ANALYSIS TO SUPPORT PETITIONS BEFORE THE
ENERGY FACILITIES SITING BOARD
EFSB 22-03 and DPU 22-21

Greater Cambridge Energy Program

Cambridge, Somerville & Boston

Volume I

Submitted to:
Energy Facilities Siting Board
One South Station
Boston, Massachusetts 02114

Submitted by:
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Westwood, MA 02090

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In Association with:
Keegan Werlin, LLP

March 10, 2022

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March 10, 2022

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Executive Summary

EXECUTIVE SUMMARY

NSTAR Electric Company d/b/a Eversource Energy proposes to construct eight new, underground 115-kilovolt electric transmission lines housed in five duct banks, totaling approximately 8.3 miles, a new 115/14-kV substation in Cambridge, and other ancillary modifications to existing substation facilities in the Cities of Cambridge, Somerville, and the Allston/Brighton section of Boston. The "Greater Cambridge Energy Program" or "Project" is located in the Cities of Cambridge, Boston, and Somerville and will connect to Eversource substations in each City. The Project consists of the five "New Lines", the "New Substation" and necessary modifications at the existing Eversource Substations.

The Project is designed to be an integrated, long-term solution to address reliability needs in areas of the City of Cambridge (the "Project Area", as further defined in Section 2) that are experiencing rapid economic development and sustained load growth. Eversource must address the deficiency in the East Cambridge Substation firm capacity, mitigate the potential for contingencies on existing transmission lines to cause outages to the entire Project Area for prolonged periods, and resolve transmission line overloads that would require customer load shedding in the Project Area under certain foreseeable contingencies. These system reliability needs are significant and require immediate resolution to maintain a reliable system.

After analyzing various approaches to resolve the identified need, the Company determined that the Proposed Project is the best solution and will provide the infrastructure needed to support the forecasted load in the Project Area, as well as ensure the reliability of transmission service within the Project area. The Project provides the critical link needed to reliably serve the customers while interconnecting substations through the Project Area and strengthening the transmission system.

Eversource has worked closely with City of Cambridge officials, staff and neighborhood groups to successfully identify a location for the New Substation. The New Substation has been designed not only to minimize the size and footprint of the equipment, but also to provide opportunities to install additional capacity equipment to support future load growth in Cambridge. In addition, Eversource has committed to construct the New Substation underground, further reducing the Project footprint.

Eversource considered many geographically distinct solutions for the Project, including the location of the New Lines. To support the Analysis, Eversource conducted extensive community outreach, participating in meetings with the State and City representatives, government officials, private developers, residents, and other stakeholders. The clear and distinct advantages of constructing the Project as proposed are articulated in the Analysis. After careful consideration, the Company confirmed that this approach will best balance the goals of minimizing cost and environmental impacts while meeting the identified needs.

The Project Area and surrounding portions of Cambridge are experiencing considerable development growth and change. Eversource considered several options to the New Lines proposed as part of the Project, recognizing that there is still uncertainty surrounding the scope and schedule of the projected growth in this load pocket and construction of other nearby third-party infrastructure projects. Inclusion of the Route Variations for the New Lines provides the flexibility to respond to changing circumstances during the Siting process as the known uncertainties become clearer.

The Company seeks authority to construct and operate the Project to fulfill its obligation to ensure the safe and reliable transmission of electric power. As described in greater detail in the remaining sections of this Analysis, the Project meets the Energy Facilities Siting Board's standards on need, alternatives, routing, and minimization of environmental impacts under G.L. c. 164, § 69J and § 72 and, therefore, should be approved.

Section 1.0

Project Overview

1.0 PROJECT OVERVIEW

1.1 Introduction

Pursuant to G.L. c. 164, § 69J, NSTAR Electric Company d/b/a Eversource Energy ("Eversource" or the "Company") submits this analysis (the "Analysis") to the Energy Facilities Siting Board (the "Siting Board") in support of its petition for authority to construct facilities to ensure the reliability of the transmission system in Cambridge. These reinforcements consist of five projects, which together constitute the Greater Cambridge Energy Program. The five projects are:

1) The Transmission Lines Project: the construction of eight new 115-kilovolt ("kV") underground transmission lines that will be housed in a total of five new duct banks (the "New Lines"), totaling approximately 8.3 miles.

2) The Transmission Substation and **(3)** the Distribution Station Projects: a new 115-kV transmission substation (more fully described below) and a new 14-kV distribution substation (more fully described in Section 5.6.1), which will be collocated in an underground vault between Broadway and Binney Streets in Cambridge ((2) and (3), collectively, the "New Substation" or "Station 8025").

3) The Remote Stations Modifications Project: ancillary modifications to existing substation facilities (more fully described in Section 5.6.2) in the Cambridge, Somerville, and the Allston/Brighton section of Boston (together with (1), (2) and (3) the "Project").

4) The Distribution Lines Project: a set of 36 distribution feeders and associated duct banks and other equipment (more fully described in Section 3.3.2) that connects the New Substation to the existing distribution network in the public ways immediately adjacent to the New Substation.[1]

Construction of the Project will serve the public interest because it is designed to address both the need for additional capacity to reliably supply customers in the Project Area, as well as the reliability issues surrounding the potential for existing transmission line overloads that would result in a loss of service to customers in the Project Area. Specifically, the proposed Project will result in an integrated, long-term solution that will provide the infrastructure needed to support the rapidly growing current and projected load requirements and will maintain reliable energy supply to customers, including many large office and laboratory uses.

[1] While distribution lines are not jurisdictional to the Siting Board's review under G.L. c. 164, § 69G or § 72, as part of the Project, the Company is nevertheless including information about its build-out of the electric distribution system through the addition of 36 underground distribution feeders and associated infrastructure to identify the full scope of facilities that will be constructed in concert with the Project.

The proposed Project entails the construction of approximately 8.3 miles of new underground transmission line duct banks located primarily in public roadways and all beginning at the New Substation.[2] Two new transmission duct banks will connect to the Eversource Brighton Substation #329 located in the Allston/Brighton area of Boston, for a total of 5.9 miles, with one duct bank crossing the Charles River using an existing bridge (River Street Bridge) and the other using a Horizontal Directional Drill ("HDD") trenchless crossing technique. One new transmission line duct bank, 1.3 miles in length, will connect to Eversource Somerville Substation #402, while another new transmission line duct bank, 0.6 miles in length, will connect to Eversource East Cambridge Substation #875. The final new transmission line duct bank, a total of 0.5 miles, will tie into the existing Eversource East Cambridge to Putnam 115-kV transmission line located in Memorial Drive.

In addition to the proposed transmission lines, the Project also contemplates construction of the New Substation and modifications to five existing substation facilities located in Cambridge, Boston, and Somerville. All improvements to the existing substation facilities will occur within the existing fence lines. To minimize the size and footprint of the New Substation, 115-kV gas-insulated switchgear ("GIS") will be used in a breaker-and-a-half configuration totaling twenty-two 115-kV breakers that would provide both fault isolation and switching capability, connecting the new 115-kV transmission lines to the New Substation. The New Substation would include three 90 MVA 115/14-kV transformers and associated switchgear, with the option to add a fourth transformer and associated switchgear for use in the future when the substation load is projected to exceed 90% of the substation's 180 MVA of firm capacity.[3] At full build out, the firm capacity of the New Substation would be 180 MVA, expandable to 270 MVA.

A locus map showing all elements of the proposed Project is provided on Figures 1-1 and 1-2.

The balance of Section 1 presents an overview of the Project. The remaining sections of this Analysis provide detailed information to support the Project; specifically, an explanation of the need for the Project (Section 2), a comparison of Project Alternatives (Section 3), a description of the transmission line route selection process that was used to identify the Preferred Routes and Noticed Alternative Routes within each respective study area (Section 4), a comparative analysis of impacts, cost and reliability of the Preferred and Noticed Alternative Routes (Section 5), and an analysis of the Project's consistency with the health, environmental protection, resource use and development policies of the Commonwealth of Massachusetts (Section 6).

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[2] Three of the five duct banks house double circuit transmission circuits, totaling eight circuits.

[3] The fourth transformer addition is projected beyond the ten-year planning horizon based on the 2021 load forecast. Because it is beyond the ten-year planning horizon, it is not part of the Project for which the Company seeks the Siting Board's approval at this time.

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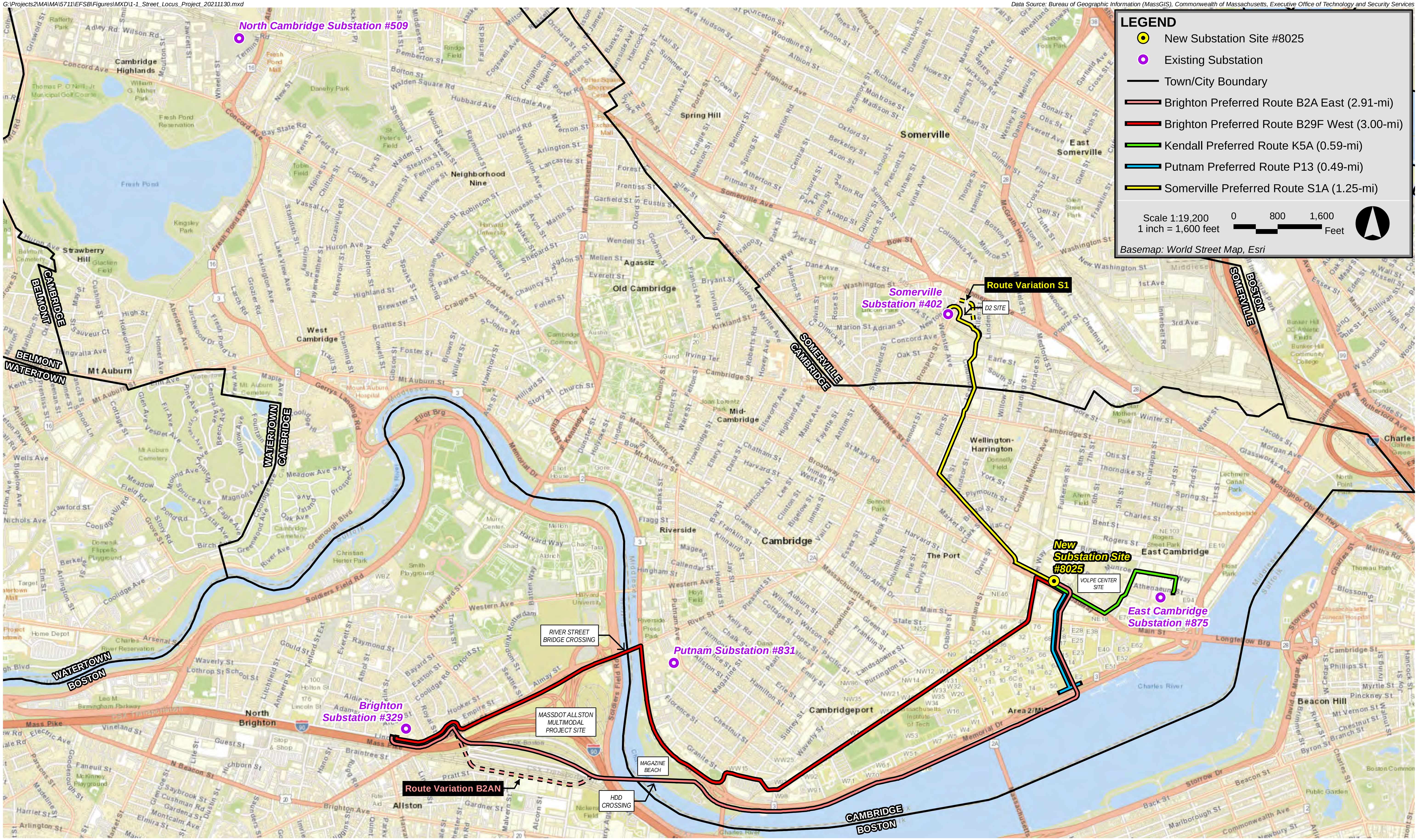
Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



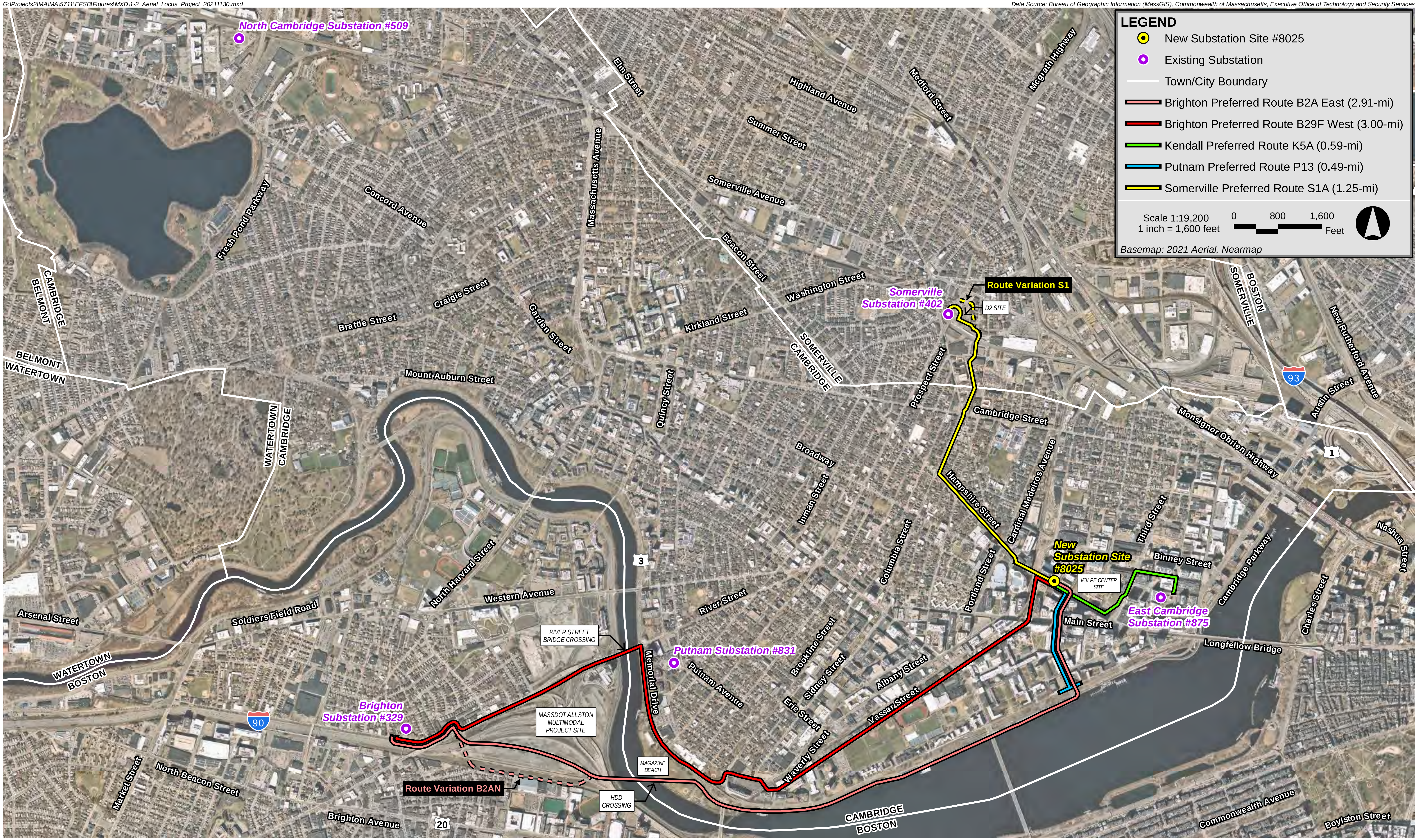
Greater Cambridge Energy Program

EVERSOURCE

Figure 1-1

Locus Map (Project)

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



Greater Cambridge Energy Program

Figure 1-2

Aerial Locus Map (Project)

1.2 Project Need

The Project is designed to be an integrated, long-term solution to address reliability needs in areas of the City of Cambridge that are experiencing rapid economic development and sustained load growth. The Company must address the deficiency in the East Cambridge Substation firm capacity, mitigate the potential for existing transmission line contingencies to cause outages to the entire Project Area for prolonged periods, and resolve transmission line overloads that would require customer load shedding in the Project Area under certain foreseeable contingencies. While the loss of service risks from certain N-1-1 transmission contingencies are a current reliability concern, transmission line overloads from certain N-1 transmission contingencies also emerge as early as 2022. These projected overloads and associated loss of service risks increase over the ten-year forecast period. At the distribution stations, given the current load and expected load growth, there is an elevated risk of substation failure during emergency conditions due to transformer overloads beginning in 2022.

As discussed more fully in Section 2, these system reliability needs are significant, and have already required near-term interim measures, while still requiring the immediate resolution of a long-term solution to address reliability.

1.3 Project Alternatives

In accordance with Siting Board precedent, the Company evaluated various Project Alternatives to address the reliability and capacity needs within the Project area to determine the approach that best balance's reliability, cost, and environmental impact. Section 3 of this Analysis contains the detailed evaluation used to identify and evaluate alternative means of meeting the identified needs. These include a no-build alternative, wires alternatives, and non-wires alternatives ("NWAs"). The Company dismissed the no-build alternative because it would not address the identified need for the Project. Similarly, no feasible or practical NWAs were identified that could reliably and economically satisfy the need. The Company's analysis showed that new generation (either photovoltaic ("PV") or conventional), with or without a contribution from energy efficiency ("EE") and demand response ("DR"), would be impractical and infeasible to meet the identified need. Regarding the wires alternatives, the Company determined that such alternatives are inferior from a reliability, cost, and environmental-impact perspective.

As described in Section 3, the Company's analyses show that construction of the Project is the best approach to meeting the identified need based on a balancing of reliability, cost, and environmental-impact considerations.

1.4 Routing Analysis and Identification of Preferred and Noticed Alternative Routes

After determining that the transmission solution associated with the proposed Project was the superior alternative for meeting the identified need, Eversource undertook a thorough and objective analysis to identify the Preferred Route for underground transmission line duct banks between the proposed New Substation facility in East Cambridge and existing substation facilities in Somerville, Cambridge, and the Allston/Brighton section of Boston. Given the need for interconnection with multiple existing substations, the Company identified four largely distinct study areas, referred to in this Analysis as the Brighton, Somerville, Kendall, and Putnam Study Areas.

The Company's methodology for siting new electric transmission lines within the Study Areas, referred to as a "routing analysis," is an adaptive and iterative approach to identify and evaluate possible routes for the proposed Project. The routing analysis identified the top transmission line routes for the Project as the options that best balance the minimization of environmental impacts (including developed and natural environment impacts, and constructability constraints), reliability and cost. Section 4 of this Analysis presents this routing analysis in detail. The iterative route selection process entailed:

- Identifying a geographic study area.
- Identifying an initial array of potential routes within the Putnam, Kendall, Somerville, and Brighton Study Areas.
- Determining the most viable candidate routes within each of the referenced Study Areas.
- Evaluating developed and natural resource environment impacts, constructability, reliability, and cost of the candidate routes.
- Seeking input and feedback from federal, state, and municipal officials, landowners, residents/businesses, and other stakeholders.
- Selecting the Preferred Route and a Noticed Alternative Route within each study area based on the established evaluation criteria.

At the conclusion of this process, the Company identified the top two routes within the Putnam, Kendall, and Somerville Study Areas and the top four routes within the Brighton Study Area that best balance environmental impacts, costs and reliability and enable the Company to meet the identified need. A more detailed examination and comparison of these top routes is presented in Section 5. Following that more detailed examination, the Company identified and confirmed the Preferred Routes within each Study Area. Collectively, the Preferred Routes best balance the applied route selection criteria, along with considerations of reliability and cost. The Preferred Routes are summarized on the following table and depicted on Figures 1-1 and 1-2.

Table 1-1 Preferred Routes

Study Area	Preferred Route Name	Communities Crossed by Routes
Putnam	P13 (Ames Street)	Cambridge
Kendall	K5A (Linskey Way)	Cambridge
Somerville	S1A (Hampshire Street/D2 Site)	Cambridge, Somerville
Brighton (East)	B2A (Magazine Beach HDD)	Cambridge, Boston
Brighton (West)	B29F (River Street Bridge)	Cambridge, Boston

Geographically distinct routing alternatives were also selected from each study area. Collectively, these routes comprise the "Noticed Alternative." The Noticed Alternative Routes are summarized on the following table.

Table 1-2 Noticed Alternative Routes

Study Area	Noticed Alternative Route Name	Communities Crossed by Routes
Putnam	P11 (Massachusetts Avenue)	Cambridge
Kendall	K11 (Fifth Street)	Cambridge
Somerville	S11C (Grand Junction RR Multi-Use Pathway)	Cambridge, Somerville
Brighton (East)	B31 (River Street Bridge)	Cambridge, Boston
Brighton (West)	B30 (Anderson Bridge)	Cambridge, Boston

1.5 New Substation and Ancillary Facilities

As part of the addition to the proposed transmission lines, the Project also involves construction of a New Substation facility in East Cambridge and modifications to five existing substation facilities located in Cambridge, Boston, and Somerville to accommodate the new transmission line(s). The five substations are Somerville Substation #402, Putnam Substation #831, North Cambridge Substation #509, Brighton Substation #329, and East Cambridge Substation #875, as shown on Figures 1-1 and 1-2. As is described in Section 4 of the Petition, the New Substation facility will provide both a new interconnection to the existing 115-kV electric transmission system and a new location at which the high voltage power from the transmission system will be "stepped down" (i.e., the voltage will be decreased) for distribution to Eversource's residential, commercial, institutional, and industrial customers. A description of the work that is necessary to construct the New Substation and the work that is necessary to implement the improvements at the existing substation facilities is described in Section 5. All improvements to the existing substation facilities will be installed within the existing fence lines.

1.6 Summary of Project Schedule and Cost

Assuming timely receipt of all necessary permits and authorizations, construction of the Project is anticipated to commence in 2024. Construction is anticipated to occur over a five-year period, with completion on a rolling basis beginning 2028 through 2029.

The current planning grade cost estimate (-25%/+25%) for the Project and associated distribution facilities are summarized on Table 1-3 below.

Table 1-3 Project Cost Estimates

Project Components	Cost ($ millions)
Transmission Substation	$456.5
Distribution Substation	$258.1
Transmission Lines	$572.8
Distribution Lines	$141.2
Ancillary Substation Work	$37.6
TOTAL COST	$1,466.2

Consistent with the Company's established cost estimation process and past Siting Board reviews, these estimates reflect the best information now available to the Company and include typical categories of materials and supplies, labor (both internal and external), engineering and permitting, allowance for funds used during construction ("AFUDC"), inflation, insurance, and contingencies for unforeseeable conditions. The cost estimate does not include unforeseeable project costs, such as changes in interest rates, supply chain disruption, labor shortages, or other large-scale economic impacts.

1.7 Agency and Community Outreach

The Company is committed to working with municipal officials, community groups, businesses and residents along the New Line routes and providing proactive and transparent communications throughout the life of the Project. Ever since the first discussions on this Project were held in January 2019, the Company has engaged relevant stakeholders and municipal leaders on aspects of the Project, including the need for the Project, consulted with numerous stakeholders on the route selection of the New Lines, explained the overall Project schedule and the permitting and siting processes and how to participate in those processes.

This stakeholder engagement has included numerous opportunities for public input. Public hearings held by the Cambridge Transportation and Public Utilities Committee provided open forums for residents, city elected officials, staff, and other persons to learn about the need for the Project and potential impacts and benefits for area residents. Collaboration with community stakeholders and development partners helped create the innovative solution that this Project represents. Extensive, iterative line routing discussions were held with municipal staff of the localities through which the line routes would run, agency stakeholders, community groups and private property owners over the past 24 months, as further discussed in Section 4.3.4. Focus group meetings were held to solicit feedback on the top New Line routes. In-community events helped explain maturing Project details and encouraged participation at a series of public open house events. The Company has provided live simultaneous interpretive and other translation services at in-community and open house events to ensure language access for the residents of the communities through which the Project will traverse.

A summary of these outreach activities is listed below, and the details are set forth in Appendix 1-1:[4]

<u>Municipal and Stakeholder Briefings</u>: The Company met regularly with municipal staff, agency organizations and other stakeholders in Boston, Cambridge, and Somerville about line routing options, navigation around existing infrastructure, future development plans, and how they might affect proposed project activities, and other issues where collaboration and coordination would be helpful. This iterative discussion, feedback, and project design modification process has resulted in a well-vetted project.

<u>Community and Focus Group Meetings:</u> The Company also met regularly with key community stakeholders, including Boston's Office of Neighborhood Services, and relevant neighborhood and civic associations, such as the Kendall Residents Association, the East Cambridge Planning Team, Allston Civic Association, and the Somerville Main Streets Association. In total, 47 community-focused outreach meetings were held to provide iterative updates and solicit feedback on the Project.

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4 See also Appendix 4-1 which provides additional detail, including a summary of key input provided by the stakeholders that played a significant role in the development and content of the transmission line routing analysis.

Additionally, Boston Properties, Inc. ("BXP") (the owner of the parcel upon which the New Substation will be located in Cambridge), participated in numerous meetings specific to their redevelopment plans that indirectly included discussions on aspects of the Project. These additional meetings were typically in an open meeting forum and served to provide additional details and information for the community about the Project.

In-Community Pop Up Events and Open Houses: The Company held a series of local outreach events aimed at engaging with the community at locations where they live, work, and play in addition to a series of more traditional public open house events (which were held virtually). These events, specifically geared to reach members of environmental justice ("EJ") communities, were in addition to the Company's previous outreach practices, as discussed further in Section 5.8. To date, ten (10) of these pop-up events were held. These in-community events included Project information and map boards, print collateral in multiple languages and live interpretive services for non-English speaking residents. Discussions included Project basics, soliciting feedback about line routes, opting in for future project notifications, and encouraging participation in upcoming open houses. Additional events are scheduled through the end of 2021 and will be continued throughout the siting process to the start of construction. During construction, outreach will focus on neighbors, abutting property owners, and local businesses where construction work is being conducted.

To date, six (6) virtual open house events have been held, two (2) for each community. These virtual events mixed time-of-day and day-of-week opportunities for the public to interact with Project subject matter experts, ask questions and share concerns. At the virtual Open Houses, the Company provided information on the need for and benefits of the Project, described the siting process, explained the route selection process, and provided detail on Project design and location, schedule, and construction activities. The Company mailed invitations to property owners within a ¼ mile of the proposed New Substation and those within 300 feet from each of the Preferred Routes and Noticed Alternative Routes as identified through municipal assessor lists, and to municipal officials within the cities of Boston, Cambridge, and Somerville. The Company will be conducting additional virtual open house events, with mailings intended to provide notice to community members within a ¼ mile of the five remote substations in Cambridge, Somerville, and Boston to which the New Lines will connect. These events will be continuing at least through the end of Q2 2022; additional outreach activities will be ongoing throughout Project permitting and construction.

The Company conducted door-to-door outreach at properties adjacent to the top routes, targeting locations where tenants might reside to ensure they received notification and to personally invite them to learn more about the proposed Project. Newspaper advertisements for the Open Houses were published in English in the Cambridge Chronicle & Tab, the Somerville Times, and the Transcript Tab; Spanish-language ads were placed in El Mundo; and Portuguese-language ads were placed in O Journal Newspaper and The Portuguese Journal in advance of the events.

Website: A website has been developed for the Project. The website provides basic Project information, maps, regular updates, and contact resources. This website will be kept up to date for the duration of the Project. For more information about the Project, visit www.eversource.com/greater-cambridge-energy-project.

Project Hotline: A toll free number has been created as the Project Hotline. The Project Hotline number is listed in all Project outreach materials, including fact sheets, mailings, the website and at all community events. Eversource is committed to responding promptly to all inquiries. For more information about the Project, call 800-793-2202.

Project E-mail: An email address has been created and listed in all Project outreach materials, including fact sheets, mailings, the website and at all community events. Like the Hotline, Eversource is committed to responding promptly to all inquiries. For more information about the Project, send an email to ProjectInfo@eversource.com.

Construction Community Outreach Plan: Eversource will execute a comprehensive construction community outreach plan to keep property owners, businesses and municipal officials including fire, police, and emergency personnel, up to date on planned construction activities. The Company will notify abutting property owners and municipal officials of its planned construction start and work schedule prior to commencing construction and will work closely with both to limit construction impacts. Once the construction schedule is finalized, the Company will notify direct abutters of the hours of construction and address any concerns raised. All notifications will occur as soon as it is practicable. Typically, notification one to two weeks in advance of construction has proven to be sufficient on previous projects.

In consultation with property owners and local officials and further discussed in Section 5.8, the Company will also develop traffic management plans ("TMPs") and ensure safety is maintained along the construction route. The Company will provide a construction schedule to the municipalities for publication on their webpages (and/or provide a link to the Project webpage). Additionally, the Company will work with the local chamber(s) of commerce, neighborhood services, neighborhood groups and local business groups to ensure that Project updates and information will be available throughout the Project's duration. As needed, Project personnel will arrange for specific notifications to route abutters that might be adversely affected or have need for advice of specific Project activities. The Company will distribute fliers directly to abutter addresses, as needed.

1.8 Project Team

The Company has assembled an experienced team of planners, engineers, environmental scientists, attorneys, and project outreach specialists for the Project. The team's principal organizations are identified below.

NSTAR Electric Company d/b/a Eversource Energy (Project Proponent)

NSTAR Electric Company is a Massachusetts corporation and a wholly owned subsidiary of Eversource Energy, which operates New England's largest energy delivery system. The Company transmits and delivers energy to approximately 3.7 million electric and natural gas customers in Connecticut, Massachusetts, and New Hampshire. In Massachusetts, Eversource's electric service territory includes 140 municipalities, including Boston, covering an area of approximately 3,192 square miles.

Epsilon Associates, Inc. (Environmental Consultants)

Epsilon is an engineering and environmental consulting firm based in Maynard, Massachusetts. Epsilon's engineers, scientists, planners, and regulatory specialists are engaged in environmental analyses, modeling, licensing, and permitting for energy infrastructure projects throughout the northeast. Epsilon conducted the transmission line routing analysis and the assessment of environmental impacts for the Project and is providing local, state, and federal environmental permitting support.

Keegan Werlin LLP (Outside Counsel)

Keegan Werlin LLP, based in Boston, serves as regulatory counsel for the Project on siting, permitting, and licensing matters. The firm specializes in representing clients in all aspects of energy, environmental and regulatory processes. Keegan Werlin's attorneys include former utility regulators and attorneys from energy, environmental and resource management agencies. Attorneys in the firm have represented transmission companies and project developers in numerous applications to the Siting Board, Department of Public Utilities, and other permitting agencies for approval to construct electric transmission lines, bulk generating facilities and natural gas pipelines.

Exponent, Inc. (EMF Consultants)

Exponent Inc., based in New York City, is a multidisciplinary organization of scientists, physicians, engineers, and business consultants that performs in-depth investigations including evaluation of complex human health and environmental issues. Exponent Inc. has been contracted to assess the effect of the Project on electric and magnetic fields ("EMF") levels at the edge of the roadway and Project vicinity.

POWER Engineers, Inc. (Transmission Engineers)

POWER Engineers, Inc. ("PEI"), is an international, multidiscipline engineering firm and a leader in the design and implementation of power delivery systems – from overhead and underground transmission lines and substations, wind, solar and gas power generation, to electrical system studies, testing and energization, utility automation, program management and environmental services. PEI was contracted to assist with verifying the constructability of the various line routes identified.

1.9 Conclusion

Construction of the Project is needed and will serve the public interest. The Project is designed to address both the need for additional capacity to supply customer and load growth in the Project Area, as well as the reliability concerns surrounding the existing transmission line overloads that could result in a loss of service to customers in the Project Area. The Company seeks authority to construct the Project to fulfill its obligation to ensure safe and reliable electricity service to its customers. The Company will meet this objective through construction and operation of the Project. For the reasons described in greater detail in the subsequent sections of this Analysis, the Project meets all Siting Board standards on need, alternatives, routing and minimization of environmental impacts and costs under G.L. c. 164, § 69J, and therefore, should be approved by the Siting Board.

Section 2.0

Project Need

2.0 PROJECT NEED

2.1 Introduction

The Project is designed to be an integrated, long-term solution to address reliability needs in areas of the City of Cambridge that are experiencing rapid economic development and sustained load growth. The Company must address the deficiency in the East Cambridge Substation firm capacity, mitigate the potential for existing transmission line contingencies to cause outages to the entire Project Area for prolonged periods, and resolve transmission line overloads that would require customer load shedding in the Project Area under certain foreseeable contingencies. While the loss of service risks from certain N-1-1 transmission contingencies are a current reliability concern, transmission line overloads from certain N-1 transmission contingencies (more fully described in Section 2.3.1) also emerge as early as 2022. These projected overloads and associated loss of service risks increase over the ten-year forecast period. At the existing distribution substations, given the current load and expected load growth, there is an elevated risk of substation failure during emergency conditions due to transformer overloads beginning in 2022.

To address these immediate and near-term transformer overloads, and the associated safety and reliability risks, Eversource has implemented one interim operational measure (adding a 4th transformer at Putnam Substation #831) and will be implementing a second interim operational measure (adding a 3rd transformer at Somerville Substation #402) before the Summer of 2023. Despite these interim measures, with all adjacent stations near their firm capacity by 2027, along with the East Cambridge Substation capacity deficiency, the need for the Project re-emerges by 2028. Moreover, the interim operational measures do not address the N-1 and N-1-1 transmission overloads and contingencies that are currently a significant reliability concern in the Project Area.

This Section 2 describes the specific transmission and distribution needs that the Project will address. As discussed more fully below, the Project is a comprehensive solution that ensures that the Company fully and thoroughly addresses these immediate and long-term system reliability needs in the Project Area.

2.2 Description of the Existing Project Area Transmission and Distribution System

2.2.1 The Project Area

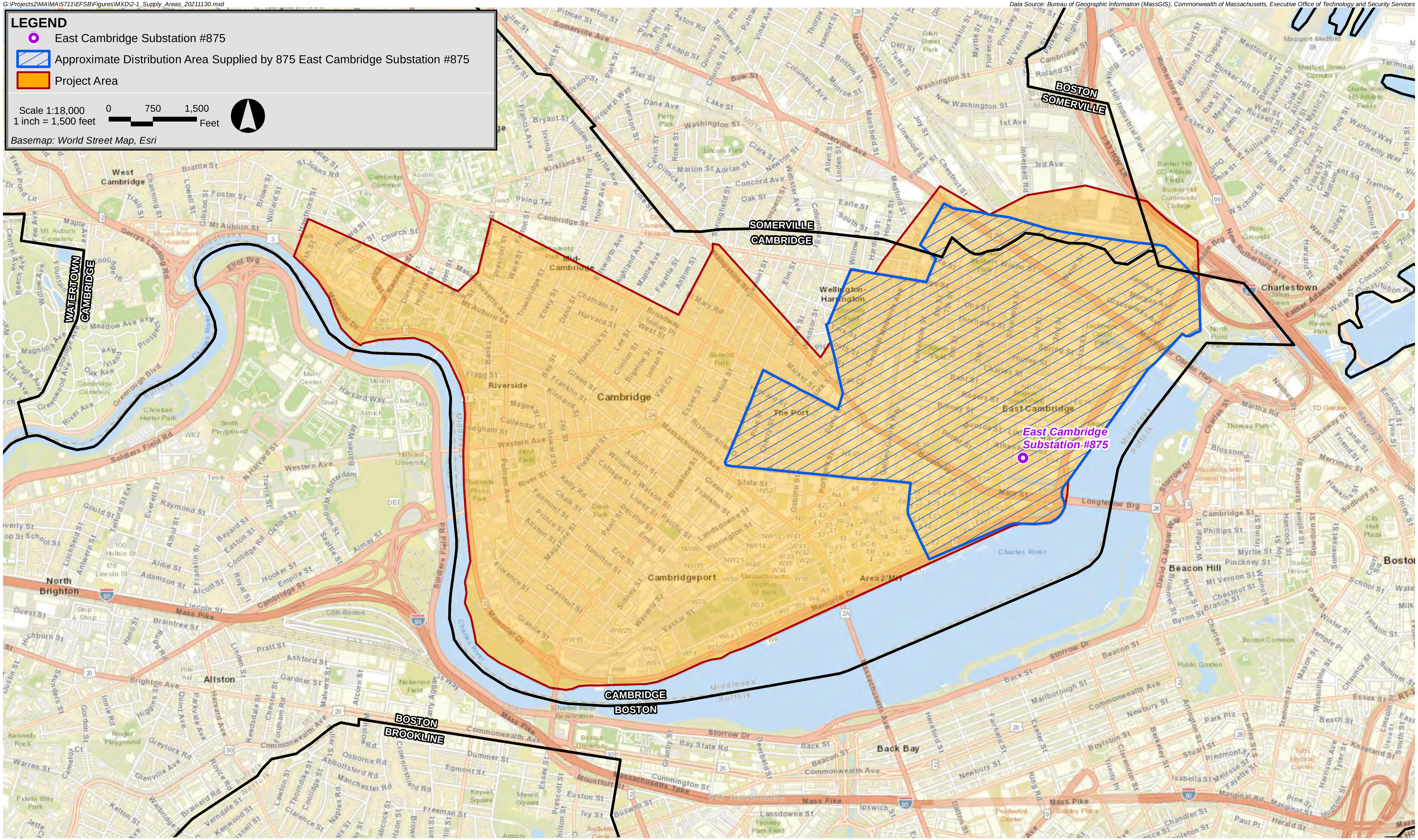
The Project Area, which is shown on Figure 2-1, is roughly defined by the Cambridge/Somerville municipal boundary to the northeast, the Charles River to the east, south and west, and the Harvard University campus to the northwest. More specifically, the Project Area includes customers across all or some of the following City of Cambridge neighborhoods: East Cambridge, Area 2/MIT, Cambridgeport, Riverside, West Cambridge, Mid-Cambridge, Wellington-Harrington, and the Port. The Company's customers in the Project Area include many large biotechnology and laboratory facilities, a multitude of retail, hospitality and office customers, educational institutions, medical facilities, and residences. As an example, Kendall Square, which straddles several of the City's neighborhoods, has been transformed from a former industrial district to one of the world's leading centers for biotech research and innovation. Attendant with this growth, Kendall Square has seen the proliferation of hotels, restaurants, shops, and housing that serve the area's cluster of life science and technology firms, the MIT community, and surrounding neighborhoods. Major new developments include Cambridge Center, Cambridge Research Park, Technology Square, and One Kendall Square, as well as several large lab and office buildings along Binney Street. The Project Area is home to some of the largest employers in Cambridge, including MIT, Biogen, Novartis, Sanofi Aventis, Takeda Pharmaceuticals, the Cambridge Innovation Center, the U.S. Department of Transportation, Google, Hubspot, the Broad Institute, Akamai Technologies, Moderna, and Pfizer.

Figure 2-1 on the following page also illustrates the approximate geographic area supplied by the existing East Cambridge Substation. The East Cambridge Substation supply area, which is a subsection of the overall Project Area, is roughly defined by the Cambridge/Somerville municipal boundary to the northeast, the Charles River to the east, Main Street to the south, Columbus Street to the southwest, and Webster Avenue to the northwest. The need for a solution is particularly acute in this subregion of the Project Area because it is exposed to loss of load risks from both transmission and substation capacity needs.

2.2.2 Existing Project Area Transmission System

As shown schematically in the single-line diagram in Figure 2-2 on page 2-4, the Project Area (yellow oval) contains the Company's existing Putnam (#831) and East Cambridge (#875) substations, supplied by the two radial 115-kV lines out of North Cambridge Substation, and the Kendall Generating Station. Together, these two lines supply a load pocket[5] consisting of both the Putnam and East Cambridge Substations.

5 A load pocket is an electrically connected load area primarily supplied radially by a specific power source(s) (i.e., the load area supplied by all the feeders from a specific substation).



Greater Cambridge Energy Program

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Figure 2-1

Project Area and Approximate Distribution Area Supplied by East Cambridge Substation #875

Figure 2-2 Project Area Single-Line Diagram

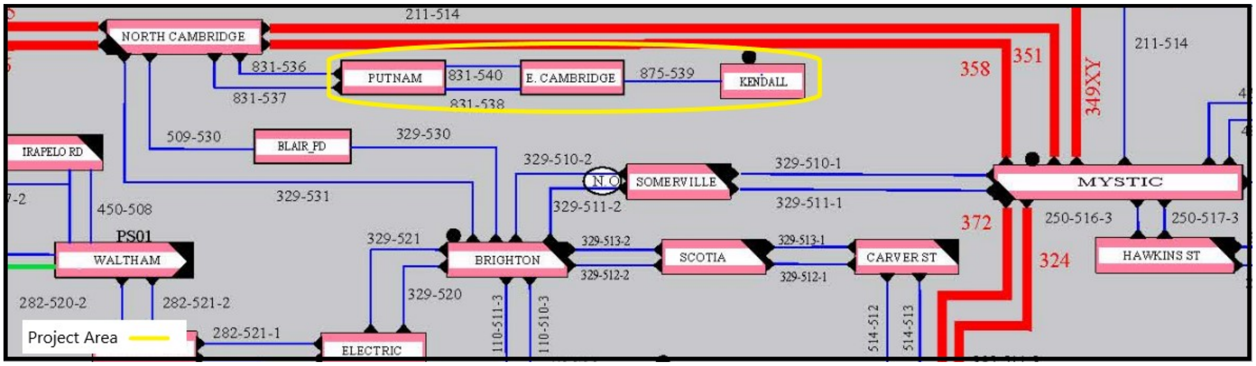
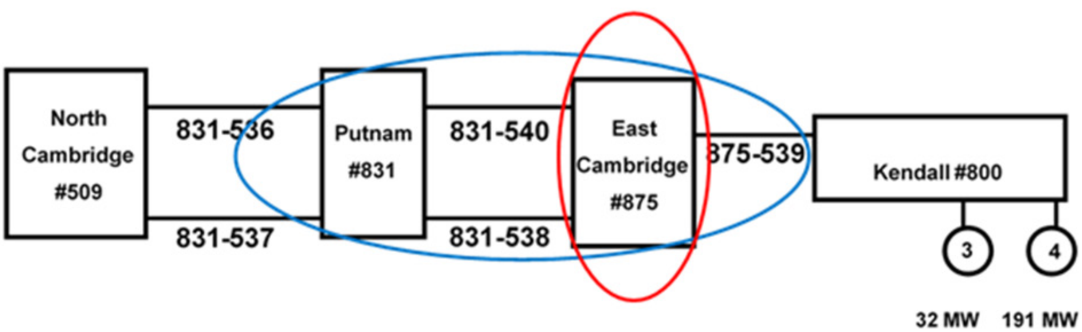


Figure 2-3 shows an isolated view of the 115-kV supply to the combined Putnam/East Cambridge Load Pocket, which is circled in blue. The individual East Cambridge Load Pocket is circled in red. The end of the load pocket terminates at the Kendall Generating Station (owned by Vicinity Energy), which consists of three generators: Kendall #4 rated at 191 MW; Kendall #3 rated at 32 MW; and the Kendall Jet #1 rated at 21 MW. Kendall generating units #3 and #4 are interconnected to the 115-kV transmission system in the Project Area via the Kendall-East Cambridge 115-kV line, Line 875-539. The Kendall Jet is connected to the Company's 14-kV distribution system at the Putnam Substation 14-kV bus sections E and F and therefore is not shown in the 115-kV diagram.

Figure 2-3 Existing 115-kV Supply to Putnam – East Cambridge



2.2.3 Existing Project Area Distribution System

The Project Area distribution system is served largely by two existing substations: East Cambridge Substation #875 and Putnam Substation #831. The existing East Cambridge Substation has three 115/14-kV step-down transformers, each with a 37/50/62.5 MVA nameplate rating.[6] The total nameplate capacity of the three transformers is 187.5 MVA. Any loading of one of these transformers above 62.5 MVA constitutes an emergency loading. The Company's long-time emergency ("LTE") ratings (cyclic capability) are 75 MVA for each of the transformer banks.[7] There are five sections of 14-kV switchgear at the existing East Cambridge Substation. The five 14-kV bus sections are supplied by three 115/14-kV transformers (Transformers 110A, 110B and 110C). There is a 14-kV Automatic Bus Restoral ("ABR") system. Upon the loss of transformer 110A, 110B or 110C, the bus section tie breakers will close automatically so that all the load at the substation will be supplied via the remaining two in-service transformers. The Firm Capacity[8] of the existing East Cambridge Substation is based on the loss of one transformer is 150 MVA. This substation does not have any transfer switching capability to adjacent stations.

The Putnam Substation has four 115/14-kV step-down transformers. Transformer 110A, 110B, and 110C each has a nameplate rating of 37.5/50/70 MVA and an LTE rating (cyclic capability) of 73 MVA.[9] Transformer 110D has a nameplate rating of 37.5/50/62.5 MVA and an LTE rating of 75 MVA. The total nameplate capacity of the four transformers is 285 MVA. The Putnam Substation has seven sections of 14-kV switchgear. Bus sections A, B, C and D are supplied in parallel by Transformers 110A and 110B. Bus sections E and F are supplied by Transformer 110C, while bus section J is supplied by Transformer 110D. The Firm Capacity of Putnam Substation #831, based on the loss of one transformer, is 211 MVA.[10]

Putnam Substation #831 is expected to provide up to 34 MVA of interim load relief for East Cambridge Substation #875 via distribution transfers from 2021 to 2024 (discussed further below). Beyond that, the Putnam Substation #831 has no further transfer capability.

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6 Liquid-immersed transformers can have three load ratings, OA/FA/FOA, depending on the amount and type of cooling and ventilation present: self-cooling, natural ventilation (no fans), ("OA"), forced air cooling with fans ("FA") and forced oil cooling (pumps) with fans ("FOA")

7 The Summer LTE rating is the 12-hour capability of the transformer, which requires that any emergency loading affecting this transformer may last no more than 12 hours.

8 Firm Capacity is defined as the total LTE rating of the remaining transformer(s) after the loss of the largest transformer.

9 As discussed above and further below in Section 2.6 (Interim Operational Measures), to address immediate and near-term distribution transformer overloads, and the associated safety and reliability risk, Eversource installed a fourth transformer at Putnam in 2020.

10 Firm capacity of the substation is based on the LTE capability of the limiting equipment after the loss of the largest transformer (by nameplate): 73 + 73 + 65 = 211 MVA.

Adjacent to the Project Area is the Somerville Substation #402, located to the northwest of the East Cambridge Substation, which is connected to Prospect Street Substation #819 in Cambridge and normally serves portions of load in various parts of Cambridge. As discussed below in Section 2.6, Somerville Substation #402 is included in the Company's interim operational measures to partially relieve projected East Cambridge Substation #875 overloads. Somerville Substation #402, a 115-kV/14-kV distribution substation, is the source for 14-kV distribution tie lines (819-1457XY, 1458XY, 1459XY and 1460XY) supplying Prospect Street Substation #819, a distribution station also located in Cambridge, just to the north of the Project Area. Each of the four tie lines is rated for 22 MVA. The Somerville Substation consists of two 115/14-kV transformers with a nameplate rating of 37/50/62.5 MVA and two sections of 14-kV switchgear. The total capacity of the two transformers is 131 MVA. The Firm Capacity of Somerville Substation #402 is currently 75 MVA, based on the LTE rating of one transformer.

2.3 Company Planning Standards

The Company's Electric Power System ("EPS") Planning Criteria and Standards provide a consistent uniform approach to designing an efficient and reliable electric transmission and distribution system. As a regulated utility, the Company has an obligation to provide reliable service in accordance with applicable safety codes and regulatory requirements. The basic goal is to provide orderly, economic expansion of equipment and facilities to meet future system demand with acceptable system performance. The key objectives include building sufficient capacity to meet instantaneous demand, satisfy power quality/voltage requirements within applicable standards, provide adequate availability to meet customer requirements, and deliver power with the required frequency.

To meet these objectives at the transmission level, the transmission system is designed in accordance with North American Electric Reliability Corporation ("NERC") reliability standards, Northeast Power Coordinating Council ("NPCC") regional standards, and ISO-NE criteria. The Company must also plan for transmission system deficiencies to mitigate the consequences of the loss of transmission elements.

At the distribution level, the Company's standard SYSPLAN 10[11] establishes the guidelines and criteria for how the Company plans and designs its bulk distribution substation and electric distribution facilities to avoid capacity, voltage, and reliability violations in accordance with internal planning standards and procedures.

2.3.1 Transmission Planning Criteria

The Company's transmission system is an integral part of the EPS delivering electricity to customers in Cambridge. To maintain the integrity of the EPS, the Company must ensure that adequate transmission resources are available to meet the projected load requirements safely and reliably over the Company's forecast horizon.

The North Cambridge - Putnam and Putnam - East Cambridge 115-kV Lines, which supply the existing Putnam and East Cambridge Substations, are not classified as Pool Transmission Facilities ("PTF") but are NERC Bulk Electric System ("BES") elements. Because they are BES elements, they are subject to the criteria listed in NERC Reliability Standard TPL-001-4 "Transmission System Planning Performance Requirements" and the Company's Planning Criteria – SYSPLAN 1[12] and SYSPLAN 15.[13] The Company plans its local transmission system consistent with the applicable NERC, NPCC and ISO-NE standards, as well as its own internal planning standards.

