Transmission Developers Inc.

January 25, 2010

Via Overnight Delivery

January 25, 2010

Anthony Como
Director, Permitting and Siting
U.S. Department of Energy
1000 Independence Avenue SW
Room 6H-050, OE-20
Washington, D.C. 20585

SUBJECT: Champlain Hudson Power Express HVDC Transmission Project Application for a Presidential Permit

Dear Mr. Como:

On behalf of Champlain Hudson Power Express Inc. (CHPEI or the Applicant), Transmission Developers Inc. (TDI) hereby files the enclosed application for a Presidential Permit with the U.S. Department of Energy (DOE). As described in the application, CHPEI proposes to develop the Champlain Hudson Power Express Project (Project) to connect renewable sources of power generation in central and eastern Canada with load centers in and around the New York City and southwestern Connecticut regions. The proposed Project will include underwater and underground, high-voltage direct current (HVDC) transmission cables connecting HVDC converter stations in Canada with HVDC converter stations in Yonkers, New York, and Bridgeport, Connecticut. To the extent possible, CHPEI proposes to install the transmission cables along existing waterways to minimize overland transportation routes. CHPEI believes that this innovative approach will minimize the visual and landscape impacts associated with traditional overhead transmission lines, while simultaneously providing the critical capacity required to meet the increasing clean energy demands of the greater New York City metropolitan area and State of Connecticut.

The proposed Project is a 2,000-megawatt (MW) HVDC Voltage Source Converter controllable transmission system, comprising two 1,000-MW HVDC bipoles. Each of these two bipoles includes two submarine or underground cables connected as a bipole pair. At the international boundary, the Project will link with a system having identical technical characteristics and originating at an HVDC converter station near Hydro-Québec TransÉnergie's 765/315-kilovolt (kV) Hertel substation, located southeast of Montreal. The proposed transmission cables will follow an overland route before entering the Richelieu River and travelling upstream to the border between the United States and Canada.

South of the international boundary, the submarine transmission cables will continue through Lake Champlain and travel south to the northern entrance of the Champlain Canal, near Whitehall, New York. To the extent practicable, the submerged cables will continue through the Champlain Canal to Fort Edward, where the canal joins the Hudson River. While the Applicant intends to minimize overland sections of the Project, existing infrastructure and ongoing remediation activities along the Project's proposed route will require limited sections of the HVDC transmission cables to be installed on land. CHPEI expects that an overland bypass will be necessary to circumvent Lock C12 at Whitehall and Lock C11 Fort Ann. These bypass sections will likely extend for a combined distance of approximately 2.1 miles along an existing railroad right-of-way (ROW). The cables will also use 0.5 mile-long overland route to bypass Lock C9, and an overland bypass will be necessary north of the Champlain Canal/Hudson River confluence to avoid activities associated with the Hudson River Polychlorinated Biphenyls Dredging Project. Accordingly, the transmission cables will exit the Champlain Canal near Lock C8 and the cables will be buried within a railroad ROW for a distance of approximately 69.9 miles. The cables will re-enter the Hudson River near the Town of Coeymans, downstream from the City of Albany. South of Coeymans, the proposed alignment follows the Hudson River to the New York City metropolitan area.

Two cables (one bipole) will terminate approximately 318.7 miles south of U.S./Canadian border at an HVDC converter station near Wells Avenue in Yonkers, New York. The remaining two cables will continue along the Hudson River to the entrance of Spuyten Duyvil Creek. The cables will then follow a 65.8-mile-long route through Spuyten Duyvil Creek, the Harlem River, and the East River into Long Island Sound before terminating at a converter station near 1 W Avenue in Bridgeport, Connecticut. Submarine or underground alternating current (AC) cables will transmit electricity from the HVDC converter stations to substations connected to the electrical grid.

The 384.5-mile-long section of the Project located within the United States will be owned and operated by the Applicant. However, the Applicant will not own or operate any transmission infrastructure in Canada; instead, CHPEI will work with Hydro-Quebec's transmission arm, TransÉnergie, to link the Project to a connecting transmission line north of the international border.

The Applicant believes that construction and operation of the Project will supply additional capacity while providing economic and environmental benefits to the region. As proposed, the Project would utilize competitively priced renewable sources of energy and would not contribute to emissions of particulate matter or greenhouse gasses in New York City or Bridgeport. Construction of the Project would also reduce regional dependence on imported oil and domestic natural gas. Disruptions in the supply of these fossil fuels have previously had significant and widespread economic impacts on generating facilities serving the New York City metropolitan area. The additional capacity provided by the Project would also place downward pressure on the price of electricity and would have an estimated annual energy cost-savings to New York City consumers of over $1.3 billion over the life of the Project.

In accordance with Executive Order 10485, as amended by Executive Order 12038, CHPEI is applying to the DOE for a Presidential Permit authorizing the construction, operation, maintenance, and connection of facilities for the transmission of electric energy at the international border between the United States and Canada. The enclosed application has been prepared in accordance with the DOE's applicable administrative procedures at 10 CFR § 205.320 *et. seq*. The required $150 application filing fee has also been enclosed with this submittal.

I look forward to working with your office as we proceed with this exciting Project, and I welcome the opportunity to discuss this matter with you at any time. Should you have any additional questions or comments regarding this application, please contact me at (416) 214-0018 or via e-mail at Donald.Jessome@transmissiondevelopers.com.

Very truly yours,

Donald Jessome
President and CEO
Transmission Developers Inc.

Enls.

cc: W. Helmer (TDI)
T. Turner (TDI)

CHAMPLAIN HUDSON POWER EXPRESS HVDC TRANSMISSION PROJECT

PRESIDENTIAL PERMIT APPLICATION

Prepared for:
Transmission Developers Inc.
on behalf of
CHAMPLAIN HUDSON POWER EXPRESS, INC.
Toronto, Ontario

JANUARY 2010

CHAMPLAIN HUDSON POWER EXPRESS
HVDC TRANSMISSION PROJECT
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Acronym List

AC	alternating current
Canal Corp	New York State Canal Corporation
Canal System	New York State Canal System
CHPEI or Applicant	Champlain Hudson Power Express, Inc.
COD	commercial operation date
ConEd	Consolidated Edison
COTP	Captain of the Port
CSO	combined sewer overflow
CTDEP	Connecticut Department of Environmental Protection
CWA	Clean Water Act
DC	direct current
DO	dissolved oxygen
DOE	U.S. Department of Energy
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMF	electromagnetic field
EMI	electromagnetic interference
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Map
GIS	geographic information system
HAA	Hartgen Archaeological Associates, Inc.
HDD	horizontal directional drilling
HVDC	high-voltage direct current
IPNPS	Indian Point Nuclear Power Station
Joint Management Team	Joint New York State Department of Environmental Conservation / Stony Brook University Flax Pond Unit Management Plan Development Team
kg	kilogram

kV..kilovolt
LCMM ....Lake Champlain Maritime Museum
LCRC ....Lake Champlain Research Consortium
LHG ....liquefied hazardous gas
LPC ....Landmarks Preservation Commission
LPFF ....Low-pressure Fluid-Filled
mg/L..milligrams per liter
MIND..Mass-impregnated, non-draining
MPA..marine protected area
MW ....megawatt
NAD..North American Datum
National Register ....National Register of Historic Places
NE-ISO ....New England Independent System Operator
NEPA ....National Environmental Policy Act of 1969
NGO..non-governmental organizations
NMFS..National Marine Fisheries Service
NOAA ....National Oceanic and Atmospheric Administration
NPS ....National Park Service
NRCS ....Natural Resources Conservation Service
NRE...National Resources Energy, LLC
NWI...National Wetlands Inventory
NYCDEP...New York City Department of Environmental Protection
NY-ISO...New York Independent System Operator
NYSDEC...New York State Department of Environmental Conservation
NYSDOS...New York State Department of State
OSI ....Ocean Surveys, Inc.
PCBs ....polychlorinated biphenyls
POD...Permitting Overview Document
Project ....Champlain Hudson Power Express Project
PVC...polyvinyl chloride

ROD ....Record of Decision
ROW ....right-of-way
SFHA ....Special Flood Hazard Area
SHPO ....State Historic Preservation Office
Southern Tier Board...........................Southern Tier Central Regional Planning and Development Board
T&E...threatened and endangered
TDI ....Transmission Developers Inc.
TUHC..TDI-USA Holdings Corporation
UI ....United Illuminating Company
USACE ....U.S. Army Corps of Engineers
USEPA..U.S. Environmental Protection Agency
USFWS ....U.S. Fish and Wildlife Service
USMA...United States Military Academy
VSC...voltage source converter
VTDEC ....Vermont Department of Environmental Conservation
VTFWD ....Vermont Fish and Wildlife Department
WI/PWL..Waterbody Inventory/Priority Waterbodies List
XLPE...cross-link polyethylene

UNITED STATES OF AMERICA

BEFORE THE DEPARTMENT OF ENERGY
OFFICE OF ELECTRICITY DELIVERY AND
ENERGY RELIABILITY

Champlain Hudson Power Express, Inc.

Docket No. PP-________

APPLICATION OF CHAMPLAIN HUDSON POWER EXPRESS, INC. FOR A PRESIDENTIAL PERMIT FOR THE CHAMPLAIN HUDSON POWER EXPRESS HVDC TRANSMISSION PROJECT

January 25, 2010

In accordance with Executive Order 10485, as amended by Executive Order 12038, Champlain Hudson Power Express, Inc. hereby applies to the United States Department of Energy for a Presidential Permit authorizing the construction, operation, maintenance, and connection of facilities for the transmission of electric energy at the international border between the United States and Canada. This application is made pursuant to the United States Department of Energy's applicable administrative procedures (10 CFR § 205.320 *et. seq.*).

Section 1
Information Regarding the Applicant

1.1 Legal Name of Applicant

Champlain Hudson Power Express, Inc. (CHPEI or the Applicant) is the Applicant for this Presidential Permit. CHPEI is a Transportation Corporation organized and existing pursuant to the Transportation Corporations Law of the State of New York. CHPEI has its principal place of business at 600 Broadway, Albany, New York 12207-2283.

CHPEI is a joint venture of TDI-USA Holdings Corporation (TUHC), a Delaware corporation, and National Resources Energy, LLC (NRE). TUHC, the majority shareholder in CHPEI, is a wholly owned subsidiary of Transmission Developers Inc. (TDI), a Canadian Corporation. NRE is a wholly owned subsidiary of National RE/sources Group, a limited liability corporation duly organized under the laws of the State of Connecticut.

1.2 Legal Name of All Partners

CHPEI is the sole Applicant for this Presidential Permit.

1.3 Communications and Correspondence

All communications and correspondence regarding this application should be addressed to:

Mr. Donald Jessome, President
Transmission Developers Inc.
Pieter Schuyler Building, 600 Broadway
Albany, New York 12207-2283
Phone: (416) 214-0018
Cellular: (902) 440-0664
Fax: (416) 352-1634
Email: donald.jessome@transmissiondevelopers.com

1.4 Foreign Ownership and Affiliations

Neither the Applicant nor its proposed transmission facilities are owned wholly or in part by any foreign government or instrumentality thereof.

The majority share of CHPEI is owned by TUHC. TUHC is a wholly owned subsidiary of TDI, a Canadian Corporation duly organized and existing pursuant to the Business Corporations Act of the Province of Ontario. Neither CHPEI nor any of its equity shareholders have any agreement pertaining to ownership by or assistance from any foreign government or instrumentality thereof.

1.5 List of Existing Contracts with Foreign Governments or Foreign Private Concerns Relating to the Purchase, Sale or Delivery of Electric Energy

The Applicant does not have any existing contracts with any foreign government or any foreign private concerns relating to the purchase, sale, or delivery of electric energy. CHPEI does not intend to apply for authorization to export electricity from the United States.

1.6 Opinion of Counsel

Appendix A includes a signed opinion of counsel attesting that the construction, connection, operation, and maintenance of the proposed Champlain Hudson Power Express Project is within the Applicant’s corporate powers and that CHPEI has complied with or will comply with all pertinent federal and state laws.

Section 2

Information Regarding the Proposed Transmission Facility

2.1 Project Overview

CHPEI proposes to develop the Champlain Hudson Power Express Project (Project) to connect renewable sources of power generation in central and eastern Canada with load centers in and around the New York City and southwestern Connecticut regions. The Project will include underwater and underground, high-voltage direct current (HVDC) transmission cables connecting HVDC converter stations in Canada with HVDC converter stations in Yonkers, New York, and Bridgeport, Connecticut. There will be no overhead transmission lines. To the extent possible, CHPEI proposes to install the transmission cables along existing waterways to minimize overland transportation routes. The Applicant believes that this innovative approach will minimize the visual and landscape impacts associated with traditional overhead transmission lines, while simultaneously providing the additional capacity required to meet the increasing clean energy demands of the greater New York City metropolitan area and State of Connecticut.

The proposed Project is a 2,000-megawatt (MW) HVDC Voltage Source Converter (VSC) controllable transmission system, comprising two 1,000-MW HVDC bipoles. Each of these two bipoles includes two submarine or underground cables connected as a bipole pair. Each bipole will at all times utilize its partner in the bipole pair as a metallic return. The ground will never be used as a return. In total, four cables will be laid between Quebec and the converter stations in New York City, where two will be terminated. The remaining two will continue to Bridgeport, Connecticut.

In Canada, the Project will originate at an HVDC converter station near Hydro-Québec TransÉnergie's 765/315-kilovolt (kV) Hertel substation, located southeast of Montreal. From the converter station, the transmission cables will traverse an overland route for a distance of approximately 13 miles to the Richelieu River. Submarine transmission cables will follow the Richelieu River nearly 22 miles south to the international border between the United States and Canada. South of the international boundary, the submarine transmission cables will continue through Lake Champlain and travel south to the northern entrance of the Champlain Canal, near

Whitehall, New York. To the extent practicable, the submerged cables will continue through the Champlain Canal to Fort Edward, where the canal joins the Hudson River. CHPEI expects that an overland bypass will be necessary to circumvent Lock C12 at Whitehall and Lock C11 Fort Ann. These bypass sections will likely extend for a combined total of approximately 2.1 miles along an existing railroad right-of-way (ROW). The cables will also use 0.5 mile-long overland route to bypass Lock C9, and an overland bypass will be necessary north of the Champlain Canal/Hudson River confluence to avoid activities associated with the Hudson River Polychlorinated Biphenyls (PCBs) Dredging Project, which occupies the Upper Hudson River. Accordingly, the transmission cables will exit the Champlain Canal near Lock C8 and the cables will be buried within a railroad ROW for a distance of approximately 69.9 miles. The cables will re-enter the Hudson River near the Town of Coeymans, downstream from the City of Albany. South of Coeymans, the proposed alignment follows the Hudson River to the New York City metropolitan area.

Two cables (one bipole) will terminate approximately 318.7 miles south of U.S./Canadian border at an HVDC converter station near Wells Avenue in Yonkers, New York. The remaining two cables will continue along the Hudson River to the entrance of Spuyten Duyvil Creek. The cables will then follow a 65.8-mile-long route through Spuyten Duyvil Creek, the Harlem River, and the East River into Long Island Sound before terminating at a converter station near 1 W Avenue in Bridgeport, Connecticut.

Submarine or underground alternating current (AC) cables will transmit electricity from the converter stations to substations connected to the electrical grid. From the Yonkers converter station, AC cables will re-enter the Hudson River and travel south along the East River, Spuyten Duyvil Creek, and the Harlem River for a distance of approximately 6.7 miles. The AC cables will terminate at the existing Consolidated Edison (ConEd) Sherman Creek/Academy substation, near the intersection of West 201st Street and 9th Street, in the Borough of Manhattan. From the Bridgeport converter station, AC cables will carry electricity a distance of approximately 150 feet to the existing Singer substation, owned and operated by the United Illuminating Company (UI).

The Project's precise final route is subject to a number of factors, including resource issues, permitting, land acquisition, and stakeholder agreement. A general map of the Project is presented in Appendix B of this application. A detailed map showing the physical location, longitude, and latitude of the proposed international border crossing is presented in Appendix C.

The 384.5-mile-long section of the Project located within the United States will be owned and operated by the Applicant. However, the Applicant will not own or operate any transmission infrastructure in Canada; instead, CHPEI will work with Hydro-Quebec's transmission arm, TransÉnergie, to link the Project to a connecting transmission line north of the international border. The Applicant is continuing ongoing consultation with TransÉnergie to finalize an agreement regarding the Canadian portion of the Project.

As proposed, the Project would utilize competitively priced renewable sources of energy and would not contribute to emissions of particulate matter or greenhouse gasses in New York City or Bridgeport. Construction of the Project would also reduce regional dependence on imported oil and domestic natural gas. Disruptions in the supply of these fossil fuels have previously had significant and widespread economic impacts on generating facilities serving the New York City metropolitan area.

The additional capacity provided by the Project would also place downward pressure on the price of electricity in the markets operated by the New York Independent System Operator (NY-ISO), and would have an estimated annual energy cost-savings to New York City consumers of over $1.3 billion over the life of the Project (London Economics International, LLC 2009).

CHPEI anticipates that the initial permitting phase of this Project will continue through the second quarter of 2011. Initial site preparation at the converter station sites is currently planned for early 2011, with major construction commencing in 2011. Installation of the HVDC cables is scheduled to be completed in three phases between 2012 and 2014. CHPEI anticipates a 2015 commercial operation date (COD) for the Project. The estimated total capital cost is approximately $3.8 billion.

2.2 Technical Description

As noted above, the Project will utilize HVDC VSC technology, such as the ABB HVDC Light™ or Siemens HVDC Plus™ technology, interconnected by HVDC cross-link polyethylene (XLPE) cables. Specific technical information regarding the proposed Project is presented below.

2.2.1 HVDC Cables

Cable Description

Each 1,000 MW HVDC bipole will be comprised of two cables, and each cable will have a fiber optic communication cable. CHPEI will use solid dielectric XLPE cables for this Project. The HVDC cables contain no insulating or cooling fluids, and their strength and flexibility make them well suited for submarine and terrestrial installation. In general, each cable is comprised of a 1,400 mm^2 copper conductor, conductor screen, insulation, insulation screen, lead sheath, steel armor, and outer serving.

The HVDC transmission cables use a triple-extruded, dry-cured polymer insulation system. Submarine cables include a polyethylene sheath extruded over a lead alloy sheath to provide superior mechanical and corrosion protection. A layer of tensile armor comprised of galvanized steel wires embedded in bitumen and laid in counter helix provides additional protection for submarine cables. The outer serving of the submarine cables will consist of an asphaltic compound with polypropylene reinforcement. For terrestrial cables, the outer sheathing will be an ultraviolet-stabilized, extruded polyethylene layer. The outside diameter of each proposed submarine HVDC transmission cable will be approximately 5 inches, and the cables will each have a weight of about 30 lb per ft. Terrestrial cables will have an outside diameter of approximately 4.5 inches, and each cable will have weight of about 20 lb per ft.

Occasional variations in the size of the conductor and diameter of the HVDC cables may be necessary along certain sections of the Project’s alignment. These required variations will be identified and detailed through the engineering design process.

Unlike traditional AC lines, DC cables are non-radiant and the buried cables have negligible fields (EMF) at ground level. The Project will have a nominal operating voltage of ±300 kV, but will periodically be operated at the maximum operating voltage of 350 kV.

Preliminary technical diagrams of the proposed HVDC cable design have been included in Appendix D of this application document.

Cable Installation

CHPEI intends to minimize the environmental impacts of the Project by installing the transmission cables within existing waterways. Analysis of similar HVDC cable projects has demonstrated that burying submarine cables minimizes unwanted cable movement and provides protection from external mechanical damage. Therefore, where feasible, the Applicant proposes to bury the submarine cables beneath the beds of the Lake Champlain, the Champlain Canal, the Hudson River, Spuyten Duyvil Creek, the Harlem River, and Long Island Sound. The Applicant intends to bury the submarine cables along the majority of the Project's proposed route at a depth of approximately 3 to 4 feet beneath the bed surface. Notwithstanding this approach, burial depths may vary in response to site-specific factors identified along the proposed route. These factors may include the presence of existing infrastructure, the identification of archaeological or historic resources, environmental concerns, or localized geological or topographical obstacles.

In certain instances, burial depths may also be dictated by federal agency specifications. In areas where the cables may cross federal navigation channels or anchorage areas, the cables will be buried according to the specifications of the U.S. Army Corps of Engineers (USACE). Current USACE guidelines provide a minimum burial depth of 15 feet below the authorized project depth (i.e., authorized depth of navigation channel). On a case-by-case basis, the USACE District Engineer may modify this depth requirement where circumstances are deemed appropriate. Burial depth may also vary at existing cable or pipeline crossings, at significant transitions in substrate type, or approach to landfall locations. In areas where the submarine cables cross existing infrastructure (i.e., cables, pipelines), the cables will generally be laid atop the existing infrastructure and protected by material placed over the cables. Protective materials may include concrete (i.e., rip rap, grout mattress) or other proven low impact protective armoring.

The transmission cables may also encounter “cable ferries” in Lake Champlain. These ferries use two parallel steel guidance cables that are lifted and carried by steel sheaves. The guidance cables rest along the bottom of the lake when not in use, and the cables are typically replaced every four years (Middlebury Vermont Community Network 2009). The Applicant proposes to temporarily remove the guidance cables from the lakebed so that the submarine transmission cables can be installed and buried. The guidance cables will then be replaced over the top of the power cables. Detailed coordination and discussions will be held with the owners/operators of these features to ensure the use of proper methodologies and scheduling.

In instances where the presence of surficial bedrock, existing infrastructure, or other bottom conditions does not permit burial, the cables will be laid on the bed and protected by material placed over the cables. Protective materials may include concrete (i.e., rip rap, grout mattress) or other proven low impact protective armoring.

It is anticipated that the vast majority of the cables will be buried using a proven low impact technique known as water-jetting. In areas where sediment conditions are such that water jetting cannot obtain the required depth of cable burial, a mechanical plow will be used. Both water-jetting and mechanical plowing displace seafloor sediment within a narrow trench, permitting the cables to sink under their own weight. This process allows the displaced sediment to naturally settle, backfilling the trench within a short time-period following cable installation.

Horizontal directional drilling (HDD) will be used to bore a conduit horizontally so that the cable may be pulled from the water at landing areas. In intertidal and shoreline areas, HDD is often preferred to open trenching because it does not expose the surface to wave action. As a result, HDD minimizes the suspension of sediment. The directional drill is expected to exit the water at a depth sufficient to avoid impacts to intertidal and foreshore habitat. HDD may also be used in special circumstances to avoid obstacles along the route.

Overland sections make up a relatively small portion of the Project’s overall route. In general, the transmission cable will be routed overland to avoid locks and dams along the Champlain Canal and to bypass dredging activities along the Upper Hudson River. The Applicant intends to use a combination of HDD and mechanical plowing to install the transmission cables along these overland sections.

The HVDC cables comprising each bipole will be installed approximately 3 feet apart along a majority of the Project's alignment. However, the Applicant intends to modify this cable spacing to facilitate a low probability future repair in deeper water. Cable repair at a water depth of 100 feet or more requires barges to raise the damaged portion to the surface to allow new cable material to be spliced in. Therefore, the cable spacing along sections of the Project route where water depths exceed 100 feet will be at a distance of approximately 20 feet, in order to facilitate access and repair operations.

The minimum ROW required for installation and operation of cables along the proposed overland sections of the Project will be 12 feet. This ROW is necessary to permit installation of the two bipoles without damage. The ROW will also facilitate any required maintenance along the overland section of the transmission system.

The minimum ROW required for installation and operation of the submarine cables will be dependant on the water depth. Details regarding the submarine cable ROW will be provided as a supplement to this application document.

2.2.2 Converter Stations[1]

The VSC systems utilize converter stations to rectify/invert AC power. The system utilizes fully controllable insulated gate bipolar transistors to achieve high operational speed and independent control of both active and reactive power. The reliable control of mixed active and reactive power can support the integrity of the grid during stressed conditions. The HVDC system also offers additional advantages, including voltage and frequency control of interconnected AC systems and black start capability.

The proposed converter stations have a modular design and require less space than conventional HVDC converters. This smaller footprint means that both of the Project's 3-acre converter station sites in the United States can be designed to blend into the local environment and surroundings. The indoor design of the converter stations limits the need for exterior equipment at the sites, including switchyards. CHPEI anticipates that only the transformers, cooling, and

[1] This Section is provided for informational purposes. The converter station in Yonkers will be located entirely within the State of New York. Similarly, the converter station in Bridgeport will be located entirely within the State of Connecticut.

power line carrier filters will be installed outside of the building. The indoor design also reduces audible sound and the risk of flashover. Preliminary technical diagrams of the proposed converter stations are presented in Appendix D of this application document.

2.3 Bulk Power System Information

Pursuant to the requirements of 10 CFR § 205.322(b)(3), the Applicant is providing the following bulk power supply information for this Project.

2.3.1 Expected Power Transfer Capability

The proposed maximum power transfer capability is 2,000 MW. The ultimate maximum capacity will be determined as the Project's design is finalized. In general, the power transfer capability is limited by the maximum thermal capacity of the proposed transmission line. The normal continuous capacity for each of the HVDC bipoles is approximately 1,000 MW. The estimated short-time (2-hour) emergency overload capability will be approximately 1,150 MW for each bipole.

2.3.2 System Power Flow

Federal regulations at 10 CFR § 205.322(b)(3)(ii) require CHPEI to provide system power flow plots for the Applicant's proposed service areas for heavy summer and light spring load periods, with and without the proposed international interconnection, for the year the line is scheduled to be placed in service and for the fifth year thereafter. CHPEI is currently conducting system studies of the transmission networks and energy markets administered by the NY-ISO and the New England Independent System Operator (NE-ISO). At the completion of these studies, CHPEI will provide the required system power flow plots as a supplement to this application document.

2.3.3 Interference Reduction Information

The proposed transmission cables will primarily follow existing waterways as they extend south from the international boundary between the United States and Canada. Where practicable, the Applicant proposes to bury the transmission cables beneath the beds of these waterways to prevent disturbance to the conductors. In instances where the Project is required to follow an overland route, CHPEI intends to bury the cables to avoid mechanical disturbance and minimize the impacts typically associated with overhead transmission lines.

The Applicant anticipates that the proposed HVDC technology and the installation methods will be sufficient to eliminate any potential television and/or radio electromagnetic interference (EMI) along the transmission corridor. The converter stations in Yonkers and Bridgeport will be designed to meet the requirements of local radio, television, and telephone EMI limits. Additional details regarding the features required to minimize EMI at the converter stations will be developed during the Project's detailed design phase. CHPEI will furnish this information as a supplement to this application document.

2.3.4 Description of the Relay Protection Scheme

The HVDC VSC system will allow the Project to integrate with Smart Grid goals and enabling technologies. By providing features for embedded applications in the AC grid, the HVDC VSC technology will enable better congestion management, facilitate more reliable integration of renewable energy sources, and provide an improved system dynamic response to disturbances (Pan et al. 2008). Phasor measurement units (PMUs) and associated time-aligned synchronizing technologies will be adapted into the Project's converter station design. These technologies will improve reliability and visibility through the measurement and control of the power system. The system will also be able to modulate power flows very quickly to stabilize the associated AC power systems as required by the power system operator. The voltage control capability of the VSC transmission system makes it possible to operate the grid closer to the upper limit, while reducing losses throughout the system.

The relay protection scheme will be designed in coordination with the NY-ISO, NE-ISO, ConEd, and UI. Details of this scheme will be developed during the detailed design phase of the Project. The Applicant will provide a description of the relay design scheme, including associated equipment and proposed functional devices, as a supplement to this application document.

2.3.5 System Stability Analysis

As provided in 10 CFR § 205.322(b)(3)(v), the U.S. Department of Energy (DOE) may require the Applicant to prepare a system stability analysis following the DOE's review of the power flow plots. If requested, CHPEI will furnish said analysis as a supplement to this application document.

Section 3
Information Regarding Potential Environmental Impacts

3.1 Introduction

The proposed Project will deliver up to 2,000 MW of renewable energy from sources in Canada to load centers in the New York City and Bridgeport, Connecticut. Early in the technical design process, CHPEI recognized the benefits of employing VSC HVDC technology to bridge the geographical gap between sources of renewable generation and regions where electrical demand is approaching critical levels. The HVDC system allows the applicant to utilize submarine cables to transmit electricity along existing waterways while avoiding many of the landscape impacts associated with conventional HVAC or HVDC overhead transmission lines.

Submarine transmission cables are generally sited to maximize the system's operational reliability while minimizing the costs and the potential environmental impacts of construction and operation. Cables must also be sited to avoid areas that could cause damage to the system or impede future maintenance activities. As a part of the feasibility and design process, CHPEI undertook a desktop survey of available information to develop a proposed route for the Project.

CHPEI prepared a pre-feasibility study and subsequent Permitting Overview Document (POD) to identify potential environmental impacts that may result from Project construction and operation. The POD compiled existing information and presented a preliminary analysis of potential Project impacts. The POD also included an outline of proposed studies designed to formally evaluate Project effects on a number of resources. As part of the siting and design process, CHPEI distributed the POD to resource agencies whose interests may potentially be affected by the Project, including federal and state resource agencies and non-governmental organizations (NGOs). Based on this consultation activity, CHPEI has initiated studies in several resource areas to collect additional data necessary to assess the potential environmental impacts of the Project. The Applicant will continue to consult with the DOE, federal and state resource agencies, NGOs, federally recognized Indian tribes, and other stakeholders to determine additional information required to assess the Project's environmental impacts.

The Applicant recognizes that the National Environmental Policy Act of 1969 (NEPA) requires the DOE to give due consideration to the environmental impacts associated with issuing a Presidential Permit. The DOE's implementing regulations at 10 CFR Part 1021 describe the agency's NEPA review process. This Project does not qualify for a categorical exemption and the Applicant understands that an Environmental Impact Statement (EIS) will very likely need to be completed. Pursuant to 10 CFR § 205.328, the Applicant intends to contract with an independent third-party consultant to prepare an EIS for this Project. CHPEI anticipates that additional field studies and data collection activities will be required to complete the development of an EIS for this Project.

While a formal NEPA scoping process will be necessary to solicit recommendations for studies, development of the POD and associated informal consultation activities have allowed the Applicant to identify several resource areas that may be impacted by the Project. Information regarding the Project's potential impact on each of these resource areas is presented in this Section.

3.2 Substrates

3.2.1 Environmental Setting

The type of substrate along the proposed submarine transmission corridor influences the cable design and installation methods, including the burial depth and protection requirements. The type of substrate may also influence the extent of the Project's environmental impacts. Stiff sediments (e.g., clay) can hinder cable burial and can affect heat dissipation and cable performance. Rock outcroppings prevent cable burial and often require additional cable protection measures to prevent excess wear and cable fatigue. Sand and soft clay are the preferred sediment types for cable installation.

The proposed submarine transmission cables will enter Lake Champlain at the international border between the United States and Canada. The cables travel south through the lake to the northern entrance of the Champlain Canal near Whitehall, New York. Although small-scale, localized variations in the substrate are found along the Project's entire route, the substrate along Lake Champlain generally varies from dark gray mud (i.e., silt, clay, and organic material) to diatomaceous muds and clays (Lake Champlain Research Consortium [LCRC] 2004). Due to changes in bathymetry, shifts in substrate type (e.g., sand to rock) are common, especially in near-shore zones and around islands. In areas where the corridor is constrained in width and the cable approaches the near-shore zone, bottom sediments may consist of mud and a higher content of debris and organic matter.

The substrate along the Champlain Canal varies from glacial till to fine sediments. As the Project corridor enters the Hudson River, it traverses the mud-dominated central section and the freshwater section of the Hudson River estuary that is dominated by fluvial sands. The proposed transmission cable corridor leaves the Hudson River and travels through Spuyten Duyvil Creek and the Harlem River to the East River. The Harlem River is scoured daily by tidal action, and bottom sediments tend to be a mixture of sand, gravel, and cobble (New York City Department of Environmental Protection [NYCDEP] 2004). The East River has similar conditions, with the Lower East River substrate consisting of a shallow layer of sediment (2 to 12 inches) on top of gravel, cobble, rocks, and boulders (New York City Transit Authority 2004). The corridor continues into western Long Island Sound where the predominant substrate types are a mixture of sand, silt, and clay.

The varied substrate types along the submarine cable corridor differ in physical characteristics, level of contaminants, and associated benthic invertebrate communities. As a result, potential environmental impacts from cable installation vary from area to area, and measures to protect the environment during cable installation will consider these changes.

3.2.2 Environmental Impacts

While the installation of a submarine cable will cause temporary disturbance, the Applicant does not anticipate that this Project will have a significant, long-term impact to the substrate or bottom sediments along the proposed route.

As described above, the proposed submarine cables will generally be buried to a depth of approximately 3 feet, for protection against mechanical damage. Notwithstanding this approach, depths will vary along the cable route based on existing conditions (e.g., infrastructure) and regulatory requirements. The preferred method of burial will be by water-jetting, where burial is accomplished by gently fluidizing the seabed with low-pressure water released from jets and directed backwards, allowing the cable to sink by its own weight. As the cable sinks into the trench, the water-jetting machine moves forward, allowing the fluidized material to backfill the trench. In certain instances, mechanical plowing may be used in conjunction with water-jetting to achieve burial depth requirements.

Research related to previous submarine cable projects has shown that the suspension of sediments associated with water-jetting techniques is generally limited to the hypolimnion and the benthic zone. Existing sediment transport patterns restore the deposition of sediments to ambient conditions (OSI 2005; Applied Science Associates, 2006). In evaluating the impact of water-jetting on mollusks, the USACE (2004) equated jet plowing with a storm event, "… which causes an increase in suspended sediment load for a short period of time for which clams have the ability to close and survive for the duration of such events." Other researchers have reported that benthic communities impacted by submarine cable installation should be able to opportunistically re-colonize within a short time period after the disturbance (Scott Wilson Ltd. and Downie 2003).

Notwithstanding these considerations, water-jetting will disturb bottom sediments and may re-suspend chemical contaminants if they are present in the substrate. The distribution of the re-suspended material would depend on local hydrodynamics in the vicinity of the burial location. Because the cables will be placed in riverine and estuarine segments of the Hudson River, the magnitude of runoff at the time of installation could also influence the resuspension and distribution of sediments. Avoidance of high flow conditions during installation could be used to control the dispersal of sediments and contaminants. The potential adverse effects of re-suspended contaminants would be dependent on the concentration and type of contaminant at any given location. The Applicant intends to avoid siting the cables in areas where serious contamination has previously been identified or may be found in subsequent sampling programs.

The cables may encounter existing utilities, sections of exposed rock, or other features that prohibit burial within the substrate. If a cable cannot be buried, it will be covered with riprap or other protective cover (such as concrete mattresses) to hold it in place and to protect it from disturbance and damage from above. The presence of the cable and protective covering would permanently alter the type and contour of the substrate. The covering may also modify and/or reduce the habitat value of the original substrate, although in bedrock areas the loss of benthic invertebrate habitat would be minimal.

The Applicant is collecting supplemental information regarding the substrate along the proposed transmission cable corridor. A detailed assessment of the Project's potential impacts on substrates will be provided in the EIS.

3.3 Water Quality

3.3.1 Environmental Setting

The majority of the Project falls within waters under the jurisdiction of New York State. The New York State Department of Environmental Conservation (NYSDEC) classifies freshwater and marine water bodies on their highest and best uses based on historic and current water quality. Uses are classified for recreational and commercial purposes, as well as for fish health. Recreational uses include swimming, fishing, and boating. Commercial uses include shellfishing. Fish survivability and propagation fall into the next lowest use standard. Standards are based on a number of factors including total levels of coliform, fecal coliform, and dissolved oxygen (DO).

The majority of New York State waters support all intended uses (i.e., recreation, fishing). However, there are waterbodies that are affected by some level of water quality impact, use impairment, or are otherwise threatened by various activities. NYSDEC's Division of Water maintains an extensive inventory/database of these waters. The Waterbody Inventory/Priority Waterbodies List (WI/PWL) provides summaries of general water quality conditions and tracks the degree to which the waterbodies support (or do not support) a range of uses. The WI/PWL also monitors progress toward the identification and resolution of water quality problems, pollutants, and sources.

Significant sources of water quality impairment in New York State include:

- Industrial and municipal point sources: While industrial and municipal point sources continue to be sources of water use impairment, their impact on water quality has diminished significantly in the past 30 years.
- Nonpoint sources: Water quality impacts from nonpoint sources are primarily attributed to agricultural runoff.
- Contaminated sediments: Contamination from priority organics (PCBs), atmospheric deposition, and pesticides and heavy metals in bottom sediments are responsible for virtually all of these impacts.
- Streambank erosion: Siltation and sedimentation caused by streambank erosion is a frequently cited cause of water quality impact/impairment in rivers and streams.

Basin-wide assessments have been completed for the following drainage basins within the Project study area: Lake Champlain, Upper Hudson, Lower Hudson River, and Atlantic Ocean/Long Island Sound (NYSDEC 2008a). Portions of these assessments relevant to the proposed Project are presented below.

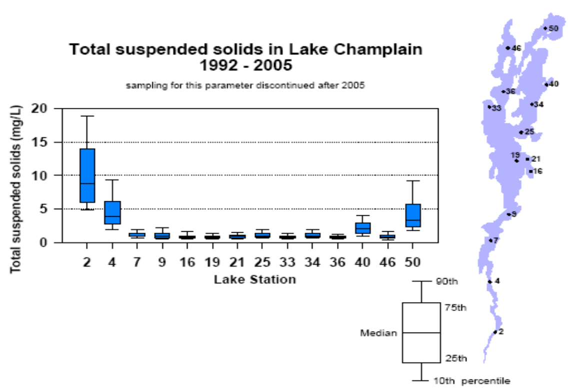
Lake Champlain

The submarine cables will enter Lake Champlain from the Richelieu River at the international boundary between the United States and Canada. The proposed transmission cable corridor within Lake Champlain is located entirely within waters under the jurisdiction of New York State. While waters within this portion of the Project's corridor are listed on the Priority Waterbodies List, Lake Champlain is listed as a stressed water body that fully supports appropriate uses. Atmospheric deposition and contaminated sediments appear as significant sources of impairment, and these factors have contributed to a fish consumption advisory for all of Lake Champlain proper. Streambank erosion, road sanding, and agricultural activities are the most prominent sources of impacts in the Lake Champlain Basin. In the more developed areas of the basin, urban runoff and storm sewers are listed as major sources of pollutants (NYSDEC 2008a).

Lake Champlain is one of the largest freshwater lakes in the United States. It is an ecologically diverse system that serves as a major recreational hub and a drinking water source. Like many large lakes, it receives municipal and industrial wastes, as well as runoff from agricultural and urban areas, all of which contribute to recognized water quality problems within the lake and watershed. The Lake Champlain Basin Program, the Vermont Center for Clean and Clear, and the Vermont Department of Health, among others, use data generated through the Long-term Water Quality and Biological Monitoring Program to identify water quality issues of concern and assess progress in reducing lake pollution (NYSDEC 2008a).

The Long-Term Water Quality and Biological Monitoring Project for Lake Champlain has been in operation since 1992. The project is conducted by the Vermont Department of Environmental Conservation (VTDEC) and the NYSDEC, with funding provided by the Lake Champlain Basin Program and both states. Water quality within Lake Champlain varies seasonally. Turbidity within Lake Champlain varies from 5 to 20 milligrams per liter (mg/L) (Figure 3.3-1).

FIGURE 3.3-1
TOTAL SUSPENDED SOLIDS IN LAKE CHAMPLAIN, 1992-2005



Upper Hudson River

South of Whitehall, the proposed submarine transmission corridor will generally extend along the Champlain Canal to its confluence with the Upper Hudson River at Fort Edward. To avoid conflicts with the Upper Hudson River PCB Dredging Project, the transmission cables will exit the Champlain Canal near Lock C8 and will be buried within a railroad ROW for a distance of approximately 69.9 miles. The cable will re-enter the Hudson River downstream from the City of Albany, in the Town of Coeymans.

The Upper Hudson River Basin is comprised of the Hudson River drainage above its confluence with the Mohawk River at the Troy Federal Dam. Water quality in much of the Upper Hudson River Basin above Hudson Falls/Fort Edward is good to excellent. Over 80 percent of assessed river and stream miles in the basin fully support designated uses. Impacts from human activities within the basin are limited and generally localized. However, the basin does experience significant water quality impacts that are the result of past historic activities and pollutant sources from outside the boundaries of the basin. These impacts include PCB contamination of sediments in the Upper Hudson, acid rain, and atmospheric deposition of mercury (NYSDEC 2008a).

During an approximate 30-year period ending in 1977, two General Electric Company (GE) capacitor manufacturing plants located at Hudson Falls and Fort Edward discharged between 209,000 and 1.3 million pounds of PCBs into the Hudson River (U.S. Environmental Protection Agency [USEPA] 2002; USEPA 2008). The vast majority of the PCBs accumulated in the sediments directly downstream of the two point sources. In October 1973, a dam at Fort Edward was removed, allowing PCB-laden sediment to be transported downstream. This resulted in a significant increase in PCB loadings throughout the river and estuary (USEPA 2002). The approximately 200-mile-long stretch of the Hudson River from Hudson Falls to the Battery in New York City was declared a Federal Superfund site in 1983. The Upper Hudson River—an approximately 40-mile-long reach of the river from Hudson Falls to Troy, in Washington, Saratoga, and Rensselaer Counties—was the major focus of the USEPA's reassessment, and is the reach that was targeted for remediation. The USEPA is the lead agency for cleanup of the Hudson River PCBs Superfund Site. The February 2002 Record of Decision (ROD) called for targeted environmental dredging and removal of approximately 2.65 million cubic yards of PCB-contaminated sediment from a 40-mile stretch of the Upper Hudson. The Upper Hudson River PCB Dredging Project began in 2009 and is currently underway (USEPA 2009).

Lower Hudson River

The proposed submarine transmission corridor follows the Hudson River south to the New York City region. Water quality within the Lower Hudson River varies based on land use. Although the establishment of water quality regulations, such as the Clean Water Act (CWA), has led to gradual improvements to water quality, the surface waters are impaired in areas where bathymetry and/or shoreline alterations have affected natural flows and flushing (USACE 2009). The most notable water quality problem in the Lower Hudson Basin is the effect of contaminated sediment in the Hudson River. This contamination is primarily the result of historic PCB discharges in the Upper Hudson and has resulted in extensive fish consumption advisories, including a prohibition on the commercial harvesting of striped bass and restrictions on the consumption of blue crabs (NYSDEC 2008b). The Hudson River is listed as impaired as a result of various nonpoint sources, sediment contamination, and streambank erosion. However, the river supports a diverse aquatic community and significant coastal habitats.

Atlantic Ocean / Long Island Sound

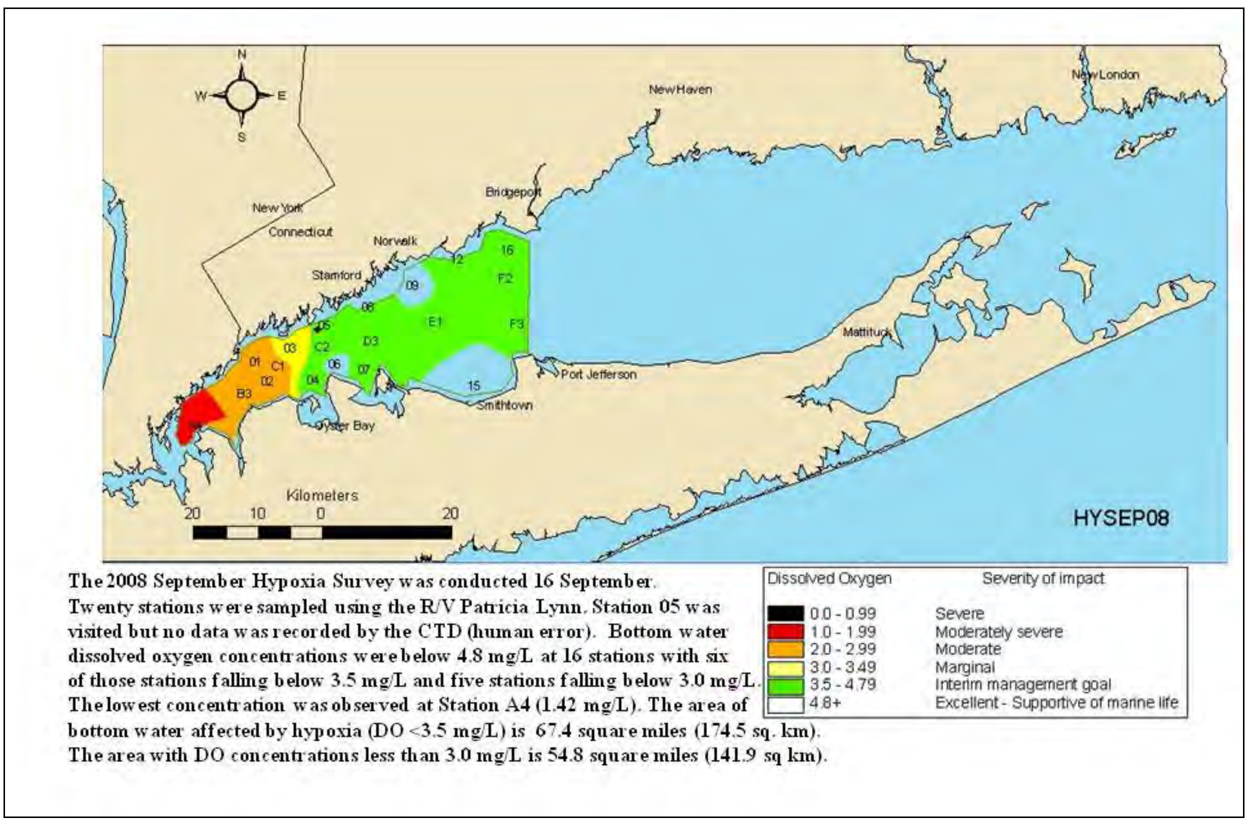
The final segment of the proposed transmission cable corridor turns east through Spuyten Duyvil Creek, and follows the Harlem River and the East River into Long Island Sound before terminating in Bridgeport, Connecticut. Numerous sources contribute to water quality problems in these waterbodies. These sources include municipal and industrial discharges, urban storm runoff, combined and separate sewer overflows, contaminated sediments, oil and hazardous material spills, nonpoint source runoff, and thermal discharges.

Seasonal low DO levels in Long Island Sound have been the focus of considerable study. Hypoxia in the bottom waters of the western sound have caused fish and crustacean kills and have induced finfish to avoid the area. Excessive algal blooms in the sound have been attributed to nitrogen loads from wastewater treatment plant discharges, combined sewer overflows (CSOs), and stormwater and urban runoff. The most significant pollutant loadings to western Long Island Sound are the New York City water pollution control plants on the Upper East River.

NYCDEP conducts the Harbor Survey Program. This long-term water quality sampling program consists of 62 sampling stations, which include the lower Hudson River, New York/New Jersey Harbor, Harlem River, East River, and Western Long Island Sound. Water quality parameters include dissolved oxygen, secchi transparency, chlorophyll a, and fecal coliform bacteria.

The Connecticut Department of Environmental Protection (CTDEP), on behalf of the Long Island Sound Study, conducts a year-round Long Island Sound Water Quality Monitoring Program. In addition, the CTDEP conducts a Summer Hypoxia Survey, which is part of the broader Long Island Sound Water Quality Monitoring Program. The CTDEP has provided a description of the extent and duration of low DO concentrations for the summer months since 1991. Each summer, low DO levels render hundreds of square kilometers of bottom water unhealthy for aquatic life. DO levels follow seasonal patterns with a decrease in bottom water DO over the course of the summer. Hypoxic conditions during the summer are mainly confined to the Narrows and Western Basin sections of Long Island Sound (Figure 3.3-2).

FIGURE 3.3-2
DISSOLVED OXYGEN IN LONG ISLAND SOUND BOTTOM WATERS



Source: Connecticut Department of Environmental Protection

The presence of contaminants such as PCBs and pesticides, as well as bacteriological contamination from urban runoff, CSOs, storm sewers, and other discharges, has resulted in fish consumption advisories and prohibitions against shellfishing in some of the marine waters around New York City and Long Island (NYSDEC 2008a).

Numerous public beaches and marinas in New York City, Nassau, Suffolk, and Westchester counties attract bathers and boaters from throughout the area and beyond. While waters generally support these recreational uses throughout the basin, public health warnings and occasional beach closures resulting from raw sewage bypasses, CSO, separate sewer and stormwater overflows, municipal discharges, and urban runoff do occur. New York City; Nassau, Suffolk, and Westchester counties; New Jersey; and Connecticut all conduct beach water quality monitoring programs (NYSDEC 2008a).

Urban and stormwater runoff from impervious surfaces in this highly urbanized watershed transport significant amounts of various pollutants into the waters of the basin. These pollutants include nutrients, silt/sediment, pathogens, floatables, oil/grease, metals, and other substances. In addition, untreated discharges from CSOs introduce oxygen-demanding substances, pathogens, floatables and more to the waters (NYSDEC 2008a).

3.3.2 Environmental Impact

Potential impacts to water quality along the proposed submarine transmission corridor are closely associated with substrate type and contaminants (see Section 3.2). Resuspension of silt and sediments may result in an increase in turbidity, which can impair aquatic communities and habitats, as well as interfere with recreational activities. During in-water construction activities associated with cable installation, there is the potential for short-term aquatic impacts, caused by the suspension of both contaminated sediments and fine-grained sediments.

Potential environmental impacts due to increases in suspended sediments during cable installation will be minimized through the use of water-jetting. During trenching operations, hydraulic pressure is adjusted based on sediment type to ensure that the cable is buried to the proper depth. Fluidized sediments are contained largely within the confines of the trench wall, allowing the trench to be backfilled quickly. Some sediment would be expected to settle quickly in areas immediately adjacent to the trench, depending on the sediment type, grain size, composition, and hydraulic jetting forces used. Sediment disturbance and resuspension would be localized and limited to the area directly within the cable route. Dispersion of sediments resuspended during cable installation would be influenced by horizontal advection dominated by local hydrodynamics and settling rates.

Disturbance of bottom sediments may result in a temporary increase in turbidity and suspended sediment concentrations during installation, but is not expected to impact temperature, DO levels, or salinity within the water column. Resuspension may cause contaminants adsorbed to sediment particles to dissociate from the sediment particles, thereby becoming more readily available to aquatic organisms. Recovery of the habitat would be expected, but the aquatic community may undergo changes in abundance (density) or species composition compared to the community prior to installation. The ecological value of the re-established community may represent an increase or decrease compared to original values.

The Applicant is collecting supplemental information regarding the existing water quality along the proposed transmission cable corridor. A detailed assessment of the Project's potential impacts on water quality will be provided in the EIS.

3.4 Fisheries

3.4.1 Environmental Setting

<u>Finfish</u>

From the Hertel substation south of Montreal, the proposed transmission cables will follow an overland route before entering the Richelieu River and travelling upstream to the border between the United States and Canada. The Project will enter Lake Champlain south of the international boundary. Lake Champlain supports several species of game fish, and the lake provides excellent opportunities for recreational fishing. Eighty-one species of fish have been identified in Lake Champlain, and about 20 of these species are actively sought by anglers. NYSDEC and the Vermont Fish and Wildlife Department (VTFWD) stock rainbow, lake, and brown trout in basin waters. Additionally, the U.S. Fish and Wildlife Service (USFWS) stocks young Atlantic salmon. Table 3.4-1 lists fish species identified in the Lake Champlain Basin in 2006 as compiled by the Lake Champlain Basin Program. The table also designates the status of the species and whether the species is native to Lake Champlain.

TABLE 3.4-1
FISH OF THE LAKE CHAMPLAIN BASIN 2006

COMMON NAME	SCIENTIFIC NAME	NATIVE
Alewife	*Alosa pseudoharengus*	no
Largemouth bass	*Micropterus salmoides*	yes
Rock bass	*Ambloplites rupestris*	yes
Smallmouth bass	*Micropterus dolomieu*	yes
Bluegill	*Lepomis macrochirus*	yes
Bowfin	*Amia calva*	yes
Brown bullhead	*Ameiurus nebulosus*	yes
Burbot	*Lota lota*	yes
Common carp	*Cyprinus carpio*	no
Channel catfish	*Ictalurus punctatus*	yes
Cisco	*Coregonus artedi*	yes
Black crappie	*Pomoxis nigromaculatus*	yes
White crappie	*Pomoxis annularis*	no
Longnose dace	*Rhinichthys cataractae*	yes
Eastern sand darter	*Ammocrypta pellucidum*	yes
Tessellated darter	*Etheostoma olmstedi*	yes
Freshwater drum	*Aplodinotus grunniens*	yes
American eel	*Anguilla rostrata*	yes
Fallfish	*Semotilus corporalis*	yes
Longnose gar	*Lepisosteus osseus*	yes
Blueback herring	*Alosa aestivalis*	no
Banded killifish	*Fundulus diaphanus*	yes
American brook lamprey	*Lampetra appendix*	yes
Sea lamprey	*Petromyzon marinus*	yes/no
Silver lamprey	*Ichthyomyzon unicuspis*	yes
Logperch	*Percina caprodes*	yes
Bluntnose minnow	*Pimephales notatus*	yes
Fathead minnow	*Pimephales promelas*	yes
Mooneye	*Hiodon tergisus*	yes
Central mudminnow	*Umbra limi*	yes
Muskellunge	*Esox masquinongy*	yes
White perch	*Morone americana*	no
Yellow perch	*Perca flavescens*	yes
Chain pickerel	*Esox niger*	yes
Northern pike	*Esox lucius*	yes
Pumpkinseed	*Lepomis gibbosus*	yes
Quillback	*Carpiodes cyprinus*	yes
Greater redhorse	*Moxostoma valenciennesi*	yes
Shorthead redhorse	*Moxostoma macrolepidotum*	yes
Silver redhorse	*Moxostoma anisurum*	yes
Rudd	*Scardinius erythrophthalmus*	no
Atlantic salmon	*Salmo salar*	yes

COMMON NAME	SCIENTIFIC NAME	NATIVE
Sauger	*Stizostedion canadense*	yes
Mottled sculpin	*Cottus bairdi*	yes
Slimy sculpin	*Cottus cognatus*	yes
Gizzard shad	*Dorosoma cepedianum*	no
Blackchin shiner	*Notropis heterodon*	yes
Bridle shiner	*Notropis bifrenatus*	yes
Common shiner	*Luxilus cornutus*	yes
Emerald shiner	*Notropis atherinoides*	yes
Golden shiner	*Notemigonus crysoleucas*	yes
Mimic shiner	*Notropis volucellus*	yes
Rosyface shiner	*Notropis rubellus*	yes
Sand shiner	*Notropis stramineus*	yes
Spotfin shiner	*Cyprinella spiloptera*	yes
Spottail shiner	*Notropis hudsonius*	yes
Brook silverside	*Labidesthes sicculus*	no
Rainbow smelt	*Osmerus mordax*	yes
Lake sturgeon	*Acipenser fulvescens*	yes
Longnose sucker	*Catostomus catostomus*	yes
White sucker	*Catostomus commersoni*	yes
Tench	*Tinca tinca*	no
Brown trout	*Salmo trutta*	no
Lake trout	*Salvelinus namaycush*	yes
Rainbow trout	*Oncorhynchus mykiss*	no
Trout-perch	*Percopsis omiscomaycus*	yes
Walleye	*Stizostedion vitreum*	yes
Lake whitefish	*Coregonus clupeaformis*	yes

Notes: Native: yes = species endemic to Lake Champlain, no = nonnative.
Source: Lake Champlain Basin Program 2006.

Of those species identified in the Lake Champlain Basin, three are listed as threatened in the State of New York: Eastern sand darter, mooneye, and lake sturgeon. None are listed as threatened or endangered at the federal level. Threatened species are determined by the NYSDEC as likely to become endangered within the foreseeable future in New York State and are fully protected under the Section 11-0535 of the New York State Environmental Conservation Law.

The current fishery in Lake Champlain is almost entirely based on angling. Although commercial licenses are still permitted in Quebec, the commercial fishery has not been active since 2004. Popular sport fisheries include the four salmonid species, walleye, yellow perch, bass, and pike. Summer tournaments, several of which focus on bass fishing, bring substantial revenues to the area. Ice fishing for yellow perch, walleye, and smelt is popular during the winter months. Charter fishing has declined since the mid-1990s, due to an overall reduction in the salmonid fishery as a consequence of sea lamprey predation. Currently, commercial harvest in the U.S. waters of Lake Champlain consists only of the sale of fish caught by angling, or the licensed harvest and sale of bait fish. The majority of the fish sold are yellow perch, with smelt and panfish also being marketed.

