EVERSOURCE

ANALYSIS TO SUPPORT PETITIONS BEFORE THE
ENERGY FACILITIES SITING BOARD
EFSB 19-06

Mid Cape Reliability Project



VOLUME I

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

Submitted by:
NSTAR Electric Company d/b/a Eversource Energy
247 Station Drive
Westwood, Massachusetts 02090

Prepared by:
Epsilon Associates, Inc.
3 Mill & Main Place, Suite 250
Maynard, Massachusetts 01754

In Association with:
Keegan Werlin LLP

November 8, 2019

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3 Mill & Main Place, Suite 250
Maynard, MA 01754

In Association with:

KEEGAN WERLIN, LLP
99 High Street, Suite 9000
Boston, MA 02110

November 8, 2019

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Executive Summary

EXECUTIVE SUMMARY

NSTAR Electric Company d/b/a Eversource Energy proposes to construct a new, approximately 12.5-mile, overhead 115-kilovolt ("kV") electric transmission line sited along an existing Company right-of-way that is occupied by existing transmission and distribution facilities. This "New Line" will pass through the municipalities of Bourne, Sandwich and Barnstable and connect at the Bourne Switching Station and West Barnstable Substation. The New Line and associated station work is referred to as the Mid Cape Reliability Project (the "Project").

The Project is part of a larger plan to reinforce the Southeastern Massachusetts transmission system and to bring the system into compliance with applicable national and regional reliability standards. The Project is one of approximately 25 individual transmission projects to emerge from an extended transmission study, the Southeastern Massachusetts and Rhode Island ("SEMA-RI") Assessment, which was led by the Independent System Operator of New England ("ISO-NE").

The Project itself will resolve potential thermal overloads and low voltage conditions that could result in the loss of electric service to the entire Cape Cod area and the islands of Martha's Vineyard and Nantucket, totaling over 500 megawatts of load. Such an outage could affect over 200,000 customers in the Cape Cod area.

Eversource considered various routes for the New Line, including the use of both overhead and underground designs. The Company's analysis demonstrated the clear and distinct advantages of constructing the Project overhead along the existing transmission corridor. The Company also conducted extensive community outreach, participating in meetings with the municipalities, government officials, residents and other stakeholders. 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.

Notably, in this petition, the Company also offers a variation in the Project design intended to provide flexibility for the future expansion of the electrical system on Cape Cod to accommodate the interconnection of new renewable generation. This "Noticed Variation" is to build the Project's transmission structures to be capable of operating at 345-kV should the need for operation at that voltage materialize in the future. The ISO-NE has completed multiple studies for offshore wind facilities proposing to interconnect in the Cape Cod Area with over 2,600 MW of generation proposing to connect to the Barnstable or West Barnstable Substations. To meet the current identified need for the Project and to minimize the potential siting, cost, community and environmental impacts of an entirely distinct 345-kV line or rebuilding the proposed 115-kV line to 345-kV standards in the future, the Company is presenting this Noticed Variation to build the Project to 345-kV standards but operate at 115-kV. The Company offers this option recognizing that there is uncertainty surrounding the viability of the generating resources proposed to interconnect in the Barnstable area and the designation of a party or parties responsible for the costs of the incremental upgrades. Inclusion of the Noticed Variation provides the flexibility to respond to changing circumstances during the Siting Board's review of the Project as the uncertainties become clearer.

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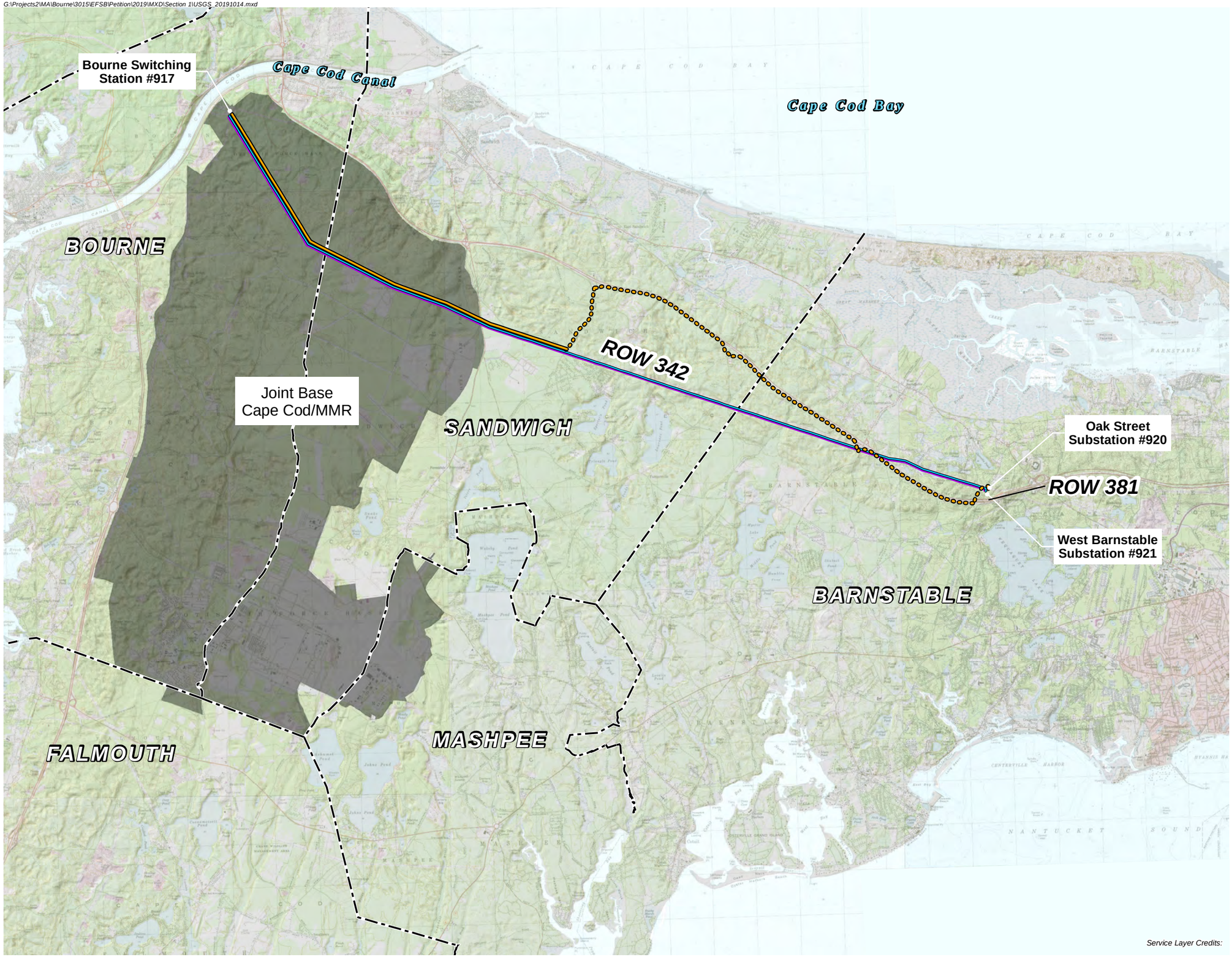
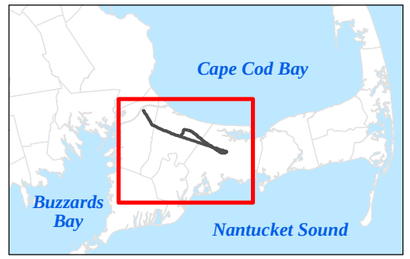


Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

Basemap: USGS Quadrangles, MassGIS

LEGEND

Project:

ROW 342 (12.5 miles)
(115 kV overhead design)

Noticed Variation:

ROW 342 (12.5 miles)
(345 kV design, operated at 115 kV)

Noticed Alternative:

ROW 342 (6.1 miles)
(115 kV overhead design)

Quaker Meeting House Road North
(7.9 miles) (115 kV underground design)

Town Boundary

Joint Base Cape Cod/MMR

Figure 1-1

USGS Locus Map

Epsilon ASSOCIATES INC.

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Mid Cape Reliability Project

EVERSOURCE

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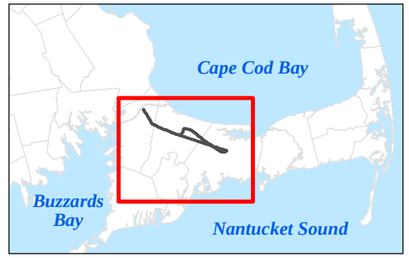

SCALE

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1 inch = 7,000 feet

0 3,500 7,000 Feet

Basemap: World Imagery, ESRI

LEGEND

Project:
- ROW 342 (12.5 miles) (115 kV overhead design)

Noticed Variation:
- ROW 342 (12.5 miles) (345 kV design, operated at 115 kV)

Noticed Alternative:
- ROW 342 (6.1 miles) (115 kV overhead design)
- Quaker Meeting House Road North (7.9 miles) (115 kV underground design)
- Town Boundary
- Joint Base Cape Cod/MMR

Figure 1-2

Aerial Locus Map

Epsilon Associates Inc.

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, therefore, should be approved.

Section 1.0

Project Overview

1.0 PROJECT OVERVIEW

1.1 Introduction: Siting Board Jurisdiction

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, operate and maintain a new 115-kilovolt ("kV") electric transmission line ("New Line") between Eversource's Bourne Switching Station and West Barnstable Substation. The improvements, known as the "Mid Cape Reliability Project" (the "Project"), include approximately 12.5 miles of new 115-kV overhead transmission line on existing Eversource right-of-way ("ROW") and related station improvements.

Construction of the Project will serve the public interest by increasing the reliability of the regional electric transmission system on Cape Cod, Martha's Vineyard and Nantucket (the "Project Area"). Consistent with the Siting Board's standards, the Project will provide a reliable energy supply for the Commonwealth with a minimal impact on the environment at the lowest possible cost.

The Company's proposed route for the 115-kV line and the locations of Bourne Switching Station and West Barnstable Substation are shown on a United States Geological Survey ("USGS") quadrangle base map (see Figure 1-1, USGS Locus Map). Figure 1-2 shows the proposed route on a Massachusetts Bureau of Geographic Information ("MassGIS") aerial photo. The New Line will be located in the towns of Bourne, Sandwich and Barnstable.

Consistent with the Section 69J Petition, Eversource also has filed with the Department of Public Utilities ("DPU"): (1) a request for approval of the Project pursuant to G.L. c. 164, § 72 ("Section 72 Petition"); and (2) a request for exemptions from the operation of the Town of Barnstable Zoning Ordinance for work proposed at the West Barnstable Substation pursuant to G.L. c. 40A, §3 ("Chapter 40 A, §3") ("Zoning Exemption Petition"). Section 72 requires a petitioner to seek approval from the DPU "for authority to construct and use or to continue to use as constructed or with altered construction a line for the transmission of electricity for distribution in some definite area." Under this statute, the DPU must determine that "such a line will or does serve the public convenience and is consistent with the public interest." Chapter 40A, § 3 authorizes the DPU to issue zoning exemptions for "[l]ands or structures" to be used by "public service corporations" if such zoning exemptions are required and "reasonably necessary for the convenience or welfare of the public."

The Analysis is presented in six sections. The balance of this Introduction (Section 1) presents a general overview of the Project and Project team. The remaining sections of this Analysis provide detailed information to support the Project; specifically, an explanation for the need for the Project (Section 2); a comparison of Project alternatives (Section 3); a description of the route selection process that was used to identify the Project and Noticed Alternative (Section 4); a comparative analysis of environmental impacts, cost and reliability of the Project, Noticed

Variation[1] and Noticed Alternative (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).

1.2 Project Need

In accordance with the rules of the North American Electric Reliability Corporation ("NERC"), the Northeast Power Coordinating Council ("NPCC"), as delegated by NERC, and the Independent System Operator of New England ("ISO-NE"), the Company's transmission system must be planned and built to withstand certain operating contingencies while, at the same time, meet customer demand on the system. The Project is one of approximately 25 individual projects to emerge from a transmission system study process conducted by ISO-NE and the Southeastern Massachusetts and Rhode Island ("SEMA-RI") Working Group (the "Working Group") to identify and address reliability needs of the regional transmission system that serves southeastern Massachusetts and Rhode Island.

Section 2 of the Analysis summarizes the results of the SEMA-RI Need study for the area of Cape Cod and the Islands of Martha's Vineyard and Nantucket. The Project will address ISO-NE's determination of a need for additional transmission capacity within this area.

As described more fully in Section 2, the Working Group identified overloads, voltage violations and the potential for voltage collapse that could result in loss of over 500 MW of load; the loss of electric service to approximately 200,000 customers in the Cape Cod area. The Project will resolve the potential for these thermal overloads and low voltage situations on the transmission system. More recently, the Company verified the need for the Project using updated information, confirming that the existing transmission system currently does not have sufficient capacity to reliably serve the Cape Cod area at peak load conditions. The Updated Need Assessment and the Company's own analysis demonstrate that there is an immediate need for additional capacity in this area to reliably serve electric customers. Addressing this issue is not discretionary; it is a requirement imposed by ISO-NE and NERC.

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[1] This Noticed Variation is to build the Project's transmission structures to be capable of operating at 345-kV. The Company would not operate the line at 345-kV unless the need to do so in fact materializes. The Company offers this option recognizing that there is uncertainty surrounding the viability of the generating resources proposed to interconnect in the Barnstable area and the designation of a party or parties responsible for the costs of the incremental upgrades. Inclusion of the Noticed Variation provides the flexibility to respond to changing circumstances during the siting process for the Project as the uncertainties become clearer. If the Noticed Variation is approved and the need for the New Line to be operated at 345-kV in fact materializes in the future, the Company would return to the Siting Board for permission to operate the line at 345-kV at that time. In addition to documenting the need for operation at 345-kV, the Company would also provide the Siting Board with information relative to incremental environmental impacts that would be associated with operating the line at 345-kV that are not necessary to construct the New Line at this time with 345-kV infrastructure.

1.3 Project Alternatives

The Company evaluated a series of Project alternatives with the potential to meet the need identified in the Project Area to determine the approach that best balances reliability, cost and environmental impact. Section 3, Project Alternatives, contains the detailed analyses used to identify and evaluate alternative means of meeting the identified need. These include a no-build alternative, two transmission alternatives and non-transmission alternatives ("NTAs") such as incremental energy efficiency ("EE"), demand response ("DR"), energy storage and new generation. The Company dismissed the no-build alternative because it would not address the identified need for the Project. For transmission alternatives, the Company considered the proposed Project (new 115-kV overhead line), as well as a second transmission alternative that involves the reconductoring, rebuilding and bifurcation of existing 115-kV overhead transmission lines from Bourne Switching Station to West Barnstable and Barnstable Substations, including the construction of the associated terminal system upgrades. As described in greater detail in Section 3, the Project was determined to be the superior transmission alternative.

In addition, the Company considered several technologies in assessing possible NTAs to address the potential load loss from the equipment overload and low-voltage situations discussed in Section 1.2 above. First, the Company considered whether known generation and energy storage projects under development or proposed on the Cape could be utilized as an alternative to the proposed Project. The Company concluded that the three distribution-connected energy storage projects under development on Cape Cod, including on Martha's Vineyard, and Nantucket address distribution reliability needs and, due to their location, size and technology, none of these projects obviate the need for the proposed Project.

The only approved large-scale, transmission-connected generation project in the ISO-NE Interconnection Queue, interconnecting on Cape Cod, that is not yet in-service, is an 800 MW offshore wind project (Vineyard Wind interconnecting at Eversource's Barnstable Switching Station). Since Vineyard Wind, or a similar generator located at Barnstable, would be unable to interconnect unless the Project is constructed, it is not an alternative to the proposed Project.

Next, the Company considered whether further projects could be developed as an alternative to the proposed Project. These other possible NTA technologies include: combined-cycle gas turbines; simple cycle gas turbines (aero-derivative combustion turbines, and large frame combustion turbines); utility-scale solar, with and without storage; distribution-scale solar with and without storage; active demand response; and passive demand response. As described in further detail in Section 3 of this Analysis, there are several practical challenges that would prevent any of these NTA technologies from being developed sufficiently to replace the Project. These challenges include the necessary development time, land requirements and infrastructure requirements.

In summary, the Company's analysis shows that generation projects under construction or planned for the area are not sufficient to offset the need for the Project or, indeed, in the case of Vineyard Wind, are dependent upon the Project. In addition, an NTA would be difficult to implement, particularly with an in-service date comparable to that of the Project and, even if the challenges could be overcome, the higher cost to customers of the least-cost NTA to the Project, combined with the physical and logistical difficulties of implementing such a solution in a timely fashion, makes an NTA a substantially inferior solution. Accordingly, from cost, environmental impact, reliability and constructability perspectives, the Company determined that construction of the proposed Project is the best approach to meet the identified need.

1.4 Routing Analysis

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 a transmission line between the Bourne Switching Station and West Barnstable Substation. Section 4 of this Petition presents this routing analysis. The iterative route selection process entailed:

- Identifying a project study area;
- Identifying an array of initial route corridors and candidate routes;
- 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; and
- Selecting the route for the Project and a Noticed Alternative based on the established evaluation criteria.

As described in Section 4, the Company's selection of the Project balances established environmental criteria, cost and reliability to reflect the standards of the Siting Board. The preferred route for the New Line is approximately 12.5 miles of new overhead transmission line along existing, occupied Eversource Right of Way ("ROW") that runs through the towns of Bourne, Sandwich and Barnstable. The New Line originates at the Bourne Switching Station and travels easterly along Eversource's ROW 342 and terminates at the West Barnstable Substation. The Project presents the shortest and most direct route identified by the Company during the route selection process.

The Noticed Alternative, which is approximately 14 miles long, is a geographically distinct route that would satisfy the identified need. The Noticed Alternative would involve construction of a new overhead line on a segment of ROW 342 and an underground line predominantly within public roads beginning at Quaker Meetinghouse Road in Sandwich, passing through the towns of Bourne, Sandwich and Barnstable. The overhead segment is approximately 6.1 miles and the underground segment is approximately 7.9 miles.

The Project and the Noticed Alternative are shown on Figures 1-1 and 1-2.

Construction of the Project or the Noticed Alternative will require upgrades to the Bourne Switching Station[2] and West Barnstable Substation. These stations are shown on the locus map provided in Figure 1-1. The improvements at the Bourne Switching Station and West Barnstable Substation are described in Section 5. The Bourne Switching Station design includes space to accommodate the Project, including the New Line and associated station equipment, and will not require expansion of the fence line. The improvements to the West Barnstable Substation would require an expansion of the existing fence line and footprint of the station.

Section 5 of this Analysis describes the methodology by which the Project will be constructed, assesses the potential for environmental impacts and describes potential mitigation measures, including a detailed comparison of the Project and the Noticed Alternative based on environmental factors, cost and reliability. Based on this comparison, the Company determined that, while each would offer comparable reliability, the Project is superior to the Noticed Alternative on balance of cost, reliability and potential for environmental impacts.

Finally, Section 6 of this Petition provides an analysis of the Project's consistency with the health, environmental protection and resource use and development policies of the Commonwealth.

1.5 Summary of Project Schedule and Cost

Assuming receipt of all necessary permits and approvals, construction of the Project is anticipated to commence in Q3 2020. Construction is anticipated to occur over an approximately 10-month period. The current planning grade cost estimate for the Project is approximately $59.1 million (-25%/+25%).

1.6 Agency and Community Outreach

The Company is committed to working with municipal officials, businesses and residents along the Project route and providing proactive and transparent communications throughout the life of the Project. The Company's initial outreach efforts have been aimed at briefing local officials and other stakeholders on the need for the Project, detailing the overall Project schedule and explaining the permitting and siting processes, including opportunities for public input. The Company will continue these efforts during the siting and permitting process and will maintain a focused communications program throughout construction, including outreach to municipalities and local businesses along the route regarding construction scheduling, staging and laydown plans. This outreach program is designed to engage the community, foster public participation and solicit feedback from stakeholders.

[2] Eversource is in the process of replacing the existing Bourne Switching Station with a new 115-kV transmission switching station. Completion of this work is expected in 2023.

Key elements of the Company's outreach program, as well as its outreach efforts to date, are described below.

Municipal and Stakeholder Briefings: The Company has met regularly with municipal officials and other stakeholders in Bourne, Sandwich and Barnstable. A list of outreach meetings with the municipalities, regulatory agencies and other officials is provided in Table 1-1 below.

Open Houses: The Company held Open Houses to provide the public with opportunities to interact with Project subject matter experts, ask questions and share concerns. At the 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 Open Houses were held in Sandwich on July 29, 2019 and in Barnstable on July 30, 2019. The Company mailed invitations to property owners within 300 feet from the route of the Project, identified through local assessors lists, and to municipal officials in Sandwich and Barnstable. The Company conducted door-to-door outreach to all properties within the proposed Project route to personally invite property owners, tenants, business owners and employees to learn more about the proposed Project and to the Open House. Newspaper advertisements for the Open Houses were published the two weeks preceding the open houses in the Friday and Sunday editions of the Cape Cod Times. As a result of the Open Houses, the Company will be conducting follow-up, on-site meetings with specific property owners to address discrete concerns.

Door-to-Door Outreach and Mailings: After the Open Houses, the Company conducted door-to-door outreach to direct abutters of the Project route. Door hangers were distributed and included a Project Fact Sheet that offered individual meetings or phone calls. The Company will continue to hold on-site meetings as they are requested and will keep property owners apprised of the Project schedule. Since there is a high possibility that residences along the Project route are not occupied year-round, the Company sent out a mailer on October 10, 2019 to property owners providing an overview of the Project scope, the anticipated schedule, and an offer for individual meetings or phone calls with subject matter experts to ask questions and share concerns.

Website: A website was developed for this Project (see https://www.eversource.com/content/ct-c/about/projects-infrastructure/projects/massachusetts-transmission-projects/mid-cape-reliability-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.

Project Hotline: The toll-free Hotline number for the Project is 1-800-793-2202. The Project Hotline number is listed in all Project outreach materials, including fact sheets, subsequent mailings, the website, and at all community events. Eversource is committed to responding promptly to all inquiries.

Project E-mail: An email address (ProjectInfo@Eversource.com) is designated for a timely response to property owner and other stakeholder questions, comments or concerns. The email address is listed in all Project outreach materials, including fact sheets, subsequent mailings, the website and at all community events. Like the Hotline, Eversource is committed to responding promptly to all inquiries.

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.

The outreach plan will also include:

- In-person pre-construction briefings with municipalities, abutting residences and businesses, and other stakeholder groups, as requested, to outline the overall construction process, key milestones, and expected timelines;
- Regular e-mail updates to municipal officials;
- Periodic letters or postcards to abutters and other stakeholders regarding advance notice of scheduled construction activities and/or milestone construction activities;
- Work area signage as appropriate; and
- Outreach staff available to meet with affected property owners prior to each major stage of construction.

A summary of the Project outreach meetings conducted to date is provided on Table 1-1 on the following page.

Table 1-1 Summary of Project Outreach Meetings

Date	Group	Summary of Topics Discussed
June 9, 2017	Town of Sandwich	Overview of Project and discussion of additional rights needed within Eversource's existing ROW 342.
July 21, 2017	Town of Barnstable	Overview of Project and discussion of easement rights needed from the local Conservation Commission and municipal property within Eversource's existing ROW 342.
October 18, 2017	Town of Sandwich	Unanimous vote to support Warrant Article at Town Meeting to amend easement rights in ROW 342.
November 13, 2017	Town of Sandwich	Unanimous vote to authorize Board of Selectmen to amend existing easement rights in ROW 342.
December 27, 2017	Town of Bourne	Overview of Project, including work contemplated at Bourne Switching Station within JBCC and schedule.
February 9, 2018	Town of Barnstable	Overview of Project, including a specific discussion of work proposed within ROW 342; and a request to amend Eversource's existing easement rights on an approximately 7,800 square feet ("s.f.") portion of Town-owned land crossed by ROW 342, identified on the Town of Barnstable Assessor's maps as Map 86, Parcel 1.
February 9, 2018	Town of Sandwich	Overview of Project and review of potential locations on ROW 342 where additional gates could be installed to minimize ATV use and other unauthorized uses on Conservation Land.
March 30, 2018	Town of Barnstable	Follow up discussions and next steps regarding the easement rights described above for ROW 342.
May 11, 2018	Town of Barnstable	Follow up discussions on consideration and appraisal analyses associated with the modified easement on ROW 342.
November 9, 2018	Massachusetts Executive Office of Energy and Environmental Affairs (MEPA Unit)	Project status, review of MEPA jurisdiction (Article 97) and timing of Environmental Notification Form.
April 9, 2019	Town of Barnstable	Eversource presentation to Conservation Commission regarding amended rights and Commission Vote. The Commission voted unanimously to grant the expanded easement rights.
May 14, 2019	Town of Barnstable	Project status, and overview of the Noticed Alternative and West Barnstable Expansion, including the potential zoning relief required for the modifications at West Barnstable.

Table 1-1 Summary of Project Outreach Meetings (Continued)

Date	Group	Summary of Topics Discussed
June 6, 2019	Town of Barnstable	Eversource presentation to Town Council regarding amended rights on ROW 342.
June 6, 2019	Town of Barnstable	Town Council hearing to vote approving grant of amended rights to Eversource on ROW 342.
July 1, 2019	Town of Barnstable	Overview of project and discussion of West Barnstable Substation expansion and the Company's zoning analysis.
September 13, 2019	Army National Guard & Environmental Management Commission Staff	Project status, discussion of work proposed in JBCC, review of EMC Performance Standards.
September 17, 2019	Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program	Project status, review of mapped habitat and limits of work, construction best management practices to avoid impacts to rare species, approach to permitting.
October 20, 2019	Town of Barnstable	Overview of project, including inclusion of the Noticed Variation, West Barnstable Substation expansion and the Company's zoning analysis and easement agreements with the Town of Barnstable.

1.7 Project Team

The Petitioner has assembled a capable team of planners, engineers, environmental scientists, attorneys and project outreach specialists for the Project. The team's principal organizations are outlined 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 Energy's electric service territory includes 140 municipalities, including Boston, covering an area of approximately 3,192 square miles.

Epsilon Associates, Inc. (Environmental Consultants)

Epsilon Associates 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 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.

1.8 Conclusion

The Project will address critical reliability issues affecting the Cape Cod area transmission system. The Company seeks authority to construct the Project to fulfill its obligation to ensure the safe and reliable transmission of power 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 New England transmission grid consists of transmission lines that transmit bulk power generated by various sources to substations that convert the power to lower voltage for delivery to homes and businesses. The grid is designed to meet reliability standards and criteria developed by the North American Electric Reliability Corporation ("NERC"), which sets the minimum standards for electric power transmission for all North America, the Northeast Power Coordinating Council ("NPCC") and Independent System Operator of New England ("ISO-NE"). The reliability standards and criteria established by NERC, NPCC and ISO-NE require transmission operators, including Eversource, to design and test their systems to withstand representative operating contingencies as specified in the criteria. If identified criteria violations are not addressed, transmission equipment could overload or voltage levels could be outside of acceptable operating ranges under certain system conditions. The impacts could result in equipment damage and wide-scale power outages.

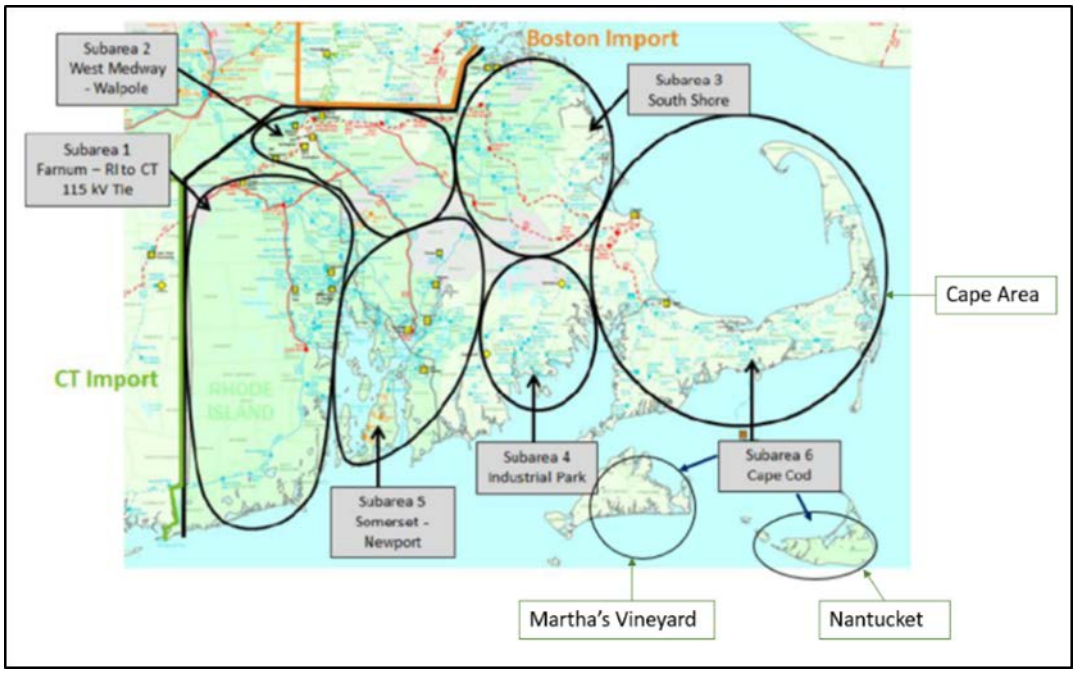
Eversource's transmission system is an integral part of the region's bulk electric system delivering electricity to customers in New England. Per NERC reliability standards, Eversource's transmission system must have capability to serve forecasted load under the conditions outlined in the SEMA-RI assessment. In this Analysis, the Company is proposing to install a new 115-kV transmission line that, in addition to other identified transmission upgrades, alleviates thermal overload conditions, provides voltage support, and prevents a voltage collapse that could affect over 500 MW of load on Cape Cod and the islands of Martha's Vineyard and Nantucket. Such an outage would affect over 200,000 customers in 22 towns on Cape Cod and the islands.[3]

The Mid-Cape Reliability Project is part of a larger plan to reinforce the Southeastern Massachusetts transmission system and to bring the system into compliance with applicable national and regional reliability standards. The Project is one of approximately 25 individual transmission projects to emerge from an extended transmission study process conducted by a Transmission Planning Working Group ("Working Group") led by ISO-NE. The goal of the Working Group was to first identify the reliability needs for that part of the transmission system that serves Southeastern Massachusetts and Rhode Island, including transmission networks serving Cape Cod and the Islands owned and operated by Eversource and New England Power ("NEP"). The Working Group initiated this assessment in 2015 and completed it in May 2016. The results are documented in the SEMA-RI Area Transmission Needs Assessment ("Needs Assessment") dated

[3] The estimated 200,000 customers affected by the potential voltage collapse in the Group 6 Cape Cod Subarea include approximately 198,000 Eversource customers and 13,000 National Grid customers.

May 2016 (see Appendix 2-1).[4] As shown in Figure 2-1, the Working Group identified six geographic need areas, which are referred to as Groups. The Needs Assessment identified several criteria violations in the Group 6 Cape Cod Subarea ("Cape Cod Subarea"). As described more fully below and as documented in the Needs Assessment, certain existing transmission lines serving the Cape Cod Subarea would overload under various contingencies at existing peak load levels, which would lead to a voltage collapse and the consequent loss of service described above. Thus, there is an immediate and substantial need to address reliability issues in the Cape Cod Subarea.

Figure 2-1 Existing SEMA-RI Area Transmission System



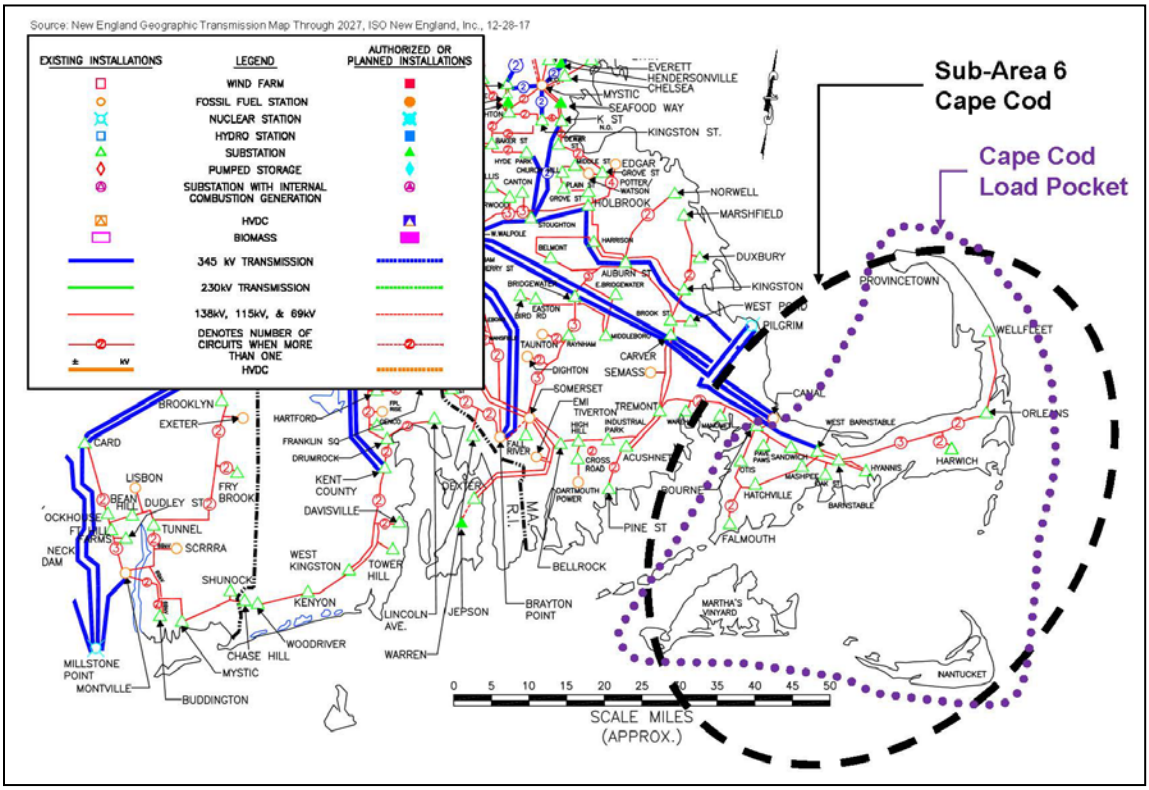
Eversource updated the analysis conducted by the Working Group to evaluate transmission needs in Cape Cod Subarea 6, to reflect the 2019 Capacity, Energy, Loads, and Transmission ("CELT") report, including the updated energy efficiency and solar photovoltaics ("PV") forecast, to confirm the need for the Project remains. As described in detail in Section 2.6 below, the Eversource analysis verified that the transmission system's reliability is compromised and that the potential for line overloads, low voltage and voltage collapse persists.

[4] Appendix 2-1 has been redacted for the public record in order to avoid disclosure of Critical Energy Infrastructure Information ("CEII"). An unredacted copy has been provided to the Siting Board under seal and subject to a Motion for Protective Treatment and will be provided to eligible parties who have executed CEII Non-Disclosure Agreements.

2.2 Description of Existing Transmission System

The SEMA-RI Working Group identified six general geographic need areas. The Cape Cod Subarea includes a southeastern portion of Plymouth County, Cape Cod and the islands of Martha's Vineyard and Nantucket, as shown in Figure 2-2. Cape Cod and the Islands portion of the Cape Cod Subarea is supplied by five transmission lines: three 345-kV transmission lines and two 115-kV transmission lines. Two of the 345-kV transmission lines, Line 322 and Line 342, terminate at the Canal Substation and the third, Line 399, terminates at West Barnstable Substation. The 322 and 342 lines connect the Canal Generating Station in Sandwich and the Pilgrim Nuclear Generating Station in Plymouth to the transmission system. The 115-kV lines, Lines 108 and 113, connect the Tremont Station in Wareham to the Bourne Switching Station.

Figure 2-2 Existing Transmission System

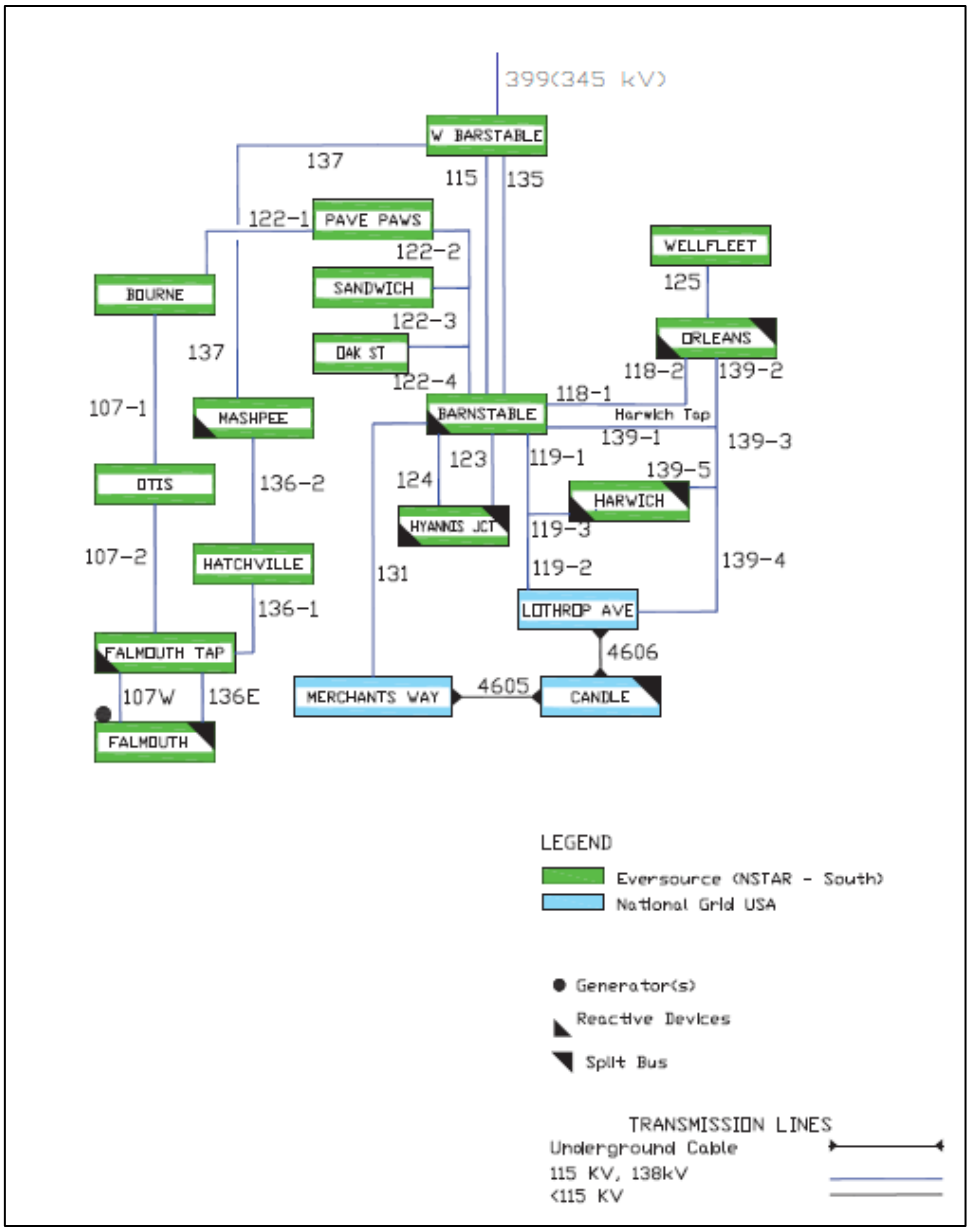


The primary transmission system on the Cape runs west to east, from Bourne Switching Station to West Barnstable Substation to Barnstable Switching Station to Harwich Tap before continuing eastward to the Orleans Substation. From the Orleans Substation, a single 115-kV overhead transmission line extends north to the Wellfleet Substation.

On the western end of the Cape, the Falmouth/Mashpee area is served by a 115-kV line (Line 107), which heads south from the Bourne Switching Station to Falmouth Tap and another 115-kV line (Line 136/137), which runs southwesterly from the West Barnstable Substation to the Mashpee Substation.

The 345-kV overhead transmission Line 399 begins at the Carver Substation and heads southeasterly to an aerial crossing of the Cape Cod Canal in the Town of Bourne. After crossing the Cape Cod Canal, the line passes just to the north of the Bourne Switching Station, bypassing the station, and then continues easterly for approximately 13 miles to the West Barnstable Substation. From the Bourne Switching Station to the West Barnstable Substation, a 115-kV line (Line 122) joins Line 399 for the entire 13-mile length. 13.8-kV distribution circuits coexist with these lines at various locations along the corridor. In this Analysis, the portion of the Cape Cod Subarea east of Bourne Switching Station is defined as the "Cape Cod Load Pocket" and is depicted in Figure 2-3. The Project is proposed to be constructed alongside Lines 399 and 122.