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11 SYSPLAN 10 is Eversource's bulk distribution substation assessment procedure that is used by System Planning Engineers to ensure there is adequate capability to reliably supply customers during both normal and contingency conditions. Section 4.11.2 (Bulk Distribution Substation – General Design Criteria) specifies loading criteria for bulk distribution substations under normal and emergency conditions:

a) Bulk transformer winding loads should not exceed 75% of the normal rating, under normal (scheduled) operating conditions/configurations.
b) Bulk transformer winding loads above the normal rating, but below the LTE rating are allowed for one load cycle per event.
c) Bulk transformer winding loads above the LTE rating, but (I) below the Short Time Emergency ("STE") rating must be lowered to below the LTE rating within 30 minutes, and (ii) below the Drastic Action Limit ("DAL") rating must be lowered to below the LTE rating within 5 minutes.
d) Loading transformer windings above the STE/DAL rating is not accepted under planning criteria for any duration. This is intended as an operational rating only.

When transformer winding loads approach 75% of the normal rating (under normal operating conditions), there are three options available:

1) Permanently transfer loads to other supply sources with available capacity.
2) Temporarily close a normally open bus-tie where the second transformer is under-utilized, when balancing load is impractical and there is no adverse impact on available fault current, circulating flows, or voltage.
3) Provide additional transformer capacity by a) Installing a larger transformer, or b) Installing additional transformers in the area.

12 SYSPLAN 1 is Eversource's transmission system reliability standard and it describes how to conduct transmission planning assessments and develop transmission solutions to address reliability needs.

13 SYSPLAN 15 is Eversource's Consequential Load Loss ("CLL") guideline, and it describes how to conduct transmission system planning assessments of CLL and develop transmission solutions. This system planning standard is further described below in this Section 2.3.1.

The contingency conditions examined through the planning process as defined in SYSPLAN 1 and 15 are as follows:

<u>"N-1" Single Contingencies</u>

- ♦ Loss of one transmission circuit, one transformer, one major generator, one bus section, or one shunt device; or
- ♦ Opening of a line section without a fault; or
- ♦ Loss of multiple transmission components (circuit, transformer, or generator) sharing a common circuit breaker (i.e., stuck breaker); or
- ♦ Loss of two adjacent transmission circuits on a multiple circuit transmission tower; or
- ♦ Loss of a bipolar direct current ("DC") line.

<u>"N-1-1" Contingencies</u>

- ♦ Loss of one major generating unit followed by loss of a generator, transformer, transmission circuit, shunt device or single pole of a DC line; or
- ♦ Loss of a transmission circuit, transformer, shunt device, or single pole of a DC line followed by loss of one of the elements listed under N-1.

An "N-1" and "N-1-1" contingency analysis involves a load-flow analysis to evaluate the real and reactive power flowing in each line, as well as system voltages and angles that result under various contingency conditions. These analyses result in a determination of whether the resultant loadings exceed the capability of any given element on the system and whether resultant transmission system voltages violate acceptable voltage limits. The loading capability of a given transmission element is a function of the element's heat-dissipation capability, and therefore, this analysis is also referred to as a thermal limit. In summary, the primary goal of the load-flow analysis is to ensure that the occurrence of a single contingency (N-1), or one contingency followed shortly thereafter by a second contingency (N-1-1), does not result in thermal limit violations for a transmission element beyond its LTE rating, or violate acceptable system voltage limits.

The Eversource transmission system is designed to have sufficient capacity to serve area loads under normal operating conditions, as well as during specified contingency events. Facility outage conditions include planned or unplanned events wherein one or more transmission elements, such as transmission lines, substation transformers, or autotransformers are out of service. Application of the criteria to maintain sufficient transmission capacity following the loss of critical system elements requires that the system be designed to withstand the loss of one system element (N-1) followed by a second system element (N-1-1) without introducing overloads or voltage problems on the remaining elements.

If the Company's transmission system does not have sufficient capability to serve the forecasted load for either normal conditions (all facilities in-service), or under specified contingencies, the Company must plan and implement system additions and upgrades to address the identified deficiencies. When planning for transmission sufficiency, the Company accounts for the amount of load, restoration times, the type of load/customer and the impact of lengthy outages to these load/customer types (e.g., hospitals, large commercial and industrial facilities, etc.).

The Company must also comply with NERC standards that dictate the extent to which load shedding may be an appropriate mitigation measure in certain conditions. NERC reliability standard TPL-001-4 does not allow non-consequential load loss to address reliability issues for N-1 conditions that involve loss of a single transmission component. In addition, the Company's standard SYSPLAN 15, "Consequential Load Loss Guideline," states that any situation in which consequential load loss is greater than 50 MW at one substation or a group of substations served by two underground transmission lines is unacceptable and must be addressed.

2.3.2 Distribution Bulk Substation Planning Criteria

At the distribution level, it is Eversource's goal to have customer's electric service automatically restored upon loss of supply to Bulk Distribution Supply Buses. In high load density areas, such as the Project Area, a higher degree of reliability is ensured by maintaining supply, without the loss of power, to Bulk Distribution Buses following an N-1 contingency condition.

The Company's Bulk Distribution Substation planning criteria focus on the following high-level reliability criteria (including lack of capacity):

- Each distribution bus has at least two means of supply (primary and secondary);[14]
- Upon loss of a source of supply, customer electric service is automatically restored; and[15]
- The number of bulk distribution buses with no power source because of a single contingency is minimized.[16]

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14 SYSPLAN 10 Section 1.9.2 (Applicable Reliability Criteria): "Each distribution bus, within a bulk distribution substation, shall have at least two means of supply (primary and secondary). In this context, primary supply is provided by connection to the secondary winding of a Bulk Distribution Transformer."

15 SYSPLAN 10 Section 1.9.1 (Applicable Reliability Criteria): "It is Eversource's ultimate goal to have customers electric service automatically restored upon loss of supply to Bulk Distribution Supply Buses."

16 SYSPLAN 10 Section 4.11.2 (Bulk Distribution Substation – General Design Criteria): "Bulk Distribution Substation designs should address the following areas … A single transmission system contingency that causes loss of supply to more than one Bulk Distribution Supply Bus."

These planning standards are employed in the Company's annual overall assessment of its system, which it submits each year to the Department of Public Utilities (the "Department" or "DPU") in its "Annual Reliability Report." The Company's most recent Annual Reliability Report was submitted in D.P.U. 21-ARR-02.

In accordance with the Company's distribution planning standards set forth in SYSPLAN 10,17 under normal operating conditions and configurations ("N-0"), substation transformer loads should not exceed 75% of the normal rating and substation transformers should not exceed their LTE rating after implementation of the automatic bus restoral ("ABR") scheme in response to N-1 contingency outages involving loss of a bulk transformer. When actual or projected transformer loads approach 75% of the normal rating (under normal operating conditions), there are two options available: (1) permanently transfer loads to other substations in the area, or (2) provide additional transformer capacity by installing a larger transformer, or additional transformers in the area.

2.3.3 Eversource Load Demand Forecast Methodology

As part of the Company's substation planning process, the Company develops a ten-year forecast of peak load for the purposes of testing and evaluating the performance of the system and evaluating substation capacity. Eversource forecasts electrical load independently for each of its distribution companies because of the unique characteristics of each of these areas, which serve as the basis for historical service-area configurations.

Operational Company Peak Load Forecast

The Operational Company system-level peak demand is forecasted using an econometric model that evaluates historical peak demand as a function of peak-day weather conditions and the economy. The econometric model utilizes a three-day weighted temperature humidity index weather variable to forecast summer peak demand. The forecast assumes normal weather conditions based on the most recent ten-year period. Moody's Analytics, an international economic consulting company, provides the economic history and forecast. The resulting forecast is referred to as the trend forecast and does not include incremental adjustments for energy efficiency ("EE"), solar, electric vehicles ("EV"), and large customer projects, which are accounted for separately.

After a trend forecast is produced, the net forecast is derived by adjusting for EE, solar, EV, and large customer projects. Company-sponsored EE projections are based on the most readily available three-year plan, while solar projections are developed consistent with historical trends.

[17] SYSPLAN 10 Section 4,11.2 (Bulk Distribution Transformer Loading): "Bulk transformer winding loads should not exceed 75% of the normal rating, under normal (scheduled) operating conditions/configurations."

The Company's forecast projects a significant increase in the penetration of electric light duty passenger vehicles. Specific, identified large development projects that the econometric forecasts could not otherwise predict are added to the Company's forecast.

Substation Peak Load Forecast

Each substation's peak load forecast is a function of the substation's historical peaks and the relevant operational company's peak load history and forecast. Manual adjustments are made to individual substation forecasts for: (1) specific, identified large development projects and expected changes in system operations that could not otherwise be predicted by the operational company's econometric forecasts or the individual substations' share of those forecasts;[18] (2) substation peak load forecasts are reduced for Company sponsored EE and behind-the-meter solar installations; (3) substation peak load forecasts are increased for EV additions; and (4) in compliance with the Department's guidance in D.P.U. 13-86, the Company has amended its load forecasting methodology to change how it reconstitutes loads for distributed generation. The Company no longer reconstitutes loads for distributed generation units larger than 5 MW, unless those customers are on Standby Delivery Service. For customers on Standby Delivery Service, the Company is obligated to be:

> *Standing ready to provide delivery of electricity supply to replace the portion of the Customer's internal electric load normally supplied by the Generation Units be unable to provide all, or a portion of, the expected electricity supply.*[19]

It is the Company's obligation to provide service to these customers regardless of whether the Generation Units that can serve a portion of the customer's load are operating or not. To reflect this obligation, forecasted loads are reconstituted for the portion of load that may be served by the Generation Units.

Tables 2-1 through 2-4, on the following pages, show the ten-year forecasted 90/10 summer peak loads in MVA for each of East Cambridge, Putnam, and Somerville Substations from 2021 through 2030 from the "2021-2030 Extreme Weather NSTAR North Area Station Load Forecast."[20] Table

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[18] Large customers with projects or buildings not yet completed generally provide a letter to the Company detailing the expected connected loads of all the electrical equipment in their building and break it down for single phase and three phase loads. This information underlies the Company's substation load forecasts.

[19] See M.D.P.U. No. 255F, page 2 of 6.

[20] In addition to the Company's ten-year planning and forecast horizon for capital projects, the Company has undertaken a longer-term, scenario-based electric demand assessment that accounts for the Massachusetts 2050 Decarbonization Roadmap and relevant local considerations. This assessment focuses on the energy transition to distributed generation as well as the conversion of mobility and heating sectors to electric loads and is used by the Company to review projects for their long-term adequacy. See Section 6 for more information on this assessment..

2-4 shows the ten-year forecasted 90/10 summer peak loads in MVA for the Project Area. In each of the referenced tables, forecasted adjustments for EE, photovoltaics ("PV") and EV capture only incremental amounts above and beyond what is already included in the trend forecast.

Table 2-1 Company Forecast for East Cambridge Substation (MVA)

Year	Trend	Step Loads	EE	PV	EV	Generation[21]	Total
2021	121.8	23.7	-0.8	0.0	0.0	5.2	149.9
2022	126.8	47.7	-0.8	0.0	0.1	5.2	178.9
2023	127.1	61.7	-0.8	0.0	0.1	5.2	193.3
2024	127.4	73.2	-0.8	0.0	0.1	5.2	205.1
2025	127.7	78.2	-0.8	0.0	0.2	5.2	210.5
2026	128.0	87.2	-0.8	0.0	0.3	5.2	219.9
2027	128.2	92.2	-0.8	0.0	0.5	5.2	225.3
2028	128.5	97.2	-0.8	0.0	0.6	5.2	230.8
2029	128.8	102.2	-0.8	0.0	0.9	5.2	236.3
2030	129.2	107.2	-0.8	0.0	1.2	5.2	241.9

Table 2-2 Company Forecast for Putnam Substation (MVA)

Year	Trend	Step Loads	EE	PV	EV	Generation	Total
2021	121.3	11.1	-0.8	-1.0	0.0	20.3	151.0
2022	126.1	20.1	-0.8	-1.4	0.1	20.3	164.3
2023	126.4	22.1	-0.8	-1.6	0.1	20.3	166.5
2024	126.7	22.1	-0.8	-1.6	0.1	20.3	166.8
2025	126.9	22.1	-0.8	-1.6	0.2	20.3	167.1
2026	127.2	22.1	-0.8	-1.6	0.3	20.3	167.5
2027	127.4	22.1	-0.8	-1.6	0.4	20.3	167.9
2028	127.7	22.1	-0.8	-1.6	0.6	20.3	168.3
2029	128.0	22.1	-0.8	-1.6	0.8	20.3	168.9
2030	128.4	22.1	-0.8	-1.6	1.1	20.3	169.5

21 "Generation" means customer onsite generation for which the Company has an obligation to reserve backup capacity (for example MIT generation). See Footnote 19, above.

Table 2-3 Company Forecast for Somerville Substation (MVA)

Year	Trend	Step Loads	EE	PV	EV	Generation	Total
2021	51.8	0.0	-0.3	0.0	0.0	0.0	51.4
2022	52.9	0.0	-0.3	-0.1	0.0	0.0	52.5
2023	53.0	0.0	-0.3	-0.1	0.0	0.0	52.6
2024	53.0	0.0	-0.3	-0.1	0.0	0.0	52.7
2025	53.1	0.0	-0.3	-0.1	0.1	0.0	52.8
2026	53.2	0.0	-0.3	-0.1	0.1	0.0	52.9
2027	53.2	0.0	-0.3	-0.1	0.2	0.0	53.0
2028	53.3	0.0	-0.3	-0.1	0.3	0.0	53.2
2029	53.4	0.0	-0.3	-0.1	0.4	0.0	53.3
2030	53.4	0.0	-0.3	-0.1	0.5	0.0	53.5

Table 2-4 Company Forecast for Putnam and East Cambridge Project Area (MVA)

Year	Trend	Step Loads	EE	PV	EV	Generation	Total
2021	243.1	34.8	-1.5	-1.0	0.1	25.5	300.9
2022	252.9	67.8	-1.5	-1.4	0.1	25.5	343.2
2023	253.5	83.8	-1.5	-1.6	0.2	25.5	359.8
2024	254.1	95.3	-1.5	-1.6	0.2	25.5	371.9
2025	254.6	100.3	-1.5	-1.6	0.3	25.5	377.6
2026	255.2	109.3	-1.5	-1.6	0.6	25.5	387.4
2027	255.6	114.3	-1.5	-1.6	0.9	25.5	393.2
2028	256.2	119.3	-1.5	-1.6	1.3	25.5	399.1
2029	256.8	124.3	-1.5	-1.6	1.7	25.5	405.2
2030	257.6	129.3	-1.5	-1.6	2.3	25.5	411.4

The Company produces both a “normal” and an “extreme”’ peak load forecast by each operating company. The normal peak load is based on average historical weather data, and the extreme peak is based on the 90th percentile of that historical weather data. These weather assumptions are the only differences between the normal and extreme peak load forecasts. Both Distribution and Transmission System Planning groups utilize the 90/10 weather data for their peak load forecasts in their planning efforts to confirm that the Company can safely and reliably meet customer needs during extreme, but realistic, weather events.

Eversource Energy Efficiency Programs

The Company’s load forecasting and transmission planning efforts are performed within the backdrop of the Company’s aggressive and industry-leading energy efficiency programs, which not only incentivize energy conservation measures, but increasingly also support building electrification (e.g., adoption of heat pumps). Eversource offers EE programs across all customer segments, including residential, low income, and commercial and industrial (“C&I”). Program offerings typically include incentives for new construction projects, retrofits, and energy efficient products/appliances. Eversource invests approximately $600 million a year in energy efficiency across its three-state service territory. The Company considers these investments the most economical way to reduce the region's emissions and increase its economic competitiveness. In Massachusetts alone, the 2019-2021 Three Year Energy Efficiency Plan calls for an investment of over $900 million in electric energy efficiency programs.[22]

During its most recently completed three-year Energy Efficiency Plan, 2016-2018, Eversource Electric EE programs reduced summer peak load across its service territory by over 318 MW and saved over 2 million MWh on an annual basis. In 2019, Eversource EE programs saved over 102 MW of summer peak load and 520,000 MWh of electricity on an annual basis. In 2020, which was affected by the pandemic, Eversource EE programs saved over 168 MW of summer peak load and 635,000 MWh of electricity on an annual basis.

Eversource works closely with community leaders, residents, schools, and businesses to reduce energy consumption, increase the use of renewable resources, and encourage participation in available energy programs. The Company engages with the communities in its service territory in numerous ways, including offering educational training workshops and informational booths at industry, community, and regional events.

Eversource also actively works with businesses small and large to identify and implement energy improvement opportunities, reduce operational costs, and increase productivity and competitiveness. The Company retains teams of highly skilled technical staff dedicated to connecting customers to those solutions and to the attractive financial incentives that help facilitate implementation. The Company establishes long-term strategic partnerships with high energy users and leverages these partnerships to provide a roadmap for energy-efficient construction and upgrades that feature aggressive energy and carbon reduction goals.

These partnerships enable larger customers to better plan and forecast their investments, ensure that they have the engineering support needed, and leverage the benefits resulting from a comprehensive approach to energy efficiency. The Company is currently working with or has previously worked with Harvard, MIT, and BXP to name a few.

The energy marketplace is evolving quickly, and the Massachusetts Program Administrators (including the Company) have been at the center, driving the changing landscape of energy efficiency. The Program Administrators' nation-leading and collaborative efforts have accelerated market transformation, and contributed to lower demand, lower energy prices, and a more efficient energy system. Sustaining very high claimable savings goals becomes increasingly difficult in each subsequent year as markets become saturated with already-implemented EE,

[22] Eversource has submitted a 2022-2024 Three Year Energy Efficiency Plan that is subject to review by the Massachusetts Department of Public Utilities.

"easy" savings no longer exist, and rising baselines continue to reduce claimable savings opportunities. For example, socket surveys show that more and more sockets are being filled with efficient lighting products, reducing future opportunities for energy efficiency.[23]

Load Growth in the Project Area

The Project Area is expected to experience rapid load growth. Despite the Covid-19 pandemic, which resulted in a suppressed 2020 peak summer load of 111 MVA, substantial load growth is still predicted to occur. Beginning 2021 through 2025, there are nine (9) major customer load additions[24] either in-service, with work orders under construction, or planned for. These major projects would add potentially 68 MVA of new load during 2021-2025. Among the new load additions is the continued build-out of the Cambridge Crossing development, a 4.5 million square foot master planned development on 43 acres by DIVCO West. These and other future developments, such as the Massachusetts Institute of Technology Investment Management Company's ("MITIMCO") development of the 14-acre Volpe Center Site, which will include a new federal office building, 1,400 apartments, commercial and lab buildings, are expected to increase the region's load, on average, by 5 MVA annually. The new load, in combination with the continued load growth within the remainder of the Project Area, will further strain the capability of the existing East Cambridge Substation to reliably supply customer load requirements. This dramatic trend is expected to continue through at least 2030, with an estimated 130 MVA of new loads projected for the broader City of Cambridge Area.

2.4 Results of the Eversource Analysis

2.4.1 Transmission System Results

Load flow analysis was conducted for 2030, which is consistent with the Company's typical long-term planning horizon. Various generation-out-of-service cases were tested. N-1 overloads were identified on the North Cambridge to Putnam 115-kV transmission lines as soon as 2022. The worst-case contingency overloads are shown in Table 2-5, below.

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23 https://ma-eeac.org/wp-content/uploads/MA19R15-E-2019-ResLtgOnsite_FINAL_2020.12.09.pdf.

24 The proposed customer additions include Biotech developments on 60 First St, 161 First Street, Cambridgeside Galleria, the continued "roll-out" of the Cambridge Crossing (Former North Point development) and the mixed-use facility (residential/office) on First Street and MITIMCO developments at Kendall Square.

Table 2-5 2030 N-1 Analysis Results – Worst Case Overloads

Monitored Element	Monitored Element Number	Contingency	% LTE (MVA)
North Cambridge to Putnam	831-536	N-1	146
North Cambridge to Putnam	831-537	N-1	148

N-1-1 analysis was also conducted for the Cambridge area. LTE overloads were also identified, with the worst-case overloads shown in Table 2-6, below.

Table 2-6 2030 N-1-1 Analysis Results – Worst Case Overloads

Monitored Element	Monitored Element Number	Contingency	% LTE (MVA)
Brighton to Blair Pond	329-530	N-1-1	137
Brighton to North Cambridge	329-531	N-1-1	148
North Cambridge to Putnam	831-536	N-1-1	162
North Cambridge to Putnam	831-537	N-1-1	160
Putnam to East Cambridge	831-538	N-1-1	152
Putnam to East Cambridge	831-540	N-1-1	166

All the N-1 and N-1-1 transmission overloads shown in Table 2-5 and Table 2-6 exceed the respective circuits' DAL ratings. Based on the DAL ratings, immediate actions, such as load shedding, would need to be taken to reduce the loading below the LTE ratings within 5 minutes to prevent damage to equipment. However, load shedding is not an acceptable mitigation measure because NERC Reliability Standard TPL-001-4 does not allow Non-Consequential Load Loss, as would be experienced here, to be a Corrective Action Plan to address reliability issues for loss of a single transmission component.[26]

[26] Refer to NERC TPL-001-4, Footnote 12 for Table 1.

In addition to the N-1-1 overloads, two load pockets exist in the East Cambridge area: (1) the North Cambridge-to-Putnam Load Pocket; and (2) the Putnam-to-East Cambridge Load Pocket. The transmission needs may be summarized as follows:

- Loss of one transmission element followed by the loss of a second transmission element affecting the North Cambridge-to-Putnam Load Pocket could result in the loss of supply to both Putnam and East Cambridge Substations, exceeding 343 MVA of load in 2022, growing to 411 MVA in 2030.

- Loss of one transmission element followed by the loss of a second transmission element affecting the Putnam-to-East Cambridge Load Pocket could result in the loss of supply to the East Cambridge Substation with approximately 179 MVA of unserved load in 2022, growing to 242 MVA in 2030.

- N-1 transmission line overloads – beginning in 2022, resulting in line overloads and associated area load shedding upon the loss of one transmission element in the Cambridge area.[27]

- N-1-1 transmission line overloads – beginning in 2022 and resulting in line overloads and potentially area load shedding upon the loss of two transmission elements in the Cambridge area.

2.4.2 Results of Distribution Analysis

2.4.2.1 Initial Results of Peak Load Performance Analysis

The Company examined whether the existing supply system served by the East Cambridge Substation is or will be deficient. Table 2-7 on the following page shows the ten-year forecasted 90/10 summer peak loads in MVA at the East Cambridge Substation from 2021 through 2030 from the "2021-2030 Extreme Weather NSTAR North Area Station Load Forecast." Table 2-7 also shows the Firm Capacity at the East Cambridge Substation and the projected deficiency between load and supply. If all interim operational measures described below in Section 2.6, and associated load transfers, were not implemented (as discussed further below), for the loss of one of the 115/14-kV transformers, East Cambridge Station #875 would exceed the station's Firm Capacity, resulting in 29 MVA of load at risk in 2022 and expanding to 92 MVA of load at risk in 2030.

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[27] If certain N-1 conditions were to occur, approximately 55 MVA of load would need to be shed to return the transmission element to under its LTE rating. However, as noted above, load shedding is not an acceptable mitigation measure because NERC reliability standard TPL-001-4 does not allow non-consequential load loss to address reliability issues for N-1 conditions that involve the loss of a single transmission component. In addition, because the loss of just one of either the East Cambridge or Putnam Substation would result in greater than 50 MW of load loss, the Project is needed to address the consequential loss of load at the substations.

Table 2-7 East Cambridge Substation #875 – Load (MVA) vs. Capacity

	Year									
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
East Cambridge Substation Load Forecast	126	131	132	132	132	133	133	134	134	135
Additional East Cambridge Load	24	48	62	73	78	87	92	97	102	107
East Cambridge Total	150	179	193	205	211	220	225	231	236	242
Firm Capacity	150	150	150	150	150	150	150	150	150	150
% Firm Capacity	100%	119%	129%	137%	140%	147%	150%	154%	158%	161%
Load at Risk	0	-29	-43	-55	-61	-70	-75	-81	-86	-92

The existing distribution system in East Cambridge is or will be deficient according to the following criteria:[28]

- Substation Individual Transformer Loads Exceeding 75% of normal rating under N-0 conditions (Note: two violations at Transformers 110B and 110C occurred on August 12, 2016).
- Substation Transformer Loads approaching or exceeding LTE rating after the ABR scheme has operated in response to N-1 contingency outages involving loss of a bulk substation transformer (Note: three violations occurred starting in 2019).

The two interim mitigation measures described below at Putnam Substation #831 and Somerville Substation #402 will provide partial relief for the East Cambridge Substation #875 overload until 2028, at which point no further mitigation through load transfers is available.

2.4.2.2 Additional Period and Loading Condition Analyses – East Cambridge Substation Results

The initial peak-level analysis reveals deficiencies in the distribution system under peak conditions. However, the distribution system need is far more extensive and acute than just a peak-hour need. To study behavior of the electric system during all periods, not just peak, and under different loading conditions, a distribution load-flow model for the East Cambridge

[28] SYSPLAN 10, Section 4.11.2, Bulk Distribution Transformer Loading.

Substation #875 with associated 14-kV and 4-kV electric distribution circuits was developed and used to calculate currents, voltages, angles, real and reactive power flows, equipment loading and losses over the annual operating profile.

The holistic needs assessment for East Cambridge Substation #875 was completed using both a peak day and a time-series (8760) load-flow model that accounts for every hour in a year. Due to the large amount of data points in an 8760 simulation, the results are summarized in a tabular format showing only the substation violations during the entire 8760-hour simulation. For Figures 2-4 and 2-5 that show the 8760 hourly results, the X axis represents the hour in the (non-leap) year, from 1 to 8760, and the Y axis is the MVA demand at that hour. Table 2-8 below can be used as a reference when reviewing the results of figures with 8760 plots. It lists the months and the associated hourly range in that month for the 8760 hours in a year. The summer period starts in June (hour 3625) and ends in August (hour 5832). Historically, peak summer demand is observed between July and August or hour 4,345 hour to 5,832.

Table 2-8 8760 Hours by Month Breakdown

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Hour Range	1 - 744	745- 1,416	1,417- 2,160	2,161- 2,880	2,881- 3,624	3,625- 4,344	4,345- 5,088	5,089- 5,832	5,833- 6,552	6,553- 7,296	7.297- 8,016	8,017- 8,760

The following analysis represents the substation level load-flow results at East Cambridge Substation #875. The analysis was completed for year 2030 using the forecasted load values and factors from the Company's 2030 load forecast, as referenced in Section 2.3.3:

The demand for all three bulk distribution substation transformers were modeled and summarized as follows:

- **Peak Demand Summary Table** – resulting transformer/substation MVA loading during the highest load hour of the year.
- **8760 Plot** – resulting transformer/substation MVA loading for the entire year, or 8760 hours, chronologically from January to December.
- **8760 Plot Summary Table** – sum of hours the transformer or substation is loading projected to be above normal operational conditions (90% of nameplate rating—referred to as the "Operational Limits"), and/or emergency limits (i.e., LTE).

As shown in Table 2-9, the load-flow simulation results demonstrate that East Cambridge Substation #875 is projected to exceed the substation normal thermal limits by 125 MVA during the peak-load day in 2030. The deviation in MVA violation from the 2030 forecast, 242 MVA versus 266 MVA, is the difference between the 2030 Company forecast at the distribution customer level and the resulting power flows observed at the substation level. Due to the electric distribution system characteristics, a higher MVA output is required at the substation in order to supply the same amount of demand at the distribution customer level – especially when the system is operated close to or above its normal limits and at lower power factor levels. Both the Substation and the Electric Distribution System demands values are provided in the Peak Demand Summary Table below assume the following conditions:

- Due to the complexity of allocating exact demand values at the hundreds of actual customer load points in the distribution model, an exact load match between the forecasted value and the load flow results is not always achieved. The results are the closest load flow results assuming load is increased at the substation level and then allocated to the individual customer load points (i.e., 238 MVA compared to 242 MVA).

- Peak Demand Modeled at the Distribution Level – forecasted 2030 load allocated at the Distribution Customer Level. This MVA demand closely matches the 2030 forecast because it accounts for load growth by customer.

- Peak Demand Results at the Substation Level – MVA demand observed at the substation level resulting from the allocation of the 2030 forecasted demand at the Distribution Customer Level driven by the electrical characteristics of the East Cambridge distribution system. Based on load flow results, a much higher MVA demand is required at the substation level to supply the forecasted customer demand due to the increase in reactive power support and system losses.

For the substation level results, the substation transformer Normal Limit is compared with the expected 2030 transformer MVA output and the resulting MVA deficit is shown.

Table 2-9 2030 Peak Day Simulation Results for All Substation Transformers

East Cambridge Substation 875	Peak Demand Distribution Customer Level (MVA)	Peak Demand Substation Level (MVA)	MVA Deficit over Normal Limit - Substation Level	Substation Power Factor
Transformer 1	95	108	-61	0.88
Transformer 2	72	80	-33	0.91
Transformer 3	71	78	-31	0.91
Total	238	266	-125	0.90

In addition to the peak load analysis, Figure 2-4 below shows the results of the 8760 load-flow simulations for all three distribution bulk transformers at East Cambridge Substation. The results clearly demonstrate that all three transformers will be operating above their normal thermal limit (75% of nameplate or 47 MVA) for most hours of the year.

Figure 2-4 2030 Forecasted Transformer Loading Over Normal Limit

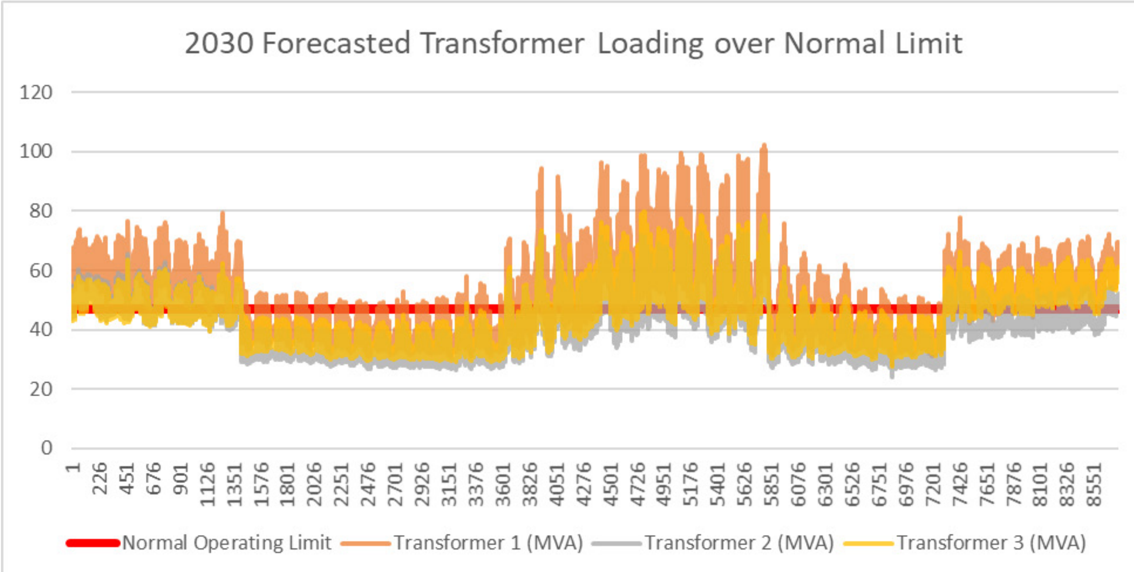
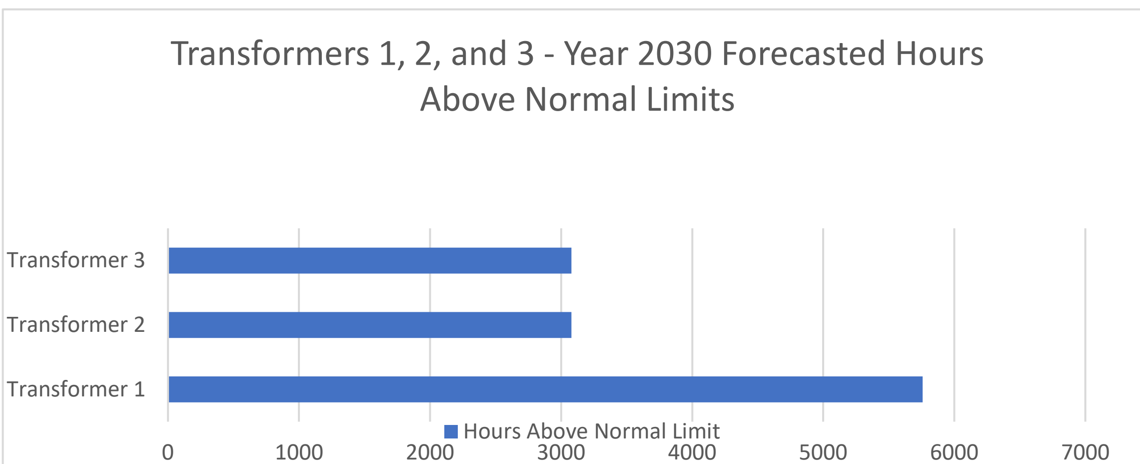


Figure 2-5 below tabulates the number of hours from Figure 2-4 during which each transformer is operating above normal limits.

Figure 2-5 Number of Yearly Hours Transformer Forecasted Load Exceeds Normal Limits



In addition to analyzing the normal operational limits of the transformers individually, the Company performed additional analysis of the substation as a whole at its limit. The 2030 Forecasted Substation Loading figure below (Figure 2-6) below shows the 8760-hour simulation results for the East Cambridge Substation as it compares with the overall substation Operational and Emergency Limits.

Figure 2-6 2030 Forecasted Transformer Loading Over Operational and Emergency Limits

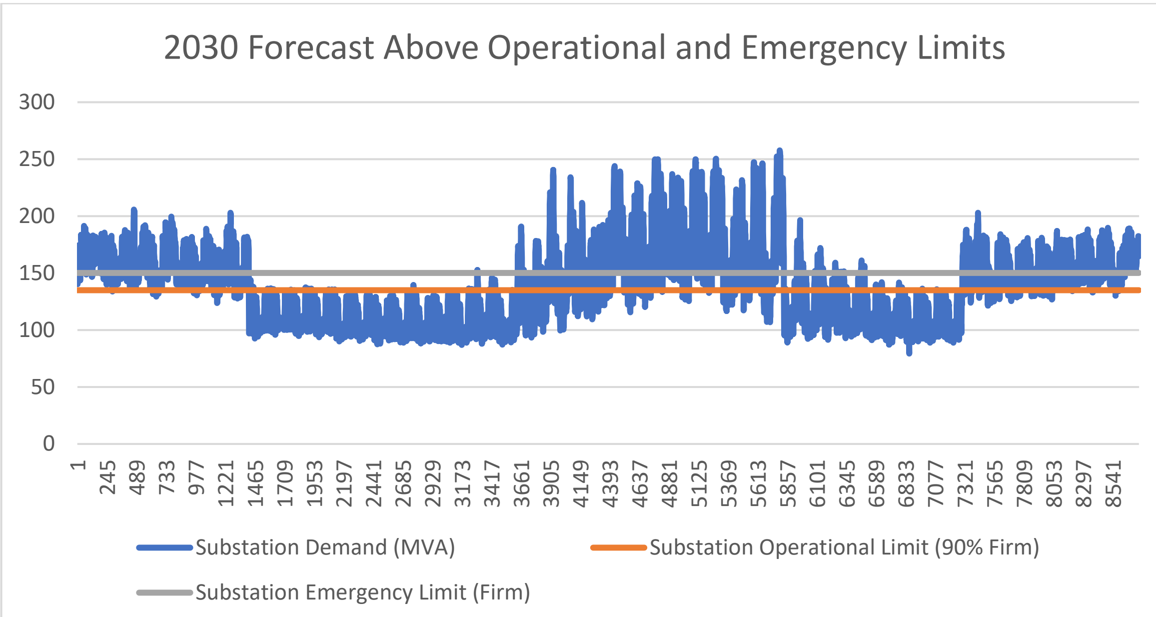
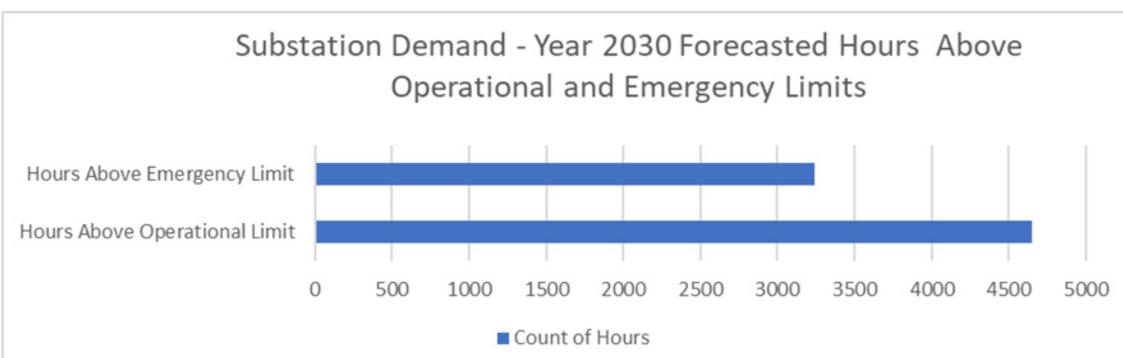


Figure 2-7 below tabulates the number of hours from Figure 2-6 above during which the substation transformer is operating above Operational and Emergency limits.

Figure 2-7 Number of Yearly Hours Substation Forecasted Load Exceeds Operational and Emergency Limits



The results clearly demonstrate that, during the forecast period, the East Cambridge Substation will be operating above Operational and Emergency Limits during most of the year, for a total of 4648 and 3243 hours respectively. A need of this magnitude cannot be addressed through operational measures alone.

2.5 Summary of Need Without Interim Operational Measures

The Company's analyses and forecasts demonstrate:

- N-1 transmission line overloads – beginning in 2022, resulting in line overloads and potentially area load shedding upon the loss of one transmission element in the Cambridge area.

- N-1-1 transmission line overloads – beginning in 2022, resulting in line overloads and potentially area load shedding upon the loss of two transmission elements in the Cambridge area.

- Complete losses of load at Putnam and East Cambridge Substations under certain N-1-1 contingencies (343 MVA of load in 2022, growing to 411 MVA of load in 2030).

- Complete loss of load at the East Cambridge Substation under certain N-1-1 contingencies (179 MVA of load in 2022, growing to 242 MVA of load in 2030); and

- N-1 distribution transformer overload at the East Cambridge Substation, or the loss of one of the other distribution transformers, resulting in distribution feeder overloads and 92 MVA of load at risk of requiring load shedding in 2030 with increasing risk each year thereafter.

The N-1 and N-1-1 transmission overloads are violations of NERC Reliability Standards TPL-001-4.

In short, the load in the area served by the East Cambridge substation is rapidly growing well beyond the capacity of the existing East Cambridge Substation and it is projected to exceed 100% of its LTE rating by 2022. Based on the Company's analyses, a comprehensive solution to all of the needs identified is required.

2.6 Interim Operational Measures

As referenced above, to address these immediate and near-term distribution transformer overloads, and the associated safety and reliability risk, the Company has implemented one interim operational measure (adding a fourth transformer at Putnam Substation #831). The Company also plans to implement a second interim operational measure (adding a third transformer at Somerville Substation #402) before Summer 2023. Despite these interim measures, with all adjacent stations approaching their Firm Capacity by 2027, the East Cambridge Substation capacity deficiency re-emerges by 2028. Moreover, the interim operational measures do not fully address all of the needs that exist over the planning horizon, particularly the existing transmission reliability issues in the Project Area and were taken only out of necessity as interim actions due to unexpected delays with implementing the permanent solution.

As an historical matter, the Company first identified a need for a reliability solution in East Cambridge in 2014. The Company initially hoped to address the then-identified need through expansion of the Prospect Street Substation in Cambridge. That solution ultimately was determined to be infeasible because of community opposition. The Company then identified a parcel on Fulkerson Street in East Cambridge in 2017. However, this location also became untenable due to community feedback. After an extensive collaborative process with stakeholders, including the City of Cambridge, the Company reached agreement with BXP (2019) to reserve rights for a potential reliability solution on a parcel of land in Kendall Square being redeveloped by BXP.

Each time the Company has attempted previously to solve the reliability need in East Cambridge; it has not been able to move forward. Therefore, the Company identified interim operational measures to partially defer identified substation and transformer violations.

The first such interim step is an expansion of the Putnam Substation through the addition in 2020 of a fourth transformer and related equipment.[29] The Company installed a fourth 62.5 MVA 115/14-kV transformer at Putnam Substation #831, a section of 14-kV distribution switchgear at Putnam Substation #831 and a distribution duct bank from Putnam Substation #831 to the Kendall Square area to relieve the East Cambridge Substation #875 overload. The Putnam Substation #831 initially had three 70 MVA rated transformers with LTE capability of 73 MVA, giving a substation Firm Capacity of 146 MVA. The addition of the fourth transformer with LTE capability of 65 MVA (limited by substation equipment) increased the Putnam Substation #831 Firm Capacity from 146 MVA to 211 MVA, allowing for a total planned load transfer of 34 MVA from East Cambridge Substation #875 to Putnam Substation #831. This mitigation measure provides two years of relief[30] before the existing East Cambridge Substation #875 is overloaded again.

The second interim measure is currently being implemented at Somerville Substation #402. The Company plans to install a third 62.5 MVA 115/14-kV transformer and two additional sections of 14-kV switchgear at the Somerville Substation #402 in 2023, to relieve projected overloads in the Project Area. The third 115/14-kV transformer would add an additional 75 MVA of Firm Capacity

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29 Due to physical limitations at the existing East Cambridge Substation #875 site, expansion at that facility is not possible.

30 Additional transfer capacity, beyond the 34 MVA, is not possible since an additional load transfer would result in Putnam Substation exceeding its Firm Capacity prior to 2030. Moreover, this is an emergency interim solution since Putnam Substation is expected to exceed its Operational Limit stating in 2025.

to Somerville Substation #402. The third transformer will permit the Company to implement additional load transfers from East Cambridge Substation #875 between 2023 and 2027, when the Company's proposed Project is expected to be in service.[31]

2.6.1 Transmission System Results

To test the effectiveness of the interim operational measures, load flow analysis was conducted for 2030, which is consistent with the Company's typical long-term planning horizon – after application of interim operational measures; however, transmission overloads still remain. Various generation out-of-service cases were tested. N-1 overloads were identified on the North Cambridge to Putnam 115-kV transmission lines as soon as 2022. The worst-case contingency overloads are shown in Table 2-10 below.

Table 2-10 2030 N-1 Analysis Results – Worst Case Overloads

Monitored Element	Monitored Element Number	Contingency	% LTE (MVA)
North Cambridge to Putnam	831-536	N-1	116
North Cambridge to Putnam	831-537	N-1	117

N-1-1 analysis was also conducted for the Cambridge area. LTE and DAL overloads were identified, with the worst-case LTE overloads shown in Table 2-11 on the following page. The N-1-1 transmission overloads above respective circuits' DAL ratings would require immediate actions such as load shedding to reduce the loading below the LTE ratings within 5 minutes to prevent damage to equipment. As seen on Table 2-11 on the following page, despite the interim operational measures, N-1-1 transmission overloads persist.

31 Somerville does not have room for an additional fourth transformer, and therefore, cannot provide a permanent solution to the overload issues identified in East Cambridge. By 2028, continuing to operationally mitigate East Cambridge overloads through transfers to Somerville Substation will put Somerville above its own operational limits. Thus, the mitigation to East Cambridge overloads provided by the additional transformer at Somerville Substation is only an emergent interim solution until the Project can be placed in service to address the full area needs.

Table 2-11 2030 N-1-1 Analysis Results – Worst Case Overloads

Monitored Element	Monitored Element Number	Contingency	% LTE (MVA)
Brighton to Blair Pond	329-530	N-1-1	111
Brighton to North Cambridge	329-531	N-1-1	120
North Cambridge to Putnam	831-536	N-1-1	121
North Cambridge to Putnam	831-537	N-1-1	119
Putnam to East Cambridge	831-538	N-1-1	100
Putnam to East Cambridge	831-540	N-1-1	110

In addition to the N-1-1 overloads, two load pockets exist in the East Cambridge area: (1) the North Cambridge-to-Putnam Load Pocket; and (2) the Putnam-to-East Cambridge Load Pocket. The transmission needs may be summarized as follows:

- Loss of one transmission element followed by the loss of a second transmission element affecting the North Cambridge-to-Putnam Load Pocket could result in the loss of supply to both Putnam and East Cambridge Substations, exceeding 343 MVA of load in 2022, growing to 367 MVA in 2030.

- Loss of one transmission element followed by the loss of a second transmission element affecting the Putnam-to-East Cambridge Load Pocket could result in the loss of supply to the East Cambridge Substation, with approximately 147 MVA of unserved load in 2022, growing to 164 MVA in 2030.

- N-1 transmission line overloads – beginning in 2022, resulting in line overloads and associated area load shedding upon the loss of one transmission element in the Cambridge area.[32]

[32] If certain N-1 conditions were to occur, approximately 55 MVA of load would need to be shed to return the transmission element to under its LTE rating. However, as noted above, load shedding is not an acceptable mitigation measure because NERC reliability standard TPL-001-4 does not allow non-consequential load loss to address reliability issues for N-1 conditions that involve the loss of a single transmission component. In addition, because the loss of just one of either the East Cambridge or Putnam Substations would result in greater than 50 MW of load lost, the Project is needed to address the consequential loss of load at such substations.

- N-1-1 transmission line overloads – beginning in 2022, resulting in line overloads and potentially area load shedding upon the loss of two transmission elements in the Cambridge area.

2.6.2 Results of Distribution Analysis

The following Table 2-12 below shows the resulting substation load levels over capacity for the substations in the Project Area, plus Somerville (which will be taking on some of the East Cambridge load for the period until a permanent solution is implemented).

Table 2-12 Project Area and Somerville Substations – Load (MVA) vs. Capacity

Substations	Capacity	Years									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
East Cambridge #875	Load	135	147	148	147	148	148	147	153	158	164
	Firm Capacity	150	150	150	150	150	150	150	150	150	150
	Load/Firm Capacity	90%	98%	99%	98%	98%	99%	98%	102%	106%	109%
Putnam #831	Load	166	196	199	201	201	202	202	202	203	204
	Firm Capacity	211	211	211	211	211	211	211	211	211	211
	Load/Firm Capacity	79%	93%	94%	95%	95%	96%	96%	96%	96%	96%
Somerville #402	Load	55	57	70	81	86	95	101	101	101	102
	Firm Capacity	75	75	120	120	120	120	120	120	120	120
	Load/Firm Capacity	74%	75%	58%	67%	72%	79%	84%	84%	84%	85%

These operational measures only serve to delay the date of critical substation capacity need and do not provide a comprehensive, long-term solution to the needs identified. The section below expands on substation level load-flow results at East Cambridge Substation accounting for interim operational measures.

Similar to the analysis presented in Section 2.4, the analysis in this section was completed for year 2030 using the forecasted load values. The demand for all three bulk distribution substation transformers were modeled and summarized in the Peak Demand Summary Table, the 8760 Graph, and the 8760 Graph Summary Table all set forth in in Section 2.4.2.2.

Figure 2-8 below shows the results of the 8760 load-flow simulations for all three distribution bulk transformers at East Cambridge Substation. The results clearly demonstrate that each of the three transformers will be operating above the transformer-level normal limit (75% of nameplate or 47 MVA) for most of the summer period.

