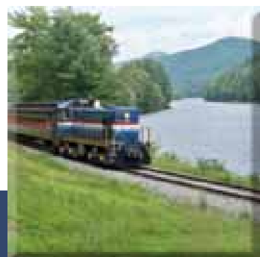
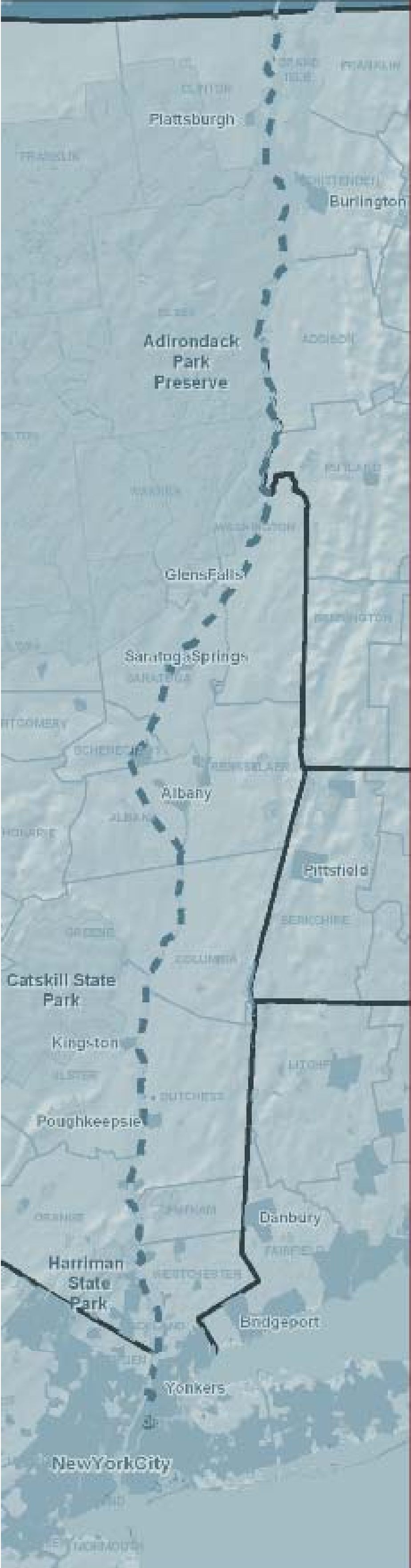


APPENDIX R

Essential Fish Habitat Assessment



Revised

ESSENTIAL FISH HABITAT ASSESSMENT

Addressing the
Proposed Champlain Hudson Power Express
Transmission Line Project

U.S. DEPARTMENT OF ENERGY
OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY
WASHINGTON, DC

June 2014

ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
µV/cm	microvolts per centimeter
AIM	Algonquin Incremental Market
BMP	best management practice
°C	degrees Celsius
°F	degrees Fahrenheit
AC	alternating current
CFR	Code of Federal Regulations
CHPE	Champlain Hudson Power Express
cm	centimeter
CMP	Coastal Management Program
cSEL	cumulative sound exposure level
CSX	CSX Transportation
ConEd	Con Edison
CP	Canadian Pacific
dB	decibel
dB re 1 µPa	decibels relative to 1 micropascal
dB re 1 µPa2-s	decibels relative to 1 micropascal-squared second
DOE	U.S. Department of Energy
DC	direct current
EFH	essential fish habitat
EIS	Environmental Impact Statement
EMF	electromagnetic field
EM&CP	Environmental Management and Construction Plan
ERRP	Emergency Repair and Response Plan
ESA	Endangered Species Act
FWCA	Fish and Wildlife Coordination Act
G	gauss
HAPC	habitat area of particular concern
HDD	horizontal directional drilling
HDPE	high-density polyethylene
HVAC	high-voltage alternating current
HVDC	high-voltage direct current
Hz	hertz
km	kilometer
kV	kilovolt
mG	milligauss
mg/L	milligrams per liter
MP	milepost
MSA	Magnuson-Stevens Fishery Conservation Management Act
mV/cm	millivolts per centimeter
MW	megawatt
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic Atmospheric Administration
NYISO	New York Independent System Operator
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation
NYSDPS	New York State Department of Public Service
NYSPSC	New York State Public Service Commission
PCB	polychlorinated biphenyl
ppt	parts per thousand
psi	pounds per square inch
rms	root mean square
ROI	region of influence
ROW	right-of-way
SAV	submerged aquatic vegetation
SCFWH	Significant Coastal Fish and Wildlife Habitat
SPL	sound pressure level
TSS	total suspended solids
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
XLPE	cross-linked polyethylene

REVISED

ESSENTIAL FISH HABITAT ASSESSMENT

ADDRESSING THE
PROPOSED CHAMPLAIN HUDSON POWER EXPRESS
TRANSMISSION LINE PROJECT

U.S. DEPARTMENT OF ENERGY
OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY

JUNE 2014

ESSENTIAL FISH HABITAT ASSESSMENT FOR THE CHAMPLAIN HUDSON POWER EXPRESS TRANSMISSION LINE PROJECT

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1. Introduction

The U.S. Department of Energy (DOE) has prepared this Essential Fish Habitat (EFH) Assessment in support of the National Environmental Policy Act (NEPA) review of potential environmental impacts related to the proposed Champlain Hudson Power Express (CHPE) Transmission Line Project (proposed CHPE Project). The DOE released the Draft Environmental Impact Statement (EIS) for the proposed CHPE Project in September 2013 (DOE 2013). The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires Federal agencies to consult with the National Marine Fisheries Service (NMFS) on any action authorized, funded, or undertaken or proposed to be authorized, funded, or undertaken by the agency that may adversely affect EFH identified under the MSA (16 United States Code [U.S.C.] Part 1855[b][2]). The goal of the consultation is to develop EFH conservation measures and to satisfy the response requirements of U.S.C. Part 1855 (b)(4)(A) and 1855(b)(4)(B) of the MSA. Federal agencies initiate consultation by preparing and submitting to NMFS a written assessment of the effects of the proposed Federal action on EFH. To promote efficiency and avoid duplication, this EFH Assessment is being submitted to NMFS in support of EFH consultation under the MSA for the proposed CHPE Project that is integrated into the existing environmental review under NEPA.

EFH is defined in the MSA implementing regulations at 50 Code of Federal Regulations (CFR) Part 600.10 as "those waters and substrates necessary to fish spawning, breeding, feeding, or growth to maturity. 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; 'substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle." All of the EFH that occurs within the proposed CHPE Project route occurs in the seawater zone and the mixing zone of the Hudson River Estuary (NOAA 1998a). Therefore, EFH within the proposed CHPE Project area occurs in the Hudson River just south of Poughkeepsie, New York, which is the approximate northern limit of the mixing zone, and continues south through the Harlem and East rivers (NOAA 1997).

Pursuant to 50 CFR Part 600.810(a), an adverse effect on EFH is defined as any impact that substantially reduces the quality or quantity of EFH. An adverse effect can result from direct impacts (e.g., contamination or disturbance), indirect impacts (e.g., loss of prey or change in quantity or quality of habitat), and individual or cumulative impacts. Adverse effects on EFH could result from actions occurring within or outside of EFH. If a Federal agency determines that an action will not adversely affect EFH, no consultation is required. Per the EFH Final Rule (67 *Federal Register* 2354), temporary effects are those that would have limited durations and that would allow the environment to recover without a noticeable effect. Minimal effects are those that could result in relatively small changes to the affected environment and insignificant changes in ecological function.

NMFS EFH Consultation Guidance indicates that the Fish and Wildlife Coordination Act (FWCA) requires consultation "with the U.S. Fish and Wildlife Service, National Oceanic Atmospheric Administration (NOAA) Fisheries, and appropriate state agencies whenever any body of water is proposed to be modified in any way and a Federal permit or license is required. These agencies determine the possible harm to fish and wildlife resources, the measures needed to both prevent the damage to and loss of these resources, and the measures needed to develop and improve the resources, in connection with water resource development. NOAA Fisheries submits comments to Federal licensing and permitting agencies on the potential harm to living marine resources caused by the proposed water development project, and recommendations to prevent harm" (NMFS 2004).

This EFH Assessment provides a description of the proposed CHPE Project, defines the region of influence (ROI) wherein effects on EFH could occur, provides detailed EFH descriptions and analyses on potential effects from the CHPE Project, and addresses avoidance and minimization measures intended to reduce potential effects (NMFS 2004).

2. Description of the Proposed Project

The proposed CHPE Project would include construction, operation, and maintenance of an approximately 336-mile (541-kilometer [km])-long, 1,000-megawatt (MW), high-voltage electric power transmission system that would have both aquatic (underwater) and terrestrial (underground) portions. The underwater portions of the transmission line (196 miles [316 km]) would be buried in the beds of Lake Champlain and the Hudson, Harlem, and East rivers, and the terrestrial portions of the transmission line (140 miles [225 km]) would be buried underground, principally in railroad and roadway rights-of-way (ROWs).

The transmission system would consist of one 1,000-MW, high-voltage direct current (HVDC) transmission line; communications cable; and ancillary aboveground facilities, including cooling stations at selected locations where required and a direct current (DC)-to-alternating current (AC) converter station. The transmission line would be a bipole consisting of two transmission cables, one positively charged and the other negatively charged.

2.1 Description of the Route Segments Used in the EIS Analyses

For the purposes of understanding the various environmental settings associated with the proposed CHPE Project, and to facilitate the analysis in the EIS, the transmission line route was divided into four geographically logical segments as follows:

- **Lake Champlain Segment**
- **Overland Segment**
- **Hudson River Segment**
- **New York City Metropolitan Area Segment.**

From the U.S./Canada border, the HVDC transmission line would be located in the bed of Lake Champlain for approximately 101 miles (163 km), from near the Town of Champlain, New York, to the Town of Dresden, New York. This portion of the route composes the ***Lake Champlain Segment*** (see **Figure 2-1**).

The ***Overland Segment*** begins at the southern end of Lake Champlain at the Town of Dresden, where the HVDC transmission line would exit the water at milepost (MP) 101 and be installed underground in the New York State Department of Transportation (NYSDOT) ROW, the Canadian Pacific (CP) railroad ROW, and the CSX Transportation (CSX) railroad ROW for 127 miles (204 km) until the transmission line would enter the Hudson River at MP 228 in the Town of Catskill, New York (see **Figure 2-2**).

The ***Hudson River Segment*** begins at MP 228 where the HVDC transmission line would be buried in the bottom of the Hudson River for approximately 67 miles (108 km) to the Town of Stony Point, New York, where the transmission line would exit the river and follow a terrestrial route along the CSX railroad ROW and the U.S. Route 9W ROW between MPs 295 and 303 to bypass Haverstraw Bay (see **Figure 2-3**). The transmission line would be buried underground through this entire terrestrial stretch before reentering the Hudson River at MP 303. The Hudson River Segment originally involved continuous installation of the transmission line within the river through Haverstraw Bay. During the New York State Public Service Commission (NYSPSC) Article VII permitting process for the proposed CHPE Project, the route was altered for approximately 8 miles (13 km) to bypass Haverstraw Bay, thus avoiding potential adverse effects on EFH in the bay (NYSPSC 2013) (see **Figure 2-4**). The transmission line would then reenter the Hudson River at MP 303 for approximately 21 miles (34 km) until it reaches the end of the Hudson River Segment at Spuyten Duyvil Creek and the Harlem River in New York City at MP 324. A detailed description of alternatives considered for the proposed CHPE Project is presented in Section 2.5 of the EIS.

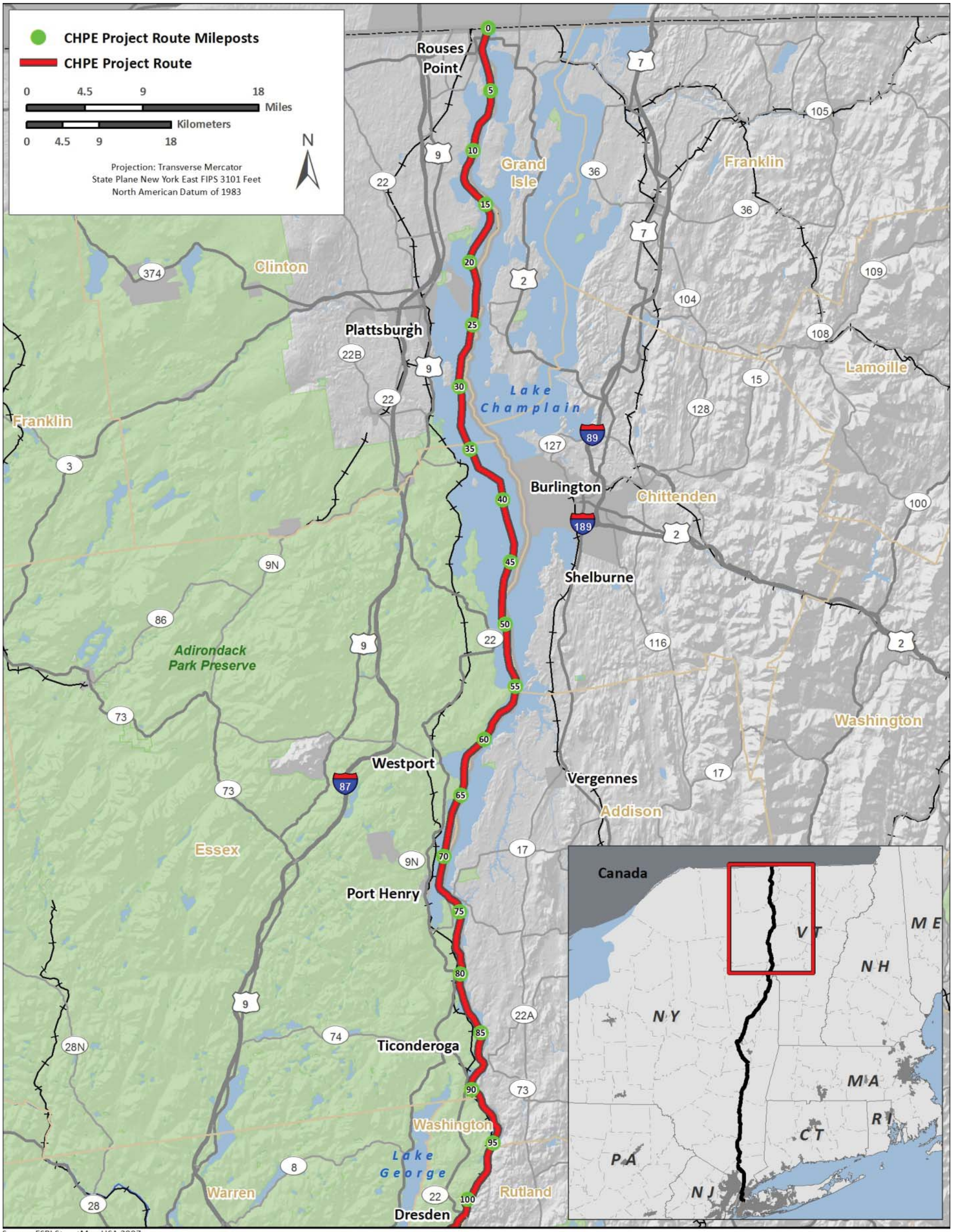


Figure 2-1. Lake Champlain Segment

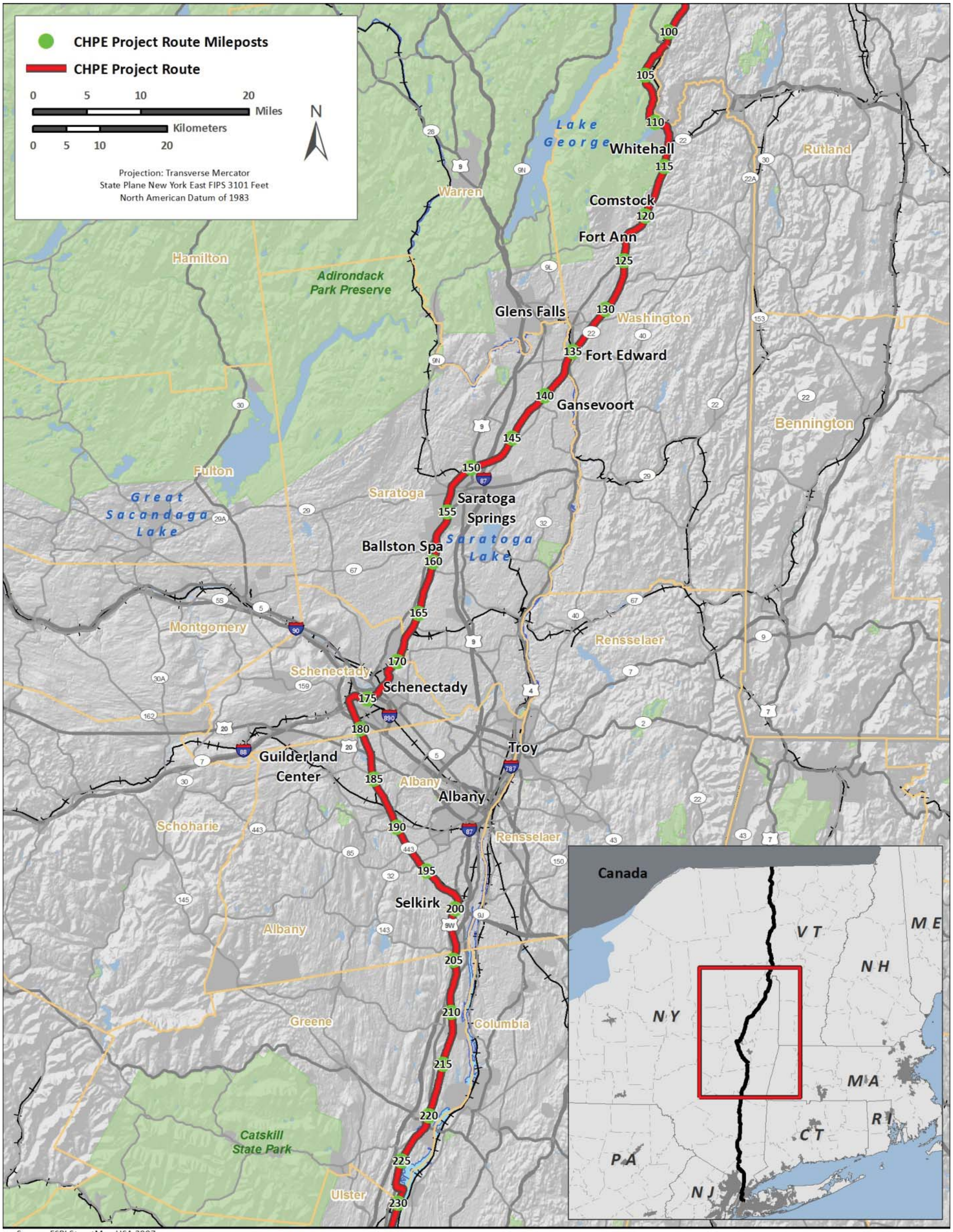


Figure 2-2. Overland Segment

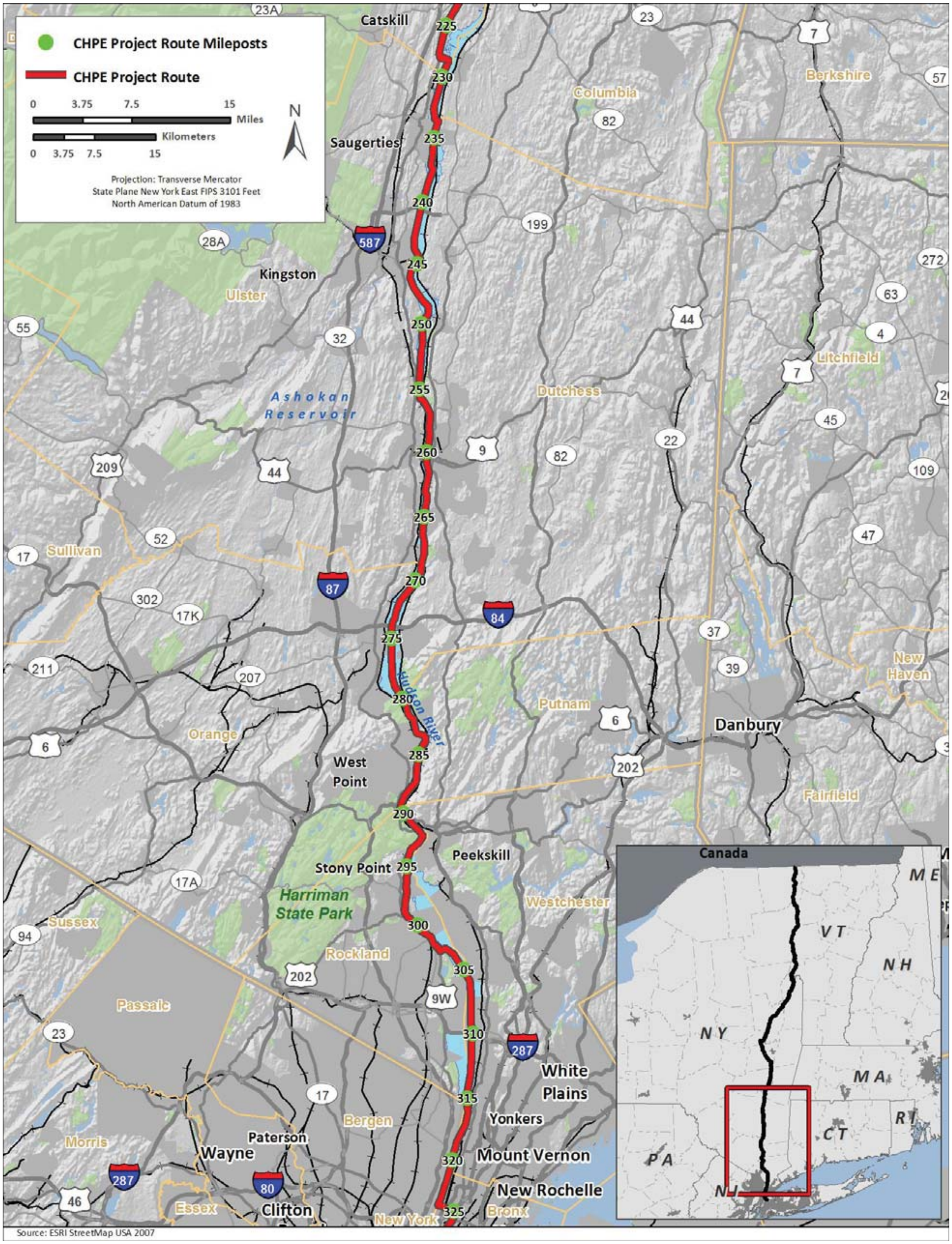


Figure 2-3. Hudson River Segment

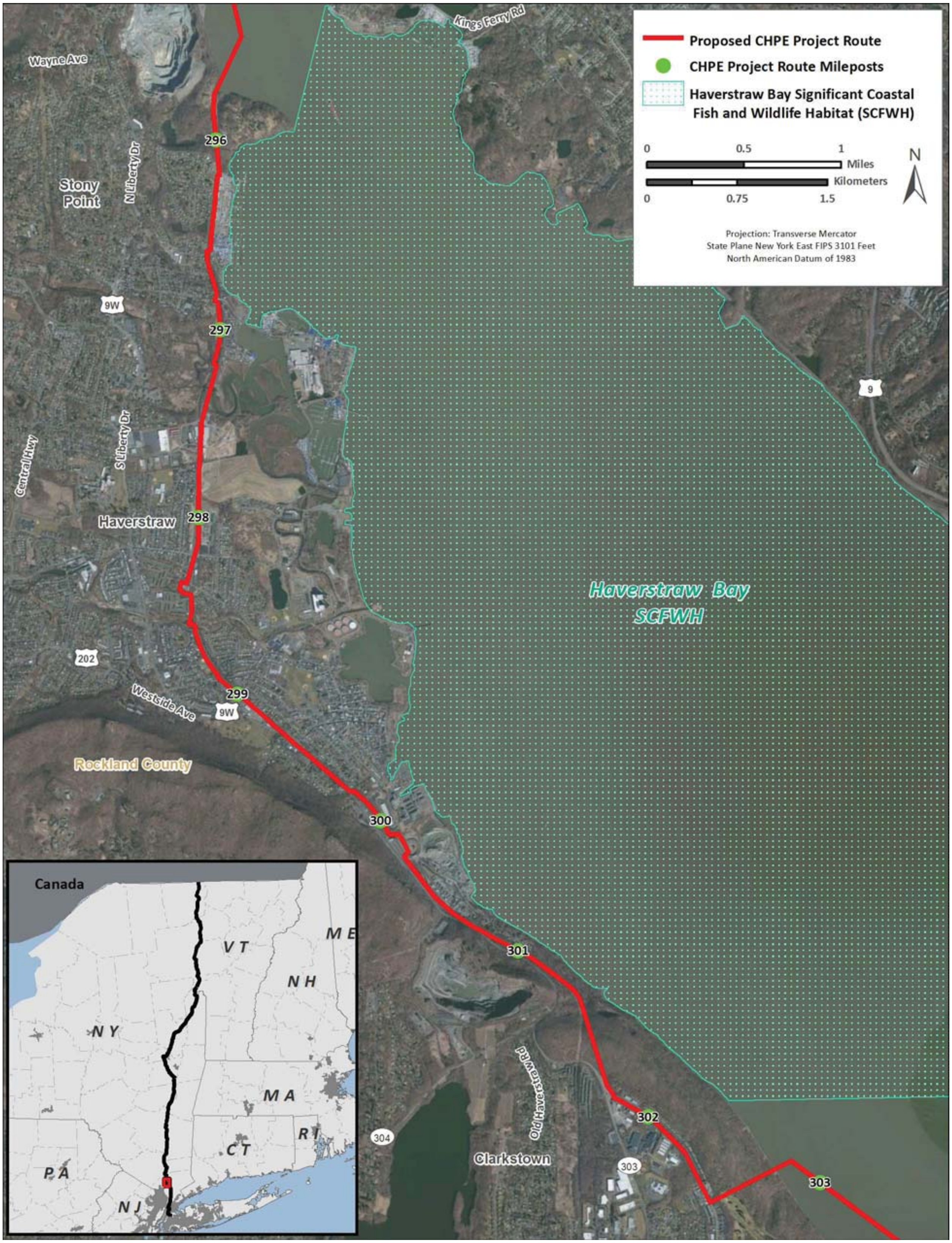


Figure 2-4. Proposed CHPE Project near Haverstraw Bay

The ***New York City Metropolitan Area Segment*** begins at Spuyten Duyvil (the area where the Harlem River shipping channel connects to the Hudson River) at MP 324, where the HVDC transmission line would enter the Harlem River and continue south in the river for a distance of approximately 6 miles (10 km) to a point north of the Willis Avenue Bridge in the borough of the Bronx at MP 330 (see **Figure 2-5**). The transmission line would exit the river and proceed east through the NYSDOT railroad corridor and rail yards along the northern side of the Bronx Kill to the East River at MP 331 and cross under the river via HDD southeast to the site of the Consolidated Edison (ConEd) Charles Poletti Power Plant complex in Astoria, Queens, New York, at MP 332.