From Lake Champlain, the transmission cables will generally travel south through a portion of the Champlain Canal to join the Hudson River at Fort Edward. Fish species within the canal are not well documented and often vary as the canal is open seasonally from May and drained in mid-November. Aquatic nuisance species documented as occurring within the Canal consist of zebra mussel, sea lamprey, alewife, white perch, and tench.

The Hudson River is now home to over 200 species of fish. The Hudson River Fisheries Unit of the NYSDEC's Bureau of Marine Resources focuses studies on migratory fish in the 152 miles of the Hudson River estuary from the George Washington Bridge in New York City to the Federal Dam located in Troy. Since 1976, high levels of PCBs in fish have led New York State to close various recreational and commercial fisheries and to issue advisories restricting the consumption of fish caught in the Hudson River (Limburg 2000). There are several areas along the Hudson River that are closed or restricted to recreational and consumptive fishing. Table 3.4-2 identifies the common and scientific names of species caught by recreational anglers in the Hudson River.

TABLE 3.4-2
COMMON SPECIES CAUGHT BY RECREATIONAL ANGLERS IN THE HUDSON RIVER IN 2005

COMMON NAME	SCIENTIFIC NAME
Shortnose sturgeon	*Acipenser brevirostrum*
Atlantic sturgeon	*Acipenser oxyrhynchus*
American eel	*Anguilla rostrata*
Alewife	*Alosa pseudoharengus*
Blueback herring	*Alosa aestivalus*
American shad	*Alosa sapidissima*
Gizzard shad	*Dorosoma cepedianum*
Common carp	*Cyprinus carpio*
Shorthead redhorse	*Moxostoma macrolepidotum*
Unidentified catfishes	*Ictaluridae*
White catfish	*Ameiurus catus*
Brown bullhead	*Ameiurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Northern pike	*Esox lucius*

COMMON NAME	SCIENTIFIC NAME
Chain pickerel	*Esox niger*
Unidentified codfishes	*Gadidae*
Atlantic tomcod	*Microgadus tomcod*
Red hake	*Urophycis chuss*
Spotted hake	*Urophycis regia*
White perch	*Morone americana*
White bass	*Morone chrysops*
Striped bass	*Morone saxatilis*
Sunfishes	*Lepomis* spp.
Rock bass	*Ambloplites rupestris*
Black bass	*Micropterus* spp.
Smallmouth bass	*Micropterus dolomieu*
Largemouth bass	*Micropterus salmoides*
Yellow perch	*Percaflavescens*
Walleye	*Stizostedion vitreum*
Bluefish	*Pomatomus saltatrix*
Freshwater drum	*Aplodinotus grunniens*
Atlantic croaker	*Micropogonias undulatus*
Blue crab	*Callinectes sapidus*

Source: Normandeau 2007a

The U.S. Coast Guard's Coast Pilot notes that commercial fishtraps are planted each spring along a 30-mile-long stretch of the Hudson River, extending from a point approximately 5 miles above the Battery in New York City to Stony Point, New York. Permits from the USACE are required for placing nets and poles in charted areas, and nets are required to be marked by flags and lights.

American shad are an important commercial and sportfish fishery. The biggest American shad run on the east coast goes into the Hudson River estuary. American shad appear in the lower Hudson around late March. At this point, the fish often rest to adjust to the lower salt content upstream before continuing to their spawning grounds. Adult American shad spawn in the Hudson River for 6 to 8 weeks between April and June, with the largest concentrations of spawning occurring in the stretch of river between Kingston and Troy. After spawning, the shad return to the ocean and the eggs drift downstream with the currents. Juvenile American shad remain in the Hudson Estuary until autumn, at which point they move out to the Atlantic Ocean.

Striped bass, another anadromous fish, appears in the Hudson River estuary in late March, around the same time as American shad. Striped bass often congregate in the lower estuary from the Tappan Zee Bridge through Haverstraw Bay until the water warms, at which point the fish continue north to their spawning grounds. Spawning takes place in May and early June near

Kingston. After spawning, the adult striped bass return to the Atlantic. In early fall, young striped bass begin to move out of the estuary to nearshore coastal areas. A limited fall commercial fishery is now permitted for striped bass. Both the American shad and striped bass are monitored by the NYSDEC's Hudson River Fisheries Unit under the Interstate Fishery Management Plan developed by the Atlantic States Marine Fisheries Commission. The Hudson River striped bass population supports a major recreational fishery within the State of New York (Peterson 1998).

Another resident sport fishery popular with recreational anglers in the Hudson River are black bass (largemouth and smallmouth bass). The Hudson River estuary provides spawning ground for these species. A study conducted by the NYSDEC tagged a total of 8,150 black bass (6,650 largemouth, 1,500 smallmouth) in the Hudson River and tidal tributaries between 1999 and 2001. The study also located wintering areas and spawning areas for smallmouth bass.

Two species of river herring migrate into the Hudson River to spawn on an annual basis. Alewives arrive in the Hudson in late March and early April when water temperatures reach 40 degrees Fahrenheit, migrating upriver to spawn in the Hudson and tributaries below the Federal Dam at Troy. Alewives prefer spawning habitats of barrier beach ponds, brackish streams, and mid-river or upstream freshwater sites (Normandeau 2007b). Blueback herring arrive in New York's estuaries from mid-May to June, and their range includes the upper Hudson and Mohawk rivers, Lake Champlain, and Oneida Lake via the canal system. Bluebacks primarily spawn in the Hudson and tributaries below the Federal Dam at Troy, but have increased their use of the Mohawk River for spawning. After spawning, both species of river herring return to the ocean.

Both the Atlantic sturgeon and shortnose sturgeon occur within the Hudson River, and their presence is monitored by the NYSDEC. Historically, the population supported a valuable commercial fishery from the late 19th century through 1996. In 1996, NYSDEC placed a moratorium on the Hudson River Atlantic Sturgeon Fishery after evidence of overfishing became apparent. In 1998, the Atlantic States Marine Fisheries Commission placed a moratorium on the fishery that extends along the entire coast. The anadromous Atlantic sturgeon is a federally protected species and spawns in the Hudson between April and June. Female Atlantic sturgeon return to the ocean after spawning, whereas males remain in the river until the fall. Once hatched, young Atlantic sturgeon remain in the river feeding on benthic organisms for 2 to 7 years before returning to the Atlantic. Studies completed for the NYSDEC indicate a downstream fall migration of juvenile Atlantic sturgeon once water temperatures drop below 20 degrees Celsius. Studies also indicate that the Haverstraw Bay/Tappan Zee region of the Hudson River was an area of over wintering concentrations (Sweka et al. 2006).

The shortnose sturgeon, which is listed as federally endangered, is semi-anadromous. Each year between April and May, adult sturgeons migrate up the Hudson from their mid-Hudson overwintering area to spawn in freshwater sites north of Coxsackie. Once hatched, the fry drift with the currents along the bottom of the river and move downriver into the brackish waters of the lower Hudson. Both Atlantic and shortnose sturgeons are bottom feeders, and they spend most of their time in deep channels of the Hudson River. The shortnose sturgeon, in particular, seldom travels beyond the Hudson River estuary, and are found from the southern tip of Manhattan upriver to the Federal Dam in Troy. The NYSDEC participates in a variety of sturgeon monitoring program, including the juvenile Atlantic sturgeon sonic tracking project.

Long Island Sound measures approximately 100 miles long and is 21 miles wide at its broadest point. Bordered by the states of New York and Connecticut, the Sound is unusual in that it is connected to the ocean at opposite ends. On its eastern end, “the Race” connects the Sound with the Atlantic Ocean. The western end of Long Island Sound is connected by the East River (a tidal strait) to New York Harbor, which opens into the Atlantic Ocean. The Sound’s fresh water sources are the Housatonic, Connecticut, and Thames rivers. An estimated $8.25 billion per year are generated from activities related to the Long Island Sound (CTDEP 2007), including sport fishing, boating, swimming, tourism, and commercial fishing. Opportunities for saltwater fishing exist at many coastal access points along Long Island Sound. As a result, Connecticut and New York offer some of the best and most diverse fishing possibilities in the country.

Long Island Sound is home to numerous game fish species, including striped bass (*Morone saxatilis*), bluefish (*Pomatomus saltatrix*), and scup (*Stenotomus chrysops*). Ocean-based commercial fisheries are also intimately tied to Connecticut’s Long Island Sound, because bait fish are produced in the Sound and many juvenile striped bass migrate through before migrating offshore. The juvenile life stages of many important recreational and commercial species, such as flounder species and scup, depend on the fringing wetland of Connecticut's shoreline for nursery areas. Bluefish and striped bass, which are also important recreational species, inhabit the Sound and adjacent rivers, but depend on coastal wetlands for the small fish that are their food. The Sound also supports a healthy community of ichthyoplankton, which are the egg and larval life stages of finfish.

The CTDEP conducts the Long Island Sound Trawl Survey annually to measure the abundance and distribution of finfish, squid, and other macro-invertebrates (lobster, crabs, horseshoe crabs, whelks) in the Sound. By comparing this information against available fishery data (landings, catch/effort), a comparison can be made of species abundance against harvesting by commercial and recreational fishing. The survey also provides a detailed characterization of the size and age composition of species that enter the Sound. To date, 97 finfish species and more than 60 invertebrate taxa have been documented.

Shellfish and Benthic Resources

New York and New Jersey support small commercial and recreational fisheries for blue crab, which have been steadily increasing since the 1970s. In the Hudson River, the blue crab is known to inhabit the entire estuary from New York Harbor to the Federal Dam at Troy. The NYSDEC has monitored the blue crab population in order to sustain and enhance the commercial and recreational blue crab fishery in the estuary. Blue crabs generally reside over the winter in high salinity waters near the mouths of major fresh water inputs and bays. As the water temperature and salinity increase, the spawning population moves upstream into fresh water to spawn. Female crabs then travel downstream to the lower estuary to release eggs in areas of high salinity. The area between Liberty State Park and Newburgh provides nursery habitat for blue crabs. The crab fishery in the Hudson River estuary is generally a summer and fall endeavor, typically occurring near the Tappan Zee Bridge and to the north. There is no known winter fishery in the Hudson River for blue crab (Normandeau Associates 2004)

Long Island Sound is also home to several species of shellfish. Mollusk species in the Sound include the razor clam (*Ensis directus*) and blue mussels (*Mytilus edulis*). Crustaceans, such as the blue crab (*Callinectes sapidus*), portly spider crab (*Libinia emarginata*), and the American lobster (*Homarus americanus*) also inhabit Long Island Sound. The American lobster is of particular importance in the deep waters of the Sound, due to its contribution to commercial fishing in the region. In addition, the Long Island Sound's oyster fishery is one of the largest in the United States, generating a significant percentage of the nation's oysters. The most important commercial species, hard clams, depends on coastal wetlands for the detrital food chain that supports their growth.

Oysters in Long Island Sound are beginning to make a return. In the 1990s the Sound's oyster population experienced a dramatic decrease due to the two parasitic diseases that were introduced, MSX and Dermo. Efforts have been made in New York and Connecticut to raise disease-resistant oysters. In 2006, the oyster harvest in the Sound increased by 70 percent, and a year later increased by another 93 percent from 2006. Clams within the Sound have seen a 282 percent increase of harvested bushels from 1995, reflecting a harvest increase in Connecticut and a slight increase in New York (Long Island Sound Study 2008).

The proposed cable route currently travels through three specially designated shellfish areas. The landing site in Bridgeport is located adjacent to a prohibited area, where the harvesting of shellfish is prohibited at all times. The cable corridor also crosses a "conditionally approved" shellfish area. Beds in this area do not conform to "approved" area criteria due to the occurrence of specified hydrologic or meteorological events or conditions, but will predictably return to the "approved" area criteria. Prior to conducting any activity in a conditionally approved area during the "closed" status, the licensee must notify the local shellfish control authority and the CTDEP's Division of Law Enforcement. The third designated area the cable route passes through is a restricted-relay area. This shellfishing area classification is designated for areas that the Department of Agriculture and Bureau of Aquaculture utilize for relay or transplant activities in conformance with National Shellfish Sanitation Program Model Ordinance criteria.

Essential Fish Habitat

The proposed cable corridor passes through areas designated as Essential Fish Habitat (EFH) by the National Marine Fisheries Service (NMFS). EFH is defined under the Magnuson-Stevens Fishery Conservation and Management Plan, as amended by the Sustainable Fisheries Act of 1996, as "those waters and substrate necessary to fish for spawning, breeding, and feeding or growth to maturity." The Sustainable Fisheries Act requires that EFH is identified for those species actively managed under federal fishery management plans. EFH can consist of both the water column and underling surface (substrate) of a particular area and it includes habitats that support the different life stages of each managed species.

Portions of the Hudson River have been designated by the NMFS as EFH for species including the red hake (*Urophycis chuss*), winter flounder (*Pleuronectes americanus*), Atlantic herring (*Clupea harengus*), and king mackerel (*Scomberomorus cavalla*). The proposed cable corridor passes through areas designated as EFH for the following species within Long Island Sound: Atlantic herring (*Clupea harengus*), ocean pout (*Macrozoarces americanus*), pollock (*Pollachius virens*), red hake (*Urophycis chuss*), silver hake (*Merluccius bilinearis*), windowpane flounder (*Scophthalmus aquosus*), and winter flounder (*Pleuronectes americanus*).

3.4.2 Environmental Impact

The Applicant is collecting supplemental information regarding fisheries along the proposed transmission cable corridor. A detailed assessment of the Project's potential impacts on fisheries will be presented in the EIS.

Finfish

Potential impacts on the finfish community along the Project's route are associated with the disturbance of bottom sediments and habitat during cable installation. In general, these impacts are expected to be temporary and short term, as they are only related to cable installation. Fish species occurring along the cable route may be temporarily displaced during the cable installation operations, either directly by cable installation equipment or indirectly by exposure to short-term changes in suspended sediments and turbidity.

In areas where the cables cannot be buried, the presence of the cables and concrete mattresses may permanently alter the type and contour of the substrate. Where the mattresses cover bedrock, the loss of finfish habitat would be minimal. However, if mattresses cover productive substrates, such as rubble/cobble and silty sand, the mattresses would provide less habitat value than the original substrate.

The cables will be buried, and there are no anticipated effects to the water temperature that will result from Project operations.

Shellfish and Benthic Resources

Potential impacts on the benthic invertebrate and shellfish community along the cable routes in all locations would include the temporary disturbance of sediments and bottom habitat during cable installation. Sediment disturbance may impact benthic invertebrates and shellfish directly, through physical disturbance of the substrate and habitat. Sediment disturbance can also impact shellfish and benthic invertebrates indirectly, through the suspension of sediments within the water column. Suspended sediments have the potential to bury benthic organisms as the sediments settle or increase turbidity to levels that interfere with benthic invertebrate respiration and feeding. Most shellfish and other invertebrates are unlikely to be impacted by turbidity changes because these are expected to be within ambient levels observed during wind or storm events.

Recovery of benthic communities disturbed by trenching is expected to occur at varying rates following installation, depending on species composition. Post-construction monitoring for the Cross Sound Cable, which connected Connecticut with Long Island, found no significant differences between the benthic communities along the cable and outside the cable route (OSI 2005).

In areas where the cables cannot be buried, the presence of the cables and concrete mattresses may permanently alter the type and contour of the substrate. Where the mattresses cover bedrock, the loss of benthic habitat would be minimal. However, if mattresses cover productive substrates, such as rubble/cobble and silty sand, the mattresses would provide less habitat value than the original substrate.

EFH

EFH has been designated for several species along the proposed cable route. Potential impacts on EFH would differ between species, as the cable installation is more likely to affect demersal (bottom-oriented) species and life stages than pelagic species. Short-term water quality impacts to EFH due to cable installation would most likely be limited to changes in turbidity levels and suspended solids within the immediate vicinity of the proposed cable route.

3.5 Wetlands

3.5.1 Environmental Setting

The Project's principal features will be primarily oriented around the existing waterways and shoreline areas that comprise Lake Champlain, the Champlain Canal, the Hudson River, Spuyten Duyvil Creek, the Harlem River, the East River, and Long Island Sound. These freshwater and saltwater waterbodies include deepwater habitats that are permanently inundated. Additionally, these waterbodies provide transitional environments between terrestrial and aquatic systems that support a unique variety of plant and animal types.

A wide range of wetland types and deepwater habitats are likely to exist in the vicinity of the Project, including marine, estuarine, riverine, palustrine, and lacustrine systems. A review of the USFWS's National Wetlands Inventory (NWI) indicates that a variety of freshwater and tidal wetland classes are present along the proposed transmission cable corridor. Congress established federal regulatory power concerning wetlands under Section 404 of the CWA. The federal regulatory program is administered by the USACE and implemented at a state level. Additional state and municipal regulations also provide for the protection of wetlands.

Freshwater wetlands along the Project's proposed alignment are likely to be found along the shorelines of Lake Champlain, the Champlain Canal, and the Upper Hudson River. The New York State Freshwater Wetlands Act provides protections for wetlands within the state with a minimum area of at least 12.4 acres. Many of the species likely to occur in the Project area typically use freshwater wetland or riparian habitats at some stage in their life cycle. Wetlands serve as important nurseries for fish stock and nesting habitat for many species of waterfowl. Some of the most common visiting birds and waterfowl in freshwater wetlands in the northeast include red-winged blackbird (*Agelaius phoeniceus*), great blue heron (*Ardea herodias*), mallard (*Anas platyrhynchos*), mergansers (*Mergus spp.*), and Canada goose (*Branta canadensis*).

In upland areas along the transmission cable corridor, naturally or anthropogenically created depressions may serve as habitat for several wetland-dependent species. These riverine, riparian or palustrine emergent (Cowardin et al. 1979) wetlands may appear isolated from waterways or channels, but may be connected via groundwater conduits or culverts. These freshwater wetlands have the possibility of providing habitat for herpetofauna, avian, macro and micro-invertebrate, mammal, and plant species.

Tidal wetlands have been recognized as unique habitat types, and both New York and Connecticut have implemented Wetlands Protection Acts to preserve these important resources. Tidal wetlands have been identified along the entire Hudson River estuary, from the Federal Dam in Troy, to the southern tip of Staten Island. These wetlands also extend along the New York and Connecticut coastlines of Long Island Sound.

The NYSDEC has established the New York State Official Tidal Wetlands Inventory to delineate and classify all tidal wetlands within New York State. Based on the NYSDEC's criteria, several categories of tidal wetlands exist along the shorelines of the Hudson River estuary and Long Island Sound. These wetland categories are presented in Table 3.5-1, below.

TABLE 3.5-1
NEW YORK STATE TIDAL WETLAND CATEGORIES

CATEGORY	DESCRIPTION
Coastal Shoals, Bars, and Mudflats	The tidal wetland zone that at high tide is covered by saline or fresh tidal waters, at low tide is exposed or is covered by water to a maximum depth of approximately 1 foot, and is not vegetated.
Littoral Zone	The tidal wetland zone that includes all lands under tidal waters which are not included in any other category.
Formerly Connected	The tidal wetlands zone in which normal tidal flow is restricted by man-made causes. *Phragmites spp.* is the dominant vegetation.
Vegetated Coastal Shoals, Bars, and Mudflats	The tidal wetland zone that at high tide is covered by saline or fresh tidal waters, at low tide is exposed or is covered by water to a maximum depth of approximately 1 foot, and is vegetated.
Broad-Leaf Vegetation	The vegetated tidal wetlands zone that includes all lands that generally receive daily flushing from fresh tidal water. This area is generally lower than the graminoid vegetation area and is characterized by broad leaf emergent vegetation.
Intertidal Marsh	The vegetated tidal wetland zone lying generally between average high and low tidal elevations in saline waters. The predominant vegetation in this zone is low marsh cordgrass *(Spartina alterniflora).*

CATEGORY	DESCRIPTION
Fresh Marsh	The tidal wetland zone found primarily in the upper tidal limits of the riverine systems where significant fresh water inflow dominates the tidal zone. Species normally associated with this zone include narrow leaved cattail, tall brackish water cordgrass, and the more typically emergent fresh water species.
Graminoid Vegetation	The vegetated tidal wetlands zone that includes all lands that receive at least periodic flushing from fresh water. This area is generally higher than the broad leaf vegetation area. The lower elevated portions of this area may receive daily flushing and the higher elevations periodic flushing from storm tides. It is characterized by graminoid vegetation such as cattail (*Typha angustifolia*).
High Marsh	The normal upper most tidal wetland zone usually dominated by salt meadow grass and spike grass. This zone is periodically flooded by spring and storm tides and is often vegetated by low vigor (*Spartina alterniflora*) and seaside lavender (*Limonium carolinianum*). Upper limits of this zone often include black grass, (*Juncus gerardi*) and chairmaker's rush, (*Scirpus spp.)*, amongst other species.
Swamp Shrub	Includes all land that receives periodic inundation from tidal fresh waters. Characterized by shrubs such as alder (*Alnus spp.*), buttonbush (*Cepahalanus occidentalis*), and bog rosemary (*Andromeda glaucophylla*).
Swamp Tree	Includes all land that receives periodic inundation from tidal fresh waters and is characterized by trees such as red maple (*Acer rubrum*), and willows (*Salix spp.*).
Fern Marsh	Includes all land that receives periodic inundation from tidal fresh waters. Characterized by ferns such as cinnamon fern (*Osmunda cinnamomea*) and sensitive fern (*Onoclea sensibilis*).
Adjacent Area	Includes those land areas not included in the any of the above categories that are generally not inundated by tidal waters and that extend 300 feet landward of the most landward tidal wetlands boundary or to an elevation of 10 feet.
Dredged Spoil	All areas of fill material.
Dead Tree Area	Areas where dead trees are dominant.
Default Area	Includes all areas awaiting classification into one of the above categories.

Source: NYSDEC 2009

Tidal wetlands along the Project's route include brackish marshes and salt marshes along the Hudson River estuary and Long Island Sound. Intertidal marshes, mudflats, and high salt marshes are all considered tidal wetlands, and each of these environments may include a biologically diverse community of plants and animals. In general, tidal wetlands are typically dominated by marine grasses such as cordgrass, spike grass (*Distichlis spicata*), or saltmeadow hay (*Spartina patens*). Shrubs and trees may also be present in tidal wetlands, particularly in transitional zones or in areas that are only periodically inundated.

Tidal wetlands provide a rich habitat for many species of marine invertebrates, including fiddler crabs (*Uca pugnax and U. pugilator*), grass shrimp (*Palaemonetes spp.*), blue mussel (*Mytilus edulis*), razor clam (*Ensis directus*), hardshell clam (*Mercenaria mercenaria*), Eastern oyster (*Crassostrea virginica*), blue crab (*Callinectes sapidus*), mud crabs (*Panopeus herbstii and Dyspanopeus sayi*), horseshoe crab (*Limulus polyphemus*), and softshell clam (*Mya arenaria*) (Joint Management Team 2008). As with freshwater wetlands, tidal wetlands are important nurseries for fish stock, and they serve as wintering and nesting habitat for many species of shorebirds. The abundance of marine fish and invertebrates provides an important forage habitat for many species of piscivorous birds, including the great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), doublecrested cormorant (*Phalacrocorax auritus*), belted kingfisher (*Megaceryle alcyon*), herring gull (*Larus argentatus*), ring-billed gull (*Larus delawarensis*), and black-crowned night heron (*Nycticorax nycticorax*). A variety of fish species are also commonly encountered in tidal wetlands, including piscivorous species such as the bluefish (*Pomatomus saltatrix*) and striped bass (Joint Management Team 2008; NYSDEC 2009).

An important tidal wetland research facility is also located along the Project's proposed route. The Hudson River National Estuarine Research Reserve is comprised of four tidal wetland sites on the Hudson River estuary and is part of the National Estuarine Research Reserve System. Nearly 5,000 acres of tidal wetlands and upland buffer represent the diverse plant and animal communities of the Hudson River estuary at four locations: Stockport Flats in Columbia County, Tivoli Bays in Dutchess County, and Piermont Marsh and Iona Island in Rockland County. These areas provide critical habitat for a host of natural communities and serves as an important spawning and nursery ground for anadromous and freshwater fish.

NWI and NYSDEC maps identifying wetlands along the Project's proposed route have been provided in Appendix E of this application.

3.5.2 Environmental Impact

The submarine cables will be installed primarily within existing waterbodies linking Lake Champlain with Long Island Sound. Therefore, activities associated with Project construction have the potential to impact wetlands and deep water habitats. Wetlands within the proposed submarine transmission cable corridor are generally classified as riverine, lacustrine, estuarine, or marine unconsolidated bottoms. As such, CHPEI anticipates that any disturbance that may result from burying the submarine transmission cables will be temporary. The water-jetting process allows sediments to backfill the trench, and the Applicant anticipates that animal and plant communities in unconsolidated bottom sediments will quickly re-colonize the area.

The known overland portions of the Project include the sections bypassing Champlain Canal Locks C12, C11, C9, and the PCB dredging activities in the Upper Hudson River; the entry/exit points at the HVDC converter stations, and the HVDC converter stations themselves. Additional overland sections may be necessary in order to avoid existing features such as submerged infrastructure, submarine cables, other locks in the Champlain Canal, significantly contaminated areas, historic sites, and significant fish/wildlife habitat.

At each waterbody exit and entry location there is high potential for wetland impacts, particularly within freshwater floodplains and estuarine intertidal zones. However, most of the impacts to wetlands and nearby waterbodies are expected to be temporary. The sites would be disturbed during trenching for cable placement, but all trenched materials would be maintained on site, returned to their original location, and the area restored to its original condition following construction. Some loss of wetland functions and values may result if site conditions and wetland characteristics are altered (for example, conversion from one community type to another) as a result of Project activities. No wetlands or nearshore tidal areas are expected to be permanently filled or lost as a result of the cable installation component of Project construction.

Two HVDC converter stations and permanent access roads are proposed as part of the Project. Any habitat located within the footprint of these structures would be lost entirely and would be considered a fill activity if the structure were placed in a wetland or waterbody. However, these locations are in highly urbanized settings, and the Applicant will make every effort to ensure permanent structures avoid wetlands and other sensitive areas to the extent practicable. Therefore, no wetlands or nearshore tidal areas are expected to be permanently filled or lost as a result of the construction of structures associated with the Project.

The Applicant is collecting supplemental information regarding freshwater and tidal wetlands along the proposed transmission cable corridor. A detailed assessment of the Project’s potential impacts on wetlands will be provided in the EIS.

3.6 Floodplains

3.6.1 Environmental Setting

The proposed Project will generally follow existing waterways south from the United States/Canadian border to converter stations located in Yonkers, New York, and Bridgeport, Connecticut. While the Applicant intends to minimize overland sections of the Project, existing infrastructure and ongoing remediation activities along the Project's proposed route will require limited sections of the HVDC transmission cables to be installed on land.

Project features may be located on low-lying lands adjacent to waterways that are naturally subject to periodic flooding. These lands have been defined by the Federal Emergency Management Agency (FEMA) as floodplains (44 CFR § 59.1). Land in the floodplain subject to a 1 percent or greater chance of flooding in any given year are designated by FEMA as Special Flood Hazard Areas (SFHAs).

A review of FEMA Flood Insurance Rate Maps (FIRMs) indicates that portions of the Project will be located within or adjacent to floodplains designated as SFHAs. Development activities within areas mapped as SFHAs—including dredging, installation of utilities, drilling operations, filling, grading, or excavations of any type—are regulated by municipalities (Southern Tier Central Regional Planning and Development Board [Southern Tier Board] 2009a). Minimum standards for floodplain development have been established by the federal government. Adherence to local/municipal floodplain development standards may also be required as a condition of compliance with federal or state standards (Southern Tier Board 2009a).

Floodplains within the vicinity of the proposed Project that have been designated as regulatory floodways are subject to additional regulations. Regulatory floodways include the channel of the watercourse and any adjacent land that must be reserved in order to discharge the base flood without cumulatively increasing the water surface more than a designated height (FEMA 2009). Any new encroachment in the floodway that could obstruct flood flows is typically subject to an engineering analysis to determine the potential impact of the proposed development on flood hazards (Southern Tier Board 2009b).

3.6.2 Environmental Impact

In general, the Applicant does not anticipate that the Project will have any significant impacts on floodplains located along the transmission cable corridor. Where possible, the transmission cables will avoid areas designated as SFHAs. Any construction activity that must be undertaken in these areas is not expected to have a long-term impact on the floodplains along the Project's route.

The Applicant's preferred method of cable installation is to bury the submarine cable beneath the beds of existing waterways. However, there be will be sections of the Project's route where the presence of surficial bedrock, existing infrastructure, or other bottom conditions do not permit burial. In these instances, the cables will be laid on the bottom and protected by placing material such as concrete blankets or riprap over the cables. The installation of additional materials within existing waterbodies has the potential to increase the water surface levels. However, the scale of the waterways along the Project's route makes it extremely unlikely that installation of transmission cables will have any appreciable effect on surface water levels.

At present, digital floodplain data has not been compiled by FEMA for the entire transmission line corridor. As available, the mapped floodplains within the vicinity of the proposed Project are presented in Appendix F of this application document. The Applicant is collecting further information regarding floodplains along the proposed transmission cable corridor, including additional maps to supplement the digital coverage available from FEMA. CHPEI anticipated that the EIS will include a detailed assessment of the Project's potential impacts on floodplains and floodplain maps for the Project's entire proposed alignment.

3.7 Threatened and Endangered Aquatic Species

3.7.1 Environmental Setting

The Project will traverse a series of interconnected waterways as it extends southward from Lake Champlain to the New York City metropolitan region. A coarse-level review of the Project's proposed route identified several habitat types likely to occur within the transmission cable corridor. The ranges and distribution of species also suggests that numerous threatened or endangered (T&E) aquatic species may be located and/or have critical habitat along the Project's alignment throughout the year (Table 3.7-1). While several species were identified through this broad assessment, it is expected that consultation with federal and state agencies will further refine the list presented in Table 3.7-1, below.

TABLE 3.7-1
THREATENED AND ENDANGERED AQUATIC SPECIES THAT MAY OCCUR WITHIN THE PROPOSED TRANSMISSION CABLE CORRIDOR
ONLY THOSE SPECIES DESIGNATED AS THREATENED OR ENDANGERED BY CT, NY, OR THE ENDANGERED SPECIES ACT ARE IDENTIFIED

SPECIES		**FEDERAL OR STATE LISTED**		
COMMON NAME	**SCIENTIFIC NAME**	**FEDERAL**	**NEW YORK**	**CONNECTICUT**
Aquatic Mammals				
Finback whale	*Balaenoptera physalus*	E	E	-
Humpback whale	*Megaptera novaeangliae*	E	E	-
Right whale	*Eubalaena glacialis*	E	E	-
Harbor porpoise	*Phocoena phocoena*	-	SC	-
Fishes				
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	E
Lake sturgeon	*Acipenser fulvescens*	-	T	-
Atlantic sturgeon	*Acipenser oxyrinchus*	-	-	T
Mooneye	*Hiodon tergisus*	-	T	-
Eastern sand darter	*Ammocrypta pellucida*	-	T	-
Round whitefish	*Prosopium cylindraceum*	-	E	-
Aquatic Reptiles				
Atlantic Ridley sea turtle	*Lepidochelys kempii*	E	E	E
Leatherback sea turtle	*Dermochelys coriacea*	E	E	E
Green sea turtle	*Chelonia mydas*	T	T	-
Loggerhead sea turtle	*Caretta caretta*	T	T	T

Notes: E = Endangered; T = Threatened; SC = Special Concern; - = Not Listed

Existing information indicates that up to eight federally listed species have the potential to occur in the Project area. These species include:

- <u>Shortnose sturgeon</u>: The shortnose sturgeon typically occurs in estuaries and large coastal rivers. In New York, this species is most often located Lower Hudson River, ranging from the southern tip of Manhattan upriver to the Federal Dam at Troy.
- <u>Atlantic Ridley sea turtle</u>: The Atlantic Ridley sea turtle prefers habitats of sheltered areas along the coastline, such as large estuaries, bays, and lagoons. The waters of Long Island Sound have been identified as a critical habitat for this species.

- Leatherback sea turtle: The leatherback sea turtle is the most pelagic sea turtle and is found regularly in the waters of Long Island Sound.
- Green sea turtle: Green sea turtles prefer inlets, bays, and estuaries. While these turtles do not typically rest on beaches in New York or Connecticut, they may be present in Long Island Sound.
- Loggerhead sea turtle: Loggerhead sea turtles are found in estuaries, coastal streams, and salt marshes along the Atlantic Coast and may be present in Long Island Sound.
- Finback whale, humpback whale, and North Atlantic right whale: These three whale species may also be present in Long Island Sound. In general, these species are more likely to occur outside of the Project area, towards the eastern end of the Sound.

In addition to the New York State-listed T&E species identified in Table 3.7-1, above, the NYSDEC has also identified species of concern within the State. The NYSDEC has determined that these species warrant additional attention, although current information does not justify listing the species as threatened or endangered. The harbor porpoise is currently listed in New York as a species of concern.

Significant Habitats

There are no marine mammal protected areas or known USFWS-designated critical habitats near the Project's anticipated route. There is, however, one marine protected area (MPA) located within the proposed transmission cable corridor. As described in Section 3.5.1, the Hudson River National Estuarine Research Reserve is an MPA comprised of four tidal wetland sites on the Hudson River estuary. The MPA is part of the National Estuarine Research Reserve System and includes four disparate coastal wetlands along a 100-mile-long stretch of the Lower Hudson River. Activities conducted at this MPA include estuarine research, stewardship, and education. Nearly 5,000 acres of tidal wetlands and upland buffer represent the diverse plant and animal communities of the Hudson River estuary. Components of this MPA are located at Stockport Flats in Columbia County, Tivoli Bays in Dutchess County, and Piermont Marsh and Iona Island in Rockland County. These areas provide critical habitat for a host of natural communities and serve as an important spawning and nursery ground for anadromous and freshwater fish.

3.7.2 Environmental Impact

Potential environmental impacts will differ between aquatic T&E species. Fish species may be temporarily displaced by Project construction activities, either directly by cable installation equipment or indirectly by exposure to short-term changes in suspended sediments and turbidity. Fish displacement along the proposed route will be limited to the period of active cable installation. Fish present during cable installation are capable of avoiding the installation equipment and areas temporarily affected by increased turbidity.

Potential impacts would be limited to primarily demersal (bottom-oriented) species and life-stages. These impacts are expected to be short term, but will potentially affect species that rely on benthic habitats for food, cover, or spawning habitat. Pelagic species and life-stages are expected to continue using the water column during cable installation, although there may be avoidance of the small portion of the water column occupied by cables and cable installation equipment during the installation process.

For aquatic mammals and reptiles, the cable installation process should represent a limited and avoidable disturbance. The slight changes in water quality associated with sediment disturbance and turbidity during installation should not pose a significant impact on any of these species.

The Applicant is collecting supplemental information regarding the Project's potential impacts on aquatic T&E species along the proposed transmission cable corridor. A detailed assessment of the Project's potential impacts on aquatic T&E species will be provided in the EIS.

3.8 Terrestrial Threatened and Endangered Species

3.8.1 Environmental Setting

The proposed transmission cables will primarily follow existing waterways as it extends southward from the international boundary between the United States and Canada. In general, the Applicant anticipates that minimizing the required overland sections of the transmission cable route will significantly reduce the overall costs associated with Project construction. However, existing infrastructure and ongoing remediation activities along the Project's route will require limited sections of the HVDC transmission cable to be installed on land. The Project will follow an overland route when necessary to avoid infrastructure such as locks along the Champlain Canal, or to avoid historic sites and important fish/wildlife habitat. Other sections of the transmission cables will be routed overland to avoid significantly contaminated sections of waterways and the ongoing remediation activities associated with the Upper Hudson River PCB Dredging Project. The overland sections required to avoid this ongoing PCB dredging work will follow an existing railroad ROW to avoid impacts to previously undisturbed land. The Applicant intends to route other overland sections through similar areas to minimize Project impacts to the terrestrial environment.

A preliminary review of the Project's proposed route identified several terrestrial habitat types likely to occur within the transmission cable corridor. The ranges and distribution of species also suggests that numerous T&E terrestrial species or species of special concern may be located and/or have critical habitat within the proposed transmission cable corridor throughout the year (Table 3.8-1). While several species were identified through this broad assessment, it is expected that consultation with federal and state agencies will further refine the list presented in Table 3.8-1, below.

TABLE 3.8-1
THREATENED AND ENDANGERED TERRESTRIAL SPECIES THAT MAY OCCUR WITHIN THE PROPOSED TRANSMISSION CABLE CORRIDOR
ONLY THOSE SPECIES DESIGNATED AS THREATENED OR ENDANGERED BY CT, NY, OR THE ENDANGERED SPECIES ACT ARE IDENTIFIED

SPECIES		FEDERAL OR STATE LISTED		
COMMON NAME	**SCIENTIFIC NAME**	**FEDERAL**	**NEW YORK**	**CONNECTICUT**
Birds				
Piping plover	*Charadrius melodus*	T	E	T
Roseate tern	*Sterna dougallii*	E	E	E
Bald eagle	*Haliaeetus leucocephalus*	EP	T	E
Spruce grouse	*Falcipennis canadensis*	-	E	-
Upland sandpiper	*Bartramia logicauda*	-	T	E
Peregrine falcon	*Falco peregrinus*	-	E	E
Common tern	*Sterna hirundo*	-	T	SC
Least Tern	*Sterna antillarum*	-	T	T
Sharp-shinned hawk	*Accipiter striatus*	-	SC	E
Northern harrier	*Circus cyaneus*	-	T	-
Loggerhead shrike	*Lanius ludovicianus*	-	E	-
American kestrel	*Falco sparverius*	-	-	T
Short-eared owl	*Asio flammeus*	-	E	T
Grasshopper sparrow	*Ammodramus savannarum*	-	SC	E
Great egret	*Ardea alba*	-	-	T
American bittern	*Botaurus lentiginosus*	-	SC	E

SPECIES		FEDERAL OR STATE LISTED		
COMMON NAME	SCIENTIFIC NAME	FEDERAL	NEW YORK	CONNECTICUT
Osprey	*Pandion haliaetus*	-	SC	-
Least Bittern	*Ixobrychus exilis*	-	T	T
Snowy egret	*Egretta thula*	-	-	T
Horned lark	*Eremophila alpestris*	-	SC	E
Golden-winged warbler	*Vermivora chrysoptera*	-	SC	E
Sedge wren	*Cistothorus platensis*	-	T	E
Terrestrial Mammals				
Least shrew	*Cryptotis parva*	-	-	E
Indiana bat	*Myotis sodalis*	E	E	E
Terrestrial Reptiles				
Queen snake	*Regina septemvittata*	-	E	-
Eastern massasauga	*Sistrurus catenatus*	-	E	-
Timber rattlesnake	*Crotalus horridus*	-	T	-
Fence lizard	*Sceloporus undulatus*	-	T	-
Five-lined skink	*Eumeces fasciatus*	-	-	T
Invertebrates[1]				
Karner blue butterfly	*Lycaeides melissa samuelis*	E	E	-
Plants[1]		-		
Seabeach amaranth	*Amaranthus pumilus*	T	-	-
American Hart's-tongue fern	*Asplenium scolopendrium americanum*	T	-	-
Sandplain gerardia	*Agalinis acuta*	E	-	-
Northern wild monkshood	*Aconitum noveboracense*	T	-	-
Small Whorled pogonia	*Isotria medeoloides*	T	-	-

Notes: E = Endangered; T = Threatened; SC = Special Concern; EP = Bald and Golden Eagle Protection Act; - = Not listed or unlikely occur within the Project's vicinity; * = Extirpated

[1] An additional 37 invertebrates and 156 plants are state-listed species in Connecticut, and 510 plants are state-listed in New York. Only federally listed invertebrates or plants are shown in this table.

The nature and character of terrestrial resource areas vary considerably along the extent of the proposed Project. The glaciated St. Lawrence-Champlain Plain south of the international border is dominated by broad, nearly level sandy deltas and lacustrine basins. A thin mantle of till covers the region, although extensive areas of sandy glacial outwash and eolian deposits also occur. Local relief is provided by glacial till ridges, hills, till plains, and outwash terraces that are interspersed across the lake plain. In the Champlain Valley, these deposits are underlain by marine sediments deposited during the Wisconsin glaciation (Natural Resources Conservation Service [NRCS] 2006).

The St. Lawrence-Champlain region is overwhelmingly rural, with farms and forestland dominating the landscape. The region supports both hardwood and conifer forests, although the beech-birch-sugar maple forest type is the principal climax forest type on uplands (NRCS 2006). Typical tree species include basswood (*Tilia spp.*), American elm (*Ulmus americana*), white pine

(*Pinus strobus*), black cherry (*Prunus serotina*), white ash (*Fraxinus americana*), and maple species (*Acer spp.*). Sawlogs, pulpwood, maple syrup, and Christmas trees are the principal forest products produced across the region. Dairy farms and beef operations are common, as are grain and corn grown for silage (NRCS 2006).

Significant indigenous animal species common to the region include white-tailed deer (*Odocoileus virginianus*), American black bear (*Ursus americanus*), ruffed grouse (*Bonasa umbellus*), and furbearing mammals, such as red fox (*Vulpes vulpes*), beaver (*Castor canadensis*), and muskrat (*Ondatra zibethicus*) (NRCS 2006). Several state-listed T&E terrestrial species or species of special concern may occur within this section of the Project's proposed route, including the Peregrine falcon, short-eared owl, and the timber rattlesnake.

South of St. Lawrence-Champlain region, the transmission cables will enter a glaciated upland area of rolling hills along the Hudson River Valley (NRCS 2006). This central section of the Project begins near Fort Edward and extends south to the northern boroughs of New York City. The central section of the transmission cable corridor is characterized by till plains and drumlins dissected by narrow valleys (NRCS 2006). A thin mantle of till, glacial lake sediments, and outwash deposits form the primary parent materials for soils along this section of the Hudson River (NRCS 2006).

The Hudson River flows through a drowned river valley that was inundated by rising ocean levels following the Wisconsinan glaciation. South of the Federal Dam at Troy, the Hudson River is tidally influenced and is characterized as an estuary. This distinctive estuary environment creates several unique habitat types along the central portion of the transmission cables, including tidal wetlands, freshwater tidal areas, coastal grasslands, heaths, and dunes (NRCS 2006).

Much of the Hudson River Valley was cleared for agriculture during the colonial period. Over the last 100 years, a great deal of agricultural land has been abandoned, and the area experienced a period of reforestation (NRCS 2006). Currently, the Hudson River Valley supports a mixture of northern and central hardwood forests. Major deciduous tree species include sugar maple (*Acer saccharum*), birch (*Betula spp.*), beech (*Fagus spp.*), oaks (*Quercus spp.*), and hickories (*Carya spp.*). White pine and hemlock (*Tsuga spp.*) are the primary conifers. Upland areas along the central section of the Project also support several distinctive habitat types, including limestone fens, rocky summits, peat bogs, and sand barrens. Lakes, rivers, swamps, and streams are also widespread across the Hudson River Valley (NRCS 2006).

Woodland animal species, including the black bear, beaver, white-tailed deer, turkey, and a variety of songbirds, are relatively common in the region. The Hudson River Valley, particularly the section south of Troy, is experiencing rapid urban and suburban expansion. The growth of suburban communities north of New York City provides habitat for animals that are adaptable to human behavior and settlement (NRCS 2006). In many of these communities, former agricultural land has been repurposed for residential communities. The population of species such as the Eastern gray squirrel (*Sciurus carolinensis*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), and white-tailed deer are increasing in these areas.

Several state-listed terrestrial T&E species or species of special concern may potentially be present along the central section of the transmission line corridor. These species include the Karner blue butterfly, northern cricket frog, and upland sandpiper.

As the transmission cable approaches New York City, it enters an area of coastal lowlands characterized by nearly level to rolling plains. The glaciated coastal plain in comprised of deep outwash deposits of sand and gravel overlain by a thin mantle of glacial till (NRCS 2006). The diversity and availability of terrestrial habitat types diminishes as the proposed transmission cable corridor approaches the dense urban areas of New York City. Much of the landscape in the New York City area has been significantly modified by urban development. Dredge and fill activities have shaped the waterways and altered the original topography. Glacial till, outwash, post-glacial marine sediments, and anthropogenic fill form the primary parent materials for soil formation along this section of the transmission cable corridor (New York Soil Survey 2005). Terrestrial wildlife species likely to occur along this section of the Project's alignment are generally well-adapted to the urban environment. These species include the Norway rat (*Rattus norvegicus*), Eastern gray squirrel, raccoon, pigeon (*Columba livia*), and sparrow (*Passer sparrow*) (NRCS 2006). The Peregrine falcon is among the few state-listed T&E terrestrial species potentially occurring within the urban environment of the New York City metropolitan area.

Sand dunes, intertidal marshes, mudflats, and high salt marshes are all prevalent along the coastlines of Long Island Sound. These unique habitat areas support a variety of terrestrial species, including several species of birds. Black duck (*Anas rubripes*), great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), doublecrested cormorant (*Phalacrocorax auritus*), and great blue heron (*Ardea herodias*) commonly occur in these tidal wetland areas (Joint New York State Department of Environmental Conservation / Stony Brook University Flax Pond Unit Management Plan Development Team [Joint Management Team] 2008). State-listed terrestrial T&E species or species of special concern that may occur along the coastal regions of Long Island Sound include the short-eared owl least tern, osprey, and the red-shouldered hawk (Joint Management Team 2008).

Federally listed T&E terrestrial species that may occur along the Project's proposed route include piping plover and roseate tern. Both these species inhabit sandy coastal areas of New York and Connecticut, including the coastlines of Long Island Sound. The Indiana, bat which inhabits wooded and riparian areas in the Hudson River Valley, may also occur along the Project's alignment. The federally listed Karner blue butterfly is found in dry sandy areas with open woods and clearing within the Hudson River Valley sand belt. In addition to the animal species, the five plant species listed in Table 3.8-1 may also occur along the proposed transmission cable corridor. The bald eagle, although not an Endangered Species Act-listed species, is protected under the Bald and Golden Eagle Protection Act and may occur in the Project's vicinity. The bald eagle inhabits environments in close proximity to large waterbodies, including lakes, rivers, estuaries, and nearshore areas along the coast.

<u>Significant Habitats</u>

While there are no known USFWS designated critical habitats in the Project area, the NYSDEC has identified several distinct types of vegetative communities that provide habitat for rare, threatened, or endangered plants and animals along the corridor route. The New York State Department of State (NYSDOS) has identified Significant Coastal Fish and Wildlife Habitat throughout the Project corridor. In addition, portions of the corridor route that traverse the Hudson River and Long Island Sound have been designated as ESH.

3.8.2 Environmental Impact

From the United States/Canadian border, the transmission cables will be laid within waterbodies that include Lake Champlain, the Champlain Canal, Hudson River, Spuyten Duyvil Creek, the Harlem River, the East River, and Long Island Sound. The known overland portions of the Project is the section bypassing the PCB dredging activities in the Champlain Canal, the cables' entry/exit points at the HVDC converter station locations, and the construction footprint of the HVDC converter stations and appurtenant facilities. Additional overland routes may be necessary in order to avoid features such as submerged infrastructure, locks along the Champlain Canal, significantly contaminated sites, historic resources, and significant fish/wildlife habitat.

The terrestrial impacts associated with cable installation are expected to be temporary. The sites would be disturbed during trenching for cable placement, but all trenched materials would be maintained on site, returned to their original location, and the area restored to its original condition following construction. Mobile species would avoid the area during construction and utilize similar habitats nearby. The primary impact would be the potential for direct mortality of plants and species of low mobility within the disturbance footprint. To the extent practicable, the Applicant will undertake efforts to avoid or minimize potential impacts to T&E species and to ensure that no significant wildlife habitats are altered or permanently lost as a result of the cable installation component of the Project.

The primary permanent terrestrial impacts from the Project would be the installation of the two HVDC converter stations and appurtenant facilities. Any habitat located within the footprint of a structure would be lost entirely, and species dependant on that habitat would relocate permanently. Plants and immobile species unable to avoid the area during construction could also suffer direct mortality. However, these sites are located in highly urbanized areas and efforts will be made to ensure permanent structures avoid sensitive areas and T&E species. The Applicant does anticipates that no T&E species will be directly negatively affected by the Project and no significant wildlife habitats will be altered or permanently lost as a result Project construction.

The Applicant is collecting supplemental information regarding the terrestrial T&E species and species of concern along the proposed transmission cable corridor. A detailed assessment of the Project's potential impacts on these species will be provided in the EIS.

3.9 Historic and Cultural Resources

3.9.1 Environmental Setting

The proposed Project corridor includes portions of southeastern New York, the Hudson River Valley, the Lake Champlain region, Long Island Sound, and the southern New England coastline. Waterways in these regions have served as important conduits for transportation, communication, and trade throughout the prehistoric and historic periods. There is a long and detailed body of research regarding the prehistoric and historic occupations of these regions, including archaeological investigations and historical studies. While a meticulous description of the prehistoric and historic periods is beyond the scope of this application document, key events and activities along the transmission cable corridor have been summarized to provide an overview of the cultural and historic resources potentially located in the vicinity of the proposed Project.

<u>Prehistoric Period</u>

Rivers, lakes, estuaries, and coastal areas in the vicinity of the Project have been used by Native American groups since the end of the Pleistocene epoch. During the Wisconsinan glaciation, the proposed transmission cable corridor was blanketed by continental glaciers that once extended as far south as Long Island. Glacial retreat at the end of the Pleistocene exposed a landscape that had been significantly modified by ice. The postglacial environment that confronted the first Americans was vastly different than that of the present day, and Paleoindian groups entering the eastern New York/southern Connecticut region would likely have encountered a mosaic of rapidly changing environments. Paleoenvironmental reconstruction suggests that the extent of environments along the proposed transmission cable corridor may have ranged from spruce parkland and tundra in the north to grasslands along the Atlantic Coastal Plain, near present-day New York City (Carr and Adovasio 2002). The Pleistocene megafauna that initially inhabited this environment (mastodon, mammoth, bison) became extinct at the end of the Late Glacial episode and were replaced by modern species, including elk, moose, and caribou (Carr and Adovasio 2002).

Archaeological evidence suggests that Paleoindian hunter-gatherers entered the eastern New York region at least 11,300 years ago (Laub 2002). Seasonal changes in resource availability meant that Paleoindian groups developed resource procurement strategies that required seasonal migration. Despite this migratory pattern, it is probable that these groups returned to known occupation sites that were close to critical resources, such as water and lithic raw materials. Intact archaeological sites in the Northeast and in the New England-Maritimes suggest that Paleoindian populations favored rich ecological zones associated with swamps, rivers, and postglacial lakes (Pasquariello and Loorya 2006). Archaeologically, Paleoindian artifact assemblages within the Northeast are dominated by lithic technologies, particularly fluted projectile points, utilized flakes, and smaller bifacial tools, such as scrapers and burins (Carr and Adovasio 2002). Paleoindian populations also relied heavily on perishable technologies, such as textile, bone, and wooden tools. However, differential preservation of archaeological materials typically makes these technologies far less visible in the artifact assemblages from known sites in the region.

In general, Paleoindian sites are uncommon in the Northeast. A number of factors contribute to the lack of sites from this period. While several fluted points have been recovered along the proposed transmission cable corridor, the age of Paleoindian deposits, subsequent landscape modifications, and associated ground disturbance make the likelihood of encountering intact Paleoindian sites relatively low. Other significant factors that affect the visibility of intact sites include the low population densities during the Paleoindian period, the nature of material culture types common to hunter-gatherer groups, and the general environmental conditions in the region at the end of the Wisconsinan glaciation. Natural changes in the landscape may also affect the archaeological sensitivity of the Project’s proposed route, and the relationship between modern landscape features and the paleoenvironmental landscape requires additional analysis to determine if areas of high probability exist.

A warming climate and a greater ecological diversity following glacial retreat prompted changes in subsistence strategies and technologies (Ritchie 1965). The Archaic period (10,000-3,000 years ago) saw the emergence of mixed deciduous-coniferous forests and the appearance of essentially modern faunal assemblages in the Northeast (Quinn et al. 1999). Technological developments, such as smaller projectile points, indicate a trend towards hunting strategies that relied on smaller, locally available fauna, such as white-tailed deer, turkey, waterfowl, and black bear. Seasonal availability of game animals, aquatic resources, and wild plant foods continued to make hunting and foraging successful resource procurement strategies, particularly in coastal areas. These strategies contributed to a population growth throughout the Northeast during the Archaic period (Fagan 2000).

Although the Early Archaic is poorly understood in New York, sites from this period have been identified in the Upper Hudson River drainage and in the southeastern portion of the state. Projectile points associated with the Early Archaic have been found along the Hudson River Valley, but single-component sites have not been excavated in this region.

Within the Project area, the Middle Archaic is characterized by an adaptive strategy that relied on a combination of hunting, fishing, and gathering (Pasquariello and Loorya 2006). Middle Archaic sites are typically associated with rivers, swamps, lakes, estuaries, and coastlines. The proximity of these sites to existing waterways suggests that Middle Archaic populations were exploiting seasonal fish runs and bird migrations along the Eastern Flyway (Pasquariello and Loorya 2006). The emergence of ground and polished stone tools during the Middle Archaic indicate that techniques to process nuts and edible plants were also becoming better refined during this stage (Ritchie 1965).

The Late Archaic saw the fluorescence of a number of cultural manifestations across the Northeast. In the vicinity of the Project, Late Archaic sites from the Laurentian Tradition and the Lamoka phase have been identified. While the relationship between these two phases in New York is somewhat unclear, it is apparent that by the Late Archaic period cultural diversity was expanding rapidly (Quiggle 2008). The settlement patterns that developed in resource-abundant areas suggest the use of seasonal base camps to augment migratory resource procurement strategies. This semi-sedentary pattern is represented by an increase in the number house structures, storage pits, and larger quantities of organic food remains (Quinn et al. 1999; Ritchie

1965). While typical Late Archaic sites in the vicinity of the Project continue to be relatively small, they are found on all landforms and environmental areas.

Archaeologists have long recognized a Terminal Archaic period that bridges the Archaic and Woodland periods in the Northeast (Ritchie 1965). Characteristics of the Terminal Archaic include the use of steatite cooking vessels and the appearance of Orient Fishtail projectile points. Orient Fishtail points are typically found throughout the Long Island, southern New England, and the Hudson River Valley, although morphological correlates have been identified throughout the Northeast (Justice 1987).

The most significant technological development to occur during the Woodland period (3,000 years ago—AD 1550) was the widespread manufacture and use of ceramic vessels. Ceramic vessels appeared in isolated areas in eastern North America during the Late Archaic, but became only regionally significant in the Northeast approximately 3,000 years ago (Quinn et al. 1999). Ceramic manufacture reflects increasingly sedentary settlement patterns and a growing dependence on domesticated plants, although evidence for cultigens is somewhat lacking for much of the Northeast during the Early Woodland period.

Although the variety of cultural manifestations continued to appear throughout the Woodland period, a regional assessment indicates that Middle Woodland populations continued a shift toward more sedentary communities. Marine resources—particularly shellfish—became increasingly important during the Middle Woodland, and researchers have identified an increase in coastal and riverine settlements during the period (Pasquariello and Loorya 2006).

Maize, bean, and squash agriculture became an important source of subsistence during the Late Woodland period (Quiggle 2005). Major sociopolitical changes accompanied the widespread adoption of cultivation practices, including increased territorialization and changes in residence patterns. These changes led to the emergence of an identifiable Iroquoian Tradition within western, central, and northern New York State by AD 1300. At the time of European contact, people speaking closely related Eastern Algonquian dialects occupied southern New England, eastern Long Island, and sections of the Hudson River Valley, near present-day Albany (Pasquariello and Loorya 2006; Ritchie 1965).

Large, nucleated semi-permanent Iroquoian settlements were originally located along floodplains, river terraces, or coastlines. However, by the 1300s, Iroquoian communities began to relocate villages to defensible upland areas. In many cases, these villages were protected by stockade walls erected as an additional fortification. Conversely, Algonquian-speaking populations in the Project's vicinity generally occupied small, decentralized camps. Both Algonquian and Iroquoian communities were oriented around maize, bean, and squash cultivation in fields near settlements. Temporary upland camps and task-specific activity sites augmented the resources available in the lowland areas surrounding villages.

In contrast to their Iroquoian and Algonquian-speaking neighbors, southeastern New York was occupied by people speaking a Munsee dialect of the Delaware language at the close of the Late Woodland. The Munsee cultural area stretched along the "Lower Hudson River Valley and across western Long Island across southeastern New York and northern New Jersey to northwestern Pennsylvania above the Forks of the Delaware" (Grumet 1995). Sixteenth century Munsee, Iroquoian, and Algonquian-speaking populations apparently shared many common life-ways typical of Late Woodland peoples in the Northeast. However, there is little archaeological evidence to indicate that Munsee communities cultivated plants prior to European arrival in the Americas. The lack of arable soils, dearth of archaeological evidence of agriculture, and the abundant marine resources in the region all suggest that the Munsee's primary resource procurement strategy emphasized hunting, fishing, and gathering practices (Grumet 1995). Archaeological evidence indicates that semi-sedentary Late Woodland Munsee communities were located along major drainages and coastlines, but it does not appear that they built fortified villages.

