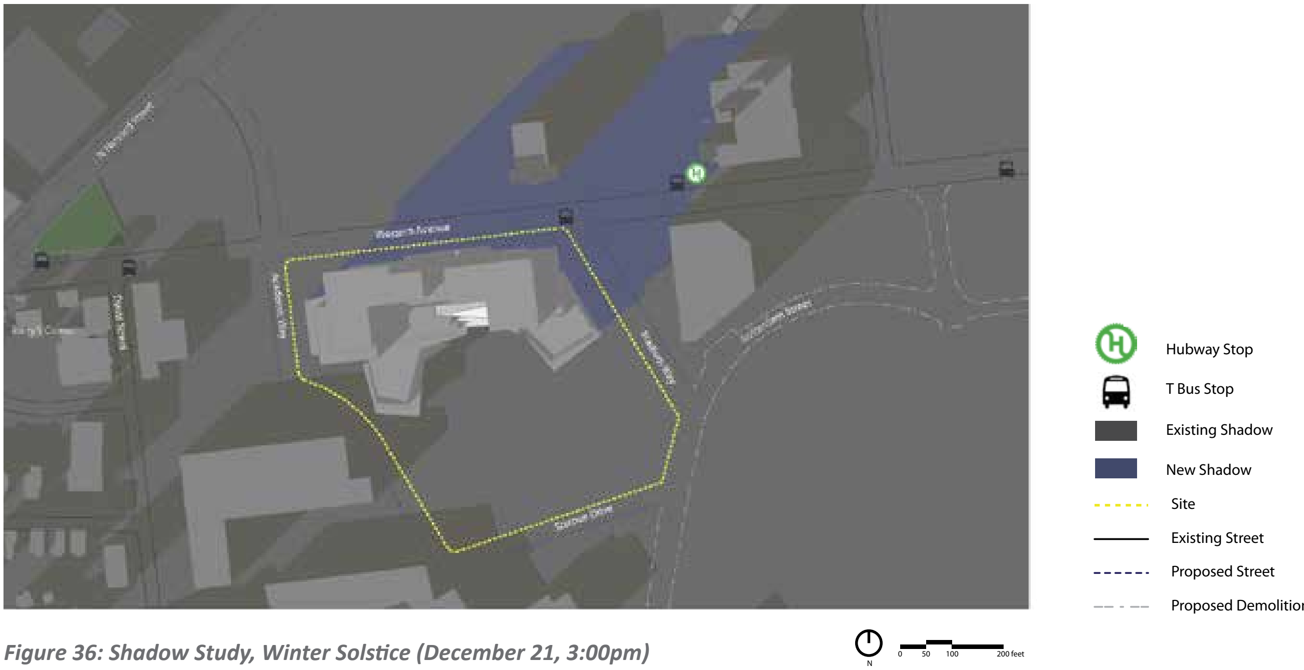


Figure 36: Shadow Study, Winter Solstice (December 21, 3:00pm)

Conclusions

Although the Project will create new shadow, due to the building's setbacks, new shadow will mainly be limited to the areas immediately surrounding the site, particularly Western Avenue. In addition, the Project will have limited shadow impact on the central courtyard. No new shadow will be cast onto nearby public spaces or residential buildings.

3.4 Daylight

Introduction

The purpose of the daylight analysis is to estimate the extent to which a proposed Project will affect the amount of daylight reaching the public streets, sidewalks, and open areas adjacent to the Project site. The DPIR filed in June 2007 included a daylight analysis for the 2007 Science Project, and included an analysis of the existing context and proposed conditions. The analysis in the DPIR found that given the existing conditions of the area—low-rise buildings and open parking lots, the previously approved project would increase daylight obstruction values.

To analyze the changes to the Project, a new daylight analysis has been completed that compares the SEC to the 2007 Science Project using the same viewpoints. Since only a portion of the site is now proposed to be developed, several viewpoints are not relevant for the proposed Project. There are no changes proposed to the exterior of 114 Western Avenue, so the renovation of that building will not result in any changes to daylight obstruction. In addition, to provide comparison to the surrounding area, new daylight analysis viewpoints for the existing context have been included. The analysis shows that the proposed Project's daylight obstruction values will be higher from the viewpoint on Western Avenue than the 2007 Science Project, and only slightly higher than the area context, while other viewpoints will have a lower daylight obstruction value than the 2007 Science Project given the open area on the southern portion of the site.

Methodology

The daylight analysis was performed using the Boston Redevelopment Authority Daylight Analysis (BRADA) computer program[1]. This program measures the percentage of sky-dome that is obstructed by a project and is a useful tool in evaluating percentage of obstruction from the proposed build conditions.

Using BRADA, a silhouette view of the building is taken at ground level from the middle of the adjacent city streets or pedestrian ways centered on the proposed building. The façade of the building facing the viewpoint, including heights, setbacks, corners and other features, is plotted onto a base map using lateral and elevation angles. The two-dimensional base map generated by BRADA represents a figure of the building in the "sky dome" from the viewpoint chosen. Due to the constraints of the BRADA program, the building may be simplified or it may be divided into sections in some cases. The BRADA program calculates the percentage of daylight that will be obstructed on a scale of zero percent to 100 percent based on the width of the view, the distance between the viewpoint and the building, and the massing and setbacks incorporated into the design of the building; the lower the number, the lower the percentage of obstruction of daylight from any given viewpoint.

The DPIR included an analysis of four viewpoints for the existing context and six viewpoints for the proposed conditions. Since 2007, there have been a number of changes in the area, including the demolition of the previous Charlesview Apartments and construction of the Continuum project. The Expanded PNF for the Continuum project included a daylight analysis. Relevant results from that analysis are included as part of the area context for comparison to the proposed Project[2].

In addition to the changes in the surrounding area, the proposed Project has changed in such a way that certain daylight analysis viewpoints previously studied are no longer relevant (Viewpoints 2, 4, 5 and 6).

1 Method developed by Harvey Bryan and Susan Stuebing, computer program developed by Ronald Fergle, Massachusetts Institute of Technology, Cambridge, MA, September 1984.

2 Barry's Corner Residential and Retail Commons, Boston, Massachusetts, Expanded Project Notification Form, Epsilon Associates, Inc., et al., December 14, 2012.

Results

Table 14 provides the results of the previous daylight analysis and the analysis for the proposed Project, as well as viewpoints from the Continuum project. Figure 37 shows the viewpoint locations, and Figure 38 - Figure 41 include the daylight analysis results.

Table 14: Daylight Obstruction Values

Viewpoint Locations		**2007 Science Project**	**Science and Engineering Project**
Viewpoint 1	Project from Western Avenue	29.1%	64.3%
Viewpoint 2	Project from Rena Street extension	51.6%	N/A
Viewpoint 3	BI from internal courtyard	52.7%	22.3%
Viewpoint 4	BII from internal courtyard	4.0%	N/A
Viewpoint 5	BIII from internal courtyard	39.6%	N/A
Viewpoint 6	BIV from internal courtyard	46.3%	N/A
Viewpoint 7	Looking west at the site from Stadium Way	N/A	14.5%
Viewpoint 8	Looking east at the site from Academic Way	N/A	12.5%
Area Context Viewpoints			
Area Context 1	Western Avenue looking south	36.6%	
Area Context 2	Central parking area looking east	17.7%	
Area Context 3	Central parking area looking west	27.8%	
Area Context 4	125 Western Avenue from Western Avenue	27.1%	
Area Context 5[1]	Teele Hall from Western Avenue	54.3%	
Area Context 6[1]	178 Western Avenue from Western Avenue	31.1%	
Area Context 7[1]	Barry's Corner Residential Building from Western Avenue	57.7%	
Area Context 8[1]	Barry's Corner Residential Building from North Harvard St.	30.4%	

Note:
1. Viewpoint from the Barry's Corner Residential and Retail Commons, Boston, Massachusetts, Expanded Project Notification Form, Epsilon Associates, Inc., et al., December 14, 2012.

The proposed changes to the Project place the building as one continuous structure on the northern portion of the site, rather than two buildings with an opening between them on the northern portion of the site, and two additional buildings on the southern portion of the site. With the elimination of the space between the buildings, the daylight analysis shows that the daylight obstruction from Western Avenue looking at the Project (Viewpoint 1) will increase from the previously approved project to 64.3%. The daylight obstruction will be higher than the area context viewpoints.

From the center of the site looking at the building (Viewpoint 3), the daylight obstruction will decrease compared to the 2007 Science Project due to the changes to the building and the large areas open on the west and east sides of the site. The daylight obstruction value will also be lower than the area context viewpoints at 22.3%.

Given the large open area on the southern portion of the site, daylight obstruction values from viewpoints looking east and west towards the site are lower than the area context and Viewpoints 7 and 8—14.5% and 12.5%, respectively.

Figure 37: Daylight Analysis Viewpoints

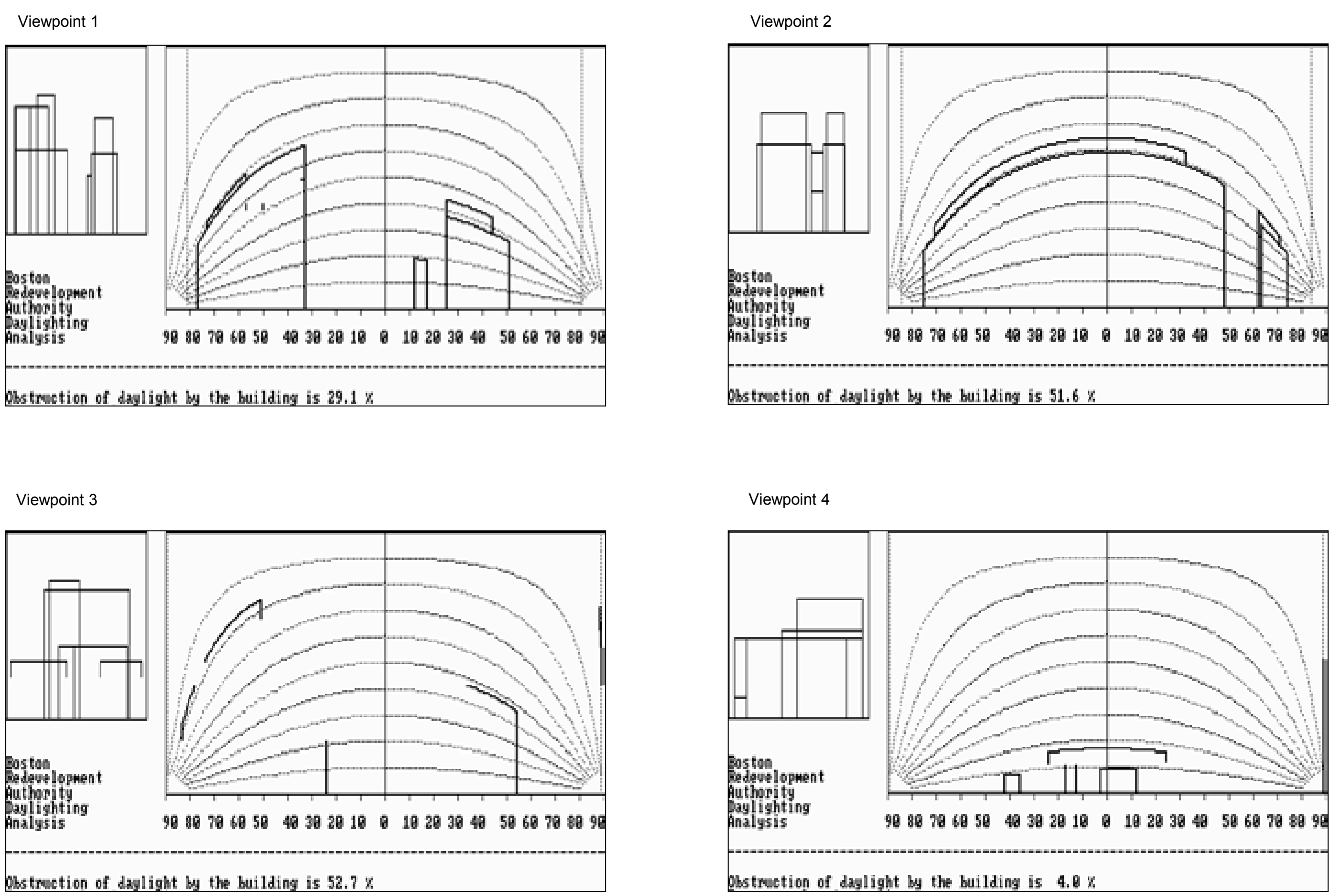
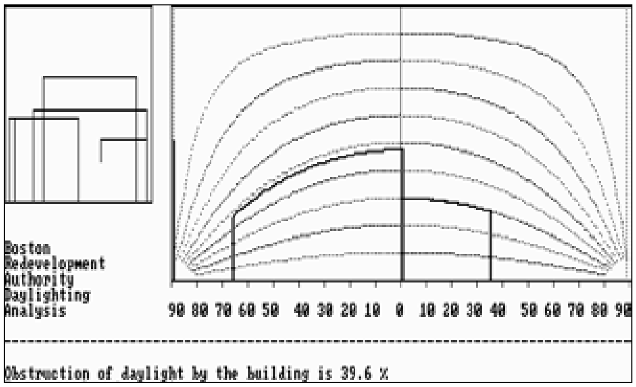