2.2 Region of Influence

The ROI for this assessment is the Hudson, Harlem, and East rivers within the Hudson River Segment (see **Figure 2-3**) and the New York Metropolitan Area Segment (see **Figure 2-5**). EFH within the ROI includes the entire Hudson River from as far north as the City of Poughkeepsie, New York (MP 260), and continues south through the Harlem and East rivers (see **Attachment 1** for a mapbook of the route through the Hudson, Harlem, and East rivers). EFH that occurs along the proposed CHPE Project route occurs in the seawater zone and mixing zone of the Hudson River Estuary (NOAA 1997, NOAA 1998a). No EFH is designated along any portion of the Lake Champlain or Overland segments of the proposed CHPE Project route. Species not managed by NMFS, such as anadromous fish (e.g., river herring, American shad, and striped bass), shellfish, and other benthic resources, are considered in this analysis throughout the ROI (i.e., not limited to EFH).

This EFH Assessment analyzes potential effects on EFH in the Hudson River from Poughkeepsie south to Spuyten Duyvil into the Harlem and East rivers. Habitat parameters of each waterway are described as follows:

- The Hudson River is tidally influenced from its mouth to a distance as far north as 150 miles upriver (SUNY 2013, Geyer and Chant 2006). Generally, the Hudson River Estuary can be divided into three salinity zones that transition with the influx of fresh water with distance upriver (NOAA 1997). These salinity zones are seawater (greater than 25 parts per thousand [ppt]), mixing (0.5 to 25.0 ppt), and tidal fresh (less than 0.5 ppt). The location of these zones varies seasonally and daily depending on tidal and fresh water inputs. A vertical salinity gradient (i.e., salt wedge) is prominent in the region of the estuary located between 20 and 40 miles (32 to 64 km) upriver where the channel deepens and irregularities create turbulence and vertical mixing. The upper limit of the salt line has been approximately 75 miles upriver near Poughkeepsie, New York, two times in the past 50 years (1964 and 1995) (Geyer and Chant 2006). The river's depth ranges from 30 to 708 feet (9 to 216 meters). Average water temperatures within the estuary generally follow mean air temperature. Temperatures range from 32 degrees Fahrenheit (°F) (0 degrees Celsius [°C]) in January to a July maximum of 81 °F (27 °C). In the spring and summer, temperature decreases toward Battery Park (i.e., "the Battery") in Manhattan as colder saline water enters with tidal flow. This horizontal temperature gradient reverses in late fall and winter because salt water cools to a lesser extent than shallow fresh water (Historic Hudson River 2004).
- The Harlem River is an approximately 7-mile (11-km)-long, narrow, tidally dominated strait that separates the Manhattan Borough from the Bronx Borough in New York City and connects the Hudson River with the East River as part of the Hudson River Estuary. The channel depth ranges from 15 to 22 feet (5 to 7 meters) and the salinity is less than 30 ppt (Riverkeeper 2013). NOAA (1997) designates the Harlem River as mixing zone. Temperature ranges are the same as the Hudson River.

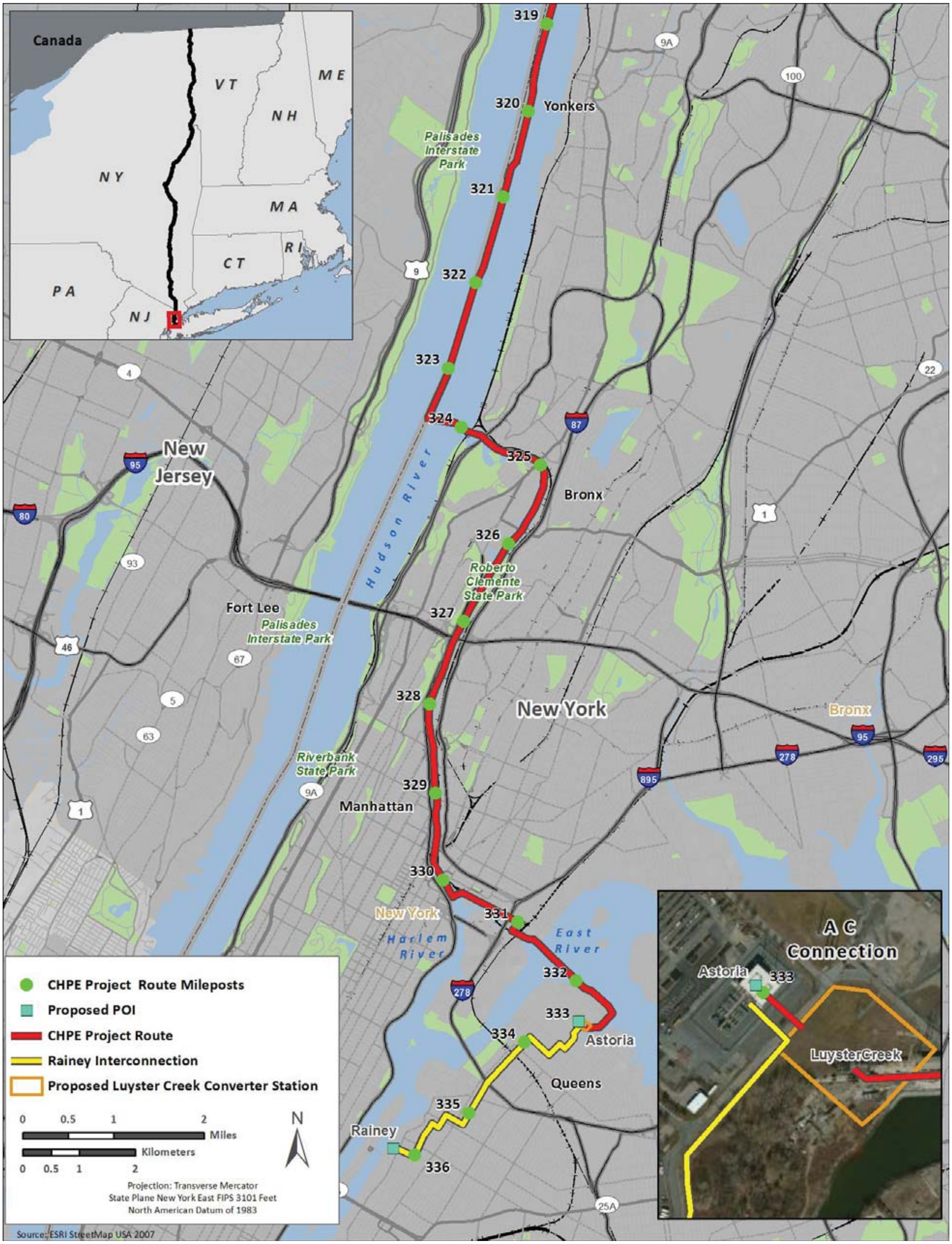


Figure 2-5. New York City Metropolitan Area Segment

- The East River is a narrow, tidally dominated straight that connects Long Island Sound with the upper part of New York Harbor. From its origin near the Battery to the end of Long Island Sound, the East River extends approximately 17 miles (27 km). Salinity ranges from 20 ppt near the Battery to 25 ppt near Long Island Sound, varying seasonally with tidal influx and vertical mixing. NOAA (1997) designates the East River as mixing zone. The river's depth ranges from 30 feet (10 meters) to 99 feet (30 meters) (Blumberg and Pritchard 1997) and the temperature range is the same as the Hudson River.

Since the water quality, bottom habitats, and EFH within the aquatic portions of the Hudson River and New York City Metropolitan Area segments of the proposed CHPE Project route are nearly identical and support nearly identical species, the analysis in this EFH Assessment describes impacts applicable for both segments and does not differentiate between them.

2.3 Descriptions of Construction Methods

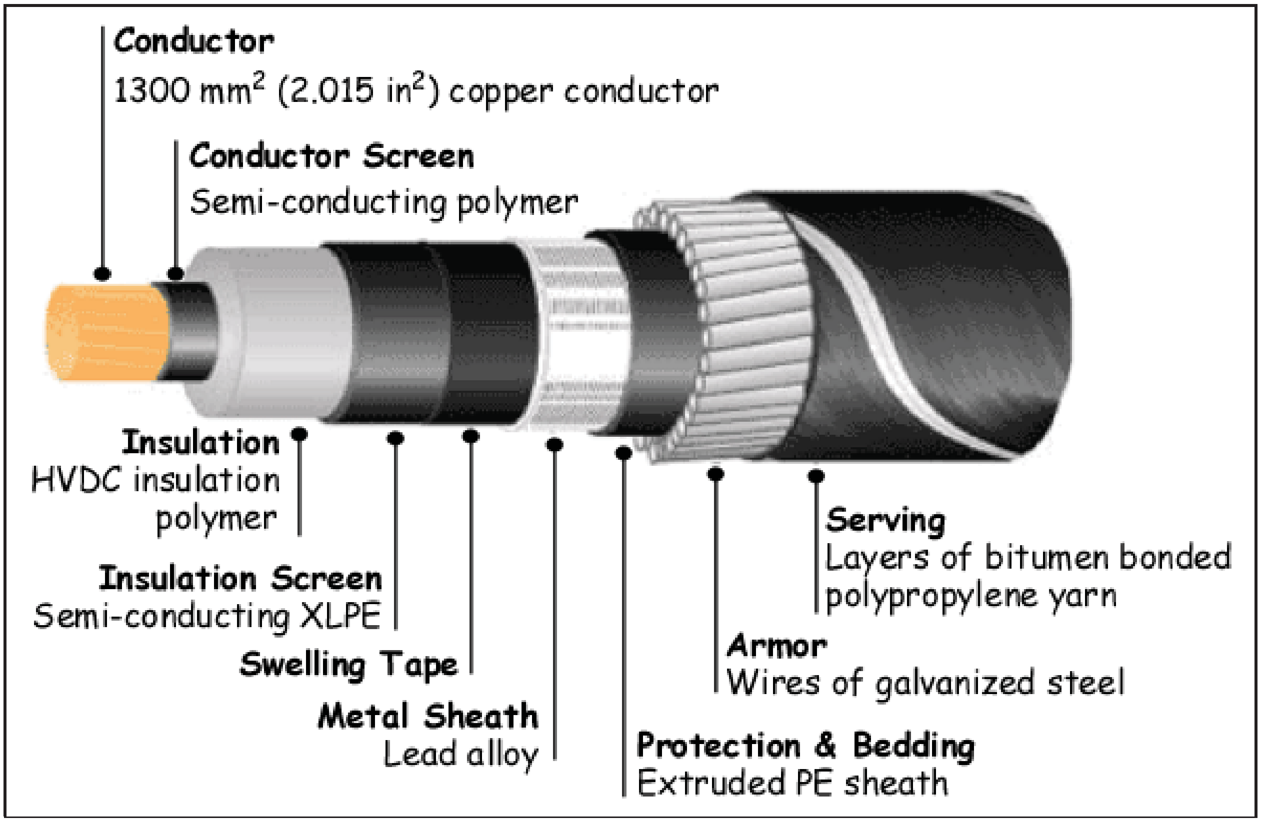
The following subsections describe the specific engineering details of the transmission system as approved by the NYSPSC Order granting the Certificate of Environmental Compatibility and Public Need (Certificate) for the proposed CHPE Project issued to the Applicant in April 2013 (NYSPSC 2013). The following subsections also discuss how the Applicant proposes to install and operate the transmission line and aboveground facilities of the proposed CHPE Project.

2.3.1 Aquatic Direct Current Transmission Cable

The transmission cables proposed for installation in the aquatic portions of the Lake Champlain, Hudson River, and New York City Metropolitan Area segments would be cross-linked polyethylene (XLPE) HVDC cables rated at 300 to 320 kilovolts (kV). An armored layer of galvanized steel wires embedded in bitumen provides additional protection for the aquatic transmission cables (see **Figure 2-6**). The transmission cables would be buried beneath the beds of Lake Champlain and the Hudson, Harlem, and East rivers at a depth of at least 4 to 8 feet (1.2 to 2.4 meters) to prevent disturbance to the cables from unrelated marine operations in the waterways. The depth of burial that can be achieved would depend on available marine construction equipment, soil types and depth to bedrock, existing utilities, and the types of marine activities occurring and their potential threat to cable integrity (TDI 2010).

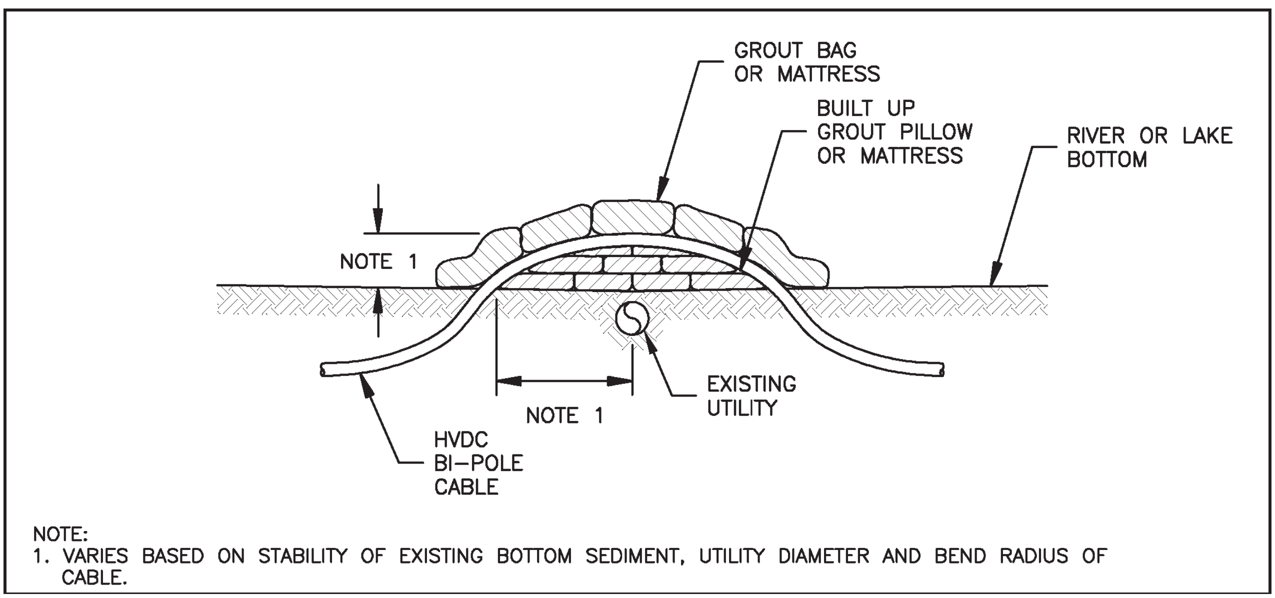
Where the transmission cables cross bedrock (approximately 11 locations in the Hudson River) or an existing utility such as a pipeline or another cable (approximately 66 locations in the Hudson River and 26 locations in the Harlem River), it would be laid over the rock or existing utility and a protective covering, such as an articulated concrete mat, would be installed over the cable crossing (CHPEI 2012a) (see **Figure 2-7**). Concrete mats would be 40 feet (12 meters) long, 8 feet (2.4 meters) wide, and 9 inches (23 centimeters [cm]) deep. An average of three concrete mats would be placed lengthwise end-to-end over each crossing. Physical surveys, including diver surveys of each utility, would be performed prior to cable installation in an attempt to reduce the requirement for concrete mats.

In the year preceding transmission line installation, debris would be removed from the route (i.e., route clearing). Debris removal would occur from September 15 through October 30 in the Hudson River within the appropriate construction windows and would be accomplished in 20 calendar days during 12-hour shifts. Debris removal would occur in the Harlem River during the May 31 to November 30 construction window. Route clearing could require one to three stages based on the site conditions. All stages of route clearing would use a tug and barge equipped with cutter wheel equipment, or with a smaller tug if possible. Support vessels would include a crane barge to remove larger debris as required or a debris barge to transport recovered riverbed debris. The initial stage of route clearing is designed to find and remove debris lying on and just below the river floor. This stage is performed with large grapnel equipment (see **Figure 2-8**). In areas of extensive debris or suspect areas, a second stage clearing would



Source: Cross-Sound Cable Company 2012

Figure 2-6. Example Aquatic HVDC Transmission Cable Cross-Section



Source: CHPEI 2012a

Figure 2-7. Representative Schematic of Protective Measures for Aquatic Transmission Cables

Source: Kingbird 2014

Figure 2-8. Example of Grapnel Used for Debris Removal

be performed with a de-trenching grapnel. This grapnel provides penetration of up to 3 feet (0.9 meters) into the riverbed.

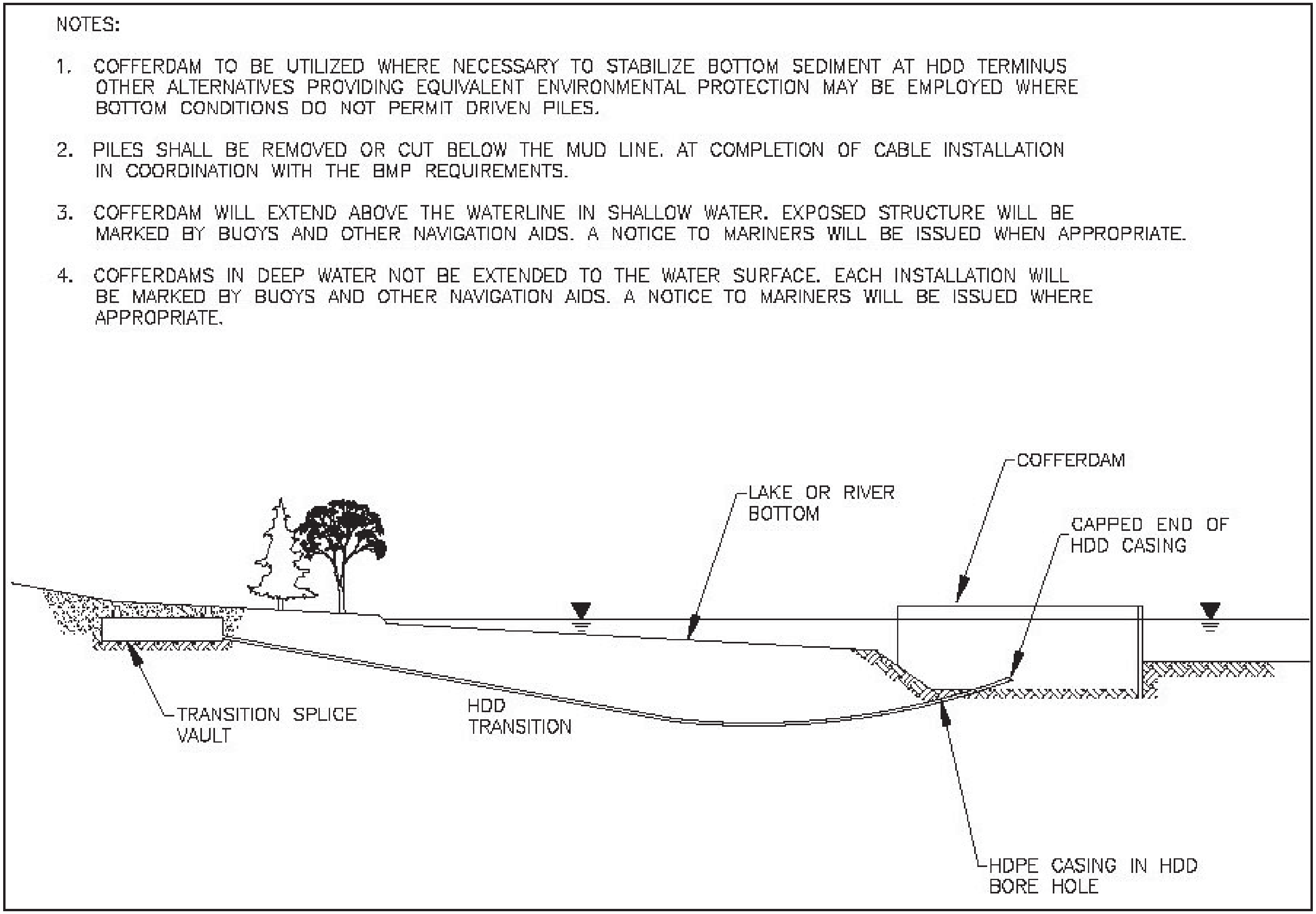
After completion of the grapnel runs, a third stage of clearing (i.e., plow pre-rip) would be required if the site conditions indicate the potential for sub-surface debris. The plow pre-rip is designed to clear and prove the entire route to the full burial depth, and would be performed in the Hudson and Harlem rivers using a jet plow but without the cables loaded.

Transit routes for the route clearing equipment would vary based on the location of marine-based yards along the route, but the yards would generally be no more than 50 miles (81 km) from the equipment's location. Temporary marine yards would be set up and moved as the route clearing operation progresses. Transit speeds would be no faster than 8 to 12 knots depending on weather, currents, and barges in tow. Vessel drafts would vary from 8 feet (2.4 meters) for supply barges to 16 feet (5 meters) for supply tug boats, with 4-foot (1.3-meter) drafts for local push tugs. Work barges would generally draw 12 feet (4 meters), depending on the load. This level of activity and associated vessel speeds are consistent with existing vessel use on the Hudson River. During debris removal, the barge would proceed at a speed of 1.5 knots or less. In areas with significant side-scan and magnetometer targets, the speed would be reduced to less than 1 knot. The route transected for clearing would follow the path of the proposed transmission line.

2.3.2 Horizontal Directional Drilling (HDD)

HDD would be used to install the transmission cables in transition areas between aquatic and terrestrial portions of the proposed CHPE Project route at the transitions from water to land and land to water at MPs 101, 228, 295, 303, and 330; at environmentally sensitive areas such as wetlands or streams; under roadway or railway crossings where trenching is not possible; and under the East River.

The HDD operation at a water-to-land transition would include an HDD drilling rig system, a drilling fluid collection and recirculation system, temporary cofferdam installed at the water exit to maintain exit pit stability following dredging of the pit, and associated support equipment (see **Figure 2-9**). For each proposed HDD location, two separate drill holes would be required, one for each cable. During installation, a drill rig would be placed on shore behind a temporary fluid return pit and a 40-foot (12-meter) drill pipe with a cutting head would be set in place to begin the drilling process. As the initial pilot borehole is drilled, slurry composed of water and bentonite would be pumped into the hole to transport the drill cuttings to the surface, to aid in keeping the borehole stable, and to lubricate the drill. After the final drill length has been achieved, high-density polyethylene (HDPE) conduits would be



Source: CHPEI 2012c. Note: Not to scale.

Figure 2-9. Example HDD Techniques

pulled into the drilled hole. Once the HDPE conduits are in place, the transmission cables would be pulled through these pipes and into a transition splice vault, which would remain in place to protect the transmission cable.

Cofferdams would be installed in the Hudson River at approximate MPs 228, 295, and 303. The anticipated dimensions of each cofferdam would be approximately 16 feet (4.9 meters) by 30 feet (9 meters) or 480 square feet (44 square meters). Dredging activities associated with the proposed CHPE Project would only be for cofferdam installation, which is expected to last from 5 to 10 days using a single dredge and result in a total dredged area limited to less than 1 acre in the Hudson River. Dredging and cofferdam installation would occur during the construction windows established for this project, which are outside of shortnose and Atlantic sturgeon spawning season. The spawning seasons for these species are approximately April 1 to June 30 for shortnose sturgeon and approximately April 15 to mid-summer for Atlantic sturgeon depending on where spawning is occurring on the Hudson River).

Material would be dredged using a closed clamshell dredge (also known as an environmental bucket) and removed by barge to an appropriately permitted processing facility. Dredging would be conducted during 8- to 12-hour shifts daily. The cofferdam would extend 6 feet (1.8 meters) below the mudline. Approximately 107 cubic yards (82 cubic meters) would be removed from within each cofferdam, for a total of 321 cubic yards (246 cubic meters) of dredge material removed from all three cofferdam sites on the Hudson River. A barge or dredge scow could hold up to 2,500 cubic yards (1,923 cubic meters) of material. Therefore, only one barge trip should be needed to remove all material. Silt curtains would be used as required around the work area; however, it is not anticipated that any silt would escape from within the cofferdam.

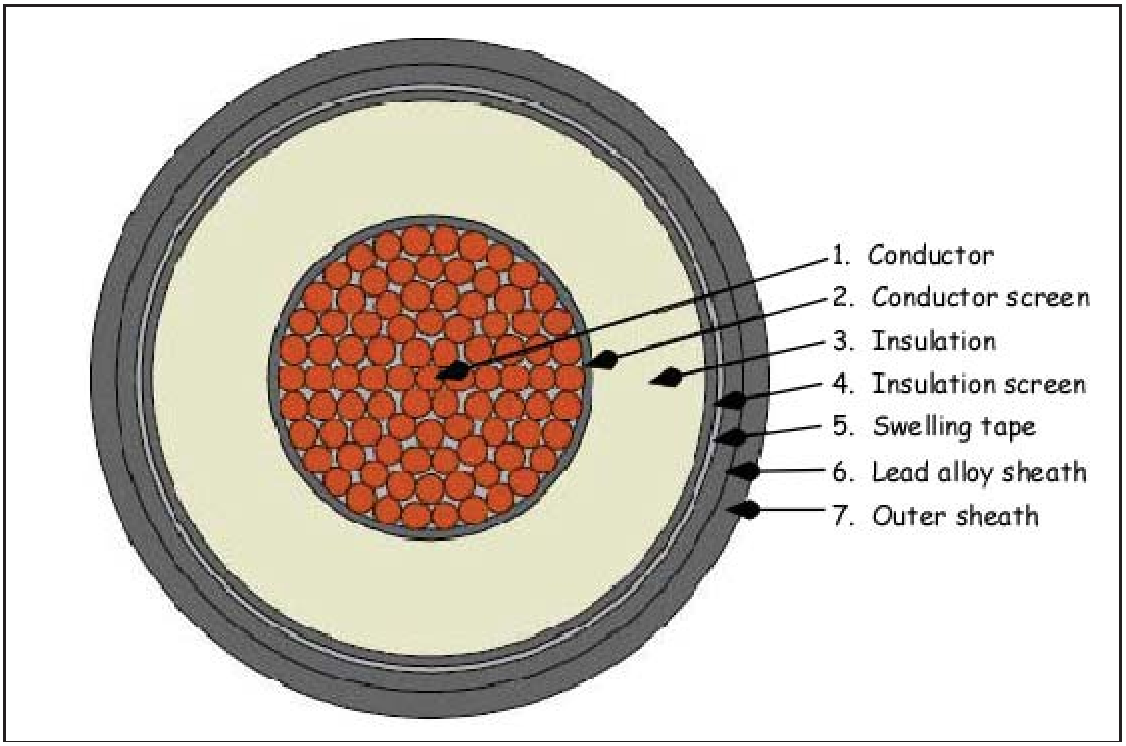
Sheet pile used to construct cofferdams would be installed with a vibratory hammer, and would be installed in pairs with 8 to 10 pairs of sheets installed per day. Each pair of sheets would provide a wall 4 feet (1.3 meters) wide and approximately 50 feet (15 meters) tall. A single pair of sheets can be installed in 30 to 120 minutes depending on the geotechnical conditions. After the vibratory penetration, each sheet would be "seated" into hard strata as required. Approximately 4 to 6 strikes per pair of sheets would be required to "seat" the pile wall. The Applicant has committed to using soft starts for vibratory installation. Each cofferdam would be constructed within 25 to 30 days, for a total duration of sheet pile installation of 75 to 90 days for all three cofferdams. All cofferdams would be inspected for trapped fish following installation. It is anticipated that the cofferdam would be cut at the mudline using divers and underwater cutting or burning equipment such as exothermic rods when installation activities are completed.

