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Champlain Hudson Power Express Transmission Line Project Environmental Impact Statement

Volume IV: Appendices Q - U

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

August 2014

FINAL

CHAMPLAIN HUDSON POWER EXPRESS TRANSMISSION LINE PROJECT ENVIRONMENTAL IMPACT STATEMENT

Volume IV: Appendices Q - U

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

COOPERATING AGENCIES

U.S. ENVIRONMENTAL PROTECTION AGENCY
U.S. ARMY CORPS OF ENGINEERS
U.S. FISH AND WILDLIFE SERVICE
U.S. COAST GUARD
NEW YORK STATE DEPARTMENT OF PUBLIC SERVICE
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

AUGUST 2014

FINAL

CHAMPLAIN HUDSON POWER EXPRESS
TRANSMISSION LINE PROJECT
ENVIRONMENTAL IMPACT STATEMENT

VOLUME IV: APPENDICES

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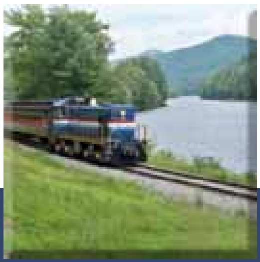

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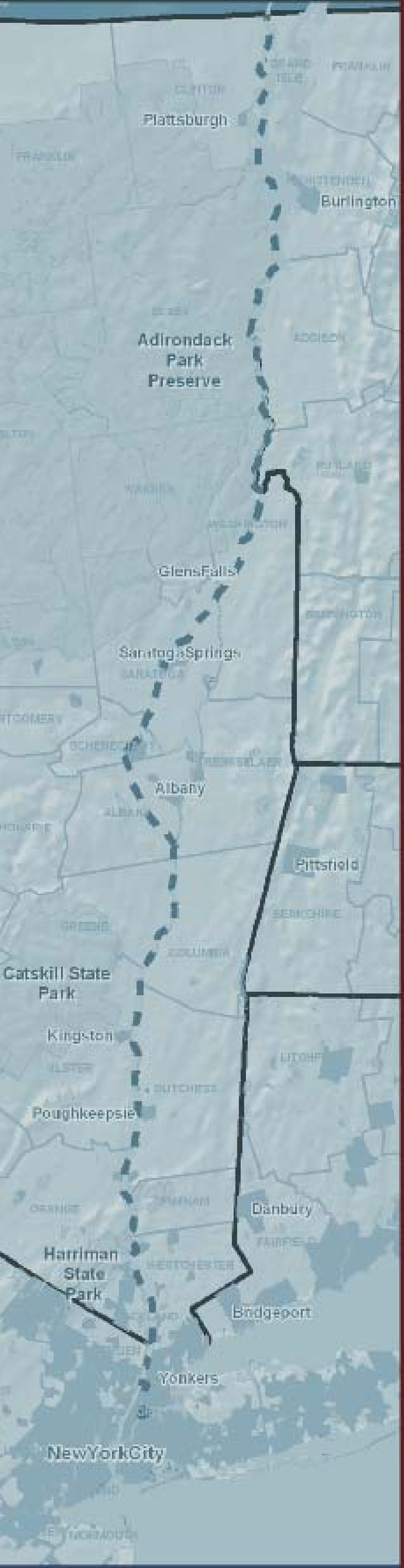