Figure 38: Daylight Analysis 2007 Science Project

Viewpoint 5



Viewpoint 6

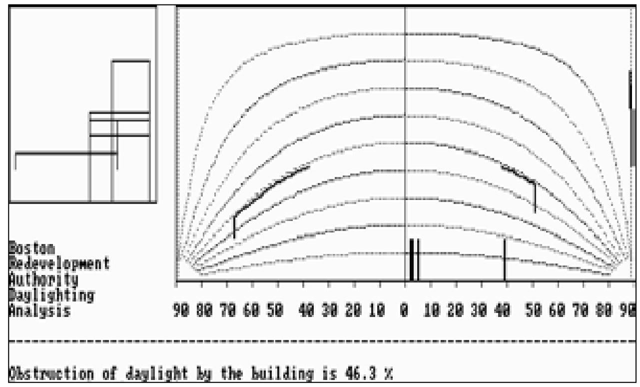
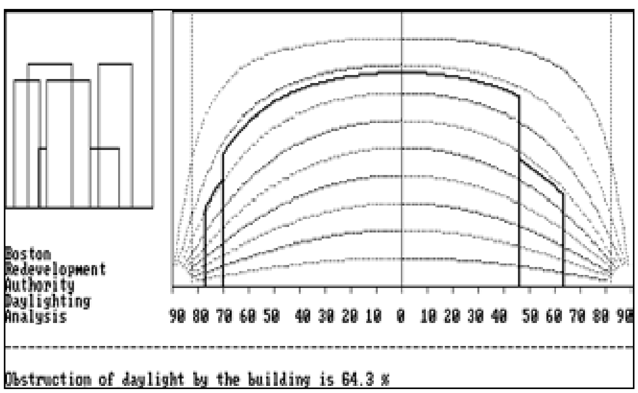
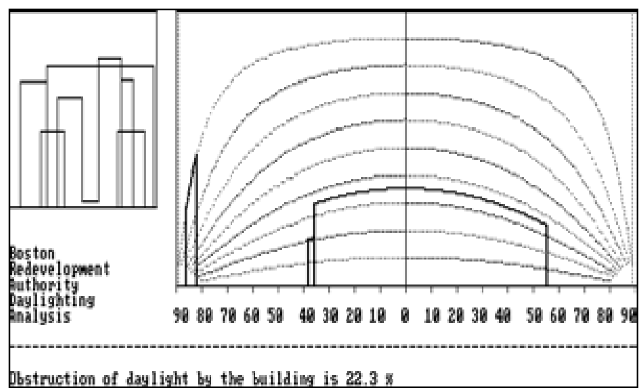


Figure 39: Daylight Analysis 2007 Science Project (cont.)

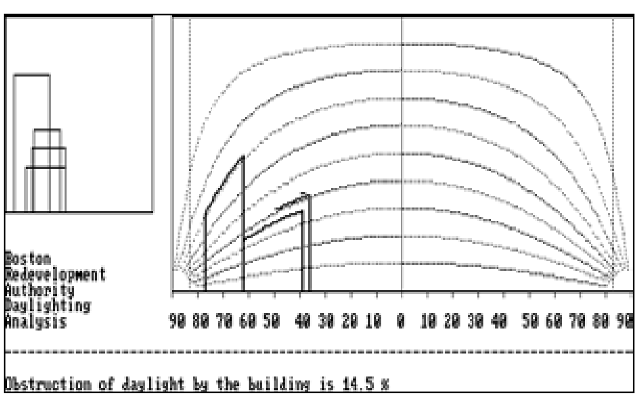
Viewpoint 1



Viewpoint 3



Viewpoint 7



Viewpoint 8

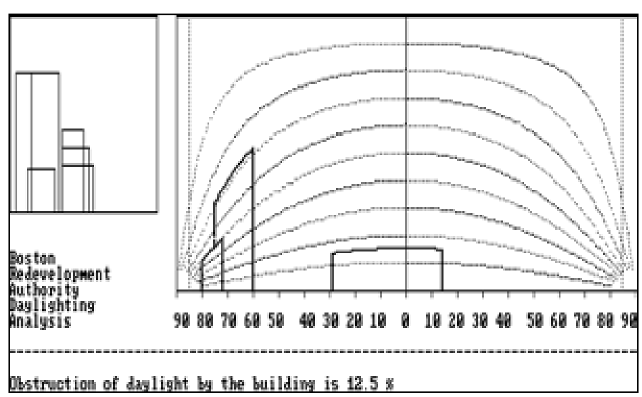


Figure 40: Daylight Analysis Proposed Project

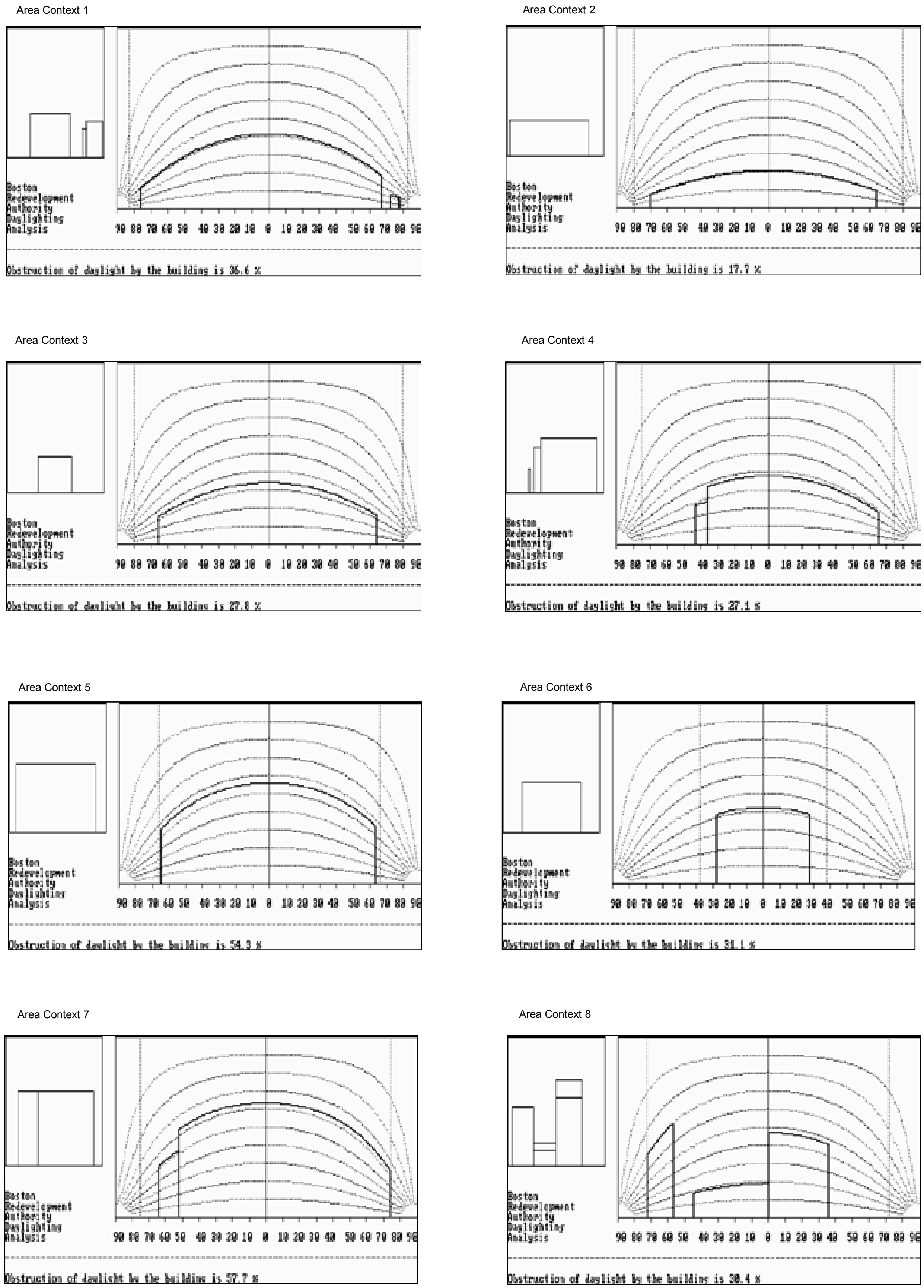


Figure 41: Daylight Analysis Area Context

Conclusion

Overall, the daylight obstruction values will be similar or lower than daylight obstruction values for the surrounding area, with the exception of the view from Western Avenue which will have a higher daylight obstruction value than the 2007 Science Project. The daylight obstruction values are consistent with similar urban areas of Boston.

3.5 Solar Glare

The design of the Project does not include the use of reflective glass or other reflective materials on the building facades that would potentially cause adverse impacts from reflected solar glare.

3.6 Air Quality

An air quality analysis has been conducted to determine the impact of pollutant emissions from mobile sources generated by the Project. Specifically, a microscale analysis was performed to evaluate the potential air quality impacts of carbon monoxide (CO) resulting from traffic flow around the Project area. Any new stationary sources will be reviewed by the Massachusetts Department of Environmental Protection (MassDEP) during permitting under the Environmental Results Program (ERP).

National Ambient Air Quality Standards and Background Concentrations

Background air quality concentrations and federal air quality standards were utilized to conduct the above air quality impact analyses. Federal National Ambient Air Quality Standards (NAAQS) were developed by US Environmental Protection Agency (EPA) to protect human health against adverse health effects with a margin of safety. The modeling methodologies were developed in accordance with the latest Massachusetts Department of Environmental Protection (MassDEP) modeling policies and Federal modeling guidelines[1]. The following sections outline the NAAQS standards and detail the sources of background air quality data.

National Ambient Air Quality Standards

The 1970 Clean Air Act was enacted by the US Congress to protect the health and welfare of the public from the adverse effects of air pollution. As required by the Clean Air Act, EPA promulgated National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants: nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM) (PM10 and PM2.5), carbon monoxide (CO), ozone (O_3), and lead (Pb). The NAAQS are listed in Table 15. Massachusetts Ambient Air Quality Standards (MAAQS) are typically identical to NAAQS.

NAAQS specify concentration levels for various averaging times and include both “primary” and “secondary” standards. Primary standards are intended to protect human health, whereas secondary standards are intended to protect public welfare from any known or anticipated adverse effects associated with the presence of air pollutants, such as damage to vegetation. The more stringent of the primary or secondary standards were applied when comparing to the modeling results for this Project.

A one-hour NO_2 standard was promulgated on January 22, 2010 to protect public health, including the health of sensitive populations (e.g., people with asthma, children, and the elderly). The final rule for the new hourly NO_2 NAAQS was published in the Federal Register on February 9, 2010 and became effective on April 12, 2010. The form of this

1 40 CFR 51 Appendix W, Guideline on Air Quality Models, 70 FR 68228, Nov. 9, 2005

standard is the three-year average of the 98th percentile of the daily maximum one-hour concentrations.

Similarly, a one-hour SO_2 standard was promulgated on June 2, 2010 to protect public health, including the health of sensitive populations (e.g., people with asthma, children, and the elderly). The final rule for the new hourly SO_2 NAAQS was published in the Federal Register on June 22, 2010 and became effective on August 23, 2010. The form of this standard is the three-year average of the 99th percentile of the daily maximum one-hour concentrations.

The inhalable particulate (PM10) NAAQS were promulgated on July 1, 1987 at the federal level with the intent of replacing the existing standards limiting ambient levels of Total Suspended Particulate (TSP). In 2006, the annual PM10 standard was revoked. However it remains codified in 310 CMR 6.00. EPA also promulgated a Fine Particulate (PM2.5) NAAQS, effective December 2006, with an annual standard of 15 $\mu g/m^3$ and the 24-hour standard of 35 micrograms per cubic meter ($\mu g/m^3$). The annual standard has since been strengthened to 12 $\mu g/m^3$ (in 2012).

The NAAQS also reflect various durations of exposure. The non-probabilistic short-term periods (24 hours or less) refer to exposure levels not to be exceeded more than once a year. Long-term periods refer to limits that cannot be exceeded for exposure averaged over three months or longer.

Table 15: National (NAAQS) and Massachusetts (MAAQS) Ambient Air Quality Standards

Pollutant	**Averaging Period**	**NAAQS ($\mu g/m^3$)**		**MAAQS ($\mu g/m^3$)**	
		Primary	**Secondary**	**Primary**	**Secondary**
NO_2	Annual[1]	100	Same	100	Same
	1-hour[2]	**188**	None	**None**	None
SO_2	Annual[1,9]	80	None	80	None
	24-hour[3,9]	365	None	365	None
	3-hour[3]	None	1300	None	1300
	1-hour[4]	**196**	None	**None**	None
PM2.5	Annual[1]	**12**	**15**	**None**	**None**
	24-hour[5]	**35**	**Same**	**None**	**None**
PM10	Annual[1,6]	**None**	None	50	Same
	24-hour[3,7]	150	Same	150	Same
CO	8-hour[3]	10,000	Same	10,000	Same
	1-hour[3]	40,000	Same	40,000	Same
Ozone	8-hour[8]	**147**	Same	**235**	Same
Pb	3-month[1]	1.5	Same	1.5	Same

Notes:
1. Not to be exceeded
2. 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
3. Not to be exceeded more than once per year.
4. 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
5. 98th percentile, averaged over 3 years
6. EPA revoked the annual PM10 NAAQS in 2006.
7. Not to be exceeded more than once per year on average over 3 years
8. Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years.
9. EPA revoked the annual and 24-hour SO_2 NAAQS in 2010. However they remain in effect until one year after the area's initial attainment designation, unless designated as "nonattainment".
Source: http://www.epa.gov/ttn/naaqs/criteria.html and 310 CMR 6.04

NAAQS have been developed for various durations of exposure. Massachusetts Ambient Air Quality Standards (MAAQS) are codified in 310 CMR 6.04, and generally follow the NAAQS but are not identical (highlighted in **bold** in Table 15.)