A visual and operational monitoring program would be developed and conducted during HDD operations to detect any losses of drilling fluid. Visual observations of drilling fluid in the water, or excessive loss of volume or pressure in the borehole would trigger response actions by the HDD operator, including halting drilling activities and initiating cleanup of released bentonite. A barge with a pumping system would be positioned at the cofferdam during drilling to collect any drilling fluid released into the cofferdam enclosure.

HDD could also be used to install the transmission cables beneath other sensitive areas such as wetlands, streams, and existing infrastructure along the terrestrial portions of the proposed CHPE Project route, and in special circumstances to avoid obstacles along the CHPE Project route, such as road or railroad crossings where open trenching would not be possible (TDI 2010). It is expected that at least three different sized HDD rigs would be employed on the project, requiring varying staging area sizes depending on the length of the drill at the particular location, proximity to sensitive areas such as wetlands, access limits, and other constraints.

2.3.3 Terrestrial Direct Current Transmission Cable

Approximately 42 percent of the proposed CHPE Project route would be composed of underground (terrestrial) portions. For the underground portions of the transmission line route, the two cables within the bipole system would typically be laid side-by-side in a trench. After the cables are laid in the trench, the trenches would be backfilled with low thermal resistivity material, such as well-graded sand to fine gravel, stone dust, or crushed stone. For the underground transmission cables, the outer sheathing insulation would be composed of an ultraviolet-stabilized, extruded polyethylene layer (see **Figure 2-10**). The underground transmission cables would have an outside diameter of 4.5 inches (11 cm), and each cable would weigh approximately 20 pounds per foot (2.8 kilograms per meter) (TDI 2010). A protective cover of HDPE, concrete, or polymer blocks would be placed directly above the low thermal resistive backfill material.



Source: CHPEI 2012d

Figure 2-10. Example Terrestrial HVDC Transmission Cable Cross-Section

A combination of HDD and trenching techniques would be used to install the transmission line underground along upland portions of the route. Trenchless technologies would be used where roadways and railroad beds would be crossed by the transmission line. Trenchless technologies could include HDD, horizontal boring, or pipe jacking. Following completion of the transmission cable installation, the excavated area would be backfilled and regraded, and the disturbed area would be returned to its previous condition as much as possible (CHPEI 2012b).

The proposed CHPE Project would be in the existing ROW of both the CP and CSX railway systems between MPs 112 and 228 and MPs 295 and 301. The Applicant has stated that drafts of Occupancy Agreements for easements along the railroad corridor have been exchanged with CP and CSX and are currently under negotiation. The final agreements would establish the terms of occupancy of the ROWs and refine required offsets of the transmission cables from the track centerline.

2.3.4 Cooling Stations

In certain situations where there is a long segment of cable installed by HDD, heat can accumulate in the HDPE conduit and reduce the performance of the transmission system. The Applicant has identified 16 sections of underground cabling where the potential for heat accumulation could require that cooling equipment stations be installed at approximate MPs 110, 112, 145, 146, 158, 185, 208, 227, 228, 296, two at 298, 299, two at 302, and 331. Each cooling station would consist of a chiller unit and pumping system within the building and this equipment would circulate chilled water through tubing in a closed-loop system alongside the HVDC cable to cool the cables. The heat emitted from the cables within the buried conduit would then be transferred by the coolant back to the cooling station and then to the outside atmosphere above ground. It is anticipated that the cooling systems would be operated primarily during peak electric load conditions (CHPEI 2012c).

2.3.5 Luyster Creek HVDC Converter Station

An HVDC converter station would be constructed near Luyster Creek in Astoria, New York, to convert the electrical power from DC to AC. The converter station site would be approximately 4.5 acres (1.8 hectares) in size. The HVDC converter station building would be approximately 165 feet by 325 feet (50 meters by 99 meters) with a building footprint of 1.2 acres (0.5 hectares) and a height of approximately 70 feet (21 meters), with transformers, cooling equipment, and power line carrier filters being installed outside of the building. The converter station would be powered by electricity taken directly from the proposed CHPE Project transmission line and would not require onsite personnel during normal operations.

2.3.6 Astoria Annex Substation Interconnection

The Luyster Creek Converter Station would deliver its energy by underground cable to the Astoria 345-kV, sulfur hexafluoride gas-insulated substation that serves as the primary point of interconnection to the grid. The Applicant has proposed to modify the electrical configuration of the Astoria Annex Substation by adding a four-breaker, gas-insulated switch ring bus to connect both the cable from the Luyster Creek Converter Station and the Astoria-Rainey Cable to the one remaining empty bus at the Astoria Annex Substation. This new ring bus could require construction of a new building approximately 72 feet (22 meters) long, 58 feet (18 meters) wide, and 40 feet (12 meters) high. If constructed, the new ring bus building would be 4,176 square feet (388 square meters) in size and would be located on the same parcel of land as the Luyster Creek Converter Station. The new ring bus would be connected to both the converter station and the Astoria Annex Substation by gas-insulated switch cables in underground pipes (CHPEI 2012e). However, no obstacles have been identified that would prevent the expansion of the existing ring bus at the Astoria Annex Substation to eight breaker positions. Therefore, it is unlikely that it would be necessary to build a new building to house the ring bus.

2.3.7 Astoria to Rainey Interconnection

The Applicant would also construct a 345-kV high-voltage alternating current (HVAC) cable circuit from the Astoria Annex Substation to ConEd's Rainey Substation in Queens to deliver power reliably into ConEd's 345-kV system. This interconnection would consist of HVAC cables buried beneath city streets for approximately 3 miles (5 km) (see **Figure 2-5**). The XLPE HVAC cables would be buried in a trench to a depth of more than 4 feet (1.2 meters) with a separation distance of 9 inches (23 cm) between the cables in the trench.

2.4 Additional Engineering Details

Heat. Ambient water temperatures in the Hudson, Harlem, and East rivers range from 32 °F (0 °C) in January to a July maximum of 81 °F (27 °C) (Historic Hudson River 2004, Riverkeeper 2013, Blumberg and Pritchard 1997). The proposed CHPE Project's HVDC cables would be designed to operate at normal temperature of 158 °F (70 °C). Under limited durations (i.e., maximum of 2 hours) of emergency overload conditions, the temperature would be limited to 176 °F (80 °C). At these temperatures, heat must be carried away from the conductors for them to operate efficiently, and soils in and around a trench perform this for underground cables. Where required on land, a clean, low thermal resistive backfill material would be used instead of native soil in the trench around the cables to ensure sufficient standard heat transfer to the surrounding soils and groundwater.

It is estimated that that for cable burial at 4 and 8 feet (1.2 and 2.4 meters), the maximum expected temperature change would be less than 1 °F (0.0001 °C and 0.0002 °C for 4- and 8-foot [1.2- and 2.4-meter) burial, respectively) in the water column above the riverbed, approximately 1.8 °F (1.20 °C and 1.24 °C, respectively) at the riverbed surface, and 9 °F and 4 °F (5 °C and 2.46 °C), respectively, at 0.2 meters below the riverbed surface. This is based on modeling that used a flow rate of 1.38 feet (0.4 meters) per second (CHPEI 2012j). This flow rate might be considered conservative inasmuch as Nepf and Geyer (1996) indicated ebb tide velocities can reach approximately 6.6 feet (2 meters) per second in the Hudson River under normal flow conditions. While the temperature change is not directly linear, it is reasonably expected that based on these calculations that the expected water, surface, and subsurface temperatures that would be expected at a burial depth of 7 feet (2.1 meters) would be closer to those identified for the 8-foot (2.4-meter) burial rather than the 4-foot (1.2-meter) burial.

Where the transmission cables cannot be buried to their full depth due to utilities or bedrock and must be covered with concrete mats, the estimated increase in ambient water temperature surrounding the cables covered by the concrete mats is expected to be negligible (less than 0.25 °F [0.14 °C]). This is expected to be within the range of daily variation of water temperatures experienced in the Hudson and Harlem rivers. The highest increase in ambient temperature in the top 2 inches (5 cm) of sediment along the sides of the concrete mat is expected to be 1.26 °F (0.7 °C) or less (Exponent 2014). This assumes a river depth of 16 feet (5 meters) and an average water velocity of 1.38 feet (0.4 meters) per second.

Electric and Magnetic Fields. Operation of the proposed CHPE Project transmission line would produce electric and magnetic fields. Transmission lines, like all electric devices, produce electric and magnetic fields, or electromagnetic fields (EMFs). Voltage, the force that drives the current, is the source of the electric field. Current, the flow of electric charge in a wire, produces the magnetic field. The strength of the EMF depends on the design of the electrical line and the distance from it. EMF is found around any electrical wiring, including household wiring, electrical appliances, and equipment.

Electric fields are measured in volts per meter or kV per meter. Electric field strength is reduced by shielding or by intervening objects such as structures and vegetation. The proposed CHPE Project transmission line cables would be shielded within a lead-alloy sheath (see **Figure 2-10**) and buried, which would effectively eliminate any exposure to the electric field (Cross-Sound Cable Company 2012, WHO 2012). In areas where the cable cannot be buried (e.g., when installed over existing utility lines or bedrock), protective covering, such as concrete mats, would be installed over them.

Magnetic fields diminish with distance from the source. Unlike electric fields, however, intervening objects between the source and the receptor, such as structures or soil over a buried transmission line, do not reduce magnetic field strength. Consequently, while electrical appliances can produce the highest localized magnetic fields, power lines serving neighborhoods and distribution lines and transformers serving individual homes or businesses are a common source of longer-term magnetic field exposure (BPA 2010).

Magnetic fields are measured in units of gauss (G) or milligauss (mG). The average magnetic field strength in most homes (away from electrical appliances and wiring) is typically less than 2 mG. Outdoor magnetic fields in publicly accessible places can range from less than a few mG to 300 mG or more, depending on proximity to power lines and the voltage of the power line.

Table 2-1 and **Figure 2-11** provide the magnetic field strengths for the proposed CHPE Project transmission lines at an assumed burial depth of 3.3 feet (1.0 meter). The table and figure demonstrate that magnetic field levels are reduced the closer the cables are to each other.

Table 2-1. Magnetic Field Levels for the Proposed CHPE Transmission Cables

Distance From Cables (feet)	Levels at Various Spacing Between Cables (values in mG)			
	1 foot	2 feet	3 feet	6 feet
+5	161.8	322.7	481.6	932.3
+10	76.9	154.1	231.9	472.1
+15	41.0	82.1	123.5	251.3
+20	24.8	49.6	74.6	151.0
+25	16.4	32.9	49.4	99.6
+30	11.6	23.3	34.0	70.4
+50	4.3	8.6	12.9	25.9

Source: CHPEI 2012i

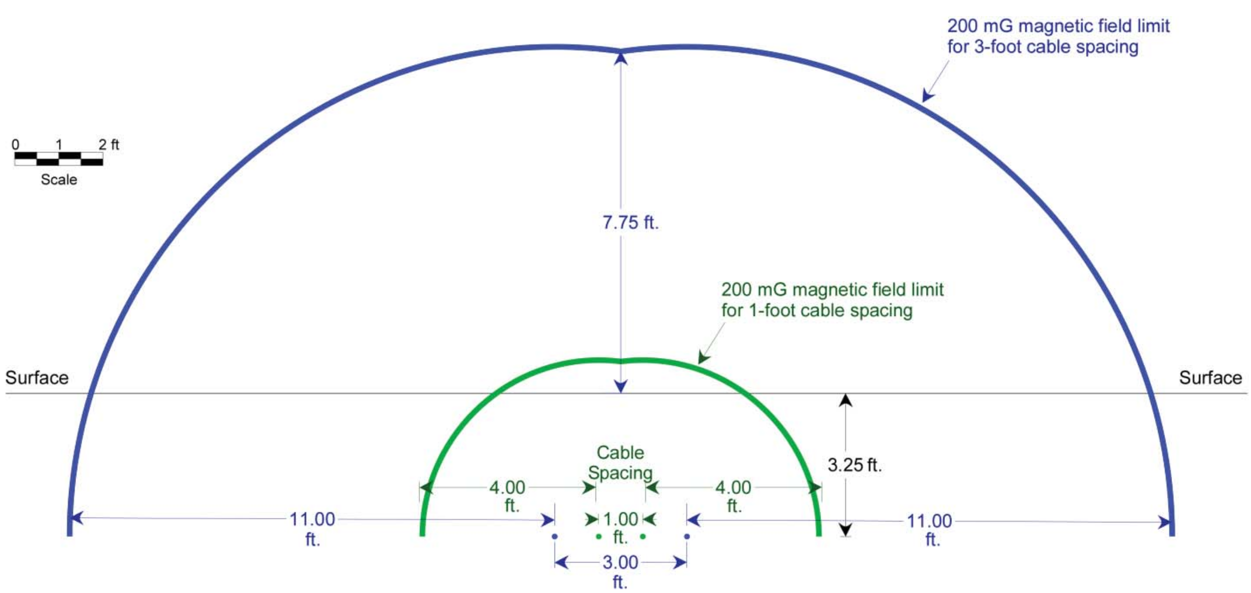


Figure 2-11. 200-mG Magnetic Field Strengths with Cable Spacings of 1 Foot and 3 Feet

2.5 Construction and Schedule

The Applicant anticipates that the initial permitting phase of the proposed CHPE Project would continue through early 2014, with major construction commencing later in 2014. Installation of the transmission cables is proposed to be completed in three phases between 2014 and 2017. The Applicant anticipates that the commercial operation date for the proposed CHPE Project would be 2017 (TDI 2010, CHPEI 2012h).

2.5.1 Aquatic Transmission Cable Installation

To the extent practical, the aquatic transmission cables would be buried beneath the beds of existing waterways at depths ranging between 4 and 8 feet (1.2 and 2.4 meters) beneath the bed surface. In Lake Champlain, the cables would be buried in the lake bottom to a target depth of 8 feet (2.4 meters) in the soft sediment within the Federal navigation channel, and at least 4 feet (1.2 meters) in the lakebed outside of the navigation channel. In the Hudson River, the cables would be buried to a minimum depth of 7 feet (2.1 meters); the transmission line would not traverse the federally maintained navigation channel in the Hudson River. Cable installation in the Harlem River would be entirely within the navigation channel at depths of 8 feet (2.4 meters) in the soft sediment and 6 feet (1.8 meters) in rock. The transmission line would be installed along the entire East River route using HDD; therefore, trench burial depths would not apply.

Aquatic installation and burial of the transmission line would occur via jet plow in all locations except where installed by shear plow in southern Lake Champlain (south of MP 74), HDD at water-to-land transitions and under the East River, laid on the surface over bedrock or utility line crossings and covered with concrete mats (total of 3.0 miles [4.8 km] for the entire proposed CHPE Project route), or blasting of 460 feet (140 meters) of trench at MP 324.5 in the Harlem River. The jet plow is fitted with hydraulic pressure nozzles that create a downward and backward flow to fluidize the sediment within a trench approximately 2 feet (0.4 meters) wide and 4 to 8 feet (1.2 to 2.4 meters) deep depending on the burial requirements, allowing the transmission cables to settle to the bottom of the trench under their own weight before the sediments settle back into the trench.

The Applicant would employ a fleet of approximately four vessels, including the cable-laying vessel, survey boat, crew boat, and tugboat or tow boat, which would be used to coordinate laying of cable. The plowing process would be conducted using a dynamically positioned cable barge and towed plow device that simultaneously lays and embeds the aquatic transmission cables in a trench. The transmission cables composing the bipole would be deployed from the vessel to a funnel device on the plow. The plow is lowered to the lake or river bed, and the plow blade cuts into the lake or riverbed while it is towed along the pre-cleared route to carry out a simultaneous lay-and-burial operation. The plow would bury both cables of the bipole in the same trench at the same time. Anchorage of vessels during installation of the aquatic transmission line would be used in the event that bottom conditions are encountered that either stop forward progress at reasonable tow tension or result in excessive rolling or pitching of the jet plow. Specific areas where anchorage would be anticipated include construction and removal of temporary cofferdams and cable landings at water-to-land transitions, marine splicing locations (although this could also be accomplished using dynamically positioning), and possibly along the 460-foot (140-meter) length of bedrock trenching in the Harlem River (at MP 324.5).

Burial depths could vary in response to site-specific factors (e.g., presence of existing infrastructure or archaeological resources, localized geological or topographical obstacles, or other environmental concerns) identified along the proposed CHPE Project route. Where the transmission cables would cross areas that contain surficial bedrock or existing infrastructure (e.g., other cables or pipelines), the transmission cables would generally be laid atop the existing bedrock or infrastructure and protected by material placed over the transmission cables. Protective material could include concrete (e.g., rip-rap or concrete mattresses), protective cable ducts, or other low-impact protective armoring (TDI 2010).

The burial depth for the area of rock excavation in the Harlem River is stated in the U.S. Army Corps of Engineers (USACE) Public Notice for the proposed CHPE Project Clean Water Act Section 404 Permit Application as being 6 feet (1.8 meters) below waterbody bottom (USACE 2013). The proposed transmission line would cross exposed bedrock for approximately 460 feet. Geologic maps indicate this rock is Fordham gneiss having unconfined compressive strength that is too hard to remove by cutterhead, ripping, hoe-ramming, or non-explosive methods. Blasting trials would be conducted using a pre-packaged chemical demolition agent (e.g., Green Break or RocKracker) that would be inserted into holes drilled into rock. These packaged demolition agents would be loaded into boreholes and when ignited would generate an expansive force to fracture the rock. The rock fragments would then be removed by long-reach hydraulic excavating buckets and deposited in a barge. If the trials are successful, a vertical pattern of holes would be drilled into the rock to form a trench. The broken rock would be dredged sequentially from each end of the trench progressing towards the middle with the rock fragments placed into a barge. Turbidity would be generated as a result of operations. However, impacts are expected to be minimal because of the crystalline nature of the rock and because silt curtains would be used to surround the operations to avoid the spread of a turbidity plume.

In the event that trials with the pre-packaged chemical demolition agent are unsuccessful, due to the rock's hardness or other reasons, it would be necessary to use water gel dynamites to fracture the rock so it can be dredged. The dynamite would produce a shock wave upon detonation. The force of the shock wave could be decreased by stemming the top of the blast holes with pea gravel, which might require an increase in the number of boreholes needed to be drilled to get the powder factor (i.e., pounds of dynamite per cubic yard of rock) required to break the rock. Each blast hole would be detonated in a controlled sequence to move the rock towards the open end of the trench, and to minimize vibrations that would travel towards the shoreline. Explosives would be detonated during each delay (typically 8 milliseconds apart). Blasting would occur within the proposed CHPE Project construction window for the Harlem River (see **Table 2-2**).

The blasting program in the Harlem River is estimated to last 10 weeks, requiring approximately 300 drill holes with each drill taking 30 to 60 minutes to complete. Nominal noise, vibration, and turbidity are expected from the drilling process, which would employ small diameter drill holes (~1.5 inches [~3.8 cm]) that generate a small amount of suspended sediment. The sediment would be contained by means of floating silt curtains as appropriate. Air compressors mounted on the barge would generate additional construction noise. Drilling is anticipated to be conducted from a barge on spuds. Prior to blasting, the barge would be moved off the drilled holes with clearance of the vicinity as required by the fire marshal and the harbormaster.

The blast events are anticipated to last only a few seconds, but they would be preceded and followed by warnings and clearings of the area for inspections, all of which could take approximately 2 hours. The exact production schedules would be developed by the blasting construction contractor. Preliminary construction sequencing studies indicate that 15 to 20 separate blasts could be required. Peak ground vibrations are predicted to range from 0.25 inches (0.64 cm) per second at a distance of 200 feet (61 meters) from the trench, 1 inch (2.5 cm) per second at a distance of 75 feet (23 meters), 2 inches (5.1 cm) per second at 50 feet (15 meters), and 4 inches (10.2 cm) per second at 30 feet (9 meters). Peak water pressures are predicted to be 10 pounds per square inch (psi) at 200 feet (61 meters), 30 psi at 75 feet (23 meters), 50 psi at 50 feet (15 meters), and 85 psi at 30 feet (9 meters) from the trench.

Following clearance by the blaster, mucking of blasted trench materials would be completed with long-reach backhoes to lift muck out of the trench and, if the fragmentation is good, put it to the side.

Large rocks would require removal to shore and disposal. An estimated 1,200 tons of rock material would be anticipated to be removed from the trench and temporarily stored on the river bottom adjacent to the trench. The cables would be laid over a sand backfill in the trench and covered with sand layer. The remainder of the trench would be backfilled with the blasted aggregate materials.

The NYSPSC Certificate issued for the proposed CHPE Project established construction work schedule windows identifying times of the year when work associated with the underwater portion of the transmission line may take place (NYSPSC 2013). These established work windows and time of year restrictions were developed in part to avoid impacts on overwintering, spawning migrations, spawning activity, and larval stages of Endangered Species Act (ESA)-listed fish species. **Table 2-2** presents the underwater construction windows for the Hudson, Harlem, and East rivers. The New York State Department of State (NYSDOS) has conditionally concurred with these construction windows as part of its Coastal Management Program (CMP) consistency certification for the proposed CHPE Project. Restriction of construction activities to specific windows of time would protect EFH fish species during spawning migrations, which are vital and sensitive stages of their lifecycle.

Table 2-2. Underwater Construction Windows

CHPE Milepost	Location	Construction Window	Primary Construction Method
Hudson River			
228 to 269	Cementon (Catskill) to New Hamburg	August 1 to October 15 [a]	Jet Plow
269 to 295	New Hamburg to Stony Point	September 15 to November 30	Jet Plow
303 to 324	Clarkstown to Harlem River	July 1 to October 31	Jet Plow
Harlem and East Rivers			
324 to 330	Harlem River	May 31 to November 30 [b]	Jet Plow
331 to 331	East River	May 15 to November 30	HDD

Source: NYSPSC 2013, CHPEI 2014a

Notes:

[a] The transmission line would be installed between MPs 245 and 269 between September 14 and November 30 to avoid impacts on the Kingston-Poughkeepsie Deepwater Significant Coastal Fish and Wildlife Habitat (SCFWH).

[b] Blasting would take place between July 1 and November 30.

2.5.2 Terrestrial Direct Current Transmission Cable Installation

The general sequence for installing the terrestrial DC transmission cables along the road and railroad ROWs would be conducted in steps as follows (CHPEI 2010a):

- Initial clearing operations (where necessary) and storm water- and erosion-control installation
- Trench excavation
- Cable installation
- Backfilling
- Restoration and revegetation.

The typical trench would be up to 9 feet (2.7 meters) wide at the top and approximately 3 feet (0.9 meters) deep to allow for proper depth and a 1-foot (0.3-meter) separation required between the two transmission cables to allow for heat dissipation. If shallow bedrock is encountered, the rock would be removed by the most suitable technique given the relative hardness, fracture susceptibility, and expected volume of material. The operation of the transmission cables would result in the generation of heat, which would reduce the electrical conductivity of the cables; therefore, prior to laying the cables, the trenches would be backfilled with low thermal resistivity material such as sand to prevent heat from one cable affecting a nearby cable. There would be a protective concrete cover consisting of a layer of weak concrete directly above the low thermal resistive backfill material. The whole assembly would have a marker tape placed 1 to 2 feet (0.3 to 0.6 meters) above the cables (CHPEI 2010a).

For crossings of waterbodies, the following five dry-ditch crossing methods would be used for installation of the transmission line:

- *Attachment to a Bridge.* Where available and feasible, the transmission line would be affixed directly to an existing railroad bridge as it spans the waterbody.
- *Flume Crossing Method.* This method involves installing a flume pipe to carry the stream around the work area in an enclosed pipe, allowing the trenching to be done in a dry condition, limiting the amount of sediment that can enter the waterbody.
- *Dam and Pump Crossing Method.* For this method, the stream is dammed upstream of the work area and a pump and hose are used to transport the stream flow to bypass the trenching area to a point downstream where it would be discharged back to the streambed.
- *HDD.* Under this method, cable conduits would be installed under the streambed using HDD and avoiding any disturbance to the streambed, and the cables would then be pulled through the conduits.
- *Open Cut.* The open cut method of construction involves digging an open trench across the streambed, laying the cable, and backfilling the trenched area without diverting the stream around the work area.

The waterbody crossing methods would be determined based on the New York State Department of Public Service (NYSDPS) stream width classification, New York State Department of Environmental Conservation (NYSDEC) stream type classification, and conditions present during the time of construction; and would be in accordance with NYSDPS's *Environmental Management and Construction Standards and Practices for Underground Transmission and Distribution Facilities in New York State* (NYSPSC 2003).

In wetland areas, the cables would generally be installed by trenching. The typical sequence of activities would include vegetation clearing, installation of erosion controls, trenching, cable installation, backfilling, and ground surface restoration. Equipment mats or low-ground-pressure tracked vehicles would be used to minimize compaction and rutting impacts on wetland soils. To expedite revegetation of wetlands, the top 1 foot (0.3 meters) of wetland soil would be stripped from over the trench, retained, and subsequently spread back over and across the backfilled trench area to facilitate wetland regrowth by maintaining physical and chemical characteristics of the surface soil and preserving the native seed bank. Trench plugs or other methods would be used to prevent draining of wetlands or surface waters down into the trench.

The permanent ROW required for maintenance and operation of the transmission line along the terrestrial portions of the proposed CHPE Project route would be up to 20 feet (6.1 meters) for both railroad and roadway ROWs. The permanent ROW would provide protection of the transmission cables against third-party damage and would facilitate any required maintenance or repairs (TDI 2010).

2.5.3 Staging Areas

Aquatic Transmission Cable Support Facilities. For the portions of the proposed CHPE Project route where aquatic transmission cables would be installed, it is anticipated that minimal land-based support would be required. Transport of the aquatic transmission cables would occur via the cable-laying vessel, supported by resupply barges operated from a temporary storage area on land. This land-based support facility is expected to be no greater than 200 by 300 feet (61 by 91 meters), and would be at an existing port with heavy lift facilities, likely the Port of Albany or the Port of New York and New Jersey (CHPEI 2010b).