Figure 2-8 2030 Forecasted Transformer Loading Over Normal Limit

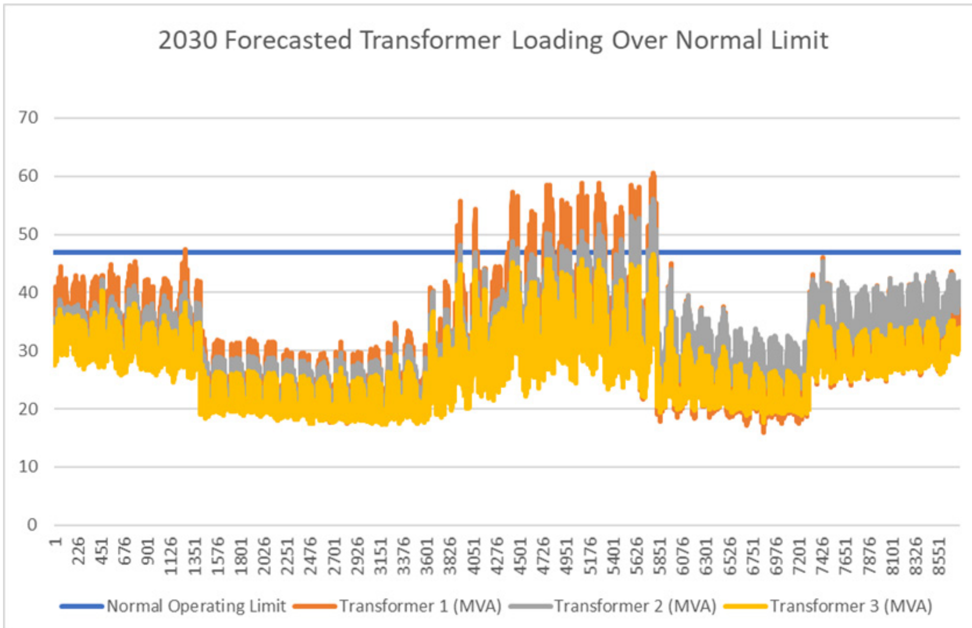
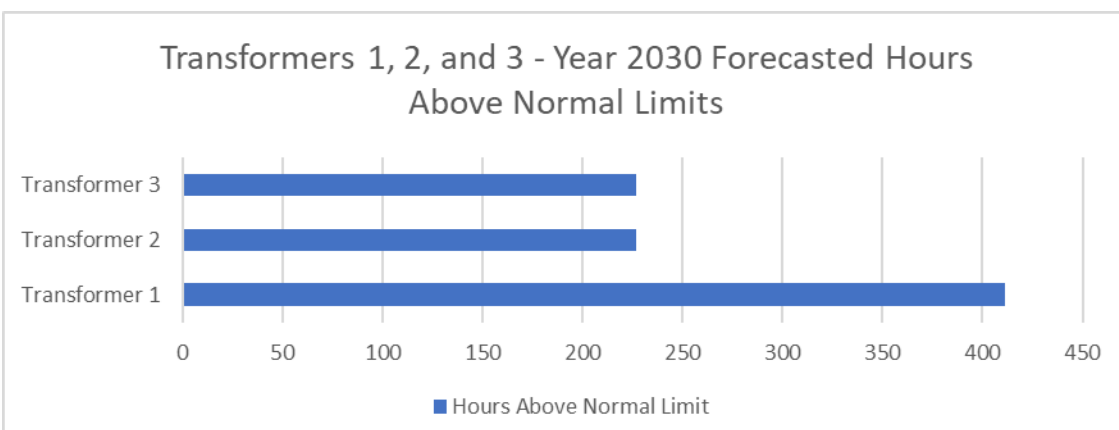


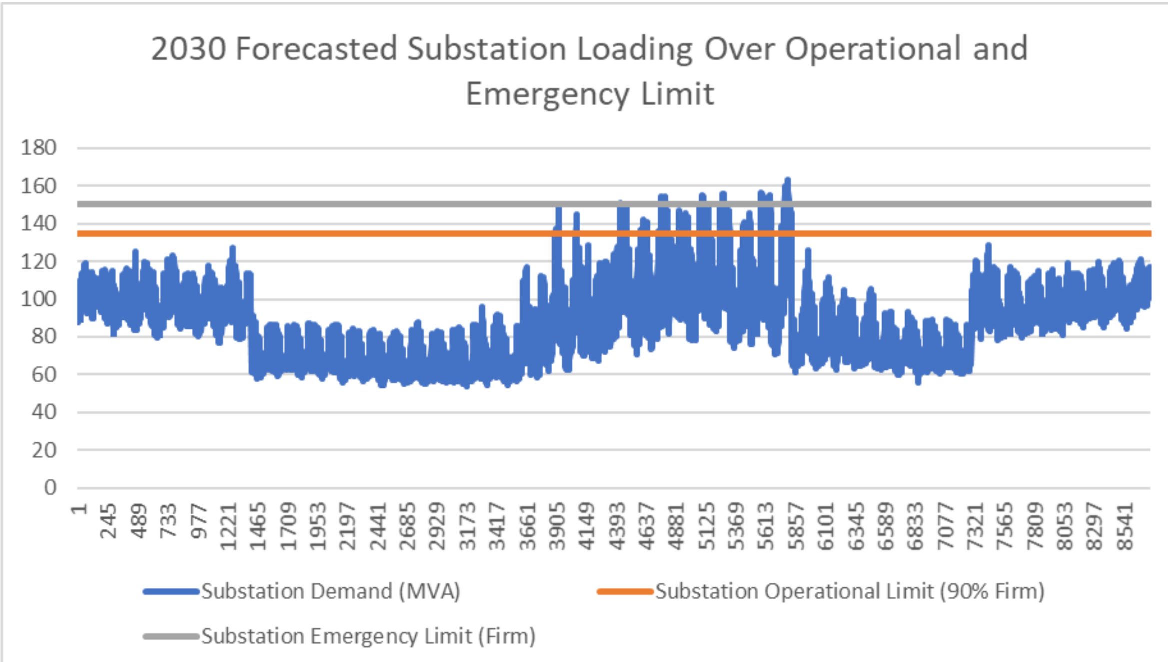
Figure 2-9 below tabulates the number of hours from Figure 2-8 that each transformer is operating above normal limits.

Figure 2-9 2030 Forecasted Transformer Loading Over Normal Limit



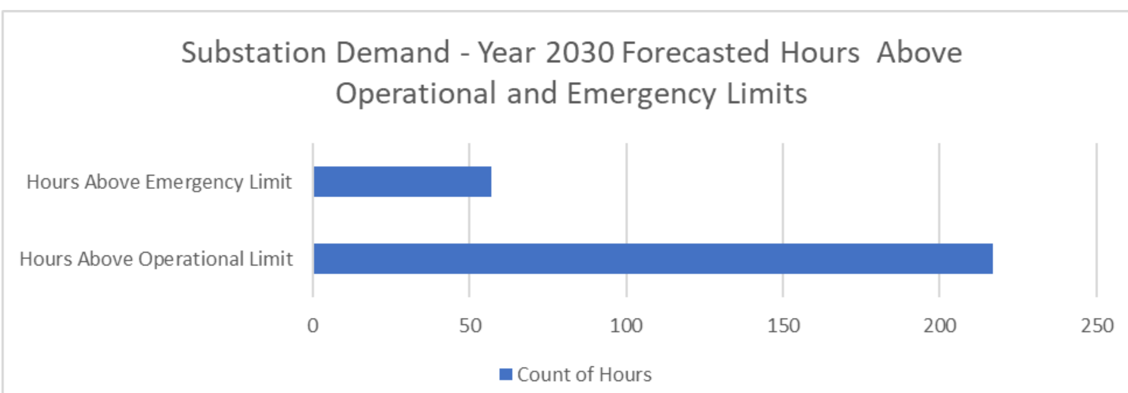
In addition to analyzing the normal operational limits of the transformers individually, the Company performed additional analysis of the substation as a whole. The 2030 Forecasted Substation Loading Figure 2-10 below shows the 8760-hour simulation results for the East Cambridge Substation as it compares with the Operational and Emergency Limits.

Figure 2-10 2030 Forecasted Substation Loading Over Operational and Emergency Limits



The following Figure 2-11 tabulates the number of hours during the year the limits are exceeded.

Figure 2-11 Sum of Yearly Hours Substation Forecasted Load Exceeds Emergency and Operational Limits



As shown in Table 2-13 below, the load-flow simulation results including the interim operational measures demonstrate that East Cambridge Substation is projected to exceed the substation normal limits by 27 MVA[33] during the peak-load day in 2030. The peak demands values[34] are provided at the distribution customer and substation levels.[35]. For the substation level results, the substation transformer normal limit is compared with the expected 2030 transformer MVA output and the resulting MVA deficit is shown.

Table 2-13 2030 Peak Day Simulation Results for East Cambridge Substation Transformers – After Implementation of Interim Operational Measures

East Cambridge Substation 875	Peak Demand Distribution Customer Level (MVA)	Peak Demand Substation Level (MVA)	MVA Deficit over Normal Limit - Substation Level	Substation Power Factor
Transformer 1	61	68	-21	0.90
Transformer 2	48	50	-3	0.96
Transformer 3	48	50	-3	0.96
Total	157	168	-27	0.94

These results clearly demonstrate that, during the forecast period, the East Cambridge Substation #875 will be operating above Operational and Emergency Limits during most of the summer period (217 hours to 57 hours, as per Figure 2-11 on the prior page). A need of this magnitude cannot be addressed through additional operational measures, given that that nearby substation capacity has been exhausted by 2030.

As noted above, not only is the distribution loading at East Cambridge Substation #875, as well as transmission line loadings from North Cambridge to Putnam to East Cambridge transmission lines remaining unresolved, the interim measures in Section 2.6.2 now fully exhaust the available capacity of nearby substations. As seen above in Table 2-13, these interim measures now result

33 The deviation in MVA violation from the 2030 forecast is the difference from adding the 2030 Company forecast at the distribution customer level and analyzing the resultant power flows at the substation level. Due to the electric distribution system characteristics, a higher MVA output is required at the substation in order to supply the same amount of demand at the distribution level

34 Due to the complexity of allocating exact demand values at the hundreds of actual customer load points in the distribution model, an exact load match between the forecasted value and the load flow results is not always achieved. The results are the closest load flow results assuming load is increased at the substation level and then allocated to the individual customer load points.

35 Refer to Section 2.4.2.2.

in all three stations (East Cambridge, Putnam, Somerville) operating above Operational Limits – exposing the broader region to a sustained loss of load in the event of a station transformer failure with no adjacent station being able to provide operational relief.

Therefore, a solution is required not only to relieve the distribution overload at East Cambridge and radial transmission overloads in Putnam and East Cambridge, but to comprehensively balance the loading of all substations in the Project Area, including Somerville Substation #402 for the long-term reliability of this region.

As seen in Table 2-14 below, with the energization of a comprehensive solution, the loadings at East Cambridge, Putnam, and Somerville substations are properly balanced and reduced to meet normal and operational limits, as well as leaving some headroom for expected future growth. The lower 2030 substation MVA load values are the result of 50 MVA of demand transferred out of East Cambridge Substation in year 2028[36], in addition to 50 MVA out of Putnam and 20 MVA out of Somerville Substation #402.

Table 2-14 Cambridge and Somerville Area Substations after Implementation of a Comprehensive Solution – Load (MVA) vs. Capacity

Substations	Capacity	Years									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
East Cambridge #875	Load	135	147	148	147	148	148	147	103	108	114
	Firm Capacity	150	150	150	150	150	150	150	150	150	150
	Load/Firm Capacity	90%	98%	99%	98%	99%	99%	98%	69%	72%	76%
Putnam #831	Load	166	196	199	201	201	202	202	152	153	153
	Firm Capacity	211	211	211	211	211	211	211	211	211	211
	Load/Firm Capacity	79%	93%	94%	95%	95%	96%	96%	72%	73%	73%
Somerville #402	Load	55	57	70	81	86	95	101	81	81	82
	Firm Capacity	75	75	120	120	120	120	120	120	120	120
	Load/Firm Capacity	73%	76%	58%	68%	72%	79%	84%	68%	68%	68%

[36] Note that the Table 2-14 shows a net reduction of approximately 44 MVA from 2027 to 2028; this is due to load growth of a little over 5 MVA at the East Cambridge Substation that is projected to occur in the same time period as the transfer.

Table 2-14 Cambridge and Somerville Area Substations after Implementation of a Comprehensive Solution – Load (MVA) vs. Capacity (Continued)

Substations	Capacity	Years									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Alewife #828	Load	85.8	91.9	92.1	95.2	96.4	97.7	98.9	100.2	101.6	103
	Firm Capacity	123	123	123	123	123	123	123	123	123	123
	Load/Firm Capacity	70%	75%	75%	77%	78%	79%	80%	81%	83%	84%
Comprehensive Solution[37]	Load								120	126	132
	Firm Capacity								180	180	180
	Load/Firm Capacity								67%	70%	73%

With the continued de-loading of the adjacent stations coupled with accommodating new load growth in the Cambridge area, the 180 MVA of Firm Capacity is projected to be 73% utilized by 2030. Beyond 2030, with continued load growth expected, it is likely that additional transformer capacity will be needed in the Project Area given the high loading of all five substations serving the Project Area and surrounding portions of Cambridge.

Therefore, the interim operational measures do not address the distribution need. The interim operational measures also do not eliminate any of the N-1 and N-1-1 transmission overloads described above, nor do they eliminate the loss of load under any N-1-1 transmission loss contingencies. Accordingly, despite its deployment of operational mitigation measures, the Company's analysis demonstrates a continuing critical transmission and distribution need that requires a comprehensive, long-term solution.

2.7 Summary of Need after Interim Operational Measures

The Company's analyses and forecasts demonstrate that, even after application of the interim operational measures, the following needs remain and must be addressed:

- N-1 transmission line overloads – beginning in 2022, resulting in line overloads and potentially area load shedding upon the loss of one transmission element in the Cambridge area.

[37] 2028-2030 Project loadings are based on current planning projections. These loadings may change over time as the Company continues to update its annual forecast in the future.

- N-1-1 transmission line overloads – beginning in 2022, resulting in line overloads and potentially area load shedding upon the loss of two transmission elements in the Cambridge area.

- Complete losses of load at Putnam and East Cambridge Substations under certain N-1-1 contingencies (343 MVA of load in 2022, growing to 367 MVA of load in 2030).

- Complete loss of load at the East Cambridge Substation under certain N-1-1 contingencies (147 MVA of load in 2022, growing to 164 MVA of load in 2030); and

- N-1 distribution transformer overload at the East Cambridge Substation, or the loss of one of the other distribution transformers, resulting in distribution feeder overloads and 14 MVA of load at risk of requiring load shedding in 2030 with increasing risk each year thereafter.

The N-1 and N-1-1 transmission overloads are violations of NERC Reliability Standards TPL-001-4.

In short, the load in the area served by the East Cambridge Substation is rapidly growing beyond the capacity of the existing East Cambridge Substation and it is projected to exceed 100% of its LTE rating by 2022. Based on the Company's analyses, a comprehensive solution to all of the needs identified is required.

2.8 Conclusion

As shown by the foregoing analysis, the Company must address the potential for existing transmission line overloads as well as the need for additional distribution substation capacity that would result in a loss of service to customers in the Project Area under certain contingencies. Given current loads and expected growth, the need for solutions to address these issues is immediate and significant. The Company's analysis of potential comprehensive solutions follows in Section 3.

Section 3.0

Project Alternatives

3.0 PROJECT ALTERNATIVES

3.1 Introduction

This Section describes the process the Company used to identify and evaluate a variety of alternatives to address the reliability and capacity needs within the Project Area. As discussed in Section 2, a solution is needed to comprehensively address: (1) N-1 and N-1-1 transmission line overloads beginning in 2022 that would potentially lead to load shedding in the Project Area; (2) N-1 distribution transformer overloads at the East Cambridge Substation, or the loss of one of the other distribution transformers, resulting in distribution feeder overloads and 92 MVA of load at risk requiring load shedding in 2030 with increasing risk each year thereafter; and (3) the complete loss of load at the East Cambridge Substation and Putnam Substation under certain N-1-1 contingencies.

Consistent with Siting Board precedent, the Company has performed an analysis of potential alternatives from the perspective of their ability to reliably meet the identified needs with a minimum impact on the environment and at the lowest possible cost. The Company considered the following alternatives: (1) a "No-Build" alternative; (2) wires alternatives; and (3) non-wires alternatives ("NWAs"), including new generation (both distributed and utility-scale resources, as well as both conventional and renewable energy resources), demand reduction programs such as energy efficiency ("EE") and demand response ("DR"), as well as energy storage technologies. The analysis presented in this Section demonstrates that the Company's proposed Project is, on balance, the superior alternative available to fully address the identified needs with a minimum impact on the environment and at the lowest possible cost.

3.2 No-Build Alternative

Under the No-Build Alternative, the Company would only implement the interim operational measures described in Section 2.6. However, these interim solutions are limited in their ability to negate the need during the planning horizon and thereafter. The interim solutions merely defer the above-described need, and the underlying need would still require addressing by 2028. Beyond those interim measures, the Company would not pursue any new facilities or resources in the Project Area, but instead would continue to rely upon the existing system configuration, while maintaining and operating it in a prudent manner.

In addition to insufficiently addressing the distribution need, this approach was dismissed from consideration because it would not address the critical transmission reliability and substation capacity needs that are discussed in Section 2 of this Analysis. If these needs are left unaddressed, there would be no capacity to serve known new customer loads and, in fact, customer load in Cambridge would need to be shed under certain contingencies to eliminate equipment overloads. The result is that the Company would be non-compliant with established industry and internal reliability standards.

As a regulated utility, the Company has an obligation to provide reliable distribution and transmission service in accordance with NERC reliability standards, NPCC regional standards, and ISO-NE criteria. The No Build Alternative was thus rejected by the Company because it would not provide a solution to the identified existing and projected substation capacity and transmission reliability needs.

3.3 Wires Alternatives

The Company assessed several wires alternatives to address the identified transmission reliability and substation capacity needs. The alternatives are described more fully below.

3.3.1 Potential Wires Alternatives

The Company evaluated various wires alternatives, focusing on potential locations for the needed incremental substation capacity that: (1) would accommodate the addition of substation transformers with sufficient combined capacity to address the project needs identified above; and (2) are in sufficiently close proximity to both the transmission system and the East Cambridge Load Pocket to be an effective solution.

Fulfilling the identified needs led the Company to consider both Company-owned property and new substation locations. The Company evaluated the Somerville and Putnam Substations. The Somerville and Putnam Substations are the sites of the interim operational measures and are therefore unavailable as potential Project sites (refer to Section 2.6). Alewife Substation also supplies the City of Cambridge, and it was considered both as a site for an interim solution and a permanent solution. However, it was deemed to a non-viable alternative due to its distance from the East Cambridge Load Pocket and to the lack of sufficient additional space in the substation to house the equipment needed for a comprehensive solution to the identified needs.

The next potential options on Company-owned property for Bulk Distribution system expansion in proximity to both the transmission system and the East Cambridge Load Pocket were the Company's Linwood Street area work center and the existing Prospect Street distribution switching substation. The Company also considered a new substation on new property not yet owned by the Company.

The suite of wires alternatives reviewed by the Company were:

a) a new 115/14-kV substation in East Cambridge and associated transmission infrastructure,
b) three new transformers at Prospect Street and two new transformers (expandable to three) at Linwood Street,
c) two new transformers at Prospect Street and three new transformers at Linwood Street, and
d) three new transformers (expandable to four) at Linwood Street.

The Company determined that option (d) was the least desirable, as compared to options (c) and (b), because the property at Linwood Street is located furthest from the Load Pocket, thereby requiring substantially more distribution infrastructure, and imposing greater community and other impacts as compared to the other three possible wires solutions.

In consideration of option (c), again, proposing more substation infrastructure at Linwood than would be located there as compared to either option (b), it suffers from the same increased difficulty and impacts as option (d) and therefore option (c) was also determined to be inferior.

The Company then evaluated options (a) and (b) because they had fewer of these drawbacks. Option (a) became Alternative 1 and is described further below in Section 3.3.2. Option (b) became Alternative 2 and is described further below in Section 3.3.3.

Out of the four potential alternatives reviewed, the Company selected options (a) and (b) for further analysis. Option (a) became Alternative 1 and is described further below in Section 3.3.2. Option (b) became Alternative 2 and is described further below in Section 3.3.3. Options (c) and (d) were not considered further because they do not result in sufficient substation firm capacity close to the Load Pocket.

3.3.2 Alternative 1 – Preferred Solution (the "Project")

Alternative 1 would include the construction of a new 115/14-kV substation in East Cambridge between Broadway and Binney Streets, to be designated by the Company as Substation #8025 ("New Substation"). The site of the proposed New Substation is approximately 35,000 square feet (0.8 acres). The New Substation would use 115-kV gas-insulated switchgear ("GIS") ultimately with seven (7) bays of 115-kV circuit breakers in a breaker-and-a-half configuration totaling 22 115-kV breakers that would provide both fault isolation and switching capability, connecting the new 115-kV transmission lines to the station. The New Substation would include three 90 MVA 115/14-kV transformers and associated switchgear, with the option to add a fourth transformer and associated switchgear for use when the substation load is projected to exceed 90% of the substation's 180 MVA of Firm Capacity.[38] This equipment would allow the electrical load to be moved from East Cambridge Substation #875, thus eliminating projected overloads on the existing transformers at East Cambridge Substation #875. With this solution, electrical load would be transferred from Putnam Substation #831 and Prospect Street Substation #819 to decrease the heavy loading conditions at both substations. The Firm Capacity of the New Substation would be 180 MVA, expandable to 270 MVA.[39]

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38 The fourth transformer addition is projected beyond the ten-year planning horizon based on the 2021 load forecast. Because it is beyond the ten-year planning horizon, it is not part of the Project for which the Company seeks the Siting Board's approval at this time.

39 While not directly jurisdictional to the Siting Board, the Company will be installing 36 distribution feeders, expandable to 48 feeders should a fourth transformer need to be added in the future. The new distribution street infrastructure would consist of 34,300 linear feet of conduit and 103,200 linear feet of cable.

The New Substation would be supplied by eight transmission circuits in five duct banks for a total length of approximately 8.3 miles of duct bank as depicted in Figure 3-1 below, to be accomplished with the following components:

- ♦ Replace the existing segment of Lines 329-510 and 329-511 between Brighton Substation #329 and Somerville Substation #402 (approximately 2.91 and 3.0 miles of duct bank) with new cross-linked polyethylene ("XLPE") cables from Brighton Substation #329 to proposed New Substation #8025 (approximately 5.91 miles). These two duct banks will each contain one transmission line.

- ♦ Install new XLPE cables from the proposed New Substation #8025 to Somerville Substation #402 (approximately 1.28 miles of duct bank). The lines between proposed New Substation #8025 and Somerville Substation #402 would be designated Lines 250-510 and 250-511 and each line would be installed in the same duct bank (i.e., this duct bank would house two transmission lines).

- ♦ The existing Putnam – East Cambridge 115-kV XLPE Line 831-538 from Edwin H. Land Boulevard, Cambridge to the proposed New Substation #8025 would be reconfigured by cutting the line and extending the two segments to the proposed New Substation #8025 (approximately 0.49 miles of duct bank). The line between Putnam Substation #831 and the proposed New Substation #8025 would be designated Line 831-538 and the line between East Cambridge Substation #875 and the proposed New Substation #8025 would be designated Line 875-538. At Putnam Substation #831, two series reactors, each 3.97 Ohms, would be installed in existing Lines 831-536 and 831-537. The duct bank used for this route will house two separate transmission lines.

- ♦ Lastly, two new 115-kV, XLPE lines would be constructed from the New Substation #8025 to the East Cambridge area. The first (Line 875-539) would connect the New Substation #8025 to East Cambridge Substation #875 (0.59 miles). The second (Line 850-539) would connect the proposed New Substation #8025 to the Kendall Generating Station #850. The duct bank used for this route will house two separate transmission lines.

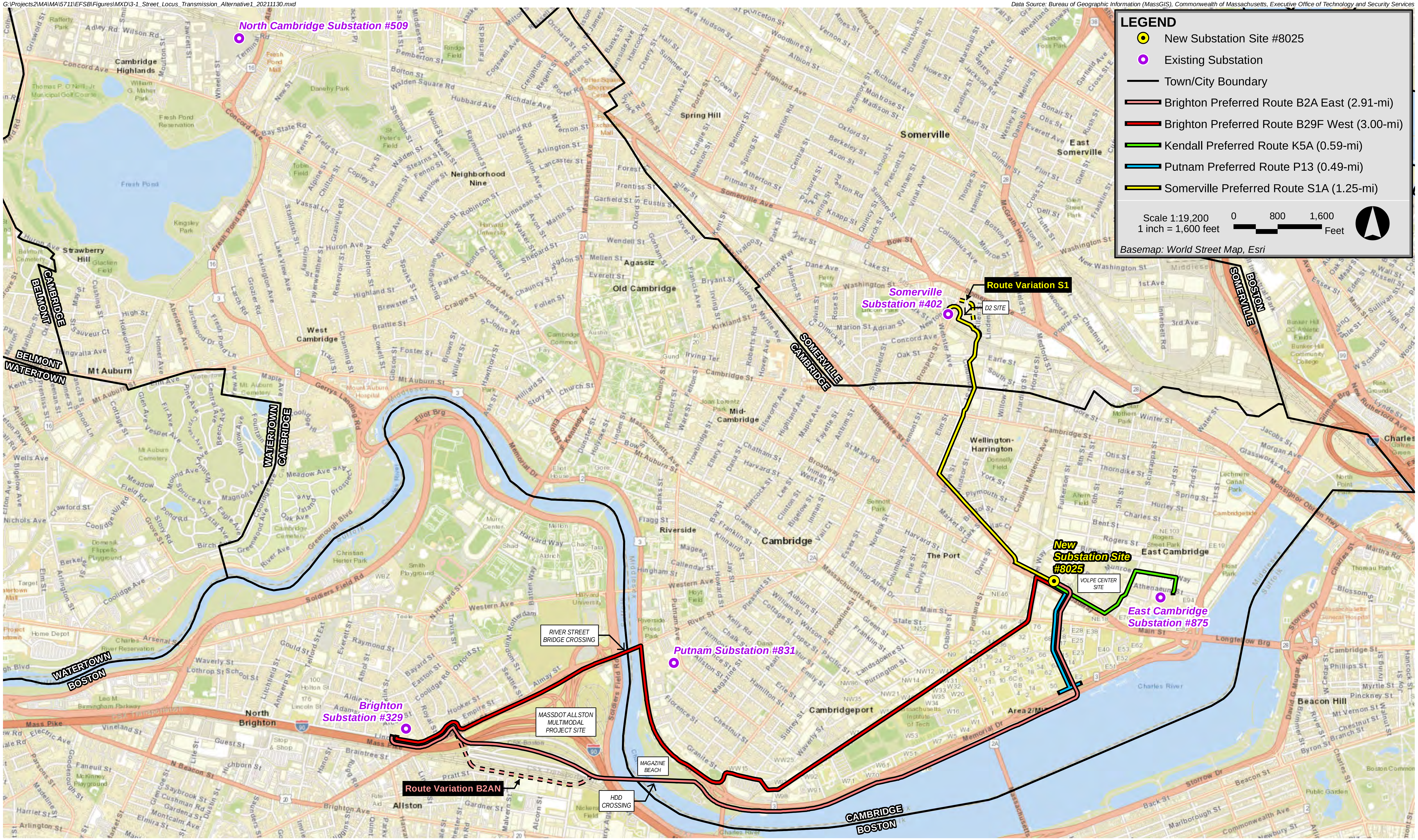

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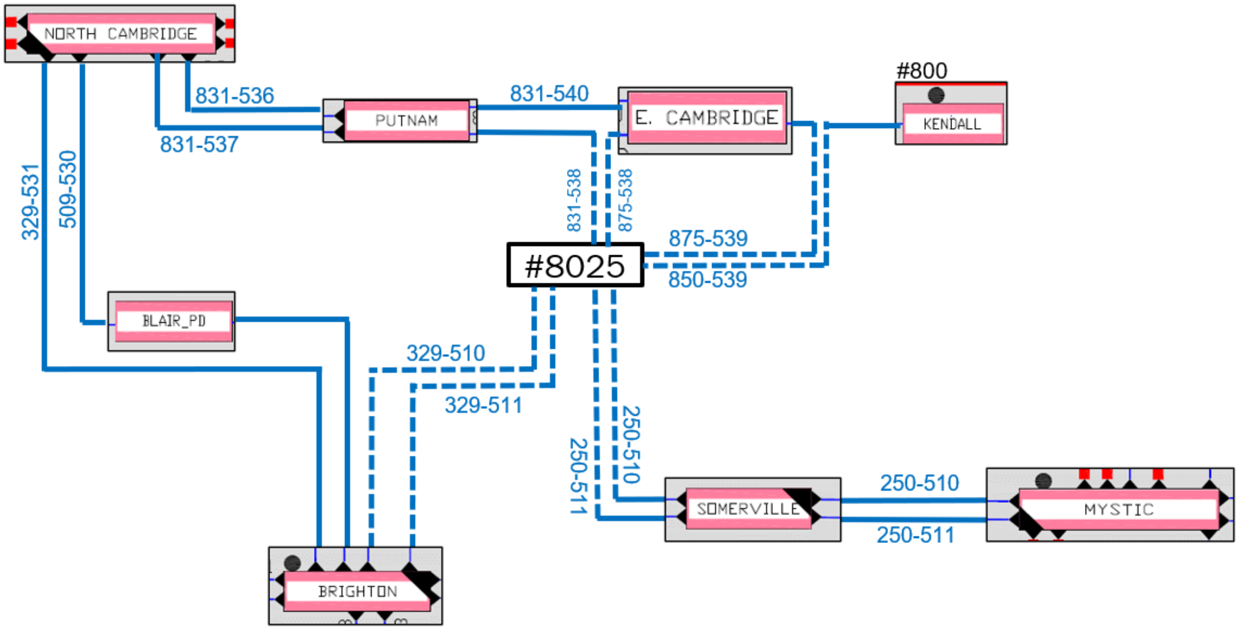
Figure 3-1

Transmission Alternative 1 (Project)

Figure 3-2 below illustrates the transmission line connections to proposed New Substation #8025.

Figure 3-2 115-kV Transmission Connections of the Project to the New Substation #8025



3.3.3 Alternative 2

Alternative 2 would involve the construction of two new or expanded 115/14-kV substations: (1) one at Prospect Street Substation #819 in Cambridge, which is an existing distribution switching station, and (2) the other on existing Company-owned property at Linwood Street in the City of Somerville. The two new substations would be supplied by eight new transmissions lines in approximately 17.6 miles of new duct bank. Alternative 2 is shown in Figure 3-3 on the following page. The station and line configuration of Alternative 2 is shown in Figure 3-4 on page 3-8.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

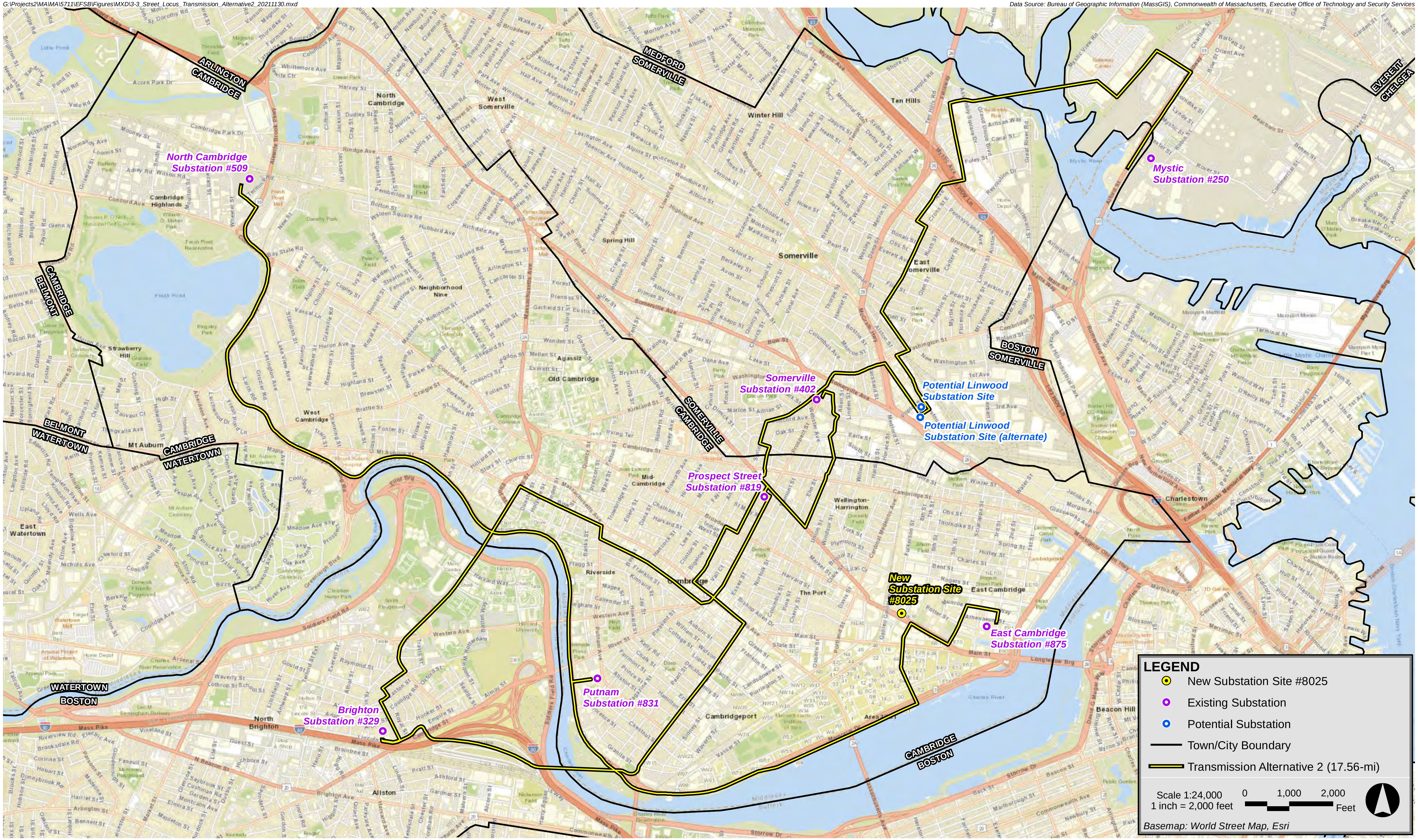

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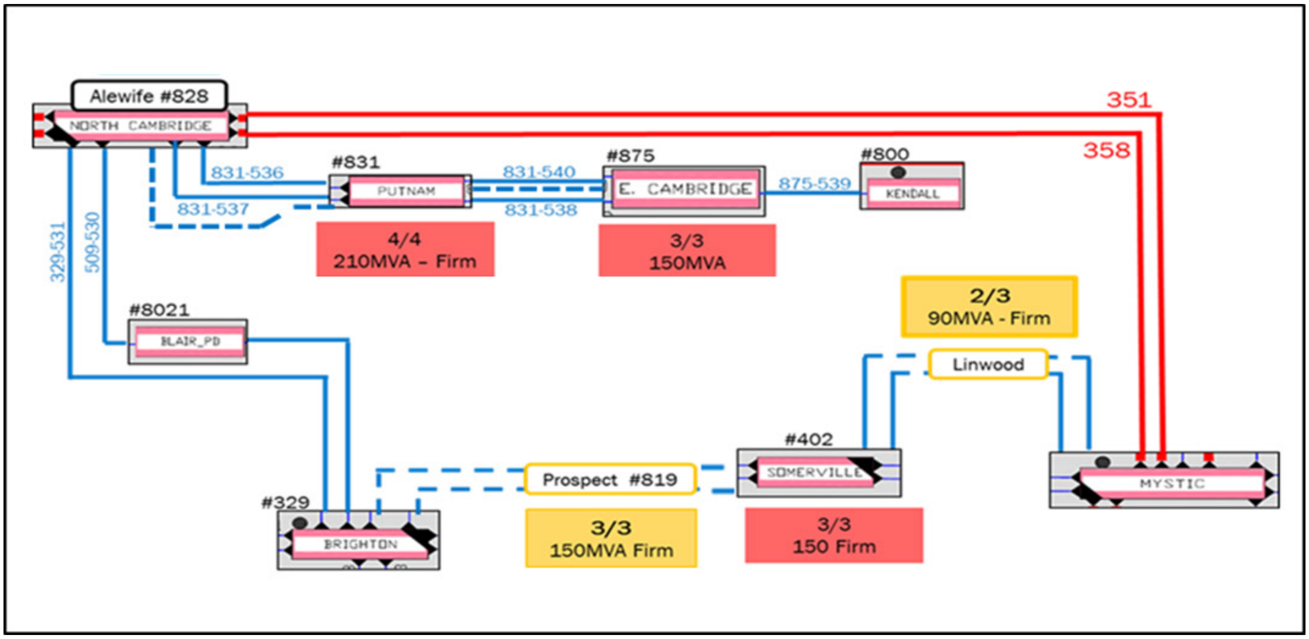
Figure 3-3

Transmission Alternative 2

Figure 3-4 Prospect Street Substation #819 and Linwood Street Substation – 115kV Configuration



As shown in Figure 3-4 above, the expanded Prospect Street Substation #819 would be supplied by two new 115-kV XLPE lines from Brighton Substation #329 (2.77 miles and 2.99 miles, respectively), and two new XLPE lines from Somerville Substation #402 in Somerville (0.95 miles and 0.59 miles, respectively). The site for the Prospect Street Substation is part of an existing Eversource distribution switching station, on an approximately 32,600 square feet (0.75 acres) parcel of land containing an existing building.

The expanded Prospect Street Substation would consist of 115-kV GIS with four bays of 115-kV circuit breakers in a breaker-and-a-half configuration totaling twelve (12) 115-kV circuit breakers that would provide both fault isolation and switching capability, connecting the 115-kV transmission lines to the substation. Three 37/50/62.5 MVA transformers would be installed. This alternative would utilize the existing four sections of 14-kV switchgear and install two new sections of 14-kV switchgear. The New Substation #8025 would support local distribution loads, allowing load to be moved from East Cambridge Substation #875 to Prospect Street Substation, thus eliminating the projected overloads on the existing transformers at the East Cambridge Substation #875. Load would also be transferred from Putnam Substation #831 to the Prospect Street Substation load pocket, thereby decreasing the heavy loading conditions at Putnam Substation #831. The Firm Capacity of the expanded Prospect Street Substation would be 150 MVA.

Twelve new distribution feeders would be installed. The new distribution street infrastructure for Prospect Street under this alternative would consist of 84,000 linear feet of conduit and 420,000 linear feet of cable.

A second substation would also be required for this alternative to supply the needed capacity for East Cambridge Substation #875, Putnam Substation #831, and Prospect Substation #819 relief and load growth. The second substation would be located on a portion of the Linwood site currently used as a surface parking lot for the Company's Somerville Service Center. The new Linwood Street Substation would be supplied by Lines 329-510/511 out of Mystic Station #250. These existing circuits would be rebuilt with new XLPE cable, in a single duct bank, looping into the Linwood Street Station (3.32 miles of duct bank). The lines would then loop out of the Linwood Street Substation and continue to Somerville Substation #402 in Union Square, Somerville (0.67 miles).

The Linwood Street Substation would consist of two 90 MVA 115/14-kV transformers, expandable to three transformers. Initial Firm Capacity would be 90 MVA, expandable to 180 MVA. The new distribution street infrastructure from Linwood Street would consist of 28,000 linear feet of conduit and 126,000 linear feet of cable in addition to the infrastructure required for Prospect Street.

Lastly, to address the existing Putnam and East Cambridge Load Pockets, as well as the existing overloads on the North Cambridge to Putnam 115-kV cables, one new 115-kV transmission line would need to be installed from North Cambridge Substation #509 to Putnam Substation #831 (3.41 miles) and a new 115-kV transmission line would need to be constructed from Putnam Substation #831 to the East Cambridge Substation #875 (2.86 miles) for a total of 6.27 miles of duct bank, as shown in Figure 3-4. Even with this line added, the loading at the East Cambridge and Putnam substations must be kept at or below 290 MVA because cable capacity limits between North Cambridge and Putnam under N-1-1 conditions require that the combined substation loading of East Cambridge and Putnam cannot exceed the transmission line capacity. This limits these substations from being utilized at their combined Firm Capacity of 360 MVA.

3.3.4 Wires Alternatives Comparison

This section compares Alternative 1 and Alternative 2 with respect to reliability, environmental impact, and cost.

3.3.4.1 Reliability

Alternative 1 has several advantages over Alternative 2 from a reliability perspective:

- Alternative 1 provides solutions to the transmission system violations that must be addressed and permanently eliminates the radial configuration of the transmission supply into East Cambridge. Specifically, Alternative 1 mitigates the potential loss of load during an N-1-1 contingency, upwards of 367 MVA in 2030[40]. Alternative 1 provides the needed

40 Includes the interim operational measures described in Section 2.6, projected to be completed prior to 2028. Without the interim operational measures, loss of load during an N-1-1 contingency could be upwards of 411 MVA in 2030, as per Table 3-3.

capacity and is strategically located near the load center. Alternative 1 also allows for easier expansion to accommodate long-term load growth. In comparison, while Alternative 2 provides similar increase in substation capacity to Alternative 1, it requires construction of two distribution substations instead of one, with one of the substations far from the load center and is therefore less beneficial in terms of community and environmental disruptions, which makes system expansion more complex.

- Alternative 2 results in higher loadings on several 115-kV lines and requires additional transmission line upgrades to address all the transmission overload issues. Alternative 2 does not provide a transmission supply from additional sources and the Putnam and East Cambridge Load Pocket would continue to be radially served. Alternative 2 also limits the loading at Putnam and East Cambridge to 290 MVA, which is below their firm capacity of 360 MVA, due to cable capacity limits between North Cambridge and Putnam under N-1-1 conditions.

- Alternative 1 improves the distribution reliability by reducing distribution feeder lengths. There is an approximately 69% reduction in the length of the distribution conduit and approximately 81% less cable associated with Alternative 1 as compared to the amount of distribution cables needed for Alternative 2. Comparatively, Alternative 1 would result in fewer line losses, less exposure to dig-ins and faults. In addition, the second substation in Alternative 2, at Linwood Street in the City of Somerville, is further away from the load center, which will make it challenging for Alternative 2 to match the capacity supply capabilities of Alternative 1 at a comparable cost because the distance requires more expensive underground distribution facilities and the path from the Linwood Street site to the Project Area is more constrained than from the Alternative 1 proposed site (which is within the Load Pocket).

- Alternative 2 has a risk of more severe customer outages during construction because part of the alternative requires construction at an existing substation. The Prospect Street 115/14-kV Substation will add up to 150 MVA of station capacity to the Mystic-Brighton 115-kV lines 329-510 and 329-511. To support both the new Prospect Street 115/14-kV Station and the existing Prospect Street Substation #402, it would be necessary to replace the Brighton to Somerville 329-510/511 lines with new XLPE cables.

- Alternative 1 also establishes a network for the East Cambridge area substations that provides more diverse paths for the Kendall generation's output to get on the area transmission network. For Alternative 2, Kendall generation would remain radial through East Cambridge and Putnam Substations. Under outage conditions of the North Cambridge – Putman lines or Putman – East Cambridge lines, the Kendall generation can supply its output to the transmission network in Alternative 1, whereas the Kendall generation would need to be offline during these outage conditions in Alternative 2.

- Alternative 2 establishes a 115-kV substation at Prospect Street in Cambridge and a new 115-kV substation at Linwood Street in Somerville. The 115 kV lines 329-510/511 between Mystic and Somerville need to be tied into the Linwood Station so that the Linwood Station is not radial. These lines were found to overload under N-1-1 conditions and need to be rebuilt with new XLPE cables with higher ratings. In addition, the 115-kV lines between the Brighton Station and the Prospect Street Station were found to overload under N-1-1 conditions if the same ratings of the new Brighton – Station #8025 lines in Alternative 1 were assumed. As a result, higher ratings are required for the new Brighton – Prospect Street lines.

For the foregoing reasons, the Company determined that Alternative 1 is superior to Alternative 2 from a reliability perspective.

3.3.4.2 Comparison of Environmental Impacts

A desktop analysis of key environmental elements for both wires alternatives was conducted to compare the potential environmental impacts of each.

Alternative 1 (the Project) involves construction of: (1) a new substation in East Cambridge; (2) 8.3 miles of new underground transmission line duct banks; and (3) related upgrades at five existing substations (Putnam, East Cambridge, Brighton, North Cambridge, and Somerville). This alternative requires a bridge crossing (River Street Bridge) and a horizontal directional drill (“HDD”) waterway crossing of the Charles River in Cambridge and Boston. The proposed transmission line routes associated with this alternative are consistent with those identified as the Preferred Routes for the Project in Sections 4 and 5 of the Analysis. Refer to Figure 3-1 for the locations of the transmission line routes and substation facilities.

Alternative 2 involves construction of approximately 17.6 miles of new underground transmission line duct banks and related upgrades at the same five substations referenced above, as was shown in Figure 3-3 and Figure 3-4. Alternative 2 requires construction of two new substation facilities, one adjacent to the existing Prospect Substation #819 in Cambridge and the other within existing Company-owned property on Linwood Street in Somerville. This alternative requires a bridge crossing and an HDD waterway crossing of the Charles River in the same location referenced above for Alternative 1, plus an HDD crossing of the Mystic River in Everett and Somerville. The proposed transmission line routes associated with this alternative were identified using a combination of desktop analysis, field reconnaissance and preliminary constructability assessments of complex crossings (e.g., waterways, rail, etc.). Wherever possible, the Company relied upon the Preferred Route segments that are associated with the Project to route Alternative 2 between the common substation facilities where connections would occur.

Table 3-1 on the following page presents a desktop analysis of key environmental elements for both wire alternatives.

Table 3-1 Wires Alternatives Potential Environmental Impact Comparison Summary

Analyzed Criteria	Wires Alternative 1 (Project)	Wires Alternative 2
Affected Municipalities	3 (Cambridge, Somerville, Boston)	4 (Cambridge, Somerville, Boston, Everett)
Total Length of Route (miles)	8.3	17.6
Number of Residential Units Along Route	2,592	6,159
Number of Commercial / Industrial Units Along Route	396	1,217
Number of Sensitive Receptors Along Route	17	52
Number of Historic Resources Along Route	44	60
Wetland Resource Areas, Buffer Zones and Tidelands Crossed by the Route (linear feet)	10,364	37,891
Number of MassDEP Listed Contamination Sites Along Route	88	73
Length of Article 97 Lands Crossed by the Route (linear feet)	885	2,367
Number of Public Shade Trees Along Route	1,403	2,584
Number of Complex Crossings (e.g., railroad, waterway, highway)	10	15

As shown in Table 3-1 above, Alternative 1 has less potential environmental impacts for all but one of the environmental parameters that were compared (Number of MassDEP Listed Contamination Sites). This is not surprising because Alternative 2 requires the installation of more than 9 miles of additional underground transmission line duct bank relative to Alternative 1, requires two major waterway crossings, construction of two new substations (as opposed to the one for Alternative 1), and work in an additional community (Everett), among other factors. Based on this comparison, the Company concluded that Alternative 1 is superior to Alternative 2 regarding the potential for minimizing environmental impacts.

3.3.4.3 Comparison of Costs

The Company prepared cost estimates for the alternatives using a process consistent with ISO-NE procedures as defined in Attachment D of the ISO-NE Planning Procedure 4 (‘PP4”). The planning grade estimate (-25%/+25%) for Alternative 1 is $1,466.2 million; an order of magnitude estimate (-50%/+200%) for Alternative 2 is $1,884.4 million. Table 3-2 on the following page summarizes the Company’s cost assessment of the wire’s alternatives.

Table 3-2 Cost Comparison for the Wires Alternatives by Project Component ($ in millions)

Alternative	Transmission Substation	Transmission Lines	Distribution Station	Distribution Lines	Remote Stations	Total ($ millions)
Transmission Alternative 1	$456.5	$572.8	$258.1	$141.2	$37.6	$1,466.2
Transmission Alternative 2	$115.9	$1,213.8	$107.8	$365.2	$81.7	$1,884.4

Alternative 1 was found to be superior in terms of cost. A key driver in the cost differential between the alternatives is the extent of transmission line work associated with each alternative. Specifically, Alternative 1 requires the construction of eight transmission lines housed in five duct banks totaling 8.3 miles. Alternative 1 includes two complex crossings: (1) HDD under the Charles River and (2) a bridge crossing over the Charles River. Comparatively, Alternative 2 requires the installation of eight transmission lines for a total of 17.6 miles of duct bank. This alternative also requires a bridge crossing and an HDD waterway crossing of the Charles River in the same locations referenced above for Alternative 1, but additionally needs a third river crossing (HDD) of the Mystic River in Everett and Somerville (in comparison, Alternative 1 only require two total river crossings). The higher cost anticipated by the Company for Alternative 2 is due principally to this additional transmission line infrastructure.

In sum, Alternative 1 is superior to Alternative 2 on the basis of cost.

3.3.5 Conclusion on Wires Alternatives

Alternative 1 is superior to Alternative 2 because it is a more reliable solution, has fewer environmental impacts, and is less costly. Alternative 1 is more reliable because it is closer to the Load Pocket that drives the need for the Project and is a more robust solution that provides additional capacity to address the identified need and is expandable to accommodate future growth and reliability needs outside the forecast horizon. Alternative 1 is better in minimizing environmental impacts because Alternative 2 requires the installation of nearly 18 miles of underground transmission line duct banks, with the associated community disruption, relative to Alternative 1 which requires only 8.3 miles of underground lines, and it requires three major waterway crossings (Alternative 1 only has 2), construction of two new substations (as compared to only one for Alternative 1), and construction work in an additional community (Everett), among other factors. Lastly, Alternative 1 is substantially more cost-effective because it is almost $420 million (or 22%) less expensive than Alternative 2. Accordingly, Alternative 1 was carried forward by the Company for further analysis.

3.4 Non-Wires Alternatives

The evaluation of NWAs for the needs identified in Section 2 requires the assessment of two scenarios discussed in Section 2 under which critical loading conditions exist: (1) the Transmission Contingency Case (also referred to as the transmission need); and (2) the Distribution Contingency Case (also referred to as the distribution need).

