DOCKET NO. 461 – Eversource Energy Application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a 115-kilovolt (kV) bulk substation located at 290 Railroad Avenue, Greenwich, Connecticut, and two 115-kV underground transmission circuits extending approximately 2.3 miles between the proposed substation and the existing Cos Cob Substation, Greenwich, Connecticut, and related substation improvements.	}	Connecticut
	}	Siting
	}	Council
	}	April 11, 2016

Proposed Findings of Fact

Introduction

1. The Connecticut Light and Power Company doing business as Eversource Energy (Eversource), in accordance with provisions of Connecticut General Statutes (CGS) § 16-50g, et seq., applied to the Connecticut Siting Council (Council) on June 26, 2015 for a Certificate of Environmental Compatibility and Public Need (Certificate) for the construction, maintenance, and operation of a 115-kV bulk substation located at 290 Railroad Avenue, Greenwich, Connecticut, and two 115-kV underground transmission circuits extending approximately 2.3 miles between the proposed substation and the existing Cos Cob Substation, Greenwich, Connecticut, and related substation improvements, referred to as the Greenwich Substation and Line Project (Project). (Eversource 1, pp. A-1, B-1)

2. The purpose of Eversource's proposed Project is to provide immediate load relief and add transformation capacity to the electric distribution system to the Town of Greenwich. (Eversource 1, pp. ES-1, A-1)

3. With the new capacity provided by a new bulk substation source and two new 115-kV transmission circuits, the risk of projected overloads on lines and equipment will be mitigated, thereby improving system reliability. (Eversource 1, pp. ES-2)

4. Eversource has an obligation to serve all of the customers on the hottest summer day, the coldest winter night. (Transcript 4, p. 61)

5. The parties in this proceeding are the applicant, the Office of Consumer Counsel, and the Town of Greenwich. The intervenors are Parker Stacey, Pet Pantry Super Discount Stores, LLC, Field Point Estate Townhouses, Christine Edwards, Richard Granoff, Cecilia Morgan, Bella Nonna Restaurant and Pizzeria, Greenwich Chiropractic and Nutrition, Joel Paul Berger, and Meg Glass. (Transcript, September 1, 2015, 3:00 p.m., pp. 4-8; Transcript, January 12, 2016, 11:00 a.m., p. 5; Service List, February 1, 2016)

6. Pursuant to CGS §16-50*l*(b), public notice of the application was published in The Greenwich Time on June 24, 2015 and in The Stamford Advocate on June 25, 2015. (Eversource 1, p. Q-15, Eversource 1(i) – Bulk Filing #2; Eversource 9, pp. 55-56)

7. Pursuant to CGS §16-50*l*(b), notice of the application was provided to each Eversource customer located within the vicinity of the three alternate route options on a separate enclosure with each customer's monthly bill for one or more months not earlier than 60 days prior to the filing of its

application with the Council. This included notice to all Eversource customers in the Town of Greenwich. (Eversource 1, p. Q-15, Eversource 1(i) – Bulk Filing #2; Eversource 9, p. 55)

8. Pursuant to CGS § 16-50*l*(b), notice of the application was provided to all thirty-four (34) abutting property owners of the Proposed Site and Alternate Site for the Substation by certified mail. (Eversource 1, p. Q-15, Eversource 1(a) – Bulk Filing #1; Eversource 3, Q-CSC-014; Eversource 9, p. 55)

9. For the notice of the application, Eversource received 24 proof of delivery receipts and two undeliverable receipts. Eversource sent an additional notice via first class mail to the remaining 10 abutters from whom Eversource did not receive delivery receipts. (Eversource 3, Q-CSC-014)

10. Eversource provided notice to all federal, state and local officials and agencies listed under CGS § 16-50*l*(b). (Eversource 1, p. Q-14; Affidavits of Notification; Eversource 9, p. 55)

11. On August 18, 2015, Eversource erected six (6) 4-foot by 6-foot signs notifying the public of the hearing on its application at the following locations: (1) proposed Substation site at 290 Railroad Avenue; (2) alternate Substation site at 281 Railroad Avenue (2 signs); (3) Cos Cob Substation site on Sound Shore Drive; (4) intersection of Bruce Park Drive and Kinsman Lane; and (5) Arch Street Parking Lot. (Eversource 6; Eversource 9, p. 56)

12. In accordance with Section VIII of the Council's Electric and Fuel Transmission Line Facility and Electric Substation Facility Application Guides, Eversource provided notice to a number of community groups including: Greenwich Chamber of Commerce, The Greenwich Land Trust, The Garden Education Center of Greenwich, Greenwich Chapter of National Audubon Society, Connecticut League of Conservation Voters, Connecticut Chapter of The Nature Conservancy, Citizens Campaign for the Environment, Greenwich Riding & Trails Association, Inc., Mianus River Watershed Council, Mianus River Gorge Preserve, Friends of Mianus River Park, Trout Unlimited – Mianus Chapter 258, Wood-Pawcatuck Watershed Association, Farmington River Watershed Association, Farmington River Coordinating Committee, Connecticut Trust for Historic Preservation, The Greenwich Historical Society, Connecticut Fund for the Environment, SoundWaters, Soundkeeper, and Long Island Sound Foundation. (Eversource 1, Affidavits of Notification)

13. In accordance with Section VIII of the Council's Electric and Fuel Transmission Line Facility and Electric Substation Facility Application Guides, Eversource provided notice to the Aquarion Water Company of Connecticut. (Eversource 1, Affidavits of Notification)

14. The Council conducted a public field review of the proposed project on September 1, 2015, beginning at 1:00 p.m. (Council's Hearing Notice dated July 24, 2015, Council's Field Review Notice dated August 25, 2016)

15. Pursuant to CGS § 16-50m, the Council, after giving due notice thereof, held a public hearing on September 1, 2015, beginning at 3:00 p.m. and continuing at 6:30 p.m. at the Greenwich Library, Cole Auditorium, 101 West Putnam Avenue, Greenwich, Connecticut. (Council's Hearing Notice dated July 24, 2015; Transcript 1 – September 1, 2015 at 3:00 p.m., pp. 3-4; Transcript 2 – September 1, 2015 at 6:30 p.m., p. 3)

16. The Council continued the evidentiary hearings on October 6, 2015, beginning at 11:00 a.m.; on December 1, 2015, beginning at 11:00 a.m.; on January 12, 2016, beginning at 11:00 a.m.; on February 23, 2016, beginning at 11:00 a.m.; and on March 10, 2016, beginning at 1:00 p.m. All continued hearings were held at the Council's offices at Ten Franklin Square, New Britain. (Transcript 3 – October 6, 2015, 11:00 a.m., p. 5; Transcript 4 – December 1, 2015, 11:00 a.m., pp. 5-6; Transcript 5 – January 12, 2016, 11:00 a.m., p. 4, Transcript 6 – February 23, 2016, p. 5; Transcript 7 – March 10, 2016, p. 4)

17. On September 18, 2015, Eversource notified abutters to the Preferred or Alternate Sites and Cos Cob Substation of the Council's continuation of the evidentiary hearing to be held on October 6, 2015 at the Council's office and the opportunities to participate in the Council's process. (Eversource 25, pp. 15-16)

Municipal and Community Outreach

18. Eversource representatives began discussing the pressing need for improvements to the local electrical system with Town of Greenwich officials on June 11, 2011. Project updates were provided periodically to the First Selectman and Department Heads throughout 2012, 2013 and 2014. (Eversource 1, p. N-1)

19. Pursuant to CGS § 16-50x(d), on February 6, 2015, Eversource filed its Location Review Filing with the Greenwich Planning and Zoning Commission and the Greenwich Inland Wetlands and Watercourse Agency. (Eversource 1, Bulk Filing #1; Eversource 9, p. 54)

20. Pursuant to CGS §16-50*l*(e), Eversource submitted a Municipal Consultation Filing (MCF) to the Town of Greenwich on February 6, 2015, and provided copies of the MCF to the First Selectman's office, the Greenwich Library and its Byram, Shubert and Cos Cob branches, the Planning and Zoning Commission and the Inland Wetlands and Watercourses Agency. (Eversource 1, p. ES-10, Q-16; Eversource 9, p. 53)

21. As of the filing of the application, Eversource conducted public outreach efforts by holding two Open Houses at the Greenwich Town Hall on March 3, 2015 and July 15, 2015. Eversource also appeared before the Town's Inland Wetlands and Watercourses Agency (March 23, 2015), Architectural Review Committee (March 4, 2015), and Planning and Zoning Commission (March 10 and 14, 2015) to present information on the project and respond to any questions. Eversource developed a Project website, email address and hotline through which residents and stakeholders could communicate with Project representatives. (Eversource 1, pp. ES-10, A-1, N-1 – N-2; Eversource 3, Q-CSC-001; Eversource 9, pp. 54-55)

22. There is no other municipality within 2,500 feet of the proposed Greenwich Substation, Cos Cob Substation or any portion of the Preferred Route or alternative routes presented in the application. (Eversource 1, p. Q-14; Eversource 9, p. 53)

23. As of the filing of the application, the Project team has held two Project update meetings with representatives of the Town of Greenwich since the conclusion of the MCF. (Eversource 9, p. 54)

24. In connection with the permits and approvals that would be required for the construction and operation of the Project, Eversource consulted, and is continuing to consult with, the following federal and state agencies:

- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- CT DEEP, Natural Diversity Data Base
- Department of Economic and Community Development, Connecticut Historic Preservation Office
- ConnDOT
- CT DEEP, Office of Long Island Sound Programs

(Eversource 9, p. 55)

25. Through Eversource's MCF and other public outreach efforts, it acquired information and recommendations from the Town of Greenwich to assist in the design and construction of transmission improvements that would provide needed system reliability while minimizing the Project's effects on the community. (Eversource 1, p. Q-16)

26. Eversource has endeavored to work closely with the Town of Greenwich and its residents by actively seeking community input on the proposed Project and listening to suggestions and concerns. Suggested design changes were received through:

    - Several meetings, field walk-throughs and presentations with the First Selectman and Town department heads;
    - Conversations and correspondence with local property owners;
    - Two public presentations before the Planning and Zoning Commission;
    - Two presentations before the Architectural Review Committee;
    - Two Project Open Houses; and
    - Field review and testimony before the Siting Council.

(Eversource 32, p. 6)

State Agency Comment

27. On July 24, 2015, the Council solicited written comments on Eversource's application from the following state agencies: Department of Energy and Environmental Protection, Department of Public Health, Public Utilities Regulatory Authority, Department of Economic and Community Development, Connecticut Airport Authority, State Historic Preservation Office, Department of Emergency Services and Public Protection, Department of Agriculture, Council on Environmental Quality, Office of Policy Management, and Department of Transportation. (Council's Hearing Notice Package, July 24, 2015)

28. The Council did not receive comments from any state agencies regarding this project. (Record)

Project Need

Overview

29. The proposed Greenwich Substation will serve three important purposes: (a) it will address the need for capacity to avoid transformer overloads at Cos Cob Substation; (b) it will eliminate potential overloads of distribution feeders that supply power to Prospect Substation from Cos Cob Substation; and (c) it will reduce the risk of transformer overloads at Prospect Substation. (Eversource 1, pp. E-3 – E-8)

30. The proposed Project focuses on three parts of needed reliability: assurance of adequate supply; a decrease in the frequency of power interruptions witnessed by Greenwich customers; and allowance for recovery after catastrophic events in a timely manner. (Transcript 7, pp. 132-133)

31. Cos Cob Substation is the cornerstone of the electrical distribution system supplying electric service to Greenwich customers. Cos Cob Substation performs critical functions, including acting as an electrical "off-ramp," taking power at 115 kV from the transmission system (the highway system of electrical lines that move high voltage power over long distances) and reducing the transmission voltage levels down to distribution voltage levels, in this case 27.6 and 13.2 kV, which levels are reduced further to serve homes and businesses; supplying power at 27.6 kV to other substations in Greenwich to enable those substations to serve homes and businesses; and supplying power at 27.6 kV to large commercial customers and the secondary network in downtown Greenwich. (Eversource 1, p. E-3; Eversource 39, pp. 3-4)

32. Cos Cob Substation is the most heavily loaded bulk substation in Connecticut, serving approximately 176 MVA of load. (Eversource 1, p. E-9)

33. In July of 2015, Eversource had three contingency situations that occurred on three different underground feeders between Cos Cob and Prospect Substation that exceeded the normal ratings. As a result, Eversource had to use the emergency ratings; in one case, the emergency ratings were used for more than 24 hours. These situations were the result of cable failures on the 27-kV system between Cos Cob and Prospect Substations. (Transcript 1, p. 58; Transcript 3, p. 53, 138; Transcript 4, p. 72; Eversource 36, Q-OCC-042)

34. Utilities in general, and Eversource in particular, push the capability of their equipment so that they get the maximum capacity without jeopardizing the equipment's physical integrity. However, many utilities now only use nameplate ratings, and will not allow their equipment to tolerate increased loading, even for short periods of time. (Transcript 5, p. 75)

35. Cos Cob Substation has a permissible load rating of 135 MVA at 27.6 kV. Based on 2013 actual loads, Cos Cob Substation served 130.5 MVA of load at 27.6 kV. Eversource's projected 27.6-kV loads at Cos Cob Substation in 2017, without the proposed Greenwich Substation, would exceed its permissible load rating at 135.8 MVA if certain contingency events occur. (Eversource 1, p. E-5)

36. To avoid such overloading, 27.6-kV load relief at Cos Cob Substation should be in place in 2018. (Eversource 1, p. E-5)

37. Greenwich is the third-largest user of electricity in Eversource's service territory, which serves 149 municipalities. (Transcript 3, p. 86; Eversource 25, p. 6; Eversource 29, Q-PANTRY-050)

38. In 1990, the population of Greenwich was 58,441; 20 years later it was 61,171. Although this is a modest population increase, the electrical demand during the same time period has increased by 45 percent. (Transcript 7, p. 50)

39. Based on the customer-metered, actual usage data, customer usage (kilowatt hours) in Greenwich for 2015 was 1.5% greater versus 2014. (Transcript 7, pp. 140-141)

40. The Project would open up future capability to switch between the Cos Cob and Greenwich Substations and provide customers with automatic backup where they do not have it today; currently, there is nowhere to move the load. (Transcript 3, p. 139)

41. Adding the proposed new bulk substation in Greenwich would enable Eversource to meet the projected load in 2018 and approximately 30 years thereafter, as well as provide capacity for additional load increases that will likely arise from continuing economic development in Greenwich. Long-term planning necessitates designing substations and substation components with a very long end of life expectancy with sufficient margin for long-term load growth. (Eversource 1, p. E-6; Eversource 29, Q-PANTRY-054)

42. Building the Greenwich Substation near the load center will establish a new independent power supply source, will increase capacity in the area and improve reliability of the distribution system by reducing its dependence on the 27.6-kV distribution system. The benefit that customers will receive is improved reliability and a substation infrastructure that can support economic growth for decades to come. (Eversource 1, p. E-10, Fig. E-2; Eversource 29, Q-PANTRY-058)

Background

43. The electric distribution system in Greenwich was designed more than 50 years ago to serve substantially lower load levels than exist today. (Eversource 1, p. E-6)

44. As part of an ongoing analysis of its distribution system, in 1989 Eversource identified the need for a new Greenwich-area substation because Cos Cob Substation was projected to reach capacity in 1994. However, in 1994, Eversource was able to postpone construction of a new substation and provide the needed additional capacity at a lower cost by upgrading Tomac Substation, located to the east of Indian Harbor, where it could tap into an existing 115-kV transmission line. (Eversource 1, p. E-9)

45. To address additional incremental growth since that time, Eversource added a 25-MVA transformer at Cos Cob Substation in 2000. From 2010-2012, Eversource further postponed construction of a new substation west of Indian Harbor by upgrading equipment at the existing substations in Greenwich (explained more fully under "Distribution Alternatives"). During 2011-2013, Eversource was also able to move load to Waterside Substation in Stamford to relieve Tomac Substation. However, none of these improvements were a long-term solution for the need of a new substation close to the load center in Greenwich. (Eversource 1, pp. E-9 – E-10)

46. In June of 2011, Eversource made a public announcement in Greenwich that the company was planning on building a new substation after a series of underground and overhead failures that left Eversource with having to shed a significant number of customers in the north Greenwich area. Approximately 5,000 Eversource customers experienced power interruptions. (Eversource 9, p. 32; Transcript 1, p. 56; Transcript 3, pp. 136-137; Eversource 32, p. 1)

47. Eversource listed the proposed Greenwich Substation with the ten-year forecast of loads and resources in 2012, and went through the ISO-New England process to create a design with a two-line solution. (Transcript 3, p. 137)

48. The Greenwich Substation was included in the Connecticut Department of Energy and Environmental Protection's ("CT DEEP") 2012 Integrated Resources Plan for Connecticut as a "concept" new substation. (Eversource 1, p. E-3)

49. In CT DEEP's 2014 Integrated Resources Plan for Connecticut, the Greenwich Substation is listed as a "planned" new substation; two new 115-kV transmission lines, Cos Cob – Greenwich are also listed as "planned". (Eversource 1, p. E-3)

50. The Project received Proposed Plan Application ("PPA/I.3.9") approval from ISO-New England on February 11, 2014, and a revised version of the Project received PPA/I.3.9 approval from ISO-New England on May 1, 2015. (Eversource 14, Q-OCC-001)

51. In 2014, Eversource submitted a distribution rate increase request to the Public Utilities Regulatory Authority. The Project was listed as part of Eversource's capital program for five years. (Transcript 3, p. 138)

52. In its 2012/2013 Forecast Final Report dated December 12, 2013, the Council identified the new Greenwich Substation in Appendix C: Planned Substations, and the new Cos Cob Substation – Greenwich Substation lines as "concept" transmission lines. (Eversource 1, p. E-2)

53. The proposed Greenwich Substation was included in Eversource's tables listing proposed substation projects in its 2012-2015 Forecasts of Loads and Resources. The proposed 115-kV transmission supply lines were included in the Company's 2013-2015 filings. (Eversource 1, p. E-2)

54. In its "2014/15 Connecticut Siting Council Review of the Ten Year Forecast of Connecticut Electric Loads and Resources," the Council listed the Project as currently under review for Electric Transmission in Southwest Connecticut. (Record)

55. If Eversource does not pursue this Project, it could face penalties from the Public Utilities Regulatory Authority (PURA) and be ordered to build the very facilities it is seeking to have approved. (Transcript 3, p. 146)

56. The initial step in Eversource's long-range plan for the Stamford-Greenwich Sub-area was the Stamford Reliability Cable Project ("SRCP"). Eversource proposed the SRCP to bring the benefits of the major transmission improvements of Southwest Connecticut to the Stamford-Greenwich Sub-area. The next step in the long-range plan for the Stamford-Greenwich Sub-area is to address a local load area deficiency by adding a new bulk substation in Greenwich and adding transmission connections to the new Greenwich Substation. (Eversource 1, p. E-22)

Load Forecasting

57. Eversource utilized the 2013 actual peak loads for each substation serving customers in Greenwich and applied 1% load growth per year for the subsequent years. The 1% load growth reflects the average load growth experienced at the Cos Cob Substation transformers and other substations in Greenwich and its surrounding area. (Eversource 3, Q-CSC-012)

58. The year 2013 was chosen as the base starting point for Eversource's projections because it represents the highest peak demand of the last past five years. This base reflects the hot temperatures and high heat indices that occurred during the 2013 summer. (Eversource 35, Q-OCC-031)

59. The 2013 demand is the actual demand in MVA seen at Cos Cob Substation on the 27.6-kV system during the summer of 2013; usage (actual MWh) or historical trending are not included in the forecast. (Eversource 35, Q-OCC-031)

60. Eversource derived its 1-percent growth forecast from a group of substations in the Norwalk-Stamford subarea for 2010 – 2012. (Transcript 3, pp. 154-155; Eversource 24, Q-OCC-022)

61. Eversource compared the load growth used for Cos Cob Substation of 1% with the larger southwest Forecast Area (also 1.0%), and the ISO-NE Forecast Data in Southwest Connecticut and NOR (Norwalk, Stamford and Greenwich) of 1.2% Compound Annual Growth Rate (CAGR). The ISO-NE Forecast Data does include the application of weather-normalization. (Eversource 35, Q-OCC-031; Eversource 38, Q-FPET-004, Q-FPET-009)

62. Eversource combined the Forecast Area with the Greenwich Project area to validate the Cos Cob load growth calculation by taking a broader view of load growth in the area and to mitigate any variability of the Cos Cob Substation results. Using this method, the Project Area results were mitigated for the Cos Cob Substation load growth between 2010 to 2011 based on actual peak MVA load of 1.7% (119.7 MVA in 2010 vs. 121.8 MVA in 2011) and the load growth percentage of 1.8% between 2012 and 2013 (128.2 MVA in 2012 vs. 130.5 MVA in 2013). For the Forecast Area, Eversource also looked at the load growth of substations in Stamford, Darien, Norwalk, Weston and Wilton and averaged the load growth. This average was about 1.0%. Eversource felt the 1% load growth applied to Cos Cob Substation load was a conservative approach. Note this was more conservative than the ISO-NE CAGR of 1.2%. (Eversource 35, Q-OCC-030)

63. ISO-New England has projected a 1.2 percent load growth that is above Eversource's projections; Eversource has projected only a 1 percent load growth. (Transcript 4, pp. 113-114)

64. As of October, a 1.5% increase in usage had occurred in 2015. (Transcript 3, pp. 66-67; Transcript 4, p. 66; Transcript 5, p. 104)

65. The ISO-NE Capacity, Energy, Loads and Transmission ("CELT") report load forecast of 1.2% growth for southwest Connecticut is weather normalized. The Eversource load forecast of 1% growth is not weather normalized. (Eversource 42, Q-OCC-067)

66. Eversource does not forecast annual usage of power (MWh) by service area. The capacity of electrical equipment including lines and transformers are measured in volt-ampere unit of measurement (MVA). The actual annual usage of power from 2010 to 2015 year to date as of November 2015 – MWh and the actual peak demand and project peak demand 2010 through 2022 are included in the following chart.