Historic Period

Ephemeral contact between Native Americans and Europeans along the Atlantic Coast may have begun as early as the 1490s. Unverified evidence from archival records indicates that European fishing fleets may have made landfall along the coast of Newfoundland and the Gulf of St. Lawrence toward the end of the 15th century (Grumet 1995). In 1524, Italian explorer Giovanni da Varrazzano made the first documented contact with Native Americans along the Atlantic seaboard. Shortly after Varrazzanno's encounter, French explorer Jacques Cartier traveled inland along the St. Lawrence River to present-day Montreal and made contact with St. Lawrence Iroquoian groups in the region. Hostilities between Native Americans and the French limited trade relations and stifled European attempts to establish a colony in the region during the 1500s (Grumet 1995). Notwithstanding these difficulties, archaeological evidence indicates that European trade items were obtained by indigenous coastal groups from European fishing and whaling fleets and made their way inland through trading intermediaries during the 16th century (Quiggle 2008).

The 17th century was a period of tremendous social and political upheaval across the entirety of Northeastern North America. Sustained contact in the vicinity of the proposed Project began with Samuel de Champlain's exploration of the region in 1609 (Lake Champlain Maritime Museum [LCMM] 2009a). The same year, Dutch explorer Henry Hudson navigated the river that now bears his name north to the present-day City of Albany (Grumet 1995). European settlers that soon followed these explorers encountered an indigenous population wracked by epidemic diseases brought from the Old World. Waves of epidemics killed thousands of Native Americans living in the Northeast during the early contact period. These epidemics were compounded by internecine hostilities fostered by competition for access to European trade goods (Quiggle 2006). Warfare among indigenous populations would kill thousand of Native Americans and force others to flee the region during the 17th century (Grumet 1995).

Territorial expansion also caused conflict between Native Americans and European settlers pushing inland up the Hudson, Connecticut, and St. Lawrence River valleys. Regional conflicts such as the Pequot War ravaged both Indian and colonial communities throughout the region. European settlers and their Indian allies also attacked other settlements in the Northeast in an attempt to wrest political control of the region (Grumet 1995). These conflicts were primarily motivated by access to trade goods and Old World rivalries that spread to the colonies. Defenses sprang up at sites along the Champlain Valley as the French and British struggled for control of waterways that provided transportation for furs and other trade items (LCMM 2009b). In the southeast of the region, New York City passed through Dutch hands twice before finally falling to the English in 1673 (Grumet 1995). This struggle for military control over important waterways and ports would continue throughout most of the seventeenth and eighteenth centuries.

Despite widespread conflict, the European powers were able to gain a tentative foothold in the region. By the 18th century, farms dotted the Hudson River Valley, and cities such as Kingston, Albany, and New York had become important English strongholds in the New World. The Champlain Valley remained a contested area throughout this period, and the French attempted to solidify control over the important transportation route provided by Lake Champlain through construction of a series of defenses at Crown Point (LCMM 2009b). In 1754, French attacks on a British fort along the Connecticut River reignited large-scale regional conflict. The Champlain and Lake George regions became hotbeds of military activity during the French and Indian War, as the colonial powers and their Indian allies fought a bloody and protracted battle for control of the continent. After the fall of Fort William Henry, France was able to exercise military control over the region through its naval forces on Lake Champlain and the French forts at Ticonderoga, Crown Point, and Chimney Point (LCMM 2009b). This control was short-lived, as the British returned with a large naval flotilla in 1759. British troops and warships attacked French ships on Lake Champlain and the garrisons at Crown Point and Ticonderoga. Undersupplied and outnumbered, France lost control of its major fortifications in the region by 1760. The 1763 Treaty of Paris ended the French and Indian War and brought a temporary peace to the Champlain Valley (LCMM 2009b).

The proposed transmission cable corridor was again the scene of conflict during the American Revolution. From Lake Champlain to Long Island, the entire region was embroiled in the struggle for American independence. At the outset of the conflict, American forces under Ethan Allen and Benedict Arnold captured the British fortifications at Ticonderoga and Crown Point in a daring surprise attack. Subsequent victories in the region gave the Americans control of the lake and access to Canada. Despite these early successes, the attempt to invade Canada ultimately failed, and the American Army was forced to retreat overland in early 1776 (LCMM 2009c). The Americans were able to command Lake Champlain with a small naval force that included captured British vessels and ships built at local American shipyards on the lake. This control ended in 1776, with the British defeat the American naval forces at the Battle of Valcour Island. Notwithstanding this naval success, the British were unable to dislodge the American forces from the redoubts at Ticonderoga and Mount Independence during the 1776 campaign. Consequently, the British again returned to the Champlain Valley in 1777 (LCMM 2009c). British General John Burgoyne was able to secure the undefended Mount Defiance above the

American garrisons and fired a fusillade from cannons stationed on the high ground. The American forces were forced to retreat and to relinquish control of Lake Champlain throughout the reminder of the war (LCMM 2009c).

In the south, New York became an occupied city after the fledgling American Army fled north following the Battle of Long Island (Pasquariello and Loorya 2006). North of New York, present-day Westchester County was known as the "Neutral Ground" that separated the British and American forces. Despite this moniker, Westchester County was the scene of the battles of Pelham and White Plains in 1776 (Pasquariello and Loorya 2006). The region was home to both Tory sympathizers and revolutionaries, and it remained a hotbed of partisan activity throughout the war.

Early in the conflict, both the American and British forces recognized the strategic importance of controlling traffic on the Hudson River. The Americans attempted to block the British fleet from gaining access to the interior by constructing an iron chain across the river near Fort Montgomery (United States Military Academy [USMA] 2009). When this attempt failed, General George Washington sought to establish fortifications upstream from Fort Montgomery at a high plateau with commanding views of the river valley. In 1779, an American military garrison was established at West Point, near the present-day village of Highland Falls, New York. The fortifications included a 150-ton iron "Great Chain" strung across the Hudson control river traffic. Although the Great Chain was never tested by the British fleet, the garrison nearly fell into British hands toward the end of the conflict (USMA 2009). In 1780, Benedict Arnold was given commend of West Point. Arnold's attempt to pass detailed plans of the fortifications to the British was discovered, and Arnold narrowly escaped down the Hudson on a British sloop. Today, the garrison at West Point is home to the U.S. Military Academy, and is the oldest continuously occupied military outpost in the United States (USMA 2009).

A critical American victory took place upriver from West Point near Albany, New York. In 1777, American forces defeated Burgoyne's army at the Battle of Saratoga, giving the Americans an important strategic victory. Often called the turning point of the American Revolution, the victory at Saratoga also convinced the French to ally themselves with the Americans (NPS 2008). With the assistance of the French, the American forces were able to defeat the British at the Battle of Yorktown in 1781. The conflict was formally ended with signing of the Treaty of Paris in 1783.

The 19th century was characterized by increased economic growth throughout the region. The War of 1812 brought further conflict to the Champlain Valley, as British and American forces again sought control of Lake Champlain. The defeat of the British Royal Navy in 1814 essentially ended the era of naval fleets on the lake and brought a sustained peace to the region (LCMM 2009d). While raw materials such as timber, potash, and iron were becoming economically important, growth in the Champlain Valley was complicated by the difficulty in transporting raw goods and bulk materials south to processing and manufacturing centers (LCMM 2009e). The construction of the Champlain Canal between 1817 and 1823 provided a vital link between communities in the north and manufacturing centers along the Hudson River and the Atlantic seaboard (Hartgen Archaeological Associates, Inc. [HAA] 2009). The canal underwent several realignments and improvements throughout the 1800s to accommodate increased traffic and larger vessels.

Brick manufacturing, quarrying, iron smelting, and ice cutting became important industrial activities along the Hudson River Valley during the 19th century, fueled in part by the successes of the Erie and Champlain Canals that connected distant markets (Pasquariello and Loorya 2006). The growth of the railroads decreased the significance of the canal system, but brought new economic benefits to the region. Although the northern sections of Manhattan had remained sparsely populated and primarily agrarian throughout the 18th century, the influx of immigrants into the New York City region provided an important stimulus for the growth of the city during the 19th century. Commercial shipping and manufacturing supported New York City’s rise as a regional and national economic center, and similar activities along the coastline of Long Island Sound allowed for the development of cities such as Stamford, Connecticut. The firearms industry was an important factor in the growth of Bridgeport, which saw the development of the largest munitions factory in the world during the 1800s.

The Champlain Canal was replaced by the modern Barge Canal in the early 20th century. Although the Barge Canal was an attempt to revitalize the canal system, commercial traffic peaked in the 1890s and has continued to decrease. Today, Lake Champlain and the Champlain

Valley remain popular recreation destinations. South of the canal, the central New York region is centered on the capital city of Albany. The Lower Hudson River Valley experienced increased suburban growth and development following World War II.

The New York City region continues to be one of the largest population centers in the United States, with an increasing dependence on the financial and service sectors. While the western section of the Long Island coastline is characterized by urban and suburban development associated with New York City, the eastern portion of the coast has become a tourist destination. Western sections of the Connecticut coastline along the Project's proposed route are characterized as the "Gold Coast" region of the state. These communities, including Greenwich, Stamford, and Norwalk, have experienced suburban growth in the wake of a declining manufacturing base. Multimillion dollar estates and private developments dot the Connecticut coastline in the vicinity of these economic centers. Connecticut's largest city, Bridgeport, has experienced a decline in the manufacturing sector that has had a significant economic impact on the city and its environs.

3.9.2 Environmental Impact

Federal, state, and local statutes governing the protection of historic properties have applicability to the proposed Project. Section 106 of the National Historic Preservation Act of 1966, as amended (Section 106), establishes the statutory responsibilities of federal agencies to consider the effects of their undertakings on historic properties listed in or eligible for inclusion in the National Register. Because the Project will require federal permits, Section 106 and its implementing regulations at 36 CFR § 800 are applicable to the entire undertaking.

In addition to Section 106, portions of the Project permitted by the New York State Public Service Commission are subject to the provisions of Section 14.09 of the New York State Historic Preservation Act of 1980 (Section 14.09). Section 14.09 requires state agencies to consult with the State Historic Preservation Officer (SHPO) if it appears that any project may cause any change, beneficial or adverse, to historic properties listed in or eligible for inclusion in the National or State Registers of Historic Places.

The environmental permitting process required by the New York State Public Law Article VII and the Connecticut Public Utility Environmental Standards Act also require applicable state agencies to consider the effects of proposed projects on historic resources. For purposes of the New York City Environmental Quality Review, the New York City Landmarks Preservation Commission (LPC) serves as the city's expert agency for historic resources and is typically consulted prior to authorizing projects that require discretionary action by city agencies. Pursuant to the New York City Landmarks Law of 1965, the LPC is also the agency responsible for regulating construction and improvements at New York City Landmark sites and districts.

The Project has the potential to effect historic properties, including, buildings, structures, objects, districts, and sites listed in or eligible for inclusion in the National Register of Historic Places (National Register). The proposed transmission cable corridor will be located along historically significant waterways in New York and Connecticut. This corridor follows sections of waterways where historic shipwrecks have been reported and which may potentially include Pleistocene terraces suitable as prehistoric occupation sites. The transmission line will also be located in the vicinity of historic buildings and structures, including historic canalways and their associated infrastructure. The terminal converter stations and overland bypass sections of the route may be located in archaeologically sensitive areas or in the vicinity of other historic resources.

Project construction has the potential to affect the integrity and character-defining features of historic properties. Installation of the transmission cables will require subsurface trenching that could impact buried archaeological deposits or damage historic shipwrecks. Based on a review of the New York SHPO's public geographic information system (GIS), the entire New York section of the Project corridor is considered an archaeologically sensitive area. Although there are limited terrestrial portions of the transmission line, those sections are located in areas that may have significant prehistoric and historic period cultural deposits. Additionally, it is possible that submerged deposits exist along portions of the proposed Project alignment. Submerged prehistoric period cultural material may have been deposited prior to marine transgression, and intact sites may exist along undisturbed portions of waterways. Historic period archaeological deposits are also known to exist in the vicinity of the Project, including sites associated with the military and commercial history of the region.

Numerous shipwrecks have been mapped along the proposed transmission line route or in the vicinity of the Project. The historical significance and integrity of these shipwreck sites have not been reported. The LCMM has conducted extensive investigations to maps and record hundreds of shipwrecks and submerged archaeological sites in Lake Champlain. Southward along the transmission cable corridor, researchers have reported over 200 potential shipwrecks along the Lower Hudson River. While only a portion of these wrecks have been mapped by the National Oceanographic and Atmospheric Administration (NOAA), the New York SHPO has indicated that the remaining sites have been recorded by the DEC. Although hundreds of shipwrecks have been mapped within Long Island Sound, NOAA data indicates that only 17 wrecks are located in the vicinity of the proposed Project alignment.

Several historic buildings, structures, and districts that are listed in the National Register are located along the proposed Project alignment. These historic properties include locks along the Champlain Canal, districts that encompass portions of the canal itself, and historic bridges along the Hudson River. These resources are all located along the proposed Project alignment, and they may potentially be directly affected by installation of the Project. The Project may also impact resources associated with National Heritage Areas and New York State Heritage Areas, including the Mohawk Valley Heritage Corridor and the “RiverSpark” (Hudson-Mohawk) Heritage Area.

Construction of the Project has the potential to affect historic properties listed in or eligible for inclusion in the State or National Registers. The Applicant is collecting supplemental information and field data regarding the Project’s potential impacts on cultural resources along the proposed transmission cable corridor. These efforts are being coordinated with the SHPOs, the LPC, federally recognized Indian tribes, and other stakeholders. A detailed assessment of the Project’s potential impacts on historic properties will be provided in the EIS. The EIS will also include a list of identified resources listed in or eligible for inclusion in the National Register that may be impacted by Project construction and operations.

3.10 Indian Lands

3.10.1 Environmental Setting

From the U.S./Canadian border, the Project will extend south along existing waterways to converter stations in New York City metropolitan region. The transmission cable corridor includes portions of the Lake Champlain region, the Hudson River Valley, southeastern New York, and the coastline of Long Island Sound.

Neither the transmission cable corridor nor the converter stations will be located on lands designated by the federal government as Indian Reservations or tribal lands. Nonetheless, a review of the OPRHP's Indian Nation Area of Interest map identified six federally recognized Indian tribes that currently have designated areas of interest encompassing portions of the proposed transmission cable corridor in New York State. These tribes include the Stockbridge-Munsee Community, the Delaware Nation, the St. Regis Mohawk Tribe, the Onondaga Nation of New York, the Oneida Nation of New York, and the Tuscarora Nation of New York. Two New York State-recognized Indian tribes, the Shinnecock Indian Nation and the Poospatuck Nation, have designated areas of interest that include Long Island and may include portions of Long Island Sound. Neither the Shinnecock nor the Poospatuck nations are recognized by the federal government.

There are two federally recognized Indian tribes in Connecticut: the Mashantucket Pequot Tribe of Connecticut and the Mohegan Tribe of Connecticut. It is likely that these tribes will have an interest in the sections of the Project located in the vicinity of Bridgeport. The Delaware Nation may also have an interest in the Connecticut section of the proposed transmission cable. The Golden Hill Paugussett Tribe, the Paucatuck Eastern Pequot Tribe, and the Schaghticoke Bands are recognized by the State of Connecticut, but are not formally recognized by the federal government. These state-recognized tribal entities may also have an interest in the Connecticut sections of the Project.

3.10.2 Environmental Impact

The proposed Project will not have any impact on federally recognized Indian Reservations or designated tribal lands in New York or Connecticut. The Applicant will continue to coordinate assessment activities with Indian tribes to determine the Project's potential effects on cultural or historical resources located on lands of interest to Native American nations in New York and Connecticut.

3.11 Public Health and Safety (Electromagnetic Fields)

3.11.1 Environmental Setting

The Project will connect renewable sources of power generation in Canada with load centers in the greater New York City region. HVDC cables will be installed along existing waterways to transmit electricity from a converter station near Montreal to converter stations in Yonkers, New York and Bridgeport, Connecticut. Double-circuit 345 kV AC underwater and underground cables will connect the converter stations to nearby substation facilities.

An EMF is produced by almost any electrically charged object. It is the combination of an electrical field (created by voltage or electrical charge) and a magnetic field (created by electrical current). Both AC and DC transmission lines are considered a source of EMF, and there has been considerable debate over the risks associated with exposure to magnetic fields generated by these lines. HVDC transmission cables are installed in pairs, where current has no frequency, and is equal and opposite in direction. The resulting magnetic field generated by the underwater or underground transmission lines can be considered negligible.

3.11.2 Environmental Impact

The majority of the transmission cables employed by this Project will be HVDC. There are no extremely low frequency EMF emissions associated with HVDC. The static EMF associated with HVDC transmission is generally considered to be negligible.

There will be approximately 5.3 miles of double-circuit 345 kV AC cable connecting the converter station in Yonkers with the Sherman Creek/Academy substation in Manhattan. The cable will be buried when making landfall and otherwise laid in the Hudson River, Spuytin Duyvil Creek, and Harlem River riverbeds. At Bridgeport, a 0.2 mile length of 345 kV AC cable will be buried underground to connect the converter station to the nearby UI substation.

The Applicant anticipates providing calculations of EMF under 1) peak load conditions; and 2) projected seasonal maximum 24-hour average current load on the line anticipated within five years after the line is placed in operation. EMF values will be calculated from the centerline of the Project at intervals of 25 feet out to a distance of 500 feet on each side of the centerline. The analysis will also likely include engineering controls that will be applied to modify EMF levels (including burial of the cable) and the location of nearby sensitive receptors (e.g., schools, day care facilities, and playgrounds). Detailed EMF calculations and an assessment of the Project's potential EMF impacts will be provided in the EIS.

3.12 Transportation

3.12.1 Environmental Setting

The proposed transmission cables will be installed along existing waterways to avoid or minimize the landscape impacts typically associated with conventional, overhead transmission lines. In certain areas, existing infrastructure and ongoing remediation activities along the Project's route will require limited overland installation of the HVDC cables. The Project will follow an overland route when necessary to avoid infrastructure such as locks along the Champlain Canal, or to avoid historic sites and important fish/wildlife habitat. Other sections of the transmission cable will be routed overland to avoid significantly contaminated sections of waterways and the ongoing dredging activities associated with the Upper Hudson River PCB Dredging Project. The overland section required to avoid this ongoing dredging will follow an existing railroad ROW to avoid impacts to previously undisturbed land. As currently proposed, the Project will intersect with several transportation networks, including the New York State Canal System, railroads, highways, ferries, and navigation channels.

New York State Canal System

Sections of the transmission cables will be installed along the Champlain Canal which joins Lake Champlain and the Hudson River. Originally completed in 1823, the 60-mile-long Champlain Canal begins near Whitehall, New York, at the southern end of Lake Champlain. From Whitehall, the canal follows canalized sections of Wood Creek and a land cut, ascending 43.5 feet through three locks at Fort Edward. The canal follows the canalized Hudson River south from Fort Edward, descending 124.8 feet through a series of eight locks. The Champlain Canal joins the Erie Canal in Waterford, New York, approximately 2.3 miles up the Hudson River from the Troy Federal Lock.

The Champlain Canal is part of the 524-mile-long New York State Canal System (Canal System) that links the Hudson River, Lake Champlain, Lake Ontario, the Finger Lakes, and the Niagara River. The Canal System is operated and maintained by the New York State Canal Corporation (Canal Corp), a subsidiary corporation of the New York State Thruway Authority.

The navigation depth in the Champlain Canal is 12 feet in all channels and through all locks and guard gates. These channels have minimum widths of 75 feet in earth cuts, 94 feet in rock cuts, and generally 200 feet in canalized sections of rivers. Locks along the Canal System are massive concrete structures of similar design and standard dimensions, with a width of 44.5 feet and a length of 300 feet. Locks are controlled by large steel double-leaf miter gates that swing into place like doors. The dams that were built as a means for controlling the canalized rivers are either gravity dams or “movable” dams. The Champlain Canal has not been regularly deepened since 1979, due to PCB contamination in the Hudson River.

The Canal System was originally designed and operated primarily for the purposes of commercial navigation. While commercial operations continue along the Canal System, the Champlain Canal is currently used primarily for recreational purposes. According to the Canal Corp, the primary Canal System user groups are: transient boaters, local recreational boaters/anglers, tour boats/cruise boats, hire boat operators/users, commercial operators, trail users, and tourists via land. The Champlain Canal navigation season generally runs from early May to the middle of November. Locks and spillways are opened at the end of the navigation season, and the water level in the canal is lowered to natural hydraulic conditions.

Railroads / Highways

The proposed transmission cables will be installed in the vicinity of the Lake Champlain Bridge. The bridge spans the state line between Crown Point, New York, and Chimney Point, Vermont, and was first opened to traffic in 1929 (New York State Department of Transportation [NYSDOT] 2009). In 2009, the NYSDOT and the Vermont Agency of Transportation (VTrans) completed a safety assessment that identified significant deterioration of the bridge's support piers. As a result of these findings, the bridge was closed to vehicle traffic in late 2009 (NYSDOT et al. 2009). The assessment also indicated that neither repair nor rehabilitation of the existing bridge were viable options. Consequently, the NYSDOT and VTrans have undertaken an accelerated process to complete environmental permitting and construction of a new bridge at the Crown Point/Chimney Point crossing. This project will require in-water construction activities in the vicinity of the proposed transmission cable route. Based on the expedited schedule, NYSDOT anticipates that construction of the bridge will be completed in 2011.

The transmission cables will follow an overland bypass to circumvent Champlain Canal Lock C12 at Whitehall and Lock C11 north of Fort Ann. This bypass will likely extend for approximately a combined distance of approximately 2.1 miles along an existing railroad ROW. The cables will also use 0.5 mile-long overland route to bypass Lock C9, and an overland bypass will be necessary south of the Champlain Canal/Hudson River confluence to avoid activities associated with the Hudson River Polychlorinated Biphenyls PCBs Dredging Project. The Hudson River PCBs Site (USEPA Identification Number NYD980763841) includes a nearly 200-mile-long stretch of the Hudson River from the Village of Hudson Falls to the Battery in New York City. In May of 2009, the USEPA initiated the dredging of approximately 2.65-million cubic yards of PCB-contaminated sediment from the Upper Hudson River, including approximately 341,000 cubic yards from the Champlain Canal. The entire dredging project is scheduled to be completed in 2016.

To avoid remediation activities associated with the dredging project, TDI proposes to install sections of the transmission cables along an overland route. The transmission cables will exit the Champlain Canal just north of Lock C8 and the cables will be buried within a railroad ROW for a distance of approximately 69.9 miles. The cables will re-enter the Hudson River near the Town of Coeymans, downstream from the City of Albany.

Ferries

Ferries in Lake Champlain supplement the limited bridge crossings between New York and Vermont. Similarly, ferries in Long Island sound provide transportation between Connecticut and Long Island. These ferries circumvent New York City and are heavily used by tourists and vacationers during the summer months.

Navigation Corridors

There are no designated navigation corridors within Lake Champlain or the Champlain Canal.

On the Hudson River, a 14-foot channel is maintained from the Troy Lock and Dam to Albany, New York, at which point a 32-foot channel opens for the remainder of the river. There is a channel in the Harlem River and the East River main channel has a project depth of 35 feet. Long Island Sound has a dredged deep water channel with an extension that enters Bridgeport Harbor through two breakwaters.

3.12.2 Environmental Impact

New York State Canal System

Direct and indirect impacts to commercial and recreational use of the canal are expected to be temporary and limited. Construction of the Project may temporarily affect recreational and commercial use of the Champlain Canal. During Project construction, the cable installation vessel will move slowly through the canal and may create elevated noise levels, increased turbidity, and additional vehicle or vessel traffic. These impacts may temporarily disrupt recreational activities, including boating, angling, and sightseeing. Similarly, cable installation may create a temporary navigational hazard that could cause delays in commercial boat traffic along the Champlain Canal. The Applicant will coordinate installation and construction with the Canal Corp to avoid or minimize impacts to commercial and recreational use of the Canal System.

Consultation with the Canal Corp indicates a strong preference for selecting an upland route when encountering existing infrastructure (e.g., movable dams, gravity dams, guard gates), so as to not threaten the structural integrity of these features. The Canal Corp owns the land immediately adjacent to the locks and dams. The Applicant anticipates coordinating Project engineering with the Canal Corp to ensure that the integrity of existing infrastructure is maintained during the construction and operational phases of the Project.

Railroads / Highways

The transmission cables will follow an overland bypass route to avoid remediation activities associated with the Upper Hudson River PCB Dredging Project. The bypass option follows an existing railroad ROW, stretching between Fort Edward and Coeymans. In general, the transmission cables will parallel the CP and CSX tracks for a total distance of approximately 69.9 miles. The Applicant proposes to bury the transmission cables within the ROW, so the only impact may be temporary interference with normal traffic patterns during installation.

Formal engineering studies will be required to ensure the proper placement of the transmission cables around canal structures as well as in railroad or highway right-of-ways. This analysis will need to consider, among other factors, water depths, lift, geology, and structural constraints. It is anticipated the bulk of this work will occur as a condition for permitting.

Ferries

The Project may have a temporary impact on the operation of ferries in Lake Champlain and Long Island Sound. The Applicant will coordinate cable installation activities with ferry operators to avoid adverse effects to ferry schedules and operations. CHPEI will also consult with operators to determine the appropriate schedule for installing cables that may intersect with existing ferry routes.

Navigation Corridors

Potential impacts on navigation are related to the installation of the proposed cables along existing waterways. Impacts from vessels and related equipment required install the proposed cables are expected to be short term and slight. In the Lake Champlain region, the primary concern will be the three ferry lines that regularly cross the lake: 1) Grand Isle, Vermont to Plattsburgh, New York (24-hour service, year round), 2) Burlington, Vermont to Port Kent, New York (mid-June to mid-October), and 3) Charlotte, Vermont to Essex, New York (varying schedule year round). Caution will also need to be exercised in the vicinity of the cable ferry that extends along the western shoreline between the western terminus of a submarine cable and the Ticonderoga Light.

As the installation route progresses south, vessels installing the cables will also need to accommodate the commercial and recreational traffic that occurs along the Hudson River, the Spuyten Duyvil Creek, the Harlem River, and the East River. The U.S. Coast Guard has also established six permanent safety and security zones with the New York Captain of the Port (COTP) Zone. Navigation and marine activities within these zones are restricted. Safety and security zones within close proximity to the proposed transmission cable corridor include the following:

- Indian Point Nuclear Power Station (IPNPS): All waters of the Hudson River within a 300-yard radius of the IPNPS pier in Buchanan, New York.
- U.S. Coast Guard Cutters and Shore Facilities: All waters within 100 yards of a) each moored or anchored Coast Guard Cutter; and b) the Coast Guard Station at Kings Point, New York.
- Commercial Waterfront Facilities: All waters within 25 yards of each commercial waterfront facility that is capable of accepting barge, ferry, or other commercial vessels. This includes piers, wharves, docks, and similar structures to which barge, ferry, or other commercial vessels may be secured; areas of land or water under and in immediate proximity to commercial waterfront facilities; buildings on such structures or contiguous to them; and equipment and materials on such structures and in such buildings.
- Bridge Piers and Abutments, Overhead Power Cable Towers, Piers and Tunnel Ventilators: All waters within 25 yards of any bridge, pier, abutment, overhead power cable tower, pier, or tunnel ventilators located south of the Troy, New York Locks. Vessels are allowed to transit through any portion of the zone that extends into the navigable channel, for the sole purpose of direct and expeditious transit through the zone, as long as they remain within the navigable channel and maintain the maximum safe distance from the facility.

- New York City Passenger Ship Terminal, Hudson River, New York: All waters of the Hudson River bound by the following points: Pier 96 where it intersects the seawall, west to approximate position 40°46’23.1”N / 073°59’59.0”W, south to approximate position 40°45’55.3”N / 074°00’20.2”W (North American Datum [NAD] 1983), then east to the southeast corner of Pier 84 where it intersects the seawall, then north along the shoreline to the point of origin. This zone is restricted whenever passenger vessels are pierside at Pier 88, 90, or 92, or whenever the passenger ship terminal or the adjacent Intrepid Sea, Air, and Space Museum, in Manhattan, is being used as an Emergency Operations Center.
- La Guardia Airport, Bowery and Flushing Bays, Queens, New York: All waters of Bowery and Flushing Bays within approximately 200 yards of La Guardia Airport. Specific shoreline points and positions are given in 33 CFR § 165.169 Safety and Security Zones. The regulations note that the enforcement in these zones is effective at all times; however, a request for special authorization can be made to the COTP.
- Liquefied Hazardous Gas (LHG) Vessels: All waters within a 200-yard radius of any LHG vessel that is underway, and all waters within a 100-yard radius of any moored LHG vessel.
- Cruise Ships: All waters within a 100-yard radius of any cruise ship.
- Designated Vessels: All waters within 100 yards of a) vessels carrying government officials, dignitaries, or other passengers requiring protection by the U.S. Secret Service or other federal, state, or local law enforcement agencies; b) barges or ships carrying petroleum products, chemicals, or other hazardous cargo; and c) passenger vessels authorized to carry more than 400 passengers.

In addition to these permanent safety and security zones, there is an established security zone adjacent to the United Nations headquarters in the West Channel of the East River, and temporary safety and security zones may be created by the U.S. Coast Guard on an as-needed basis. The regulations allow for temporary, occasional, or intermittent use of safety and security zones, pending notification and permission from appropriate agencies.

The U.S. Coast Guard has also established a regulated navigation area that includes the Long Island Sound Marine Inspection and COTP Zone, as delineated in 33 CFR § 3.05-35. There are permanent safety zones, security zones, and regulated activities within the portion of the transmission cable corridor that extends through this Marine Inspection and COTP zone, including:

- Ferry Vessels: Vessels of 300 gross tons or more are prohibited from entering all waters within a 1,200-yard radius of any ferry without prior authorization.
- Vessels engaged in commercial service: No vessel may enter within a 100-yard radius of any vessel engaged in commercial service, without prior authorization.
- Bridge Foundations: Vessels must make a direct, immediate, and expeditious passage beneath bridges. No vessel may approach within a 25-yard radius of a bridge foundation, stanchion, or support at any time, except as required for immediate passage.
- U.S. Coast Guard Vessels Safety and Security Zones: All waters within 100 yards of each moored or anchored Coast Guard vessel.

Formal engineering studies will be required to ensure the proper placement of the transmission cables around canal structures as well as in railroad ROWs. This analysis will need to consider, among other factors, water depths, lift, geology, and structural constraints. It is anticipated the bulk of this work will occur as a condition for permitting.

In terms of navigational concerns, regulations regarding permanent safety and security zones allow for temporary, occasional, or intermittent use, pending notification and permission from appropriate state agencies, the U.S. Coast Guard Commandant, COTP, and the National Geospatial-Intelligence Agency, Hydrographic Center. The Applicant will contact the affected agencies and operators if construction activities are expected to infringe on the designated safety and security areas within the Project vicinity. At a minimum, the Applicant anticipates publishing a Notice to Mariners, coordinating with the local pilot associations to minimize any potential impacts between the construction of the proposed Project and pilotage, and facilitating the publishing of the location of the transmission cables on nautical charts. The Applicant will also coordinate with relevant agencies to discuss circumstances where it may be the most appropriate to install the cable within the navigation corridor. A detailed assessment of the Project's potential effects on navigation will be provided in the EIS.

Formal engineering studies will be required to ensure the proper placement of the transmission cables around canal structures as well as in railroad or highway right-of-ways. This analysis will need to consider, among other factors, water depths, lift, geology, and structural constraints. It is anticipated the bulk of this work will occur as a condition for permitting. An assessment of the Project's potential effects on transportation infrastructure will be provided in the EIS.

3.13 Noise

3.13.1 Environmental Setting

Elevated noise levels could be associated with both the construction and operation phases of the Project. Underwater noise levels will rise above background levels due to the presence of vessels and cable installation equipment (including HDD equipment). Construction activities will generate noise around the proposed sites for the converter stations and the converter station contains equipment that can generate acoustic noise during operation.

3.13.2 Environmental Impact

Underwater noise from the operation of vessels and installation of cables could impact fish and mammal behaviors, although these impacts should be temporary and limited. The cable installation vessel will move slowly along the transmission corridor, with engines running at low revolutions per minute, and most trenching activities will not involve breaking rock. Therefore, it is expected that noise levels would be below those levels that could cause temporary hearing impairments or physical injury. Because the installation would produce a fairly constant noise, fish and other aquatic species could hear the noise and avoid the area. The Applicant will consult with state and federal agencies to determine if limiting in-water work to certain seasons would further mitigate the impact.

Residents and businesses could be temporarily impacted by noise from construction activities associated with the installation of the land portions of the cables and the converter stations. Noise is regulated by zoning regulations, which differ from community to community in terms of maximum noise levels allowed at the property line during different times and in different planning zones. All applicable zoning regulations will be adhered to during the construction phase of the Project.

The operation of the converter station may raise ambient noise levels in the vicinity of the converter station. However, unlike AC transmission cables, HVDC cables do not emit sound, and the AC lines connecting the converter stations to substations will be buried. Noise from the converter stations can be mitigated through acoustic-damping wall and roof materials, screening or enclosing equipment, use of specialized equipment designed to reduce noise, or the orientation of equipment away from the most sensitive sound direction. Therefore, noise levels within the vicinity of the converter station will be within applicable zoning regulations and not out of character with surrounding noise.

Due to its limited duration and maximum expected levels, underwater noise is not expected to result in any injury to aquatic life. The Applicant anticipates consultation with fish and wildlife agencies to determine if restricting cable installation to certain seasons would further mitigate this impact.

Construction noise associated with the installation of the transmission lines and converter stations will be temporary in nature. Construction in the vicinity of any single residence or business will last only a few days to a week as construction progresses along the corridor. A detailed assessment of the Project's potential noise impacts will be provided in the EIS.

3.14 Air Quality

3.14.1 Environmental Setting

Air pollutants originate from many human activities. Most pollutants come from a) industries that manufacture chemicals and other goods; b) on- and off-road vehicles; c) power equipment; and d) from energy facilities that burn oil, gas or coal. Pollutants emitted from tall stacks move high in the air, descending to earth miles downwind from their source. In its 2008 State of the Air report, the American Lung Association (2008) reported that the New York metropolitan region—including New York City; Newark, New Jersey; and Bridgeport, Connecticut—was ranked the 13th most polluted region in the United States by short-term particle pollution. The metropolitan region was ranked and the 8th most ozone-polluted region in the country.

3.14.2 Environmental Impact

There will be no permanent degradation of air quality as a result of the installation and operation of the proposed Project. Minimal temporary influences on air quality as a result of Project-related construction activities may include construction personnel commuter traffic, exhaust from construction vehicles, and fugitive dust generated by construction activities along unpaved areas. Residents and businesses in the area adjacent to construction activities may be susceptible to slightly elevated increases in fugitive dust and air emissions during construction, but these impacts will generally be insignificant. There will be no increase in air pollution from the operation or maintenance of the HVDC converter stations. There will be some minor traffic associated with maintenance of the transmission system, but it will not increase air emissions significantly.

A detailed assessment of the Project's potential impacts on air quality will be provided in the EIS.

3.15 Visual

3.15.1 Environmental Setting

The Project's principal features will be primarily oriented around the existing waterways and shoreline areas that comprise Lake Champlain, the Champlain Canal, the Hudson River, and Long Island Sound. There are six general types of land uses in the vicinity of the proposed transmission cable corridor: 1) relatively large tracts of agricultural land; 2) wooded riparian forests; 3) cleared undeveloped land with rural residential development; 4) developed residential areas; 5) commercial/industrial developed areas; and 6) large tracts of wooded forest. Lake Champlain, the Hudson River, and portions of Long Island Sound are valued for their scenic character. However, the Project also travels through heavily populated areas consisting of dense residential, industrial, and commercial development, including the New York City metropolitan area and the City of Bridgeport.

3.15.2 Environmental Impact

Where practicable, the proposed transmission cables will be installed along canals, rivers, and other waterbodies to minimize the visibility of the Project. Impacts to the visual quality and scenic character of the Project area could be associated with both the construction and operation phases of the Project. During the construction phase, various types of marine vessels will be used to install the cable in water portions of the route. HDD and traditional construction equipment (e.g., excavators) may be used to install the cable along overland sections. Construction equipment will be visible from many different areas and vantage points, and this equipment could have a short-term visual impact on the scenic character of the region. However, the cable-related impact should be considered temporary, as disturbed areas will be allowed to naturally regenerate and riparian vegetation will be preserved as much as possible to minimize visual impacts on shoreline habitats.

Permanent impacts associated with the Project will be two HVDC converter stations located in heavily developed areas. Construction of the converter stations may have a negative visual impact on residents and businesses in these areas. To the greatest extent as feasible, the converter stations will be designed in scale with the surrounding landscapes. The Applicant anticipates that the converter stations will have only a minimal visual impact on the overall regional visual quality.

A detailed assessment of the Project's potential visual impact will be presented in the EIS.

Section 4

Alternatives to the Proposed Project

Potential alternatives to the proposed Project are discussed in this Section of the application document. As the formal NEPA scoping process has not occurred, a complete list of specific potential Project alternatives has not yet been developed. Nonetheless, CHPEI has identified several general types of alternatives that may be considered for this Project, including alternative cable routes, converter station sites, transmission technologies, and technical design options. While the Applicant believes that the proposed route best meets the technical and economic goals of the Project with the least degree of impact to the environment, a detailed assessment of these alternatives and their potential effects on the existing environment will be considered in the NEPA process.

4.1 Transmission System and Electrical Cable Technology Alternatives

4.1.1 AC Transmission System

CHPEI considered the construction of an HVAC underground/underwater transmission system to connect renewable sources of electrical generation with load centers in the New York City and southwestern Connecticut regions. However, the technological limits of HVAC systems do not permit transmission over the significant distances required for this Project. Therefore, to match the capacity of the proposed Project, an AC transmission system would need to utilize overhead (air-insulated) cables and transmission towers. Recent attempts by private entities to construct large-scale overhead transmission lines in New York State have encountered widespread opposition from a number of agencies, non-governmental organizations, and citizens groups. Any large-scale AC system would have significant impacts to a number of resources areas, including aesthetics, terrestrial resources, air quality, noise, and cultural resources. The AC system would also require a substantially larger ROW for construction, operation, and maintenance of Project facilities. Costs for permitting and constructing an overhead transmission system with a capacity similar to the proposed Project are projected to be significantly greater than the preferred option. Furthermore, an HVAC transmission system would not provide the same Smart Grid integration and black start capabilities that an HVDC transmission system could provide.

4.1.2 Electrical Cable Alternatives

Until the mid-1990s, HVDC systems have utilized primarily paper-lapped, low-pressure fluid-filled (LPFF) or solid, mass-impregnated, non-draining (MIND) cables. Both of these options were considered as alternatives to the XLPE cables currently proposed for the Project. LPFF cables require auxiliary equipment to maintain pressure, and are not suitable for long-distance applications (DOE and the Bonneville Power Administration 2007). LPFF cables also present an oil spill risk, as they typically utilize low-viscosity oils to maintain pressure. While MIND cables are widely used in HVDC systems, they present greater installation and maintenance challenges for a transmission system of the Project's proposed dimensions. MIND cables also utilize oil in the cable insulation and have limitations in the operating conductor temperature. Therefore, the XLPE technology remains the Applicant's preferred design for the Project's transmission system.

4.2 Alternative Cable Routes and Converter Station Locations

4.2.1 Bypass Alternatives

Alternatives to the proposed Project may follow one or more of several potential additional bypass options. These options would primarily be utilized to avoid existing infrastructure and sensitive environmental areas along the transmission cable route, particularly along sections of the Champlain Canal and the upper Hudson River. Bypass options along the canal and the Hudson would likely follow sections of an existing railroad ROW to circumvent locks and other facilities. These alternatives would require extended sections of overland construction, and the environmental impacts of these activities would need to be considered. The technological and economic feasibility of any bypass alternatives would also need to be evaluated, as the overall costs of these alternatives likely to be substantially higher than those assumed for the preferred route.

4.2.2 Upland Alternatives

Upland alternatives would utilize primarily overland routes from the U.S./Canadian border to the New York City region. As an example, the HVDC transmission cables could be buried along an existing railroad ROW that extends south from the international boundary to Albany. From Albany, the cables could continue along existing railroad ROW to converter stations in the New York City region or follow existing transmission corridors extending south to the Yonkers and Bridgeport converter stations. As with bypass options, these upland alternatives will need to be evaluated in terms of their potential impacts on wetlands, noise levels, air quality, cultural resources, terrestrial species, and other resource areas. The economic and technological viability of the se alternatives would also need to be considered, as the costs of extended upland construction are likely to be much greater than those estimated for the Project's preferred route.

4.2.3 Alternative Converter Station Locations

In developing this Project, CHPEI considered alternative converter station locations in the New York City and Bridgeport regions. As designed, the proposed Project requires construction of converter stations near waterways. Several factors, including proximity to existing substations, substation upgrade costs, current infrastructure, and existing environmental resources, were considered in identifying the preferred converter station locations.

4.3 No Action Alternative

Under the no action alternative, the Project would not be constructed as described in this application, and the potential environmental impacts described herein would not occur as a result of Project construction or operations. However, the loss of the 2,000 MW of additional capacity that would be provided by the Project may result in other potentially significant environmental and economic impacts. Without construction of the Project, other sources of electrical generation or transmission will be required to meet the forecasted demand for commercial and industrial capacity (New York State Energy Planning Board 2009). Generating facilities or new transmission options would also be required to replace existing facilities that are scheduled or proposed for decommissioning. Construction of additional fossil-fuel power plants that may be necessary to meet this demand would result in increased emissions that could be avoided by Project construction. The additional capacity provided by the Project would also place downward pressure on the price of electricity in the markets operated by the NY-ISO, and would have an estimated annual energy cost-savings to New York City consumers of over $1.3 billion over the life of the Project (London Economics International, LLC 2009). These important economic and environmental benefits would not be realized without Project construction.

Section 5

Verification Statement

The undersigned attests that he is an officer of Champlain Hudson Power Express, Inc. and that he has read and has knowledge of the matters set forth in this application for a Presidential Permit, and that the facts and representations set forth in said application are true and correct to the best of his knowledge.

By: William S. Helmer

Vice President

Section 6
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APPENDIX A

OPINION OF COUNSEL

CHAMPLAIN HUDSON
POWER EXPRESS, INC.

I, William S. Helmer, General Counsel and Corporate Secretary of Champlain Hudson Power Express, Inc. ("CHPE"), do hereby state and give my opinion, pursuant to 10 CFR §205.322(a)(6) as follows:

1. I have examined and am familiar with CHPE's Certificate of Incorporation and By-laws;

2. I have examined and am familiar with the contents of the CHPE's Applications for Presidential Permit, to which this Opinion is attached as an Exhibit; and

3. I am of the opinion that the operation and maintenance of the facilities, as proposed in said Application, is within the corporate power of CHPE as set out in CHPE's Certificate of Incorporation and By-laws.

Dated: January 22, 2010

CHAMPLAIN HUDSON POWER EXPRESS, INC.

William S. Helmer

William S. Helmer, Esq.
General Counsel and Corporate Secretary

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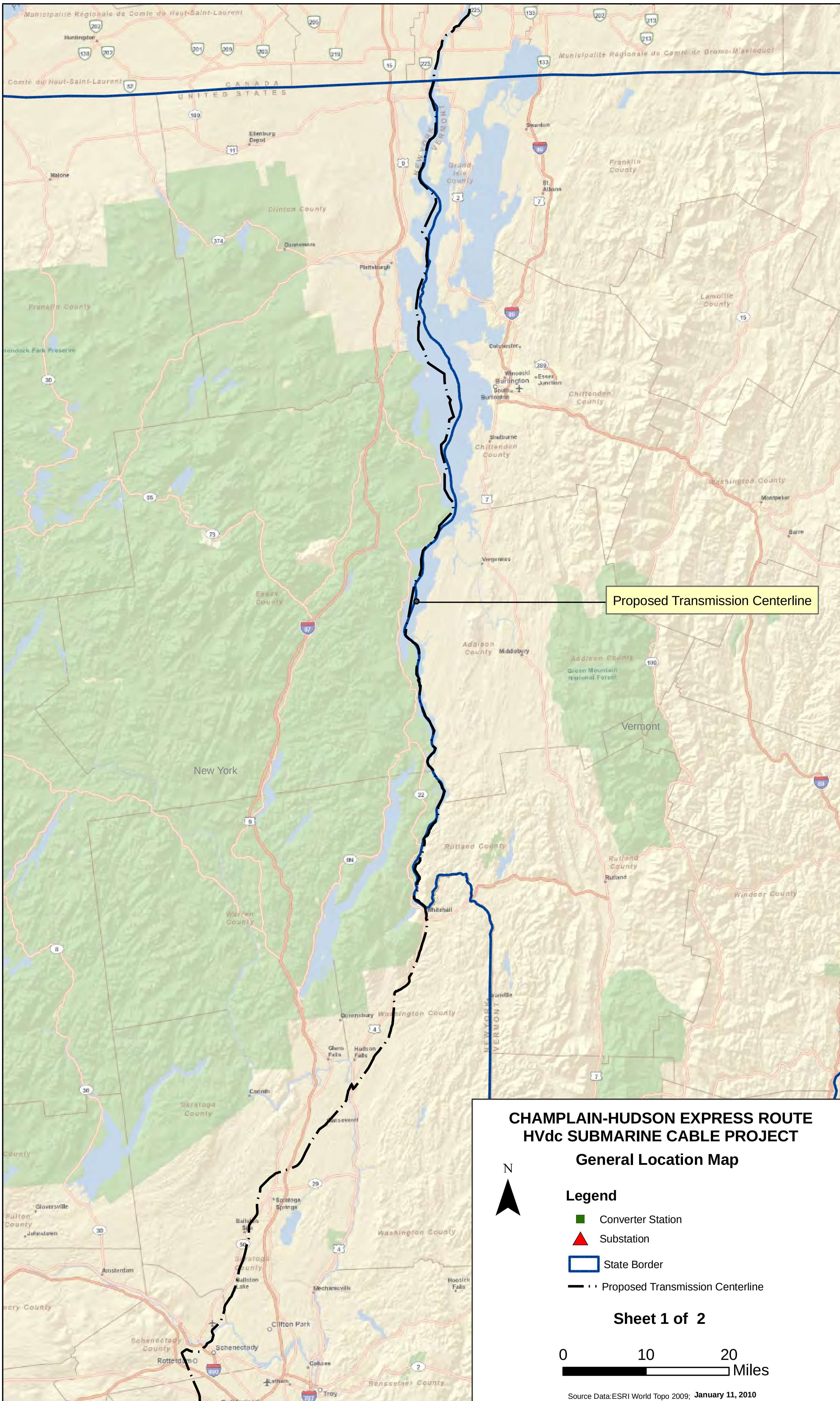
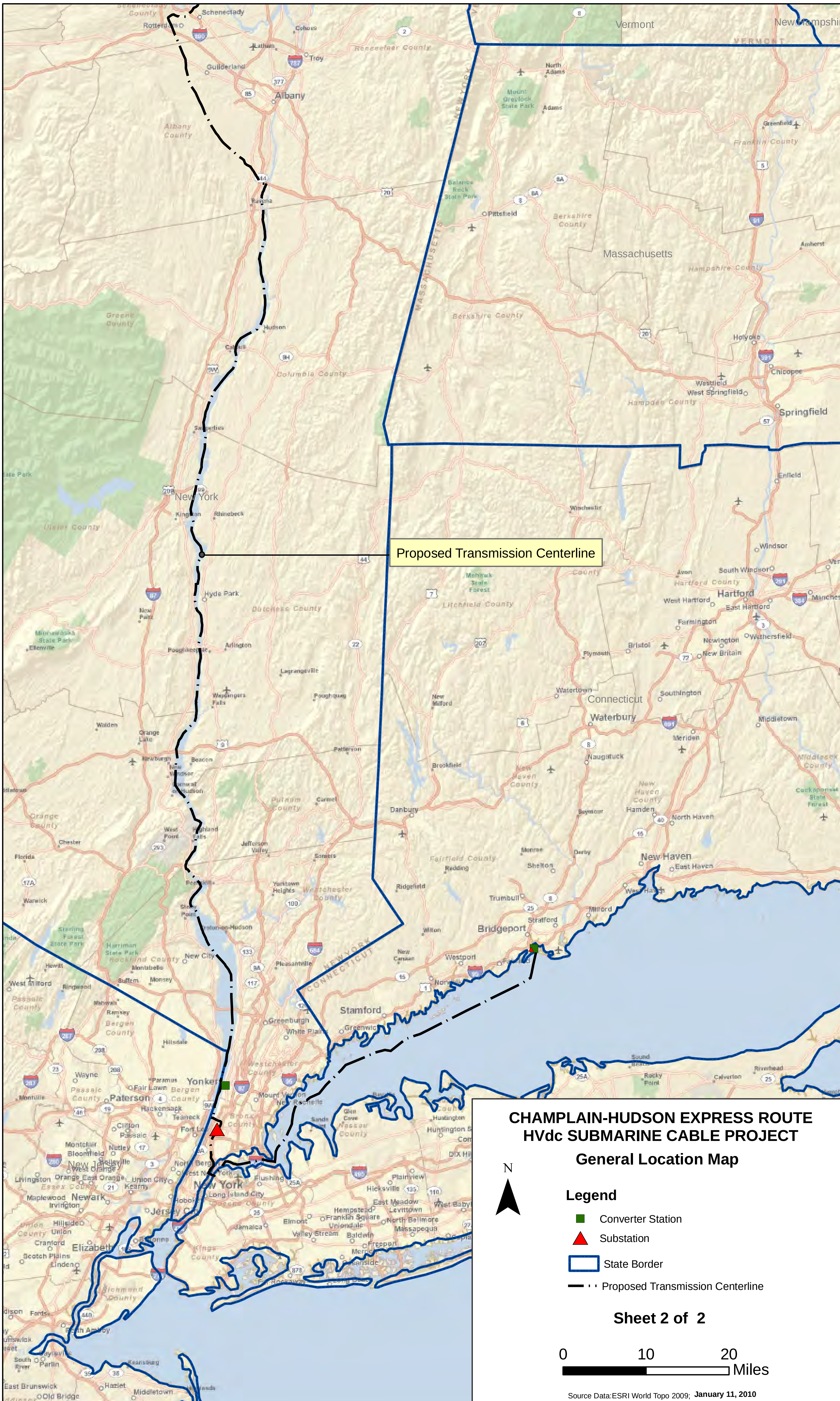
APPENDIX B

GENERAL LOCATION MAP

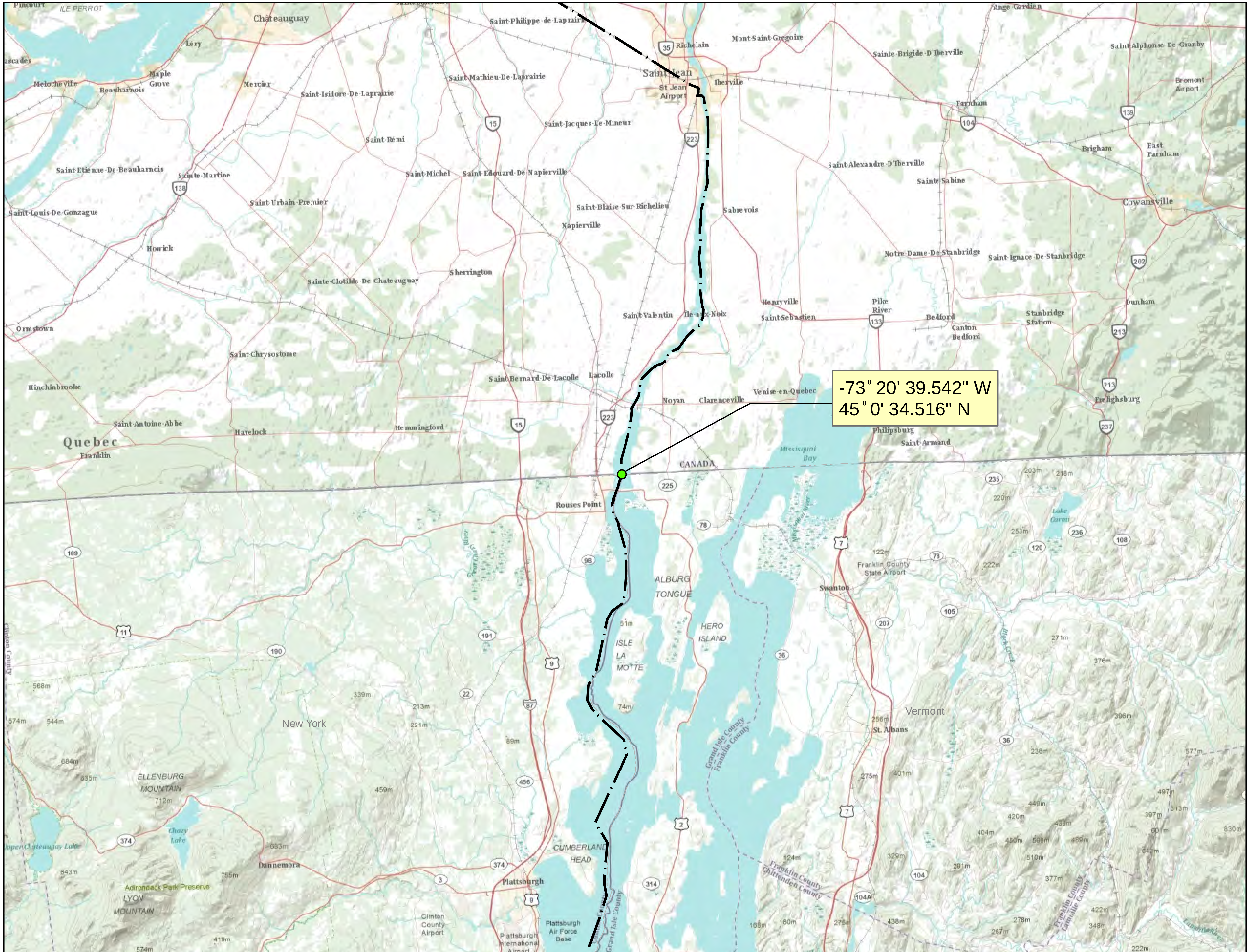


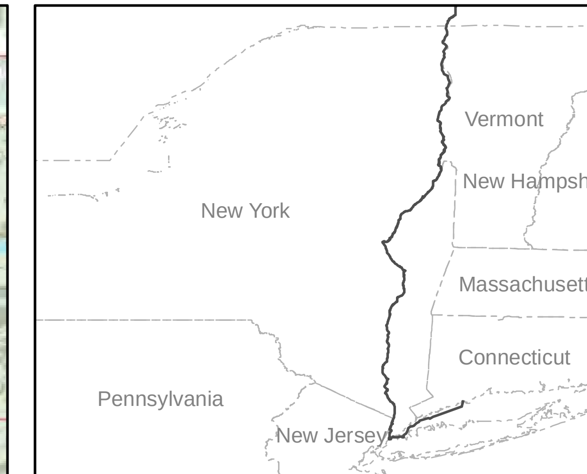
CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT
General Location Map
N
Legend
Converter Station
Substation
State Border
Proposed Transmission Centerline
Sheet 1 of 2
0
10
20
Miles
Source Data:ESRI World Topo 2009;
January 11, 2010
Proposed Transmission Centerline
New York
Vermont
CANADA
UNITED STATES
Clinton County
Franklin County
Essex County
Warren County
Saratoga County
Washington County
Addison County
Rutland County
Chittenden County
Grand Isle County
Lamoille County
Plattsburgh
Burlington
Middlebury
Whitehall
Rutland
Queensbury
Saratoga Springs
Schenectady
Clifton Park
Troy
Guilderland
Amsterdam


CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT
General Location Map
N
Legend
Converter Station
Substation
State Border
Proposed Transmission Centerline
Sheet 2 of 2
0 10 20
Miles
Source Data:ESRI World Topo 2009; January 11, 2010
Proposed Transmission Centerline
Vermont
New Hampshire
Massachusetts
Connecticut
New York

APPENDIX C

DETAILED MAP SHOWING THE PHYSICAL LOCATION, LONGITUDE, AND LATITUDE OF THE PROPOSED INTERNATIONAL BORDER CROSSING





General Location Map

CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Location Map of US / Canadian Border

Proposed Transmission Centerline

N

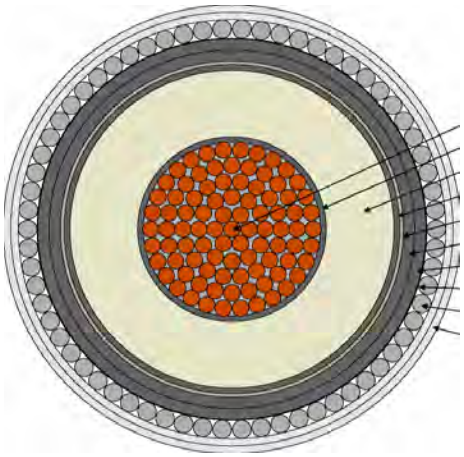
0 2.5 5 10 Miles

Source Data:ESRI StreetMap USA, 2009

APPENDIX D

PRELIMINARY TECHNICAL INFORMATION AND DIAGRAMS

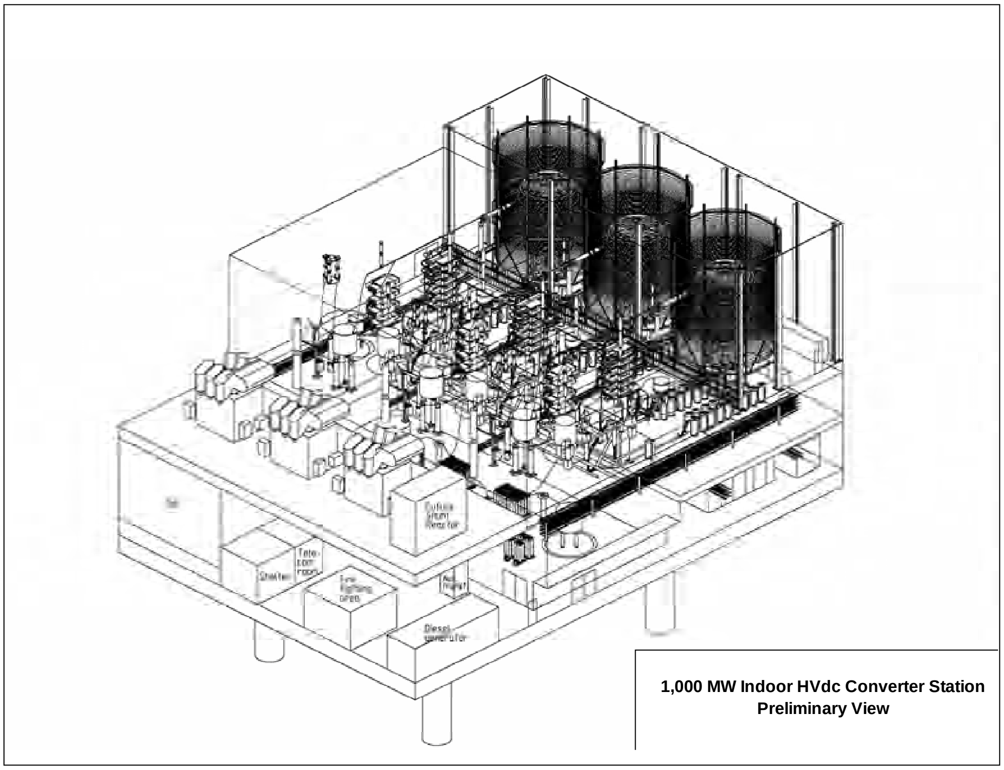
Nexans, 300 kV HVDC 1,000 MW XLPE cable



1. Conductor
2. Conductor screen
3. Insulation
4. Insulation screen
5. Swelling tape
6. Lead alloy sheath
7. Inner sheath
8. Bedding tape
9. Armour
10. Outer serving

Actual Cable Size

Typical compact (voltage sourced) HVDC converter station and (outdoor substation)



Typical compact (voltage sourced) HVDC converter station (indoor substation)

CHAMPLAIN HUDSON
POWER EXPRESS

CABLE SYSTEM STUDY REPORT

SUBMITTED BY: NEXANS NORWAY AS
REF. NO.: 29772
DATE: JANUARY 18 2010

Table of Contents

D 01

DATA COLLECTION

Discussion on completeness of TDI data and recommendations for further data collection

LIST OF CONTENTS

1 INTRODUCTION

This document should be read in conjunction with the report on the cable route.