Figure 2-3 Area of Exposure



2.3 Transmission Planning Standards

In planning its transmission system, Eversource must adhere to reliability standards and criteria that are established by NERC, which has national authority to ensure the reliability of transmission systems across most of North America. NERC oversees a number of regional councils, including NPCC. Within the NPCC, New England is a "control area" subject to the supervision and control of ISO-NE. ISO-NE has responsibility for dispatching generation and for conducting the day-to-day operation of the integrated transmission system. ISO-NE operates the various transmission networks owned by electric utilities in New England as a single transmission system. The standards established by NERC, NPCC and ISO-NE have been developed to ensure that the electric power system serving New England, including Eversource's service territory, is designed, constructed and maintained to provide adequate and reliable electric power to the region. NERC establishes a general set of rules and criteria applicable to all geographic areas. NPCC establishes a set of rules and criteria that are specific to the northeast region (New England and portions of Eastern Canada) and refine the more general NERC standards. In turn, ISO-NE develops standards and criteria that are specific to New England but are also coordinated with the NPCC. The Company is required to comply with the following reliability and planning standards when planning its transmission system:

- NERC TPL-001-4 Transmission System Planning Performance Requirements;
- NPCC Regional Reliability Reference Directory #1, "Design and Operation of the Bulk Power System;"
- ISO-NE Planning Procedure 3, "Reliability Standards for the New England Area Pool Transmission Facilities;"[5] and
- ISO-NE Planning Procedure 5-3, "Guidelines for Conducting and Evaluating Proposed Plan Application Analyses."

If identified criteria violations are not addressed, under certain system conditions, transmission equipment could overload, conductors above ground could sag to hazardous levels, or voltage levels could be outside of acceptable operating ranges. The impacts could range from unsafe conditions to equipment damage to widespread line and power outages.

The Needs Assessment was performed in accordance with the above-listed standards.

[5] In 2017, Planning Procedure 3 was revised and renamed to "Reliability Standards for the New England Area Pool Transmission Facilities."

2.4 ISO-NE Planning Process

Under the Federal Energy Regulatory Commission ("FERC")'s regulatory authority, ISO-NE, an independent, not-for-profit corporation, is authorized to perform three critical, complex, interconnected roles for the New England region, which encompasses all of the six New England states: (i) grid operation: keeping electricity flowing over the region's high voltage transmission system; (ii) market administration: designing, running, and overseeing the billion-dollar markets where wholesale electricity is bought and sold; and (iii) power system planning: performing studies, analyses and planning to make sure New England's electricity needs will be met now and into the future. Together, these three core responsibilities help protect the health of the region's economy and the well-being of its residents by ensuring the constant availability of competitively-priced wholesale electricity today and for future generations.

In administering the regional system planning process, ISO-NE has a number of responsibilities relating to transmission resources. ISO-NE's primary functions in this are to (i) conduct periodic needs assessments on a system-wide or specific-area basis, as appropriate, and (ii) develop an annual regional transmission plan using a 10-year planning horizon.

Needs assessments are designed to identify future system needs on the regional transmission system, or within a subarea of the system, with consideration of available market solutions. Needs assessments examine various aspects of system performance and capability, identify the timing and details of system needs, and analyze whether transmission facilities in the New England transmission system (i) meet applicable reliability standards (ii) support the efficient operation of the wholesale electric markets; and (iii) are sufficient to integrate new resources and loads on an aggregate or regional basis. Needs assessments identify the location and nature of any potential problems with respect the current and future operation of the transmission system. Conditions that significantly affect the reliable and efficient operation of the system are evaluated, along with any critical time constraints for addressing the specific, identified needs and to facilitate the development of market responses and the pursuit of a regulated transmission solution.

The ISO-NE 10-year transmission plan is referred to as the Regional System Plan ("RSP"). The RSP is a compilation of the regional system planning process activities conducted by ISO-NE, transmission owners and other stakeholders and presents the results and findings of the ongoing ISO-NE regional planning process. The RSP addresses system needs and deficiencies, as determined by ISO-NE through its periodic needs assessments, with updates occurring on a going forward basis to (i) account for changes in PTF system conditions; (ii) ensure reliability of the transmission system; (iii) comply with national and regional planning standards, criteria and procedures; and (iv) account for market performance and economic, environmental and other considerations. The Company's planning process is integrated with and coordinated by ISO-NE as part of its regional planning process and RSP.

For major transmission upgrades, the regional transmission planning process includes the following steps: (i) system needs are identified through a periodic needs assessment undertaken by ISO-NE; (ii) regulated transmission solutions are suggested to meet identified system needs; (iii) solution studies are prepared to identify the most cost-effective transmission solution; (iv) proposed regulated transmission solutions are reviewed and approved by ISO-NE; and (v) a transmission cost allocation review is conducted.

Regional planning is carried out by ISO-NE as part of an open and transparent process involving planning committees made up of various stakeholders and which include the New England Power Pool ("NEPOOL") Reliability Committee, the Environmental Advisory Group and the Planning Advisory Committee (the "PAC"). Membership in the PAC includes market participants, public utility commissions, consumer advocates and Attorneys General, environmental regulators and other interested parties. The PAC provides input and feedback to ISO-NE regarding the regional system planning process including (i) the development of the RSP; (ii) assumptions for studies performed; (iii) the results of needs assessments and solutions studies, and (iv) potential market responses to the needs identified by ISO-NE through a needs assessment. Based on input and feedback provided by the PAC, ISO-NE refers issues and concerns to the appropriate technical committees, including but not limited to, the NEPOOL Markets Committee, Reliability Committee and Transmission Committee, for further investigation and consideration of potential changes to rules and procedures.

In 2015, the Working Group, led by ISO-NE, was formed to evaluate the performance of the SEMA-RI area transmission system, in accordance with the above-listed standards and process, to identify reliability-based transmission needs and develop transmission solutions to address each need. In May 2016, the Working Group completed its initial needs assessment and documented the results in the May 2016 Needs Assessment, which is provided as Appendix 2-1.

The Needs Assessment evaluated the reliability performance in the SEMA-RI load zone, consisting of six geographic subareas within Massachusetts south of Boston and all of Rhode Island under 2026 projected system conditions, including forecasted load. The Needs Assessment found thermal and voltage violations across all subareas within the SEMA-RI load zone, including N-1-1 conditions in the Cape Cod Subarea resulting in thermal overload conditions and voltage collapse that could affect over 500 MW of load.

2.5 Study Assumptions and Analysis Methodology

2.5.1 Methodology

As part of the Needs Assessment, the Working Group used load flow analysis to assess the performance of the area transmission system under a series of defined contingency situations, including the following:

N-1 Contingencies

- Loss of one transmission circuit, transformer, generator, bus section or shunt device;
- Opening of a line section without a fault;
- Loss of two transmission components (circuit, transformer or generator) sharing a common circuit breaker; and
- Loss of two transmission circuits on a multiple circuit transmission tower.

N-1-1 Contingencies

- Loss of one major generating unit, transmission circuit or transformer followed by an N-1 contingency as defined above.

The primary goal of load-flow analysis is to determine whether the occurrence of a single contingency (N-1), or one contingency followed by a second contingency (N-1-1), would load any transmission element beyond its emergency ratings (long-time emergency ("LTE") or short-time emergency ("STE")), or result in unacceptable voltage levels. 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 analysis. In addition, ISO-NE studies whether N-1 or N-1-1 contingencies could cause consequential load loss approaching or exceeding 300 MW of customer load in load pockets within the system. As part of the SEMA-RI Needs Assessment, a short-circuit analysis was also performed to ensure that 115-kV and 345-kV circuit breakers are within the short-circuit interrupting capabilities.

2.5.2 Load Levels Tested

The Needs Assessment evaluated transmission system reliability over a long-term (ten-year, 2026) planning horizon, based on the 2015 Capacity, Energy, Loads, and Transmission ("CELT") Report,[6] which was the most recent CELT Report available at the time the Needs Assessment was performed. The study models reflected the summer peak 90/10[7] load conditions outlined in Table 2-1:

[6] The 2015 CELT Report, published on May 1, 2015, is available at http://www.iso-ne.com/static-assets/documents/2015/05/2015 celt report.pdf

[7] The 90/10 forecasted load level is an extreme weather level and is the peak demand expected once every ten years. The 90/10 extreme peak load level has a 10% chance of being exceeded in any year because of weather conditions.

Table 2-1 Summer Peak 90/10 Load Conditions

Year	Net[8] New England Peak Load[9] (MW)	NET SEMA Area Load (MW)	Net Cape Cod Load Pocket Peak Load (MW)
2026	31,040	4,041	599

Table 2-2 below shows the gross load as well as the various load reducers at each substation in the Cape Cod Load Pocket. A detailed explanation of the load reducers is provided in Section 2.5.2.1 and 2.5.2.2.

Table 2-2 Forecasted Summer Peak Loads (MW) based on 2015 CELT (minus passive Demand Resources, Energy Efficiency forecast, Photovoltaic forecast).

Station	Load	Passive DR	PV	EE	Net load
Pave Paws	2.6	-0.2	-0.1	-0.1	2.2
Sandwich	32.9	-2.2	-0.9	-1.5	28.3
Oak Street	53.1	-3.5	-1.6	-2.4	45.6
Hyannis	100.3	-6.7	-2.9	-4.5	86.2
Candle St. (Nantucket)	63.4	-4.2	-1.8	-2.9	54.5
Harwich	86.0	-5.7	-2.5	-3.9	73.9
Orleans	88.2	-5.8	-2.5	-4.0	75.9
Wellfleet	42.8	-2.9	-1.2	-1.9	36.8
Mashpee	40.2	-2.6	-1.2	-1.8	34.6
Hatchville	52.9	-3.5	-1.6	-2.4	45.4
Falmouth	104.6	-7.0	-3.0	-4.7	89.9
Otis	30.4	-2.0	-0.9	-1.4	26.1
Totals	**697.4**	**-46.3**	**-20.2**	**-31.5**	**599.4**

[8] Load adjusted for transmission losses, demand resources and forecasted EE and PV as well as the addition of non-CELT and station service loads.

[9] The 2015 CELT forecast only has projected peak demands from 2015-2024. To determine the 2026 peak demand forecasted load, the growth rate from years 2023-2024 was extrapolated to 2026.

2.5.2.1 Passive and Active Demand Resource Assumptions

Demand resources ("DR") are resources that reduce end-use demand for electricity from the power system and fall into two general types: Active DR (load that is called on to curtail based on ISO-NE dispatch instructions under real-time system conditions) is activated only when needed by ISO-NE and Passive DR (designed to save electricity use at all times). Passive and Active DR were modeled as load reductions, that is, the customer load that must be met by dispatching generation resources is reduced by the amount of load represented by DR. Passive DR included Passive DR that bid into and were ultimately selected in Forward Capacity Auction ("FCA") #9[10] conducted by ISO-NE as Forward Capacity Market ("FCM") resources. This "cleared" amount of Passive DR was combined with forecasted energy efficiency (captured in the EE column in the above Table 2-2) for the study year, as provided in the 2015 CELT Report.

Active DR was also modeled at levels that cleared FCA #9, multiplied by a Performance Factor of 75% based on historical performance of similar resources. The 2026 load flow base cases used for the SEMA-RI study incorporated demand resource assumptions as shown in Appendix 2-1, pages 14 and 15. The Passive DR information, as well as the EE forecast for the stations impacted by the voltage collapse is listed in Table 2-2, above. The 3 MW of Active DR assigned to these substations per the 2015 CELT is not considered as part of the load lost in the Cape Cod Load Pocket, as that reduction is controlled by ISO-NE and implemented only when the transmission system is operating in a capacity deficiency due to loss of generation. 3 MW is the total of the active demand response assigned to the substations listed in Table 2-2.

2.5.2.2 Forecasted Photovoltaic (PV) Generation

The 2015 CELT PV generation forecast includes the PV generation that has been installed as of the end of 2014 and provides a forecast by state of the total PV (by AC nameplate) that is expected to be in service by the end of the forecast year for the next 10 years. For years beyond 2024, the rate of PV generation growth from 2023-2024 was used to extrapolate the PV generation forecast. An availability factor of 26% was applied to the values from the PV generation forecast. As noted in the ISO Transmission Planning Technical Guide, based on a review of historic solar PV outputs, the ISO has determined a 26% availability factor to be appropriate for PV-related transmission planning studies. Table 3-4 in Appendix 2-1 summarizes the PV generation used in the study cases for New England. The PV information for the substations affected by the voltage collapse is shown in Table 2-2, above.

[10] FCA #9 covered the capacity commitment period of 2018/2019. These were the most recently available FCA results at the time of the Needs Assessment.

2.5.3 Generating Resources

Generation projects in New England that had an FCM Capacity Supply Obligation ("CSO") as of FCA #9 were included in the study base case. In addition, two generators that received CSOs in FCA #10 were also included, QP-449 – Canal #3 (333 MW) and QP-489 – Burrillville Energy Center (485 MW).

Non-price retirements ("NPRs") from FCA #9 were included in the base case as well as the one NPR from FCA #10 in the SEMA-RI area, Pilgrim Nuclear Power Station, which ceased generation on May 31, 2019. The unit was modeled out of service in all cases. Please see Appendix 2-1, page 12, for a complete list of the NPRs modeled in the base case.

Within the Cape Cod Subarea, generation resources include the Canal 1 and 2 generating units, 547 MW and 545 MW, respectively. At the time, the Canal 3 generating unit was in construction and scheduled to be on-line in 2019. (The unit has since commenced commercial operation in June 2019.) The dispatch of the existing Canal generating units does not have a significant impact on the need for additional thermal capacity for the supply to the Cape Cod -Load Pocket. This is because these generating units are outside the Cape Cod Load Pocket.

Martha's Vineyard and Nantucket each have small diesel generators located in the Cape Cod Load Pocket. On Martha's Vineyard, there are five (5) backup diesels, 2.5 MVA each, with a total capacity of 12.5 MW. Nantucket has two diesel generators capable of 3 MW each, for a total capacity of 6 MW. The Nantucket generators are in the process of being replaced with a new 15 MW generator and a 6-MW/48-MW/48-MWh battery energy storage system. However, these resources are too small to have a significant impact on the supply to the Cape Cod Load Pocket. There is no other generation in the Cape area that can influence the supply limitation to the Cape Cod Load Pocket.

2.5.4 Generation Dispatch Scenarios

For the 2026 study year, the Needs Assessment evaluated 33 generation dispatch cases representing a range of possible generation dispatch and availability conditions. Various combinations of one and two generating units out of service conditions were studied. The generation dispatches evaluated are described in Tables 3-8 and 3-9 on pages 21-22 of Appendix 2-1.

The 33 generation dispatch cases were then applied to three different sets of interface level conditions for a total of 99 cases. The interface level referred to as A was a High East to West with High North – South power flows within New England. Interface level B was a High West to East with low North-South. The last interface scenario was high West to East with medium North – South.

In any case, as described above, generation dispatch has no significant impact on the identified thermal capacity deficiency needs since there is no generation in the Cape Cod Load Pocket except for the small diesel generating units.

2.5.5 Summary of Study Assumptions and Analysis Methodology of Needs Assessment Results for Cape Cod Subarea

The Needs Assessment evaluated the reliability performance of the transmission system in the Cape Cod Subarea for 2026 for the projected system conditions and was performed in accordance with the reliability and planning standards and criteria and load levels referenced in Section 2.3 above. Consistent with the reliability criteria established by NERC, NPCC and ISO-NE, the ISO SEMA-RI Working Group assessed the ability of the local area transmission system to withstand a single-contingency (N-1) and one contingency followed by a second contingency (N-1-1) conditions given projections of peak load, generator availability and dispatch conditions.

The Needs Assessment identified thermal overloads and cases that would not converge for various N-1-1 contingencies. The overloads remain even under the most recent revision of the ISO Planning Procedure #3, which eliminated some of the N-1-1 contingencies that are required to be studied. Some of the most severe N-1-1 contingencies and the number of cases for which they did not converge are identified in Appendix 2-1, Table 5-47 on pages 109-110. The reason the cases would not converge, or solve, is because the overloads were so severe, resulting in voltage collapse in the area. Depending on the contingency pair, overloads would occur on the 107, 122, 136 or 137 115-kV lines. As shown in Table 5-47 in Appendix 2-1, most of the non-convergence occurs for all 99 cases. Therefore, these problems exist under all system operating conditions tested, including the then current and forecasted system load levels. The following subsections summarize the overloads and resulting voltage collapse for the few cases that did solve.

2.5.5.1 Design Case Overloads

The Needs Assessment identified severe N-1-1 thermal overloads on various 115-kV lines in the Cape Cod Load Pocket as shown in Table 2-3 below. Most of the thermal violations were also STE violations. Many of the load flow cases did not actually converge (i.e., solve and produce overload results) due to the severity of the problems. For the cases that did converge, the results are shown in Table 2-3 below.

Table 2-3 Worst Case Thermal Overloads

Element #	Element Name	Worst-case overload (% of LTE)	Worst-case overload (% of STE)
107-1	Otis - Bourne	162	119
107-2	Falmouth Tap - Otis	155	130
136-2	Falmouth Tap- Hatchville	211	194
136-3	Hatchville-Mashpee	190	178
137	Mashpee - W. Barnstable	172	140
122-1	Bourne - Pave Paws	120	100.5
122-2	Pave Paws- Sandwich	119	N/A
122-3	Sandwich - Oak St	113	N/A
122-4	Oak St. - Barnstable	112	N/A

2.5.5.2 Voltage Violations

The Needs Assessment also identified voltage violations and voltage collapse. Many of the load flow cases did not actually converge (i.e., solve and produce results) due to the severity of the problems. For the cases that did converge, the voltages are substantially below the minimum voltage criteria of 0.95, as shown in Table 2-4.

Table 2-4 Worst Case Voltage Violations

Station	Voltage (per unit)
West Barnstable	0.63
Barnstable	0.62
Falmouth	0.78
Harwich	0.59
Hatchville	0.75
Hyannis	0.62
Mashpee	0.70
Orleans	0.59
Otis	0.90
Wellfleet	0.56
Sandwich	0.66
Oak St	0.66
Bourne	0.93
Pave Paws	0.92

2.6 Eversource Updated Project Needs Analysis

Eversource conducted an analysis for the year 2026 using data in the 2019 CELT report to confirm that the need for the Project remains. The 2019 CELT Report includes updated energy efficiency and solar PV forecasts and incorporates the results of FCA #13. Table 2-5 below shows the Summer Peak 90/10 Load Conditions in year 2026. The Company's Updated Analysis verified that the Project is still needed to resolve the thermal overloads and voltage collapse issues that were identified in the Needs Assessment.

Table 2-5 Summer Peak 90/10 Load Conditions

Year	Net[11] New England Peak Load (MW)	NET SEMA Area Load (MW)	Net Cape Cod Load Pocket Peak Load (MW)
2026	26,421	3,387	508

[11] Load adjusted for transmission losses, demand resources and forecasted PV and EE as well as the addition of non-CELT and station service loads.

Table 2-6 below shows the gross load as well as the various load reducers at each substation in the Cape Cod Load Pocket.

Table 2-6 Forecasted Summer Peak Loads (MW) based on 2019 CELT (minus EE and PV forecast)

Station	Load	PV	EE (includes passive DR)	Net load
Pave Paws	2.3	-0.2	-0.4	1.7
Sandwich	30.4	-2.9	-5.5	22.0
Oak Street	45.7	-4.4	-8.3	33.0
Hyannis	101.5	-9.6	-18.4	73.5
Candle St. (Nantucket)	87.9	-5.5	-16.0	66.4
Harwich	92.1	-9.1	-16.8	66.2
Orleans	69.4	-6.7	-12.6	50.1
Wellfleet	41.3	-3.9	-7.6	29.8
Mashpee	41.2	-3.9	-7.5	29.8
Hatchville	48.0	-4.6	-8.7	34.7
Falmouth	110.7	-11.3	-20.0	79.4
Otis	30.3	-0.4	-2.9	21.5
Totals	**700.8**	**-65.4**	**-127.3**	**508.1**

Eversource's Updated Analysis was conducted with all the other SEMA-RI Solution Projects in service except for the Project. The remaining N-1-1 overloads are shown in Table 2-7 below.

Table 2-7 Remaining N-1-1 Overloads

Element #	Element Name	Worst-case overload (% of LTE)	Worst-case overload (% of STE)
107-1	Otis - Bourne	139	103
107-2	Falmouth Tap - Otis	133	112
136-2	Falmouth Tap- Hatchville	188	173
136-3	Hatchville-Mashpee	179	167
137	Mashpee - W. Barnstable	165	134
122-1	Bourne - Pave Paws	113	N/A
122-2	Pave Paws- Sandwich	113	N/A
122-3	Sandwich - Oak St	108	N/A
122-4	Oak St. - Barnstable	111	N/A

Eversource's Updated Analysis also included an N-1-1 voltage analysis. The low voltage results, which confirm the low voltage issues in the Cape Cod load pocket identified in the SEMA-RI Needs Assessment, are shown in Table 2-8.

Table 2-8 Worst Case Voltage Violations

Station	Voltage (per unit)
West Barnstable	.72
Barnstable	.72
Falmouth	.84
Harwich	.68
Hatchville	.81
Hyannis	.72
Mashpee	.77
Orleans	.69
Otis	.94
Wellfleet	.64
Sandwich	*
Oak St	*
Bourne	.99
Pave Paws	.99

NOTE*: The voltage at these stations went so low that the cases would not converge and a voltage level could not be identified.

The foregoing tables demonstrate the thermal overloads and voltage violations still exist using the 2019 CELT forecast.

The Eversource updated analysis tested the non-convergent cases due to voltage collapse and thermal overloads using a study case for the year 2019. The contingency scenarios were still non-convergent for this case, as they were for the 2026 cases. Many of the load flow cases did not actually converge (i.e., solve and produce results) due to the severity of the problems. Non-convergent cases are an indication of severe system performance issues. As noted in Table 2-6, the forecasted load in the Cape Cod Load Pocket is approximately 508 MW. The 107, 136, and 137 lines addressed by the Project fail to meet reliability requirements under N-1-1 conditions at load conditions in the Cape Cod Subarea of approximately 315 MW, thus resulting in thermal overloads. The actual peak load in the summer this year for the Cape and Islands was 623 MW. The Cape's peak does not typically coincide with the ISO-NE peak. The Cape peaked this year on a summer night at approximately 6:40PM. The ISO-NE peak was on a Tuesday night at 6PM. The existing load for the Cape and Islands is already well above the critical load level of 315 MW. Thus, per this updated analysis and actual load information, there remains an immediate need for transmission system upgrades in the Cape Cod Load Pocket to prevent severe thermal overloads and voltage collapse affecting approximately 200,000 customers.

2.7 Potential for Additional Generation Interconnection in the Cape Cod Sub Area

Generators seeking to interconnect to the New England transmission system must follow the ISO-NE interconnection process. The process begins when a generator submits an interconnection request to ISO-NE. The generator is then assigned a position in the ISO-NE interconnection queue. Queue positions are assigned in the order in which the applications are received. Per its tariff,[12] ISO-NE is required to conduct one or more engineering studies to determine if interconnecting the proposed generator would result in adverse reliability impacts to the transmission system (such as new overloads, instability, etc.). If adverse impacts are identified, ISO-NE and the owners of the affected transmission facilities develop upgrades or other modifications to mitigate the impacts.

The interconnection study process may involve several studies, including an optional Feasibility Study, a mandatory System Impact Study ("SIS"), and an optional Facilities Study. If a generator wishes to participate in the capacity market, an Overlapping Impact Test ("OIT") will also need to be performed to ensure the generator can deliver its full capacity when other generators are also online.

ISO-NE has completed three Feasibility Studies and one SIS for offshore wind facilities proposing to interconnect in the Cape Cod Area. Based on ISO-NE's analysis, there is currently a potential need for additional upgrades, including a new 345-kV line for some generators to interconnect. Given that there is now over 2,600 MW of proposed generation in the ISO-NE queue connecting to West Barnstable Substation (which is over and above the 800 MW of wind interconnection at Barnstable for the Vineyard Wind Project), it is likely that the need for a new 345-kV line on Cape Cod will materialize in the near future. Therefore, to minimize any likely siting, costs and environmental impacts of rebuilding the proposed 115-kV line to 345-kV in the future, the Company has proposed as a Noticed Variation to design and build the Project to 345-kV standards to accommodate a large injection of wind generation in the West Barnstable area. Converting the proposed 115-kV line from West Barnstable to Bourne to 345-kV would meet the needs of the Project as well as contribute to the needed capacity for wind interconnections in the West Barnstable area.

[12] See Schedule 22 of the Open Access Transmission Tariff (https://www.iso-ne.com/static-assets/documents/regulatory/tariff/sect_2/sch22/sch_22_lgip.pdf)

On May 23, 2019, Massachusetts issued an RFP for up to an additional 800 MW of offshore wind power to meet its target of 1,600 MW of offshore wind by 2027. Winning bidders are expected to be announced in November 2019. On top of the 1,600 MW offshore wind target by 2027, Massachusetts is expected to issue additional rounds of RFPs for an additional 1,600 MW of offshore wind power. Therefore, there is a significant likelihood of additional wind generation being developed and interconnecting in the West Barnstable/Barnstable area.[13]

2.8 Summary of Project Need

The need for the Project is based upon conditions studied and analyses performed by the ISO-NE-led SEMA-RI Working Group, with the results presented at the March 22, 2016 PAC meeting and published in the May 2016 Needs Assessment report. As described above, the Needs Assessment presents an evaluation of the Cape Cod Subarea and determined that a large portion of Cape Cod, referred to as the Cape Cod Load Pocket, could not be reliably served in the event of certain N-1-1 contingencies. Specifically, the ISO SEMA-RI Working Group identified reliability issues in the Cape Cod Load Pocket including potential thermal overloads and high-level loss of load due to area voltage collapse. The need for the Project is immediate as the potential for voltage collapse and thermal overloads occurs at levels significantly below the 2019 projected load level. The Company's recent analysis utilizing the current 2019 CELT Report confirmed the need for the Project. The loss of load could potentially impact the entire Cape Cod area and islands, affecting over 508 MW of load in 2026. Such an outage would affect over 200,000 customers in the Cape Cod area.

With the identified needs described above, Eversource undertook an analysis of Project Alternatives to address the overload consequences and ensure system reliability as fully described in Section 3.

[13] In anticipation of this future generation that would need to be interconnected, the Company is proposing a noticed design variation for the Project whereby the Company would construct the Project using 345-kV transmission line infrastructure (e.g., structures); however, the Company would operate the New Line at 115-kV. Because the need for and full scope of impacts associated with operating the New Line at 345-kV is not known at this time, the Company would return to the Siting Board for permission to operate the line at 345-kV when warranted.

Section 3.0

Project Alternatives

3.0 PROJECT ALTERNATIVES

3.1 Introduction

This Section describes the processes used to identify and evaluate alternative means of addressing the identified electric system reliability need in the Cape Cod Subarea. Any viable alternative solution must address the needs outlined in Section 2; specifically, to alleviate thermal overload conditions, provide voltage support, and prevent a voltage collapse that could result in a substantial loss of load for customers in the Cape Cod Load Pocket. In its review of potential solutions, the Company evaluated a "No-Build Alternative," two Transmission Alternatives and Non-Transmission Alternatives ("NTAs") including incremental energy efficiency ("EE"), demand response ("DR"), distributed generation ("DG"), energy storage and new generation.

After completing the SEMA-RI Needs Assessment, the Working Group conducted a transmission solution study to identify solutions to address the various needs. This resulted in the February 2017 issuance of the SEMA-RI Transmission Solutions Study ("Solution Study"), provided in Appendix 3-1.[14] The Solution Study identified the selection of a new, 115-kV transmission line between Bourne Switching Station and West Barnstable Substation as the preferred solution to meet the needs identified for the Cape Cod Load Pocket. The Needs Assessment and the Solution Study provide the necessary evaluations and determinations required by NERC, NPCC, and ISO-NE.

The Company's further evaluation of project alternatives confirmed that the Project is the best alternative to meet the identified need, with a minimum impact on the environment, with a great degree of reliability and at the lowest possible cost.

3.2 No-Build Alternative

Under the No-Build Alternative, no improvements would be made to the existing electric supply system service for Eversource and National Grid customers in the Cape Cod Subarea to address the identified need. The Company would not pursue any new facilities or resources to address the area's deficiencies, but instead would continue to rely upon the existing system configuration. This approach was dismissed from further consideration because it would not address the identified transmission system reliability need, which exists at current load levels and would not meet mandatory transmission reliability planning standards and criteria.

[14] Appendix 3-1 has been redacted for the public record in order to avoid disclosure of Critical Energy Infrastructure Information ("CEII"). An unredacted copy has been provided to the Siting Board under seal and subject to a Motion for Protective Treatment and will be provided to eligible parties who have executed CEII Non-Disclosure Agreements.

3.3 Transmission Alternatives

The ISO-NE-led Working Group evaluated two transmission system alternatives to address the needs in the Cape Cod Subarea as part of the SEMA-RI Solutions Study: (1) Transmission Alternative 1 (the Project); and (2) Transmission Alternative 2. The proposed Project is superior to Transmission Alternative 2. Each transmission alternative is described in greater detail below.

3.3.1 Transmission Alternative 1 – Preferred Transmission Alternative (the "Project")

The preferred transmission alternative, the Project, would involve construction of a new overhead 115-kV transmission line between the Bourne Switching Station and West Barnstable Substation (approximately 12.5 miles). In addition to the New Line, the Company would also undertake improvements at the West Barnstable Substation, including the addition of a new 115-kV switchyard bay (circuit breakers and bus work) on the west side of the existing substation. There is sufficient space at Bourne Switching Station to terminate the New Line.[15] The western fence line of West Barnstable Substation will be expanded by approximately 65 feet to accommodate the new terminal. Figure 3-1 provides an overview of the preferred transmission alternative.

The total estimated planning grade estimate (-25%/+25%, in 2019 dollars) of Transmission Alternative 1 is approximately $59.1 million.

3.3.2 Transmission Alternative 2

Transmission Alternative 2 consists of the following components that would feed the Cape Cod Load Pocket: (1) reconductor and rebuild a 115-kV overhead transmission line from Bourne Switching Station to West Barnstable Substation (approximately 26.5 miles); (2) bifurcate a 115-kV transmission line from Bourne Switching Station to Barnstable Switching Station (approximately 16.0 miles); and (3) construct the associated terminal system upgrades. The details of this alternative are outlined below and shown in Figure 3-2.

Reconductor and Rebuild

The 26.5 miles of the 115-kV transmission line reconductor and rebuild includes Line 107 from Bourne Switching Station to Falmouth Tap (approximately 10.0 miles) and Line 136 and Line 137 from Falmouth Tap to West Barnstable Substation (approximately 16.5 miles). The existing conductors would be replaced with a combination of bundled and single conductors that would increase the current carrying capacity of the overhead transmission line.

[15] As described in Section 1 of this Petition, as a separate project, the Company plans to construct a replacement Bourne Switching Station in parallel with the Project described herein.

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

Basemap: ESRI World Imagery

LEGEND

- Town Boundary
- Eversource ROW 342
- Joint Base Cape Cod/MMR

Figure 3-1

Transmission Alternative 1

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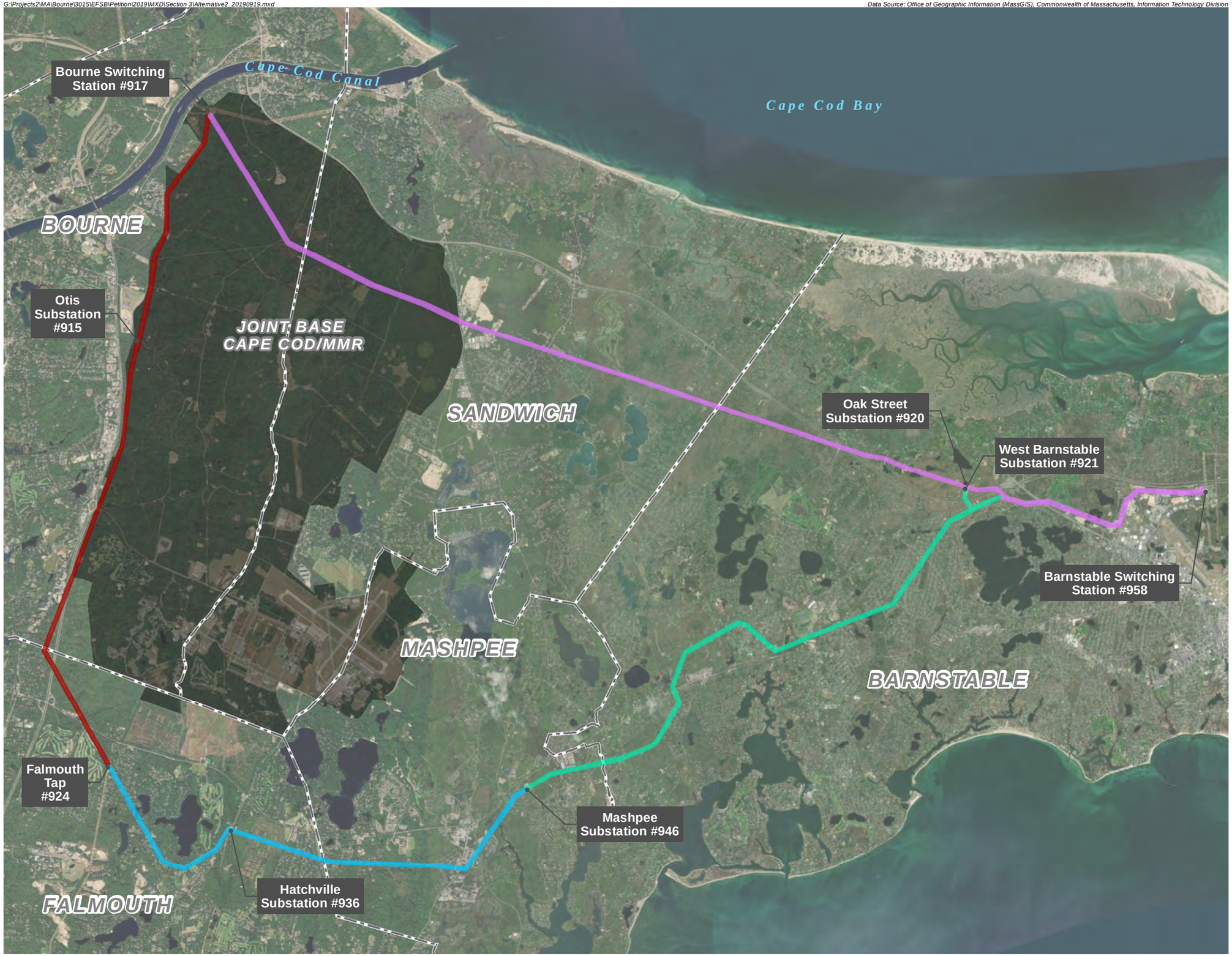
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

Basemap: ESRI World Imagery

LEGEND

- Town Boundary
- Joint Base Cape Cod/MMR

Transmission Alternative 2 Components

- Reconductor 107 Line and Structure Replacement
- Bifurcate 122 Line and Structure Replacement
- Reconductor 136 Line and Structure Replacement
- Reconductor 137 Line

Figure 3-2

Transmission Alternative 2

Line 136

To meet ground clearance requirements and to support the new conductor, approximately 5% of the existing wooden H-frame transmission structures would be replaced with taller steel H-Frame structures. To support the new conductor, additional bracing would be added to approximately 65% of the existing wooden H-Frame wooden structures.

All structures would be grounded to protect from lightning events.

Line 137

To support the new conductor, all wood H-frames would be reinforced by removing the wood cross brace and installing two sets of steel cross braces.

All structures would be grounded to protect from lightning events.

Line 107

To meet ground clearance requirements and to support the new conductor, all the existing wooden H-frames, 70 in total, would be replaced with new taller steel H-frame structures. To minimize line sag and span between replacement structure, approximately 21 new intermediate H-frame tangent structures would be installed 5-10 feet from replacement structures.

The existing structures would be removed to grade following re-energization of the re-conductored lines. In addition, all structures would be grounded to protect from lightning events.

Bifurcation

The bifurcation of 16 miles of Line 122 would require installation of additional conductor and replacement of steel transmission structures between Bourne Switching Station and West Barnstable Substation. The additional conductor would be bifurcated to the existing conductor. To support the additional conductor, approximately 10% of the steel transmission structures would need to be replaced. The remaining steel monopoles would require the addition of insulators on the vacant side on the vacant side of the structure prior to the installation of the conductors.

Terminal System Upgrades

Terminal upgrades would be required at several substations to accommodate the increased line flows include the following:

- Bourne: two switches and one wave trap would be upgraded to 3000amps (“A”).
- Pave Paws: one, 2,000A sectionalizing switch would be upgraded to 3,000A.
- Otis: two, 2,000A sectionalizing switches would be upgraded to 3,000A.

- Falmouth Tap: one 2,000A circuit breaker, one 2,000A disconnect switch, two 2,000A sectionalizing switches and one 2,000A wave trap would be replaced with 3,000A equipment.

- Hatchville: two 2,000A sectionalizing switches and strain bus would be upgraded to 3,000A equipment.

- Mashpee: existing wire bus taps and circuit breaker taps would be replaced with 3,000A equipment.

- West Barnstable: bus sections and risers would be replaced with 3,000A equipment.

- Sandwich: three 2000A disconnect switches, two 2,000A sectionalizing switches and associated switch taps would be replaced with 3,000A equipment.

- Oak Street: two 2,000A disconnect switches would be replaced with 3,000A equipment.

- Barnstable Switching Station: two 2,000A circuit breakers would be replaced with 3,000A equipment.

The conceptual grade estimate (-25%/+50%, in 2019 dollars) of Transmission Alternative 2 is approximately $69.1 million.

3.3.3 Transmission Alternatives Comparison and Conclusions

A comparison of Transmission Alternative 1 and Transmission Alternative 2 is presented below.

3.3.3.1 Cost

As noted above, the total estimated cost of the Transmission Alternative 1 is approximately $59.1 as compared to the total estimated cost of $69.1 million for Transmission Alternative 2. Accordingly, Transmission Alternative 1 is the superior transmission alternative based on cost.

3.3.3.2 Reliability

The Project would provide an incremental transmission capacity of approximately 388 MVA normal, 484 MVA long-time emergency rating, to the Cape Cod Subarea. Transmission Alternative 1 would also provide a fourth source of transmission line capacity into the Cape Cod Load Pocket, thereby reinforcing system reliability in the overall area. Transmission Alternative 2 would provide a significantly lower amount of incremental transmission capacity (approximately 221 MVA normal, 316 MVA long-time emergency).

While both proposed transmission alternatives would meet the identified need, the Project introduces a new source of transmission line capacity within the Cape Cod Load Pocket, which has the potential to facilitate future renewable energy generation. Also, the Project would not require the lengthy line outages required to construct Transmission Alternative 2. With such outages,

there are times the Cape Cod Load Pocket would be served by two lines, with the 3rd line out of service for reconductoring or station upgrades. Therefore, an N-1 event with loss of one of the two remaining lines would result in voltage collapse and loss of all the Cape Cod Load Pocket.

Transmission Alternative 2 would have an overall capacity of 600 MVA. The Project will provide an incremental source with a capacity of 388 MVA. Combined with the existing lines, it will provide an overall capacity of approximately 765 MVA for the Cape. Therefore, if the load projection increases for the Cape Cod Load Pocket, the Project will provide additional MVA capacity.

For these reasons, Transmission Alternative 1 was determined to provide a superior solution from a reliability perspective.

3.3.3.3 Potential Environmental Impacts

A desktop analysis of key environmental elements for both transmission alternatives was conducted to compare the potential environmental impacts of both Transmission Alternatives. As compared to the Project, Transmission Alternative 2 would:

- affect two additional municipalities (Falmouth, Mashpee);
- result in construction along approximately 30 additional miles of existing ROW;
- potentially affect approximately 951 more residential properties directly abutting the ROWs;
- involve work (including structure installation and use of swamp mats in certain locations) within or near 55 more acres of wetland resource areas and buffer zones and 12 major waterbodies;
- involve work:
    - within or near 79 more acres of mapped rare species habitat;
    - along 5.5 more miles of archaeologically sensitive areas;
    - along 6 more miles of public water supply lands; and
    - through four more miles of conservation land/protected open space.

One environmental benefit of Transmission Alternative 2 is that, unlike the Project, it would not require Article 97[16] authorization.

Based on this comparison, the Company concluded that the Project is superior to Transmission Alternative 2 regarding the potential for environmental impact, as outlined in Table 3-1.

Table 3-1 Transmission Alternatives Potential Environmental Impact Comparison Summary

Analyzed Criteria	Transmission Alternative 1	Transmission Alternative 2
Affected Municipalities:	Bourne, Sandwich, Barnstable	Bourne, Sandwich, Barnstable, Falmouth, Mashpee
Approximate Total Length (miles):	12.5	43
Tree Clearing (acres):	0.19	0
Wetlands & Buffer Zones in ROW (acres)	12	67
Number of Major Waterbody Crossings	2	14
Mapped Rare Species Habitat in ROW (acres)	253	332
Moderate and High Sensitivity Archaeology Areas (miles crossed by ROW)[17]	4.5	10
Residential Units (direct abutters to ROW)	70	1,021
Public Water Supplies (miles crossed by ROW)	5	11
Conservation Land (miles crossed by ROW)	9	13

[16] Article 97 requires that certain land or easements taken or acquired for natural resource purposes shall not be used for other purposes unless the Massachusetts Legislature approves the change by a two-thirds vote. The Project would require Article 97 review on a parcel of municipal conservation land crossed by ROW 342 in Barnstable because the existing easement or property rights do not allow for construction or operation of additional lines.

[17] The Company's archaeology consultant, Public Archaeology Lab ("PAL"), conducted an Archaeological Sensitivity Assessment and/or field surveys of the Transmission Alternative ROWs between 2015 and 2017 to document previously identified archaeological resources within and adjacent to the proposed project corridors; to document existing conditions within and adjacent to the ROW (project corridor); and to assess the potential for the project corridor to contain significant archeological resources.