Background Concentrations

To estimate background pollutant levels representative of the area, the most recent air quality monitor data reported by the MassDEP in their Annual Air Quality Reports was obtained for 2012 to 2014. The 3-hour and 24-hour SO_2 values are no longer reported in the annual reports. Data for these pollutant and averaging time combinations were obtained from the U.S. EPA's AirData website.

The Clean Air Act allows for one exceedance per year of the CO and SO_2 short-term NAAQS per year. The highest second-high accounts for the one exceedance. Annual NAAQS are never to be exceeded. The 24-hour PM-10 standard is not to be exceeded more than once per year on average over three years. To attain the 24-hour PM-2.5 standard, the three-year average of the 98th percentile of 24-hour concentrations must not exceed 35 µg/m^3. For annual PM-2.5 averages, the average of the highest yearly observations was used as the background concentration. A new 1-hr NO_2 standard was recently promulgated. To attain this standard, the 3-year average of the 98th percentile of the maximum daily 1-hour concentrations must not exceed 188 µg/m^3.

Background concentrations were determined from the closest available monitoring stations to the proposed development. All pollutants are not monitored at every station, so data from multiple locations are necessary. The closest monitor is at Kenmore Square in Boston, roughly 1 mile northwest of the project location. However this site samples for all but Ozone and Lead. The next closest site is at Harrison Avenue, roughly 3.3 southeast of the project. This site samples for the remaining pollutants. A summary of the background air quality concentrations are presented in Table 16.

Table 16: Observed Ambient Air Quality Concentrations and Selected Background Levels

Pollutant	Averaging Time	2012	2013	2014	Background Concentration (μg/m³)	NAAQS	Percent of NAAQS
SO_2 [1,6]	1-Hour[5]	34.584	31.44	25.414	30.5	196.0	16%
	3-Hour	27.772	36.418	24.628	36.4	1300.0	3%
	24-Hour	14.148	15.72	13.1	15.7	365.0	4%
	Annual	4.8994	2.62	2.4628	4.9	80.0	6%
PM-10	24-Hour	28	50.0	53	53.0	150.0	35%
	Annual	15.7	19.0	14.9	19.0	50.0	38%
PM-2.5	24-Hour[5]	22.1	18.0	14.6	18.2	35.0	52%
	Annual[5]	9.03	8.0	6.02	7.7	12.0	64%
NO_2 [3]	1-Hour[5]	92.12	90	92.12	91.5	188.0	49%
	Annual	35.908	33.4	32.2796	35.9	100.0	36%
CO[2]	1-Hour	1489.8	1489.8	1489.8	1489.8	40000.0	4%
	8-Hour	1031.4	1031.4	1031.4	1031.4	10000.0	10%
Ozone[4]	8-Hour	153.114	115.817	106.002	153.1	147.0	104%
Lead	Rolling 3-Month	0.014	0.006	0.014	0.014	0.15	9%

Notes:
From 2012-2014 MA DEP Annual Data Summaries. Missing data (in italics) from EPA's AirData Website
1. SO_2 reported ppb. Converted to μg/m³ using factor of 1 ppm = 2.62 μg/m³.
2. CO reported in ppm. Converted to μg/m³ using factor of 1 ppm = 1146 μg/m³.
3. NO_2 reported in ppb. Converted to μg/m³ using factor of 1 ppm = 1.88 μg/m³.
4. O_3 reported in ppm. Converted to μg/m³ using factor of 1 ppm = 1963 μg/m³.
5. Background level is the average concentration of the three years.
6. The 24-hour and Annual standards were revoked by EPA on June 22, 2010, Federal Register 75-119, p. 35520.

Air quality in the vicinity of the Project site is generally good, with all (except ozone) local background concentrations found to be well below the NAAQS. Compliance with the 8-hour ozone NAAQS continues to be a challenge throughout the Commonwealth, although it has been improving.

For use in the microscale analysis, background concentrations of CO in ppm were required. The corresponding maximum background concentrations in ppm were 1.3 ppm (1,490 μg/m³) for one-hour and 0.9 ppm (1,031 μg/m³) for eight-hour CO.

Methodology

Microscale Analysis

The BRA typically requests an analysis of the effect on air quality of the increase in traffic generated by projects subject to Large Project Review. This "microscale" analysis is typically required for any intersection (including garage entrances/exits) where 1) Project traffic would impact intersections or roadway links currently operating at LOS D, E, or F or would cause LOS to decline to D, E, or F; 2) Project traffic would increase traffic volumes on nearby roadways by 10% or more (unless the increase in traffic volume is less than 100 vehicles per hour); or, 3) the Project will generate 3,000 or more new average daily trips on roadways providing access to a single location. The microscale analysis involves modeling of carbon monoxide (CO) emissions from vehicles idling at and traveling through signaled intersections. Predicted ambient concentrations of CO for the Build and No Build cases are compared with federal (and state) ambient air quality standards for CO.

The microscale analysis typically examines ground-level CO impacts due to traffic queues in the immediate vicinity of a project. CO is used in microscale studies to indicate roadway pollutant levels since it is the most abundant pollutant emitted by motor vehicles and can result in so-called "hot spot" (high concentration) locations around congested intersections. The NAAQS standards do not allow ambient CO concentrations to exceed 35 parts per million (ppm) for a one-hour averaging period and 9 ppm for an eight-hour averaging period, more than once per year at any location. The widespread use of CO catalysts on current vehicles has reduced the occurrences of CO hotspots. Air quality modeling techniques (computer simulation programs) are typically used to predict CO levels for both existing and future conditions to evaluate compliance of the roadways with the standards. The analysis for the Project followed the procedure outlined in U.S. EPA's intersection modeling guidance[1].

The microscale analysis has been conducted using the latest versions of EPA's MOVES and CAL3QHC programs to estimate CO concentrations at sidewalk receptor locations.

Baseline (2012) and future year (2022) emission factor data calculated from the MOVES model, along with traffic data, were input into the CAL3QHC program to determine CO concentrations due to traffic flowing through the selected intersections.

Existing background values of CO at the nearest monitor location at Kenmore Square were obtained from MassDEP. CAL3QHC results were then added to background CO values of 1.3 ppm (one-hour) and 0.9 ppm (eight-hour), as provided by MassDEP, to determine total air quality impacts due to the Project. These values were compared to the NAAQS for CO of 35 ppm (one-hour) and 9 ppm (eight-hour).

The modeling methodology was developed in accordance with the latest MassDEP modeling policies and Federal modeling guidelines[2].

Modeling assumptions and backup data for results presented in this section are provided in the Appendix C.

1 U.S. EPA, Guideline for Modeling Carbon Monoxide from Roadway Intersections; EPA-454/R-92-005, November 1992.
2 40 CFR 51 Appendix W, Guideline on Air Quality Models, 70 FR 68228, Nov. 9, 2005

Intersection Selection

As stated previously, a “microscale” analysis is typically required for the Project at intersections where 1) Project traffic would impact intersections or roadway links currently operating at LOS D, E, or F or would cause LOS to decline to D, E, or F; 2) Project traffic would increase traffic volumes on nearby roadways by 10% or more (unless the increase in traffic volume is less than 100 vehicles per hour); or, 3) the Project will generate 3,000 or more new average daily trips on roadways providing access to a single location.

There are a number of intersections included in the traffic study that meet the above conditions (see Section 3.1). The traffic volumes and LOS calculations provided in Section 3.1 form the basis of evaluating the traffic data versus the microscale thresholds. These were narrowed to the worst four intersections based on delay and volume data. The intersections chosen for inclusion in the microscale analysis are:

- the intersection of Soldiers Field Road and Everett Street;
- the intersection of Cambridge Street and North Harvard Street;
- the intersection of Soldiers Field Road and Cambridge Street; and,
- the intersection of Soldiers Field Road and Western Avenue.

Microscale modeling was performed for these intersections based on the aforementioned methodology. The 2012 existing conditions, and the 2022 No Build, Build, and Mitigated Build conditions were each evaluated for both morning (a.m.) and afternoon (p.m.) peak.

Emissions Calculations (MOVES)

The EPA MOVES computer program was used to estimate motor vehicle emission factors on the roadway network. Emission factors calculated by the MOVES model are based on motor vehicle operations typical of daily periods. The Commonwealth’s statewide annual Inspection and Maintenance (I&M) program was included, as well as the county specific vehicle age registration distribution, fleet mix, meteorology, and other inputs. The inputs for MOVES for the existing (2012) and build year (2022) are provided by MassDEP.

All link types for the modeled intersection were input into MOVES. Idle emission factors are obtained from factors for a link average speed of 0 miles per hour (mph). Moving emissions are calculated based on speeds at which free-flowing vehicles travel through the intersection as stated in traffic modeling (SYNCHRO) reports. A speed of 30 mph is used for all free-flow traffic. Speeds of 10 and 15 mph were used for right (and U-turns, if necessary) and left turns, respectively. Roadway emissions factors were obtained from MOVES using EPA guidance[1].

Winter CO emission factors are typically higher than summer. Therefore, January weekday emission factors were conservatively used in the microscale analyses.

1 U.S. EPA, 2010. Using MOVES in Project-Level Carbon Monoxide Analyses. EPA-420-B-10-041

Receptors & Meteorology Inputs

Sets of up to roughly 150 receptors were placed in the vicinity of the modeled intersection. Receptors extended approximately 300 feet on the sidewalks along the roadways approaching the intersection. The roadway links and receptor locations of the modeled intersection are presented in Figure 42 through Figure 45.

For the CAL3QHC model, limited meteorological inputs are required. Following EPA guidance[1], a wind speed of one meter per second, stability class D (4), and a mixing height of 1,000 meters were used. To account for the intersection geometry, wind directions from 0° to 350°, every 10° were selected. A surface roughness length of 370 centimeters was selected[2].

Impact Calculations (CAL3QHC)

The CAL3QHC model predicts one-hour concentrations using queue-links at intersections, worst-case meteorological conditions, and traffic input data. The one-hour concentrations were scaled by a factor of 0.9 to estimate eight-hour concentrations[3]. The CAL3QHC methodology was based on EPA CO modeling guidance. Signal timings were provided directly from the traffic modeling outputs.

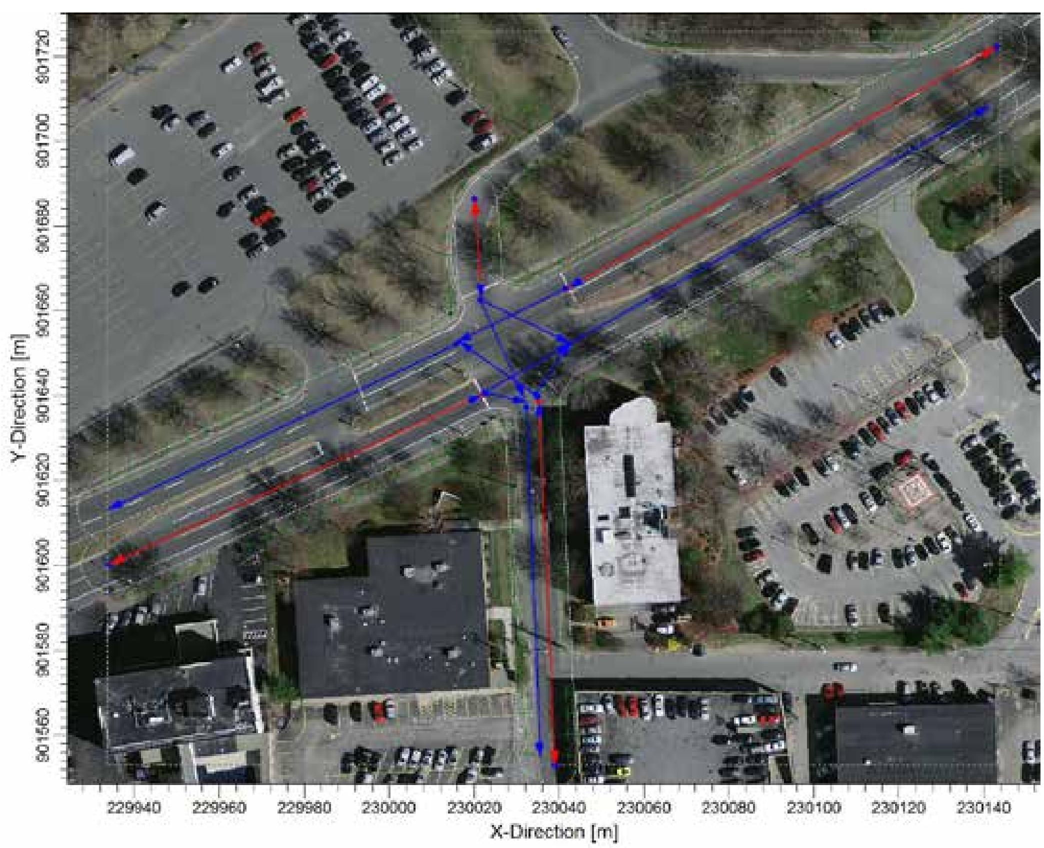


Figure 42: Link and Receptor Locations for CAL3QHC Modeling, Soldiers Field Road & Everett Street

1 U.S. EPA, Guideline for Modeling Carbon Monoxide from Roadway Intersections. EPA-454/R-92-005, November 1992.

2 U.S. EPA, User's Guide for CAL3QHC Version 2: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections. EPA –454/R-92-006 (Revised), September 1995.