The document gives a brief review of the findings of the prefeasibility study made by HDR/DTA, dated April 2009, and outlines recommendations for supplementary data collection.

2 SUMMARY

Seen in connection with the route data reviews with detailed route descriptions, maps and figures, the document gives very detailed section by section information of the route, possible obstacles and special environmental concerns.
Each major finding is also discussed and a summary conclusion presented.
These conclusions, among other sections of the report, give directions to further work.
Section 5, Permitting Requirements, seem to sum up all major permits required to carry through a project of this magnitude.

Areas of further data collection and information search will be:

- Obstacles: Identification and location
- Crossings: Owner identification and location
- Vessel traffic and fishing in the areas: Classification and anchor details
- Exclusion periods: Wildlife preservation and other reasons
- Exclusion areas: Wildlife preservation, contamination, other reasons
- Sediment transport analysis
- Environmental Monitor and DEC
- Compensation to users of the sea/river

3 OBSTACLES

Identification, classification and location of obstacles need to be performed, but can be deferred to become part of a detailed route survey.
Obstacles may normally be circumvented or, at the worst, can be removed or left in place if alternative protection is allowed.
The HDR/DTA concludes that no known obstacles are likely to prohibit the installation of the project.

4 CROSSINGS

There is an abundance of submerged infrastructures along the route. These can be communication cables, power cables, water – oil and gas pipelines, sewer lines etc.

A large number will have to be crossed, and a few seem to run in parallel with the cables for some distance.
The exact location will have to be determined as part of the detailed route survey, the Owners identified and formal crossing agreements made.

The owners may have very different views on how a crossing shall be designed to protect their own utility and might require detailed engineering to prove that the cables will not cause harm. For example one pipeline owner asked for very detailed corrosion studies to be made, taking into account the entire existing pipeline, pier and neighbouring structures in the area.

Nexans can propose a variety of crossing solutions and assist with further development. Please see the document “Crossing of cables and pipelines”.

5 VESSELS TRAFFIC AND FISHING

The protection of the cables by burial or protective cover is a very important issue. It is important to define what the cables shall be protected against as well as analyzing the risk for occurrences to prevent “worst case” being the minimum standard.

The protection level envisaged in TDI’s documents and the HDR/DTA report seem appropriate. A desktop study of vessel traffic and fishing activities including use and type of anchors is recommended.
Any other regular marine activity should also be noted and assessed.

6 EXCLUSION PERIODS

From available information on wildlife preservation schemes, it will be possible to tabulate exclusion periods for protected species, such as spawning season, mating season for birds etc.
These periods may vary along the route as it spans over several types of environment.
The exclusion periods for various species may overlap at times, making certain periods of the project implementation phase theoretically unworkable due to the work window needed.
This is not likely to occur, however it is anticipated that relevant permits can be given subject to submitting detailed and satisfactory plans for mitigating actions in case there is a conflict with an exclusion period.

7 EXCLUSION AREAS

This item addresses areas that will be periodically or permanently excluded from the cable route. These areas may be permanent wildlife exclusion zones/ sanctuaries or areas where the seabed is contaminated and construction activities may be prohibited.
From the report we understand that no such areas that are known will have a bearing on the implementation of the project.
This type of information will have to be reconfirmed at the time of project permitting.

8 SOIL SAMPLES and SEDIMENT TRANSPORT ANALYSIS

An analysis of sediment transportation, suspension and dispersion resulting from the installation – mainly burial by water jetting – is likely to be requested for permitting purposes. E.g. as an attachment to Article VII in New York and for filing with Connecticut Siting Council.

Methods exist to analyze the sediment transport caused by water jetting and other relevant cable protection methods. Independent third party assessments can be made by experts already known to local authorities.

Reliable information from a desktop search or soil sampling as part of the route survey will be required. The HDR/DTA report have evaluated sediment types for pats of the route and give directions to further information.

9 ENVIRONMENTAL MONITOR

Requirements from the authorities to have a DEC representative or a third party Environmental Monitor onboard for parts of or the full duration of the work should be clarified. This might have an impact on accommodation onboard and shuttle services to and from shore.

10 COMPENSATION TO USERS OF THE SEABED

Users of the waterways and seabed, such as fishers and leasers of shellfish/oyster areas may seek compensation for disruption to their work or for permanent or temporary exclusion from their normal work areas.

Such users should be made aware of the project and an agreement made through their associations or unions in due time.

D 02

REPORT ON CABLE ROUTE

Installation

Main Review and Method Description

Contents

1 Type of cables

There are two types of cables discussed in this study.

1. A XLPE HVDC 300 kV submarine and underground cable type, which is the preferred type of cable. [TKRA-L / TKXE-L]
2. A mass-impregnated paper insulated HVDC 300 kV submarine and underground cable type. [NOVA-L / NOEE-L]

This study will mainly be based on the XLPE type, but the MI type will also be mentioned for comparison.

1.1 Design data – short version

The table below is in both metric and US customary units.

Submarine Cable Type	Diameter	Weight	Bending radius	Burial depth	Axial distance
	mm	kg/m	m	m	m
TKRA-L 300 kV 1 x 1400 mm² KQ	122	41	1,9	0,9	1,8
NOVA-L 300 kV 1 x 2000 mm² Cu	119	50	3,0	0,9	1,8
	in.	lbs./ft.	ft.	ft.	ft.
TKRA-L 300 kV 1 x 1400 mm² KQ	4,80	27,6	6,2	3,0	5,9
NOVA-L 300 kV 1 x 2000 mm² Cu	4,69	33,6	9,8	3,0	5,9

Underground Cable Type	Diameter	Weight	Bending radius	Burial depth	Axial distance
	mm	kg/m	m	m	m
TKXE-L 300 kV 1 x 1400 mm² KQ	105	29	1,6	0,9	0,5
NOEE-L 300 kV 1 x 2000 mm² Cu	108	38	2,7	0,9	0,5
	in.	lbs./ft.	ft.	ft.	ft.
TKXE-L 300 kV 1 x 1400 mm² KQ	4,13	19,5	5,4	3,0	1,6
NOEE-L 300 kV 1 x 2000 mm² Cu	4,25	25,5	9,0	3,0	1,6

The cable data may change if the burial depth increases or axial distance decreases. These parameters must be decided during detailed route engineering. For instance, crossing areas or canals which are dredged at certain time intervals, a substantial increase in burial depth is expected as a requirement.

2 Limitations

2.1 The Champlain Canal

The New York State Canal Corporation rules and regulations are given on the web-side: http://www.dos.state.ny.us/info/nycrr.html , following these steps.

1. Select the **NYCRR** link, then
2. Select **TITLE 21. MISCELLANEOUS**, then
3. Select **Chapter III New York State Thruway Authority**, then
4. Select **Subchapter D Canal System**

The official canal data are summarized below for Champlain Canal.

		feet	meters
The maximum dimensions of a vessel which may enter the locks of the canal system are:	length	300	91.44
	width	43.5	13.26
Limiting vertical clearance under bridges		15.5	4.72
Design depth		12	3.66

Other canal data:

Minimum bottom width, land line, earth section	*75*	*22.86*
Width of channel, water surface, land line, earth section	*123*	*37.49*
Minimum bottom width, land line, rock section	*94*	*28.65*
Bottom width of channel in canalized rivers, generally	*200*	*60.96*

2.2 Hudson River

The Hudson River is a navigable year-round waterway with a channel draft of 32 feet (9.75 meters). Maximum draft at Albany is 31 feet (9.45 meters), fresh water

A channel 600 feet (182.93 meters) wide from New York City to Kingston, New York then 400 feet (121.95 meters) wide to Albany with a mean range of tide of 4.70 feet (1.43 meters)

There is a turning basin of 1,100 feet (335.8 meters) at Albany Port.

The Hudson River accommodates ships with overall lengths of up to 750 feet (288.6 meters) and maximum beam of 110 feet (33.53 meters). Vertical clearance above sea level is 134 feet (40.84 meters).

2.3 Port of Albany - Crane Capabilities

The lifting capacity in Albany Port is according to www.portofalbany.us.

- Liebherr Mobile Harbor Crane with a lift capacity that ranges from 123 short tons at 65 feet to 38 short tons at 158 feet (112 metric tonnes at 20 meters to 35 metric tonnes at 48 meters)
- American Crawler Crane with a lift capacity that ranges from 114 short tons at 25 feet to 10 short tons at 130 feet (103 metric tonnes at 8 meters to 9 metric tonnes at 40 meters)
- Forklifts capacity from 5,000 lbs to 80,000 lbs (2268 kg to 36287 kg)

However, barge mounted cranes with capacity up to 1,000 short tons (907 metric tonnes) are available upon request.

2.4 US Legislation - Cable Laying Work inside USA

It is assumed that the HVDC cables are manufactured in NY State and Europe and laid by one or more US registered vessel(s). Nexans are using their own cable laying vessel C/S Nexans Skagerrak, as a model for a vessel that can carry and lay large quantity of cable.

If parts of the HVDC cables are manufactured outside USA, the cables have to be re-loaded to a cable laying vessel (ship or barge) for operation in the Champlain Canal.

1. The U.S. Merchant Marine Act of 1920, Section 27 ("Jones Act"), requires that all goods transported by water between US ports shall be carried in US flagged ships, constructed in the United States, owned and crewed by US citizens.
   This Act apply when cargo is loaded and discharged within the US (cable is loaded in US port and laid in US waters).
   If the cable is loaded abroad, the cable can be laid in US waters by a non-US vessel, like Nexans' cable laying vessel C/S Nexans Skagerrak.
   If Canada has a similar law like "Jones Act" is not known. We assume that a US registered vessel can operate in Canada.

2. US Dredges (Act of May 28, 1906) require that dredging shall be performed by an US registered vessel. However, dredging is an operation where sediments are removed from the seabed and deposited elsewhere. A water jetting machine will not created any residual of seabed on either side of the trench. The same apply for a cable plough.
   Nexans have performed cable trenching by water jetting off the US coast.

However, it should be checked if there is some legal limitations inside USA. If so, the water jetting system can in whole be built in USA according to Nexans specifications.

2.5 Cable delivery lengths

2.5.1 Cable laying vessel C/S Nexans Skagerrak

The turntable on the cable laying vessel C/S Nexans Skagerrak can accommodate 7000 metric tonnes or up to the top of the turntable, depending on which of the criteria that comes first.

The table below gives an indication of maximal submarine cable length onboard:

	km	miles	tonnes	short tons
TKRA-L 300 kV 1 x 1400 mm² KQ	160	99	6480	7141
NOVA-L 300 kV 1 x 2000 mm² Cu	135	84	6737	7424

2.5.2 Submarine cable installation north of Albany

For the cable installation north of Albany a vessel designed for the New York State canal system must be applied. The best ways to organize this is by transporting the cable in baskets to Albany Port and relocate the basket(s) to the laying vessel. A practical limit for basket + cable is in the range of 300 to 500 metric tonnes. The height of the basket must comply with minimum vertical clearance. Assuming vessel deck 4 ft. above water, height of carousel is 4 ft.; the height of basket cannot be larger than 7 ft. These assumptions give the following table:

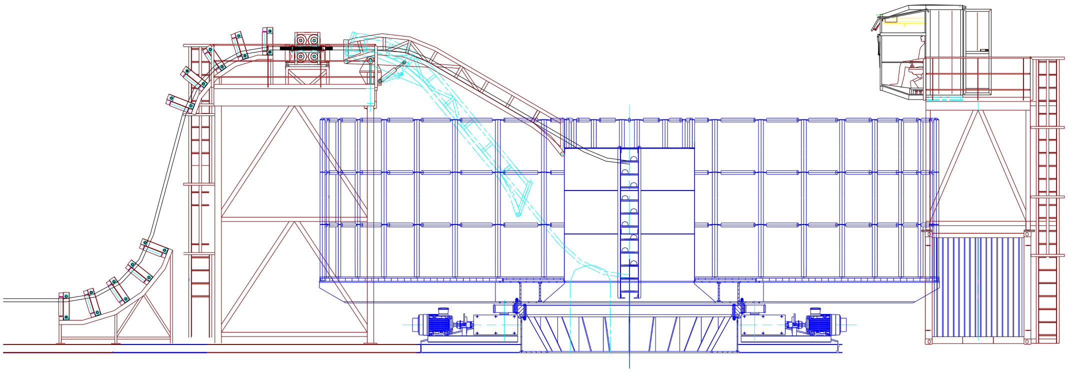
	km	miles	tonnes	short tons
TKRA-L 300 kV 1 x 1400 mm² KQ	11	6,8	446	491
NOVA-L 300 kV 1 x 2000 mm² Cu	9	5,6	449	495

A comprehensive engineering work is required to design vessel, turntable/basket and the laying equipment in order to optimize this part of the installation. The lifting capability in Albany is also part of it.

The preliminary basket data is for XLPE submarine cable:

	m	~ft.
Core diameter	4	13
Outer diameter	11	36
Height	2	7
Net weight	Not evaluated	

Below is an example of a turntable equipped for cable laying. Due to the height restrictions, cable guides and operator's cabin must be redesigned for quick removal when passing fixed bridges.



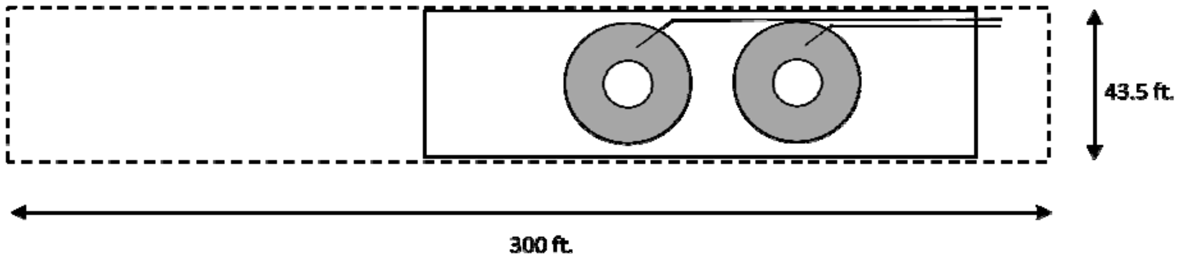
2.6 Cable laying vessels

2.6.1 C/S Nexans Skagerrak

A description of the cable laying vessel C/S Nexans Skagerrak is attached.

2.6.2 Vessel used in canal

It is anticipated that suitable vessels are limited, if not absent. The canal regulations set limits which vessel and laying equipment must comply with. The deck arrangement will include one turntable/basket, preferable two. Due to limited depth in the canal the laying gear can be very simple. However, the required minimum bending diameter must be maintained for all parts of the cable guides. In addition to laying gear there must be space for cable jointing. It is assumed a barge towed by a tug. The canal locks are not operated during night. A 12-hour working time for transport and cable laying is expected and that overnight stop for the crew is on land. Cabin(s) onboard can therefore be limited to day room.



Barge inside a lock. The dotted line represents the lock dimension.

The cable laying operation can be done by tug. However, if a more precise laying operation is required, the barge can be equipped with outboard azimuth thrusters, one in each corner.

These thrusters can turn 360° and be leveled upwards when not in use. The most sophisticated steering system is when the thrusters are connected to a GPS system and linked to the route coordinates. (Dynamic Positioning System). In any case a GPS system is useful. It will monitor the position of laid cables.

It is recommended to evaluate a new vessel. Starting from the drawing table may sometimes be cheaper than doing modifications on an existing vessel.

3 Comments to the Route

Below are some observations and comments from a cable installer point of view. They must be considered during detailed engineering. The observations start from landfall at St.-Jean-Sur Richelieu and going southwards. The land parts are discussed in a separate section.

3.1 Estimated overall route length

TDI have provided the following route lengths. The nautical distances are roughly in accordance with distances measured on Google Earth and found in the NOAA's "Distances between US ports". The amount of HVDC submarine cables are 4 times the distance to Yonkers (4 x 296 mi./4 x 445 km) and 2 times the distance between Yonkers and Bridgeport (2 x 63 mi./2 x 100 km). The total amount of underground cables are 4 x 76 mi./ 4 x 120 km.

Champlain Hudson Power Express (CHPE)	miles	km
Hertel to St. Jean-Sur-Richelieu (land cable)	13	20
Richelieu River to Canada/US border (submarine cable)	25	38
Canada/US border to Champlain Canal Lock 12 (submarine cable)	110	165
Champlain Canal Lock C-12 to Lock C-7 (submarine cable)	24	36

Lock C-7 to Albany (land cable installed in railroad ROW)	63	100
Albany to New York HVDC terminal (submarine cable)	137	206
Sub-total Route Length to New York City:	**372**	**565**
New York City to Connecticut (submarine cable)	63	100
Sub-total Route Length to Connecticut:	**435**	**665**

3.2 Canada to Yonkers

3.2.1 Saint-Jean-Sur-Richelieu to Champlain Lock # 7

A study of the nautical charts reveals that the installation of HVDC cables will cross previous installed manmade objects in seabed and vertical obstacles.

Naval Chart #	Champlain Canal Chart #	Observations
CHS # 1351		St.-Jean-Sur-Richelieu: Pont Gouin. Bascule bridge. Vert. Cl. closed 3.10 m Crossing submarine cable 45° 15': Crossing sewage pipe 45° 09': Crossing submarine cable 45° 7.5': Crossing submarine cable 45° 7.5': Ferry crossing 45° 04': Crossing submarine cable 45° 04': Bridge. Vert. Cl. 18.00 m 45° 3.7': Railroad swing bridge. Ver. Cl. closed 3.70 m *Canada-US border*
NOAA # 14781		*US-Canada border* Fort Montgomery: Fixed bridge; Hor. Cl. 237 ft, Ver. Cl. 56 ft. Fort Montgomery: Disused submarine cable Rouses Point: Abandoned pile railroad bridge - **See NOTE 1** Rouses Point: Disused submarine cable Long Pt. - Sandy Pt.: crossing submarine cable
NOAA # 14782		Cumberland Head: crossing submarine cables & ferry (Port Kent - Burlington: Passenger & automobile ferries) Port Douglas - Burlington: crossing submarine cable
NOAA # 14783		---
NOAA # 14784 -1		Crown Point: Fixed bridge; Hor. Cl. 186 ft. Ver. Cl. 91 ft. Fort Ticonderoga: crossing submarine cable Fort Ticonderoga: crossing cable ferry - **See NOTE 2** Fort Ticonderoga: Submerged piles i canal
NOAA # 14784 -2		Chipman Point: Abandoned Cable Ferry. 43° 35' N: Submarine cable Champlain Lock # 12 Fixed bridge C-32: Hor. Cl. 45 ft. Ver. Cl. 16 ft.

		Fixed bridge C-30: Hor. Cl. 100 ft. Ver. Cl. 15 ft. Fixed bridge C-29: Hor. Cl. 75 ft. Ver. Cl. 18 ft. Fixed bridge C-28: Hor. Cl. 75 ft. Ver. Cl. 17 ft.
NOAA # 14786 -26	C-10	See above
NOAA # 14786 -25	C-9	---
NOAA # 14786 -24	C-9	Fixed bridge C-27: Hor. Cl. 75ft. Ver. Cl. 18 ft. Champlain Lock #11 Overhead pipeline: Hor. Cl. 45 ft. Ver. Cl. 28 ft. Fixed bridge C-25: Hor. Cl. 75 ft. Ver. Cl. 21 ft.
NOAA # 14786 -22	C-8	Fixed bridge C-24: Hor. Cl. 75 ft. Ver. Cl. 18 ft. Fixed bridge C-23: Hor. Cl. 75 ft. Ver. Cl. 18 ft.
NOAA # 14786 -23	C-8	Fixed bridge C-22: Hor. Cl. 75 ft. Ver. Cl. 18 ft.
NOAA # 14786 -21	C-7	Fixed bridge C-21: Hor. Cl. 75 ft. Ver. Cl. 17 ft. Foot bridge: Hor. Cl. 45 ft. Ver. Cl. 18 ft. Champlain Lock # 9 Fixed bridge C-19: Hor. Cl. 75 ft. Ver. Cl. 17 ft.
NOAA # 14786 -20	C-7	Fixed bridge C-18: Hor. Cl. 75 ft. Ver. Cl. 21 ft. Champlain Lock # 8
NOAA # 14786 -18	C-6	Fixed bridge C-17: Hor. Cl. 75 ft. Ver. Cl. 17 ft. Fixed bridge C-16: Hor. Cl. 87 ft. Ver. Cl. 17 ft. Crossing sewage pipe Fixed bridge C-14: Hor. Cl. 75 ft. Ver. Cl. 15 ft. Crossing sewage pipe Champlain Lock # 7 Overhead power cable: Ver. Cl. 55 ft. Reported.

Note 1: Rouses Point: *"A breakwater, marked by a light, extends NE from Stony Point to protect the harbor from the S, and an abandoned pile railroad bridge trestle protects the harbor from the NE."* Part of the bridge trestle must be removed before cable laying or a detour of cables on land.

Note 2: *"Fort Ticonderoga Ferry crosses the lake about 1.7 miles above La Chute. The ferry is towed by a tug and guided across the lake by two cables which are fixed on either shore. Passing through guides and carrier wheels on the ferry, the cables are dropped to the bottom astern and picked up ahead. The cables reach the bottom about 400 feet from either end of the ferry thus allowing vessels to pass by the moving ferry."* To avoid removal of ferry cables before laying of HVDC cables a detour on land should be considered. A short distance to south there are submerged piles in the river. They may also block a HVDC cable laying and trenching operation and this part may also be included as a land installation.

At Chipman Point there is an abandoned cable ferry. There is no further information, but most likely are the ferry cables left on the seabed and have to be removed.

There are more overhead power lines crossing river or canal than written in the table above. Since no vertical clearance is given, it is anticipated that the vertical clearances are too large to cause any problems for vessels in the canal system.

3.2.2 Albany to Yonkers

From a cable layers view the nautical charts reveals the following observations which must be taken into consideration during detailed engineering.

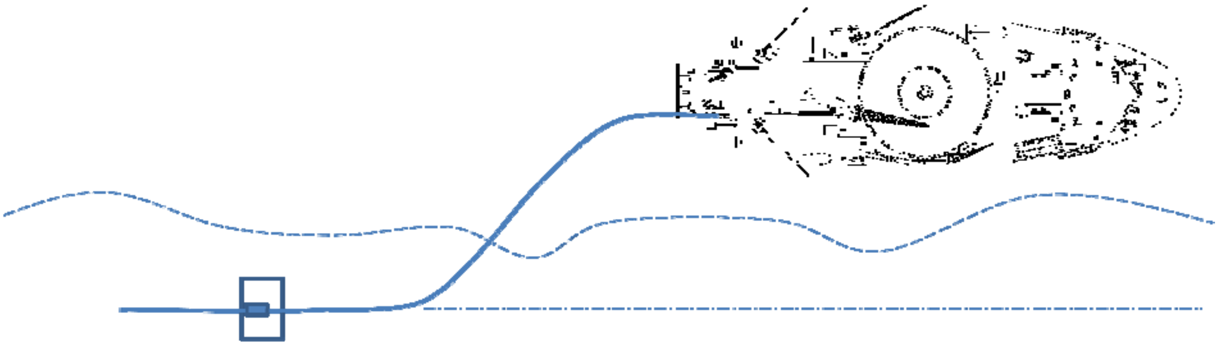
Chart #	Observations
NOAA # 12348 -1	*Port of Albany: Turning basins* Copper Kill: Crossing pipeline area Overhead power cable. Authorized Cl. 194 ft. Overhead power cable. Authorized Cl. 169 ft. Parda Hook: Crossing pipeline area Cedar Hill: Crossing cable area Castleton-on-Hudson Fixed Bridge. Hor. Cl. 552 ft. Vert. Cl. 135 ft. Overhead power cable. Authorized Cl. 145 ft. Railroad bridge. Hor. Cl. 566 ft. (west span). Vert. Cl. 139 ft. Overhead power cable. Authorized Cl. 185 ft.
NOAA # 12347 -1	Athens; Several cable and pipeline area Athens: Overhead power cable. Authorized Cl. 145 ft. Rip Van Winkle fixed bridge: Hor. Cl. 480 ft. Vert. Cl. 142 ft. Kingston Rhinecliff fixed bridge: (two channel spans). Hor. Cl. 760 ft. Vert. Cl.135 ft.
NOAA # 12347 -2	Kingston Point: Cable area Poughkeepsie: Crossing cable and pipeline area Fixed bridge. Hor. Cl. 490 ft. (C span). Vert. Cl. 167 ft. Submerged piles reported Mid Hudson Suspension bridge. Vert. Cl. 134 ft. for middle 1080 ft. Clinton Point: Crossing cable area
	Danskammer Point: Crossing pipeline and cable area

NOAA # 12343 -2	Newburgh-Beacon fixed bridge: Hor. Cl. 960 ft. Vert. Cl. 147 ft. For middle 760 ft. Vert. Cl. 172 ft. at center Beacon: Crossing Cable and pipeline area Highland Falls: Crossing cable area Bear Mountain fixed bridge: Hor. Cl. 1584 ft. Vert. Cl. 155 ft. Tomkins Cove: Crossing pipeline area Overhead power cable: Authorized Cl. 160 ft. Stony Point: Crossing cable area
NOAA # 12343 -1	Tarrytown: Crossing cable area Tappan Zee fixed bridge: Center span: Hor. Cl. 1042 ft. Vert. Cl. 139 ft. East and West spans: Hor. Cl. 470 ft. Vert. Cl. 123 ft. Dobbs Ferry: Crossing cable area (New York - New Jersey border) *Yonkers* *(Spuyten Duyvil Creek / Harlem River)*

It is anticipated using the laying vessel is C/S Nexans Skagerrak, sailing in the shipping channel in Hudson River. Vertical clearance is no obstacle for the vessel. The HVDC cables should at least be laid close to the edge of the channel in order to minimize risk.

Maritime traffic is always a risk to cables. The best solution is to move the cables sideways - outside the shipping channel - during laying operation. The shipping channel is marked by lighted buoys on either side. They represent an obstacle for sideways cable moving. If temporary removal of buoys on one side will be allowed, the cables can be laid in a safer position compared to being laid in the channel. This is perhaps most important for sections of the shipping channel exposed to regular dredging work to keep the guaranteed water depth. The buoys should be easy to remove and reinstall. The US Coast Pilot tells that the lighted buoys marking the channel are replaced by smaller lighted ice buoys during winter.

The sketch below indicates the operation. However, there is practical limitation in how far the cable can be moved sideways.



Cable burial operation is in this way minimally affected by maritime traffic in the river.

3.2.3 Yonkers to Gowanus

Chart #	Observations
NOAA # 12343 -1	*Yonkers* Anchorage areas
NOAA # 12341 -1	George Washington Bridge: Vert. Cl. 195 ft. East End, Vert. Cl. 213 ft. Center, Vert. Cl. 210 ft. West End 135 St. W: Crossing pipeline area 75 St. W: Crossing pipeline area Anchorage areas. Safety zones.
NOAA # 12335 -1	Holland Tunnel: Crossing pipeline area The Battery: Crossing cable area. Anchorage areas. Safety zones.
NOAA # 12334 -1	*Gowanus*

The cables for this part of the route can be laid by a large cable laying vessel like C/S Nexans Skagerrak. Both water depth and vertical clearance is sufficient. The Hudson River along Manhattan and Upper New York Bay (that is New York and New Jersey Harbor area) has an extensive traffic of vessels. Anchorage areas should be avoided. Based on previous RFQs for cable crossings in these areas stringent demands for burial depth can be expected i.e. larger depths than what usually can be achieved by water jetting.

3.3 New York to Connecticut

The shortest distance from Yonkers to Connecticut goes through Harlem River and East River. From Gowanus the route follows East River to Long Island Sound.

3.3.1 Harlem River – East River – Long Island Sound

Chart #	Observations
NOAA # 12343 -1	*Yonkers* *(Spuyten Duyvil Creek / Harlem River)*
NOAA # 12342 -1	*(Spuyten Duyvil Creek / Harlem River)* Spuyten Duyvil Railway Swing Bridge: Hor. Cl. 100 ft. Vert. Cl. 5 ft. closed Crossing cable area Henry Hudson Fixed Bridge: Hor. Cl. 418 ft. Vert. Cl. 142 ft. center, 53 ft. at abut. Broadway Lift Bridge: Hor. Cl. 288 ft. Vert. Cl. 24 ft. Down. Vert. Cl. 135 ft. Up. (24 hr notice) Crossing cable and pipeline area Crossing cable area Crossing cable and pipeline area University Heights Swing Bridge: **Hor. Cl. 85 ft.** Vert. Cl. 25 ft. closed. Crossing cable area Crossing pipeline area Washington Bridge: Hor. Cl. 354 ft. Vert. Cl. 134 ft. Alexander Hamilton Fixed Bridge Hor. Cl. 366 ft. Vert. Cl. 103 ft. at center, 79 ft. at 250 ft. High Fixed Bridge: Hor. Cl. 322 ft. Vert. Cl. 102 ft. at center, 77 ft. at 250 ft. Crossing cable area Macombs Dam Swing Bridge: Hor. Cl. 164 ft. Vert. Cl. 27 ft. closed. Crossing cable and pipeline area 145th Street Swing Bridge: Hor. Cl. 104 ft. Vert. Cl. 30 ft. closed Madison Avenue Swing Bridge: Hor. Cl. 104 ft. Vert. Cl. 25 ft. closed Park Avenue Railway Lift Bridge: Hor. Cl. 225 ft. Vert. Cl. 25 ft. Down. Vertical Cl. 135 ft. Up Crossing cable and pipeline area Third Avenue Swing Bridge: No info on chart Willis Avenue Swing Bridge: Hor. Cl. 109 ft. Vert. Cl. 25 ft. closed. Triborough Lift Bridge: Hor. Cl. 204 ft. Vert. Cl. 54 ft. Down. Vert. Cl. 136 ft. Up. Crossing cable and pipeline area Crossing cable and pipeline area

NOAA # 12339 -1	Ward's Island Lift Foot Bridge: Hor. Cl. 300 ft. Vert. Cl. 55 ft. Down. Vert. Cl. 136 ft. Up. *(East River at Hell Gate)* Robert F. Kennedy / Triborough Fixed Bridge: Hor. Cl. (unlimited?). Vert. Cl. 138 ft. Hell Gate Fixed Bridge: Hor. Cl. 830 ft. Vert. Cl. 134 ft. Crossing cable area. Crossing cable and pipeline area. Crossing cable and pipeline area.
NOAA # 12366 -1	Bronx - Whitestone Fixed Bridge: Hor. Cl. 2265 ft. Vert. Cl. 135 ft. Throgs Neck Bridge: Main span: Hor. Cl. 1711 ft. Vert. Cl. 138 ft. (152 ft. at center) North span: Hor. Cl. 411 ft. Vert. Cl. 123 ft. NOTE: there is a pipeline coming from Hunts Point that follows the East River fairway towards Long Island Sound. HVDC cables may cross at one or several points. Depend upon chosen cable route. Crossing pipeline area Crossing cable area
NOAA # 12367 -1 NOAA # 12368 -1 NOAA # 12369 -1	NOTE: There is a pipeline in Long Island Sound that the HVDC cables may cross one or several times, depending on chosen cable route.

The traffic in Harlem River is heavy and the bridge opening can vary. The US Coast Pilot 2 gives extensive information about everything that regulates the traffic in the area. Some of the information is enclosed.

The width and depth is too small for the cable laying vessel C/S Skagerrak in Harlem River. A smaller vessel or barge must be used for the cable laying operation between Spuyten Duyvil Creek and Hell Gate in East River. From Hell Gate to Bridgeport the HVDC cables can be laid by C/S Nexans Skagerrak or a similar vessel.

3.3.2 Gowanus to East River at Hell Gate

Chart #	Observations
NOAA # 12334 -1	*Gowanus* Butttermilk Channel: Crossing pipeline area Butttermilk Channel: Crossing cable area

NOAA # 12335 -1	Brooklyn Fixed Bridge: Hor. Cl. 1350 ft. Vert. Cl. 127 ft. (110 ft. under moving platforms) Manhattan Fixed Bridge: Hor. Cl. 1200 ft. Vert. Cl. 134 ft. Crossing cable area Williamsburg Fixed Bridge: Hor. Cl. 1536 ft. Vert. Cl. 133 ft. Crossing pipeline area Queensboro Fixed Bridge: East span: Hor. Cl. 760 ft. Vert. Cl. 133 ft. West span: Hor. Cl. 896 ft. Vert. Cl. 131 ft. Overhead cable car: Authorized Cl. 135 ft. Crossing cable area
NOAA # 12339 -1	East side of Roosevelt Island: Roosevelt Island Lift Bridge: Hor. Cl. 400 ft. Vert. Cl. 40 ft. Down, Vert. Cl. 90 ft. Up. Underwater turbines *Hell Gate*

If the cable route is laid west of Roosevelt Island there will be no obstacles regarding depth and vertical clearance. C/S Nexans Skagerrak can be used for cable laying.

3.3.3 Landfall Bridgeport

The Bridgeport Entrance Channel is deep enough for C/S Nexans Skagerrak to enter the harbor. Channel depths are usually guaranteed and maintained by dredging. The HVDC cables should therefore be laid outside the channel to avoid any relation with maintaining channel depth.

3.4 Cable and Pipeline Crossings

The route crosses a multitude number of cables and pipelines. The owners may require a separation between the new cables and the existing cables / pipelines. This can be done by riprap or a protective sleeve around the new cables (Uraduct or similar). Burial by water jetting cannot be used for the crossings. The usual way is using riprap or mattresses. However, the guaranteed depth in the Champlain Canal or other ship channels must be maintained. Therefore each crossing must be evaluated separately.

3.5 Cable Burial

The usual burial depth by water jetting is 1 to 2 m (4 to 7 ft.) provided that the seabed has a consistency that jetting can be applied. Required larger burial depths must be evaluated for each case. For harder seabed materials pre-trenching by excavator is used or the cables are covered by riprap or mattresses.

3.6 Land sections

There will be 2 major land sections; one from Hertel substation to St.-Jean-Sur-Richelieu in Canada; the other in USA from Champlain Lock #7 to Albany following a railroad track. There is very little information about the land parts. The following information is presented in a generalized way.

We have provided information for two types of underground cables:

1. Type TKXE-L is a XLPE insulated HVDC cable. This is the preferred alternative by TDI.
2. Type NOEE-L is a mass-impregnated paper insulated HVDC cable.

The table below is in both metric and US customary units. The cable delivery length is indicative and has to be adjusted to the actual site and joint pit locations during the Engineering phase. This also applies to reel size and reel weight.

Cable type	Diameter	Weight	Bending radius	Delivery length	Reel diameter	Reel width	Weight Reel + cable
	mm	**kg/m**	**m**	**m**	**m**	**m**	**kg**
TKXE-L 300 kV 1 x 1400 mm² KQ	105	29	1,6	1 000	5,0	3,0	38 110
NOEE-L 300 kV 1 x 2000 mm² Cu	108	38	2,7	1 000	5,0	3,0	47 410
	in.	**lbs./ft.**	**ft.**	**ft.**	**ft.**	**ft.**	**short tons**
TKXE-L 300 kV 1 x 1400 mm² KQ	4,13	19,5	5,4	3 281	16,4	9,8	42,0
NOEE-L 300 kV 1 x 2000 mm² Cu	4,25	25,5	9,0	3 281	16,4	9,8	52,3

Below is an indication of space needed during the installation period. The space need not to be square. Therefore the space is also indicated in m^2 / ft.^{2}.

The actual space will be decided during Engineering.

	m	**m**	**m²**
Main lay down area (storage of reels, materials, etc.)	100	100	10 000
Local lay down area, incl. joint pit	20	20	400
	ft.	**ft.**	**ft^2.**
Main lay down area (storage of reels, materials, etc.)	325	325	105 625
Local lay down area, incl. joint pit	65	65	4 225

The underground cables are designed with an axial horizontal distance of 0.5 m (1.65 feet) and a depth of 0.9 m (3 feet). This can be accomplished by one large trench or two smaller trenches. It is usual to lay / pull-out one cable at the time.

Typical dimension of a jointing pit for 4 cables is given below:

	L	W	D
	m	m	m
Jointing pit (metric)	10	13	2
	ft.	ft.	ft.
Jointing pit (US units)	33	43	7

4 Attachments

1. Abstracts from US Coast Pilots
2. Cable laying vessel C/S Nexans Skagerrak

Some important information found about cable routes and sites.

Abstracts from US Coast Pilots

US Coast Pilot 2 (38th Ed. 2009)
Chapter 9 - Western Long Island Sound
Chapter 12 - Hudson River

US Coast Pilot 6 (39th Ed. 2009)
Chapter 14 – Hudson River, New York Canals and Lake Champlain

The US Coast Pilots were downloaded from www.nauticalcharts.noaa.gov/nsd/cpdownload.htm

Abstracts from US Coast Pilot 2 – Chapter 9 - Western Long Island Sound

Norwalk

Channels

(108) Norwalk Harbor and River are entered through a dredged channel that extends 3 miles northeasterly from Sheffield Island Harbor between Manresa Island on the west and White Rock and numerous islets and foul ground on the east, to the first highway bridge at South Norwalk, and thence northerly for another 1.3 miles to the basin at the head of navigation at Norwalk. The tall stack on Manresa Island, marked on top by red lights, is very prominent and can be seen for many miles from sea.

(109) A Federal project provides for a depth of 12 feet from Sheffield Island Harbor to the State Route 136 bridge, thence 10 feet to a 10-foot basin at the head of navigation at Norwalk; an anchorage basin opposite Fitch Point has a project depth of 10 feet. (See Notice to Mariners and latest editions of charts for controlling depths.) The channel is marked by buoys and lights to the South Anchorage Basin.
Caution

(110) Chemically contaminated material has been buried in the navigation channel off Oyster Shell Point about 140 yards below Interstate Route 95 bridge. The material is covered with a layer of noncontaminated dredged material not less than 3 feet thick.

Tides

(119) The mean range of tide is about 7 feet.

Currents

(120) The tidal currents in Long Island Sound off Norwalk have a velocity of about 1 knot. In Norwalk River, off Gregory Point, the velocity of current is about 0.6 knot. The currents in the harbor follow the direction of the channel, the ebb current being somewhat stronger than the flood. (See the Tidal Current Tables for predictions.)

Glenbrooke

(136) Cove Harbor, northward of Smith Reef and about 1 mile westward of Long Neck Point, has depths of about 5 to 10 feet. Local knowledge is necessary to avoid several rocky areas in the approach to the harbor and to the basin at the northwestern end of the harbor at Cove Mills. A depth of about 1 foot can be carried across the bar at the entrance to the basin; private buoys, one of which is a seasonal speed limit buoy, mark the approach. A municipal marina is in the basin.

Harlem River

Charts 12339,12342

(470) Harlem River, which joins East River in Hell Gate between Wards Island and Manhattan Island, extends northward about 7 miles and connects with Hudson River through Spuyten Duyvil Creek. The channel through Harlem River is narrow, tortuous, and navigable only for powered vessels. By taking care to avoid several isolated 11- to 13-foot spots, a depth of about 14 feet can be carried to the Hudson River; the chart is the guide.

(471) Traffic is heavy in Harlem River. Vessels with heights too great to pass under the closed drawbridges should make the passage against the current.

Bridges

(472) There are more than a dozen draw and fixed bridges over Harlem River. The minimum clearance under closed drawspans is 24 feet except at the railroad bridge over the entrance from Hudson River where it is only 5 feet. Clearance under raised vertical-lift spans exceed 100 feet. (See 117.1 through 117.59 and 117.789, chapter 2, for drawbridge regulations.) Minimum clearances under fixed bridges exceeds 100 feet at the center of the spans.

(473) Four bridges over the Harlem River, the 103rd Street lift bridge, the Triborough lift bridge, the Park Avenue lift bridge, and the Conrail swing bridge at Spuyten Duyvil, at 0.1 mile, 1 mile, and 1.7 miles, and 6.7 miles, respectively, above the entrance, are equipped with radiotelephones. The bridgetenders monitor VHF-FM channel 13; call signs KIL-820, KGW-326, and KA-5059, and KU-9797, respectively. The Conrail bridge is maintained in the open position except for the passage of trains or for maintenance.

Tides

(474) The mean range of tide in Harlem River is 5.1 feet in Hell Gate and 3.6 feet at the entrance from Hudson River.

Currents

(475) The tidal currents in Harlem River run southward from Hudson River to East River while the east-going current is running in Hell Gate; and the reverse. The south-going current in Harlem River is considered the flood. The times of slack water are subject to variations depending upon freshet conditions in Hudson River. The velocity of the current is 2 knots or more in the narrower parts of the channel. (See the Tidal Current Tables for predictions.)

Abstracts from US Coast Pilot 2 – Chapter 12 (2009) – Hudson River

Hudson River
(1) This chapter describes the Hudson River from New York City to Troy, N.Y., and includes the principal cities of Yonkers, Newburgh, Poughkeepsie, Kingston, and Albany.

(2) Mileages shown in this chapter for the Hudson River as Mile 0.9E, Mile 12W, etc., are the nautical miles above The Battery; the letters N, S, E, and W denote by compass points the side of the river where each feature is located. Mile 0.0 is a point at the mouth of the Hudson River in 40°42.1'N., 74°01.5'W.

(3) It is to be understood that the mileages given are approximations. The values are not intended to be finite. The intended degree of accuracy is only supposed to be enough to put the user of the chart into the general vicinity of the cited object, for the purpose of locating the object.

Charts 12335,12341,12345-12346,12343, 12347-12348
(4) Hudson River, sometimes called North River in New York City, has its source in the Adirondack Mountains, about 275 miles along its course from a junction with East River at The Battery, N.Y., and flows in a general southerly direction into New York Upper Bay. Troy Lock and Dam, 134 miles above The Battery, permit vessels to pass from tidewater to the upper river and the New York State Canal System. The river water is usually fresh as far south as Poughkeepsie, halfway from Troy Lock and Dam to The Battery.

(5) New York City extends along the eastern bank of Hudson River for a distance of about 14 miles above The Battery. For about 5 miles northward from The Battery, the New York waterfront is an almost continuous line of wharves and piers, some of which can accommodate the largest transatlantic liners.

(6) On the opposite side of Hudson River from New York City are Jersey City, Hoboken, Weehawken, West New York, Guttenberg, Edgewater, Fort Lee and Englewood Cliffs. The shoreline from Jersey City to Edgewater is lined with ruined piers and piling fields. Mariners must check with local authorities and property owners for approval prior to mooring.

Channels
(7) The lower Hudson River has depths of 43 feet or more in mid-channel from deep water in Upper New York Bay off Ellis Island to the upper limit of New York City's major wharves at 59th Street, about 5.3 miles above the entrance. Above this point, the Federal project depth is 32 feet to Albany, except for that section of the channel along the New Jersey Weehawken- Edgewater waterfront between 85th Street and

156th Street, Manhattan, where the project depth is 30 feet. (See Notice to Mariners and latest editions of charts for controlling depths.)

Seasonal buoyage

(8) The lighted buoys marking the Hudson River channel are replaced during the winter by smaller lighted ice buoys or unlighted buoys.

Bridges

(9) The bridges over Hudson River from New York to Albany have either fixed or suspension spans.

(10) The limiting bridge clearance over the lower Hudson River is 139 feet, at the Tappan Zee Bridge (IS 87/287). The middle Hudson River has a limiting bridge clearance of 134 feet at the Mid-Hudson Bridge (US Route 44) at Poughkeepsie. The upper Hudson River has a limiting bridge clearance of 135 feet at the Castleton-on-Hudson Bridge (New York State Thruway/ IS 90 E-W). The least clearance of the overhead cables is 145 feet.

Anchorages

(11) General anchorages begin 5 miles above The Battery and extend upriver for about 10 miles. (See 110.1 and 110.155, chapter 2, for limits and regulations.)

(12) Vessels proceeding from New York to Albany occasionally anchor overnight in the vicinity of Kingston, 79 miles above The Battery and 47 miles below Albany, to await daylight hours for passing through the constricted part of the river.

(13) A buoyed anchorage, 400 feet wide and 2,400 feet long, with depths of 32 feet is on the east side of the channel just above Stuyvesant, 111 miles above The Battery and 15 miles below Albany.

Dangers

(14) Numerous fishtraps are planted each spring, usually from about mid-March to mid-May, during the seasonal run of shad to the spawning grounds in the upper Hudson. The charts show the fishtrap areas in the 30-mile stretch beginning about 5 miles above The Battery and extending upriver to Stony Point; Corps of Engineers permits are required for the placing of shad nets and poles in the charted areas. Outer limits of the nets usually are marked by flags during the day and by lights during the night. Caution is advised when navigating a fishtrap area because broken-off poles from previous traps may remain under the surface.

(15) Navigation of the river is easy as far north as Kingston, but above Kingston it is more difficult because of the numerous steep-to shoals and middle grounds. In general tows are apt to follow the shoreline which is most favorable as regards wind and current; with a strong northwest wind, tows will follow the west shore regardless of the direction in which they are traveling.

Tides

(20) The tides in Hudson River are affected by freshets, winds, and droughts. Because of these variables the predictions given in the Tide Tables for points above George Washington Bridge are based upon averages for the 6-month period, May to October, when the freshwater discharge is at a minimum.

(21) The mean range of tide is 4.5 feet at The Battery, 3.7 feet at Yonkers, 2.8 feet at Newburgh, 3.1 feet at Poughkeepsie, 3.7 feet at Kingston, 4.6 feet at Albany, and 4.7 feet at Troy. (Daily predictions for The Battery and Albany are given in the Tide Tables.) Currents

(22) The currents in Hudson River are influenced by the same variables that affect the tides. The times of slack water and the velocities and durations of flood and ebb are subject to extensive changes; the times of strengths are less likely to be affected. The currents usually set fair with the channels except in the vicinities of bends and wharves.

(23) Velocities of currents are 1.4 knots flood and 1.4 knots ebb northwest of The Battery, 1.6 and 2.2 knots at George Washington Bridge, 0.9 and 1.1 knots at Newburgh, 1.1 and 1.2 knots at Poughkeepsie, 1.3 and 1.6 knots at Kingston, and 0.3 knot flood and 0.8 knot ebb at Albany. Near Troy Lock and Dam, the current does not flood and the ebb has a velocity of 0.7 knot. These values are for the summer when the freshwater discharge is at a minimum.

(24) Daily current predictions for The Narrows, New York Harbor, are given in the Tidal Current Tables. Predictions for places along Hudson River may be obtained by applying the differences and ratios listed for these places in the tables.

(25) During the summer of 2004, tidal observations were made in the Hudson River near Haverstraw and it was found that there were significant differences in the timing of the tidal current phases as compared with the predicted tidal current phases. The greatest time difference was observed in the slack before ebb, which on average may occur one hour later than the predictions given in the 2005 Tidal Current Tables. The National Ocean Service's (NOAA) Center for Operational Oceanographic Products and Services (CO-OPS) issued special daily tidal current predictions for the Hudson River at eight locations, where data were collected during 2005, in the 2007 edition of the Atlantic Coast of North America Tidal Current Tables. Mariners should exercise caution when using the published tidal current predictions.

Abstract from US Coast Pilot # 6 – Chapter 14 – Hudson River, New York Canals and Lake Champlain

(19) Elsewhere in the New York State Canal System, the project depth is 12 feet in all channels and through all locks and guard gates. These channels have widths of 75 feet in earth cuts, 94 feet in rock cuts, and generally 200 feet in canalized rivers.

(20) The canal system is well marked by lights, lighted ranges, lighted and unlighted buoys, and daybeacons, all maintained by the State of New York. The arrangement of aids considers the entire canal system as a waterway extending from the Hudson River to interior parts of the State. All red lights, daybeacons, and buoys are on the right or starboard hand, and all white lights, daybeacons, and buoys are on the left or port hand when proceeding up or away from the Hudson River, or away from the main line in the branches. This arrangement extends W to Tonawanda on the Niagara River. However, buoyage in the Niagara River is based on the principle that "proceeding from seaward" is proceeding from Lake Erie toward the Niagara Falls. Mariners are therefore reminded, after exit from the canal into the Niagara River, to keep red buoys to port and green buoys to starboard when continuing on to Lake Erie.

Locks

(21) The New York State Canal System has a total of 56 locks plus the Federal lock at Troy. The controlling dimensions of the locks are a length of 300 feet and a width of 43.5 feet. The locks and guard gates have a depth of 12 feet over the sills at normal pool level, except 13 feet over the sills in the Great Lakes-Hudson River Waterway Improvement. The lock lifts range from 6 feet to 40.5 feet, with an average lift of 17.7 feet. The guard gates at various points in the canal system have a pier in midchannel with a clear passage of 55 feet on either side.

Bridges

(22) The canal system is crossed by a total of over 300 bridges. Most of the bridges are fixed, except where local conditions necessitate other types. The least vertical clearance for bridges crossing the part of the system known as the Great Lakes-Hudson River Waterway Improvement is 20 feet, and the least clearance for all other parts of the canal system is 15 feet.

Chart Datum, Lake Champlain

(29) The plane of reference for depths shown on the charts covering Lake Champlain is low lake level, which is 93.0 feet above mean sea level.

Fluctuations of water level

(33) The water level of Lake Champlain is subject to variation from year to year; the observed range is from 0.6 foot below to 8.8 feet above the reference plane of low lake level. During each year, the seasonal fluctuation is 4 to 5 feet, the lowest stage occurring in September or October and the highest stage in April or May.

Chart 14784

Cable ferry

(38) Fort Ticonderoga Ferry crosses the lake about 1.7 miles above La Chute. The ferry barge is towed by a tug and guided across the lake by two cables which are fixed on either shore. Passing through guides and carrier wheels on the ferry, the cables are dropped to the bottom astern and picked up ahead. The cables reach the bottom about 400 feet from either end of the ferry thus allowing vessels to pass by the moving ferry. The tug and barge are marked by lights, and signs on both and along the shore warn vessels of the presence of the ferry and the cables. Extreme caution is advised when passing the cable ferry. The ferry should never be passed close by.

Chart 14781

(73) A breakwater, marked by a light, extends NE from Stony Point to protect the harbor from the S, and an abandoned pile railroad bridge trestle protects the harbor from the NE.

D 03

ROUTE SURVEYS

Recommendations for further data studies and scope for marine and land route survey

LIST OF CONTENTS

1 INTRODUCTION

This document should be read in conjunction with the report on the cable route.

The document outlines requirements to route survey where satisfactory information is not available. The main scope will be the marine survey, but a land survey of the underground sections is just as important w.r.t. soil thermal conditions, alignment of cables, joint bays and cable handling criteria.

The document outlines the minimum requirements; however the full scope of the work should be specified in consultations with professional consultants familiar with national and local requirements.

2 SUMMARY

Four cables, two bi-poles, run from Hertel to Yonkers, New York, about 595 route km, and two cables continue to Bridgeport, Connecticut, a further 90 route km. The exact locations may be subject to change.
The cables are planned to be installed two at a time where they are installed by barge with two turntables, and one at a time where the CLV Nexans Skagerrak is used.

As a result of the laying methods and the natural width limitations in the waterways, the cable corridor to be surveyed will vary in width from 20-25 m to up to about 100 m in the deeper parts in the Hudson River and Long Island Sound.

An outline of the scope of work is detailed below, but the actual survey must be planned for each stage of the route w.r.t. scope of the work and suitable survey vessel.

The location and length of the survey corridor shall be communicated to the Survey Contractor in due and reasonable time before the survey starts.

The order of installation might have an impact on the survey work.
One method is to install all cables section by section. Another scenario is to install the cables in two major campaigns; one pole complete to Yonkers, New York and then the entire second pole to Connecticut as a separate campaign.

The underground part of the work is about 130 km route length, in itself a major survey task. The work, as for the marine survey, comprise a desk study, verification of crossing or near by utilities and soil analysis w.r.t. thermal properties and chemical composition.

3 CORRIDOR WIDTH AND SURVEY LINES

A corridor for each cable or cable pair shall be surveyed to establish the best routes for the cables to be installed. Exact location will be subject to permitting.

- 20-25 m for four cables in one corridor in rivers and canals where laying will be by barge. This includes the Harlem River if this option is chosen.
- About 100 m for the remaining parts of the routes, i.e. from Albany in the Hudson River and in Long Island Sound.

The survey work shall be completed in good time for permitting purposes, but some details may be staggered in time with the installation programme.

The number of survey lines to be run will depend on the equipment offered by the survey contractor, but can be 2-3 in shallow water and up to 7 in deeper waters. Infill lines and cross-ties to be run as appropriate.