- **Transmission Contingency Case**: The transmission contingency case represents the fundamental use scenario for the NWA analysis and occurs under an N-1-1 contingency and loss of supply to the Putnam / East Cambridge Load Pocket. If under this contingency, supply was lost to the Load Pocket, the NWA would need to be able to restore service to the Load Pocket. This scenario would require the Putnam / East Cambridge Load Pocket to sustain itself in an islanded operation.[41] Alternative 1 would prevent such an outage in the described case; therefore, any NWA solution must achieve the same objective of supplying the Putnam/East Cambridge Load Pocket.

- **Distribution Contingency Case**: The distribution contingency case represents an N-1 contingency at the 875 East Cambridge Substation with the loss of service on one of the three 62.5 MVA transformers, which allows the station to be operated at a combined maximum of 150 MVA. As of today, the 875 East Cambridge Substation does not meet the N-1 criterion (loss of one bulk transformer). The substation proposed with Alternative 1 would permanently offload enough load from East Cambridge to ensure N-1 reliability. Therefore, any NWA solution must be designed to offset enough load to ensure 875 East Cambridge N-1 reliability by supplying the required capacity (MVA) and energy (MWh) to address an N-1 contingency.

At the outset of the NWA analysis, the Company determined the injection power (MVA) and energy (MWh) requirements to address the transmission and distribution needs. Eversource then evaluated a wide variety of technologies (and combinations thereof) as NWAs under the contingency cases. Any proposed NWA must provide sufficient relief to address the contingencies in a technically feasible and reliable manner while also balancing considerations of environmental impacts and costs. Both the Transmission Contingency Case and the Distribution Contingency Case require the NWA to sustain their respective loads for multiple days to weeks because restoration of underground transmission cables can last 30 days or more.

As part of this analysis, Eversource commissioned an independent evaluation of demand reduction (EE and DR) potential conducted by Dunsky Energy Consulting ("Dunsky") to determine how much EE and DR could be secured with an NWA approach.

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41 An islanded operation describes a situation where a portion of the grid is isolated from the bulk power system and cannot rely on services, such as frequency control, provided by ISO-NE.

The results of the Company's analyses are summarized below.

3.4.1 Determining NWA Injection Requirements

In analyzing NWAs to attempt to solve the transmission and distribution needs identified in Section 2, the Company determined the injection requirements[42] through 2030 using the Company's forecasted load. The NWA evaluation was then conducted as a two-step analysis. First, the Company evaluated how to solve the distribution contingency at East Cambridge Substation #875. Second, the Company assumed that a distribution contingency solution would be available through one or more NWAs and then evaluated the transmission contingencies with the remaining load. Table 3-3 below shows the distribution load progression based on the Company's forecast without the interim operating measures (load transfers) in place. The interim operational measures as outlined in Section 2.6 are not considered in an NWA analysis because they provide only temporary relief whereas a permanent long-term solution for the needs is required.

Table 3-3 Load Forecast without Interim Mitigation Measures

Station	Capacity	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
East Cambridge 875	Load	150	179	193	205	210	220	225	231	236	242
	Firm Capacity	150	150	150	150	150	150	150	150	150	150
	Load/Firm Capacity	**100%**	**119%**	**129%**	**137%**	**140%**	**147%**	**150%**	**154%**	**158%**	**161%**
Putnam 831	Load	151	164	167	167	167	168	168	168	169	169
	Firm Capacity	211	211	211	211	211	211	211	211	211	211
	Load/Firm Capacity	**72%**	**78%**	**79%**	**79%**	**79%**	**79%**	**80%**	**80%**	**80%**	**80%**
Prospect Street 819	Load	51	53	53	53	53	53	53	53	53	54
	Firm Capacity	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5
	Load/Firm Capacity	**82%**	**84%**	**84%**	**84%**	**84%**	**85%**	**85%**	**85%**	**85%**	**86%**
Alewife 828	Load	86	92	92	95	96	98	99	100	102	103
	Firm Capacity	123	123	123	123	123	123	123	123	123	123
	Load/Firm Capacity	**70%**	**75%**	**75%**	**77%**	**78%**	**79%**	**80%**	**81%**	**83%**	**84%**
Somerville #402	Load	55	57	57	57	57	57	57	57	57	58
	Firm Capacity	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
	Load/Firm Capacity	**74%**	**75%**	**75%**	**76%**	**76%**	**76%**	**76%**	**76%**	**76%**	**77%**

3.4.1.1 Distribution Contingency Injection Requirements

In the event of an N-1 contingency at the East Cambridge Substation #875 resulting in the loss of one of the three 62.5 MVA transformers, the Firm Capacity of the station is 150 MVA**,** which can supply 3,600 MWh of energy in 24 hours. In such an event, any NWA solution would be required to step in and fill the gap between the firm station capacity of 150 MVA and forecasted load on the system. Both the capacity gap created by the contingency and the duration of the contingency must be addressed by an NWA; consideration of these factors determines which solutions can support the system over an extended period and therefore address the identified need.

[42] The injection requirements are the required capacity (MVA) and energy (MWh) to achieve N-1 or N-1-1 reliability, respectively.

In 2030, East Cambridge Station #875 is expected to peak at 242 MVA (Table 3-3), which leaves a required injection of 92 MVA.[43] Table 3-4 shows the number of event days where a station overload would result from an N-1 contingency, as well as the power and energy injection requirements by year. Notably, the energy injection requirements listed in Table 3-4 below represent only a one-day event duration; any multi-day event would require respective multiples of the energy injection requirement while the daily power injection requirement would remain constant. Critically important, the need would present itself for the full 24 hours of any given day and for 317 days a year as seen in Table 3-4, which points to a near continuous requirement of the NWA solution, which in turn plays a critical role in evaluating the feasibility of NWA solutions.

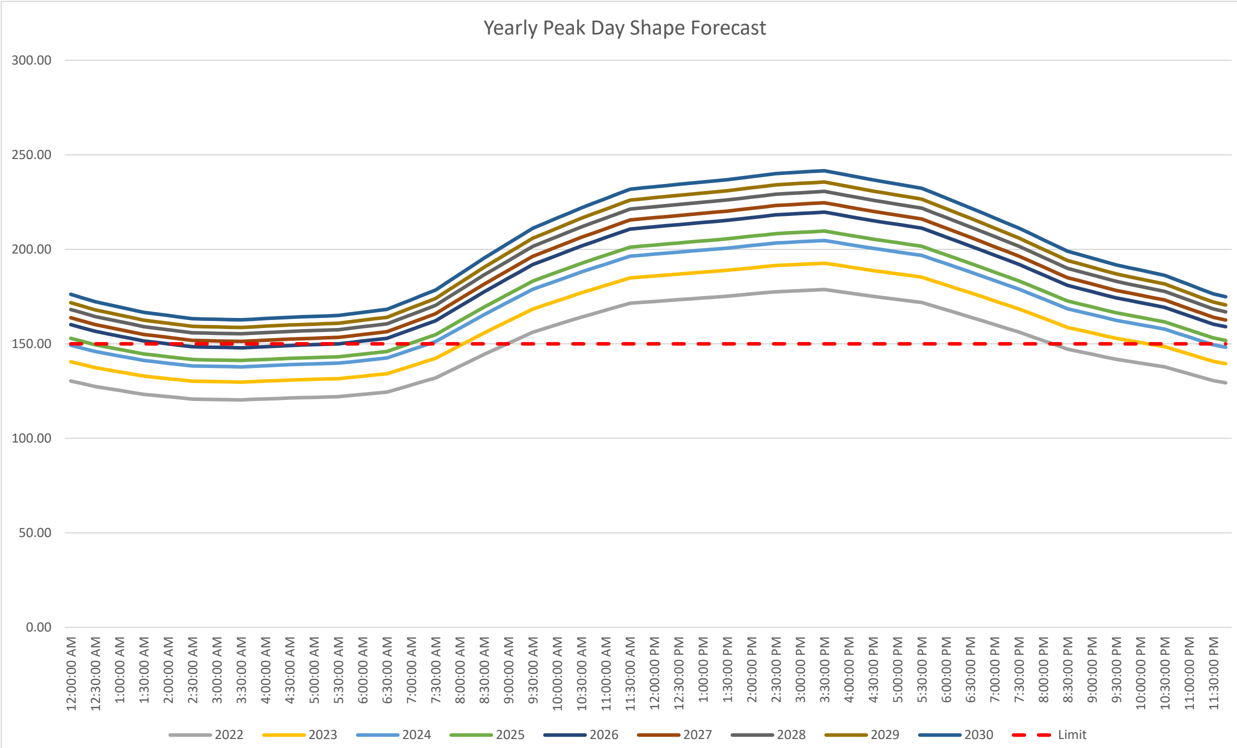
Table 3-4 Injection Requirements for the Distribution Contingency

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
Number of days per year with a Need	53	89	171	179	211	240	273	301	317
Peak Constraint Power / MW	28.7	42.7	54.7	59.7	69.6	74.6	80.6	85.6	92.0
Peak Constraint Energy / MWh	211.5	375.0	539.3	614.0	776.6	871.8	991.1	1090.5	1217.4

Figure 3-5 on the following page shows the peak load profile of the East Cambridge Substation #875 for a 24-hour period, which highlights that in 2030, East Cambridge Substation #875 load is above Firm Capacity every hour of the peak day.

43 92 MVA = 242 MVA – 150 MVA.

Figure 3-5 Peak Day Load Shape at East Cambridge Substation for the Distribution Contingency Case



3.4.1.2 Transmission Contingency Injection Requirements

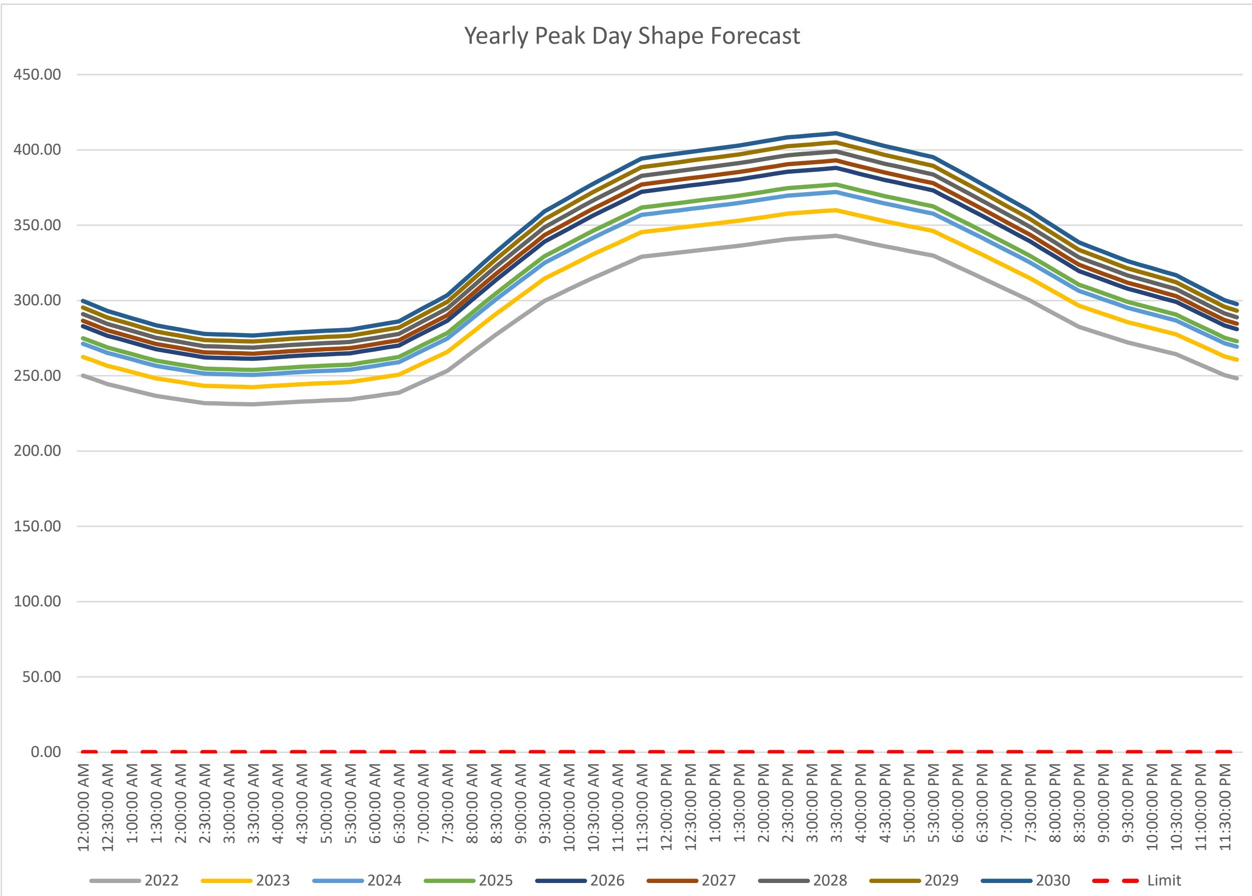
In the event of an N-1-1 contingency of the transmission supply to the Putnam / Cambridge Load Pocket, an NWA solution must be able to pick up the associated load of both Putnam and East Cambridge Substations. Unlike the distribution contingency scenario, the transmission contingency scenario also requires the ability of the Load Pocket to be served in an island condition since no further connections to the bulk power system would be present. This requires the NWA solution to provide functions such as frequency and voltage control. The total projected joint peak load of Putnam and East Cambridge Substations, per Table 3-5 below, is expected to be 411 MVA by 2030, which given the nature of the contingency also equals the injection requirement.

Table 31-5 Injection Requirements for the Transmission Contingency

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
Number of days per year with a Need	365	365	365	365	365	365	365	365	365
Peak Constraint Power / MW	343.0	360.0	372.0	377.0	388.0	393.0	399.0	405.0	411.0
Peak Constraint Energy / MWh	6828.0	7166.4	7405.3	7504.9	7723.8	7823.4	7942.8	8062.3	8181.7

As noted above with Table 3-4, the energy injection requirements listed in Table 3-5 represent only a single-day event duration. Longer outage events, as could be reasonably expected during a transmission contingency, would require respective multiples of the energy injection requirement. Figure 3-6 below shows, similar to Figure 3-4, the forecasted load profile during the peak day of each respective year relative to the available supply capacity. With no remaining connection to the bulk system, the Load Pocket can no longer be supplied, resulting in a supply capacity of 0 MVA.

Figure 3-6 Peak Day Load Shape for the Putnam / East Cambridge Load Pocket



3.4.2 Non-Wires Feasibility Assessment – East Cambridge Distribution Contingency

Eversource considered four (4) technologies for the NWA analysis: (1) distributed generation ("DG"), (2) battery energy storage systems ("BESS"), (3) EE/DR, and (4) photovoltaic ("PV") installations. A technically feasible NWA technology is defined as one that could effectively resolve the need with comparable reliability performance and response time as Alternative 1. When considering whether a specific technology has the operating characteristics (performance, duration, and response time) needed to respond to contingency conditions, the Company used the peak-day profiles set forth above against which to model the resource dispatch capabilities. The fundamental requirement of an NWA solution is that the NWA resource(s) must be able to continue to operate until the failed system element is repaired or until loads decline. Depending on the contingency and the difficulty of addressing it, the time period of an outage for which an NWA would need to be able to address the needs could be several days- or multiple weeks-long (e.g., 30 days).

3.4.2.1 Energy Efficiency and Demand Response

EE programs are principally designed to save energy by increasing the efficiency of customer-owned equipment. They reflect a permanent reduction of load, which with some EE programs can also reduce peak loads. DR resources are designed to encourage end-users to make short-term reductions in energy demand (such as increase thermostat settings) in response to a price signal from the wholesale electricity market, or a trigger initiated by the electricity grid operator.

The Company used the aforementioned Dunsky report to perform a targeted study for Cambridge that used the same model assumptions as the statewide study, but customized by using Cambridge-specific customer characteristics, which was more heavily commercial and industrial (including laboratories). Based on Dunsky's targeted study, the maximum achievable peak reduction that could be potentially achieved by targeted demand reduction programs (EE and DR) in the area over and above the amounts already included in the Company's load forecast is 5.7 MW.[44] Therefore, demand reduction programs alone are not deployable to the scale necessary to fully meet the East Cambridge injection requirement of 92 MVA.

While targeted demand reduction programs alone are not deployable to the scale necessary to address the needs in East Cambridge, the Company assumed that such programs could hypothetically be developed and contribute 5.7 MVA towards the East Cambridge distribution injection requirement. Under this hypothetical, there would be a remaining 86.3 MVA that must be met with other technically feasible distributed resources.

3.4.2.2 Photovoltaics

PV facilities convert sunlight into electricity and are a non-dispatchable resource because they produce electricity only during hours of the day when there is sunlight available. PV is also susceptible to weather conditions. For example, cloud cover or hazy conditions negatively affects generation output, making the resources highly intermittent, which, in turn, diminishes the ability of PV to meet identified reliability needs. Indeed, distributed solar PV technologies alone are not technically feasible because of their intermittency; an NWA would be required to produce electricity continuously during all hours of the day, including the overnight hours when no sunlight is available. However, much like demand reduction programs, PV can be evaluated as part of a broader solution.

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[44] Specifically, 2.4 MW of DR and 3.3 MW of EE.

To understand the technical maximum potential, the Company determined how much theoretically possible rooftop space is available in East Cambridge,[45] and how much PV would be able to contribute to the remaining 86.3 MVA needed from an NWA solution. If hypothetically all rooftops in East Cambridge were used, that rooftop space would yield approximately 47.8 MVA[46] of distributed solar PV. However, because solar is a highly intermittent and weather-dependent energy source, it cannot be assumed in the Company's analysis at the full nameplate value. Therefore, in a 24-hour interval during summer events, it can be reasonably assumed that only about 116.5 MWh[47] (which represents less than 10% of the distribution need) could be generated in a 24-hour interval.

Figure 3-7 on the following page shows the adjusted solar profile in reference to the remaining need for East Cambridge during a peak day, including the previously determined EE and DR contributions. The remaining need after application of PV and demand reduction programs is 77 MVA, as well as 1038 MWh of required energy injection. In Figure 3-7 below, this represents the maximum distance from the red load profile to the available capacity as well as the total area under the red load profile, respectively.

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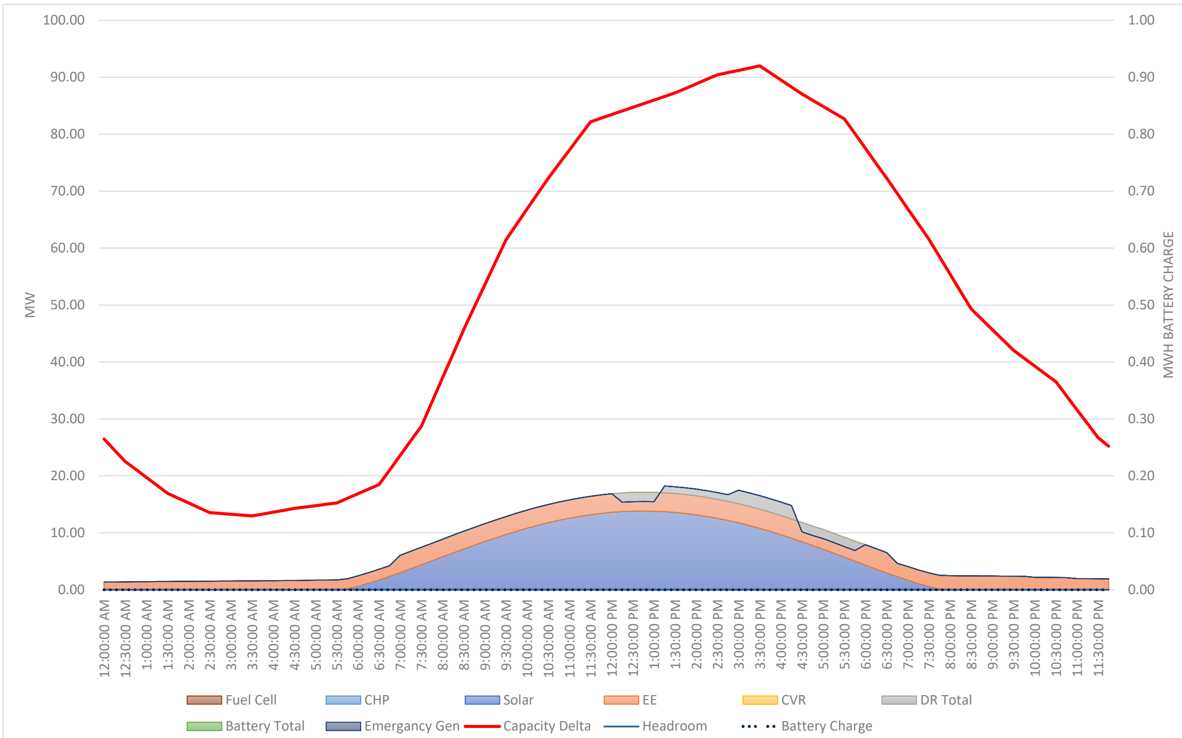
45 Utility-scale PV solutions are technically not feasible due to their size requirements and the limited land availability in East Cambridge. For instance, an installation of 1 MW of PV panels would require anything upward of 2.5 acres. There is insufficient land available in the greater Cambridge area to support a utility-scale PV solution that would be adequately sized to meet the identified need.

46 The 47.8 MVA reflect values for zip codes 02142 and 02141 taken from Google Project Sunroof (https://sunroof.withgoogle.com/), which is an open-source calculator that estimates rooftop solar capacity for US Google Earth locations ("Sunroof"). A conversion from panel capacity ("MW") to inverter capacity ("MVA") was done using a ratio of 1.2.

47 Output is based on a weather-adjusted irradiance profile that represents 24% of the ideal clear sky irradiance profile.

Figure 3-7 Peak Day Capacity Requirements to Meet Station Firm Capacity and 90/10 Weather Adjusted Solar Profile



3.4.2.3 Energy Storage Systems

Given the remaining injection requirement of 77 MVA after the hypothetical and aggressive application of EE/DR and PV, the Company then assessed whether an energy storage system could feasibly address the remaining need, which for a 24-hour period is 1038 MWh. For purposes of determining whether a storage system could meet the need, a round-trip efficiency[48] of 85%,[49] for the storage system was assumed, resulting in 1126 MWh of storage capacity that must be discharged to meet the daily 1038 MWh need. The matching storage solutions would therefore total 77 MVA /1126 MWh.[50]

48 Round-trip efficiency means the "[r]atio of total energy storage system output (discharge) divided by total energy input (charge) as measured at the interconnection point" - Source: DoE, Discussion of Data for Smart Grid Metrics and Benefits, Storage System Performance Supplement, Nov.2010. For purposes of this analysis, the Company assumed: Charge Efficiency = Discharge Efficiency, therefore, discharge efficiency = √(Round Trip Efficiency).

49 Based on the "NREL Cost Projections for Utility-Scale Battery Storage: 2021 Update" report, Figure 7.

50 These are the raw values calculated without reserves for unavailability factors of individual battery units.

The critical challenge with utilizing an energy storage system to solve the multi-day distribution transformer outage need (even when paired with EE and solar PV and even if an appropriate site location for the size needed could be found) is that such a system must charge from the grid in order to contribute to satisfying the need; otherwise, the battery would be unavailable to serve the system for outages longer than a 24-hour period. As highlighted in Section 3.4.1.1, the 2030 need at East Cambridge Substation exceeds the Firm Capacity throughout the entire peak day, leaving no options for storage to recharge. Furthermore, the need, as shown in Section 3.4.1.1, is expected to occur on 317 days per year, making it impossible for storage systems to recharge reliably. Therefore, even when paired with demand reduction programs and PV, energy storage cannot meet a sustained multi-day need, disqualifying it on a technical feasibility basis.

3.4.2.4 Conventional Distributed Generation

Given the infeasibility of energy storage to fill the remaining energy need for long duration outages, conventional generation was assessed as a potential NWA in addition to the EE/DR and solar solutions. Conventional generation facilities convert the chemical energy stored in fossil fuels (such as natural gas, oil, coal, or diesel) to heat energy, then to mechanical energy, which is used to spin a generator to produce electricity. Conventional generation requires a steady and continuous fuel source to generate electricity so that it is capable of producing electricity during every hour of the day. The Company assumed a configuration of 69 units[51] of 1.2 MVA[52] distributed conventional generation resources to address the remaining 77 MVA East Cambridge injection requirement after applying the assumed PV contribution as well as the targeted demand reduction programs and considering unit availability.

While conventional distributed generation may be able to address the distribution need, there are several challenges that render it infeasible and inferior to Alternative 1. For example, based on the Company's analysis, any material amount of new resources proposed to be connected directly to the distribution system at East Cambridge would not be able to interconnect without exceeding the fault current interruption capability of the circuit breakers at East Cambridge Substation.[53] Therefore, no new resources would be able to interconnect directly to the

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[51] This assumption used an average availability rate of 93%.

[52] 1.2 MVA is the typical capacity rating of an off-the-shelf small generator (such as a Jenbacher Type 4).

[53] The distribution system has protection devices (circuit breakers) that are used to isolate parts of the system when faults occur. Faults are typically short circuits caused by failed equipment or anything coming in contact with energized equipment that could create a path to ground (such as animal contact). If a fault occurs, the nearest protective device will open, de-energizing the faulted part of the system to allow crews to safely remove or repair the cause of the fault without affecting the rest of the system. Circuit breakers at the substation have a maximum amount of fault current that they can interrupt, and as more generators are added to the system, they add additional fault current.

distribution system served from the East Cambridge Substation without significant system upgrades to increase the fault current interruption capability of the circuit breakers or system modifications to reduce the fault current.

The most practical means to reduce fault current would be the installation of reactors to reduce the amount of fault current coming from the transmission system, allowing more resources to interconnect to the distribution system. The Company determined, however, that no amount of series reactors installed on distribution feeders would be enough to allow the full amount of distributed conventional generation to be able to interconnect. Despite increasing reactor size or increasing the number of reactors, fault current remains greater than the breaker ratings.

The Company's analysis determined that only 18 of the 35 distribution feeders in East Cambridge have requisite hosting capacity to interconnect distributed generation. Each of the 18 feeders can theoretically interconnect up to 4 MW of generation, or three 1.2 MVA units. Therefore, only 54 of the 69 units required could potentially be installed on existing feeders. This would require additional feeders to accommodate the remaining 15 units, which would necessitate significant expansion of the East Cambridge Substation. This would necessitate, among other equipment, up to two new secondary switchgear sections, new underground structures, and conduit from the substation to the generation sites; however, East Cambridge Substation represents a space constrained setting without sufficient room to accommodate new equipment of this magnitude. Consequently, this solution is not technically feasible.

With a high number of required sites for distributed generation, the challenges would be formidable. Each site would require a suitable location in proximity to appropriate interconnection points on the distribution system, timely completion of permitting processes, timely completion of interconnection studies, and securing an available and reliable fuel supply, which would likely require further upgrades to the existing natural gas distribution system to ensure adequate pressure and volume. Each site would also require sufficient land and buffering compatible with the required zoning requirements for a generating facility. These hurdles make it impractical to develop enough distributed conventional generation within the same certainty and timeframe as Alternative 1.

Notwithstanding hosting capacity limitations and associated unresolved reliability need, placement of 69 distributed conventional generation units in multiple, disparate sites is practically infeasible due to the limited land availability in a highly developed urban setting such as the City of Cambridge. Furthermore, the CO_2 emissions resulting from 300+ days of operation of 69 – 1.2

MVA would increase local emissions significantly.[54] Obtaining permits for such any new fossil fuel-based emissions source in Cambridge would be a significant challenge. In addition, because this NWA addresses need only up to year 2030, it cannot readily accommodate anticipated load growth beyond 2030 and is therefore not as robust a solution as Alternative 1.

3.4.2.5 Conclusion for the Distribution NWA Feasibility Assessment – East Cambridge

For the reasons discussed above, there is no NWA or combination of NWAs that is technically or practically achievable in East Cambridge for purposes of fully meeting the identified distribution need.

3.4.3 Transmission Contingency Non-Wires Feasibility Assessment

As discussed above, there is no technically feasible or otherwise practical NWA solution to solve the distribution need in East Cambridge; however, for purposes of undertaking the NWA analysis for the transmission need for the Load Pocket, the Company nevertheless assumed, as a matter of conservatism, that the combination of NWAs for the distribution need in East Cambridge was feasible. With that assumption, the Company evaluated a combination of NWAs to solve the transmission need and its associated injection requirement of 411 MVA[55.] Figure 3-8 on the following page demonstrates the severity of the challenge because it illustrates the gap between the amount of energy available from generous assumptions of NWA availability (e.g., the full 92 MVA of the distribution NWA, plus additional assumptions for EE/DR and PV) as compared with the load needed to be served during a contingency on a peak load day. Because this level of system support would be insufficient to address the transmission needs identified in Section 2, the Company considered what additional resources would be required to address the remaining transmission need (maximum vertical difference between the capacity delta and the available capacity) of 317.5 MVA for the Load Pocket: EE, Demand Response, and Conventional Generation. It bears emphasis that restoration for underground transmission cables can be expected to last 30 days or more, and therefore, an NWA solution needs to solve the transmission contingency for each day during the restoration period.

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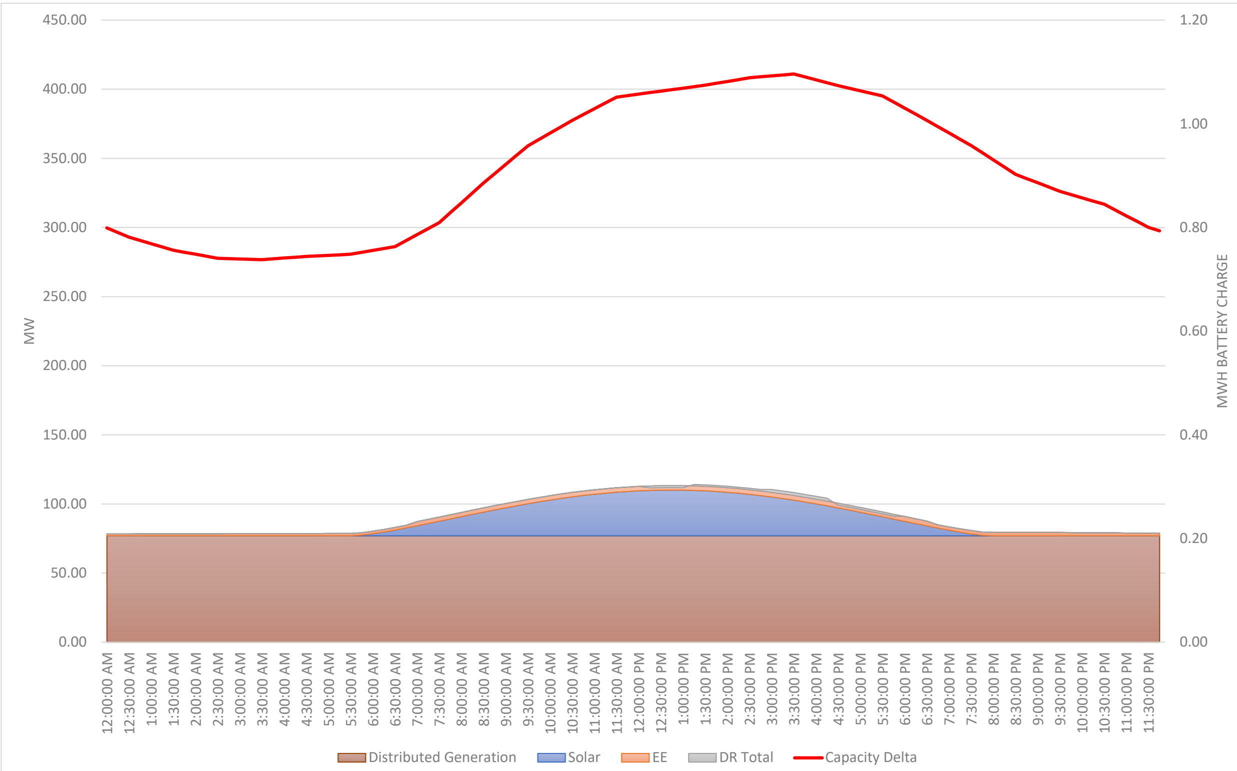
[54] If one assumes the use of generators with a capacity rating of 77 MVA and an electric efficiency of 41.5% (for example, the Jenbacher Type 4), and assumes a natural gas equivalent of 6184 therms of natural gas per hour, such a combination of distributed conventional generation units would result in approximately 74,000 lbs of CO_2 emissions per hour (assuming 12 lbs/therm emissions).

[55] Sum of Putnam and East Cambridge Station Forecasts in 2030.

Figure 3-8 Injection Requirements with East Cambridge NWA Solution and Additional Solar + EE Assumptions



3.4.3.1 Energy Efficiency and Demand Response

Consistent with the analysis performed for the distribution need in East Cambridge, in analyzing the transmission need for the Load Pocket, the Company concluded that demand reduction programs are not suitable standalone alternatives in this application. Demand reduction programs can only reduce the load and cannot serve load in an isolated manner that would be required to resolve the Transmission Contingency Case. As part of the study conducted for Eversource, the wider area maximum achievable demand reduction potential was reported by Dunsky at 26.5 MW (EE at 13.1 MW and DR at 13.5 MW), of which 5.7 MW are accounted for in East Cambridge, leaving 20.8 MW for the rest of Cambridge. An assumption can be made that 53%[56] (10.41 MW) of those savings can be attributed to Putnam Station. With the application of the Putnam demand reduction program assumptions in addition to the East Cambridge Station solution, the remaining transmission need injection requirement is 306.5 MVA and 5947 MWh.

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56 The remaining demand reduction was allocated to the Putnam Station area proportionally to the 2027 forecasted peak load by bulk stations in Cambridge. The maximum achievable demand reduction is given by Dunsky for 2027

3.4.3.2 Photovoltaics

Because PV can produce electricity only during hours of the day when there is sunlight available, PV can support the load only on an intermittent basis and would not be an effective solution for a long-term transmission contingency outage. PV also requires a significant amount of land compared to other technologies, even when paired with battery storage. Based on the NWA analysis for East Cambridge, the space limitations of solar are clear and show how little it can contribute, even with all available space occupied. The maximum amount of solar installations throughout the Putnam and East Cambridge Load Pocket is 114 MVA[57] (including 47.8 MVA in East Cambridge and 66.2 MVA in Putnam) of solar panels. Even with this hypothetical contribution from PV, the remaining injection requirements for the Putnam / East Cambridge Load Pocket is 294 MVA / 5785 MWh.

3.4.3.3 Energy Storage Systems

As explained above, energy storage systems can charge from the grid and store the electricity for later use. As a potential NWA for the needs identified in Section 2, energy storage is technically infeasible by itself because it would be unable to charge from the grid in a post-contingency situation and would be limited to only the hours of energy on hand as discussed in detail in Section 3.4.2.3. Furthermore, an underground cable failure typically requires more time to locate the source of the problem and conduct required repairs, resulting in outage durations that can extend for a prolonged duration (i.e., restoration can take 30 days or more). Therefore, by definition, this NWA cannot meet the transmission need because it would be physically impossible and practically limited in its ability to charge from the electric grid each day for the duration of a potential contingency.

If one were to assume the installation of the required amount of NWA capacity for East Cambridge, as well as the additional maximum achievable demand reduction and PV contribution for Putnam, the required energy storage would equal 6275 MWh. This level of energy storage provides a solution for only 24 hours during peak day conditions. Therefore, an NWA solution relying on storage would be an infeasible solution to solve the transmission contingency case.

3.4.3.4 Conventional Distributed Generation

Under similar assumptions for distributed generation as described in the East Cambridge distribution analysis for the Load Pocket, there would be a need for 263 distribution connected combustion engines at 1.2 MVA per unit, a number that, for the same reasons as described for the East Cambridge analysis, is impractical to achieve. Furthermore, given the nature of the

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[57] The 114 MVA reflect values for the relevant zip codes taken from Google Project Sunroof (https://sunroof.withgoogle.com/), as referenced above in Footnote 46.

transmission need, these 263 units would require a centralized control infrastructure to manage, monitor, and stabilize the Putnam/East Cambridge Load Pocket, which is an endeavor that would carry unknown (but significant) costs and risk factors.

3.4.3.5 Conventional Utility Scale Generation

Given that the NWA technologies considered are either ineffective or impractical in this application because they can support the load only temporarily and, even if feasible, would require a significant investment into a real-time control and monitoring capabilities to island the Load Pocket, the Company's analysis next focused on utility-scale conventional generation. There are currently no utility-scale generation projects proposed in the Project Area in the ISO-NE interconnection queue, so the most likely NWA solution would be the construction of at least two new, fast-start and black-start capable combustion turbines.[58] At least two combustion turbines would need to be installed in the vicinity of either substation to address the potential loss of the two transmission lines supplying the Putnam and East Cambridge substations, each with enough capacity to serve the Load Pocket on its own (more continuous capacity than 294 MVA per unit).

To implement the combustion turbine alternative, the Company would need to overcome numerous practical, and likely insurmountable, challenges associated with the availability of land in Cambridge, limitations on the interconnection of generation at the Putnam and East Cambridge substations, as well as potential significant capacity upgrades to the available gas infrastructure. Land acquisition and interconnection challenges (assuming they could be overcome) would add considerably more cost, as well as the cost to operate and maintain these generation assets. Data from a recent similarly sized project in New England[59] indicate that land requirements of approximately 15-30 acres for the two combustion turbine generators would be needed. There is extremely limited land available in the vicinity of Putnam and East Cambridge substations that would be suitable for a generator of this size. Even if such land were to become available, which is unlikely, the land costs alone would be prohibitively high, as Cambridge has some of the highest real estate costs in the country.

In addition to cost considerations, a gas supply lateral to the closest natural gas pipeline would need to be constructed for any new gas-fired generation, and upgrades to existing pipelines could be required to ensure enough pressures and volumes for any gas-fired generation. A dual-fuel generation unit would also require a backup supply (such as a storage tank for fuel oil onsite), which would increase the costs, further complicate the permitting process, and increase land requirements. Each generator would also need to complete the ISO-NE interconnection process

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[58] Because this generation would serve a reliability purpose in solving the transmission contingencies, more than one turbine is required to ensure continuous operation during long duration events.

[59] The Medway project owned by Exelon approved by the Siting Board in 2016. Exelon West Medway, LLC, EFSB 15-01/D.P.U. 15-25 (2016).

as well as extensive regulatory siting and permitting requirements to address issues such as air emissions, noise, and visual impacts. These considerations make the availability of conventional generation to meet the identified transmission need practically infeasible, and therefore, an inferior alternative.

3.4.3.6 Conclusion for Transmission Non-Wires Alternative

Due to the magnitude of the need, the only technically feasible NWA is the installation of conventional fast and black-start capable commercial-sized power plants. From a technical perspective, such a solution could theoretically sustain the Putnam / East Cambridge Load Pocket. However, a multitude of practical constraints, such as the cost and availability of land, the need for supply system upgrades, interconnection requirements and significant permitting challenges, as well as the unit cost themselves, in addition to the impacts on quality of life in Cambridge through air and noise pollution, render such a solution infeasible, and thus, inferior to Alternative 1.

3.4.4 NWA Conclusion

Demand reducing programs, such as EE and DR, are not deployable to the scale necessary to mitigate the needs addressed by the Project on their own. Neither solar PV nor energy storage alone is feasible due to technical limitations. While demand reducing programs when combined with conventional generation and distributed solar PV could theoretically resolve the East Cambridge Distribution Contingency Case, an additional utility-scale NWA would be required to meet the full NWA injection requirement of 411 MVA. However, conventional generation would need to overcome numerous significant challenges, including the necessary development time, land requirements, fuel supply availability, permitting difficulties and infrastructure requirements and therefore would not be practical.

Given their technical and practical inability to solve the identified transmission and distribution contingencies, all NWA solutions were deemed inferior to a wires solution and eliminated from further consideration.

3.5 Conclusion on Project Alternatives

The Company's alternatives analysis demonstrates that Alternative 1, the Project, will best address the need to serve load growth and improve reliability to the Project Area with a superior combination of reliability, cost, and environmental impact. No technically or practical feasible NWAs were identified by the Company to meet the various needs. As such, they were eliminated from further consideration. Accordingly, Alternative 1, the Project, was carried forward to the routing analysis presented in Section 4 of this Analysis.

Section 4.0

Transmission Line Routing and New Substation Site Selection

4.0 TRANSMISSION LINE ROUTING AND NEW SUBSTATION SITE SELECTION

4.1 Introduction

As presented in Section 3, the Company's proposed solution to address the electrical system need and growing demand for electricity in the Project Area described in Section 2 involves the construction of eight new 115- kV underground transmission lines to be housed in a total of five new duct banks ("New Lines"). The proposed transmission line duct banks will connect the proposed New Substation in East Cambridge with existing substation facilities in Somerville, Cambridge, and the Allston/Brighton section of Boston. Connections to the Brighton Substation #329 require the construction of two new 115-kV transmission line duct banks, while only one new transmission line duct bank is required to each of the other three substations: Somerville Substation #402, East Cambridge Substation #875, and Putnam Substation #831. This Section describes the Company's process to identify and evaluate possible transmission line routes that led to the identification of two top routes within four largely distinct study areas, referred to herein as the Brighton, Somerville, Kendall, and Putnam Study Areas. For context, this Section also describes the site selection process for the New Substation facility as it is integral to the routing analysis associated with the new transmission line connections.

4.2 New Substation in East Cambridge

4.2.1 Overview

The New Substation will provide both a new interconnection to the existing 115-kV electric transmission system and a new location at which the high voltage power from the transmission system can be "stepped down" (i.e., the voltage will be decreased) for distribution to Eversource's customers.[60] The New Substation will consist of 22 115-kV circuit breakers in a breaker-and-a-half configuration, three control rooms that will contain protective relay and control equipment, communication equipment and control batteries, three 90-megavolt amps ("MVA") 115/14-kV transformers, six 14-kV, 9.6-MVAR capacitor banks, and sections of distribution switchgear that will interconnect through the new transmission lines and distribution lines. There will be room reserved within the New Substation for an additional future transformer, switchgear, capacitor bank and shunt reactor.

[60] While distribution lines are not jurisdictional to the Siting Board's review under G.L. c. 164, § 69G or § 72, as part of the Project, the Company is including information about its build-out of the electric distribution system through the addition of 36 underground distribution feeders and associated infrastructure in order to better explain how the Project is a comprehensive solution. The purpose of the distribution system is to transport electrical energy from the transmission system to Eversource customers within the Project Area. The proposed distribution lines would be installed predominantly within existing roads using similar open trench construction techniques such as that employed for transmission line construction, albeit within smaller footprints and work areas. A typical distribution line duct bank detail and construction methodology is provided in Section 5.

4.2.2 Site Selection Objectives for New Substation

The primary objectives of the Company's site selection evaluation for the New Substation were to:

1. Identify and assess locations of suitable size in proximity to relevant load centers that can accommodate the infrastructure required to meet the identified transmission and distribution system needs.

2. Evaluate potential substation sites based on a multitude of additional factors, including: (a) ownership status of potential sites; (b) applicable local zoning; (c) community input; (d) engineering and planning design considerations; (e) constructability; (f) environmental impacts; and (g) cost considerations.

4.2.3 Proposed Site of the New Substation

The availability of parcels of land to accommodate a new substation in densely developed urban areas like Cambridge, Boston, and Somerville, is limited. However, given the Project Area's concentrated loads, constructing the New Substation facility in the East Cambridge area was the critical siting criterion.

The Company first identified a need for a reliability solution in East Cambridge in 2014. The Company initially hoped to address the then-identified need through significant expansion of the Prospect Street Substation in Cambridge. That solution ultimately was determined to be infeasible because of community opposition. The Company then identified an approximately 0.85-acre parcel of land at #135 Fulkerson Street in East Cambridge and acquired it in 2017 as a potential site for a reliability solution (see Figure 4-1 below). The parcel is occupied by a single-story concrete block building that would have been demolished to facilitate construction of the identified solution facilities. While this site could accommodate construction of a new substation or other infrastructure, use of this site was strongly opposed by local officials and Cambridge residents because of its location in a residential neighborhood and its proximity to the Kennedy Longfellow School and John A. Ahern playing fields. Based on feedback from local officials and the community, Eversource began to engage local property owners and real estate developers to determine if there was a more desirable site in the Project Area.

After a series of discussions and meetings with several parties, including the Cambridge City Manager, Cambridge City Councilors, Cambridge Redevelopment Authority, private landowners, and community stakeholders, Eversource identified an alternate site on a parcel of land currently owned by BXP. within the Kendall Square Mixed Use ("MXD") Zoning District (the "New Substation Site") (see Figure 4-2 below). In 2019, the Company and BXP entered into an arrangement to reserve rights for a potential reliability solution on that parcel of land in Kendall Square being redeveloped by BXP. The parcel is currently occupied by the six-story Kendall Center Blue Garage at #290 Binney Street in East Cambridge. To accommodate construction of the proposed

G:\Projects2\MA\MA\5711\EFSB\Figures\MXD\4-1_Fulkerson_Street_Substation_20211112.mxd Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

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Figure 4-1

135 Fulkerson Street Substation Site

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Figure 4-2
Proposed New Substation Site

substation, BXP will demolish the existing Blue Garage and replace it with underground parking in roughly the same location. Following demolition of the existing parking garage facility, the New Substation will be constructed predominantly underground. The total footprint of the New Substation facility is approximately 35,000 square feet ("s.f."). The balance of the property is being re-developed by BXP with a mix of residential, commercial, and public open space.[61] The design plans include adequate space within the parcel to install all the Eversource electrical substation infrastructure and associated electric line duct banks and to ensure the ongoing safe operation and maintenance of such equipment.

The Kendall Center Blue Garage site meets the Company's selection criteria for the location of the New Substation as it is located proximate to the load center, meets engineering, constructability and environmental considerations, having been incorporated into the development plans for the site utilizing an innovative design in a highly urbanized environment to address the electricity demand and reliability needs identified, and has received positive input from the municipality and other stakeholders.

Please refer to Section 5 of this Analysis for additional detail describing the substation construction process and construction schedule at the New Substation Site.

4.3 Transmission Line Routing Analysis

4.3.1 Overview

The Company's methodology for siting new electric transmission lines, referred to as a "routing analysis," is an adaptive and iterative approach to identify and evaluate possible routes for the proposed Project. The routing analysis identified the top transmission line routes for the Project as the options that best balance the minimization of environmental impacts (including developed and natural environment impacts, and constructability constraints), reliability and cost.

In initiating the routing analysis, the Company first established routing objectives, which are described in more detail below. The routing analysis methodology presented herein uses previously established approaches for evaluating electric transmission routing options and is a consistent and standard process implemented by the Company and historically approved by the Siting Board.

[61] See https://www.cambridgeredevelopment.org/kendallredevelopmentoverview.

4.3.2 Routing Analysis Objectives

The goal of the Company's routing analysis was to identify a cost-effective and technically feasible design that achieved the required transmission system load growth and reliability improvements by interconnecting the specified substations while meeting certain design objectives. These objectives are to:

- Comply with all applicable federal and state statutory requirements, regulations, and policies.
- Achieve a reliable, operable, and cost-effective solution.
- Maximize the reasonable, practical, and feasible use of existing linear corridors (e.g., roadways, railroad) to the extent possible.
- Minimize/avoid potential impacts to the developed and natural environment.
- Minimize/avoid the need to acquire property rights wherever practicable; and
- Maximize the potential for direct routing options over circuitous routes.

4.3.3 Routing Analysis Methodology

Consistent with the Company's standard methodology, the routing analysis for the Project consisted of the following steps:

- **Identification of Project Study Area:** Focused the routing analysis within the region of the New Substation Site that is located between Broadway and Binney Street at the Kendall Center Blue Garage site in East Cambridge, and existing substation facilities located in the East Somerville neighborhood and the Allston neighborhood of Boston, as well as the Riverside neighborhood of Cambridge. For ease of review and analysis, the overall Project Study Area was then divided into smaller individual Study Areas between specific substation facilities where proposed transmission line interconnections would potentially occur. As described in further detail below, a total of four individual Study Areas were delineated, including: Brighton, Putnam, Kendall, and Somerville.
- **Development of Universe of Routes:** Identified numerous routing options within each individual Study Area between substation facilities including the evaluation of existing linear corridors (e.g., MBTA Grand Junction Railroad, roadways) to develop an initial set of potential routes ("Universe of Routes").
- **Identification of Candidate Routes:** From the Universe of Routes, determined the most viable routes (collectively referred to herein as "Candidate Routes") within each individual Study Area that met the need parameters for the Project and were consistent with the objectives of the Company's routing analysis.

- **Environmental Analysis**: Compared the potential for environmental (developed and natural) impacts and constructability constraints along the Candidate Routes within each Study Area.
- **Cost Analysis:** Compared the estimated costs for the Candidate Routes.
- **Reliability Analysis:** Compared the reliability of the Candidate Routes.
- **Selection of Routes:** Evaluated the results of the above analyses and identified the Company's top routes and potential route variations within each individual Study Area that best balanced reliability, minimization of environmental impacts, constructability constraints, and cost.