3.3.3.4 Conclusion on Transmission Alternatives

As described above, the Project is superior to Transmission Alternative 2. The Project is a more robust solution to meet the identified reliability need, has fewer environmental impacts and is approximately $10 million less costly. The Project offers a more robust, reliable and flexible solution that facilitates the integration of future renewable energy generation with the transmission grid.[18]

3.4 Non-Transmission Alternatives (NTA)

The Company also considered several possible NTAs to the proposed Project. As described more fully below, the Company first conducted an analysis to determine the size and location of new resources that could address the identified transmission reliability needs in the Cape Cod Load Pocket without constructing the proposed Project. Next, the Company evaluated whether known generation and energy storage projects under development or proposed on the Cape could be utilized as an alternative to the proposed Project. Finally, the Company evaluated whether additional, hypothetical resources could be utilized as an alternative to the proposed project. For both known generation and energy storage, as well as hypothetical resources, the Company's analysis included consideration of whether the resources could provide a technically feasible, practical, and cost effectiveness alternative to the proposed Project. For the reasons outlined below, NTAs or a combination of NTAs are not practical or cost-effective alternatives.

3.4.1 NTA Injection Requirements

At the outset of the NTA assessment, the Company conducted an analysis to determine the amount of energy injection required (in terms of megawatts or "MW") and location of those energy requirements (new resources), to address the identified transmission reliability needs in the Cape Cod Load Pocket without constructing the proposed Project. This assessment considered the reliability needs for the projected 2026 transmission system serving the Cape Cod study area under N-1-1 contingency conditions at load levels based on the 2019 CELT forecast. The analysis identified the specific capacity of resources and their specific locations within the transmission system that would be required to mitigate transmission overloads seen on the current and 2026 transmission system absent construction of the Project.

This analysis determined that the minimum level of resources necessary to resolve the projected transmission overloads from the N-1-1 contingencies addressed by the Project is 180 MW. This amount of resources could be located at Barnstable or West Barnstable Substation, or potentially

[18] There is currently approximately 2,600 MW of proposed generation in the ISO-NE Interconnection Queue connecting to West Barnstable Substation (which is separate from the 800 MW of wind interconnection at Barnstable for the Vineyard Wind Project). The Vineyard Wind Project's currently-approved interconnection (ISO-NE Interconnection Queue Position ("QP") 624) requires the installation of the Project.

at other substations further to the east, such as Hyannis, Harwich, Orleans or Wellfleet. The Company then conducted additional analysis, described below, to assess whether the construction of 180 MW of resources in an appropriate location could be a feasible or cost-effective alternative to the project.

3.4.2 Known Generation and Energy Storage Projects Under Development

In addition to the 193 MW of EE and DG that is already included in the 2019 load forecast for the Cape Cod Load Pocket and in the Company's reassessment of the need for the Project, the Company considered whether known generation and energy storage projects under development and proposed to connect to the Cape Cod Load Pocket could be utilized as an alternative to the proposed Project.

The Company first considered whether proposed large-scale, transmission-connected generation projects in the ISO-NE Interconnection Queue could be utilized as an alternative to the proposed Project. More specifically, the ISO-NE Interconnection Queue currently contains a proposed 800 MW offshore wind project (Vineyard Wind, QP 624), which has proposed to interconnect at the Barnstable Switching Station. As of February 11, 2019, Vineyard Wind had completed a System Impact Study and received ISO-NE approval on their Proposed Plan Application. On February 5, 2019, Vineyard Wind also obtained a Capacity Supply Obligation of 54 MW in ISO-NE's 13th Forward Capacity Auction. After approval of its Proposed Plan Application, Vineyard Wind will need to execute an Interconnection Agreement with Eversource and ISO-NE prior to starting construction. Vineyard Wind will also need to complete several other milestones, including completing the balance of its environmental permitting and securing all financing necessary to commence and complete construction of the project.[19]

In general, many proposed generation projects withdraw at various stages of the ISO-NE interconnection process, and projects that have not received an approved Proposed Plan Application and obtained a Capacity Supply Obligation in a Forward Capacity Auction are not considered in the ISO-NE or Company planning studies.[20] However, because Vineyard Wind QP

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[19] Vineyard Wind's petitions to the Energy Facilities Siting Board and Department (EFSB 17-05/D.P.U. 18-18/18-19) to build the Massachusetts components of its offshore wind project were approved on May 10, 2019 for QP 624. The Department approved the Power Purchase Agreements on April 12, 2019 in D.P.U. 18-76/18-77/18-78. Vineyard Wind is currently seeking a Certificate of Environmental Impact and Public Interest ("Certificate") from the Siting Board to secure its remaining state and local permits necessary to build the proposed project. Vineyard Wind's Certificate request is docketed as EFSB 19-05 and remains pending as of the date of this Analysis.

[20] ISO-NE Transmission Planning Technical Guide: https://www.iso-ne.com/static-assets/documents/2017/03/transmission_planning_techincal_guide_rev4.pdf [Page 43].

624 was selected to enter into long-term Power Purchase Agreements with the Company and the other Massachusetts electric distribution companies,[21] the Company gave further consideration to the impact of Vineyard Wind on the need for the proposed Project.

The Company evaluated whether the energy injection from Vineyard Wind could contribute to the NTA injection requirement and concluded it could not. The Company received its Proposed Plan Application approval for the Project from ISO-NE prior to the initiation of the System Impact Study for Vineyard Wind that was performed by ISO-NE. Deferring or canceling the Project and pursuing a non-transmission alternative to the Project based on the energy injection provided by Vineyard Wind could invalidate the System Impact Study performed for Vineyard Wind, potentially leaving Vineyard Wind unable to interconnect. This would require an additional study to identify the transmission upgrades that would be needed to allow for the reliable interconnection of Vineyard Wind. Even if such upgrades could be developed, the length of time to develop, plan, and obtain approvals for such upgrades could delay the in-service date for Vineyard Wind.

Beyond Vineyard Wind, the Company is aware of three distribution-connected energy storage projects under development on Cape Cod, Martha's Vineyard and Nantucket. These include two battery storage projects that the Company itself is developing on the Outer Cape and on Martha's Vineyard. The Company anticipates that the projects will be approximately 25 and 14.7 MW, respectively, with the Martha's Vineyard project constructed in two phases.[22] The third project is being developed by Nantucket Electric d/b/a National Grid.[23] The Company understands that this project will add approximately 15 MW of net injection on Nantucket.[24] All three projects are being developed to address distribution reliability needs.

Of these three projects, the Martha's Vineyard project has no impact on the need for the proposed Project because it is electrically connected to Cape Cod in Falmouth, west of Barnstable Switching Station. While operation of the Nantucket and outer Cape projects could contribute

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21 Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid ("National Grid") and Fitchburg Gas and Electric Company d/b/a Unitil ("Unitil").

22 See NSTAR Electric Company and Western Massachusetts Electric Company each d/b/a Eversource Energy, D.P.U. 17-05, at 459-465 (November 30, 2017). On November 30, 2018, pursuant to G.L. c. 40A, § 3, the Company submitted a petition to the Department of Public Utilities seeking exemptions from the Town of Oak Bluffs Zoning Bylaws in connection with the Company's proposed battery storage project on Martha's Vineyard. See NSTAR Electric Company d/b/a Eversource Energy, D.P.U. 18-155.

23 National Grid Local System Plan: https://www9.nationalgridus.com/oasis/non_html/pdf/National%20Grid%20Local%20System%20Plan%202018.pdf.

24 As noted in Section 2.5.3, the Nantucket project will add a new 15-MW generator and a 6-MW/48-MWh battery energy storage system. However, approximately 6 MW of existing generation will be retired, for a net increase of 15 MW.

approximately 31 MW towards meeting the injection requirement, the storage projects themselves are not expected to be capable of operating for sufficient duration to fully mitigate the reliability need.[25] As a result, the Company determined that these alternatives would not be able to address the project need in isolation. All proposed resources beyond the mentioned projects do not have approved contracts, such as CSOs or Power Purchase Agreements, and therefore do not fit the criteria to be considered as a potential solution.

3.4.3 Other Potential NTA Alternatives

In addition to the known proposals from the distribution utilities and applicable projects in the ISO-NE interconnection queue, the Company considered whether further, hypothetical projects could be developed as an alternative to the proposed Project. Possible NTA technologies include:

- Combined-cycle gas turbines;
- Simple cycle gas turbines (aero-derivative combustion turbines, and large frame combustion turbines);
- Utility-scale solar, with and without storage;
- Distribution-scale solar with and without storage;
- Slow and fast-discharge battery storage;
- Active demand response; and
- Passive demand response (energy efficiency).

A "technically feasible" NTA technology is defined as one that can effectively resolve the transmission need with sufficient performance and response time. When considering whether a specific technology has the operating characteristics (performance and response time) needed to respond to contingency conditions, a threshold response time of within 30 minutes of the occurrence of the first contingency was used. The resource must then be able to continue to operate until the failed transmission system element is repaired or until loads decline.

Energy storage technologies alone are not technically feasible due to the lack of transmission capacity available to provide energy for storage to charge in the off-peak hours. Based on the Company's analysis, the overload duration is 15 hours, which only leaves 9 hours of charging that would be available and would not be enough time to recharge. Furthermore, commercially-available storage systems have typically been sized to operate at full capacity for four hours or

[25] In the case of energy storage, the Company determined that energy storage alone would not be a feasible NTA as it would need to provide an additional 20 MW of energy injection for the duration of an outage. The two applicable storage projects have the capability to deliver 89 MWh of energy.

less without recharging, and therefore would only be able to cover a short portion of the overload. Similarly, solar photovoltaic ("PV") technologies alone are not feasible due to the inability of solar to cover the duration of the overload and is not a technically feasible solution. However, both technical limitations could be overcome when solar PV is paired with storage.

In terms of active or passive demand response (energy efficiency), these strategies are not deployable to the scale necessary to mitigate the needs addressed by the Project. For example, future energy efficiency is already forecasted to reduce the area load by only approximately 61 MW (or a reduction of about 9% of the area load) by 2026, while an additional reduction of 180 MW would be required to address the identified transmission needs.

The only remaining technically feasible NTA technologies are conventional generation and solar PV paired with storage. There are several practical challenges that would prevent any of the remaining NTA technologies from being developed. These challenges include the necessary development time, land requirements and infrastructure requirements.

The development time for any additional generation connected in the vicinity of Barnstable would likely be lengthy, as additional generation would not be able to move through the ISO-NE Interconnection process until the completion of the interconnection studies for earlier queued projects (including Vineyard Wind, which will require the proposed Project in order to interconnect). As an example, Canal Unit 3 in the Town of Sandwich entered the ISO-NE interconnection queue in March of 2014, completed interconnection studies more than one year later (in June of 2015), and went into service in July of 2019. Canal Unit 3 was developed at the site of an existing generator. By contrast, the Company would expect a lengthier development time for a large generation project in the vicinity of Barnstable because a greenfield site would be required.

Any NTA would need to be developed in the vicinity of Barnstable Switching Station, or at substations further to the east, and would require an amount of land in this area appropriate for each technology. For example, the availability of a large amount of unencumbered land is a prerequisite for developing a large installation of solar PV and energy storage and, as a practical matter, land compatible with industrial uses would be preferable for a gas-fired generator. The expected land impacts from any of the NTA technologies (for example, at least 1,686 acres would be required for the development of a solar PV array in combination with storage, over 374 times the size of Barnstable Switching Station) would significantly exceed the land requirements associated with the Project.

Finally, some NTA technologies would require additional accommodating infrastructure. 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 generator. A dual-fuel generator 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.

While noting the significant practical challenges associated with development of each of the technically feasible NTA technologies, the Company also considered the potential costs of developing a technically feasible NTA as an alternative to the proposed Project. The Company concluded that the potential costs of any technically feasible NTA would be significantly higher than the cost of the proposed Project. For example, the least expensive NTA would utilize frame peaker gas turbine technology, and the Company estimates that the cost to install one turbine of sufficient size would be approximately $268M. All technically feasible NTAs would also have additional costs associated with acquisition of land, siting and permitting, site preparation and other necessary activities that are not factored into these estimates.

3.4.4 NTA Conclusion

Storage or solar PV alone are not feasible due to technical limitations due to their inability to cover the duration of the overload. Even when paired, the amount of land required for solar PV would significantly exceed the land requirements associated with the Project. Active and passive demand response are not deployable to the scale necessary to mitigate the needs addressed by the Project. Conventional generation would need to overcome a variety of challenges, including the necessary development time, land requirements and infrastructure requirements and therefore would not be practical.

Generation under development in the Project area will require the construction of the Project in order to interconnect to the transmission system. Some NTAs, such as active or passive demand response would have limited impact on the environment, while others, such as solar or natural gas-powered generation may have significant impacts to land, water, and air quality, along with substantial physical disturbances and property rights acquisition. Further, the higher cost to customers of any NTA to the Project, combined with the physical and logistical difficulties of implementing such a solution in a timely fashion, makes an NTA or any combination of NTAs substantially less desirable solution to the identified need than the Project. Overall, the Project better meets the goal of providing a robust, secure and reliable energy supply with a minimum impact on the environment at the lowest possible cost.

3.5 Conclusion on Project Alternatives

The Company's analyses demonstrate that the Project will best address the identified need and improve reliability to the Cape Cod Load Pocket. Relative to the other transmission and non-transmission alternatives studied, the Project meets the need, with minimal environmental and construction impacts at the lowest possible cost.

Therefore, the Project, a new 115-kV transmission line between Bourne Switching Station and West Barnstable Substation, was the solution selected to undergo the routing analysis presented in Section 4 of this Petition.

Section 4.0

Route Selection

4.0 ROUTE SELECTION

4.1 Introduction

As presented in Section 3, the Company's proposed solution to address the electrical system need described in Section 2 involves the construction of a new 115-kV transmission line between the Bourne Switching Station and West Barnstable Substation (the "New Line"), with associated modifications at each station. This Section describes the Company's process to identify and evaluate possible routes that lead to a determination of the Preferred Route for the Project and a Noticed Alternative. This Section also describes the Company's evaluation of design variations considered, resulting in the identification of a Noticed Variation for the Project.

4.1.1 Routing Analysis 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 route for the Project as the option that best balances 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 standard process implemented by the Company and historically accepted by the Siting Board.

For this case, the Company evaluated three different design variations to the physical configuration of the proposed New Line to supplement the standard evaluation of potential alternative route options. Specifically, the designs the Company considered were a primarily overhead transmission line, a primarily underground transmission line and combinations of overhead/underground transmission line. Given that design variations along the routes pose different potential environmental impacts to developed and natural environmental features and have varying associated costs, the Company included these design variations in the following routing analysis.

In addition, to allow the Siting Board to consider the anticipated future potential need of the interconnection of additional renewable generation, the Company introduces the concept of constructing the Project to support the potential future operation of the 115-kV transmission line as a 345-kV transmission line.

4.1.2 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 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., transmission line, highway, railroad or pipeline ROWs) to the extent possible;
- Minimize/avoid potential impacts to the developed and natural environment;
- Minimize/avoid the need to acquire property rights; and,
- Maximize the potential for direct routing options over circuitous routes.

4.1.3 Routing Analysis Methodology

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

- **Identification of Project Study Area:** Focused the routing analysis within the region of the Bourne Switching Station and West Barnstable Substation.
- **Development of Universe of Routes:** Identified numerous routing options with associated design variations including utilization of existing linear corridors within the Project Study Area 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 and associated design variations (collectively referred to herein as "Candidate Routes") 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.
- **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 Preferred Route for the Project, a Noticed Variation and a Noticed Alternative that best balance reliability, minimization of environmental impacts, constructability constraints, and cost.

4.2 Identification of Project Study Area

Following the establishment of the routing objectives, the Company reviewed the geographic area between Bourne Switching Station and West Barnstable Substation and demarcated a geographic "Project Study Area," as depicted in Figure 4-1, within which to concentrate the investigation of potential routes. Within the Project Study Area, the Company looked for existing linear corridors (e.g., existing rail, gas, and electric ROWs and public roadway corridors) that appeared to be feasible to facilitate construction of the New Line and could provide a reasonably direct route between the two stations.

The Project Study Area encompasses portions of the towns of Bourne, Sandwich, Barnstable, Falmouth and Mashpee. The northern edge of the Project Study Area is roughly defined by Eversource's transmission ROW 380 and Cape Cod Bay. The western edge of the Project Study Area is defined by Eversource transmission ROWs 380 and 340 in Bourne, and the Project Study Area and is anchored by the West Barnstable Substation at its eastern edge. The southern boundary of the Project Study Area is generally defined by Eversource ROWs 345 and 340 in Falmouth, Mashpee and Barnstable.

Land use within the Project Study Area consists of federal, municipal and private open space areas including conservation and water protection supply areas. The Joint Base Cape Cod ("JBCC" or "MMR") property occupies a significant portion of the western half of the Project Study Area. Numerous existing Company-owned stations are located within the Project Study Area, including Falmouth Tap, Hatchville Substation, Mashpee Substation, Otis Substation, Bourne Switching Station, West Barnstable Substation and Oak Street Substation. The Project Study Area's linear corridors, in addition to those identified above, include electric transmission ROWs 342 and 381. With respect to public roadways, the Project Study Area only had a few feasible east-west roads, limited to Route 6 and 6A.

4.3 Route Selection

4.3.1 Identification of Universe of Routes

Using the routing objectives identified in Section 4.1, the Company reviewed U.S. Geological Survey ("USGS") maps, Massachusetts Geographic Information System ("MassGIS") data and aerial photography, as well as, field reconnaissance to identify a Universe of Routes that could support a New Line between the two stations, including the utilization of existing linear corridors.

The Universe of Routes are summarized in Table 4-1, below, and are depicted on Figure 4-2. Figures 4-2a through 4-2j include additional detail specific to each route.

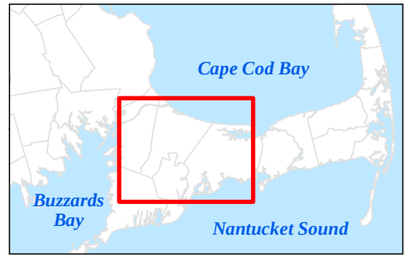
G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\study_area_20190701.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

Basemap: ESRI World Imagery

LEGEND

- Town Boundary
- Study Area

Existing Eversource Rights of Way

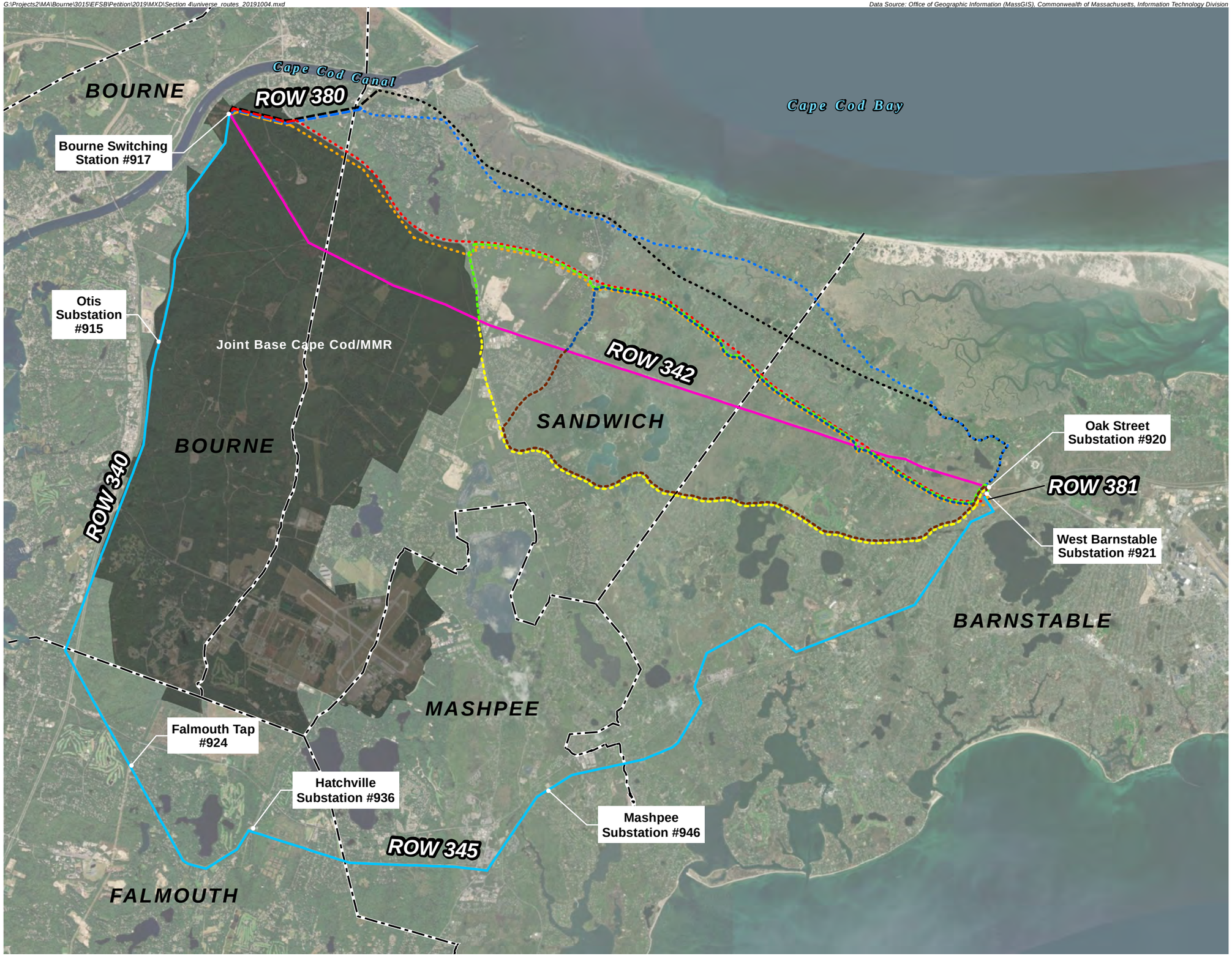
- ROW 340
- ROW 342
- ROW 345
- ROW 380
- ROW 381
- Joint Base Cape Cod/MMR

Figure 4-1

Routing Study Area

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\universe_routes_20191004.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- ROW 342 (12.5 miles)
- ROWs 340, 345 and 381 (26.5 miles)
- ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- ROW 342/Quaker Meetinghouse Road South (15.5 miles)
- ROW 380, Natural Gas Pipeline ROW and Service Road (13.0 miles)
- Route 6 (Mid Cape Highway) (12.7 miles)
- Route 6A, Sandwich Road (Old King's Highway) (13.7 miles)
- Railroad Route (13.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR

NOTE: Solid line represents an overhead segment, a dotted line represents an underground segment, and a dashed line represents a segment that may be either overhead or underground.

Figure 4-2
Universe of Routes

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\a_Railroad_20190702.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Canal Substation

Cape Cod Central Railroad

Tupper Road

Joint Base Cape Cod/MMR

Route 6A (Main Street)

Oak Street

Oak Street Substation #920

West Barnstable Substation #921

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

FALMOUTH

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROW 380 (2.3 miles)(OH or UG)
- Railroad (11.3 miles)(underground)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 380

Figure 4-2a

Universe of Routes:
Railroad Route
(Combination Overhead/Underground)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\b_Route6_20190702.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Route 6 (Mid Cape Highway)

Joint Base Cape Cod/MMR

Oak Street Substation #920

West Barnstable Substation #921

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

FALMOUTH

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROW 380 (1.0 miles)(OH or UG)
- Route 6 (11.7 miles)(underground)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 380
- ROW 381

Figure 4-2b

Universe of Routes:
Route 6 (Mid Cape Highway) Route
(Combination Overhead/Underground)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\c_Route6A_20190702.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Route 6A (Old King's Highway)

Route 6A (Main Street)

Oak Street

Oak Street Substation #920

West Barnstable Substation #921

Joint Base Cape Cod/MMR

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

FALMOUTH

Cape Cod Canal

Cape Cod Bay

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROW 380 (1.9 miles)(OH or UG)
- Route 6A (11.8 miles)(underground)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 380

Figure 4-2c

Universe of Routes:
Route 6A, Sandwich Road
(Old King's Highway) Route
(Combination Overhead/Underground)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\d_ROW380_Gas_Service_20190702.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Gravel Access Road (Marist Street)

Marist Street

Spectra Gas Pipeline ROW

Spectra Gate Station

Spaulding Rehabilitation Hospital

Corpus Christi Church

Sandwich Hollows Golf Club

Service Road

Joint Base Cape Cod/MMR

Prospect Street

Oak Street Substation #920

Service Road

West Barnstable Substation #921

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

FALMOUTH

GREAT MARSHES

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROW 380 (0.9 miles)(OH or UG)
- Natural Gas Pipeline ROW, Service Road (12.1 miles)(underground)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 380
- ROW 381

Figure 4-2d

Universe of Routes: Eversource ROW 380, Natural Gas Pipeline ROW, and Service Road Route (Combination Overhead/Underground)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\e_ROW342_20190702.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Joint Base Cape Cod/MMR

Cranberry Bogs

Oak Street Substation #920

West Barnstable Substation #921

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

FALMOUTH

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROW 342 (12.5 miles)(overhead)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 342

Figure 4-2e

Universe of Routes:
Eversource ROW 342 Route
(115 kV or 345 kV Overhead)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\f_ROW340_345_381_20190702.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Otis Substation #915

Joint Base Cape Cod/MMR

Paved Road Crossing At Rotary

Route 28 Crossing

Route 28 Crossing

Railroad Crossing

Falmouth Tap #924

Hatchville Substation #936

River Crossing

River Crossing

Mashpee Substation #946

Route 6 Crossing (underground line to substation)

Oak Street Substation #920

West Barnstable Substation #921

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

FALMOUTH

GREAT MARSHES

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROWs 340, 345 and 381 (26.5 miles) (overhead)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 340
- ROW 345
- ROW 381

Figure 4-2f

Universe of Routes: Eversource ROWs 340, 345, and 381 Route (Overhead)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\g_ROW342_ForestdaleSouth_20190708.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

BARNSTABLE

MASHPEE

FALMOUTH

Joint Base Cape Cod/MMR

Rte 130 (Forestdale Road)

Cotuit Road

Farmersville Road

Race Lane

Old Stage Road

Oak Street

Oak Street Substation #920

West Barnstable Substation #921

Route 6 Bridge Crossing

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROW 342 (4.8 miles)(overhead)
- Route 130 (Forestdale Road South) (9.6 miles) (underground)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 342

Figure 4-2g

Universe of Routes:
Eversource ROW 342/Route 130 (Forestdale Road) South Route (Combination Overhead/Underground)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\h_ROW342_ForestdaleNorth_20190708.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Service Road

Rte 130 (Forestdale Road)

Prospect Street

Joint Base Cape Cod/MMR

Oak Street

Oak Street Substation #920

Prospect Street

Service Road

West Barnstable Substation #921

Route 6 Bridge Crossing

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

FALMOUTH

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROW 342 (4.8 miles)(overhead)
- Route 130 (Forestdale Road North) (9.9 miles) (underground)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

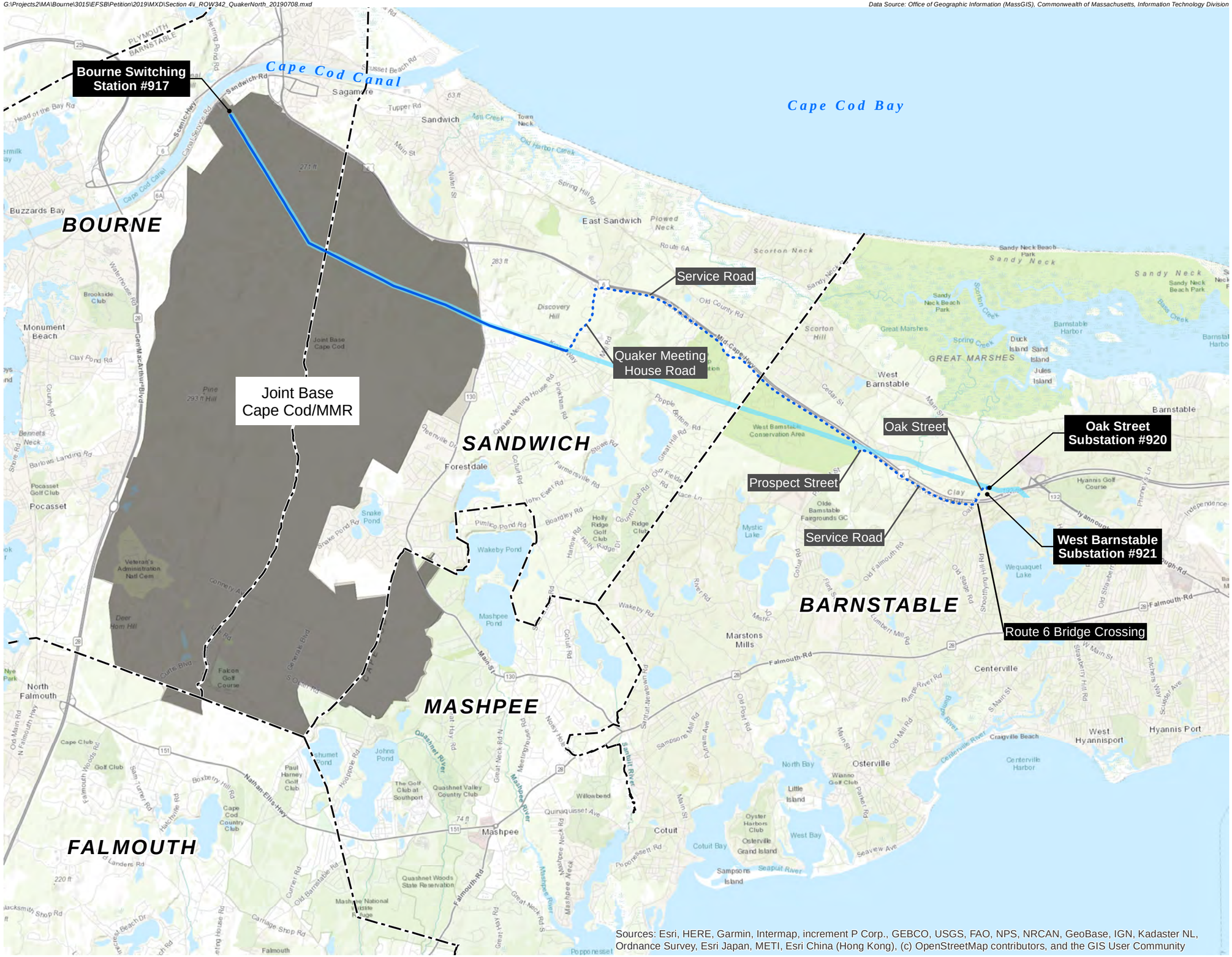
- ROW 342

Figure 4-2h

Universe of Routes:
Eversource ROW 342/Route 130 (Forestdale Road) North Route (Combination Overhead/Underground)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4_ROW342_QuakerNorth_20190708.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

LEGEND

- ROW 342 (6.1 miles)(overhead)
- Quaker Meeting House Road North (7.9 miles) (underground)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 342

Figure 4-2i

Universe of Routes: Eversource ROW 342/Quaker Meeting House Road North Route (Combination Overhead/Underground)

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\j_ROW342_QuakerSouth_20190708.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Joint Base Cape Cod/MMR

Quaker Meeting House Road

Cotuit Road

Farmersville Road

Race Lane

Old Stage Road

Oak Street

Oak Street Substation #920

West Barnstable Substation #921

Route 6 Bridge Crossing

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

FALMOUTH

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

LEGEND

- ROW 342 (6.1 miles)(overhead)
- Quaker Meeting House Road South (9.4 miles) (underground)
- Town Boundary
- Joint Base Cape Cod/MMR

Eversource Rights-of-way

- ROW 342

Figure 4-2j

Universe of Routes:
Eversource ROW 342/Quaker Meeting House Road South Route
(Combination Overhead/Underground)

Table 4-1 Universe of Routes

Route Name	Figure Reference	Route Length	Municipalities Crossed by Route	Transmission Line Design
Railroad Route	Fig. 4-2a	13.6 miles	Bourne, Sandwich, Barnstable	Combination Overhead/Underground
Route 6 (MidCape Highway) Route	Fig. 4-2b	12.7 miles	Bourne, Sandwich, Barnstable	Combination Overhead/Underground
Route 6A, Sandwich Road (Old King's Highway) Route	Fig. 4-2c	13.7 miles	Bourne, Sandwich, Barnstable	Combination Overhead/Underground
ROW 380, Gas Pipeline ROW and Service Road Route	Fig. 4-2d	13.0 miles	Bourne, Sandwich, Barnstable	Combination Overhead/Underground
Eversource ROW 342	Fig. 4-2e	12.5 miles	Bourne, Sandwich, Barnstable	Overhead
Eversource ROWs 340, 345 and 381 Route	Fig. 4-2f	26.5 miles	Bourne, Barnstable, Falmouth, Mashpee	Overhead
Eversource ROW 342/Route 130 (Forestdale Road) South Route	Fig. 4-2g	14.4 miles	Bourne, Sandwich, Barnstable	Combination Overhead/Underground
Eversource ROW 342/Route 130 (Forestdale Road) North Route	Fig. 4-2h	14.7 miles	Bourne, Sandwich, Barnstable	Combination Overhead/Underground
Eversource ROW 342/Quaker Meetinghouse Road North Route	Fig. 4-2i	14.0 miles	Bourne, Sandwich, Barnstable	Combination Overhead/Underground
Eversource ROW 342/Quaker Meetinghouse Road South Route	Fig. 4-2j	15.5 miles	Bourne, Sandwich, Barnstable	Combination Overhead/Underground

4.3.2 Screening Methodology

The Universe of Routes identified by the Company consisted of ten different route options that were initially screened by reviewing publicly available data to consider existing adjacent land uses and the presence of natural resources such as wetlands, waterways and rare species habitat. The existing ownership and easement details, including the potential requirement of Article 97, were

reviewed along each of the various routes and various easement constraints were identified. The Company also identified constructability constraints, such as difficult crossings and reviewed order of magnitude cost estimates.

4.3.2.1 Summary of Eliminated Routes

As previously stated, the Company initially identified a Universe of Routes for consideration and review. Based on the screening process described above, the Company eliminated four routes in the Universe of Routes from further consideration. The remaining six routes were advanced as Candidate Routes for more detailed evaluation, as described below in Section 4.4. A description of each of the eliminated routes is provided below.

Railroad Route

The screening eliminated the Railroad Route because it was unsuitable for the New Line due to its significant environmental impacts and costs related to the more than 11 miles of underground transmission line construction (see Figure 4-2a). The significant environmental impacts include:

- **Sensitive Environmental Resources -** The Railroad Route abuts and crosses the Sandy Neck Barrier Beach System, which is an Area of Critical Environmental Concern ("ACEC"). The route's construction has the potential to significantly affect large expanses of sensitive resource areas within the ACEC, including coastal wetland resource areas, major waterbodies and salt marsh habitat.

- **Requires Article 97 Authorization -** The Railroad Route would require widening about 2.3 miles of ROW 380 that passes through ecologically sensitive areas within the JBCC starting at the Bourne Switching Station. The ROW needs to be widened because its current width (360 feet for 2.2 miles and 400 feet for 0.1 miles) would not provide adequate clearance between the Project and existing transmission infrastructure. Acquiring and clearing the JBCC property would adversely affect an important and ecologically sensitive land area on Cape Cod and, in addition, would require Article 97 approval from the State Legislature.[26] The Company discussed the potential acquisition with staff from the Massachusetts Environmental Management Commission ("EMC"), Massachusetts Army National Guard ("ARNG") Environmental and Readiness Center and NHESP. Staff from these agencies were united in their lack of support for this route given other more feasible routes that would result in fewer environmental impacts.

[26] In addition, obtaining an easement to install the transmission line would also require new property rights from the owner of the railroad property and adjacent residential and commercial property owners to access the work zone and install the line.

Given the anticipated significant environmental impacts and regulatory constructability challenges and the need for property rights from multiple parties abutting the route, the Railroad Route option was determined to be impracticable and clearly inferior to the other potential routes analyzed herein. Therefore, the Railroad Route was not advanced for further evaluation and scoring as a Candidate Route.

Route 6 (Mid Cape Highway) Route

The Route 6 Route is a 12.7-mile combination overhead/underground route originating at Bourne Switching Station and follows Eversource ROW 380 for about a mile (either as an overhead or underground line design) as was described above for the Railroad Route, then permanently transitions to an underground line design that follows Route 6 for about 11.7 miles through the towns of Bourne, Sandwich and Barnstable where it would then enter Eversource ROW 381 at the West Barnstable Substation. Route 6 is a major four-lane, divided, fully controlled access state highway on Cape Cod that runs east-west between the stations. The Route 6 Route is shown on Figure 4-2b.

The screening process determined that the Route 6 Route was undesirable due to its more significant environmental impacts, construction challenges and significant additional cost of installing nearly 12 miles of underground transmission line in Route 6, relative to other potential overhead or hybrid overhead/underground routes.

The significant environmental impacts described above for the segment of the Railroad Route that passes through JBCC, including a united lack of support from EMC, NHESP and ARNG, would also apply to the segment of the Route 6 Route located on ROW 380. Accordingly, the Route 6 Route option was determined to be impracticable and clearly inferior to the other potential routes analyzed herein and was not advanced for further evaluation and scoring as a Candidate Route.

Route 6A Sandwich Road (Old King's Highway) Route[27]

The Route 6A Route is a 13.7-mile combination overhead/underground route originating at Bourne Switching Station and follows Eversource ROW 380 (either as an overhead or underground design) through JBCC until it reaches Route 6A. The new line would permanently transition to an underground line design that follows Route 6A for approximately 12 miles through the towns of Bourne, Sandwich and Barnstable until it connects to the West Barnstable Substation (see Figure 4-2c).

[27] Sandwich Road is also referred to as Old King's Highway.

The screening process determined that the Route 6A Route was undesirable for new line construction due to its more significant environmental impacts and additional cost associated with nearly 12 miles of underground transmission line construction in Route 6A, relative to other potential overhead or hybrid overhead/underground routes. For perspective, Route 6A is a major two-lane uncontrolled access state highway on Cape Cod that runs east-west between the stations. Installation of underground facilities within an uncontrolled access state highway layout, such as Route 6A, would result in disruptions to residential neighborhoods and local traffic, as compared to other potential routes. The 6A Route would also cross through the Old King's Highway Historic District, which includes all land north of Route 6 and south of Cape Cod Bay from the Town of Sandwich to the Town of Orleans. The Sandwich Historical Commission lists 54 historic home and building addresses along the Route 6A Route in Sandwich that are over 100 years old.

The significant environmental impacts described above for the segment of the Railroad Route and Route 6 Route that pass through JBCC, including a united lack of support from EMC, NHESP and ARNG, would also apply to the segment of the Route 6A Route located on ROW 380. In light of the above, the Route 6A Route option was determined to be impracticable and clearly inferior to the other potential routes analyzed herein and was not advanced for further evaluation and scoring as a Candidate Route.

ROW 380, Gas Pipeline ROW and Service Road Route

This approximately 13-mile combination overhead/underground transmission line route originates at Bourne Switching Station, then heads east on Eversource ROW 380 as an overhead transmission line before transitioning to an underground transmission line at a point parallel to Marist Road, a gravel access road on the JBCC. The route then runs adjacent to the Spectra Energy natural gas pipeline ROW along the northern edge of the JBCC.[28] The route would exit the Spectra Energy ROW and run east within the paved limits of Service Road through Sandwich and a large portion of Barnstable for about 6.6 miles. The route exits Service Road in Barnstable, turning onto Oak Street to the West Barnstable Substation entrance. The ROW 380, Gas Pipeline ROW and Service Road Route is shown on Figure 4-2d.

The Service Road segment between Route 130 in Sandwich and Chase Road in Barnstable has existing utility infrastructure that includes the new construction of a 20-inch diameter natural gas pipeline that is part of National Grid's ongoing effort to complete the Sagamore Reinforcement

[28] The route runs adjacent to the Spectra Energy ROW because Spectra Energy policy does not allow third-party use of their easements that are restricted to their pipelines and related infrastructure. Thus, the routing analysis routed the potential route adjacent to this ROW.

Project.[29] The Town of Barnstable has indicated to the Company that it would not prefer construction of a new transmission line on Service Road because of the current impacts to the community from the ongoing natural gas pipeline construction and potential future infrastructure construction.

The screening also identified that construction on this route would have other potential environmental impacts, including similar impacts to the natural environment as those noted above for the segment of the Railroad Route, Route 6 Route and Route 6A Route relative to Article 97, as well as archaeology, ROW widening, tree removal, and permanent rare species habitat impacts. A united lack of support from EMC, NHESP and ARNG, would also apply to the segment of this route where it passes through JBCC on ROW 380 and adjacent to the Spectra Energy ROW.

Given the anticipated significant environmental impacts, regulatory and constructability challenges, the need for Article 97 approval, and the anticipated substantial costs to construct the transmission line, the ROW 380, Gas Pipeline ROW and Service Road Route option was determined to be impractical and clearly inferior to the other potential routes analyzed herein and was not advanced for further evaluation and scoring as a Candidate Route.

Table 4-2 below provides a summary of the eliminated routes described above and the remaining six routes that were retained for scoring/ranking and more detailed analysis.

[29] See Colonial Gas Company d/b/a KeySpan Energy Delivery New England, EFSB 05-2 (2006); Colonial Gas Company d/b/a National Grid, EFSB 05-2A (2014); Colonial Gas Company d/b/a National Grid, EFSB 18-05 (2019).