Terrestrial Transmission Cable Support Facilities. For the terrestrial portions of the proposed CHPE Project route where underground transmission cables would be installed, additional nearby temporary aboveground support facilities would be established. Support facilities could include contractor yards, storage areas, access roads, and additional workspace. Additional workspace might be required at HDD locations, cable jointing locations, and areas with steep slopes. The support facilities would be sited within the existing road and railroad ROWs (CHPEI 2010b).

2.5.4 Operations and Maintenance

The proposed CHPE Project has an expected life span of 40 years or more (CHPEI 2012c). During this period, it is expected that the transmission system would maintain an energy availability factor of 95 percent, meaning that the transmission system would be delivering electricity 95 percent of the time, with the remaining 5 percent allocated for scheduled and unscheduled maintenance.

The HVDC and HVAC transmission cables would be designed to be relatively maintenance-free and operate within the specified working conditions. However, selected portions or aspects of the transmission system would be inspected to ensure equipment integrity is maintained (CHPEI 2010b).

ROW Maintenance. During operation of the proposed CHPE Project, vegetation clearing in the transmission line ROW would be performed on an as-needed basis. Vegetation management would include mowing, selective cutting to prevent the establishment of large trees (i.e., greater than 20 feet [6 meters] tall) directly over the transmission line, and vegetation clearing on an as-needed basis to conduct repairs.

Transmission Cable Repairs. While not anticipated, it is possible that over the lifespan of the proposed CHPE Project, the transmission cables could be damaged, either by human activity or natural processes. Before operation of the proposed CHPE Project begins, an Emergency Repair and Response Plan (ERRP) would be prepared to identify procedures and contractors necessary to perform maintenance and emergency repairs. The typical procedure for repair of a failure within the aquatic and terrestrial portions of the proposed CHPE Project route is described as follows:

- *Aquatic Transmission Cable Repair*. In the event of aquatic cable repair, the location of the problem would be identified and crews of qualified repair personnel would be dispatched to the work location. A portion of the transmission cable would be raised to the surface, the damaged portion of the cable cut, and a new cable section would be spliced in place by specialized jointing personnel. Once repairs were completed, the transmission cable would be reburied using a remotely operated vehicle jetting device (CHPEI 2010b).
- *Terrestrial Transmission Cable Repair*. In the event of terrestrial transmission cable repair, contractors would excavate around the location of the problem and along the transmission cable for the extent of cable to be repaired or replaced. Specialized jointing personnel would remove

the damaged cable and install new cable. Once complete, the transmission cable trench would be backfilled and the work area restored using the same methods described for the original installation (CHPEI 2010b).

Transmission Service. The maximum electrical power delivery capability for the proposed CHPE Project under normal conditions would be 1,000 MW. The ultimate maximum capacity would be determined during final design of the proposed CHPE Project. The estimated short-time (i.e., 2-hour) emergency overload capability would be approximately 1,150 MW for the transmission system (TDI 2010).

The New York Independent System Operator (NYISO) would be the controlling authority for the proposed CHPE Project and the operator of the system where the energy would originate, Hydro-Québec, would coordinate with the NYISO.

Decommissioning. The Applicant proposes to de-energize and abandon the proposed CHPE Project transmission line in place following expiration of its useful life. This proposed approach or any changes to the plan for decommissioning would be subject to applicable Federal and state regulations in place at that time.

3. EFH Species and FWCA Resources Designations in the ROI

3.1 EFH Species Designations

The NOAA NMFS Web site, *Guide to Essential Fish Habitat Designations in the Northeastern United States,* and the complementary *Guide to Essential Fish Habitat Descriptions,* were used to determine which species have designated EFH in waterbodies associated with the proposed CHPE Project (NOAA 1998a, NOAA1998b, NOAA 1998c). The NMFS guides present information on species with EFH in tabular format for 10 x 10 minute squares of latitude and longitude. For the proposed CHPE Project, squares 4040/7350 and 4040/7400 covering the ROI were analyzed to determine which species life stages had potential EFH within the ROI. NMFS also presents information on species with EFH in estuaries in a tabular format. For the proposed CHPE Project, the table covering the Hudson River/Raritan/Sandy Hook Bays in the New York/New Jersey area was used. Further, the written EFH designations on the NMFS Web site were used as the final determination for which species and life stages had EFH designated in the ROI.

Of the species with EFH identified in the previously described NMFS guides, cobia, Spanish mackerel, king mackerel, Atlantic mackerel, pollock, and sand tiger shark would not likely be found within the ROI for the proposed CHPE Project. The written EFH designations for these species include higher salinity regimes or other habitat parameters described as follows that do not occur within the ROI:

- EFH for coastal migratory pelagic fish species, including cobia, Spanish mackerel, and king mackerel, is designated as sandy shoals of capes, offshore bars with high profile rock bottoms, and barrier island oceanside waters from the surf zone to the shelf break. These types of habitats are not found within the ROI. Additionally, cobia EFH includes high-salinity (i.e., greater than 25 ppt) bays and bays and estuaries with seagrass habitats. These salinities and habitats do not occur within the proposed CHPE Project ROI.
- Atlantic mackerel prefer salinities greater than 25 ppt (NOAA 1998b, NOAA 2013). Because salinity levels in the proposed CHPE Project ROI do not exceed 25 ppt, EFH for these species would not generally be expected to occur within the Hudson, Harlem, or East rivers.
- The EFH designated for juvenile and adult pollock includes saline environments with salinity levels greater than 30 ppt and only occurs in Long Island Sound (NOAA 1998c). Because salinity levels in the proposed CHPE Project ROI do not exceed 25 ppt, EFH for these species would not generally be expected to occur within the Hudson, Harlem, or East rivers.
- The EFH description indicates that sand tiger shark juveniles and adults are not generally found north of Barnegat Inlet, New Jersey. Neonates could occur farther north; however, the closest they occur to the proposed CHPE Project area is the southeastern end of Long Island (NOAA 1998b, NOAA 2009). Therefore, EFH for sand tiger sharks is not designated in the CHPE Project ROI.

Because designated EFH for these species would not occur within the proposed CHPE Project ROI, they are excluded from further discussion in this assessment. **Table 3-1** presents the species and life stages with designated EFH in the ROI. These species are managed by the New England Fishery Management Council, Mid-Atlantic Fishery Management Council, and NMFS Highly Migratory Species Division.

The species with designated EFH in the ROI include benthic/demersal (bottom of the water column at the sediment) and pelagic (within the water column) species. These species, while predominantly marine, have one or more life stages that occur in the fresh or brackish waters of the Hudson River Estuary

Table 3-1. Species with EFH in the ROI

Species	Life Stage				
	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Atlantic butterfish *(Peprilus triacanthus)*		X	X	X	
Atlantic sea herring *(Clupea harengus)*		X	X	X	
Black sea bass *(Centropristus striata)*			X	X	
Bluefish *(Pomatomus saltatrix)*			X	X	
Red hake *(Urophycis chuss)*		X	X	X	
Scup (*Stenotomus chrysops*)	X	X	X	X	X
Summer flounder *(Paralicthys dentatus)*		X	X	X	
Winter flounder *(Pleuronectes americanus)*	X	X	X	X	X
Windowpane flounder *(Scopthalmus aquosus)*	X	X	X	X	X
Clearnose skate (*Raja eglanteria*)			X	X	
Little skate (*Leucoraja erinacea*)			X	X	
Winter skate (*Leucoraja ocellata*)			X	X	

Sources: NOAA 1998a, NOAA 1998b, NOAA 1998c, NOAA 2014

(NOAA 1998c). EFH generally includes pelagic and demersal waters and benthic substrates. Some species are more structure-oriented and have EFH composed of artificial or natural reefs (e.g., existing infrastructure such as docks), sand/shell fragments, biogenic structures (e.g., algae-covered rocks), and aquatic vegetation. However, many species have soft-bottom EFH composed of sand or mud or a sand/mud mixture. **Table 3-2** provides a summary of the EFH types associated with fish with designated EFH in the ROI, along with the species and life stages associated with the habitat type. The habitat associations (e.g., salinity, temperature, depth, habitat type), time of occurrence, and relative abundance for each life stage of the 12 fish species that have EFH designated within the ROI are presented in **Table 3-3**.

Winter flounder could be particularly vulnerable to the impacts of the proposed CHPE Project. Sensitive life stages of this species tolerate wide salinity ranges, including 10 ppt to 30 ppt for eggs and 4 ppt to 30 ppt for larvae (NOAA 1999h), and are expected to be found in the ROI. Winter flounder migrate into shallow water or estuaries and coastal ponds to spawn, and tagging studies show that most return repeatedly to the same spawning grounds (Lobell 1939, Saila 1961, Grove 1982). They typically spawn in the winter and early spring although the exact timing is temperature-dependent and thus varies with latitude (Able and Fahay 1998). Winter flounder have demersal eggs that sink and remain on the bottom until they hatch. Winter flounder eggs, once deposited on the substrate, are vulnerable to sedimentation with decreased hatching success of eggs observed when covered in as little as 0.04 inches (1 millimeter) of sediment and burial in sediments greater than 0.1 inch (2.5 millimeters) have been shown to cause no hatch (Berry et al. 2011). After hatching, the larvae are initially planktonic, but following metamorphosis they assume an epibenthic existence. Winter flounder larvae are negatively buoyant (NOAA 1999h), and are typically more abundant near the bottom (Able and Fahay 1998).

Table 3-2. Summary of EFH Types and Associated Fish Species in the Hudson River Segment

Specific EFH Type	Species	Life Stage
Substrate		
Artificial and Natural Reefs and Shipwrecks	Black sea bass	A
Rock, Pebbles, Gravel, and Shell Fragments	Winter flounder	E, J, A, SA
Sand/Shell Fragment Mix	Black sea bass	J, A
	Red hake	J
Biogenic Structure: Algae-covered Rock, Aquatic Vegetation, Shell Beds, and Sponges	Black sea bass	J, A
	Summer flounder	J
Macrophytes/Aquatic Vegetation	Summer flounder	J, A
	Scup	J
Sand, Silt, and Mud	Red hake	A
	Summer flounder	J
	Windowpane flounder	J, A, SA
	Winter flounder	E, J, A, SA
	Clearnose skate	J, A
	Little skate	J, A
	Winter skate	J, A
	Scup	J, A
Rock and Gravel	Clearnose skate	J, A
	Little skate	J, A
	Winter skate	J, A
Waters		
Demersal	Black sea bass	J, A
	Summer flounder	J, A
	Winter flounder	L
	Scup	J, A
Pelagic	Winter flounder	L
	Atlantic butterfish	L, J, A
	Atlantic sea herring	L, J, A
	Bluefish	J, A
	Windowpane flounder	L
	Scup	E, L
Surface	Red hake	L
	Summer flounder	L
	Windowpane flounder	E
Marsh Creeks	Summer flounder	J

Source: NOAA 1998c

Key: E = Eggs; L = Larvae; J = Juveniles; A = Adults; SA = Spawning Adults

Table 3-3. Designated EFH Descriptions and Associated Fish Species Occurrence within the ROI

Species	Life Stage	EFH Characteristics[1,2,3,4,5]				
		Salinity (ppt)	Temp (°F)	Depth (feet)	Habitat Type	Relative Abundance and Occurrence
Atlantic butterfish[6] *(Peprilus triacanthus)*	Egg	25–33	53–73	30–4,000	ND	Not present
	Larvae	25–33	39–82	30–5,800	Pelagic waters; typically estuaries	Common: July–August Rare: September–November
	Juvenile	3–34.7	40–85	30–1,100	Pelagic waters	Common: May–November
	Adult	3.8–33	40–79	30–1,200	Pelagic waters	Common: May–November
	Spawning Adult	ND	> 59	ND	ND	ND
Atlantic sea herring[7] *(Clupea harengus)*	Egg	ND	ND	ND	ND	Not present
	Larvae	32	< 61	160–300	Pelagic waters	Common: April–May Rare: June
	Juvenile	26–32	< 50	50–450	Pelagic waters and demersal habitats	Common: January–May Rare: June–December
	Adult	> 28	< 50	66–430	Pelagic waters and demersal habitats	Common: January–May Rare: June–December
	Spawning Adult	ND	ND	ND	ND	ND
Black sea bass[8] *(Centropristus striata)*	Egg	ND	ND	ND	ND	ND
	Larvae	ND	52-79	100-160	ND	ND
	Juvenile	20–33	37–73	10–75	Demersal waters; Substrate with sand/shell fragment mix; biogenic structure*	Rare: April–November
	Adult	20–33	52–73	16–66	Demersal waters; Substrate with sand/shell fragment mix; biogenic structure*; artificial and natural reefs (including shipwrecks)	Rare: April–November
	Spawning Adult	ND	ND	ND	ND	ND

Species	Life Stage	EFH Characteristics[1,2,3,4,5]				
		Salinity (ppt)	Temp (°F)	Depth (feet)	Habitat Type	Relative Abundance and Occurrence
Bluefish[9] *(Pomatomus saltatrix)*	Egg	ND	46–79	100–230	ND	ND
	Larvae	ND	63–79	100–230	ND	ND
	Juvenile	19–32	54–75	16–66	Pelagic waters	Abundant/Common: June–September
	Adult	29–36	46–68	3–330	Pelagic waters	Common: May–October
	Spawning Adult	ND	ND	ND	ND	ND
Red hake[10] *(Urophycis chuss)*	Egg	> 30	41–50	ID	ND	Not present
	Larvae	> 0.5	< 66	< 660	Surface waters	ID
	Juvenile	31–33	< 60	< 330	Substrate of sand/shell fragment mix	Common: November -May Rare: June
	Adult	33–34	< 54	33–430	Substrate of sand, silt, and mud	Common: March-May Rare: November-February
	Spawning Adult	> 30	41–50	ND	ND	ND
Scup[11] (*Stenotomus chrysops*)	Egg	> 15	55–73	< 98	Pelagic waters in estuaries	May–August
	Larvae	> 15	55–73	< 66	Pelagic waters in estuaries	May–September
	Juvenile	> 15	> 45	0–125	Demersal waters and inshore estuaries; Substrate of various sands, mud, mussel and eelgrass beds	Common: May–November Rare: November–April
	Adult	> 15	> 45	7–607	Demersal waters and inshore estuaries	Common: April–December
	Spawning Adult	15	48–75	< 98	Substrate from weedy to sandy	May–August

Species	**Life Stage**	**EFH Characteristics**[1,2,3,4,5]				
		Salinity (ppt)	**Temp (°F)**	**Depth (feet)**	**Habitat Type**	**Relative Abundance and Occurrence**
Summer flounder[12] *(Paralicthys dentatus)*	Egg	ND	ND	ND	ND	ND
	Larvae	0.5–25	ID	100–750	Surface waters	Rare: April–June
	Juvenile	0.5–25	> 36	Shore to 1,600	Demersal waters, marsh creeks; Substrate with biogenic structure*, macrophytes and aquatic vegetation, sand, silt, and mud	Common: May–October Rare: November–December and March–April
	Adult	0.5–25		Shore to 1,600	Demersal waters; Substrate with macrophytes, and aquatic vegetation; all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed; and loose aggregations, within adult and juvenile summer flounder EFH	Common: May–October Rare: November–December and March–April
	Spawning Adult	ID	ID	ID	ND	Not present
Windowpane flounder[13] *(Scopthalmus aquosus)*	Egg	< 25	< 68	< 230	Surface waters	Common: April–October
	Larvae	< 25	< 68	< 230	Pelagic waters	Common: April–November
	Juvenile	5.5–36	< 77	3–330	Substrate of sand, silt, and mud	Common: January–December
	Adult	5.5–36	< 80	3–250	Substrate of sand, silt, and mud	Common: January–December
	Spawning Adult	5.5–36	< 70	3–250	Substrate of sand, silt, and mud	ID
Winter flounder[14] *(Pleuronectes americanus)*	Egg	10–30	< 50	< 300	Demersal waters; Substrate with rocks, pebbles, gravel, shell fragments, sand, silt, and mud	Abundant/Common: November–April
	Larvae	4–30	< 59	< 300	Pelagic and demersal waters	Abundant/Common: November–May Rare: June
	Juvenile	4–30	< 59	< 20	Demersal waters; Substrate with rocks, pebbles, gravel, shell fragments, sand, silt, and mud	Abundant/Common: January–December
	Adult	15–33	< 77	3–330	Demersal waters; Substrate with rocks, pebbles, gravel, shell fragments, sand, silt, and mud	Abundant/Common: January–June Rare: July–December
	Spawning Adult	5.5–36	< 59	< 260	Demersal waters; Substrate with rocks, pebbles, gravel, shell fragments, sand, silt, and mud	Abundant/Common: November–May

Species	Life Stage	EFH Characteristics[1,2,3,4,5]				
		Salinity (ppt)	**Temp (°F)**	**Depth (feet)**	**Habitat Type**	**Relative Abundance and Occurrence**
Clearnose skate[15] (*Raja eglanteria*)	Egg	ND	ND	ND	ND	ND
	Larvae	22–30	45–75	16–46	ND	ND
	Juvenile	> 22	48–68	3–100	Demersal habitats with substrate of rock, gravel, silt and mud	Common: May–October Rare: April, November
	Adult	> 27	48–70	16–26	Demersal habitats with substrate of rock, gravel, silt and mud	Common: May–October Rare: April, November
	Spawning Adult	ND	ND	ND	ND	ND
Little skate[16] (*Leucoraja erinacea*)	Egg	ND	> 45	ND	ND	ND
	Larvae	ND	ND	ND	ND	ND
	Juvenile	15–35	36–72	12–80	Demersal habitats with rocks, gravel, sand, silt, and mud	Relative abundance unknown; January–December
	Adult	15–35	36–72	12–80	Demersal habitats with rocks, gravel, sand, silt, and mud	Relative abundance unknown; January–December
	Spawning Adult	ND	ND	ND	ND	ND
Winter skate[17] (*Leucoraja ocellata*)	Egg	ND	ND	ND	ND	ND
	Larvae	ND	ND	ND	ND	ND
	Juvenile	15–34	36–79	13–72	Demersal habitats with sand, gravel, or mud	Common
	Adult	30–35	36–66	3–1,000	Demersal habitats with sand, gravel, or mud	Not present
	Spawning Adult	30–35	36–66	3–1,000	ND	ND

Sources: (1) NOAA 1998b, (2) NOAA 1998c, (3) NOAA 2014, (4) NYSDEC 1986, (5) NMFS 2013, (6) NOAA 1999a, (7) NOAA 1999e, (8) NOAA 2007, (9) NOAA 2006a, (10) NOAA 1999b, (11) NOAA 1999g, (12) NOAA 1999c, (13) NOAA 1999f, (14) NOAA 1999d, (15) NOAA 2003a, (16) NOAA 2003b, (17) NOAA 2003c

Key: ID = insufficient data; ND = none designated

Note: * = Biogenic structure is derived from biological material such as algae-covered rock, aquatic vegetation, shell beds, and sponges.

3.2 Fish and Wildlife Coordination Act Resource Designations

FWCA resources primarily consist of fish, shellfish and benthic communities, and submerged aquatic vegetation (SAV). These resources can be used by species with EFH in the ROI for food, shelter, or spawning.

3.2.1 Fish

Section 3.3.4 of the EIS for the proposed CHPE Project indicates that up to 128 fish species could occur in the Hudson River. Anadromous American shad (*Alosa sapidissima*), river herring, striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrinchus*), and catadromous American eel (*Anguilla rostrata*) have historically supported important commercial fisheries in the Hudson River (NYSDEC 2012). Life history characteristics of representative marine, diadromous, and freshwater species of the Hudson River are presented in Table H.2-3 in Appendix H of the EIS.

Section 3.4.4 of the EIS indicates that a variety of habitats in the Harlem and East rivers in the New York City Metropolitan Area Segment support marine, estuarine, anadromous, and catadromous fish. Despite the relatively low value of the East River as resident fish habitat, it serves as a major migratory route for some species from the Hudson River to the Long Island Sound. Winter flounder, scup (*Stenotomus chrysops*), bluefish, Atlantic silverside, striped killifish (*Fundulus majalis*), common killifish (*Fundulus heteroclitus)*, striped bass, Atlantic tomcod, members of the herring family, and American eel are among the species seasonally present in the Harlem and East rivers (MTA 2004). Table H.2-3 in Appendix H of the EIS identifies the general spawning periods of marine and estuarine fish species in the Hudson River Estuary, which includes the Harlem and East rivers.

The proposed CHPE Project would intersect the following Significant Coastal Fish and Wildlife Habitats (SCFWHs) in the Hudson River:

- Catskill Creek (MPs 221 to 222)
- Esopus Estuary (MPs 234 to 235)
- Kingston-Poughkeepsie Deepwater Habitat (MPs 245 to 267 and MPs 268 to 270)
- Hudson Highlands (MPs 276 to 295)
- Lower Hudson Reach (MPs 317 to 325).

The shallow, subtidal beds of the Esopus Estuary SCFWH provide spawning, nursery, and feeding habitats for anadromous fish such as striped bass, American shad, and the semi-anadromous white perch (*Morone americana*); and for resident freshwater species, such as largemouth bass (*Micropterus salmoides*), brown bullhead (*Ameiurus nebulosus*), yellow perch (*Perca flavescens*), American eel, carp, and shiners (*Cyprinidae*). Kingston-Poughkeepsie Deepwater Habitat SCFWH supports anadromous fish such as alewife (*Alosa pseudoharengus*), American eel, American shad, blueback herring (*Alosa aestivalis*), and striped bass; estuarine fish such as fourspine stickleback (*Apeltes quadracus*), hogchoker (*Trinectes maculatus*), killifish (*Fundulus diaphanous*), threespine stickleback (*Gasterosteus aculeatus*), and white perch; and freshwater fish such as bluegill (*Lepomis macrochirus*), brown bullhead, common carp (*Cyprinus carpio*), golden shiner (*Notemigonus crysoleucas*), largemouth bass, pumpkinseed (*Lepomis gibbosus*), smallmouth bass (*Micropterus dolomieui*), spottail shiner (*Notropis hudsonius*), white catfish (*Ameiurus catus*), and yellow perch. The Hudson Highlands SCFWH provides striped bass spawning habitat with swift currents, rocky substrate, and freshwater inflow and has some of the highest striped bass egg abundance in the Hudson River Estuary. The Lower Hudson Reach SCFWH provides important wintering habitat for large numbers of young-of-year, yearling, and older striped bass between mid-November and mid-April, with the distinguishing feature being the salt front. Other estuarine/marine fish that use the Lower Hudson Reach SCFWH include yearling winter flounder in winter months (generally from December to April); summer flounder; white perch; and marine fish such as Atlantic tomcod, Atlantic silversides, bay anchovy, hogchokers, and American eel in significant numbers. This area of the river could also be important for marine fish such as bluefish and weakfish young–of-year (NYSDOS 2014).

The transmission line is routed on land to avoid the Haverstraw SCFWH, which provides important habitat for freshwater, anadromous, estuarine, and marine fish. The SAV in Haverstraw Bay SCFWH provides food for fish, invertebrates, and waterfowl and refuge for fish and invertebrates. This SCFWH regularly composes a substantial part of the nursery area for anadromous and estuarine fish such as striped bass, American shad, white perch, Atlantic tomcod, and Atlantic sturgeon. It is also a major nursery and feeding area for marine species such as bay anchovy, Atlantic menhaden, and Atlantic blue crab (*Callinectes sapidus*). River herring spawn in upstream freshwater areas and move south and concentrate in Haverstraw Bay SCFWH before leaving the river in the fall (NYSDOS 2014).

Atlantic and shortnose sturgeon overwinter in Haverstraw Bay. Adult Atlantic tomcod, bluefish, fourspine stickleback, hogchoker, killifish, rainbow smelt, Atlantic silverside, summer flounder, threespine stickleback, white perch, common carp, American eel, and white catfish are also found in this area (NYSDOS 2014).

3.2.2 Shellfish and Benthic Communities

Benthic community structure and population density are dependent on factors including water quality, sediment type, the presence or absence of SAV, and human alterations. Benthic communities vary in distribution in the Hudson River depending on bottom type (i.e., hard or soft substrate), salinity, SAV, and location along the river.

Broadscale sediment type data from the NYSDEC Hudson River Estuary Program indicate that the sediments along the transmission line route primarily consist of sand, sandy mud, muddy sand, and mud. The transmission line occasionally crosses or travels near areas of sandy gravel, gravelly sand, or gravelly mud. There are a couple of locations where the transmission line crosses gravel or travels near gravel. These areas are near MP 269 (Hudson River mile 67) and MP 310 (Hudson River mile 27). The sediment type interpretation is based on the grain size analysis of the cores and grabs with some guidance from the backscatter data. The sediment profile imagery data has also been used to supplement these interpretations. These data represent general trends and are not meant for finescale interpretation (Bell et al. 2006).

The primary purpose of sediment cores sampled during the marine survey conducted for the proposed CHPE Project in 2010 was for geotechnical and chemical characterization of sediments along the route. These cores indicate that surficial sediments (0 to 63 inches [0 to 160 cm] from the sediment surface) along the cable route consists primarily unconsolidated sediments, including the following:

- A range from well-mixed sand and gravel with cobbles to soft silt/clay (Coxsackie Landing [north of the transmission line route] to Kingston)
- Predominantly soft unconsolidated silts with one core with cobble and gravel in a silt/clay matrix (Kingston to Peekskill)
- Soft silts and clays with occasional lenses of fine shell hash (Peekskill to Spuyten Duyvil) (CHPEI 2012l).

The sediments in the Harlem River were characterized as gray to black sands and silts with trace clay and organics (CHPEI 2012l). Although these data can provide a qualitative characterization of surficial sediments, they cannot be used for a quantitative analysis.

The benthic macroinvertebrates in the Hudson River Segment form a diverse community that includes approximately 300 species of annelids, mollusks, crustaceans, and insects. However, the benthic community has been subject to pollution and human alterations over the past 200 years (Levinton and Waldman 2012). Shellfish data are not available for the entire proposed CHPE Project route in the Hudson River, but limited data are available for three discrete areas. Available shellfish information indicates that zebra mussel beds occur sporadically between approximate MP 232 to MP 246 (NYSDEC 2014a). No shellfish beds have been recorded between approximately MP 261 and MP 281 (NYSDEC 2014a). Oyster beds occur from near Ossining at MP 305 to south of the Tappan Zee Bridge near MP 310 (NYSDEC 2014a, AECOM 2011). Section 3.3.4 of the EIS provides additional detail on the shellfish and benthic communities within the ROI in the Hudson River Segment.

The majority of benthic invertebrate species found in the disturbed habitats of the Harlem and East rivers in the New York City Metropolitan Area Segment are tolerant of highly variable conditions. Biological surveys of these areas have found the benthic community to be composed of both suspension and deposit feeders, including polychaetes, crustaceans, and bivalves (Levinton and Waldman 2012). Section 3.4.4 of the EIS provides additional detail on the shellfish and benthic communities within the ROI in the New York Metropolitan Area Segment.