4.3.4 Summary of Stakeholder Input

Beginning in early Q1 2019, members of the Project's outreach team engaged with community representatives on broad topics of the proposed Project. The original site on Fulkerson Street in Cambridge received swift community opposition which led the Company to begin a dialogue with the City and other key stakeholders on alternatives to the proposed location. After extensive discussions with private landowners, Cambridge officials and private developers, the Company and BXP agreed in concept to a solution that involved relocating the substation to a parcel currently occupied by a parking garage (known as the "Blue Garage") in Kendall Square. As this location gained solid footing as a viable alternative to the Fulkerson Street site, Company representatives began meeting with federal, State, and municipal officials, residents/business owners, developers, representatives from Harvard University and the Massachusetts Institute of Technology ("MIT"), and other stakeholders to discuss the Universe of Routes under consideration for the new transmission lines. It was explained that these lines would serve to interconnect the proposed New Substation to our existing substations in Allston-Brighton, Cambridge, and Somerville and that the team was interested in obtaining input on the routing options described herein. This process began in Q4 2019 and, as of the date of this filing, has included more numerous meetings with a wide range of stakeholder related to the proposed project. The outreach and stakeholder activities are detailed in Sections 1.7 and 5.8 and summarized in Appendices 1-1 and 4-1. The table provided in Appendix 4-1 summarizes key input provided by the stakeholders and played a significant role in the development and content of the routing analysis. Community feedback and input received from focus group meetings on the proposed routes directly contributed to the Company's process to narrow down routing options and resulting in the selection of the Preferred and the Noticed Alternative Routes. Note that the information in this table is not inclusive of additional meetings, conversations, or other discussions where some of the same routing related topics were discussed and/or conveyed to the Company, but aims to provide a general sense of how this collaborative iterative approach over the last year and a half helped the Company craft what the Company believes is a very well vetted, constructable and community supported selection of line routes.

4.4 Identification of Transmission Line Routing Study Area

Following the establishment of the routing objectives, the Company reviewed the geographic area between the New Substation Site proposed in East Cambridge and certain existing Eversource substation facilities where transmission line interconnections would be made, including Prospect Substation #402 in East Somerville, East Cambridge Substation #875 in the Kendall Square region of Cambridge, Putnam Bulk Substation #381 near the Charles River in the Riverside neighborhood of Cambridge and Brighton Substation #329 on the west side of the Charles River in the Lower Allston neighborhood of Boston. Collectively, these facilities resulted in a geographic "Project Study Area," as depicted in Figure 4-3A, within which to concentrate the investigation of potential transmission line routes.

The Project Study Area encompasses portions of the cities of Boston, Cambridge, and Somerville. The Project Study Area generally consists of densely developed, urban neighborhoods that include residential, commercial and pockets of industrial areas. The primary campuses and athletic facilities of Harvard and MIT are located within the Project Study Area, on both sides of the Charles River. There are several Massachusetts Bay Transit Authority ("MBTA") commuter rail routes (Fitchburg Line, Framingham/Worcester Line), subway routes (Red Line and Green Line), public transportation bus routes and multimodal travel ways (e.g., multiuse pathways and bicycle lanes). Sensitive receptors including schools, daycare facilities, places of worship, and so forth are present throughout the Project Study Area. The Charles River and its associated wetlands, Riverfront Area, and 100-year floodplain are the predominant environmental resource areas located within the Project Study Area, along with filled and flowed tidelands regulated under the Massachusetts Public Waterfront Act ("Chapter 91"). There are areas of protected public open space (land protected by Article 97 of the Massachusetts Constitution) within the Project Study Area, including the Massachusetts's Department of Conservation and Recreation's ("MassDCR") Charles River Reservation, Christian A. Herter Park ("Herter Park"), Magazine Beach, Longfellow (Riverbend) Park, other municipal properties (e.g., Riverside Press Park) and multi-use pathways (Dr. Paul Dudley White Path, Grand Junction Railroad). With few exceptions, most of the Project Study Area contains Environmental Justice ("EJ") Populations, as such term is defined under Massachusetts law. See Section 1.7 and 5.8.1, regarding interactions with these EJ communities.

Within each individual Study Area (Brighton, Putnam, Kendall, and Somerville), the Company looked for existing linear corridors (e.g., existing rail, and roadway corridors) that could potentially facilitate construction of the new underground transmission lines and provide a reasonably direct route between each of the referenced substation facilities, as appropriate. A more detailed description of each individual Study Area is provided below. Note that all the individual Study Areas partially overlap near the New Substation Site in East Cambridge where all the proposed transmission lines connect with the New Substation facility.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

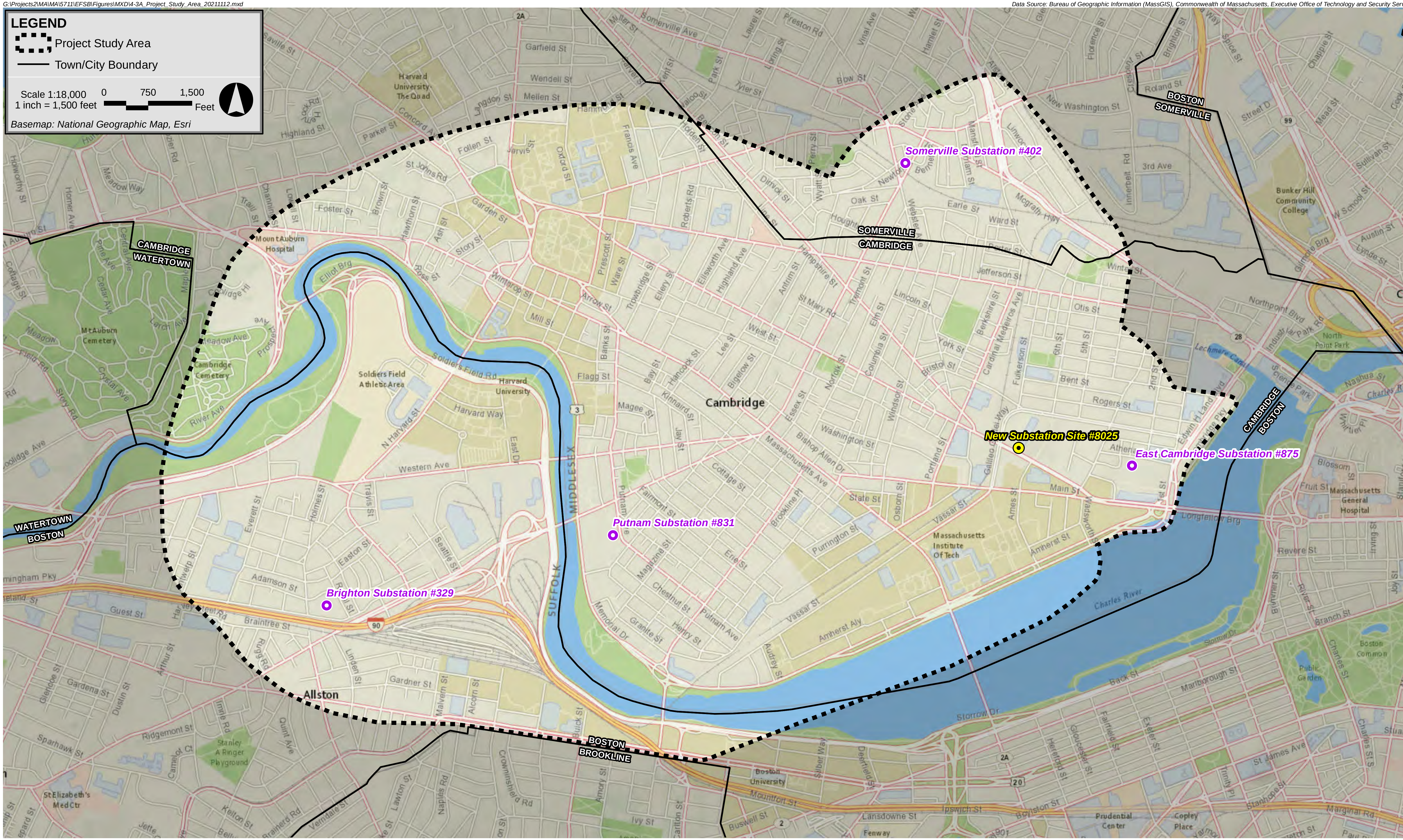

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Figure 4-3A

Project Study Area

4.4.1 Brighton Study Area

The Brighton Study Area encompasses approximately 4.8 square miles (see Figure 4-3B). It is the largest of the four Study Areas identified by the Company and overlaps portions of the other three Study Areas described below. The Brighton Study Area includes portions of Cambridge and Boston and considers proposed transmission line interconnections between the New Substation in East Cambridge and the existing #329 Brighton Substation located on Lincoln Street in the Allston/Brighton section of Boston. The northern edge of the Brighton Study Area is generally delineated by the Cambridge / Somerville municipal border and Cambridge Street. The eastern perimeter is generally defined by Fulkerson Street and Broadway Avenue in Cambridge. The southern and western edges are generally delineated by the Boston/Watertown and Boston/Brookline municipal borders. The Charles River bisects the Brighton Study Area in an east-west direction. The man-made Charles River Basin is non-tidal, being located upstream of the old and new Charles River Dams and downstream of the Watertown Dam. A potential transmission line route between the New Substation in Cambridge and the Brighton Substation in the Lower Allston area of Boston would require a crossing of the Charles River via horizontal directional drill ("HDD") or other trenchless crossing technique; or via one of the existing bridge crossings (e.g., Western Avenue, River Street, Anderson Memorial Bridge, or Grand Junction Railroad trestle bridge), or potentially on a separate self-supporting utility bridge, if feasible. The Charles River crossing is unique to the Brighton Study Area and adds complexity to the design, construction, and environmental permitting processes, as does utilizing the state-controlled bridges and infrastructure.

East of the Charles River in the City of Cambridge, the Brighton Study Area is characterized by the main campuses of MIT and Harvard University, major public roadways such as Memorial Drive, Massachusetts Avenue, River Street and Western Avenue, densely developed single family and multi-family residential neighborhoods, MassDCR recreational properties (Magazine Beach and other Charles River Reservation facilities), and areas of commercial, office space, hotels, research and development space, laboratory space, and biotechnology companies. A segment of the MBTA's Red Line subway tunnel and several public bus routes are located within the Brighton Study Area, extending through Cambridge and into Somerville.

West of the Charles River in the City of Boston, most of the Brighton Study Area consists of heavily developed commercial and industrial areas with areas of residential neighborhoods (single family and multi-family residential), located generally between North Harvard Street and Franklin Street. Harvard University athletic facilities and sports complexes occupy the northwest corner of the Brighton Study Area up to Soldiers Field Road. MassDCR's Herter Park and the Dr. Paul Dudley White Bike Path are located along the western edge of the Brighton Study Area and represent significant public open space areas within the larger Charles River Reservation. Interstate 90 ("I-90" or the "Mass Pike") passes through the southerly edge of the Brighton Study Area parallel to the MBTA commuter rail tracks (Framingham/Worcester Line). There is also a CSX Transportation

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

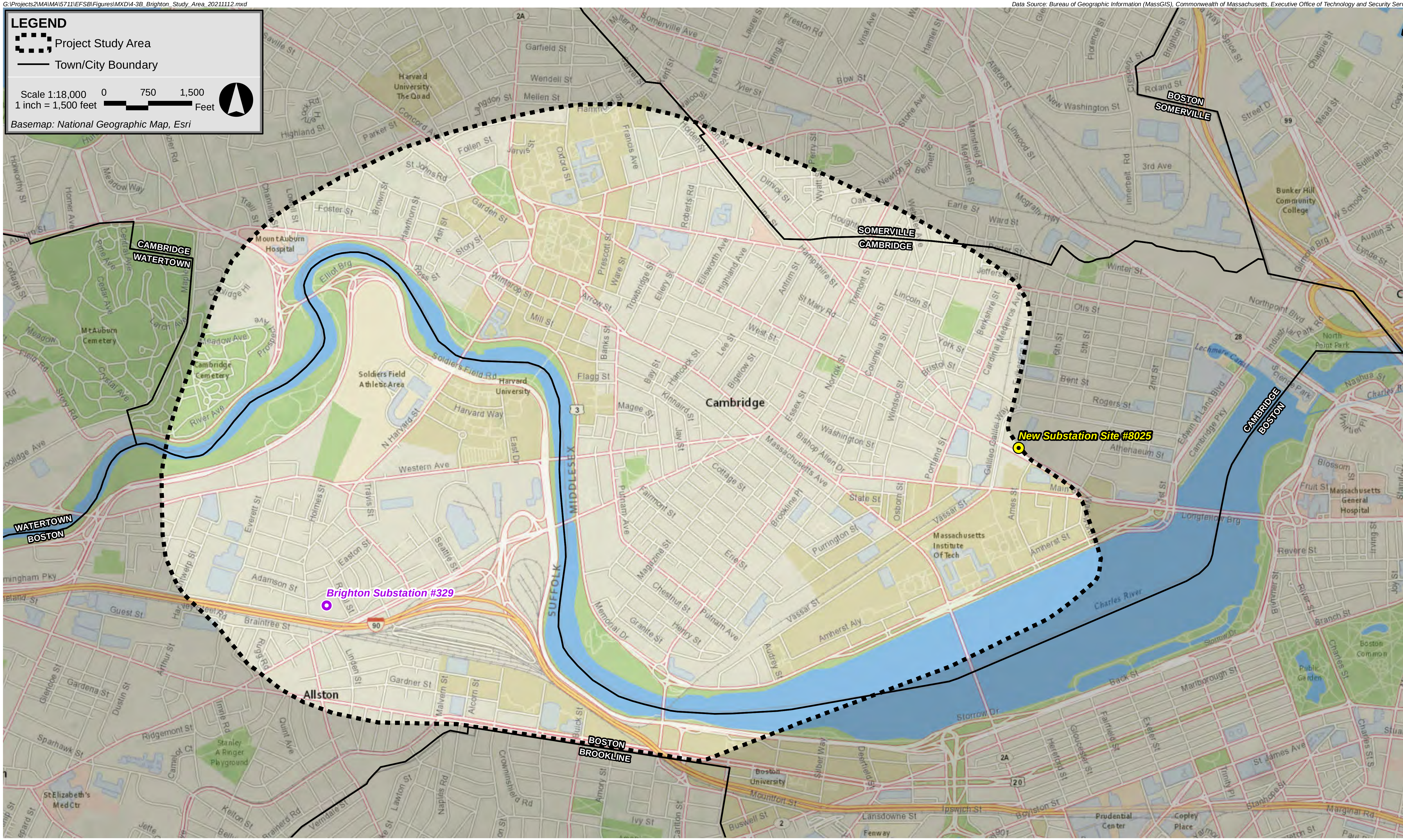

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Figure 4-3B

Brighton Study Area

rail yard located south of the I-90 interchange and ramp areas approaching the Charles River. This area is scheduled to be redeveloped as part of the Massachusetts Department of Transportation's ("MassDOT") Allston Multimodal Project.[62]

4.4.2 Putnam Study Area

The Putnam Study Area encompasses approximately 1.5 square miles (see Figure 4-3C). The Putnam Study Area is located entirely in Cambridge and considers proposed transmission line interconnections between the New Substation Site in East Cambridge and transmission lines supplying the existing #831 Putnam Bulk Station located on Putnam Avenue. The Putnam Study Area is generally located between the Charles River and Cambridge Street to the east. A significant portion of the Putnam Study Area also falls within the overlapping Brighton Study Area, east of the Charles River as described above. Densely developed residential neighborhoods (single family and multi-family developments) characterize much of the Putnam Study Area including along River Street, Franklin Street, Sidney Street, Allston Street and Colombia Street in Cambridge. There are pockets of sensitive receptors within this Study Area (e.g., places of worship, fire station on River Street, MIT campus, etc.), but fewer in extent when compared to the other Study Areas described herein. The Putnam Study Area does not contain a waterbody crossing, which minimizes the extent of environmental permitting and certain construction challenges. Memorial Drive occupies the southern and western limits of this Study Area. Memorial Drive is under the care and custody of MassDCR and is a component of the Charles River Reservation.

4.4.3 Kendall Study Area

The Kendall Study Area encompasses approximately 0.41 square miles (see Figure 4-3D). The Kendall Study Area is relatively compact, located entirely in Cambridge. The Kendall Study Area considers proposed transmission line interconnections between the New Substation Site in East Cambridge and the existing #875 East Cambridge Substation located on Athenaeum Street to the east. The northern edge of the Kendall Study Area is defined by Charles Street. Memorial Drive and the Charles River generally delineate the eastern and southern perimeters of the Kendall Study Area. Massachusetts Avenue, Vassar Street, Galileo Way and Fulkerson Street generally delineate the western edge. The main campus of MIT occupies a significant portion of this Study Area, between Memorial Drive and Vassar Street. The Kendall Study Area is comprised of mixed-use commercial developments, restaurants, hotels, office space, laboratory, research and development, biotechnology space and several above grade and below grade parking garages. Dense residential neighborhoods border the northern edge of the Kendall Study Area (single and multi-family housing) along Charles Street. There are also residential apartment complexes located in and around Binney Street and Third Street.

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62 See https://www.mass.gov/allston-multimodal-project.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

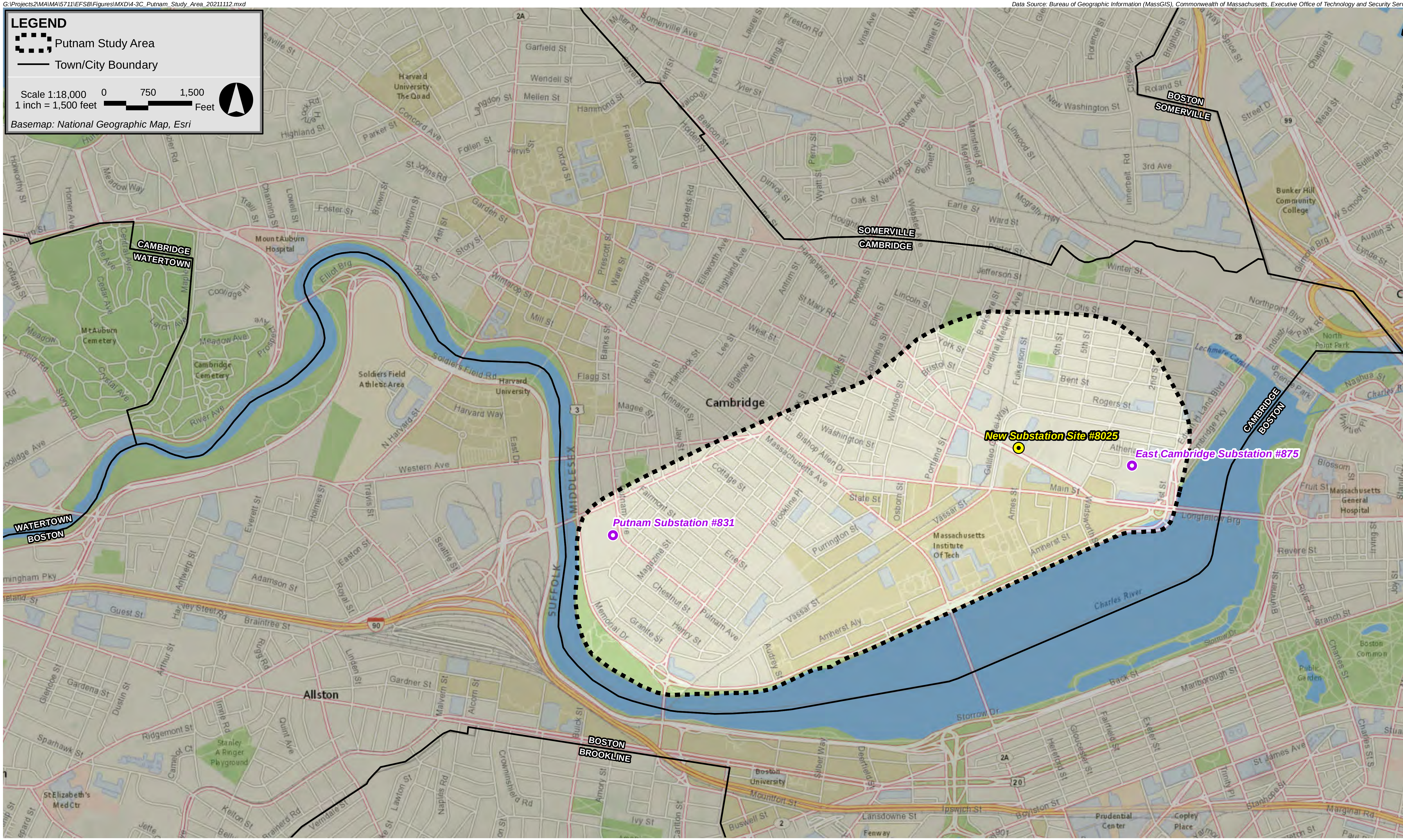

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Figure 4-3C
Putnam Study Area

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

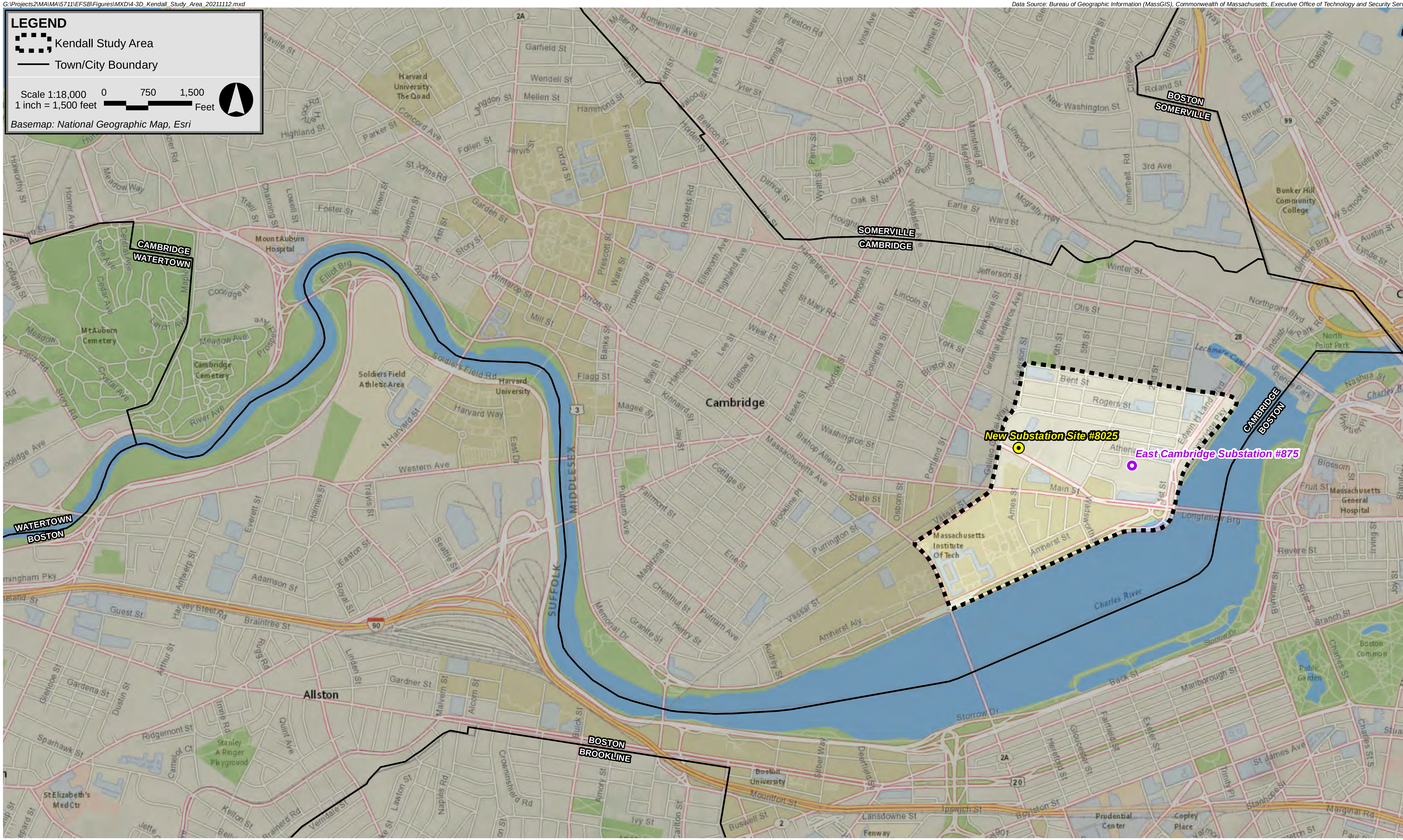

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Figure 4-3D

Kendall Study Area

4.4.4 Somerville Study Area

The Somerville Study Area encompasses approximately 1.2 square miles (see Figure 4-3E). The Somerville Study Area is in Cambridge and Somerville and considers proposed transmission line interconnections between the New Substation Site in East Cambridge and the existing Somerville Substation #402 located on a triangular piece of depressed land between Webster Avenue, Prospect Street and Newton Street in Somerville. The MBTA commuter rail (Fitchburg Line) delineates the southern edge of the Somerville Substation site and bisects the Somerville Study Area in an east-west direction. The MBTA's Green Line Extension Project[63] involves ongoing construction work in Somerville through a portion of the Study Area generally between the existing Lechmere Station to Union Square, northwest of the existing #402 Somerville Substation on Prospect Street. Massachusetts Avenue in Cambridge delineates the southern edge of this Study Area, in Cambridge.

In addition to the public transit facilities described above, the Somerville Study Area is characterized by significant areas of residential development (single family and multi-family housing) and pockets of sensitive receptors (e.g., schools, places of worship, and public parks). Commercial, retail, research and development and bio-technology companies exist towards the center and northern edge of the Somerville Study Area. The Company has a Customer Service Center located in an industrially developed area along Linwood Street, east of the Somerville Substation facility.

4.5 Transmission Line Route Selection

4.5.1 Identification of Universe of Routes

Using the routing objectives identified in Section 4.3.2, the Company reviewed U.S. Geological Survey ("USGS") maps, utility and roadway survey data, Massachusetts Geographic Information System ("MassGIS") data and aerial photography, as well as field reconnaissance to identify a Universe of Routes that could potentially support new underground transmission lines between the New Substation facility and the four aforementioned existing substation facilities, including the utilization of existing linear corridors. Notably, the common gateway for all the proposed transmission line routes begins at the entrance to the New Substation facility on Broadway Avenue in Cambridge, with potential routes heading east or west from the New Substation depending on the locations of existing substation facilities to which the New Lines propose to interconnect. From a routing perspective, bringing five new underground transmission line duct banks to a single interconnection point presents several challenges. For example, during the routing process the Company was mindful of space, design and operational constraints associated with locating a new transmission line duct bank on a particular roadway segment within an

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63 See https://www.mass.gov/green-line-extension-project-glx.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

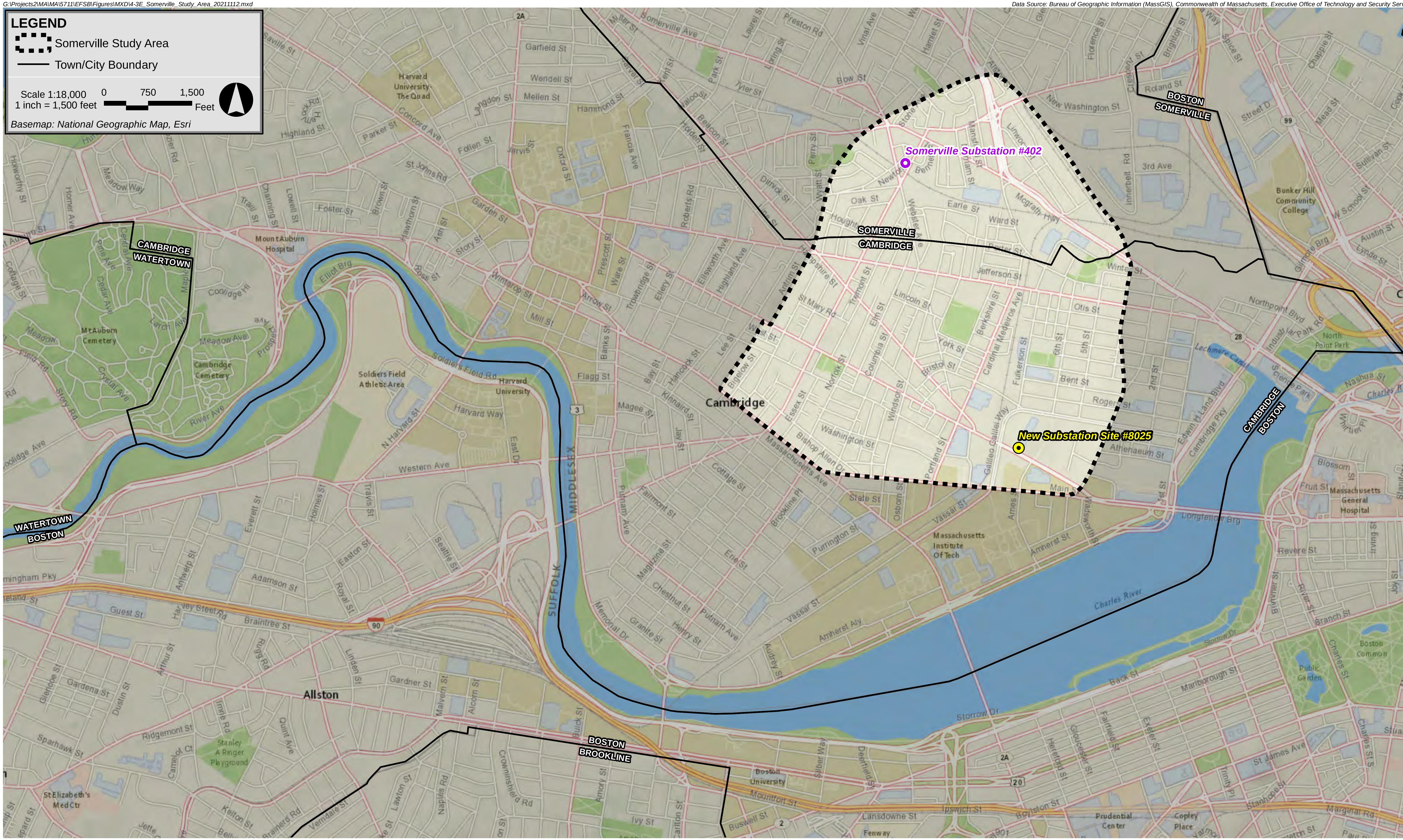

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Figure 4-3E

Somerville Study Area

individual Study Area that could also potentially serve as a viable route for another transmission line duct bank located in a separate but overlapping Study Area. This is particularly true in and around the New Substation Site where all the individual Study Areas converge. The Company also considered the presence and concentration of existing underground utility infrastructure (which is extremely dense in most of the Project Study Area and particularly so near the New Substation Site) and ensure there was adequate space for the future distribution lines required to connect to the New Substation to supply Eversource's customers. Moreover, the Brighton Study Area involves construction of two new transmission line duct banks, necessitating a separate evaluation of potential routes that head east or west from the New Substation onto Broadway Avenue to ensure some measure of geographic diversity required by the Siting Board while being mindful of space and constructability constraints to install and operate the new transmission lines. The installation of underground transmission lines, near other transmission lines (or any other heat source) for any appreciable length can potentially impact the performance and design rating of the lines. If the lines are close to each other, mutual heating of the lines could potentially reduce the rated current carrying capability of the transmission facilities (i.e., derating existing lines and/or increasing the size of the conductor for the new line(s) to achieve required ratings). As the separation between transmission lines decreases, the mutual heating and associated negative thermal impacts increase. The Company was also mindful of near term and longer-term development plans such that installation of a new transmission line across private properties would not adversely affect the ability of the landowner(s) to develop the properties in the future (e.g., Harvard, MIT, several other private developers). The amount of development planned within the Project Study Area, and the need for electricity, continues along a rapid growth trajectory.

The Company also conducted a thorough and objective evaluation of undeveloped open space areas such as MassDCR's Magazine Beach and Herter Park, located adjacent to the Charles River within the Brighton Study Area. While the Company strives to avoid/minimize the need to acquire property rights wherever practicable, under certain circumstances these types of public properties and private properties can present opportunities to implement less intrusive routing alternatives or construction techniques, such as HDD crossings beneath the parkland and river, while undertaking appropriate mitigation and restoration measures that result in an overall net benefit to the effected properties and, in this case, public resources. Similarly, routes that propose to follow existing railroad corridors or cross the Charles River on a self-supporting utility bridge or repurpose an existing bridge (e.g., railroad trestle beneath the Boston University ("B.U.") Bridge), can present opportunities to partner with stakeholders relative to collocating the new transmission line with future planned multi-use pathway connections (e.g., Cambridge's Grand Junction Railroad Multi-Use Pathway).[64] Previously disturbed properties scheduled for redevelopment can also present opportunities relative to the placement of needed utility infrastructure including siting of new transmission lines. For example, within the Brighton Study Area the MassDOT Allston Multimodal Project Area is presently occupied by the CSX rail yard, MBTA Worcester commuter rail main line and I-90 interchange. This entire area is scheduled to

64 https://www.cambridgema.gov/CDD/Projects/Transportation/GrandJunctionPathway.

undergo a major transformation, including realigning existing and constructing new roadways, and reconfiguring open space areas and multi-use pathways along the Charles River. Construction of the first phase of the MassDOT Allston Multimodal Project is anticipated to commence in late 2023 or early 2024.[65] With proper coordination and sequencing, these types of developments can present opportunities to avoid and minimize impacts during construction by locating new transmission lines within the layout of future roadway/utility corridors and previously developed and altered areas. Other examples exist within the Somerville Study Area where adjacent properties in and around the existing Somerville Substation are scheduled to be redeveloped. The MBTA is currently constructing a new train station platform as part of the Green Line Extension Project adjacent to the City of Somerville's Union Square and Boynton Yards development projects.[66] Not unlike MassDOT's Allston Multimodal Project, these Somerville development projects also propose to realign existing roads and construct new roads in and around the development footprints, presenting opportunities to site new transmission lines within the new roadway and utility corridors while avoiding and minimizing impacts to existing roadway infrastructure.

For brevity and ease of review, Appendix 4-2 includes a table with a detailed description of the routes considered by the Company. As noted therein, a total of 79 routes were considered suitable for additional screening, including 42 routes within the Brighton Study Area, 5 routes within the Putnam Study Area, 14 routes within the Kendall Study Area, and 18 routes within the Somerville Study Area, including several discrete route variations across certain parcels of land. Collectively, these routes comprise the Universe of Routes. Note that on the referenced table provided the Brighton Routes include an "East" or "West" designation after the route ID to indicate the direction of the route as it exits the New Substation Site onto Broadway Avenue in Cambridge. Figure 4-4 on the following page provides a graphical depiction of the Universe of Routes within each respective Study Area.

Section 4.5.2 below describes the screening methodology employed by the Company to refine the Universe of Routes to a reasonable set of Candidate Routes for more direct comparison and analysis within each respective Study Area.

4.5.2 Screening Methodology

The Universe of Routes identified by the Company, with input from stakeholders, consisted of 79 different route combinations that were advanced for screening. The initial screening process included reviewing publicly available data to consider existing abutting land uses and natural resources such as wetlands, floodplain and waterways associated with the Charles River, and

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65 https://www.mass.gov/service-details/recent-developments-and-next-steps-for-the-allston-multimodal-project

66 https://www.somervillema.gov/departments/union-square-planning.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

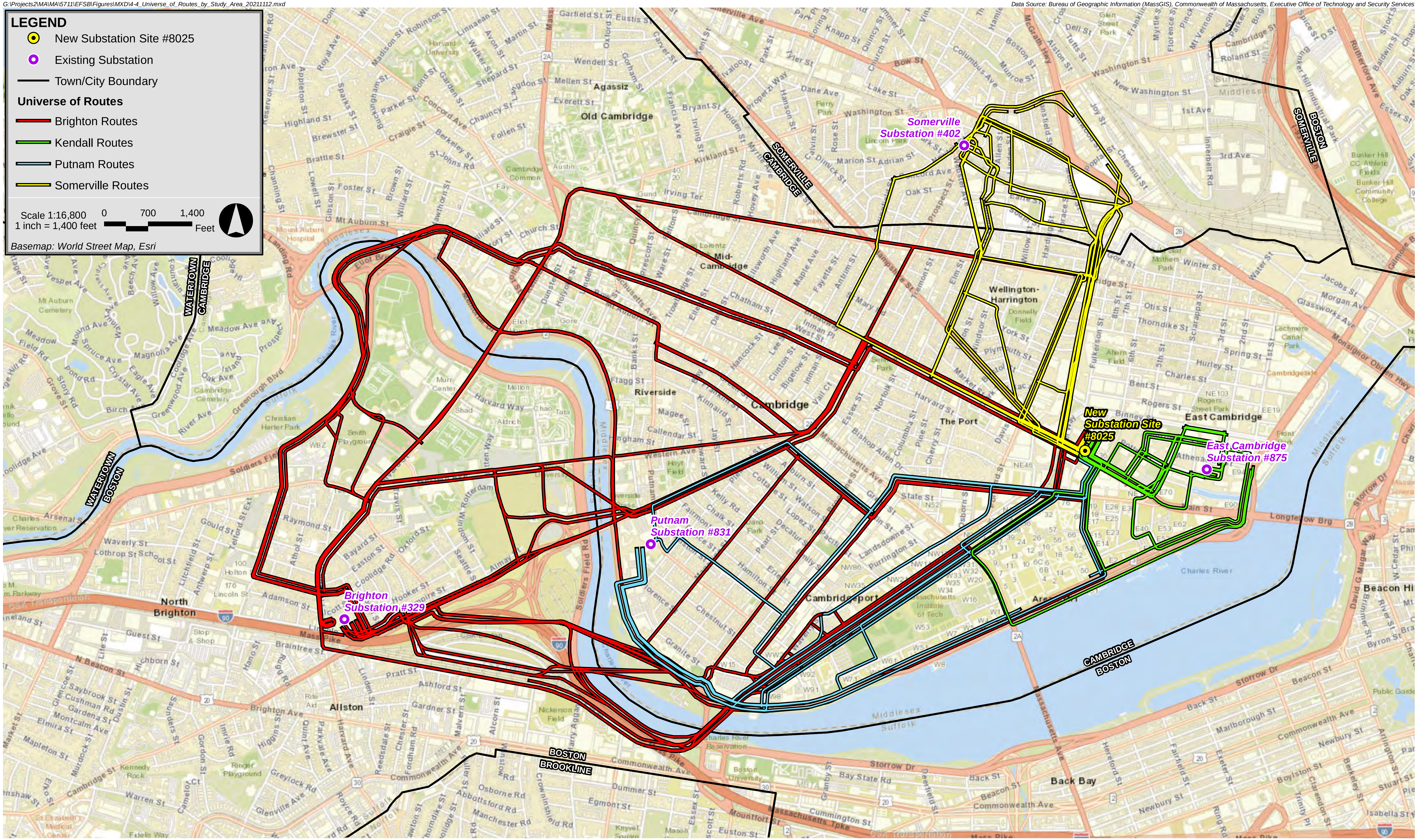

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Figure 4-4

Universe of Routes

protected open space and recreational areas. In addition, traffic experts assessed general multimodal traffic patterns and traffic volumes, as applicable to the routes, and evaluated public transportation and bicycle usage as well as the degree of pedestrian use. The Company also reviewed the proposed transmission line routes for constructability constraints, such as identified areas of existing underground utility congestion, complex crossings (e.g., railroad tracks and subway tunnels, Charles River, major roadways, and bridges) and reviewed order of magnitude cost estimates for addressing these challenges. The Company also considered information received from municipal and state agency staff members, private landowners, and stakeholder groups, including information regarding planned developments along the proposed transmission line routes where opportunities might exist to collocate (e.g., MassDOT Allston Multimodal Project area, Cambridge's Grand Junction Multi-Use Pathway, Union Square and Boynton Yards Development in Somerville and so forth). Route options were screened out and eliminated from further consideration if they were determined to be unsuitable or inferior for transmission line development relative to other routes available for consideration by the Company.

One of the major obstacles encountered during the screening and route selection process was existing underground utility density and infrastructure and available space to construct and operate up to five new transmission line duct banks and splice vault installations. While utility density can be a challenge for underground transmission line projects in general, in this case it is amplified because five new transmission line duct banks are proposed, all of which extend onto adjacent roadways from the New Substation Site utilizing a single exit point on to Binney Street in Cambridge. Moreover, the Study Area within Cambridge, Somerville and Boston is a densely developed urban environment that presently contains a high concentration of underground utilities that serve existing and future planned developments. Based on feedback from local engineering and public works officials, private developers, and input from the Massachusetts Water Resources Authority ("MWRA"), MBTA, MassDCR, MassDOT and Rail Divisions, MIT, Harvard University, and utility surveys performed by the Company, certain potential routes or route segments were more constrained by utilities and other infrastructure than other potential routes or route segments. From a routing perspective, such routes are routinely eliminated or avoided to the extent practicable through the initial screening process. Some representative examples include:

- **MBTA Red Line Subway Tunnel** – Within the Project Study Area, the Red Line subway tunnel is located beneath Massachusetts Avenue and Main Street through the City of Cambridge. According to the MBTA, the depth to the ceiling of the Red Line subway tunnel is shallow in certain locations, particularly in and around Harvard Square and the Central Square area approaching the intersection of River Street/Western Avenue and Prospect Street in Cambridge. The shallow depth of the tunnel can constrain potential crossing locations for the new transmission line. As per conversations with the City of Cambridge and MBTA, the Company also understands the Red Line subway tunnel is located towards the center of Main Street and Massachusetts Avenue through the Study Area within Cambridge, with existing utilities located on either side. The arrangement of these facilities within the roadway reduces the amount of available space to construct and operate a new transmission line and install splice vaults parallel to the Red Line subway tunnel on these streets. Accordingly, route segments crossing over or running parallel with the Red Line tunnel on Massachusetts Avenue and Main Street through Cambridge were avoided whenever possible. That said, it was not possible to avoid crossing the Red Line Subway tunnel in the Brighton and Putnam Study Areas given the north-south alignments of the identified potential routes relative to the east-west alignment of the subway corridor near the New Substation Site. In these instances, the Company worked with the MBTA to minimize the extent of longitudinal installations and identify crossing locations where the tunnel was deep enough to facilitate transmission line installations above the subway tunnel.

- **Other MBTA Facilities** – The MBTA commuter rail Fitchburg Route Main Line is in the Somerville Study Area and the Framingham/Worcester Line is in the Brighton Study Area, west of the Charles River. The Grand Junction Railroad corridor bisects the Project Study Area through Somerville, Cambridge and over the Charles River via a trestle bridge into Boston. The MBTA Railroad Operations Directorate (the "Directorate") prescribes specifications for any construction and/or related activities on, over, under, within or adjacent to railroad property owner by the MBTA. One of these specifications is that proposed underground transmission lines should cross perpendicular to the tracks whenever feasible and be installed in a steel casing, preferably with a minimum cover of 6.5 feet. Potential routes that were unable to cross substantially perpendicular to the tracks (or unable to meet other specifications in the Directorate, such as rail clearance requirements without relief from the MBTA), were avoided whenever possible. This was particularly true for certain routes in the Somerville Study Area approaching the McGrath Highway (Route 28) area near Somerville Avenue Extension and the Brighton Study Area west of the Charles River. In less travelled areas, such as the lightly used Grand Junction Railroad Corridor generally between Broadway and Medford/Gore Street in Cambridge, the MBTA indicated that it would consider granting relief from the Directorate specifications for non-perpendicular crossings in these discrete locations provided certain design and construction measures were employed. The MBTA further indicated that routing alongside the Framingham/Worcester Line commuter tracks in Allston adjacent to the MassDOT Multimodal Project Site was not feasible due to insufficient clearance between the tracks and the retaining walls and bridge abutments that border the route(s). In addition, the section of the Grand Junction Railroad corridor between Main Street and Massachusetts Avenue in Cambridge is not suitable for transmission line construction because of the presence of MIT's Brain and Cognitive Sciences Building, which spans the railroad tracks via a tunnel/archway. This area is also constrained by existing steam lines that pass beneath the tracks to the MIT buildings and was thus avoided.

- **Grand Junction Railroad Trestle Bridge** – The Company considered routes in the Brighton Study Area that could potentially repurpose the existing MBTA Grand Junction Railroad Trestle Bridge crossing of the Charles River, including possibly collocating with a future multi-use pathway contemplated by the City of Cambridge. However, this crossing option was determined to be impracticable for several reasons, including but not limited to the following:

- The MassDOT Multimodal Project "Throat Design" on the west side of the Charles River, where the transmission line would cross, has not yet been finalized and presents an unacceptable schedule and construction risk to the Company, that could jeopardize the Project's in-service date.
- The uncertain future of the bridge for expanded rail use.
- Inability to re-purpose the existing bridge superstructure and piers for utility installation and a future multi-use pathway (project engineers determined that the existing trestle bridge structure cannot support the weight of the new transmission line).
- Likelihood of extensive removal of mature trees and other vegetation on both sides of the Charles River for staging and laydown, equipment, and construction access (including access for large cranes and space for pulling cable).
- Construction activities could likely require barge setups and cofferdam installation and dewatering work in the Charles River to install piers (also presenting a navigation challenge during construction to users of the river).
- The Company considered a self-supporting utility bridge parallel to the trestle bridge but determined that there was insufficient space for such a structure within the bounds of the route trajectory, in addition to potential concerns anticipated from the Massachusetts Historical Commission ("MHC") regarding viewshed effects to the Charles River Basin Historic District.
- As per discussions with MassDCR, if the transmission line collocated with a multi-use pathway project, the American Disability Act design constraints would likely present a significant challenge where the utility bridge/multiuse pathway intersects with the Dr. Paul Dudley White Bike Path on the south side of the Charles River, that would likely require a robust switchback ramp system to transition back at an appropriate slope to reach grade on Soldiers Field Road.

Accordingly, route segments that relied upon the Grand Junction Railroad Trestle Bridge to reach the Brighton Substation were avoided.

- **Harvard/MIT Properties** – Harvard and MIT have significant properties in the overall Study Area within Cambridge and Boston, including academic buildings, student housing, ancillary buildings, parking lots, athletic field complexes and real estate identified for re-development or expansion plans (new academic buildings, student housing, parking, public transportation projects, etc.). Some of these properties targeted for future development present opportunities for routing the transmission line, particularly in the Brighton Study Area where with proper planning and coordination such projects might be able to accommodate a new transmission line(s) (e.g., roadway realignments associated with MassDOT's Allston Multimodal Project). However, other university properties presented constraints that should be avoided to the extent practicable. For example, MIT and Harvard requested that potential routes crossing over certain properties not constrain their ability to re-develop the land in the future, and that any proposed transmission lines or splice vaults be located off the property or as close to the property line(s) as possible, versus towards the center of the parcel(s) where these facilities would have greater potential to conflict with future redevelopment plans. Adhering the transmission line route to these areas is not always technically feasible, particularly when there are frequent and significant bends of the transmission line. Specifically, MIT requested that Eversource avoid and/or eliminate potential routes that bisect the Volpe Center Site adjacent to the New Substation Site in Kendall Square and certain campus properties between Vassar Street and Albany Street/Waverly Street over the Grand Junction Railroad tracks in Cambridge, reasoning that the presence of a new transmission line across the center of these parcels would severely constrain future redevelopment plans. Harvard expressed similar concerns with routes bisecting its athletic complex in Boston, generally between Soldiers Field Road and North Harvard Street as well as planned development footprints within the MassDOT Allston Multimodal Project Area.

- **Potential Future Development Plans by Others** – As a matter of Company policy, established ROWs, including public roadways should be used for underground transmission line location and use of private property avoided to the extent possible. Using existing public roads can limit the need to acquire property rights and limit impact to existing land uses, depending on project specifics.

- Certain properties within the Study Area were avoided in response to landowner concerns that the presence of a new transmission line and/or splice vaults would adversely affect the ability of the landowner to develop the parcel(s) in the future. For example, within the Brighton Study Area the Company explored the feasibility of routing a transmission line through the WBZ-TV studio's property on Soldiers Field Road to avoid work on the adjacent City of Boston William E. Smith Playground property and the Harvard University athletic field complex. According to the Boston Planning and Development Agency ("BPDA") and conversations with the developer (National Development), the site is scheduled to be redeveloped with a new studio for WBZ-TV, several life-science buildings, greenspace, and parking.[67] In consultation with National Development and the BPDA, it was determined that locating a new transmission line across this property would significantly constrain potential redevelopment opportunities and should be avoided. Similarly, the Company explored potential routes across certain areas of the Boynton

67 http://www.bostonplans.org/projects/development-projects/1170-1200-soldiers-field-road

Yards redevelopment site that is located adjacent to Union Square and Cambridge's Inman Square, generally between South Street and Columbia Street. This industrial site is proposed to be redeveloped as a mixed-use district comprised of laboratory, office, multifamily and neighborhood retail, and community arts space.[68] In consultation with the City of Somerville Redevelopment Authority ("SRA") and the private developer, it was recommended that potential transmission lines through these areas be routed in a manner that considers, and does not restrict, the future development plans as described in the City's master planning documents.