Table 4-2 Results of Route Selection After Initial Screening

Route Name	Route Length	Municipalities Crossed by Route	Status
Railroad Route	13.6 miles	Bourne, Sandwich, Barnstable	Eliminated from further consideration (see Section 4.3.2.1)
Route 6 (MidCape Highway) Route	12.7 miles	Bourne, Sandwich, Barnstable	Eliminated from further consideration (see Section 4.3.2.1)
Route 6A, Sandwich Road (Old King's Highway) Route	13.7 miles	Bourne, Sandwich, Barnstable	Eliminated from further consideration (see Section 4.3.2.1)
ROW 380, Gas Pipeline ROW and Service Road Route	13.0 miles	Bourne, Sandwich, Barnstable	Eliminated from further consideration (see Section 4.3.2.1)
Eversource ROW 342 Route	12.5 miles	Bourne, Sandwich, Barnstable	Retained for Scoring
Eversource ROWs 340, 345 and 381 Route	26.5 miles	Bourne, Barnstable, Falmouth, Mashpee	Retained for Scoring
Eversource ROW 342/Route 130 (Forestdale Road) South Route	14.4 miles	Bourne, Sandwich, Barnstable	Retained for Scoring
ROW 342/Route 130 (Forestdale Road) North Route	14.7 miles	Bourne, Sandwich, Barnstable	Retained for Scoring
Eversource ROW 342/Quaker Meetinghouse Road North Route	14.0 miles	Bourne, Sandwich, Barnstable	Retained for Scoring
Eversource ROW 342/Quaker Meetinghouse Road South Route	15.5 miles	Bourne, Sandwich, Barnstable	Retained for Scoring

4.3.3 Review of Candidate Routes

Following the elimination of four routes from the Universe of Routes during the screening process, the Company advanced six Candidate Routes for more detailed analysis and scoring and ranking, as described and presented in Figure 4-3. A description of the Candidate Routes is presented below.

Candidate Route 1 - Eversource ROW 342

Candidate Route 1 involves construction of approximately 12.5 miles of new overhead transmission line on Eversource ROW 342. Candidate Route 1 is the shortest and most direct route, originating at Bourne Switching Station and traversing east on ROW 342 through Bourne, Sandwich and Barnstable where it connects at West Barnstable Substation. Refer to Figure 4-2e for the location of Candidate Route 1.

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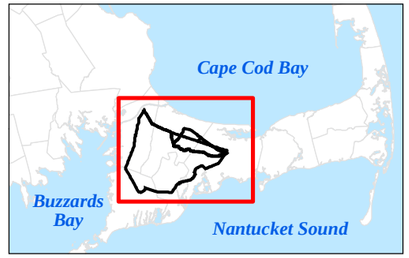
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
- Candidate Route 2: ROWs 340/345/381 (26.5 miles)
- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR

Figure 4-3
Candidate Routes

ROW 342 runs east for approximately 12.5 miles to West Barnstable Substation terminating shortly thereafter. The first approximately 4.8 miles of ROW 342 is located on JBCC property. ROW 342 varies in width from approximately 230 feet to 265 feet from its beginning at Bourne Switching Station through the JBCC property up to Route 130 (Forestdale Road). East of Route 130 to the West Barnstable Substation, ROW 342 is 185-feet to 190-feet wide. ROW 342 contains an overhead 115-kV line on its north side, and an overhead 345-kV line roughly in the center of the ROW.

ROW 342 can support either overhead or underground transmission line design, but the overhead line design is the clearly superior design option since underground line design is more expensive to construct and has more potential environmental impacts. An underground line design option would require that the Company secure underground rights from public (state and local) and private landowners to construct the Project, including Article 97 approval across conservation lands that cross the ROW in several locations. Installing an underground line in the ROW would also result in greater potential environmental impacts than an overhead line due to trenching and backfilling during construction. For example, the cluster of wetlands and active commercial cranberry bogs located at the east end of the ROW would potentially be more adversely affected by underground line construction through trenching and backfilling. Although there are few trees and wetlands present on ROW 342, there are archaeologically sensitive areas and mapped rare species habitats that trenching and backfilling could potentially affect. Lastly, an underground design would be significantly more expensive than an overhead design.

An overhead line design on ROW 342 would largely avoid and substantially minimize the constraints and potential impacts noted above for the underground line design because the overhead line can readily span most of the referenced sensitive areas (e.g., rare species habitats, archaeological, etc.) and the structure foundations can often be located outside of resource areas. Because ROW 342 is currently cleared of trees and maintained to its full width, there is no additional tree removal necessary to construct the new overhead line except for the removal of a small area of trees (approximately 0.19 acre) where the transmission line connects into Bourne Switching Station on JBCC. In addition, the Company obtained easements in the Town of Sandwich and Barnstable and Article 97 endorsement from the Town of Barnstable Conservation Commission that specifically allows for and accommodates the construction of a new overhead line on ROW 342.[30]

As a result of the above, ROW 342 was retained for detailed evaluation and scoring as an overhead transmission line route.

[30] Refer to the Company's MEPA ENF, included herein as Appendix 6-1, for additional detail on the topic of Article 97 and coordination with the Town of Barnstable.

Candidate Route 2 – Eversource ROWs 340, 345 and 381

Candidate Route 2 involves construction of approximately 26.2 miles of new overhead transmission line on existing Eversource ROWs 340, 345 and approximately 0.3 miles of new underground transmission line on ROW 381 where the line connects into West Barnstable Substation.[31] Candidate Route 2 is the longest identified Candidate Route originating at Bourne Switching Station and traversing ROWs 340 and 345 through Bourne, Falmouth, Mashpee and Barnstable where it enters ROW 381 via an underground transmission line design then terminates at West Barnstable Substation. Refer to Figure 4-2f for the location of Candidate Route 2. The Eversource ROWs that Candidate Route 2 traverses are described briefly below:

- **ROW 340** - From Bourne Switching Station, ROW 340 runs south for approximately 10.1 miles through the Towns of Bourne and Falmouth terminating at Falmouth Tap, a switching station in the northern portion of the Town of Falmouth. The first approximately 7 miles of ROW 340 is located on JBCC property. The width of ROW 340 varies between approximately 150 feet and 250 feet. ROW 340 contains 115-kV overhead transmission lines and a 23-kV overhead distribution line.

- **ROW 345** - From Falmouth Tap, ROW 345 runs easterly for approximately 16.1 miles through the Towns of Falmouth, Mashpee and Barnstable to West Barnstable Substation. ROW 345 is approximately 210-feet wide along its entire length. An existing 115-kV line is located on the north/central portion of the ROW; there is also a 23-kV distribution line on the north side of the ROW between the West Barnstable and Hatchville stations.

- **ROW 381** - The ROW is a 0.3-mile long north-south connector between ROWs 342 and 345 and contains the West Barnstable Substation. ROW 381's maintained portion is 100 feet wide. The ROW contains three sets of 115-kV overhead transmission lines and an overhead distribution line.

The Company's existing easements allow for the construction of the New Line; no new property rights would be needed.

Therefore, Candidate Route 2 (ROW 340/345/381) was retained for detailed evaluation and scoring as an overhead transmission line design.

[31] An underground transmission line design along the entirety of this 26.5-mile route was deemed infeasible for the same reasons described for Candidate Route 1.

Candidate Route 3 - Eversource ROW 342/Route 130 (Forestdale Road) South

Candidate Route 3 involves construction of a new combination overhead/underground transmission line approximately 14.4 miles long. Candidate Route 3, which originates at Bourne Switching Station, traverses ROW 342 overhead for 4.8 miles, entirely within the JBCC, before transitioning to an underground line design at Route 130 and continuing, predominately within public roads, for 9.6 miles to connect to the West Barnstable Substation.[32] Candidate Route 3 passes through the communities of Bourne, Sandwich and Barnstable. Refer to Figure 4-2g for the location of Candidate Route 3.

As was discussed for Candidate Route 1, constructing an underground line on ROW 342 would add significant costs and environmental impacts from trenching and backfilling construction when compared to the overhead design option, thus, an all underground line design was not considered further. The Company's existing rights on ROW 342 allow for the approximately 320 feet of underground transmission line construction that would be required on ROW 342 prior to reaching the public way in Route 130.

Route 130 is a two-lane, uncontrolled access state highway. The underground transmission line would follow Route 130 in a southerly direction for approximately 0.5 miles before turning southeast onto Cotuit Road for approximately 1.4 miles. From Cotuit Road, the route would turn east onto Farmersville Road for approximately 2.5 miles before turning onto Race Lane. From Race Lane, the route would head east for approximately 3.7 miles where it turns into Old Stage Road, going approximately 0.2 miles to turn onto Oak Street, where the route would head north for 1.3 miles to West Barnstable Substation. Prior to reaching the West Barnstable Substation, Oak Street passes over Route 6. This bridge crossing would likely be accomplished by: (1) installing the cable in the bridge deck/roadway pavement; (2) attaching the cable to the side of the bridge; (3) by constructing a separate self-supporting utility bridge to carry the cable over Route 6; or by (4) installing the cable beneath Route 6 using an HDD method. Farmersville Road, Race Lane, Old Stage Road and Oak Street are all locally designated Scenic Roads.

The proposed Candidate Route 3, a combination overhead/underground transmission line route, provides an alternative approach and design to the all-overhead Candidate Routes 1 and 2 while also providing some measure of geographic diversity. Accordingly, Candidate Route 3 was retained for detailed evaluation and scoring.

[32] Route 130 presents the first opportunity to exit ROW 342 and potentially transition to underground transmission line construction along existing roadways for the balance of the route to West Barnstable Substation.

Candidate Route 4 - Eversource ROW 342/Route 130 (Forestdale Road) North

Candidate Route 4 involves construction of a new combination overhead/underground transmission line approximately 14.7 miles long. As with the other Candidate Routes, Candidate Route 4 originates at Bourne Switching Station, then traverses ROW 342 as an overhead line design for 4.8 miles, entirely within the JBCC, before transitioning to an underground line design at Route 130 where it continues predominately within public roads for about 9.9 miles to connect to the West Barnstable Substation. Instead of heading south on Route 130, as proposed with Candidate Route 3, the underground segment would head north on Route 130. Candidate Route 4 passes through the towns of Bourne, Sandwich and Barnstable. Refer to Figure 4-2h for the location of Candidate Route 4.

The underground segment follows Route 130 for approximately one mile before turning east onto Service Road. The route would then follow Service Road for approximately 8.5 miles before turning north onto Oak Street for approximately 0.3 miles where it would connect to the West Barnstable Substation. As with Candidate Route 3, Oak Street passes over Route 6 and Eversource would evaluate bridge crossing options similar to those discussed above for Candidate Route 3. Alternatively, this route could bypass Oak Street and continue along Service Road for 0.2 miles before turning north onto ROW 381 south of the West Barnstable Substation. However, exiting Service Road at ROW 381 would require two HDD crossings of Route 6 to reach West Barnstable Substation.

While the Town of Barnstable has indicated to the Company that it would prefer not to have construction of a new transmission line on Service Road because of the impacts to the community from on-going gas pipeline construction and potential future infrastructure construction, the proposed Candidate Route 4 does provide an alternative approach and hybrid design to the all-overhead Candidate Routes 1 and 2 while also providing some measure of geographic diversity. More importantly, Candidate Route 4 also avoids the significant environmental impacts, regulatory and constructability challenges, Article 97 and other factors associated with the ROW 380, Gas Pipeline and Service Road Route that was not advanced for scoring (see Section 4.4.2). Accordingly, Candidate Route 4 was retained for detailed evaluation and scoring.

Candidate Route 5 - Eversource ROW 342/Quaker Meetinghouse Road North

Candidate Route 5 involves construction of a new hybrid overhead/underground transmission line approximately 14 miles long and passes through the towns of Bourne, Sandwich and Barnstable. Refer to Figure 4-2i for the location of Candidate Route 5.

Candidate Route 5 originates at Bourne Switching Station, then traverses overhead on ROW 342 for about 6.1 miles before transitioning to an underground line design at Quaker Meetinghouse Road where it continues underground primarily within public roads.[33] From Quaker Meetinghouse Road, the underground transmission line route heads north for approximately one mile before turning east onto Service Road. The route then follows Service Road for approximately 6.5 miles to Oak Street. From Oak Street, the route heads north to the West Barnstable Substation.

Candidate Route 5 provides an alternative approach and design to the all-overhead Candidate Routes 1 and 2, while also providing some measure of geographic diversity compared to Candidate Routes 3 and 4. Accordingly, Candidate Route 5 was retained for detailed evaluation and scoring.

Candidate Route 6 - Eversource ROW 342/Quaker Meetinghouse Road South

Candidate Route 6 involves construction of a new hybrid overhead/underground transmission line approximately 15.6 miles long. The new overhead line is on a segment of ROW 342 and the underground line predominantly within public roads. From Bourne Switching Station, the route traverses 6.1 miles in ROW 342 up to the underground transition point at Quaker Meetinghouse Road. However, instead of heading north on Quaker Meetinghouse Road, as is proposed with Candidate Route 5, the underground segment would head south on Quaker Meetinghouse Road for approximately 1.5 miles before intersecting with Cotuit Road. At this point, the route would then continue easterly on Cotuit Road and then proceed along the same street segments as Candidate Route 3 described above to the West Barnstable Substation. The Candidate Route passes through the towns of Bourne, Sandwich and Barnstable. Refer to Figure 4-2j for the location of Candidate Route 6.

Candidate Route 6 provides an alternative approach and design to the all-overhead Candidate Routes 1 and 2, while also providing some measure of geographic diversity to these overhead routes and the other hybrid routes considered. Accordingly, Candidate Route 6 was retained for detailed evaluation and scoring.

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[33] There are three other paved roadway crossings of ROW 342 further east of Quaker Meetinghouse Road, including Mill Road, Great Hill Road and Service Road as well as several narrow dirt roads and trail systems within municipal conservation lands. Several of these potential route variations would add unnecessary length to the Project, increasing construction costs, duration and impacts. The Company also does not have rights to install the transmission line and create a new "greenfield ROW" within the municipal conservation land areas. These potential route variations do not offer clear or superior advantages from an environmental or constructability perspective relative to the other Candidate Routes identified by the Company. Moreover, these route variations reduce geographic diversity relative to the all-overhead route being considered entirely on ROW 342. Accordingly, these route variations were not considered further.

4.4 Analysis of Candidate Routes

The Candidate Routes described above were evaluated and ranked, applying a scoring methodology based on a number of criteria. Cost estimates were also developed, and the reliability of each Candidate Route was assessed. The routing analysis identified the routes that best balance minimization of environmental effects, reliability and cost.

4.4.1 Criteria and Weight Assessment

The Company evaluated the Candidate Routes using a set of 17 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; and,
- **Constructability Criteria** compare route location and 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-3 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 3 being the highest weight and greater importance. Lower total weighted ratio scores are better in this analysis.

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

4.4.1.1 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:

- Impacts to Residential Land Uses;
- Impacts to Sensitive Receptors;
- Impacts to Commercial/Industrial Units;
- Potential for Traffic Congestion;
- Impacts to Scenic Roadways;

- Impacts to Historic resources;
- Impacts to Archaeological Sensitive Areas; and
- Potential to Encounter Subsurface Contamination.

Residential Land Use

Residents along a Candidate Route could be subject to 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)[34] 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. A ratio score was then calculated for each Candidate Route based on the total number of individual residential units identified for each Candidate Route divided by the highest number of units found along any individual Candidate Route.

Sensitive Receptors

Sensitive receptor land uses include hospitals, elder care facilities, schools, cemeteries, daycares, district courts, nursing homes, police stations, fire stations and religious facilities. Sensitive receptors along each Candidate Route could be subject to temporary impacts due to Project construction, as well as visual impacts from the permanent removal of trees. The number of sensitive receptors includes parcels directly abutting each Candidate Route with a land use type identified as sensitive to the above temporary or permanent impacts. Sensitive receptors were evaluated using available property assessment data from MassGIS and local online databases, field reconnaissance and aerial and street imagery (Nearmap™ 2018). There are 19 sensitive receptors directly abutting the Candidate Routes in the Project Study Area. The sensitive receptors included in the scoring analysis are depicted on Figure 4-4.

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

[34] See https://docs.digital.mass.gov/dataset/massgis-data-master-address-data-basic-address-points.

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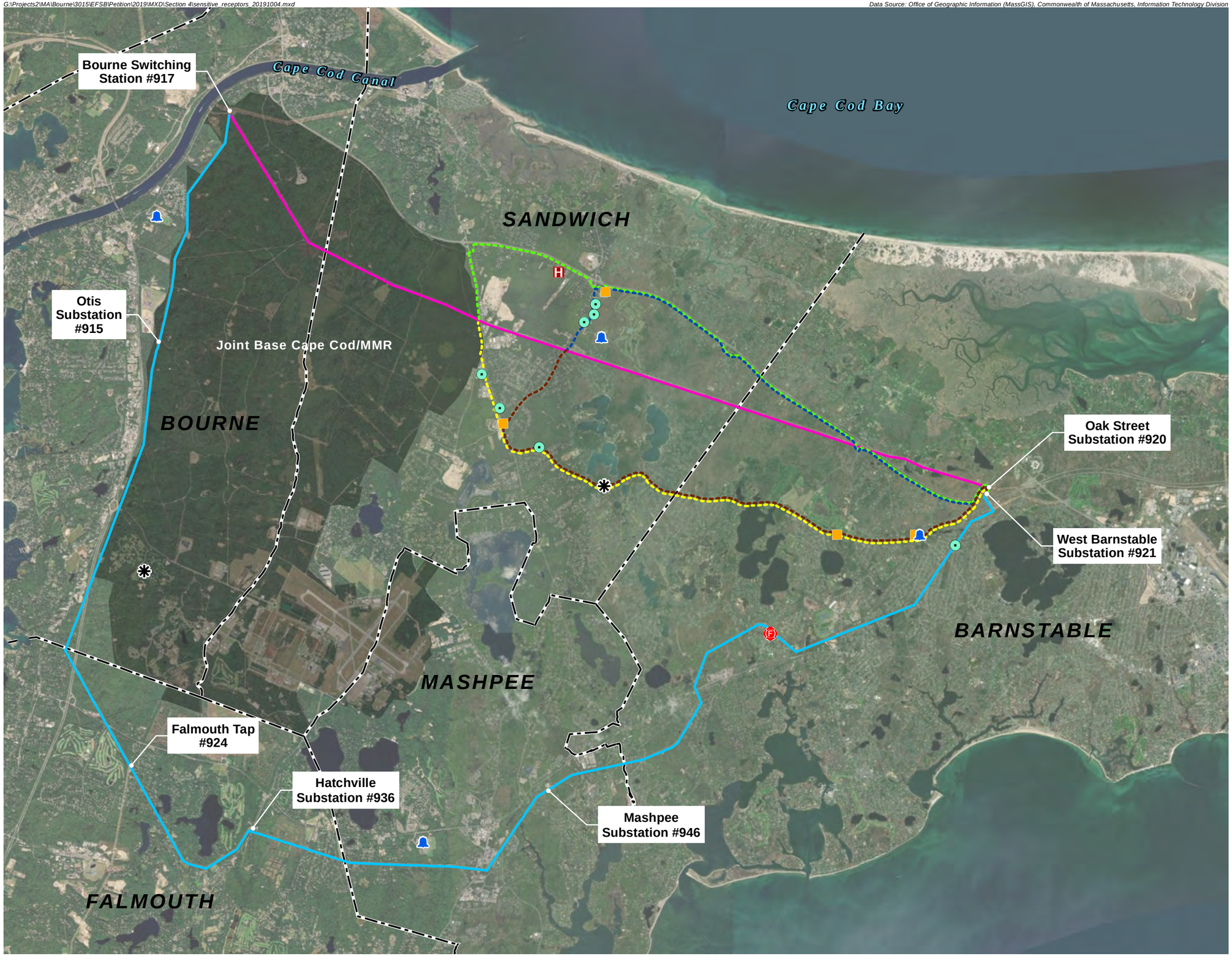
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
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- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR
- Cemetery
- Religious Facility
- Daycare
- Fire Station
- Hospital
- School

Figure 4-4
Sensitive Receptors

Commercial/Industrial Units

Commercial/industrial land uses along each Candidate Route could be subject to the same types of temporary traffic disruption, street closings, noise and other impacts due to Project construction. Commercial/industrial land uses were derived from the number of commercial/industrial units on parcels of land directly abutting each Candidate Route (Eversource ROW and roadway layout from MassGIS parcel data).[35] 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 among all the Candidate Routes.

Potential for Traffic Congestion

The installation of the Project could result in temporary increased traffic density and congestion, traffic disruption, street closings, construction noise and other temporary impacts due to project construction.

To determine an overall score for each Candidate Route, the traffic analysis relied primarily on publicly available traffic volume data (average daily trip or "ADT" data) attributed to the roadway segments comprising the Candidate Routes. The Company relied upon average annual ADT data generated by MassDOT and the Cape Cod Commission in lieu of average estimated summer ADT data, reasoning that roadway construction would not likely be permitted on Cape Cod during the summer tourist season generally between Memorial Day and Labor Day. Other factors considered by the Company included roadway length and width, presence of sidewalks, public transportation routes and MassDOT roadway classifications (e.g., urban minor arterial roads, urban principal arterial or rural major and minor arterial roads). The underground route segments were then ranked from 2 to 4, based on a review of the ADT data and these other considerations. For perspective, the ADT data ranged from 840 to 20,571 with a median ADT of 9,079. Roadway segments with ADT data $\leq$4,859 were ranked a "2"; roadway segments with ADT data between 4,860 and 14,466 were ranked a "3"; and roadway segment $\geq$14,467 were ranked a "4." Overhead route segments that cross over roads were ranked a "1." Examples of roads ranked a "2" include Service Road and Oak Street in Sandwich and Barnstable. Roads with moderate anticipated traffic volume were ranked a "3." Examples of roads ranked a "3" include Quaker Meetinghouse Road and Cotuit Road in Sandwich and Race Lane in Barnstable. Roadways with known higher traffic volumes were generally ranked a "4," including Forestdale Road (Route 130) in Sandwich and Old Stage Road in Barnstable.

[35] For scoring purposes, golf course facilities were considered a commercial/business operation.

Upon completion of route segment rankings, the total length/percentage of overhead ROW or roadway route segments were multiplied by their rank and summed to produce a raw score. The ratio score was calculated by dividing the total traffic raw score determined for each Candidate Route by the highest total traffic raw score among all the Candidate Routes.

Scenic Roadways

G.L. c. 40, § 15C allows municipalities to designate scenic roads to preserve trees, stone walls and other aesthetic features along public roadways. Bourne, Falmouth, Sandwich and Barnstable all have scenic roads, but Mashpee has not identified any scenic roads to date. None of the routes involves work on state or federally designated scenic roads. The potential impacts to scenic roadways were derived from the total length of the designated scenic roadways along the centerline of each route/design or crossing. The Company used length as a proxy for estimating potential impacts because the greater the amount of work on a Scenic Road (or crossing over a Scenic Road with an aerial span and related construction equipment / access), the greater the potential for both temporary or permanent impacts to the features that typically define a Scenic Road (e.g., stone walls, fencing, trees lining side of road). The length (miles) of scenic roadways was determined using ArcGIS and town records. The ratio score was calculated by dividing the total length of scenic roadways determined for each route/design or crossing by the greatest length of scenic roadways among the routes.

The scenic roadways included in the scoring analysis are depicted on Figure 4-5.

Historic Resources

Abutting historic resources could potentially be affected by temporary construction impacts such as earth movement and traffic disruption, as well as by the permanent removal of trees and the placement of transmission facilities in or near historic resources. Identification of historic resources involved a search of Massachusetts Historical Commission ("MHC") records to locate resources including buildings, local historic districts and National Register-listed individual buildings and districts. Historic resources were evaluated using GIS data from MHC's Massachusetts Cultural Resource Information System, which catalogs federal, state and local historic resources.

For Candidate Route underground segments, the number was derived from the total number of historic sites directly abutting the underground segments (roadway layouts from MassGIS parcel data). For Candidate Route overhead segments, the number was derived from historic resources located within 0.25 miles of the proposed route. A ratio score was calculated for each route based on the total number of historic resources determined for each route divided by the highest number of units found along all the routes.

The historic resources included in the scoring analysis are depicted on Figure 4-6.

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

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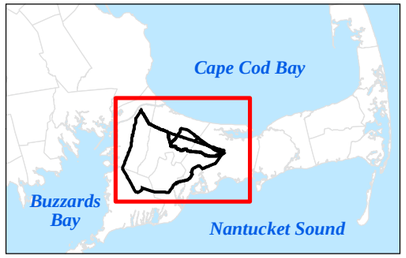

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

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- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR
- Scenic Road Crossing
- Scenic Road Coincident with Route

Figure 4-5
Scenic Roads

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Mid Cape Reliability Project

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- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR

MHC Historic Inventory Points

- Nat'l Register of Historic Places
- NRHP and LHD
- Inventoried Property

MHC Historic Inventory Areas

- Preservation Restriction
- Local Historic District
- Inventoried Area

Figure 4-6

Historic Resources

Archaeological Sensitive Areas

Transmission line construction on Eversource ROWs can potentially impact archaeological resources when earth movement disturbs subsurface artifacts, such as during grading and excavation.

The underground line segments of the Candidate Routes within public roads have been modified by construction of the road, itself, as well as by the installation of above and below-ground utilities, and therefore it is unlikely that natural/undisturbed soils or potentially significant archaeological deposits would be located below or immediately adjacent to a linear excavation in the established roadway. Overhead construction of Candidate Routes on Eversource ROWs could potentially impact these resources. Therefore, the Company's archaeology consultant, Public Archaeology Lab ("PAL"), conducted an Archaeological Sensitivity Assessment and/or field surveys on Candidate Routes with overhead line construction on Eversource ROWs. This work documented previously identified archaeological resources within and adjacent to the proposed construction on the ROWs and assessed the potential to contain significant archeological resources.

Areas of archaeological sensitivity contain known archaeological sites that have not been markedly affected by prior land-altering activities, such as construction, excavation, and erosion; or environmentally sensitive areas that have been determined to have been minimally impacted by prior land-altering activities. Areas that are perennially wet or extensively impacted by land-altering activities were not considered archaeologically sensitive. The extent of potential archaeological resource areas was derived from the length (miles) of archaeological sensitivity areas identified within the ROW limits for the overhead transmission line segments located on Eversource ROWs. A ratio score was calculated for each route based on the total number of miles of archaeologically sensitive areas determined for each route divided by the highest number of units found along all the routes.

The mapped archaeological sensitivity areas are depicted on Figure 4-7.

Potential to Encounter Subsurface Contamination

Subsurface contamination could add complexities to construction, resulting in impacts to cost and schedule. The potential to encounter subsurface contamination was derived from the number of sites on or directly abutting each Candidate Route where a documented release of oil and/or hazardous materials occurred, or where past land uses potentially resulting in contamination have been documented in the MassDEP Bureau of Waste Site Cleanup online database, pursuant to the MCP. The documented release sites included in the scoring analysis are depicted on Figure 4-8.

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

Otis Substation #915

Joint Base Cape Cod/MMR

ROW 342

Oak Street Substation #920

ROW 340

ROW 381

West Barnstable Substation #921

BARNSTABLE

MASHPEE

Falmouth Tap #924

Hatchville Substation #936

Mashpee Substation #946

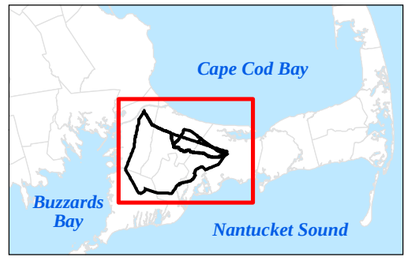
ROW 345

FALMOUTH

Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

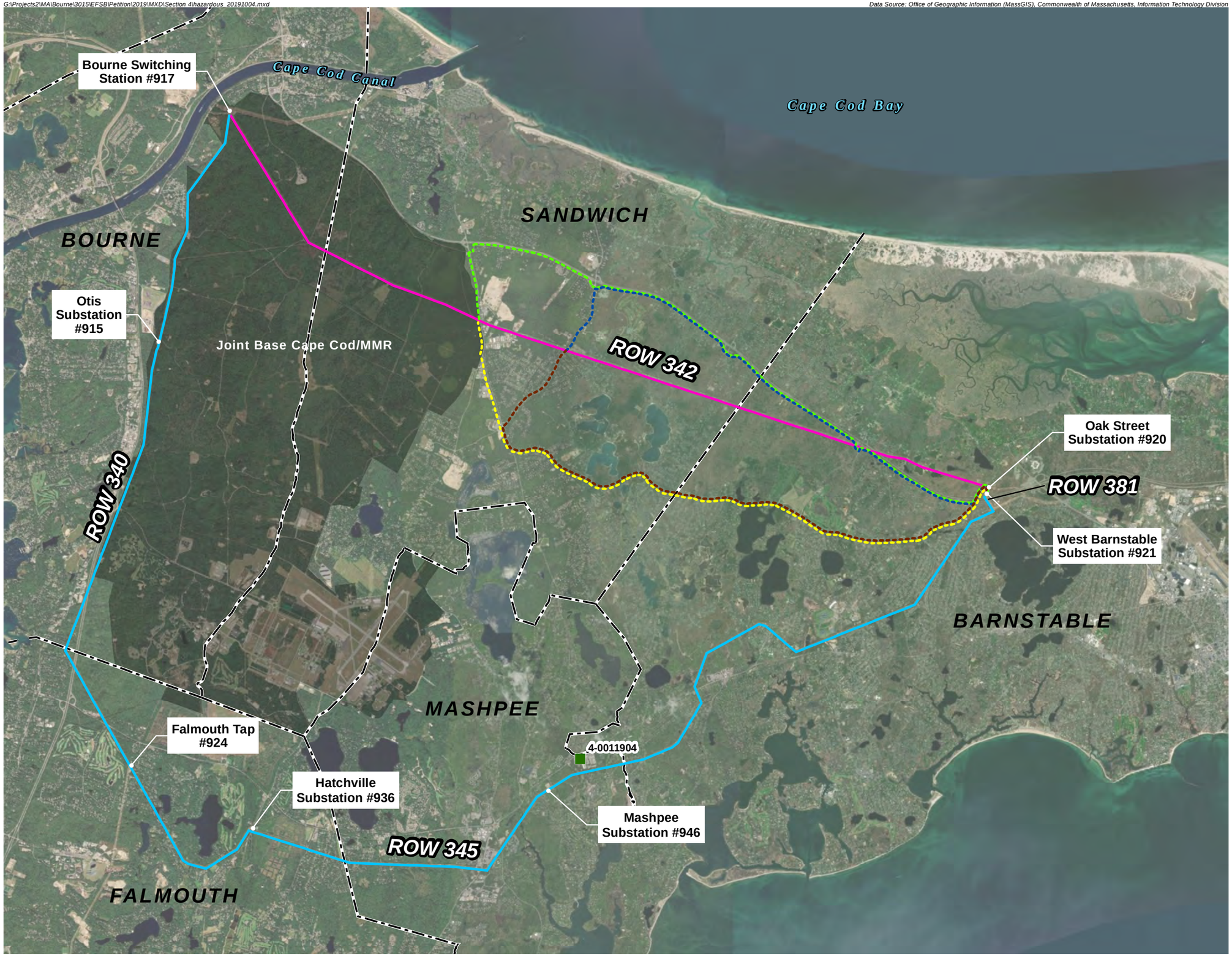
- Candidate Route 1: ROW 342 (12.5 miles)
- Candidate Route 2: ROWs 340/345/381 (26.5 miles)
- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- High/Moderate Archaeological Sensitivity
- Joint Base Cape Cod/MMR
- Town Boundary

Figure 4-7

Archaeological Resources

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 4\hazardous_20191004.mxd

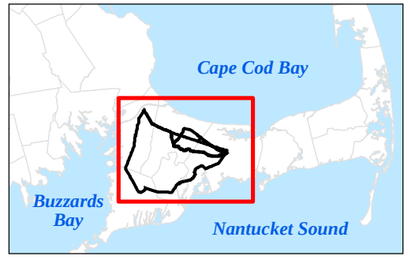
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
- Candidate Route 2: ROWs 340/345/381 (26.5 miles)
- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR

MassDEP Tier Classified Sites (MGL c.21E)

- Tier II

Figure 4-8

MassDEP Tier Classified Oil and/or Hazardous Material Sites, and Sites with Activity and Use Limitations

4.4.1.2 Natural Environment Criteria

Natural environment criteria compare existing conditions of, and potential impacts to, the natural environment. The natural environment criteria included in the scoring analysis are:

- Tree Removal;
- Wetland Resource Areas and Buffer Zones;
- State-listed Rare Species Habitat;
- Public Water Supplies;
- Open Space (conservation lands uses); and
- Article 97 Authorization.

Tree Removal

To accommodate the construction and safe operation of the line, tree removal would be required. Potential tree removal areas associated with the overhead line segments of the Candidate Routes were evaluated on ArcGIS using aerial photogrammetric mapping and confirmed during an on-the-ground survey in 2017. It was assumed that trees would need to be removed from the centerline of the new overhead transmission line structures to the ROW edge or 100 feet, whichever is closer, during the calculation of the criterion score. The ratio score was calculated by dividing the total acreage of tree removal determined for each Candidate Route by the highest number of acres to be removed among all the Candidate Routes.

Underground installation within public roadways was assumed to require no tree removal for scoring purposes; however, the detailed design and engineering of a Candidate Route could identify the need for selective tree removal and/or tree trimming to facilitate construction.

Tree removal included in the scoring analysis is depicted on Figure 4-9.

Wetland Resource Areas and Buffer Zones

Transmission line construction could affect wetland resource areas and their buffer zones through land disturbance, including access road building/hardening, work pad construction, vegetation removal, dewatering activities and material laydown. For scoring purposes, the greater the amount of wetland resource areas and buffer zones within or near the work zone the greater the potential for impacts during construction.

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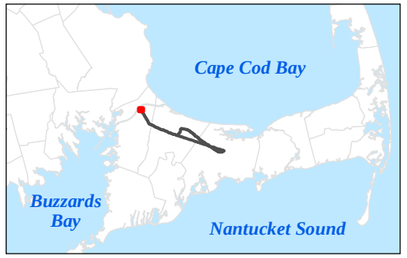
Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:2,400
1 inch = 200 feet

0 100 200 Feet

Basemap: Nearmap Aerial Imagery

LEGEND

- Proposed Structure (Project)
- Proposed Structure (Noticed Variation)
- Existing Bourne Switching Station
- Replacement Bourne Switching Station (approximate)
- Proposed Tree Clearing

Figure 4-9

Limit of Tree Clearing for 115 kV or 345 kV Design Connection

Epsilon ASSOCIATES INC.

The criterion score was derived from the total combined area of state and local jurisdictional wetland resources and buffer zones present within the Eversource ROWs and roadway layouts from MassGIS parcel data for each Candidate Route. Wetland resource areas applicable to the routing analysis, as defined in the Massachusetts Wetland Protection Act regulations (310 CMR 10.00) or local wetlands regulations, included:

- Bordering Vegetated Wetlands;
- Isolated Vegetated Wetlands;
- 100-year floodplain (Bordering Land Subject to Flooding);
- 200-foot Riverfront Area;
- Mapped Vernal Pools; and
- 100-foot Buffer Zones.

Bordering Land Subject to Flooding, 100-foot Buffer Zone and 200-foot Riverfront Area are associated with the underground segments of the Candidate Routes where these resource areas overlay the roadway layouts, as derived from MassGIS parcel data.

Wetland resource areas were identified using a combination of field delineation conducted on Eversource ROWs and utilizing ArcGIS with the most current data available for the underground route segments and adjacent off-ROW areas. The ratio score was calculated by dividing the total acreage of wetland resource areas and buffer zones determined for each Candidate Route by the highest acreage of wetland resource areas and buffer zones among all the Candidate Routes.

Wetland resource areas and buffer zones included in the scoring analysis are depicted on Figure 4-10.

State-listed Rare Species Habitat

Underground installation within public roadways was assumed to have no impacts on state-listed rare species habitat given the developed nature of these areas.

Overhead transmission line construction on existing Eversource ROWs could potentially affect protected habitats for state-listed rare species through construction access, vegetation removal and land disturbance. Areas of protected habitat for state-listed rare species were determined

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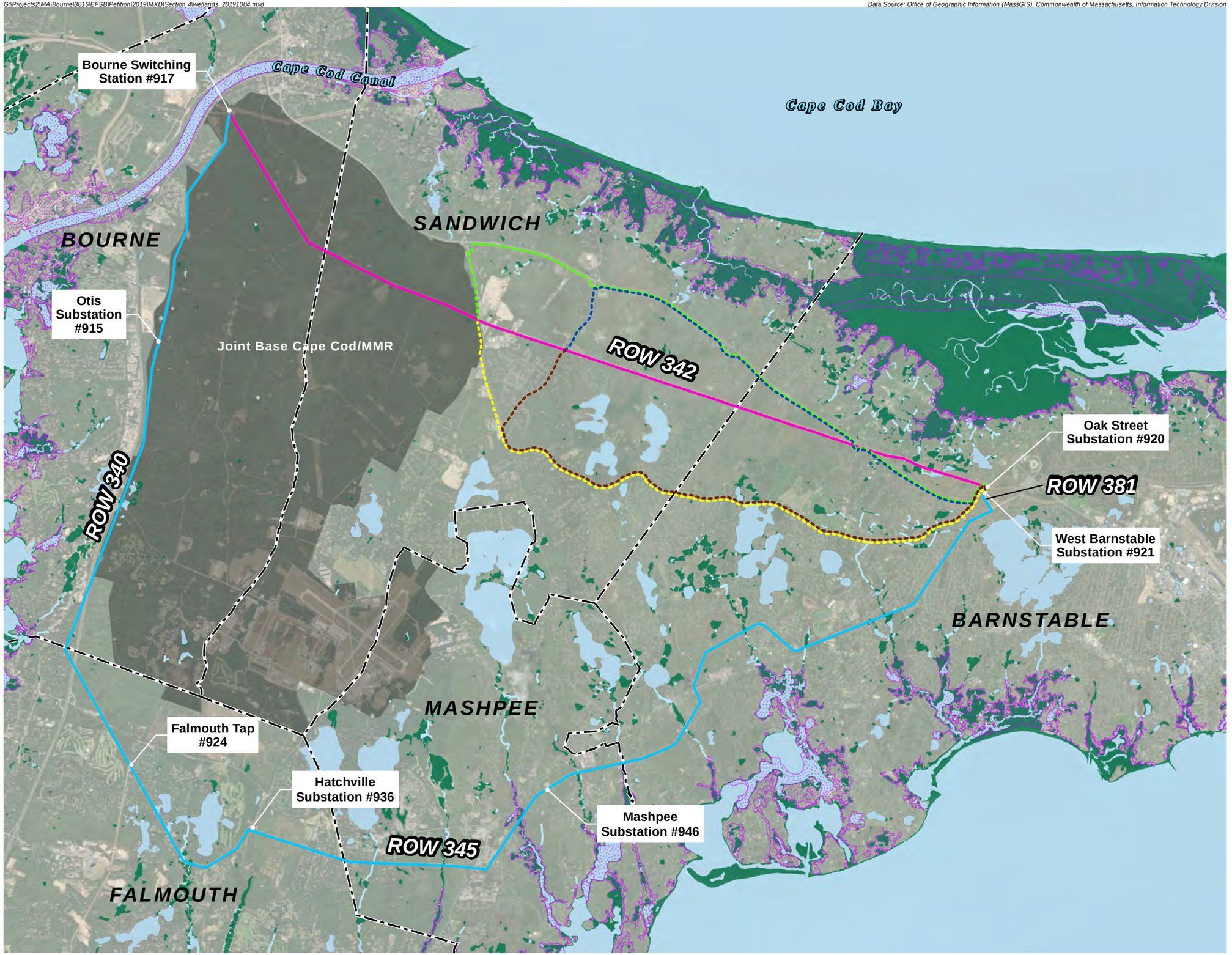
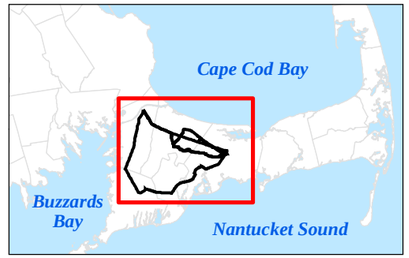
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
- Candidate Route 2: ROWs 340/345/381 (26.5 miles)
- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR
- FEMA Flood Zones A/AE

MassDEP Wetlands (2005)

- Hydrologic Connection
- Wetland
- Open Water

Figure 4-10

Wetland Resource Areas and Buffer Zones

from the areas of Priority or Estimated Habitat, as defined by the NHESP,[36] present within the Eversource ROWs along each Candidate Route involving overhead transmission line construction. Areas of rare species habitat were confirmed utilizing ArcGIS and applying MassGIS mapping of NHESP Priority and Estimated Habitat areas.

The ratio score for each Candidate Route was calculated by dividing the total acreage of NHESP Priority and Estimated Habitat determined for each Candidate Route by the highest measured acreage among all the Candidate Routes.

The mapped state-listed rare species habitat included in the scoring analysis is depicted on Figure 4--11.

Public Water Supplies

Cape Cod is a unique landform in that its underlying aquifer provides drinking water to the area and is managed through eighteen separate water districts or departments. A total of 158 gravel-pack water supply wells and one surface reservoir serve public water to approximately 85% of Cape Cod. The entirety of Cape Cod has also been designated by the U.S. Environmental Protection Agency ("USEPA") as a Sole Source Aquifer.[37] The EPA defines a Sole Source Aquifer as one which supplies at least 50% of the drinking water consumed in the area overlying the aquifer.