Revised

BIOLOGICAL 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

July 2014

ACRONYMS AND ABBREVIATIONS

° C	degrees Celsius
° F	degrees Fahrenheit
AC	alternating current
BA	Biological Assessment
BMP	best management practice
CCC	Criterion Continuous Concentration
CFR	Code of Federal Regulations
CHPE	Champlain Hudson Power Express
CHPEI	Champlain Hudson Power Express, Inc.
cm	centimeters
CMP	Coastal Management Program
ConEd	Consolidated Edison
CP	Canadian Pacific
cSEL	cumulative sound exposure level
CSX	CSX Transportation
DC	direct current
DOE	U.S. Department of Energy
DPS	distinct population segment
EIS	Environmental Impact Statement
EM&CP	Environmental Management and Construction Plan
EMF	electromagnetic field
EO	Executive Order
ERRP	Emergency Repair and Response Plan
ESA	Endangered Species Act
G	Gauss
GIS	geographic information systems
GPS	global positioning system
HDD	horizontal directional drill
HDPE	high-density polyethylene
HVAC	high-voltage alternating current
HVDC	high-voltage direct current
Hz	Hertz
I	Interstate
kg/m	kilograms per meter
kV	kilovolt
kV/m	kilovolt(s) per meter
lb/ft	pound(s) per foot
µg/L	micrograms per liter
µPa	micropascal
µT	microTesla
mG	milliGauss
mg/L	milligrams per liter
MP	Milepost
mV/cm	millivolts per centimeter
MW	megawatt
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NYNHP	New York Natural Heritage Program
NYISO	New York Independent System Operator
NYSDEC	New York State Department of Environmental Conservation
NYSDPS	New York State Department of Public Service
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation
NYSPSC	New York State Public Service Commission
NYPA	New York Power Authority
PAS	population analysis site
PCB	polychlorinated biphenyl
POI	point of interconnection
PRD	Protected Resources Division
psi	pounds per square inch
rms	root-mean-square
ROI	region of influence
ROV	remotely operated vehicle
ROW	right-of-way
SCFWH	Significant Coastal Fish and Wildlife Habitat
SF6	sulfur hexafluoride
SPCC	Spill Prevention, Control, and Countermeasures
SPL	sound pressure level
TDI	Transmission Developers, Inc.
TSS	total suspended solids
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
V/m	volts per meter
WNS	White-nose Syndrome
XLPE	cross-linked polyethylene
YOY	young-of-year

REVISED

BIOLOGICAL ASSESSMENT

ADDRESSING THE
PROPOSED CHAMPLAIN HUDSON POWER EXPRESS
TRANSMISSION LINE PROJECT

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

JULY 2014

REVISED BIOLOGICAL ASSESSMENT
ADDRESSING THE
PROPOSED CHAMPLAIN HUDSON POWER EXPRESS TRANSMISSION LINE PROJECT

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Executive Summary

Champlain Hudson Power Express, Inc. (CHPEI), as the Applicant for a Presidential permit, proposes to develop the proposed Champlain Hudson Power Express (CHPE) Project as a merchant transmission facility to connect renewable sources of power generation in Canada with load centers in the New York City metropolitan area. According to the Applicant, the estimated total capital cost for the proposed CHPE Project would be approximately $2.2 billion and is projected to be in service by 2017. It is estimated by the Applicant that the proposed CHPE Project would create more than 300 direct construction jobs during its estimated 4-year construction period.

The proposed CHPE Project would include construction, operation, and maintenance of an approximately 336-mile (541-kilometer [km])-long, 1,000-megawatt (MW), electric-power transmission system. This system includes a high-voltage direct current (HVDC) transmission line that would run from the U.S./Canada border to Astoria, Queens, New York, and associated equipment, such as cooling stations, a proposed converter station, improvements to the Astoria Annex Substation, and high-voltage alternating current (HVAC) interconnection from this substation to Consolidated Edison's (ConEd) Rainey Substation in Queens. The proposed CHPE Project transmission line would be installed using both aquatic (underwater) and terrestrial (underground) portions of the route. The underwater portions of the proposed transmission line would be buried in the beds of Lake Champlain and the Hudson, Harlem, and East rivers, and the terrestrial portions of the transmission line would be buried principally in railroad right-of-ways (ROWs) and to a lesser extent roadway ROWs. The proposed CHPE Project would be owned and operated in the United States by the Applicant.

This Biological Assessment (BA) has been prepared in accordance with the legal requirements set forth under regulations implementing Section 7 of the Federal Endangered Species Act (50 CFR 402; 16 U.S.C. 1536(c)). The purpose of this BA is to review the proposed project in sufficient detail to determine if the proposed action may affect any federally threatened or endangered species and critical habitat.

Based on the description of the proposed CHPE Project in **Section 2** of this BA and further described in the associated CHPE Environmental Impact Statement (EIS) (DOE 2013), the status of potentially affected protected species and environmental baseline conditions described in **Sections 3** and **4** and the analysis of potential impacts in **Section 5** of this BA, DOE concludes determinations of effect for the species that occur in the project area as identified in **Table ES-1**. Similarly, DOE concludes that this project would have no effect on the species identified in **Table ES-2**.

Table ES-1. Determinations of Effect for Protected Species Potentially Affected by the Proposed CHPE Project

Common Name	Scientific Name	ESA Status	Determination of Effect
Fish			
Shortnose sturgeon	*Acipenser brevirostrum*	T	May affect, but not likely to adversely affect
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	T[1], E[2,3,4,5]	May affect, but not likely to adversely affect
Mammals			
Indiana bat	*Myotis sodalis*	E	May affect, but not likely to adversely affect
Northern long-eared bat	*Myotis septentrionalis*	PE	May affect, but not likely to adversely affect
Invertebrates			
Karner blue butterfly	*Lycaeides melissa samuelis*	E	May affect, but not likely to adversely affect

Table Key: E = Federally listed as endangered; T = Federally listed as threatened; PE = Proposed species for listing as endangered.