3.2.3 Submerged Aquatic Vegetation

Two predominant species of SAV in the Hudson River Segment are the native water celery (*Vallisneria americana*) and the exotic water chestnut (*Trapa natans*). Due to light penetration limits, plants are generally found in water shallower than 10 feet (3 meters), although beds can be deeper in upriver sections. Other native species of SAV in the Hudson River include the clasping leaved pondweed (*Potamogeton perfoliatus*) and slender naiad (*Najas flexilis*). In addition to the water chestnut, other nonnative species include curly pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) (Findlay et al. 2006, NYSDEC 2013). Mapped *Vallisneria* sp. and *Trapa* sp. are presented in **Attachment 1**. Section 3.3.4 of the EIS provides additional detail on SAV within the ROI in the Hudson River Segment.

The aquatic vegetation in the Harlem and East rivers in the New York City Metropolitan Area Segment is tolerant of highly variable and harsh conditions. Freshwater and marine phytoplankton are the dominant primary producers in these waterbodies. Diatoms are generally the dominant group of phytoplankton. Residence times of phytoplankton species within New York Harbor are short and individuals move quickly through the system. While SAV is not typically found in these waterbodies, macroalgae do occur on hard surfaces and sandy or muddy bottoms (MTA 2004).

4. Assessment of Potential Effects

As indicated in **Section 2.2**, the EFH that occurs within the Hudson River and New York City Metropolitan Area segments of the proposed CHPE Project is nearly identical and supports nearly identical species groups. Additionally, effects on EFH species would be similar, if not identical, to effects on other resources covered under FWCA. Therefore, this assessment of direct, indirect, and cumulative effects on EFH and other resources is not differentiated in the following analysis. Effects on EFH could result from construction, operation, and maintenance activities associated with the proposed CHPE Project. These effects are discussed in the following subsections and summarized in **Table 4-1**. No effects on EFH would be expected from decommissioning of the transmission line. The line would be de-energized and abandoned in place, which would not result in any sediment disturbance or other effects on EFH.

4.1 Effects from Construction

Introduction. During transmission line installation activities in the Hudson, Harlem, and East rivers, vessel operation, and transmission cable installation would result in a temporary disturbance in the water column and substrates from direct bottom disturbance; increased turbidity and associated water quality degradation, lights, noise, and vibrations; and the potential for release of hazardous materials. Sediment disturbance would primarily affect sand, silt, and mud, which serve as EFH for various life stages of red hake, summer flounder, windowpane flounder, winter flounder, scup, clearnose skate, and little skate (see **Table 3-2**). Increased turbidity, noise and vibration, lights, and any release of contaminated materials would affect the water column, designated as EFH for different life stages of various surface water, pelagic, and demersal species, including the black sea bass, summer flounder, winter flounder, Atlantic butterfish, Atlantic sea herring, bluefish, scup, windowpane flounder, and red hake. Forage species for EFH species would be expected to experience similar water column effects. Effects on EFH are expected to be temporary and localized. Fish are expected to move away from the disturbance and would return to the area once the disturbance has ended, minimizing any potential impacts.

As detailed in Sections 5.3.4 and 5.4.4 of the EIS for the proposed CHPE Project, installation of the aquatic transmission line during the spawning season could have a greater impact on fish because it could affect several sensitive life stages, including spawning adults, eggs, and larvae. Impacts could include a behavioral disruption (i.e., interruption or obstruction) of the migration and spawning of adult fish, or physical effects of turbidity on eggs and larvae. However, based on the proposed CHPE Project aquatic construction schedule for the Hudson River Segment (see **Table 2-2**), impacts on most spawning fish and the eggs and larval stages, including the anadromous fish, would be avoided (see Table H.2-3 in Appendix H of the EIS for fish spawning seasons). There is overlap with parts of the spawning seasons for some forage fish such as bay anchovies, killifish, sticklebacks, and sheepshead minnows, and young-of-year for some commercially or recreationally important fish such as Atlantic menhaden and weakfish. The construction window required by the NYSPSC Certificate for the proposed CHPE Project is from May 15 through November 30 in the Harlem and East rivers (CHPEI 2012g, NYSPSC 2013). However, construction activities would be avoided in the Harlem River from December 1 through May 31 (CHPEI 2014a). Restricting construction to this timeframe would avoid impacts on spawning winter flounder, eggs, and larvae. In cases where there is some overlap of spawning and installation activities, impacts are not expected to be significant. Installation activities in any single area would occur over a short period of time, as the cable installation would advance at an average rate of 1.5 miles (2.4 km) per day. The proposed CHPE Project construction corridor, which is 50 feet wide, is approximately 0.9 percent of the total area of the Hudson, Harlem, and East rivers in the vicinity of the proposed CHPE Project. Because available spawning habitat for these species is widespread and the proposed CHPE

Table 4-1. Summary of the Effects of the Proposed CHPE Project on EFH

Effect	EFH Type	
	Water Column	**Sediments (includes sand, silt, mud; sand/shell fragment mix; and sandy shoals in the ROI)**
Proposed CHPE Project Construction and Potential Emergency Repairs		
Riverbed disturbance	♦ N/A	♦ Alteration of habitat from installation of concrete mats ♦ Disruption of habitat features, such as burrows, depressions, and sand waves. ♦ Redeposition of sediments
Sediment resuspension and turbidity	♦ Temporary avoidance of turbidity plumes by EFH species (i.e., juvenile, adult, and spawning adult life stages) and forage species ♦ Potential for resuspending contaminated sediments	♦ Temporary reductions in benthic food sources ♦ Potential for resuspending contaminated sediments
Spills	♦ Decreased water quality ♦ Temporary avoidance of contaminated area ♦ Temporary introduction of contaminants into the water column	♦ Temporary reduction in benthic food sources ♦ Introduction of contaminants to benthic habitat
Noise	♦ Temporary increase in the underwater noise environment and vibrations from construction vessel operation ♦ Temporary displacement of EFH species sensitive to noise vibrations (i.e., juvenile, adult, and spawning adult life stages)	♦ N/A
Blasting	♦ Temporary displacement of EFH species ♦ Potential for resuspending contaminated sediments	♦ Disruption of habitat features, such as burrows, depressions, and sand waves. ♦ Redeposition of sediments
Vessel strikes	♦ Temporary displacement of EFH species within 12 feet (4 meters) of the water surface; expected low chance of vessel-related mortalities	♦ N/A
Lighting	♦ Temporary attraction to vessel lighting and associated increase in predation events	♦ N/A

Effect	EFH Type	
	Water Column	Sediments (includes sand, silt, mud; sand/shell fragment mix; and sandy shoals in the ROI)
Proposed CHPE Project Operations		
Magnetic and induced electric fields	♦ Minimal effects on EFH species in immediate vicinity of the transmission line from magnetic and induced electric fields	♦ N/A
Heat	♦ Minimal effects on EFH species from increased temperatures	♦ N/A
Decommissioning	♦ No impact	♦ No impact

Key: N/A = Not applicable.

Project construction corridor is small, the effects of turbidity are expected to be temporary and localized and would not occur throughout spawning habitat for the entire spawning season. These effects would not cause spawning failure or decrease a species' ability to survive.

SAV is designated as habitat area of particular concern (HAPC) for juvenile summer flounder. SAV would be avoided by the proposed CHPE Project (see **Attachment 1**). SAV is generally found in water depths of less than 10 feet (3 meters), and the transmission line would generally be installed in deeper waters (i.e., greater than 20 feet [6 meters]). Therefore, impacts such as the uprooting and crushing of SAV would be avoided. As detailed in Sections 5.3.4 and 5.4.4 of the EIS, impacts on SAV and macroalgae could occur from riverbed disturbance, turbidity, and sediment redeposition. These impacts would not be significant because the transmission line would not traverse any existing mapped SAV beds (NYSDEC 2014b). Little, if any, SAV is present in the Harlem and East rivers; however, macroalgae does exist in the area. Because the Harlem and East rivers within the New York City Metropolitan Area Segment are already exposed to harsh and variable conditions, impacts are not expected to be significant. Any impacted SAV beds would be expected to regrow once construction activities have ceased.

Shellfish and benthic invertebrates can provide structure and forage for fish with EFH designated in the ROI. Impacts on shellfish and benthic communities could occur from riverbed disturbance and the resulting turbidity and sediment redeposition. However, benthic communities in the Hudson River are already adapted to human disturbances and other impacts such as degraded water quality, dredging, shoreline hardening, and invasive species. Functional communities would be expected to recolonize these areas over time. Recovery times for the benthic communities vary from several months to several years depending on the community composition and severity and frequency of disturbance (Newell et al. 2004, Carter et al. 2008). Construction is expected to occur at MPs 228 through 295 (crossing the Catskill Creek, Esopus Estuary, Kingston-Poughkeepsie Deepwater Habitat, and Hudson Highlands SCFWHs) from August 1 through November 30 to avoid impacts on overwintering, spawning migrations, spawning activity, and larval stages of ESA-listed fish species. Construction is expected to occur at MPs 303 through 324 (crossing the Lower Hudson Reach SCFWH) from July 1 through October 31. The Lower Hudson Reach SCFWH provides important habitat for striped bass from November through April, winter flounder spawning from December through April, and overwintering striped bass and winter flounder. Impacts would be avoided during that time period. The transmission line is routed on land to avoid the Haverstraw Bay SCFWH, which provides valuable habitat for juvenile and adult freshwater, anadromous, estuarine, and marine species.

Riverbed Disturbance. Aquatic installation would occur via jet plow in all locations in the Hudson River and New York City Metropolitan Area segments, except where HDD is used to cross the East River and at water-to-land transitions, where the transmission line is laid on the surface over bedrock or utility line crossings and covered with concrete mats (for a total of 2.4 miles [3.9 km] in the Hudson and Harlem rivers), and in the Harlem River where a 460-foot (140-meter) trench would be blasted at MP 324.5.

Debris removal and installation activities would primarily disturb soft benthic sediments, including silts, clays, and sands. There could be some areas with mixed sand and gravel or silt and clay with cobbles, or shell hash mixed with silt and clay, although these areas are not expected to be common (CHPEI 2012l). Additionally, concrete mats would cover the transmission line in approximately 10 locations in the Hudson River where bedrock is exposed and approximately 65 locations in the Hudson River and 26 locations in the Harlem River over soft sediments as a protective covering for existing utilities (CHPEI 2012a).

Debris removal would occur in the Fall preceding installation activities the next year. During the initial phase of debris removal, the riverbed would be disturbed less than during installation activities. If plow pre-rip is also required and the jet plow is used, impacts would be similar to water jetting, with a similar or smaller impact corridor. Depending on the debris found, it is expected that the total riverbed area disturbed would be a maximum of 15 feet (5 meters) wide along the 94-mile (151-km) portion of the transmission line corridor in the Hudson and Harlem rivers, for a maximum total 171 acres (69 hectares). Along most of the route, it is likely that little or no large debris would be found and the disturbance would be limited to the 3-foot (0.9-meter) grapnel penetration, which would be much narrower than 15 feet. Assuming a disturbance width of 5 feet (1.5 meters), this equates to 57 acres (23 hectares). This would all occur within the area to be disturbed by actual transmission line installation within the following year. A similar number or fewer vessels would be used during debris removal as would be used during installation.

Installation activities could also result in the disruption of transient habitat features such as burrows, depressions, and sand waves and the potential displacement of EFH species at various life stages (e.g., egg, larval, juvenile, adult, and spawning adult). SAV would be avoided (see **Attachment 1**). SAV is generally found in water depths of less than 10 feet (3 meters) and the transmission line would generally be installed in deeper waters. Shellfish data are not available for the entire route in the Hudson River. Zebra mussel beds occur sporadically between approximate MP 232 to MP 246 (NYSDEC 2014a). To avoid the spread of zebra mussels farther in the Hudson River, the Applicant would train and educate transmission system contractors and subcontractors to identify aquatic invasive species, and site-specific prescriptions for preventing or controlling their transport throughout or off of the proposed CHPE Project site. There are no shellfish beds from approximate MPs 261 to 281. The transmission line route is expected to avoid oyster beds documented from Ossining at MP 305 to south of the Tappan Zee Bridge near MP 310. Rock and hard bottom would be avoided whenever possible.

The approximately 94-mile (151-km) portion of the aquatic transmission line route within the Hudson and Harlem rivers would be installed and buried using water-jetting techniques. Jet plow activities would directly affect an area of approximately 25 feet (7.6 meters) on each side of the transmission line (for a 50-foot [15-meter] construction corridor) during cable installation. The total area affected by jet plowing would be approximately 569 acres (230 hectares), including 533 acres (216 hectares) in the Hudson River and 36 acres (15 hectares) in the Harlem River. This area includes settlement zones where the majority of the sediment disturbed by installation of the transmission line would settle. Depressions in the river bottom over the installed cable are anticipated after installation, but the bathymetry is expected to return to pre-installation conditions through natural redeposition of the disturbed material into the trench depression within 3 years (CHPEI 2012c, Newell et al. 1998).

Barge positioning, anchoring, anchor cable sweep, and the pontoons on the jet plow could result in additional riverbed disturbance. Vessel positioning and anchorage during installation of the transmission line can be used in the event that bottom conditions are encountered that either stop forward progress at reasonable tow tension or result in excessive rolling or pitching of the jet plow. In such a case, the barge would be stopped, anchors deployed to hold the barge in position, and obstructions investigated and remedied. Anchors would also be employed during cable splicing and idle periods due to weather conditions. Open water anchorages are not envisioned as a common event. Areas where anchorage is also anticipated include construction of the four temporary water-to-land transition cofferdams in the Hudson and Harlem rivers, and possibly along the 460-foot (140-meter) length of bedrock trenching in the Harlem River (MP 324.5). The collective length of all work areas where anchors might be deployed and potentially result in impacts on benthic habitat is projected to be less than 1 percent of the approximately 94-mile (151-km) portion of the aquatic transmission line route in the Hudson and Harlem rivers. The anchors would have a total impact area of approximately 15 square feet (1.4 square meters) per deployment. Anchors require approximately 200 square feet (18 square meters) (20 feet [6 meters] by 10 feet [3 meters]) to dig in and stabilize. For four anchors, that is a total of 800 square feet (72 square meters) or 0.02 acres (0.01 hectare). Midline buoys would be used to prevent anchor chain sweeps that might otherwise affect benthic habitat. Therefore, the total benthic habitat area of Hudson and Harlem rivers affected by anchorage during cable installation would be small, and the impacts would be temporary.

Recovery rates of benthic macroinvertebrate communities following dredging range from a few weeks or months to a few years, depending upon the type of bottom material, the physical characteristics of the environment, and the timing of disturbance (Hirsch et al. 1978, LaSalle et al. 1991). In a 2-year study in the lower Hudson River, Bain et al. (2006) (as cited in NMFS 2014) reported that within a few months following dredging, the fish and benthic communities at a dredged location were no different from seven nearby sites that had not been dredged, and that there were no indications of a lasting effect at the dredged site.

Where appropriate, concrete mats would be installed to help protect the transmission line in areas with bedrock at or near the surface and over existing submerged infrastructure lines for approximately 1.8 miles (2.9 km) and 1.7 acres (0.7 hectares) of the 88-mile (151-km) aquatic portion of the project route in the Hudson River, and 0.6 miles (1.0 km) and 0.6 acres (0.2 hectare) of the 6-mile (10-km) aquatic portion in the Harlem River. This represents approximately 2.6 percent of the aquatic portion of the transmission line route in the Hudson and Harlem rivers and an even smaller proportion of the habitat. The transmission line would be installed under the East River via HDD. Of the total to be installed in the Hudson River, approximately 1.0 miles (1.6 km) and 1.0 acres (0.4 hectares) of concrete mats would be installed as protective covering for the transmission line in SCFWHs, or less than 0.01 percent of the total acreage of the affected SCFWHs. SCFWHs that would be affected are the Kingston-Poughkeepsie Deepwater, Hudson Highlands, and Lower Hudson Reach SCFWHs. The transmission line is routed on land to avoid the Haverstraw Bay SCFWH, which provides valuable habitat for juvenile and adult freshwater, anadromous, estuarine, and marine species.

The majority of these areas are associated with existing infrastructure areas. Other areas not suitable for cable burial are generally associated with rock outcroppings. The Applicant is committed to burying the cable where possible, as burial provides the greatest protection against interactions with vessels (e.g., anchor drops or snags). Physical surveys, including diver surveys of each utility, would be performed and possibly reduce this estimate. Rock outcroppings would be avoided wherever possible. In the case of the Harlem River, designated cable and pipeline areas extend over substantial areas or occur frequently along the length of the river, so that the placement of protection over the exposed transmission line can be continuous over several adjacent infrastructure elements. The detailed design developed as part of the Environmental Management and Construction Plan (EM&CP) developed for the proposed

CHPE Project would optimize the placement of protection to minimize the area of the bottom covered by concrete mats (CHPEI 2012j).

Hard-bottom habitat is not common within the ROI. Installation of concrete mats could alter EFH if the concrete mats replace soft sediment. The concrete mats would extend 9 inches (23 cm) above the river bottom. Placement of concrete mats over soft sediments would bury the benthic communities that directly underlie them, including potential prey of fish species with designated EFH in the area. The mats could also alter local hydrodynamic conditions such that some sediment deposition or scouring could occur around the mats. However, the overall change in bathymetry would be minimal relative to the available soft-bottom habitat in the Hudson and Harlem rivers and the SCFWHs that occur there, and adjacent habitat would still be available. When the concrete mats are placed in areas of fine sediment, the spaces between the individual concrete elements would be filled by suspended sediment and the surficial habitat would be partially restored. New and functional communities would be expected to recolonize these areas over time. As noted, recovery times for the benthic communities vary from several months to several years depending on the community composition and severity and frequency of disturbance (Newell et al. 2004, Carter et al. 2008). Post-installation monitoring efforts for the Long Island Replacement Cable in 2010 suggested that concrete mats were not a major disturbance to benthic communities after 2 years (ESS Group 2011).

The type of organisms recolonizing over the mats could differ from the original benthic community if portions of the original substrate were soft sediment. In some locations, protective mats would only be used in areas where the existing substrate consists of hard bottom, and the communities recolonizing the new hard bottom created by the mats would be expected to be similar to what had occurred previously. Post-installation monitoring efforts conducted for the Long Island Replacement Cable in 2010 (construction completed in fall 2008) suggested that concrete mats were not a major disturbance to benthic communities. The 2010 monitoring revealed that benthic macroinvertebrate assemblages did not differ significantly in overall abundance, species richness, or community composition between the control and the concrete mats. This report did not indicate any observations of invasive species, with the exception of a naturalized macroalgae that was observed in control and impacted sites. No major seasonal differences in the macroinvertebrate communities were observed (ESS Group 2011). Further, because impacts from installation of concrete mats are expected to be small and localized, and the materials to be used (concrete blocks and cables or synthetic ropes) would not promote the introduction of invasive species any more than other species, significant changes to the benthic community's species composition would not be expected. The placement of the rip-rap or concrete mats would be very limited and generally sporadic and, therefore, would not significantly affect foraging or migration (Scenic Hudson and Riverkeeper 2013). In areas where use of concrete mats or rip-rap could extend some distance, the width of the armoring would only extend over a small area (approximately 8 feet [2.4 meters] in width), leaving ample undisturbed foraging habitat available on either side of the armoring. Species occurring in these affected areas would be able to use adjacent areas for foraging and other activities. Because the area where the mats would be placed is small (2.6 percent) of the transmission line route in the Hudson and Harlem rivers, the impact on habitat would be negligible.

Riverbed disturbance would also include the redeposition of suspended sediment. The estimated thickness of the sediment as it settles back to the riverbed would never exceed 0.4 inches (10 millimeters). Over the 94 miles (151 km) of the Hudson and Harlem rivers that would be plowed during installation of the transmission line, approximately 32 acres (13 hectares) would accumulate 0.2 inches (5 millimeters) or greater in sediment depth. The majority of the sediment redeposition would occur in the 569-acre (230-hectare) area that would be disturbed by the jet plow (CHPEI 2014b). The effects of increased sedimentation in the habitat could include reduced water quality, reduced ability to locate food, decreased gas exchange, toxicity to aerobic species, reduced light intensity in the water column, physical abrasion, and smothering of benthic and demersal species present at the time of the activity (Wilber et al. 2005).

Additionally, some fish species (e.g., clearnose skate and winter flounder) deposit demersal eggs that remain on the bottom until larval hatching, and some of these eggs could be smothered as well. Redeposition of sediments causes larval mortality by clogging gill tissues and through gill abrasion (Reine et al. 1998). Previous experiments have shown that a viable hatch of winter flounder eggs is reduced when the eggs are buried by as little as one half of one egg diameter, approximately 0.02 inches (0.5 millimeters) of sediment (Berry et al. 2003, USFWS 2002). However, EFH for winter flounder eggs is in waters with salinities that from 10 to 30 ppt, impacts would only be expected south of the Tappan Zee Bridge (i.e., near MP 310). The area of impact from sediment redeposition in the lower Hudson River and the Harlem River is approximately 7 acres (3 hectares), representing approximately 21 percent of the transmission line installation route in these rivers. However, construction activities would be conducted in the lower Hudson River from July 1 to October 31 and in the Harlem River from May 31 through November 30. Restricting construction to this timeframe would generally avoid impacts on spawning winter flounder, eggs, and larvae.

Redeposition of sediments could also change the bottom composition of the riverbed if existing coarser grains lie on top of finer grains. The layering could be reversed after sediments are disturbed because finer grains take longer to settle out of the water column. Such a change would affect the species composition of the benthic community, and locally would be composed of those that could thrive in this sediment. Mobile species that prefer coarser sediment grains would likely relocate to areas with coarser grains. Sessile (immobile) species would likely die off locally if they could not adapt to the new sediment conditions (Germano and Cary 2005). However, this effect is expected to be localized and the affected area would be minimal relative to the available habitat.

Sediment Resuspension and Turbidity. Installation of the aquatic transmission line would increase turbidity temporarily in the water column as a result of sediment disturbance and resuspension. This could also disturb previously settled contaminants. Depending on the sediment particle-size composition, the majority (approximately 70 to 80 percent) of the disturbed sediment would be expected to remain within the limits of the trench under limited water movement conditions, with 20 to 30 percent of suspended sediment traveling outside the footprint of the area directly impacted by the plow. With higher currents, more sediment can be transported outside the trench area (HTP 2008, MMS 2009, CHPEI 2012m). Water quality modeling indicates that, on average, the initial sediment plume would be approximately 1 mile (1.6 km) long and 500 feet (152 meters) wide (an area of about 60 acres [24 hectares]). The maximum suspended sediment concentrations would range from 80 to 200 milligrams per liter (mg/L) range above background (depending on sediment properties) in the water column immediately above the sediment bed where the jet plow would be operating. The plume concentrations would be highest near the river bottom. At the surface, concentrations would be approximately one-tenth of the bottom values. The discernible plume width at the bottom would be approximately 500 feet (152 meters) wide. Because maximum concentrations are expected to be 200 mg/L, installation is not expected to exceed 200 mg/L above background at the edge of the 500-foot (152-meter) mixing zone, as required by the CWA Section 401 Water Quality Certification issued for the proposed CHPE Project (NYSDPS 2013). At approximately 4,500 feet (1,372 meters) downstream, which is near the edge of the discernible plume, the maximum concentration would be 10 mg/L above background condition and by approximately 1 mile (1.6 km) downstream the concentrations would be back to background.

Total suspended solids (TSS) would be elevated by 15 mg/L for approximately 9 hours, based on the assumption of 24-hour-per-day installation operations. However, if installation activities cease for longer than 2 hours, the plume would dissipate before operations would be restarted. Plumes would be continually affected by tidal action; over the course of a tidal cycle, they would reverse direction.

Reduced jetting speeds (e.g., 4 knots) would be used to reduce turbidity when crossing sensitive areas such as SCFWHs. The most appropriate speeds would be coordinated with the construction contractor.

The construction contractor would consider existing sediment conditions, cable weight, and multiple other factors to arrive at an installation speed that allows for a reduction in impacts and safe and efficient cable installation. Reductions in TSS would be calculated after the installation specifications have been set as part of the construction design. Furthermore, the transmission line is routed on land to avoid the Haverstraw Bay SCFWH, which provides valuable habitat for juvenile and adult freshwater, anadromous, estuarine, and marine species.

The Applicant has developed and would implement a Water Quality Monitoring Plan for the installation of the proposed CHPE Project transmission line. If TSS concentrations exceed 200 mg/L beyond the 500-foot (152-meter) mixing zone, the Applicant would employ one or more of the following measures: changing the rate of advancement of the jet plow, modifying hydraulic pressures, or implementing other reasonable operational controls to reduce suspended sediments.

Turbidity associated with anchors and the installation of sheet pile is expected to be similar. Turbidity levels during these activities would be expected to be less than 50 mg/L above background, diminishing to 5 to 10 mg/L above background within a few hundred feet (CHPEI 2014b).

An environmental bucket, a variation of the conventional clamshell dredge bucket that has been developed to limit spillage and leakage of dredged material, would be used for the dredging associated with the cofferdams. The enclosed dredge bucket features covers designed to prevent material from spilling out of the bucket while it is raised through the water column. The design also employs rubber gaskets or tongue-in-groove joints that reduce leakage through the bottom of the closed bucket. Environmental buckets were used for the two dredges used for 91 days of dredging associated with the Tappan Zee Bridge construction. None of the TSS samples at the 500-foot (152-meter) mixing zone were more than 200 mg/L over background conditions and more than 90 percent of the TSS samples were less than 100 mg/L over background (TZC 2014). There were also no observations of turbidity resulting in substantial visible contrasts from ambient conditions to the Hudson River outside of the 500-foot (152-meter) mixing zone from dredging. However, sediment properties are site-specific variables that cannot be controlled. In general, fine-grained, less-cohesive sediments have the greatest potential for resuspension and would travel farther before resettling to the bottom. The goal would be to eliminate or minimize to the greatest extent practical sediment resuspension during clamshell dredging. The Applicants propose to achieve this goal by limiting the amount of dredging to only three small cofferdam locations; dredging only inside the cofferdam; positioning the receiving barge as close to the dredging site as possible to minimize dripping into open water; and using well-trained and experienced dredge operators as smooth and controlled hoisting can limit resuspension during clamshell dredging.

The sensitivity of fish to suspended sediment is species- and life-stage-specific, and depends on abiotic factors of the sediment, sediment concentration, and duration of exposure (Berry et al. 2003). Sensitive fish would experience lethal effects from TSS levels of approximately 600 mg/L, although effects at 1,000 mg/L would be more typical (NMFS 2014).

Suspended sediment could cause pelagic eggs to sink to the bottom. Fish larvae are more sensitive to suspended sediments than eggs, juveniles, or adult fish. The installation of the proposed aquatic transmission line would cause a temporary disturbance on benthic habitat, which supports benthic prey items for some EFH species, but would remain usable as EFH. Temporary and localized reductions in available benthic food sources are also anticipated because some mortality of benthic infaunal organisms that serve as prey for EFH species would occur.

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of mg/L before an acute toxic reaction is expected (Wilber and Clarke 2001). The studies reviewed demonstrated lethal effects on fish at concentrations of 580 mg/L over one day for a sensitive species such as Atlantic silversides to no effect at 14,000 mg/L for species such as oyster toadfish and spot.