Substation	kV	2010 MWh	2011 MWh	2012 MWh	2013 MWh	2014 MWh	YR-TO-DATE 2015 (NOV15)) MWh
Cos Cob 11R 27.6kV	27.6	202,277,230	478,812,970	464,887,551	475,093,662	470,489,183	389,983,021

(Eversource 35, Q-OCC-031

67. The tables below reflect the peak demand – actual and projected – at Cos Cob Substation.

Cos Cob 27.6-kV System LOAD [MVA]						
Transformers	Actual Peak Demand					
	2010 MVA	**2011 MVA**	**2012 MVA**	**2013 MVA**	**2014 MVA**	**2015 MVA**
11R-1X	19.1	24.3	30.4	26.8	22.4	24.2
11R2X+3X	100.6	97.5	97.8	103.7	85.3	90.6
Total MVA	119.7	121.8	128.2	130.5	107.7	114.8

Cos Cob 27.6-kV System LOAD [MVA]							
Transformers	Projected Peak Demand						
	2016 MVA	**2017 MVA**	**2018 MVA**	**2019 MVA**	**2020 MVA**	**2021 MVA**	**2022 MVA**
11R-1X	27.6	27.9	28.2	28.4	28.7	29.0	29.3
11R2X+3X	106.8	107.9	108.9	110.0	111.1	112.2	113.4
Total MVA	134.4	135.7	137.1	138.5	139.9	141.3	142.7

(Eversource 35, Q-OCC-031)

68. The Cos Cob Substation peak demand forecast is based on actual demand data that already reflects the conservation load management programs and energy efficiency programs offered to the existing Greenwich customers. A new large customer load would be considered for distribution line and substation capacity upgrades, however, none are included in Eversource's forecast. (Eversource 35, Q-OCC-031)

69. The causes of the drops in peak demand in 2007, 2008 and 2014 were mainly due to summer weather and economic conditions. (Eversource 24, Q-OCC-022)

70. Eversource's forecast is not directly related to the number of customers. (Eversource 24, Q-OCC-022)

71. Eversource's forecast is not based on the Town of Greenwich's population, but rather on metered data gathered from the load generated by that population. (Transcript 5, p. 102)

72. In 2015, Cos Cob's 27.6-kV substation usage likely increased to approximately 484,235,481 kWhrs, which is well above the annual substation usage for the past five years, based on actual data and estimated usage for September 13 through November 1 of 2015 when the 11R-1X transformer meter was not working. (Eversource 45)

73. It would not be prudent for Eversource to disregard numerous studies showing that temperatures are warming and the climate in Connecticut will continue to change. (Transcript 3, p. 187)

74. Projections across the region, the country, and globally, show that summer heating will increase over time. Eversource must accommodate climate change in its infrastructure improvements. (Transcript 4, p. 67)

75. In 2015, the month of December was the warmest on record; the month of February was the coldest on record. (Transcript 7, p. 45)

Constraints on Existing System

Cos Cob Substation

76. Electric load in Greenwich is currently served primarily by one bulk substation (Cos Cob Substation), which was built in 1964 and is located over two miles east of the current load pocket. Most of the projected load growth and the greatest concentration of existing load are in the area. (Eversource 1, pp., E-1, E-2, E-15; Eversource 9, p. 32)

77. Cos Cob Substation feeds three distribution substations at 27.6 kV in Greenwich: Prospect Substation (built in 1934), Byram Substation (built in 1955) and North Greenwich Substation (built in 1972). It also supplies power directly to large commercial customers and the secondary network, and provides a backup power source to two other Greenwich substations, Mianus and Tomac Substations. (Eversource 1, pp. E-3, E-15)

78. When the transformer load is increased above the normal load for an extended period of time, the excessive temperatures deteriorate the windings and insulation, or a hot spot would develop. (Transcript 5, p. 73)

79. The proposed Project addresses the need for capacity to avoid transformer overloads at Cos Cob Substation, eliminates potential distribution feeder overloads supplying power to Prospect Substation from Cos Cob Substation and addresses the need for capacity to reduce the risk of transformer overloads at Prospect Substation. Use of larger transformers at Cos Cob Substation (presuming that this would be possible) would address at most only the issue of transformer overloads at Cos Cob Substation and would not address the risk of potential distribution feeder overloads or potential overloads at Prospect Substation. (See Eversource Exhibit 32; Eversource 39, p. 4)

80. No percentage of the anticipated load that will be handled at the new Greenwich Substation can be handled by improvements at Cos Cob Substation. (Transcript 5, p. 69)

81. Cos Cob Substation's permissible load rating (for its 27.6-kV system) of 135 MVA is a 2-hour rating based upon the loss of the largest element (the 50.4-MVA transformer). At this load level with the largest transformer out-of-service, the remaining two transformers (with a combined nameplate rating of 93.4 MVA) would be operating at 145% of their combined nameplate rating. After two hours, the load must be reduced to the 22-hour rating of 124 MVA (133% of nameplate rating). Eversource maximizes the use of these emergency equipment ratings to address the infrequent or "sporadic" contingency conditions that can arise, and accepts the loss of remaining life on the equipment that will occur. However, Cos Cob Substation does not have any 27.6-kV electrical connection with any other bulk substation to which its 27.6-kV load could be transferred. (Eversource 38, Q-FPET-009)

82. Eversource cannot operate Cos Cob Substation (or the associated distribution feeder circuits) in their emergency ratings for extended periods of time without permanent damage to equipment. The 13.2-kV system from Cos Cob Substation has very limited options and is used to relieve 11 MVA

to achieve the 22-hour rating on the substation's 27.6-kV transformers. (Eversource 38, Q-FPET-009)

83. The power factor at the projected peak load day of 135.8 MW is 0.998; therefore, there is no advantage in putting capacitors at Cos Cob Substation to go to unity. This additional equipment would not reduce the loading of the transformers. (Transcript 3, p. 148-149)

84. Cos Cob Substation operates on a fully utilized property; there is insufficient space to add transformers and associated feeders. (Eversource 1, p. E-15)

85. Eversource's distribution engineers have determined that neither 60 MVA nor 80 MVA transformers at Cos Cob Substation can be added to its existing footprint due to space constraints. There are inadequate electrical clearances to place larger transformers within Cos Cob Substation. (Eversource 39, p. 3; Eversource 36, Q-OCC-56; Transcript 3, pp. 30-31; Transcript 5, p. 67)

86. If 80 MVA transformers were installed at Cos Cob Substation within the existing footprint of the 27.6-kV transformers, the transformers would physically hit each other. If 60 MVA transformers were installed, they would be so close that Eversource employees could not work around them; the door openings could not be maintained. (Transcript 5, p. 68)

87. In response to the Town of Greenwich's request, Eversource investigated two manufacturers which the Town claimed could provide 80 MVA transformers for fitting into the existing Cos Cob Substation, Toshiba and WEG. The Toshiba transformer was not an equivalent transformer because it did not have a load tap changer required for voltage control. The WEG design, however, is similar in size to the design of the manufacturer that Eversource currently uses, ABB. Eversource's ABB design for an 80 MVA transformer is actually smaller than the WEG design. Eversource would be unable to fit the ABB design within Cos Cob Substation; the transformers would physically overlap each other. Additionally, Eversource would not be able to maintain electrical clearances to put the 80 MVA transformers into Cos Cob Substation. (Transcript 7, pp. 129-130)

88. Eversource's evaluation of larger transformers at Cos Cob Substation was based on the following: replacement transformers would be 115- to 27.6-kV, 48/64/80 MVA; replacement transformers would be purchased in accordance with Eversource's standard specification for substation transformers that supply distribution customer load. This includes a requirement that the transformer include voltage regulating equipment ("tap changer operable under load") to allow proper regulation of customer voltage. The existing transformers have the required voltage regulating equipment and any future replacements would need to have the required voltage regulating equipment as well; the installation of the replacement transformers would meet Eversource standards for clearances between equipment; the installation of the replacement transformers would require sufficient space around each transformer to permit rigging onto the foundation, assembly, maintenance, and future removal/replacement of the transformer without the need to remove adjacent equipment from service; Eversource has existing 48/64/80 MVA transformers on its system, and used the as-built drawings for those transformers to evaluate space requirements at Cos Cob Substation for direct replacement of the existing 115- to 27.6-kV transformers. In addition, the as-built drawings for existing 36/48/60 MVA transformers on Eversource's system were used to evaluate space requirements. Although 36/48/60 MVA transformers were determined to be insufficient to meet the load requirements, they were evaluated for use as an interim measure. (Eversource 39, pp. 2-3)

89. For the proper functioning of the equipment at Cos Cob Substation, any replacement transformers at Cos Cob Substation would require voltage regulating equipment (tap changer operable under load); otherwise, Eversource would not be able to maintain proper voltage for the downtown network or for its customers that are supplied at 27.6 kV. (Eversource 39, p. 3)

90. In order to properly expand the Cos Cob Substation to accommodate an additional transformer, the cost would be approximately $190 million. Eversource would require the purchase of a commercial building nearby. It would also have to run two new 13.2-kV duct banks from Cos Cob Substation to Prospect Substation at a cost of approximately $84 million. This was a distribution alternative considered by Eversource. (Transcript 3, pp. 37-38; Transcript 5, pp. 68-69)

91. The addition of capacity at Cos Cob Substation would not help because if Cos Cob Substation went down, most customers in Greenwich would lose service. If the transmission path is lost from Southend Substation, then Tomac, Cos Cob, and Greenwich Substations would be interrupted. (Transcript 5, pp. 91-92)

92. The addition of capacity at Cos Cob Substation would eliminate overloading of the substation transformers, but it would not impact the distribution feeder reliability, including the underground network in downtown Greenwich. It does not provide flexibility and redundancy between the two substations. (Transcript 5, p. 92)

93. Overloads on the 27-kV feeders between Cos Cob and Prospect Substations would not be solved by larger transformers at Cos Cob Substation. (Transcript 3, p. 31)

94. Eversource has already uprated the two smaller transformers at Cos Cob Substation by about 30%. While the radiator cooling could be increased, there are other design limitations internal to the transformer such as winding conductor size and ampacity limits of leads and bushings. Due to the significant existing uprate, it is likely that further uprate would either be minimal or would require remanufacturing of a particular unit. (Eversource 36, Q-OCC-056)

Prospect Substation

95. Prospect Substation is a distribution substation that was built in 1934 on a 0.35-acre portion of a 1.3-acre property. The property is bounded by public roads and bisected by an underground brook within a concrete culvert and a municipal sewer main. (Eversource 1, p. E-15)

96. Prospect Substation is a non-bulk substation that carries more load than a typical distribution substation and, in fact, more load than many existing bulk substations, due to the current system facilities operating in Greenwich and the current high level of demand. It is served by only the 27.6-kV supply from Cos Cob Substation with very limited backup (about 1% of the load). (Eversource 1, p. E-7)

97. The existing distribution substation in the area of highest load concentration, i.e., Prospect Substation, would be exposed to transformer overloads beginning in 2021. The increase in load is due to the forecast 1% load growth in the area, which is attributable to a general increase in usage of electricity. (Eversource 1, pp. E-1, E-8; Eversource 27, Q-PANTRY-053)

98. 115-kV cables cannot be built to Prospect Substation and operated at 27 kV unless Prospect Substation is completely rebuilt. (Transcript 3, p. 33)

Byram Substation

99. Byram Substation is a distribution substation built in 1955 on a 0.2-acre portion of a 1.17-acre property. (Eversource 1, p. E-15)

100. Byram Substation's site has severe slopes and is bounded by residential properties on the north, Pemberwick Road on the west, a commercial property on the east and Route 1 on the south. (Eversource 1, p. E-15)

101. Byram Substation is located too far west of Cos Cob Substation to serve as an alternate site for a new bulk substation; it is at the western extent of the customer load in Greenwich. (Eversource 1, p. E-15)

North Greenwich Substation

102. North Greenwich Substation is a distribution substation built in 1956 on an approximately 0.31-acre property. (Eversource 1, p. E-15)

103. North Greenwich Substation is not adequate for a bulk substation expansion because there is very little existing unused space. There is no abutting property that would be sufficient or available for either an expansion or building a new bulk substation. The property is constrained immediately to the west and to the north (across Old Mill Road) by Converse Pond Brook and associated wetlands. Land to the east and south is owned and maintained by CTDOT as part of the Merritt Parkway ROW corridor. A new, separate bulk substation would have to be constructed somewhere nearby on other property within what has become an increasingly developed residential area, requiring acquisition of property for the sole purpose of building a new bulk substation. (Eversource 41, Q-LF-011)

104. North Greenwich Substation cannot be fed from Cedar Heights Substation. There is no 27-kV supply available at Cedar Heights Substation, so Eversource would be required to build that capability. Cedar Heights Substation currently is supplied by two underground transmission cables that would need to be replaced if Cedar Heights Substation were to supply 50 MVA to North Greenwich Substation. (Transcript 5, p. 116-117; Eversource 44, Q-LF-021)

105. To feed North Greenwich Substation transformers from Cedar Heights Substation at 27.6-kV with a capacity of 50 MVA, the total cost of the required modifications would be approximately $202 million; this is $62 million more than the Project and would achieve only a small portion of the benefits realized by the Project. Feeding North Greenwich Substation from Cedar Heights Substation would require the following:

- Upgrade of two transmission cables: replace high pressure fluid filled ("HPFF") cable in existing pipe for the two parallel underground transmission lines from Glenbrook to Cedar Heights Substations, approximately 4.9 miles, to increase the long-term emergency rating from 103 MVA to 138 MVA on each cable.
- Cedar Heights Substation would require the extension of 115-kV bus and additional support structures; the addition of two 115- to 27.6-kV 60 MVA transformers and associated disconnect switches; addition of 27.6-kV bus and cables from the transformers to the switchgear; addition of Double Bus switchgear; addition of station service for transformer cooling and switchgear; and expansion of the substation yard.

- Add distribution feeders from Cedar Heights Substation to North Greenwich Substation which would include installation of ten miles of duct bank, three feeder cables, and extra manholes due to very winding road configuration.
- Prospect Substation work would include an upgrade of transformers and replacement of switchgear.

(Eversource 44, Q-LF-021)

106. Feeding North Greenwich from Cedar Heights Substations assumed an underground route. An overhead route would require Eversource to run new pole lines on both sides of the street. This is typically not an acceptable solution in most towns when Eversource would potentially be taking and adding three circuits or three pole lines along the same public ROW. (Transcript 7, p. 62)

107. North Greenwich Substation's transformers have additional available capacity. However, since both Prospect Substation and North Greenwich Substation are supplied from Cos Cob Substation's 27.6-kV supply, transferring load from Prospect Substation to North Greenwich Substation would not provide any benefit in reducing load on Cos Cob Substation. (Eversource 36, Q-OCC-057)

108. If the purpose of a bulk North Greenwich Substation would be to replace the existing distribution North Greenwich Substation, the scope of construction would be similar to that of the proposed Greenwich Substation, and the cost would be similar as well. However, there would also be costs for the expansion at the 115-kV source substation as well as the 115-kV lines, which would most likely be different than the proposed Project and there might be additional costs to upgrade the 115-kV supply lines to the source substation. (Eversource 41, Q-LF-011)

Mianus Substation

109. Mianus Substation is a distribution substation that was built in 1956 on an approximately 0.31-acre property. (Eversource 1, p. E-15)

110. Mianus Substation is bounded by Mianus River, a senior care facility, a public road and a business. (Eversource 1, p. E-15)

111. Because it is located too far from the center of customer load in Greenwich, Mianus Substation could not serve as an alternative site for a new bulk substation. (Eversource 1, p. E-15)

Tomac/Waterside Substation

112. Tomac Substation is a limited bulk substation that was built in 1971 on a 0.45-acre portion of an approximately 0.86 acre property (includes 0.1 acre for access easement to the railroad and 0.189 acre railroad easement). It is bounded by wetlands, a golf course, a railroad and a public road. (Eversource 1, p. E-15)

113. Due to its constrained space, there is no room to expand the Tomac site. (Transcript 3, p. 35)

114. Even if Tomac Substation did not have a constrained space, it is located too far from the center of the customer load to serve as an alternative site for a new bulk substation. (Eversource 1, p. E-15)

115. Eversource cannot delay the Project by transferring some of the load to Waterside/Tomac. A new circuit for such a transfer would be approximately 20 MVA. Tomac Substation cannot accept 20

MVA of load from Cos Cob Substation since it does not have 20 MVA of available spare capacity. (Transcript 3, pp. 36-37; Eversource 36, Q-OCC-048)

116. Tomac Substation could not provide a source into the 27.6-kV network either. When supplying a network system, all transformers must be supplied from a common 115-kV supply and also must have their secondary side tied together in a common bus with special voltage controls that link all transformers to maintain a common voltage with minimum circulating current. (Eversource 36, Q-OCC-048)

117. Waterside Substation could not supply 27.6 kV because it does not have 115- to 27.6-kV transformers. Furthermore, if a 115- to 27.6-kV transformer were installed at Waterside Substation, it would not be able to supply the Greenwich 27.6-kV network for the same reasons that prevent the Tomac Substation from supplying the same. (Eversource 36, Q-OCC-048)