1. Gulf of Maine DPS.
2. New York Bight DPS.
3. Chesapeake Bay DPS.
4. Carolina DPS.
5. South Atlantic DPS.

Table ES-2. Nearby Listed Species Not Affected by the Proposed CHPE Project

Common Name	Scientific Name	ESA Status
Marine Mammals		
Fin whale	*Balaenoptera physalus*	E
Humpback whale	*Megaptera novaeangliae*	E
North Atlantic right whale	*Eubalaena glacialis*	E
Sei whale	*Balaenoptera borealis*	E
Sperm whale	*Physeter macrocephalus*	E
West Indian manatee	*Trichechus manatus*	E
Sea Turtles		
Green sea turtle	*Chelonia mydas*	T[1]
Kemp's ridley sea turtle	*Lepidochelys kempii*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Loggerhead sea turtle	*Caretta caretta*	T[2]
Aquatic Invertebrates		
Dwarf wedgemussel	*Alasmidonta heterodon*	E
Piping plover	*Charadrius melodus*	T
Roseate tern	*Sterna dougallii dougallii*	E
Red knot	*Calidris canutus rufa*	PT
Terrestrial Reptiles		
Bog turtle	*Clemmys muhlenbergii*	T
Plants		
Northern wild monkshood	*Aconitum noveboracense*	T
Small whorled pogonia	*Isotria medeoloides*	T

Table Key: E = Federally listed as endangered; T = Federally listed as threatened; PT = Proposed species for listing as threatened

1. Since the nesting areas for turtles encountered at sea often cannot be determined, a conservative approach to management requires the assumption that all greens in the Gulf of Mexico are endangered.
2. There are nine DPSs for this species; the Northwest Atlantic DPS is the most likely to occur in waters in the vicinity of the proposed CHPE Project.

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1. Introduction

The purpose of this Biological Assessment (BA) is to evaluate the potential impacts of the proposed Champlain Hudson Power Express (CHPE) Transmission Line Project (proposed CHPE Project) on federally listed threatened or endangered species, and to comply with the requirements of the Endangered Species Act (ESA) of 1973 (16 United States Code [U.S.C.] 1531–1534). The Proposed Federal Action by the U.S. Department of Energy (DOE) is the issuance of a Presidential permit that would authorize Champlain Hudson Power Express, Inc. (CHPEI) (the Applicant) to construct, operate, and maintain the proposed CHPE Project crossing of the U.S./Canada border. DOE has prepared an Environmental Impact Statement (EIS) for the proposed CHPE Project (DOE 2013) to comply with the requirements of the National Environmental Policy Act. Therefore, DOE is preparing this BA as the lead Federal Action Agency for the proposed CHPE Project. That EIS contains additional details about the project and potential effects on the natural and human environment, and is incorporated into this BA by reference. The U.S. Army Corps of Engineers (USACE) has a Federal action related to the implementation of the proposed CHPE Project regarding issuance of a Clean Water Act Section 404 permit for the project. Other cooperating agencies involved with the EIS process include the U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (USEPA), U.S. Coast Guard, New York State Department of Public Service (NYSDPS), and New York State Department of Environmental Conservation (NYSDEC).

CHPEI, as the Applicant for a Presidential permit, proposes to develop the proposed CHPE Project as a merchant transmission facility to connect renewable sources of power generation in Canada with load centers in the New York City metropolitan area (TDI 2010). According to the Applicant, the estimated total capital cost for the proposed CHPE Project would be approximately $2.2 billion and is projected to be in service by 2017 (CHPEI 2012a). It is estimated by the Applicant that the proposed CHPE Project would create more than 300 direct construction jobs during its estimated 4-year construction period (TDI 2010).

The proposed CHPE Project would include construction, operation, and maintenance of an approximately 336-mile (541-km)-long, 1,000-megawatt (MW), electric-power transmission system. This system includes a high-voltage direct current (HVDC) transmission line that would run from the U.S./Canada border to Astoria, Queens, New York, and associated equipment, such as cooling stations, a proposed converter station, improvements to the Astoria Annex Substation, and high-voltage alternating current (HVAC) interconnection from this substation to Consolidated Edison’s (ConEd) Rainey Substation in Queens. The proposed CHPE Project transmission line would be installed using both aquatic (underwater) and terrestrial (underground) portions of the route. The underwater portions of the proposed transmission line would be buried in the beds of Lake Champlain and the Hudson, Harlem, and East rivers, and the terrestrial portions of the transmission line would be buried principally in railroad right-of-ways (ROWs) and to a lesser extent roadway ROWs. The proposed CHPE Project would be owned and operated in the United States by the Applicant.