- **Miscellaneous Roadway Segments** – Other roadways and/or roadway segments within the Study Area were determined to be infeasible or otherwise inferior from a routing perspective because of several constraints, including greater utility density that would restrict the Company's ability to construct a new transmission line duct bank or install splice vaults relative to other roadways and/or roadway segments. For example, the City of Cambridge Department of Public Works ("DPW") recommended that to the extent practicable, the Company should avoid routes along Western Avenue, Main Street, Hayward Street, Albany Street, Cardinal Medeiros Avenue, River Street (between Memorial Drive and Pleasant Street), portions of Galileo Way, Broadway and Binney Street, Hampshire Street/Broadway intersection, Harvard Street, and the Harvard Square/Inman Square areas. The City of Somerville indicated that routes following Somerville Avenue between Medford Street and Prospect Street were not likely feasible due to existing infrastructure and planned roadway reconstruction work and should similarly be avoided to the extent practicable. The Boston Water and Sewer Commission staff ("BWSC") indicated that Everett Street in Brighton is not likely a feasible route given the presence of existing electric distribution lines and other significant utilities. The BWSC expressed similar concerns regarding existing utilities in Western Avenue. The MWRA provided input relative to its sewer and water facilities, which are extensive throughout the Study Area, including certain major infrastructure in Cambridge such as large diameter sewer interceptor pipes on Cardinal Medeiros Avenue (North Metropolitan Cambridge Branch) and Albany Street (North Charles Relief Sewer). In other locations, it was determined that certain roadway segments would not likely have adequate space to accommodate multiple transmission lines, such as Kendall Street near the East Cambridge Substation where there is extensive steam tunnel infrastructure and a relatively shallow underground parking garage resulting in insufficient cover for a new transmission line, and Athenaeum Street and Broad Canal Way where there is extensive existing transmission and distribution line congestion, gas line expansion plans and steam lines.

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68 https://2xbcbm3dmbsg12akbzq9ef2k-wpengine.netdna-ssl.com/wp-content/uploads/2018/07/Union-Square-NP-FINAL-WEB.pdf

The section of Cambridge Street between the Grand Junction Railroad corridor and Harvard Square is constrained by an existing narrow roadway tunnel and ongoing intersection improvement work at the Springfield Street/Hampshire Street intersection.

- **Other Electric Transmission and Distribution Lines and Steam Lines** - Other significant utility related challenges encountered during the route selection and screening process included inadequate space to collocate the new transmission line duct banks with existing and proposed electric distribution lines and minimizing interactions with heat producing sources such as existing steam lines and other transmission lines. As was described in Section 4.5.1, the installation of a new transmission line within 10-feet of an existing transmission line or steam line for any appreciable length can potentially impact the performance of the existing line and the design basis (rating) for the new line. Accordingly, installing the new transmission lines within existing underground transmission line duct banks in the Study Area is not a viable possibility. Installing transmission lines in geographically diverse corridors minimizes the potential for a single contingency event to cascade and cause the failure of multiple transmission lines at once. In situations where it was not possible to attain a greater level of geographic diversity, the Company was mindful of potential routes overlapping each other from within separate Study Areas, to ensure a particular route segment could accommodate two new electric transmission line duct bank and/or splice vaults.

- **Article 97 Lands** – Acquisition of additional property rights, including lands subject to Article 97 of the Amendments to the Constitution of the Commonwealth in connection with the “conversion of land” held or owned by the Commonwealth for natural resource purposes (“Article 97 approval”) were avoided, when possible. In instances where it was not possible to avoid Article 97 lands (such as those routes requiring a crossing of the Charles River between Cambridge and Boston), the Company located the transmission line routes in a manner that would minimize impacts during construction as well as the length of transmission lines across these properties.

- **Public Shade Trees** – Public shade trees are important in any community, but particularly important in densely developed urban areas where they play an important role in improving scenic quality and aesthetic appeal, mitigating the heat island effect by reducing temperature through shading and filtering air pollutants as well as providing other public health and environmental benefits. To the maximum extent practicable, the Company avoided routes that would require the removal of healthy public shade trees on sidewalks or adjacent areas.

While the Company strived to adhere to the above-referenced recommendations and guidance provided by stakeholders during the route screening process, it was not feasible in all instances to avoid routes along some of the referenced roadways, private lands, open space and recreational areas and rail corridors given the complexities of routing five new transmission line duct banks in the densely developed urban environment that characterizes the Project Study Area. In certain instances, it was necessary to carry forth certain routes for scoring purposes and more detailed analyses, knowing the constructability and permitting challenges associated with these routes. Some examples include advancing routes involving work on Article 97 lands like Magazine Beach; MBTA railroad and subway tunnel crossings; routes that cross private properties planned for development by MIT, Harvard, and others; routes on Hampshire Street, Broadway, Cardinal Medeiros Avenue and Third Street in Kendall Square, and Lincoln Street in Allston, where there is particularly heavy utility congestion and limited space to install the transmission line. By means of this screening process, the Company determined that of the 79 original potential routes, 57 of these routes were inappropriate for further consideration as Candidate Routes and the remaining 22 routes were advanced for more detailed evaluation.

The rationale for dismissing these routes from further consideration is summarized on the following Tables 4-1 through 4-5.

Table 4-1 Summary of Routes Eliminated After Initial Screening (Brighton Study Area East)

Route ID	Municipalities Crossed by Route	Rationale for Dismissing Route from Further Analysis
B2/B2B/B2C East	Cambridge, Boston	This route and related alignment variations across the MassDOT Multimodal Project Site were eliminated in response to feedback from MassDCR regarding the extent of work across Magazine Beach, potentially resulting in significant impacts to mature trees on the property and the availability of other less impactful alternatives proposed on the property (e.g., B2A/AN East).
B4 East	Cambridge, Boston	The City of Cambridge Public Works and Engineering Departments indicated that the route segment on Main Street between Ames Street and Sidney Street in Cambridge, is significantly constrained by existing utilities and other infrastructure including steam lines on both sides of the road (noting that work on Main Street should be avoided to the extent practicable). The MBTA Red Line subway tunnel is also located towards the center of the road with existing utilities on either side, adding further complexity to construction. Further, the City of Cambridge Public Works and Engineering Departments indicated that the segment of the route that follows River Street generally between Pleasant Street and Memorial Drive, is significantly constrained by existing utilities, likely making it technically infeasible to construct a new line and/or install splice vaults in this location. The BWSC indicated that Western Avenue on the west side of the Charles River between Soldiers Field Road and North Harvard Street in Boston is significantly constrained by existing utilities (including large diameter MWRA sewer line(s)) and should be avoided to the extent practicable. Harvard University provided similar input and noted the challenges of finding sufficient space in Western Avenue to install transmission line splice vaults.
B11 East	Cambridge, Boston	See discussion above for other routes involving work on Main Street and River Street in Cambridge including constraints associated with existing utilities, steam lines and shallow depth and location of MBTA Red Line subway tunnel. In addition, the BWSC indicated that the route segment that follows Western Avenue between the Western Avenue Bridge to North Harvard Street in Boston, is significantly constrained by existing utilities (including large diameter MWRA sewer line(s)) and should be avoided. Harvard provided similar input and noted the challenges of finding sufficient space in Western Avenue to install transmission line splice vaults.
B12 East	Cambridge, Boston	This route was eliminated from further analysis because of the segment that follows Main Street in Cambridge. See discussion above for other routes involving work on Main Street and River Street in Cambridge, including significant constraints from existing utilities, MBTA Red Line subway tunnel with utilities on either side and steam lines.
B14 East	Cambridge, Boston	This route was eliminated from further analysis because of the segment that follows Main Street in Cambridge. See discussion above for other routes involving work on this road, including significant utility constraints from existing steam lines and other infrastructure and the MBTA Red Line subway tunnel with utilities on either side.
B15 East	Cambridge, Boston	This route was eliminated from further analysis because of the segment that follows Main Street in Cambridge. See discussion above for other routes involving work on this road, including significant utility constraints from existing steam lines and other infrastructure and the MBTA Red Line subway tunnel with utilities on either side.
B16 East	Cambridge, Boston	This route was eliminated from further analysis because of the segment that follows Main Street in Cambridge. See discussion above for other routes involving construction on this road, including significant utility constraints from existing steam lines and other infrastructure and the MBTA Red Line subway tunnel with utilities on either side.
B19 East	Cambridge, Boston	This route was eliminated from further analysis because of the segments that follow Main Street and River Street in Cambridge and Western Avenue in Boston. See discussion above for other routes involving construction on these roads, including significant constraints from existing steam lines and other infrastructure, MBTA Red Line subway tunnel with utilities on either side, large diameter MWRA sewer lines, etc.
B21A[69]	Cambridge, Boston	This route was eliminated in response to feedback from MassDCR regarding the extent of work across Magazine Beach, potentially significant impacts to mature trees on the property and the availability of other less impactful alternatives proposed on the property. It was also eliminated because it would have resulted in substantial impacts to the Danny Lewin Park, opposite the New Substation site, and a difficult turn across a private driveway onto Galileo Galilei Way in Cambridge.

69 Note that B21A does not head east or west from the New Substation. Rather, it heads south directly across Broadway and through a parcel of privately owned land before turning west towards Galileo Galilei Way.

Table 4-2 Summary of Routes Eliminated After Initial Screening (Brighton Study Area West)

Route ID	Municipalities Crossed by Route	Rationale for Dismissing Route from Further Analysis
B1 West	Cambridge, Boston	This route was eliminated from further analysis because of the route segment that follows the Grand Junction Railroad corridor between Main Street and Massachusetts Avenue in Cambridge beneath MIT's Brain and Cognitive Sciences Building, which spans the railroad tracks via a tunnel / archway. The City of Cambridge Public Works and Engineering Departments and MIT also indicated that this stretch was not technically feasible from a construction perspective given existing infrastructure and significant utility constraints that pass beneath the MIT buildings (including steam lines).
B3 West	Cambridge, Boston	The City of Cambridge Public Works and Engineering Departments recommended that Eversource avoid work on Cambridge Street because of existing utility constraints and significant construction and permitting challenges at the Springfield Street intersection (Inman Square reconstruction project). In addition, the route segment that follows River Street between Putnam Avenue and Memorial Drive, is significantly constrained by existing utilities, making it technically infeasible to construct a new line and/or install splice vaults in this location.
B5 West	Cambridge, Boston	Like Route B4 East above, the City of Cambridge Public Works and Engineering Departments indicated that the route segment that follows River Street, generally between Pleasant Street and Memorial Drive, is significantly constrained by existing utilities, likely making it technically infeasible to construct a new line and/or install splice vaults in this location.
B6 West	Cambridge, Boston	The City of Cambridge Public Works and Engineering Departments recommended that Eversource avoid work on Cambridge Street because of existing utility constraints and significant construction and permitting challenges at the Springfield Street intersection (Inman Square reconstruction project). Construction would also be particularly challenging through the Cambridge Street Tunnel and should be avoided. The Harvard Square Plaza area also presents a significant challenge given the location of the existing historic headhouse (kiosk) and MBTA Harvard Square Subway Station and the Red Line subway tunnel located towards the center of Massachusetts Avenue with existing utilities on either side. The subway tunnel ceiling is also only about 18-inches deep in the square. The City of Cambridge Public Works and Engineering Departments did not see a viable route through the Harvard Square area.
B7 West	Cambridge, Boston	The City of Cambridge Public Works and Engineering Departments indicated that the route segment along Western Avenue, generally between Massachusetts Avenue and Memorial Drive, is significantly constrained by existing utilities (particularly at the intersection with Memorial Drive) and should be avoided. The City of Cambridge Public Works and Engineering Departments also indicated that utilities were recently replaced along Western Avenue and there is insufficient space within the roadway layout to accommodate construction of a new transmission line and/or splice vault installations without relocating these recently replaced utilities.
B8 West	Cambridge, Boston	The City of Cambridge Public Works and Engineering Departments recommended that Eversource avoid work on Harvard Street, generally between Prospect Street and Harvard Square (John F. Kennedy Street), because of significant existing utility constraints. Further, as noted above for Route B6, the Harvard Square area presents a significant challenge given the location of the existing historic headhouse (kiosk) and MBTA Harvard Square Subway Station and Red Line subway tunnel with existing utilities on either side. The City of Cambridge Public Works and Engineering Departments did not see a viable route through this area.
B9 West	Cambridge, Boston	Based on feedback from the City of Cambridge Public Works and Engineering Departments, the route segment on Cambridge Street and the Harvard Square area is unsuitable for a new transmission line and splice vault installation(s) for the reasons identified above for other routes that considered using these same roadway segments. Work on Broadway between Inman Street and Cambridge Street, is particularly challenging because of significant existing utility constraints, including Verizon's primary backbone telecommunications cable network.
B10 West	Cambridge, Boston	See discussion above for other routes involving work on Harvard Street and through the Harvard Square area in Cambridge. In addition, the route segment on Everett Street in the City of Boston between Soldier's Field Road and Aldie Street, is significantly constrained by existing Eversource electric distribution lines. The BWSC indicated that Everett Street is significantly constrained by other existing utilities including a 72-inch diameter storm drain (the road was recently reconstructed as part of a drainage improvement project) and that routes involving work on Everett Street should be avoided.
B13 West	Cambridge, Boston	This route was eliminated from further analysis because of the segments that follow Harvard Street and Massachusetts Avenue through Harvard Square in Cambridge; and Everett Street in Boston. See discussion above for other routes involving work on these roads, including significant constraints from existing utilities (steam and electric distribution lines) and the MBTA Red Line subway tunnel with utilities on either side.
B17 West	Cambridge, Boston	This route was eliminated from further analysis because of the segments that follow Western Avenue in Cambridge and Everett Street in Boston. See discussion above for other routes involving construction on these roads, including significant utility constraints from existing large diameter MWRA sewer line(s), electric distribution lines, large diameter storm drains and recent road re-construction work on Everett Street.
B18 West	Cambridge, Boston	This route was eliminated from further analysis because of the segment that follows Everett Street in Boston. See discussion above for other routes involving work on this road, including significant constraints from existing electric distribution lines, large diameter storm drains, and recent road reconstruction work.
B20 West	Cambridge, Boston	This route was eliminated from further analysis because of the segments that follow River Street in Cambridge and Western Avenue in Boston. See discussion above for other routes involving construction on these roads, including significant constraints from existing utilities and large diameter MWRA sewer line(s), etc.

Table 4-2 Summary of Routes Eliminated After Initial Screening (Brighton Study Area West) (Continued)

Route ID	Municipalities Crossed by Route	Rationale for Dismissing Route from Further Analysis
B21 West	Cambridge, Boston	This route was eliminated in response to feedback from MassDCR regarding the extent of work across Magazine Beach, potentially significant impacts to mature trees on the property and the availability of other less impactful alternatives proposed on the property.
B22 West	Cambridge, Boston	This route was eliminated from further analysis because of the segment that follows Everett Street in Boston. See discussion above for other routes involving work on this road, including significant constraints from existing electric distribution lines, large diameter storm drains, and recent road reconstruction work.
B24B	Cambridge, Boston	This route was eliminated from further analysis because of the additional work on Soldiers Field Road relative to Routes B24 and B24A and challenges and coordination issues associated with gaining access across the WBZ studio property that is being redeveloped by National Development.
B24C	Cambridge, Boston	This route was eliminated from further analysis because of the significant constructability and traffic management challenges associated with routing the line through the Eliot Bridge/Soldiers Field Road intersection, relative to Routes B24 and B24A.
B26 West	Cambridge, Boston	This route was eliminated from further analysis because the MBTA indicated that routing alongside the Framingham/Worcester Line commuter tracks in Allston was not feasible because of clearance requirements between the tracks and the retaining walls and bridge abutments that border the route.
B27 West	Cambridge, Boston	This route was eliminated from further analysis for the same reasons identified above for Route B26 West.
B28 West	Cambridge, Boston	This route was eliminated because it was not practicable to cross the Charles River on the MBTA trestle bridge.
B29 West	Cambridge, Boston	This route (and related alignment variations A through C below) were eliminated because it was not practicable to cross the Charles River on the MBTA trestle bridge.
B29A West	Cambridge, Boston	See B29 above.
B29B West	Cambridge, Boston	See B29 above.
B29C West	Cambridge, Boston	See B29 above.
B29D West	Cambridge, Boston	This route was eliminated because MIT asked that Eversource avoid crossing its property (former Cal-Paint site) due to potential soil contamination concerns and potential future development plans for the parcel, north of the Grand Junction Railroad Tracks on Albany Street.
B29E West	Cambridge, Boston	This route was eliminated because it was impracticable to cross the Grand Junction Railroad tracks in accordance with the MBTA Directorate at a nearly perpendicular crossing while avoiding work on the former Cal-Paint site and potential impacts to adjacent building foundations due to proximity of work during construction.

Table 4-3 Summary of Routes Eliminated After Initial Screening (Putnam Study Area)

Route ID	Municipalities Crossed by Route	Rationale for Dismissing Route from Further Analysis
P14	Cambridge	This route was eliminated from further analysis because it was determined there was no viable way to extend the transmission line onto Memorial Drive from the Grand Junction Railroad corridor (Memorial Drive spans the railroad in this location at a substantially higher elevation and embankment relative to the railroad tracks).
P15	Cambridge	This route was eliminated from further analysis for the same reasons identified above for Route P14.

Table 4-4 Summary of Routes Eliminated After Initial Screening (Kendall Study Area)

Route ID	Municipalities Crossed by Route	Rationale for Dismissing Route from Further Analysis
K1	Cambridge	This route was eliminated from further analysis because of the segment that follows Main Street and Ames Street. As previously noted, Main Street is significantly constrained by existing utilities including steam lines on both sides of the road and the MBTA Red Line subway tunnel with utilities on either side. In addition, Ames Street was identified as a more viable corridor for other routes leaving the New Substation Site within the Brighton and Putnam Study Areas, with the assumption that routes within the Kendall Study Area could be constructed without involving work on Ames Street (thus leaving Ames Street available as an option for other routes).
K2	Cambridge	This route was eliminated from further analysis because of the segment that follows Hayward Street and Wadsworth Street. The City of Cambridge Engineering and Public Works Departments indicated that Wadsworth Street is "packed" with utilities and was an impracticable option. Hayward Street was also determined not to be a viable option because of the existing MIT parking garage located beneath the street, connecting to either side.
K3	Cambridge	This route was eliminated from further analysis because of the segment that follows Ames Street. As previously noted, Ames Street was identified as a more viable corridor for other routes leaving the New Substation Site within the Brighton and Putnam Study Areas, with the assumption that routes within the Kendall Study Area could be constructed without involving work on Ames Street (thus leaving Ames Street available as an option for other routes).
K4	Cambridge	This route was eliminated from further analysis because of the segment that follows Main Street. As previously noted, Main Street is significantly constrained by existing utilities including steam lines on both sides of the road and the MBTA Red Line subway tunnel with existing utilities on either side.
K5	Cambridge	This route was eliminated because of significant utility congestion within the Third Street/Broadway intersection and because it would have required the removal of several mature public shade trees located on the middle median of Broadway, that Cambridge DPW indicated was not permittable.
K6	Cambridge	This route was eliminated for the same reasons described above for Route K5.
K7	Cambridge	This route was eliminated because it would bisect MIT's Volpe Center Site and significantly constrain future development by MIT.
K8	Cambridge	Like Route K7, this route was eliminated because it would bisect MIT's Volpe Center Site and significantly constrain future development by MIT.
K9	Cambridge	This route was eliminated due to existing utilities, presence of major steam tunnel infrastructure and shallow underground parking garage on Kendall Street.

Table 4-5 Summary of Routes Eliminated After Initial Screening (Somerville Study Area)

Route ID	Municipalities Crossed by Route	Rationale for Dismissing Route from Further Analysis
S3	Cambridge, Somerville	This route was eliminated from further analysis because of the segment that follows Cambridge Street between Cardinal Medeiros Avenue and Webster Avenue (existing utility constraints and significant municipal roadway re-construction projects planned for this area). The City of Cambridge Public Works and Engineering Departments also recommended that to the greatest extent practicable Eversource avoid work on Cardinal Medeiros Avenue because of existing utility constraints and other significant construction projects.
S4	Cambridge, Somerville	This route was eliminated from further analysis because of the segment that follows Somerville Avenue between Linden Street and Prospect Street. The City of Somerville indicated that Somerville Avenue is significantly constrained by existing infrastructure, including installation of a substantial box culvert/drainage system, and does not likely have sufficient space to accommodate a new transmission line and/or splice vault installation and should be avoided.
S5	Cambridge, Somerville	This route was eliminated from further analysis because of the segment that follows Somerville Avenue between McGrath Highway and Prospect Street. As noted above, the City of Somerville indicated that this stretch of Somerville Avenue is significantly constrained by existing infrastructure, including installation of a substantial box culvert/drainage system, and does not likely have sufficient space to accommodate a new transmission line and/or splice vault installation. In addition, to reach Somerville Avenue, the line would require an impracticable east-west switchback bend radius beneath the McGrath Highway overpass on the MBTA commuter rail tracks, back to Somerville Avenue Extension and Somerville Avenue.
S6	Cambridge, Somerville	This route was eliminated from further analysis for the same reasons identified above for Route S4 (Somerville Avenue segment between Medford Street and Prospect Street).

Table 4-5 Summary of Routes Eliminated After Initial Screening (Somerville Study Area) (Continued)

Route ID	Municipalities Crossed by Route	Rationale for Dismissing Route from Further Analysis
S7	Cambridge, Somerville	This route was eliminated from further analysis for the same reasons identified above for Route S5 (Somerville Avenue segment between McGrath Highway and Prospect Street).
S8	Cambridge, Somerville	This route was eliminated from further analysis because of the segment located on the Prospect Street bridge, approaching the Somerville Substation facility. More specifically, the Prospect Street bridge is elevated above the eastern edge of the Somerville Substation over the MBTA commuter rail tracks, resulting in inadequate space to connect the transmission line to the substation with a reasonable bend radius.
S9	Cambridge, Somerville	This route was eliminated for the same reasons identified above for Route S8.
S10	Cambridge, Somerville	Like Route S5, this route was eliminated from further analysis because of the impracticable east-west switchback bend radius beneath the McGrath Highway overpass on the MBTA commuter rail tracks and the lack of space within the MBTA commuter rail track corridor to construct and operate a new transmission line without adverse effects to the commuter rail facilities.
S11	Cambridge, Somerville	This route was eliminated for the same reasons identified above for Route S10 (impracticable crossing of the MBTA commuter rail tracks beneath the McGrath Highway).
S11A	Cambridge, Somerville	This route was eliminated because it did not collocate with the future multi-use pathway proposed by the City of Cambridge along the Grand Junction Railroad corridor.
S11B	Cambridge, Somerville	This route was eliminated because it did not collocate with the future multi-use pathway proposed by the City of Cambridge along the Grand Junction Railroad corridor.
S14A	Cambridge, Somerville	This route was eliminated because it was unable to interconnect with the Somerville Substation due to constructability issues associated with the Prospect Street concrete retaining wall/bridge abutments, MBTA infrastructure associated with the new Green Line Extension train platform, inadequate space for trenchless construction to install the new transmission line beneath the Prospect Street Bridge, and the layout of the existing Somerville Substation equipment.

Tables 4-6 through 4-10 below provides a summary of the eliminated routes described above and the remaining 22 routes that were retained for scoring/ranking and more detailed analysis as Candidate Routes.

Table 4-6 Results of Route Selection After Initial Screening (Brighton Study Area East)

Route ID	Route Length (miles)	Municipalities Crossed by Route	Status
B2 East	2.94	Cambridge, Boston	Eliminated from Further Analysis
B2A East	2.91	Cambridge, Boston	Retained for Scoring
B4 East	3.23	Cambridge, Boston	Eliminated from Further Analysis
B11 East	3.13	Cambridge, Boston	Eliminated from Further Analysis
B12 East	2.75	Cambridge, Boston	Eliminated from Further Analysis
B14 East	2.89	Cambridge, Boston	Eliminated from Further Analysis
B15 East	2.89	Cambridge, Boston	Eliminated from Further Analysis
B16 East	3.11	Cambridge, Boston	Eliminated from Further Analysis
B19 East	3.11	Cambridge, Boston	Eliminated from Further Analysis
B21A	2.78	Cambridge, Boston	Eliminated from Further Analysis
B25 East	5.49	Cambridge, Boston	Retained for Scoring
B25A East	5.40	Cambridge, Boston	Retained for Scoring
B31 East	3.26	Cambridge, Boston	Retained for Scoring

Table 4-7 Results of Route Selection After Initial Screening (Brighton Study Area West)

Route ID[70]	Route Length (miles)	Municipalities Crossed by Route	Status
B1 West	2.82	Cambridge, Boston	Eliminated from Further Analysis
B3 West	3.84	Cambridge, Boston	Eliminated from Further Analysis
B5 West	2.63	Cambridge, Boston	Eliminated from Further Analysis
B6 West	3.76	Cambridge, Boston	Eliminated from Further Analysis
B7 West	3.39	Cambridge, Boston	Eliminated from Further Analysis
B8 West	3.20	Cambridge, Boston	Eliminated from Further Analysis
B9 West	3.33	Cambridge, Boston	Eliminated from Further Analysis
B10 West	4.08	Cambridge, Boston	Eliminated from Further Analysis
B13 West	3.64	Cambridge, Boston	Eliminated from Further Analysis
B17 West	4.35	Cambridge, Boston	Eliminated from Further Analysis
B18 West	4.31	Cambridge, Boston	Eliminated from Further Analysis

70 Note that Route B23 West does not exist (it ultimately became Route B21 West during the route screening and selection process).

Table 4-7 Results of Route Selection After Initial Screening (Brighton Study Area West) (Continued)

Route ID[71]	Route Length (miles)	Municipalities Crossed by Route	Status
B20 West	3.00	Cambridge, Boston	Eliminated from Further Analysis
B21 West	2.80	Cambridge, Boston	Eliminated from Further Analysis
B22 West	4.15	Cambridge, Boston	Eliminated from Further Analysis
B24 West	4.14	Cambridge, Boston	Retained for Scoring
B24A West	4.05	Cambridge, Boston	Retained for Scoring
B24B West	4.07	Cambridge, Boston	Eliminated from Further Analysis
B24C West	3.95	Cambridge, Boston	Eliminated from Further Analysis
B26 West	2.83	Cambridge, Boston	Eliminated from Further Analysis
B27 West	2.84	Cambridge, Boston	Eliminated from Further Analysis
B28 West	2.79	Cambridge, Boston	Eliminated from Further Analysis
B29 West	2.84	Cambridge, Boston	Eliminated from Further Analysis
B29A West	2.85	Cambridge, Boston	Eliminated from Further Analysis
B29B West	2.81	Cambridge, Boston	Eliminated from Further Analysis
B29C West	2.91	Cambridge, Boston	Eliminated from Further Analysis
B29D West	3.01	Cambridge, Boston	Eliminated from Further Analysis
B29E West	2.99	Cambridge, Boston	Eliminated from Further Analysis
B29F West	3.00	Cambridge, Boston	Retained for Scoring
B30 West	3.43	Cambridge, Boston	Retained for Scoring

Table 4-8 Results of Route Selection After Initial Screening (Putnam Study Area)

Route ID[72]	Route Length (miles)	Municipalities Crossed by Route	Status
P11	0.87	Cambridge	Retained for Scoring
P12	1.44	Cambridge	Retained for Scoring
P13	0.49	Cambridge	Retained for Scoring
P14	1.53	Cambridge	Eliminated from Further Analysis
P15	1.76	Cambridge	Eliminated from Further Analysis

[71] Note that Route B23 West does not exist (it ultimately became Route B21 West during the route screening and selection process).

[72] Routes within the Putnam Study Area begin with "P11".

Table 4-9 Results of Route Selection After Initial Screening (Kendall Study Area)

Route ID	Route Length (miles)	Municipalities Crossed by Route	Status
K1	1.74	Cambridge	Eliminated from Further Analysis
K2	0.94	Cambridge	Eliminated from Further Analysis
K3	1.27	Cambridge	Eliminated from Further Analysis
K4	0.55	Cambridge	Eliminated from Further Analysis
K5	0.65	Cambridge	Eliminated from Further Analysis
K5A	0.59	Cambridge	Retained for Scoring
K6	0.73	Cambridge	Eliminated from Further Analysis
K6A	0.67	Cambridge	Retained for Scoring
K7	0.63	Cambridge	Eliminated from Further Analysis
K8	0.64	Cambridge	Eliminated from Further Analysis
K9	0.47	Cambridge	Eliminated from Further Analysis
K10	0.63	Cambridge	Retained for Scoring
K11	0.61	Cambridge	Retained for Scoring
K12	0.69	Cambridge	Retained for Scoring

Table 4-10 Results of Route Selection After Initial Screening (Somerville Study Area)

Route ID[73]	Route Length (miles)	Municipalities Crossed by Route	Status
S1A	1.25	Cambridge, Somerville	Retained for Scoring
S3	1.36	Cambridge, Somerville	Eliminated from Further Analysis
S4	1.48	Cambridge, Somerville	Eliminated from Further Analysis
S5	1.65	Cambridge, Somerville	Eliminated from Further Analysis
S6	1.39	Cambridge, Somerville	Eliminated from Further Analysis
S7	1.42	Cambridge, Somerville	Eliminated from Further Analysis
S8	1.14	Cambridge, Somerville	Eliminated from Further Analysis

[73] Note that Route S2 does not exist (it ultimately became Route S13 during the route screening and selection process).

Table 4-10 Results of Route Selection After Initial Screening (Somerville Study Area) (Continued)

Route ID[74]	Route Length (miles)	Municipalities Crossed by Route	Status
S9	1.26	Cambridge, Somerville	Eliminated from Further Analysis
S10	1.47	Cambridge, Somerville	Eliminated from Further Analysis
S11	1.64	Cambridge, Somerville	Eliminated from Further Analysis
S11A	1.74	Cambridge, Somerville	Eliminated from Further Analysis
S11B	1.56	Cambridge, Somerville	Eliminated from Further Analysis
S11C	1.56	Cambridge, Somerville	Retained for Scoring
S12	1.48	Cambridge, Somerville	Retained for Scoring
S13	1.57	Cambridge, Somerville	Retained for Scoring
S13A	1.82	Cambridge, Somerville	Retained for Scoring
S14	1.38	Cambridge, Somerville	Retained for Scoring
S14A	1.31	Cambridge, Somerville	Eliminated from Further Analysis

4.5.3 Review of Candidate Routes

A detailed description of the 22 Candidate Routes advanced for more detailed analysis, scoring and ranking is presented below.

4.5.3.1 Brighton Study Area

Eastern Routes

The Company identified four Candidate Routes in the eastern half of the Brighton Study Area.

[74] Note that Route S2 does not exist (it ultimately became Route S13 during the route screening and selection process).

Candidate Route B2A East (Magazine Beach HDD)

Candidate Route B2A East is approximately 2.91 miles long and is located in Cambridge and Boston (see Figure 4-5). This route heads east from the New Substation Site in Cambridge onto Broadway before turning south onto Ames Street. The segment of Candidate Route B2A East between the New Substation Site on Broadway to Ames Street is bordered by laboratory space, research and development facilities, pharmaceutical and biotechnology companies. Broadway is a wide (approximately 60 to 70-feet), well-travelled roadway with several lanes of two-way vehicular traffic, sidewalks on both sides of the road and dedicated bike lanes. MassDOT's functional classification of Broadway is a principal urban arterial roadway.[75]

The route follows Ames Street through the Main Street intersection, and the MBTA Red Line subway tunnel beneath it, to the intersection with Memorial Drive. The Ames Street segment of this route south of Main Street is bordered entirely by MIT campus facilities located on either side of the road, including its media lab and visual arts center, biology department, student housing, lab space, research facilities and courtyard/green space. Ames Street accommodates two-way vehicular traffic with on-street parking and dedicated bike lanes and sidewalks. Ames Street is classified by MassDOT as a major collector roadway.[76]

At Memorial Drive, the route turns to the west following the east bound lanes to MassDCR's Magazine Beach property. The Memorial Drive segment is located within the Charles River Reservation and is under the care and custody of MassDCR. Memorial Drive is a 3.9-mile parkway along the north bank of the Charles River in Cambridge. It runs parallel with two major Boston parkways (Soldiers Field Road and Storrow Drive), which run parallel with the south bank of the Charles River. The western terminus of Memorial Drive is in West Cambridge at Greenough Boulevard and Fresh Pond Parkway. The eastern terminus of Memorial Drive is at Main Street and the Longfellow Bridge near Kendall Square. Memorial Drive is classified by MassDOT as an urban principal arterial roadway. The Memorial Drive route segment is bordered by the Charles River to the south, including several sailing pavilions and boathouses, MassDCR's Magazine Beach property and the Dr. Paul Dudley White Bike Path up to the River Street Bridge. The north side of Memorial Drive along this same segment of roadway is predominantly bordered by MIT campus facilities. There are areas of commercial properties including banks, pharmaceutical companies, restaurants and coffee shops and a hotel (Courtyard Marriott).

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75 Functional classifications are used by MassDOT and the Federal Highway Administration. Classifications are determined by the road type and characteristics of the vehicles using the road (see https://gis.massdot.state.ma.us/roadinventory/). An arterial road is a high-capacity road. The primary function of an arterial road is to deliver traffic from collector roads to freeways, and between urban centers at the highest level of service possible. As such, many arterials are limited-access roads, or feature restrictions on private access.

76 A collector road is a low-to-moderate-capacity road that serves to move traffic from local streets to arterial roads.

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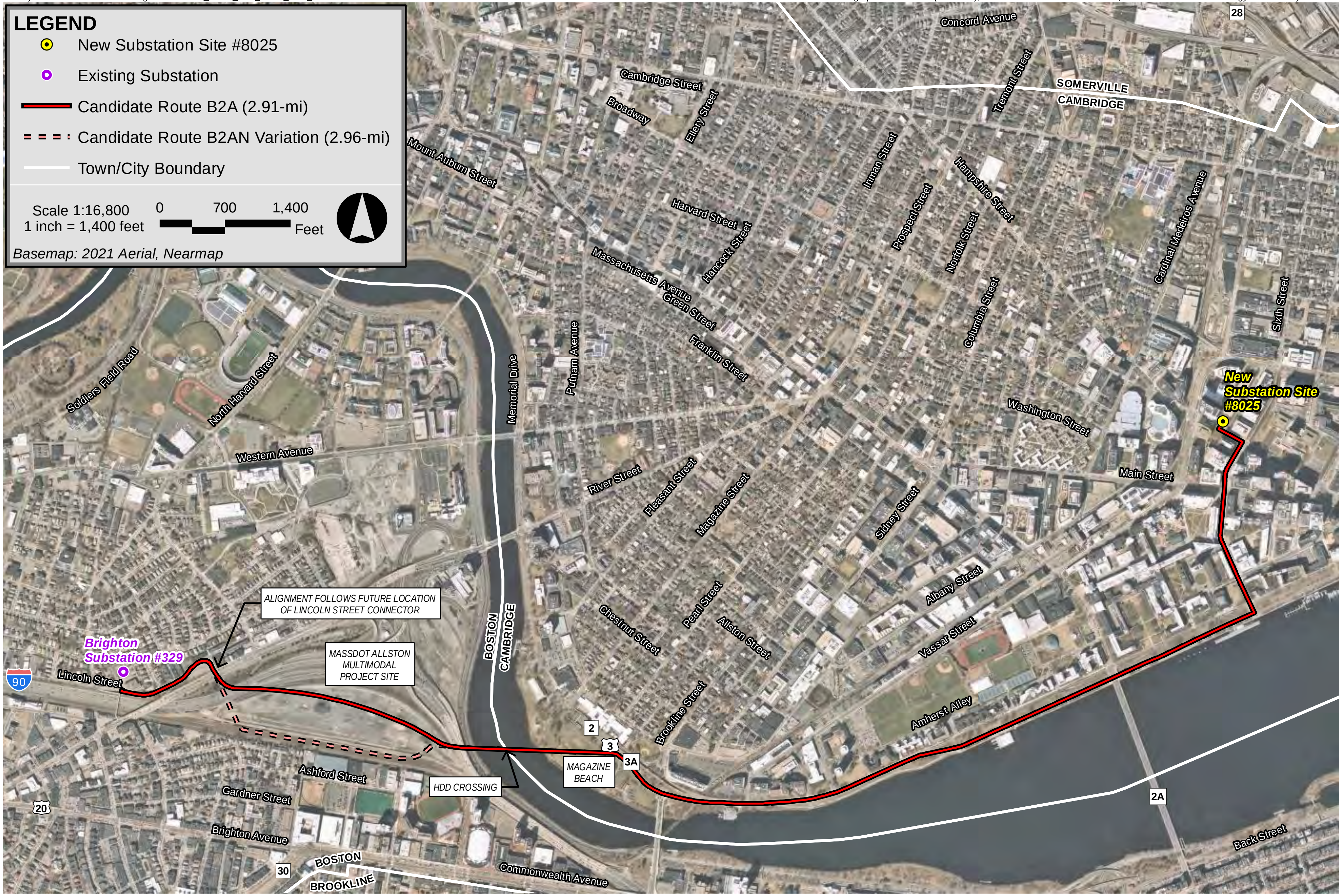

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Figure 4-5

Candidate Route B2A/B2AN East (Magazine Beach HDD)

At Magazine Beach, the route crosses beneath the Charles River into Boston via HDD. The limits of the HDD work will be located on the edge of the Magazine Beach property as close to Memorial Drive as practicable to avoid impacts to existing trees, athletic fields, and the outdoor gym space (see Section 5 of Petition for additional detail). After crossing beneath the Charles River, Soldier's Field Road and I-90 the HDD would extend onto MassDOT's Allston Multimodal Project site, which is presently disturbed and altered by existing roadway and rail facilities and is largely devoid of any vegetation. The route then transitions to open trench construction following the general alignment of the anticipated future location of the Lincoln Street Connector that is being constructed as part of MassDOT's Allston Multimodal Project. The route segment along Cambridge Street, Empire Street and Lincoln Street up to the Brighton Substation connection is predominantly bordered by mixed commercial/industrial uses and residential properties. Cambridge Street is classified by MassDOT as minor arterial roadway. Empire Street is classified by MassDOT as a local roadway and Lincoln Street is classified as major collector roadway.

The Company also evaluated a route variation to Route B2A East associated with the orientation of the HDD path across the MassDOT Allston Multimodal Project Site. This alignment variation, referred to as Route B2AN East. The "N" stands for "no-build" and represents a potential workaround route across the MassDOT Multimodal Project site should that separate project not be advanced to construction. This route variation does not add any appreciable length (approximately 0.05 miles) relative to Candidate Route B2A, and generally runs parallel with the southerly property line. This route variation provides routing flexibility should the MassDOT Allston Multimodal Project not be advanced into construction as currently proposed, while also minimizing potential future development constraints to the present landowner (Harvard) should it seek to develop this property in the future.

Candidate Route B25 East (Herter Park HDD and Memorial Drive)

Candidate Route B25 East is approximately 5.49 miles long and is in Cambridge and Boston (see Figure 4-6). This routes heads east from the New Substation Site in Cambridge onto Broadway before turning south onto Ames Street to Memorial Drive. This route crosses over the MBTA Red Line subway tunnel at the Ames Street/Memorial Drive intersection. As with Candidate Route B2A East above, the Ames Street segment between Main Street and Memorial Drive is bordered entirely by the same MIT campus facilities located on either side of the road; and is comprised of the same segment of Ames Street with two-way vehicular traffic, on-street parking and dedicated bike lanes and sidewalks and classification as a major collector roadway by MassDOT.

At Memorial Drive, the route turns to the west (following the east bound lanes of Memorial Drive) to the Reid Rotary at the B.U. Bridge, continuing west on Memorial Drive. The Memorial Drive segment is as described above for Candidate Route B2A East. As noted therein, Memorial Drive is located within the Charles River Reservation and is under the care and custody of MassDCR. To properly align the proposed HDD crossing of the Charles River from Longfellow (Riverbend) Park, Candidate Route B25 East turns north from Memorial Drive onto Ash Street and then west onto Mt. Auburn Street and onto Longfellow (Riverbend) Park. The Ash Street segment is about 500-

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

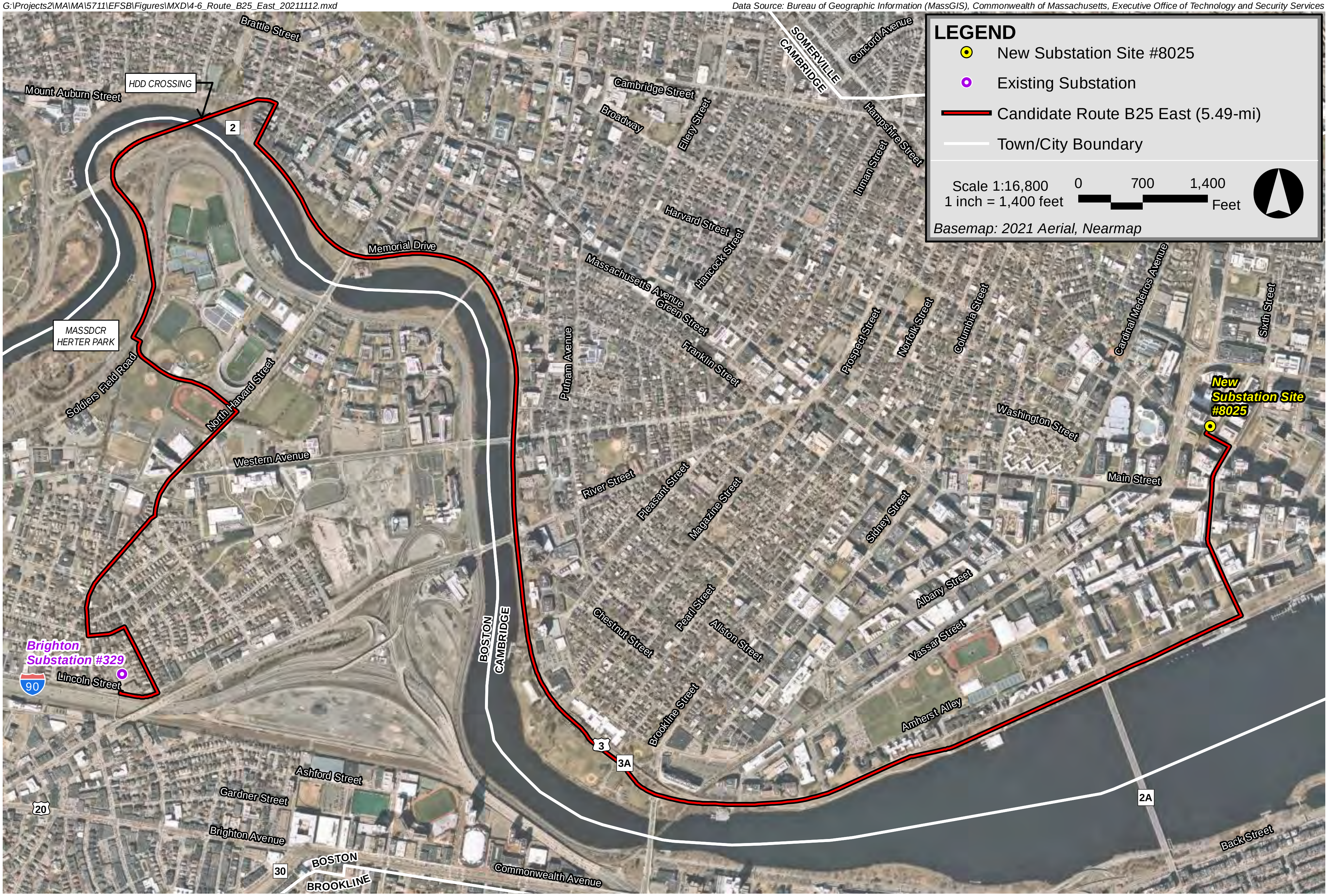

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Figure 4-6

Candidate Route B25 East (Herter Park HDD and Memorial Drive) feet long. Ash Street is bordered by residential properties including apartments and condominium complexes. Ash Street accommodates one-way vehicular traffic, has sidewalks on both sides and on-street parking. Ash Street is classified by MassDOT as a local roadway. From this point forward, the route follows the same alignment as Candidate Route B24 West (see description below) and passes by the same land uses described above except that, instead of following Franklin Street to the Brighton Substation, this route follows Franklin Street to Bradbury Street and Mansfield Street before terminating at the Brighton Substation facility.

Candidate Route B25A East (Herter Park HDD and Harvard Athletic Complex)

Candidate Route B25A East is approximately 5.4 miles long and is located in Cambridge and Boston (see Figure 4-7 on the following page). This route follows the same alignment described above for Route B25 East. However, instead of crossing the Harvard University athletic complex in an east-west direction to North Harvard Street, this route would generally follow the Harvard University property line before turning south towards the Smith Playground and Western Avenue. The route would then cross Western Avenue onto Spurr Street before turning south onto North Harvard Street. From this point forward, the route would follow the same alignment described above for Candidate Route B25 East to the Brighton Substation.