Without proper best management practices ("BMPs") and pollution prevention measures (spill kits, re-fueling protocols, sedimentation/erosion controls, dewatering, contractor training, etc.), construction activities on Eversource ROWs or within public roads have the potential to affect drinking water supplies. The public water supply areas considered by the Company in the scoring analysis included the boundaries of aquifers, Zone I and Zone II Water Supply Protection Areas, Wellhead Protection Areas and locally identified water supply protection districts. These drinking water supply resources were identified using available data layers from MassGIS. The length of each Candidate Route that passed through a mapped public water supply resource area was

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[36] As part of the implementation of the Massachusetts Endangered Species Act ("MESA"), NHESP is responsible for reviewing projects and providing and maintaining maps that identify protected species habitat. These maps are available in a statewide paper atlas and GIS format (the "Atlas"). Shown on these maps are two types of protected species habitat. These habitat types include Priority Habitat for State Protected Species ("PH") and Estimated Habitats for Rare Wildlife ("EH"). PH includes habitats for wetland and non-wetland wildlife and plant species. EH includes habitat for wetland dependent wildlife (animal) species only and is intended for use by both the NHESP and local Conservation Commissions during the review of projects subject to the Wetlands Protection Act. No federally-listed species or habitat were identified.

[37] The Safe Drinking Water Act provides USEPA the authority to designate aquifers which are the sole or principal drinking water source for an area, and which, if contaminated, would create a significant hazard to public health. After a Sole Source Aquifer is designated, no commitment for federal financial assistance may be provided for any project which the USEPA determines may contaminate the aquifer through its recharge area to create a significant hazard to public health.

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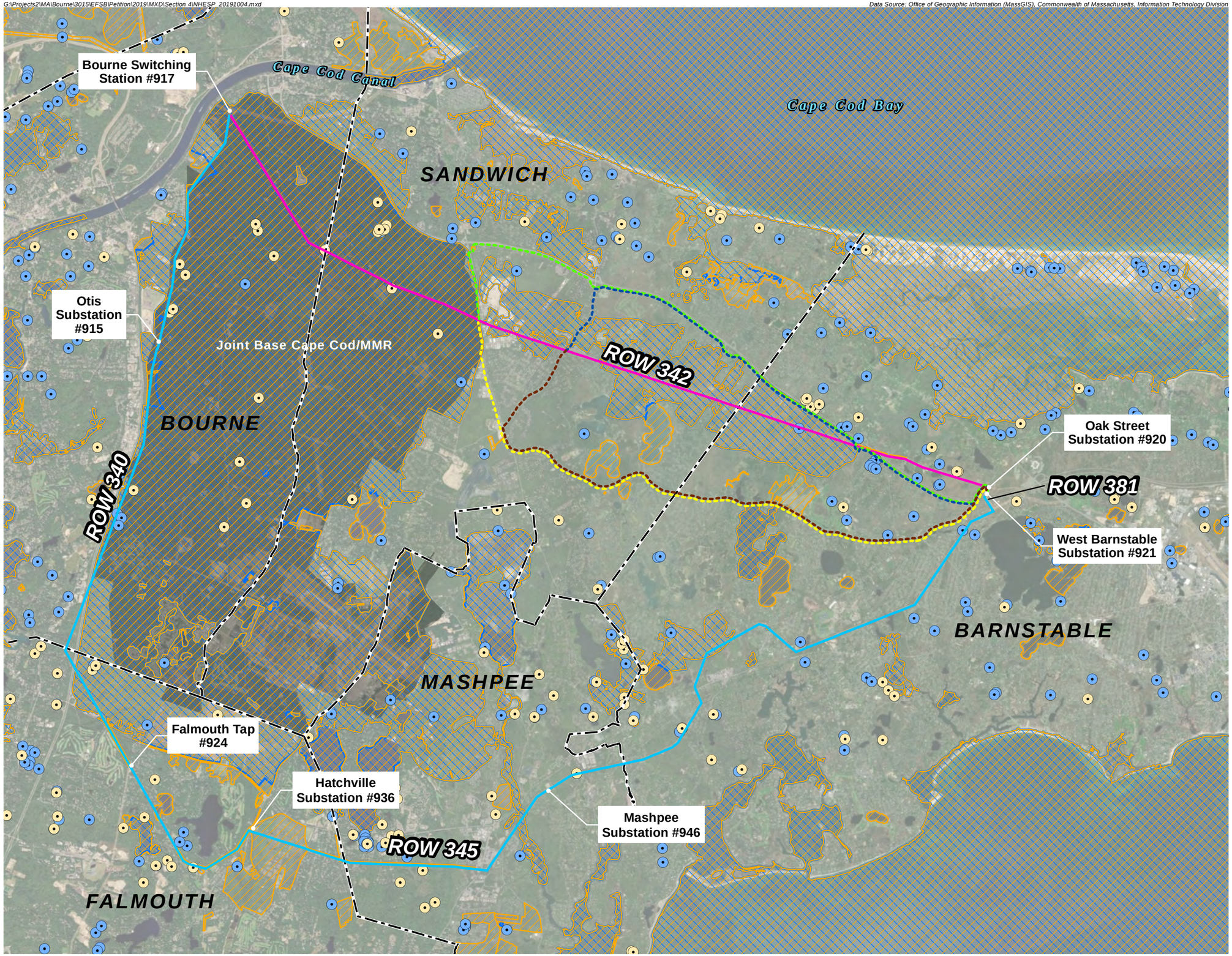
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
- Candidate Route 2: ROWs 340/345/381 (26.5 miles)
- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR
- NHESP 2019 Certified Vernal Pools
- NHESP Potential Vernal Pools: NOT equivalent to Certified Vernal Pools
- NHESP 2017 Priority Habitats for State-Protected Rare Species
- NHESP 2017 Estimated Habitats for Rare Wildlife: For Use with the MA Wetlands Protection Act Regulations (310 CMR 10)

Figure 4-11

Mapped Rare Species Habitats

calculated using ArcGIS. The ratio score was calculated by dividing the total length (measured in miles) of public water supply resources along each Candidate Route by the highest measured length among all the Candidate Routes.

The public water supply areas included in the scoring analysis are depicted on Figure 4-12.

Protected Open Space (Conservation Lands)

The construction and operation of an overhead transmission line could potentially result in impacts to protected open space (conservation lands) crossed by the Candidate Routes through vegetation removal, construction access and land disturbance. Protected open space lands were defined as those properties that were primarily protected for conservation purposes, as identified in available MassGIS data, including town forests, state forests, federal wildlife refuges, privately held forest lands and JBCC. Note that parcels of protected open space land crossed by the Candidate Routes that require Article 97 approval to construct and operate the Project are analyzed under the separate Article 97 criterion (see below).

The length of each overhead segment of the Candidate Routes that crossed conservation lands was derived using ArcGIS. The ratio score was calculated by dividing the total length (measured in miles) of conservation lands crossed by each Candidate Route overhead segment by the highest measured length among all the Candidate Routes.

Underground installation within public roadways was assumed to have no impact on conservation lands because the work would presumably be confined to the existing roadways. Accordingly, for route comparison purposes, the Company scored the segments of Candidate Routes involving underground transmission line construction in roadways as a "0."

The conservation land use areas included in the scoring analysis are depicted on Figure 4-13.

Article 97 Authorization

Article 97 requires, in part, that certain land or easements taken or acquired for natural resource purposes shall not be used for other purposes unless the Massachusetts Legislature approves the change by a two-thirds vote.

The ratio score for this criterion was calculated by dividing the total number of parcels requiring Article 97 approval to construct the transmission line along each Candidate Route by the greatest number of parcels requiring Article 97 approval among all the Candidate Routes.

The parcel requiring Article 97 authorization included in the scoring analysis for Candidate Route 1 is identified on Figure 4-14.

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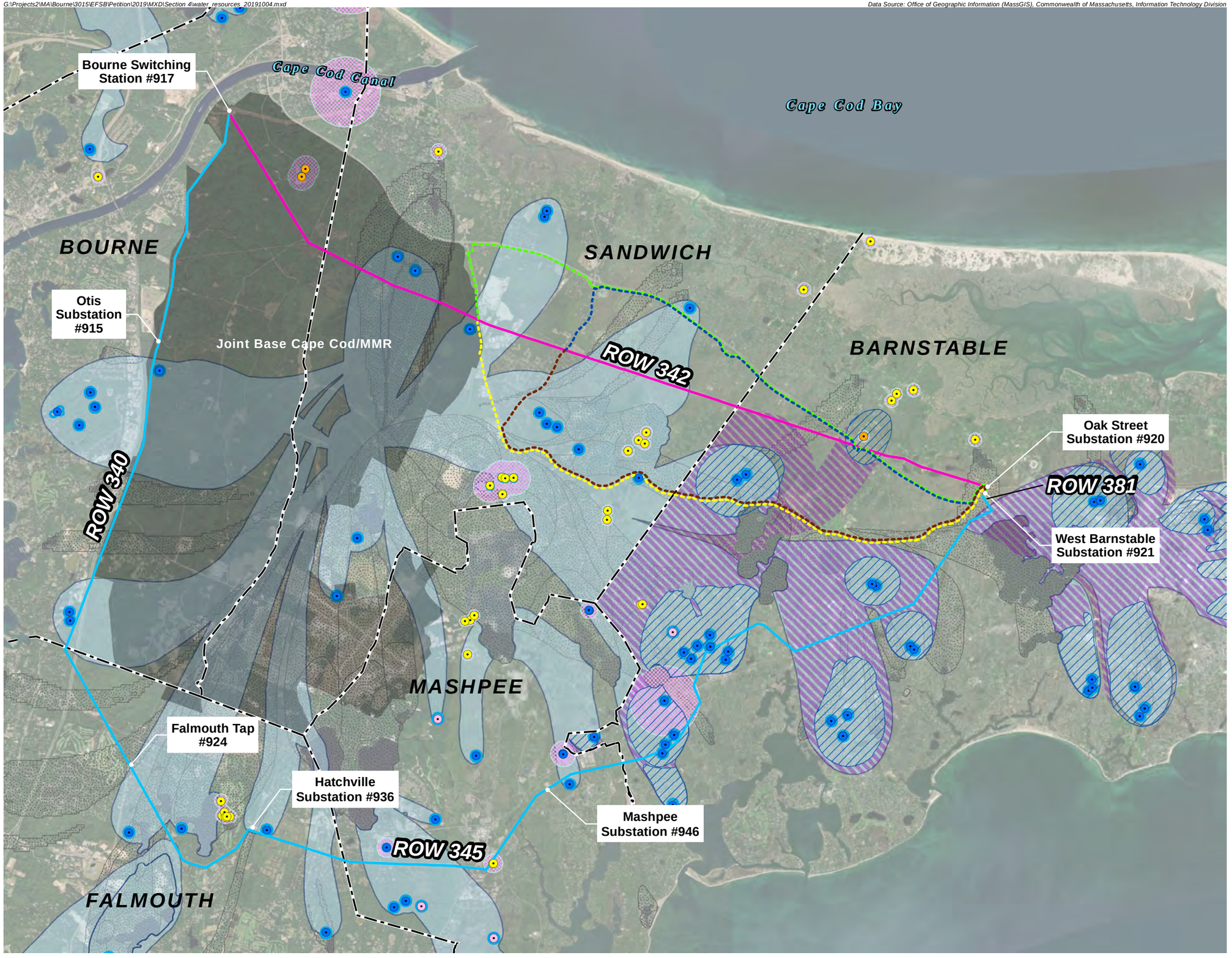
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
- Candidate Route 2: ROWs 340/345/381 (26.5 miles)
- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR
- Public Water Supply Well
- Small Volume Wells, Non-Transient
- Small Volume Wells, Transient
- Proposed Public Water Supply Well
- Barnstable Wellhead Protection Overlay District
- Barnstable Groundwater Protection Overlay District
- Identified Freshwater Recharge Area (CCC Regional Policy Plan)
- DEP Approved Zone I
- Interim Wellhead Protection Area
- Wellhead Protection Area (Zone II)

Figure 4-12

Water Resources

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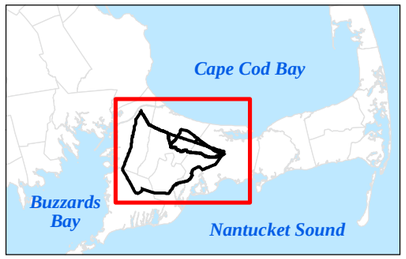
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

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1 inch = 7,000 feet

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Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
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- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR
- Protected Open Space

Figure 4-13
Protected Open Space

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Bourne Switching Station #917

Cape Cod Canal

Cape Cod Bay

BOURNE

SANDWICH

Proposed Easement Modifications
Map 86, Parcel 1 (7,800 s.f.)

Otis Substation #915

Joint Base Cape Cod/MMR

ROW 342

Oak Street Substation #920

ROW 340

ROW 381

West Barnstable Substation #921

BARNSTABLE

MASHPEE

Falmouth Tap #924

Hatchville Substation #936

Mashpee Substation #946

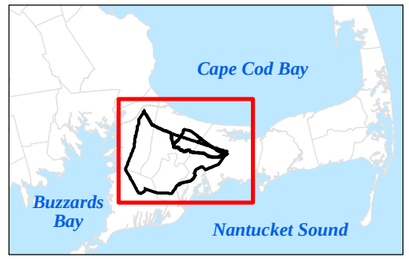
ROW 345

FALMOUTH

Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

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1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
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- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR
- Protected Open Space

Figure 4-14
Article 97 Lands

4.4.1.3 Underground Transmission Line Constructability Criteria

This criterion applies to Candidate Routes involving underground transmission line construction in roadways. Constructability criteria compared route location and design factors that add complexity, schedule delays, reliability concerns or cost to the Project, particularly regarding the underground segments of the Candidate Routes. Constructability factors can also affect the magnitude and duration of impacts. The constructability criteria used in the scoring analysis for this Project, are:

- Existing Utility Density;
- Number of Trenchless Crossings; and
- High Impact Crossings.

These constructability factors are important construction considerations or impacts that allow the Company to identify measurable factors that differentiate between the duration and magnitude of impact to natural and built environmental considerations along each Candidate Route, as well as, cost considerations.

Refer to the following sections for additional detail regarding constructability criteria analyzed by the Company.

Existing Utility Density

The number and location of existing underground pipes, utility conduits and other subsurface features (i.e., drainage manholes and catch basins), and the depth of these facilities in the roadway, can affect the available space below grade to physically install the proposed cable and manhole system. Route options with a higher density of underground utilities along a majority of the route could result in longer construction periods, challenges associated with relocating utilities and/or the need for deeper excavations to avoid such utilities, all of which can have an effect on project costs, schedule and impacts to the community. This can be an important factor in differentiating the potential order of magnitude of impacts to the human environment along various underground routes.

Utility density along the underground segments of the Candidate Routes was assessed using GIS mapping data to assess the number of observed utility manholes and catch basins within the roadway limits. These surficial indicator features were then used to estimate underground utility density. The existing utility data was then normalized in 500-foot increments along each Candidate Route to identify route segments as “low,” “moderate” and “high” for utility density. The delineation of low ($\leq$2 utilities per 500 feet), moderate (3 to 6 utilities per 500 feet) and high ($\geq$7 utilities per 500 feet) is based on the range of collected data. The number of moderate and high segments was totaled for each Candidate Route and divided by the total route length to

generate a ratio representing the utility density score. This ratio score was calculated by dividing the utility density score for each Candidate Route by the highest score found among all the Candidate Routes.

Number of Trenchless Crossings

Trenchless crossings are methods of underground transmission line installation where the traditional open-cut trench method is potentially infeasible (e.g., at crossings of major water bodies or under highways and railroads), therefore requiring alternative methods, such as jack-and-bore ("J&B") or horizontal directional drill ("HDD"). Trenchless crossings can result in a prolonged period of construction with an inherently longer period of impact to abutting land uses. They can also result in a greater amount of temporary land disturbance at the exit and entry pits for the staging of the equipment and lay out of materials needed to accomplish the trenchless installation, which can result in a greater impact than traditional open-cut trench installation.

The Company estimated the number of potential trenchless crossings based on a review of GIS mapping of stream/culvert crossings and field reconnaissance that would potentially be required for the underground segments of the Candidate Routes. For scoring purposes, the analysis is considered conservative because during the detailed design phase it is possible that certain culverts could be crossed with supportive open-cut excavation techniques in lieu of trenchless techniques. The potential trenchless crossing locations included in the scoring analysis for Candidate Route 3 are depicted on Figure 4-15.

High Impact Crossings

High impact crossings are types of crossings requiring extended construction duration and greater potential for extended and severe construction impacts. The selection and feasibility of a particular bridge crossing technique is determined by site specific factors including but not limited to the presence of existing utilities, environmental constraints, depth of cover, bridge design, structural engineering loading requirements, construction access and workspace requirements and cost considerations. Such work would likely be completed over multiple months over a major state roadway, likely outside the tourist season (generally between Memorial Day and Labor Day) on Cape Cod. Depending on the crossing methodology, such crossings could cause a disruption to the public associated with construction noise, visual impacts from tree removal on either side of the bridges, traffic, dust generation and the use of road shoulders to support construction. The number of high-impact crossings was identified for each Candidate Route and a ratio score was calculated by dividing the number of high-impact crossings on the route by the greatest number of such crossings required for any individual Candidate Route (in this case, one).

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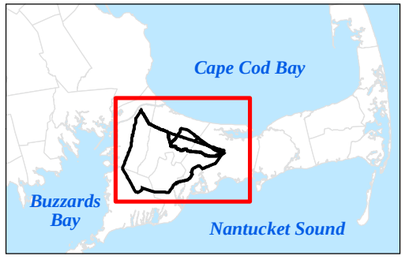
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- Candidate Route 1: ROW 342 (12.5 miles)
- Candidate Route 2: ROWs 340/345/381 (26.5 miles)
- Candidate Route 3: ROW 342/Rt. 130 (Forestdale Road) South (14.4 miles)
- Candidate Route 4: ROW 342/Rt. 130 (Forestdale Road) North (14.7 miles)
- Candidate Route 5: ROW 342/Quaker Meetinghouse Road North (14.0 miles)
- Candidate Route 6: ROW 342/Quaker Meetinghouse Road South (15.6 miles)
- Town Boundary
- Joint Base Cape Cod/MMR
- Potential Trenchless Crossing
- Potential Trenchless and High Impact Crossing

Figure 4-15

Potential Trenchless and High Impact Crossings

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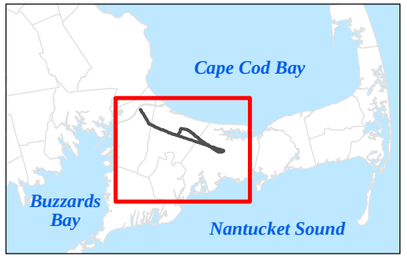
Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

Basemap: ESRI World Imagery

LEGEND

Project:
- ROW 342 (12.5 miles) (115 kV overhead design)

Noticed Variation:
- ROW 342 (12.5 miles) (345 kV design, operated at 115 kV)

Noticed Alternative:
- ROW 342 (6.1 miles) (115 kV overhead design)
- Quaker Meeting House Road North (7.9 miles) (115 kV underground design)
- Town Boundary
- Joint Base Cape Cod/MMR

Figure 4-16

Project, Noticed Variation and Noticed Alternative

Epsilon Associates Inc.

4.5 Criteria Evaluation Methods

The Company scored each Candidate Route based on the evaluating criteria presented in 4.4.1 above. After gathering data for each of the criteria, the Company identified the Candidate Route that had the largest data (number) for each criterion. All other routes/designs were then compared against this number to arrive at an unweighted "raw ratio score" for each Candidate Route on a scale of 0 to 1. For example, if Candidate Route X had 5 trees to be removed, Candidate Route Y had 10 trees, and Candidate Route Z had 15 trees, the unweighted raw ratio scores would be calculated as shown in the following table.

Candidate Route	Number of Trees	Unweighted Raw Ratio Score
Candidate Route X	5	5 ÷ 15 = **0.33**
Candidate Route Y	10	10 ÷ 15 = **0.66**
Candidate Route Z	15	15 ÷ 15 = **1.00**

The ratio scores for each criterion were then added to arrive at total raw ratio scores. The lowest total raw ratio score would equate to the lowest potential for impact at this stage of the analysis. This means that lower total raw scores are better in this analysis. Use of unweighted raw data to compare the Candidate Routes provides a meaningful comparison but does not consider the degree of importance of each criterion to the Project routing.

Accordingly, the Company then conducted a separate scoring analysis that applied weights to the evaluation criteria that were deemed to be of higher significance than other criteria. Use of a 1-to-3 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 3 being the highest weight and greater importance. Lower total weighted ratio scores are better in this analysis. The applied weight for each criterion is compiled on Table 4-3 on the following page.

Table 4-3 Applied Weights for Scoring Criteria

	Scoring Criterion	Applied Weight
DEVELOPED ENVIRONMENT CRITERIA	Residential Units	3
	Sensitive Receptors	3
	Potential for Traffic Congestion	3
	Commercial/Industrial Units	2
	Scenic Roadways	1
	Historic Resources	1
	Archaeological Resources	1
	Potential to Encounter Subsurface Contamination	1
NATURAL ENVIRONMENT CRITERIA	Tree Removal	3
	Wetland Resource Areas & Buffer Zones	1
	Mapped State-listed Rare Species Habitat	2
	Public Water Supply	3
	Protected Open Space (Conservation Lands)	1
	Article 97 Authorization	3
CONSTRUCTABILITY CRITERIA	Existing Utility Density	1
	Number of Trenchless Crossings	1
	High Impact Crossings	3

4.6 Environmental Impact Analysis Results

Table 4-4 on the following page provides an overview of all raw data, total ratio scores and total weighted scores for each Candidate Route. Note that the scoring results are the same for Candidate Route 1 (overhead transmission line on ROW 342), whether it includes a 115-kV or 345-kV overhead transmission line design.

Table 4-4 MidCape Reliability Project Candidate Route Scoring Matrix

		HUMAN ENVIRONMENT CRITERIA								NATURAL ENVIRONMENT CRITERIA						CONSTRUCTABILITY CRITERIA			
CANDIDATE ROUTE		Residential Units	Sensitive Receptors	Potential for Traffic Congestion	Commercial & Industrial Units	Scenic Roadways	Historic Resources	Archaeological Resources	Potential to Encounter Subsurface Contamination	Tree Clearing	Wetland Resource Areas & Buffer Zones	Rare Species Habitat	Public Water Supply	Parcels Requiring Article 97 Authorization	Protected Open Space (conservation land)	Trenchless Crossings	High Impact Crossings	Utility Density	TOTAL SCORE
	Weight	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**2**	**3**	**3**	**1**	**1**	**3**	**1**	
Candidate Route 1: OH on ROW 342	Raw Ratio Score	0.07	0.00	0.52	0.08	0.01	0.40	0.47	0.00	0.003	0.18	0.81	0.43	1.00	0.66	0.00	0.00	0.00	4.63
	Weighted Ratio Score	**0.21**	**0.00**	**1.55**	**0.16**	**0.01**	**0.40**	**0.47**	**0.00**	**0.01**	**0.18**	**1.62**	**1.30**	**3.00**	**0.66**	**0.00**	**0.00**	**0.00**	**9.56**
Candidate Route 2: OH on ROWs 340/345/381	Raw Ratio Score	1.00	0.63	0.52	1.00	0.02	0.85	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.25	0.00	0.00	11.26
	Weighted Ratio Score	**3.00**	**1.88**	**1.55**	**2.00**	**0.02**	**0.85**	**1.00**	**1.00**	**3.00**	**1.00**	**2.00**	**3.00**	**0.00**	**1.00**	**0.25**	**0.00**	**0.00**	**21.54**
Candidate Route 3: Hybrid-ROW 342/Route 130 (Forestdale Road) South	Raw Ratio Score	0.38	1.00	1.00	0.88	1.00	1.00	0.12	0.00	0.003	0.03	0.44	0.72	0.00	0.38	1.00	1.00	1.00	9.96
	Weighted Ratio Score	**1.15**	**3.00**	**3.00**	**1.76**	**1.00**	**1.00**	**0.12**	**0.00**	**0.01**	**0.03**	**0.88**	**2.16**	**0.00**	**0.38**	**1.00**	**3.00**	**1.00**	**19.49**
Candidate Route 4: Hybrid - ROW 342/Route 130 (Forestdale Road) North	Raw Ratio Score	0.11	0.25	0.76	0.34	0.52	0.45	0.12	0.00	0.003	0.04	0.44	0.35	0.00	0.38	0.25	1.00	0.63	5.64
	Weighted Ratio Score	**0.34**	**0.75**	**2.28**	**0.67**	**0.52**	**0.45**	**0.12**	**0.00**	**0.01**	**0.04**	**0.88**	**1.05**	**0.00**	**0.38**	**0.25**	**3.00**	**0.63**	**11.36**
Candidate Route 5: Hybrid - ROW 342/Quaker Meetinghouse Road North	Raw Ratio Score	0.15	0.63	0.61	0.11	0.52	0.45	0.17	0.00	0.003	0.04	0.51	0.29	0.00	0.38	0.25	1.00	0.25	5.38
	Weighted Ratio Score	**0.46**	**1.88**	**1.84**	**0.22**	**0.52**	**0.45**	**0.17**	**0.00**	**0.01**	**0.04**	**1.03**	**0.87**	**0.00**	**0.38**	**0.25**	**3.00**	**0.25**	**11.38**
Candidate Route 6: Hybrid - ROW 342/Quaker Meetinghouse Road South	Raw Ratio Score	0.46	0.75	0.90	0.14	1.00	0.65	0.17	0.00	0.003	0.03	0.51	0.73	0.00	0.38	1.00	1.00	0.92	8.64
	Weighted Ratio Score	**1.38**	**2.25**	**2.69**	**0.29**	**1.00**	**0.65**	**0.17**	**0.00**	**0.01**	**0.03**	**1.03**	**2.18**	**0.00**	**0.38**	**1.00**	**3.00**	**0.92**	**16.97**

Table 4-5 presents a summary of the Candidate Routes ranked by a total weighted environmental score. The lowest score equates to the lowest potential for impact based on the criteria used in this analysis. The Candidate Route that has the lowest and highest potential for impact is highlighted in green (lowest) and red (highest), respectively.

Table 4-5 Environmental Rank by Total Weighted Scores

Candidate Route	Route Length (miles)	Total Weighted Score	Rank
Route 1 - OH on ROW 342	12.5	9.56	1
Route 2 - OH on ROWs 340/345/381	26.5	21.54	6
Route 3 – Hybrid: ROW 342/Route 130 (Forestdale Road) South	14.4	19.49	5
Route 4 – Hybrid: ROW 342/Route 130 (Forestdale Road) North	14.7	11.36	2
Route 5 – Hybrid: ROW 342/Quaker Meetinghouse Road North	14.0	11.38	3
Route 6 – Hybrid: ROW 342/Quaker Meetinghouse Road South	15.5	16.97	4

As shown in Table 4-5, Candidate Route 1 has the lowest weighted environmental score and would result in the lowest potential for impact of the six Candidate Routes evaluated. It is also the shortest Candidate Route to construct. Candidate Route 4 had the second lowest weighted environmental score and would result in fewer potential impacts relative to the remaining four Candidate Routes. This route is also a geographically distinct routing alternative to Candidate Route 1. Candidate Route 2 had the highest weighted environmental score and would result in the greatest potential for impacts of all the Candidate Routes.

The following sections provide more detailed comparisons and observations of the environmental analysis results.

4.6.1 Environmental Scoring Criteria Overview Tables

Tables 4-6 through 4-8 on the following pages provide an overview of how each Candidate Route scores with respect to the three distinct subcategories of the environmental criteria: the developed environment, the natural environment, and constructability.

As shown in these tables, Candidate Route 1 has the lowest potential for impacts to the developed environment and is least difficult to construct. Candidate Route 1 and the other all-overhead Candidate Route 2 have a higher potential for impacts to the natural environment (scoring 5 and 6 respectively) when compared to the routes involving underground line construction in public roads, due to the previously developed/built conditions of the roadway routes versus the more natural, vegetated and maintained open ROW conditions (wetlands, rare species, tree removal, Article 97, etc.). Candidate Route 2 is nearly 27 miles long; significantly longer than any other overhead and combination overhead/underground routes considered, resulting in significant impacts to cost and schedule and, as such, is reasonably considered to have greater costs and impacts. Though representing a geographically diverse route, Candidate Route 2 is an outlier to the other routes analyzed herein, all of which have generally comparable lengths.

With regard to underground route options, the potential for impacts to the developed environment and construction difficulty increases for those underground routes heading south from ROW 342 on Route 130/Forestdale Road (Candidate Route 3) or Quaker Meetinghouse Road (Candidate Route 6), where the potential for impacts increases to a number of scoring criteria including: sensitive receptors, commercial / industrial properties, potential for traffic congestion, scenic roadways, historic resources, number of trenchless crossings, and public water supply areas.

Refer to Tables 4-6 and 4-7 on the following page for additional detail.

Table 4-6 Overview of Developed Environment Scores

Candidate Route	Developed Environment	
	Weighted Score	Rank
Route 1 - OH on ROW 342	2.79	1
Route 2 - OH on ROWs 340/345/381	11.29	5
Route 3 - Hybrid: ROW 342/Route 130 (Forestdale Road) South	11.03	6
Route 4 - Hybrid: ROW 342/Route 130 (Forestdale Road) North	5.14	2
Route 5 - Hybrid: ROW 342/Quaker Meetinghouse Road North	5.55	3
Route 6 - Hybrid: ROW 342/Quaker Meetinghouse Road South	8.43	4

Table 4-7 Overview of Natural Environment Scores

Candidate Route	Natural Environment	
	Weighted Score	Rank
Route 1 - OH on ROW 342	6.77	5
Route 2 - OH on ROWs 340/345/381	10.00	6
Route 3 - Hybrid: ROW 342/Route 130 (Forestdale Road) South	3.45	3
Route 4 - Hybrid: ROW 342/Route 130 (Forestdale Road) North	2.35	2
Route 5 - Hybrid: ROW 342/Quaker Meetinghouse Road North	2.33	1
Route 6 - Hybrid: ROW 342/Quaker Meetinghouse Road South	3.63	4

As reflected in Table 4-8 below, the constructability criteria (utility density, trenchless crossings and high impact crossings) were applied to the underground transmission line segments of hybrid Candidate Routes 3 through 6 and Candidate Route 2 (trenchless crossing to connect into West Barnstable Substation). The all-overhead transmission line design associated with Candidate Route 1 was not considered to have these constructability concerns.

Table 4-8 Overview of Constructability Scores

Candidate Route	Constructability	
	Weighted Score	Rank
Route 1 - OH on ROW 342	0.00	1
Route 2 - OH on ROWs 340/345/381	0.25	2
Route 3 - Hybrid: ROW 342/Route 130 (Forestdale Road) South	5.00	6
Route 4 - Hybrid: ROW 342/Route 130 (Forestdale Road) North	3.88	4
Route 5 - Hybrid: ROW 342/Quaker Meetinghouse Road North	3.50	3
Route 6 - Hybrid: ROW 342/Quaker Meetinghouse Road South	4.92	5

4.7 Cost Analysis

The Company evaluated cost estimates for each Candidate Route.

Many factors could affect the cost of a transmission line project, including cost and availability of materials and equipment, labor, presence of contaminated soils and potential for work hour restrictions or time-of-year restrictions imposed by project permits, the local community or other entities. Subsurface conditions, such as the type and depth of soil and rock that must be excavated in order to place the duct bank or the tower footings could also significantly affect project cost. Waterbodies or other features that may need to be traversed by trenchless or other more complex crossing options, could also significantly affect project cost. Please see Table 4-9 below for the cost estimates for the Candidate Route options.

Table 4-9 Candidate Route Cost Estimates

Candidate Route	Cost[38] (millions)	Cost Ranking	Percent More than Lowest Cost Estimate
Route 1 - OH on ROW 342 (115-kV/345kV design)	$59.1 – $68.0[39]	1	0%
Route 2 - OH on ROWs 340/345/381	$102[40]	2	73%
Route 3 - Hybrid: ROW 342/Route 130 (Forestdale Road) South	$304.2	5	414%
Route 4 - Hybrid: ROW 342/Route 130 (Forestdale Road) North	$312.5	6	429%
Route 5 - Hybrid: ROW 342/Quaker Meetinghouse Road North	$262.3	3	344%
Route 6 - Hybrid: ROW 342/Quaker Meetinghouse Road South	$303.8	4	414%

4.8 Reliability Analysis

The Company considered whether there was a difference in the Candidate Routes with regard to reliability. Increased length of a transmission system, in theory, could introduce additional exposure to potential faults and increase the risk to the reliability of the transmission system. However, this factor is difficult to quantify and not a dispositive factor in this case. Both overhead,

[38] Cost estimates include transmission line design; substation modifications /connections; survey; environmental compliance; environmental mitigation; siting and permitting; construction management; public outreach; risk contingency; any related distribution line work; and other potential associated costs.

[39] A planning grade estimate (-25%/+25%) was developed for Candidate Route 1 (115-kV design) based on the detailed engineering drawings ($59.1 million). An order of magnitude estimate (-50%/+200%) was developed for Candidate Route 1 345-kV design ($68.0 million) based on conceptual engineering drawings.

[40] An order of magnitude estimate (-50%/+200%) was developed for Candidate Routes 2 through 6 based on conceptual engineering drawings.

underground and combination transmission designs are inherently reliable. While an underground line may be less susceptible to weather-induced outages, an overhead line takes much less time to repair in the event of an outage (days rather than weeks). Accordingly, reliability was not a determining factor when comparing Candidate Routes.

4.9 Selection of Project, Noticed Variation and Noticed Alternative Route

Table 4-10 provides a comprehensive summary of the Candidate Routes and their relative rankings with respect to the natural environment, developed environment, constructability, overall environmental score and cost.

Table 4-10 Ranking Summary of Candidate Routes/Designs

Candidate Route	Developed Environment	Natural Environment	Constructability	Total Environmental	Total Cost
Route 1 - OH on ROW 342 (115-kV design)	1	5	1	1	1
Route 2 - OH on ROWs 340/345/381	5	6	2	6	2
Route 3 - Hybrid: ROW 342/Route 130 (Forestdale Road) South	6	3	6	5	5
Route 4 - Hybrid: ROW 342/Route 130 (Forestdale Road) North	2	2	4	2	6
Route 5 - Hybrid: ROW 342/Quaker Meetinghouse Road North	3	1	3	3	3
Route 6 – ROW 342/Quaker Meetinghouse Road South	4	4	5	4	4

As a result of the above, Eversource made the following selections, with respect to the Project:

Project: The Company balanced considerations of impacts and costs in selecting Candidate Route 1 for its Preferred Route with the lowest overall environmental score (9.56) and lowest cost. Accordingly, this route has been incorporated as a component of the Project.

Noticed Alternative: Candidate Route 4 has the second lowest overall environmental score (11.36). Candidate Route 5 has a comparable overall environmental score (11.38). While these environmental scores are close, Candidate Route 4 would cost $50 million dollars more to construct when compared to Candidate Route 5 ($312.5 million vs. $262.3 million). The

difference in cost between these two routes is attributed primarily to the longer section of underground transmission line in public roads (1.7 miles) for Candidate Route 4, versus less expensive overhead line construction on existing ROW.

Candidate Route 5 ranked third overall from a cost perspective and is the lowest cost combination route considered by the Company. It is nearly $42 million dollars less expensive to construct then the next lowest hybrid route, Candidate Route 6. Candidate Route 5 also provides a measure of geographic diversity relative to the Project. Accordingly, Candidate Route 5 has been identified as the Noticed Alternative.

Noticed Variation: The Company has also identified, for the Siting Board's consideration, a variation to the Project that would involve the design and construction of 345-kV transmission line on the same ROW but operated at 115-kV (the "Noticed Variation"). As the Noticed Variation will be operated at 115-kV, it does not incorporate any other impacts such as station or ROW expansion. No change to the environmental criteria scoring was identified during the routing analysis when compared to the Project's 115-kV design. The primary difference in the Project and the Noticed Variation is in the physical size of the structures and a slight increase in conductor size. Therefore, this variation with the 345-kV design option still has the lowest overall environmental score (9.56). While the costs are higher to install 345-kV structures (+ $8.9 million) relative to the Project, it would provide the flexibility to support potential expansion to 345-kV operation that could facilitate future interconnections of renewable energy generation proposed for Barnstable Switching Station and West Barnstable Substation.

4.10 Conclusion

In accordance with the Siting Board's standard of review, the Company's Petition objectively and comprehensively assessed a wide array of potential routes and design variations within the bounds of the Project Study Area. At the conclusion of this process, the Company preliminarily identified a preferred Project, Noticed Variation and Noticed Alternative that best balance environmental impacts, costs and reliability and enable the Company to meet the identified need (see Figure 4-16).

A more detailed examination and comparison of the Project, Noticed Variation, and Noticed Alternative is presented in Section 5 of this Analysis.

Section 5.0

Route Comparison

5.0 ROUTE COMPARISON

5.1 Introduction and Overview

As presented in Section 4, the Company selected Candidate Route 1 as the Project because it provided the best balance of the applied route selection criteria, along with considerations of reliability and cost. A geographically distinct routing alternative, Candidate Route 5, was selected as the Noticed Alternative.

This Section provides an overview of the construction sequence and provides a detailed comparison of the potential environmental impacts and mitigation, cost and reliability associated with the construction and operation of the Project and the Noticed Alternative. Included herein are descriptions, maps and construction methods and photographs of each of the options along with a description of associated modifications to the work proposed at Eversource's West Barnstable Substation. The construction methods and associated impacts described in this Section are based on preliminary engineering designs. A more detailed engineering design will be developed as part of the final design phase and will include continued input from stakeholders, such as the Towns of Bourne, Barnstable and Sandwich.

Based on this detailed comparison, the Company determined that, while the Project and Noticed Alternative would offer comparable reliability, the Project, on balance, is superior to the Noticed Alternative. The Project would cost the least with mitigatable impacts to the natural environment. The Noticed Variation, which would involve the design and construction of a 345-kV transmission line on the same ROW as the Project but operated at 115-kV, costs more with similar impacts to the natural environment as the Project, while providing potential synergy for future interconnections of renewable generation. The Noticed Alternative would have the least potential for impacts to the natural environment but would have a much higher cost.

Because the primary difference between the Noticed Variation and the Project is the physical size of the transmission line structures (but not the number of structures) and a different conductor configuration, the Noticed Variation will only be discussed for the remainder of Section 5 when it is different from the Project.

5.2 Route Descriptions

The routes for the Project and Noticed Alternative (collectively the "Routes") are depicted in Figure 5-1. Photos of existing locations along the Routes are provided in the Photo Key Sheet, Appendix 5-3.

5.2.1 Proposed Project

The Project design consists of approximately 12.5 miles of a new overhead transmission line on existing Eversource ROW 342 to ROW 381 between the Bourne Switching Station and the West Barnstable Substation. A detailed map set of the Project is provided in Appendix 5-1.

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Mid Cape Reliability Project

EVERSOURCE

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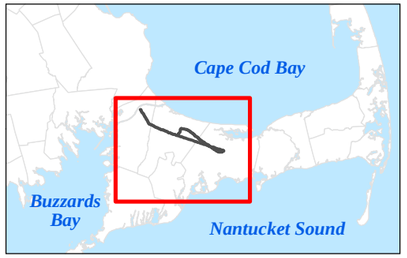

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

LEGEND

Project:
- ROW 342 (12.5 miles) (115 kV overhead design)

Noticed Variation:
- ROW 342 (12.5 miles) (345 kV design, operated at 115 kV)

Noticed Alternative:
- ROW 342 (6.1 miles) (115 kV overhead design)
- Quaker Meeting House Road North (7.9 miles) (115 kV underground design)
- Town Boundary
- Joint Base Cape Cod/MMR

Figure 5-1

Project, Noticed Variation and Noticed Alternative

Epsilon Associates Inc.

5.2.2 Noticed Alternative

The Noticed Alternative includes construction of 14 miles of new transmission line, of which 6.1 miles is a new overhead line on a segment of ROW 342 and the remaining 7.9 miles is a new underground transmission line located primarily in public roadways. The Noticed Alternative shares its 6.1-mile overhead segment with the Project until it transitions to the underground segment at Quaker Meetinghouse Road in Sandwich and runs through local streets to West Barnstable Substation. A detailed map set of the Noticed Alternative is provided in Appendix 5-2.

5.3 Ancillary and Related Facilities

Improvements and equipment modifications are required at the Bourne Switching Station and West Barnstable Substation to accommodate the New Line, the specifics of which will vary depending on whether the approved construction requires overhead or underground transmission connections. To connect the New Line, the existing western fence line at the West Barnstable Substation[41] will be expanded by approximately 65 feet to provide space for the required new equipment. The expansion work will take place on some existing disturbed and graveled areas but will also include approximately 1.4 acres of tree removal where grading, modifications to an existing stormwater swale, reconfiguring an existing gravel access road and relocating the existing 25-kV distribution line poles will occur. The new substation equipment would consist of two new 115-kV circuit breakers and terminal equipment specific to either an overhead or underground connection. No new transformers are proposed. New control equipment will be added within the existing control house located along the eastern edge of the substation.

As depicted on Figure 5-2, the nearest residential parcel to the existing West Barnstable Substation fence line is 575 Oak Street, located approximately 320 feet to the west; and 550 Oak Street, located approximately 340 feet to the west.

[41] NSTAR constructed the West Barnstable Substation in 2012 as part of the NSTAR Lower Southeastern Massachusetts ("SEMA") Reliability Project (EFSB 10-2/DPU 10-131/DPU 10-132). The substation facilities are bordered to the north by Eversource ROW 342 and residential properties; to the east by undeveloped woodland; to the south by Route 6 (Mid Cape Highway) and Eversource ROW 381; and to the west by undeveloped woodland and residential properties. The wooded portions of the site are comprised primarily of oak and pine species. A small approximately 2,600 s.f. isolated vegetated wetland exists just north of the West Barnstable Substation fence line. To the extent the Siting Board considers the proposed work at West Barnstable Substation associated with this Project to be a project change from its original approval in EFSB 10-2/D.P.U. 10-131/10-132, the Company respectfully requests that the Siting Board determine that the Project does not require further inquiry beyond its review and analysis of the Company's proposal in this proceeding.