Interim Measures

118. Beginning in 2010, Eversource implemented several interim measures at a total cost of approximately $36 million to bolster the functioning and capacity of substations and the distribution system in the Greenwich area. This included an upgrade of switchgear, a tie connection between two transformers and a new 30-MVA transformer at Cos Cob Substation; equipment upgrades at Byram and Mianus Substations; replacement of distribution cables from Cos Cob Substation to Prospect Substation; the addition of an aerial feed to North Greenwich Substation and upgrade of the right-of-way; the replacement of three distribution transformers at North Greenwich; and the replacement of underground distribution cable from Cos Cob Substation to Sound Shore Drive. (Eversource 1, p. E-16; Eversource 9, p. 35; Transcript 3, p. 42; Eversource 32, p. 2)

	Substation	In-service Date	Initiative	Company Investment (millions)
1	Cos Cob	2010	Upgrade switchgear – 27 kV	$3.8
2	Cos Cob	2012	Tie connection between two transformers	$1.2
3	Cos Cob	2012	Add a new 30-MVA transformer	$4.8
4	Byram	2011	Upgrade equipment – install two reclosers	$0.2
5	Mianus	2012	Upgrade equipment – Install underground cable and switching to serve load from Cos Cob	$0.8
6	Distribution Feeder Improvements	2012	Replace distribution cables from Cos Cob Substation to Prospect Substation	$2.0
7	North Greenwich	2012	Add an aerial feed to North Greenwich Substation and upgrade right-of-way	$8.4

8	North Greenwich	2010-2012	Replace three distribution transformers	$14.0
9	Distribution Underground Cable Improvements	2012	Replace underground distribution cable from Cos Cob Substation to Sound Shore Drive	$1.1
			Total	$36.3

(Eversource 1, p. E-16, Table E-4; Eversource 9, p. 35)

119. After the proposed Greenwich Substation is built, these interim measures will complement the new circuits from the Greenwich Substation and improve the distribution tie capabilities between the substations in Greenwich going forward. (Eversource 1, p. E-16)

120. Even with Eversource's incremental improvements, the system in Greenwich is still not as robust as the rest of Connecticut. (Transcript 7, p. 133)

Current Reliability Issues in Greenwich and Future Enhanced Reliability

121. Since Cos Cob Substation first reached its capacity in 1994, Eversource has postponed incurring the substantial cost of an additional bulk substation by implementing a series of incremental improvements to the electric supply system in Greenwich. However, the extent and location of the load growth that must be served make further incremental measures imprudent. (Eversource 1, p. E-1)

122. In most geographic areas of Connecticut with large amounts of customer load, two or more bulk substations that have multiple transmission supply lines are used to supply power, so that if one power source is unavailable, the remaining bulk substation(s) would supply the needed power. In contingency conditions, significant load can be quickly transferred from any of these substations to one or more of the others, through the use of automatic distribution recloser transfer systems. (Eversource 1, pp. E-5 – E-6)

123. If electric overloads were allowed to occur, widespread service interruptions to homes and businesses and damages to Eversource's equipment may result. To avoid the overloads, controlled load shedding (targeted blackouts) would likely be required. (Eversource 1, p. E-1)

124. If Cos Cob Substation goes out-of-service, the majority of Greenwich customers would be without service until Cos Cob Substation is restored. A portion of customers in the northern section of Greenwich would continue to be served from Tomac Substation, as would a small number of customers in Greenwich who are fed from Stamford. (Transcript 5, pp. 90, 137)

125. Customers served from Cos Cob Substation were impacted twice since 2011 due to problems occurring at Cos Cob Substation and Cos Cob Substation feeders. In June 2011, North Greenwich lost its power supply source due to feeder faults at Cos Cob Substation. A total of 5,100 customers were impacted and without power. In October 2011, due to an animal contact, a fault occurred on the Cos Cob 27.6-kV bus, which caused the loss of the three 27.6-kV power transformers. All

customers fed by Cos Cob Substation's 27.6-kV system were impacted including the Greenwich secondary network. (Eversource 44, Q-LF-024)

126. The last two blackout events in Greenwich took place in 2012. Storm Sandy's outage event on October 30, 2012 affected 87% of Greenwich. A tree-related event on August 6, 2012, adversely affected 99.5% of Greenwich. (Eversource 27, Q-PANTRY-046)

127. Of the 149 towns served by Eversource, Greenwich is the only town in the last five years in which customer load needed to be shed during peak conditions. (Transcript 7, p. 77)

128. The estimated $140 million for the Project includes additional reclosers and more effective circuit sectionalizing. These are the same type of investments that are part of Eversource's storm hardening program, although it is not technically storm hardening. It is being funded as part of the Cos Cob and North Greenwich Substation upgrades to interconnect the substation, and the same methodology, same practices and same benefits will result. (Transcript 7, pp. 75-76)

129. Currently, there are no additional feasible interim measures at the distribution level that could be undertaken to continue to provide reliable service, other than construction of a new substation in Greenwich. Because Eversource's transmission lines end at Cos Cob Substation, and distribution substations which serve a large amount of Greenwich's customer load are fed by distribution feeders that originate at Cos Cob Substation, Greenwich is electrically isolated; its system is difficult to operate. (Eversource 1, p. E-17; Eversource 9, p. 31; Transcript 4, p. 147)

Needs Addressed by Project

130. The Greenwich Substation would address the increased electrical demand in Greenwich, which currently exposes the distribution system to risk of overloads on transformers and distribution lines. Based upon current load forecasts, the existing electric system must have additional capacity in order to avoid potential overloads of Cos Cob Substation transformers, which could occur as early as 2017. (Eversource 1, pp. ES-1, E-1; Eversource 9, pp. 32-33; Eversource 25, pp. 4-6; Eversource 23, Q-FPET2-007)

131. For a substation to perform as a bulk substation, it must be connected directly to the transmission system. For the proposed Greenwich Substation, the nearest transmission lines available are at Cos Cob Substation, so new transmission lines would be required. (Eversource 1, p. E-20)

132. The Project includes two new underground 115-kV transmission supply lines whose purpose would be to extend the 115-kV transmission system and allow transmission of power west from Cos Cob Substation to the location of the new Greenwich Substation. (Eversource 1, p. E-20)

133. Eversource also identified and presented an overhead line alternative along the Metro-North Railroad ("MNRR"), which has been confirmed by the CTDOT to be a viable constructible solution. The overhead option would avoid some of the areas in Bruce Park and would lower the Project's total cost by approximately $20 million. (Transcript 5, pp. 83-84)

134. The overhead line alternative proposed by Eversource satisfies many of the stakeholder needs that have been examined during the Siting Council proceedings for this Project. It addresses some of the cost issues that the Council and OCC have raised, and it is a route that is now supported by the Town of Greenwich. CTDOT and MNRR have supported Eversource's overhead line alternative, as it was presented to them. (Transcript 7, p. 42)

135. Additional 27.6-kV load relief is needed at two distribution substations, Prospect and Byram Substations, which are supplied from Cos Cob Substation. The new Greenwich Substation would reduce the existing load on the 27.6-kV feeders. (Eversource 1, p. E-5; Eversource 38, Q-FPET-010; Transcript 3, p. 78)

136. With the proposed Greenwich Substation built, Cos Cob Substation will retain the 27.6-kV and 13.2-kV transformers. Apart from feeding North Greenwich Substation, Cos Cob Substation will continue to feed the Prospect Substation 27.6-kV load, the Greenwich secondary network and other 27.6-kV customers. The existing 13.2-kV 6X and 5X transformers will remain in place and will continue feeding four 13.2-kV circuits and providing the redundant supply for MNRR's signal control system. (Eversource 43, Q-OCC-075)

137. During Storm Sandy, Eversource's distribution automation saved approximately 100,000 customers; the customers were automatically restored with an alternate feed. Such automation technology could be used between Cos Cob Substation and the proposed Greenwich Substation so that very few customers would have a permanent interruption if the Cos Cob Substation was out-of-service. (Transcript 3, pp. 50-51; Transcript 5, p. 91; Transcript 7, p. 44)

138. The Greenwich Substation will allow for restoration of approximately 85% of the customers now served from Cos Cob automatically and instantaneously. For the customers fed by the Greenwich Substation, depending on the time of year, all 100% of customers could be backed up by either the Cos Cob Substation or the Greenwich Substation. (Transcript 7, pp. 43-44)

139. The new Greenwich Substation will result in a dramatic improvement in blue sky reliability for the Town of Greenwich. In the event of a catastrophic event, reliability would still be improved by approximately 20%. (Transcript 7, p. 44)

140. The proposed substation would provide a power source closer to load demands, reducing the length of distribution feeders. (Eversource 1, p. E-2)

141. Although there would be additional capacity after the construction of the Greenwich Substation, this additional capacity would be used upon contingency. The additional capacity would vary based upon whether a contingency were to occur or a very hot summer day were to occur. (Transcript 7, p. 99)

142. The transformer capacity is different than the substation's permissible load rating as the substation's rating accounts for the largest contingency or loss of the largest transformer/system element and use of emergency equipment ratings for the remaining equipment. The new Greenwich Substation will eliminate the need for transformation at the Byram and Prospect Substations, and will increase the capacity to serve the 13.2-kV system. (Eversource 18, Q-FPET-009; Eversource 27, Q-PANTRY-056)

143. After the Greenwich Substation is placed into service, the entire loads formerly supplied by the Byram and Prospect Substations at 13.2 kV would be transferred to it. (Eversource 1, p. E-18; Eversource 18, Q-FPET-009; Eversource 38, Q-FPET-010)

144. In total, 80 MVA of transformation at Prospect and Byram Substations will be retired as part of the Project. (Transcript 7, p. 98)

145. Eversource would also remove distribution transformers and associated equipment at Prospect Substation, which would continue to be a critical distribution tie station for the existing 27.6-kV system. (Eversource 1, pp. E-18, G-9; Eversource 9, p. 20; Eversource 43, Q-OCC-077)

146. Eversource would remove distribution transformers and associated equipment at Byram Substation, which would continue to be used for voltage regulation for the west portion of the Town of Greenwich. (Eversource 1, pp. E-18, G-9; Eversource 9, p. 20; Eversource 43, Q-OCC-077)

147. The table below shows how the customer load in Greenwich would be split between the proposed Greenwich Substation and Cos Cob Substation.

	Loads in MVA		Permissible Load Ratings in MVA
	2013	2018	
Cos Cob Substation	130.5	66.7	135*
Greenwich Substation	N/A	70.5	134**
Total	130.5	137.2	

*Cos Cob at 27.6 kV. Reflects the loss of largest transformer and two hour rating on remaining 67.5 MVA + 67.5 MVA = 135 MVA.

**Greenwich at 13.2 kV. Based on expected ratings of ratings for new transformers and normal rating for 2 transformers with third out-of-service 67.0 MVA + 67.0 MVA =134 MVA.

(Eversource 1, p. E-17, Table E-5)

148. The Greenwich Substation addresses the capacity issue at Cos Cob Substation; it also addresses the distribution reliability issues for the 27.6-kV system. The Substation would allow for more flexibility in how Eversource operates its system in Greenwich. With the new 13.2-kV system, automatic backups will be provided to essentially all customers in Greenwich. (Transcript 4, p. 68)

149. Under the proposed design, Cos Cob Substation would feed the Greenwich secondary network (five 27.6-kV feeders), the North Greenwich Substation (two Cos Cob Substation 27.6-kV feeders and one Prospect 27.6-kV feeder) and several Prospect commercial customers at 27.6 kV.

- For failure of the two 27.6-kV Cos Cob Substation feeders to North Greenwich, the proposed Greenwich Substation would back up the entire North Greenwich load through automatic 13.2-kV loop schemes in conjunction with the Prospect Substation 27.6-kV feeder. No customers would be impacted.
- For loss of three of four Cos Cob Substation 27.6-kV feeders that feed Prospect Substation, North Greenwich Substation would feed the commercial customers via the 27.6-kV Prospect Substation feeder. North Greenwich Substation transformers would be off-loaded via the proposed Greenwich Substation's 13.2-kV feeder loop schemes. No customers would be impacted.
- The proposed Greenwich Substation would have automatic loop schemes ties with North Greenwich Substation feeders and automatic loop scheme ties between proposed Greenwich Substation feeders that would be fed by different substation buses, different substations' transformers and different substation transmission lines. The proposed

Greenwich Substation feeders will have redundant backup between themselves. The only vulnerability would if both transmission lines from Cos Cob Substation to the proposed Greenwich Substation were lost. In this scenario, North Greenwich Substation would back up most of the load of Greenwich Substation feeders via the 13.2-kV system. (Eversource 36, Q-OCC-058)

150. In the event that the entire proposed Greenwich Substation were out-of-service (all three transformers), presuming that automatic switching equipment had been installed as planned, and after operation of the automatic switching equipment, electric service to customers representing 47 MVA (or 67% Greenwich Substation load at the time) would continue to have electric service. Further, electric service to customers representing the remaining 23 MVA (or 33% of the Greenwich Substation load at the time) could be restored manually through operator actions, depending on system conditions. (Eversource 43, Q-OCC-080)

151. The only beneficiaries of the Greenwich Substation would be the Town of Greenwich; none of the electricity would benefit Stamford, Rye, or Port Chester. (Transcript 3, p. 83; Eversource 25, p. 6)

Energy Usage in Greenwich

152. Eversource has witnessed economic activities in Greenwich, where it currently has 92 applications in design phase for either upgraded or new services. (Transcript 3, p. 77)

153. As of March 2016, the number of service upgrade requests in Greenwich had increased to 115. In each of those cases, the average service size has more than doubled. Although the development may be built on the same property, the service request to Eversource is for service that is twice the size of the existing service. (Transcript 7, p. 52)

154. Metrics around building permits and demolitions in the Town of Greenwich were in a positive direction; in some cases, construction numbers were at their highest since the downturn in 2007/2008. (Transcript 7, pp. 53-54)

155. The Town of Greenwich's 2013/2014 Annual Report lists a total of 2,286 building permits, which represents an 8-percent increase over fiscal year 2012/2013. The construction value reported in the Annual Report was approximately $409 million, which represents a 49% increase over fiscal year 2012/2013. (Transcript 6, pp. 103-104; Eversource Admin. Notice, 34)

156. The Town of Greenwich's 2013/2014 Annual Report lists more than 1,191 residential add and alter permits, which accounted for approximately one-half of all issued permits. (Transcript 6, p. 104; Eversource Admin. Notice, 34)

157. The Town of Greenwich's 2013/2014 Annual Report lists a 63% increase in new residential permits over the previous fiscal year, which exceeded 100 for the first time since 2007/2008; and a 47% increase in demolition permits over 2012/2013. (Transcript 6, pp. 103-104; Eversource Admin. Notice, 34)

158. Data from the 2013/2014 Annual Report includes:

- 102 special permit applications (increase of 30 over prior fiscal year)
- 19 new subdivision applications (increase of 2 over prior fiscal year)

- 966 site plans (increase of 8% over prior fiscal year and 60% increase from Fiscal Year 2011/2012)

(Eversource 32, p. 8)

159. Greenwich is the third-largest user of electricity in Eversource's service territory, which serves 149 municipalities. With 28,000 customers, it has a far smaller number of customers than are served in the two largest towns – Hartford and Stamford. (Transcript 3, p. 86; Eversource 25, p. 6; Eversource 29, Q-PANTRY-050)

160. The graph below reflects 2014 kWh sales to towns served by Eversource.

CL&P dba Eversource Energy
2014 kWh Sales by Town

Town	Total kWh
STAMFORD	1,387,706,218
HARTFORD	1,140,616,182
GREENWICH	869,829,569
WATERBURY	807,157,464
DANBURY	715,078,553
NORWALK/EAST NORWALK/S NORWALK	566,618,937
BRISTOL/FORESTVILLE	518,066,074
MANCHESTER / BUCKLAND	466,375,240
NEW BRITAIN	426,186,933
WEST HARTFORD	422,091,034

Source: Sales and Load Forecasting

(Eversource 42, Q-OCC-64)

161. Although the population in Greenwich remains stable, there have been a number of reconstruction projects over the last few years in which existing older homes are either significantly renovated and increased in size, or removed and replaced with a new home that requires a sizable increase in energy demand. (Transcript 4, p. 47)

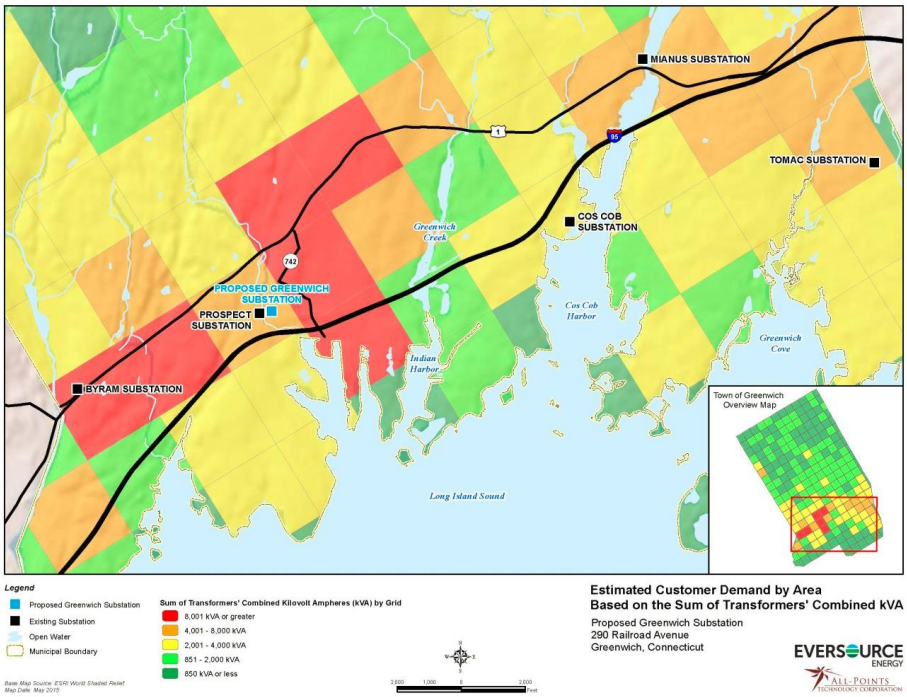
162. Eversource continues to see a number of requests for three-phase power rather than the normal single-phase. It is not uncommon that an existing 200 or 400 amp service will be replaced by 1,000 or 1,200 amp services. (Transcript 4, p. 48; Transcript 7, p. 52)

163. The steep drop in usage at Cos Cob Substation in 2005 was due to a duplication error. The steep drops in usage in 2009 and 2010 are attributed to a substation upgrade project that resulted in meters not communicating properly due to the multiple open breakers during the project, which affected the data collecting of the meters. (Eversource 24, Q-OCC-022)

164. Because there has been no curtailment of actual usage by customers in Greenwich, there is every expectation that demand will go up during high heat or high humidity days. (Transcript 4, 60)

165. The residential customers in Greenwich use more than two times the electricity of the average Connecticut residential customers. (Eversource 9, p. 31)

166. The figure below is an illustration of estimated customer demand by area in Greenwich.



(Eversource 1, p. E-10, Fig. E-2)

167. The Project's large investment in Greenwich is similar to large investments that Eversource has made in other areas of the State. No customer deserves better service than another, but all customers should be provided a base level of service that ensures their lights do not go out on a hot day or in the middle of winter. (Transcript 3, p. 87; Transcript 4, p. 61)

168. Eversource has proposed this Project despite opposition by several Greenwich residents because it has an obligation to serve all customers; no customer in Greenwich has said he does not want to be served by Eversource any longer. (Transcript 3, p. 84)

169. Eversource has an obligation to serve all customers, even those who choose not to take advantage of energy efficiency programs promulgated within Greenwich. (Transcript 3, pp. 88-89)

Distribution Alternatives

170. To achieve load relief alone, Eversource considered a number of additional actions involving only improvements to its distribution system. Those actions consist of (1) establishing a substation expansion module adjacent to Cos Cob Substation, (2) increasing transformer capacity at Prospect Substation, and (3) enhancing the existing duct bank systems and loop schemes. (Eversource 1, pp. F-2 – 3; Eversource 9, p. 36).