Candidate Route B31 East (River Street Bridge)

Candidate Route B31 East is approximately 3.26 miles long and is located in Cambridge and Boston (see Figure 4-8 on page 4-42). This route heads east from the New Substation Site in Cambridge onto Broadway before turning south onto Ames Street. The route follows Ames Street up to its intersection with Memorial Drive. This route crosses over the MBTA Red Line subway tunnel at the Ames Street / Memorial Drive intersection. At Memorial Drive, the route turns to the west (following the eastbound lanes of Memorial Drive) to the Reid Rotary at the B.U. Bridge, continuing west on Memorial Drive to the River Street Bridge. At this location, the route turns to the west across the River Street Bridge, over the Charles River, and onto Cambridge Street in Boston. The River Street Bridge is under the care and custody of MassDOT, connecting River Street in Cambridge, to Cambridge Street in Boston near the southern end of the Harvard University campus. The arch-style bridge carries one-way vehicular traffic going east, into Cambridge. Westbound traffic must take the nearby Western Avenue Bridge. There are sidewalks on both sides of the bridge. MassDOT classifies River Street as a principal arterial roadway. The bridge crossing would be accomplished by installing the cable in the bridge deck/roadway pavement.[77]

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77 MassDOT indicated to Eversource that it is moving forward with certain repairs and upgrades to the River Street Bridge and confirmed there is sufficient space within the roadway deck to accommodate a new transmission line.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

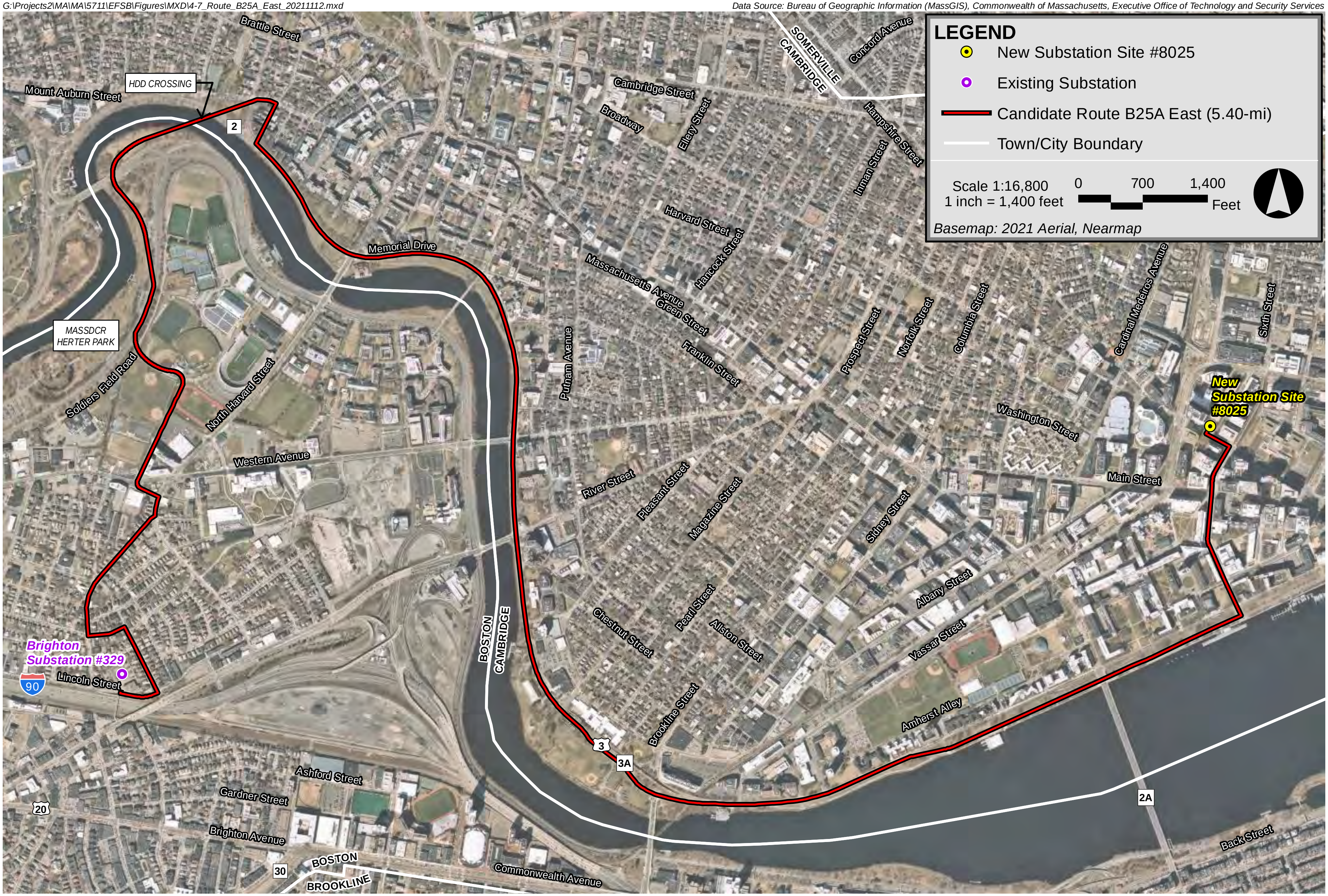

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Figure 4-7

Candidate Route B25A East (Herter Park HDD and Harvard Athletic Complex)

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

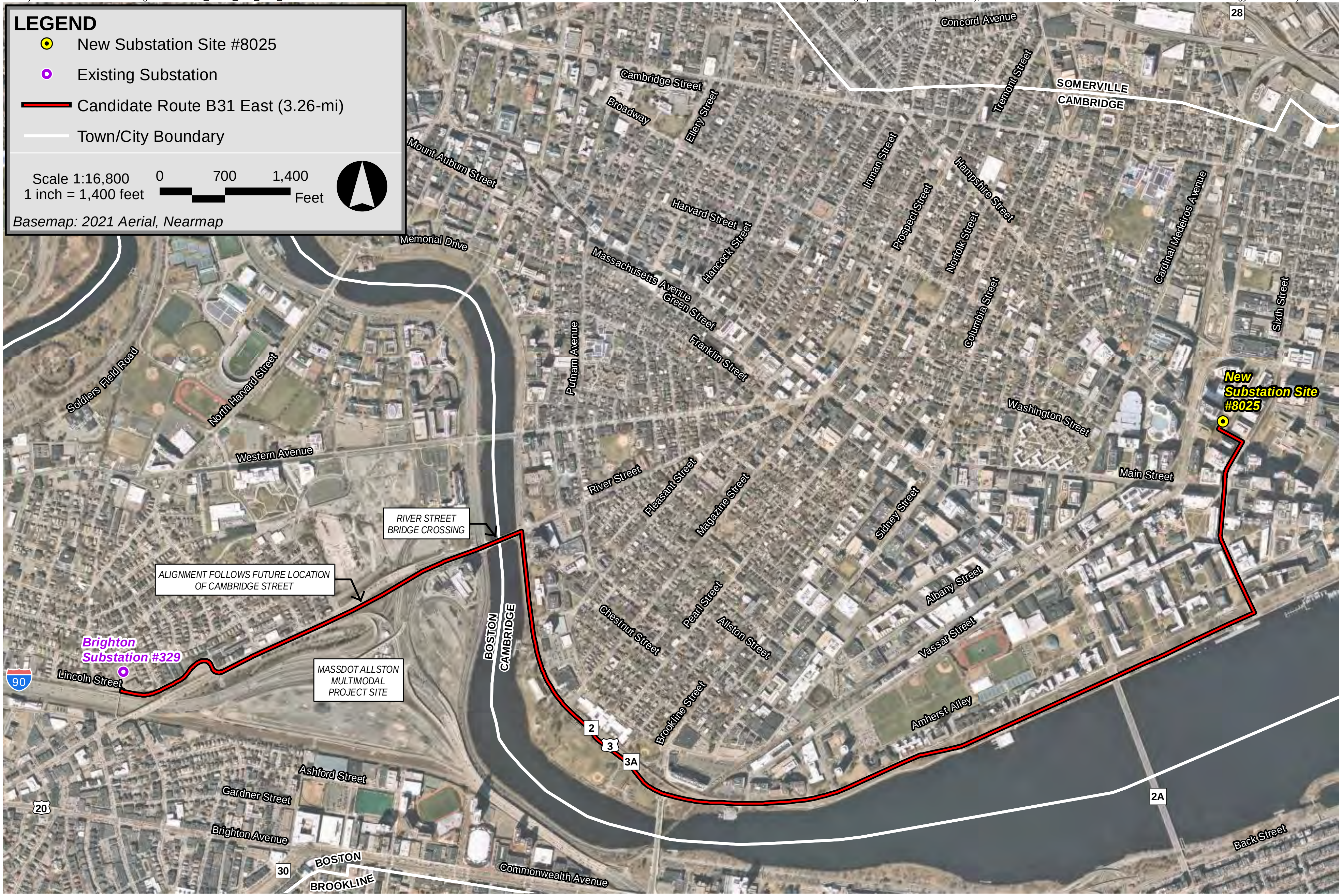

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Figure 4-8

Candidate Route B31 East (River Street Bridge)

On the Boston side of the Charles River, the route would cross over the I-90 ramps following the approximate location of the future planned Cambridge Street reconstruction at-grade as part of MassDOT's Allston Multimodal Project (the route cannot be constructed along the existing elevated section of Cambridge Street that spans the I-90 ramps). After passing through a short stretch (approximately 500 feet) of wooded area adjacent to the roadway shoulder within the state highway layout, the route transitions back onto Cambridge Street until it reaches Lincoln Street. The route follows Lincoln Street to the Brighton Substation.

Land uses bordering the route and MassDOT roadway classifications are the same as those described above for Candidate Route B25 East, including the River Street Bridge crossing of the Charles River.

Western Routes

The Company identified four Candidate Routes in the western half of the Brighton Study Area.

Candidate Route B24 West (Herter Park HDD and Mount Auburn Street)

Candidate Route B24 West is approximately 4.14 miles long and is located in Cambridge and Boston (see Figure 4-9 on the following page). This route heads west from the New Substation Site in Cambridge onto Broadway Street before turning south onto Prospect Street, through the Central Square area, and west onto Western Avenue and Green Street. The Broadway Street segment between the Hampshire Street intersection and Prospect Street passes through residential neighborhoods, commercial land uses, restaurant space, convenience stores, an elementary school (Fletcher Maynard Academy) and Sennott Park, a municipal park land situated adjacent to a local youth center at the corner of Norfolk Street. It is comprised of multi-purpose playing fields, a playground, water play, basketball courts, green space, and walking paths. Broadway accommodates two-way vehicular traffic, has sidewalks on both sides, on-street parking, and dedicated bike lanes. This stretch of Broadway is classified by MassDOT as a minor arterial roadway.

The Prospect Street route segment is not dissimilar from the Broadway in that it is bordered by a mix of residential development (including apartment complexes), commercial space and an urgent care medical facility (Mass General Brigham Urgent Care). Prospect Street accommodates two-way vehicular traffic, has sidewalks on both sides, on-street parking, and dedicated bike lanes. This stretch of Prospect Street is classified by MassDOT as a minor arterial roadway.

From Prospect Street, the route crosses over Massachusetts Avenue (including the MBTA Red Line subway tunnel) onto Western Avenue/River Street to Green Street. Green Street is bordered by several types of facilities including the Cambridge Senior Center, YMCA, U.S. Postal Service facility, convenience stores, several surface parking lots, apartment complexes, restaurants, office space residential neighborhoods. Green Street accommodates one-way vehicular traffic with on-street parking and sidewalks on both sides of the road. Green Street is classified by MassDOT as a local roadway.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

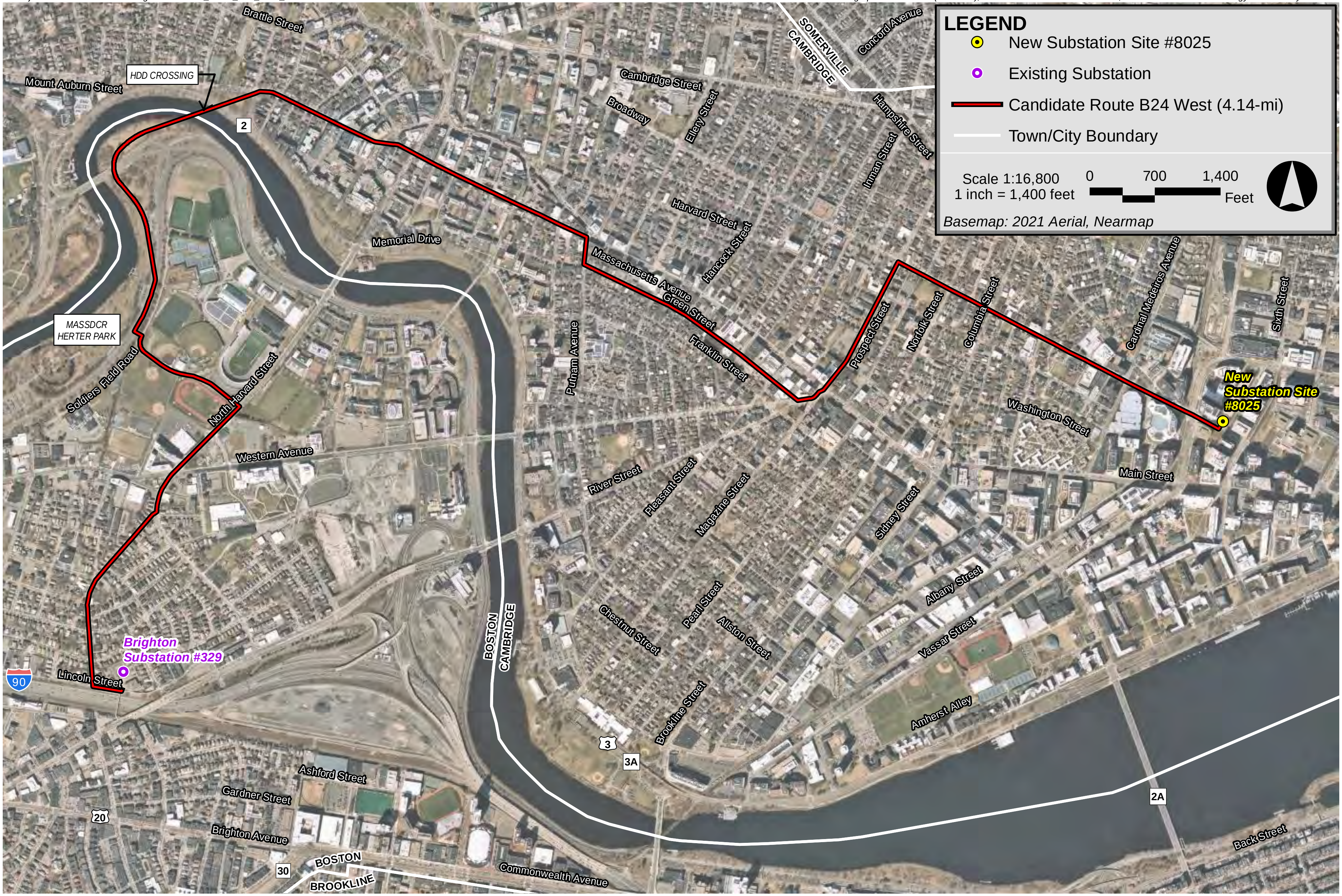

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Figure 4-9

Candidate Route B24 West (Herter Park HDD and Mount Auburn Street)

From Green Street, the route follows Putnam Avenue to Mt. Auburn Street. The Putnam Avenue segment is relatively short (about 300-feet) and is bordered by residential properties and commercial office space as it approaches Mt. Auburn Street. Putnam Avenue accommodates two-way vehicular traffic, has sidewalks on both sides and on-street parking. Putnam Avenue is classified by MassDOT as a minor arterial roadway.

The Mt. Auburn Street segment to Longfellow (Riverbend) Park is predominantly bordered by mixed commercial uses, office space, places of worship, restaurants and coffee shops and residential neighborhoods. The properties of Harvard University border a significant segment of this route. Mt. Auburn Street accommodates one-way vehicular traffic for much of its length, has sidewalks on both sides, on-street parking in select locations and dedicated bike lanes. It is classified by MassDOT as a principal arterial roadway.

From Longfellow (Riverbend) Park, the route crosses Memorial Drive and the Charles River via HDD. The entry/exit pit would be situated towards the northeast corner of the park, near Mt. Auburn Street. On the Boston side of the Charles River, the HDD entry/exit pit would likely be situated towards the center of the open grassed area within MassDCR's Herter Park, between Soldiers Field Road and the Charles River. Herter Park accommodates several facilities and uses including the Dr. Paul Dudley White bike path, green space, public shade trees, seating, and picnic areas for the public and several large surface parking lots. There is also a canoe/kayak rental facility in the park. The route travels through Herter Park, largely running parallel with the Dr. Paul Dudley White Path, to the Eliot Bridge and Soldier's Field Road. A second trenchless crossing would occur in this location to cross beneath Soldiers Field Road and access Herter Park on the south side.

The route then crosses through Herter Park to Soldier's Field Road for a relatively short distance (approximately 700 feet), crossing the median and turning east onto Harvard University's athletic facility complex. The segment of Soldiers Field Road is classified by MassDOT as an urban principal arterial roadway. Soldiers Field Road accommodates two-way vehicular traffic (with a median strip and curbing in the middle) and sidewalks or grassed shoulders on either side.

The route then follows an existing Harvard University campus access drive and parking lot in an east-west direction across the athletic field complex to reach North Harvard Street. The North Harvard Street segment is bordered by Harvard University facilities for much of its length, as well as by mixed commercial uses (supermarket, gas station, coffee shop, etc.) and pockets of residential neighborhoods. North Harvard Street accommodates two-way vehicular traffic, has sidewalks on both sides, on-street parking, and dedicated bike lanes. It is classified as a principal arterial roadway by MassDOT.

The balance of the route follows Franklin Street to Brighton Substation on Lincoln Street. Franklin Street is predominantly bordered by residential neighborhoods and some commercial uses (laundromat, convenience stores, etc.). Franklin Street accommodates two-way vehicular traffic, has sidewalks on both sides, some on-street parking and dedicated bike lanes. It is classified as a local roadway by MassDOT.

Candidate Route B24A West (Herter Park HDD and WBZ Site)

Candidate Route B24A West is approximately 4.05 miles long and is located in Cambridge and Boston (see Figure 4-10). This route follows the same alignment described above for Candidate Route B24. However, instead of crossing Harvard University's athletic field complex, the route follows Soldier's Field Road in a westerly direction before turning to the southeast across the National Development/WBZ-TV studio property, parallel to the City of Boston's William E. Smith Playground, to Western Avenue. As previously noted, this studio property is scheduled to be redeveloped with a new television studio and life science facilities.[78] The transmission line alignment would follow the approximate location of National Development's utility corridor and internal circulation drive. The route then turns east onto Western Avenue and then southeast to Spurr Street. From Spurr Street, the route turns to the southwest along Franklin Street before turning east to Bradbury Street, south to Mansfield Street and west to Lincoln Street before entering the Brighton Substation from the south.

The length of the short segment along Western Avenue is approximately 400 feet. In this location, Western Avenue is predominantly bordered by Harvard University campus facilities and the municipal playground. Western Avenue accommodates two-way vehicular traffic, has sidewalks on both sides and on-street parking. Western Avenue is classified as a principal arterial roadway by MassDOT.

Spurr Street is a short connector road between Western Avenue and Franklin Street. It is bordered by a Dunkin Donuts and gas station facility. Spurr Street accommodates one-way vehicular traffic, has sidewalks on both sides and on-street parking. It is classified as a local roadway by MassDOT.

The balance of the route follows Franklin Street to Brighton Substation on Lincoln Street, as described above for Candidate Route B24 West.

Candidate Route B29F West (River Street Bridge)

Candidate Route B29F West is about 3 miles long and is located in Cambridge and Boston (see Figure 4-11). This route heads west from the New Substation Site in Cambridge onto Broadway before turning south onto Galileo Way to Vassar Street. The majority of Vassar Street is bordered by MIT's campus on both sides of the road. The route follows Vassar Street before crossing northwest through a parking lot, a portion of which is owned by MIT and the MBTA. From this point, the route crosses the Grand Junction Railroad using a trenchless construction technique to reach a parking lot on a second parcel of land owned by MIT (referred to as #634 Memorial Drive). The route then follows Waverly Street to Brookline Street through the Reid Rotary at the B.U.

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78 See http://www.bostonplans.org/projects/development-projects/1170-1200-soldiers-field-road

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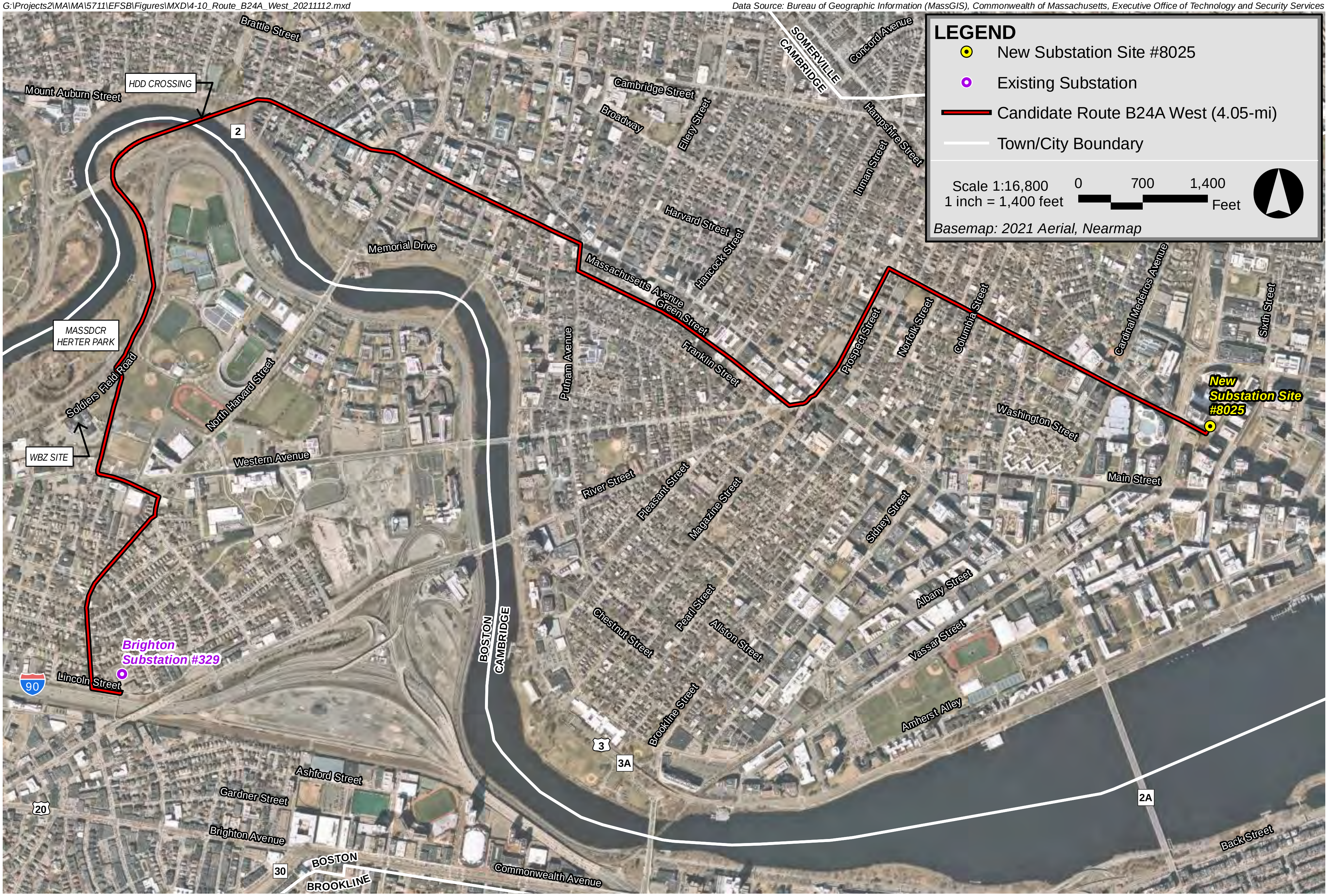

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Figure 4-10

Candidate Route B24A West (Herter Park HDD and WBZ Site)

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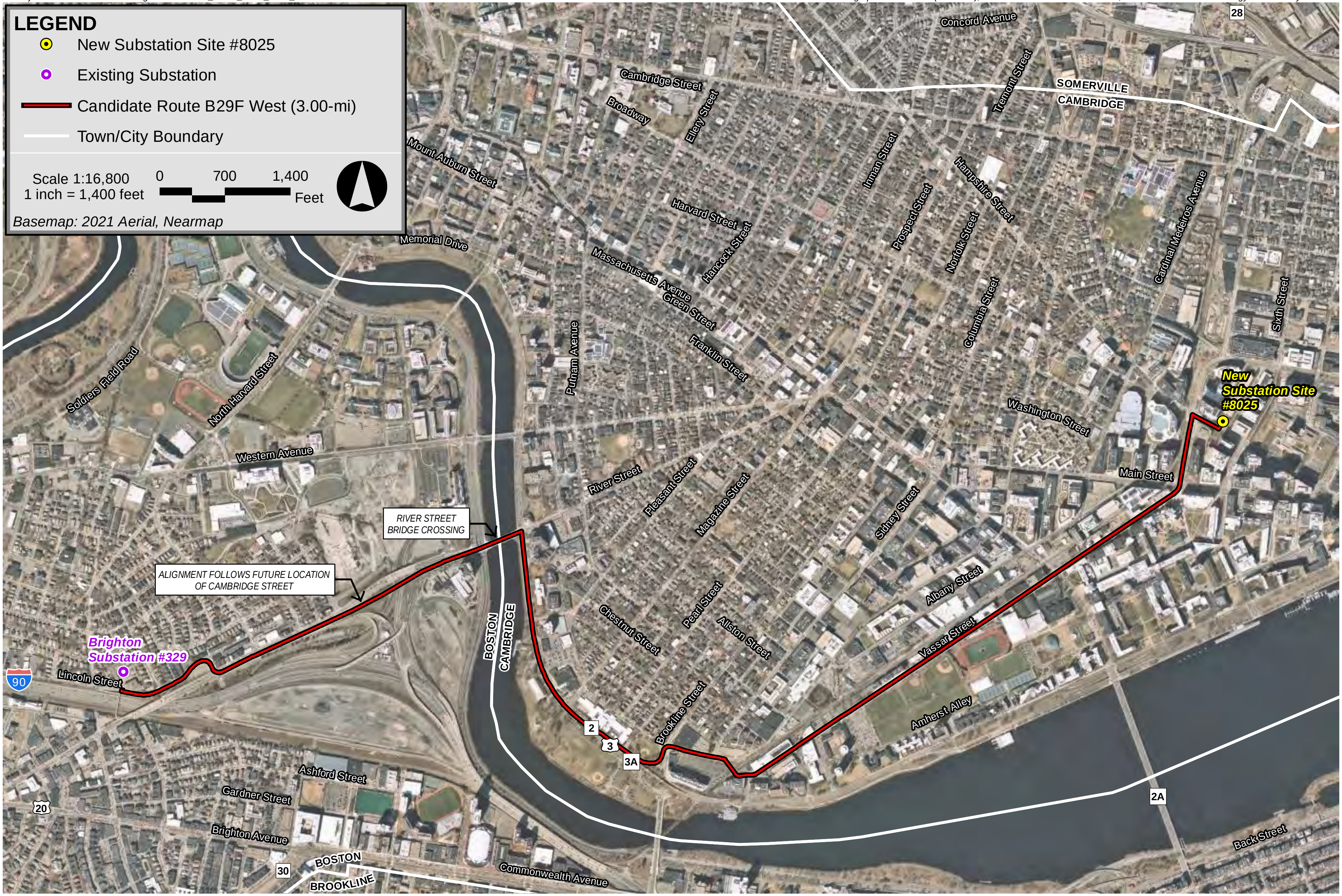

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Figure 4-11

Candidate Route B29F West (River Street Bridge)

Bridge, continuing west on Memorial Drive to the River Street Bridge. The Waverly Street segment is bordered by residential apartments, commercial properties, and MIT campus facilities. The Morse Elementary School and playground area borders Brookline Street approaching the Reid Rotary and Memorial Drive. From Memorial Drive, the route turns to the west across the River Street Bridge, over the Charles River, and onto Cambridge Street in Boston.

As was described for Candidate Route B31 East, the River Street Bridge is under the care and custody of MassDOT, connecting River Street in Cambridge, to Cambridge Street in Boston near the southern end of the Harvard University campus. The arch-style bridge carries one-way vehicular traffic going east into Cambridge. Westbound traffic must take the nearby Western Avenue Bridge. There are sidewalks on both sides of the River Street Bridge. MassDOT classifies River Street as a principal arterial roadway. The bridge crossing would be accomplished by installing the cable in the bridge deck/roadway pavement.[79]

On the Boston side of the Charles River, the route would cross over the I-90 ramps following the approximate location of Cambridge Street after it is reconstructed at-grade as part of MassDOT's Allston Multimodal Project (the route cannot be constructed along the existing elevated section of Cambridge Street that spans the I-90 ramps). After passing through a short stretch (approximately 500 feet) of wooded area adjacent to the roadway shoulder within the state highway layout, the route transitions back onto Cambridge Street until it reaches Lincoln Street. The route follows Lincoln Street to the Brighton Substation.

Candidate Route B30 West (Anderson Bridge)

Candidate Route B30 West is approximately 3.43 miles long and is located in Cambridge and Boston (see Figure 4-12 on the following page). As with Candidate Route B24 West described above, this route heads west from the New Substation Site in Cambridge onto Broadway before turning south onto Prospect Street and then west onto Western Avenue and Green Street. The route crosses over the MBTA Red Line subway tunnel on Massachusetts Avenue. The route follows Green Street to Putnam Avenue where it turns north and then west onto Mt. Auburn Street. The route follows Mt. Auburn Street to John F. Kennedy Street. The route segment located on John F. Kennedy Street is predominantly bordered by Harvard University campus facilities including the Harvard Kennedy School of Government, student dormitories and restaurants/cafes. In addition to the Charles River Reservation along the Charles River, there are two areas of open space bordering John F. Kennedy Street. The first public open space is Winthrop Square, located at the intersection of John F. Kennedy Street and Mount Auburn Street. This parcel contains footpaths, greenspace,

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[79] As with Candidate Route B31 East, MassDOT indicated to Eversource that it is moving forward with certain repairs and upgrades to the River Street Bridge and that there is sufficient space within the roadway deck to accommodate the new transmission line.

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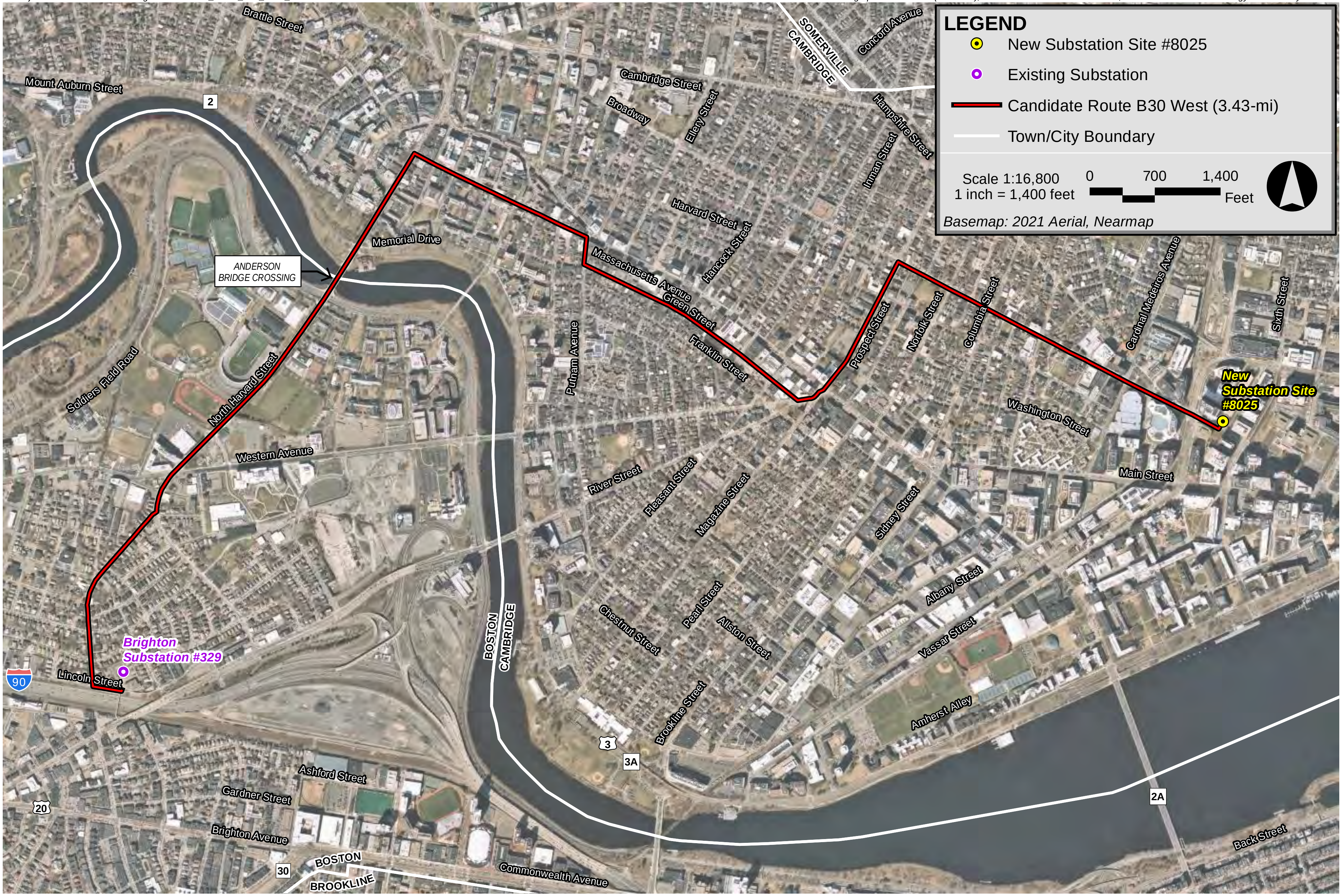

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Figure 4-12

Candidate Route B30 West (Anderson Bridge) and seating areas. There is a café and coffee shop adjacent to it. The second public open space parcel is J.F.K Memorial Park. This public park borders the west side of the John F. Kennedy Street, approaching Memorial Drive. The approximately one-acre park is managed by MassDCR and contains footpaths, seating areas and greenspace. John F. Kennedy Street accommodates two-way vehicular traffic, has sidewalks on both sides and a dedicated bike lane. John F. Kennedy Street is classified by MassDOT as a principal arterial roadway.

The route then heads south along John F. Kennedy Street to the Anderson Memorial Bridge over the Charles River. The arch-style Anderson Memorial Bridge is owned by MassDOT and MassDCR and was rehabilitated by MassDOT in 2016. The rehabilitation project repaired the arches and replaced the parapets, sidewalks, lighting, and the bridge deck. The bridge presently has three lanes of traffic (two northbound and one southbound) and one bicycle lane and stands next to the Harvard-owned Weld Boathouse. The bridge crossing would be accomplished by installing the cable in the bridge deck/roadway pavement. On the Boston side of the Charles River, the route follows North Harvard Street to Franklin Street before connecting into the Brighton Substation from the west.

After crossing over the Charles River, the route transitions from the bridge onto North Harvard Street. North Harvard Street is bordered by Harvard University campus facilities on both sides of the road up to Western Avenue, including the football stadium, Harvard Business School, and several athletic fields. North Harvard Street accommodates two-way vehicular traffic, has sidewalks on both sides and includes several bus stops, on-street parking, and dedicated bike lanes. MassDOT classifies North Harvard Street as a principal arterial roadway.

From this point forward, Candidate Route B30 West follows the same alignment and is bordered by the same land uses as described above for Candidate Route B24 West to the Brighton Substation.

4.5.3.2 Putnam Study Area

Candidate Route P11 (Massachusetts Avenue)

Candidate Route P11 is approximately 0.87 miles long and is located entirely within Cambridge (see Figure 4-13). This route heads east from the New Substation Site onto Broadway and then south onto Ames Street to the intersection with Main Street. The route heads west on Main Street parallel to the MBTA Red Line subway tunnel before crossing over the tunnel onto Vassar Street. The route heads south on Vassar Street to Massachusetts Avenue, where it then turns towards the southeast on Massachusetts Avenue to Memorial Drive. At Memorial Drive, the route ends in a “T” configuration with the line being spliced into existing Eversource line(s) #831-538 and #540 to the east and west on Memorial Drive.

The land uses adjacent to Candidate Route P11 include primarily biotechnology, research and development and laboratory space in the Kendall Square area, mixed commercial space including restaurants and coffee shops, several parking garages and two major hotels (Boston Marriott

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

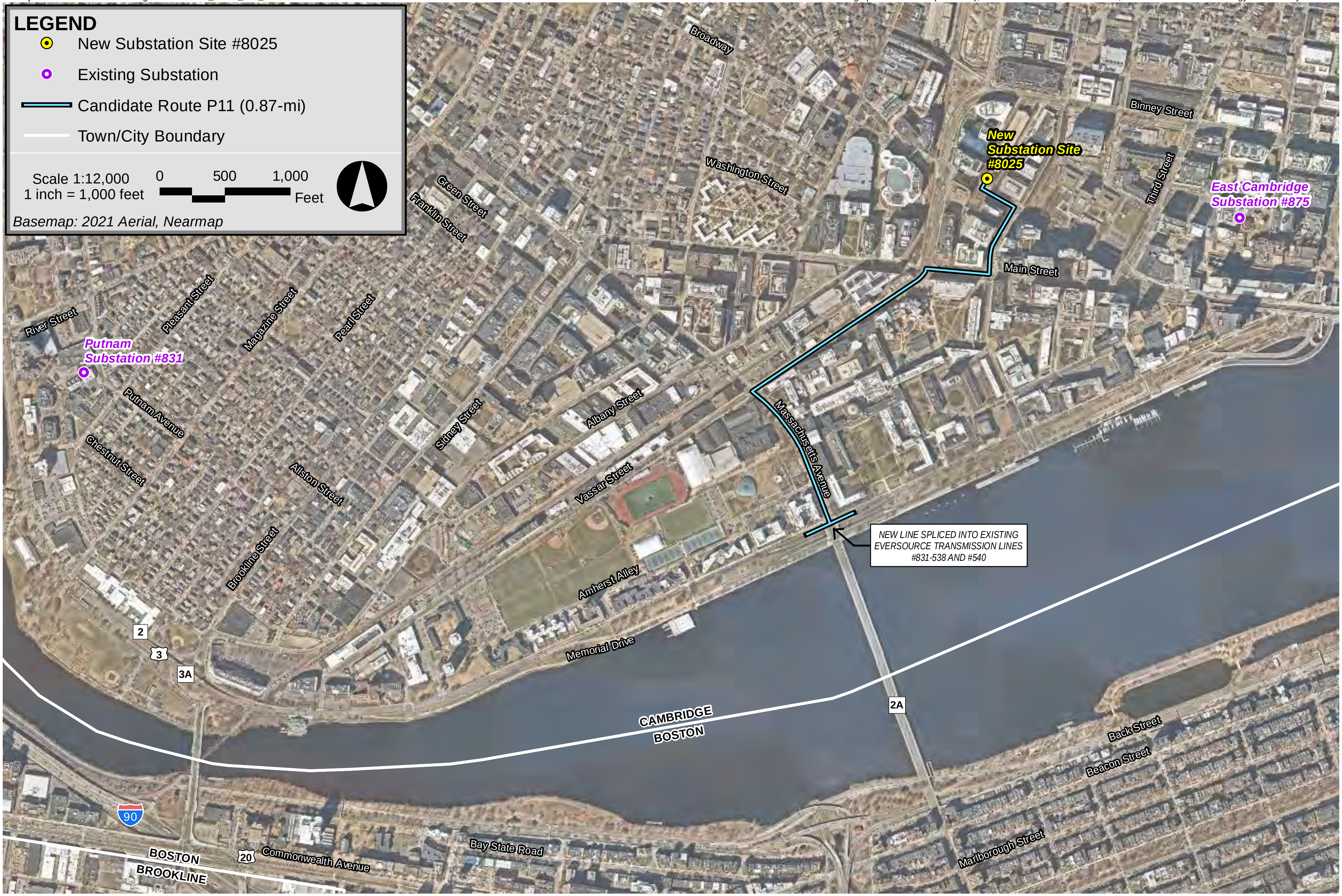

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Figure 4-13

Candidate Route P11 (Massachusetts Avenue)

Cambridge and Residence Inn Cambridge). A significant portion of the route passes by the MIT campus along Vassar Street and Massachusetts Avenue. Memorial Drive is located within MassDCR's Charles River Reservation. Each of the roadways comprising the route vary in width and lane configuration but generally include some level of on-street parking, accommodations for two-way vehicular traffic, dedicated bike lanes, sidewalks, and public transit bus stops. The MBTA Red Line subway tunnel is located beneath Main Street. Ames Street is classified by MassDOT as an urban collector roadway. Vassar Street is classified by MassDOT as an urban minor arterial roadway. Main Street and Massachusetts Avenue are classified by MassDOT as urban principal arterial roadways. Memorial Drive is a state-controlled roadway under the jurisdiction of MassDCR. Memorial Drive is classified by MassDOT as a principal arterial roadway.

Candidate Route P12 (Vassar Street)

Candidate Route P12 is approximately 1.44 miles long and is located entirely within Cambridge (see Figure 4-14). This route follows the same alignment described above for Candidate Route P11. However, instead of following Massachusetts Avenue to Memorial Drive, this route follows Vassar Street to Memorial Drive. At this point, the route ends in a "T" configuration with the line being spliced into existing Eversource transmission line(s) #831-538 and #540 to the east and west on Memorial Drive. Like Candidate Route P11, approximately 500 feet of this route follows Main Street and the MBTA Red Line subway tunnel located beneath it.

The roadway classifications and land use adjacent to Candidate Route P12 are like those described above for Candidate Route P11. The segment of Vassar Street between Massachusetts Avenue and Memorial Drive is predominantly bordered by MIT campus facilities, including surface parking lots and recreational facilities (e.g., football stadium, track and field, tennis courts, baseball, and soccer fields). This segment of Vassar Street also accommodates two-way vehicular traffic with on-street parking and dedicated bike lanes and sidewalks. As previously noted, Vassar Street is classified by MassDOT as a minor arterial roadway.

Candidate Route P13 (Ames Street)

Candidate Route P13 is approximately 0.49 miles long, located entirely within Cambridge (see Figure 4-15). Candidate Route P13 is the shortest of the three Candidate Routes identified within the Putnam Study Area. This route heads east from the New Substation Site onto Broadway Street and south onto Ames Street. The route follows Ames Street through the Main Street intersection, and the MBTA Red Line subway tunnel beneath it, to the intersection with Memorial Drive. At Memorial Drive, the route ends in a "T" configuration with the line being spliced into existing Eversource transmission line(s) to the east and west on Memorial Drive.

The roadway classifications and land use adjacent to Candidate Route P13 are as other Candidate Routes previously described. The segment of Candidate Route P13 that follows Ames Street to Massachusetts Avenue is bordered entirely by MIT campus facilities located on either side of the road, including its media lab and visual arts center, biology department, student housing, lab

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

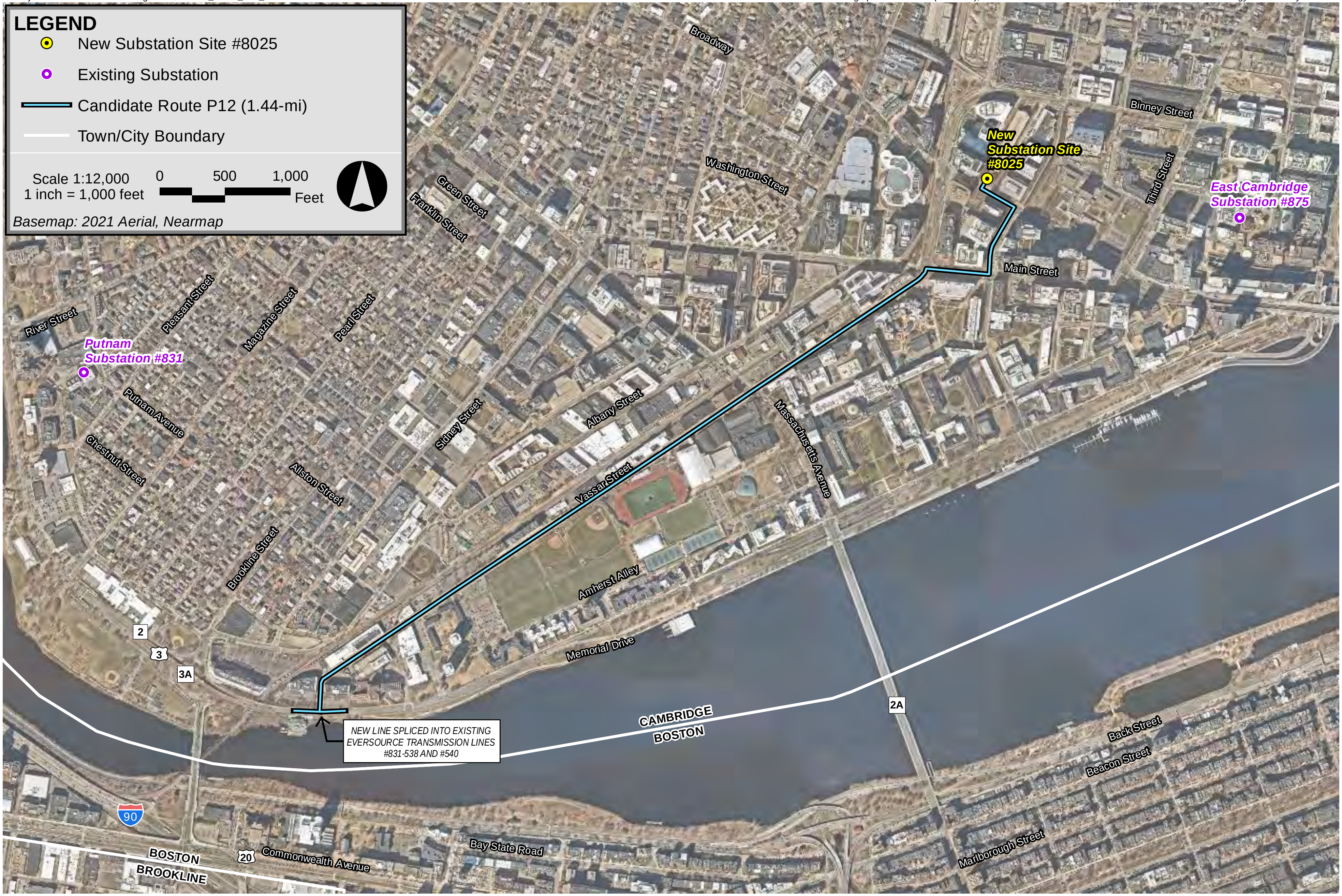

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Figure 4-14

Candidate Route P12 (Vassar Street)

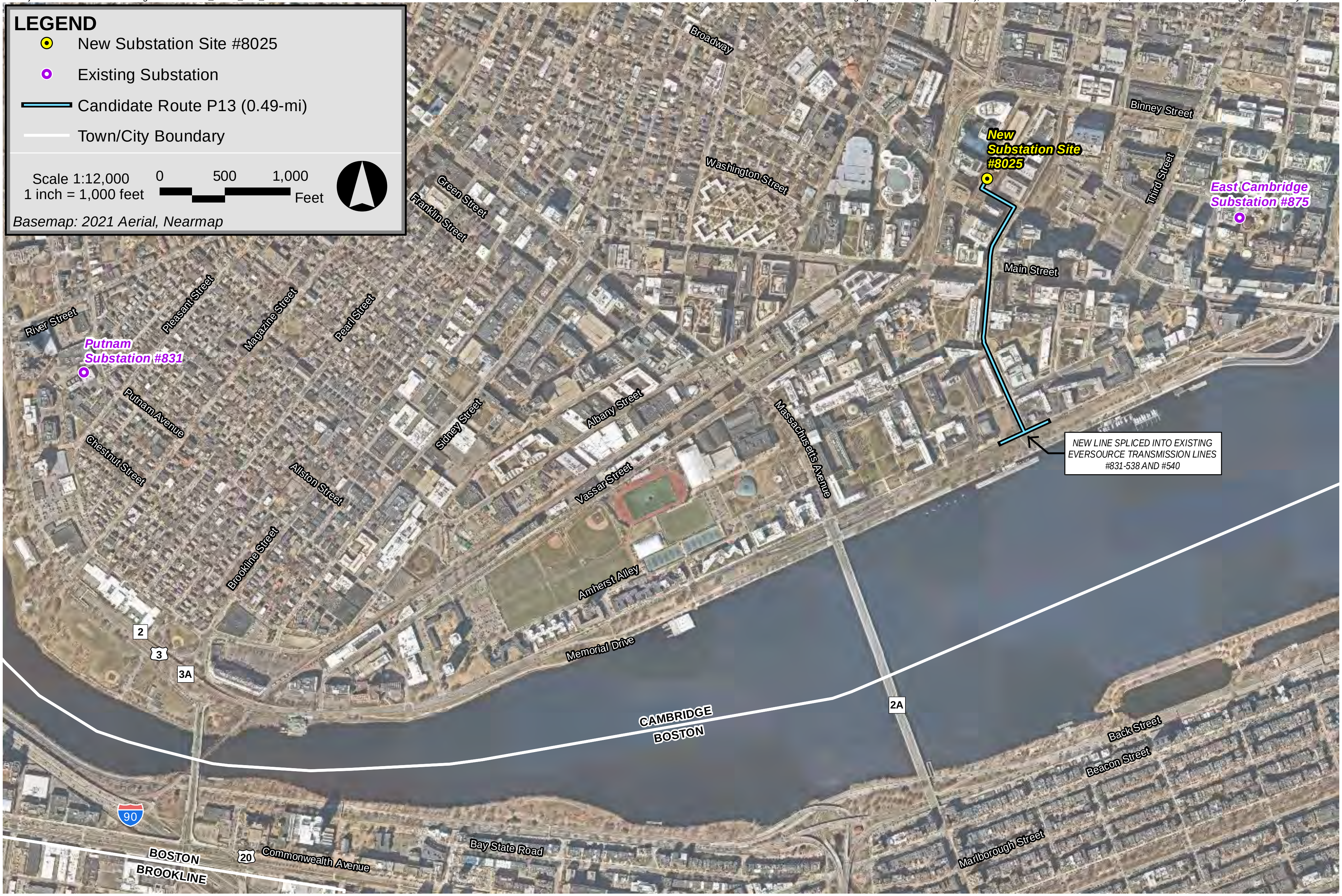

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Figure 4-15

Candidate Route P13 (Ames Street)

space, research facilities and courtyard/green space. This segment of Ames Street accommodates two-way vehicular traffic with on-street parking and dedicated bike lanes and sidewalks. Ames Street is classified by MassDOT as a major collector roadway.

4.5.3.3 Kendall Study Area

Candidate Route K5A (Linskey Way)

Candidate Route K5A is approximately 0.59 miles long and is located entirely within Cambridge (see Figure 4-16). This route heads east from the New Substation onto Broadway before turning in a northeasterly direction across the Volpe Center Site. Broadway is approximately 60 to 70-feet wide, with several lanes of two-way traffic, median and street trees in the middle, sidewalks on both sides and dedicated bike lanes. This segment of Broadway is classified by MassDOT as a principal arterial roadway.

The alignment across the easterly end of the Volpe Center Site between Broadway and Third Street, was developed in consultation with MIT (the owner/ developer of the site)[80] and the City of Cambridge DPW with the goal of avoiding significant utility congestion in the Broadway /Third Street intersection and significant public shade tree removal in the median strip of Broadway Street. The route traverses through future greenspace and an expanded sidewalk area that will be constructed as part MIT's redevelopment of the Volpe Center Site. At the northeast corner of the Volpe Center Site, approaching Prospect Street, the route enters Third Street. The Third Street segment is bordered by apartment style housing, restaurants and cafes, and a fitness facility. Third Street accommodates two-way vehicular traffic with on on-street parking and dedicated bike lanes and sidewalks. Third Street is classified by MassDOT as a minor arterial roadway.

From Third Street, the route turns east onto Linskey Way and south onto Second Street, where it connects into the East Cambridge Substation. The Linsksey Way segment of Candidate Route K5A is predominantly bordered by pharmaceutical companies, restaurants and cafes, the Kendall Center Green Parking Garage, and a pre-school facility. Linskey Way accommodates two-way vehicular traffic with on-street parking and dedicated bike lanes and sidewalks. Linskey Way is classified by MassDOT as a local roadway.