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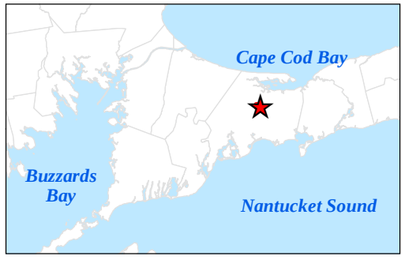
Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:2,400
1 inch = 200 feet

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Basemap: Nearmap Imagery

LEGEND

Tax Parcel Boundary (MassGIS)

Figure 5-2

Adjacent Residential Properties at West Barnstable Substation

Epsilon Associates Inc.

With the proposed substation expansion, the distance to these residential parcels from the expanded West Barnstable Substation fence line will be approximately 265 feet and 283 feet, respectively. The residential structures on these lots will be approximately 286 feet and 390 feet from the new substation fence line. See Figure 5-3a for additional detail.

While a wooded buffer of approximately 200 feet will remain between these residences and the expanded substation facility, the Company will consult with the abutting property owners to provide additional screening, as may be necessary.

With respect to the Bourne Switching Station, the Company is currently rebuilding the facility in a design that has sufficient space to accommodate additional future line terminations such as the New Line. The Bourne Switching Station is located in a remote section of JBCC. The nearest residential neighborhood is located approximately 1,000 feet northeast of the station in the Hobbler Road neighborhood of Bourne. The substation equipment will include a new 115-kV bus, one 115-kV breaker and line terminal disconnect switch, disconnect switches and the associated control work within the new control house constructed as part of the station rebuild.

5.4 General Construction Sequence for the Overhead Transmission Line

Eversource will construct the new overhead facilities in several stages, some overlapping in time. The following summarizes the typical sequence of construction activities:

- Survey and stake the ROW boundaries (where necessary), vegetation clearing boundaries, and new structure locations;
- Mark the boundaries of previously delineated wetlands and water courses;
- Establish construction field offices and laydown yards and prepare storage and staging areas to support the construction effort;
- Install erosion and sediment controls;
- Perform tree and vegetation removal;
- Improve existing access roads and/or construct new temporary and permanent access roads as necessary;
- Construct work pads and pull pads;
- Relocate existing 25-kV distribution line;
- Construct structure foundations;
- Install structure grounding systems, including counterpoise (where needed);
- Erect/assemble new transmission line structures;

- Install conductor and shield wire;
- Remove temporary roads and construction debris and restore disturbed sites; and
- Maintain temporary erosion and sediment controls until vegetation is re-established or disturbed areas are otherwise stabilized. Upon completion of sufficient revegetation and site stabilization, temporary erosion and sediment controls will be removed.

5.4.1 Mobilization and Laydown

Prior to the start of construction, Eversource's contractor will identify a marshaling/storage yard in the general vicinity of the Project or Noticed Alternative. This area is typically an existing contractor's yard or unused space at a commercial or industrial facility. The staging area(s) will have temporary offices, sanitation facilities, dumpsters and containers specifically for collection and recycling of shipping and crating material and scrap metals. The identified yard will be reviewed and designed to minimize the impact to vegetation and the environment.

5.4.2 Installation of Erosion and Sediment Controls

Following mobilization, erosion and sediment ("E&S") controls will be installed in accordance with Eversource's BMP Manual. E&S controls could include straw bales, silt fence, compost filter tubes and/or straw wattles or otherwise in accordance with applicable environmental permit requirements. The E&S controls will be installed between the work areas and environmentally sensitive areas, such as wetlands and streams, as required. The E&S controls will be inspected regularly and promptly repaired or replaced, as needed. The approximate locations of these BMPs are provided in Appendices 5-1and 5-2.

5.4.3 Tree and Vegetation Removal

Some tree removal (approximately 0.19 acres) in the ROW near the Bourne Switching Station is required to construct the Routes, but ROW 342 is otherwise maintained and cleared of mature trees from edge-to-edge (see Figure 4-9 in Section 4.0 of the Petition).

Approximately 1.4 acres of tree removal is proposed at West Barnstable Substation for work associated with the substation's expansion (see Figures 5-3a and 5-3b).

5.4.4 Installation of Access Roads and Work Pads

There are existing gravel access roads within ROW 342 that will be used for construction work. Most of the existing gravel access roads that run the length of the ROW are well maintained and in good condition. Some minor grading and top-dressing of existing access roads will be required to support the heavy equipment required to install the overhead transmission line. This includes the first approximately half-mile of ROW 342 heading east from Bourne Switching Station and

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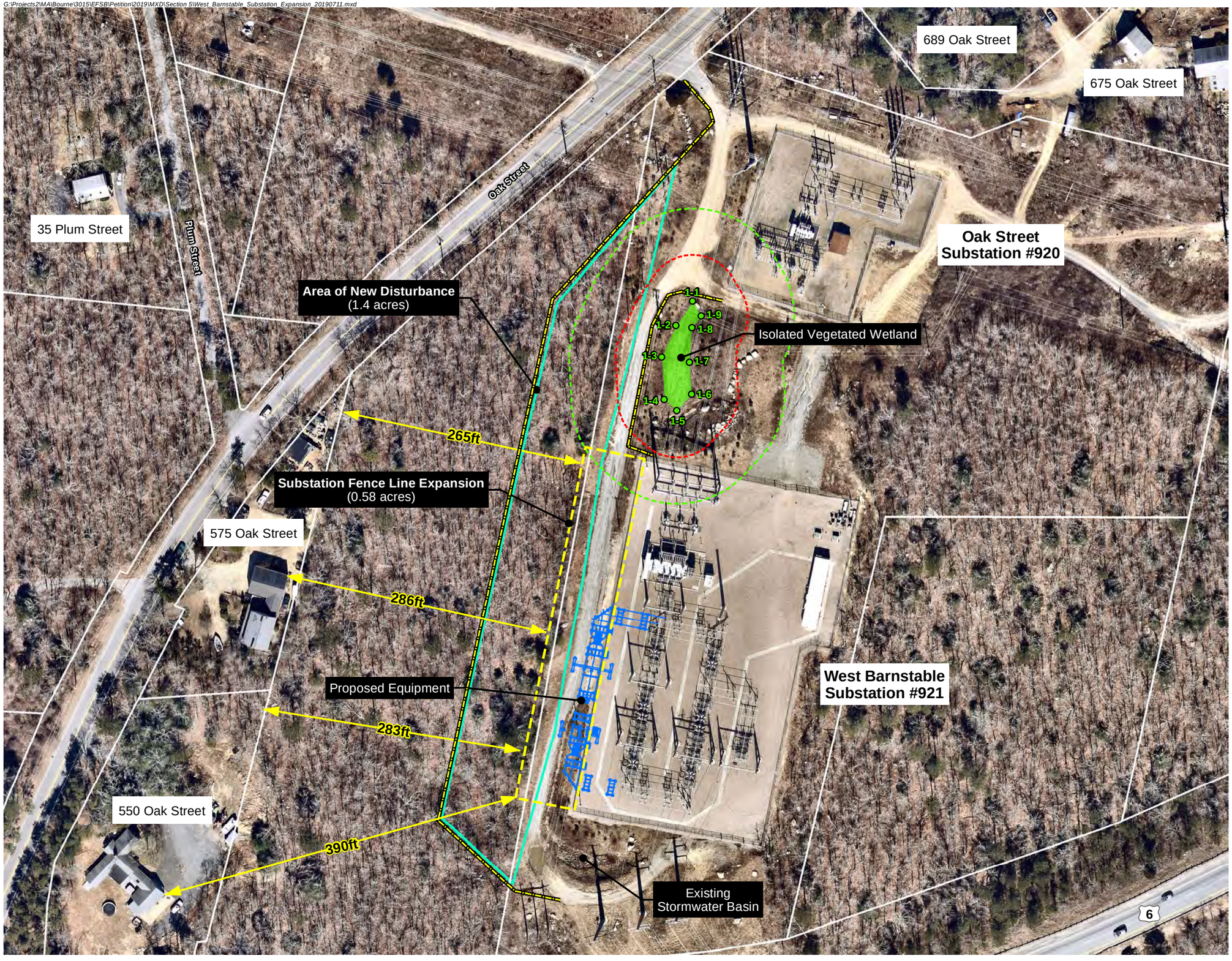
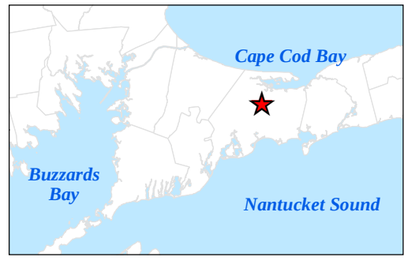


Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:1,200
1 inch = 100 feet

0 50 100 Feet

Basemap: 2019 Nearmap Imagery

LEGEND

- Wetland Flag
- Proposed Equipment
- Proposed Erosion Controls
- 100 foot Buffer Zone
- 50 foot Buffer Zone
- Isolated Vegetated Wetland
- Substation Fence Line Expansion
- Area of New Disturbance
- Tax Parcel Boundary (MassGIS)

Please note that the mapped area is located entirely within the Residence F District, Aquifer Protection Overlay District, and Resource Protection Overlay District, as shown on the Zoning Map of the Town of Barnstable (last amended 9/8/2011).

Figure 5-3a

Mid Cape Reliability Project
West Barnstable Substation
Proposed Expansion for
Project and Noticed Variation

Epsilon ASSOCIATES INC.

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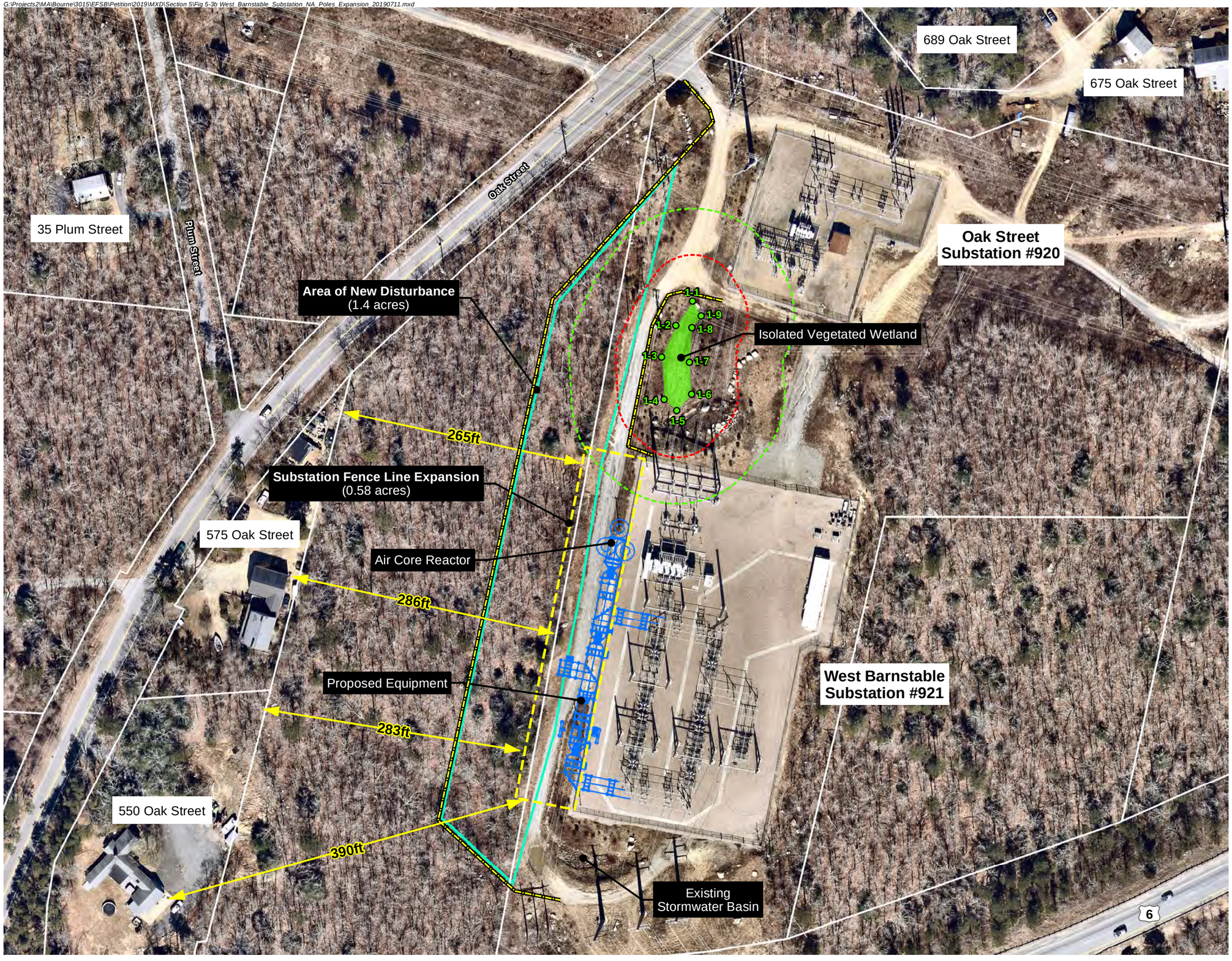
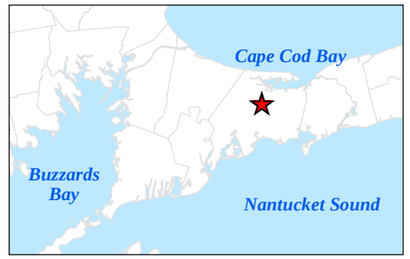


Mid Cape Reliability Project

EVERSOURCE

LOCUS



SCALE

1:1,200
1 inch = 100 feet

0 50 100 Feet

Basemap: 2019 Nearmap Imagery

LEGEND

- Wetland Flag
- Proposed Equipment
- Proposed Erosion Controls
- 100 foot Buffer Zone
- 50 foot Buffer Zone
- Isolated Vegetated Wetland
- Substation Fence Line Expansion
- Area of New Disturbance
- Tax Parcel Boundary (MassGIS)

Please note that the mapped area is located entirely within the Residence F District, Aquifer Protection Overlay District, and Resource Protection Overlay District, as shown on the Zoning Map of the Town of Barnstable (last amended 9/8/2011).

Figure 5-3b

Mid Cape Reliability Project
West Barnstable Substation
Proposed Expansion for
Noticed Alternative Route

Epsilon Associates Inc.

potentially other locations within the ROW where there is steep topography or evidence of erosion. Beyond these contemplated improvements to existing access roads, the installation of new access roads is not anticipated.

The public road network and the access roads will provide the principal means for transporting equipment and material to the transmission line structure locations. Potential construction access points onto ROW 342 are depicted in Appendices 5-1 and 5-2.

At each proposed structure location, a safe and level work area is required for construction equipment to install foundations and assemble the structures. Work pads of approximately 100 feet by 100 feet are required and will be created by mowing low growing woody vegetation and brush followed by minor grading, if necessary, to create the level work space. The work pads may be slightly smaller or larger depending on terrain, equipment and overall site conditions at each structure location. The few sporadic wetlands located within the ROW will be avoided, therefore the use of timber construction mats within wetlands is not necessary.

Pull pads, which may be required at certain locations along the ROW for conductor installation, will typically be 100 feet by 200 feet, but can be as large as 100 feet by 300 feet and will be constructed using similar techniques to those described above for work pads at structure locations.

5.4.5 Relocate Existing Distribution Line

Approximately 7.6 miles of the existing 25-kV distribution line on ROW 342 will be permanently relocated towards the center of the ROW to accommodate construction of the Project. To accommodate construction of the Noticed Alternative's overhead segment, approximately 1.3 miles of the existing 25-kV distribution line on ROW 342 will be permanently relocated towards the center of the ROW.

5.4.6 Installation of Transmission Line Foundations

The installation of concrete foundations for new overhead transmission structures will consist of drilled piers (also known as drilled caissons) that range from 6 to 8-feet in diameter and 15 to 30-feet in depth, depending on the height and load conditions for the structure.[42] Dead-end or angle structures may require somewhat larger foundations, typically 8 to 10-feet in diameter.

No new structure foundations are proposed to be located in wetlands. Nonetheless, dewatering of groundwater may be required during the foundation installation in upland areas. Where groundwater is encountered in excavations, the water will be pumped into a sediment filter bag

[42] The foundations would be slightly larger diameter (8 to 12-feet) and deeper to accommodate the Noticed Variation's 345-kV design.

within a straw bale/silt fence corral (basin) located within the upland area. The basin and all accumulated sediment would be removed following dewatering operations and the area would be restored, as needed.

5.4.7 Installation of Transmission Line Structures

The Project would require construction of 89 steel monopole transmission structures. The common overhead segment of the Noticed Alternative would require construction of 42 steel monopole transmission structures. The Project and Noticed Alternative transmission structures would have the same design and would range in height from 90 feet to 110 feet tall, depending on topography and span length. One structure would be 120 feet. The Noticed Variation's 345 kV transmission design structures are taller, ranging in height from 100 feet to 150 feet (eleven structures). For perspective, the existing steel monopole structures on ROW 342 are similar to the proposed structures, with an average range in height from 90 feet to 150 feet (one structure). Figure 5-4a and 5-4b depict the typical cross-sections of the existing and proposed transmission structures. Appendix 5-5 includes a complete transmission structure list, with proposed structure heights.

The new structures will be delivered to installation locations by flatbed trucks, then assembled using a crane. Davit arms, or insulated supports, would be individually hoisted and framed to the monopole. Insulators, clamps, travelers (stringing blocks, consisting of urethane-lined sheaves or pulley wheels) and other hardware would be installed.

5.4.8 Installation of Conductor and Shield Wire

Following the erection of the transmission structures, conductors and shield wire would be installed in sections that may range from one to three miles using either helicopters or ground-based pulling and tensioning trucks and equipment. The conductors would be pulled under tension and, to maintain clearance at road and other crossings during the conductor and shield wire installation, temporary guard structures or boom trucks will be positioned beneath the lines, adjacent to the crossings. Eversource will coordinate with state and municipal highway authorities, as appropriate, regarding traffic control during pulling operations across roads.

The insulators, hardware and wires would then be installed and sagged in accordance with industry standards and design specifications.

5.4.9 Restoration and Demobilization

At the completion of the Project, the temporary construction access areas will be restored and all construction equipment and debris will be removed from the ROW as well as signs, flagging and fencing. Soils disturbed during construction will be stabilized, as necessary, with an appropriate seed mixture, stone, erosion control blankets and/or mulch, in accordance with applicable regulations and permit conditions. Temporary erosion and sediment control measures will be removed when site stabilization is achieved.

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Mid Cape Reliability Project

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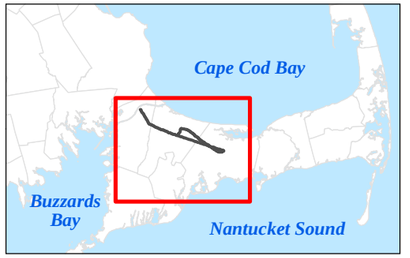

SCALE

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1 inch = 7,000 feet

0 3,500 7,000 Feet

N

LEGEND

Project:

- ROW 342 (12.5 miles)(overhead)

Noticed Alternative:

- ROW 342 (6.1 miles)(overhead)
- Quaker Meeting House Road North (7.9 miles) (underground)
- Joint Base Cape Cod/MMR
- Municipal Boundary

Figure 5-4a

Typical ROW Cross Sections Project and Noticed Alternative

Epsilon Associates Inc.

Bourne Switching Station #917

Cape Cod Canal

Cape Cod Bay

SECTION 1

SECTION 2

SECTION 3

BOURNE

SANDWICH

MASHPEE

BARNSTABLE

Quaker Meeting House Road

Service Road

ROW 342

Joint Base Cape Cod/MMR

Oak Street

Oak Street Substation #920

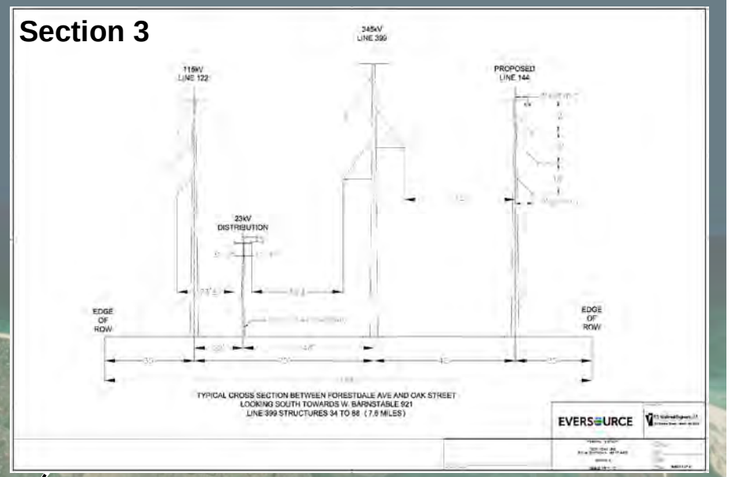
ROW 381

Prospect Street

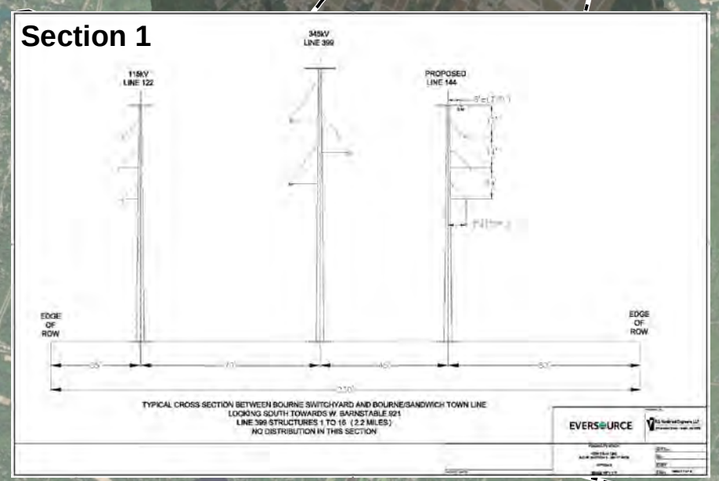
Service Road

West Barnstable Substation #921

Section 3



Section 1



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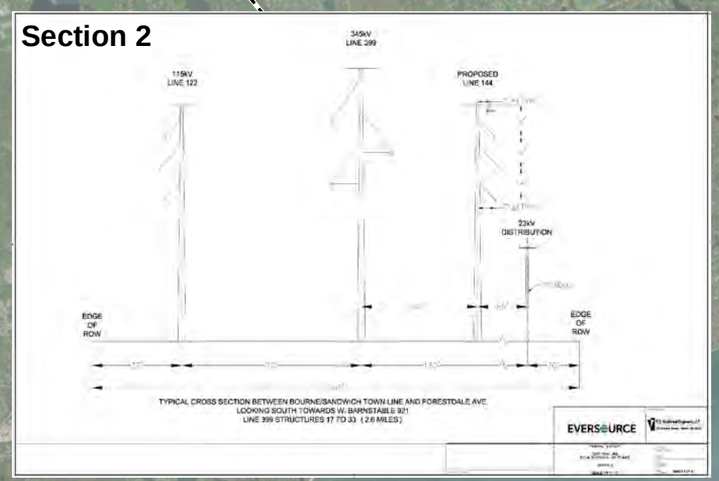

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Bourne Switching Station #917

Cape Cod Canal

Cape Cod Bay

SECTION 1

SECTION 2

SECTION 3

BOURNE

Quaker Meeting House Road

Service Road

ROW 342

Joint Base Cape Cod/MMR

SANDWICH

Oak Street

Oak Street Substation #920

Prospect Street

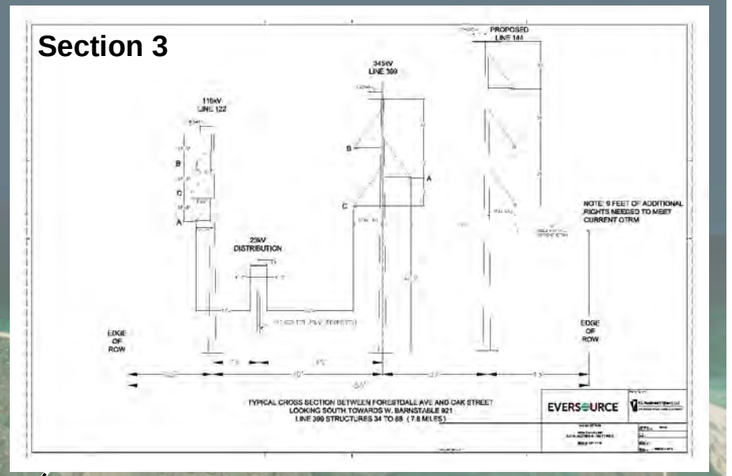
ROW 381

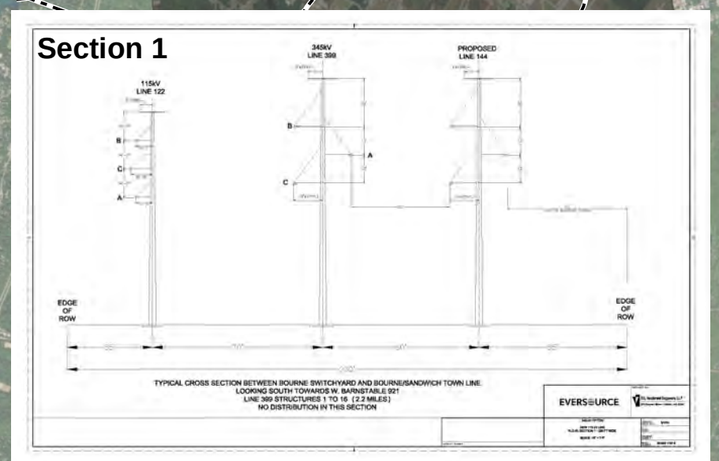
Service Road

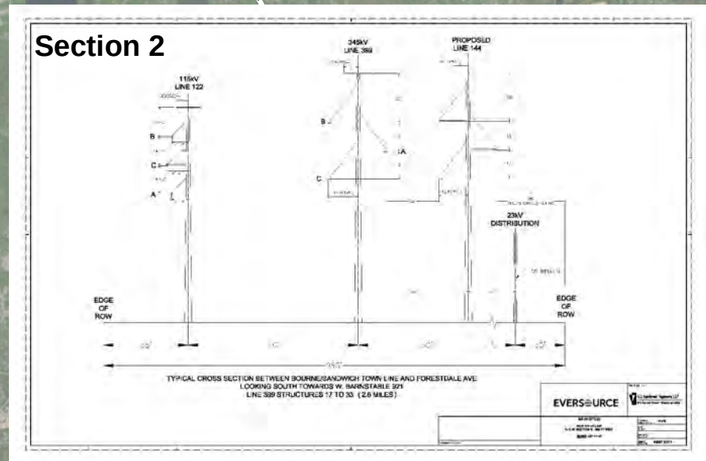
West Barnstable Substation #921

MASHPEE

BARNSTABLE







Mid Cape Reliability Project

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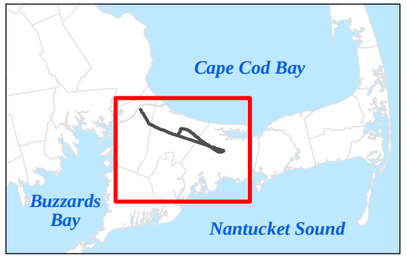


SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

LEGEND

Noticed Variation:

- ROW 342 (12.5 miles) (345 kV design, operated at 115 kV)
- Joint Base Cape Cod/MMR
- Municipal Boundary

Figure 5-4b

Typical ROW Cross Sections
Noticed Variation

Epsilon Associates Inc.

5.5 General Construction Sequence for Underground Transmission Line

This section describes the construction sequence for the underground transmission line segment of the Noticed Alternative. In parallel with the construction activities described below specifically related to underground construction, the Noticed Alternative will require that the last of the 42 structures constructed for the overhead portion of the route be configured as a transition structure. The construction sequence for the transition structure will be the same as is described for the overhead structures in section 5.4 above.

As described above, the Noticed Alternative will transition from an overhead to an underground line design at Quaker Meetinghouse Road in Sandwich. From Quaker Meetinghouse Road, the underground transmission line route continues 7.9 miles in the public roadways to West Barnstable Substation.

The construction sequence for the underground segment is provided below. Some of these activities would run parallel with the overhead construction:

- Installation of erosion and sediment controls;
- Installation of manholes/splice vaults;
- Trenching and duct bank installation;
- Cable pulling, splicing, and testing; and
- Restoration.

5.5.1 Installation of Erosion and Sediment Controls

To minimize the potential for erosion and sediment migration during construction, temporary erosion and sediment control measures will be installed prior the initiation of soil disturbing activities and will be inspected regularly and maintained during construction. Erosion and sediment controls such as straw bales, silt fence, compost filter tubes and/or straw wattles and catch basin filter protection will be installed in accordance with Eversource's BMP Manual and with any applicable environmental permit requirements. These controls will be installed between the work areas and environmentally sensitive areas, including wetlands and streams. Catch basins along roadways will be protected with silt sacks. The approximate locations of these BMPs are provided on the detailed map set provided in Appendix 5-2, Noticed Alternative Map Set.

5.5.2 Installation of Manholes /Splice Vaults

Pre-cast concrete splice vaults will be installed prior to trenching and installation of the duct bank. Splice vaults facilitate cable installation and splicing and provide access for future maintenance. Each splice vault is approximately 10-feet wide by 8-feet high by 30-feet long. The depth of the

splice vault would vary by location and be located entirely underground with only the manhole cover visible at ground level. A precast communication handhole measuring 4-feet by 4-feet by 4-feet will be located at each splice vault.

Splice vaults are spaced approximately 1,500 to 1,800 feet apart but could be a shorter distance. The factors contributing to final placement of the splice vaults include the maximum length of a cable that can be transported on the reel; allowable pulling tensions for the specific location; sidewall pressure on the cables as they are pulled around a bend; and accessibility. On average, each splice vault takes approximately seven to ten days to install.

The Noticed Alternative's underground section has some existing underground utilities in roadways that may need to be relocated to create space for the new splice vaults (this would be determined during detailed design). The Company would work with the local communities and utility owners regarding these relocations on a case-by-case basis.

In the event contaminated soils or other regulated materials are encountered during excavation of the splice vaults, soils/materials would be managed pursuant to the Utility-Related Abatement Measure ("URAM") provisions of the Massachusetts Contingency Plan ("MCP"). The Company would also contract with a Licensed Site Professional ("LSP") as necessitated by conditions encountered along the Project alignment, consistent with the requirements of the MCP at 310 C.M.R. 40.0460 et seq.

Please refer to Figure 5-6, Typical Manhole Plan and Figure 5-7, Typical Manhole Section and Detail for additional detail.

5.5.3 Trenching and Duct Bank Installation

Following installation of the splice vaults, the underground duct bank construction will begin. The underground line segment will consist of three cross-linked polyethylene ("XLPE") insulated cables. The duct bank will contain a total of eight conduits: four high density polyethylene ("HDPE") 8-inch-diameter conduits (including one spare) for the insulated XLPE cables, two 4-inch-diameter polyvinyl chloride ("PVC") conduits for relay and communication cables and two 2-inch-diameter PVC conduits (one for a grounding conductor and one for possible future temperature-monitoring cables). A common thermal concrete envelope encases the conduits to form the "duct bank." See Figure 5-5 for a depiction of the general arrangement in the duct bank.

The primary method for underground duct bank construction in roadways is open cut trenching. The trench will be approximately four feet wide and five and a half to eight feet deep, depending on the final design profile of the duct bank. For installation of the transmission line within roadways, the width of the trench would be marked on the street, Dig-Safe would be contacted, the location of existing utilities would be marked and the pavement would be saw-cut. Saw cutting provides a clean break in the pavement and defines the parameters of the trench for asphalt removal and trench excavation.

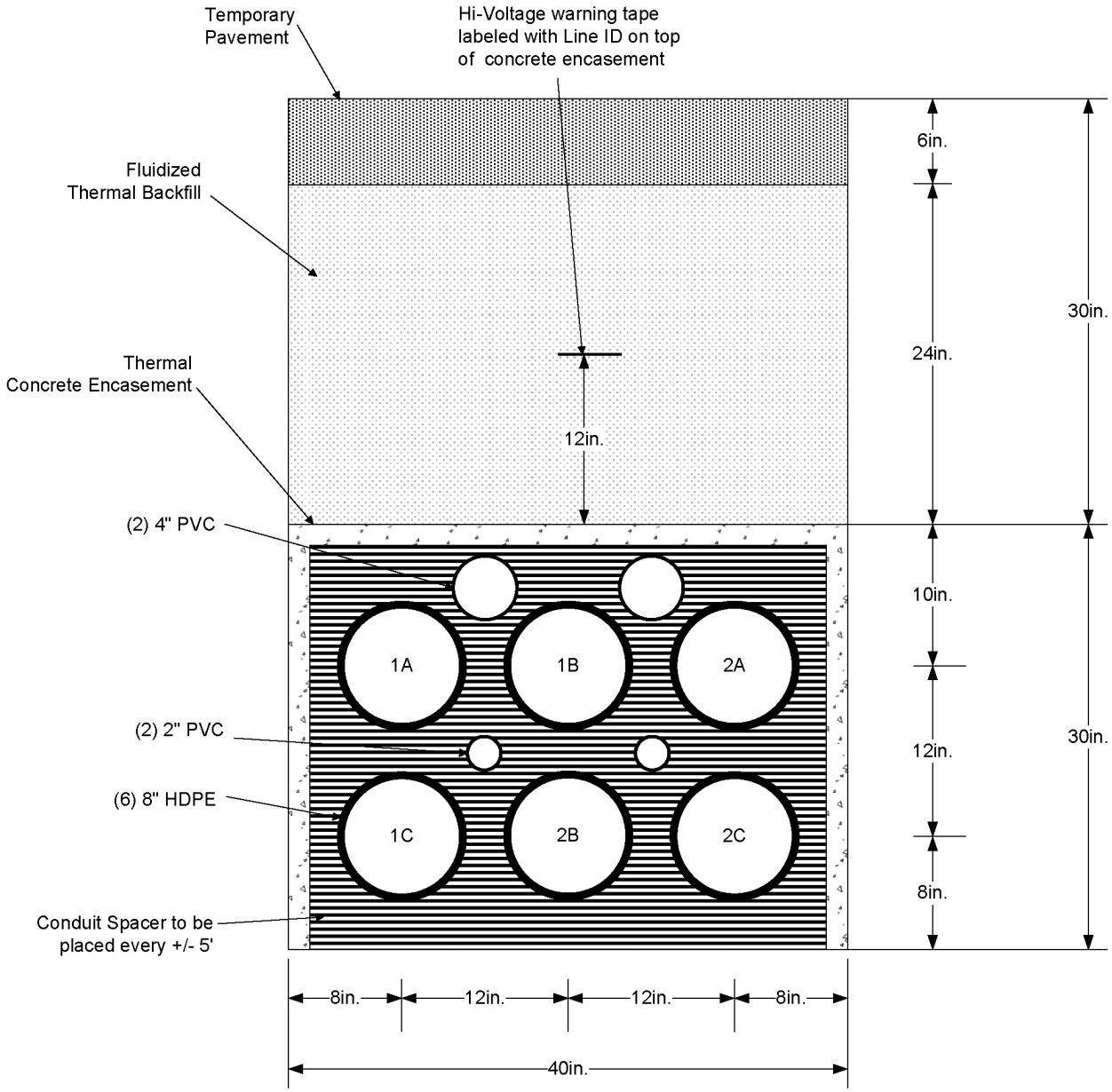
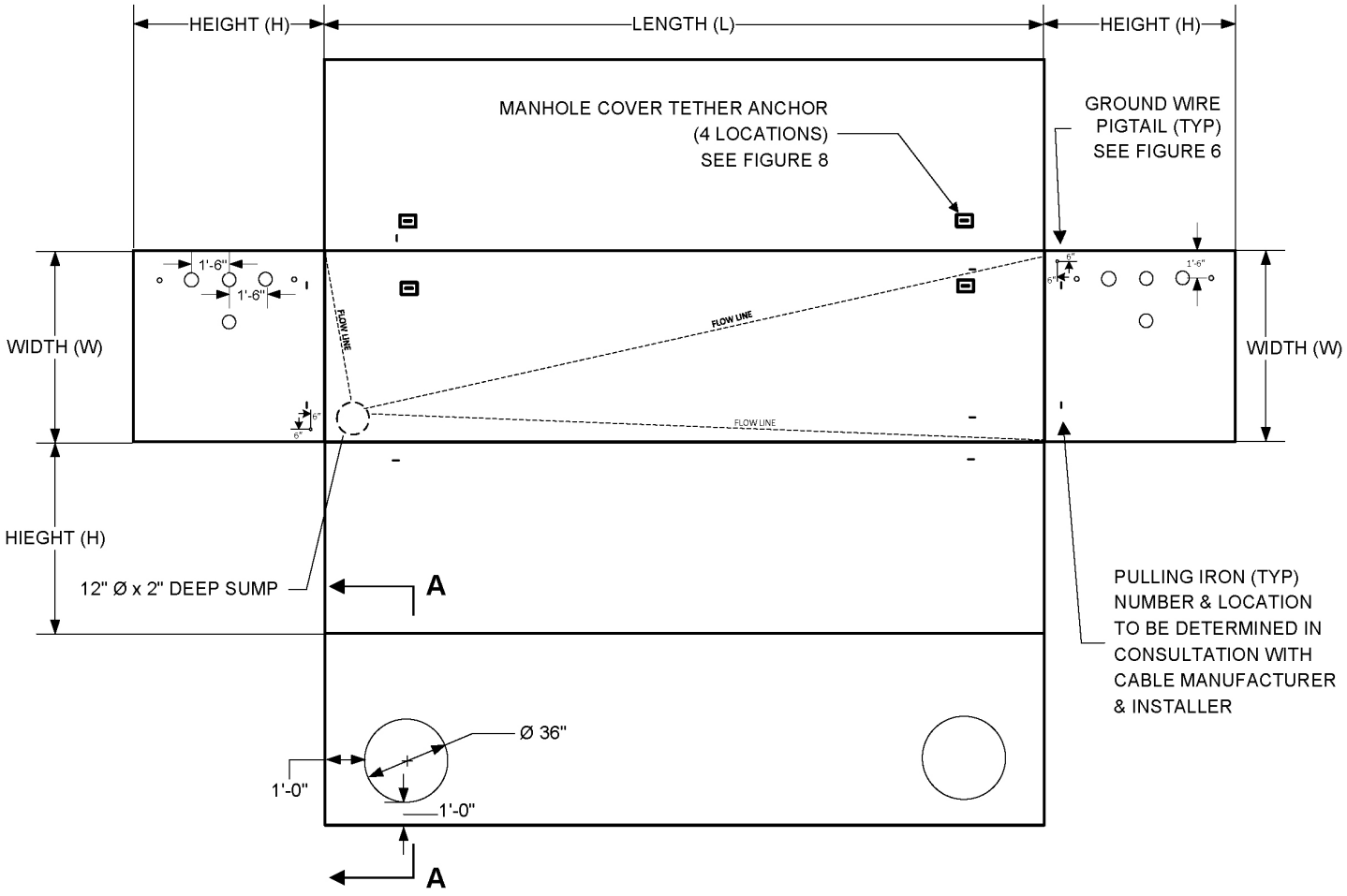


Figure 1
2 x 3 Two Line Installation

Note: All pipe sizes are nominal



VOLTAGE	CABLE TYPE	LENGTH (L)	WIDTH (W)	HEIGHT (H)
345kV	SOLID DIELECTRIC	30'	8'	8'
115kV	SOLID DIELECTRIC	22'	7'	7'

Figure 1
Typical Manhole Layout Plan
Solid Dielectric Cables

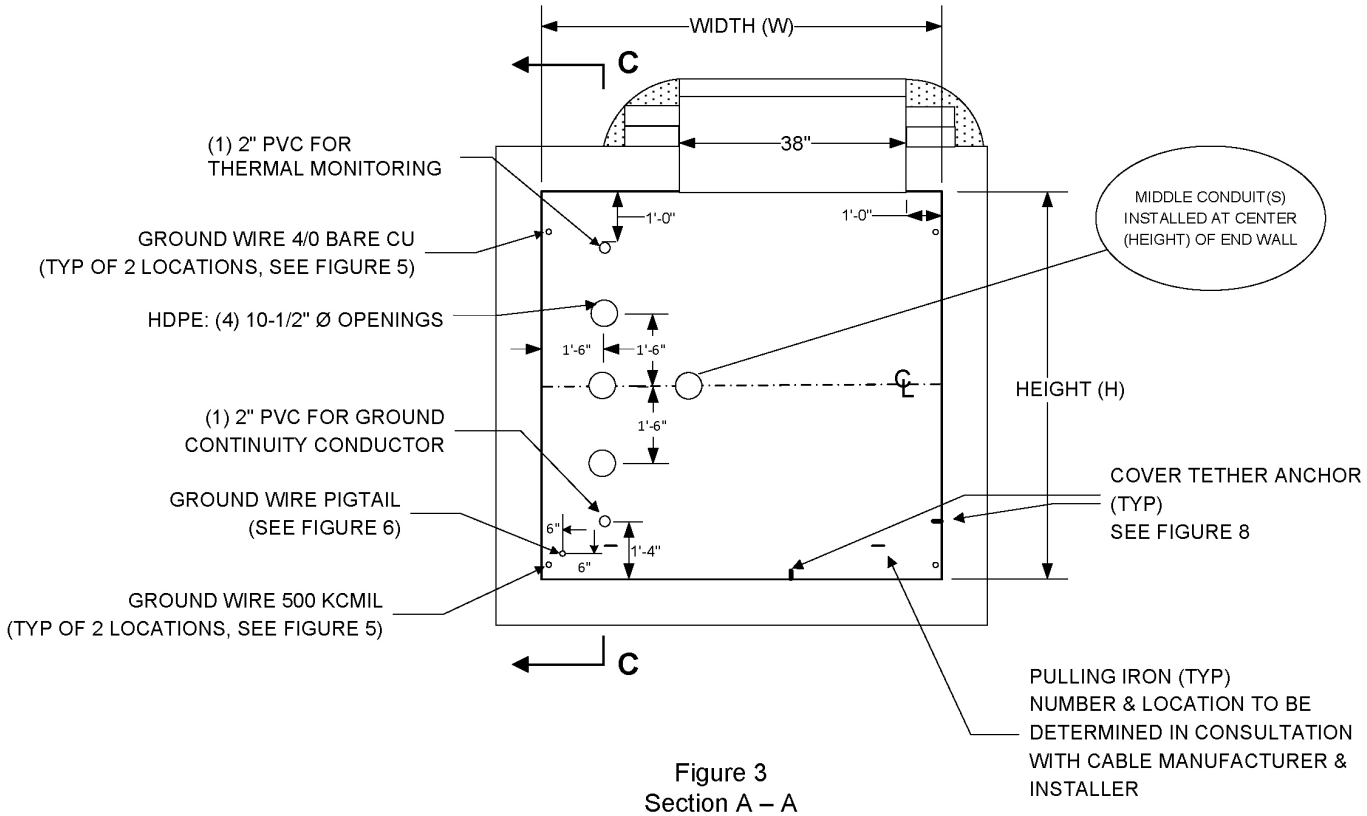


Figure 3
Section A – A
End View – Solid Dielectric Manholes

Notes:
1. Manhole dimensions shown are inside dimensions.
2. All pulling eyes shall be designed for multidirectional cable pulls.
3. Drawings not to scale.
4. Wall thickness is 12".