171. Eversource rejected this distribution alternative because (a) the estimated cost would exceed the cost of the proposed Project and (b) the same reliability benefits achieved by the Project cannot be achieved by the distribution alternative. The cost of the distribution alternative would be approximately $50 million higher than the Project cost and achieve a capacity increase that is 60 MVA lower than the Project capacity increase (more money for less capacity). Moreover, the

distribution alternative would not address the long-term reliability needs that are met by the proposed Project by adding capacity and bringing a reliable power supply source to the center of the customer demand. (Eversource 1, pp. F-2 – 3; Eversource 9, p. 36)

172. Eversource does not believe moving any of the 27.6-kV load is a feasible alternative for the Project for the following reasons:

- There are no 27.6-kV transformers currently located at Waterside, South End or Glenbrook Substations.
- Eversource would need to build a new 27.6-kV transformation at one of these substation sites. Therefore, Eversource would be required to build a new 115- to 27.6-kV bulk substation in close proximity or adjacent to one of these existing substations.
- Using Waterside Substation as an example since it is the closest substation to the Cos Cob Substation location, analysis indicates that nine 27.6-kV feeders at 5.5 circuit miles each would need to be built. This would involve building three separated triple circuit pole lines and/or a combination of overhead and underground circuit configurations.
- Eversource would need to build a second substation for 27.6- to 13.2-kV transformation at the Proposed or Alternate Substation Site.
- Such an alternative would be substantially more costly, would not meet the Project need, would be difficult to construct, and would be a technically inferior design option.

(Eversource 15, Q-OCC-009)

173. Eversource reviewed an alternative of using distribution facilities to supply 50 MW of load from New York and an alternative of supplying the Greenwich Substation at the transmission level from New York. This would require building a new 13.2-kV substation at the New York border and initially serving 50 MVA of load in Connecticut at 13.2 kV. The new substation would be required because Consolidated Edison Company of New York ("Con Ed") staff indicated that Con Ed does not presently have 50 MVA of capacity available at the distribution level at the New York border. (Eversource 41, Q-LF-013)

174. A distribution alternative to supply 50 MW of load from New York would require reconfiguring the existing Byram and Prospect Substations as follows:

- Supply 3 new distribution feeders at 13.2 kV from the New York border to Byram Substation and interconnect with the existing feeders.
- Supply 6 new distribution feeders at 13.2 kV from the New York border to Prospect Substation and interconnect with the existing feeders.
- Add feeder regulation as required.
- Add loop scheme reconfigurations.

This alternative would be a costly solution due to the length of the needed transmission lines (approximately 14 circuit miles); the extensive substation improvements required for the interconnection in New York; and the time and cost of permitting in New York. (Eversource 41, Q-LF-013)

175. The alternative of supplying the new Greenwich Substation from two transmission supplies in New York was considered cost prohibitive based on the following factors:

- The length of the lines needed of approximately 20 circuit miles via roads;

- The extensive substation improvements required for the interconnection in New York, including a 345/115-kV autotransformer to provide a 115-kV source for the lines to Greenwich; and
- The time and cost of permitting in New York.

(Eversource 41, Q-LF-013)

176. In order to supply 27 kV from Stamford into Greenwich, a new bulk substation would be required. Further, there is minimal ability to transfer load from Cos Cob Substation to Waterside Substation without the construction of additional distribution circuits. (Transcript 3, pp. 34-35)

177. A new substation located in Stamford, even if achievable, would not be more efficient to serve the load pocket in Greenwich. The proposed new Greenwich Substation is planned to be located in the heart of the area of the greatest demand in Greenwich. (Eversource 27, Q-PANTRY-018; Eversource 36, Q-OCC-059)

178. The Con Edison proposals for electrical upgrades in Brooklyn reflect 41 megawatts of customer side nontraditional solutions that would be approximately $150 million, or approximately $3.7 million per megawatt. The 11 megawatts of utility-side nontraditional solutions are estimated at $50 million, or approximately $4.5 million per megawatt. The Con Edison project defers the need for a new substation by five years at a cost of $200 million. The Project proposed by Eversource is just over $1 million per megawatt. (Transcript 3, pp. 179-180)

179. Currently, there are no additional feasible interim measures at the distribution level that could be undertaken to continue to provide reliable service, other than construction of a new substation in Greenwich. Because Eversource's transmission lines end at Cos Cob Substation, and the distribution substations that serve a large amount of Greenwich's customer load are fed by distribution feeders that originate at Cos Cob Substation, Greenwich is electrically isolated; its system is difficult to operate. (Eversource 1, p. E-17; Eversource 9, p. 31; Transcript 4, p. 147)

Non-Transmission Alternatives

180. Eversource considered and rejected a "no action" alternative to the Project because it would undermine Eversource's comprehensive efforts to improve the adequacy of the electric power system in Greenwich. (Eversource 1, p. F-1; Eversource 9, p. 33)

181. Eversource analyzed a range of long-term electric system alternatives, including distribution alternatives, energy alternatives and demand side management alternatives. These alternatives are not currently available in sufficient amounts to meet the immediate needs that the Project would address. (Eversource 1, pp. F-1 - F-18; Eversource 31, Q-OCC-035; Eversource 38, Q-FPET-007)

182. A limited amount of generation could be connected to Byram Substation. Installing a large amount of generation that could exceed the load being served from Byram Substation would result in power flows back into the distribution circuits supplying Byram Substation. Furthermore, this would require additional relay equipment at Byram Substation and result in challenges to system protection and voltage control that could impose limitations of generation, depending on the type of generation and characteristics of the generator(s) and methods of connection. (Eversource 1, p. F-9)

183. There are no non-transmission alternatives that would increase the reliability of the system with a new reliable capacity source sufficient to supply anticipated customer demand for the long-term

future or extend the bulk power transmission infrastructure closer to the demand center. (Eversource 1, p. F-18; Eversource 9, p. 34; Eversource 31, Q-OCC-035)

184. Eversource is a national leader in its commitment to conservation programs. It has made a $700 million investment in energy conservation over the last three years. (Transcript 3, p. 90)

185. The following table provides energy efficiency participation rates from January 1, 2010 through November 30, 2015 by town. Of the towns listed, Greenwich had the lowest participation rate for Residential Program Participation and Residential Rebate Participation, and the second lowest participation rate for Business and Municipal Program Participation after New Canaan.

Town	Residential Program Participation	Residential Rebate Participation	Business and Municipal Program Participation
Hartford	25.20%	0.20%	15.40%
Manchester	22.60%	1.40%	15.50%
Waterbury	20.90%	0.70%	14.00%
New Britain	18.40%	0.60%	19.00%
Bristol	15.00%	1.50%	17.10%
West Hartford	13.70%	3.40%	16.50%
New Canaan	13.00%	3.10%	7.80%
Norwalk	11.80%	1.70%	8.30%
Danbury	11.30%	2.70%	14.60%
Darien	11.20%	3.00%	10.50%
Stamford	9.90%	1.50%	12.60%
Greenwich	5.80%	1.60%	8.80%

(Eversource 44, Q-LF-017)

186. Various active demand resource programs in Greenwich only reduced demand by 2.0 MW in 2013. This included energy efficiency (0.3 MW), distributed generation (0.4 MW), photovoltaic (1.1 MW), and emergency generators (0.2 MW). These programs are already accounted for in the actual load for Greenwich and Eversource's projections for its future load. (Eversource 1, p. F-16 – F-17)

187. Eversource representatives work with Greenwich's conservation committee to promote energy efficiency campaigns and workshops. However, on the whole, there is limited participation by Greenwich customers. Only about 5% of homeowners have participated in residential programs from January 2010 to July 2015. (Eversource 32, p. 4)

188. Greenwich residents receive energy efficiency solutions messaging throughout the year via a variety of advertising mediums:

- Radio: In 2015, 4 radio campaigns executed that included ads on WEBE-FM, WEZN-FM, WFOX-FM and Pandora Radio – all cover Greenwich.
- Targeted Digital Display Advertising (throughout the year): Greenwich Zip codes are included in the advertising purchase.
- Display advertising on www.nbcconnecticut.com: This NBC CT affiliate website has the largest reach into Fairfield County, including Greenwich customers.
- Television: April-June campaign included Fairfield County media buy on Comcast and News 12 (reaches Greenwich audience).

(Eversource 24, Q-OCC-26)

189. Greenwich businesses primarily receive information via the Eversource energy efficiency sales team and dedicated account executives. Account executives have individually contacted 66 commercial and industrial customers served by the Cos Cob Substation within the last two years to promote energy efficiency and demand reduction services. Additionally, small businesses in Greenwich are targeted through a digital display advertising campaign and also were an audience for the television campaign. Greenwich residents were sent Direct Mail energy efficiency letters in August 2015. (Eversource 24, Q-OCC-026; Eversource 30, Q-LF-006)

190. In 2013, the Town of Greenwich was selected for Solarize Connecticut, a Green Bank project to promote solar energy, due to its future capacity needs. Eversource has interconnected only 92 solar PV installations in the Town of Greenwich since 2010. Currently there are 28 pending applications for solar energy in Greenwich, which accounts for approximately 400 kW of peak load occurring between 10:00 and 11:00 a.m. This accounts for less than one-half of one percent of the projected peak load at Cos Cob Substation, and does not occur at the same time as the peak load in Greenwich, i.e., between 4:00 and 6:00 p.m. (Eversource 9, p. 37; Transcript 3, pp. 63-64)

191. While solar energy curtails the peak load in the early afternoon hours, it drops off dramatically into the midafternoon, when almost no solar generation occurs. Solar alternatives provide energy, but not capacity. (Eversource 9, p. 38; Transcript 3, pp. 65- 66)

192. In order to provide a feasible alternative to the Project, nearly 8,800 acres of solar panel coverage would be required in proximity to the load center. This is roughly equivalent to 147,400 roofs on an average 2,600 square foot northeastern home. (Eversource 1, p. F-7; Eversource 25, p. 15)

193. A microgrid is not a technically feasible alternative because generally, generation assets in microgrids in Connecticut range from 400 kW to 5 MW, well below the capacity needed in Greenwich to provide demand relief starting in 2018 and to accommodate future load growth. (Eversource 1, p. F-11; Eversource 8, p. 37)

194. In its 2014 Integrated Resources Plan for Connecticut, CT DEEP stated that "*there are many technical, operational and economic challenges with implementing microgrids*," including "*ensuring overall power quality to customers while the microgrid is islanded from the rest of the distribution system . . . through a complex system of measurement and communications equipment and engineering applications to ensure system stability, voltage control, and frequency control. The microgrid also requires security systems and ongoing maintenance. . . and major capital requirements as the system ages*." (Eversource 1, p. F-11; Eversource 9, p. 37)

195. Eversource has gone through two solicitations in Connecticut for microgrids, but has not received any responses from the Town of Greenwich. (Transcript 3, pp. 140-141)

196. Eversource has recently completed its first interconnection of two wind turbines, which are located in Colebrook, Connecticut. There are presently no new applications for wind power in Greenwich. (Eversource 29, Q-PANTRY-031)

197. Eversource has begun to look at applications for battery storage, but the process is highly variable due to weather conditions. There are currently many demonstration pilots underway, but it is not presently available at the utility scale. (Transcript 3, pp. 176-177)

198. The experience of volt/VAR control under the Conservation Voltage Reduction Program at Eversource since the 1980s has been positive for customers. Under the program, Eversource has lowered the upper level of the allowable voltage tolerance from +5/-5% to +3/-5% and has resulted in approximately 1% reduction in energy usage. This reduction is contained in the actual measured usage by customers and in Eversource's substation load measurements. (Eversource 24, Q-OCC-028)

199. An aggressive program of load management, including solar, electric and thermal, would not have a material effect on the load in Greenwich. Eversource has attempted this program at other locations across its company. It is a customer choice and customer behavior issue. (Transcript 7, p. 135)

200. Eversource has fully considered the use of non-transmission alternatives not only individually, but also in combination to provide sufficient demand relief to Greenwich's distribution system. Such alternatives are not currently available, or available in sufficient amounts to meet the immediate needs that the Project would address. Further, such alternatives would not increase the reliability of the system with a new reliable capacity source to supply anticipated customer demand for the long-term future or extend the bulk power transmission infrastructure closer to the demand center. (Eversource 1, p. F-18; Eversource 9, pp. 38-39; Eversource 32, p. 3)

Substation Site Selection

201. Eversource considered engineering, environmental, community and economic factors in conducting its search for a potential site for the new substation. This included: proximity to the load pocket; proximity to existing distribution feeders; proximity to existing transmission electrical circuits; proximity to public water supply, watershed and aquifer areas; ease of access for construction and maintenance; zoning and adjacent land uses; earthwork requirements; suitability of a site to accommodate the substation; and minimizing effects on the environment. (Eversource 1, p. H-3; Eversource 9, pp. 6-7; Eversource 25, pp. 2-3)

202. In 2012 and 2013, Eversource's real estate staff began to conduct site searches with the help of a local real estate broker. The search boundaries were determined by Eversource's Distribution Design group and encompassed the load pocket. (Eversource 1, p. H-3)

203. Eversource rejected parcels under 0.5 acres and those that did not have at least two sides with a minimum 150-feet property line depth. (Eversource 1, p. H-3)

204. Eversource considered a parcel located on Old Track Road that was mentioned by the Town of Greenwich during preliminary discussions. (Eversource 1, pp. H-3, H-10 – 11)

205. An additional search was conducted in 2014 to determine if any new potential parcels had become available, though no new feasible candidates resulted from this search. (Eversource 1, p. H-4)

206. The Site Selection Evaluation Team ultimately identified four substation location sites for further evaluation. (Eversource 1, p. H-4)

207. The following table provides a summary of the sites evaluated in the Greenwich Substation Search Area.

Site Selection Review Criteria	SITES EVALUATED IN GREENWICH SUBSTATION SEARCH AREA			
	Proposed Site	Alternate Site		
	290 Railroad Ave	281 Railroad Avenue	330 Railroad Avenue	Old Track Road
Proximity to Customer Load	**Within load pocket**	Within load pocket	Within load pocket	Within load pocket
Proximity to Existing Feeders	**Existing distribution feeders in street**	Existing distribution feeders in street	Existing distribution feeders in street	0.25 mile extension of distribution feeders needed via new easement
Proximity to Existing Transmission Circuits	**2.3 miles**	2.3 miles	2.3 miles	2.6 miles
Ease of Access	**Direct access from Field Point Road and Railroad Avenue**	Direct access from Railroad Avenue and Woodland Drive	Direct access from Railroad Avenue, Field Point Road and Prospect Street	Limited vehicular access; additional/expanded access rights would be required from one or more landowners
Size (acres)	**0.81**	0.75	0.92*	2.49
Consistency with Existing Land Uses	**Commercial Neighbors**	Commercial and Residential Neighbors	Commercial Neighbors	Commercial and Residential Neighbors
Earthwork requirements	**Level terrain - limited grading needed**	Level terrain - limited grading needed	Significant earthwork and grading needed	Level terrain - limited grading needed
Site Constraints	**Existing building**	Existing utility easements require relocation - would likely need to purchase adjacent property to meet noise regulations at the property line	Existing building, distribution substation, municipal sanitary sewer line and culvert**	Existing gas easement; easements required for access and utility installations
Environmental Effects	**None**	None	In 500-year Floodplain; Horseneck Brook flows under property in culvert	None

* Does not include 0.35 acre occupied by the existing distribution Prospect Substation and 0.25 acre by existing culvert and sewer line.

** The time required to locate an alternate route (working with the municipality) and then move the municipal sanitary sewer off of the property, in addition to undertaking the supplemental earthwork and the design modifications required to construct the substation in the 500-year flood plain, would likely delay project schedule and jeopardize the facility's target in-service date.

(Eversource 1, p. H-12; Eversource 9, p. 11)

Proposed Site

208. The Proposed Site is located at 290 Railroad Avenue and is 0.81 acre in size. The property is commercial, and has been controlled by Eversource with a long-standing lease for more than 40 years. Eversource has an option to buy the Property, which may be exercised in 2021. (Eversource 1, pp. G-1, H-6, H-12; Eversource 18, Q-FPET-004, Q-FPET-006; Eversource 29, Q-PANTRY-060)

209. The Proposed Site is proximately located to the load pocket and is adjacent to existing distribution feeders. Because it is surrounded by other commercial properties and is in close proximity to transportation infrastructure, a substation on the Proposed Site would be compatible to other existing uses within the immediate vicinity. (Eversource 1, p. H-6, H-12; Eversource 9, pp. 7-8)

210. The Proposed Site is level and no major earthwork would be required for property development. (Eversource 1, p. H-6, H-12)

211. The Proposed Site has no utility encumbrances, nor any municipal sewer facilities located on it. (Eversource 9, p. 8; Eversource 25, p. 3)

212. No wetlands or watercourses exist on or are proximate to the Proposed Site, nor do any residential properties abut the Proposed Site. (Eversource 1, p. H-6 – 7, H-12; Eversource 25, p. 3)

213. The Proposed Site is located outside both the 100-year and 500-year flood zones. (Eversource 9, p. 8; Eversource 27, Q-PANTRY-045)

Alternate Site

214. The Alternate Site is located at 281 Railroad Avenue. The property is commercial, and is owned by Eversource. The area is currently used as a storage area for materials, and was previously used for additional parking for the former Greenwich Area Work Center. (Eversource 1, p. H-7, H-12; Eversource 9, pp. 7-8)

215. The Alternate Site is proximately located to the load pocket and existing distribution feeders, near commercial and residential properties. (Eversource 1, p. H-7, H-12)

216. The Alternate Site is level and no major earthwork would be required for property development. (Eversource 1, p. H-7, H-12)

217. The Alternate Site would require the purchase of at least three additional properties to mitigate substation noise and comply with applicable noise regulations. Existing utility easements would require relocation. (Eversource 1, p. H-7, H-12; Transcript 1, pp. 59-60)

218. The Alternate Site would have a greater visual impact on nearby residences than the Proposed Site, as it would be visible from Woodland Drive and from residential properties on both the west and east side. (Transcript 1, p. 48)

330 Railroad Avenue

219. The third site considered by Eversource is located at 330 Railroad Avenue. The property is commercial and currently includes Eversource's former Greenwich Area Work Center building and Prospect Substation. (Eversource 1, p. H-8; Eversource 9, p. 10)

220. The site is located within the customer load pocket, with existing distribution feeders along Railroad Avenue. (Eversource 1, p. H-8, H-12)

221. The property contains two major subsurface obstacles: Horseneck Brook, which flows beneath the property within a 16-foot wide culvert; and a municipal sanitary sewer easement with a 15-inch sewer pipe, which is adjacent to Horseneck Brook. The property is also located within a floodplain. (Eversource 1, pp. H-8 – 9, H-12; Transcript 1, p. 71)

222. Although engineering solutions could possibly be incorporated to work around the site's subsurface obstacles, development at this site would add costs and introduce risks for constructing, operating and maintaining a new substation. It would also create risks to the substation's construction schedule. (Eversource 1, p. H-9)

223. Prospect Substation, which is located at 330 Railroad Avenue, is an operating substation serving load in Greenwich that must remain energized both during and after the construction of the new substation. (Eversource 1, p. E-15)