3 U.S. EPA, AERSCREEN User's Guide; EPA-454/B-11-001, March 2011.

Figure 43: Link and Receptor Locations for CAL3QHC Modeling, Cambridge Street & North Harvard Street

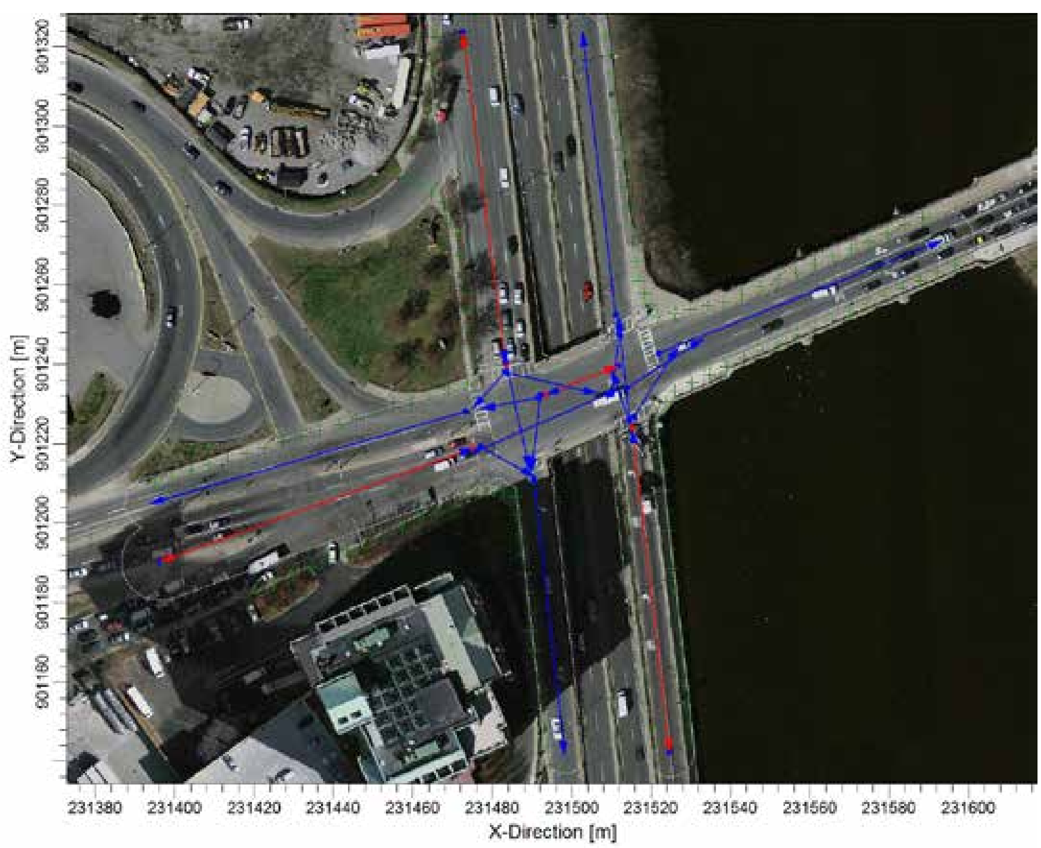


Figure 44: Link and Receptor Locations for CAL3QHC Modeling, Soldiers Field Road & Cambridge Street

Figure 45: Link and Receptor Locations for CAL3QHC Modeling, Soldiers Field Road & Western Avenue

Air Quality Results

Microscale Analysis

The results of the maximum one-hour predicted CO concentrations from CAL3QHC are provided in Table 17 through Table 20 for the 2012 and 2022 scenarios. Eight-hour average concentrations are calculated by multiplying the maximum one-hour concentrations by a factor of 0.9[1].

The results of the one-hour and eight-hour maximum modeled CO ground-level concentrations from CAL3QHC were added to EPA supplied background levels for comparison to the NAAQS. These values represent the highest potential concentrations at the intersection as they are predicted during the simultaneous occurrence of "defined" worst case meteorology. The highest one-hour traffic-related concentration predicted in the area of the Project, for the modeled conditions (1.0 ppm) plus background (1.3 ppm) is 2.3 ppm for the all AM peak cases at three of the four intersections. The highest eight-hour traffic-related concentration predicted in the area of the Project for the modeled conditions (0.9 ppm) plus background (0.9 ppm) is 1.8 ppm for the same locations and scenarios. All concentrations are well below the one-hour NAAQS of 35 ppm and the eight-hour NAAQS of 9 ppm.

Conclusions

Microscale Analysis

Results of the microscale analysis show that all predicted CO concentrations are well below one-hour and eight-hour NAAQS. Therefore, it can be concluded that there are no anticipated adverse air quality impacts resulting from increased traffic in the area.

1 U.S. EPA, AERSCREEN User's Guide; EPA-454/B-11-001, March 2011.

Table 17: Summary of Microscale Modeling Analysis (Existing 2012)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
1-Hour					
Soldiers Field Road and Everett Street	AM	0.6	1.3	1.9	35
	PM	0.8	1.3	2.1	35
Cambridge Street and North Harvard Street	AM	1.0	1.3	2.3	35
	PM	0.9	1.3	2.2	35
Soldiers Field Road and Cambridge Street	AM	1.0	1.3	2.3	35
	PM	1.0	1.3	2.3	35
Soldiers Field Road and Western Avenue	AM	0.9	1.3	2.2	35
	PM	1.0	1.3	2.3	35
8-Hour					
Soldiers Field Road and Everett Street	AM	0.5	0.9	1.4	9
	PM	0.7	0.9	1.6	9
Cambridge Street and North Harvard Street	AM	0.9	0.9	1.8	9
	PM	0.8	0.9	1.7	9
Soldiers Field Road and Cambridge Street	AM	0.9	0.9	1.8	9
	PM	0.9	0.9	1.8	9
Soldiers Field Road and Western Avenue	AM	0.8	0.9	1.7	9
	PM	0.9	0.9	1.8	9

Note: CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.9.

Table 18: Summary of Microscale Modeling Analysis (No-Build 2022)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
1-Hour					
Soldiers Field Road and Everett Street	AM	0.3	1.3	1.6	35
	PM	0.4	1.3	1.7	35
Cambridge Street and North Harvard Street	AM	0.5	1.3	1.8	35
	PM	0.5	1.3	1.8	35
Soldiers Field Road and Cambridge Street	AM	0.4	1.3	1.7	35
	PM	0.4	1.3	1.7	35
Soldiers Field Road and Western Avenue	AM	0.3	1.3	1.6	35
	PM	0.4	1.3	1.7	35
8-Hour					
Soldiers Field Road and Everett Street	AM	0.3	0.9	1.2	9
	PM	0.4	0.9	1.3	9
Cambridge Street and North Harvard Street	AM	0.5	0.9	1.4	9
	PM	0.5	0.9	1.4	9
Soldiers Field Road and Cambridge Street	AM	0.4	0.9	1.3	9
	PM	0.4	0.9	1.3	9
Soldiers Field Road and Western Avenue	AM	0.3	0.9	1.2	9
	PM	0.4	0.9	1.3	9

Note: CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.9.

Table 19: Summary of Microscale Modeling Analysis (Build 2022)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
1-Hour					
Soldiers Field Road and Everett Street	AM	0.3	1.3	1.6	35
	PM	0.4	1.3	1.7	35
Cambridge Street and North Harvard Street	AM	0.5	1.3	1.8	35
	PM	0.5	1.3	1.8	35
Soldiers Field Road and Cambridge Street	AM	0.4	1.3	1.7	35
	PM	0.4	1.3	1.7	35
Soldiers Field Road and Western Avenue	AM	0.3	1.3	1.6	35
	PM	0.4	1.3	1.7	35
8-Hour					
Soldiers Field Road and Everett Street	AM	0.3	0.9	1.2	9
	PM	0.4	0.9	1.3	9
Cambridge Street and North Harvard Street	AM	0.5	0.9	1.4	9
	PM	0.5	0.9	1.4	9
Soldiers Field Road and Cambridge Street	AM	0.4	0.9	1.3	9
	PM	0.4	0.9	1.3	9
Soldiers Field Road and Western Avenue	AM	0.3	0.9	1.2	9
	PM	0.4	0.9	1.3	9

Note: CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.9.

Table 20: Summary of Microscale Modeling Analysis (Mitigated Build 2022)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
1-Hour					
Soldiers Field Road and Everett Street	AM	0.3	1.3	1.6	35
	PM	0.4	1.3	1.7	35
Cambridge Street and North Harvard Street	AM	0.5	1.3	1.8	35
	PM	0.5	1.3	1.8	35
Soldiers Field Road and Cambridge Street	AM	0.4	1.3	1.7	35
	PM	0.4	1.3	1.7	35
Soldiers Field Road and Western Avenue	AM	0.3	1.3	1.6	35
	PM	0.4	1.3	1.7	35
8-Hour					
Soldiers Field Road and Everett Street	AM	0.3	0.9	1.2	9
	PM	0.4	0.9	1.3	9
Cambridge Street and North Harvard Street	AM	0.5	0.9	1.4	9
	PM	0.5	0.9	1.4	9
Soldiers Field Road and Cambridge Street	AM	0.4	0.9	1.3	9
	PM	0.4	0.9	1.3	9
Soldiers Field Road and Western Avenue	AM	0.3	0.9	1.2	9
	PM	0.4	0.9	1.3	9

Note: CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.9.

3.7 Groundwater and Geotechnical Impacts

The Project site is located in an area of high groundwater. In addition, this area is underlain progressively by layers of fill, organic soils, clay, glacial till, and bedrock.

The Science and Engineering Complex will continue to use the pump system that infiltrates the groundwater that is picked up by the building's under slab. This water is currently recharged within a 24-inch perforated infiltration pipe surrounded by crushed stone along the east side of the foundation. The infiltration piping within this area is sized to recharge the groundwater that is pumped from inside the building.

The renovation of 114 Western Avenue will not be reusing groundwater but will be mitigating any stormwater runoff from the site through the use of underground infiltration chambers. Any stormwater runoff from the building will reuse the current closed connections to Western Avenue and will not be recharged into the ground.

3.8 Solid and Hazardous Waste

Solid waste generated by the Project will be collected and disposed of off-site by a licensed contractor as part of the University's existing campus wide waste program.

The work conducted in the SEC will be typical of most laboratories doing engineering and technology work. The work that will be conducted at the Project site is the very same profile of activity utilizing similar materials as is being conducted by SEAS on the Cambridge campus. It is likely that both the quantities and the number of different chemicals used in the work will be significantly lower than those used regularly on the Cambridge campus. For those that are present, the storage and use of these substances is rigorously regulated and monitored to mitigate any risks.

The SEC contains a below grade, 8-bay enclosed loading dock that will serve the various functions of the building. Among other purposes, the loading dock will be used to receive hazardous materials as well as ship out hazardous waste in support of the building's laboratory users.

Upon receiving hazardous materials into the building's loading dock, all material will be inventoried and then relocated to either the building's central storage rooms on the first level above grade or directly to laboratory users within 30 minutes of arrival. A single shipment of hazardous materials will be limited to quantities that would be permitted in a below grade control area. Based on the proposed use of the building, it is not anticipated that delivery of such a large quantity of hazardous materials would be necessary. Hazardous waste scheduled to be removed from the building will not be relocated to the loading dock until the waste removal truck has arrived. Similar to material being received, a single outgoing shipment of hazardous waste will be limited in size to that permitted in a single below grade control area. The frequency of hazardous waste removal will based upon satisfying this objective.

The enclosed loading dock will be provided with dedicated exhaust fans and gas detection sensors capable of maintaining acceptable levels of carbon monoxide and nitrogen dioxide in accordance with the International Mechanical Code and OSHA standards.

3.9 Noise Impacts

A sound level assessment of the SEC has been conducted by Epsilon Associates, Inc. to evaluate noise impacts from the Project within the surrounding community. The study included a baseline sound monitoring program to measure existing sound levels in the vicinity of the Project site, computer modeling to predict operational sound levels from mechanical equipment associated with the Project, and a comparison of future Project sound levels to applicable City of Boston Zoning District Noise Standards.