Following saw cutting, the pavement would be removed with an asphalt bucket on an excavator and loaded into a dump truck with a backhoe. Pavement material would be handled separately from excavated soil and would be recycled at an asphalt batching plant. Subsequently, a backhoe/excavator would excavate the trench to the required depth. In some areas, excavation may be done by hand to avoid disturbing existing utility lines and/or service connections. Soil removal would likely be a "clean trench" or "live loading" method in which soil would be loaded directly into a dump truck to an off-site facility for recycling, reuse or disposal. Soil would not typically be stockpiled along the edge of the roadway, thus reducing the size of the required work area and the potential for sedimentation or the creation of nuisance dust. Any rock encountered during excavation would be removed by mechanical means and brought to an off-site facility for recycling, reuse or disposal.

As with the splice vault excavation described above, if contaminated soils or other regulated materials are encountered during trenching for the duct bank, the contaminated soils/materials would be managed pursuant to the URAM provisions of the MCP.

Once a section of the trench is prepared, each of the conduit sections would be assembled inside the trench or pre-assembled at the ground surface and then lowered into the trench. The area around the conduit would be filled and protected with high-strength thermal concrete (3,000 pounds per square inch ("psi")) that creates a duct bank around the conduits. The trench would then be backfilled with fluidized thermal backfill or native soil.

The length of time for trench excavation, duct bank installation and pavement patching in front of any single property would generally be two to three weeks. The pace of construction may be slower in areas of higher existing utility density, unanticipated obstructions, such as ledge or rock, the trench depth is increased or higher traffic volumes.

Groundwater can be encountered during constructing the underground utility facilities. If feasible based on site-specific conditions, the least costly method when dewatering will typically be to recharge the groundwater back into the adjacent subsurface. This can either be done by discharging back within the open excavation/trench associated with the project/pipe installation or discharging to the nearby ground surface via a filter bag or dewatering corral (if necessary) allowing groundwater to infiltrate back into the soil.

At locations where on-site recharge of groundwater is not an option and manageable amounts of groundwater (<50,000 gallons per day) are expected to be generated, a vacuum truck can be used to pump out and appropriately dispose/recycle groundwater encountered. The water would be tested to ensure proper disposal/recycling.

At locations where larger amounts of groundwater (>50,000 gallons per day) are encountered and on-site recharge and off-site disposal are not feasible options, discharging into the municipal stormwater and/or sewerage systems may be used. However, this activity must be coordinated with the municipality and U.S. Environmental Protection Agency ("USEPA") beforehand and would not occur without written consent from the municipality and the USEPA.

5.5.4 Trenchless Crossings

As noted in Section 4 of the Petition, the Noticed Alternative contemplates one trenchless crossing where Oak Street passes over Route 6 prior to reaching the West Barnstable Substation.

As described in Section 4, the Route 6 bridge crossing would likely be accomplished by: (1) installing the cable in the bridge deck/roadway pavement; (2) attaching the cable to the side of the bridges; (3) constructing a separate self-supporting utility bridge to carry the cable over Route 6; or (4) by installing the cable beneath Route 6 using trenchless methods. Two potential trenchless methodologies are described in more detail below.

Horizontal Directional Drill

If the horizontal directional drill ("HDD") method is used, staging areas would be set up on both sides of the crossing. An HDD installation generally requires a larger temporary construction footprint than a J&B because the boring equipment is larger, and the supporting equipment requires more space. The staging areas would be sized accordingly to accommodate the drilling and high-density polyethylene ("HDPE") casing fuse welding equipment. Additional shallow pits would be required on both sides to collect the drilling fluid.

A temporary drill rig, likely mounted on a trailer, would be hauled to the site and positioned to drill at the desired angle. The drilling would be guided along a selected path, typically an arc, under the state highway to an exit point on the opposite side. The fuse welded HDPE casing would then be pulled back through the hole. The entire casing would be filled with thermal grout to seal the installation. Due to the high risk that the bore hole could collapse, once the "pullback process" begins, it cannot be stopped until the entire length of the HDPE casing is in place. If an HDD fails at any point during execution of the work, the existing drill would be abandoned, and the entire process would need to start again in an adjacent location.

Jack and Bore

The jack and bore ("J&B") method is used for shorter lengths to install a casing horizontally under a conflicting object where trenching cannot be accommodated. This method is typically used for crossing under railroads, ditches, streams, streets and shallower existing underground facilities.

A J&B installation is accomplished by digging a bore pit on one side of the feature to be crossed and a receiving pit on the other side. The bore pit houses the drilling and jacking equipment, while the receiving pit receives the casing on the other side of the feature being crossed.

The casing is then jacked (pushed) in the bore hole as it is being drilled under the feature. Once in place, the casing is cleaned out, and smaller HDPE or PVC pipes are installed inside the casing to contain the cables. When completed, the duct bank will mate up with the casing on each side of the crossing. Prior to cable installation, the casing is filled with a thermal grout.

Once the J&B equipment is in place, it must remain in place and the drill pits must remain open until the operation is completed.

Smaller culvert crossings within local roads would likely be accomplished by supportive excavation where the transmission line would be installed using standard open trench techniques above or below the existing culverts, with the culvert being supported in-place by shoring.

5.5.5 Cable Installation and Testing

Each conduit is tested and cleaned by pulling a mandrel (a close-fitting cylinder designed to confirm a conduit's shape and size) and swab through each of the ducts, prior to cable installation. The cables are installed in sections between two adjacent splice vaults. A cable reel is set up at the "pull-in" splice vault and a cable puller is set up at the "pull-out" splice vault. Once the mandrel and pulling line are pulled through each duct, a hydraulic cable winch and tensioner is used to pull cables individually between the pull-in and pull-out splice vaults. Installation of cable sections typically takes three 8-hour days and is repeated until all cables are installed.

Adjacent cable sections are then spliced together inside the vaults over the course of several extended workdays. Splicing high-voltage solid-dielectric transmission cable is a time consuming, complex operation that typically requires 40 to 60 hours to splice all three cables at each vault. The splicing activities are not continuous but take place over four or five extended (12-hour) workdays at each splice vault location. The splicing operation requires a specialized splicing van and a generator. The splicing van will contain all the equipment and material needed to make a complete splice. An air conditioning unit may be used to control the moisture content in the splice vaults during the splicing activity. A portable generator will provide the electrical power for the splicing van and air conditioning unit and will be muffled to minimize noise. Typically, the splicing van will be located over one splice vault access cover. The air conditioner will be located near the second splice vault access cover and the generator will be in a convenient area nearby out of the immediate work zone.

Once the cable is installed and the splicing completed, the communications fiber cable will be pulled and spliced in the communications manholes.

Since the communications fiber cable is a single strand and is much smaller than the electric cable, pulling it is a much faster operation. Up to three sections can be pulled per day.

After all the communications fiber cable sections are in place, they will be spliced together inside the communications manholes. Splicing the communications fiber cable typically requires three (10-hour) workdays to complete at each of the manholes.

Once the cable system installation is complete, the cables will be field-tested from the substations. At the completion of successful testing, the line will be energized.

5.5.6 Restoration

Following installation of the duct bank and splice vaults, work areas will be restored, as needed. Roadway surfaces would be restored to pre-construction condition or better, in compliance with applicable state and local standards.

5.6 Construction Schedule and Hours

5.6.1 Schedule

Construction of the all-overhead transmission line for the Project within the existing ROW requires less civil work when compared to the combination overhead/underground transmission line associated with the Noticed Alternative, which impacts schedule in addition to cost. The Project is anticipated to require 10 months of construction, a shorter construction duration than that estimated for the Noticed Alternative. The Noticed Alternative would require approximately 14 to 16 months to complete, given additional length of the line (approximately 1.5 miles) and the methods associated with underground line construction within public streets including the Route 6 crossing.

5.6.2 Construction Hours

Typical construction work hours for the Project and Noticed Alternative are proposed to be from 7:00 AM to 7:00 PM Monday through Friday and from 9:00 AM to 5:00 PM on Saturdays, when daylight and weather conditions allow.

In some instances, and as dictated by MassDOT or the local authority, the Company may be required to perform work at night to minimize daytime impacts to commuters and abutters. The Company will work with MassDOT and the local communities through the MassDOT access permit and Grant of Location processes to formalize allowable work hours and schedule.

Some work tasks, once started, may require continuous operation until completion. Work requiring scheduled outages and work that requires continuous operation until completed may need to be performed on a limited basis outside of normal work hours, including evenings, Sundays and holidays.

5.7 Comparison of Potential Environmental Impacts Between the Project and Noticed Alternative

The following sections build upon the scoring and route selection analysis provided in Section 4 of this Petition and present a more detailed comparative analysis of potential impacts along the Routes. The potential environmental impacts presented herein are based upon the current conceptual design for the routes developed by the Company and represent a reasonable attempt

to identify and characterize the differences in potential for environmental impacts associated with the routes. In addition, the overview of mitigation measures presented herein includes those typically implemented by the Company or that may be required by applicable local, state or federal regulations.

Project-specific topics analyzed in further detail below include:

- Adjacent land use;
- Sensitive receptors;
- Electric and magnetic fields;
- Potential for traffic congestion during construction;
- Noise;
- Public water supply protection areas;
- Wetlands and water resources;
- Rare species habitat;
- Visual impacts; and
- Cultural resources.

5.7.1 Adjacent Land Use

Land use along the Routes was assessed using current Massachusetts Geographical Information System (MassGIS) Land Use data (2016). Land use was tabulated in acres within approximately 100 feet of the edge of Eversource ROW 342 and at edge of roadways. Results are listed in Table 5-1 on the following page. MassGIS land-use areas are depicted on Figure 5-8.

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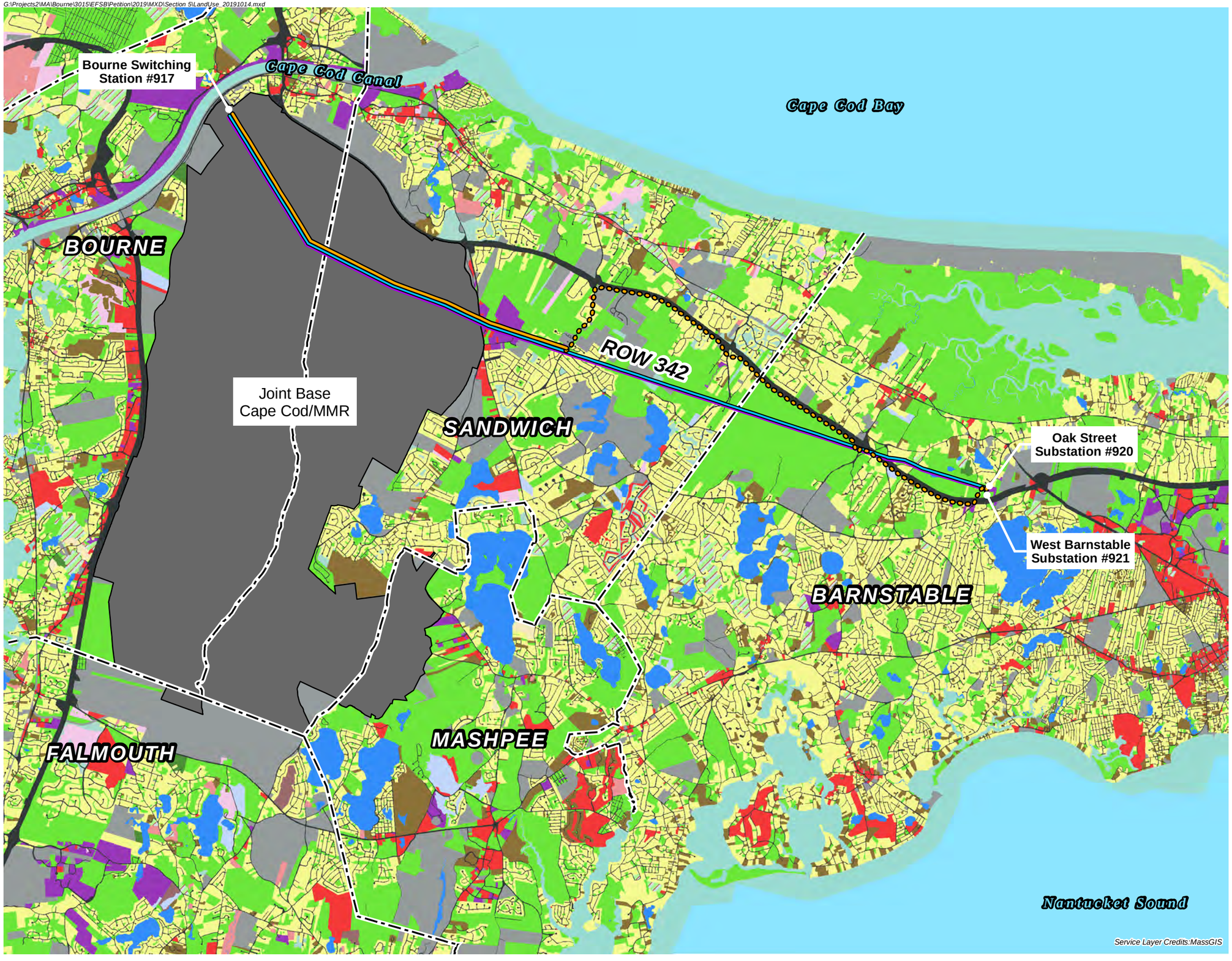

Mid Cape Reliability Project

EVERSOURCE

SCALE

1:84,000
1 inch = 7,000 feet

0 3,500 7,000 Feet

N

LEGEND

Project:

- ROW 342 (12.5 miles)(115 kV overhead design)

Noticed Variation:

- ROW 342 (12.5 miles)(345 kV design, operated at 115 kV)

Noticed Alternative:

- ROW 342 (6.1 miles)(overhead design)
- Quaker Meeting House Road North (7.9 miles) (underground design)
- Joint Base Cape Cod/MMR
- Municipal Boundary

Land Use (2016), MassGIS

- Agriculture
- Commercial
- Forest
- Industrial
- Mixed Use - Primarily Residential
- Mixed Use - Primarily Commercial
- Mixed Use - Other
- Open Land
- Recreation
- Residential - Single Family
- Residential - Multi-Family
- Residential - Other
- Right-of-Way
- Tax Exempt
- Unknown
- Water

Figure 5-8

Land Use

Epsilon ASSOCIATES INC.

Table 5-1 Land Use within 100 feet of the Project & Noticed Alternative

Land Use Type	Project (acres)	Noticed Alternative		
		Overhead Segment (acres)	Underground Segment (acres)	Total (acres)
Agriculture	0.19	0	0	0
Open Land	111.30	9.56	20.87	30.43
Recreation	0	0	0.99	0.99
Industrial	11.91	9.79	3.51	13.3
Commercial	2.39	2.39	0.45	2.84
Mixed Use – Primarily Residential	0	0	0.10	0.10
Residential – Single Family	28.26	1.9	19.22	21.12
Residential – Multi-Family	0	0	0.70	0.70
Tax Exempt (JBCC, Ch.61 parcels, etc)	130.68	123.96	6.72	130.68
Water	0.73	0	0	0

Comparison of Potential Impacts to Adjacent Land Use

As described in the table above, with the exception of Open Land, the land use types near the Routes are generally comparable. The predominant land uses are Tax Exempt Land, Open Land and Residential – Single Family. There is substantially more Open Land near and within the Project route as compared to the Noticed Alternative (111.30 acres vs. 30.43 acres) because the Project route follows Eversource ROW 342 through several expansive municipal conservation lands in Sandwich and Barnstable (including West Barnstable Conservation Area), whereas the Noticed Alternative exits ROW 342 before these conservation lands and then follows public roadways. However, there are no changes to Open Land associated with construction of the Project along either of the Routes, including work proposed within Eversource ROW 342.

With respect to Residential – Single Family properties, most of this land use category is associated with that portion of the Project that is not common with the Noticed Alternative and with the underground segment of the Noticed Alternative. While the overhead segment of the Project is adjacent to over 7 more acres of residential land use, compared to the Noticed Alternative, the Project has only approximately 70 residential units directly abutting the route whereas the Noticed Alternative has approximately 158 residential units directly abutting the route (including 150 residential units along the underground line segment). Residential land uses directly abutting the Routes are more likely to be temporarily affected during construction when compared to other land uses located further away on street that are not directly affected by construction. Because the number of residences directly abutting the Noticed Alternative is greater (>2:1 ratio), the Project was determined to be superior with respect to land use impacts.

5.7.2 Sensitive Receptors

Sensitive receptors include schools, hospitals, cemeteries, daycare facilities, fire stations and religious facilities. Depending on their location, these types of facilities could be affected by temporary construction impacts such as traffic disruption, property access, noise, and dust and are perceived to be locations that are more susceptible to potential impacts from a project and where extra consideration should be made in developing potential mitigation measures to minimize these impacts.

Sensitive receptors directly abutting the Project and Noticed Alternative are summarized in the following table. The sensitive receptors included in the scoring analysis are depicted on Figure 4-4 provided in Section 4.

Table 5-2 Number of Sensitive Receptors Directly Abutting the Project & Noticed Alternative

Sensitive Receptor	Project	Noticed Alternative	
		Overhead Segment	Underground Segment
Schools	0	0	1
Hospitals	0	0	0
Cemeteries	0	0	0
Daycare Facilities	0	0	3
Fire Station	0	0	0
Religious Facilities	0	0	1
TOTAL	**0**	**0**	**5**

As noted in the above table, the Project does not have any sensitive receptors directly abutting the route. The nearest sensitive receptor is the Oak Ridge School, which is located approximately 1,000 feet north of ROW 342, just south of the Quaker Meetinghouse Road aerial crossing. The Noticed Alternative has five sensitive receptors associated with the underground segment. They are generally clustered on Quaker Meetinghouse Road. Accordingly, the Project was determined to be superior to the Noticed Alternative relative to this criterion.

5.7.3 Electric and Magnetic Fields

Electric fields ("EF") and magnetic fields ("MF"), collectively known as EMF, are forms of energy that surround an operating electrical device.

Electric fields are produced within an area surrounding the object (e.g., a wire) when a voltage is applied to it and are measured in units of kilovolts per meter ("kV/m"). The level of EF near an energized power line depends on the applied voltage, the distance between the conductors and the distance to the measurement location.

Magnetic fields are produced within the area surrounding the conductor or device that is carrying an electric current and are measured in units of milligauss ("mG"). The level of MF near transmission line conductors depends on the magnitude of the current, the distance between conductors and the distance to the measurement location. MF levels can vary moment to moment, depending on current flow, and so calculations to predict levels of MF generated from a specific source, in this case a new 115-kV transmission line, are based on predicted annual average and peak line loadings. The best estimate of the MF on a typical day is provided by calculations based on the annual average load.

Both electric and magnetic fields decrease rapidly as the distance from the source increases, and even more rapidly from electric equipment and underground transmission lines in comparison to overhead transmission lines. EF levels are further weakened by obstruction such as vegetation (trees), buildings or walls, while MF levels are not blocked by most materials. Where powerlines run in parallel, the levels of EF and MF also depend on the phasing of the conductors between the circuits.

For the underground portion of the Noticed Alternative, the underground transmission line is not a source of EF above ground, as the electric field is totally shielded by the cable sheath.

Status of EMF Health Research

Research into the extremely low frequency ("ELF") EMF, which are associated with transmission lines and other electrical sources, has been ongoing for more than 40 years, with most of the focus on magnetic fields. In 2007, the World Health Organization ("WHO") published a comprehensive review of the research and reached conclusions consistent with earlier reviews from other health authorities. While some epidemiology studies have reported statistical associations between MF and various health conditions, no health agency has determined that there is a causal relationship. This is because of uncertainties in the epidemiology studies, inconsistency with the results of other areas of research, including long-term animal studies, and no biophysical mechanism has been confirmed for any adverse health effect from MF. Presently available on the WHO website is the statement: "*The main conclusion from the WHO review is that EMF exposures below the limits recommended in the ICNIRP[43] international guidelines do not appear to have any known consequences on human health*."[44] Other national and international agencies have evaluated the scientific evidence regarding ELF EMF and their conclusions are in line with those of the WHO. These include, but are not limited to, the National Institute for Environmental and Health Sciences in 1999, the International Agency for Research on Cancer in 2002, the Australian Radiation Protection and Nuclear Safety Agency in 2003, the National Radiological Protection Board of Great Britain in 2004, the Health Council of the Netherlands in 2005 and the European Union Scientific Committee on Emerging and Newly Identified Health Risks

[43] International Commission on Non-Ionizing Radiation Protection

[44] See https://www.who.int/peh-emf/standards/en/

in 2015. Additionally, in 2010, ICNIRP revised its guidelines for maximum permissible exposure to magnetic fields for the general public increasing from 833 mG to 2,000 mG. The state of the research supports the conclusion that ELF EMF at the levels encountered in an everyday environment, including those near electric power lines, do not lead to negative health impacts.

EMF Exposure Guidelines and Public Policy

There are no federal or state laws or regulations in Massachusetts that limit human exposure to EMF. There are international exposure guidelines that have been developed by ICNIRP and the International Committee on Electromagnetic Safety ("ICES") to protect workers and the public from known adverse effects at very high levels of EMF.[45] These limits are summarized in Table 5-3 below.

Table 5-3 Summary of Extremely Low Frequency Electric and Magnetic Field Exposure Guidelines from International Agencies

Organization, Recommended Limit	Magnetic Field	Electric Field[46]
ICNIRP, reference level	2,000 mG	4.2 kV/m
ICES, maximum permissible Exposure (MPE) [47]	9,040 mG	5 kV/m (Off ROW) 10 kV/m (On ROW)

The WHO has recommended the EMF guidelines above as protective of public health and further recommended that, considering the weight of the evidence reviewed, implementing very low-cost measures to reduce exposure to magnetic fields is reasonable when constructing new facilities.

Consistent with the WHO recommendations, the Siting Board has in prior cases recognized public concern about magnetic fields and has encouraged the use of practical and low-cost design to minimize magnetic fields along transmission ROWs.[48] The Siting Board requires magnetic field mitigation that, in its judgment, is consistent with minimizing cost.

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45 The ICNIRP reference levels are 2,000 mG and 4.2 kV/m (ICNIRP, 2010); the ICES maximum permissible exposure levels are 9,040 mG and 5 kV/m (ICES, 2002).

46 Both ICNRIP and ICES concluded that evidence for effects from long-term exposure was insufficient for setting exposure standards.

47 IEEE Standards Coordinating Committee 28. "C95.6 IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0-3 kHz". 23 October 2002.

48 NSTAR Electric Company d/b/a Eversource Energy, EFSB 16-02, at 70 (May 18, 2018).

Calculated EMF Levels for the Project and Noticed Alternative

The attached report, "Mid-Cape Reliability Project – Electric and Magnetic Field Assessment" (Appendix 5-6), summarizes the Company's calculations of the electric and magnetic fields for the proposed line along the Routes. Calculations were made for the specific line configurations at projected annual average and peak loadings in 2021.

Calculations for the EF for the various Project segments are summarized in Tables 5-4 and 5-5 below. Table 5-4 lists the anticipated EF levels from the Project, and the common overhead portion of the Noticed Alternative. Anticipated EF levels from the Noticed Variation are different due to the transmission structure locations and design.

Table 5-4 Electric Field (kV/m) Calculations for Project and Overhead Portion of Noticed Alternative[49]

Project Segment	Existing/ Proposed	North Edge of ROW	Max in ROW	South Edge of ROW
Bourne S/S to Pave Paws Tap	Existing	0.24	4.22	0.32
	Proposed	0.24	4.28	0.25
Pave Paws Tap to Sandwich Town Line	Existing	0.24	4.22	0.32
	Proposed	0.24	4.28	0.25
Sandwich Town Line to Sandwich S/S	Existing	0.24	4.22	0.04
	Proposed	0.24	4.28	0.04
Sandwich S/S to West Barnstable S/S	Existing	0.24	4.22	0.36
	Proposed	0.29	4.20	0.19

MF levels will vary along different portions of the line consistent with the type of proposed construction (e.g., overhead, underground, and splice vault). As mentioned above, MF levels will vary with line loading (current flow) levels in response to customers' electricity use and generation dispatch. The calculated MF levels for the Project are summarized in Table 5-5 below. Anticipated MF levels from the Noticed Variation are different due to the transmission structure locations and design.

[49] As no external EF will be generated by the underground portion of the Noticed Alternative, no EF levels are provided.

Table 5-5 Magnetic Field (mG) Calculations at Average Annual Loading for the Project

Project Segment	Existing/ Proposed	North Edge of ROW	Max in ROW	South Edge of ROW
Bourne S/S to Pave Paws Tap	Existing	31.6	49.6	3.1
	Proposed	25.6	42.5	6.1
Pave Paws Tap to Sandwich Town Line	Existing	31.2	48.9	3.2
	Proposed	25.0	41.8	6.2
Sandwich Town Line to Sandwich S/S	Existing	31.2	49.0	9.3
	Proposed	25.0	41.9	11.1
Sandwich S/S to Great Hill Rd	Existing	20.0	29.8	10.0
	Proposed	22.4	47.4	19.0
Great Hill Rd to West Barnstable S/S	Existing	19.9	30.0	7.7
	Proposed	19.9	32.7	17.8

The common sections of the overhead design will have different current flows on the transmission lines due to the electrical differences between the Project and the Noticed Alternative. Therefore, despite having identical conductor configurations on the overhead section, the magnetic fields will be different between the two options. The calculated MF levels from the common section with the Project are summarized in Table 5-6 below.

Table 5-6 Magnetic Field (mG) Calculations at Average Annual Loading for the Noticed Alternative

Project Segment	Existing/ Proposed	North Edge of ROW	Max in ROW	South Edge of ROW
Bourne S/S to Pave Paws Tap	Existing	31.6	49.6	3.1
	Proposed	22.5	43.5	9.3
Pave Paws Tap to Sandwich Town Line	Existing	31.2	48.9	3.2
	Proposed	22.1	43.4	9.3
Sandwich Town Line to Sandwich S/S	Existing	31.2	49.0	9.3
	Proposed	23.9	44.2	12.3

The calculated MF levels for the underground segment of the Noticed Alternative directly above and at 25 feet from the center of the phase conductors at annual average loading are listed below in Table 5-7.

Table 5-7 Magnetic Field Levels (mG) at Annual Average Loading for Underground Segment of the Noticed Alternative

Configuration	-25 feet	Max Over Line	+ 25 feet
Underground – Inverted Delta	0.3	14.0	0.3
Underground Manhole	9.6	54.1	9.6

Calculated EMF Levels for the Noticed Variation

Although both the Project and Noticed Variation will operate at 115-kV, the EF and MF levels will differ due to the 345-kV structures being on a different alignment and conductors having a different configuration. The calculated EF levels for the Noticed Variation are summarized in Table 5-8.

Table 5-8 Electric Field (kV/m) Calculations for Noticed Variation

Project Segment	Existing/ Proposed	North Edge of ROW	Max in ROW	South Edge of ROW
Bourne S/S to Pave Paws Tap	Existing	0.24	4.22	0.32
	Proposed	0.24	4.38	0.51
Pave Paws Tap to Sandwich Town Line	Existing	0.24	4.22	0.32
	Proposed	0.24	4.38	0.51
Sandwich Town Line to Sandwich S/S	Existing	0.24	4.22	0.04
	Proposed	0.24	4.38	0.14
Sandwich S/S to West Barnstable S/S	Existing	0.24	4.22	0.36
	Proposed	0.30	4.28	0.17

Due to the taller structures required to maintain safety clearances from the 345-kV conductors, predicted MF levels within and at the edge of the ROW from the New Line will be slightly less than that for the Project and the overhead portion of the Noticed Alternative. The calculated MF levels from the Noticed Variation are presented in Table 5-9 below.

Table 5-9 Magnetic Field (mG) Calculations at Average Annual Loading for the Noticed Variation

Project Segment	Existing/ Proposed	North Edge of ROW	Max in ROW	South Edge of ROW
Bourne S/S to Pave Paws Tap	Existing	31.6	49.6	3.1
	Proposed	25.8	42.1	11.3
Pave Paws Tap to Sandwich Town Line	Existing	31.2	48.9	3.2
	Proposed	25.5	41.3	11.3
Sandwich Town Line to Sandwich S/S	Existing	31.2	49.0	9.3
	Proposed	25.4	41.4	13.5
Sandwich S/S to Great Hill Rd	Existing	20.0	29.8	10.0
	Proposed	21.1	48.7	22.8
Great Hill Rd to West Barnstable S/S	Existing	19.9	30.0	7.7
	Proposed	18.7	31.9	21.6

Comparison of EMF

The overhead line design of the Project and Noticed Alternative and the underground line design segment of the Noticed Alternative include various no-cost measures of reducing magnetic-field levels.

More specifically, where the transmission line is proposed to be constructed overhead, the height of conductors above ground exceeds National Electrical Safety Code standards for conductor clearance of 115-kV lines, which provides greater protection against inadvertent contact with conductors, and results in lower magnetic-field levels at ground level. Additionally, the phasing of the lines has been optimized to maximize cancellation of magnetic fields between circuits.

With respect to the underground line segment of the Noticed Alternative, the closer spacing for the underground line results in more rapid fall-off of the MF levels with distance away from the circuit centerline (i.e., more rapid decay with distance) than is the case with overhead circuits.

As the predicted magnetic field levels for the Project, Noticed Variation and Noticed Alternative all fall well below international guidelines for public exposure to EMF, the Company has concluded that there is no significant difference between these alternatives.

5.7.4 Potential for Traffic Congestion During Construction

Construction of the underground segment of the Noticed Alternative will involve trenching and backfilling in approximately 7.9 miles of public roadways, including a crossing of Route 6A. The work could require temporary road closures, traffic detours and alternating one-way traffic patterns, depending on the roadway. In addition, it is anticipated that Town officials from Sandwich and Barnstable may restrict the seasonal timing of the in-road construction to avoid

impacts to residents and local businesses during the busy tourist season and the Town of Barnstable has indicated to Eversource that it would not typically allow any road work during the summer months, generally between Memorial Day and Labor Day. Detailed Traffic Management Plans ("TMP's") would need to be developed with the Towns for the work. Implementation of a well-designed TMP would reduce the potential for traffic disruptions and inconvenience to drivers and residents.

The Project is located entirely within an existing Eversource ROW with only a few aerial crossings of existing roadways, including Forestdale Road (Route 130), Quaker Meetinghouse Road, Meetinghouse Way, Route 6, Pine Street and Oak Street. Aerial crossings typically only result in short-term impacts when stringing the wires over the roadways and the potential for traffic impacts with are significantly less when compared to the Noticed Alternative. Accordingly, the Project was determined to be superior to the Noticed Alternative relative to this criterion.

5.7.5 Noise

Noise impacts associated with the proposed New Line are limited to temporary construction noise and varies with the proximity of specific receptors along the Routes as well as the equipment used and proposed hours of operation. Typical sound from construction activities includes truck movements, heavy equipment and drilling operations, backhoe excavation, dump truck loading, concrete truck deliveries and general construction work. Heavy machinery will be used intermittently as it is needed throughout the construction phases and this activity may temporarily increase nearby sound levels during usage periods. As discussed in Section 5.6.2, typical construction work hours for the Project are proposed to be from 7:00 AM to 7:00 PM Monday through Friday and from 9:00 AM to 5:00 PM on Saturdays, when daylight and weather conditions allow and if permitted by the local municipalities. In some instances, and as dictated by MassDOT (for Route 6) or the local authority, the Company may be required to perform work at night to minimize daytime impacts to commuters and abutters.

None of the local noise ordinances specify requirements for construction noise. Copies of the noise ordinances are provided in Appendix 5-7.

Construction activities will result in localized, short-term increases in ambient noise levels near the work sites. Construction-related noise will occur because of the operation of equipment and vehicles, including, but not limited to, vegetation removal equipment, jackhammers, drilling rigs, cranes, back hoes, large trucks, depending on the approved route. The construction equipment for underground transmission line construction would likely also include pavement saws, road resurfacing vehicles and related equipment.

The Company conducted a noise analysis for the construction along the Routes. The receptor reference point for the sound levels presented are at 50 feet from the source and have also been extrapolated to estimate noise levels at the nearest residential structure from each route. The estimated typical construction noise levels at the closest residence for each route were determined using the formula Lpdesired = Lpknown – 20 log10 (Ddesired / Dknown) where Lp is

the sound level and D is the distance. Because sound levels from a point source drop off due to geometric divergence (hemispherical spreading) at a rate of 6 dB per doubling of distance, the reference sound levels at 50 feet in the following tables will decrease by 6 dBA for locations 100 feet back from the edge of construction. In a more urbanized area, setbacks may be only 25 feet from construction activity, thus increasing the sound levels from each piece of equipment by 6 dBA. However, construction equipment is generally not operated continuously, with significant variation in power and usage. Sound levels would fluctuate, depending on the construction activity, equipment type, and separation distances between source and receiver. Other factors, such as vegetation, terrain and noise attenuating features, such as buildings, will act to further reduce construction noise impacts.

The Company assessed the total number of residential units that could potentially be affected by the typical construction sound levels at 50 feet from the limit of work for the Routes. For the Project and the common overhead segment of the Noticed Alternative, the limit of work is defined as the edge of ROW. Because the Company does not have detailed design drawings for the underground segment of the Noticed Alternative, the measurements were derived from the roadway edge based on MassGIS data (e.g., shoulder, median, and road surface widths as detailed in the MassDOT road attributes layer). Because the measuring point (roadway edge or ROW edge) is likely to be closer to the receptors along the route(s) than the actual Project components, the data presented for the underground segment of the Noticed Alternative are considered to be conservative.

Overhead Transmission Line Construction

There are 23 residential units located within 50 feet of the edge of ROW for the Project. The nearest residences to proposed transmission line structures associated with the Project are approximately 67 feet. See the proposed locations for Structure 43 and Structure 44 near #14 and #26 Deerwood Drive, Sandwich, in Appendix 5-1 (sheet 19).

Sound levels from typical equipment that will be used during construction of the overhead transmission line on the Project and Noticed Alternative are listed below in Table 5-10. These levels range from 85 dBA to 95 dBA at 50 feet from the ROW. From approximately 67 feet (the closest residences to a proposed transmission line structure for the Routes), levels range from 83

Table 5-10 Typical Construction Noise Generated During Overhead Transmission Line Construction

Activity	Type of Equipment	50-feet		67-feet		Familiar Sounds with Similar Sound Levels (dBA)[50]
		Typical Sound Levels (dBA)[51]	Typical Sound Levels within Residence or Other Building Structure (dBA)	Typical Sound Levels (dBA)	Typical Sound Levels within Residence or Other Building Structure (dBA)	
Wire Pulling	Bucket trucks, pull trailers portable generator. Helicopter (optional)	85	Windows Closed: 58 Windows Open: 68	83	Windows Closed: 56 Windows Open: 66	Snow Blower: 85 Garbage Disposal: 80 Air Conditioner: 60
Work Pad and Site Preparation	Mowers, small bulldozer, dump truck	95	Windows Closed: 68 Windows Open: 78	93	Windows Closed: 66 Windows Open: 76	Lawn Mower: 90
Foundation Installation	Drill rig, concrete truck, portable generator	85	Windows Closed: 58 Windows Open: 68	83	Windows Closed: 56 Windows Open: 66	Snow Blower: 85
Tower Construction	Crane, bucket trucks, portable generator	85	Windows Closed: 58 Windows Open: 68	83	Windows Closed: 56 Windows Open: 66	See above.

[50] US EPA, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, prepared by Bolt, Baranek and Newman, Report No. NTID300.1, December 31, 1971.

[51] FHWA, 2006.

dBA to 93 dBA.[52] A building or residence will provide significant attenuation of associated construction sound levels. For instance, typical outdoor-to-indoor sound level reductions of 27 dBA can be expected during the winter (windows closed), with reductions of 17 dBA during the summer (windows open).[53] These deductions are factored into the ranges of adjusted estimated sound levels for each activity identified in the tables below. The overhead transmission line work proceeds relatively quickly, thus the duration of potential daytime construction noise effects at a given location along the ROW is limited.

Underground Transmission Line Construction

For the underground line segment of the Noticed Alternative, there are 16 residential units located within 50 feet of the edge of the roadway layout; with the closest residence being located at approximately 21 feet. Estimated construction noise levels at these locations is provided in the table below. Typical baseline sound levels at 50 feet are based on actual field measurements recorded at similar underground transmission line construction projects in October and November 2015. The sound levels provided on Table 5-11 on the following page are the calculated contribution from the construction equipment based on approximations of sound propagation.

[52] For perspective, the nearest residence to a proposed transmission line structure associated with the Noticed Alternative, is #26 Oxford Road in Sandwich. This residence is located approximately 112 feet from proposed transmission structure No. 41. See Sheet 1 in Appendix 5-2. Because the nearest residence from the overhead line segment of the Noticed Alternative is further from the nearest structure where work is proposed when compared to the Project, this reference point would experience less potential noise during construction.

[53] Source: Table B-4 of the US EPA "Levels" document ("Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety", US Environmental Protection Agency, Office of Noise Abatement and Control, 550/9-74-004, Washington, DC, March 1974).

Table 5-11 Typical Construction Noise Generated During Underground Transmission Line Construction

Activity	Type of Equipment	50-feet		21-feet		Familiar Sounds with Similar Noise Levels[54]
		Typical Sound Levels (dBA)[55]	Typical Sound Levels within Residence or Other Building Structure (dBA)	Typical Sound Levels (dBA)	Typical Sound Levels within Residence or Other Building Structure (dBA)	
Trench Excavation Pile Install, and Pavement Patching	Pavement Saw Pneumatic Hammer Mounted Impact Hammer (hoe ram) Excavator Dump truck Pipe Crane Welding Machine/Generator Concrete Batch Truck	57 to 83	Windows Closed: 30 to 56 Windows Open: 40 to 66	65 to 91	Windows Closed: 38 to 64 Windows Open: 48 to 74	Lawn Mower: 90 Snow Blower: 85 Garbage Disposal: 80 Air Conditioner: 60
Manhole Installation	Pavement Saw Excavator Manhole Crane Dump Truck Asphalt Paver	57 to 83	Windows Closed: 30 to 56 Windows Open: 40 to 66	65 to 91	Windows Closed: 38 to 64 Windows Open: 48 to 74	See above.

[54] Thalheimer, E, "Construction Noise Control Program and Mitigation Strategy at the Central Artery/Tunnel Project," Noise Control Eng. Journal 48 (5), 2000 Sep-Oct.2 US EPA, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, prepared by Bolt, Baranek and Newman, Report No. NTID300.1, December 31, 1971.

[55] TRC Environmental Corporation (TRC) conducted noise measurements during the months of October and November 2015 on behalf of the Company during several construction activities associated with underground transmission line installation work. The measurements were primarily taken using a Quest Model 1700 Type II sound level meter equipped with an octave band analyzer and several measurements were taken using a Svantek Model 971 Type I sound level meter. The measurements were hand-recorded in the field. Numbers round up or down to the nearest whole decibel.

Table 5-11 Typical Construction Noise Generated During Underground Transmission Line Construction (Continued)

Activity	Type of Equipment	50-feet		21-feet		Familiar Sounds with Similar Noise Levels[54]
		Typical Sound Levels (dBA)[55]	Typical Sound Levels within Residence or Other Building Structure (dBA)	Typical Sound Levels (dBA)	Typical Sound Levels within Residence or Other Building Structure (dBA)	
Cable Pulling, Splicing and Testing	Generator Splicing Van	60 to 67	Windows Closed: 33 to 40 Windows Open: 43 to 50	68 to 75	Windows Closed: 41 to 48 Windows Open: 51 to 58	See above.
Final Pavement Restoration	Asphalt Paver	63 to 83 Windows Closed: 36 to 56 Windows Open: 46 to 66		71 to 91	Windows Closed: 44 to 64 Windows Open: 54 to 74	See above.