4 DESK STUDY

The aim of the desk study is to gather relevant known information in order to limit the field work and to suggest additional work.
Information that should be available and relevant, based on the proposed routes, would be:

- Areas likely or known to be excluded
- Areas likely to be approved
- Areas with high risk of damage to a buried cable
- Tidal currents
- Other currents
- Water temperature high and low limits
- Soil conditions
- Requirements to burial – by Authorities
- Identification of crossing cables and pipelines – owner/position/ depth of burial

5 FIELD SURVEY WORK

The marine route survey shall be performed with the following equipment/methods.

5.1 Multibeam Bathymetric Survey

A detailed multibeam bathymetric survey would be required along the whole length of the two routes to identify navigation channels, artificial reef locations, other bottom features and to adjust suggested routes.
The multibeam bathymetry survey may limit the need for side-scan sonar (see below).

5.2 Side scan sonar survey.

A side-scan sonar survey will in general be required along the marine routes to evaluate potential surface obstructions and to identify potential submarine archaeological and historical resources.
Side-scan sonar for archaeological resources may not be required along the entire route, but may be focused in areas of special interest.

Detailed bathymetry information gained during the multibeam bathymetry survey may provide sufficient bottom detail to ascertain potential impacts to archaeological and historic resources.

5.3 Sub – Bottom Profiling

Sub-bottom profiling would be required along the marine routes to evaluate shallow subsurface geophysical conditions; including sediment composition, sediment thickness, structure, cable and pipeline crossings, debris and other potential obstructions.
For cable burial purposes, the upper 6-12 ft are of main interest.

5.4 Sediment Characteristics Sampling

Soil samples shall be taken to classify the sediment in parts of the routes with different geophysical conditions and based on the results from the Sub Bottom Profiling survey.
Samples shall be collected from areas with varying geophysical conditions and may not be required along the entire marine route. Sediment characteristic information would be used to predict the potential for cable burial and sediment disturbance during installation.

The soil analysis shall include:

- Measurement of soil shear strength, kPa
- Visual description
- ASTM classification
- Gradation analysis
- Moisture content, %
- Organic content, %
- Liquid limit
- Plastic limit
- Plasticity index

Also the following values shall be listed:
- Soil temperature measurement (see below)
- Thermal resistivity measurement, ˚C -cm/W (see below)

Actual sample sites and number of samples can be based on the desk study and the findings of the Sub Bottom profiling.

5.5 Sediment Quality Sampling

Bulk chemical analysis should include metals, pesticides, petroleum hydrocarbons, polychlorinated biphenyl (PCB) aroclors, total organic carbon (TOC), polynuclear aromatic hydrocarbons (PAHs) and semi-volatile organics (SVOCs). Sampling would likely include surface (i.e., grab) and subsurface (i.e., cores) sediment samples.

Similar to sediment characteristic sampling, the number of sediment quality samples would be dependent on the results of the sub-bottom profiling survey.

The scope for sediment quality sampling may be limited by the requirements set forth by the permitting processes.

5.6 Soil temperature measurements.

(See Sediment Characteristics Sampling above)

The temperature in the soil shall be measured in situ as part of the soil sampling.
It is important to know the soil temperature for power cable design purposes.
Measurements should generally be taken at 2 ft and 5 ft depth below seabed.
(To be adjusted according to sub bottom profiling)
Additional measurements shall be taken in areas where deep cable burial may be required – tentatively 12 ft.

5.7 Thermal Resistivity

(See Sediment Characteristics Sampling above)

It is important to know the Thermal Resistivity for power cable design purposes. Measurements should generally be taken at top, centre and bottom of a core sample.
(To be adjusted according to sub bottom profiling)

5.8 Permits for the work

The survey contractor shall assist with documentation required to obtain relevant work permits and clearances, take part in meetings and submit statements as required for this type of work.

5.9 Reference system

The geodetic datum shall be WGS84 and all reporting of positions shall be in the same datum. Positions shall be recorded using DGPS with high accuracy.
A reason for choosing WGS84 is for the survey to be compatible with the laying vessel navigation systems
A contour map shall be produced for the cable route corridor. This map will together with results from the marine route survey give the basis for the final route selection.

Working reference system and final reports may be in required local datum.

5.10 Report formats and contents

Field records shall include identification number, time of the run and events. All subbottom records shall be appropriately labelled.
The reporting shall include, but not be limited to the following.

- Specifications for the survey and position equipment used during the route survey

- Contour maps as stated below and to be accepted by Owner.
  One contour map in scale 1 : 10 000 with 1 meter equidistance of the whole route lengths. For the landing areas, rivers and channels, contour map in scale 1 : 2000 with an equidistance of 0.5 meter.
  Preliminary maps shall be made at site.
  The survey report shall include profiles and profile lengths for the selected routes. Final maps shall be worked out, with possible route modifications, after completed survey work.

- Mapping of existing cables, pipelines and obstacles found during the survey in addition to cables, pipelines and obstacles previously documented and mapped. All objects and route crossings with UTM and Geographical Co-ordinates
- List of UTM and Geographical Co-ordinates and plot for the recommended cable routes.
- Calculated cable lengths, section by section.
- Seabed Characteristics, sediment type, subbottom structure and composition, produced on separate maps or incorporated in the contour maps. Data from sediment sampling and core samples, shall also be mapped.

- Mapping with Interpretation of the Side Scan Sonar results

- Report of observations and study of Industrial, Shipping and Fishing activities, Oceanographic investigation, Marine biology, Climatology and Winds, Tides Current and Waves in the actual area.
- Copy of the ship's and survey logs covering the survey period.
- Copy of all raw data and processed data on CD

- A written daily report of work performed with estimates of percentage performed and remaining work.

If and where ROV and video filming has been used:
- ROV log copy

- Video recording with interpretation of findings of the whole routes shall be made.

6 EXTERNAL PERSONNEL, MARINE WORK

The survey vessel shall in addition to the survey personnel have accommodation for a total of two representatives from COMPANY and Cable contractor. A further one to two official or third party observers may also request accommodation onboard for parts of the work.
If 24-hour operation is contemplated, board and full time sleeping quarters are to be available for each representative.

7 UNDERGROUND SECTIONS

The underground part of the work is about 130 km route length. Two poles, i.e. four cables in parallel shall be installed the major part of the UG sections. The possibility of transporting long lengths of cable on drums to site in order to limit the number of joints will have a major effect on the installation work. Typical lengths of UG cable may vary from 500 to 1000 m, indication up to 50% savings in the jointing work if drums with 1000 m cable can be used throughout the land sections.

The desired route and Right of Way for the various sections must be investigated w.r.t. constructability. This includes evaluating access to the route with heavy equipment and transport to site of large cable reels and compiling relevant information on bridges and roads w.r.t. free height, load limits and need for temporary roads.

The work, as for the marine survey, comprise a desk study, verification of crossing or near by parallel utilities and soil analysis w.r.t. thermal properties and chemical composition. Trial holes need to be made both for soil sampling and to verify the exact location of third party utilities.

D 04

PRELIMINARY CABLE SYSTEM DESIGNS

Designs based on available data

D 05

CABLE INSTALLATION

Cable transport, installation and protection

LIST OF CONTENTS

1 INTRODUCTION

This document is a brief description of cable loading, transport, installation and protection of the submarine cables.

The installation of underground cables is not described in detail, but the trench layout is reasonable described by TDI in drawing 169201-T1.

2 SUMMARY

Cable will be manufactured at plants set up in New York State and Europe.

The project schedule indicates the chain of activities and also activities that need to be performed in parallel to maintain a satisfactory progress.

The main principles for loading and laying cable with the DP vessel Nexans Skagerrak and from a specially fitted laybarge are similar. A brief method statement including an outline of rigging for laying two cables at a time is enclosed with this document.

The principles for post lay burial by water jetting are the same for the deep water (> 10 m) and shallow water machines. The descriptions of both systems are enclosed.

Crossing of pipelines and cables will be an important issue, and we have enclosed various designs with a summary description.

3 CABLE LAYING VESSELS AND INSTALLATION PROCEDURES

The enclosed document “General Laying Procedure, The Cable laying vessel C/S Nexans Skagerrak” describes the methods that in general also need to be observed by a laybarge.

Monitoring of the loading to avoid kinking of the cable needs to be observed regardless of the vessel type.
The document “Report on Cable Route” give further outlines of laying two cables simultaneously.

4 BURIAL

The cables are planned to be buried by post-lay water jetting. The descriptions of one remote operated machine, CAPJET 1MW and one smaller CAPJET 50 are enclosed.

The large machine require to be operated from a DP vessel and is suitable at water depths > 8-10 m, depending on the vessel.
The small machine requires a diver to connect the water hoses from the pump underwater, but is operated from a small support vessel without divers in the water.

If deep burial in touch soil is required for parts of the route, some types of a jet ploughs exist in the market that can be adapted to post-lay burial. These machines operate with mechanical pulling assisted by powerful water jetting.

5 CROSSINGS

Enclosed with this document, please see a general description of pipeline and cable crossings with sample designs.
Crossing agreements need to be made with each utility owner, and crossing designs must be based on the actual location, depth of burial or exposure of the crossed object.

GENERAL LAYING PROCEDURE.

THE CABLE LAYING VESSEL C/S NEXANS SKAGERRAK.

Procedures for the cable laying operation will be elaborated during the engineering phase prior to installation. The description below is only an outline procedure.

Navigation systems

The navigation is mainly based on the use of DGPS (Differential Global Positioning System). For shore range position Artemis may also be used.

GPS is a distance measuring system where the receiver onboard the laying vessel measures the distance simultaneously to all GPS satellites above the horizon. Improvements of the accuracy can be obtained from different sources. There are several companies that have a world wide net of land stations over accurately surveyed points sending correction values via satellites. The correction values will give a position accuracy of 1 to 5 m depending on the distance from the land stations. The most accurate surface reference is achieved by setting our own land station over a surveyed point near the cable corridor, sending correction values to the receiver onboard. In this way position accuracy of 1 m or better can be achieved.

Artemis is a microwave-based system using range and bearing.

The DP-computer and the back-up computer work out the ship's position in the UTM co-ordinate system or in a similar national system. The pay-out wheel position is usually used as position reference for the calculations, but other points on board or off-board the ship can also be used.

The reference system described above is interfaced to the DP (Dynamic Positioning) computer. When cables are laid the computer is set in the AUTOTRACK mode. In this mode the C/S NEXANS SKAGERRAK will automatically follow the predetermined track in UTM co-ordinates during cable laying operations.

The ship's speed can be varied from 0 up to max. laying speed in the AUTOTRACK mode. In the AUTOTRACK mode any position can be maintained as long as any of the reference systems are received and read by the computer. This means that mooring is not required.

The position of CAPTRACK or ROVs will be monitored by the use of a hydro acoustic position reference system (HPR).

Load-out of cables

The submarine cables, already tested and stored in the Nexans factory in Halden will be loaded on board the vessel from the factory storage turntable on land. Onboard the vessel, the cables will be stored on the vessel turntable. Details of the turntable and lay system are presented together with the vessel description.

The load-out will be done in co-operation with the personnel from the factory. Permanent communication system shall be established between the factory loading supervisor and the vessel's loading supervisor. There will be a free span at the quay to accommodate the factory and vessel machinery. The loading operations will be performed around the clock.

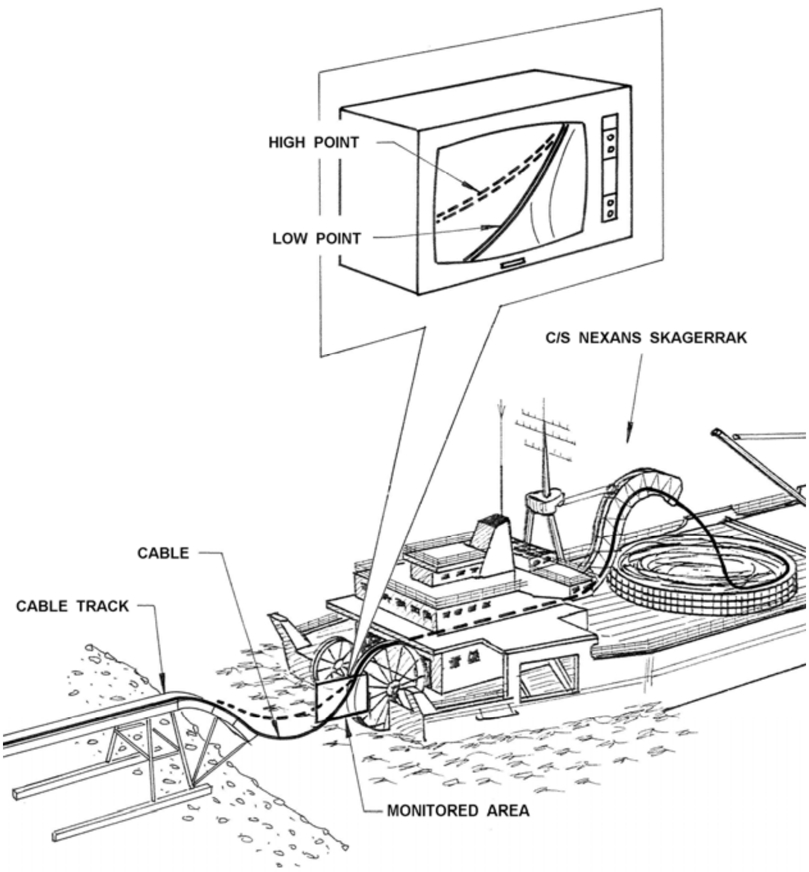


Fig. 1

All oil-filled cables will be connected to an oil tank battery onboard to maintain cable integrity.

When the cable load-out operation is completed the cable vessel will sail to site.

Pull-in at the 1. landfall

C/S NEXANS SKAGERRAK will arrive to the pre-decided position near the first landfall and stay in that position by its own dynamic positioning equipment.

The submarine cable is fed from C/S NEXANS SKAGERRAK to cable floats and pulled towards the landing point by work boats. The weather conditions and floating length will decide the number of work boats needed for this operation.

A winch wire is pulled from land by a work boat and connected to the cable leading end when reaching a water depth about 1.5 - 2 m. (Fig. 2).

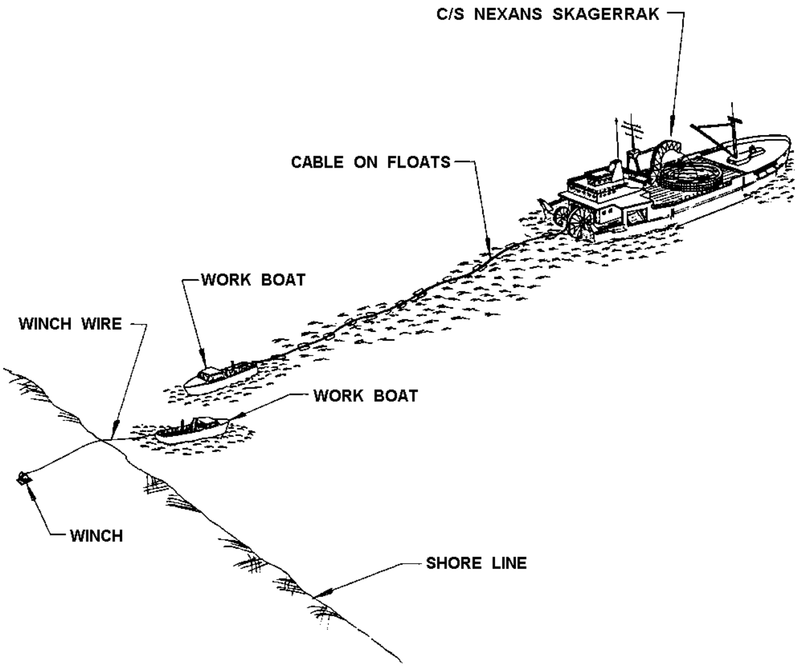


Fig. 2

The land based winch will pull the cable further while C/S NEXANS SKAGERRAK simultaneously is feeding more of the cable onto cable floats.

At the shoreline the cable is pulled over a cable guide and the floats are removed. The cable is pulled on rollers on land. (Fig. 3).

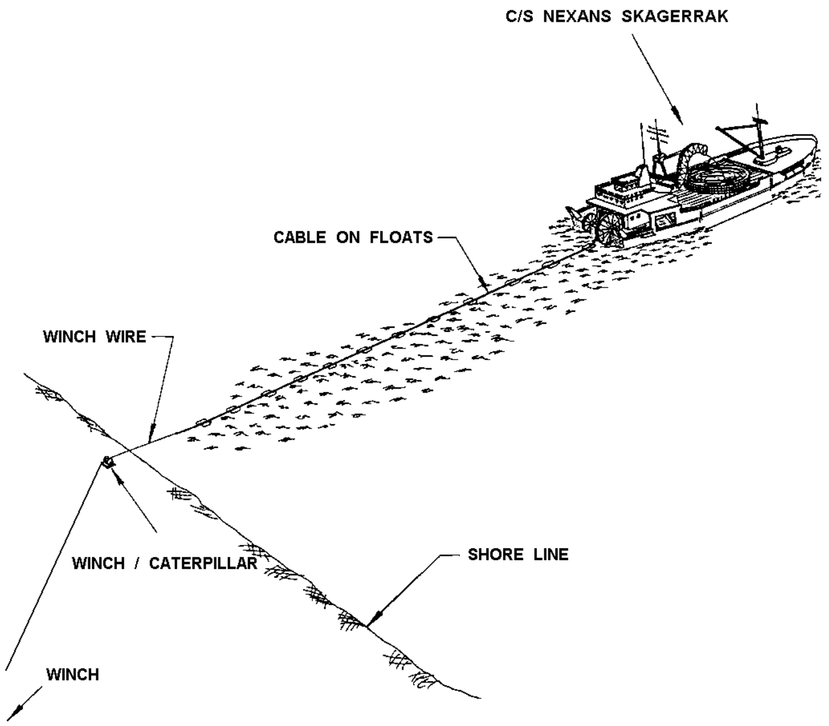


Fig. 3

When a sufficient length of cable is pulled on land, the cable is lifted away from the cable rollers. The cable is anchored on land by a Chinese finger.

Divers will now start submerging the cable by letting the air go from the floats.

The cable lay down to seabed is controlled by both divers and work boats. This operation continues until the crew have reached C/S NEXANS SKAGERRAK (Fig. 4).

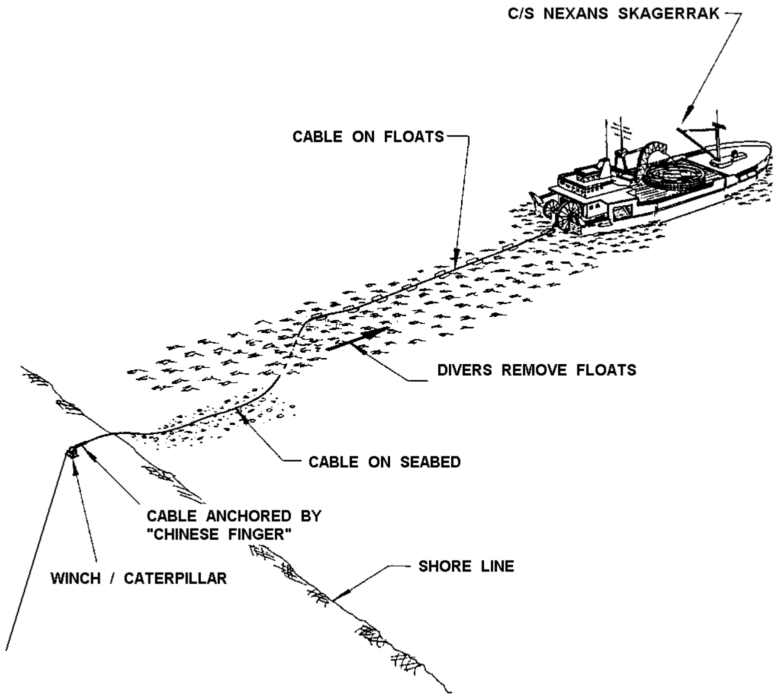


Fig. 4

Reaching C/S NEXANS SKAGERRAK all floats are collected and lifted on board.

The main lay

The laying operation proceeds by laying the cable on sea bottom or trench bottom directly from the laying vessel C/S NEXANS SKAGERRAK. (Fig. 5).

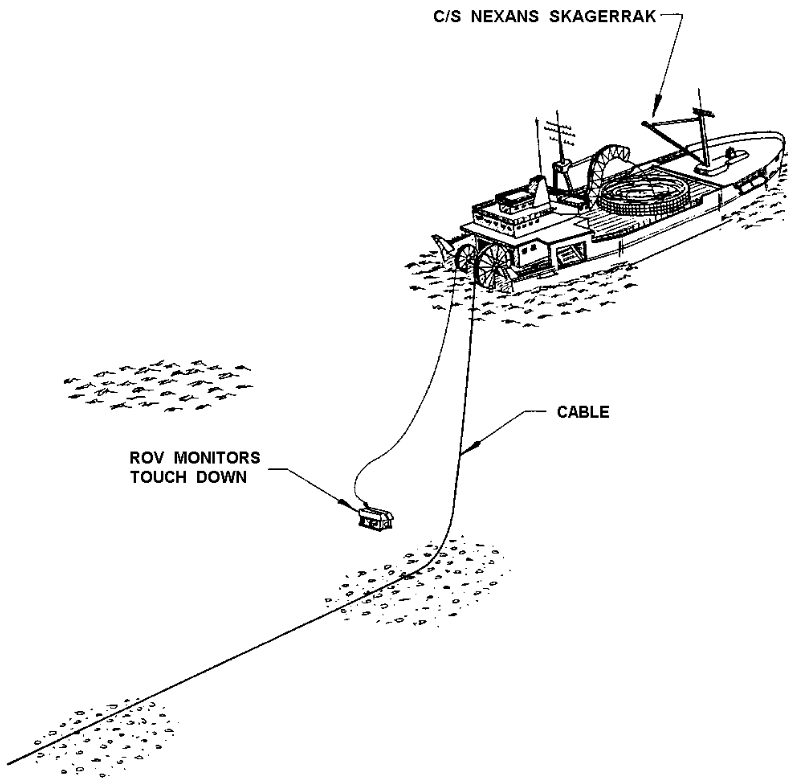


Fig. 5

The laying operation is monitored from the vessel. The following data will be continuously monitored onboard.

- Position of the vessel
- Data from the Touch Down Tracker, if applied
- ROV position, when applied on board C/S NEXANS SKAGERRAK
- Cable pay out speed
- Cable tension and angle at lay wheel
- Laying speed
- Length of laid cable
- Water depth
- Wind, velocity and direction
- Position of joints, if any

These data will be compared with pre-calculated values to ensure that the cable is laid properly on the sea bottom, see Submarine cable laying plan.

The bottom tension in the cable is normally kept to approx. 5 – 10 kN for high voltage cables.

As an option the cable touch-down may be controlled by CAPTRACK or by a Remote Operated Vehicle (ROV). The ROV can also be operated from a separate vessel that follows closely to C/S NEXANS SKAGERRAK.

If detrimental free spans occur the corrective action may be to reverse the laying (retrieve the cable) for a few meters, move the vessel sideways and resume the cable laying. A ROV touch down control during cable laying is advantageous compared to a post-lay inspection.

Regarding free spans we will execute the work in good workmanship using the most up-dated methods to secure the optimal position of the cable at the seabed. However, the rigidity of the cable together with the topography of the sea bed and water currents may create spans.

Nexans Norway AS has developed the CAPTRACK system based on our experience with ROV technology and the CAPJET trenching system. The CAPTRACK rolls on the cable a few meters above seabed equipped with HPR responder, altimeter, devices for measuring cable angel and tension, sea depth, TV camera, light or other types of sensors depending on site conditions and requirements. The CAPTRACK was used when laying both power and fibre optic cables under the severe conditions in Cook Strait, New Zealand.

Pull-in at the 2. landfall

When C/S NEXANS SKAGERRAK has reached a pre-decided position at the opposite landfall, the laying operation will temporarily stop. The DP system will allow C/S NEXANS SKAGERRAK to stay in this fixed position.

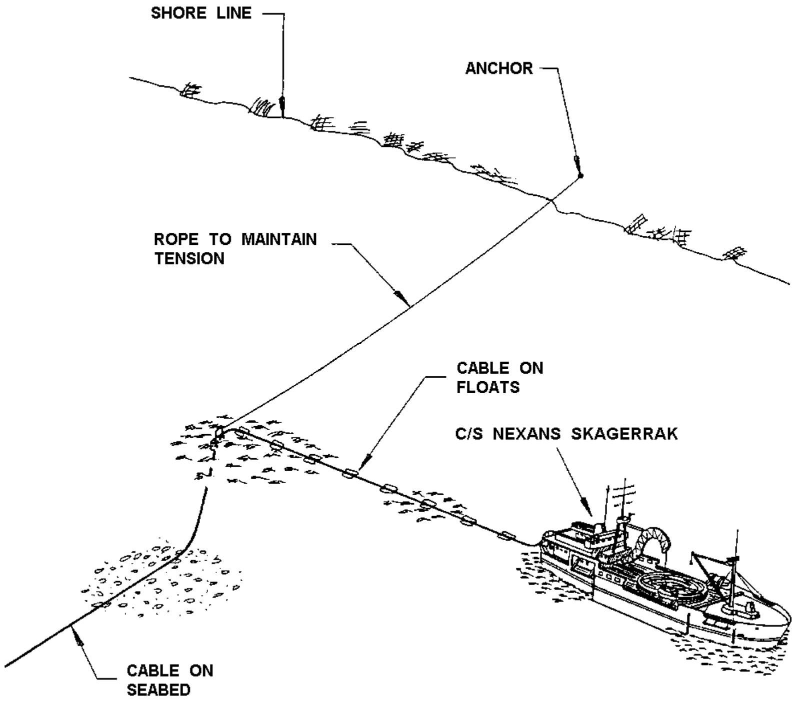


Fig. 6

Measuring out the necessary cable length to reach land will be performed. (The distance to joint bay or termination).

The required distance is measured out along the cable on board and the cutting point is defined (in the upper layer on the turntable).

The cable is cut and cable jointers seal the ends.

When the cable end is prepared for pulling, the pressure is partly relieved from the laying wheel by attaching special relieving cable floats to the cable.

A rope fixed around the relieving floats is now connected to land (or a work boat) in order to maintain tension in the route direction.

As C/S NEXANS SKAGERRAK moves forward along the shore, cable is paid out on floats. Work boats are used to keep the cable in correct position. (Fig. 6).

When the cable end has passed the laying wheel, work boats will start pulling the cable towards land. The floating cable forms a wide curve while being towed. (Fig. 7).

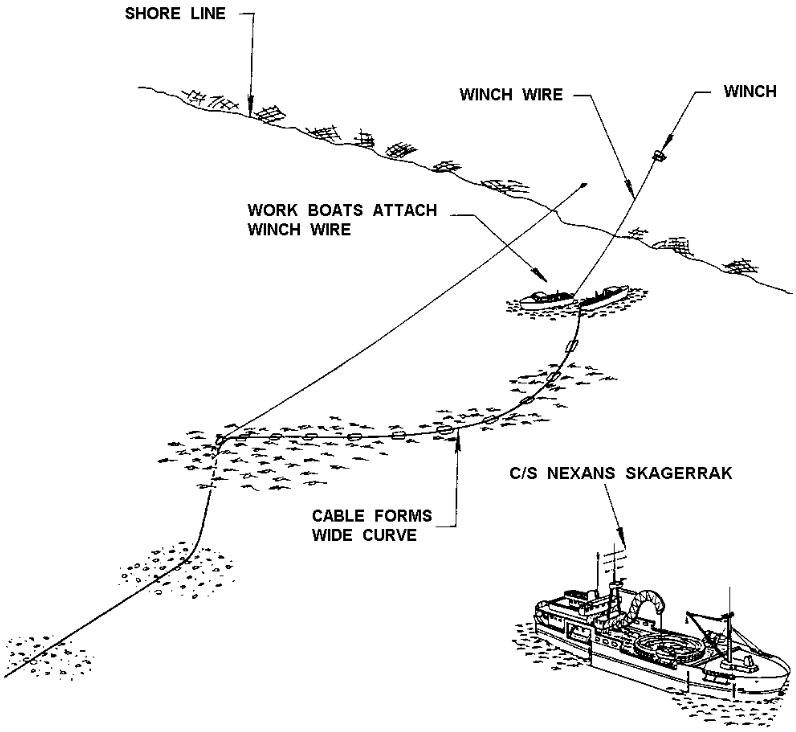


Fig. 7

Reaching a water depth of approx. 2 m, a winch wire from land is connected to the cable end and a land based winch takes over the pull.

The cable is pulled over a cable guide and the floats are removed as they reach the shoreline. The cable is pulled on rollers on land further into the land trench.

The cable is pulled until the floating cable forms a straight line between land and the relief floats.

Divers and work boats lower the cable to seabed or trench in the same way as for the previous landfall. The tension in the cable is controlled by adjusting the winch wire tension on land. The operation ends when reaching the shore line.

The winch adjusts any possible slack until the cable is in correct position from the shoreline to the joint bay or termination. The cable is lifted away from the cable rollers.

Submarine cable laying plan

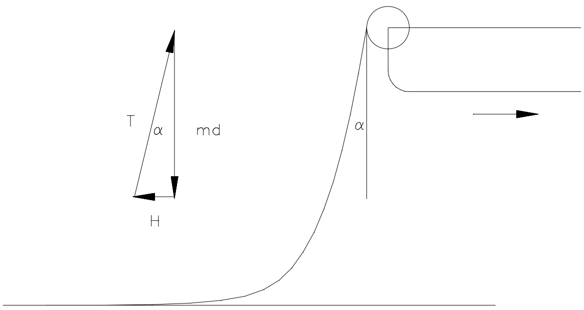
The laying speed will vary along the route, from almost 0 meter/minute at cable crossings and other points that require precision to 25 meters/minute where no obstacles are foreseen.

During cable laying

- the pulling tension (T)
- the lay angle (α)
- sea depth (d)

will be measured. The wet weight of the cable (md) is known.

The relationship between those parameters is as follows:



The total tension is the weight of cable + horizontal residual tension,

$$T = md + H$$

or

$$T = T\sin\alpha + md = \frac{md}{1-\sin\alpha}$$

The horizontal residual tension will be

$$H = T\sin\alpha = \frac{md\sin\alpha}{1-\sin\alpha}$$

The residual tension will be kept at a low value, typical 1 to 5kN. The laying angle, α, will be adjusted accordingly during the laying. The laying angle is calculated from

$$\sin\alpha = \frac{H}{T} = \frac{H}{md + H}$$

or

$$\alpha = \arcsin\left(\frac{H}{md + H}\right)$$

A complete set of calculations is part of the engineering and will be prepared for each route prior to cable laying. The calculations will be adjusted for the vessel's own speed.

Guard vessel

A guard vessel may be present during the whole laying operation, if required.

Operational limits

The operations are based on weather conditions not exceeding the following parameters given below. However, the values are guidelines only. The Captain and the Operation Manager will evaluate the weather conditions on site and act accordingly. The direction of wind and current and the resulting sea state might give other values. The Captain and the Operation Manager will decide minimum water depth during operation near the landfall. The required depth is general set to 8 to 10 meters.

	Laying only	Pulling cable ashore
Wind force:	15 m/s (29 knots)	8 m/s (16 knots)
Max. wave height:	5 m	1 m
Current, surface	1.3 m/s (2.5 knots)	0.5 m/s (1 knot)
Current, bottom	1.3 m/s (2.5 knots)	N/A
Surface visibility:	100 m	800 m
Visibility in water: (CAPTRAC / ROV)	2 m	N/A

Spare cable / surplus cable unloading

Spare and surplus cable unloading will take place at the end of the laying operations.

Depending on type and size, the cable may be

- spooled on one or more reels
- coiled into a basket
- spooled into a basket with turntable / carousel, as indicated in Fig. 8.

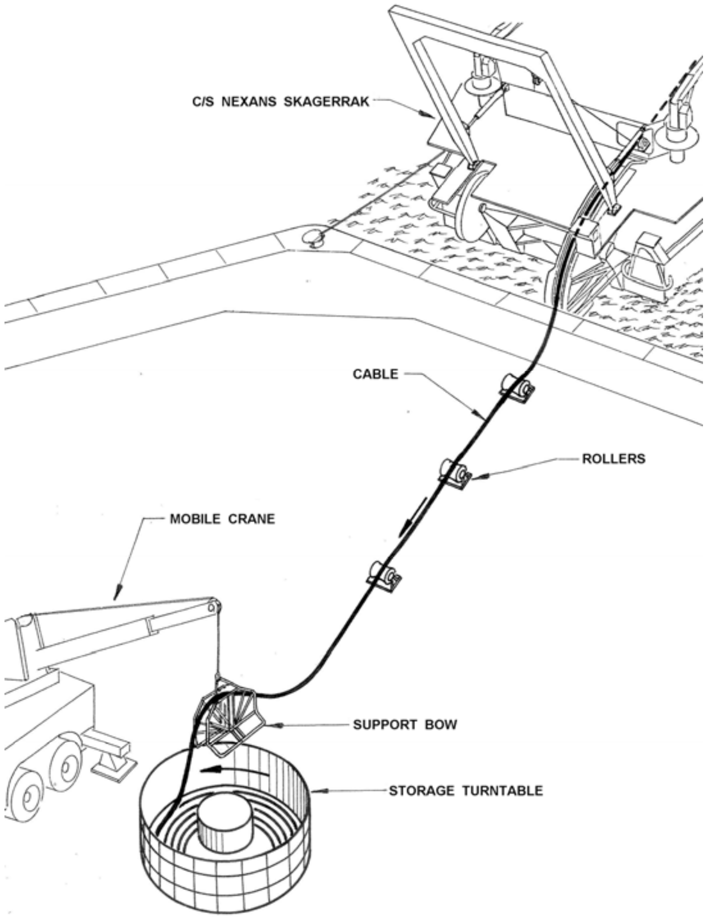


Fig. 8

The cable laying vessel will moor alongside the designated port and the cable will be transferred to storage reel / basket which is rigged for the purpose. When the cable transfer is completed the Purchaser take over care and cost.

Very few recommendations are necessary for a safe and correct storage of the spare cable length(s):

- The inner diameter of the reel / basket should be greater than specified minimum diameter
- Avoid direct sunlight to the cables by means of a proper shelter

Any transfer or bending of the cable should take place at 5 °C or above.

CAPJET 1 MW TRENCHING SYSTEM

PRINCIPLE DESCRIPTION

CAPJET 1 MW - TRENCHING SYSTEM
PRINCIPLE DESCRIPTION

CONTENTS:

Contents

1. INTRODUCTION

Nexans Norway AS is a leading company in manufacturing and installing submarine power cables and umbilicals.

Nexans Norway has accumulated a wealth of experience in the marine sector. The CAPJET System is an example of this activity. For the time being the CAPJET System has been used to bury nearly 4.000 km of cables and pipelines.

The CAPJET burial system is a non mechanical trenching system for burial of fibre optical cables, power cables, umbilicals and pipelines. The CAPJET "family" consist of a range of trenchers.

At present, Nexans Norway operates two separate remote operated systems, CAPJET 1 MW and SPIDER. CAPJET 1 MW is specially designed for trenching of cable, umbilicals, flexible pipelines and smaller ridged pipelines. SPIDER was designed for dredging and levelling of the route for pipes and umbilical along the Storegga slope for the Ormen Lange project.

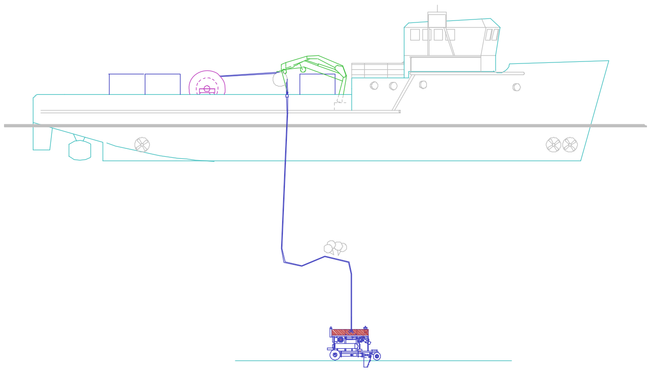
This description covers the CAPJET 1 MW system.

Nexans

CAPJET 1 MW - TRENCHING SYSTEM
PRINCIPLE DESCRIPTION

2. CAPJET 1 MW, SYSTEM DESCRIPTION

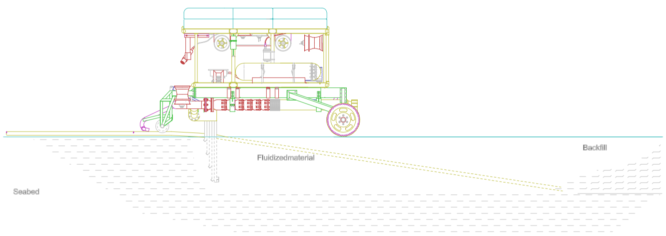
2.1 General



CAPJET 1 MW during trenching

The CAPJET 1 MW is a small, lightweight trenching system which does not require special support vessels. The CAPJET system can be operated from most DP vessels presently used for ROV and survey work. The CAPJET 1 MW has a low in air weight and is neutrally buoyant in water both during subsea manoeuvring as well as during the trenching. However, during trenching, a ballast system can be used. It has the same operational-, manoeuvring- and electronic transmission capacity as modern large ROVs.

2.2 The CAPJET trenching method



Principle of fluidization

The CAPJET trenching method combines the effect of fluidizing the seabed and hydrodynamic transport of the fluidized material. In the front, low pressure water jets are used to fluidize the seabed. The fluidized material is transported backwards utilizing other jetting nozzles. The cable or pipeline sinks by its own weight into the trench before the fluidized material is allowed to settle and start the backfilling process. The method gives a narrow partly backfilled trench. The percentage of backfill will normally vary from 30 to 90 %, dependant on the current and the actual soil conditions.

3. TRENCHING METHODS

3.1 Trenching of Cables

The CAPJET 1MW system will normally be used for trenching of power cables or umbilicals when seabed consists of silt, sand and gravel filled sand. Stiff clay or other hard soil may reduce the trenching speed. During trenching of power cables the sword will normally be positioned in the front of the machine. The same set-up can be used for trenching of flexible flow lines, since they very often have small radio curves after compression of the lines.

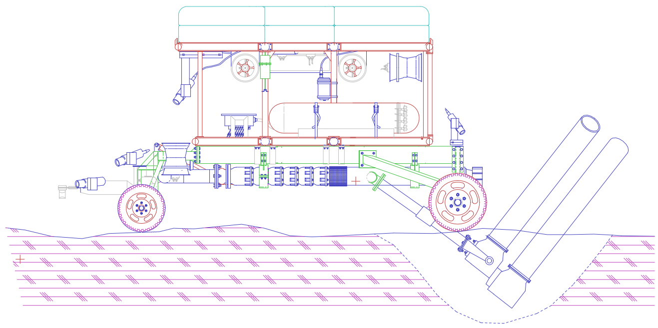
The front nozzles will open the trench in the front of the vehicle to allow the cable or pipeline to start sinking down to the bottom of the trench as early as possible, before the speed of the fluidized material reduces and the backfill of the trench starts behind the vehicle. The amount of backfill in the trench will vary depending on current and the soil conditions.

3.2 Trenching of pipelines

Trenching of flexible flow lines will normally be performed as for trenching of power cables. For trenching of rigid pipelines the trenching sword set-up will be different, due to the stiffness of the pipeline. In the front of the vehicle a set of swords are used for cutting the first part of the trench. At the rear of the vehicle another set of trenching swords are positioned. The rear swords shall fluidize the lower part of the trench and keep the soil fluidized the necessary length until the pipeline has been lowered to the required depth.

If variable trench depth is required, as for free-span corrections, a vertical adjustable sword module can be used. Trenching of pipelines can also be performed in combination with an ejector module.

3.3 The CAPJET dredging method


Dredger module

The CAPJET dredging method is based on the well proven ejector principle. A dredging module is designed for de-burial of cables or pipelines and dredging of open trenches in soft soil and sand/gravel. It is also utilized if the soil contains of stones and boulders which cannot be trenched with the standard trenching equipment. The CAPJET is manoeuvred with its thrusters during the dredging operation or tracking along an old trench. In addition to the standard dredger heads, customized dredger heads can be designed to suit the actual pipe or cable to be buried or de-buried.

The twin head dredger is hydraulically lowered to the required dredge depth. The dredger head position can continuously be monitored and logged during the operation. The CAPJET thrust itself slowly forward and the dredger intake angle is hydraulically adjusted to ensure maximum performance even during varying soil conditions. The dredging operation can be made with one or more passes dependent on the soil condition and the trench depth requirements.

The dredging module can be operated separately on together with jetting.

4. THE CAPJET SYSTEM MAJOR FEATURES

The combination of the fluidization technique and the CAPJET 1 MW system capabilities offers the following main advantages:

- No risk of cable or pipeline damage during normal operation or caused by accidental loads due to e.g. loss of DP, umbilical failure or other incidents.
- No external force imposed to the cable or pipeline during trenching.
- Operation close to structures without risk of damage to either the cable/pipe or the structure.
- Rapid trenching of spanning section and crossing of pipelines or other obstruction without risk for damage.
- A narrow partly backfilled trench immediately aft of the trencher.
- Trenching of steep curves.
- Excellent operational capabilities in soft soil conditions due to a neutral thruster controlled trencher.
- Operation in deep water with the same performance as modern ROV systems.
- Easy and cost effective operation from most DP vessels without A-frame or other special designed launching arrangement.
- Operation and launch/recovery in heavy swell.

5. CAPJET 1 MW operational characteristics

- Operational in water depth up to approx. 500 m (optional more).
- Suitable for trenching of cables and pipelines with diameter up to approx. 16".
- No diver intervention required, neither for positioning nor for trenching.
- Suitable for trenching of very narrow trenches, just wider than the object itself. Trenching depth up to more than 2 meters is possible.
- Trenching in sand, silt and clay with shear strength up to approx. 100 kPa (optional more).
- Trenching in soft clay with shear strength down to approximate 0 kPa.
- Dredging in sand, gravel, clay and crushed granite (rip rap).

CAPJET 50 trenching system for cable jetting

General

The CAPJET 50 trenching systems has been in operation since 1978, and has been used for trenching of several hundreds of kilometres. There are different versions of the trenching systems, special designed for fibre optic cables, power cables and pipelines. There are various special modules to be assembled on the trenching machines to handle various soils condition e.g. ejector modules and high pressure or rock cutting systems. The CAPJET 50 has been the basis for the development of Nexans' three remote operated trenching systems. The methods originally developed and tested for shallow water has later been adopted for deepwater operation.

The standard trenching system is used for trench depth down to 1.5 m (5 ft) for cables, with customised systems down to 3 m (10 ft).

Trenching systems

The trenching equipment is a remote controlled shallow water trencher, which does not require diver assistance during trenching. It is positioned above the cable with thrusters and locks on the cable with hydraulic roller/ tensioner system.   Especially on deeper water than 13-14 m even diving time for docking can be a significant problem.

Fiberoptic trenching CAPJET fiber

The semiautomatic trencher was used for the project in 1998. Peak performance was 30 km trenched to 1.5 m in 24 hrs. The trencher is remote controlled from surface during trenching, but require diver assistance during docking. The system has already track record of 170.000 m.

Figure 1 Fibre optic trencher

Specifications

Hydraulic power 250 HP 400 bar
Water pumps 250 HP 12 bar
(Installed on surface vessel)

Control system (job dependent)

One colour video
Heading
Pitch
Roll
Trench depth
Lights
Fully remote control of tensioner and thrusters

Control system

Radio link and RS232/RS485 network for surface and subsea control system built around OPC compliant hardware and software. Core parts of the software is later developed into the full control system for the CAPJET remote controlled trencher system.

Subsea hydraulics

Two hoses (pressure & return) is used to supply the subsea valve pack
6 way valve pack for thrusters, tensioner and hydraulic rams
Remote control of sword, docking operation and tensioner and thrusters

Topside

One off PIII Computer system for navigation and remote control system
One off radio link to surface vessel and trencher
Trench depth 1.5 m
E mail connection to transfer files for processing

Power Cable trenching CAPJET cable

For trenching of power cables there are different set-ups and some of trenchers can be configures for trenching down to 3m. The trencher below was used for the trenching of Gibraltar power cables to 3 m. (Picture taken from 3 m trenching of power cable with protection pipe)

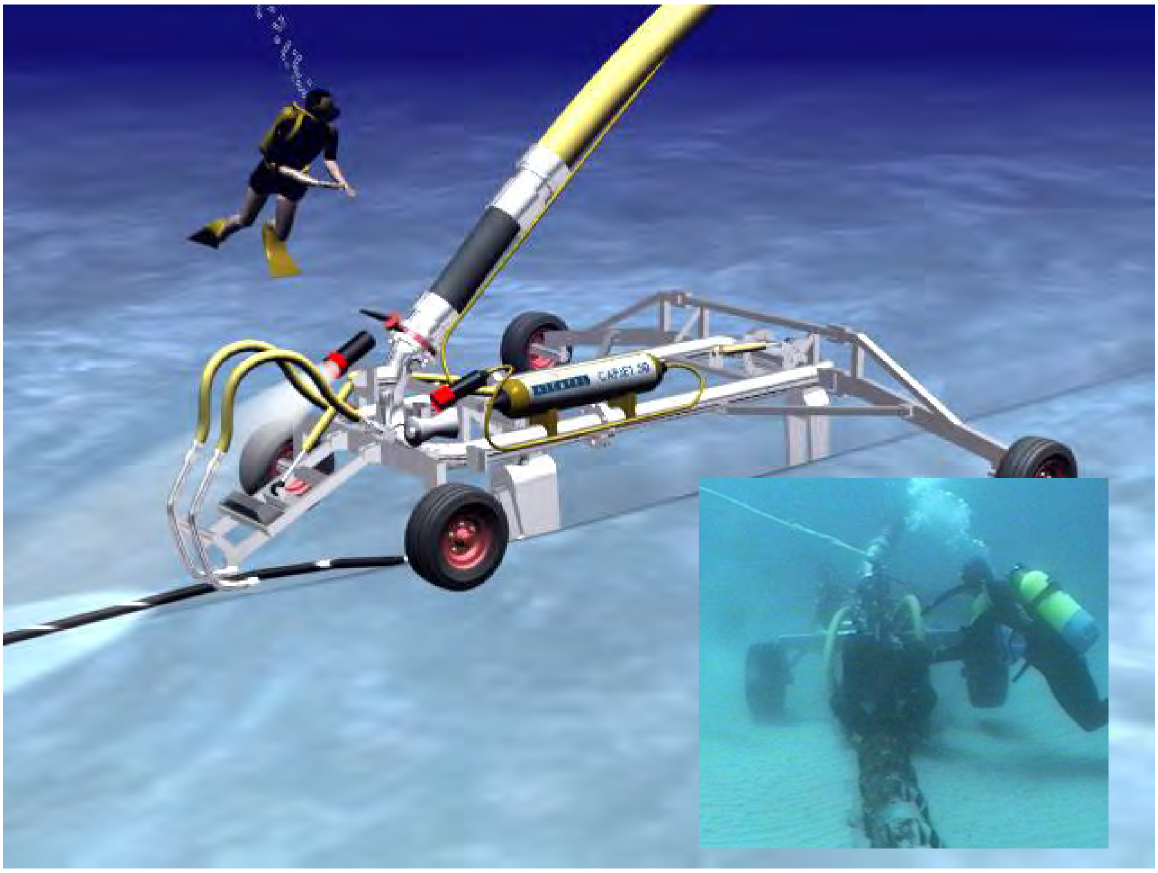


Figure 2 During 3m trenching in Gibraltar (3m)

Figure 3. The picture above is taken during 3m trenching before the backfill has started.

Specifications

Standard 1.5 m trench depth

Hydraulic power	250 HP 200 bar
Water pumps	250 HP 12 bar

(Installed on surface vessel)

3 m trench depth

Hydraulic power	250 HP 400 bar
Water pumps	350 HP 12 bar

(Installed on surface vessel)

Sensor system (job dependent)

One colour video
Heading (MRU4)
Pitch
Roll
Trench depth (linear sensor on hydraulic piston)
Lights 2 off Aquabeam
Speed measurement
Fully remote control of tensioner and thrusters

Control and software system

Radio link for control of surface vessel and tensioner (basic)
Computer system for fully remote control version with thrusters, remote docking and data logging system.

Subsea hydraulics
Basic

One of tensioner

Fully remote control

Two hoses (pressure & return) is used to supply the subsea valve pack
6 valve pack with proportional valves for thrusters,
tensioner and hydraulic rams
Remote control of sword, docking operation and tensioner and thrusters
Integrated control system submerged in oil depth rating 100 m

Topside

Basic (require diver assistance)
One off radio link to surface vessel and tensioner

Fully remote control

One off PIII Computer system for navigation and remote control system
One off radio link to surface vessel and tensioner
Radio link / tether with RS232/485 to subsea control system with OPC compliant hardware

Surface vessels

Several surface vessels can be employed depending on the nature of the operation: two shallow draft vessel with hydraulic and water pumps, both manned during operation and one off shallow draft vessel, which is unmanned during operation. The unmanned vessel is remote controlled from a local supplied small craft, and is ideally suited also for simultaneous lay and trench operation.

Propulsion	35 HP
Jetting power	250 HP
Hydraulic	250 HP
Electrical	220 V 6.3 kW
GPS	

Electronic charting system
Min draft 75 cm

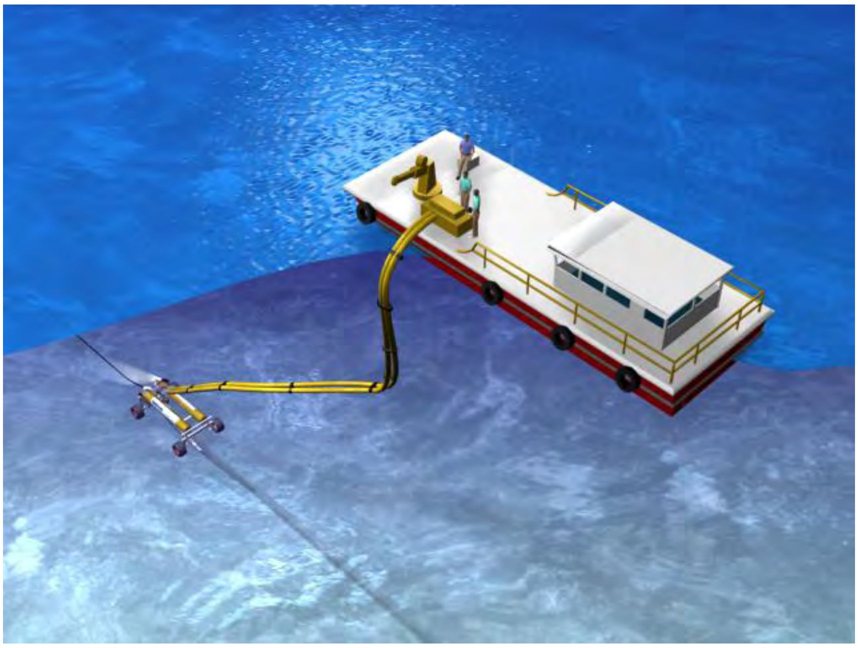


Figure 4 System used for 170 km Beihai Lingao link

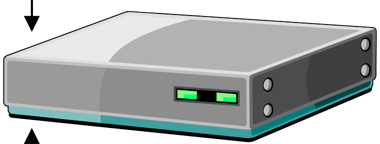
Figure 5 One of the two shallow water vessel used for landfall burial

Navigation and data logging

For long offshore sections there is normally a requirement for registration of trench versus position. The pump vessel has GPS or DGPS system installed and the trencher transmits the cutting depth to topside computer. The data is logged in Excel file, which is processed directly online before logging. The data is further processed before it can be used as input for charts or simple KP & UTM versus trench depth plots.

The data and logging system is a simpler version of the control system used for the remote controlled CAPJET trenchers owned by Nexans. A description of the concept for the full remote control system and data logging is given below.

Computer onboard support vessel with radio link to pump vessel



Conversion station from radio to subsea control line onboard pump vessel

Subsea Control system on trencher (sensor, valves, light, thusters) OPC interface

The CAPJE T 50 system is also used as development system for the remote controlled CAPEJT 650 and CAPJET 500 trenching system. The system uses the latest and most modern software and control system, and the technology is later transferred to the deepwater system. The software is written with object-orientated language and open standard OPC drivers.

Operational limits

Wind force:	5 m/s
Surface current:	0.5 m/s (1 knot)
Bottom current:	0.5 m/s (1 knot)
Wave height, H_s:	1 m
Visibility at surface:	better than 2 m
Max. undrained shear strength of seabed soil	60 kPa
Max. boulder size able to jet/depose:	0.3 m

These values are guidelines only. The Site Supervisor will evaluate the weather conditions on site and act accordingly. If divers have to intervene in the burial operation their security will decide.

CROSSING OF CABLES, PIPELINES AND UTILITY LINES

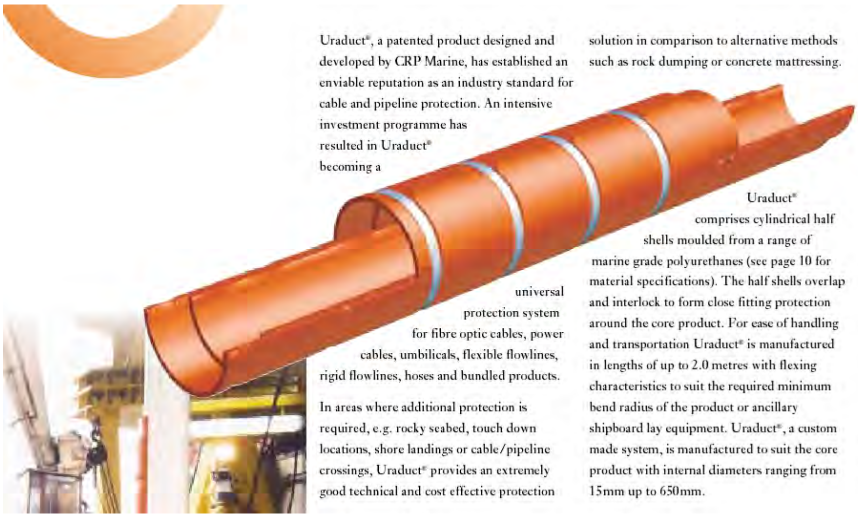
General information:
The route for the new cables will cross several existing or planned cables and/or pipelines.

Details of cable and pipeline positions and depth of burial is privileged information and is not included in this document.

Crossing of utilities owned by a third party, such as present and planned cables and pipelines, will require formal crossing agreements to be made. The design of the protection at these crossings will be subject to such agreements.

The methods for crossing different utilities will basically follow the guidelines outlined below.

Cable sleeve:
To ensure a minimum separation at the crossing point, a protective sleeve is often applied on the new power cable during installation. The sleeve shall extend to at least 5 m from each side of the crossing utility. The installed length will be 15 – 25 m (depth dependant) to ensure this requirement is met.
A typical cable protective sleeve is enclosed.



Crossing of Fiber Optic cables
(Also applying to conventional telecommunication cables)

Any crossing of existing cables (at the time of installation) will be subject to a crossing agreement with the Cable Owner. The Contractor shall accept the crossing agreement.
The Project will follow industry standards for all crossings.

Based on previous experience, the following guidelines are proposed:

Crossing of a FO cable shall, where feasible, be at 90° for about 50-100 m on each side of the cable. The cable shall be protected to the same degree as on the comparable parts of the cable route. Within a distance of 100 metres of the crossing point the method of embedding and protection will be carefully selected, and will reflect the existing burial depth of the FO cable.

The owner of the FO cable shall to be informed of the as-laid positions not later than 72 hours after the actual laying of the new power cable.

A minimum separation between the new power cable and the FO cables will be provided by installing a 15 mm thick protective sleeve on the cable at each crossing. The sleeve will be about 15 - 25 m long to ensure that it will target the crossing point. The sleeve is installed while laying cable at a reduced speed.

The new cable system, including the part with sleeve protection, will be buried by the CAPJET water-jetting machine or by plow to target depth or as limited by the actual burial depths of the FO cables.

No post-lay protection by rock berm is envisaged.

<u>Shallow buried FO cables:</u>
Due to the low risk of damage and low cost of repair, many FO cables are not buried very deep, 0.3 to1.0 m is a typical depth.
To bury the new power cable(s) to the same depth or deeper, several methods may apply. Typical are:

a) Fit sleeves on the new cable and bury until touching.
b) Increase burial depth of the existing FO cable by water jetting at the crossing point prior to installing the new cable.
c) Cut the FO cable and re-join after installing the new cable. This is feasible where the communication traffic has one or mare re-routing possibilities. (The cutting and re-jointing will normally be performed by the utility owner to COMPANY cost)

Crossing of Gas or Oil Pipeline

Any crossing of existing pipelines will be subject to a crossing agreement with The Pipeline Owner. The Contractor shall accept the crossing agreement. The Contractor will follow industry standards for cable crossing engineering operations.