This analysis, which is consistent with BRA requirements for noise studies, indicates that predicted noise levels from the Project with appropriate noise controls will comply with both state and local regulations.

Noise Terminology

There are several ways in which sound (noise) levels are measured and quantified, all of which use the logarithmic decibel (dB) scale. The following section defines the noise terminology used in this analysis.

The decibel scale is logarithmic to accommodate the wide range of sound intensities observed in the environment. A property of the decibel scale is that the sound pressure levels of two distinct sounds are not purely additive. For example, if a sound of 50 dB is added to another sound of 50 dB, the total is only a three-decibel increase (53 dB), not a doubling (100 dB). Thus, every three-decibel change in sound level represents a doubling or halving of sound energy. Related to this is the fact that a change in sound level of less than three dB is generally imperceptible to the human ear.

Another property of the decibel scale is that if one source of noise is 10 dB (or more) louder than another source, then the total combined sound level is simply that of the louder source (i.e., the quieter source contributes negligibly to the overall sound level). For example, a source of sound at 60 dB plus another source at 47 dB is 60 dB.

The sound level meter used to measure noise is a standardized instrument[1]. It contains "weighting networks" to adjust the frequency response of the instrument to approximate that of the human ear under various conditions. One network is the A-weighting network (there are also B- and C-weighting networks), which most closely approximates how the human ear responds to sound as a function of frequency, and is the accepted scale used for community sound level measurements. Sounds are frequently reported as detected with the A-weighting network of the sound level meter in dBA. A-weighted sound levels emphasize the middle frequencies (i.e., middle pitched—around 1,000 Hertz sounds), and de-emphasize lower and higher frequencies.

Because the sounds in our environment vary with time, they cannot simply be represented with a single number. In fact, there are several methods used for quantifying variable sounds which are commonly reported in community noise assessments, as defined below.

- L_{eq}, the equivalent level, in dBA, is the level of a hypothetical steady sound that would have the same energy (i.e., the same time-averaged mean square sound pressure) as the actual fluctuating sound observed.
- L_{90} is the sound level, in dBA, exceeded 90 percent of the time in a given measurement period. The L_{90}, or residual sound level, is close to the lowest sound level observed when there are no obvious nearby intermittent noise sources.
- L_{50} is the median sound level, in dBA, exceeded 50 percent of the time in a given measurement period.
- L_{10} is the sound level, in dBA, exceeded only 10 percent of the time in a given measurement period. The L_{10}, or intrusive sound level, is close to the maximum sound level observed due to occasional louder intermittent noises, like those from passing motor vehicles.
- L_{max} is the maximum instantaneous sound level observed in a given measurement period.

By employing various noise metrics, it is possible to separate prevailing, steady sounds (the L_{90}) from occasional louder sounds (L_{10}) in the noise environment. This analysis treats all noise sources from the Project as though the emissions will be steady and continuous, described most accurately by the L_{90} exceedance level.

In the design of noise controls, which do not function quite like the human ear, it is important to understand the frequency spectrum of the noise source of interest. The spectra of noises are usually stated in terms of octave-band sound pressure levels, in dB, with the octave frequency bands being those established by standard (American National Standards Institute (ANSI) S1.11, 1986). To facilitate the noise-control design process,

1 *American National Standard Specification for Sound Level Meters*, ANSI S1.4-1983, published by the Standards Secretariat of the Acoustical Society of America, Melville, NY.

the estimates of noise levels in this analysis are also presented in terms of octave-band sound pressure levels. Octave-band measurements and modeling are used in assessing compliance with the City of Boston noise regulations.

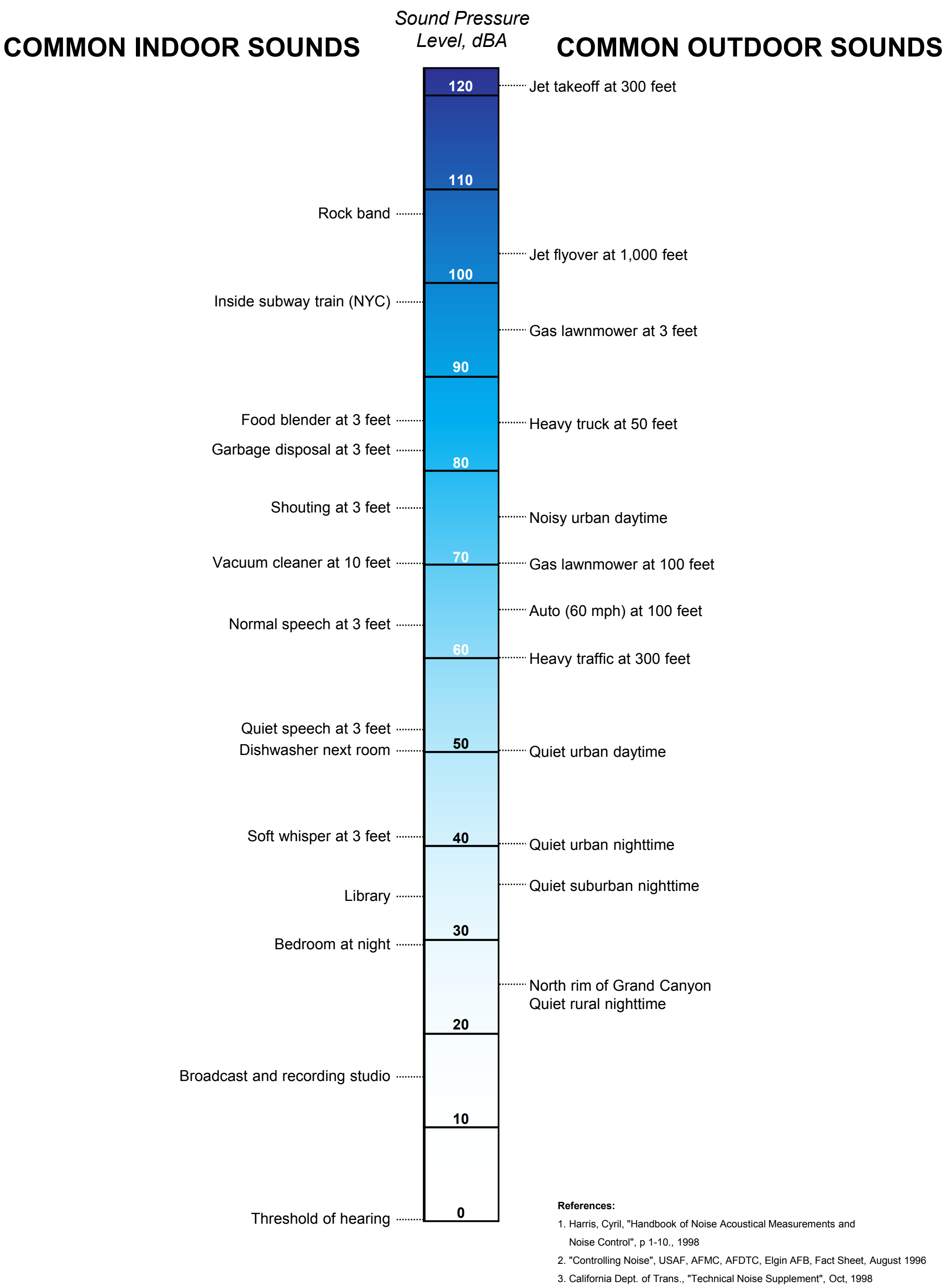


Figure 46: Common Indoor and Outdoor Sound Levels

Noise Regulations and Criteria

The City of Boston has both a noise ordinance and noise regulations. Chapter 16 §26 of the Boston Municipal Code sets the general standard for noise that is unreasonable or excessive: louder than 50 decibels between the hours of 11:00 p.m. and 7:00 a.m., or louder than 70 decibels at all other hours. The Boston Air Pollution Control Commission (APCC) has adopted regulations based on the city's ordinance - "Regulations for the Control of Noise in the City of Boston", which distinguish among residential, business, and industrial districts in the city. In particular, APCC Regulation 2 is applicable to the sounds from the proposed Project and is considered in this noise study.

Table 21 below presents the "Zoning District Noise Standards" contained in Regulation 2.5 of the APCC "Regulations for the Control of Noise in the City of Boston," adopted December 17, 1976. These maximum allowable sound pressure levels apply at the property line of the receiving property. The "Residential Zoning District" limits apply to any lot located within a residential zoning district or to any residential use located in another zone except an Industrial Zoning District, according to Regulation 2.2. Similarly, per Regulation 2.3, business limits apply to any lot located within a business zoning district not in residential or institutional use.

Table 21: City Noise Standards, Maximum Allowable Sound Pressure Levels

Octave-band Center	Residential Zoning District		Residential Industrial Zoning District		Business Zoning District	Industrial Zoning District
Frequency (Hz)	**Daytime (dB)**	**All Other Times (dB)**	**Daytime (dB)**	**All Other Times (dB)**	**Anytime (dB)**	**Anytime (dB)**
32	76	68	79	72	79	83
63	75	67	78	71	78	82
125	69	61	73	65	73	77
250	62	52	68	57	68	73
500	56	46	62	51	62	67
1000	50	40	56	45	56	61
2000	45	33	51	39	51	57
4000	40	28	47	34	47	53
8000	38	26	44	32	44	50
A-WEIGHTED (DBA)	**60**	**50**	**65**	**55**	**65**	**70**

Notes:

1. *Noise standards from Regulation 2.5 "Zoning District Noise Standards", City of Boston Air Pollution Control Commission, "Regulations for the Control of Noise in the City of Boston", adopted December 17, 1976.*
2. *All standards apply at the property line of the receiving property.*
3. *dB and dBA based on a reference pressure of 20 micropascals.*
4. *Daytime refers to the period between 7:00 a.m. and 6:00 p.m. daily, except Sunday.*

The Project site is located within the Allston Landing North Economic Development Area. Properties to the east, south and west of the Project site have been developed for commercial and light industrial/transportation purposes, while property to the north used to support residential use (Charlesview Apartments). The Harvard University Institutional Subdistrict lies further to the north (beyond Charlesview) and to the northeast.

The Boston Zoning District Noise Standard requires residential noise levels be limited to 60 dBA during the day (7:00 AM to 6:00 PM) and 50 dBA during nighttime hours (6:00 PM to 7:00 AM). This standard applies to the residential property located to the south along Windom Street and Seattle Street. Daytime residential noise limits are also applied to the educational building northeast of the Project along Western Avenue (Batten Hall).

Noise standards for business districts were applied to properties abutting the Project to the north, east, south, and west (including those located across public roads), which are presently developed for commercial use and owned by Harvard University. Noise standards for business uses require that noise levels be limited to 65 dBA at any time.

Existing Conditions Noise Measurements

Description of Baseline Noise Environment

An ambient noise level survey was conducted by Acentech, Inc. in April 2007 to characterize the "baseline" acoustical environment in the vicinity of the Project and was included in the DPIR for the 2007 Science Project. The chief source of ambient noise around the site is street traffic on Western Avenue (including heavy truck and bus traffic), Windom Street, Seattle Street, and in several parking lots near the site. Medium-weight trucks also contribute significantly to the traffic noise on Windom and Seattle Streets.

Other noise sources include wind, traffic noise from nearby highways including the Massachusetts Turnpike and Soldiers Field Road and associated access roadways, aircraft flyovers, and existing building mechanical systems.

Noise Measurement Locations

The selection of sound monitoring receptor locations was based upon a review of the current land uses in the Project area. These locations were reviewed and approved by the BRA prior to conducting the baseline noise measurement monitoring program. Baseline noise conditions were measured at five locations. Two baseline noise measurement locations were on Western Avenue, near the northwest and northeast corners of the site (to document noise conditions proximate to the former Charlesview Apartments); the third was on Windom Street to the east of the site. These locations were selected to characterize the existing noise conditions at the perimeter of the site. The fourth baseline noise measurement location was on Windom Street to the south of the site; and the fifth was on Seattle Street to the south of the site. These locations were selected to document ambient conditions closer to residential areas to the south of the Project.

Figure 47 shows the measurement locations superimposed on an aerial photograph of the existing site.

Measurement Methodology

Existing sound level measurements took place over a continuous period of 96 hours or more, timed to include at least two full weekdays and two full weekend days. Measurements were conducted from March 30 to April 4, 2007 at Locations 1, 4, and 5 and from April 11 to April 16, 2007 at Locations 2 and 3 (see Figure 47 for locations).

At each sound monitoring location, a microphone was placed at a height of approximately 3 feet above the ground, with clear exposure to nearby sound sources.

Each sound monitor sampled the A-weighted sound level (dBA) 32 times per second and recorded statistical information at 15-minute intervals. The information recorded included the overall energy average over the 15-minute period (L_{eq}), the level exceeded 1% of the time during that period (L_{01}), the level exceeded 10% of the time (L_{10}), the level exceeded 50% of the time (L_{50}), and the level exceeded 90% of the time (L_{90}).

Figure 47: Sound Level Measurement and Modeling Locations (Data Source: MassGIS)

Baseline Ambient Noise Levels

The results of the baseline sound measurement monitoring program were presented in the DPIR for the 2007 Science Project and summarized here.