On January 25, 2010, the Applicant applied to the DOE for a Presidential permit for the proposed CHPE Project pursuant to Executive Order (EO) 10485, as amended by EO 12038, and the regulations codified at 10 Code of Federal Regulations (CFR) Part 205.320 *et seq.* (2000), “Application for Presidential Permit Authorizing the Construction, Connection, Operation, and Maintenance of Facilities for Transmission of Electric Energy at International Boundaries.” Subsequently, Transmission Developers, Inc. (TDI), on behalf of the Applicant, submitted amendments to the Presidential permit application on August 5, 2010; July 7, 2011; and February 28, 2012. The February 28, 2012, amendment reflected route and project changes that resulted from negotiations, including more than 50 settlement conferences held between November 2010 and February 2012, with state agencies and stakeholder organizations pursuant to the New York State Public Service Commission's (NYSPSC) Article VII Certificate of Environmental Compatibility and Public Need process review of the project. The NYSPSC issued a Certificate of Environmental Compatibility and Public Need authorizing construction and operation of the proposed CHPE Project to the Applicant on April 18, 2013 (NYSPSC 2013). The State of New York has concurred with the proposed route for and construction and operation of the transmission line as cited in the Certificate, with conditions that the Applicant must meet during construction and operation of the line. Such conditions include pre- and post-installation surveys and sampling as described in **Section 2.5.1** and additional coordination with appropriate agencies should the transmission line require rerouting due to previously unforeseen conditions.

1.1 Endangered Species Act Requirements

The ESA establishes procedures for the protection and conservation of threatened and endangered species and the ecosystems upon which they depend. The ESA describes several categories of Federal status for plants and animals and their critical habitat, which have been designated by the USFWS or National Marine Fisheries Service (NMFS). In addition to allowing the listing of species and subspecies, the ESA allows listing of "distinct population segments" (DPSs) of vertebrate species. An "endangered" species is defined as any species in danger of extinction throughout all or a large portion of its range. A "threatened" species is defined as any species likely to become an endangered species in the foreseeable future. "Critical habitat" is defined in the ESA as "a specific geographic area that is essential for the conservation of a threatened or endangered species and that could require special management or protection." Critical habitat can include an area that is not occupied by a species but is needed for the recovery of that species. There are no designated or proposed critical habitat areas in or near the proposed CHPE Project area.

NMFS and USFWS share responsibility for implementing the ESA. Generally, the USFWS manages terrestrial and freshwater species, while NMFS manages marine and "anadromous" (i.e., born in fresh water, spends most of its life in the sea, and returns to fresh water to spawn) species. In the case of sea turtles, NMFS has the lead in the marine environment, while USFWS does on the nesting beaches. Federal agencies must consult with NMFS and USFWS, under Section 7(a)(2) of the ESA, on activities that may affect a listed species**.** These interagency consultations, or Section 7 consultations, are designed to assist Federal agencies in fulfilling their duty to ensure Federal actions do not jeopardize the continued existence of a species or destroy or adversely modify critical habitat.

1.2 Consultation History

The following interactions between DOE and USFWS or NMFS associated with the proposed CHPE Project have occurred prior to the preparation of this BA and have supported its development:

- **March 1, 2010** – Letter sent on behalf of CHPEI to NMFS to request information on protected species along the proposed transmission line route.
- **Undated letter, 2010** – Response letter sent by NMFS providing information on protected species along the proposed transmission line route.
- **June 7, 2010** – Letter from USFWS recommending surveying for Karner blue butterfly habitat along the entire route in Saratoga County (excluding actively agricultural, non-sandy or poorly drained soil areas, and lawns) rather than only certain portions of the route in Saratoga County. USFWS also requested a coarse analysis of the Schenectady and Albany County portions, for the record, to address, among other things, why there is or is not potential habitat in those areas and what level of surveys were conducted in these areas.