Based on previous experience, the following guidelines are proposed:

The pipeline is assumed to be buried, at least to a depth leaving the top of the pipeline at seabed level.
Crossing of a pipeline cable shall, where feasible, be at 90° for about 100 m on each side of the pipeline at a mutually agreed position.

The owner of the pipeline cable shall to be informed of the as-laid positions not later than 72 hours after the actual laying of the new cable.

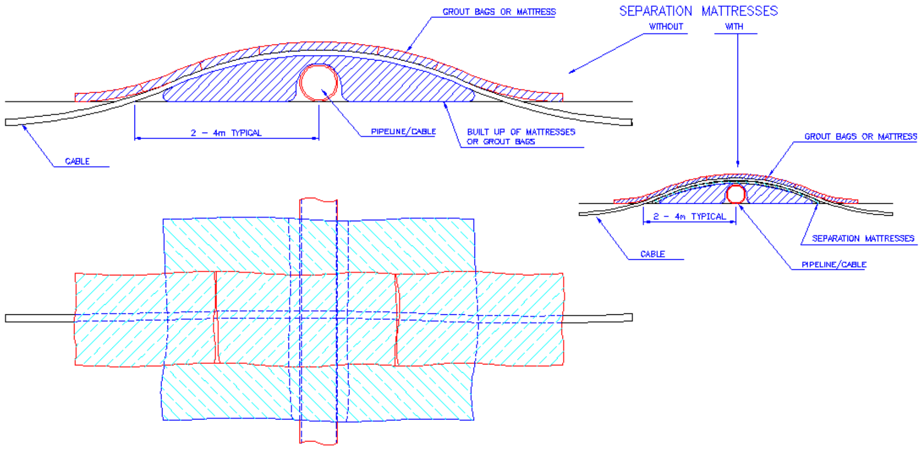
<u>Deep buried pipelines:</u>
Installing a 15-30 mm thick protective sleeve on the cable at each crossing will provide a minimum separation between the new power cable and the pipeline. The sleeve will be about 15 - 25 m long to ensure that it will target the crossing point. The sleeve is installed while laying cable at a reduced speed.
The new cable system, including the part with sleeve protection, will be buried by the CAPJET water-jetting machine or by plow to target depth or as limited by the actual burial depths of the pipeline.

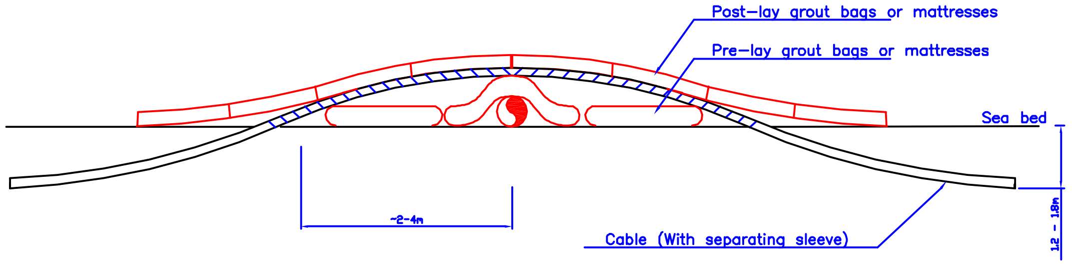
<u>Shallow buried pipelines:</u>
A minimum separation between the new power cable and the pipeline will be provided by pre-installing a 150 mm thick grout filled mattress on top of the pipeline at each crossing. The power cable and pipeline will be post-lay protected by further grout filled mattresses.

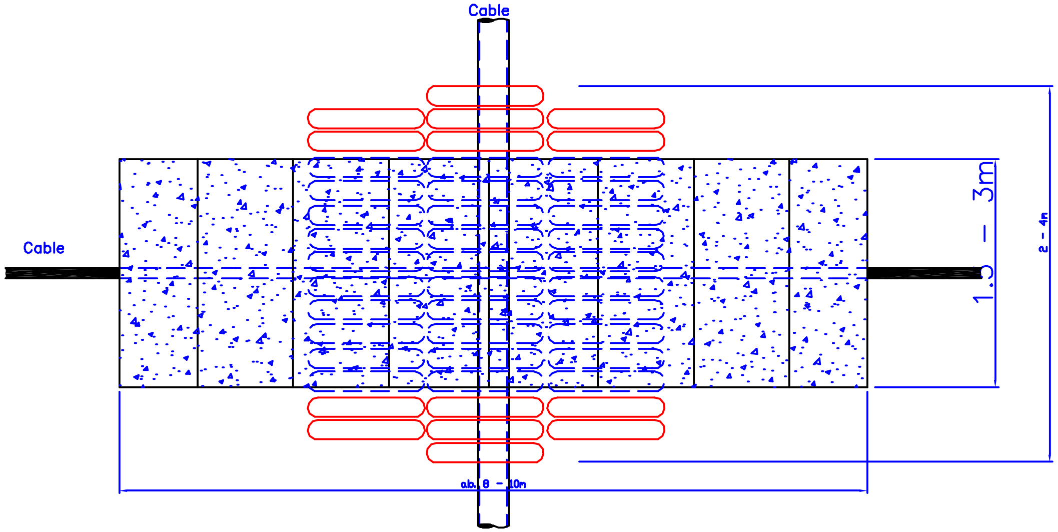
CAPJET will trench the cable system to target depth, as close to the mattresses as practical.

No post lay protection by rock berm/dumping is envisaged.

Typical protection at pipeline and cable crossing:







1b. PRE–LAID SEPARATING MATTRESS/GROUT BAGS.

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01	120203	Tender						

SCALE	FRAME : A4	PROJECTION
NEXANS NORWAY AS	CLIENT	

CLIENT:

CLIENT'S DRAWING NO.:

CONTRACT NO.:

DOCUMENT CATEGORY:

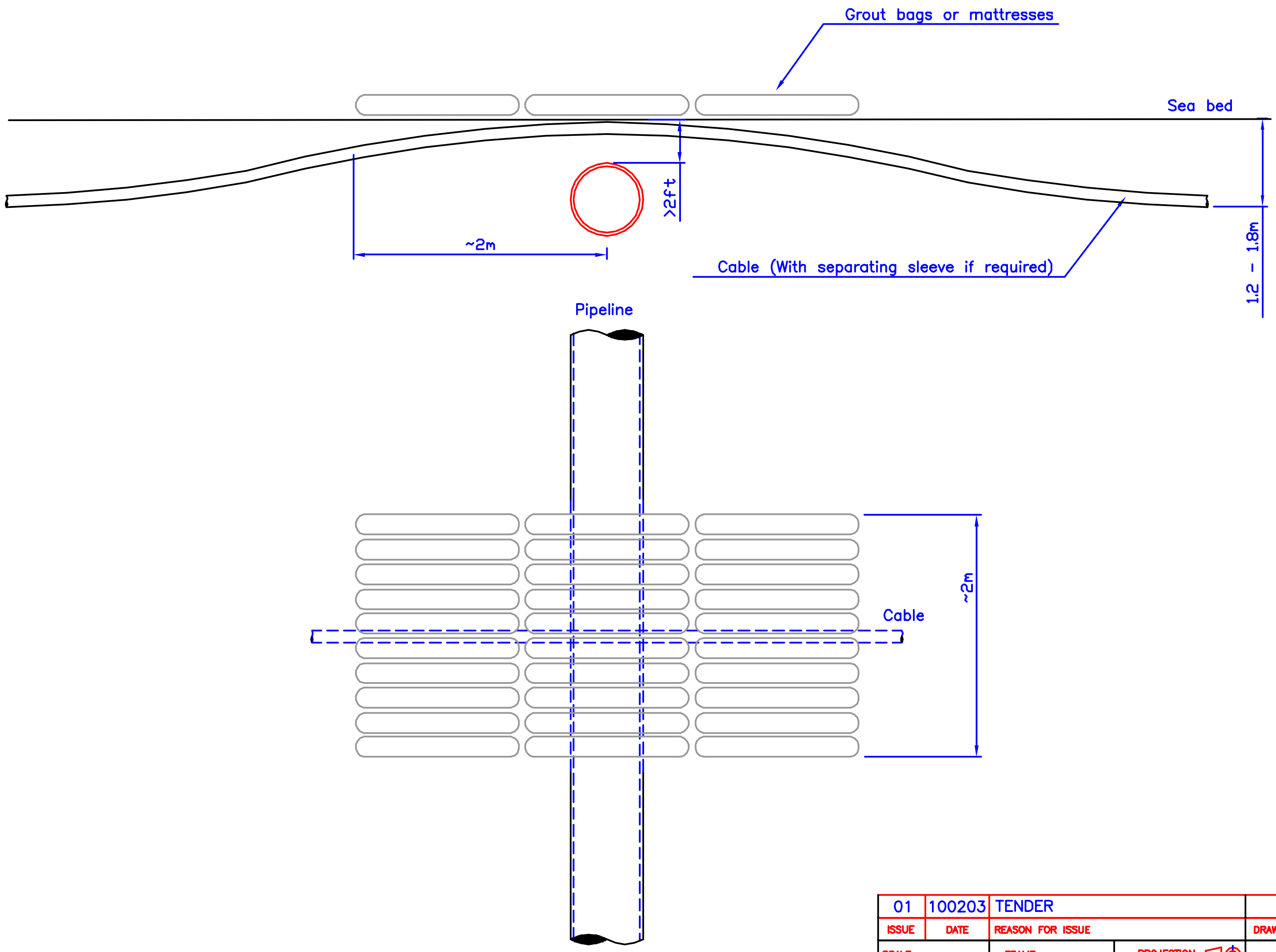
Nexans

DRAWING TITLE:

TYPICAL CROSSING OF POWER CABLE OR TELECOM CABLE ON OR JUST BELOW SEABED

NEXANS DRAWING NO.: 125497

SHEET 1



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01	100203	TENDER						

SCALE | FRAME : | PROJECTION

NEXANS NORWAY AS | CLIENT

CLIENT:

CLIENT'S DRAWING NO.:

CONTRACT NO.: | DOCUMENT CATEGORY:

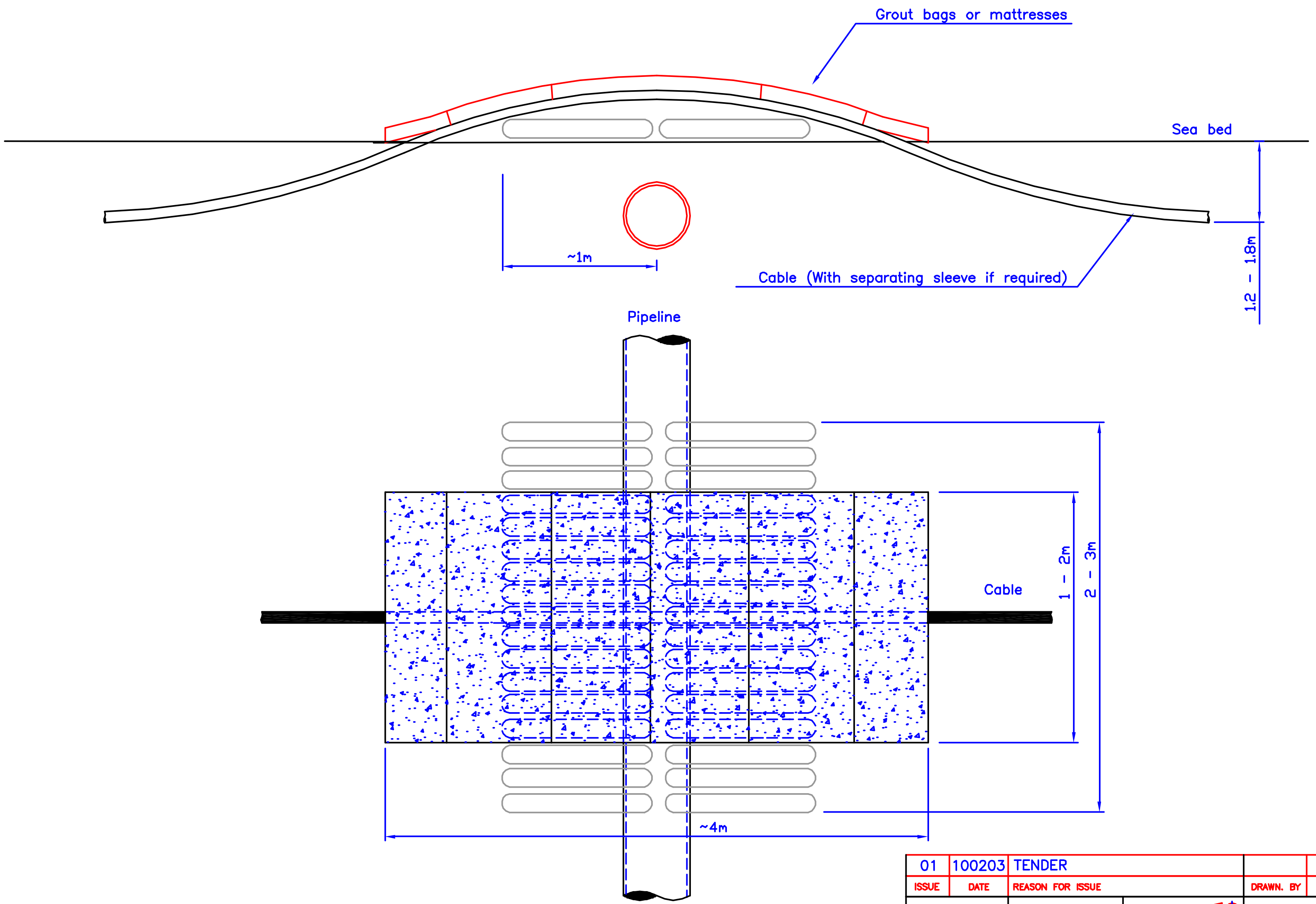
Nexans

DRAWING TITLE:

TYPICAL CROSSING OF
BURIED PIPELINE
>2 ft BELOW SEABED

NEXANS DRAWING NO.: 125493

SHEET 1



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CLIENT:

CLIENT'S DRAWING NO.:

CONTRACT NO.:

DOCUMENT CATEGORY:

Nexans

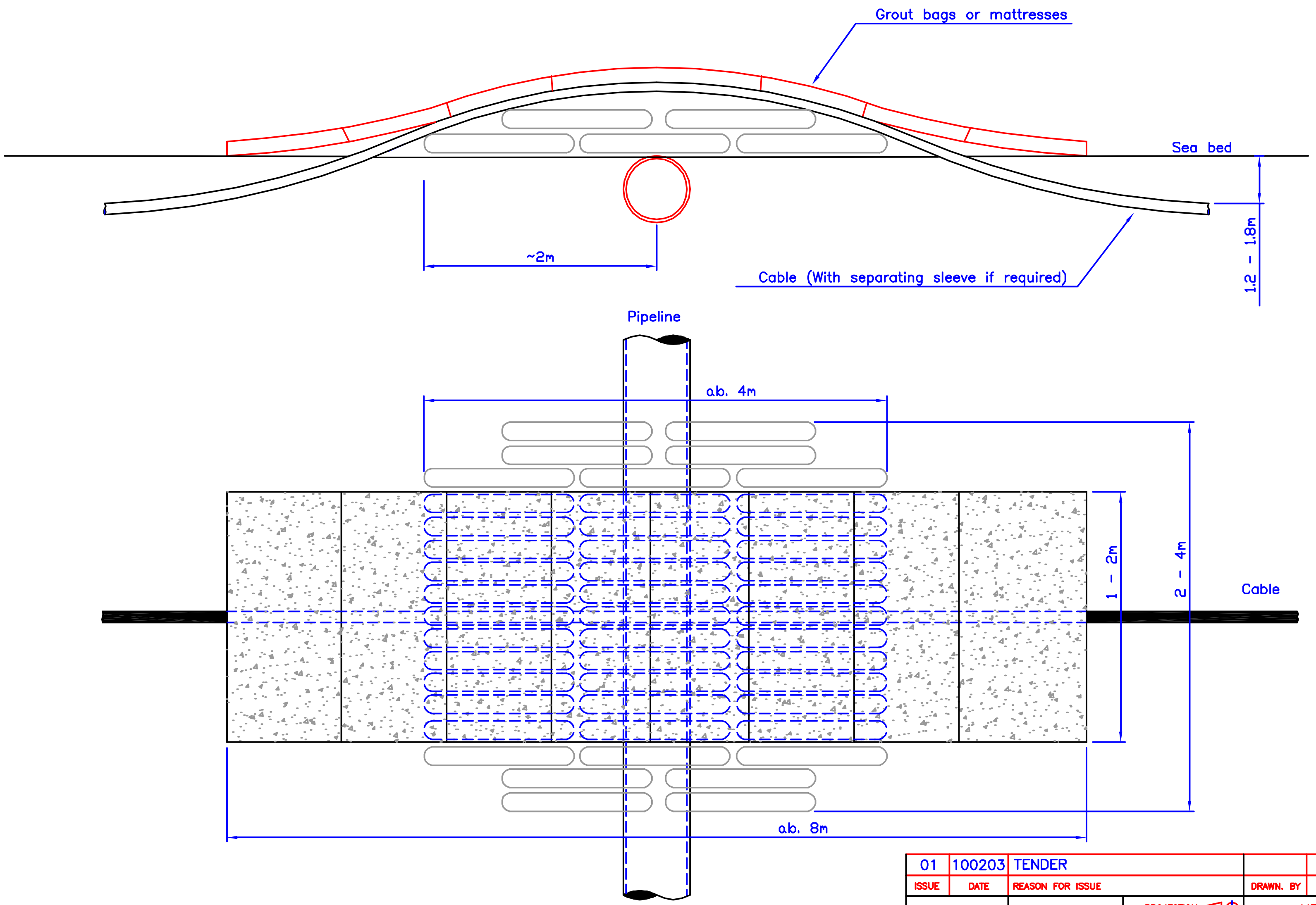
DRAWING TITLE:

TYPICAL CROSSING OF
BURIED PIPELINE
LEVEL 1 – 2 ft BELOW SEABED

NEXANS DRAWING NO.: 125492

SHEET 1

NEXANS A3



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SCALE | FRAME : | PROJECTION

NEXANS NORWAY AS | CLIENT

CLIENT:

CLIENT'S DRAWING NO.:

CONTRACT NO.: | DOCUMENT CATEGORY:

Nexans

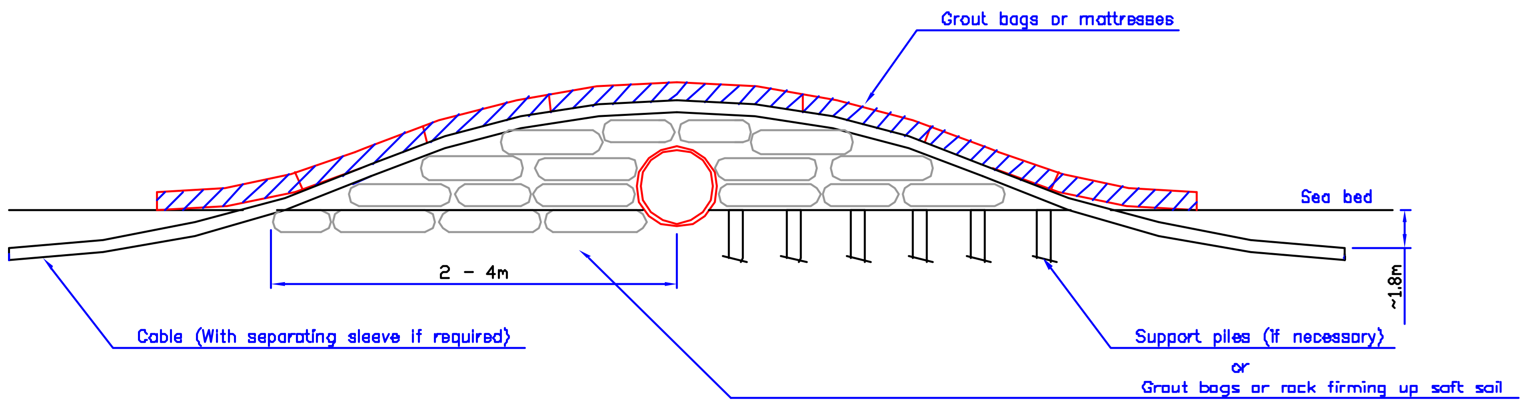
DRAWING TITLE:

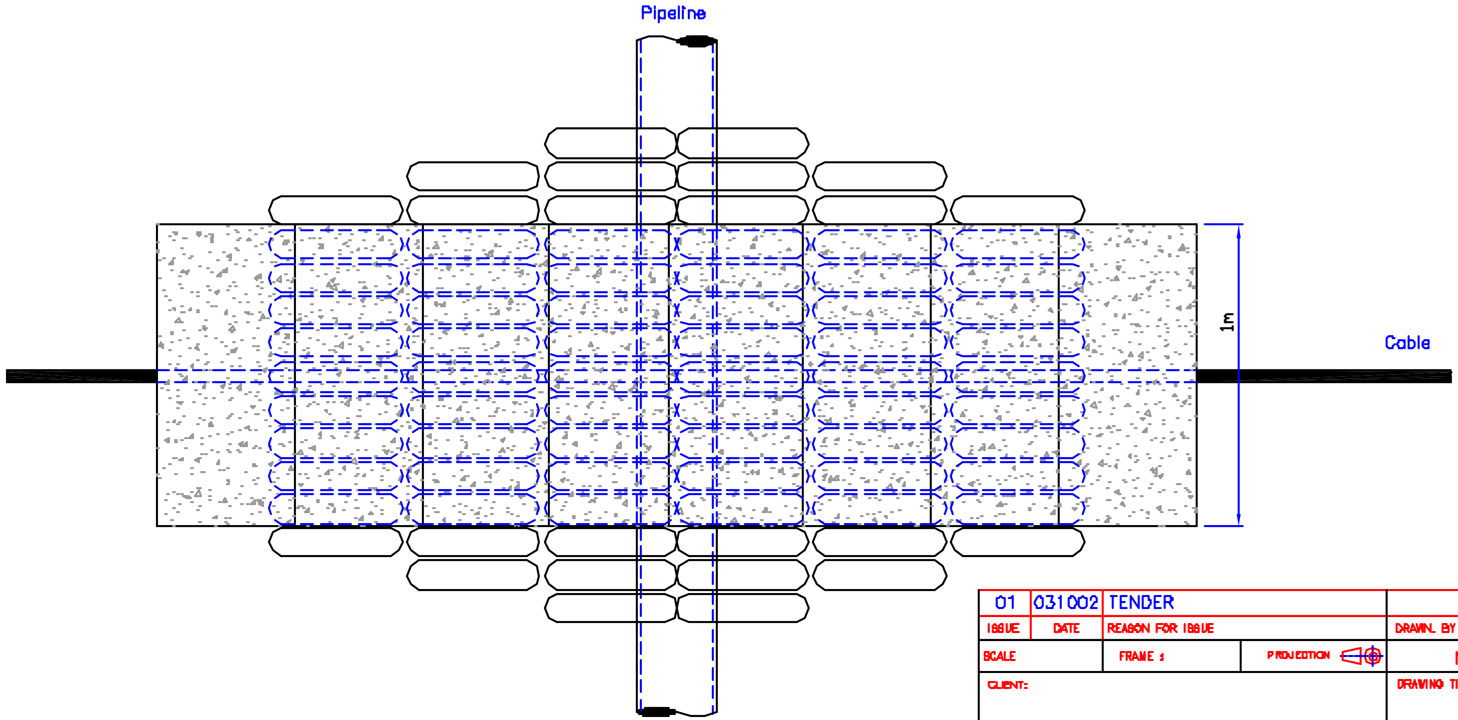
TYPICAL CROSSING OF BURIED PIPELINE LEVEL WITH SEABED

NEXANS DRAWING NO.: 125491

SHEET 1

NEXANS A3





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CLIENT:

CLIENT'S DRAWING NO.:

CONTRACT NO.: | DOCUMENT CATEGORY:

Nexans

DRAWING TITLE:

TYPICAL CROSSING OF
UNBURIED PIPELINE

NEXANS DRAWING NO.: 120868

SHEET 1

NEXANS A3

D 06

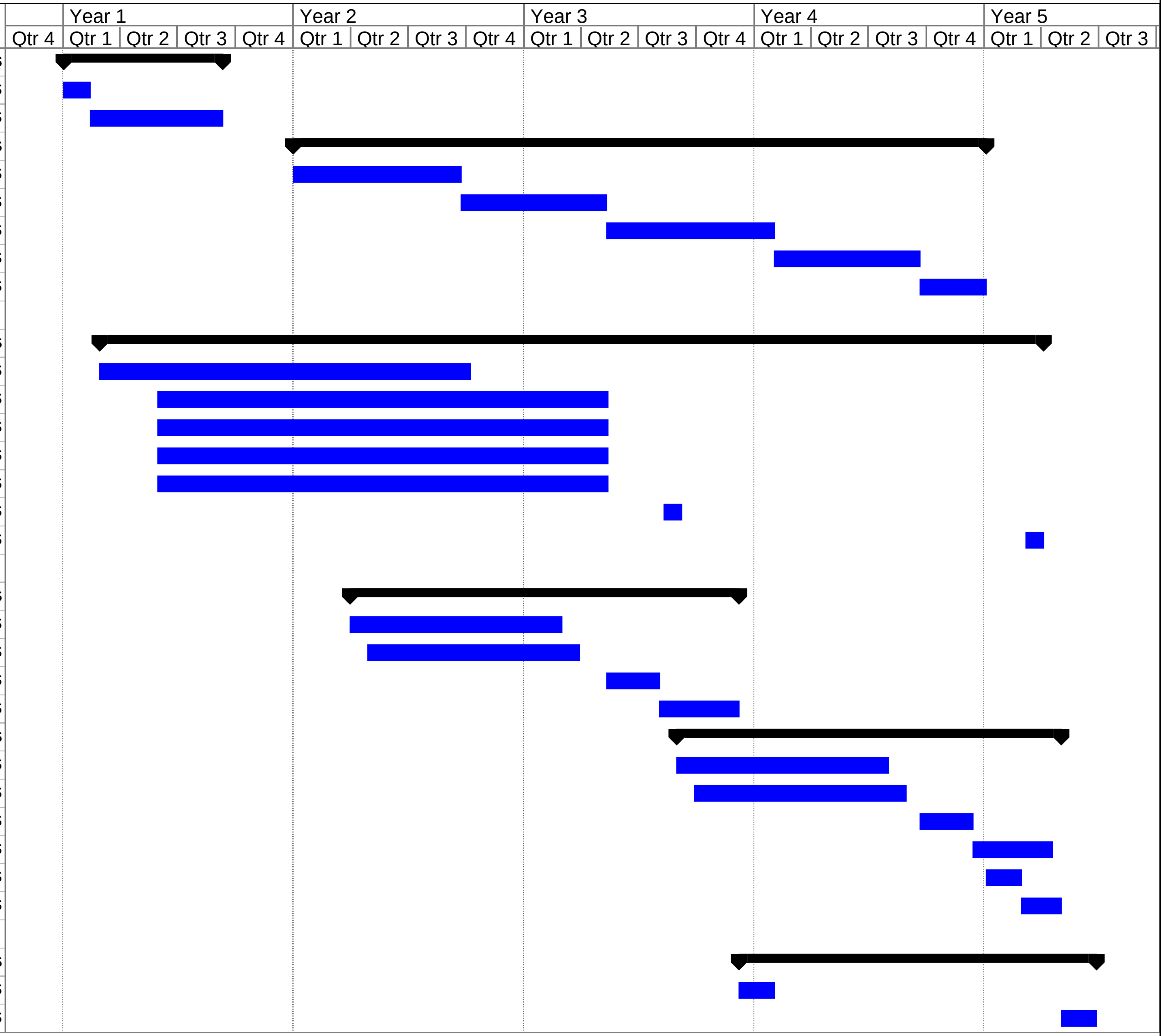
PROJECT SCHEDULE

Transmission Developers Incorporated

Champlain Hudson Power Express HVDC Transmission Project

Estimated Overall Project Schedule

ID	Task Name	Duration
1	**CABLE MANUFACTURE - EUROPE**	**252 days**
2	Hertel - St.-Jean-Sur-Richelieu	6 wks
3	Lock #7 - Albany	30 wks
4	**CABLE MANUFACTURE - NEW YORK STATE or E**	**1099 days**
5	St._Jean-Sur-Richelieu - Lock #7 (Circuit #1)	38 wks
6	Albany - New York (Circuit #1)	33 wks
7	St._Jean-Sur-Richelieu - Lock #7 (Circuit #2)	38 wks
8	Albany - New York (Circuit #2)	33 wks
9	New York - Bridgeport (Circuit #2)	15 wks
10		
11	**INSTALLATION ON LAND - CIRCUIT #1 & 2**	**1497 days**
12	Hertel - St.-Jean-Sur-Richelieu	84 wks
13	Lock #7 - Albany - Part 1	102 wks
14	Lock #7 - Albany - Part 2	102 wks
15	Lock #7 - Albany - Part 3	102 wks
16	Lock #7 - Albany - Part 4	102 wks
17	Termination works - Circuit #1	4 wks
18	Termination works - Circuit #2	4 wks
19		
20	**MARITIME INSTALLATION - CIRCUIT #1**	**617 days**
21	St._Jean-Sur-Richelieu - Lock #7	48 wks
22	- Trenching	48 wks
23	Albany - New York	12 wks
24	- Trenching	18 wks
25	**MARITIME INSTALLATION - CIRCUIT #2**	**610 days**
26	St._Jean-Sur-Richelieu - Lock #7	48 wks
27	- Trenching	48 wks
28	Albany - New York	12 wks
29	- Trenching	18 wks
30	New York - Bridgeport	8 wks
31	- Trenching	9 wks
32		
33	**TESTING & COMMISSIONING**	**567 days**
34	Circuit #1 (Cable & Converter)	8 wks
35	Circuit #2 (Cable & Converter)	8 wks



Nexans Norway AS

D 07

OPERATION AND MAINTENANCE

LIST OF CONTENTS

1 INTRODUCTION

This document is a brief description of post-installation operation and maintenance activities that are normally required for a submarine cable installation.

2 SUMMARY

Principally, the cable system is near maintenance free and designed to operate within the specified working conditions.

It is usual to make a TDR (time domain reflectometer or pulse echo meter) and/or OTDR (optical time domain reflectometer) footprint of the cable when installed. Comparisons can then be made at scheduled outages. These instruments can for most cases be used to calculate the distance from the cable ends to a fault location in case of damage, and having a footprint of good cable to compare with is an added advantage.

Note! Instruments for very long power cables need to be specially designed.
To our knowledge, a system that covers the Norway to The Netherlands cable (NorNed) has the best range at present.

Regular inspection of visible parts of the cable as well as landfall and near shore protection is also recommended.

As there is heavy traffic and regular construction activities along most part of the route, monitoring of these activities is recommended.

No regular maintenance survey of the offshore buried cable sections is necessary unless any construction activity has been recorded. We will, however, recommend spot checks of the cable protection during or after the first season and more often at locations with strong currents or in case of any abnormal occurrences, such as heavy storms or ice crush situations.

3 CABLE SYSTEM

The cable system is designed to be operated according to the specified operating conditions and switching requirements.
Any limitations imposed by an updated TNA (transient network analysis) will apply to the entire transmission system, not to the cable system alone. The TNA defines the system operating parameters, including natural surges and fault surges.

4 MAINTENANCE AND INSPECTION

The submarine cable system with accessories is near maintenance free. There are no components that are subject to wear and tear that will require regular replacement. Regular inspection of terminations and surge arrestors in connection with scheduled outages and in connection with abnormal weather or operating conditions will be sufficient.

The insulators should be inspected and cleaned if there are excess deposits of industrial contaminants and soot. Metal parts, bolt and nuts, cable cleats, earthing etc. shall be checked for corrosion and tightness.

Given the moderate water depths, offshore checks by divers will be reasonable and quick and should be performed regularly at locations where the conditions of protection are changing. (This is typically the case of migrating sandwaves, which should not be a problem here)

5 SPARE PARTS

Spare cable should be stored sheltered from direct sunlight. The cable should not be handled, i.e. subjected to bending and tension at temperatures lower than +5^{O}C.
If handling is necessary during the cold season, the cable can be pre-heated in a tent.

Terminations, joints and other accessories should be stored dry and under roof, preferably indoors. Some part of repair kits may have a limited shelf life.
The parts will be marked with such information as well as how to replenish the stock.

D 08

PROJECT COST ESTIMATES

Cost estimates and Assumptions for supply, installation and commissioning

D 09

REMEDIATION ACTIVITIES

Overview of possible remediation activities

LIST OF CONTENTS

1 INTRODUCTION

Remediation activities has for this project been clarified to mean activities at the end of life of the cable system.

2 SUMMARY

The design life time of the cable system is 40 years, and legislations that far in the future that may dictate remediation activities can not be predicted.

Current practices tend to request that Owners of new constructions have to include the removal of existing cables to be allowed to install new ones.
This does not seem to be required by the permits of this project.

Another practice is to request that Owners of a new construction pay a levy towards future removal costs, since this cost can not be predicted and the original Owner may not exist as a legal entity.
We can not see that this is imposed for this project.

For any remedial activities at end of life to be meaningful, there must be an environmental gain in removing the system as a separate activity without at the same time having other activities in the area.

3 ENVIRONMENTAL ASPECTS OF THE CABLE SYSTEM

The power cables are made with copper cores, extruded dry insulation material and steel wire armour. There are no insulating fluids that may leak into the environment due to damage or ageing.

The work of removing the cables will in itself be a major operation, involving vessels, personnel and material destruction and recovery plants.
Removing buried cables can be performed with relatively small barges or vessels as the cable can be cut into short pieces as the work progresses. Where the cables have been buried by jetting, the cable may be retrieved by pulling, or some soil fluidization may be required to lessen the grip on the cable.
The removal will generate some soil disturbance that in itself is limited, but that could at least be postponed until it can be combined with other activities.

The cable design will allow sections of the cable to be removed. The cable ends need not to be sealed.

4 DISPOSAL OF RECOVERED MATERIAL

There are in New York State at present several licensed receivers of scrap power cables that do not contain fluids. There is at the moment also at least one receiver of fluid filled cables; however these cables should be regarded as made of non-hazardous material.

There will be a value on the recovered materials, but a break-even or profit should not be expected. The material price in the future can not be predicted, but are not likely to equal the removal and separation costs.

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TYPICAL
REPAIR RESPONSE

AND

PREPAREDNESS PLAN

NOTE!

THIS IS A GENERIC DOCUMENT
CHANGES TO SUIT ANY ACTUAL INSTALLATION SHALL BE MADE IN CO-OPERATION WITH THE OWNER

LIST OF CONTENTS

1 Repair Response.

Nexans suggest a discussion with Owner with aim to define the need for and extent of a preparedness plan for a repair of the submarine and underground cables.

1.1 Preparedness Plan

The Contractor shall together with the Owner develop a preparedness plan, detailing various key data and the availability of equipment, personnel and services. The plan shall include for damage to both the power cable and the FO element. The plan shall distinguish between the requirements for repair work in "shallow water" and in "deep" water. It may also be relevant to discuss special arrangements for the intertidal zones.

Documents required

- Detailed technical data, power cables.
- Detailed technical data, FO elements/cables.
- Route data and "as-built" journals.
- Route profile.
- Repair preparedness plan, including damage notification procedures and contact points.
- Repair procedures for on-shore and off-shore work.
- Description of the specific cable repair (cable related only, including a full description of tools and equipment required).

Spares Storage

Spare submarine and underground cable and accessories are stored at sites easily accessible for the repair vessel and land transport respectively.

Cable Fault Location Equipment

Relevant types of fault location equipment must be available, such as:

For power cables

- TDR (pulse echo meter) for long submarine power cables
- Surge generator
- Filter for above
- Measuring bridge
- Current transformer
- Induction search coil

For FO elements/cables:
OTDR (pulse echo meter) for long submarine FO cables
The Owner's equipment, if available, should be checked for range and accuracy.
The provision and operation of fault locating equipment may be part of a maintenance subcontract.

1.2 Repair Preparedness - Underground Cable Sections

Resources necessary to perform maintenance and repair work on the underground sections are readily available at short notice, and are not further detailed in this document.
The Contractor shall as soon as possible mobilize qualified personnel to site to assist with fault location; this can normally be done within three working days.
A team of specialist jointers will normally be mobilized within the time required to obtain work permits and perform relevant civil works.

1.3 Repair Preparedness - Submarine Cable Section

A repair operation may consist of some or all of the below:

- Fault location
- De-burial
- Maritime cable handling
- Jointing
- Re-burial

Vessel
General:
Depending on location, water depth and availability, a variation of vessels may be suitable.

Deep water, greater than 10 m:	Fully equipped DP vessel
Shallow water:	Joy stick operated supply type vessel or Barge, Spud barge or Jack up barge

Near shore: A work platform may be used near shore, possibly in the intertidal zones.

For a repair job, it is assumed that the repair vessel will be a locally fitted out barge.
A supply type vessel or DP-vessel may not be available locally.
Due to the mobilization time, a specially equipped cable laying vessel or a vessel of similar capabilities may not be acceptable.
However, a DP- type vessel is recommended for onerous weather seasons and in areas with anchoring restrictions.

Procedures should be developed for work where the work can be performed with a small joy stick operated vessel, or a barge.
Due regard must be taken to weather conditions, time of year, vessel handling and environmental issues.

1.4 Mobilization Time

The Contractor shall as soon as possible mobilize qualified personnel to site to assist with fault location; this can normally be done within two to three working days.

Cable laying vessel, CLV:

A fully equipped CLV will not be required unless there is a major damage over a long length of cable. The mobilization time may be unacceptably long.
Another suitable cable repair vessel may be considered and mobilized sooner.

DP or Joystick operated vessel:

Vessels with a mobilization time to site of 1 – 2 weeks may be sourced in the lake area. For efficiency, some prior agreements with vessel owners need to be in place as well as a cable repair and splicing unit ready to be rigged onboard.

Local Barge solution:

An agreement with potential vessel suppliers that will ensure that they are familiar with the equipment to be brought onboard must be arranged.
The contractor should be able to store and maintain the above equipment.
Subject to the agreement and/or availability of a suitable vessel, the spread should be ready for operation in 10-14 days.

Owner's equipment:

We suggest that Owner make agreements for the provision of or invest in key equipment that might delay a repair if unavailable.
Typical equipment to be stored locally:

- Cable drum handling system or Turntable for cable basket
- Cable pick up arm and roller guide system
- Caterpillar or Linear machine

1.5 List of Typical Events for Offshore Repair Work

If a fault occurs on the subsea portion of the route (on the power cable, FO element/cable or both) the following actions will be taken:

First Notification of Cable Damage

The Owner shall notify the Contractor and relevant third parties and authorities.
Later updating and notifications to ensure necessary permits and co-operation with third parties will be part of the procedures.

Initial Fault Location

It is recommended to make a TDR/ OTDR footprint of the cables immediately after installation for later comparison.

In case of damage, it is essential to be able to locate the relevant area (rough position) early, to be able to determine what kind of repair spread will be required. Fault location equipment is assumed to be readily available.

If the power cable and FO element/cable are damaged, both TDR and OTDR measurements should be made. Normally OTDR will give better accuracy.

Optional

- Final fault location by using a small vessel equipped with GPS positioning/navigation system, applying tone to the damaged cable and using a magnetic coil system on the vessel to locate the fault.
  Vessel spread is assumed provided locally (subcontracted), while fault detection equipment is assumed to be part of the stand-by equipment.

- Notification of Contractor's operational team (indicating the type of damage and position/water depth).
- Specialized repair vessel or equipment shipped to the mobilization port.
  Possible equipment with long mobilization time to be defined and shipped to the mobilization port.

- Necessary subcontractor services defined by Contractor.
  Based on the notification, the initial contacts with relevant subcontractors (dedicated and non-dedicated) will be taken.
- Initial subcontractor discussions started.
- Scope of work for repair operation defined.
  Detailed work definition to be developed by Contractor's operational team.
- Specialized repair equipment shipped to the mobilization port

  The final equipment package will have been defined when the scope of work for the operation is defined. The final shipment of the remaining equipment to the mobilization port will then take place.

Fabrication/Purchasing of Installation Aids

A certain amount of fabrication of installation aids and procurement of general rigging tools/equipment may be required. This supply will vary according to the actual scope of work.

Procedures for the Repair Work Finalized

Procedures from the preparedness plan will be checked and adjusted to fit actual scope of work.

Land based contingency equipment checked and verified acceptable for the work.

Part of (or all) the land-based/stored contingency equipment will be used (including spare cable). It will be essential that Contractor's operational team checks all such equipment.

Note! Typically 100 - 200 meters of cable will be used for a limited cable damage, normally 2.5 – 3 times the water depth.

Mobilization
Repair spread is mobilized in a suitable port.

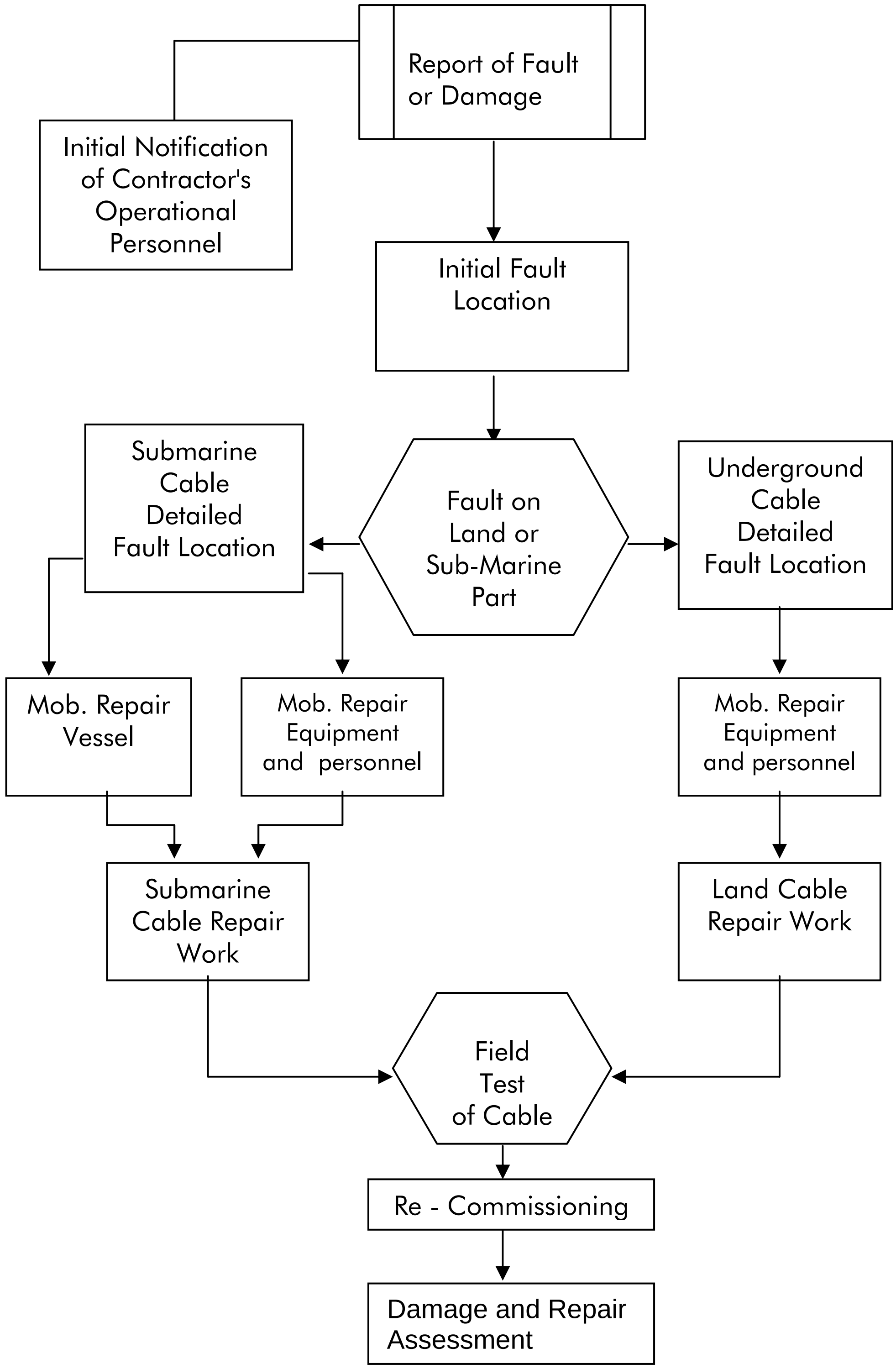
Repair Operation
To be commenced as soon as possible after the mobilization has been completed. All work will be on a continuous "around-the-clock" basis until the operations are fully completed.

Testing
Following the lay-down of the "repair hair-pin loop" the cable will be tested prior to commencement of the demobilization.

Re-commissioning
Re-commissioning of the transmission system will commence as soon as possible after the cable filed testing. The marine spread will normally be allowed to demobilize before re-commissioning is started.

Demobilization.
Certain equipment will be returned to the "contingency storage location" while certain equipment will be returned to Contractor or relevant subcontractors.
A typical set-up of the major activities is enclosed on the following page.

Major activities:



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POTENTIAL CABLE DAMAGE ASSESSMENT

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1 INTRODUCTION

Parts of the HDR/DTA Route Study have been reviewed in order to assess eventual third party activities that could have an impact of the cable safety after installation.
During the installation, notice to mariners will be issued, and guard vessels may be employed if necessary.

After it became standard practice to bury or otherwise protect submarine cables, as opposed to only surface lay cables, the failure rate has dropped dramatically.
With appropriate protection, the main risk of damage comes from heavy anchors, large fishing trawls or un-coordinated construction work or dredging work.

CIGRE Technical Brochure No. 398:
We recommend that the document “Third-Party Damage to Underground and Submarine cables” by Working Group WG B1.21 is procured, unless already in house.
This document describes:

- general methods of installing underground and submarine cables
- service experience and fault statistics including third party damage
- classifies main threats to cables
- advise on risk analysis and
- give recommendations to how the risk of damage can be reduced

2 SUMMARY

The HDR/DTA Route Study conclude that the presence of commercial and recreational fishing interests will are not likely to prohibit the installation of the project, but that co-ordination with regulatory agencies and interest groups will be required.

This should be extended to apply to the post-construction period as well.
Proper marking and charting of the cables as well as information to fishermen associations and similar organizations will be essential to inform users of the seabed and rivers of their location and hence reduce the risk of damage.

It is the responsibility of the installation contractor to provide detailed information of the as-laid co-ordinates to the Owner. Formal registration of the cable installation to relevant authorities such as the Coast Guard, charting authorities and interest organizations rests on the Owner.

3 CAUSES FOR DAMAGE TO CABLES

The origin of damage may be direct contact from third party work or direct or indirect changes to the environment.

The first type of cause can include damage to terminations, link boxes or grounding system, not only a direct hit on a cable.
The second type includes changes to the backfilling, changes to the type of soil, added depth by third party depositing excess soil on top of cables or adding/removing soil by dredging.
Thermal conditions may change due to changes in vegetation or draining systems. Even if the design should be for “dried out” soil immediately around the cables, the thermal resistivity of the main backfill may alter.

Some causes of damage to both underground and marine cable:

- Excavation work
- Horizontal drilling – incorrect trajectory
- Vertical drilling – incorrect location
- Incorrect information or use of information
- Dropped objects from vessels, building cranes and transfer of goods

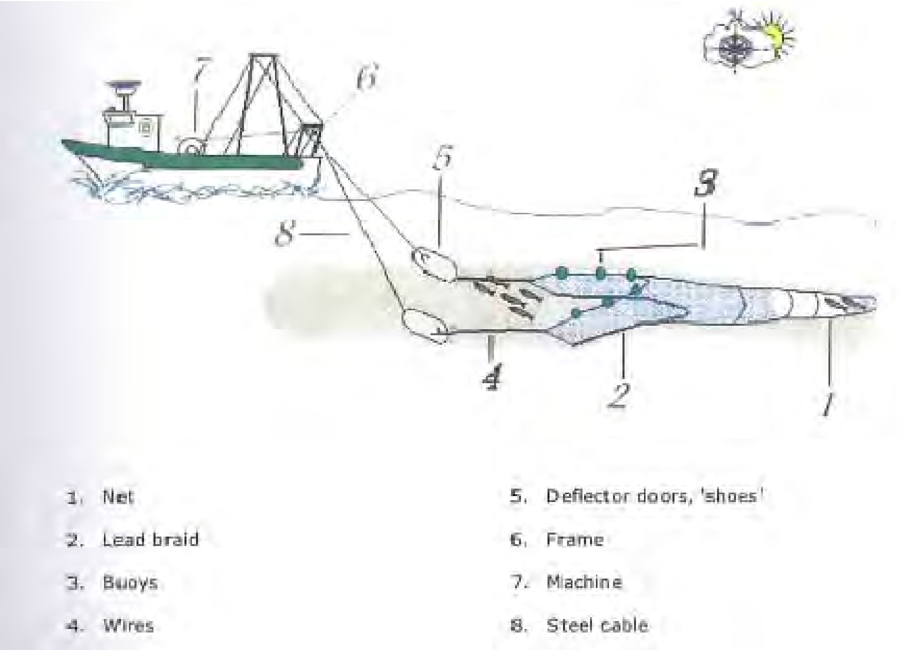
For the marine parts of the route, records of damages referred to in the CIGRE document show that some major reasons are errors in charting, vessels not having the charts onboard or outdated charts and mariners not at all being aware of new cables.

Anchoring is a cause for damage occurring in emergency anchoring. Anchoring areas and anchor prohibition zones are generally well known and respected. Methods for anchor penetration assessment are well known, but the input such as type and weight of anchors used and actual soil conditions may change over time and require local knowledge.

4 FISHING ACTIVITIES

It is noted that according to the report the fishing activities from the Canadian border to New York City is mainly angling and recreational fishing using light gear. There is no commercial fishing activity associated with dragging.

From New York City to Bridgeport, CT, some commercial trawling for fin fish may occur at various times of the year.
The gear used is typically bottom trawlers towing an otter net astern of or on the beam of the boat. The trawlboards used are of a type that usually will penetrate maximum 1 ft into the seabed and should not be harmful to buried cables.



Therefore, damage by trawl fishing is not seen as a potential threat for this project and other professional fishing activity (with nets for example) is limited, if existing along the route at all, and is not likely to impact the cable safety.

Similarly, in some areas commercial clam dredgers may operate on the vicinity of the cable route, typically in the Long Island Sound. The gear used is a towed metal dredge that also penetrate maximum 1 ft and is not likely to be harmful to a buried cable.

Leisure fishing tackle is not a threat to the cable, but there is a possibility that small craft anchors may snag the cable. We regard this risk as small because the anchors are proportionally light – less than 100 lbs, the vessels are likely to be near stationary when deploying and retrieving anchor and not likely to drag the anchor across a wide area. Anchors will normally be dropped at depths less than the depth of the major part of the route.

5 VESSEL TRAFFIC

The HDR/DTA Route Study conclude that shipping lanes, anchorage areas and vessel traffic are not likely to be a hindrance to the project.
There are several chartered anchorage areas, commercial ports and small recreational harbors along the route, but they do not represent any substantial hazard to the cable installation work or to the safety of the cable after installation.

Commercial vessels are not likely to deviate from the dedicated shipping channels and ports. Small recreational crafts may be beached at random at the cable landfalls and even pulled up on land, and could cross the cables. We do not expect this to have any impact on the cables, since they will be installed in buried pipes (HDD), buried in trenches and protected with concrete slabs on the onshore parts and protected in the water out to a depth deeper than the draft of these types of crafts. This would typically be 4-6 ft, but should be confirmed by gathering detailed information.

Vessel traffic from commercial self propelled to towed barges and from recreational crafts varies in size and frequency with the waterway dimensions, but is generally high all year round. We suggest a study of statistical records to reveal general information of the vessel types used along the route. Self propelled vessels are not likely to pose a problem. However, there may be occasional tows bound to and from the Hudson River; this would constitute in our opinion a potential, small risk to the cables. The tow line is often provided with a “dead man weight” to prevent snapping. This weight can be up to 5 tonnes. Dragged weights are sometimes used to keep the distance between barges in a tow. If the convoy finds itself in a perilous situation, use of anchors is sometimes a means to lower the speed.

An estimation of the anchor penetration depths for the type of towing vessels that are likely to sail in this area would give an indication of the cable burial depth necessary to protection the cable against such hazard. This depth is not likely to exceed the assumed burial depth of 1 m, but need to be checked. Installation of concrete mattresses is an alternative where the cable cannot be buried.

The route is, in our opinion, well planned in order to avoid the most navigation channels and anchorages. However, both vessel sizes and traffic frequencies may change over time and should be monitored and updated before and during the installation phases.

In any case, the submarine cable route will be marked on the navigation charts and buoys can be installed to indicate its presence to the marine users of the channel.
NOTE! The new cable will be marked in the electronic version of charts soon after it is reported, but a printed version may not be available for some time later.

6 OTHER CONSTRUCTION ACTIVITIES

Along the route there are the presences of several types of industry that may need regular or occasional maintenance or improvements involving large equipments to be transported by sea. The risk would be to have massive objects accidentally dropped on the cable from the transportation barge or vessel.
To avoid such event, focus will have to be brought on the transportation procedures, like seafastening and selection of the transport route, but such procedures will be outside the control of the cable owner unless they are notified of special activities.
The crossing of the cable route with the transport vessel will however, only be at a location able to receive/deliver the goods, and the cables should be protected in these areas according to the potential risk. E.g. extra burial depth or mechanical protection can be applied.
We regard this problem as very small, but the potential risk needs to be addressed.

7 RISK REDUCING MEANS

The CIGRE report have, based on member data, found that 70% of cable damages are caused by mechanical work and 40% of third party damages are due to insufficient or incorrect exchange of information between cable Owner and Third parties. Giving attention to this finding is an efficient and cheap means of reducing the risk.

Contractors (Third party) will in most circumstances be obliged to submit detailed plans and obtain permits to work from agencies that should have knowledge of existing cables and other utilities. Provided the correct data have been filed, this kind of administrative procedure will reduce the risk of direct damage.

The quality of maps/charts is very important for giving accurate location for the new cables. The quality of the location of older utilities can in comparison very poor, and should not be used as reference points unless verified in a modern system.

In the installation phase, unverified locations of existing utilities cannot be regarded as “rely on” data.

One should beware that different regional geographical co-ordinates may be used in the same area or overlapping areas, causing mistakes to be made.

The underground cables will be installed in trenches including mechanical protection, concrete slabs or similar, and a colored warning marker tape with appropriate information text. Red colored die on the top slabs is also used to draw attention to the cables. Color coded marker poles may also be installed at regular intervals and at change of direction in the ground.

The Owner / Operator of the new cables will be well served by keeping himself updated on ongoing activities, keep a good relationship with local businesses and contractors and try to anticipate activities that might damage the cables.

Regular tests of the outer sheath of underground cables may give an early warning of a damage that could develop to a breakdown.
If a telephone cable is installed along the same route, this will normally be installed above the power cables. The requirements to burial is less than for power cables, and they are cheaper to repair and can as such be regarded a sacrificial.

For the submarine part of the route, a risk reducing means is to perform post – construction surveys to detect any changes to the seabed that could have a negative bearing on the cable integrity. A survey of the burial depth and comparison with the original results may reveal changes to the seabed or local activities. This should be limited to areas of special interest, like areas with migrating sandwaves that can over-cover or uncover or expose the cables.
The burial depth can be checked and maintenance burial or other protection performed. Side scan or multibeam sonar may detect third party seabed activities, such as trawling or sand dredging (borrowing areas) that may be harmful over time.

8 CONCLUSION

Giving the available documentation and data, the potential risks for cable damage by third parties is deemed reasonably low.
The installation itself should not been jeopardized by third party activities: a notice to mariners will be issued prior to the operations and a fast, small guard vessel could be mobilized to prevent any accidental interference with the work.
This should be discussed before the project with the local marine authorities and users of the seabed/rivers.

The existence of the cable route should be explicitly marked with permanent cable warning signs at the main landfalls and at the HDDs at river locks. The underground parts should be properly buried and protected by adequate slabs and marker tapes.

We recommend that the CIGRE document “Third-Party Damage to Underground and Submarine cables” by Working Group WG B1.21 is procured.
Nexans have participated in the Working Group WG B1.21 writing the document; however according to CIGRE rules, we are not at liberty to send you a copy.