224. Because a more suitable location was identified for the proposed Greenwich Substation, 330 Railroad Avenue was placed on the market. The property is under contract for sale. (Transcript 4, p. 122)

Old Track Road

225. The fourth site considered by Eversource is located on Old Track Road, and was suggested by the Town of Greenwich as a potential substation location. It is a privately owned commercial property. (Eversource 1, p. H-10)

226. The site is located within the customer load pocket, but the length of required distribution feeders would increase substantially because all of the feeders would have to be extended to this property. This would be costly and require additional easements to use the privately owned Old Track Road for access and installation of the conduits. (Eversource 1, p. H-10 – 11; Eversource 9, p. 9)

227. New transmission lines for this site would have to be extended an additional 0.25 mile when compared to the Proposed Site, and built around the existing culvert and sewer lines crossing beneath Railroad Avenue. (Eversource 1, pp. H-10 – 11; Eversource 9, p. 9)

228. The site was also rejected because of its close proximity to abutting residential properties, located at a higher elevation, to the north. Nearby residents would be able to look directly down into the substation yard. (Eversource 1, pp. H-10 – 11; Eversource 9, p. 9)

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229. The Proposed Site would be compatible with existing commercial land uses in the vicinity, including warehouses, an electric substation (Eversource's Prospect Substation), utility storage yard, and active rail line. (Eversource 1, p. G-1)

230. The property at 290 Railroad Avenue is located within a General Business Zone. (Eversource 1, p. G-1)

231. The Greenwich Substation could be supplied from two underground 115-kV transmission supply lines originating from Cos Cob Substation on Sound Shore Drive. (Eversource 1, p. G-2)

232. The two new transmission supply lines would enter the new substation via underground pipes and terminate at gas insulated switchgear ("GIS") equipment, which would be housed in a building measuring approximately 121 feet long by 32 feet wide along Railroad Avenue; an angled façade paralleling Field Point Road would extend the southern footprint of the building an additional 13 feet in length. The main roof of the building would stand 31 feet tall, with matching tower fascia on the east and west ends extending to approximately 36 feet high. A small, rear annex on the building's east end would extend approximately 19 feet southward into the substation yard. (Eversource 1, p. G-2)

233. Based on the proximity of the proposed substation to the commercial center of the Town of Greenwich, and input received from the municipality as part of the municipal consultation process, an alternate design was developed for the GIS building for a pre-cast concrete façade with brick accents set back over 16 feet from the edge of the property line fronting Railroad Avenue. (Eversource 1, p. G-3; Eversource 32, p. 6)

234. Based on feedback Eversource received from meetings and consultations with the Town of Greenwich, Eversource made the following modifications to the design of the proposed Greenwich Substation:

- Hired an independent architect to redesign the building to more closely resemble the former Eversource Area Work Center at 330 Railroad Avenue;
- Varied the building façade to add scale and focal features by adding brick veneer, windows, a front door, and other architectural elements to the design;
- Reconfigured the building to break up the façade length by incorporating a projecting doorway and tower sections;
- Reconfigured the building to break up the building height by incorporating tower fascia on the east and west ends and reducing the height of the main roof;
- Moved the building back from Railroad Avenue to provide additional separation between the building and the curb and sidewalk;
- Reoriented the battery portion of the building extending it to the south, along the east side of the property, thereby limiting the view into the substation from the east; and
- Extended the length of the building on the west side to allow the overhead door into the GIS building to be on the back of the building, accessible from the substation yard, rather than at the intersection of Field Point Road and Railroad Avenue.

(Eversource 9, p. 15; Eversource 32, p. 6)

235. The GIS building would house six 115-kV circuit breakers and associated disconnect switches, protective relay and control equipment, as well as the battery and charger associated with the transmission equipment. (Eversource 1, p. G-3)

236. The Greenwich Substation yard would be outfitted with three 115-kV circuit switchers with integral disconnect switches and three 60-MVA power transformers that would step down the voltage from 115 kV to 13.2 kV. The three 60-MVA transformers would contain insulating oil that did not contain polychlorinated biphenyls ("PCBs"). (Eversource 1, p. G-3)

237. One metal switchgear enclosure (measuring approximately 108 feet long, 24 feet wide and 14 feet tall) would be installed to house the switching equipment and the relaying and control equipment for the 13.2-kV distribution feeders. (Eversource 1, p. G-3)

238. A pump house would be required at the new substation to support the HPFF transmission cables and maintain the requisite liquid pressure under all loading conditions. It will also provide for slow or rapid fluid circulation to even out hot spots along the line route. (Eversource 1, pp. G-4, K-14; Eversource 9, p. 27)

239. The pump house at the new substation would measure approximately 12 feet high, 50 feet long and 12 feet wide. It would be placed in the southwest corner of the Proposed Site, along the fence line adjacent to Field Point Road. (Eversource 1, p. G-4; Eversource 9, p. 27)

240. The pump house at the new substation would contain circulating pumps, valves and other controls to maintain fluid pressure, recorders, alarms, and a reservoir tank sized to accommodate fluid expansion and contraction as the load on the circuit cycles. The pump house would be serviced by two separate distribution circuits with automatic transfer for backup in case of power loss. (Eversource 1, p. G-4)

241. The proposed substation's yard would be accessed by a 20-foot wide, gated entrance from Field Point Road, and would be covered with a trap rock surface. (Eversource 1, p. G-3)

242. The substation yard would be surrounded by an eight-foot high fence for security. (Eversource 1, p. G-3)

243. The proposed substation would have low-level lighting for safety and security purposes. Additional lighting within the substation yard would be installed to facilitate work at night under emergency conditions or during inclement weather. Two or three 65-foot tall lightning masts would be installed in the substation yard. (Eversource 1, p. G-3)

244. The proposed substation equipment and supporting infrastructure would have a service life of approximately 40 years. (Eversource 1, p. G-4)

Cos Cob Substation Modifications

245. The Project would require that modifications be made to the Cos Cob Substation. (Eversource 1, G-7)

246. A revised Appendix C of the Cos Cob Site Plans was submitted to the Council on July 30, 2015, with appropriate substation component labels/property lines/vegetation. (Eversource 4, Q-CSC-016)

247. Installation of new equipment at Cos Cob Substation would be required to support the transmission lines. This includes two 115-kV 3000 Amp rated circuit breakers, five manually operated disconnect switches, two motor operated disconnect switches with grounding switch, six instrumentation potential transformers (three per underground line position), two sets of cable termination structures, ten bus support structures, one A-Frame line structure (approx. 45 feet tall), underground conduits and duct banks for communication and control cables, and underground lines and bus sections, one monopole line structure (approx. 85 feet tall), one steel structure with accessory equipment to reconstruct the mobile transformer position, relays and control and communication equipment to be installed within existing control enclosures, bus work, and underground cable vaults for the underground cable transmission lines. Associated foundations for the new equipment would also be installed. (Eversource 1, p. G-7 – 8, App. C; Eversource 9, p. 18)

248. The new equipment at Cos Cob Substation would be installed within an existing Connecticut Department of Transportation ("CTDOT") easement area on the south side of the existing substation. In order to accommodate the new equipment and provide for safe operation, the substation fence would be extended approximately 140 feet to the south on Eversource's property. (Eversource 1, p. G-7, App. C; Eversource 9, p. 19; Transcript 1 – September 1, 2015, pp. 21-23)

249. As part of the municipal consultation process, Eversource received input from Greenwich officials concerning its proposed modifications. This resulted in a design modification to minimize the impact of the modifications to the new Cos Cob Park. With the design modification, the expansion of the fence line will no longer require the use of municipal-owned property. (Eversource 1, p. G-9)

250. To accommodate the new equipment installation, the following pieces of equipment currently installed at the Cos Cob Substation would be removed: two steel A-Frame line structures and one wood H-Frame structure, strain overhead bus sections, one line trap, one manual disconnect switch, one wood pole structure with guy wires, and one lattice line structure. (Eversource 1, p. G-8, App. C)

Route Analysis

251. Eversource initially evaluated numerous overhead, underground, and marine routes, as well as hybrid combinations incorporating different segments of select options. A total of 12 routes were considered and analyzed, including four overhead routes, five underground options, one marine route, and two combination routes. (Eversource 1, p. H-17; Eversource 9, pp. 22-23)

252. For the 12 potential route options, Eversource conducted additional screening analyses involving further field reconnaissance, as well as consideration of baseline environmental data compilation and review. (Eversource 1, p. H-13)

253. Eversource requested and considered input from Town of Greenwich officials in the route selection process. (Eversource 1, p. H-14)

254. Eversource applied the following set of route selection objectives for the transmission circuit, which have been established based on experience of utility facility siting and construction in Connecticut:

- Comply with all statutory requirements, regulations and State and federal siting agency policies;

- Achieve a reliable, operable, constructible and cost-effective solution;
- Maximize the reasonable, practical and feasible use of existing linear corridors (e.g., transmission lines, highways, public roadways, railroads, pipelines);
- Minimize the need to acquire property;
- Minimize adverse effects to environmental resources, significant cultural resources, and on designated scenic resources;
- Minimize conflicts with local, state and federal land use plans and resource policies; and
- Maintain public health and safety.

(Eversource 1, p. H-13; Eversource 9, pp. 21-22)

255. During the Council's process, Eversource evaluated a primarily overhead route along the MNRR corridor, consisting of four distinct segments. (Eversource 34, Q-LF-003) (See Hybrid Solution)

Overhead Routes Initially Considered and Rejected

256. Eversource evaluated four overhead routes, which were considered early in its route evaluation; namely, the Overhead South Route, the Overhead Central Route, the Overhead North Route, and the Overhead MNRR Corridor Route (with variations). (Eversource 1, pp. H-18 – H-20)

257. The **Overhead Southern Route** was removed from further consideration because no existing ROW was available along the route; this would have required new easements/acquisitions affecting approximately 46 public and private properties. Substantial clearing requirements would also be associated with this route. (Eversource 1, p. H-17)

258. The **Overhead Central Route** would have been able to utilize existing transportation and utility ROWs; however, the width of the ROWs would not be sufficient to accommodate the proposed transmission lines. As a result, approximately 97 parcels would require easements or acquisitions. The option would also require removal of numerous trees that currently provide screening from the MNRR and I-95. Therefore, this route was removed from further consideration. (Eversource 1, p. H-18)

259. The **Overhead Northern Route** was rejected due to its high level of impact on the historic districts and very densely populated areas that it would traverse. Similar to the Overhead Southern Route option, numerous easements/acquisitions would be required because no existing ROW exists for this route. (Eversource 1, p. H-18)

260. The **Overhead Metro-North Railroad Corridor Route (the "North Easement")** would occupy a portion of the existing MNRR ROW as well as adjacent private properties. Eversource anticipated that several properties would have to be acquired due to the extent of the ROW needed on those properties. Further, construction would require the removal of existing vegetative buffers for those homes to the north of the ROW. The MNRR has also indicated that limited work hours would be imposed on Eversource in order to avoid conflicts with the rail line's active use, adding substantial time to the construction schedule. (Eversource 1, p. H-19)

261. Two variations of the Overhead MNRR Corridor Route were also evaluated:

- **Variation 1 (the "South Easement")** could reduce the number of properties directly affected by nearly 50 percent, but it would require installation of new overhead transmission support structures in Bruce Park and adjacent to the Bruce Park Museum, as

well as substantial clearing of mature trees that provide screening between the I-95 and MNRR transportation corridor and the neighborhoods to the south. Further, CTDOT policies limit the longitudinal occupation of interstate corridors unless no other practical option exists.

- **Variation 2 (the "Middle Easement")** would require that construction activities take place within a very narrow area between the MNRR and I-95 (36 feet wide at its narrowest point). In addition, a municipal sewer line and MNRR underground facilities are located in this area, creating a higher level of construction complexities. As with the South Easement, CTDOT policies limit the longitudinal occupation of interstate corridors unless no other practical option exists.

(Eversource 1, p. H-19)

262. In 2015, CTDOT determined that all three of the proposed Overhead MNRR Corridor Routes were not desirable; thus, such overhead options were removed from further consideration. (Eversource 1, p. H-20; Eversource 9, pp. 23-24)

263. By letter dated January 23, 2015, CTDOT commented on the three Overhead MNRR Corridor Routes, concluding that the "*North Easements would have a serious detrimental impact to the Department and Metro-North Railroad. . . . Both the Middle Easement and South Easement are undesirable since they would prevent the Department from making improvements to I-95.*" (Eversource 1, App. E)

Marine Route Considered and Rejected

264. Eversource considered a **Marine Route**, which would involve an underground/submarine line exiting Cos Cob Substation under Cos Cob Park directly into Cos Cob Harbor and extending south and west around Indian Field Point and Tweed Island before turning north and coming ashore in the vicinity of the Town's water treatment plant. The lines would continue underground north along Shore Road, under I-95, then turn east onto Horseneck Lane then north on Arch Street, crossing beneath the MNRR to Railroad Avenue. The route would then turn west following Railroad Avenue to the Greenwich Substation. (Eversource 1, p. H-26)

265. The **Marine Route** is significantly longer than the land routes considered, and would pose additional permitting, construction and maintenance challenges. The Project schedule might be jeopardized by the required environmental permitting process and review. Eversource would have to provide overwhelming evidence that no overland routes are feasible for regulatory agencies to consider a marine route through Long Island Sound. Moreover, transmission supply line installation below the seabed would require the use of costly technology, and the work within the harbor would be difficult given the very narrow and shallow areas in the channel. Because feasible alternatives are available, a marine option for the transmission supply line was removed from further consideration. (Eversource 1, pp. H-26 – H-27; Eversource 9, p. 24)

Combination Routes Considered and Rejected

266. Eversource assessed two combination routes, incorporating underground, overhead and marine route segments. (Eversource 1, p. H-27)

267. The **Southern Route Marine and Underground Line Combination Route** would exit Cos Cob Substation underground across Cos Cob Park and, using HDD techniques, extend southwest under Cos Cob Harbor and come ashore on private property on Mead Point. An underground line

segment would extend west through private property, across Indian Field Road, and beneath Town-owned property to Bruce Park Drive. A second HDD crossing would be required through Bruce Park and Indian Harbor to Davis Avenue. This route would then follow Davis Avenue, Indian Harbor Drive and Museum Drive westward before turning north on Arch Street to Railroad Avenue. The route would then turn 90 degrees following Railroad Avenue before interconnecting with the Greenwich Substation. (Eversource 1, p. H-27)

268. The **Southern Route Marine and Underground Line Combination Route** would incorporate both, underground and marine segments. The marine line would pose similar challenges to those discussed under the Marine Route, and the transition to the underground line would need to cross private property. Given these challenges, along with the Route's impact to Cos Cob Park and the availability of more feasible alternatives, this Route was removed from consideration by Eversource. (Eversource 1, pp. H-27 – H-28; Eversource 9, p. 24)

269. The **Central Route East Side Overhead and West Side Underground Combination Route** would extend overhead lines from Cos Cob Substation to Bruce Park Avenue west of Indian Harbor where it would transition to an underground design within private property, and follow Bruce Park Avenue and Railroad Avenue directly to the Greenwich Substation. The overhead line portion would follow Station Drive and Eversource's existing distribution ROW. (Eversource 1, p. H-28)

270. A **Variation** of the Central Route East Side Overhead and West Side Underground Combination Route would extend the overhead lines to a staging area to be located on a residential property off Circle Drive Extension, where it would transition to an underground design and cross beneath the MNRR, I-95 and Indian Harbor to Davis Avenue via HDD. The route would follow Davis Avenue, Indian Harbor Drive and Museum Drive west, then turn north on Arch Street to Railroad Avenue, where the route would turn west again to the Greenwich Substation. (Eversource 1, p. H-28)

271. The **Central Route East Side Overhead and West Side Underground Combination Route,** along with the **Variation** of the Route, would directly impact over 50 properties in order to expand an existing Eversource distribution ROW to accommodate the new overhead portion of the Route. The Route would also require removal of trees that currently provide screening between the MNRR and I-95 corridors and nearby residences. This Route was removed from consideration by Eversource because more feasible alternatives for the route were available. (Eversource 1, p. H-28; Eversource 9, p. 24)

Underground Route Alternatives

272. The **Underground Southern Alternative** would originate to the south of the Preferred Route and after crossing under an elevated portion at I-95, would extend along South Shore Drive, in place of the use of Station Drive in the Preferred Route. The HDD under I-95 would occur from private property along Sound Shore Drive. (Eversource 1, p. H-20; Eversource 9, pp. 20-21)

273. The **Underground Southern Alternative** was not identified as the Preferred Route because the eastern portion extends through a constrained area that lacks sufficient width for the new transmission lines to be located under Sound Shore Drive. Existing utilities would have to be relocated in order to utilize the roadway corridor and avoid impacting adjacent private properties. As compared to the Preferred Route, it would have increased community and environmental impacts. (Eversource 1, p. H-21; Eversource 9, p. 21)

274. The **Underground Northern Alternative** would primarily run along U.S. Route 1, mainly within the public ROW. Off-road easements for vault locations would be necessary. (Eversource 1, p. H-22; Eversource 9, p. 21)

275. The **Underground Northern Alternative** was not identified as the Preferred Route because of its greater length, conflicts with existing utilities, and CTDOT's requirements for off-road vault locations, all of which could increase the Project's cost and prolong the construction schedule. This route would have greater community and environmental impacts because it would traverse more densely populated areas than the Preferred Route, as well as through historic districts. The route would also require a number of easements on private property. (Eversource 1, p. H-23; Eversource 9, p. 21)

276. Eversource identified both, the Underground Southern Alternative and Underground Northern Alternative, as viable alternative routes to the Preferred Route. (Eversource 9, p. 20)

277. The following table presents a summary of the analysis of the Preferred and Alternative Routes and key factors.

Key Factors	Preferred Route	Southern Alternative	Northern Alternative
Route Length	2.3* miles	2.2 miles	3.1 miles
CTDOT Encroachment Agreement Required	No	No	Yes
CTDOT Encroachment Permit	Yes	Yes	Yes
CTDOT Rails License Agreement	Yes	Yes	Yes
MNRR License Agreement	Yes	Yes	Yes
Impacts on Environmental and Cultural Resources	Minimal	Minimal	Moderate
Underground Utilities Congestion	Least	Greater	Greatest
Constructability Challenges[35]	Minimal	Greater	Greatest
Easements Required[36]	10	6	10
Estimated Number of Vault Locations	6	6	8

*If Bruce Park open trench or other alternative crossing variation is selected, the Preferred Route would be slightly longer.