Jet plowing minimizes dispersal of suspended solids (and any potential sediment contaminants) because the turbidity plume is small compared to conventional dredging. As described, turbidity plumes are not expected to extend over long distances or result in any type of barriers to fish movement. However, turbidity could cause reduced growth rates and increased mortalities in planktonic larvae exposed to the turbidity plume. Adult and juvenile fish would likely leave the area temporarily to avoid unsuitable conditions in the water, such as an increase in turbidity (Clarke and Wilber 2000). This could influence migratory pathways for some fish if the installation of the aquatic transmission lines occurred during spawning season. However, construction windows were designed to avoid and minimize effects on spawing adults, eggs, and larvae of anadromous species in the Hudson River and winter flounder in the lower Hudson River and Harlem River.

The resuspension of contaminated sediments from increased turbidity within EFH could also result in exposure to fish, including some EFH species. If contaminated sediments become bioavailable or biotransferred within food chains, then, depending on the chemical form in which a contaminant occurs, effects on EFH species could occur. Water quality modeling for the proposed transmission cable installation indicates that concentrations of polychlorinated biphenyls (PCBs) would not exceed the water quality standards required by the Section 401 Water Quality Certificate of 0.09 micrograms per liter (µg/L) from MP 228.5 to MP 272.3 and 0.2 µg/L per aroclor from MP 272.3 to MP 330 (NYSDPS 2013). Water quality modeling also indicates that the chronic exposure standards for PCBs (0.5 µg/L) established by the U.S. Environmental Protection Agency (USEPA) and New York State would not be exceeded (NYSDPS 2013). These standards have been established to account for long-term, chronic exposures of aquatic life to PCBs. Since the proposed CHPE Project involves short-term construction activities, the more relevant guideline for assessing PCB concentrations would be the Engineering Performance Standard set by the USEPA for dredging resuspension at the Hudson River PCBs Superfund Site. Following these guidelines, it is expected that PCB concentration increases from resuspension of sediments would be well below the performance standard. No other state water quality standards would be exceeded as a result of transmission line installation activities (CHPEI 2012e, USEPA 2012). As such, contamination effects on EFH and associated EFH species would be negligible. Water quality sampling and monitoring would be conducted during jet plow pre-installation trials and during cable installation. If water quality certification criteria are exceeded or any other sampled contaminant, additional water quality sampling would take place at the location of the exceedance.

Spills. The vessels involved in construction of the proposed CHPE Project would contain fuel, hydraulic fluid, and other potentially hazardous fluids. There is a potential for these fluids to leak or spill into the water causing reduced water quality and potential contamination of sediments and organisms. Hazardous fluid that settles to the bottom could smother recently spawned eggs of EFH species, benthic prey, and vegetation that EFH species rely upon during growth to maturation. It is anticipated that the immediate response of fish to water contaminated with hydrocarbons would be avoidance. Oil has the potential to affect spawning success because of the physical smothering and the toxic effects on eggs and larvae (USFWS 2010). Minor releases of hydrocarbons could also affect benthic food sources. Benthic communities could also be affected by remediation operations or through physical damage to the habitats in which plants and animals live. Sediments trap the oil and affect the organisms that live in or feed off the sediments. The organisms could have toxicity effects from dermal contact or consumption of the oil (USEPA 2011). Small spills of hydrocarbons, particularly diesel fuel, are rapidly dispersed and diluted (NOAA 2006b). Spills in shallow, nearshore areas where benthic communities are closer to the water surface would be expected to have a higher potential for effects. Applicant-proposed measures, including implementation of a spill prevention plan, would prevent and reduce these effects. HDD installation activities at shorelines could result in the release of drilling fluid into the water. This fluid is composed mainly of bentonite clay and water, and can have a similar impact on benthic communities and finfish as suspended sediment. The USEPA considers drilling fluid nontoxic and no toxic additives would be used. Therefore, the only effects on EFH from HDD would be temporarily increased turbidity (composed of inorganic materials) and associated decreased water quality.

Noise. Effects of noise on species with EFH designated in the water column or water surface are expected during the construction period. Continuous noise associated with vessels and machinery would result from the proposed installation of the transmission line under all proposed installation methods. Noise could also result from cavitations (i.e., the sudden formation and collapse of low-pressure bubbles in the water from rotation of the vessel propeller) during vessel starts and stops. As with other cable installation projects (Merck and Wasserthal 2009), the primary source of underwater noise during cable installation activities is expected to be the cable-laying vessel. Research indicates that the underwater noise temporarily generated by the construction vessels used for cable laying would be similar to that of other ships and boats (e.g., pleasure boats, fishing vessels, tug boats, and ferries) already operating in the ROI (JASCO 2006, Popper and Hastings 2009).

Following are the NMFS criteria for physiological impacts from noise on fish:

- Peak sound pressure level (SPL): 206 decibels (dB) relative to 1 micropascal (dB re 1 μPa, the measurement unit for underwater noise in dB)
- Cumulative sound exposure level (cSEL) for fish above 0.07 ounces (2 grams): 187 dB relative to 1 micropascal-squared second (dB re 1 μPa2-s)
- cSEL for fish below 0.07 ounces (2 grams): 183 dB re 1 μPa2-s (NMFS 2013).

Underwater noise generated by cable-laying vessels for the Vancouver Island Transmission Reinforcement Project in British Columbia was similar to that of other ships and boats (e.g., container ships, tug boats, fishing vessels, recreational boats) already operating in the area (JASCO 2006). A summary of typical underwater source pressure levels for various vessel types is presented in **Table 4-2**.

Table 4-2. Underwater Source Pressure Levels for Various Vessels

Vessel Description	Length (feet)	Frequency (Hz)	Total Engine Power (horsepower)	Source Level (dB re 1μPa at 1 meter)
Outboard drive (2 engines, 80 horsepower each)	23	630	80 (two engines)	156
Small Supply Ships	180–279	1,000	N/A	125–135 (at 50 meters)
Mercator TSHD	500	Broadband	29,000	185.7 (dredging)
Semac 1 Pipelay Barge	487	Broadband	N/A	179.2 (pipelaying)
Castoro II Pipelay Barge	426	Broadband	3,350	168.1 (anchor operations)
Setouchi Surveyor Survey Vessel	212	Broadband	2,600 + 2,000 (thruster)	186.0 (using thrusters)
Katun AHTS	222	Broadband	12,240	181.8 (anchor pulling)

Source: Richardson et al. 1995, LGL and JASCO 2005

The source for the cable–laying vessel monitoring by JASCO (2006) was 177 dB re 1 μPa at 1 meter (3.3 feet). The report does not note the ship propulsion system that was monitored or the horsepower of the ship engines. Due to the acoustic source levels there would be no potential for the construction vessels to exceed either the Peak SPL of 206 dB re 1 μPa or the cSEL or 187 dB re 1 μPa2-s or 187 dB re 1 μPa2-s. Noise from vessel movements, cofferdam installation, and rock drilling is not expected to result in injury to fish and is only considered in terms of behavioral response.

NMFS uses a root mean square (rms) SPL of 150 dB re 1 μPa as a conservative indicator of the noise level at which there is the potential for behavioral effects (NMFS 2013). That is not to say that exposure to noise levels of 150 dB re 1 μPa rms would always result in behavioral modifications or that any behavioral modifications would result in harm or harassment of fish, but that there is the potential, upon exposure to noise at this level, to experience some behavioral response.

Behavioral responses could range from a temporary startle to avoidance of an area affected by noise. Based on the modeled noise of a cable-laying ship, behavioral impacts would occur within 1,250 feet (380 meters) from the ship. This is an average, based on a range from 853 to 1,640 feet (260 to 500 meters). That is, noise modeling indicates that 95 percent of the noise louder than 130 dB re 1 μPa would occur within 1,250 feet (380 meters) of the cable-laying vessel with a source level of 177 dB re 1 uPa-1m (JASCO 2006). Based on this information, back calculating the distance to the 150 dB rms SPL isopleth indicates a radial distance of 100 feet from the cable-laying ship. LGL and JASCO (2005) modeled broadband source levels for a dynamically positioned vessel. The source level was 188 dB re 1 μPa at 3.3 feet (1 meter) during dynamic positioning (using 2 bow thrusters and and 2 stern thrusters). Noise propagation modeling indicates the distance to the 150 dB re 1 μPa isopleth is localized, although the distance is not provided. Noise propagation was also modeled for a single workboat such as Yamaha FC-26 with a source level of a 157 dB re 1 μPa at 1 meter (3.3 feet). The 95 percent range from a single workboat to the 110 dB noise level contour was less than 360 feet (110 meters). Most fish have the capability to leave the area when underwater activities that create noise and sound pressure are occurring and returning when activities cease, thereby further reducing effects. Currently, there are no clear indications that noise impacts related to the installation of transmission cables pose a high risk for harming aquatic fauna (Merck and Wasserthal 2009). Because the anticipated noise levels associated with cable laying are relatively minimal (Popper and Hastings 2009), and because the Hudson and Harlem rivers are normally subject to substantial commercial and recreational vessel noise, any incremental increases in sound associated with the cable-laying barge would not cause physical injury from noise and are expected to be negligible. Additionally, construction windows have been developed to avoid impacts on sensitive life stages of anadromous fish, sturgeon, and winter flounder.

Noise from cofferdam installation and rock drilling is also not expected to result in injury to fish and is only considered in terms of behavioral response. Sheet pile cofferdams would be installed with a vibratory hammer. Jones and Stokes (2009) indicated that installation of piles with a vibratory hammer did not result in average peak noise levels greater than 206 dB re 1 μPa or cSEL greater than 187 dB re 1 μPa2-s (NMFS 2014). Vibratory installation noise levels of piles in the Hudson River have been measured at 170 to 185 dB re 1 μPa peak SPL at 33 feet (10 meters), which is well below the threshold expected to cause injury to fish. The maximum 90 percent rms SPL ranged from 158 to 169 dB re 1 μPa at 33 feet (10 meters) and dropped to 106 to 130 dB re 1 μPa at 2,500 feet (762 meters) (Martin et al. 2012). NMFS (2014) indicates that the footprint of the area where noise greater than 150 dB re 1 μPa rms SPL would be experienced is within 33 feet (10 meters) of the pile being installed. Therefore, the behavioral effects associated with cofferdam construction are expected to be localized. Cofferdam construction would be limited to the three HDD water-to-land transition locations in the Hudson and Harlem rivers. Rock drilling, such as that required for blasting, has been measured at 165 dB re 1 μPa peak SPL and 151 dB re 1 μPa rms SPL at 231 feet (70 meters) (Martin et al. 2012). Therefore, behavioral effects are expected to be localized. Measures to startle fish or keep fish away immediately

prior to blasting activities, such as use of sparkler guns or bubble curtains, would be used as conditions dictate. Additionally, rock drilling would only occur in the Harlem River.
Generally, construction is being scheduled to avoid impacts on sensitive life stages of anadromous fish and winter flounder (e.g., spawning migrations, spawning activity, and larval stages). Most of these impacts would be either temporary or intermittent and would be an insignificant effect on fish species in the Hudson River, including species with EFH designated.

Blasting. The burial depth at MP 324.5 where blasting excavation would occur in the Harlem River is specified in the USACE Public Notice as being 6 feet (1.8 meters) below the authorized depth. The planned excavation will cross a former rock peninsula approximately 460 feet (140 meters) in length. Blasting would disturb the river bottom and a trench would be backfilled with the blasted aggregate materials, which would provide habitat for species such as winter flounder and the skate species. Blasting would reduce biomass and photosynthesis of macroalgae in the immediate area; however, it has been demonstrated that macroalgae can recolonize a blasting location within 8 weeks. Additionally, macroalgae are not expected at the depths where the transmission line would be installed. Invertebrates are generally insensitive to pressure and other damage related to blasting (Keevin and Hempen 1997). However, it is assumed that some invertebrates would be crushed or damaged in the immediate vicinity of the blasting and mucking.

If pre-packaged chemical demolition agent was used to excavate the rock, pressure impacts on fish species would not be expected because a shock wave would not be produced. However, if water gel dynamite is used, a shock wave would be produced upon detonation. Fish injury and mortality associated with underwater blasting is related to pressure, energy flux density, and impulse (large, rapid pressure variations) (Keevin and Hempen 1997). Energy flux density is the rate of transfer of energy through a surface and determines the intensity of the shock wave (rate of energy transfer per unit area). The most common injury is swim bladder damage, although other organs, such as gills, kidney, liver, and spleen, can also be damaged. In fish with less well-developed swim bladders, neither the kidneys nor air bladder are injured, indicating that the presence of a swim bladder plays an important role in injuries to other organs. The thickness, location, and physiological connections of the swim bladder also play a role in the occurrence of injuries. Fish with swim bladders connected to the circulatory system appear to be more susceptible to injuries than fish with swim bladders connected to the esophagus. External injuries related to blasting appear to be species-specific and the magnitude of the pressure wave. The presence of the swim bladder might also be related to external injuries. Factors such as size, age, general health, water temperature, and reproductive condition can influence fish mortality related to blasting. Underwater explosions can result in structural abnormalities and mortality of fish eggs. Mortality decreased with distance to the explosion (Keevin and Hempen 1997). Impulse was determined to be the critical factor to result in mortality of larval fish because of the high magnitude over the long distance, although estimates for one project did not predict population-level impacts based on the number of larvae potentially killed (Govoni et al. 2008).

All blasting-related activities are anticipated to be completed from July through November outside of overwintering season for young-of-year, yearling and older striped bass, spawning season for winter flounder, overwintering of winter flounder, and spawning migration for river herring. This is within the construction windows agreed upon by the settlement parties, including the NYSDEC and the NYSDOS. Minimization of blasting effects on fish can be accomplished by means of avoiding blasting during slack tides, chasing fish from the site with an air-gun prior to blasts, or surrounding the site with a bubble curtain to minimize fish entry into the shock zone. Blasting activities would be performed in strict adherence to all industry standards applying to control of blasting and blast vibrations limits in compliance with the Applicant's blasting plan as part of its EM&CP.

Vessel Strikes. The Applicant proposes to use an installation barge, survey boat, crew boat, and tugboat or towboat to coordinate laying of cable. During installation, there would be potential for impacts on fish from vessel strikes. Large vessels such as cable-laying ships have been implicated of vessel strikes because of their deep draft (up to 40 to 45 feet [12 to 14 meters]), which increases the probability of vessel collision, relative to smaller vessels [less than 20 feet (5 meters)] such as those used for installation of the proposed CHPE Project. Vessel strikes of sturgeon have only been identified as a significant concern in the Delaware and James rivers in the Northeast and Mid-Atlantic United States where several vessel-struck individuals are found each year, possibly because unique geographic features in these areas (e.g., potentially narrow migration corridors combined with shallow and narrow river channels) that increase the risk of interactions between vessels and fish (NMFS 2014). Vessel strikes are not considered to be a substantial threat for sturgeon or other fish in the Hudson River because of the depth of the river. Smaller vessels and those with relatively shallow drafts provide more clearance with the river bottom and reduce the probability of vessel strikes. Because the construction vessels used for installation of the proposed CHPE Project transmission line (e.g., tug boats, barge crane, hopper scow) have relatively shallow drafts, the chance of vessel-related mortalities to fish is expected to be low.

The Applicant has proposed measures to minimize impacts from construction vessels on fish, including that all vessels associated with the installation activities would operate at “no wake/idle” speeds (less than 4 knots) at all times in the construction area (defined as marine areas which have a nominal 50-foot [15-meter] width centered along the cable alignment) and in-water depth areas where the draft of the vessel provides less than a 4-foot (1.2-meter) clearance from the bottom. In areas with substantial objects recorded in side-scan sonar and magnetometer surveys, the speed would be reduced to less than one knot. Decreased vessel speeds in shallow waters would provide fish an opportunity to move out of the way of moving vessels, thereby making it unlikely that a collision would occur. Construction would not occur during spawning migration of sturgeon (as described in the Biological Assessment) and other anadromous fish (see **Table 2-2**), avoiding this vital and sensitive portion of their lifecycle.

Based on the types of vessels to be employed and their relatively shallow draft, there should always be sufficient clearance between vessels and the river bottom. The typical draft of the cable installation barge is approximately 12 feet (4 meters), while the Hudson River has a maintained depth of at least 32 feet (10 meters) in its navigation channel and the Harlem River has a maintained depth of at least 15 feet (5 meters). Additionally, reduced vessel speeds would help to avoid vessel strikes for fish near the surface. As such, the possibility of a vessel striking a sturgeon or other fish is discountable.

Lighting. Effects of vessel lighting on EFH species in surface or pelagic waters would occur during nighttime installation of the transmission line. Larval, juvenile, and adult fish could be attracted to lights, making them vulnerable to predation or vessel strikes. To avoid this, the lights used during construction would be intentionally positioned to avoid illumination of surrounding waters, thereby reducing the potential to attract fish. Vessels operating during night construction activities would be equipped with identification lights, and working decks would be illuminated for safety. Because lighting would not be expected to reach the riverbed, effects on demersal fish species and their EFH would be unlikely.

4.2 Effects from Operations, Maintenance, and Emergency Repairs

During operational activities in the Hudson, Harlem, and East rivers, an increase in temperature and magnetic and induced electric fields would be generated by the submerged transmission cables. The transmission line would be installed in a trench at a target depth of approximately 4 to 8 feet (1.3 to 2.4 meters). The Applicant proposes to place the transmission line in a single trench, which would serve to reduce magnetic field levels. The sheathing and insulation around the cables and their burial would effectively eliminate the electric field produced by the cables (Normandeau et al. 2011). The magnetic field associated with the transmission line is calculated at less than 160 mG at the sediment-water interface directly above the buried transmission cables, and up to 600 mG in the areas where concrete mats would be placed over the unburied transmission line. This magnetic field would be extremely localized to the area immediately above the transmission line.

As detailed in Sections 5.1.4 and other similar sections of the EIS, impacts on fish species from operational activities including increased temperature, magnetic fields, and weak induced electric fields would not be expected to be significant because of the localized nature of the impact. Temperature change in the water column would be less than 0.01 °F (0.006 °C) and would not be expected to impact finfish behavior and reproduction. Results from experiments evaluating long-term exposure of benthic species (including flounder [*Plathichthys flesus*]) to a magnetic field of 37,000 mG showed no statistical differences from non-exposed flounder in survival, condition, or reproductive potential (Bochert and Zettler 2004). These experimental values were much more intense than those expected from the transmission line in the Hudson River and New York City Metropolitan Area segments, which are calculated at less than 160 mG at the sediment-water interface directly above the buried transmission cables. While electrosensitive organisms such as sturgeon and American eel can detect electric fields, given the relatively narrow area within which the induced electric field would be detected by fish and the available information of how induced currents affect fish, no significant effects on fish would be expected.

Impacts on SAV from operational activities are not expected to be significant. Any increase in temperature or magnetic or induced electric fields would be negligible and extremely localized (CHPEI 2012g). Additionally, SAV is generally found in water depths of less than 10 feet (3 meters); however, the transmission line would generally be installed in deeper waters, minimizing the potential for impact on SAV.

As detailed in Sections 5.3.4 and 5.4.4 of the EIS, impacts on shellfish and benthic communities could occur from increases in temperature and magnetic and induced electric fields. For a cable buried 3.3 feet (1.0 meter) below the surface, the estimated ambient temperature increase at 8 inches (20.3 cm) below the surface of the sediments would be 9 °F (5.0 °C); however, the ambient temperature increase at the sediment surface directly above the cable is estimated at 1.8 °F (1.0 °C) (CHPEI 2012f, CHPEI 2012j). This is likely overestimated because the cooling effect from natural water flow, which would result in further heat dissipation, and the insulation provided by the sheathing surrounding the transmission cables are not taken into account (CHPEI 2012e, CHPEI 2012g). Overall, heat would dissipate in the sediments, just below the sediment and water interface, which is the biologically productive zone in the sediments. The intensity of the magnetic field is calculated at less than 160 mG at the sediment-water interface, much less intense than experimental exposure values described in Section 5.1.4 of the EIS. The survival and reproduction of benthic organisms are not thought to be affected by long-term exposure to static magnetic fields (Normandeau et al. 2011).

Pre- and post-energizing monitoring programs for benthic communities, sediment temperature, and magnetic fields would be implemented as required by Condition 163 of the NYSPSC Certificate issued for the proposed CHPE Project to evaluate potential operational impacts on benthic communities during the lifespan of the transmission line. The post-energizing benthic surveys would be conducted at the following milestones: (a) 3 years after installation assuming cable energizing, and (b) when the transmission system is operating at 500 to 1,000 MW if it is not doing so 3 years after installation. Sediment post-energizing sampling would be conducted 3 years after installation during the same season as the first benthic sampling event. All studies would be developed in consultation with appropriate resource agencies (NYSPSC 2013).

Magnetic and Electric Fields. The proposed aquatic transmission cables would emit magnetic fields and a weak induced electric field that could be detected by electrosensitive organisms. Additionally, effects from magnetic and induced electric fields associated with the proposed CHPE Project transmission line could occur on EFH. However, given the relatively narrow area along the transmission line within which the fields might be detected by fish and the available information on how induced electric fields affect fish or the habitats used by fish, these effects are expected to be minimal. As described in the following paragraphs, no significant impacts on fish are expected due to induced electric fields and magnetic fields associated with operation of the transmission line.

The movement of charges in a magnetic field can cause an induced electric current (Normandeau et al. 2011). Induced electric fields can be created by water currents such as waves and tides, or the movement of an organism through the Earth's naturally occurring geomagnetic field. Induced electric fields can be increased with the perpendicular movement of an organism or water current relative to a magnetic field associated with a DC transmission line. Induced electric fields can vary with sediment or substrate type (Normandeau et al. 2011). Increases in the induced electric currents would result from operation of the proposed CHPE Project transmission line.

Based on the prevailing geomagnetic field in the area of the proposed CHPE Project, a fish moving east to west perpendicular across the transmission cables at a rate of 4.5 feet (1.4 meters) per second (2.7 knots) would incur a naturally occurring induced electric current of 72×10^{-5} millivolts/cm (mV/cm); a fish moving north to south at the same rate would incur an induced electric current of 67×10^{-5} mV/cm. The maximum induced electric current associated with the transmission cables would be 11.5×10^{-5} mV/cm over 1 foot (0.3 meters) above riverbed at the centerline of the cables. The induced electric field from the transmission cables would therefore contribute, at most, a 17 percent increase in the total induced electric field at all locations compared to the induced electric field due to earth's geomagnetic field in these scenarios (11.5×10^{-5} mV/cm [the maximum induced electric field]/67×10^{-5} mV/cm [the ambient induced electric field that results in the maximum percent increase]) (Bailey and Cotts 2012).

Evidence indicates that electrosensitive organisms such as sturgeon can detect induced electric fields (CMACS 2003, Normandeau et al. 2011). Fish responses to induced currents have been identified as searching for the source and beginning active foraging, or avoiding the source. The evidence for a similar response of sturgeon to bioelectric or simulated electric fields is much more limited. In the context of the environment around the proposed CHPE Project cables, these considerations suggest that sturgeon would likely be able to detect induced electric fields from the ambient geomagnetic field and other existing ambient sources in the environment, and to detect alterations in this field by the cable system. However, the change in the induced electric field calculated from the proposed CHPE Project is a small fraction of that produced by the ambient geomagnetic field and quickly diminishes with distance from the transmission cables. The induced electric field from the Earth or the transmission cables is also considerably weaker than the electric field measured over certain marine sediments. Therefore, the increment in the ambient marine electric field even over the buried cable would not be a unique or novel stimulus nor would it be strong enough to produce physiological responses (Bailey and Cotts 2012).

Because the induced electric field from water flow in a magnetic field is essentially a static DC electric field, it would not seem to be a powerful stimulus to foster feeding behavior as is reported for the low-frequency AC fields that distinguish the bioelectric fields of prey and other fish. Rather than feeding responses associated with AC electric stimuli, electric fields from static DC sources (DC cable and corrosion potentials) might elicit temporary investigatory behavior as has been seen in anecdotal observations of sharks (Tricas and McCosker 1984). Hence, the induced electric field resulting from water current flow or sturgeon swimming in the static magnetic fields in the Hudson River would be more similar to the galvanic electric fields produced by the corrosion potentials from pilings, ships, gas and petroleum pipelines, and virtually all sunken or constructed metal infrastructure (Bailey and Cotts 2012). Altogether, the data are consistent with the idea that a behavioral response of sturgeon to the induced DC electric field from the proposed CHPE Project in the Hudson River, if any, is more likely to be an investigative response (temporary and time-limited because of habituation) than a feeding response associated with the low-frequency AC field such as those produced by the bioelectric electric field produced by fish prey that would be more persistent (Bailey and Cotts 2012).

In experiments based on AC cables, sturgeon (*Acipenser gueldenstaedtii* and *Acipenser ruthenus*) responded to 50- Hz electric fields that ranged from 0.2 to 6.0 mV/cm (Normandeau et al. 2011). At range frequencies of 1.0 to 4.0 Hz and 16 to 18 Hz with field intensities of 0.2 to 3.0 mV/cm, the sturgeon response was to search for the source and begin active foraging. At 50 Hz and field intensities of 0.2 to 0.5 mV/cm, the response was to search for the source and to begin active foraging. At 50 Hz at field intensities of 0.6 mV/cm or greater, the response was to avoid the source (Basov 1999). However, these intensities were orders of magnitude higher than any potential induced currents expected from the proposed DC transmission line.

The depth of the transmission line trench is proposed to be at least 6 feet (1.8 meters) with 1 foot (0.3 meters) or less of horizontal separation between the two cables, which would be collocated in the same trench. Because the magnetic field is strongest at the transmission line and declines rapidly with distance, deeper burial would reduce the magnetic field, but would not eliminate it entirely (CMACS 2003, Normandeau et al. 2011). The magnetic field levels at the riverbed surface directly over the transmission line centerline were calculated to be less than 162 mG, and up to 600 mG in the areas where concrete mats would be placed over the unburied transmission line (CHPEI 2012k, CHPEI 2012i). These magnetic field levels are below the thresholds at which fish behavioral effects have been observed.