Location 1: Western Avenue, Northwest corner of Project Site

Sound levels on the south side of Western Avenue near the northwest corner of the Project site ranged between 47 dBA (L_{90}) in the early morning hours to levels in the 80 to near 90 dBA range (L_{01}). The L_{90} (sound level in dBA exceeded 90 percent of the time, which is the sound level observed when there are no obvious nearby intermittent noise sources) was considerably higher during weekdays than during the weekend, when it often approached and sometimes exceeded 60 dBA. Sound levels at this location typically did not drop below 50 dBA until past midnight, and increased dramatically at about 6 AM each weekday.

Location 2: Western Avenue, Northeast of Project Site

Sound levels on the north side of Western Avenue near the former New England Depository Library building ranged between approximately 45 dBA (L_{90}) in the early morning hours to levels approaching 80 dBA (L_{01}). The L_{90} was generally highest during the early afternoon on weekdays. As with Location 1, sound levels at this location typically did not drop below 50 dBA until close to midnight, and increased at about 6 AM each weekday. The quieter nighttime sound levels (as compared to Location 1) may be attributable to higher levels of eastbound traffic on Western Avenue, as compared to westbound traffic.

Location 3: Windom Street, Southeast of Project Site

Sound levels on Windom Street ranged between approximately 44 dBA (L_{90}) in the early morning hours to levels in the low 70's dBA (L_{01}). The generally quieter conditions (as compared to Location 1 and 2) can be attributed to less traffic in the immediate vicinity.

Location 4: Windom Street, South of Project Site

Sound levels on Windom Street ranged between 41 dBA in the early morning hours to levels above 70 dBA (L_{01}). The L_{90} was considerably higher on weekdays than on weekends, perhaps reflecting traffic conditions or activity on the truck yard across the street.

Location 5: Seattle Street, South of Project Site

Sound levels on Windom Street were the quietest of all the locations monitored, ranging from below 40 dBA (L_{90}) to occasional levels over 80 dBA (L_{01}). The L_{90} generally ranged from 40 dBA to mid-50 dBA.

Future Conditions

Overview of Potential Project Noise Sources and Controls

The primary sources of continuous sound exterior to the Project, as described below, consists of power generating and heating, ventilation, and air conditioning (HVAC) equipment for the proposed energy supply facility (ESF), along with ventilation and electrical system equipment for the SEC.

Energy Supply Facility Sources

As stated in Chapter 2, for analysis purposes, this IMPNF/NPC assumes that the SEC includes a district energy facility. If the results of the resiliency evaluation and the broader look at district energy indicate that a different approach to providing energy to the SEC is appropriate, these analyses will be updated in the IMP Amendment.

For analysis purposes it was assumed that the energy facility will be served by a single 2.6 MW reciprocating engine generator with hot water heat recovery equipment located below-grade in the basement to be exhausted through a rooftop stack. Mechanical noise from the engine was assumed to be well-contained within the interior of the building and was not included in the model. Noise from the rooftop exhaust stack exterior to the building was modeled and assumed the noise reduction achieved through the interior ductwork and heat recovery unit would be comparable to a typical generator exhaust silencer.

Two 800 BHP hot water boilers and three 2,500 ton chillers planned for the energy facility will be located below-grade in the basement and, due to attenuation of these quieter sources from the building and ductwork, were not considered in the model.

A single roof-mounted induced-draft cooling tower consisting of up to five 2,500 ton cells is planned to provide condenser water for the chillers and was included in the model. Sound attenuation for the cooling tower assumed in the model can be achieved through some combination of an air outlet roof deck fan barrier wall, air inlet splash attenuators, or the selection of a quieter unit.

Intake and exhaust louvers provided on the face of the building to serve the energy facility will be selected and sized for low air velocity to reduce noise. Due to insertion loss from sound attenuators within the interior ductwork, these louvered openings were not considered major noise source and were not considered in the model.

Science Building Sources

Ventilation for lab areas will be provided by a custom-fabricated heat recovery unit located on the roof adjacent to the penthouse. The unit, which features six centrifugal high plume dilution lab exhaust fans ducted through vertical stacks of approximately 30 feet, will be fitted with discharge sound attenuators and was included in the model.

Non-lab, kitchen, and general building ventilation will be provided by several exhaust fans located within the rooftop penthouse. These fans, assumed to discharging vertically through stacks above the penthouse, were included in the model.

Several air handling units serving both lab and non-lab areas of the building will be located in a basement mechanical room with outdoor air ducted through louvers mounted on the exterior of the building. As with the ESF intake and exhaust louvers, the outdoor air intake louvers will be sized for medium velocity to reduce noise and will utilize sound traps to minimize equipment noise through the ductwork. As such, the air handling units are not anticipated to be a primary source of exterior noise and were not included in the model.

Electrical backup will be provided by one 750 kW emergency diesel generator and one 1.5 MW natural gas fired standby generator, both located on the roof within a dedicated sound attenuating enclosure. Exhaust stacks for each unit, fitted with critical grade silencers, will terminate 10 feet above the custom enclosure which will be of insulated, double-wall construction designed for nominal 30 dBA attenuation.

Other secondary noise sources will either be enclosed within the building interior, located within the solid-walled rooftop penthouse or are assumed to have sound levels 10 dBA lower than the primary sources of noise, and were not considered in this analysis to contribute significantly to the overall sound level. These include several smaller heat recovery units, ventilation fans, compressors, condensers, and pumps. Smoke exhaust, stair pressurization, and elevator pressurization fans assumed to be for emergency-use only and not subject to regular testing were not included in the model as steady sources of continuous noise.

A tabular summary of the modeled mechanical equipment proposed for the Project is presented in Table 22. Sound power level data for each unit, as provided by the manufacturer or calculated from provided sound pressure level data, is presented in Table 23. Sound power levels of those units for which data was not provided were assumed based on data for similar or representative equipment based on presently planned equipment capacities. Noise reduction levels assumed in the model are provided in Table 24. The approximate locations of the mechanical equipment were provided by the Project team in a preliminary roof plan.

Table 22: Modeled Noise Sources

Noise Source	Quantity	Location	Size/Capacity per Unit
Cooling Tower	1	Roof	2,500 ton per cell
Cogen Diesel Engine	1	Roof	2,550 kW
Lab Exhaust Fan	6	Roof	50,000 CFM
Non Lab Exhaust Fan	2	Penthouse Roof	25,000 CFM
Kitchen Exhaust Fan	1	Penthouse Roof	N/A
General Exhaust Fan	6	Penthouse Roof	2,000 – 22,000CFM
Emergency Diesel Generator	1	Roof	750 kW
Standby Gas Generator	1	Roof	1,500 kW

Table 23: Modeled Sound Power Levels per Unit

Noise Source	Broad-band	32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
Cooling Tower[1]	105[8]	114	114	109	104	102	99	96	96	92
Cogen Exhaust Stack[2]	127	117	127	136	125	123	122	119	114	99
Lab Exhaust Fan[3]	92[8]	101	101	103	91	88	86	80	76	72
Non Lab Exhaust Fan[4]	91[8]	101	101	102	91	88	84	81	75	72
Kitchen Exhaust Fan[5]	87[8]	96	96	98	86	83	79	75	70	66
General Exhaust Fan[5]	87[8]	96	96	98	86	83	79	75	70	66
Emergency Diesel Generator – Open Mechanical[6]	116[8]	108	108	113	112	111	113	109	105	100
Emergency Diesel Generator – Open Exhaust[6]	118[8]	82	82	108	118	114	113	112	103	84
Standby Gas Generator – Open Mechanical[7]	127[8]	130	130	139	130	121	115	115	113	116
Standby Gas Generator – Open Exhaust[7]	128[8]	119	119	134	130	122	120	121	121	119

Notes:
1. *BAC Model 5FT-2833-125-P7FM 5-Cell Cooling Tower, or similar*
2. *Jenbacher J616 2550 kW Diesel Engine (Open Exhaust), or similar*
3. *Assumed Greenheck Model AFDW-21, 48,000 CFM, or similar*
4. *Assumed Greenheck Model 44-BISW-21, 25,000 CFM, or similar*
5. *Assumed Greenheck Model 36-BISW-21, 15,000 CFM, or similar*
6. *Assumed Caterpillar C27 750 kW Diesel Generator Set, or similar*
7. *Assumed Caterpillar 3512C 1500 kW Diesel Generator Set, or similar*
8. *No data available in 32 Hz band. Assumed equal to 63 Hz band.*

Table 24: Modeled Noise Reduction Levels

Noise Source	32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
	dB	dB	dB	dB	dB	dB	dB	dB	dB
Exhaust Silencer[1]	6[4]	12	31	38	32	26	21	21	21
Generator Enclosure[2]	11[4]	22	18	26	40	39	43	45	47
Cooling Tower Noise Reduction[3]	1	2	5	5	5	10	10	15	15

Notes:

1. Assumed typical Silex JB-6 Critical Grade Silencer, or similar. Applied to Emergency Diesel Generator (Exhaust) and Standby Gas Generator (Exhaust).

2. Assumed typical Pritchard Brown '30-dBA' enclosure, or similar. Applied to Emergency Diesel Generator (Mechanical) and Standby Gas Generator (Mechanical).

3. Assumed noise reduction spectrum applied to Cooling Tower.

4. No data available in 32 Hz band. Assumed equal to half of 63 Hz band.

Noise Modeling Methodology

Noise impacts from mechanical equipment associated with the Project were predicted using Cadna/A noise calculation software (DataKustik Corporation, 2005). This software, which uses the ISO 9613-2 international standard for sound propagation (Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation), offers a refined set of computations accounting for local topography, ground attenuation, drop-off with distance, barrier shielding, diffraction around building edges, reflection off building facades, and atmospheric absorption of sound from multiple noise sources.

An initial analysis considered all of the mechanical equipment without the emergency and standby generators running to simulate typical nighttime operating conditions at nearby receptors. A second analysis combined the mechanical equipment and both the emergency and standby generators to reflect worst-case daytime conditions during brief, routine, testing of the generators when ambient levels are higher. It is assumed that nighttime operation of the generators would only occur during emergency situations when much or all of the remaining mechanical equipment would not be operating.

Eleven modeling locations with a height of 1.5 meters above-grade were included in the analysis representing the nearest noise-sensitive residential and commercial receptors as shown in Figure 47.

Noise Modeling Results

The predicted sound levels from typical nighttime operation, presented in Table 1-5, from all mechanical equipment operating simultaneously (except the emergency and standby generators) are expected to range from 37 to 48 dBA at nearby receptors (42 to 48 at the closest residences). Table 26 presents predicted sound levels from all mechanical equipment including the emergency and standby generators during routine daytime testing periods which are expected to range from 42 to 56 dBA at nearby receptors (48 to 53 at the closest residences).

Results of this evaluation demonstrate that sound levels from Project operation are anticipated to fully comply with the City of Boston broadband and octave-band noise limits described in Table 21, as shown in Table 25 and Table 26. Additionally, for the majority of the time Project-only sound levels are predicted to remain approximately equal to or below the existing background sound levels in the area, which already often exceed many of the City of Boston limits without any contribution from the Project. As such, this analysis indicates that the proposed Project can operate without significant impact on the existing acoustical environment.

Table 25: Modeled Project-Only Sound Levels – Typical Nighttime Operation (No Emergency or Standby Generators)

Receptor ID	Land Use	Period	Broad-band (dBA)	Sound Pressure Level (dB) per Octave-band (Hz)								
				32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
R1	Residential	Night	48	66	64	60	48	44	38	33	26	16
R2	Residential	Night	48	65	63	61	48	44	38	32	24	12
R3	Business	Night	46	63	61	59	46	41	33	27	18	5
R4	Educational	Night[1]	44	60	58	58	44	39	35	27	16	0
R5	Business	Night	37	56	53	51	36	30	23	16	6	0
R6	Business	Night	44	61	59	57	45	40	34	29	18	0
R7	Residential	Night	42	59	57	55	43	38	32	26	14	0
R8	Residential	Night	43	59	57	55	43	39	33	27	15	0
R9	Business	Night	45	62	61	58	45	41	35	30	21	3
R10	Business	Night	47	65	63	59	47	43	37	32	25	15
R11	Business	Night	41	62	60	49	43	38	30	27	20	8
City of Boston Limits	**Residential**	**Night**	**50**	**68**	**67**	**61**	**52**	**46**	**40**	**33**	**28**	**26**
	Business	**Night**	**65**	**79**	**78**	**73**	**68**	**62**	**56**	**51**	**47**	**44**
	Industrial	**Night**	**70**	**83**	**82**	**77**	**73**	**67**	**61**	**57**	**53**	**50**

Notes:
1.Assumed daytime use only.