35 Includes length and angle of HDD, need for all off-road easements, limited work hours, and space constraints.

36 Estimated; all with varying complexities.

(Eversource 1, p. H-29; Eversource 9, p. 21)

278. Because more feasible alternatives were available, both the **Underground Central Route** and the **Underground Central Route Using Existing Distribution ROW** were removed from further consideration by Eversource due to their high level of community impact and property acquisition requirements. (Eversource 1, pp. H-24, H-26; Eversource 9, p. 24)

Preferred Route

279. After evaluating various route options, and following consultation with Town of Greenwich officials, Eversource identified a Preferred Route that was presented in its MCF. (Eversource 1, p. ES-4)

280. The Preferred Route was selected by Eversource based on engineering, environmental, cultural, economic, and community considerations and Project routing objectives. These objectives include: ease of constructability; minimizing conflicts with existing utilities; meeting operations and

maintenance requirements; limiting the need for ROW/easements as much as possible; and minimizing surface disruption impacts, scheduling delays, length of the route, and costs. (Eversource 1, p. ES-6)

281. The Preferred Route would be an underground configuration that exits Cos Cob Substation north under the MNRR, turns west along Station Drive, crossing beneath I-95 and extending to Town-owned property west of Indian Field Road and north of the MNRR. Approximately 1,500 feet of HDD beneath the MNRR and I-95 would be required to a staging area at the end and west of Kinsman Lane, where open trenching would continue in or adjacent to the road and into Bruce Park. HDD technology would be used to span Bruce Park and Indian Harbor for nearly 0.5 mile, to Davis Avenue near Home Place. The route would then follow Davis Avenue, Indian Harbor Drive and Museum Drive westward before turning north on Arch Street and extending beneath I-95 and the MNRR to Railroad Avenue. The route would turn west and follow Railroad Avenue to the Proposed Site. (Eversource 1, p. G-15)

282. According to the Town Road List, Listing of Locally Maintained Roads by Town as of December 31, 2014 compiled by CTDOT, Kinsman Lane is a publicly maintained road for 0.16 miles. Kinsman Lane is, in its entirety, 0.16 miles. (Eversource 31, Q-OCC-038; Eversource 32, p. 7)

283. In a letter to Eversource dated March 27, 2015, the Greenwich Inland Wetlands and Watercourses Agency stated: "*The Preferred Route with Horizontal Directional Drilling ("HDD") appears to the Agency to pose the least potential of causing adverse wetland impacts out of all of the alternatives, including the open trench variant of the Preferred Route, which would require coffer damming across Indian Harbor north of Davis Avenue."* (Eversource 9, p. 25, Att. 6)

284. During the MCF process, Eversource was encouraged to assess additional alternate crossings of Bruce Park through comments it received from the Town of Greenwich and members of the community. (Eversource 1, p. G-18)

285. Two variations of the Preferred Route were evaluated by Eversource during the MCF process:

- The **Bruce Park Underground Open Trenching Variation** (the "Yellow Variation") would generally follow Kinsman Lane and Bruce Park Drive using open trench construction for the installation of the transmission supply lines and eliminate an HDD crossing of the Park.
- The **MNRR and I-95 HDD Crossing Variation** (the "Green Variation") would use the area of Station Drive, to the east of Indian Field Road, as a staging area for the HDD equipment to accommodate an approximately 1,470-foot long trenchless crossing to the Greenwich Department of Public Works ("DPW") Town Maintenance Facility or the terminus of Kinsman Lane. The Station Drive area was selected as a more advantageous staging area to avoid an open trench crossing of Indian Field Road, which is a very busy access road to I-95.

(Eversource 1, p. G-15)

286. Eversource received comments from the Town of Greenwich and members of the community during the MCF process, encouraging it to assess additional alternate crossings of Bruce Park. In lieu of crossing Bruce Park with the longer HDD span associated with the Preferred Route, two additional route variations were presented in the application:

- The "Blue Variation" would allow for an open trench to originate either on the DPW property or the end of Kinsman Lane and extend southwest through a relative open area on the eastern side of the Park, paralleling Kinsman Lane. The trench would turn north and then west, following outside the existing trees to a point near the eastern-most waterbody, north of the baseball field. This variation would transition to HDD technology to cross westward beneath the remainder of the Park, including Indian Harbor.
- The "Orange Variation" would also originate with an open trench on the DPW property or the end of Kinsman lane and extend west through the northern portion of the Park, immediately south of I-95, to the area described in the Blue Variation near the Park's eastern-most waterbody, north of the baseball field. This variation would require removal of trees and some bedrock. The variation would transition to HDD technology and cross westward beneath the remainder of the Park, including Indian Harbor.

(Eversource 1, p. G-18)

287. Eversource would support any of these variations as part of the route for the proposed transmission supply lines, if approved by the Council. (Eversource 1, p. G-18)

288. The MNRR and I-95 HDD Crossing Variation ("the Green Variation") was identified by Eversource as an ideal variation to the Preferred Route because it avoids the opening of trenches across Indian Field Road. Indian Field Road is a major north/south corridor between Route 1 and Putnam Avenue, and both the Cos Cob train station and I-95. (Eversource 25, pp. 3-4)

Hybrid Solution

289. Based on questioning from the Council at the October 6, 2015 evidentiary hearing, Eversource investigated using an overhead line option along Interstate 95 and the railroad, minimizing the right-of-way (ROW) width for all or part of the route. It found four uniquely challenged line segments, which could be analyzed separately and examined later for possible mixing and matching. (Eversource 34, Q-LF-003) (See attached Appendix A)

- Cos Cob Substation to Indian Field Drive ("Segment 1"): Eversource examined two possible underground "getaways" from Cos Cob Substation, referred to as Segment 1A and Segment 1B, to address the lack of available space in and around the substation for a 115-kV overhead line exit.

    i. Segment 1A would exit Cos Cob Substation under the driveway turning west on the Cos Cob Park driveway and extending under Sound Shore Drive to two riser poles to be located in the MNRR parking lot south of the railroad. This variation would cost $12.7 million and require three easements and no property acquisitions.
    ii. Segment 1B would extend along the western edge of Cos Cob Substation within the fence line until it reaches the northern boundary of the fence line and then continue under Sound Shore Drive to two riser poles to be located in the MNRR parking lot south of the railroad. This variation would require further investigation to determine if there is enough space to construct between existing electric facilities, a containment structure and other third party generation facilities. Segment 1B would cost $11.2 million and require two easements and no property acquisitions.

iii. Segments 1A and 1B would merge in the MNRR parking lot and transition to overhead before extending west to Indian Field Road. The merged Segment would require a license from the railroad and minimal easements on properties. Installation along this route would face work challenges due to its close proximity to the railroad, and cost impacts due to the need to maintain adequate railroad parking.

- Indian Field Drive to Indian Harbor ("Segment 2"): This segment has three variations.

  i. Segment 2A would extend overhead along the north side of the railroad. The overhead lines would continue north of the railroad and south of residential properties on Circle Drive and Circle Drive Extension. This segment variation would cost $5.4 million and require a license from the railroad and approximately 17 easements over the back portion of residential properties. No property acquisitions are needed. Segment 2A would require removal of the majority or all of vegetation screening between residential properties and the railroad to do the construction work and provide sufficient clearance for safe operation of the transmission lines. It would also face construction challenges, given its close proximity to the railroad.

  ii. Segment 2B would extend overhead along the south side of the railroad but north of the CTDOT highway taking line. This segment variation would cost $9.2 million and require a license from the railroad. No easements or property acquisitions would be needed. It would also face construction challenges due to its location between the railroad and I-95. The segment's proximity to the highway and Greenwich's sewer would also increase the duration and cost of construction.

  iii. Segment 2C would transition from overhead to underground with riser poles and head north through a private property to Circle Drive. It would continue underground west on Circle Drive to Circle Drive Extension, where the underground would head south through another private property to the railroad. This segment variation would cost $16.7 million and require a license from the railroad, one easement over residential property, and one acquisition of a residential property. It would also face many of the same construction challenges due to its proximity to the railroad.

- Indian Harbor to Steamboat Road ("Segment 3"): This segment has two variations.

  i. Segment 3A would extend one overhead circuit along the north side of the railroad and another along the south side of the railroad but north of the CTDOT highway taking line. This variation would reduce costly acquisitions of properties on Bruce Park Avenue if both circuits were located north of the railroad in this segment. This segment variation would cost $18.7 million and require a license from the railroad and many easements over the back portion of residential property lots. It would also require removal of the majority or all of vegetation screening between many residential properties and the railroad to do construction work and provide sufficient clearance for safe operations of the transmission lines. Due to its close proximity to the railroad and town sewer, this segment variation would face construction challenges and require additional worker safety and underground facility protection measures.

ii. Segment 3B would extend two overhead circuits along the south side of the railroad but north of the CTDOT highway taking line. This segment variation would cost $13.9 million, and would require a license from the railroad; no easements or property acquisitions would be needed. It would also be subject to challenges from working between the railroad and I-95, and would require additional worker safety and facility protection measures due to its close proximity to the highway and sewer.

- Steamboat Road to the Greenwich Substation via Railroad Avenue ("Segment 4"): This segment has two variations, the second of which is an underground variation.

  i. Segment 4A would require extending overhead lines along the south side of the railroad through Plaza Drive. This is a very tight space that would require significant detailed engineering to be completed in coordination with CTDOT Office of Rails and MNRR to identify structure locations on Plaza Drive and the location to cross back to the north of the railroad at the required 90-degree crossing. This segment variation would cost $39.8 million and would require a license from the railroad, several easements over commercial properties and acquisition of at least one commercial building. This would include an easement for overhead riser structures located behind the proposed Greenwich Substation.
  ii. Segment 4B would transition from overhead to underground lines at riser poles installed near Steamboat Road. It would then head north underground along Steamboat Road before turning west on Railroad Avenue to the proposed Greenwich Substation. This segment variation would cost $13.4 million and require a license from the railroad in the area of the riser poles. Both Segments would face construction challenges due to their proximity to the railroad.

(Eversource 34, Q-LF-003)

290. To address narrow overhead corridors and reduce the Project costs, Eversource used a 556 ACSS conductor. This smaller conductor design enables cost savings associated with the use of light-duty, directly embedded, steel structures rather than heavier structures that require foundations. This structure design would not allow for larger conductors to be installed in the future without rebuilding the line, which would require replacement of structures and/or additional new structures and possible foundations. This design would typically require a 50-foot ROW to maintain proper clearances for conductor blow out; however, in the areas adjacent to the railroad and/or highway, where it can reasonably be anticipated that no buildings will be located in those corridors, the required ROW could be reduced to 40 feet. The structures would be built 15 feet from the railroad catenary structures and 25 feet from the edge of the ROW. (Eversource 34, Q-LF-003).

291. Eversource met with CTDOT and presented overhead routes for its review. CTDOT advised Eversource that it cannot support placement of any structures between the railroad and I-95 that would be within the CTDOT highway taking line because that would conflict with CTDOT's Utility Accommodation Manual (which does not allow a longitudinal use of the I-95 corridor) and would jeopardize CTDOT federal funding, unless there were no other viable alternatives to use of such locations. CTDOT also informed Eversource that it is planning to expand I-95 in that area. CTDOT provided Eversource with design criteria to work with, and has supported what Eversource is trying to accomplish. It has seen Eversource's design alternatives. (Eversource 34, Q-LF-003; Transcript 3, pp. 43, 93; Transcript 4, pp. 128-129)

292. The overhead line segments would consist of two overhead transmission lines supported primarily on double circuit line support structures. The support structures would range in height from approximately 80 – 150 feet. (Eversource 34, Q-LF-003)

293. The estimated total cost of the two all overhead transmission lines along the four segments would be approximately $76 - $77 million, which is approximately the same cost as the estimated cost of the underground transmission lines along the Preferred Route. (Eversource 34, Q-LF-003)

294. Eversource also evaluated a hybrid overhead/underground route ("Hybrid Route") that would include the Segment 4B underground variation described above. Because of its relatively short distance (approximately 2,400 feet), the underground variation would not require any splice vaults. The estimated cost for the hybrid transmission route would be approximately $50 million, which is approximately $22 million less than the estimated cost of the transmission lines along the Preferred Route. (Eversource 34, Q-LF-003)

295. The most cost-effective version of the Hybrid Route would consist of Segments 1A, 2B, 3B, and 4B. (Eversource 44, Q-LF-016)

296. The Hybrid Route would have no impact on the recreational areas in Cos Cob Park. (Transcript 7, p. 122)

297. If the Hybrid Route is approved by the Council, Eversource believes it would be able to meet the same construction deadline as is listed for the Preferred Route in its application. (Transcript 7, p. 104)

298. Eversource has a long history of coordinating its line construction projects with various utilities, and working successfully around existing water and sewer mains. (Transcript 7, p. 107)

299. If the Hybrid Route is approved by the Council, Eversource will take the Town of Greenwich's concerns into account and try to work cooperatively with the Town. (Transcript 7, p. 114)

300. Segment 1A of the Hybrid Route would traverse a common drive shared with Cos Cob Park. Currently, Eversource has easement rights only for distribution facilities in this common drive. (Transcript 7, pp. 120-121)

301. As an alternative to Segment 1A, Eversource would construct Segment 1B without any need for additional easement rights from the Town of Greenwich. (Transcript 7, pp. 119-121)

302. At the Council's request, Eversource reviewed a design to install structures on both sides of the railroad ROW from the transition structures in the MNRR parking lot just north of Cos Cob Substation to the transition structures near Steamboat Road. The route would exit the railroad ROW near Steamboat Road along two separate paths. The path along the north side of the railroad would exit by crossing through private property to Railroad Avenue which would require an easement. The path along the south side would exit onto Steamboat Road.

    - The transmission line design for the south side of the railroad is different from the design for the north side. This is due to the constraints on the south side between the I-95 taking line and the railroad catenary supply lines. Some of the spans on the south side of the railroad would be longer than spans on the north side. These longer spans do not create a

concern with blowout because this section is between the railroad and I-95 where ample clearances would exist.

- The line along the north side of the railroad would require 22 structures. The line along the south side would require 18 structures. The split design would require clearing on both sides of the railroad, including the removal of vegetation that currently provides a buffer between the residential properties on Bruce Park Avenue and Circle Drive and the railroad to the south.

- Construction of the transmission line using the split design would require approximately 50 permanent easements.

- The estimated cost for the split design option would be $57.9 million, which is $8.7 million more than the Hybrid Route along only the south side of the railroad.

(Eversource 44, Q-LF-015)

303. If the Hybrid Route is approved by the Council, transmission installations would not be sited within Bruce Park, thereby avoiding any potential impact to the waters, wildlife, and historic qualities of the Park. (Transcript 7, pp. 115, 118-119)

304. The Hybrid Route proposed by Eversource satisfies many of the stakeholder needs that have been examined during the Siting Council proceedings for this Project. It addresses some of the cost issues that the Council and OCC have raised, and it is a route that is now supported by the Town of Greenwich. CTDOT and MNRR have supported Eversource's overhead line alternative, as it was presented to them. (Transcript 7, p. 42)

305. Work on railroad ROWs must satisfy the criteria established by the Federal Railroad Administration. (Eversource 32, p. 10)

306. The constraints that Eversource would encounter include:

- Because a track must be taken out of service for construction activities to take place, MNRR would limit Eversource to a construction window of only a few hours per day, which allows a very narrow time period for mobilization, performance of work and demobilization.
- During night-time hours, the work site, which abuts the rear of residential properties, would be brightly illuminated for the safety of construction crews.
- Even with the near track out of service, the space available for the construction effort is constrained, so that the amount of work that can be safely accomplished in a few hours is less than the work that could be accomplished in an equivalent period of time on a typical, unconstrained ROW.
- Certain types of work must be suspended when MNRR decides to operate a train on any of the other tracks and work could not be resumed until it has passed.
- MNRR may cancel the scheduled track outages on short notice due to its own overriding priorities, thereby affecting the construction schedule.
- The equipment, construction procedures and protection measures employed by Eversource's contractor would be subject to approval by MNRR; this approval process is time-consuming and can cause construction delays.

- In addition to paying for the construction personnel to build the line, Eversource must also pay for MNRR safety personnel. The schedule of work would be subject to the limited availability of the MNRR personnel to implement track outages and remove the track from service prior to track outages.

(Eversource 32, pp. 10-12)

Transmission Line Construction Procedures

307. The Project facilities would be constructed in accordance with established electric utility practices and regulatory requirements, applicable best management practices, final engineering plans, Eversource's specifications and the conditions specified in the Certificate and other approvals and permits obtained for the Project. (Eversource 1, p. K-1)

308. Prior to starting construction, Eversource would complete pre-construction planning activities. This would include, but not be limited to: conducting surveys to identify existing underground and overhead infrastructure and developing plans for temporary or permanent relocation, if required; conducting analyses of soil and groundwater conditions and preparing plans for handling those conditions; and identifying locations of construction storage yards and construction support areas and obtaining approvals for their use. (Eversource 1, pp. K-10 – K-11; Eversource 9, p. 41)

309. The first step in the construction process would be to deploy appropriate E&S controls (e.g., catch basin protection, silt fence or straw bales, as necessary) at locations where pavement or soils would be disturbed. Within roads and other paved areas, the pavement would be saw cut and removed. (Eversource 1, p. K-11)

310. The most common method of installation for an underground circuit is by open cut trenching. Mechanical excavation is typically required to remove the concrete or asphalt road surface (for roadways), topsoil, and sub-grade material to the desired depth. Removed material is relocated to an appropriate off-site location for disposal or reused as backfill. (Eversource 1, p. K-1; Eversource 9, pp. 26, 39)

311. Once a length of trench is opened and shoring installed, where required, the steel pipes are placed, welded, x-rayed, and assorted conduits are assembled and lowered into the trench. The area around the pipe and conduits is filled with a low-strength thermal concrete and capped with a layer of high strength thermal concrete. After the concrete sets up, the trench is backfilled and the site restored. (Eversource 1, p. K-1; Eversource 9, pp. 26, 39)

312. The minimum dimensions for open trench construction are approximately 4.5 feet wide by 5.5 feet deep. (Eversource 1, p. K-1; Eversource 9, p. 26)

313. Trenching, conduit installation and backfilling would proceed progressively along the route such that relatively short sections of trench (typically 200 feet per crew) would be open at any given time and location. Work zones around the trench area usually range from approximately 600 to 800 feet. (Eversource 1, p. K-11; Eversource 9, pp. 41-42)

314. During non-work hours, steel plates would be installed over the open trench within paved roads to maintain traffic flow over the work area. After backfilling, the trench area would be repaved using a temporary asphalt or equivalent. (Eversource 1, pp. K-11 – K-12; Eversource 9, p. 42)

315. Both the Preferred Route and Southern Alternative would require the use of HDD technology. HDD is a steerable trenchless method of installation for underground pipes, conduits and lines in a shallow arc along a prescribed bore path by using a surface-launched drilling rig. This method is used when open trench excavation is not practical, such as under rivers, highways, or areas of congested development. (Eversource 1, K-2; Eversource 9, p. 39)

316. Eversource proposed to use bentonite as the drilling material for HDD, which is the most widely used drilling material in the industry. While other products are available, the industry professionals have recognized a lower performance of such other products when compared to bentonite's caking effect on the walls of the drill hole, which deters loss of fine particles and small leaks. (Eversource 31, Q-OCC-039)

317. Both the Preferred Route and Northern Alternative would require the use of a trenchless installation known as "pipe jacking" to cross under the MNRR corridor. Pipe jacking involves auguring or hand-mining operations that simultaneously jacks or pushes a casing into the excavated cavity. As the equipment progresses forward, subsequent casing segments are added while the soils are removed through the center of the casing. After the casing installation, three steel pipes and PVC conduits are installed inside the casing pipe using specially designed spacers, and the entire casing is then backfilled with thermally designed grout. (Eversource 1, pp. K-4 – K-5; Eversource 9, p. 40)

318. Splicing of HPFF transmission line cables would be performed inside the splice vault, under a controlled atmosphere. (Eversource 1, p. K-5; Eversource 9, p. 42)

319. For safety purposes, the splice vault excavation would be shored and fenced. Vault sites also may be demarcated by concrete barriers. Vault installation within roadways may require the closure of travel lanes in the immediate vicinity of the vault construction. (Eversource 1, p. K-12)

320. Each vault would have two points of entry to the surface. After backfilling, these entry points would be identifiable as manhole covers, which would be set flush with the ground or road surface. (Eversource 1, p. K-8; Eversource 9, p. 43)

321. Typically, high voltage HPFF transmission lines are depreciated over 40 years, although there are currently 115-kV HPFF underground transmission lines on the Eversource system that have been in operation for nearly 60 years with no immediate plans for retirement. (Eversource 20, Q-CSC-008)