Information on the impacts of magnetic fields on fish is limited. A number of fish species, including sturgeons, eels, and salmon, are suspected of being sensitive to such fields because they have magnetosensitive or electrosensitive tissues, have been observed to use electrical signals in seeking prey, or use the Earth's magnetic field for navigation during migration (EPRI 2013). Only limited research has been done, so additional studies are required on the potential effects of magnetic fields on demersal species. The current state of knowledge about the potential impacts on fish from magnetic and electric fields emitted by underwater transmission lines is variable and inconclusive (Cada et al. 2011). However, lake sturgeon (*Acipenser fulvescens*) have exhibited temporarily altered swimming behaviors in response to AC-generated EMF that ranged from 35,100 mG to 1,657,800 mG, and EMF responses disappeared below 10,000–20,000 mG (Cada et al. 2011, Bevelhimer et al. 2013). These magnetic fields are much more intense than those that would be produced by the transmission line, which would be approximately 162 mG at the sediment-water interface or 600 mG at the surface of a concrete mat directly above the buried transmission cables. No observable changes in activity levels or distribution of fathead minnows (*Pimephales promelas)*, juvenile sunfish (*Lepomis* spp.), juvenile channel catfish (*Ictalurus punctatus*), and juvenile striped bass (*Morone saxatilis*) were observed in response to static (DC) fields using a permanent bar magnet (360,000 mG at the magnet surface) (Cada et al. 2011, Cada et al. 2012). The minnows and sunfish are positioned higher in the water column and, therefore, at a greater distance from the lake bottom where the proposed cable would be buried, than the sturgeon. Based on the foregoing, impacts from magnetic field strengths generated from the proposed CHPE Project transmission line on fish species are not expected to be significant.

There has been concern about whether anthropogenic magnetic fields could affect salmonids, which are thought to use the Earth's magnetic field, and visual and olfactory cues, to navigate to natal streams to spawn (EPRI 2013). There is very little information on their responses, but no observations indicate an adverse impact (Gill and Bartlett 2010). American eels rely upon their acute senses of smell to find food and use their olfactory sense along with magnetic cues to navigate to feeding and spawning habitats (American Eel Development Team 2000, Fisheries and Oceans Canada 2013). Current knowledge suggests that magnetic and electric fields emitted from buried submarine transmission cables could influence temporary changes in the swimming direction of freshwater eels if their migration routes involved crossing over cables; this impact was especially evident in water depths of less than 66 feet (20 meters) (Gill and Bartlett 2010, Gill et al. 2012). Various field and laboratory studies on eels exposed to weak magnetic and electric fields showed some evidence that eels respond to stimuli by veering from the field source (Normandeau et al. 2011, Gill et al. 2012), but the implications of this altered behavior are not known. However, results from these studies provided little information to suggest that detection or a temporary veering response correlated further with inhibition of an eel's migrating, homing, or feeding capabilities. Nonetheless, the predicted magnetic fields for this project are below the thresholds at which fish behavioral effects have been observed.

Several fish species, including sharks, are suspected of being sensitive to such fields because they have magnetosensitive or electrosensitive tissues, have been observed to use magnetic and electrical signals in seeking prey, or use the Earth's magnetic field for navigation during migration (EPRI 2013). Research indicates that fish species with demersal EFH (e.g., summer flounder, winter flounder, and clearnose skate) are more likely to be exposed to higher field strengths, which are closer to the river bottom where the transmission line would be buried, as compared to pelagic species, which are found higher in the water column (Normandeau et al. 2011). However, there are uncertainties about how fish respond to these fields and whether they would inhibit a species ability to feed, reproduce, and survive. As described, research indicates that sturgeons in fresh water that were exposed to AC-generated electromagnetic fields that ranged from 35,100 mG to 1,657,800 mG altered their swimming direction (Cada et al. 2011). In contrast, research on European flounder (*Plathichthys flesus*) exposed to a magnetic of field of 37,000 mG showed no behavioral changes or effects on survival (Bochert and Zettler 2004). Results from experiments that exposed fathead minnows, juvenile sunfish, juvenile channel catfish, and striped bass to 360,000 mG showed no evidence of changes in behavior or activity (Cada et al. 2011, Cada et al. 2012). In each of these studies, however, the magnetic field levels were orders of magnitude higher than would be generated by the proposed CHPE Project transmission line; therefore, it is logical that EFH species would not be adversely affected.

Laboratory studies that exposed rainbow trout (*Onchorhynchus mykis*), brown trout (*Salmo trutta*), carp (*Cyprinus carpio*), and northern pike (*Esox lucius*) fish eggs and larvae to magnetic fields ranging from 5,000 mG to 150,000 mG resulted in changes in embryonic development and movement (Formicki and Perkowski 1998, Formicki and Winnicki 1998, Winnicki et al. 2004). However, survivability was not discussed. These species serve as a surrogate for other species expected to occur in the proposed CHPE Project ROI. The increase in magnetic field strength at the sediment surface is approximately 162 mG where the transmission line is buried or 600 mG above concrete mats, and would decrease with an increase in distance from the river bottom (i.e., in the water column). Because laboratory experiments used exposures that are 1 to 3 orders of magnitude higher than the magnetic field strengths of those expected from the proposed CHPE Project transmission line, the effect of the magnetic field on fish eggs and larvae is expected to be negligible, even for benthic eggs and larvae.

Impacts on shellfish and benthic communities associated with operation of the transmission line could occur due to magnetic fields and increases in temperature. According to studies, the survival and reproduction of benthic organisms are not thought to be affected by long-term exposure to static magnetic fields (Normandeau et al. 2011). Several marine benthic invertebrates, including the blue mussel (*Mytilus edulis*) and North Sea prawn (*Crangon crangon*), survived 37,000 mG with no apparent effects (Bochert and Zettler 2004). However, physiological changes (20 percent decrease in hydration and a 15 percent decrease in amine nitrogen values) were detected in blue mussels exposed to magnetic fields of 58,000, 80,000, and 800,000 mG. Experiments that exposed two freshwater mollusks, the Asiatic clam (*Corbicula fluminea*) and the freshwater snail (*Elimia clavaeformis*), to 360,000 mG showed no evidence of changes in activity (Cada et al. 2011). In these cases, experimental exposure values for magnetic fields are much more intense than those expected from the proposed CHPE Project transmission line in the Hudson River, which is calculated at less than 160 mG at the sediment-water interface directly above the buried transmission cables buried at 3.3 feet (1 meter). This field would be extremely localized. According to studies, the survival and reproduction of benthic organisms are not thought to be affected by long-term exposure to static magnetic fields (Bochert and Zettler 2004, Normandeau et al. 2011).

Heat. During operation of the transmission line, heat loss from the cables could be expected, and would result in increased temperatures in the sediments around the cables. Although there would be some changes in temperatures in the sediments immediately surrounding the cables, the depth of the burial and insulating and armoring factors of the cable would minimize effects on the benthic habitats in the immediate vicinity (CHPEI 2012c). As described in the EIS (DOE 2013), operation of the underwater cables would not result in more than a negligible increase in water temperature. It is estimated that for cable burial at 4 and 8 feet, the maximum expected temperature change would be less than 0.001 °F (0.0001 °C and 0.0002 °C, respectively) in the water above the riverbed, approximately 1.8 °F (1.20 °C and 1.24 °C, respectively) at the riverbed surface, and 9 °F and 4 °F (5.0 °C and 2.5 °C), respectively, at 0.2 meters below the riverbed surface (CHPEI 2012j). Low and high estimates were calculated for gravel, sand, and clay/silt sediments, and this range represents the lowest and highest of those estimates. Heat from the cables and the associated localized increase in temperature would dissipate in the sediments, just below the sediment and water interface, which is the biologically productive zone in the sediments.

Where the transmission cables cannot be buried to their full depth due to utilities or bedrock and must be covered with concrete mats, the estimated increase in ambient water temperature surrounding the cables covered by the concrete mats is expected to be negligible (less than 0.25 °F [0.14 °C]). This is expected to be within the range of daily variation of water temperatures experienced in the Hudson and Harlem rivers. The highest increase in ambient temperature in the top 2 inches (5 cm) of sediment along the sides of the concrete mat is expected to be 1.3 °F (0.7 °C) or less (Exponent 2014). Because the area of concrete mats is so small, any effects would be localized and not expected to have significant impacts on EFH.

Temperature increases associated with operation of the transmission line would not have more than a negligible impact on shellfish and benthic communities. The temperature increase in the top 6 inches (15 cm) of sediment where most benthic infauna (bottom-dwelling aquatic animals) occur would be less than 9 °F (5.0 °C), diminishing to 1.8 °F (1.0 °C) above ambient conditions at the sediment surface directly above the cables (CHPEI 2012e, CHPEI 2012g, CHPEI 2012j). Under normal conditions, near-surface sediments (0–2 inches [0–5 cm]) closely follow the temperature profile of the overflowing water (Lenk and Saenger 1998 and Clark et al. 1999 as cited in McDonough and Dzombak 2006). As such, any increase in temperature at the sediment water interface would be expected to be well within the range of variation throughout the year. Further, this temperature increase would be narrowly focused directly over the cable line and would dissipate rapidly with distance to either side of the centerline. Any measurable amount of local heat generation would not pose a physical barrier to fish passage and would allow SAV, macroalgae, and benthic organisms to colonize and demersal fish species (including demersal eggs and larvae, such as for winter flounder) to use surface sediments without being affected. Organisms living 2 to 6 inches (5 to 15 cm) below the riverbed surface might be adversely affected but this would be limited to within a few feet of the transmission line in sediment. Results from the 30-month post-installation monitoring for the Cross Sound Cable Project in Long Island Sound indicated that the benthos within the transmission line corridor for this project continues to return pre-installation conditions. The presence of amphipod and worm tube mats at a number of stations within the transmission line corridor are indicators that suggest construction and operation of the transmission line did not have a long-term negative effect on the potential for benthic recruitment to surface sediments (Ocean Surveys 2005). Therefore, the small increase in riverbed temperature associated with the proposed CHPE Project is similarly considered to be within normal ranges of variation and would not significantly alter EFH, and no residual effects are predicted (SSE 2009). A pre- and post-energizing benthic monitoring program would be developed in accordance with Certificate Condition 163 to evaluate operational impacts from magnetic fields and heat during the lifespan of the transmission line on benthic communities (NYSPSC 2013).

No effects on EFH or fish that use EFH would be anticipated from periodic non-intrusive inspections of the transmission line. During emergency repairs, effects from sediment disturbance and turbidity on EFH species would be similar to those described during initial construction and installation but on a smaller scale and for a shorter duration. Additional impacts associated with emergency repairs could include those associated with lighting and noise. Effects associated with emergency repair would be localized and temporary, lasting only for the duration of such activities.

Decommissioning. No effects on EFH or fish that use EFH would be anticipated from decommissioning of the proposed CHPE Project transmission line because the line would be de-energized and abandoned in place following expiration of its useful life.

4.3 Cumulative Effects

Cumulative impacts result from the "incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions"; they can result from "individually minor but collectively significant actions taking place over a period of time" (40 CFR Part 1508.7). Other actions in the proposed CHPE Project area that were considered for potential cumulative effects are summarized in **Table 4-3** and described in detail in Section 6.1.1 of the DOE EIS (DOE 2013).

Generally, other projects would result in temporary cumulative effects on EFH if construction activities overlapped with the proposed CHPE Project. Dredging activities associated with these other projects could disturb aquatic substrates, temporarily increase turbidity, resuspend contaminants that might be present in the sediment into the water column, temporarily increase noise and vibration, create light sources during nighttime construction, and increase the potential for spills. Levels of suspended sediments from the combined activities would reduce with distance from the disturbances and would diminish after activities have ceased. Recovery times for the benthic communities vary from several months to several years depending on the community composition and severity and frequency of disturbance (Newell et al. 2004, Carter et al. 2008). Post-installation monitoring efforts for the Long Island Replacement Cable in 2010 suggested that concrete mats were not a major disturbance to benthic communities after two years (ESS Group 2011). Recolonization of affected areas would begin to occur shortly after activities have ceased. Given the limited temporal overlap of the proposed CHPE Project and these other projects, cumulative effects on EFH species would be temporary and negligible.

Table 4-3: Other Actions Considered for Potential Cumulative Impacts

Action	Brief Description	Project Overlap
Hudson River Navigation Channel Dredging	Maintaining the Hudson River Federal Channel between Waterford and New York City to a depth of 32 feet (10 meters).	Current project completion expected prior to construction activities associated with the proposed CHPE Project. The CHPE Project would also be designed not to interfere with potential future dredging projects.
Hudson River PCB Dredging Project	Targeted dredging, removal, and disposal of approximately 2.65 million cubic yards (2 million cubic	Spatially separated upstream from the proposed CHPE Project.

Action	Brief Description	Project Overlap
	meters) of PCB-contaminated sediment from the Upper Hudson River and the Champlain Canal.	
Redevelopment of Stony Point Waterfront	Potential redevelopment of waterfront into 300 housing units, a new marina with 125 boat slips, yacht clubs, and restaurants.	No anticipated cumulative impact due to temporal and spatial separation.
Tappan Zee Hudson River Crossing Project	A replacement Tappan Zee Bridge (Interstate 287/Interstate 87), which crosses the Hudson River between Rockland and Westchester counties.	Anticipated construction overlap could last for approximately 1 to 2 weeks while proposed CHPE Project transmission cables are installed in this area, which could occur between 2014 and 2017.
Spectra-Algonquin Incremental Market (AIM) Natural Gas Pipeline	Creating additional pipeline capacity to deliver natural gas to New York, Connecticut, Rhode Island, and Massachusetts.	The target in-service date for the AIM project is November 2016 with construction proposed to begin in the first quarter of 2015 and scheduled to last 1.5 years, and could overlap with the proposed CHPE Project.
Haverstraw Water Supply Project	A new water source proposal to meet long-term water supply needs in Rockland County, New York.	Construction and installation activities could overlap, spatially and temporally, with the proposed CHPE Project.
Establishment of a Federal Anchorage Ground in the Hudson River	A proposed new Federal anchorage ground, Anchorage Ground No. 18, in the Hudson River west of Yonkers, New York.	The proposed CHPE Project would traverse this anchorage ground between approximately MPs 319 and 320.
West Point Transmission	A proposed 1,000-MW (expandable up to 2,000 MW) electric transmission link that would connect Athens, New York, to Buchanan, New York.	No official timeline; however, these projects could affect similar resources with the Hudson River.
West Point Net Zero Project	Various types of proposed Net Zero energy technology actions that might be implemented alone or in combination to meet U.S. Army Garrison West Point's requirements for energy.	A water intake pipeline would be installed in the Hudson River that would extend approximately 1,500 feet (457 meters) inland from the Hudson River shoreline between MP 283 and 284.
Hudson Project	A 660-MW electric transmission link between Ridgefield, New Jersey, and New York City, running underneath the Hudson River.	This project is approximately 4 miles south of the proposed CHPE Project at its closest and the two are not collocated.

5. Conclusions

5.1 EFH Species

Based upon the status of EFH designated within the ROI, the primary effects on EFH and associated species from construction activities would include temporary and localized habitat degradation, reduction in prey availability in the immediate area, reduced ability to locate prey from increased turbidity, potential for temporary disturbance of spawning, toxicity effects from sediment resuspension (including potential for resuspending contaminated sediments), behavioral effects from increased noise in the water column, potential for increased predation from vessel lighting on the water during night construction, and the potential for effects from hydrocarbon spills. Impacts on the critical life stages of spawning adults, eggs, and larvae would be avoided based on the construction schedule. Because of the temporary and localized nature of the construction, impacts are not expected to be significant.

Localized effects from heat from the transmission cables and magnetic and induced electric fields generated within the habitat would also occur, and could reduce habitat quality for EFH species as a result of operation of the transmission line. Because the transmission line itself would be designed to be maintenance-free, no effects on EFH or species that use EFH would be anticipated from maintenance activities. Because of localized and negligible increases of induced electric fields, magnetic fields, and temperature, impacts are not expected to be significant.

Effects on EFH from emergency repairs would be similar to, but less than, effects from construction. The DOE has, therefore, determined that implementing the proposed CHPE Project would have no adverse effects on EFH or EFH species and would result in only temporary and minor effects. A summary of effects on each specific type of EFH was presented in **Table 4-1**.

5.2 FWCA Resources

Construction of the transmission lines would result in a temporary reduction in shellfish and benthic communities. Benthic communities are expected to recolonize the area within weeks to 2 years. No effects on SAV or macroalgae are expected because they are not expected to occur at the depths where the transmission line is being installed. However, if any macroalgae are affected at the blasting site in the Harlem River, they are expected to recolonize in weeks. Effects on fish that are not managed by NMFS are expected to be similar to those that are managed by NMFS. However, construction of the transmission line would avoid the spawning seasons of anadromous fish.

Pre- and post-energizing monitoring programs for benthic communities, sediment temperature, and magnetic fields would be implemented as required by Certificate Condition 163 (NYSDPS 2013) to evaluate potential operational impacts on benthic communities during the lifespan of the transmission line.

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6. Avoidance and Minimization Measures

As part of its application development process, the Applicant detailed a number of industry-accepted best management practices (BMPs) that it would undertake to avoid or reduce environmental impacts during construction and operation of the proposed CHPE Project. These impact reduction measures, collectively referred to as BMPs, have been taken into account in the environmental analyses conducted for this EFH Assessment. These measures include spill prevention plans, time-of-year work restrictions, water quality monitoring, and inspection and reporting. A list of specific BMPs proposed by the Applicant as part of the proposed CHPE Project and considered in the EIS analyses is provided in **Appendix G** of the EIS (DOE 2013). The following are Applicant-proposed measures that would avoid and minimize effects on EFH. Minimization measures would continue to be developed with NMFS throughout the consultation process.

- The Applicant has proposed to establish the Hudson River and Lake Champlain Habitat Enhancement, Restoration, and Research/Habitat Improvement Project Trust. The purpose of the Trust will be "protecting, restoring, and improving of aquatic habitats and fisheries resources in the Hudson River Estuary, the Harlem and East Rivers, Lake Champlain, and their tributaries, in order to minimize, mitigate, study, and/or compensate for temporary aquatic effects and potential long-term aquatic effects and risks to these water bodies from Facility construction and operation" (NYSPSC 2013).
- In areas of exposed bedrock and existing submerged utility lines, concrete mats would be installed to help protect the transmission lines.
- Based on the seasonal aquatic construction schedule for the proposed CHPE Project, effects on many spawning fish would be avoided (see **Table 2-2** for the construction schedules in specific areas of the Hudson and Harlem rivers).
- The NYSPSC Certificate requires the Applicant to undertake a series of pre- and post-installation compliance monitoring studies, including benthic habitat and sediment monitoring, bathymetry, sediment temperature, and magnetic fields. Pre-installation surveys would be conducted prior to debris removal. Post-installation bathymetric surveys, conducted 1 and 3 years after installation, would be used to monitor the recovery of the bottom substrate by comparing the results to the pre-installation survey, which would use the same techniques. The overall objective of the surveys would be to obtain the highest quality hydrographic data using commercially available equipment and techniques. Equipment that would be used includes a high resolution side-scan sonar system with a dual frequency (100 and 500 kiloHertz) towfish, a vessel motion sensor (heave, pitch, and roll) and heading sensor, real time kinematic GPS, and a shore-based GPS receiver. The entire cable route would be surveyed in the first year to compare with the bottom elevations of the pre-installation survey. Segments where the substrate has returned to the pre-installation configuration would not be resurveyed. Segments that have not returned to pre-installation condition after 3 years would be resurveyed after 5 years and 8 years after cable installation. Each survey would take about 35 days and would likely be conducted in the late summer and early fall. The speed of the vessel conducting the survey would depend on the water current speed and the weather. It is expected that the average speed of the vessel while surveying would be about 3 to 4 knots. Transit speeds would be 8 to 10 knots. The side-scan sonar system would be operated with a towfish height above the bottom that provides adequate coverage.
- The Applicant would work closely with Federal and state agencies to establish measures prior to construction commencement to avoid or minimize effects on protected aquatic resources along the transmission line route.

- All in-water work would be conducted within applicable time windows recommended by the NYSDEC, New York Natural Heritage Program, NMFS, and the U.S. Fish and Wildlife Service (if applicable) for the protection of EFH along the transmission line route (see **Table 2-2**).
- HDD techniques would be used for the cable installation where the lines enter and exit waterbodies to avoid or minimize effects on shoreline and shallow water habitats.
- A sheet pile cofferdam would be placed at the HDD exit point in the waterbody prior to excavation of the exit point pit. The cofferdam would remain in place and functional during all phases of the dredging operations and would be removed upon completion of dredging activities.
- Weighted silt curtains suspended on floats would be positioned to enclose the work site before commencing any mechanical dredging. The curtain would remain in place and functional during all phases of the dredging operations and remain in place for 2 hours after dredging termination.
- An environmental or closed clamshell dredge would be used during excavation of HDD pits in waterbodies to minimize suspension of fine-grained unconsolidated (silty) sediments.
- The Applicant would adhere to all current proper ballast water management regulations.
- The Applicant would train and educate transmission system contractors and subcontractors to identify aquatic invasive species and site-specific prescriptions for preventing or controlling their transport throughout or off of the proposed CHPE Project site.
- The Applicant would require that vessels, equipment, and materials be inspected for, and cleaned of, any visible vegetation, algae, organisms and debris, before leaving the waterbody for another.
- An Environmental Inspector or Aquatic Inspector would have the authority to modify or suspend construction if any EFH is affected in any way by construction activities.
- During nighttime construction activities, vessels would be outfitted with identification lights and working decks would be illuminated for safety. Lights would not be directed into surrounding waters, thereby reducing the potential for effects on benthic communities and fish.
- All vessels associated with construction of the proposed CHPE Project would operate at "no wake/idle" speeds (i.e., less than 4 knots) at all times while in the construction area and while in water depths where the draft of the vessel provides less than a 4-foot (1.2-meter) clearance from the bottom. In areas with substantial objects recorded in side-scan sonar and magnetometer surveys, the speed would be reduced to less than one knot. All vessels would preferentially follow deepwater routes (e.g., marked channels) whenever possible.
- Reduced in-water pressure and jetting speeds (e.g., less than 4 knots) would be used to reduce turbidity when crossing sensitive areas such as SCFWHs. The most appropriate speeds would be coordinated with the construction contractor, who would consider existing sediment conditions, cable weight and multiple other factors to arrive at an installation speed that allows for a reduction in impacts and safe and efficient cable installation. Reductions in TSS would be calculated after the installation specifications have been set as part of the construction design phase.
- Commencement of in-river work south of the Haverstraw Bay SCFWH would occur during the high, or flood, tide condition to avoid or minimize impacts of re-suspended sediments on Haverstraw Bay, which contains important habitat for protected and sensitive species.
- Blasting would occur between July 1 and November 30. Measures to startle fish or keep fish away immediately prior to underwater blasting activities, such as use of sparkler guns or bubble curtains, would be used as conditions dictate.

- All vessels associated with the construction of the proposed CHPE Project would operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a 4-foot (1.2-meter) clearance from the bottom. All vessels would preferentially follow deepwater routes (e.g., marked channels) whenever possible.

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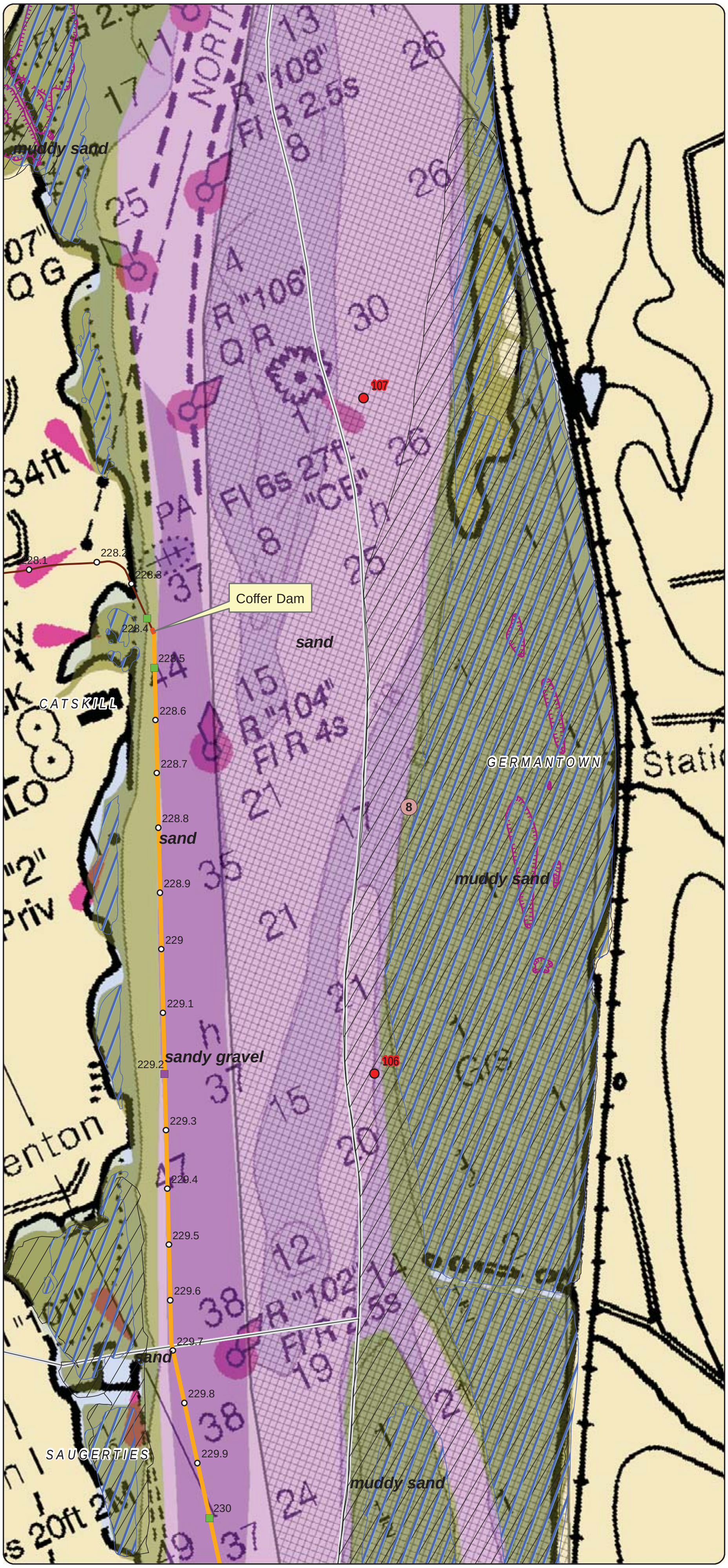
ATTACHMENT 1

Resources along the Proposed CHPE Project Route in the Hudson River



LEGEND

- Hudson River Miles
- Potential Mattress (Rock or Stiff Soils)
- Potential Mattress (Utility Crossings)
- CHPE Route Mileposts
- Proposed CHPE Submarine Route HVDC
- Proposed CHPE Terrestrial Route HVDC
- Coffer Dam
- Significant Coastal Fish and Wildlife Habitat
- Exclusion Zones (NYSDEC) — 4 Zone Number
- Contamination Site
- NMFS Identified Atlantic Sturgeon Habitat
- Submerged Aquatic Veg: Valsineria (NYSDEC)
- Submerged Aquatic Veg: Trappa (NYSDEC)

Sediment Type - NYSDEC Hudson River Estuary Program

- gravel
- gravelly mud
- gravelly sand
- mud
- muddy gravel
- muddy sand
- sand
- sandy gravel
- sandy mud
- State Boundary
- County Boundary
- Town Boundary

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 1 of 43

Created: 6/18/2014

by: HDR & TRC

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

Note: Soundings are in feet. Please see NOAA website for details on chart symbology.