Table 26: Modeled Project-Only Sound Levels – Typical Daytime Operation + Routine Testing (Emergency and Standby Generators)

Receptor ID	Land Use	Period	Broad-band (dBA)	Sound Pressure Level (dB) per Octave-band (Hz)								
				32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
R1	Residential	Day	48	67	64	61	48	44	38	33	26	16
R2	Residential	Day	49	66	64	62	48	44	38	32	24	12
R3	Business	Day	47	65	61	61	46	41	33	27	19	6
R4	Educational[1]	Day	46	64	59	60	45	39	35	27	16	0
R5	Business	Day	45	65	55	60	41	31	25	20	10	0
R6	Business	Day	55	69	62	70	54	41	37	36	29	10
R7	Residential	Day	52	67	60	67	51	39	35	34	26	0
R8	Residential	Day	53	67	60	68	52	40	35	33	25	1
R9	Business	Day	56	70	63	71	55	43	39	38	32	14
R10	Business	Day	55	71	65	70	54	44	39	39	34	20
R11	Business	Day	42	63	60	54	43	38	30	27	20	8
City of Boston Limits	**Residential**	**Day**	**60**	**76**	**75**	**69**	**62**	**56**	**50**	**45**	**40**	**38**
	Business	**Day**	**65**	**79**	**78**	**73**	**68**	**62**	**56**	**51**	**47**	**44**
	Industrial	**Day**	**70**	**83**	**82**	**77**	**73**	**67**	**61**	**57**	**53**	**50**

Notes:
1.Compared to daytime 'residential' limits.

Conclusions

Baseline noise levels were measured in the vicinity of the Project site and were compared to predicted noise levels based on information provided by the manufacturers of representative mechanical equipment or estimated from the equipment's capacity. With appropriate mitigation, the Project is not expected to introduce significant outdoor mechanical equipment noise into the surrounding community.

Results of the analysis indicate that typical nighttime noise levels from the Project as well as noise levels from routine daytime testing of the emergency generator are expected to remain well below the City of Boston Noise Zoning requirements. It should be noted that the existing ambient background levels at many locations immediately surrounding the Project already often exceed the City of Boston limits without any contribution from the Project. The results presented indicate that the Project is not anticipated to significantly impact the existing acoustical environment.

At this time, the mechanical equipment and noise controls are conceptual in nature and, during the final design of the Project, will be specified to meet the applicable City of Boston noise limits. Additional mitigation may include the selection of quieter units, screening walls, mufflers, or equipment enclosures as needed.

3.10 Construction Logistics

Over the past several years, Harvard has worked with the Boston Transportation Department to develop Institution-wide guidelines for construction management. A project-specific Construction Management Plan (CMP) based on these guidelines will be submitted to the Boston Transportation Department (BTD) for review and approval prior to issuance of a building permit. The CMP will identify construction mitigation measures and define truck routes which will help in minimizing the impact of trucks on local streets.

Transportation and Parking

As currently proposed, construction trucks accessing the site will arrive via the Mass. Turnpike to the Soldiers Field Road access road to Western Avenue and will depart using the same roadways. These trucks will be prohibited from using local neighborhood streets to arrive at or depart from the site. The construction team will manage deliveries to the site during morning and afternoon peak hours in a manner that minimizes disruption to traffic flow on adjacent streets. The construction team will provide subcontractors and vendors with Construction Vehicle & Delivery Truck Route Brochures in advance of construction activity. "No Idling" signs will be included at the loading, delivery, pick-up and drop-off areas.

To reduce vehicle trips to and from the construction site, construction workers will be encouraged to use non-auto modes, but recognizing that many workers will choose to drive to the site, the University will provide parking for construction workers on the former Charlesview site which will discourage parking on neighborhood streets. The general contractor will work aggressively to ensure that construction workers are well informed of the public and Harvard-owned transportation options serving the area.

Staging

Construction staging and material laydown will occur on site or at construction support areas at the former Charlesview site and/or the east side of the existing foundation on the former Sears site.

Communication

In an effort to have clear, open and up-to-date communications with the neighborhood, the Project will develop a communications plan consistent with other Harvard projects in Allston. A 24-hour hotline will be established upon commencement of construction activity. In addition, when construction commences, a website will provide updates on construction as well as provide Harvard with feedback from the community. A mitigation staff and protocol will be established and be available to address all Project issues. Emergency contacts will be maintained for immediate follow-up on emergency situations. Additionally Harvard will direct the Construction Manager to install community bulletin boards around the perimeter of the site. These bulletin boards will be maintained with current activity and schedule information.

Work Hours

Typical construction hours will be from 7:00 a.m. to 6:00 p.m., Monday through Friday, with most shifts ordinarily ending at 3:30 p.m. No substantial sound-generating activity will occur before 7:00 a.m. If longer hours, additional shifts, or Saturday work is required, the construction manager will submit a work permit request to the Inspectional Services Department and the Mayor's Office of Neighborhood Services in advance. Notification should occur during normal business hours, Monday through Friday.

Environmental Mitigation During Construction

Harvard and its contractor will employ a number of mitigation measures to minimize any impacts during construction, including:

- Conducting preconstruction surveys on adjacent properties prior to the start of construction based on a predetermined distance from the project;
- Installing noise and dust monitors around the perimeter of the site;
- Using wetting agents on areas of exposed soil on a scheduled basis;
- Evaluating means and methods for performing work at the site for potential vibration impacts on nearby structures and utilities; and
- Segregating materials that may be recycled.

3.11 Rodent Control

A rodent extermination certificate will be filed with the building permit application to the City. Rodent inspection monitoring and treatment will be carried out before, during, and at the completion of all construction work for the proposed Project, in compliance with the City's requirements. Rodent extermination prior to work start-up will consist of treatment of areas throughout the site. During the construction process, regular service visits will be made.

3.12 Project Sustainability

Science and Engineering Complex

The Science and Engineering Complex will be an exemplary project of integrated sustainability, in both quantitative as well as qualitative terms. In quantitative terms, the SEC project aspires to achieve, at a minimum, LEED for Building Design and Construction (LEED-BD&C) Version 4 Gold certification, a significant achievement for an energy intensive laboratory building. The SEC project is being designed to comply with the Harvard Green Building Standards, which is a set of process oriented requirements that go above and beyond those of LEED certification. To achieve these goals the SEC project will feature high-performance envelopes, highly efficient climate, ventilation, and heat recovery systems, and intelligent program zoning to ensure that air circulation, a major contributor to energy use, is minimized while optimizing occupant comfort and safety. The SEC project will serve as a model of sustainable laboratory operations, integrating facility management and staffing discussions into the design phase to ensure successful long-term operation.

In qualitative terms, the SEC will be a model for an approach to sustainability that emphasizes the integration of architectural spaces for communication and collaboration with access to daylight, natural ventilation and comfort. Collaborative space in a variety of types and scales will be woven into the building in ways that support informal discussion outside of proper laboratory spaces and that optimizes opportunities for interdisciplinary interaction. In a building of such considerable scale, the individual should be given considerable control over their environment, to open a window, to raise and lower the lights, to fine-tune temperature, and to occupy spaces appropriate to various tasks and group sizes. Fresh air and daylight will be combined with intelligent programming to create multiple climate zones appropriate to space usage, which link occupants to natural environmental conditions and improve health, productivity, and well-being.

As the LEED scorecard attached as Appendix D shows, the design team anticipates earning at least 57 points based on the SEC project design. There are an additional 43 points in the “Maybe” column, and the design team anticipates that many of these credits will be earned in addition to the 57 points listed in the “Yes” column.

114 Western Avenue

Although the existing building at 114 Western Avenue will not undergo major renovations, there will be improvements related to sustainability. The 114 Western Avenue component of the project is targeting to achieve at a minimum LEED Version 4 Gold certification and it is being designed to comply with the Harvard Green Building Standards.

Additional Materials

In addition to the LEED Scorecard included in Appendix D, Appendix E includes Climate Change Resiliency Checklists.

3.13 Urban Design

The design of the Science and Engineering Complex reinforces the key principles and goals of the IMP. While the building is institutional and researched-focus by nature, the design approach reflects a broader commitment to the larger Harvard, Allston, and Boston Community, as well as long term sustainability goals consistent with the IMP.

The design of the SEC lifts the majority of the laboratory programs two stories above the street, focusing the ground and second floor on programs and creative activities to activate Western Avenue and connect the public realm to the innovation of the SEAS community. The façade fronting Western Avenue is lined with program that contributes to street life, including a retail space and a maker/3d printing space to showcase creative enterprises and provide activity outside normal business hours.

The street frontage is broken down to address the pedestrian-scale by three recessed entrances which are double-height, flooded with natural light, and activated by exhibition space and other social spaces such as a cafe and a library. In addition to the middle entrance fronting Western Avenue, entrances are located to anchor the two ends of the site, on the west relating to Barry's Corner, and to the east relating more to the Harvard Business School campus.

The streetscape is based on the City of Boston's Complete Street Guidelines and the principles of the IMP. Materials consistent with these guiding documents will be used to create a cohesive street environment. Pervious materials will be used to manage all stormwater on site. Gathering spaces will be developed near the entrances and will include benches, bicycle parking, trash/recycling/composting receptacles, lighting, etc. to create a vibrant connection between building occupants and the Allston community.

The south side of the SEC engages the residential scale of the adjacent Allston neighborhood and provides open space consistent with the goals of the IMP and planned Greenway south of the site. The south side of the building is terraced, which creates a finer grain that relates to the quieter residential scale of the neighborhood beyond.

The courtyard landscape design creates generous and varied opportunities for use on paved and soft surfaces. The scale of spaces is appropriate for the typical daily user loads while allowing for large events like graduation. The design makes visible the systems and qualities of the lost landscape of the greater Boston area and the Allston salt marshes through progressive stormwater management and collection.

Figure 48: View from North of Western Avenue

Figure 49: View from Western Avenue East

Landscape and Public Realm Improvements

The central courtyard of the Science and Engineering Complex site will comprise a green landscape open to the public. The landscape has been designed to encourage walking and sitting in areas immediately adjacent to the Project. Further, the landscape plan has been designed to complement the series of green corridors and open spaces proposed as part of the IMP, including connections to Rena Park and Ray Mellone Park to the southwest.

The landscape approach provides an opportunity to define a major new outdoor space. It will coordinate with the overall open space master plan for Allston by reinforcing connections from the to-be-designed and built Greenway and the SEC open space. There will be a strong pedestrian connection through the SEC building at grade, linking the pedestrian realm along Western Ave with the garden space.

The landscape design will accommodate a variety of outdoor seating options. The approach will allow for casual gathering as well as larger formal events. Overall site strategies include study of the potential for future flooding. The outcomes of this study will be used to support the Project's comprehensive climate resiliency strategy.

Figure 50: Long Term Open Space Network

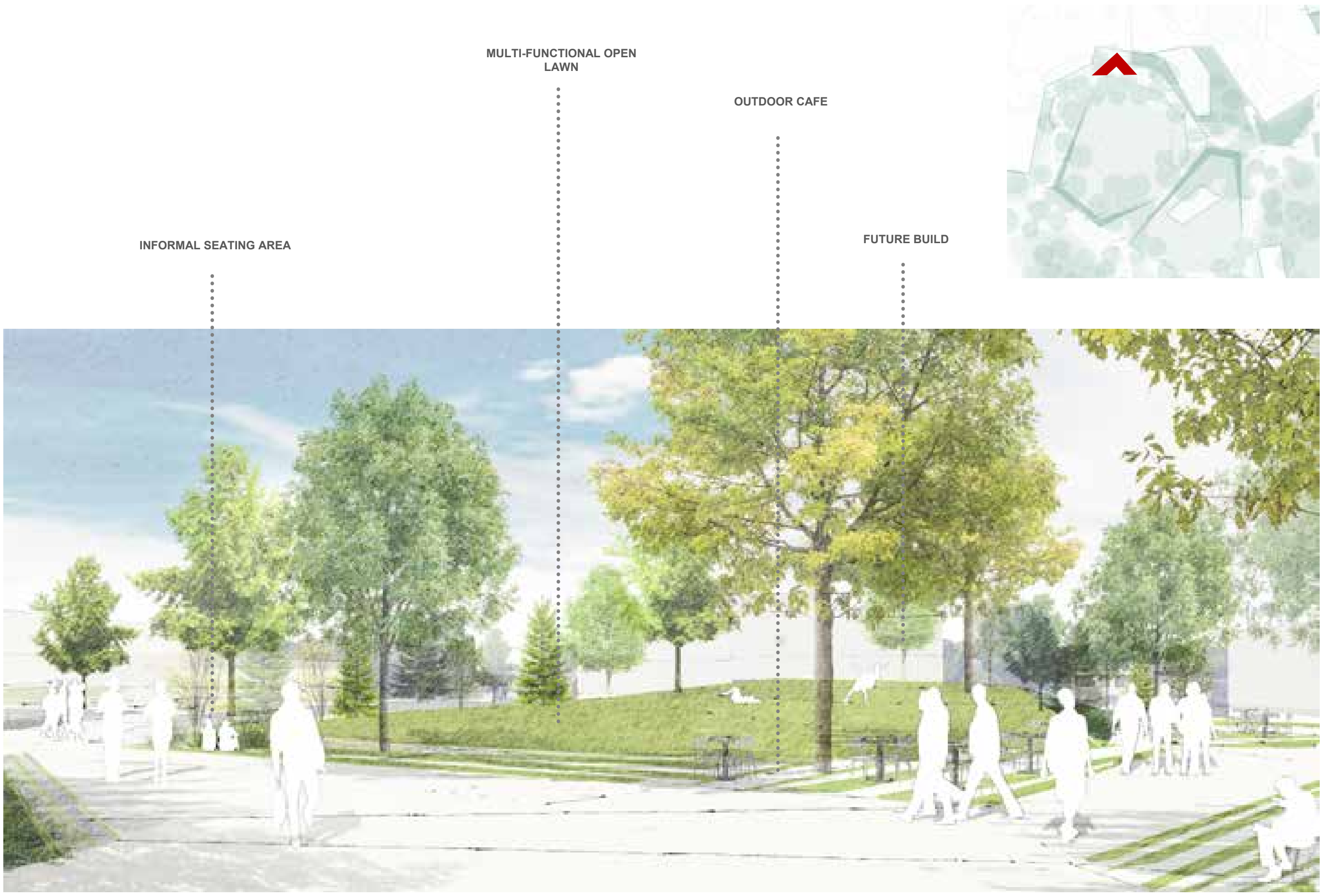


Figure 51: Courtyard Landscape

Figure 52: Landscape Approach

3.14 Historic Resources

The proposed SEC site is located on previously disturbed land. No previously identified archaeological resources are located within the Project site. No impacts to archaeological resources are anticipated.