D 12

INSTALLATION OF UNDERGROUND CABLES

Cable installation in land, canal and railroad RoW sections of the route

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1 INTRODUCTION

This document addresses the cable transport, installation, protection and jointing of underground cables on land, along railroad RoW's and canals.

Distances governing the Right of Ways will be revised after the telephone conferences between TDI, TRC and Nexans. The parameters shown in the TDI generic drawing no.169201-T1 can be defined section by section in a detailed design.

2 SUMMARY

From the route table below, the figures in red represent the land part, all of which is for four (4) cables, i.e. a total of 4x120 km = 480 km cable that shall be installed in the ground:

- on land
- along railroad
- at lock circumvention at the canals/rivers

Champlain Hudson Power Express (CHPE)	**miles**	**km**
Hertel to St. Jean-Sur-Richelieu (land cable)	13	20
Richelieu River to Canada/US border (submarine cable)	25	38
Canada/US border to Champlain Canal Lock 12 (submarine cable)	110	165
Champlain Canal Lock C-12 to Lock C-7 (submarine cable)	24	36
Lock C-7 to Albany (land cable installed in railroad ROW)	63	100
Albany to New York HVDC terminal (submarine cable)	137	206
Sub-total Route Length to New York City:	**372**	**565**
New York City to Connecticut (submarine cable)	63	100
Sub-total Route Length to Connecticut:	**435**	**665**

The Right of Way may vary along the route, and the cable design may change accordingly to satisfy actual ambient conditions, including spacing limitations and mutual heating from parallel cables.

The proximity effect of parallel utilities and constructions will have influence on the cable design and spacing. There will also be a number of crossings – over and under - third party utilities that need to be considered individually.

TRC estimate that there may be 30-40 locations requiring HDD for crossing highways, public roads and rivers. The economical and technical optimal design w.r.t. the number of pipes and dimensions need to be defined. As a starting point, we are looking at two HDD pipes each for two cables, i.e. one pole.
Please note that HDD drillings tend to go deep in parts, 6 to12 ft to attain a reasonable straight curve of the drill path. The resulting thermal resistance may be the bottleneck of the route. The HDD pipes may be filled with Bentonite or similar remedial material to improve thermal properties.

3 CABLE DRUM DIMENSIONS AND LOADS

The preferred cable type is the extruded XLPE type. Basic data for cable and drums are tabulated below.
The table below is in both metric and US customary units. The cable delivery length OF 1000 m is indicative and has to be adjusted to the actual site and joint pit locations during the Engineering phase. This also applies to reel size and reel weight.

Cable type	Diameter	Weight	Bending radius	Delivery length	Reel diameter	Reel width	Weight Reel + cable
	mm	**kg/m**	**m**	**m**	**m**	**m**	**kg**
TKXE-L 300 kV 1 x 1400 mm² KQ	105	29	1,6	1 000	5,0	3,0	38 110
	in.	**lbs./ft.**	**ft.**	**ft.**	**ft.**	**ft.**	**short tons**
TKXE-L 300 kV 1 x 1400 mm² KQ	4,13	19,5	5,4	3 281	16,4	9,8	42,0

The length of cable on one reel is set high in order to limit the number of field joints, but will have to be adjusted w.r.t. actual transport limitations.
The basic solution is to deliver the underground cables on vertical reels. The dimensions are shown in the table above.

There may be opportunities to deliver even longer lengths in cable baskets. It is realistic to accommodate and transport in excess of 3 km cable in a 6 to 7 m wide basket.
A scenario may have the following dimensions:

Cable "volume"

Inner diameter, minimum	4.3 m
Outer diameter	6.6 m
Height	2.5 m
Max. load	130 tonnes

Basket / Turntable

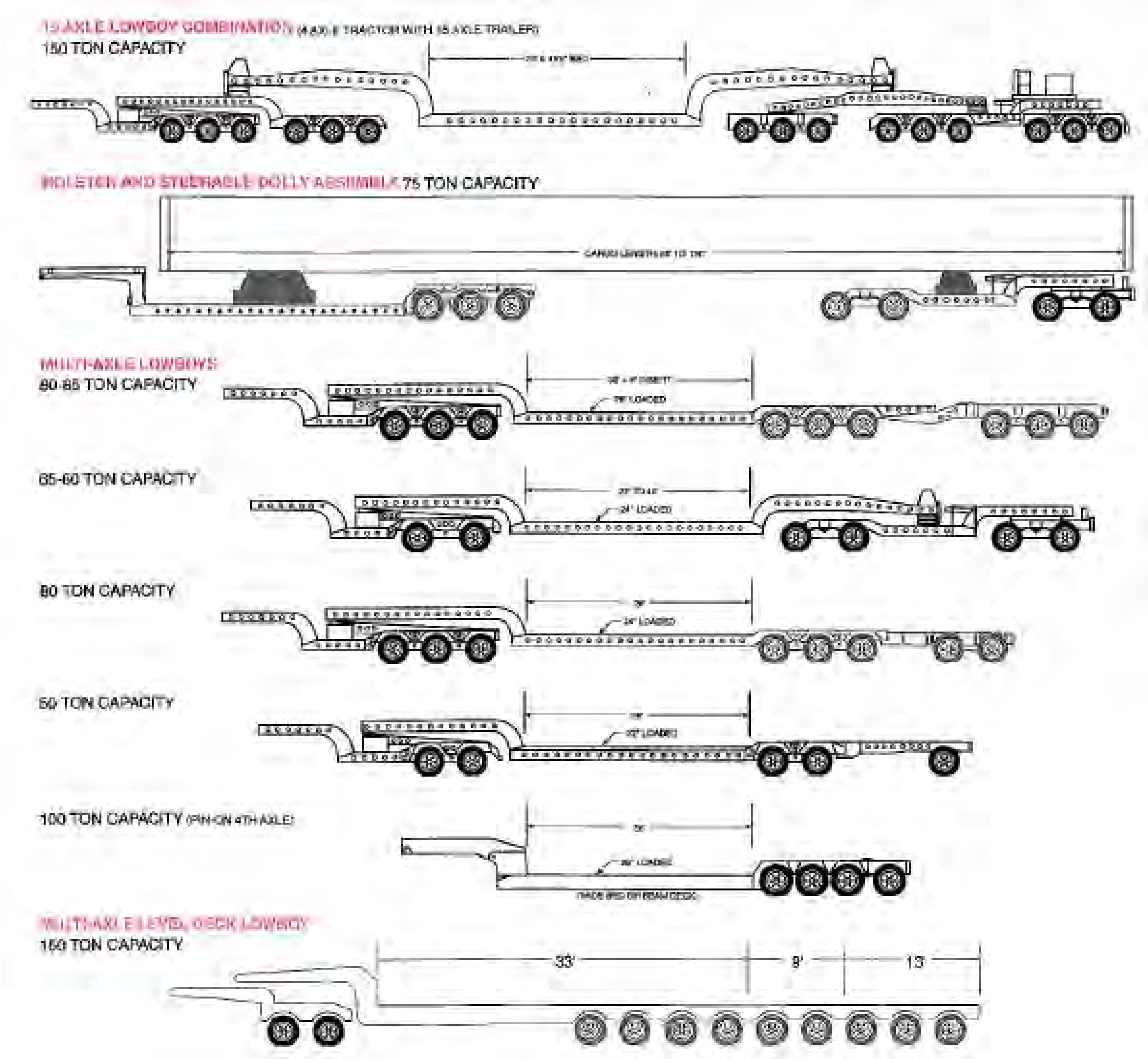
Outer diameter	7,0 m
Height incl. operating unit	3.6 m
Net weight	14 tonnes

A 3 km length of cable would, including the basket weigh about 100 tonnes.
The photographs below show a set up with a power pack driving the turntable and the cable being fed out over a sector bow held by a mobile crane.
In the case depicted, the basket was rigged at the mouth of a 3 km long tunnel under water from mainland to an island and pulled by 40 pulling machines.
This is a well proven method, however, if there are no underpasses, it might be possible to lay the cable from a railroad.

4 MEANS OF TRANSPORT

Transport to the various sites by railway, road, barge and a combination shall be evaluated during detailed engineering.
Please note that both width and height of reel and basket can be adjusted, within minimum cable handling limits, to better adapt to the means of transport.

Road transport:
Transport by road from port or manufacturing plant may be the method requiring the least transhipment, assuming the site is accessible. Multi-axle lowboys with capacity of two 1000 m reels – about 80 tonnes – are available. Road transport of a basket up to 100 tonnes is also feasible providing outsize load width is permitted.
Limitations due to bridges and road load restrictions must be investigated.



Railroad:

Similar to road transport, rail carts are available that might carry minimum two cables on reels. The reels will have to be tailor made to fit the maximum permitted load width, and may not exceed 10 ft. Both flat cars and low-loaders are available.

The type shown below has a load capacity of up to 88 tonnes.

Bulkhead Flat Car

Car Description	Car Series	Load		Dimensions		
		Tons	Tonnes	Inside Length	Outside Width	Outside Height
Bulkhead Flat Car	CNIS 621000-621299	93-94	84-85	66' [illegible]	10' [illegible]	15' 2"
These bulkhead flat cars are used to transport various forest products such as lumber, chipboard and logs. The cars' inside lengths range from 52-66 ft. in order to accommodate the shipper's various commodities, and are capable of carrying up to 9[illegible] tons.	CN 622003-622683	90-91	82-86	66' 4"	10' 1"	15' 2"
	IC/ICG 977505-977493	93-97	84-88	61' 0"	[illegible]	[illegible]
	IC/ICG 978650-978809	93	84	66' 0"	9' 11"	14' 10"
	CN 603015-603324	81	74	[illegible]	[illegible]	15' 1"
	CN 603751-603988	81	74	52' 8"	9' 11"	15' 1"
	[illegible]	[illegible]	74-78	[illegible]	[illegible]	[illegible]

Assuming the cables cannot be transported to their final destination at all sites, transhipment from the rail to road transport will require the availability of a heavy duty mobile crane.

Barge:
Cables in baskets or vertical reels can be transported major parts of the route by barge. However, the vertical clearance at some fixed bridges is as little as 15 ft. This is a minimum clearance that may vary with the operation of the waterways. This potential limitation needs to be investigated and actual limits confirmed.
The vertical cable reels will normally sit at or below the waterline in cargo barges with a conventional hold, and not on the deck of flat top barges.

Transhipment from the barge to road transport will require the availability of a heavy duty mobile crane and a suitable pier. A mobile crane is not absolutely essential where the load can be jacked up on chocks and a low loader backed up under the cargo.

5 RIGTH OF WAY

The cable design can be altered from the base design to allow for a narrower Right of Way than the assumed figures, 1.7 ft (0.5 m) between two cables of the same pole and 16 ft (5 m) between the poles. There will be limits to what is economical and technical optimal solutions, but it will be feasible to reduce the pole separation to 12 ft.

Normal underground sites:
The nominal cable spacing can be observed. There may be crossings under roads and utilities that limit the route width. The cables may have to be installed deeper than normal in such sites and a larger conductor size may be required for a limited length.

Along railroads:
TRC has advised that the minimum distance from the centre of the rail to the nearest cable is 10 ft for CP and 25 ft for CSX. The route does not run along the rails of other operator, or if it does, we can assume similar distances will apply.

The width of the RoW is desired to be kept to a minimum, but at the time being a pole separation of 12 ft will apply.

HDD drills:
Four separate HDD's, one per cable, is desired for thermal reasons, but is agreed to be unfeasible both for cost of construction and space requirements. Two cables of the same pole in separate HDPE conduits in one HDD casing will be the base case.
The RoW should allow for the second HDD for two cables to be minimum 12-16 ft from the first one.

6 JOINTING AND LAYDOWN AREAS

The combined laydown and jointing area is estimated to be about 400 m^2, about 4225 ft^2. This area will accommodate cable drums, tool containers, site office and the joint bay.

If the joints are staggered, the space for two joints of the same pole will be 10 ft wide, 30 ft long and 5-7 ft deep as the location allows.
A second joint bay for the other pole will be placed behind the first one, maintaining the separation between the poles.

7 PULLING OF CABLE

Pulling cables from reels is described in the attached document "Transport and handling of cables". The cable trench is prepared with cable rollers, underpasses and crossings prepared and guarded and proper communication set up and tested for all operators.

Although it is feasible to pull more than one cable at a time, experience show that large and heavy cables are best handled one at a time.

Where the route allows, laying longer lengths, say 3000 m, from a basket on a turntable is feasible and will save jointing time and space. The cable baskets shall be placed on stable ground, firmed up by rock fill and steel plates if necessary. The cables are pulled out by pulling machines placed evenly along the route Alternatively a nose pull by a winch or continuous bond pull can be applied.

Underpasses may occur over such a long distance. If there are no such considerations, laying cable from a truck or even from a rail cart may be feasible.

HDD's:

Pulling through HDD's prepared for road crossings, rivers and streams, a pilot line need to be installed by the HDD contractor. Alternatively a soft line can be blown through and the actual pulling wire pulled in by that.

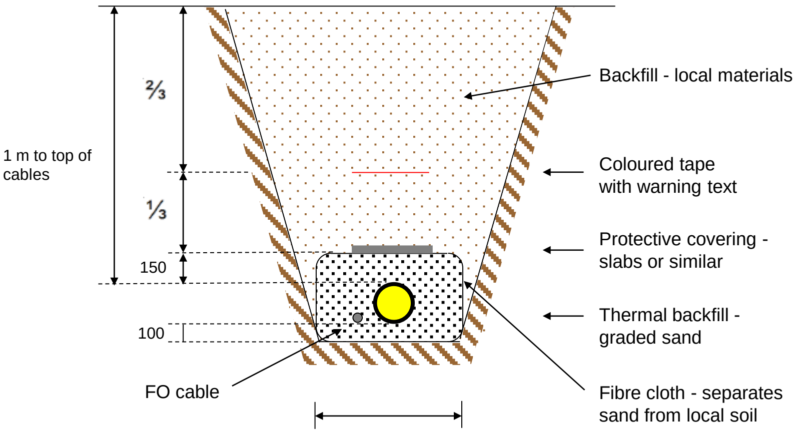
The length of the HDD should be as short as possible. Special cable design might be required for long pulls, both for thermal and mechanical reasons. For underground cables, the pulling force will mainly be taken by the conductor, but steel armour can be added to UG cables as well as submarine cables for pulling purposes.

8 CABLE TRENCH

The below cross section shows a typical cable trench for one single cable. The design will be extended to reflect the actual number of cables, their axial separation and values for bedding and cover that complies with local regulations along the route. In thermally problematic areas, special backfill, such as weak-mix, may be required above the standard level.

Typical trench section

Cable sand separated from local backfill by fibre cloth.



Sketch - not in scale

9 JOINTING AND TERMINATION WORK

Jointing and termination is performed by skilled jointers according to detailed installation instructions. The work is performed in a jointing house with controlled levels of humidity, temperature and impurities.

The jointing house is assembled from pre-constructed units that can be added to in length and width. The units include heating, air conditioners, dehumidifiers and lifting equipment like traverse carriers.

The joint bay may have a concrete base and bricked up side walls for mechanical protection and separation from parallel utilities.

The bedding, backfill and protection of the joints will satisfy the same requirements as the cables themselves. Special joint bay markers or pole markers will be installed.

At the transition between submarine and UG cables, the joint bay will be close to the water with the submarine cable pulled up through a conventional trench or HDD pipes. Special armour termination clamps and grounding systems will be installed at these locations.

The table of contents of a typical jointing instruction for a 420 kV XLPE cross-bonding joint is attached as a sample of the details given the jointers.

Table of contents

TRANSPORT AND HANDLING OF CABLES

INDEX

1 General

The descriptions below are based on an average installation practice. Each site is different and the methods of installation will be adjusted to the site in question. Detailed installation manuals are prepared during the Engineering phase with a result that may deviate very much from what is written below.

2 Transport of cables

- Cables are normally supplied spooled on wooden drums or drums made of steel.
- The drum required depends on the length, the weight and the outer diameter of the cable.
- The maximum capacity of a drum must not be exceeded.
- The core diameter of the drum must have a dimension determined by the type of cable, rated voltage and cross section.
- Normally cables are supplied in lengths up to 1000 meters on each drum.

  Greater lengths may make transport, handling and unrolling of the cable difficult. When unrolling grater lengths there is also the danger of the inner end of the cable moving. If this occurs the cable laying will have to be stopped in order to re-secure this end. The cable may kink at the transition points from one end of the layers to the next and the layers themselves may become jumbled up if it is not done from time to time.

  Therefore it has to be considered whether the saving in joints and jointing work to be carried out when installing excessive lengths of cables.

Cables are transported over land, on railway wagons or on trucks. They are secured tightly in order to prevent them from shifting or rolling during transport. The drums should be inspected for damages before unloading. Any complaints should be covered by a factual statement from the carrier in order to be able to claim damages.

A ramp or a crane may be used for unloading cable drums. If none of these are available, a provisional ramp of square timbers or beams should be erected.

NOTE! The following procedure must be carried out with the utmost care and only if absolutely necessary.
The angle of inclination should not exceed 1 in 4.

The timber and beams must be strong enough to support the weight of the drum. While rolling down the ramp the drum must be guided by holding ropes with the aid of winches or block and tackle.

It is, furthermore, advisable to pile sand approximately 20 cm high at the end of the run to act as a stop.

Neither coiled cable or drums, even if they are small and not heavy, should be allowed to drop down on the ground when unloading them, or allowed to be stopped by walls or trees as the cable is likely to be damaged in this way.

The direction of rolling a drum during transport and the (opposite) direction of turning the drum during laying will be clearly marked by painted arrows on the flange of the drum.
These instructions shall be strictly observed Otherwise the cable might move on the drum, so-called "crawling", and cause a kink.

A suitable trailer should be used for transporting the cable drum to the site. The cable may be pulled off the trailer or laid out while the latter is moving slowly, if the trailer is equipped with a bearing for the drum spindle.

If the cable is not to be laid directly off the trailer, it should be unloaded as close as possible to where it is to be pulled out later on. The drum should never be rolled over longer distances.

Coiled cables must be stored flat.

Vertically standing coils must be supported.

3 Preparations for laying cables.

The cable is best pulled off from the top of the drum set up in such a way that the painted arrows showing the direction of lay are in accordance with the pull direction. Pulling from the bottom of the drum will cause kinking of the cable during stops.
The drum has to be jacked up on the spindle high enough for a drum breaking system to be fitted. Heavy drums are jacked up on hydraulic jacks and fitted with hydraulic brakes.
For small drums a simple plank can be used for braking.

After removing the lagging from the drum, the cable should be inspected for visible damage, which may have been caused by improper handling or during transport of the drum. As cable pulling is often carried out by unskilled men, the fact that they are about to handle valuable and very easily damaged material should be made very clear in order to make them handle the cable with care. The cable should not be pulled over hard and pointed obstacles, which could damage corrosion protection or insulation, nor should it be bent more than the minimum bending radius.

There is little point in going for an excessively fast pull of the cable, most of the time spent is used on rigging and preparing the pull. The speed of lay must allow to brake the drum at any time if there is a sudden stop in order to prevent further unrolling and consequent kinking of the cable. The drum itself should be turned round by hand in order to prevent any damaging tensile stresses, which are particularly dangerous for thin cables without wire armour.

Smaller coils may be rolled out by hand. Larger coils should be pulled off a reel or horizontal turntable. Under no circumstances may the windings be lifted off a coil of drum lying flat, as this would cause the cable to be twisted and damaged.

If the ambient temperature is below + 3°C, the cable must be heated before laying as otherwise the insulation or the corrosion protection could be damaged during bending. The drums are either stored in a heated room for several days or covered by a tent and warmed up by suitable construction size heating fans. The drums should be rotated while being warmed. Care has to be taken that the cable is warmed right through to the barrel of the drum. The laying work must be carefully planned and carried out speedily to prevent the cable from cooling down excessively.

There is a minimum permissible bending radii (R) for laying and installing cables. These values may only be reduced by consulting the manufacture and will require carefully handling and bending only once before termination (around a prefabricated sector, if necessary).

4 Cables in the ground

4.1 The route

In urban areas the route should most conveniently follow the pavements; overland routes should follow footpaths. The depth of the trench depends on the number of cables to be laid one over the other and also on whether there are gas or water pipes or other supply lines already installed or to be installed in the future. The topmost cable should be at least 60 cm below the surface under pavements and footpaths and at least 1 m under roads. Cables laid at a lower depth have to be protected by sufficiently strong concrete slabs. Generally a trench depth of 1.0 – 1.2 m is usual.

If HV and LV cables are to be laid in the same trench, the HV cables should be laid on the bed of it and covered with sand and tiles. The LV cables are then laid on further bedding of sand.

If cables are laid in this way, however, the current carrying capacity will be reduced due to the mutual warming of the cables and the drying-out of the soil.

4.2 Spacing

The official regulations have to be observed when approaching or crossing cable routes of postal, railway or waterway installations. Local regulations normally apply to the approaching or crossing of other underground structures or supply lines.

Item	Topic	Distance	Comments
a)	Minimum distance from cables of Post, Railways, Highways and Police.	0.3 m	If this distance is reduced, the cables must be protected by non-inflammable plates, covers or pipes extending at least 0.5 m beyond both ends of the critical point.

b)	Minimum distance from structures of railways, waterways, highways and of telecommunication of Post, Fire Brigades and Police.	0.3 m	If the distance is between 0.3 m to 0.8 m, the cables must be protected by tiles, covers or pipes extending at least 0.5 m beyond both ends of the critical length.
c)	Crossings. Minimum distance from cables of Post, Railways, Highways, Waterways, Fire Brigades and Police.	0.3 m	If the power cable is laid on top at a distance of less than 0.3 m, an uninterrupted layer of non-inflammable material extending at least 0.5 m over the crossing must separate it from the telecommunication cables. This is in addition to the measures mentioned under a) above.
d)	Minimum distance between the top of pipes or ducts and the road surface or the bottom edge or rails	1 m	Cables crossing railways lines or roadways must be drawn into pipes or ducts in order to make possible their removal without digging.
e)	Clearance between power cables or power cables and control cables.	0.07 m	Single-core bundled in trefoil formation, if necessary.
d)	Clearance between control cables.	-	No Clearance necessary.

The mutual warming of cables in larger groups and the drying-up of the soil makes greater distances necessary in many cases.

The interference with control cables has to be checked, if these are to be laid parallel to power cables over longer distances.
The same applies to approaching and crossing of railway and telecommunication installations.

4.3 Crossing of roadways

For the crossing of roadways the cables must be drawn into pipes or into ducting blocks, which should extend under the pavements.

It is advisable always to provide spare ducts in order to avoid having to dig up the road if further cables are to be laid. Ducts, which are not used at once, should be plugged. The cables should not rest on the sharp edges at the ends of the ducts. Steel pipes should have funnel-shaped ends if possible.

If the end of a pipe or duct is level with the trench bed, a depression should be made immediately before the opening prior to drawing-in the cable in order to prevent stones or coarse soil from getting into the duct and clogging it up. The drawn-in cable should be cushioned so that it is in contact with the top of the duct at both ends.

The inner diameter of the duct shall be at least 1.5 times the outer diameter of the cable.

5 Laying the cables

The leading end of the cable is untied from the cable drum and a cable stocking placed over it and secured. A pulling wire or rope is attached to the eye of the cable stocking. No pull must be exerted on the soldered-on lead cap of a paper-insulated cable.

The following methods may be employed for laying cables:

- Laying out from a trailer
- Laying by hand
- Laying by pulling units
- Pulling by winches
- Arranging and covering
- Laying cables indoor
- Laying in a tunnel

5.1 Laying out from a trailer

This method is only possible without obstacles in the route. A suitable trailer shall be used, and this must be equipped with a bearing for the drum spindle, or steel supporters must be arranged on the vehicle.

The cable may be pulled off the trailer or laid out while the latter is moving slowly.

Care has to be taken that the cable drum is rotated by hand and braked if necessary, in order to prevent excessive tensile stresses or kinking of the cable.

5.2 Laying by hand

Rollers placed at distances of 3 to 4 m will facilitate laying. Corner rollers or similar devices should be provided where there are bends in the route, always maintaining the minimum bending radii of the cables.

This methods requires sufficient labour, it is advisable to have approximately 1 man by every 50 kg of cable. In addition it is of vital importance to have an engineer who conducts the process, either via loudspeakers or by walkie-talkie contact with the leaders of the laying teams.

By long, curved and incline cable routes it can be efficient to increase the pulling strength by means of a winch.

Nexans

5.3 Laying by pulling units

Cable rollers must be places approximately every third meter of the route.

It is advisable to install the pulling units (caterpillars) for every 50 meter; this distance depends on the character of the trench and the weight of the cable.

By means of pulling units the cables can be laid out with a speed of 10 - 12 m/min.

Usual pulling force per pulling unit is approx. 5000 - 6000N.

The pulling units work synchronised.

This method offers the advantage of fully controlled laying and also requires few persons as operators.

One engineer conducts the operator of the pulling units by means of walkie-talkie or telephone.

5.4 Pulling by winches

Pulling by a winch is possible only if there are only few bends or other obstacles in the route.

The rope may be attached directly to the conductors via a pulling eye if non-armoured or steel tape-armoured cables are to be pulled by a winch. The permissible pull is much higher than with a cable stocking, provided that all conductor strands are evenly stressed.

The following protective measures are necessary in order to ensure that the tensile stress does no exceed the permissible values:

1. A continuous check on the tensile forces by means of a strain gauge or a dynamometer attached to the rope holding the winch, with the latter resting on rollers.

2. A shearing pin or other rupturing device, which will interrupt the pulling if the maximum permissible tensile stress is exceeded, must be provided on the wire.

3. Cable and pulling rope should be guided by rollers, especially at the bends.

The tensile stresses may be still higher if the cable is pulled into a steel or plastic pipe, even if the pipes are greased, and they may reach 100 % of the weight of the cable if the bends total about 300°. Steel pipes may be greased with boiled-down soap of low alkali content.

All cables and especially single-core cables should not be straightened completely after laying, but be left slightly meandering, in order to allow for the longitudinal expansion caused by changes in the load.

The ends of paper-insulated cables should be capped at once after the cable has been cut (e.g. with lead caps), to prevent ingress of moisture. Identification strips are to be attached to the cables at distances of about 3 m, if these are to be identified later.

5.5 Arrangement of the cables in the trenches

After cables have been laid, they have to be arranged in the right formation according to the recommendation of the manufacturer.

Identification strips must be attached to the cables at distances of about 1-2 meter if these are to be identified later on.

The cables have to be covered by a 0.2 meter thick layer of sieved sand and protected with concrete slabs against future excavation works.

The rest of the trench can be filled up with excavated materials.

5.6 Laying cables indoors

The cables are fastened to walls or ceilings with clamps or are laid out on racks or steel frames.

The maximum distances between clamps for horizontal installation should be as follows:

Non-armoured Cables	20 x Outer Diameter
Armoured Cables	30 to 35 x Outer Diameter
Max. Distance	80 cm

These distances may be greater for vertical installation depending on the type cable and the clamps used; but they should not exceed 1,5 m in any case.

Back shells should be placed between the support and plastic cables or paper-insulated plastic-sheathed cables, if they are to be fastened with the usual clamps.

5.7 Cables on walls, ceilings and racks

Indoors the cables are either fastened to walls or ceilings or laid out on racks. When planning cable installations, the space required and the necessary strength of racks and outer structures has to be worked out, taking into consideration the influence of cable grouping on the current capacity and the permissible bending radii.

The space provided for cable racks has to be ample. They are either fixed to the walls or supported by free-standing structures enabling the cables to be easily installed or replaces. The racks must not have a detrimental effect on the connective heat dissipation of the cables.

5.8 Cables in tunnel

Cables inside a tunnel will in principle be installed as an underground cable using cable rollers, winch and pulling units. The tunnel is usually so long that a full cable length must be supplied to site in a basket. The basket is placed on a turntable before pulling by jacking up the basket and pushing the turntable underneath. The jacks are removed, the turntable connected to a power unit and tested to ensure a proper operation. Spacing between rollers and pulling units will be as for laying in trenches.

Laying over a large distance require a thorough monitoring of the operation.

There are usually no cable joints in a tunnel due to limited workspace and environmental conditions. However, a repair joint will be developed for each case.

The cables may be laid in a duct covered by concrete slabs or a thermal acceptable weak-mix, consisting of sand and cement.

D 13

ASSISTANCE IN THE PERMITTING PROCESS

In the stages leading up to and through the permitting process, TDI themselves and several consultants, third parties and local, state and federal agencies will be involved.

Nexans can:

- Assist with technical descriptions and documentation of design, processes and procedures.
-
- Assist with adapting the normal designs to local Canadian and New York State regulations and practices.

- Assist TDI's consultants. E.g. environmental aspects of the construction work.

- Participate in meetings with 3rd parties, such as owners of crossing or nearby utilities, users of the seabed or rivers, and explain how these may be influenced by the installation work and operation of the installed cables.

- Participate in public hearings as support to TDI. Nexans role will be to ensure that the queries raised are understood and to provide clarifications. Any clear misunderstandings may be clarified in the hearings, but responses shall normally be in writing at an agreed time.

- Assist with input to responses to "Interrogation findings", also referred to as "Staff discoveries", from various agencies.

  Agencies Nexans have had the pleasure of meeting at previous occasions:

  NYS Department of Environmental Conservation (DEC)
  (Region I and Region II)

  NYS Public Service Commission (PSC) re. Proposed Certificate Conditions

  NYC Economic Development Corporation (EDC)

  NYS Department of Public Services (DPS)

  US Army Corps of Engineers (USACE)
  (Section 404 Clean Water Act and Section 10 Rivers and Harbors)

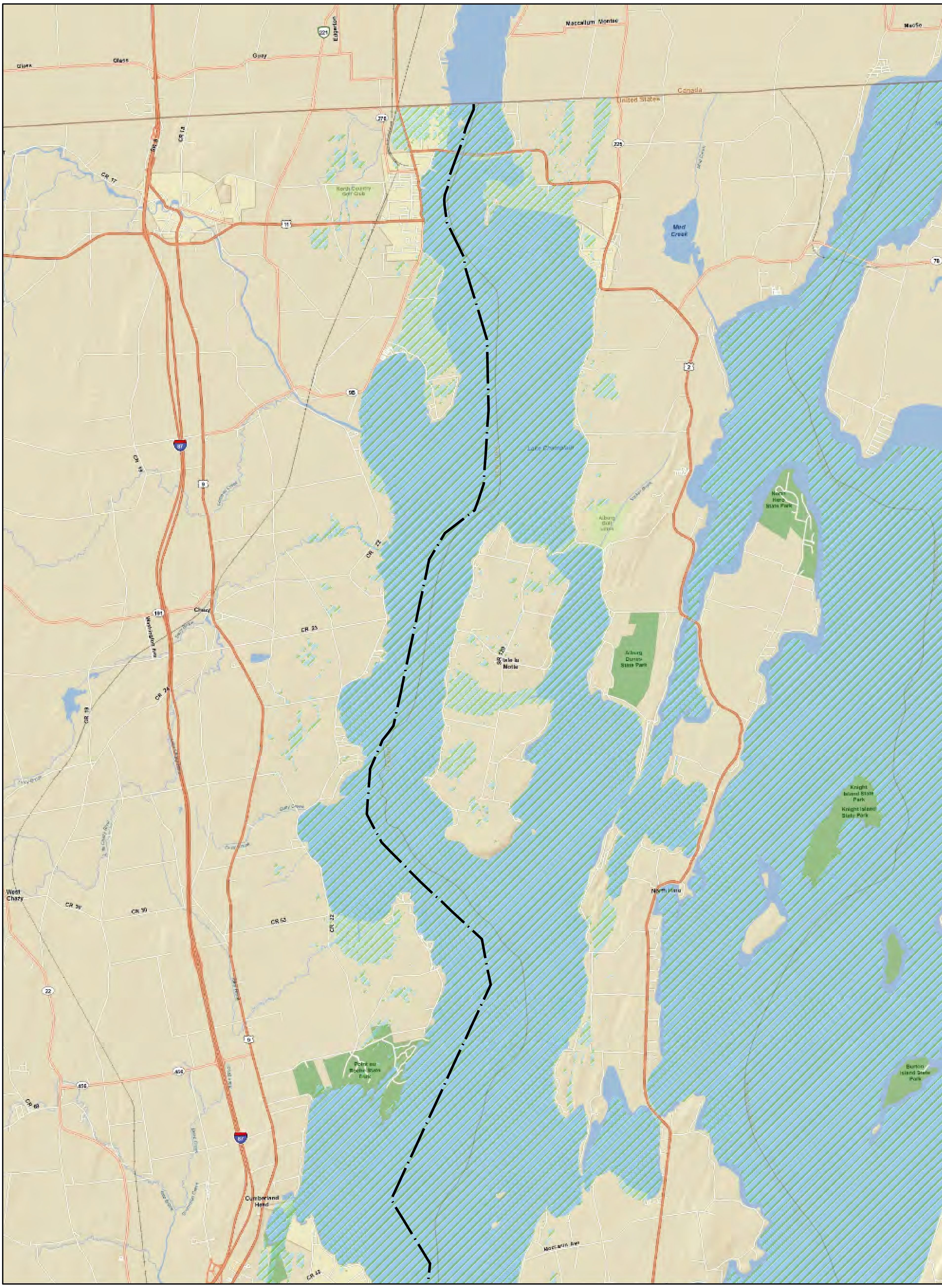
  New York City Port Authorities

Nexans have in the past reviewed documents, produced supporting documents and been present in some meetings regarding permits and consultations listed below.
Nexans have also supported a client re similar agencies in Connecticut and on Long Island.

Permit/Consultation	Administering Agency
Federal	
Federal Power Act	Federal Energy Regulatory Commission
Section 404 Clean Water Act Section 10 Rivers and Harbors	U.S. Army Corps of Engineers
Section 7 Consultation	U.S. Fish and Wildlife Service
Endangered Species and EFH Review	National Marine Fisheries Service
1	
2 State of New York	
Article VII Certificate of Environmental Compatibility and Public Need	Public Service Commission
Section 401 Water Quality Certification	Public Service Commission
Coastal Consistency Review	Department of State
Threatened and Endangered Species Consultation	Natural Heritage Program
Cultural Resources Consultation	Office of Parks and Recreation
Use of State-Owned Underwater Lands	Office of General Services
City of New York	
Waterfront Development Approval	NYC Department of Business Services
Permit for waterfront construction/alteration	NYC Economic Development Corporation
Permit to open remove or disturb the pavement of a public street	NYC Department of Transportation
Approval of conduits for use and transmission of electricity in any street or public place	NYC Department of Transportation
Permit to allow excavations for underground electrical conductors	NYC Department of Transportation
Approval to construct or connect with sewers or drains	NYC Department of Environmental Protection
Approval to connect to water main	NYC Bureau of Water Supply and Wastewater Collection
Approval of electrical wiring, sprinkler system, insulation and fixtures design	NYC Department of Buildings
Approval of waterfront related actions/ determination of consistency with waterfront revitalization program policies	NYC Planning Commission City Coastal Commission
City of New York **Zoning Codes to be aware of**	
NYC ZR 42-282 Performance standards regulating humidity, heat or glare	
NYC ZR 42-22 Performance standards regulating noise	
NYC ZR 42-21 Performance standards regulating vibration	

APPENDIX E

NWI AND NYSDEC MAPS IDENTIFYING WETLANDS ALONG THE PROJECT'S PROPOSED ROUTE



General Location Map

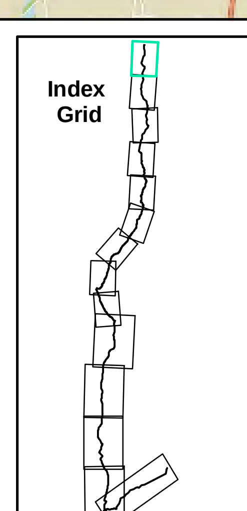
Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009

Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

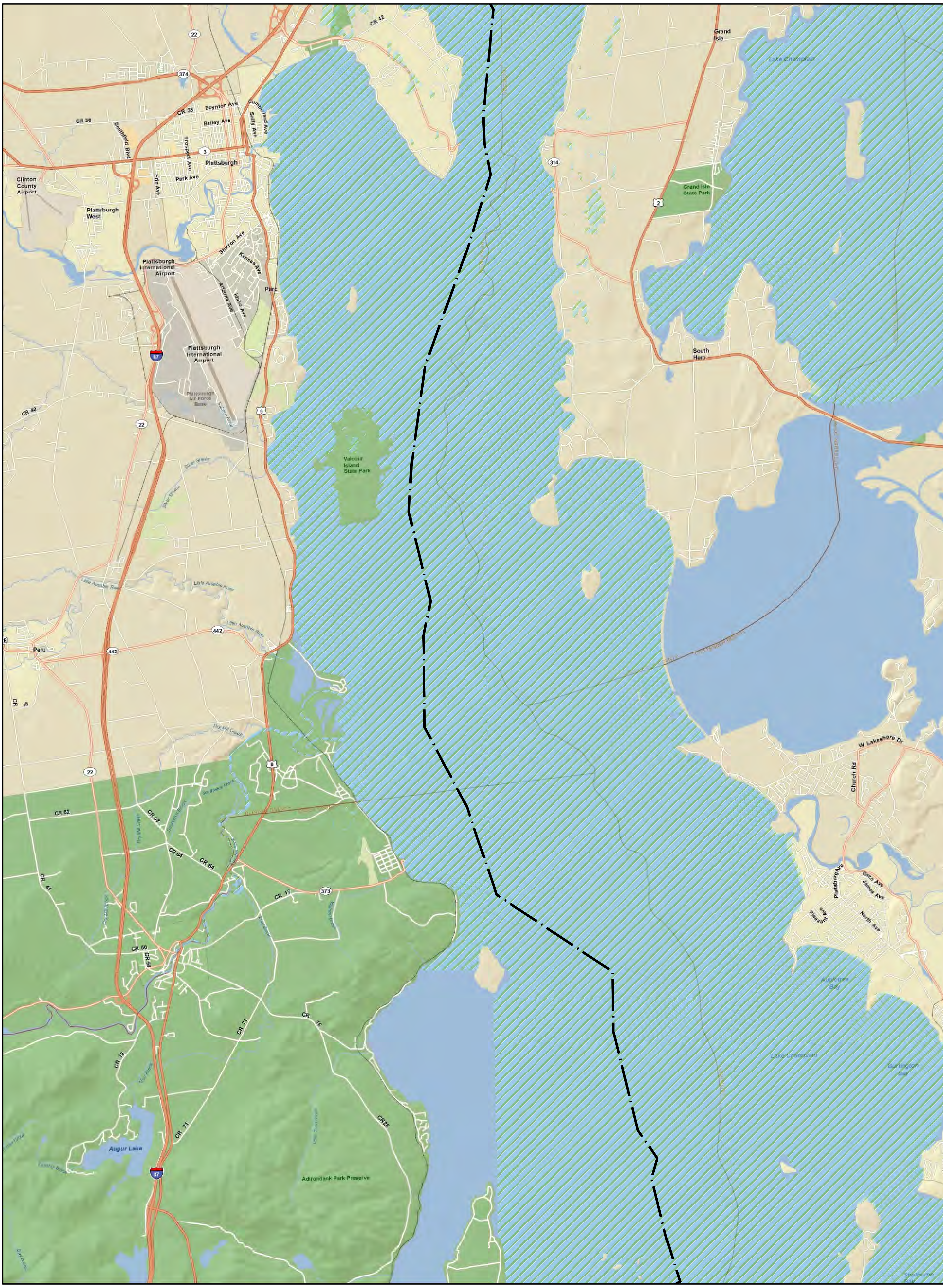
0 1 2 3 Miles



CHAMPLAIN-HUDSON EXPRESS ROUTE HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 1 of 14



General Location Map

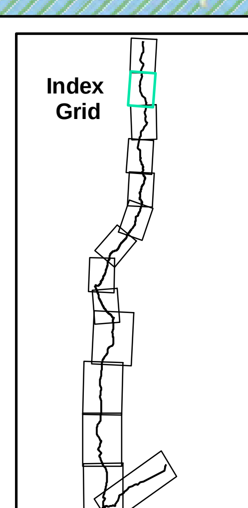
Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

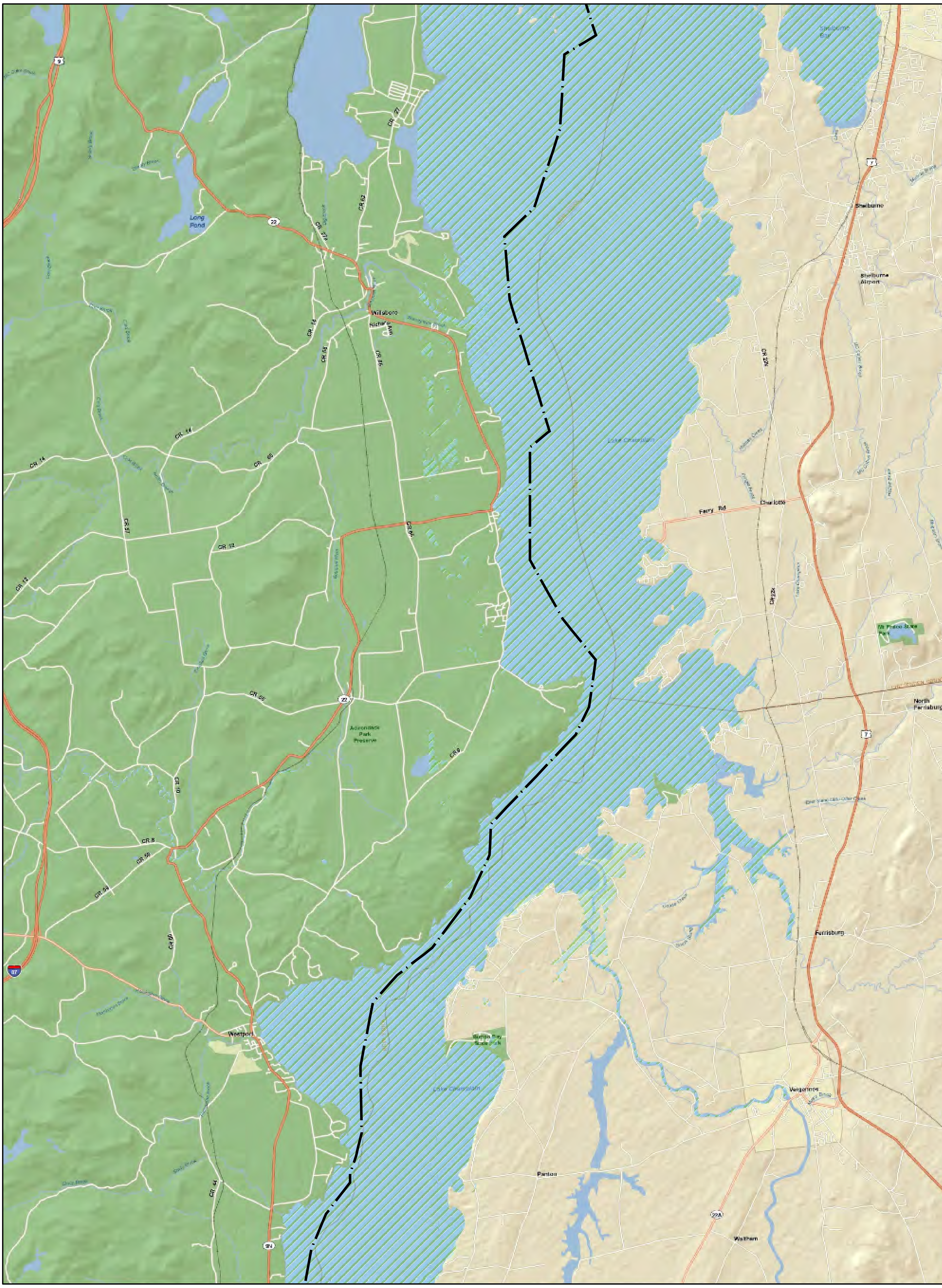
Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 2 of 14



General Location Map

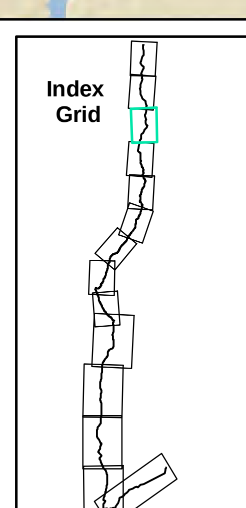
Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs.gov/NWI;2009 ;NYSDEC Wetlands 2009

Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

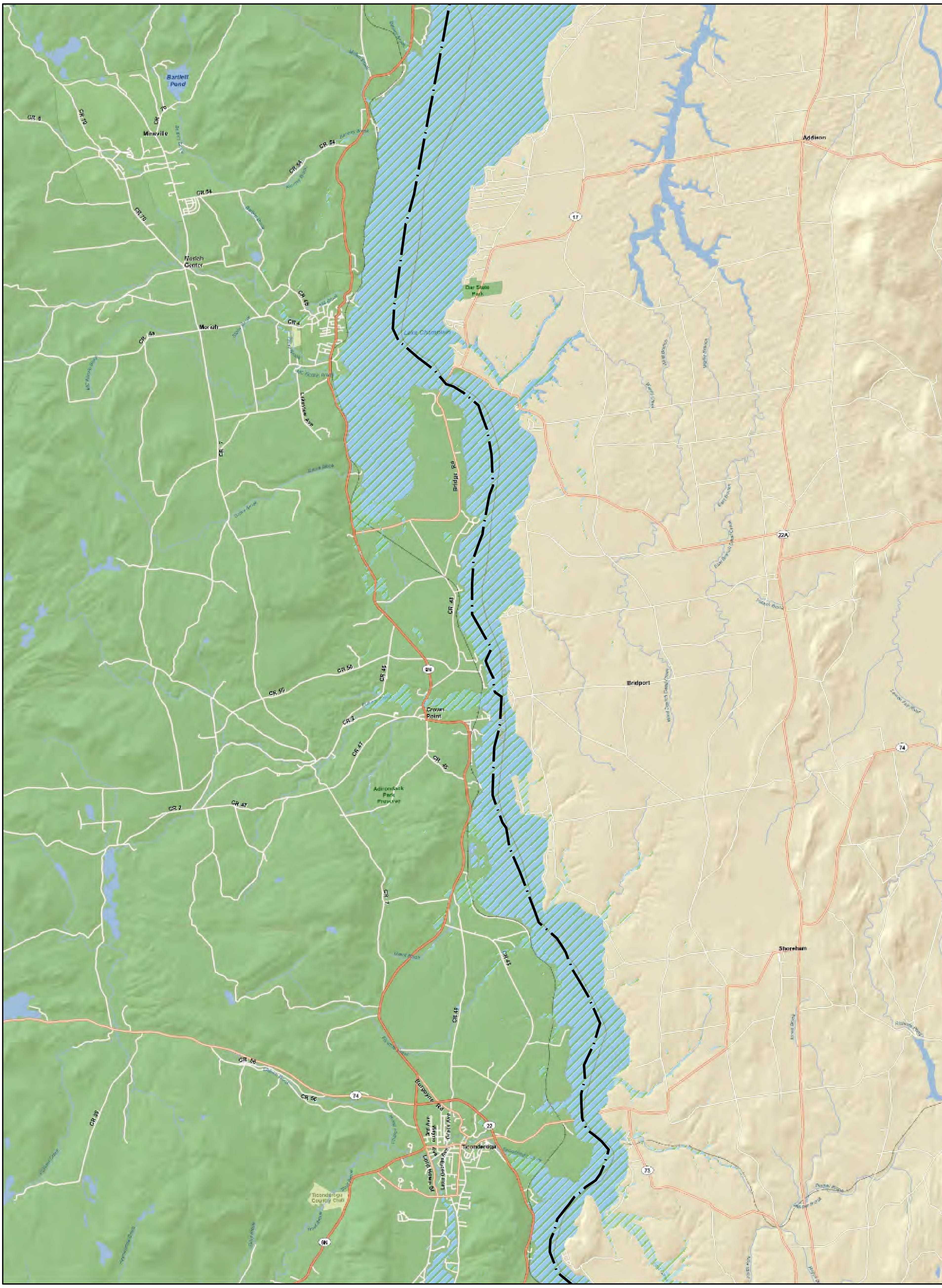
0 1 2 3 Miles



CHAMPLAIN-HUDSON EXPRESS ROUTE HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 3 of 14



General Location Map

Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009

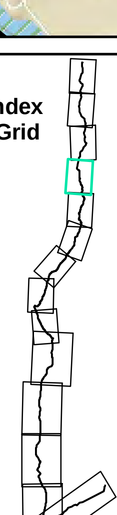
Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

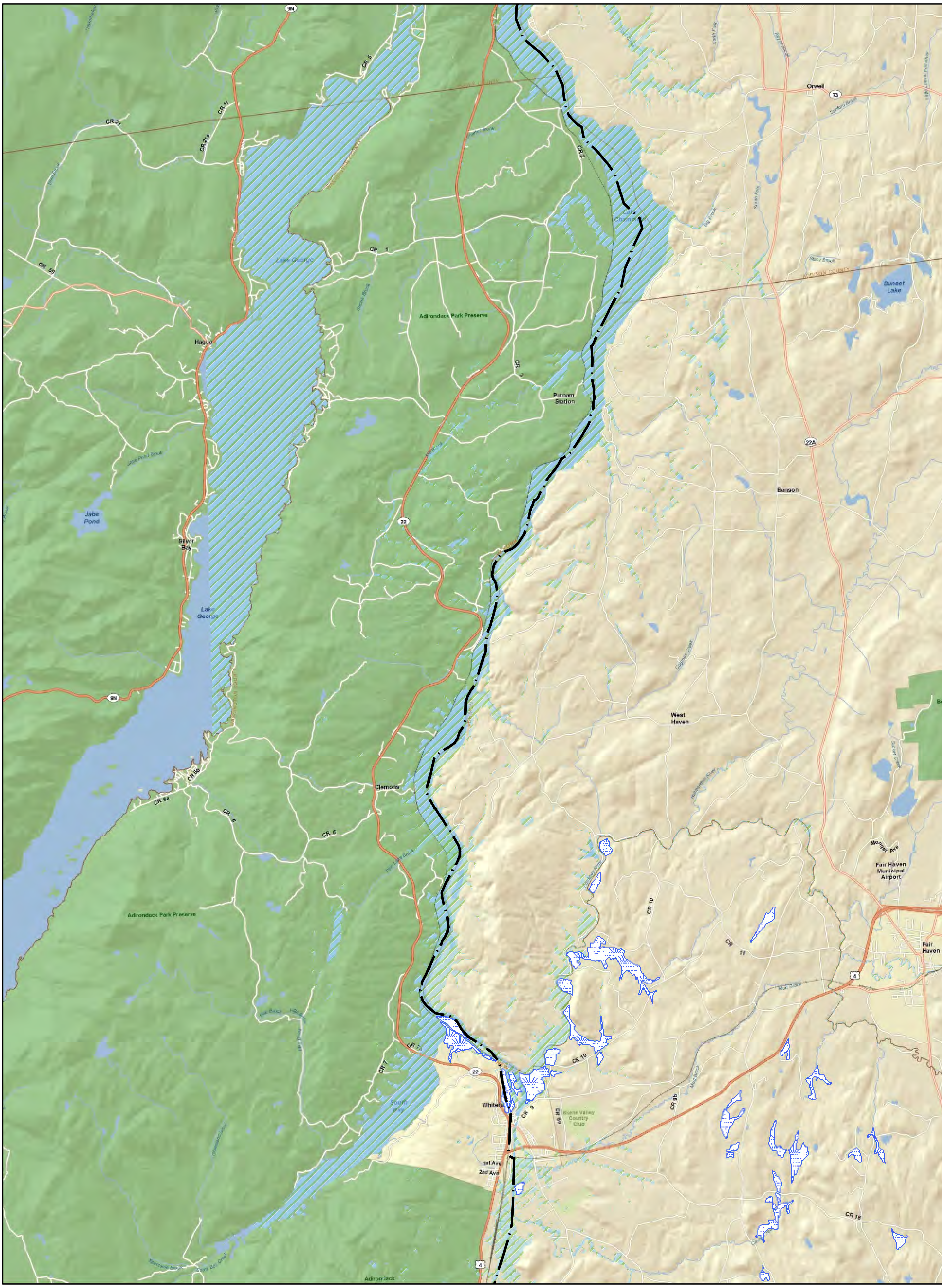
Index Grid



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 4 of 14



General Location Map

Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009

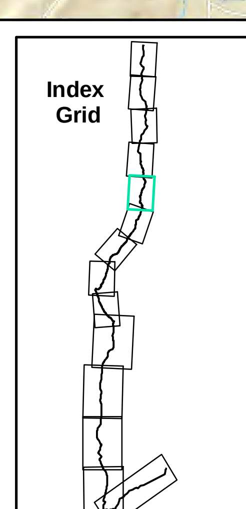
Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

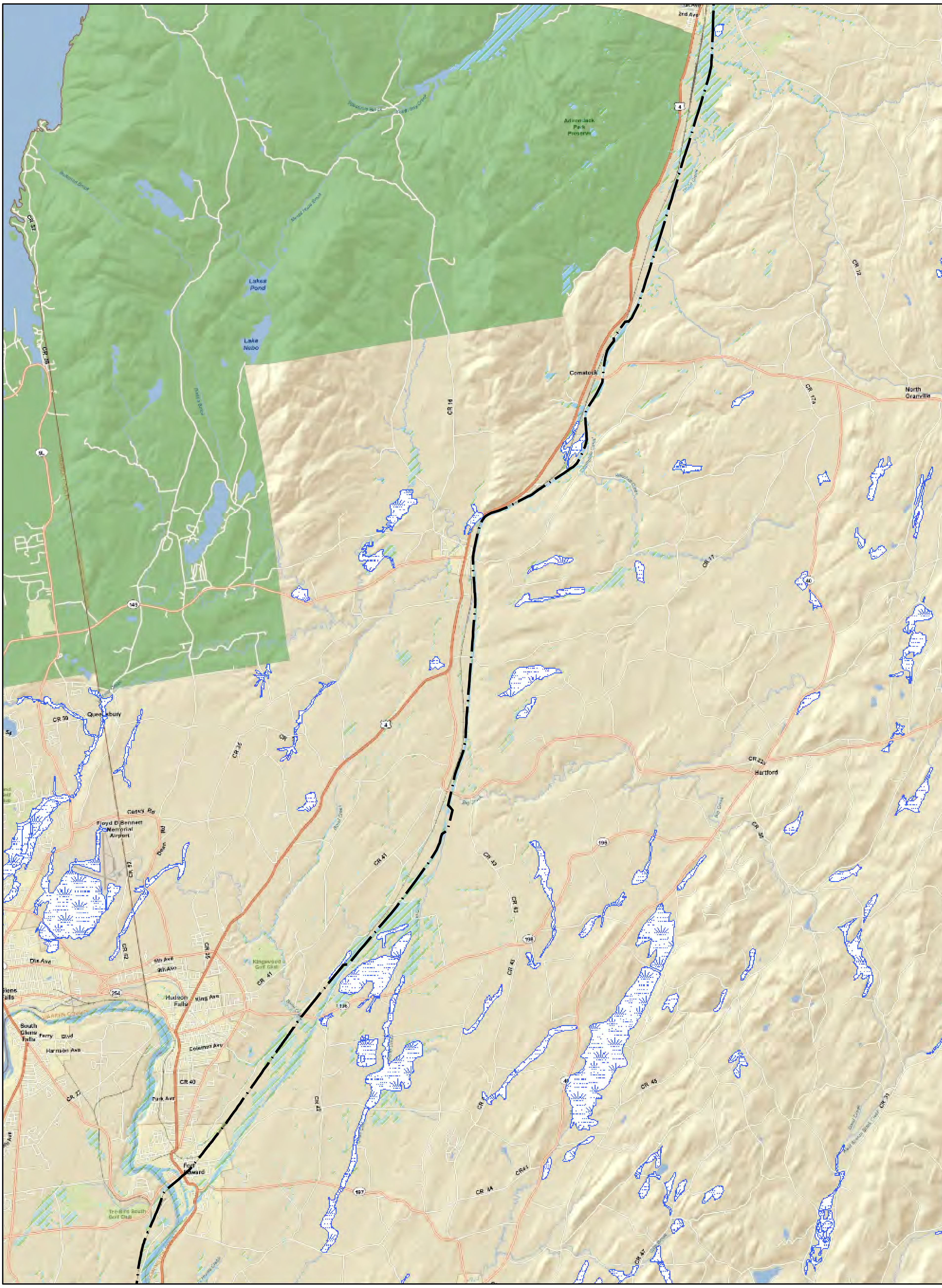
Index Grid



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 5 of 14



General Location Map

Legend

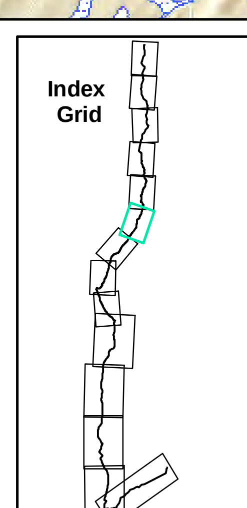
- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009