322. System components of the HPFF, such as the containment pipes, terminations, valves, and pressurization plants must be properly maintained in order to achieve longevity. Dielectric fluids are tested periodically using dissolved gas analysis ("DGA") to check for signs of an aging cable system. Periodic visual examinations of valves, terminations, and the pressurization plant components are conducted to identify and correct potential issues. System operational functions are recorded and analyzed to identify events occurring outside of the routine. (Eversource 20, Q-CSC-008)

323. When a HPFF underground system is retired, the dielectric fluid and cable are removed from the containment pipe and recycled. The pipe is swabbed clean, capped off, and abandoned in place, or it can be reused for electric facilities. (Eversource 20, Q-CSC-008)

324. The HPFF cable system is a closed system in which the dielectric fluid volume within the pipe system and the pump house reservoir is monitored for any loss of fluid. The soil impacted by a dielectric fluid leak does not meet the definition of a Resource Conservation and Recovery Act

("RCRA") hazardous waste. However, if dielectric fluid leaks into soil then all visible traces of the fluid must be treated and/or removed. Upon removal, the soils will be characterized as solid waste and managed in accordance with the CT Solid Waste Management Regulations. (Eversource 20, Q-CSC-009)

325. Polybutene is a synthetic polymer, very similar to olive oil in viscosity; it is odorless, colorless and tasteless. It is commonly used in personal hygiene products such as lipstick and mascara, and is also used in chewing gum and confectionery. (Eversource Admin. Notice 11 (272), Transcript of April 21, 2004, pp. 18-31)

326. The time to repair a leak in an HPFF cable system depends on the nature of the leak. Leaks have the greatest potential of occurring wherever equipment is joined together. Leaks detected at the potheads, valves or piping in the pump house are easily addressed and in a relatively short timeframe, typically within days. Pipe penetrations due to a dig-in can also be repaired in a relatively short timeframe. The location of the puncture along the cable route is known and the backfill around the pipe where the puncture occurred has already been excavated so there is easy access to the pipe to perform the needed repair work. (Eversource 20, CSC-010)

327. The most recent installation of HPFF underground transmission cable on the Eversource system in Connecticut has been the Bethel-Norwalk Project, which was placed in service in October 2006. Since the Bethel-Norwalk HPFF transmission cable was placed in service, there have been no repairs along the cable. (Eversource 36, Q-OCC-063)

328. Termination structures would be installed at the Cos Cob Substation. Gas insulated equipment would be used to transition the two 115-kV circuits from underground lines to the substation bus in the Greenwich Substation. (Eversource 1, p. K-6; Eversource 9, p. 27)

Environmental Considerations

329. Due to the location of the proposed Greenwich Substation in a commercial zone and its proximity to existing utility uses, the proposed location of the transmission supply lines underground and the careful design of the Project in a manner that minimizes environmental effects, the Project is compatible with the affected areas and the existing environment. (Eversource 11, p. 2)

330. There are no threatened, endangered species or species of special concern of plant or animal life within the Project area. (Eversource 11, p. 8)

331. On January 7, 2015, the U.S. Fish and Wildlife Service issued a letter confirming that no federally-listed or proposed, threatened or endangered species or critical habitat is known to occur in the Project areas. (Eversource 1, App. E; Eversource 11, p. 8)

332. On August 1, 2014, the CT DEEP issued a letter confirming the U.S. Fish and Wildlife Service's finding. A second letter supporting this previous determination was issued by the CT DEEP on July 23, 2015. (CT DEEP Letter dated 8/1/2014; CT DEEP Letter dated 7/23/15; Eversource 11, p. 8)

333. The proposed Project would not be expected to impact any fisheries. (Eversource 11, p. 13)

334. Based upon its review of research into the Project's potential for affecting significant archaeological resources, the State Historic Preservation Office ("SHPO") concluded that there is

an elevated potential for intact and significant archaeological resources to be extant within the Project area, specifically along the Southern and Preferred Routes which are in close proximity to previously recorded sites 57-49 and 57-55. (Eversource 1, App. E; Eversource 11, p. 10)

335. Eversource would conduct a professional archaeological reconnaissance survey in the sites identified as areas of concern by SHPO, including shovel testing prior to construction, if the Council approves the proposed Project facilities in these areas. Eversource would also exercise extreme caution during vibration producing activities within these areas. (Eversource 11, pp. 10-11)

336. No substantive changes in site topography or grades are anticipated from the Project. Disruption to existing soil would be temporary, and all disturbed areas would be appropriately restored. (Eversource 11, p. 11)

337. The Proposed Site and Cos Cob Substation are not located within 100-year and 500-year flood boundaries. Portions of the Preferred Route are located in such flood boundaries, primarily in low-lying areas adjacent to Indian Harbor and Bruce Park. However, because no permanent above-ground structures are proposed in these areas, no adverse effects are anticipated. (Eversource 11, p. 12)

338. Eversource recognizes that Bruce Park is a valued asset for the Town of Greenwich. Eversource's plans include the following important features to avoid any adverse impacts:

- A cable insulating fluid that is not a hazardous substance;
- Contiguous steel pipe sections welded and tested for voids;
- Low strength thermal concrete filled around the pipes within the trench;
- High strength thermal concrete cap; and
- 24/7 continuous monitoring of the cables, including fluid level alarms.

(Eversource 32, pp. 5-6)

339. Although portions of the Proposed Site, Cos Cob Substation, and the Preferred Route are located within the Connecticut Coastal Boundary, there will be no adverse impacts to coastal resources. Eversource met with the CT DEEP Office of Long Island Sound and would coordinate its efforts with this agency to promote protection of resources within the Coastal Boundary. Eversource would apply for any necessary permits from CT DEEP, Office of Long Island Sound Programs. (Eversource 1, p. O-1; Eversource 11, p. 12)

340. Although there are seven wetland resources present in the Project Area, construction of the Project as proposed would not result in any permanent or temporary, direct or indirect impacts on wetlands. Any nearby wetlands will be fully protected by erosion and sedimentation control measures. (Eversource 11, pp. 3-4)

341. Any potential work within a wetland Upland Review Area (as defined by the Town of Greenwich's Inland Wetland and Watercourses Agency ("IWWA")) would be surrounded by appropriate erosion and sedimentation control measures to protect those resources. (Eversource 11, pp. 4-5)

342. There would be no permanent or temporary, direct or indirect impacts on watercourses from the construction of the Project because these areas will be fully protected by erosion and sedimentation control measures. (Eversource 11, p. 5)

343. There is no potential risk to groundwater or surface water resources from fluids or other materials contained in the new equipment planned for Cos Cob Substation. (Eversource 11, p. 14)

344. The Project is consistent with local, state, and federal land use plans. (Eversource 1, p. J-10)

345. The Project is consistent with the future land use and planning objectives of the South Western Regional Planning Agency ("SWRPA). The SWRPA *Regional Plan of Conservation and Development 2006-2015* notes the inadequacy of southwestern Connecticut's electrical transmission grid, and encourages coordination between state and federal siting agencies to achieve a balance between the need for expanded services and preservation of the natural environment and community character. (Eversource 1, p. J-11)

346. Eversource has taken greater than 40 soil and water samples along the Preferred and Alternate Routes to obtain initial data with respect to quality and compatibility with the proposed Project. These samples were taken to assist Eversource and its engineers in preparing its preliminary engineering designs and developing a conceptual construction approach that would be in compliance with applicable regulations and permits. A Connecticut certified wetland scientist has also surveyed the Project area for the presence of wetlands. Wetland boundaries and locations will be used to mitigate and avoid potential effects. If the Project is approved, Eversource will take additional samples at the location of the new substation and along the route of the transmission lines to refine this analysis. (Eversource 27, Q-PANTRY-007; Eversource 37, Q-PANTRY-009)

347. At the proposed Cos Cob Substation expansion, there are 4 proposed soil borings. Percolation tests would be performed on all the proposed borings. (Eversource 37, Q-PANTRY-008)

348. Along the preferred 115-kV underground HPFF route, there are 3 proposed soil borings, two of which include installation of water monitoring wells, with the third to have the soil samples taken for geothermal testing. (Eversource 37, Q-PANTRY-008)

349. Close to the proposed Greenwich Substation, there are 9 proposed soil borings. Percolation tests will be performed on 6 of them. (Eversource 37, Q-PANTRY-008)

350. No portion of the Proposed Site, Cos Cob Substation, or the Preferred Route is located within any aquifer protection area. (Eversource 11, p. 13)

351. The temporary noise increase in construction-related noise associated with the Project could potentially raise localized ambient sound levels near work sites. (Eversource 1, p. J-12)

352. There are no impacts to air quality expected from the operation of the Project facilities. Any potential impacts to air quality associated with the Project would be short-term and localized, primarily from fugitive dust during some construction activities and from equipment emissions. (Eversource 11, p. 13)

353. Eversource plans to minimize fugitive dust from construction by minimizing exposed/disturbed areas, installing gravel tracking pads at construction vehicle ingress/egress, and using water to wet down disturbed soils or work areas with heavy tracking as needed. (Eversource 11, p. 13)

354. Equipment in the GIS building would contain the insulating gas, sulfur hexafluoride ("SF6"). Since the 1950s, the U.S. electric power industry has used SF6 widely to manage the high voltages carried between generating stations and customer load centers. Eversource has had long experience with

managing the potential for SF6 releases from its GIS equipment and does not anticipate any impacts to air quality as a result of its use of the proposed GIS equipment at the Greenwich Substation. (Eversource 31, Q-OCC-033)

355. No permanent adverse impacts are anticipated to scenic and recreational areas, statutory facilities or surrounding features identified in the application. Some temporary effects would occur, such as during earth work activities; however, all disturbed areas would be restored. (Eversource 11, p. 13)

356. The power transformers within the Greenwich Substation will be installed on foundations and each transformer will have insulating fluid that does not contain PCBs. Secondary containment will surround each transformer, designed to hold 110% of an insulating fluid capacity of the transformer. The containment area would be periodically inspected. (Eversource 11, pp. 8, 14; Eversource 25, pp. 8, 13)

357. The pump house will have secondary containment and a monitoring system to trigger an alarm if the fluid level reaches a prescribed level. (Eversource 11, p. 8)

358. If HPFF pipe type underground cables are used for this Project, the pipe type cables would consist of three 8-inch steel pipes, installed in a trench encased in low-strength concrete slurry and capped by a protective layer of high-strength concrete. (Eversource 11, p. 8)

359. Any potential impact to tidal ponds and associated fish and wildlife found in Bruce Park could be avoided by siting the proposed transmission line along the Hybrid Route. (Transcript 7, p. 118)

360. Generally, the environmental impacts to Bruce Park identified in the application would be avoided by use of the Hybrid Route. (Transcript 7, p. 119)

Electric and Magnetic Fields

361. Electric fields (EF) and magnetic fields (MF) are two forms of energy that surround an electrical device. Transmission lines are a source of both EF and MF. (Eversource 1, Appendix G.1, p. 1 of 12)

362. Electric fields result from voltages applied to electrical conductors and equipment. They are expressed in measurement units of volts per meter (V/m) or kilovolts per meter (kV/m). Appliances within homes and the workplace are the major sources of electric fields indoors, and power lines are the major sources of electric fields outdoors. (Eversource 1, p. M-1; Eversource 9, p. 44)

363. Magnetic fields are produced by the flow of electric currents. The level of a magnetic field is commonly expressed as magnetic flux density in units called gauss (G), or in milliGauss (mG). The magnetic field level at any point depends on characteristics of the source, which can include the arrangement of conductors, the amount of current flow through the source, and its distance from the point of measurement. (Eversource 1, pp. M-1 – 2; Eversource 9, p. 44)

364. EF and MF are collectively known as "EMF". (Eversource 9, p. 44)

365. In the United States, no state or federal exposure standards for 60-Hz MF based on demonstrated health effects have been established. There are no such standards established world-wide. However, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) has

established a level of 2,000 mG, based on extrapolation from scientific experimentation, and the International Committee on Electromagnetic Safety (ICES) has calculated a guideline of 9,040 mG for exposure to workers and the general public. (Eversource 1, Appendix G.1, p. 3 of 12; Council Administrative Notice No. 1)

366. Projected MF levels for the Project are well below these guideline levels. (Eversource 1, Appendix G.3, Table 1; Eversource 9, p. 52; Eversource 26, pp. 4-5)

367. In February 2014, the Council revised its "Electric and Magnetic Field Best Management Practices for Transmission Lines in Connecticut" ("BMP"), originally issued in 1993. The Council's EMF BMP provides precautionary guidelines to ensure a proposed transmission line would not pose an undue safety or health hazard to persons or property. (Eversource 1, p. M-5)

368. The major sources of EMF associated with Eversource's proposed Project are the proposed underground transmission supply lines and existing overhead and underground distribution lines nearby. (Eversource 1, p. M-7)

369. There would be no measurable EF from the HPFF cables that would comprise the transmission lines. The HPFF cables are contained within the sheaths of the individual cables so that EF outside the cables will be zero. (Eversource 9, p. 47)

370. Spot measurements of MF were taken by Eversource on March 3, 2015 at selected locations along the Preferred Route. The measurements were taken walking across Arch Street. The measurements are shown in the table below.

MF Levels - Arch Street (milliGauss, mG)

Maximum	Average	Median
2.96	1.91	1.92

(Eversource 1, p. M-10; Eversource 9, p. 47)

371. Measurements of MF were also taken at the affected Substation properties. The table below summarizes the results of the March 3, 2015 measurements taken at Cos Cob Substation.

MF Levels - Cos Cob S/S (milliGauss, mG)

Maximum	Average	Median
12.24	8.74	8.06

(Eversource 1, p. M-9; Eversource 9, p. 48)

372. The table below summarizes the results of the March 3, 2015 measurements taken at the proposed Greenwich Substation. Nearby sources of MF include overhead and underground distribution lines entering Prospect Substation.

MF Levels - Greenwich S/S (milliGauss, mG)

Maximum	Average	Median
26.64	8.17	6.03

(Eversource 1, p. M-12; Eversource 9, p. 48)

373. On July 15, 2015, Eversource submitted revised figures for the magnetic fields from the proposed transmission lines. The highest field would occur directly above the center of the trench and would have a value of 0.52 mG during average annual loads. The minimum measured magnetic field from the field visits on March 3, 2015 was 0.52 mG in the vicinity of the Proposed Site. (Eversource 2; Eversource 9, p. 45)

374. To calculate the MF estimates along the Preferred Route, Eversource estimated (a) annual peak load ("APL") conservatively from ISO-NE's projected 90/10 system peak loads, (b) peak-day average loads ("PDAL") over 24 hours at 85% of the system's hourly peak load (based on the 90/10 peak-load days) and (c) annual average loads ("AAL") based on the projected annual hourly average loads. (Eversource 2; Eversource 9, p. 49)

375. The MF calculations will yield conservatively high estimates. (Eversource 9, p. 50)

376. Transformers and other equipment within the Cos Cob and the proposed Greenwich Substations are also potential EMF sources, but they would cause little or no exposure to the general public because the strength of fields from equipment inside a typical substation decreases rapidly with distance, reaching very low levels at relatively short distances beyond substation perimeter fences, if at all. Eversource 1, p. M-7; Eversource 9, pp. 44, 46-47)

377. The exception to the normally low levels of EMF associated with substations is where transmission and distribution lines enter the substation. (Eversource 1, p. M-7; Eversource 23, Q-FPET-001)

378. The fields from the proposed substation based equipment (bus work, transformers and switchgear) and the transmission lines will produce magnetic fields of the following levels:

- At the North and South property boundaries, the MF will be at or below 1 mG.
- At the East and West edges of the property, the MF will be at or below 2 mG and will drop to below 1mG within 30 feet of the property line.
- The contribution of the substation equipment and the transmission line at the nearby buildings would be less than 1 mG.

(Eversource 23, Q-FPET-001)

379. At the buildings on 280 Railroad Avenue, the MF from the transmission lines would be less than 0.1 mG. At this point, MF would be dominated by other more local sources of MF such as the service lines to the building, wiring within the building, and appliances within the building. (Eversource 22, Q-CHIRO-006)

380. For overhead portions of the transmission line along the Hybrid Route, the maximum MF will be 6.5 mG underneath the line. The MF at the edge of the ROW for the overhead line that is nearest residents would be less than 1 mG. Ten feet from the center of the underground line, which would be an XLPE cable, the MF will be 1 mG or less. These figures are based on average annual load. (Transcript 4, p. 129; Transcript 7, pp. 143-144)

381. Per the Council's BMP, utilities are encouraged to determine whether special circumstances warrant additional costs to achieve further MF mitigation for underground lines. Because Eversource proposes the transmission supply lines to be constructed with HPFF technology ("pipe-type cable"), the fields are reduced with cable proximity and the material characteristics of steel

pipe. Calculated MF levels would be less than 0.6 mG for average annual load conditions. (Eversource 9, p. 45)

382. Based on the magnetic field level anticipated from the proposed transmission supply lines, Eversource concluded that the Project does not create any special circumstances that require Eversource to achieve further magnetic field mitigation. (Eversource 9, p. 46)

383. Along the Preferred Route, there are no adjacent public or private schools, licensed child day-care facilities, or licensed youth camps. (Eversource 9, p. 51)

384. There are public playgrounds adjacent to the Preferred Route; the Preferred Route originates in Cos Cob Park and passes through Bruce Park. (Eversource 9, p. 51)

385. Eversource retained scientists at Exponent, Inc. ("Exponent") to perform an analysis of new developments in scientific knowledge concerning potential health effects of MF or position changes regarding MF in Eversource's application. Exponent concluded that no recent studies provide evidence to alter the conclusion that the scientific evidence does not confirm that EMF exposure is the cause of cancer or any other disease process at the levels we encounter in our everyday environment. (Eversource 1, Appendix G.3; Eversource 9, p. 46; Eversource 26, pp. 2-3)

386. Exponent concluded that the extremely low frequency ("ELF") magnetic field associated with the operation of the proposed substations and transmission lines in the Project, at the edges of the right-of-way and beyond, and at the boundaries of the substations is expected to be within the range commonly encountered from other sources, and below applicable limits in guidelines designed to protect public health. Neither Exponent's review of the relevant scientific literature nor the health risk assessments and evaluations conducted by expert panels on behalf of scientific and health agencies confirmed the existence of any adverse effects at exposure levels that are expected to be associated with the Project, and that would predict any likely adverse impact on public health. (Eversource 26, pp. 9-10)

387. A Field Management Design Plan ("FMDP") is not needed because the Project does not create any special circumstances that require Eversource to achieve further MF mitigation. (Eversource 9, p. 51)

388. Eversource has complied with the statutory and the BMP requirements regarding EMF, as follows:

- Eversource has provided an update of scientific research and group positions re: MF; and
- Eversource has provided measurements and calculations that were developed in accordance with the BMP.