There will be minimal, if any, visual impacts to historic resources, and no mitigation for impacts to historical resources is necessary or proposed.

3.15 Infrastructure (Water, Sewer, Stormwater)

The existing building at 114 Western Avenue is currently served by Boston Water and Sewer Commission (BWSC) systems and the renovation of that building will not result in any changes to or increase in demand of those systems. Based on initial investigations, the existing infrastructure systems in the area are able to accept the incremental increase in demand associated with the development and operation of the Project.

The subsequent design processes for the Project will include the required engineering analyses and will adhere to applicable protocols and design standards, ensuring that the Project is properly supported by, and in turn, properly uses the City's infrastructure. Detailed design of Harvard's utility systems will proceed in conjunction with the design of the Project and its interior mechanical systems.

The systems discussed below include those owned or managed by the BWSC, private utility companies, and on-site infrastructure systems. There will be close coordination among these entities and with the Project team during subsequent reviews and design process.

Energy conservation measures will be an integral part of the Project's infrastructure design. The buildings will employ energy-efficient and water-conservation features for mechanical, electrical, architectural, and structural systems, assemblies, and materials where possible. A preliminary LEED checklist is included as Appendix D.

Wastewater

Existing Wastewater

Local sanitary sewer service in the City of Boston is provided by the BWSC. Sewage generated in the Project area will be conveyed to the Massachusetts Water Resources Authority (MWRA) facility on Deer Island via the MWRA South Charles Relief Sewer and the Boston Main Drainage Tunnel.

Demand/Use

The IMP included a detailed analysis of sewage generation and water demand. The IMP reported conservatively that the Project will generate approximately 59,500 gallons per day (gpd) of sewage for the building program. Generation rates from the Massachusetts State Environmental Code (Title 5) were used to support the development of these preliminary sewage generation estimates.

Proposed Connection

There are three existing sewer service stubs located along the northern Western Avenue side of the site (at STA 6+94.59, STA 7+01.57, and STA 9+11.26 respectively). The SEC will connect to these existing sewer connections, also use, an additional 6-inch connection. The SEC will connect the 8-inch sewer into the proposed sewer main to be located within Stadium Way to the east.

Domestic Water and Fire Protection

Existing Water Supply System

The Project is located in the Northern Low service area of the BWSC public water supply service areas. The three streets abutting the Harvard Business School campus: Soldier's Field Road, North Harvard Street, and Western Avenue are served by 12-inch northern low service mains. The Project is expected to be fed by either a connection to Harvard Business School's internal water system or the 12-inch BWSC main along Soldier's Field Road.

Domestic water demand is based on estimated sewage generation with an added factor of 10 percent for consumption, system losses, and other use. Based upon sewage generation rates calculated previously, and as reported in the IMP, the Project will require approximately 65,450 gallons of water per day.

Proposed Connection

There is an existing water line stubbed within the foundation, an existing stubbed 8-inch domestic service line, and an existing stubbed 10-inch fire protection line along the northern foundation wall with service to Western Avenue. The SEC will connect to these existing water connections and connect a new 10-inch fire protection line and new 8-inch water service line to the proposed water main to be located within Stadium Way to the east.

There will not be any future water connections (domestic or fire protection) needed for any subsequent site development as these connections will be stubbed within the building for future use.

Domestic water service connections required by the Project will meet the applicable city and state codes and standards, including cross-connection backflow prevention.

Compliance with the standards for the domestic water system service connections will be reviewed as part of BWSC's Site Plan Review Process. The review includes but is not limited to sizing of domestic water and fire protection services, calculation of meter sizing, backflow prevention design, and location of hydrants and siamese connections to conform to BWSC and Boston Fire Department requirements.

Stormwater Management

The stormwater management controls will be established in compliance with BWSC standards and the DEP's Stormwater Management Policy. In addition, as part of the ongoing design and engineering processes, the design team is investigating various mitigation options for stormwater that includes retention and reuse. The mitigation measures may include directing stormwater to the landscape for natural mitigation, treatment through biological processes such as treatment swales and/or water features, and infiltration back to the natural soils.

The Project is expected to improve runoff water quality through treatment and infiltration. The existing drainage pattern, which consists of closed pipe drainage discharging to the Charles River, will be matched in the future condition.

Existing Conditions

Stormwater runoff from the SEC roof will be collected in a series of underground roof leaders and discharged to the surface. As part of Project, the roof of the garage will be vegetated so that stormwater can be routed through Best Management Practices (BMPs) (e.g. bio-retention / rain gardens) to collect, treat, infiltrate and direct stormwater runoff into fiberglass rainwater reuse tanks, located within the building structure. Area drains with sumps and hoods also collect runoff throughout the site and connect into the proposed closed drainage system made up of drain manholes and corrugated plastic pipe. Runoff from these area drains runs through a proposed water quality unit to remove at least 80% total suspended solids before being discharged to fiberglass water reuse tanks.

Water from the tank will be fed back into the SEC to be reused inside the building. Overflows from the water reuse tank will be directed back into the 72-inch stormwater drain line located to the south of the site.

Stormwater runoff from the south side of the SEC will be collected by way of a trench drains and piped through a proposed water quality unit to remove at least 80% total suspended solids before being discharged into the 72-inch stormwater drain line located to the south of the site.

LEED V4 Goals for Stormwater

Construction activity produces disturbed soils, erosion, and sedimentation. A sustainable practice during construction includes implementing erosion and sedimentation controls to contain sediment on site, thereby preventing it from entering adjacent properties, municipal storm drainage systems, wetlands, and water bodies. Erosion and sedimentation controls include silt fencing, straw bales and wattles, inlet protection at catch basins and area drains, temporary sediment basins, and temporary stabilization through the use of seeding and mulching. LEED V4 Sustainable Site (SS) Prerequisite, Construction Activity Pollution Prevention, requires that the project create and implement an Erosion and Sedimentation Plan, also referred to as a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP outlines the Contractor's minimum responsibilities for onsite erosion and sedimentation control.

The intent of the rainwater harvesting system is to capture stormwater runoff from the roof, store it in a tank, and reuse it for flush fixtures, irrigation, and/or cooling tower make-up water. These systems normally utilize potable water for a non-potable use. The rainwater harvesting system will provide a source of non-potable water for these systems, thereby reducing the building's potable water consumption and water bills. It also reduces the volume of stormwater that is discharged directly to the municipal system and water bodies. LEED V4 Credits that the project can potentially achieve through the implementation of a rainwater harvesting system include Rainwater Management under Sustainable Sites, and Water Efficiency (WE) Credits including Outdoor and Indoor Water Use Reduction for both the pre-requisite and standard Credit achievement. A stormwater management system that mitigates peak runoff rates, promotes recharge to groundwater, and produces a high level of water quality helps to sustain our rivers, lakes, wetlands, and the ecosystems in these environments. The stormwater management system for the new building will incorporate deep sump catch basins with hoods, area drains with sumps, water quality structures and infiltration Best Management Practices (BMPs) to collect, treat, and infiltrate stormwater runoff.

Low impact development (LID) techniques, including water quality swales, bioretention basins, and infiltration trenches will be incorporated into the design where feasible. The stormwater management system for the new building is attempting to meet the minimum requirements for LEED V4 Rainwater Management and Water Efficiency Credits stated above. Since the system collects and recharges up to the 100-year storm event, thereby treating essentially all storms, the project may be eligible for an Innovation in Design point for exemplary performance.

Heating and Cooling

Harvard's facilities contained within the IMP Area derive their heating and cooling energy supplies from building specific (stand-alone) equipment as well as from Harvard-owned district energy systems. Building specific systems include equipment such as natural gas fired boilers, domestic hot water heaters, building-scale chillers, and cooling towers. Harvard-owned district energy systems produce and deliver steam (or hot water), electricity, and chilled water on a larger scale to multiple facilities on campus. Additionally, Harvard purchases both electricity and natural gas from local distribution companies (e.g. Eversource and National Grid) and provides service to facilities through direct connections to the utility or through Harvard-owned distribution networks serving multiple facilities.

It has been Harvard's intention to develop a strategy to provide hot water for heating, chilled water for cooling, and electricity for building power for the projects associated with the Ten-Year IMP along with the Science and Engineering Complex through the installation of district energy facilities located in the IMP Area. This strategy aggregates heating, cooling, and electric loads from multiple buildings and supplies them from district systems. The district system allows Harvard to maximize environmental control, optimize efficiency at scale, and incorporate attributes such as combined heat and power (CHP) and resilient microgrids.

For planning purposes this IMPNF/NPC assumes that the SEC includes the district energy facility described in the following sections. If the results of the resiliency evaluation and the broader look at district energy described previously indicate that a different approach to providing energy to the SEC is appropriate, these analyses will be updated in the IMP Amendment.

It was assumed that the energy facility would be generating hot water and electricity through CHP systems, such as reciprocating engines with heat recovery units, as well as hot water produced with conventional boilers. Chilled water would be generated by high efficiency electric centrifugal chillers. Additionally, a new electric service from Eversource would connect to the new Harvard electrical switching station that would, in turn, supply electricity to the Science and Engineering Complex. All systems would be designed to supply multiple Harvard buildings in the future, with equipment and distribution infrastructure installed in phases.

While exact technologies and the selection and sizing of equipment has yet to be finalized, the following equipment is described for planning purposes. Note that some smaller scale equipment may be installed initially, depending upon the timing and scale of projected loads.

- *Electric Power:* Electrical Switching Station: 10MVA, 13,800 volt incoming supply, multiple 13,800 volt circuits leaving. The Medium Voltage Switchgear Room (MVSR) would be the above grade connection point for all incoming utility power and on-site generation at the energy supply facility. The MVSR would consist of four distinct switchgear lineups totaling 26 sections of metal-clad switchgear. These switchgear lineups would be connected in a ring configuration and rated at 13.8kV, 1200A, 40kAIC. A redundant 125V DC battery system, switchgear relays, and eyewash station would be located in a separate room adjacent to the MVSR.
- *Cooling:* Chilled water would be generated by electric centrifugal chillers driven by variable frequency drives (VFDs). Three chillers (2500 tons max) would be included in the initial installation, and space for two additional chillers and associated auxiliaries would be reserved for future use. Chilled water would be supplied at 42ºF and returned at 58ºF. A variable primary pumping system would be utilized to distribute the chilled water to campus. Chiller condenser water would pass through counter flow, field erected, evaporative cooling towers driven by VFDs that are located on the roof of the building. Three cooling towers would be included in the initial installation, and space for two additional cooling towers and associated auxiliaries would be reserved for future use. Radiators would also be located on the roof to provide cooling for the reciprocating engines. One radiator would be included in the initial installation, and space for an additional radiator and associated auxiliaries would be reserved for future use. Condenser water would be supplied at 85ºF and returned at 95ºF. Constant speed condenser water pumps would be utilized to circulate the condenser water through the chillers and cooling towers. A free cooling heat exchanger and free cooling pump would also be located within the energy supply facility, which would provide the ability to produce chilled water without operating a chiller when wet bulb temperatures are low.
- *Combined Heat and Power/Heating Hot Water:* CHP Units - 2.6 MW units, boilers - 800 HP. Hot water would be generated by a CHP system consisting of a reciprocating engine and heat recovery unit (HRU) along with fire-tube boilers. Two hot water boilers would be included in the initial installation, and space for a third hot water boiler and associated auxiliaries would be reserved for future use. Similarly, one reciprocating engine and HRU would be included in the initial installation, and space for a second reciprocating engine, HRU, and associated auxiliaries would be reserved for future use. Hot water would be produced at 180ºF and returned at 150ºF. Centrifugal hot water pumps driven by VFDs would be utilized to distribute the hot water to campus.
- *Auxiliary Systems:* Auxiliary systems would be included to support the operation of the energy supply facility. Those systems include but are not limited to compressed air, water treatment, plumbing, and fire protection (integrated with building fire protection system). A distributed control system (DCS) would also be installed.

National Grid would need to install natural gas supply piping to the site and a metering station. The energy facility would also have associated energy distribution infrastructure (e.g. piping, electrical conduit/cables, etc.) that would be routed to future Harvard buildings and interconnected with future Harvard infrastructure and energy systems. Distribution infrastructure is expected to be located primarily on Harvard property; however there would likely be instances where public ways would need to be crossed.