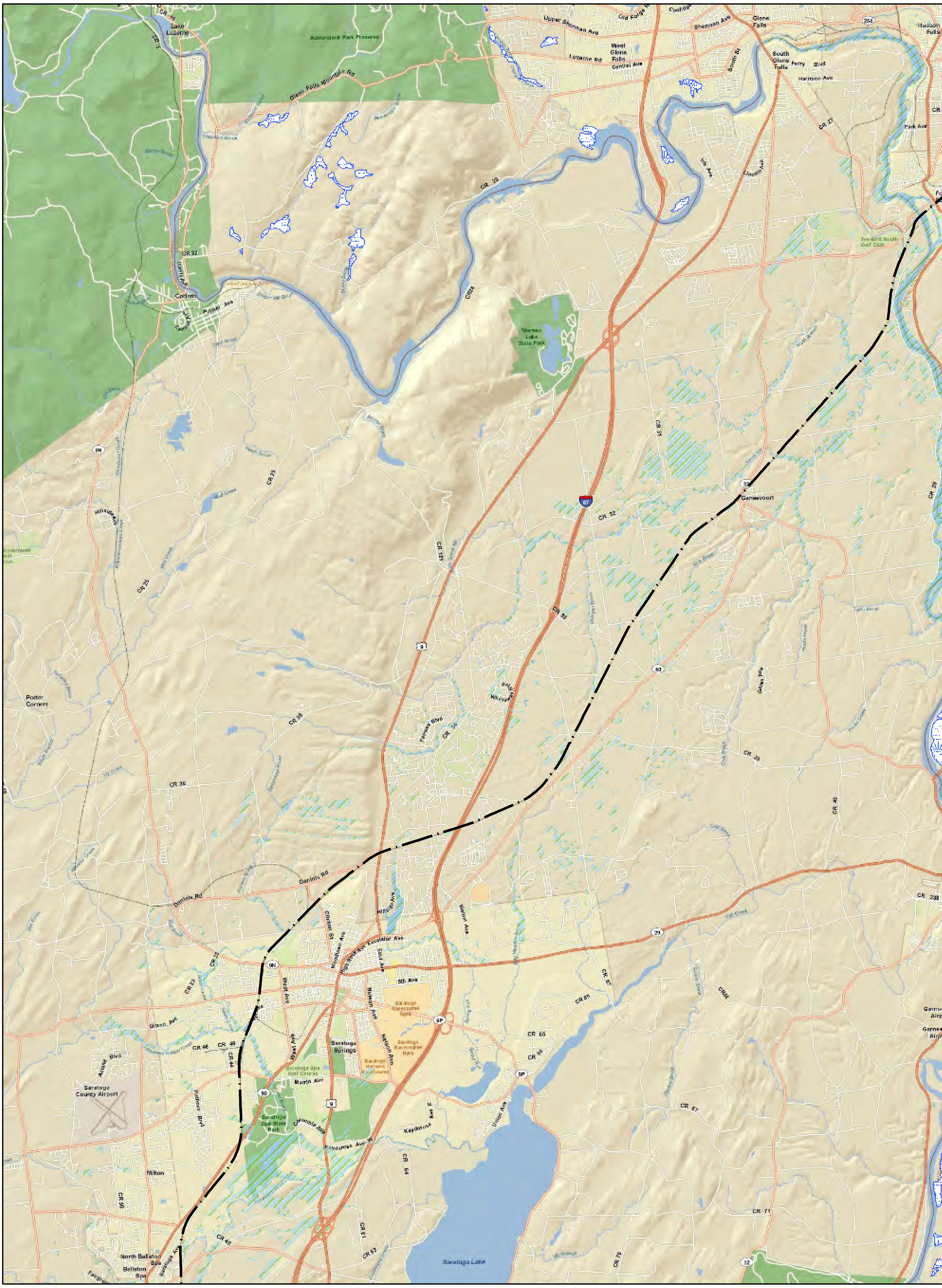
Index Grid



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 6 of 14



General Location Map

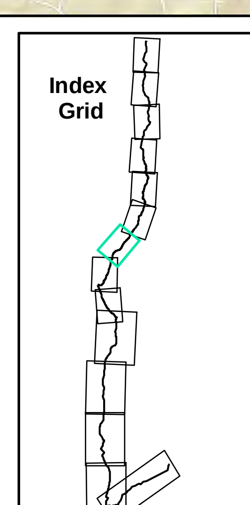
Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009

Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

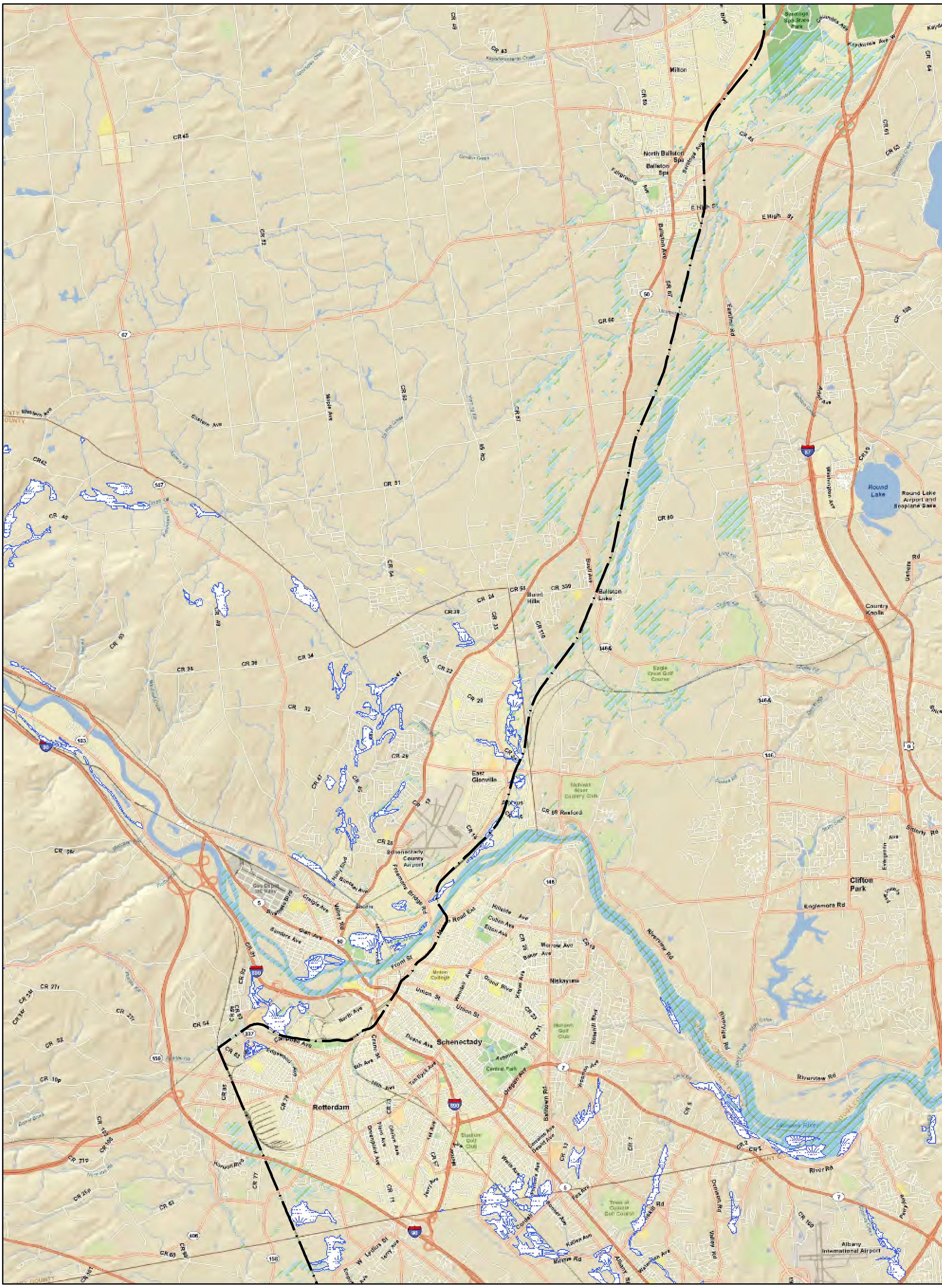
0 1 2 3 Miles



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 7 of 14



General Location Map

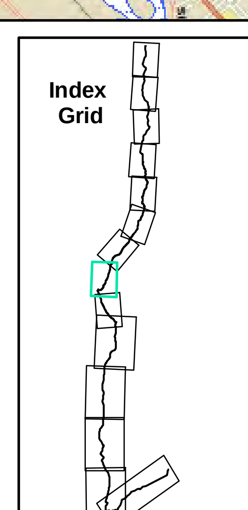
Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

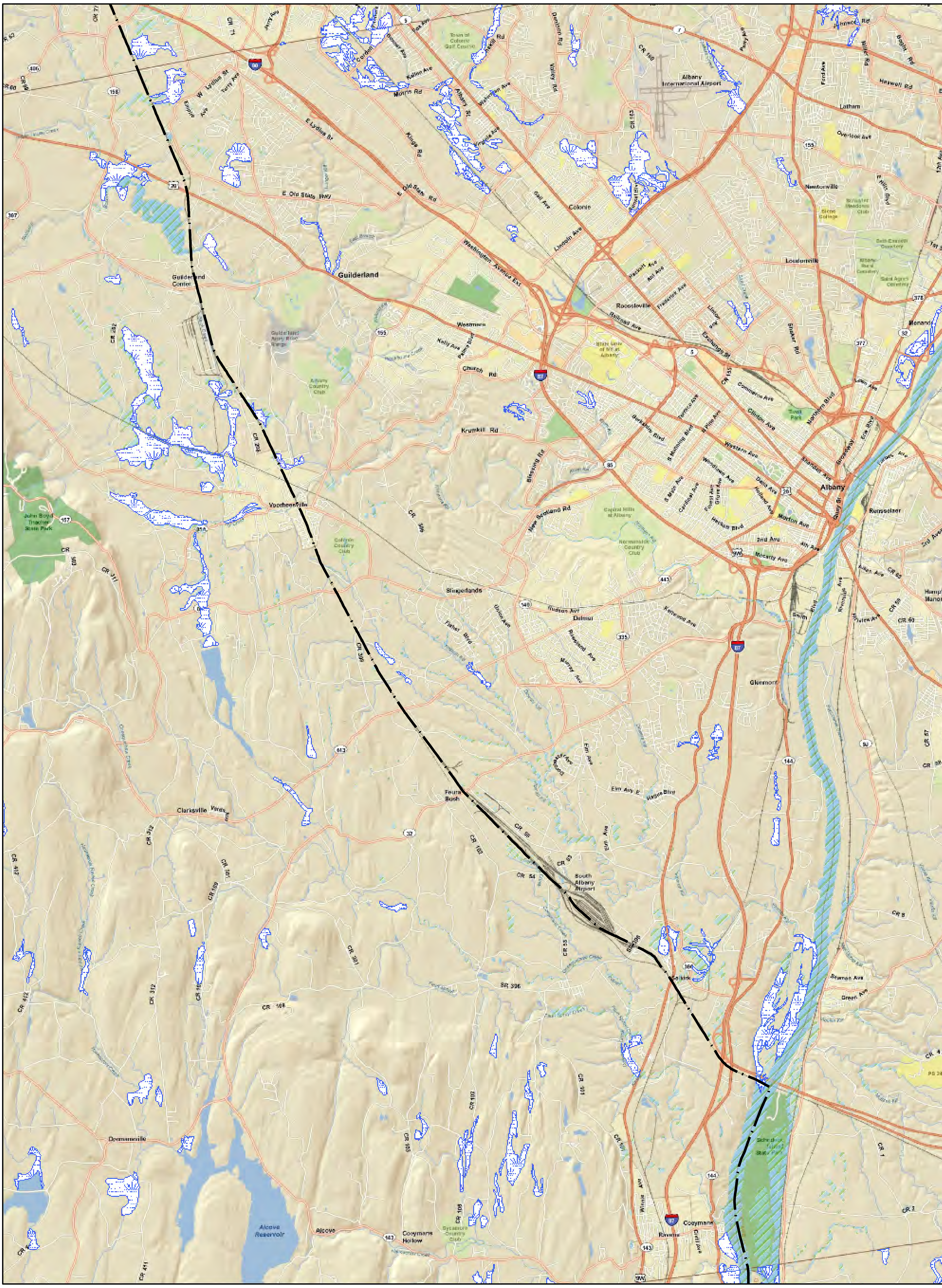
Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 8 of 14



General Location Map

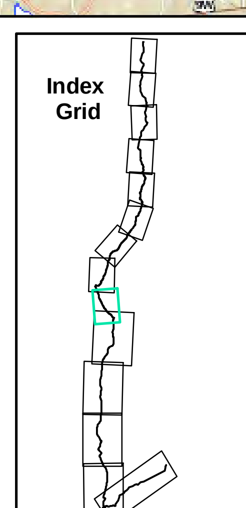
Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

Index Grid

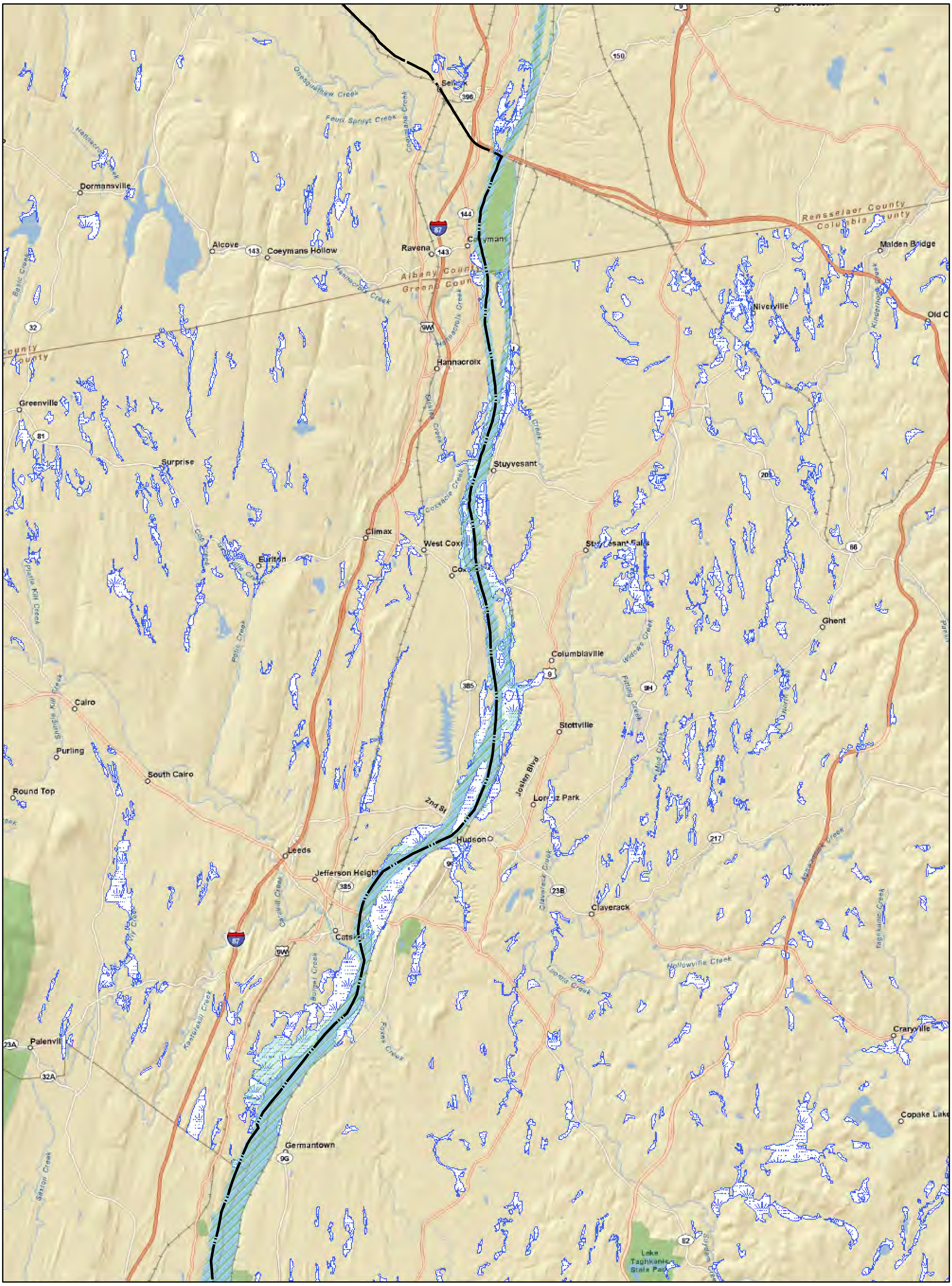


CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 9 of 14

Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009



General Location Map

Source Data:ESRI StreetMap USA, 2009;
NWI Wetlands;http//wetlandsfws.er.usgs
.gov/NWI;2009 ;NYSDEC Wetlands 2009

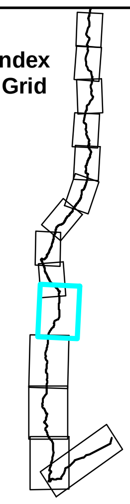
Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

Index Grid



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

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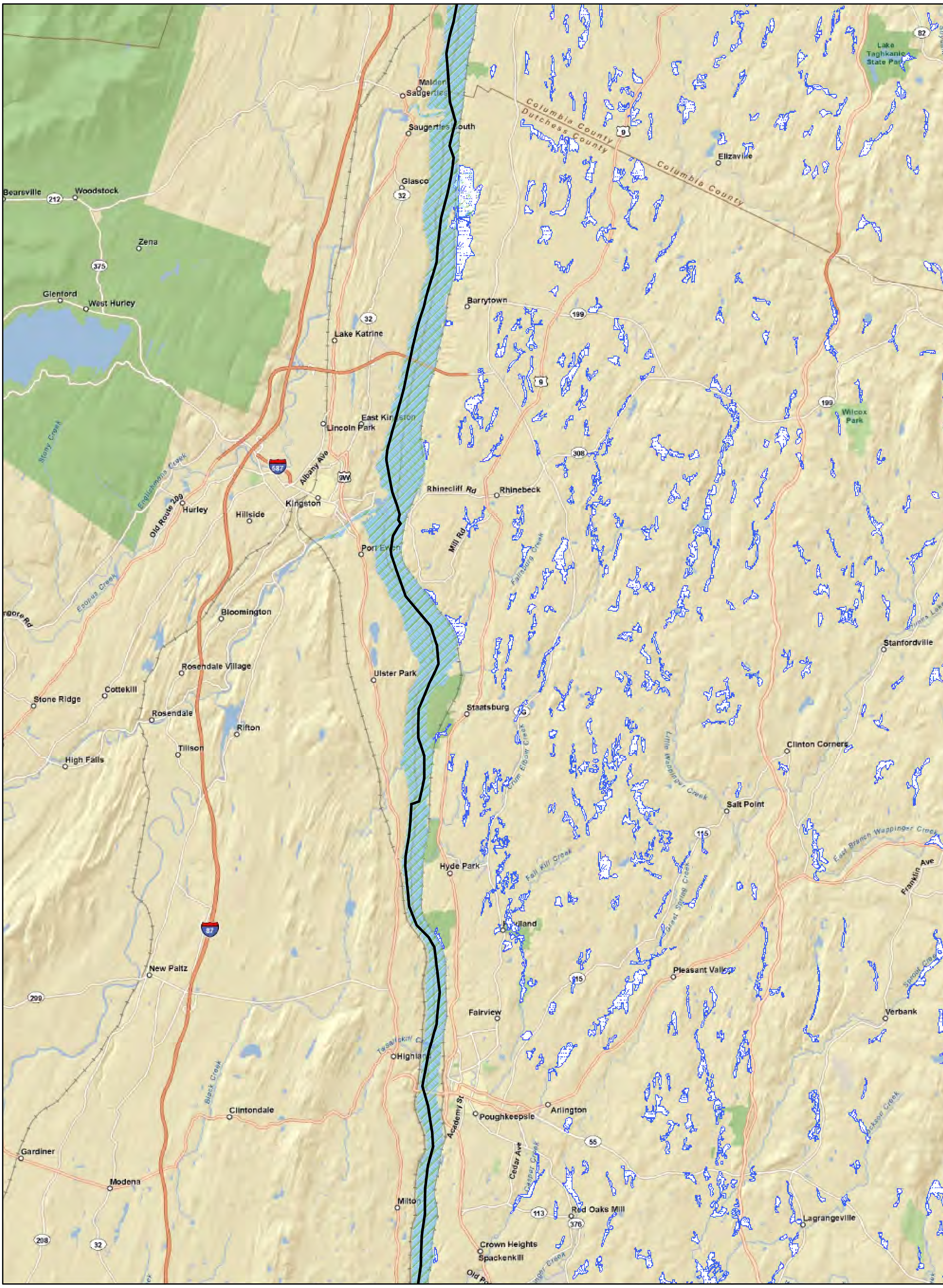


General Location Map

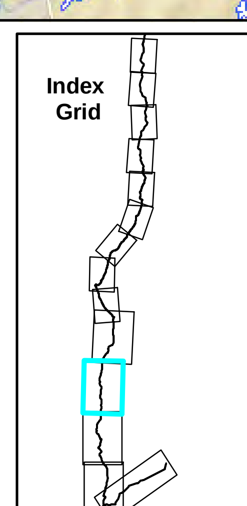
Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

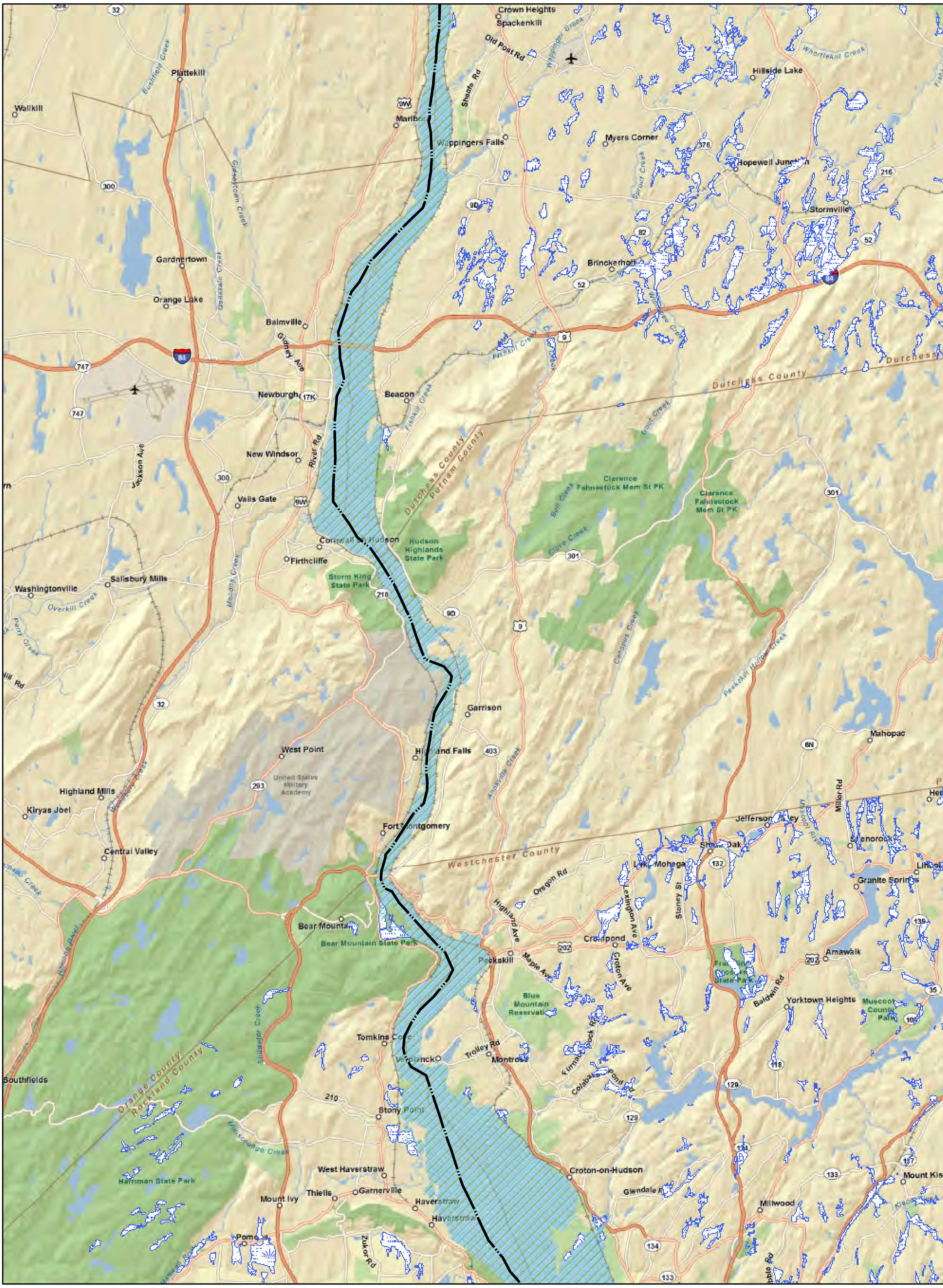
Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 11 of 14



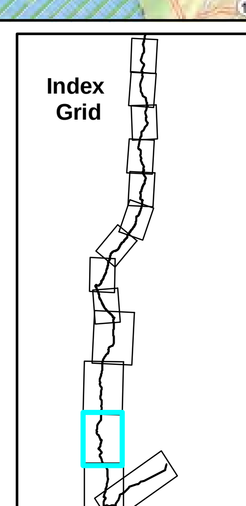
General Location Map

Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 12 of 14

Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009

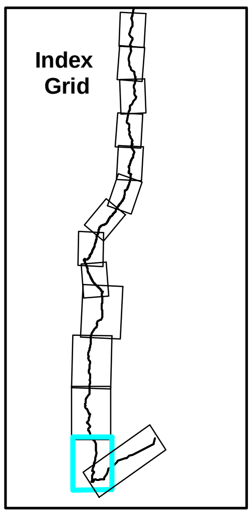

General Location Map

Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 Miles

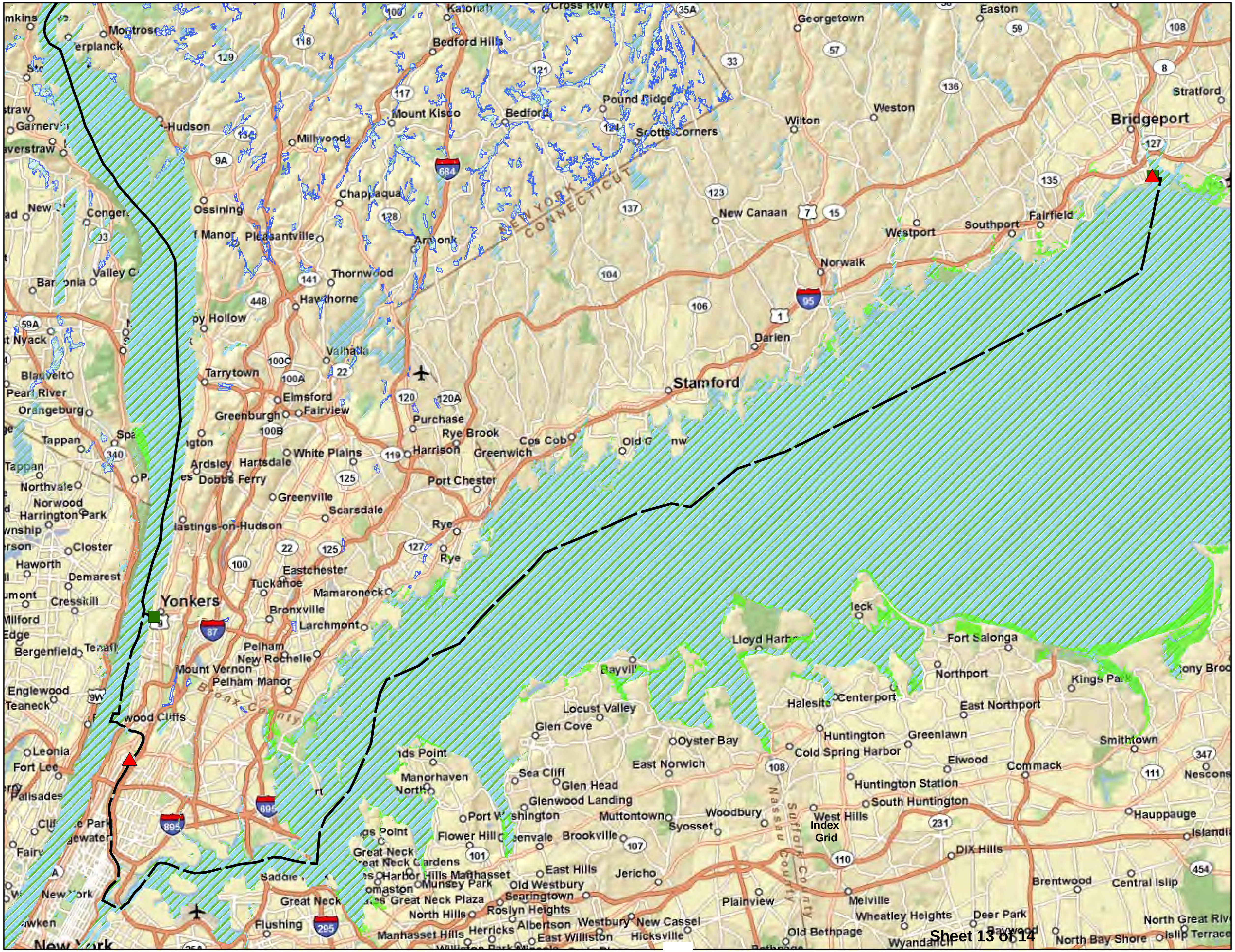


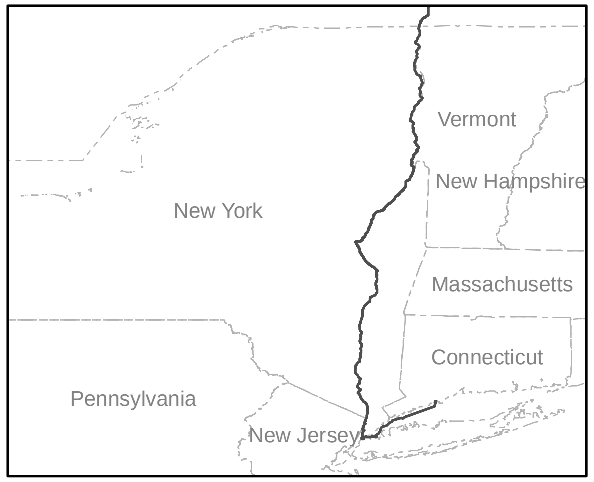
CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Sheet 13 of 14

Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009





General Location Map

CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

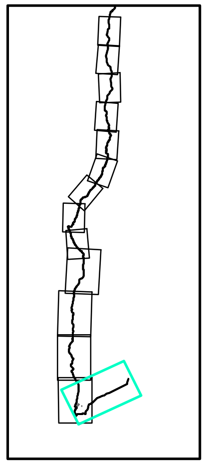
Existing NWI & NYSDEC Wetlands along the Champlain - Hudson Express Route

Legend

- Proposed Transmission Centerline
- Converter Station
- Substation
- NYSDEC Wetlands
- NWI Wetlands
- Tidal Wetland

N

0 1 2 3 4 Miles



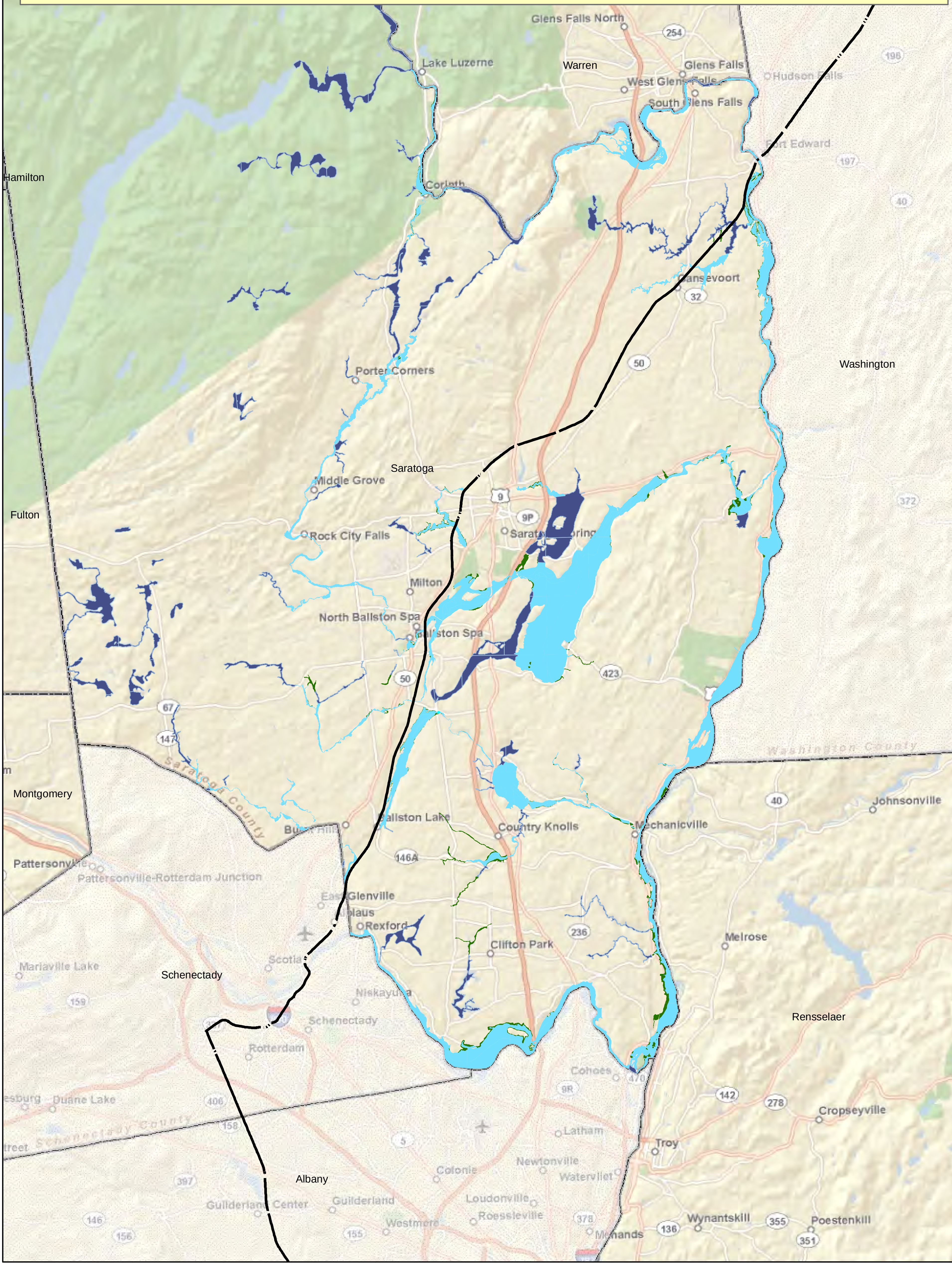
Sheet 14 of 14

Source Data:ESRI StreetMap USA, 2009; NWI Wetlands;http//wetlandsfws.er.usgs .gov/NWI;2009 ;NYSDEC Wetlands 2009

APPENDIX F

MAPPED FLOODPLAINS WITHIN THE VICINITY OF THE PROPOSED PROJECT

NOTE:
FEMA MAPPING NOT AVAILABLE FOR PORTIONS OF THE EXPRESS ROUTE NORTH OF SARATOGA COUNTY TO THE US BORDER



General Location Map

Legend

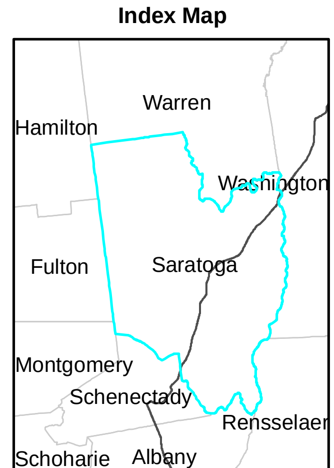
- Floodway
- A
- AE
- ANI
- AO
- (A) High Risk Areas
- Undetermined Risk Areas
- Moderate to Low Risk
- High Risk Coastal Areas
- No Data Available
- Proposed Transmission Centerline
- Converter Station
- Substation

N

0 1.5 3 4.5 Miles

Source Data:ESRI StreetMap USA, 2009;Federal Emergency Management Assoc;2009

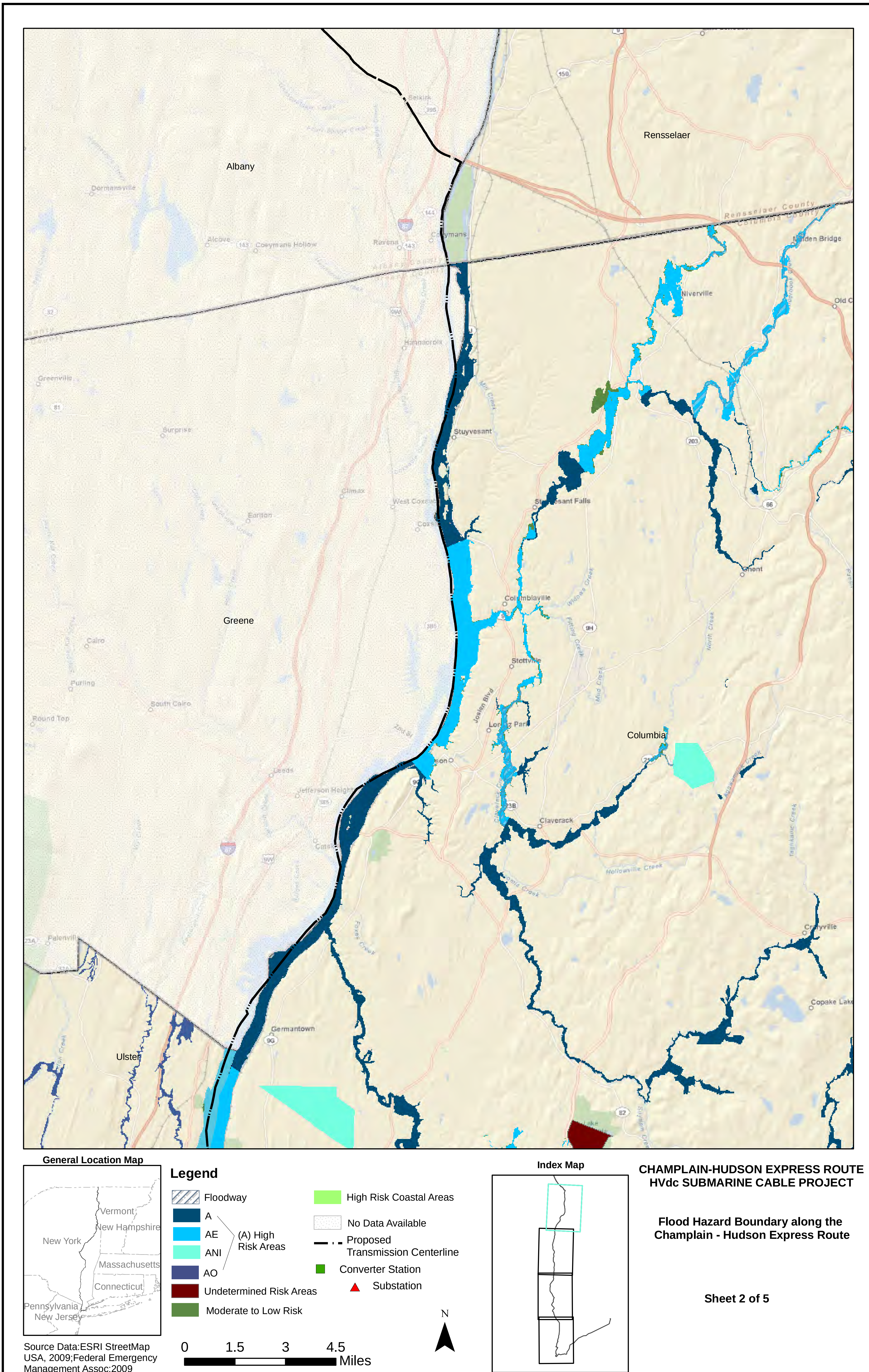
Index Map



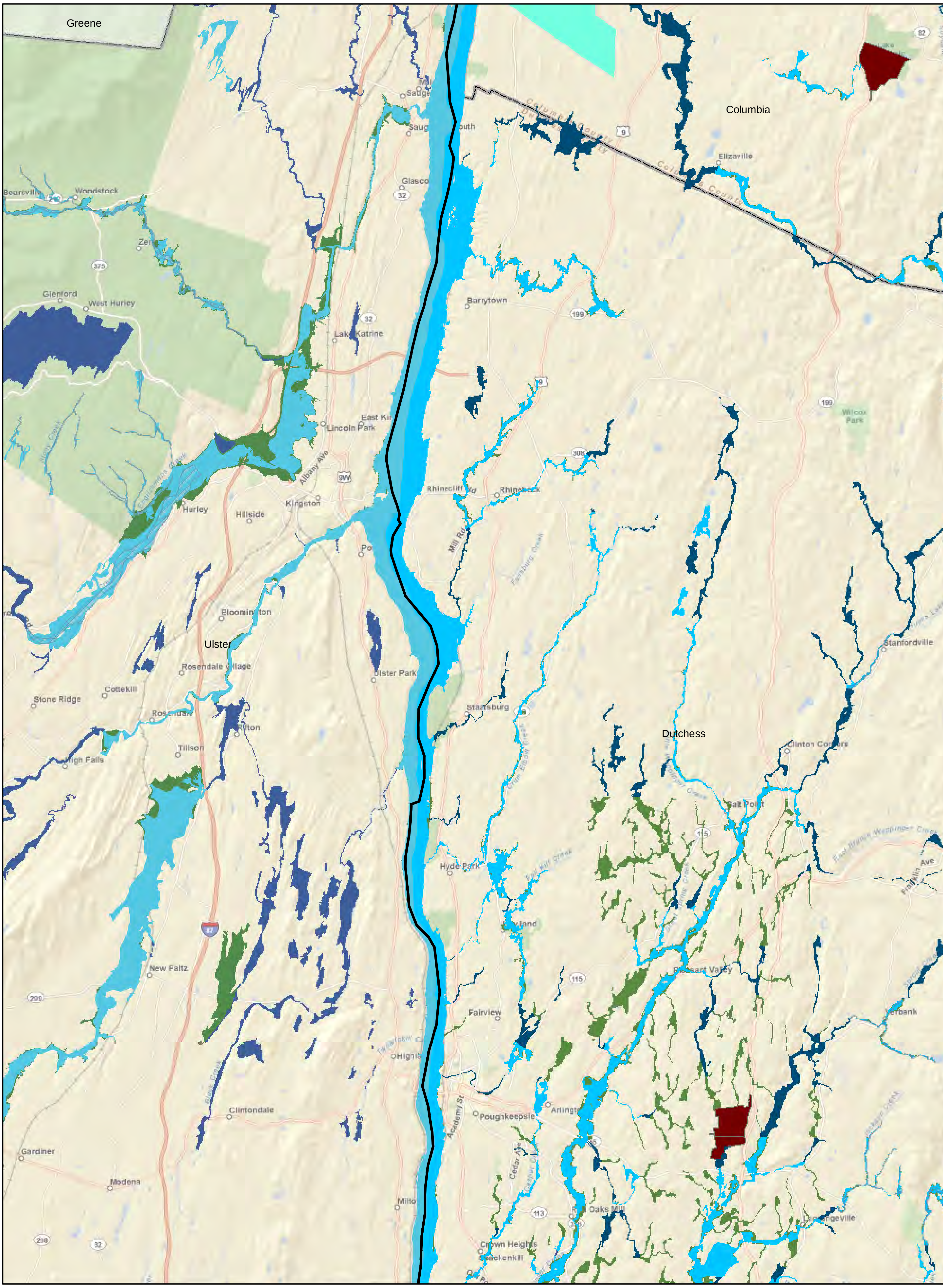
CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Flood Hazard Boundary along the Champlain - Hudson Express Route

Sheet 1 of 5



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT
Flood Hazard Boundary along the Champlain - Hudson Express Route
Sheet 2 of 5
Legend
Floodway
A
AE
ANI
AO
(A) High Risk Areas
Undetermined Risk Areas
Moderate to Low Risk
High Risk Coastal Areas
No Data Available
Proposed Transmission Centerline
Converter Station
Substation
General Location Map
Vermont
New Hampshire
New York
Massachusetts
Connecticut
Pennsylvania
New Jersey
Index Map
N
0
1.5
3
4.5
Miles
Source Data:ESRI StreetMap USA, 2009;Federal Emergency Management Assoc;2009
Albany
Rensselaer
Greene
Columbia
Ulster
Selkirk
Coeymans
Ravena
Alcove
Coeymans Hollow
Dormansville
Greenville
Surprise
Climax
Earlton
West Coxsackie
Cairo
Purling
South Cairo
Round Top
Leeds
Jefferson Heights
Palenville
Germantown
Stuyvesant
Stuyvesant Falls
Niverville
Maiden Bridge
Columbiaville
Stottville
Claverack
Ghent
Craryville
Copake Lake
Rensselaer County
Columbia County
Josten Blvd



General Location Map

Source Data:ESRI StreetMap USA, 2009;Federal Emergency Management Assoc;2009

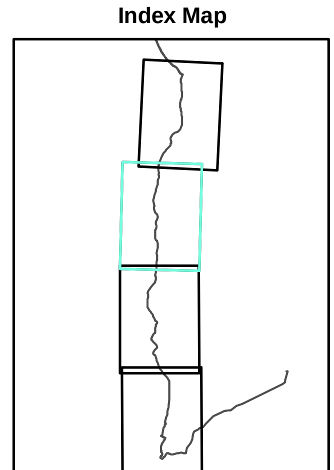
Legend

- Floodway
- A
- AE
- ANI
- AO
- (A) High Risk Areas (A, AE, ANI, AO)
- Undetermined Risk Areas
- Moderate to Low Risk
- High Risk Coastal Areas
- No Data Available
- Proposed Transmission Centerline
- Converter Station
- Substation

0 1.5 3 4.5 Miles

N

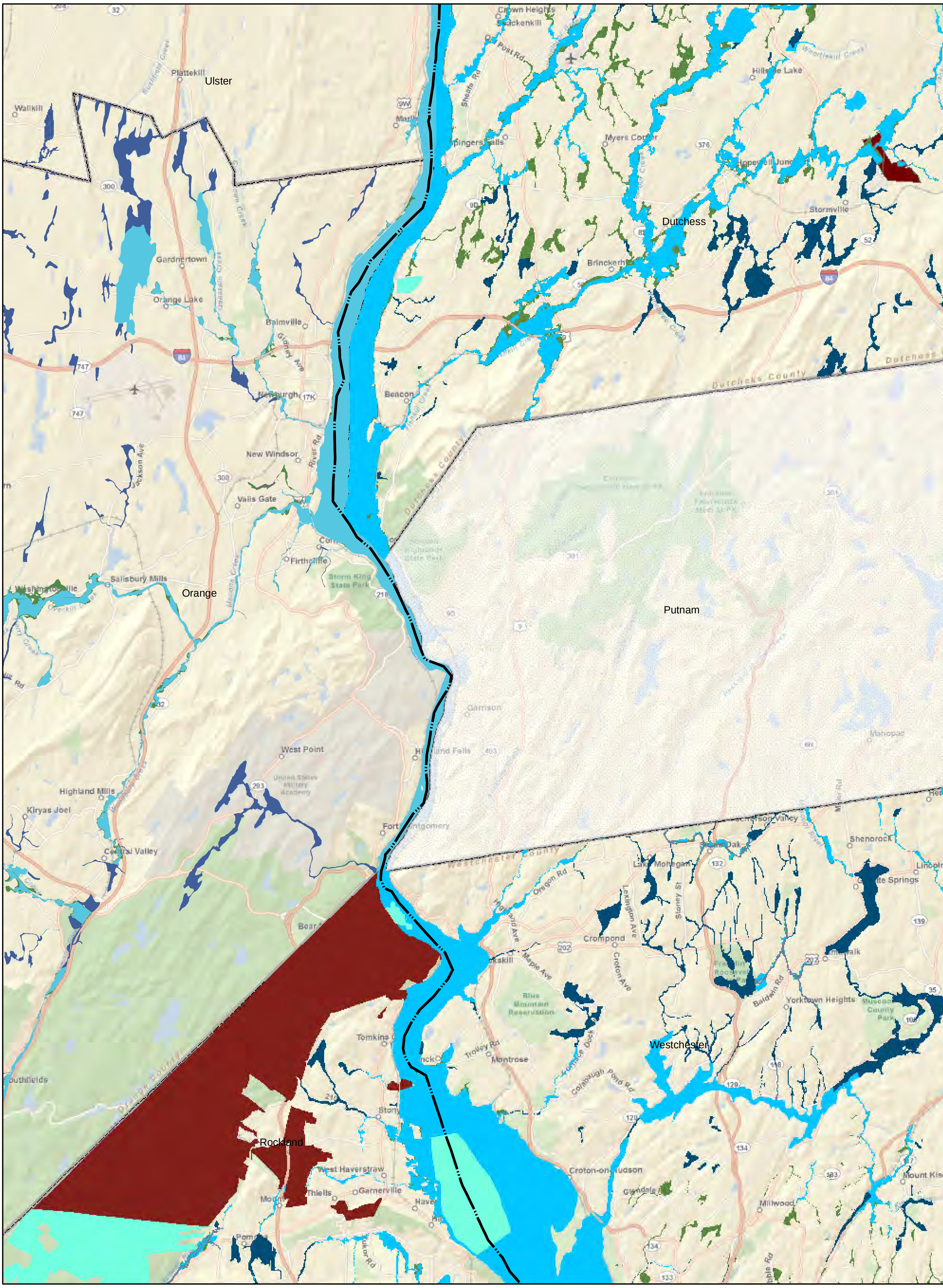
Index Map



CHAMPLAIN-HUDSON EXPRESS ROUTE HVdc SUBMARINE CABLE PROJECT

Flood Hazard Boundary along the Champlain - Hudson Express Route

Sheet 3 of 5



General Location Map

Source Data:ESRI StreetMap USA, 2009;Federal Emergency Management Assoc;2009

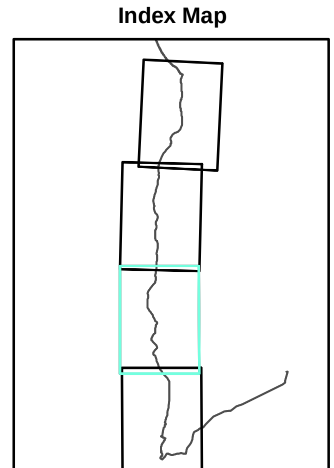
Legend

- Floodway
- A
- AE
- ANI
- AO
- (A) High Risk Areas
- Undetermined Risk Areas
- Moderate to Low Risk
- High Risk Coastal Areas
- No Data Available
- Proposed Transmission Centerline
- Converter Station
- Substation

0 1.5 3 4.5 Miles

N

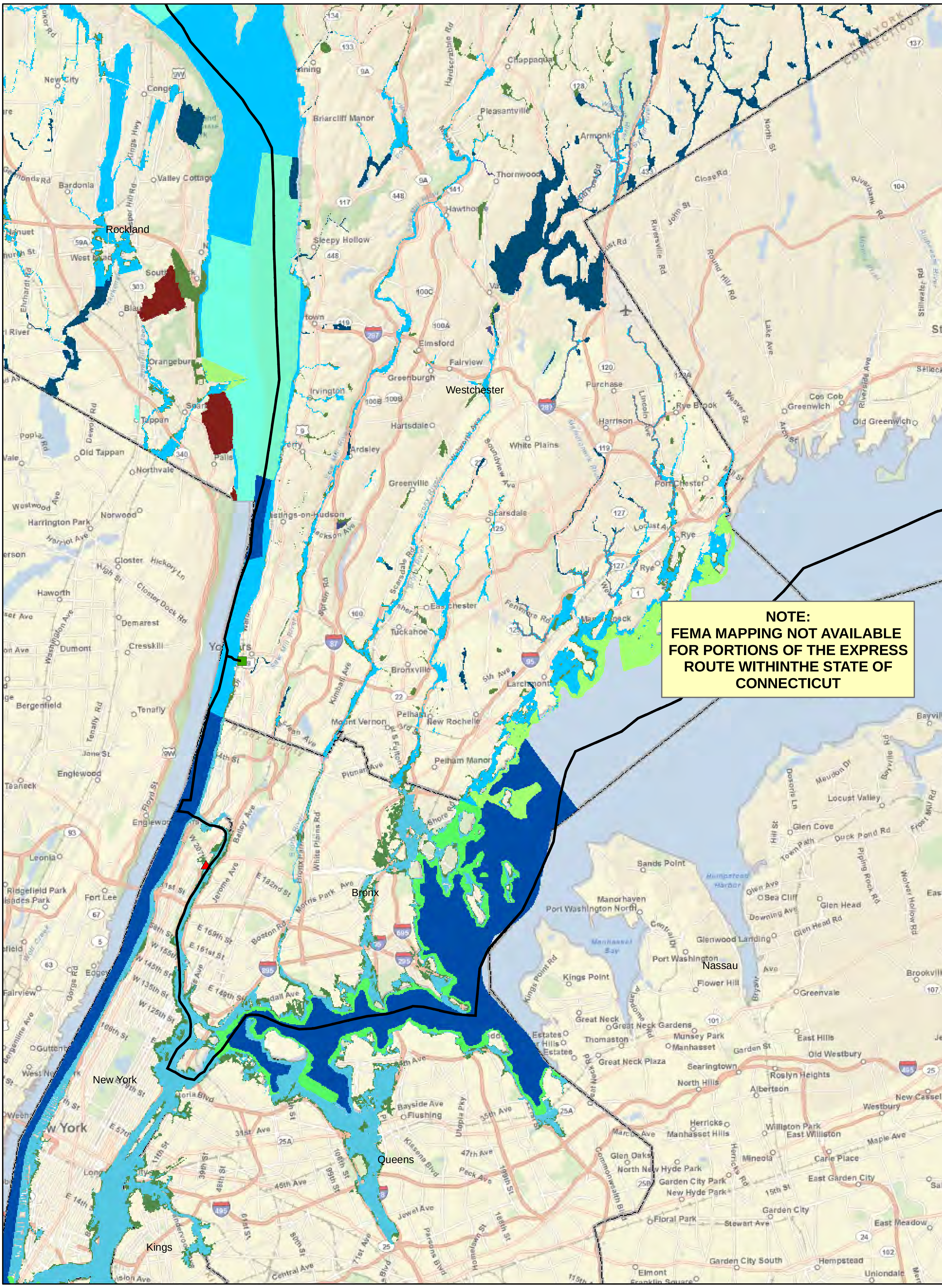
Index Map



CHAMPLAIN-HUDSON EXPRESS ROUTE
HVdc SUBMARINE CABLE PROJECT

Flood Hazard Boundary along the Champlain - Hudson Express Route

Sheet 4 of 5



General Location Map

Legend

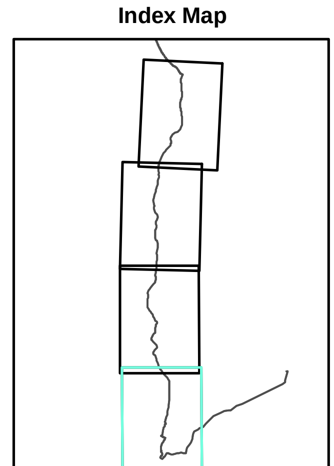
- Floodway
- A
- AE
- ANI
- (A) High Risk Areas
- AO
- Undetermined Risk Areas
- Moderate to Low Risk
- High Risk Coastal Areas
- No Data Available
- Proposed Transmission Centerline
- Converter Station
- Substation

Source Data:ESRI StreetMap USA, 2009;Federal Emergency Management Assoc;2009

0 1.5 3 4.5 Miles

N

Index Map



CHAMPLAIN-HUDSON EXPRESS ROUTE HVdc SUBMARINE CABLE PROJECT

Flood Hazard Boundary along the Champlain - Hudson Express Route

Sheet 5 of 5