As previously noted, the potential for noise impacts from construction is a function of the specific receptors along the Routes as well as the type of construction activity, equipment used, proposed hours of operation and the duration of the activity. Manhole installation, trench excavation and final pavement restoration typically are the loudest activities associated with underground transmission line construction. Under typical trenching conditions (i.e., no ledge, no excessive underground utilities), excavation and conduit installation are expected to take approximately seven days at any one location. For manhole installation, the duration of construction typically takes 7 to 10 days per location and may take longer if underground utility relocation is necessary. If ledge is encountered during construction, equipment such as a hoe ram will be used, which would temporarily increase noise levels and potentially prolong the activity at any specific location.

Generators, portable HVAC units and cable pulling motors associated with the splicing van are anticipated to be the loudest noise sources for cable pulling and splicing work. As previously noted, splicing activities typically require 48 to 60 hours to complete. The splicing activities will not be continuous but will take place over four or five extended 12-hour workdays at each manhole location.

Actual field measurements during cable splicing operations, conducted for another Eversource project using similar equipment as proposed here, were taken by TRC on October 30, 2015. The primary source of noise during this work appeared to be the generator providing power for the operations. The generator was designed with sound dampening on the diesel exhaust and sound levels from this operation ranged from 60 to 67 dBA at 50 feet.

West Barnstable Substation Expansion

The overhead line connection for the Project would require the addition of new circuit breakers and terminal equipment to accept the New Line at West Barnstable Substation and Bourne Switching Station. No new transformers or other sources of sound from new equipment are required with the overhead transmission line design.

The termination of the Noticed Alternative underground transmission line would require different equipment to connect into the station, including an air core shunt reactor at each terminal to compensate for the reactive power generated in the cable system. Air core shunt reactors can be sources of sound. For this reason, a sound level impact assessment of West Barnstable Substation equipment associated with the Noticed Alternative underground line connection was conducted by Epsilon. The assessment conducted by Epsilon included sound monitoring to measure ambient sound levels in the vicinity of the West Barnstable and Oak Street Substations; sound level

modeling to predict future impacts from the installation of an air core shunt reactor at West Barnstable Substation; and a comparison of modeled sound levels with applicable noise criteria (see Appendix 5-8, Sound Level Assessment Report, for additional detail).[56]

As described in the Epsilon report, sound levels from the proposed modifications to the West Barnstable Substation for the Noticed Alternative were evaluated against the applicable noise policy of the Massachusetts Department of Environmental Protection ("MassDEP"). The substation improvements are predicted to increase existing ambient broadband sound levels at the closest residences[57] by 9 dBA or less, which complies with the allowable increase pursuant to MassDEP's policy of 10 dBA at the property line. The evaluation was conservatively performed using ambient sound levels from the quietest measured periods. The lone exception is at the residence identified as Receptor F in the Sound Level Impact Assessment report (see Appendix 5-8, Figure 5-1), where the modeled increase predicted is 11 dBA at the residence under worst-case conditions (1 dBA above MassDEP's referenced 10 dBA threshold).

Results from the ambient sound level measurements further indicate that *existing* ambient sound exceeds the MassDEP-defined "pure tones." Incorporating the air core shunt reactor to accommodate the underground transmission line design of the Noticed Alternative is predicted to produce additional sound. Eversource is committed to mitigating the existing condition, regardless of the route and transmission line design ultimately approved by the Siting Board. If the Noticed Alternative is advanced to construction, Eversource will implement additional noise control features, to the extent they may be needed, at the West Barnstable Substation (e.g., noise barriers or other measures) to reduce the impact of sounds from the Project.

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[56] A sound level assessment was not conducted for the Noticed Alternative's connection at Bourne Switching Station given the remote location of the facility within JBCC relative to the nearest abutters. As described in Section 5.3 of this Petition, the nearest residential neighborhood is located approximately 1,000 feet northeast of the Bourne Switching Station facility, in the Hobbler Road neighborhood of Bourne. Moreover, the Project's overhead line design connection at Bourne Switching Station does not introduce new equipment, such as a shunt reactor, that might generate new operational sounds at the site. For these reasons, the potential operational noise impacts at Bourne Switching Station associated with the Noticed Alternative or Project are considered low.

[57] There are no residential units located within 50 feet of the proposed substation expansion fence line, with the nearest residence located approximately 285 feet to the west (#575 Oak Street).

Discussion

Most of the overhead transmission line construction associated with the Routes will occur in remote sections of JBCC in Bourne and Sandwich or in large expanses of conservation lands in Sandwich and Barnstable, a considerable distance from residences where the potential for noise impacts would be greater. The Routes contain a generally comparable number of residential structures within 50 feet of the approximate limits of work (17 total residential structures for the Noticed Alternative versus approximately 23 total residential structures for the Project). However, overall, the Noticed Alternative contains more than double the number of residences directly abutting the route, regardless of distance, when compared to the Project (158 residential units to 70 residential units).

The potential for operational noise impacts associated with the West Barnstable Substation expansion would be greater for the Noticed Alternative because of the type of equipment that is necessary to accept the underground transmission line to compensate for the reactive power generated in the buried cable system. This equipment is not necessary for the overhead line connection associated with the Project.

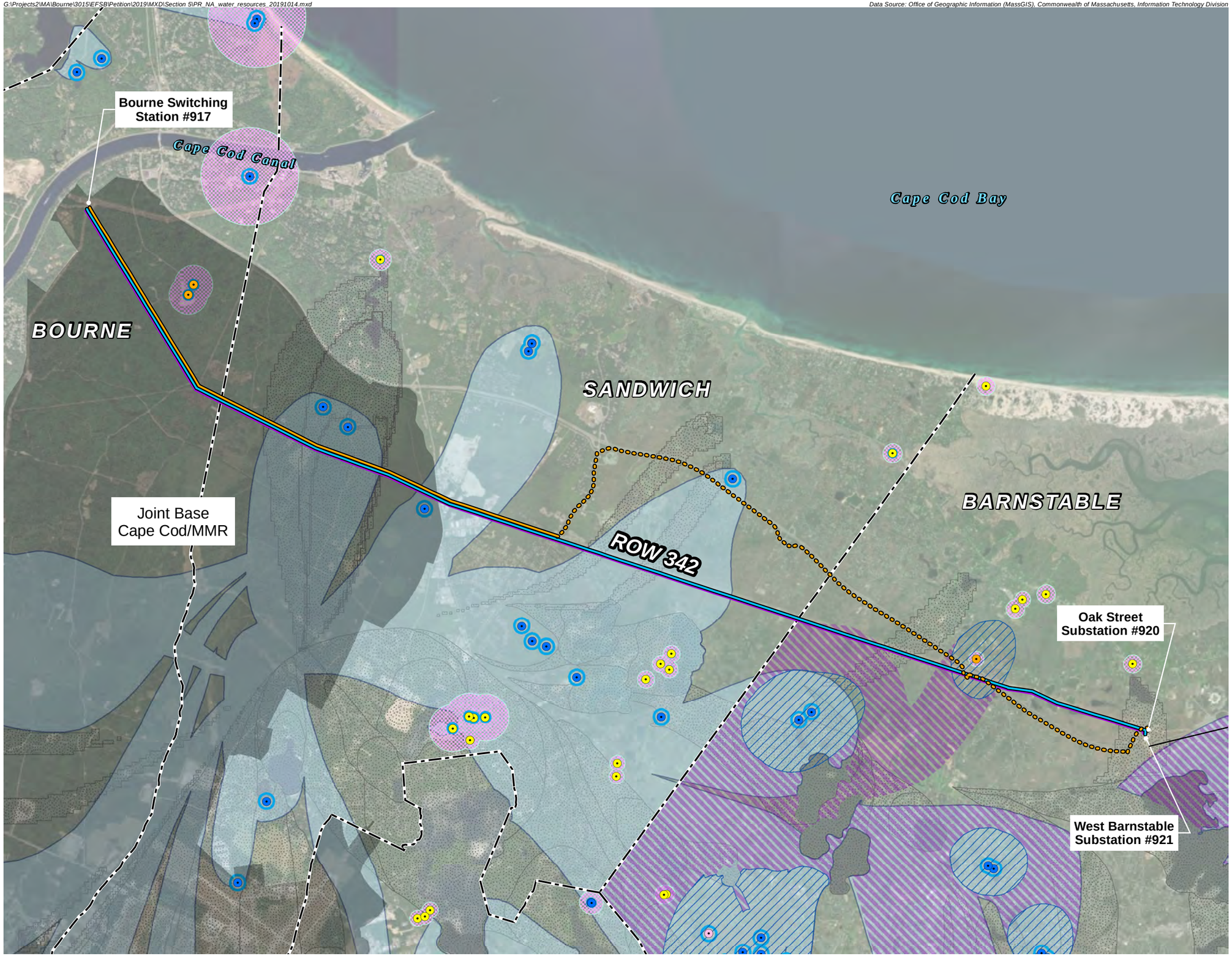
In consideration of the above, the Company determined that the Project is superior to the Noticed Alternative relative to noise.

5.7.6 Public Water Supply Protection Areas

Public water supply protection areas within the vicinity of the Project consist of Zone I and Zone II Wellhead Protection Areas ("WPAs"), both regulated by the MassDEP, freshwater recharge areas identified by the Cape Cod Commission, as well as water supply protection overlay districts that are regulated by local zoning authorities. A Zone I WPA is the protective 400-foot radius required around a public water supply well or wellfield. Zone II WPAs are those portions of an aquifer that contribute to the recharge of an existing public water supply well or wellfield. Water supply protection overlay districts are regions that are important to the recharge of local water supply sources. Figure 5-9 shows public water supply protection areas associated with the Routes. Table 5-12 below identifies the referenced water resources crossed. Note that there are no existing or proposed public water supply wells or small volume wells (transient and non-transient) within 300 feet of the Routes.

G:\Projects2\MA\Bourne\3015\EFSB\Petition\2019\MXD\Section 5\PR_NA_water_resources_20191014.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Mid Cape Reliability Project

EVERSOURCE

SCALE

1:60,000
1 inch = 5,000 feet

0 2,500 5,000 Feet

N

Basemap: ESRI World Imagery

LEGEND

- Public Water Supply Well
- Small Volume Wells, Non-Transient
- Small Volume Wells, Transient
- Proposed Public Water Supply Well

Project:

- ROW 342 (12.5 miles) (115 kV overhead design)

Noticed Variation:

- ROW 342 (12.5 miles) (345 kV design, operated at 115 kV)

Noticed Alternative:

- ROW 342 (6.1 miles) (115 kV overhead design)
- Quaker Meeting House Road North (7.9 miles) (underground design)

- Municipal Boundary
- Joint Base Cape Cod
- Barnstable Wellhead Protection Overlay District
- Barnstable Groundwater Protection Overlay District
- Identified Freshwater Recharge Area (CCC Regional Policy Plan)
- DEP Approved Zone I
- Interim Wellhead Protection Area
- Wellhead Protection Area (Zone II)

Figure 5-9

Water Resources

Table 5-12 Water Resources Crossed by Each Route

Water Resources Designation	Project (Linear Feet)	Noticed Alternative (Linear Feet)
Interim Wellhead Protection Area	0	0
MassDEP Approved Zone II	18,920	13,522
MassDEP Approved Zone I	0	0
Barnstable Wellhead Protection Overlay District	2,838	3,277
Barnstable Groundwater Protection Overlay District	4,167	559
Identified Freshwater Recharge Area (CCC Regional Policy Plan)	12,484	14,847

Both Routes have limited potential to impact groundwater and drinking water supplies during construction. To ensure that there are no impacts to public water supplies during construction over either Route, Eversource will develop and implement a Stormwater Pollution Prevention Plan ("SWPPP") that includes spill protection controls and countermeasures. The Company will prepare and implement the SWPPP in accordance with applicable permit requirements, including the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System Stormwater Construction General Permit and the Eversource BMP Manual.

Eversource will require its contractors to utilize equipment that is properly maintained to reduce the risk of a spill and to have spill containment and prevention devices (e.g., drip pans, absorbent pads, etc.) accessible to crews at each work location. The Company will also require its contractors to adhere to its BMPs, including those relative to the storage and handling of oils, lubricants and other chemicals during construction. Contractor staging areas and contractor yards typically will be located at existing developed areas (such as parking lots), where the storage of construction materials and equipment, including fuels and lubricants, will not conflict with protection of public surface water supplies or wetland resources.

To ensure that there are no impacts to public water supplies during operation of the line, the Company will continue to manage vegetation along the ROW in compliance with the Massachusetts Department of Agricultural Resources ("MDAR") regulations stated in 333 C.M.R. 11.00 and the Massachusetts Pesticide Control Act (G.L. c. 132B), which protect public water supplies.

In consideration of the above, the Company concludes that there will be no impact to public water supplies from construction using either Route.

5.7.7 Wetland and Water Resources

Transmission line construction could affect wetland resource areas and their buffer zones through land disturbance, work pad construction, vegetation clearing, de-watering, soil stockpiling, material laydown and construction access.

There are few wetlands and water resources near the Project and the overhead segment of the Noticed Alternative. These areas include freshwater wetlands, cranberry bogs, two ponds (Sandy Hill Pond, Spruce Pond) located on ROW 342 and the 100-foot buffer zone to wetland resource areas, as defined under local and state regulations.

There are limited areas of wetlands along the underground segment of the Noticed Alternative, including either side of Service Road just past Maple Street; where Service Road approaches the Route 149 rotary; and at West Barnstable Substation. See Appendix 5-2, Sheets 15, 17 and 24 for additional detail.

Based on the preliminary design work conducted by Eversource, impacts to wetlands are not anticipated during construction though there is a greater potential for wetland impacts during construction between the Project's proposed transmission line structures 80 through 83 where the transmission lines will span cranberry bogs and Sandy Hill Pond in Barnstable. The proposed location of structures 81 through 83 will also require work pad and foundation construction in the buffer zone to wetlands. The wetlands would be protected during construction by erosion and sediment controls.

Because the potential for impacts to wetlands is greater with the Project, the Noticed Alternative was determined to be superior for this criterion.

5.7.8 Rare Species Habitat

The Massachusetts Endangered Species Act ("MESA") protects state-listed rare species and their habitats and the Natural Heritage and Endangered Species Program ("NHESP") is responsible for implementing the regulations associated with MESA. During the regulatory review process, NHESP will review a proposed action and determine whether the project, as proposed, will impact state-listed species and/or habitats. If it is determined that a proposed action will result in a "take"[58] and cannot be revised to avoid a take, then the proponent must file with NHESP for the issuance of a Conservation and Management Permit ("CMP") and the proposed action must later meet the performance standards for the issued CMP. Some proposed actions located within mapped habitat may be exempt from NHESP review.

Areas of protected habitat for state-listed rare species along the Routes were identified utilizing ArcGIS™ software and applying Massachusetts Geographic Information System ("MassGIS") mapping of NHESP Priority and Estimated Habitat areas.

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[58] According to the MESA regulations, "take" is defined as the following: "In reference to animals, means to harass, harm, pursue, hunt, shoot, hound, kill, trap, capture, collect, process, disrupt the nesting, breeding, feeding or migratory activity or attempt to engage in any such conduct, or to assist such conduct; and in reference to plants, means to collect, pick, kill, transplant, cut or process or attempt to engage or to assist in any such conduct. Disruption of nesting, breeding, feeding or migratory activity may result from, but is not limited to, the modification, degradation or destruction of Habitat."

The Project

The Project is located entirely within an existing transmission line ROW. Most of the route passes through mapped rare species habitat for state-listed wildlife species (primarily eastern box turtle), invertebrate species (primarily moths and butterflies) and plant species (see Figure 4-11 in Section 4 of Analysis). Potential impacts include direct mortality during construction, primarily from movement of construction vehicles and disturbance of vegetation. Permanent impacts to mapped habitat from tree removal during construction of the Project are small and limited to approximately 0.19 acres near the Bourne Switching Station connection point. In addition, the existing understory will remain substantially intact in this location, thus contributing to the rapid and natural regeneration of low growing, early successional woody vegetation. The conversion in cover type from a forested habitat to a scrub-shrub habitat will also offer potential foraging, migratory, basking habitat for state-listed animal species (e.g., eastern box turtle) following Project construction. For certain invertebrate species (e.g., state-listed moths and butterflies), the quality of existing available habitat will in fact be improved through the conversion of vegetation cover types. Most of the existing gravel access roads that run the length of the ROW are well maintained and in good condition. The limited grading resulting in the placement of additional gravel that will be necessary in select locations, will mitigate potential impacts to rare species habitat, including state-listed plant species, from access road construction which are expected to be minimal or otherwise avoidable.

Noticed Alternative

The overhead line segment of the Noticed Alternative that is common to the overhead line segment of the Project is located entirely in mapped habitat and contains many of the same species identified above for the Project. The potential for rare species habitat impacts, as described above for tree removal, access road construction and work pad construction, would be the same for each Route along this segment.

The underground line segment of the Noticed Alternative within public roads will not result in any impacts to rare species habitat.

Discussion

Many of the state-listed species regularly utilize open canopied habitats of the ROW for foraging, reproduction, and/or thermal regulation. Following any construction for an overhead transmission line, the Eversource ROW will continue to offer suitable habitat for these species, given that there is no significant habitat conversion resulting from tree removal activity.

Regarding state-listed plants, in consultation with the NHESP, Eversource conducted plant surveys on the Project ROW during the months of August and September 2019.[59] The purpose of the surveys was to identify and document state-listed plants in or near the Project's work zone such that impacts to the plant could be avoided to the maximum extent practicable during construction. As a result of these surveys, Eversource identified "Exclusion Areas" that will be delineated with orange snow fencing and signage during construction. No construction equipment or work will be allowed inside these fenced off areas in order to avoid impacts to state-listed plants. Please refer to Appendix 5-2, Sheets 30, 31 and 33 for additional detail.

With appropriate protection measures, such as contractor training, restricted work zones, clearing sweeps for turtles prior to the start of work and/or other protective measures that may be prescribed by the NHESP, work within mapped habitat areas is unlikely to negatively impact state-listed species.

As the Project has approximately 4 miles or 78 acres of additional work within mapped habitat areas, as compared to the common overhead segment of the Noticed Alternative, the Project was determined to have a greater impact potential. Accordingly, the Noticed Alternative was determined to be superior to the Project for this criterion.

Consistent with current practices, and subsequent to the Project's completion, ongoing vegetation management within the ROW will be conducted under Eversource's VMP and Yearly Operational Plan ("YOP"), which include NHESP's required state-listed species Best Management Practices.

5.7.9 Visual Impacts

The viewsheds and/or settings of the properties near the Project, the Noticed Variation and overhead portion of the Noticed Alternative were previously altered by the presence of the existing transmission lines. In addition, none of the Routes involve tree removal that could potentially alter the overall landscape and viewshed. Although the transmission structures associated with the Noticed Variation are taller and wider than those for the Project or for the overhead portion of the Noticed Alternative, the transmission structures are proposed to be of similar height, material, line configuration and horizontal span as existing structures on ROW 342, resulting in only a modest visual change. Please refer to the photo-simulations provided in Appendix 5-9 for additional detail.

[59] The overhead segment of the Noticed Alternative that is common to the Project, does not contain state-listed plants near the proposed work zones. Accordingly, in consultation with the NHESP, Eversource focused its botanical survey efforts on the Project in locations where such plants are generally known to occur.

There are no visual impacts anticipated from the underground segment of the Noticed Alternative, as there would be no new above-ground structures (except for relatively common installations associated with the West Barnstable Substation expansion) nor any permanent vegetation removal.

While the Noticed Variation's 345-kV transmission structures are taller and would range in height from 100 feet to 150 feet (see Appendix 5-5), these structure heights are not anticipated to be significantly discernable from the existing transmission facilities as they will be similar to the existing 345-kV line within the same ROW. Due to the span length, the structure locations for the 345-kV line will be slightly different from that for the Project and overhead portion of the Noticed Alternative.

Discussion

Because the viewsheds and/or settings of the properties near the Project, the Noticed Variation and the overhead segment of Noticed Alternative have been previously altered by the presence of the existing transmission lines, the installation of new transmission line structures and relocated distribution poles will not significantly alter or modify these existing viewsheds. Notwithstanding, because the Noticed Alternative transitions to underground transmission line construction in local roads at Quaker Meetinghouse Road in Sandwich, it avoids new overhead transmission lines and distribution line relocation work near residential neighborhoods east of this location (Cobblestone Way and Bluestone Terrace). Residents in these neighborhoods could potentially perceive the new and relocated structures associated with the Project as being more impactful to their existing viewsheds. For this reason, the Noticed Alternative was determined to be superior to the Project and Noticed Variation for this criterion.

5.7.10 Cultural Resources

Transmission line construction on Eversource ROWs can potentially affect archaeological resources when earth movement disturbs subsurface artifacts, such as during grading and excavation. Therefore, in support of the transmission line routing exercise described in Section 4 of this Analysis, the Company's archaeology consultant, PAL, conducted an Archaeological Sensitivity Assessment to preliminarily identify archaeological sensitive areas having the potential to contain significant archaeological resources (see Section 4.4.1.1 for additional detail).

Building upon the preliminary findings described in the referenced Sensitivity Assessment, PAL then conducted a more detailed investigation (referred to as an Intensive (locational) Survey) within the Project area.[60] As documented in the technical report prepared by PAL and submitted

[60] On August 25, 2015, the MHC issued a permit to PAL to conduct an Intensive (locational) Survey of the Project area (Permit to Conduct Archaeological Field Investigation Permit Number 3595). Note that the Project study area is coincident with the common overhead segment of the Noticed Alternative, as well as the Noticed Variation described herein.

to the Massachusetts Historical Commission ("MHC"),[61] the combined results of PAL's archival research, walkover survey, and subsurface testing completed as part of the intensive survey did not identify any potentially significant archaeological resources within the Project area. MHC concurred with this assessment and issued a written No Effect Determination for the Project. For a copy of MHC's letter dated January 26, 2016, please see Appendix 5-10.

Regarding the underground line segment of the Noticed Alternative, the public roads comprising this route have been modified by construction of the roads, themselves, as well as by the installation of above and below-ground utilities, and therefore, it is unlikely that natural/undisturbed soils or potentially significant archaeological deposits would be located below or immediately adjacent to a linear excavation in the established roadway.[62]

In consideration of the above, the Company concludes that there will be no impact to archaeological resources from construction using either Route.

5.8 Summary of Environmental Impacts

Based upon the above comparison, the Project and Noticed Alternative have relatively minimal environmental effects, and most of those effects would be temporary and can be minimized using the proposed mitigation measures. Permanent effects, such as tree removal during construction, are minimal and limited to work near the Bourne Switching Station and West Barnstable Substation. Table 5-13 below provides a comparison of the Routes based on the criteria evaluated.[63] Overall, the Project was determined to be superior to the Noticed Alternative on four criteria: adjacent land use, sensitive receptors, potential for traffic congestion during construction and noise. The Noticed Alternative was determined to be superior to the Project on three criteria: impacts to wetlands, rare species habitat and visual. For the balance of the criteria analyzed, the Routes were determined to be comparable from an environmental impact perspective.

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[61] The technical report titled, "Intensive (Locational) Archaeological Survey, Mid Cape Reliability Project, ROW 342, 343, and Bourne Switching Station Area, Bourne, Sandwich and Barnstable, Massachusetts", was filed with and received by MHC on January 14, 2016. The technical report contains information deemed confidential by MHC and is not therefore included herein.

[62] It is also worth noting that the total number of historic sites (buildings, local historic districts, and National Register-listed individual buildings and districts) directly abutting the Noticed Alternative and Project are nearly identical (8 sites versus 9 sites, respectively).

[63] Similar conclusions are reached for the Noticed Variation, though as noted elsewhere in this section there are differences from an EMF and visual perspective given the different overhead line designs relative to the Project and Noticed Alternative.

Table 5-13 Comparison of the Project and Noticed Alternative

Evaluation Criteria	Project	Noticed Alternative
Adjacent Land Use	+	-
Sensitive Receptors	+	-
EMF	=	=
Potential for Traffic Congestion During Construction	+	-
Noise	+	-
Public Water Supply Protection Areas	=	=
Wetlands	-	+
Rare Species Habitat	-	+
Visual Impacts	-	+
Cultural Resources	=	=

In consideration of all of the above, and the scoring analysis presented in Section 4 of the Analysis, the Company has determined that, on balance, the Project is superior to the Noticed Alternative with respect to environmental impacts.

As the Project advances from design to the construction phase, the Company will continue to look to further minimize potential impacts to the natural and developed environments affected. The Company will also work closely with the affected municipalities to minimize temporary construction impacts.

5.9 Comparison of Costs

As discussed in Section 4 of the Analysis, the cost estimate is approximately $59.1M for the Project (-25%/+25%), $68.0M for the Noticed Variation (-50%/+200%) and $262.3M for the Noticed Alternative (-50%/+200%). The cost comparisons of the Project, Noticed Variation and Noticed Alternative are provided below in Table 5-14.

Table 5-14 Total Estimated Cost (millions)

Route	Transmission and Distribution Line Cost	Substation Cost	Total Project Cost
Project	$45.0	$14.1	$59.1
Noticed Variation	$53.9	$14.1	$68.0[64]
Noticed Alternative	$241.8	$20.5	$262.3

[64] The Company offers this option recognizing that there is great uncertainty surrounding the viability of the generating resources proposed to interconnect in the Barnstable area and the designation of a party or parties responsible for the costs of the incremental upgrades. Inclusion of the Noticed Variation provides the flexibility to respond to changing circumstances during the siting process for the Project as the uncertainties become clearer.

Based on the current cost estimates, the Noticed Alternative's total costs are greater than the Project and Notice Variation total costs due to the Route's underground transmission line segment and the additional substation improvements required to accommodate the underground line's transition into the West Barnstable Substation.

5.10 Comparison of Reliability

The Company considered the differences in reliability for the Project and the Noticed Alternative and determined that there was no meaningful difference between the operating characteristics for the Routes or design variation under consideration. Accordingly, the Project and Noticed Alternative are comparable from a reliability perspective.

5.11 Overall Comparison and Conclusion

The Project is superior to the Noticed Alternative on four of ten criteria analyzed by the Company (adjacent land use, sensitive receptors, potential for traffic congestion during construction, and noise) and the Noticed Alternative was superior to the Project on three of the ten criteria analyzed (wetlands, rare species habitat and visual). For the balance of the criteria analyzed (EMF, public water supply protection areas, visual impacts and cultural resources), the Routes were determined to be comparable with respect to impacts.

With respect to the impacts described above, the Noticed Variation would result in comparable impacts to those described for the Project and would be equal with respect to reliability. Slight variations in potential visual impacts and EMF modeling would result from differences in the design of the New Line as a 345-kV line, as well as an increase in cost.

The Company presents the Noticed Variation for the Siting Board's consideration to demonstrate a favorable comparison against the Noticed Alternative in providing the best balance of impacts to the natural and developed environments, while meeting the identified system need. The Noticed Variation also provides the flexibility for future expansion of the Barnstable Switching Station and West Barnstable Substation to facilitate the export of renewable generation that may interconnect at the stations while avoiding the cost inefficiency and additional burden to the community of new transmission line construction in the same or an alternate location.

For these reasons, including the Project's estimated lower cost, the Company concludes that the Project provides the best balance of impacts to the natural and developed environments, while meeting the identified system need.

Section 6.0

Consistency with the Current Health, Environmental Protection, and Resource Use, and Development Policies of the Commonwealth

6.0 CONSISTENCY WITH THE CURRENT HEALTH, ENVIRONMENTAL PROTECTION, AND RESOURCE USE AND DEVELOPMENT POLICIES OF THE COMMONWEALTH

6.1 Introduction

Pursuant to G.L. c. 164, § 69J, the Siting Board shall approve a petition to construct a facility if, inter alia, the Siting Board determines that "plans for expansion and construction of the applicant's new facilities are consistent with current health, environmental protection, and resource use and development polices as adopted by the commonwealth." As discussed below and in more detail throughout this Analysis, the Project not only satisfies the requirements of this statute, but is also fully consistent with other important state energy policies as articulated in the Electric Utility Restructuring Act of 1997 (the "Restructuring Act"), the Green Communities Act (c. 169 of the Acts of 2008), the Global Warming Solutions Act (c. 298 of the Acts of 2008) and the Energy Diversity Act (c. 188 of the Acts of 2016).

6.2 Health Policies

The Restructuring Act provides that reliable electric service is of "utmost importance to the safety, health and welfare of the Commonwealth's citizens and economy…" See Restructuring Act § 1(h). The Legislature has expressly determined that an adequate and reliable supply of energy is critical to the state's citizens and economy. The Project will be fully consistent with this policy. As discussed in the Petition, the Project will enhance the reliability of the interconnected electric transmission system on Cape Cod, enabling the Company to continue to ensure the availability of sufficient and reliable electric service to the citizens and businesses of the Commonwealth and the region.

The Company will design, build, and maintain the facilities for the Project so that the health and safety of the public are protected. This will be accomplished through adherence to all applicable federal, state, and local regulations, and industry standards and guidelines established for protection of the public. As discussed in Section 5 of the Analysis, all design, construction and operation activities will be in accordance with applicable governmental and industry standards such as the Massachusetts Code for the Installation and Maintenance of Electric Transmission Lines (220 C.M.R. §§ 125.00 et seq.), as well as the National Electrical Safety Code and Occupational Safety and Health Administration ("OSHA") regulations and will have no adverse health effects. The facilities will be designed in accordance with sound engineering practices using established design codes and guides published by, among others, the Department of Public Utilities (the "DPU"), the Institute of Electrical and Electronic Engineers, the American Society of Civil Engineers, the American Concrete Institute, and the American National Standards Institute. Following construction of the facilities, all transmission structures and substation facilities will be clearly marked with warning signs to alert the public to potential hazards.

In sum, because the Project will be consistent with, and promote, the Commonwealth's energy polices as outlined in the Restructuring Act, it will also be consistent with its health policies.

6.3 Environmental Protection Policies

The Project is consistent with the Commonwealth's environmental protection policies as set forth in Chapter 164 of the General Laws and with other state and local environmental policies as described below.

6.3.1 The Restructuring Act

The Restructuring Act provides that the Company must demonstrate that the Project minimizes environmental impacts consistent with the minimization of costs associated with mitigation, control, and reduction of the environmental impacts of the Project. Accordingly, an assessment of all impacts of a proposed facility is necessary to determine whether an appropriate balance is achieved both among conflicting environmental concerns as well as among environmental impacts, cost and reliability.

A facility that achieves the appropriate balance thereby meets the Chapter 164 requirement to minimize environmental impacts at the lowest possible cost. To determine if a petitioner has achieved the proper balance among environmental impacts, cost, and reliability, the Siting Board first determines if the petitioner has provided sufficient information regarding environmental impacts and potential mitigation measures in order to make such a determination. The Siting Board then determines whether environmental impacts are minimized. Similarly, the Siting Board evaluates whether the petitioner has provided sufficient cost information in order to determine if the appropriate balance among environmental impacts, cost, and reliability has been achieved.

In Sections 3, 4, and 5 of this Analysis, the Company demonstrated that it compared a range of alternative projects and proposed specific plans to mitigate environmental impacts associated with the construction, operation, and maintenance of the proposed transmission line, consistent with cost minimization. As such, the Project is consistent with the environmental policies of the Commonwealth as set forth in the Restructuring Act.

6.3.2 State and Local Environmental Policies

The Company will obtain all environmental approvals and permits required by federal, state and local agencies and will construct and operate the Project to fully comply with applicable federal, state and municipal regulations and environmental policies. Thus, the Project will contribute to a reliable, low cost, diverse energy supply for the Commonwealth while avoiding, minimizing and mitigating environmental impacts to the maximum extent practicable. Table 6-1, below, identifies the anticipated permits, reviews, and approvals required for the Project (in addition to the Siting Board's review). By meeting the requirements for acquiring each of these federal, state, and local permits, the Project will be in compliance with applicable state and local environmental policies.

In addition, the Project is consistent with the Commonwealth's Environmental Justice ("EJ") Policy. Environmental Justice is the equal protection and meaningful involvement of all people and communities with respect to the development, implementation, and enforcement of energy, climate change, and environmental laws, regulations, and policies and the equitable distribution

of energy and environmental benefits and burdens. The EJ Policy was initially promulgated in 2002 by the predecessor to the Executive Office of Energy and Environmental Affairs ("EOEEA"). Pursuant to Executive Order #552, which was issued in 2014, the EJ Policy was updated and re-issued by the Secretary of EOEEA on January 31, 2017. The current EJ Policy is imposed on state agencies under the EOEEA, including the Siting Board and the Department, rather than on project applicants *per se*. In turn, project applicants must comply with relevant directives and requirements established by these state agencies. Thus, the provisions and requirements of the Commonwealth's EJ Policy are not directly applicable to the Project. Nevertheless, the Company's environmental analysis in this proceeding is designed to minimize the Project's impacts to *all* populations, including EJ populations. Further, regardless of any legal obligation and consistent with the Commonwealth's EJ Policy, the Project does not traverse any EJ neighborhoods as defined in the EJ Policy and, in any event, the Company has undertaken, and will continue to undertake, an extensive community outreach effort in order to facilitate the meaningful opportunity to participate by all. As such, the Project is consistent with the Commonwealth's environmental policies.

6.3.3 Green Communities Act

The Green Communities Act is a comprehensive, multi-faceted energy reform bill that encourages energy and building efficiency, promotes renewable energy, creates green communities, implements elements of the Regional Greenhouse Gas Initiative, and provides market incentives and funding for various types of energy generation. The Green Communities Act (as amended and supplemented by St. 2012, c. 209, An Act Relative to Competitively Priced Electricity) can be expected to result in greater renewable supplies and substantial new conservation initiatives in future years. The improvements to the transmission system in the Mid-Cape area will strengthen and improve the reliability of the Company's transmission system on the Cape. While the primary Project purpose is improved reliability consistent with ISO-NE requirements, the more robust system will enable a more efficient and flexible operation of the grid as contemplated by the Green Communities Act. The Project, therefore, is consistent with the Green Communities Act.

6.3.4 Global Warming Solutions Act

The Global Warming Solutions Act ("GWSA") establishes aggressive greenhouse gas ("GHG") emissions reduction targets of 25 percent from 1990 levels by 2020 and 80 percent from 1990 levels by 2050. Pursuant to the GWSA, the Secretary of the EOEEA issued the Clean Energy & Climate Plan for 2020 in December 2010 and updated the plan in December 2015. Among other provisions, the GWSA obligates administrative agencies such as the Siting Board, in considering and issuing permits, to consider reasonably foreseeable climate change impacts (e.g., additional GHG emissions) and related effects (e.g., sea level rise). The proposed improvements to the transmission system in the Mid-Cape area will have no adverse climate change impacts or negative effects on sea levels.

As previously stated, the improvements to the transmission system in the Mid-Cape area will strengthen and improve the reliability of the Company's transmission system on the Cape. While the primary Project purpose is improved reliability consistent with ISO-NE requirements, the more robust system will be better able to accommodate future renewable energy projects at the large scale which will likely be necessary to achieve the GWSA's very ambitious 2050 greenhouse gas reductions (80% from 1990 levels). Consequently, the Project is consistent with the GWSA.

6.3.5 Energy Diversity Act

On August 8, 2016, Governor Charles Baker signed into law An Act to Promote Energy Diversity (the "Energy Diversity Act"). St. 2016, c. 188. The Energy Diversity Act is a multi-faceted energy bill that, among other things, facilitates the procurement and integration of renewable energy generation resources, including new offshore wind energy generation, firm service hydroelectric generation and new Class I RPS eligible resources. St. 2016, c. 188, § 12. The Project will improve the reliability of the Company's transmission system on the Cape and thereby create a more robust transmission system that is better able to accommodate various energy resources that may come online in the future as a result of the Energy Diversity Act. Accordingly, the Project is consistent with the Energy Diversity Act.

6.3.6 Clean Energy Act

On August 9, 2018, Governor Charles Baker signed into law An Act to Advance Clean Energy (the "Clean Energy Act"). St. 2018, c. 227. The Clean Energy Act, among other provisions, amends the Energy Diversity Act to further encourage energy storage efforts. St. 2018, c. 227, § 20. The Clean Energy Act also requires the Department of Energy Resources ("DOER") to investigate the potential for additional clean energy solicitations. St. 2018, c. 227, § 21. As noted above, the Project will improve the reliability of the Company's transmission system on the Cape, which will, in turn, enhance the Company's ability to accommodate new energy storage units as well as future renewable energy generating resources such as solar and on-shore and offshore wind in line with the Clean Energy Act. Accordingly, the Project is consistent with the Clean Energy Act.

6.4 Resource Use and Development Policies

The Project, which will contribute to the long-term maintenance and reliability of the electric transmission system in the Mid-Cape area on Cape Cod, will be constructed and operated in compliance with Massachusetts's policies regarding resource use and development. For example, in 2007, the EEA's Smart Growth/Smart Energy policy established the Commonwealth's Sustainable Development Principles, including: (1) supporting the revitalization of city centers and neighborhoods by promoting development that is compact, conserves land, protects historic resources and integrates uses; (2) encouraging remediation and reuse of existing sites, structures and infrastructure rather than new construction in undeveloped areas; and (3) protecting environmentally sensitive lands, natural resources, critical habitats, wetlands and water resources

and cultural and historic landscapes. As described more fully in Section 5 of this Analysis, the Project will support these principles because, among other reasons, the Project will be located within an existing electric transmission ROW, consistent with the reuse of existing sites.

In addition, the Article 97 lands that would be crossed by segments of the Project in the Town of Barnstable are presently located within existing Eversource ROW that already includes overhead transmission lines. Accordingly, the Article 97 land within the ROW currently exists in an altered and developed state as an active, maintained electric transmission line easement. The condition of the Article 97 land within the ROW will not change as a result of the Project. More specifically, modifying the easement documents to include another overhead transmission line "would not destroy or threaten a unique or significant resource (e.g., significant habitat, rare or unusual terrain, or area of significant public recreation)," when compared to the existing condition, nor would it detract "from the mission, plans, policies and mandates of EEA …" when compared to the existing condition, consistent with the Commonwealth's Article 97 Land Disposition Policy.

Accordingly, the Project is in compliance with, and furthers, the Commonwealth's policies regarding resource use and development.

Table 6-1 Anticipated Major Federal, State and Local Permit/Consultation Requirements for Project

Agency	Type of Permit	Required?	Comments
Federal			
FAA	Hazard Determinations	Yes	Certain structures and construction cranes in close proximity to airport facilities will require hazard determinations from the FAA prior to construction.
State			
Department of Public Utilities	G.L. c. 164, § 72, approval to construct and operate a transmission line ("Section 72 Petition"); and G.L. c. 40A, § 3, granting of individual and comprehensive zoning exemptions from the Town of Barnstable Zoning Ordinance ("Zoning Petition").	Yes	The Company has filed a motion with the Siting Board pursuant to G.L. c. 25, § 4, seeking the consolidation of the review of this Petition with the Section 72 Petition and Zoning Petition being filed with the Department.
Executive Office of Energy & Environmental Affairs	Massachusetts Environmental Policy Act	Yes	The Project exceeds a MEPA ENF review threshold relating to Article 97. Please see Appendix 6-1 for a copy of the ENF as filed with MEPA.
Massachusetts Legislature	Article 97 of the Articles of Amendment to the Constitution of the Commonwealth of Massachusetts	Yes	On April 9, 2019, the Town of Barnstable Conservation Commission voted unanimously to grant Eversource the expanded easement rights. On June 7, 2019, the Town of Barnstable Town Council voted in favor of granting Eversource the expanded easement. Eversource is working with Town Officials and the Town's legislative representatives to obtain a two-thirds vote of the Legislature in support of the disposition, as required under the state constitution. Eversource is working with the Town of Barnstable's Town Counsel on the Bill language. Once finalized, the State Sponsor will bring the bill through the Legislative process. It is anticipated that the bill will be approved on or before the end of the Legislature's 2020 formal session (July 31, 2020).
Massachusetts Historical Commission	State Register Review / Adverse Effect Determination	Yes	MHC issued a No Effect Determination on January 26, 2016 (see Appendix 5-10).
Natural Heritage and Endangered Species Program	MESA Conditional "No Take" Authorization Letter	Yes	Preliminary consultation with the NHESP indicates that the Project will not result in a Take.
Massachusetts DOT Highway Division	Access Permit	Yes	Eversource will coordinate with MassDOT regarding the aerial crossing of Forestdale Road (Route 130) in Sandwich and Route 6 in Barnstable
Massachusetts DOT Aeronautics Division	Hazard Determinations	Yes	Certain structures and construction cranes in close proximity to airport facilities will require hazard determinations from the FAA prior to construction.
Cape Cod Commission	Development of Regional Impact ("DRI")	TBD	The need for a DRI will be determined in consultation with the Cape Cod Commission as the detailed design is advanced for the West Barnstable Substation expansion work.
Local			
Conservation Commissions	Wetlands Protection Act & Wetland Bylaws Order of Conditions	Yes	Activities in the 100-foot buffer zone to local and state jurisdictional wetland resource areas in Bourne, Sandwich and Barnstable will require Orders of Conditions.
Old King Highway Regional Historic District Commissions ("OKHD")	Certificate of Appropriateness	Yes	Eversource will consult with the OKHD / Barnstable Historic Commission for any substation improvements proposed within the District in West Barnstable.