The land uses bordering Candidate Route K5A include primarily residential (Third Square Apartments), biotechnology and laboratory space along Broadway near the New Substation Site. There are several parking garages and two major hotels (Boston Marriott Cambridge and Residence Inn Cambridge).

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80 Massachusetts Institute of Technology Investment Management Corporation ("MITIMCO").

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

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Figure 4-16

Candidate Route K5A (Linskey Way)

Candidate Route K6A (Binney Street)

Candidate Route K6A is approximately 0.67 miles long and is located entirely within Cambridge (see Figure 4-17). This route follows the same alignment described above for Candidate Route 5A. However, instead of following Linskey Way, this route continues along Third Street to Binney Street. From Binney Street, the route turns south onto Second Street to its connection point with the East Cambridge Substation. The segment of Binney Street between Second Street and Third Street is bordered by an apartment complex, restaurants, office space and pharmaceutical space. A place of worship (The Church of Jesus Christ of Latter-day Saints) is located at the corner of Second Street and Binney Street. This segment of Binney Street is relatively wide with two-way vehicular traffic, on-street parking and dedicated bike lanes on the adjoining raised sidewalks. Binney Street is classified by MassDOT as a minor arterial roadway.

The roadway classifications and land use adjacent to Candidate Route K6A are like those described above for Candidate Route K5A.

Candidate Route K10 (Potter Street)

Candidate Route K10 is approximately 0.63 miles long, located entirely within Cambridge (see Figure 4-18). This route heads east from the New Substation site onto Broadway before turning north across the Volpe Center Site to Potter Street. The alignment across the Volpe Center Site was identified in consultation with MIT and Cambridge officials so as not to constrain future development activities at the site and to avoid impacts to mature public shade trees bordering the Loughrey Walkway and Bike Path west of the site. From Potter Street (a private roadway), the route heads east to the Third Street intersection. At Third Street, the route turns north for two blocks to Linskey Way. The route follows Linskey Way in an easterly direction towards Second Street. At Second Street, the route heads in a southerly direction to East Cambridge Substation.

Adjacent land uses and roadway classifications are essentially the same as those described above for Candidate Route K5A.

Candidate Route K11 (Fifth Street)

Candidate Route K11 is approximately 0.61 miles long and is located entirely within Cambridge (see Figure 4-19). This route heads east from the New Substation Site onto Broadway before turning north across the Volpe Center Site (following the same alignment as Candidate Route K10) onto Potter Street. On Potter Street, the route heads east for one block before turning north onto Fifth Street, a local roadway. From Fifth Street the route heads east onto Linskey Way, across the Third Street intersection, and then south onto Second Street where it enters East Cambridge Substation.

Adjacent land uses and roadway classifications are essentially the same as those described above for Candidate Route K6A, although this route passes by the Third Square Apartment complex on at both Fifth Street and Munroe Street.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

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Figure 4-17

Candidate Route K6A (Binney Street)

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

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Figure 4-18

Candidate Route K10 (Potter Street)

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

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Figure 4-19

Candidate Route K11 (Fifth Street)

Candidate Route K12 (Munroe Street)

Candidate Route K12 is approximately 0.69 miles long and is located entirely within Cambridge (see Figure 4-20 on the following page). This route heads east from the New Substation Site onto Broadway Street before turning north across the Volpe Center Site (following the same alignment as Candidate Routes K10 and K11) to Potter Street. On Potter Street, the route heads east for one block before turning north onto Fifth Street. From Fifth Street, the route heads east onto Munroe Street before turning north onto Third Street for one block. The route then turns east onto Binney Street and then south onto Second Street where it enters East Cambridge Substation.

Adjacent land uses and roadway classifications are essentially the same as those described above for Candidate Routes K11 and K6A.

4.5.3.4 Somerville Study Area

Candidate Route S1A (Hampshire Street and D2 Site)

Candidate Route S1A is approximately 1.25 miles long and is located within Cambridge and Somerville (see Figure 4-21 on page 4-64). This route heads west from the New Substation Site onto Broadway for about one block before turning northwest onto Hampshire Street. The segment of Candidate Route S1A between the New Substation Site and Hampshire Street is bordered by laboratory space, research facilities, pharmaceutical and biotechnology companies. Broadway is a wide (approximately 60 to 70-feet), well-travelled roadway with several lanes of traffic, sidewalks on both sides of the road and dedicated bike lanes. Broadway is classified by MassDOT as a principal arterial roadway.

The Hampshire Street segment of this route, west of Cardinal Medeiros Avenue up to Columbia Street, is predominantly bordered by residential housing and mixed commercial uses. Hampshire Street is approximately 45-feet wide, accommodates two-way vehicular traffic with on-street parking, has sidewalks on both sides and has dedicated bike lanes. Hampshire Street is classified by MassDOT as a principal arterial roadway.

From Hampshire Street, the route turns north on Columbia Street. The route follows Columbia Street into Somerville to its intersection with Windsor Place. The Columbia Street segment is predominantly bordered by residential uses up to its intersection with Cambridge Street. North of Cambridge Street, the route segment is bordered by mixed commercial/industrial uses. Columbia Street varies in width between 27 feet at its narrowest point to 38 feet at its widest point. Columbia Street accommodates two-way vehicular traffic along its entire length, with sidewalks on both sides and on-street parking in select locations. Columbia Street is classified by MassDOT as a minor arterial roadway.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

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Figure 4-20

Candidate Route K12 (Munroe Street)

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts

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Figure 4-21

Candidate Route S1A and Route Variation S1 (Hampshire Street and D2 Site)

After crossing Windsor Place, the route heads north across two private commercial parking lots towards the MBTA commuter rail tracks (Fitchburg Route Main Line). The railroad tracks would likely be crossed using a trenchless construction technique. After crossing the tracks, the route travels in a westerly direction parallel to the MBTA railroad tracks and the MBTA new Green Line train station platform, before turning north parallel to Prospect Street (and around the approximate limits of the planned development's future building footprint), and then west across Prospect Street where it enters Somerville Substation. This alignment would avoid some of the known utility constraints associated with Route Variation S1, described below, associated within Milk Alley and Bennett Court, and would potentially result in fewer construction sequencing and coordination challenges anticipated with the D-2 Block-Union Square Project Development Site ("D2" or "D2 Site"). Prospect Street is approximately 35-feet wide in this location and is classified by MassDOT as a principal arterial roadway.

The Company also identified a minor route variation, identified as S1, to Candidate Route S1A (see Figure 4-21). This route variation follows the same alignment described above for Candidate Route S1A except that after crossing the railroad tracks, the route turns in a northwesterly direction around the eastern edge of the site of the MBTA's new Green Line Union Square train station platform, across the D2 Site, generally following the approximate alignment of two proposed roadways associated with the development, identified as Milk Alley and Bennett Court. The route then crosses over Prospect Street and onto the Somerville Substation property.

Candidate Route S11C (Grand Junction RR Multi-Use Pathway)

Candidate Route S11C is approximately 1.56 miles and is located within Cambridge and Somerville (see Figure 4-22). This route heads west from the New Substation Site onto Broadway for about one block before turning north across the Galileo Galilei Way intersection onto a City-owned parcel of land (Assessors' Map 40, Parcel 43) abutting the east side of the MBTA Grand Junction Railroad corridor. The Grand Junction Railroad is a lightly used commercial freight rail facility with two to four trains running per day through Cambridge. This corridor is the only north-south rail connection east of Framingham and Worcester. The route continues north on the City-owned property parallel to the east side of the MBTA Grand Junction Railroad corridor past the Cornelius Way / Michael Way / Wellington Harrington Memorial Way residential neighborhoods. The route collocates with the potential future alignment of the City of Cambridge's Grand Junction Multi-Use Path up to Medford Street/Gore Street in Somerville,[81] including switching from City-owned land on the east side of the existing railroad corridor to City-owned land on the west side of the

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81 The Grand Junction Multi-Use Path is a proposed off-street multi-use path running alongside the existing railroad tracks in the Grand Junction corridor from Boston University Bridge to Somerville. The City of Cambridge's objective is to design, in as much of the corridor as possible, a 14-foot-wide path with 2-foot-wide buffers on both sides. See https://www.cambridgema.gov/CDD/Projects/Transportation/GrandJunctionPathway for additional detail.

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Figure 4-22

Candidate Route S11C (Grand Junction RR Multi-Use Pathway) railroad corridor. These crossovers would occur at the following at-grade street crossings: Binney Street, Cambridge Street and Medford Street. A place of worship (Saint Anthony of Padua Catholic Church)is located on the west side along with small parcel of greenspace (Alfred Vellucci Park) near the Cambridge Street crossing. North of Cambridge Street, this route segment is bordered predominantly by pockets of small businesses and more residential housing. The east side of this route segment is characterized by vacant railroad property, commercial/industrial properties, single family and multi-family residential homes, and an apartment complex (Cambridge Housing Authority - Millers River).

The Cambridge/Somerville municipal boundary is located just south of Medford Street. After crossing Medford Street (urban minor arterial roadway) via the Grand Junction Railroad corridor, the Candidate Route S11C continues north along the western edge of the MBTA ROW, past a private condominium complex (Metro 9) and the Twin City Shopping Plaza up to the intersection of the Grand Junction railroad tracks and the MBTA commuter rail tracks (Fitchburg Route Main Line). Candidate Route S11C would cross beneath the MBTA commuter rail tracks and McGrath Highway (Route 28) using a trenchless construction technique, before entering an Eversource-owned parcel of land on Linwood Street. Candidate Route S11C would then transition back to open-trench construction as it turns northwest onto Linwood Street. The route follows Linwood Street in a northwesterly direction across McGrath Highway and beneath the Route 28 overpass, where the route turns southwest onto Washington Street. Linwood Street is roughly 40-feet wide, accommodates two-way vehicular traffic, has sidewalks on both sides and on-street parking throughout much of its length. It is predominantly bordered by commercial and industrial uses including several Eversource facilities, a U-Haul facility, auto parts store and a Mercedes-Benz auto dealership. Linwood Street is classified by MassDOT as a local roadway.

The route then follows Washington Street to Prospect Street, where it then turns south towards Union Square and into the Somerville Substation. The Washington Street segment of this route passes beneath Route 28. Washington Street is a busy travel corridor, particularly at the intersection with Prospect Street and Somerville Avenue located beneath the Route 28 overpass. It is approximately 50-feet wide and bordered predominantly by mixed commercial uses, restaurants, residential housing and the Somerville Police and Fire Department facilities. Washington Street accommodates two-way vehicular traffic, has sidewalks on both sides of the road, dedicated bike lanes, and on-street parking in select locations. Washington Street is classified by MassDOT as an urban principal arterial roadway.

The length of the Prospect Street segment is approximately 600 feet before turning into Somerville Substation. This segment of Prospect Street is predominantly bordered by commercial development, including a Dunkin Donuts, restaurant uses and gym facility. The east side of Prospect Street is bordered by the same property undergoing development as that mentioned for Candidate Route S1A (D2 Site). Prospect Street is approximately 34-feet wide in this location, accommodates two-way vehicular traffic, has sidewalks on both sides of the road and dedicated bike lanes. There is no on-street parking along this segment of road. Prospect Street is classified by MassDOT as an urban principal arterial roadway.

Candidate Route S12 (Cardinal Medeiros Avenue)

Candidate Route S12 is approximately 1.48 miles long and is located in Cambridge and Somerville (see Figure 4-23). This route heads west from the New Substation Site onto Broadway Street for about one block before turning north onto Cardinal Medeiros Avenue to the intersection with Cambridge Street. The route turns east onto Cambridge Street and then north onto Warren Street up to Medford Street. At Medford Street, the route heads northwest and then west onto South Street. The route follows South Street to Columbia Street where it turns north for about 100 feet before crossing a private commercial parking lot associated with J&A Used Auto Parts, Windsor Place, and a second commercial parking lot north of Windsor Place associated with Royal Hospitality Services. From this commercial parking lot, the route crosses beneath the MBTA commuter tracks, likely using a trenchless crossing technique. After crossing under the tracks, the route then heads in a northwesterly direction around the eastern edge of the site of the MBTA's new Union Square Green Line train station platform, across the D2 Site, generally following the approximate alignment of two proposed roadways identified as Milk Alley and Bennett Court. The route then turns south onto Prospect Street and enters Somerville Substation from the east.

The segment of this route near the Broadway Street/Hampshire Street intersection is bordered by the same land uses described above for the other Somerville Study Area candidate routes. The segment of this route that follows Cardinal Medeiros Avenue and Warren Street is predominantly bordered by residential neighborhoods with pockets of commercial developments. Warren Street varies in width but is generally between 23 feet to 27 feet. It is a one-way travel street with on-street parking and sidewalks on both sides. It does not have any dedicated bike lanes. Warren Street is classified by MassDOT as a minor arterial roadway.

The segment of Candidate Route S12 that follows South Street is predominantly bordered by pockets of residential housing and commercial/industrial properties. An auto parts and auto salvage facility border the western end of South Street, adjacent to the South Street Farm located near the South Street/Windsor Street intersection. South Street varies in width from approximately 20 feet at its narrowest point to 26 feet at its widest point. It is a one-way travel street with on-street parking and sidewalks on both sides. It does not have any dedicated bike lanes. South Street is classified by MassDOT as a local roadway.

The Prospect Street segment is the same as that described above for Candidate Routes S1A, S13A, and S14 below.

Candidate Route S13 (Broadway)

Candidate Route S13 is approximately 1.57 miles long and is located in Cambridge and Somerville (see Figure 4-24). From the New Substation Site this route heads west onto Broadway Street before turning north onto Inman Street. Inman Street is predominantly bordered by residential land uses up to Inman Square. Inman Street is approximately 26-feet wide along this route

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Figure 4-23
Candidate Route S12 (Cardinal Medeiros Avenue)

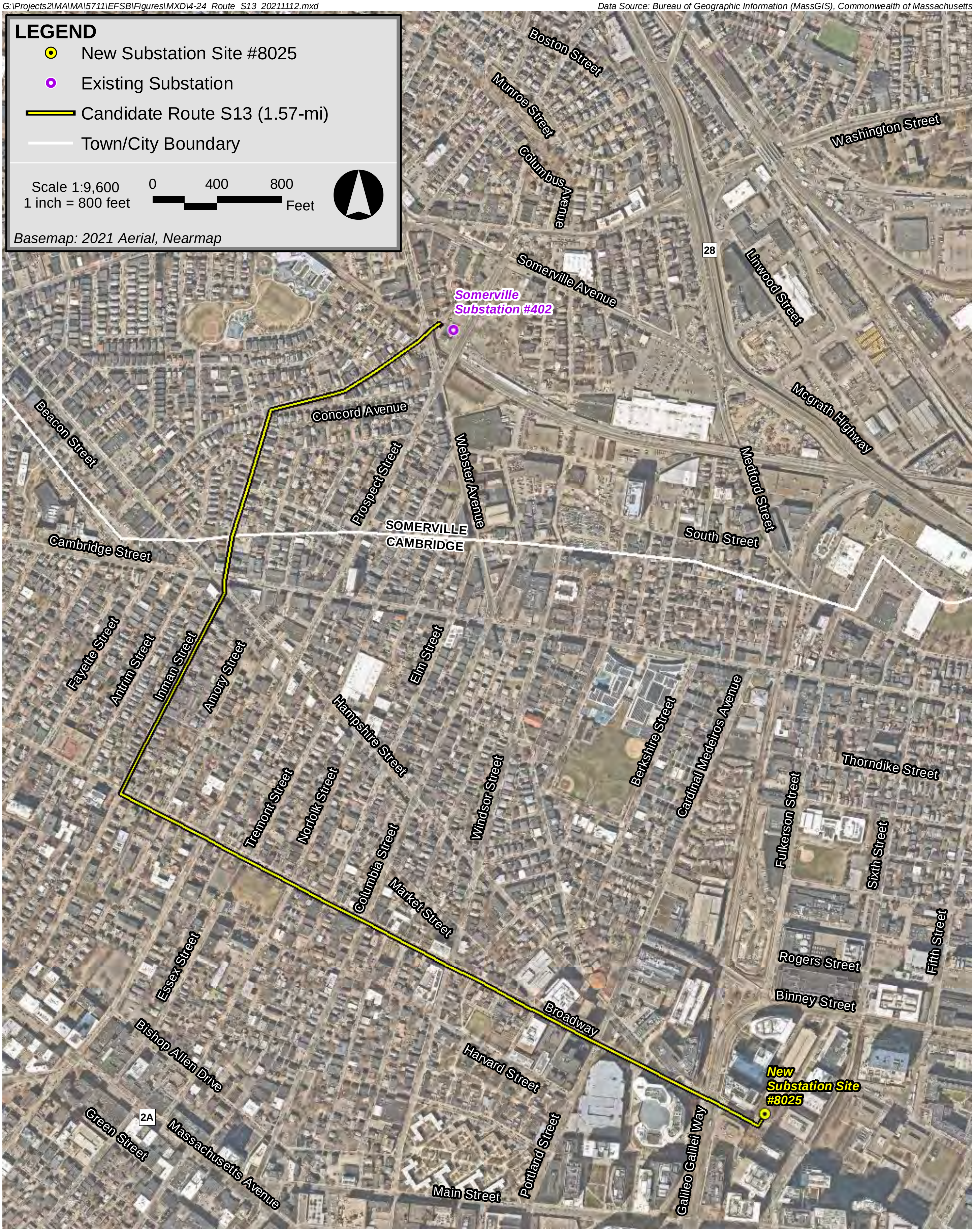

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Figure 4-24

Candidate Route S13 (Broadway)

segment. It is a one-way travel street with on-street parking and sidewalks on both sides and does not have any dedicated bike lanes. Inman Street is classified by MassDOT as a minor arterial roadway.

The route follows Inman Street through the intersection with Hampshire Street and Cambridge Street onto Springfield Street. North of the Inman Square area on Springfield Street, the route is predominantly bordered by residential land uses. Springfield Street is about 26-feet wide, accommodates two-way vehicular traffic, has sidewalks on either side and on-street parking. Springfield Street is classified by MassDOT as a major collector roadway.

From Springfield Street, the route heads northeast onto Concord Avenue turning onto Newton Street and over the MBTA commuter rail tracks and into Somerville Substation from the west. The Concord Avenue/Newton Street segment of this route is also predominantly bordered by residential land uses up to Eversource's Somerville Substation #402 on Prospect Street. Concord Avenue is approximately 34-feet wide, accommodates two-way vehicular traffic and has a sidewalk on the west side. The east side is occupied by a small patch of green space where the roadway splits onto Newton Street. Concord Avenue does not have a dedicated bike lane in this stretch. Newton Street is like Concord Avenue although it is slightly wider, ranging between 28 feet and 37 feet at its widest points. Newton Street has sidewalks on both sides. MassDOT classifies Newton Street as a major collector roadway and Concord Street as a minor arterial roadway.

Candidate Route S13A (D2 Site and Somerville Avenue)

Candidate Route S13A is approximately 1.82 miles long and is located in Cambridge and Somerville (see Figure 4-25). This route follows the same alignment and is bordered by the same land uses as those described above for Candidate Route S13; however, instead of entering the substation from the west on Newton Street, this route continues along Newton Street to Prospect Street. The route continues north onto Prospect Street for about 100-feet before turning east through Union Square onto Somerville Avenue and then south onto Milk Alley through the previously described D2 Site. The route then follows the alignment through the private development site as described above for Candidate Route S12 to enter Somerville Substation #402 from the east.

Candidate Route S14 (Columbia Street)

Candidate Route S14 is approximately 1.38 miles long and is located in Cambridge and Somerville (see Figure 4-26). From the New Substation Site this route heads west onto Broadway Street before heading north on Columbia Street. The route follows Columbia Street into Somerville to Beach Avenue where the route then heads northeast across a private commercial parking lot associated with J&A Used Auto Parts, Windsor Place, and a second commercial parking lot north of Windsor Place associated with Royal Hospitality Services. From this commercial parking lot, the route crosses beneath the MBTA commuter rail tracks, likely using a trenchless crossing technique. After crossing under the tracks, the route heads in a northwesterly direction around

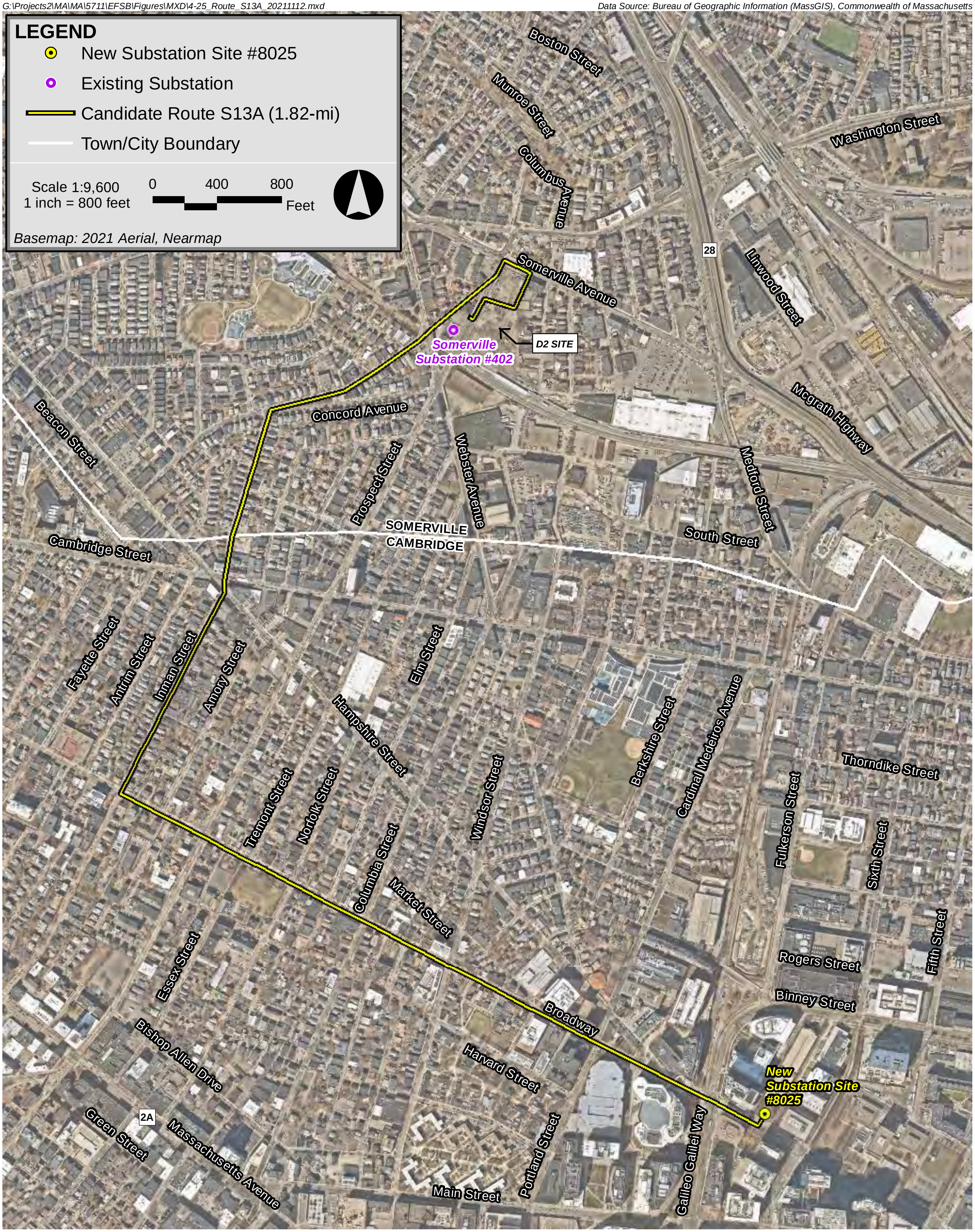

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Figure 4-25

Candidate Route S13A (D2 Site and Somerville Avenue)

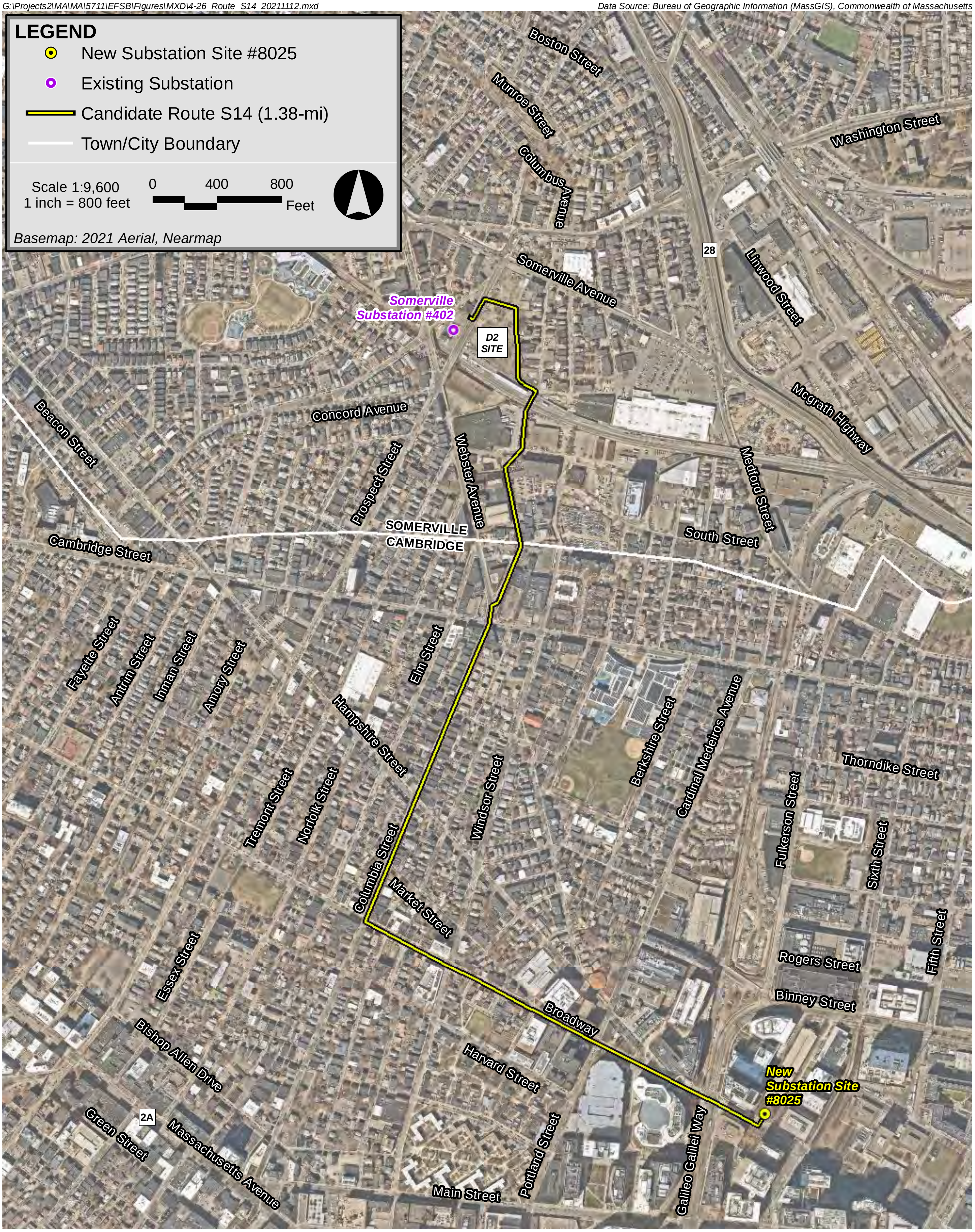

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Figure 4-26

Candidate Route S14 (Columbia Street)

the eastern edge of the future site of the MBTA's new Union Square Station train platform, across the D2 Site, generally following the approximate alignment of two proposed roadways identified as Milk Alley and Bennett Court (following the same alignment as Candidate Route S12). The route then turns south onto Prospect Street and enters Somerville Substation from the east.

MassDOT roadway classifications and roadway descriptions are the same as those described above for Candidate Route S1A. Land uses bordering the Broadway and Columbia Street segments are also similar, although the Broadway Street segment between the Hampshire Street intersection and Columbia Street passes through additional residential neighborhoods, commercial land uses and past an elementary school (Fletcher Maynard Academy).

4.6 Analysis of Transmission Line Candidate Routes within Each Study Area

The Candidate Routes described above were evaluated and ranked within each Study Area, applying a scoring methodology based on several criteria. Cost estimates were also developed for each route, and the reliability of each Candidate Route was assessed. The goal of the routing analysis was to identify the routes that best balance reliability, cost, and minimization of environmental effects.

4.6.1 Criteria and Weight Assessment

The Company assessed the Candidate Routes using a set of 11 evaluating criteria. The criteria were developed to reflect the defined routing objectives and take into consideration environmental and constructability factors. The scoring criteria include the following subcategories:

- **Developed Environment Criteria** compare existing conditions of, and potential impacts to, the developed environment and surrounding population.
- **Natural Environment Criteria** compare existing conditions of, and potential impacts to, the natural environment.
- **Technical/Constructability Criteria** compare route location and technical design factors that may add complexity to construction and ultimately result in higher costs to customers.

The Company also applied weights to the evaluation criteria that were deemed to be of higher significance than other criteria. Use of a 1-to-5 scale for weighting was considered appropriate to reflect the degree of importance of each criterion specific to this project, with 1 being the lowest weight and lesser importance and 5 being the highest weight and greater importance. Lower total weighted ratio scores are better in this analysis. The Company chose to use a scale of 1-to-5, instead of the more commonly utilized 1-to-3 scale range, to implement a scoring system that would provide greater granularity in comparing the benefits or impacts of each Candidate Route. Given the extensive amount of Candidate Routes and nuances in the route locations relative to overlapping study areas, the Company believed that the 1-to-5 scale was a better evaluation method that would provide results with a clearer numerical separation of those routes with higher degrees of impacts to the environmental criterion analyzed.

The scoring criteria identified by the Company to evaluate and compare each Candidate Route are described in further detail below.

4.6.1.1 Developed Environment Criteria

Developed Environment Criteria compare existing conditions of, and potential impacts to, the developed environment and surrounding community. The Company applied the following Developed Environment Criteria in the scoring analysis of each Candidate Route:

- Residential Land Use,
- Sensitive Receptors,
- Commercial/Industrial Land Use,
- Transportation Impacts,
- Historic & Archaeological Resources, and
- Potential to Encounter Subsurface Contamination.

Residential Land Use

Residents along a specific Candidate Route could be subject to temporary impacts from construction, such as noise, dust, traffic disruption, restricted property access and other short-term construction-related impacts. The number of residential units directly abutting the Candidate Routes were counted using a combination of MassGIS data (Master Address Database)[82] and field reconnaissance to determine the number of units along each route, including, whenever possible, unit counts for large multi-unit apartment or condominium complexes, where each individual residence that abuts the route was counted. In the case of college and university student residence halls, each building was counted as one residential unit given the seasonal fluctuations in student populations.

The ratio score for this criterion was calculated by dividing the total number of residential units for each Candidate Route within each individual Study Area by the highest number of residential units found among all the Candidate Routes within each individual Study Area.

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82 https://www.mass.gov/info-details/massgis-data-property-tax-parcels;https://www.mass.gov/info-details/massgis-data-master-address-data;https://docs.digital.mass.gov/dataset/massgis-data-master-address-data-basic-address-points.

Sensitive Receptors

Sensitive receptors could also be affected by temporary construction impacts such as access and traffic disruption, restricted access, noise, and dust. The number of sensitive receptors directly abutting the route were counted using MassGIS databases, aerial photography, internet searches, Google Street View, and field verification. Daycare facilities were further identified using the Massachusetts Early Education Search tool available through the Executive Office of Education's website. The following sensitive receptors were identified, if present, for each Candidate Route: police and fire stations, hospitals, schools (including colleges and universities), nursing homes/elder care facilities (including long term care facilities), funeral homes, places of worship, daycare facilities, district court buildings and parks and recreational facilities (other than Article 97 lands which are a separate criterion). Note that daycare facilities, chapels and libraries located on the campus of colleges and universities were not counted separately, rather they were counted under the overall school sensitive receptor. The sensitive receptors included in the scoring analysis are depicted on Figures 4-27A through D.

The ratio score for this criterion was calculated by dividing the total number of sensitive receptor units for each Candidate Route within each respective Study Area by the highest number of sensitive receptors units found among all the Candidate Routes within each individual Study Area.

Commercial/Industrial Land Use

Commercial/industrial land uses along each Candidate Route could be subject to the same types of temporary impacts as the criterion above due to Project construction. Commercial/industrial land uses were derived from the number of commercial/industrial units (i.e., businesses) on parcels of land directly abutting each Candidate Route.

The ratio score was calculated by dividing the total number of commercial/industrial units determined for each Candidate Route by the highest number of commercial/industrial units within each respective Study Area among all the Candidate Routes within each individual Study Area.

Transportation Impacts

The potential to cause transportation impacts during construction to pedestrians, bicyclists, motorists, and public transportation, was evaluated for each Candidate Route. The evaluation is based on information obtained from MassGIS, available aerial photography, field reconnaissance, the Project's traffic data collection program and the Company's familiarity and experience with the traffic flow and operations in the general area.

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

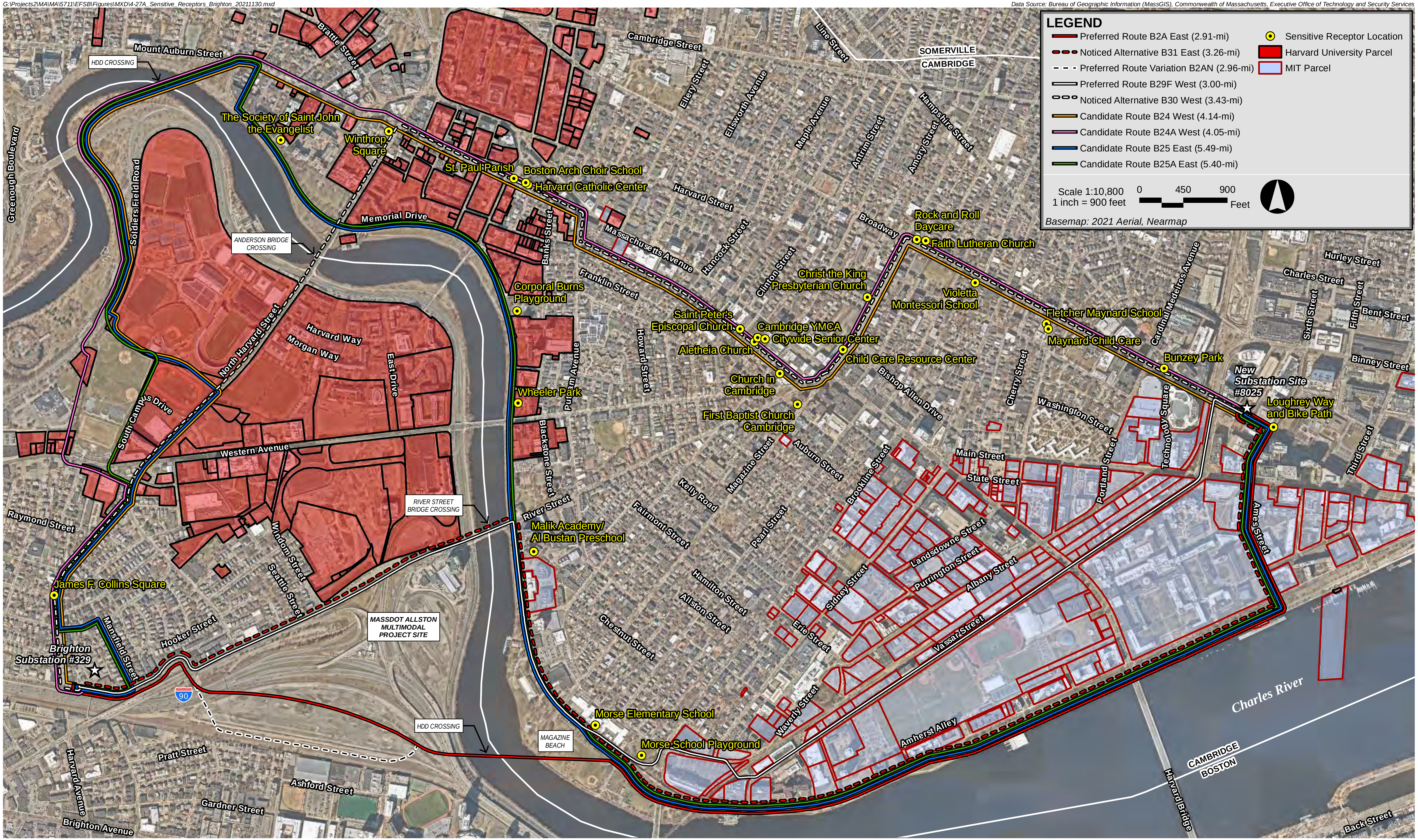

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Figure 4-27A

Sensitive Receptors: Brighton Candidate Routes

G:\Projects2\MA\MA\5711\EFSB\Figures\MXD\4-27B_Sensitive_Receptors_Putnam_20211130.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

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Figure 4-27B

Sensitive Receptors: Putnam Candidate Routes

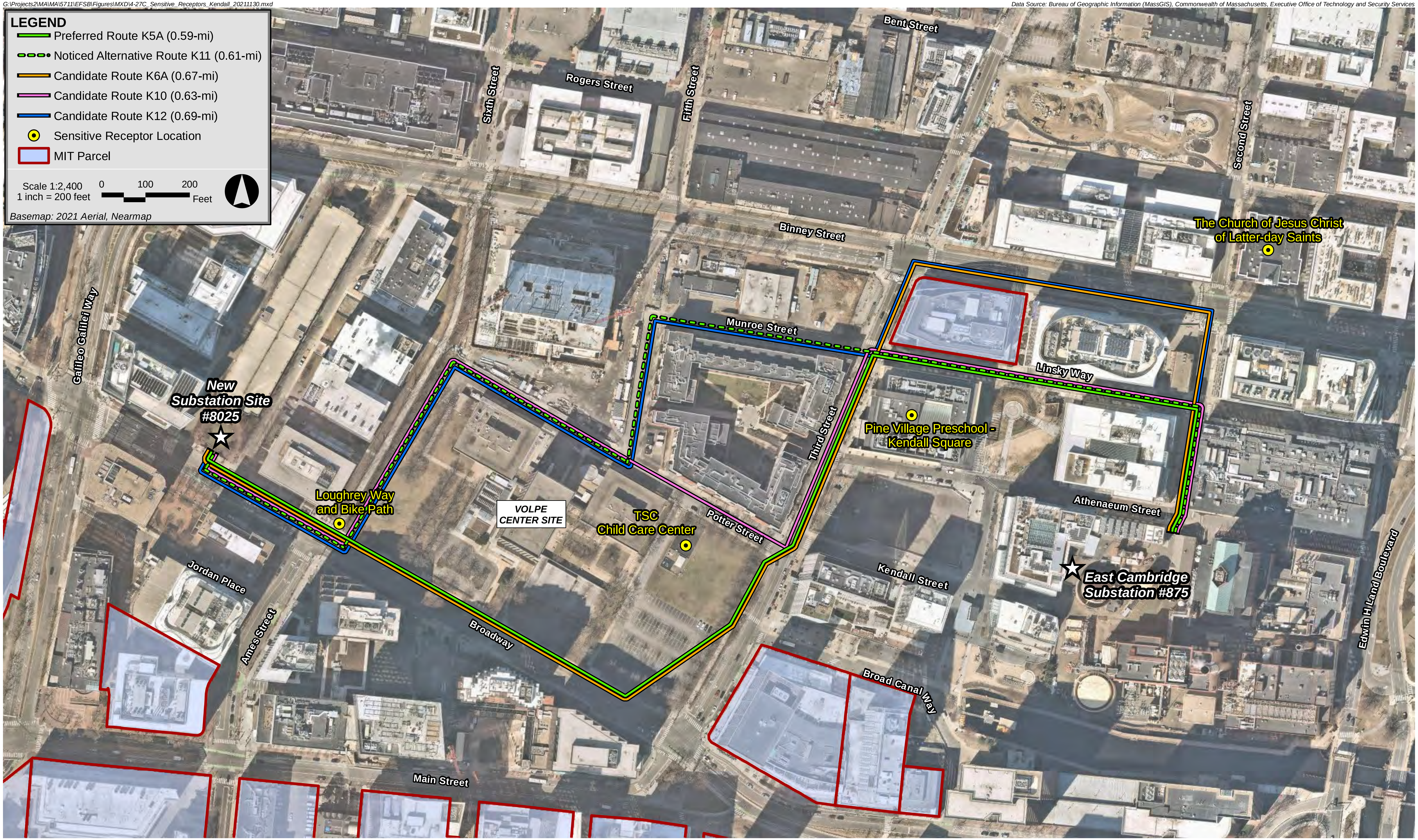

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Figure 4-27C

Sensitive Receptors: Kendall Candidate Routes

G:\Projects2\MA\MA\5711\EFSB\Figures\MXD\4-27D_Sensitive_Receptors_Somerville_20211130.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

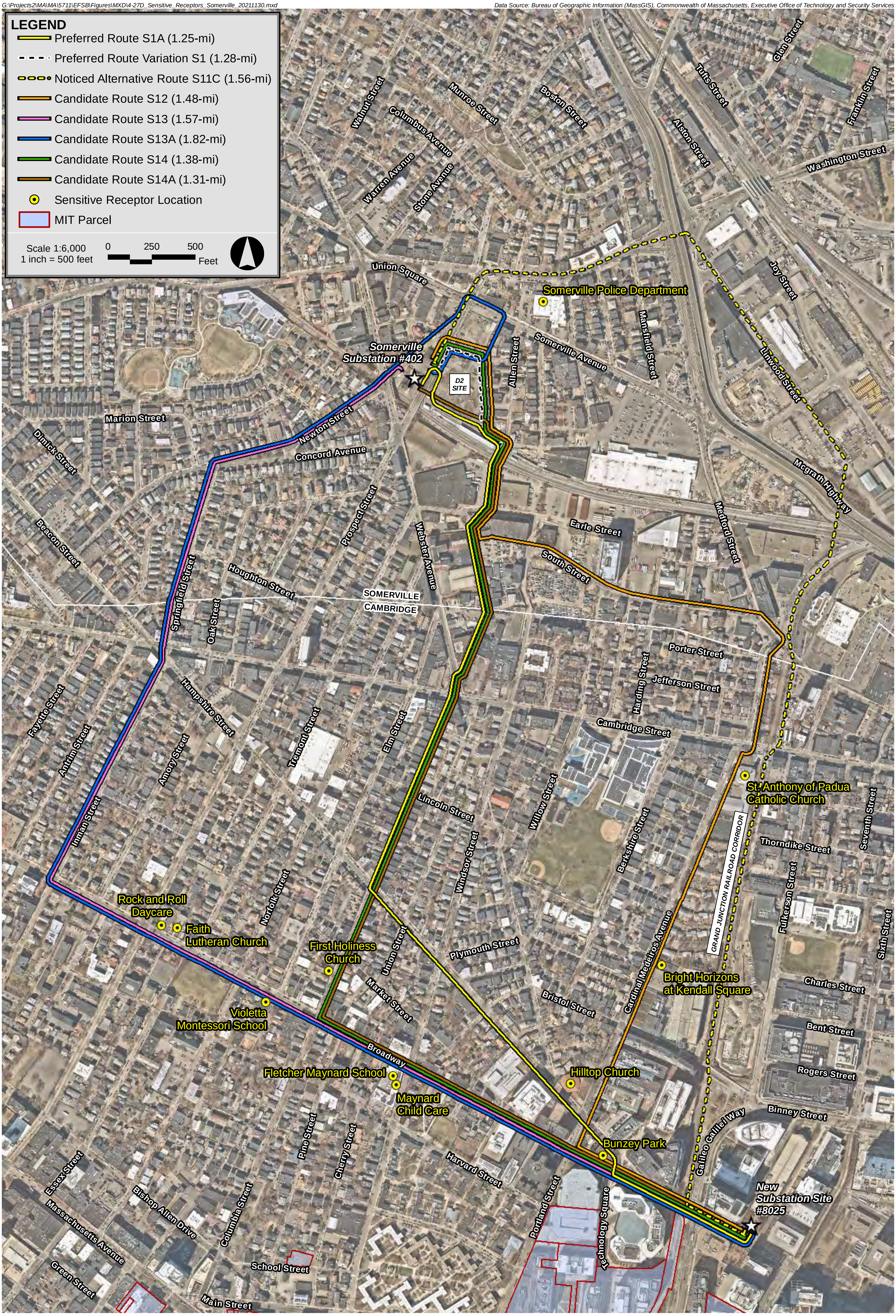

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Figure 4-27D

Sensitive Receptors: Somerville Candidate Routes

Transportation impacts can be caused by several factors, some of which can be anticipated and quantified (such as the effect of temporarily reducing travel lanes, eliminating a bus stop or closure of a sidewalk or bicycle lane, and intersection crossings) and some factors that are temporary/unanticipated, such as weather conditions, vehicle crashes, other construction activity/detours in the area, and congestion on adjacent roads that may reroute regional traffic onto other roadways. The analysis conducted by the Company provides a relative comparison of the different routes using factors that are directly attributable to the congestion and impacts that could be caused by transmission line construction. Presenting the review in the form of a relative comparison between routes using only pertinent factors removes the effect of temporary/unanticipated factors from the route selection process.

More specifically, the Company's transportation analysis considered several factors to generate a score for each Candidate Route. Roadway cross-sectional data was gathered through research of available electronic records (MassGIS, public transit maps and aerial imagery) along each route. Elemental data such as roadway classification and jurisdictional responsibilities, number and widths of vehicular and bicycle lanes, pedestrian facilities (sidewalks or pedestrian crossings), on-street parking and public transit routes were gathered. This information was later confirmed or updated through field reconnaissance efforts of the existing conditions along each route. Field reconnaissance efforts included 15-minute "spot" traffic counts (e.g., vehicles, bicycles, and pedestrians) conducted along public roadways for future comparison to actual traffic data collected along each Candidate Route.

The approximate length and available width of each roadway segment of each Candidate Route was then tabulated. A work zone impact score (from 0.5 being the lowest to 3 being the highest) was then calculated based on two factors. The first factor was the available width of the roadway in the segment compared against potential temporary traffic control approaches that could be utilized given roadway width and an assumed work zone width requirement of 16 feet to construct the new transmission line. Then the work zone impact score was adjusted by the second factor, which is according to the traffic volume that would potentially be affected. The higher the volume, the larger the number of roadway users affected, which translates to a higher work zone score. The calculated work zone impact score was then multiplied by the length of the route segment to determine the segment's affected length. Additional affected length or "sub-impacts" for each segment were then added to this figure to account for more complex and time-consuming construction work across intersections, bicycle lanes and pedestrian facilities. The total impact length for each segment is the combination of these two values. The route's total impact length is the sum of the total impact lengths for each route segment. The route's total impact length is then divided by the proposed total length of the Candidate Route to produce a total transportation score for each route. The total transportation score represents an impact factor for construction along a Candidate Route. The impact factor for each Candidate Route can then be compared to assess relative severity of the Candidate Routes to one another. A high total transportation score means a greater potential for impacts to all modes of transportation during construction when compared to a lower score.

Lastly, a ratio score was calculated by dividing the total transportation score determined for each Candidate Route within each respective Study Area by the highest transportation score found among all the Candidate Routes within each individual Study Area.

Please refer to Appendix 4-3 for additional detail.

Historical and Archaeological Resources

Historic and archeological resources could also be affected by temporary construction impacts such as access and traffic disruption, earth movement, restricted access noise and dust. Identification of historic resources involved a search of MHC records to locate resources including local and state listed historic structures, local historic districts and individual National Register-listed structures and districts. Historic resources were evaluated using GIS data from MHC's Massachusetts Cultural Resource Information System ("MACRIS"), which catalogs federal, state, and local historic resources.

The ratio score was calculated by dividing the total number of historic and archaeological resources determined for each Candidate Route within each respective Study Area by the highest number of historic and archaeological resources found among all the Candidate Routes within each individual Study Area.

The historic resources included in the scoring analysis are depicted on Figure 4-28A through D.[83]

Potential to Encounter Subsurface Contamination

Trench excavation in urban areas poses a potential to encounter polluted or contaminated soil and groundwater that could affect worker safety and may require special soil and groundwater management and disposal procedures under federal and state regulations. Releases of oil and/or hazardous material to the environment are required to be reported to the Massachusetts Department of Environmental Protection's ("MassDEP") Bureau of Waste Site Cleanup in accordance with M.G.L. Chapter 21E and procedures established in the Massachusetts Contingency Plan ("MCP") (310 CMR 40.0000). MassDEP categorizes Oil or Hazardous Material ("OHM") sites based on the level of contamination present and the level of remediation completed. Eversource's route evaluation considered several groups of OHM sites that may have the potential to affect the Project based on their status.

An online search of the MassDEP Waste Site List in combination with a review of MassGIS databases was performed to determine the potential for each Candidate Route to encounter subsurface contamination from historical releases, historic fill placement or former land use. The

[83] Note that archaeological resources are considered confidential information by MHC and are not specifically identified on this graphic.