(Eversource 9, pp. 51-52)

Cost

Summary of Costs

389. The estimated capital costs for the engineering, design and construction of the Project, including the Greenwich Substation, transmission lines and Cos Cob Substation modifications is approximately $140 million. Of this amount, the transmission lines account for $72 million and the new Substation

and distribution modifications to Cos Cob Substation account for $68 million. (Eversource 1, p. ES-11, G-23; Eversource 9, pp. 29, 57)

390. The $140 million Project cost includes additional reclosers and more effective circuit sectionalizing. These are the same type of investments that are part of Eversource's storm hardening program, although they are not technically storm hardening. They are included as part of the Cos Cob and North Greenwich Substation upgrades to interconnect the proposed substation, and the same methodology, same practices and same benefits will result. (Transcript 7, pp. 75-76)

391. The Con Edison proposals for electrical upgrades in Brooklyn reflect that 41 megawatts of customer side nontraditional solutions would be approximately $150 million, or approximately $3.7 million per megawatt. The 11 megawatts of utility-side nontraditional solutions are estimated at $50 million, or approximately $4.5 million per megawatt. The Con Edison project defers the need for a new substation by five years at a cost of $200 million. The Project proposed by Eversource is just over $1 million per megawatt. (Transcript 3, pp. 179-180)

392. For the Preferred Route, estimated construction cost breakdowns and distances for pipe jacking and HDD are as follows:

- Pipe jacking underneath the MNRR near Cos Cob Substation: approximately $2 million for a length of 100 feet
- HDD under MNRR and I-95: approximately $9.7 million for a length of 1,730 feet
- HDD under Bruce Park and its water bodies: approximately $9.3 million for a length of 1,670 feet

(Eversource 15, Q-OCC-003)

393. The estimated cost difference between the proposed façade in the Project application and Eversource's original concrete panel design is approximately $340,000. (Eversource 15, Q-OCC-003)

394. The estimated cost of building 2,500 feet of an underground double circuit 115-kV XLPE transmission getaway with no vaults from Cos Cob Substation to Indian Field Road along the Preferred Route is approximately $19.5 million, compared to $12.7 million using overhead construction. (Eversource 40, Q-CSC-001)

395. The estimated cost of building an underground double circuit 115-kV HPFF transmission line from Indian Field Road to Morningside Drive, staying within the roadways, to the end of Circle Drive for Segments 1 and 2 of the Preferred Route is approximately $38.1 million; overhead construction along the same route would cost approximately $21.9 million. (Eversource 40, Q-CSC-001)

396. The estimated cost of building an underground double circuit 115-kV HPFF transmission line from Indian Field Road, crossing private properties, to the end of Circle Drive for Segments 1 and 2 of the Preferred Route is $34.9 million; overhead construction along the same route would cost approximately $21.9 million. (Eversource 40, Q-CSC-001)

397. The cost of the Overhead Central Route through private property (27 easements, 70 acquisitions) would be approximately $299 million. (Eversource 36, Q-OCC-053)

398. In an effort to reduce overall costs of the transmission lines, Eversource evaluated the Hybrid Route which includes an underground getaway route from the proposed Greenwich Substation to the riser structures located at Steamboat Road. Because of its relatively short distance (approximately 2,400 feet), this underground variation would not require any splice vaults. The estimated cost for this hybrid transmission line route would be approximately $50 million, or approximately $22 million less than the estimated cost of the transmission lines along the Preferred Route. (Eversource 34, Q-LF-003)

399. The lowest cost route from the Hybrid Solution would include Segment 1A, Segment 2B, Segment 3B and Segment 4B, at a total estimated cost of $49.2 million. (Eversource 34, Q-LF-003)

Allocation of Costs

400. Eversource expects approximately $12 million of the estimated costs for the transmission facility to be regionalized. However, ISO-New England will make the final determination. (Eversource 9, p. 29; Transcript 1, pp. 60-61)

401. The costs of the Project are recovered through two Federal Energy Regulatory Commission ("FERC") tariffs and Connecticut Department of Energy and Environmental Protection ("CT DEEP") based rates. For the Project's transmission equipment within the FERC jurisdiction, the two FERC transmission tariffs are Regional Network System ("RNS") rate or Schedule 1 and the Local Network System ("LNS") rate or Schedule 21 Category A. Connecticut's electricity customers would pay approximately 25% of the costs that would be regionalized based on 2014 data. In addition, Connecticut's electricity customers would pay approximately 64% of the costs under the LNS rates. Lastly, the distribution costs are only borne 100% by Eversource's Connecticut customers. (Eversource 9, pp. 29-30)

402. The LNS rates are calculated in accordance with the formula contained in Schedule 21-NU, Attachment NU-H of the ISO-NE Transmission, Markets and Services Tariff. This tariff has been approved by FERC. (Eversource 24, Q-OCC-019)

403. The estimated annual transmission cost of the Project is calculated using a Carrying Charge Factor ("CCF") based on 2014 actual data of approximately 15%. Applying this CCF to the total estimated transmission costs of $119 million equates to approximately $18 million in annual transmission revenue requirements. (Eversource 15, Q-OCC-004)

404. The estimated annual distribution cost is calculated using a Revenue Requirement Factor ("RRF") of approximately 17%. Applying this RRF to the total estimated distribution costs of $21 million equates to approximately $3.6 million in annual distribution revenue requirements. (Eversource 15, Q-OCC-004)

405. CL&P ratepayers' share of the estimated annual transmission revenue requirement is approximately $10.2 million. This represents CL&P's load ratio share for the PTF and non-PTF costs of the project. The estimated distribution revenue requirement for CL&P ratepayers is $3.6 million. (Eversource 42, Q-OCC-066)

Project Timetable

406. The anticipated timetable for construction is Fourth Quarter 2016 – Second Quarter 2018. (Eversource 1, pp. ES-11, E-21; Eversource 9, p. 30)

407. The new Greenwich Substation and transmission supply lines should be placed in service as soon as possible to reduce the risk of customer outages and equipment failures. (Eversource 1, p. E-21)

408. The tentative in-service date for the Project is Second Quarter 2018. (Eversource 1, p. E-21)

Safety and Security

409. The Project facilities and equipment would not pose a safety threat or create any undue hazard to the general public, including persons or property. All work would be designed in accordance with sound engineering practices and constructed in full compliance with the standards of the National Electrical Safety Code ("NESC") and good utility practices. (Eversource 1, J-17; Eversource 9, p. 52)

410. If an outage or fault occurred on the transmission or substation equipment, protective relaying equipment would automatically detect abnormal system conditions and would send a protective trip signal to the respective circuit breakers to isolate the faulted section of the transmission system. The protective relaying schemes include fully redundant primary and back up equipment. (Eversource 1, pp. J-17, L-1; Eversource 9, pp. 52-53)

411. The access drive to the proposed Greenwich Substation would be gated, and the perimeter of the Substation would be enclosed by an eight-foot high fence to discourage unauthorized entry and/or vandalism. The entrance would be gated and locked. (Eversource 1, pp. J-17, L-2)

412. All gates would be padlocked at the end of the workday during the construction phase and at all times after the Project is completed. (Eversource 1, p. L-2)

413. Appropriate signage would be posted at the Greenwich Substation alerting the general public of high voltage facilities located within the Substation. (Eversource 1, p. J-17)

414. Similar to existing conditions, the perimeter of the Cos Cob Substation expansion area would be enclosed by a fence to discourage unauthorized entry or vandalism. The Substation entrance would continue to be gated and locked. (Eversource 1, p. J-18)

415. The physical security of the proposed facilities would be consistent with the Council's *White Paper on the Security of Siting Energy Facilities*, as amended, initially adopted in the Council's Docket 346 ("White Paper"). (Eversource 1, p. L-2)

416. Protection would also be provided by a Supervisory Control and Data Acquisition System ("SCADA"). The SCADA system allows for remote control and equipment monitoring by the Connecticut Valley Electric Exchange ("CONVEX") System Operator. (Eversource 1, p. J-18; Eversource 9, p. 53)

417. Eversource incorporates Institute of Electrical and Electronics Engineers ("IEEE"), American National Standards Institute ("ANSI") and National Fire Protection Association ("NFPA") standards for fire protection in its substation design and operates these facilities to minimize the impact of fire, in the unlikely event that a fire at the substation should occur. These standards include fire stopping, fire separations, equipment-spacing, use of non-combustible construction materials, use of low-flame-spread/low-smoke-development rated materials and substation grading. (Eversource 1, p. J-18; Eversource 25, pp. 7-8)

418. Smoke detection systems would automatically activate an alarm at CONVEX and the system operators would then take appropriate action. Additionally, the relay/control enclosure at the Greenwich Substation will be equipped with fire extinguishers; Cos Cob Substation is presently equipped with fire extinguishers. (Eversource 1, p. L-1; Eversource 9, p. 53; Eversource 25, p. 8)

419. Nearby Eversource electricians would be dispatched to make the area safe in case of a fire. They would de-energize the necessary equipment under the direction of the system operator to allow the firefighters to extinguish the fire. (Transcript 3, pp. 21-22; Eversource 25, p. 8; Eversource 37, Q-PANTRY-007)

420. Eversource's substations are intrinsically safe. Fire would be contained inside the fenced area. (Transcript 3, p. 21)

421. Municipal emergency responders are specifically trained to wait for Eversource employees to make the scene safe. (Transcript 3, p. 22)

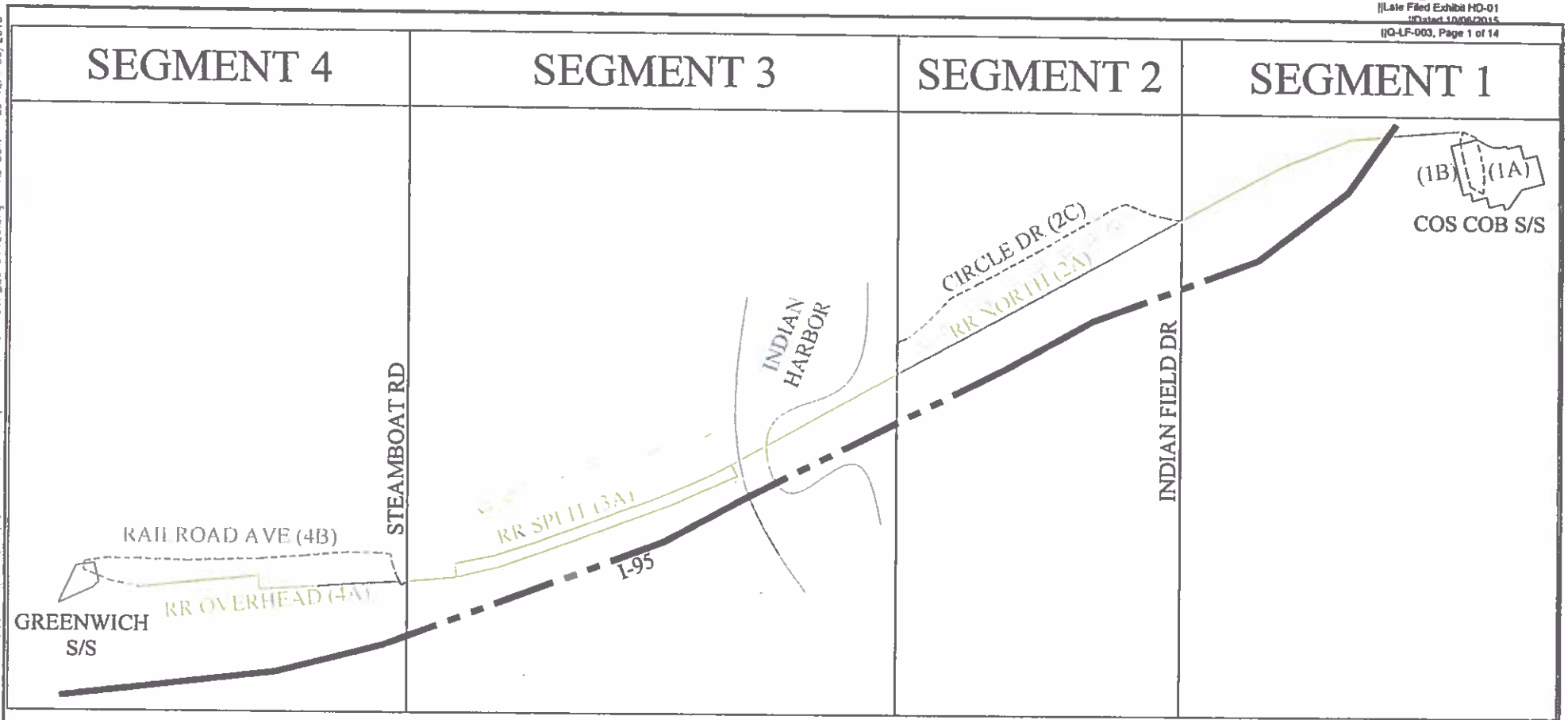
422. The offices for the personnel responsible for Greenwich substations are located at Eversource's Norwalk Work Center. Additional resources are available at Eversource's Stamford and Norwalk work centers, which would allow response to multiple emergencies. Depending on traffic, it would take approximately 15-30 minutes to arrive at the site. (Eversource 37, Q-PANTRY-007)

423. In the case of the release of transformer oil, the focus would be on containment and spill response; a contractor or group would be brought in to complete the cleanup. (Transcript 3, p. 22)

424. Eversource will require its contractor to have a Contingency and Emergency Response Plan for the Town of Greenwich under which the contractor would mobilize labor, materials, tools, and equipment to respond to and appropriately remedy a breach of the Town's sanitary sewer system, if it should occur. (Eversource 25, p. 9)

425. Steel trench cover plates with size of 8 feet long x 4 feet wide and 1 inch thick or thicker will be used to cover excavations. Message boards, barrels and traffic roll up signs and stands will be used to help ensure the protection and safety of the public. (Eversource 27, Q-PANTRY-008)

APPENDIX A



EVERSOURCE ENERGY

FACILITY
GREENWICH TRANSMISSION LINE OPTIONS
SEGMENT MAP
GREENWICH, CT

DR CPS	CHK	APP CPS	APP
DATE 11/19/2015	DWG	DATE 11/19/2015	DWG
H-SCALE N.T.S.	SIZE B	FIELD BOOK # PAGES	
V-SCALE N.T.S.	F.S.	E.C. DWG	
W.C. PROJ NUMBER		DWG NO GREEN OH OPTIONS	

N

LEGEND

PROPOSED CENTERLINE – UNDERGROUND ROUTE

PROPOSED CENTERLINE – OVERHEAD RR ROUTE

PARCEL BOUNDARY

PROPOSED EASEMENT BOUNDARY

SCALE

0 50 100 200 400

Cornerstone Energy Services

EVERSOURCE ENERGY

PROPOSED POWER LINE ROUTE FROM
COS COB SUBSTATION TO GREENWICH SUBSTATION
"SEGMENT 1A ROUTE"

SCALE: 1" = 200'	PAGE 1 OF 1	DATE: 11/20/2015

N

LEGEND

PROPOSED CENTERLINE – OVERHEAD RR ROUTE

PARCEL BOUNDARY

PROPOSED EASEMENT BOUNDARY

SCALE

0 50 100 200 400

Cornerstone Energy Services

EVERSOURCE ENERGY

PROPOSED POWER LINE ROUTE FROM
COS COB SUBSTATION TO GREENWICH SUBSTATION
"SEGMENT 2B ROUTE"

SCALE: 1" = 200'	PAGE 1 OF 1	DATE: 11/20/2015

N

LEGEND

PROPOSED CENTERLINE – OVERHEAD RR ROUTE

SCALE
0 75 150 300 600

Cornerstone Energy Services

EVERSOURCE ENERGY

PROPOSED POWER LINE ROUTE FROM
COS COB SUBSTATION TO GREENWICH SUBSTATION
"SEGMENT 3B ROUTE"

SCALE: 1" = 300'	PAGE 1 OF 1	DATE: 11/20/2015

N

LEGEND

PROPOSED CENTERLINE – UNDERGROUND ROUTE

PROPOSED EASEMENT BOUNDARY

SCALE

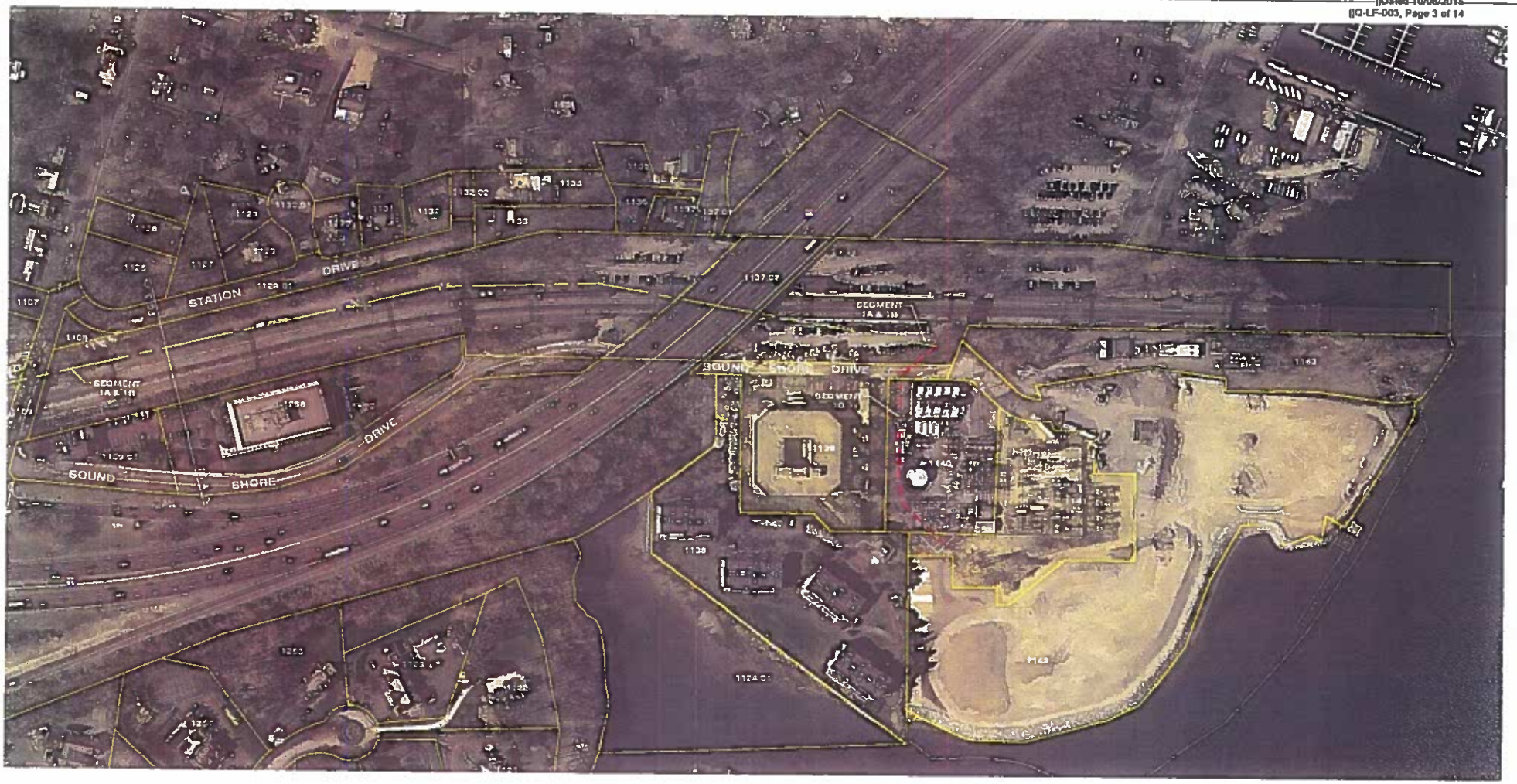
0 50 100 200 400

Cornerstone Energy Services

EVERSOURCE ENERGY

PROPOSED POWER LINE ROUTE FROM
COS COB SUBSTATION TO GREENWICH SUBSTATION
"SEGMENT 4B ROUTE"

SCALE: 1" = 200'	PAGE 1 OF 1	DATE: 11/20/2015



N

LEGEND

PROPOSED CENTERLINE – UNDERGROUND ROUTE

PROPOSED CENTERLINE – OVERHEAD RR ROUTE

PARCEL BOUNDARY

PROPOSED EASEMENT BOUNDARY

SCALE

0 50 100 200 400

Cornerstone Energy Services

EVERSOURCE ENERGY

PROPOSED POWER LINE ROUTE FROM
COS COB SUBSTATION TO GREENWICH SUBSTATION
"SEGMENT 1B ROUTE"

SCALE: 1" = 200'	PAGE 1 OF 1	DATE: 11/20/2015