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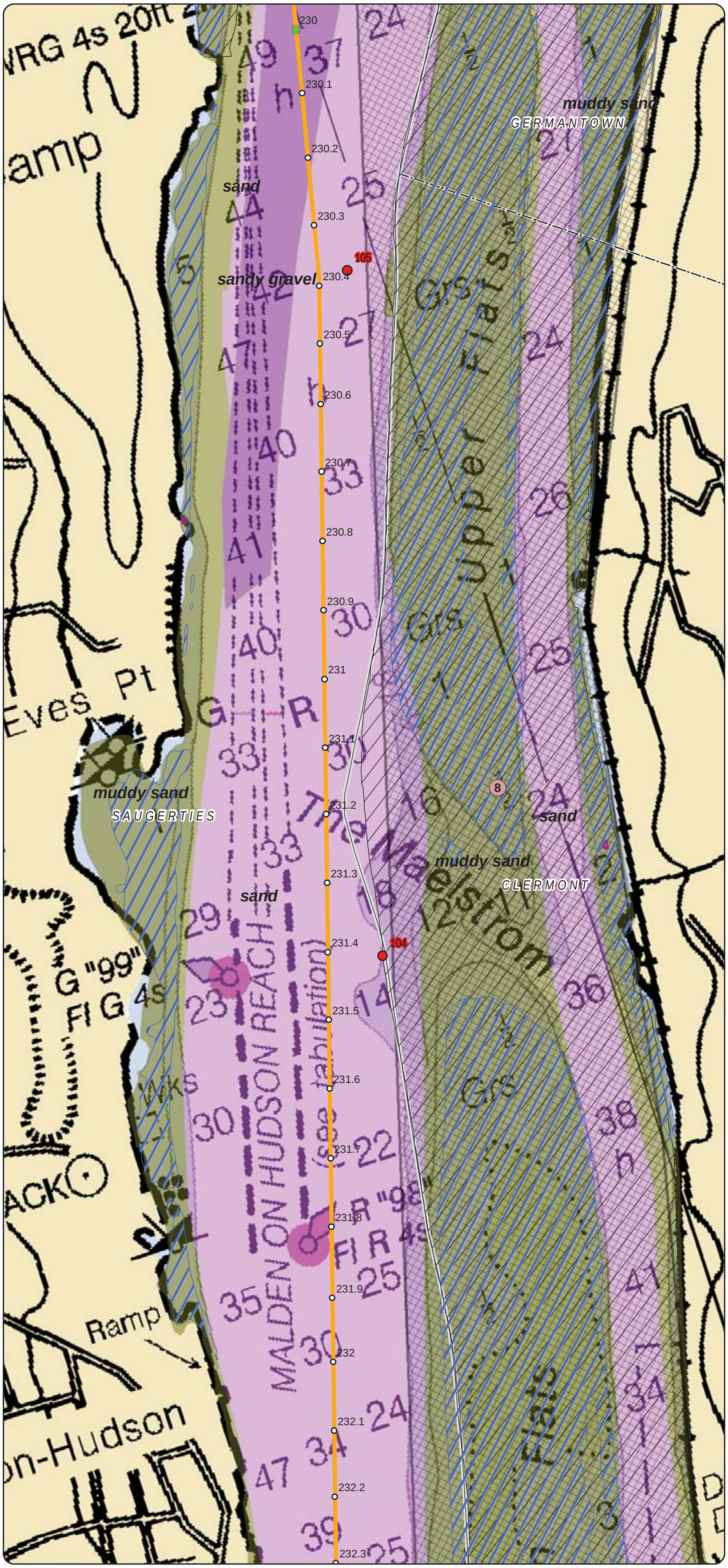

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- sandy gravel
- sandy mud
- State Boundary
- County Boundary
- Town Boundary

N

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Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 2 of 43

Created: 6/18/2014

by: HDR | TDI & TRC

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

Note: Soundings are in feet. Please see NOAA website for details on chart symbology.

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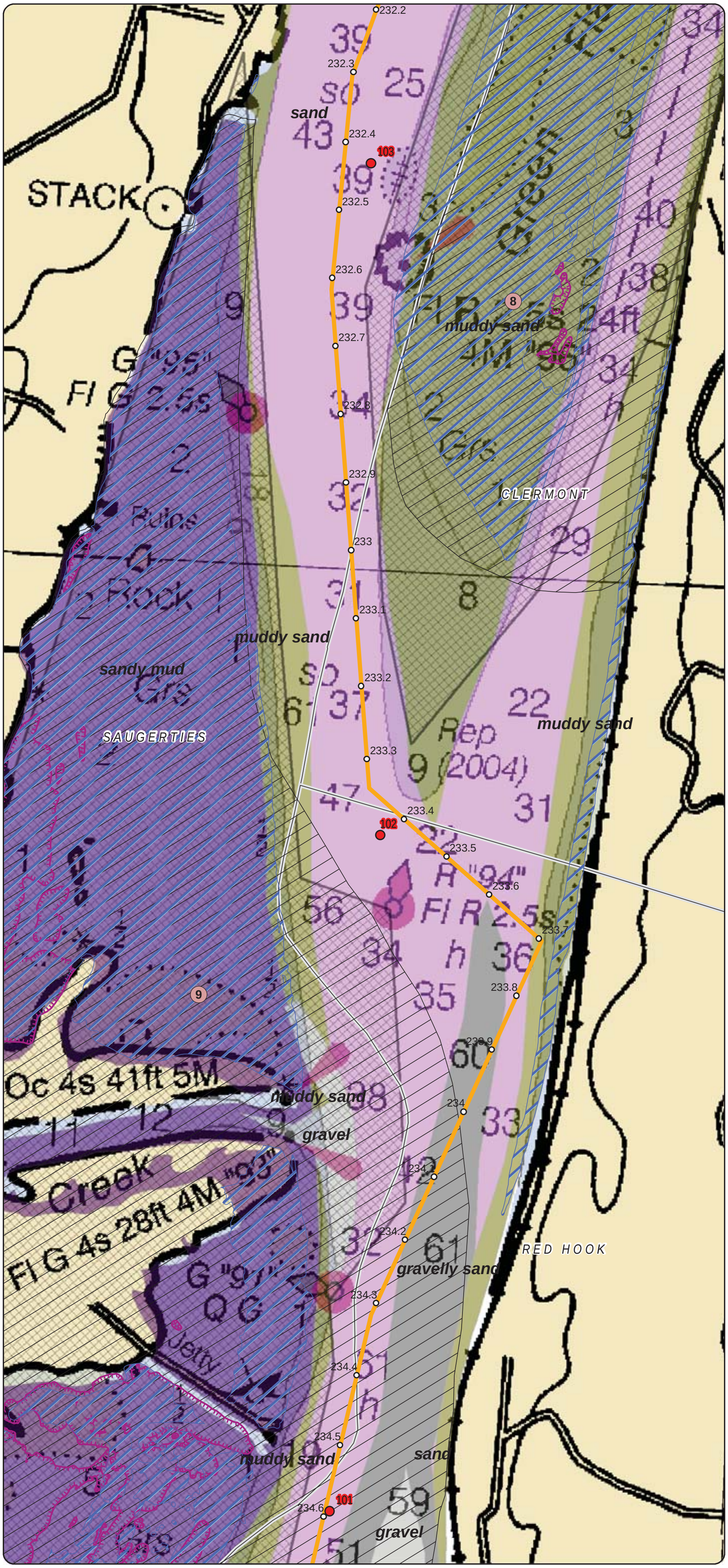

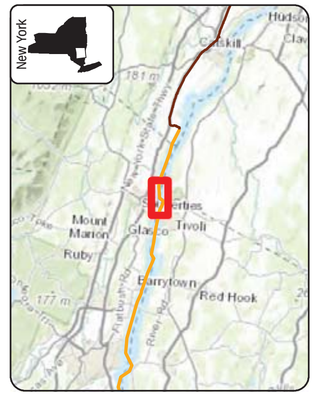

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- County Boundary
- Town Boundary

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Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 3 of 43

Created: 6/18/2014

by: HDR & TRC

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

Note: Soundings are in feet. Please see NOAA website for details on chart symbology.

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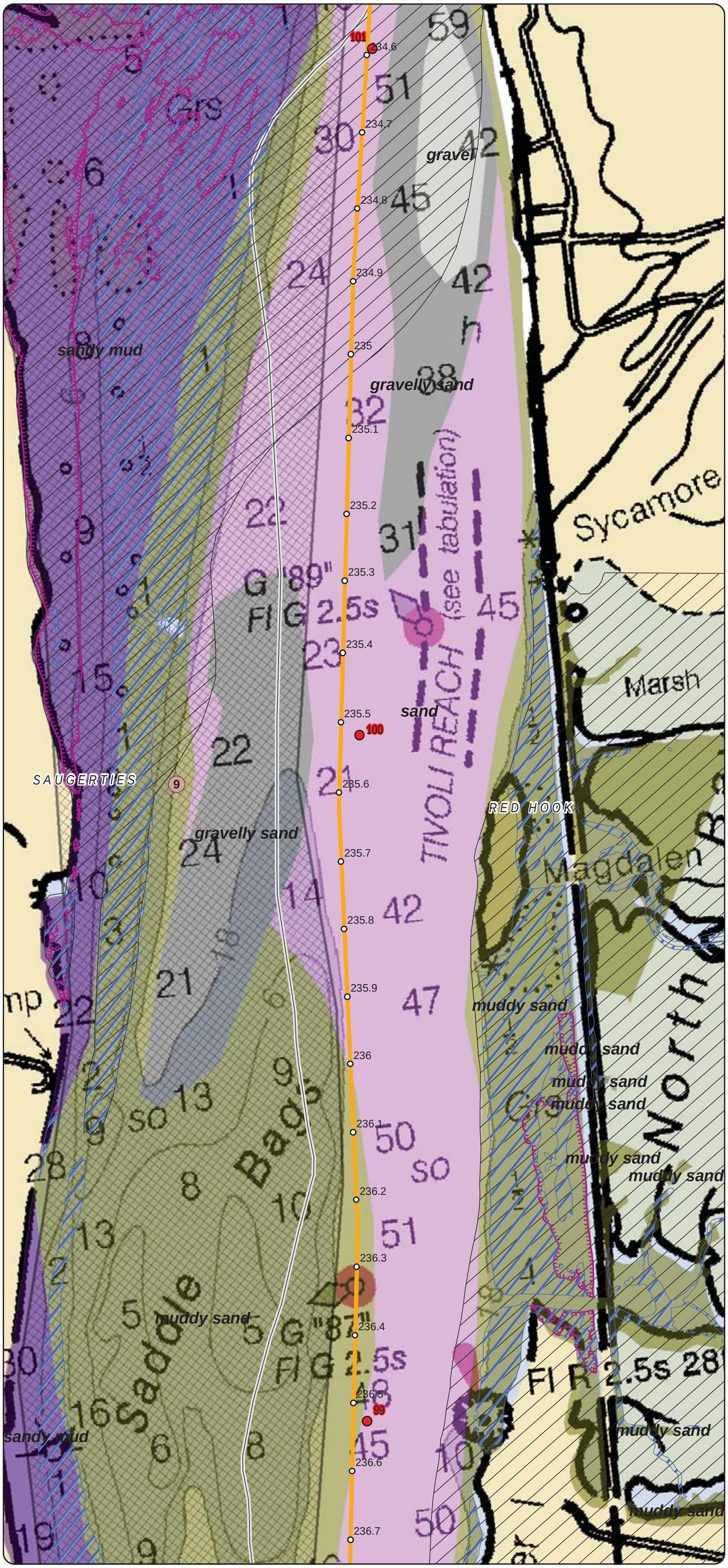

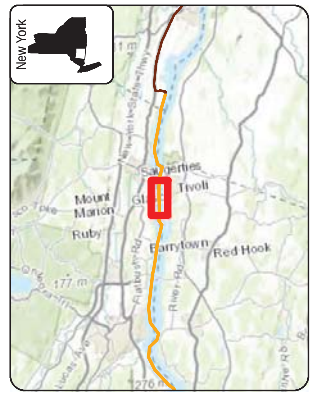

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- County Boundary
- Town Boundary

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Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 4 of 43

Created: 6/18/2014

by: HDR & TRC

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

Note: Soundings are in feet. Please see NOAA website for details on chart symbology.

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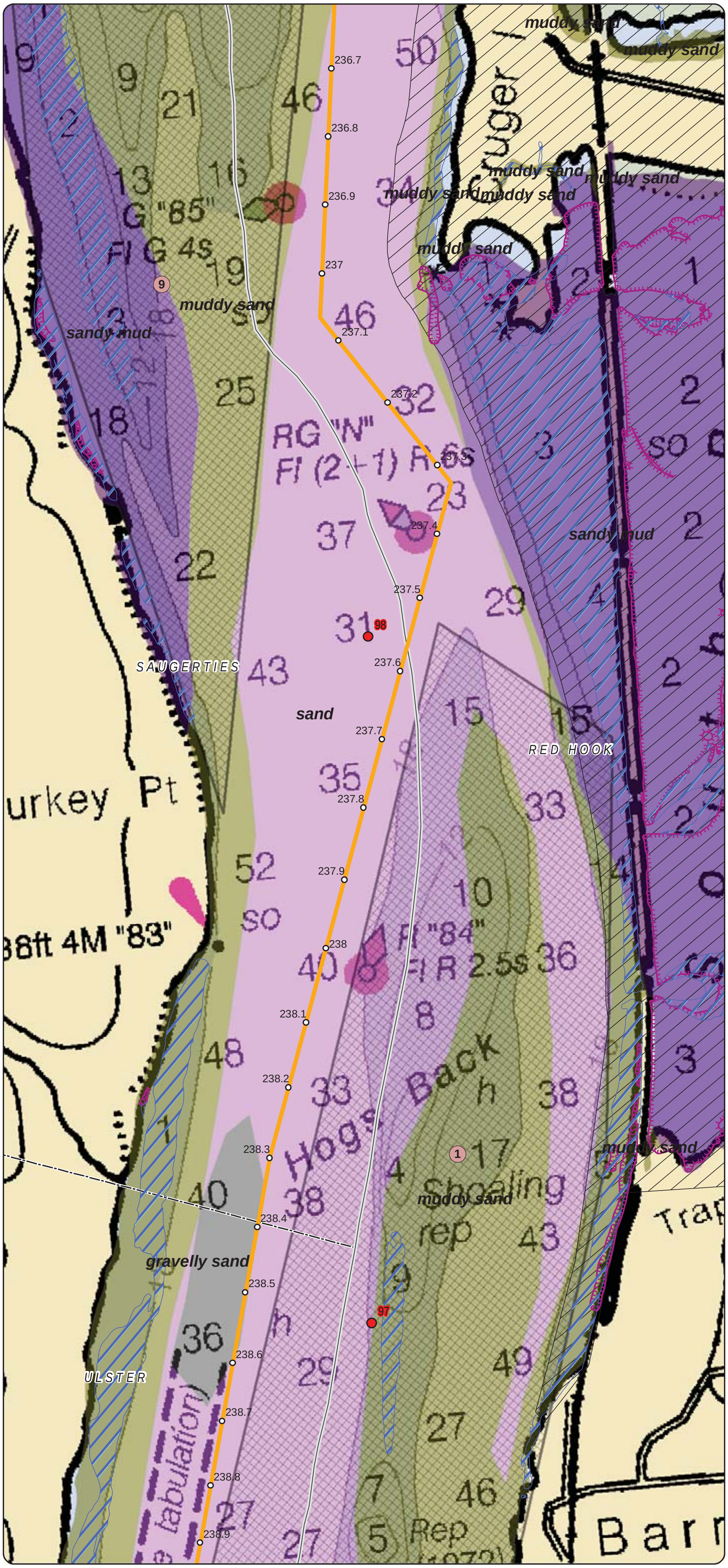

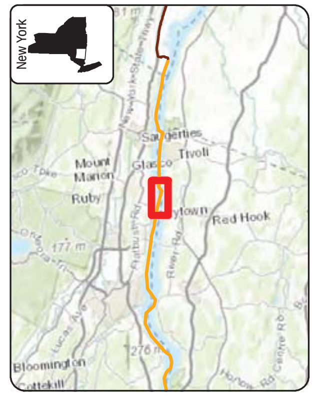

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Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 5 of 43

Created: 6/18/2014

by: HDR & TRC

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

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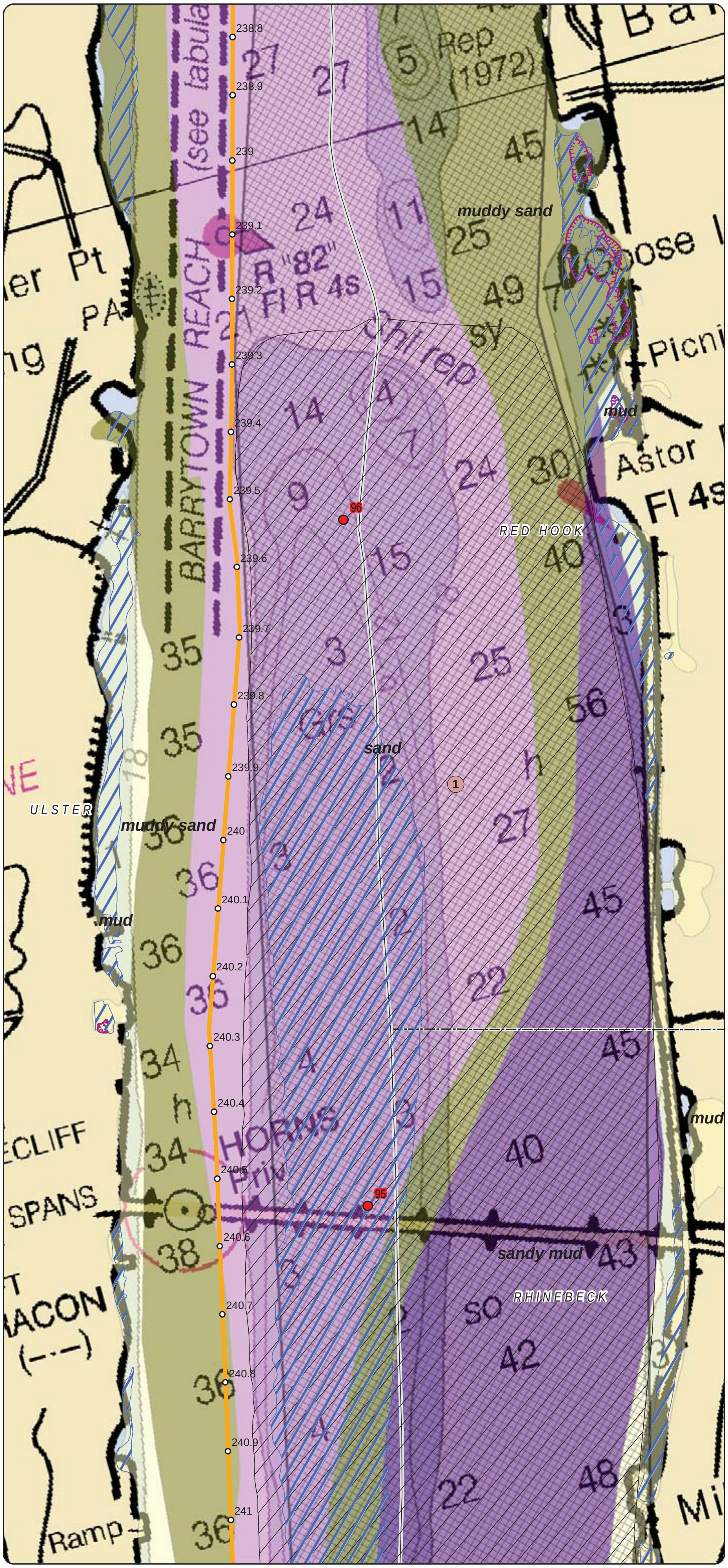

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Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 6 of 43

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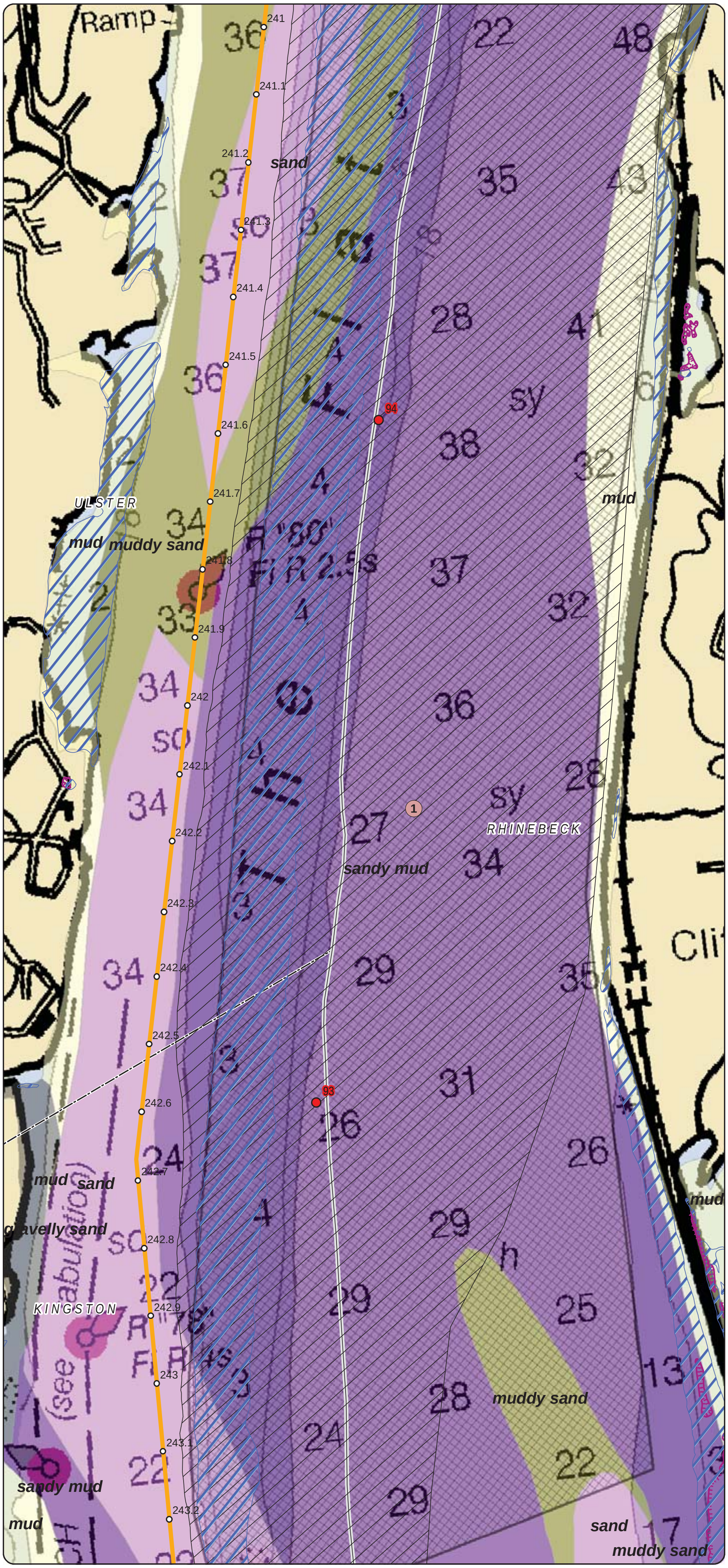

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Champlain Hudson Power Express Project

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Hudson River Project Route

Sheet 7 of 43

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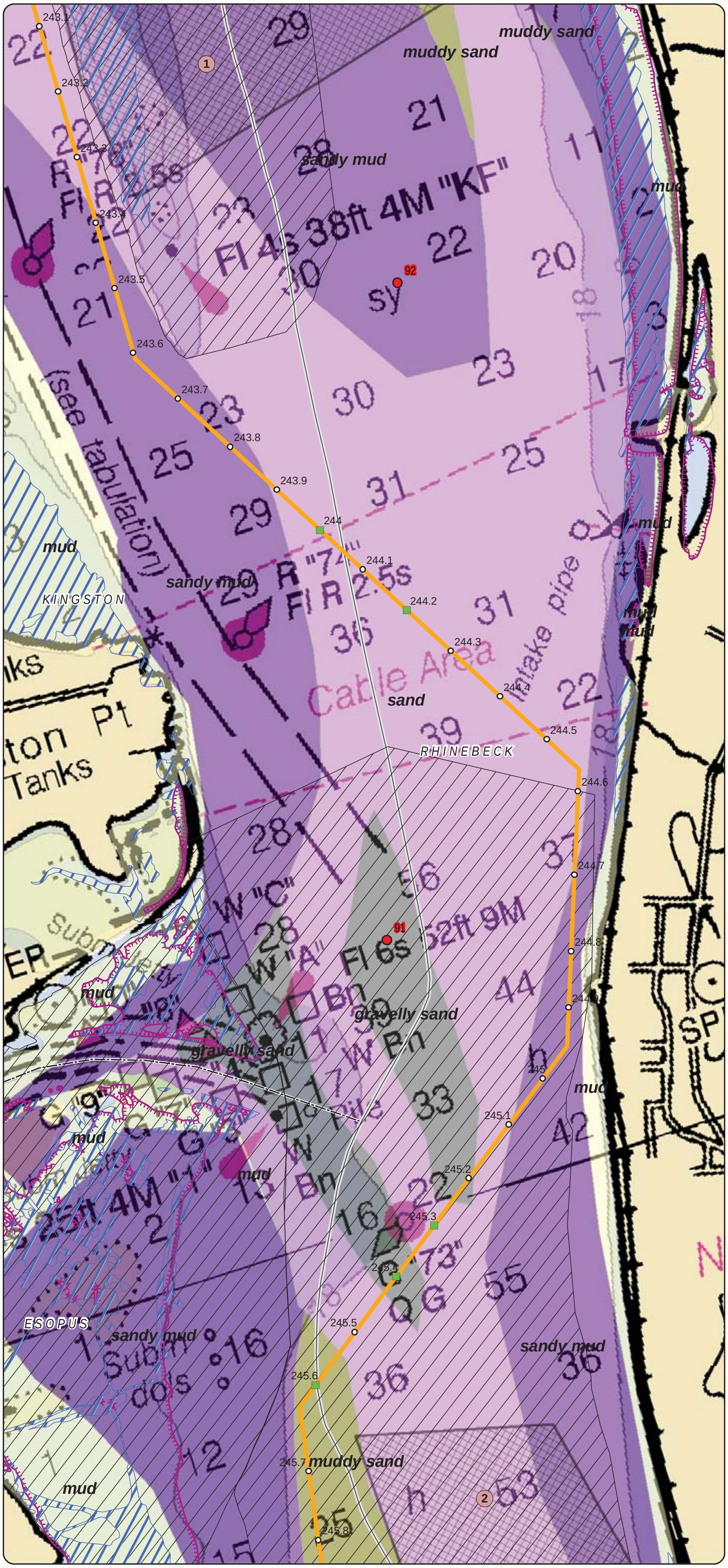

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Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 8 of 43

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