- **June 18, 2010** – DOE publishes in the *Federal Register* a Notice of Intent to prepare a Draft EIS for the proposed granting of a President Permit to CHPEI to construct and operate the proposed CHPE Project.
- **August 2, 2010** – Letter sent by USFWS to DOE responding to the June 18, 2010, *Federal Register* posting. USFWS offered technical assistance and information, in particular noting that terrestrial species and impacts should be addressed.
- **August 4, 2010** – Letters sent by DOE to USFWS and NMFS to invite the agencies to participate as Cooperating Agencies.
- **September 17, 2010** – Letter sent by USFWS to DOE agreeing to participate as a Cooperating Agency.
- **April 25, 2012** – Meeting with USFWS and NYSDEC to discuss the Karner blue butterfly. Current proposed Project route employs routing and installation techniques that avoid all mapped lupine patches, so the plan was to conduct no surveys. USFWS noted that without any survey, all lupine patches will be considered occupied.
- **June 21, 2012** – Letters sent by DOE to NMFS and USFWS to initiate informal Section 7 consultation for the proposed CHPE Project and request information on protected species along the proposed transmission line route.
- **June 28, 2012** – Letter sent by NMFS to DOE providing information on protected species along the proposed transmission line route.
- **July 17, 2012** – Letter sent by USFWS to DOE providing information on how to access Web site for information on protected species along the proposed transmission line route.
- **February 5, 2013** – Letter sent to DOE by USFWS as a cooperating agency providing comments on an internal working draft of the EIS addressing the action.
- **February 28, 2013** – Phone conversation between DOE EIS contractor (HDR EOC) and NMFS regarding Essential Fish Habitat considerations. These impacts are also applicable to ESA-listed fish species. Impacts of interest to NMFS included persistent disturbance to sediment, maintenance, heat, impacts on infauna, and impacts from electric and magnetic fields.
- **March 4, 2013** – Phone conversation between DOE and NMFS to confirm that the Agency was in concurrence that a joint BA would be prepared for the species under both USFWS and NMFS jurisdiction.
- **April 11, 2013** – Applicant briefed NMFS on the proposed CHPE Project. NMFS asked various questions about cable-laying seasons, construction windows, and the proposed transmission line route.
- **December 12, 2013** – USFWS provided comments on the biological resources sections of the Draft CHPE EIS.
- **January 15, 2013** – NMFS provided comments on the aquatic protected and sensitive species sections of the Draft CHPE EIS.
- **January 23, 2014** – Preliminary phone conversation among DOE and NMFS to discuss NMFS comments on the Draft CHPE EIS.
- **March 27, 2014** – Phone conversation among DOE, NMFS, and USACE to discuss NMFS comments on the Draft CHPE EIS and approaches and analyses for the BA.
- **April 7, 2014** – DOE submitted Draft BA to NMFS and USFWS.

- **May 7, 2014** – USFWS provided comments on the Draft BA and a phone conversation was held among DOE and USFWS.
- **May 23, 2014** – NMFS provided comments on the Draft BA.
- **May 28, 2014** – Phone conversation among DOE, NMFS, USACE, and Applicant to discuss NMFS comments on the Draft BA and approaches and analyses.
- **June 6, 2014** – Phone conversation among DOE and USFWS to further discuss USFWS comments on the Draft BA and approaches and analyses.
- **July 8, 2014** – Phone conversation among DOE and NMFS to further discuss NMFS comments on the Draft BA and approaches and analyses.

2. Description of the Proposed Action

The following section summarizes the key elements of the proposed CHPE Project, which was drawn from the DOE Draft EIS (DOE 2013). This section defines the Action Area (including the "route segments" referred to in the Draft EIS and used in this BA) and specific engineering details of the transmission system installation: the aquatic direct current (DC) transmission cables, horizontal directional drill (HDD) methods, terrestrial DC transmission cables, cooling stations, the proposed HVDC converter station and substation interconnection in Astoria, and the proposed Astoria Annex to Rainey substation alternating current (AC) interconnection.

The transmission system would consist of one 1,000-MW, HVDC transmission line, one communications cable, and ancillary aboveground facilities, including cooling stations at selected locations where required and a DC-to-AC converter station. The transmission line would be a bipole consisting of two transmission cables, one positively charged and the other negatively charged. The entire length of the transmission system would be buried, with the majority of the route beneath Lake Champlain and the Hudson River, with the exception of bridge attachments and ancillary aboveground facilities, such as at the converter station and cooling stations. A new HVDC converter station would be constructed in Queens, New York, to convert the electrical power from DC to AC and then connect to two points of interconnection (POIs) within the New York City electrical grid. The cooling stations that would be installed along the transmission line route would be for certain locations to disperse accumulated heat in long cable segments installed by HDD techniques.

2.1 Description of the Route Segments Used in the Draft EIS Analyses

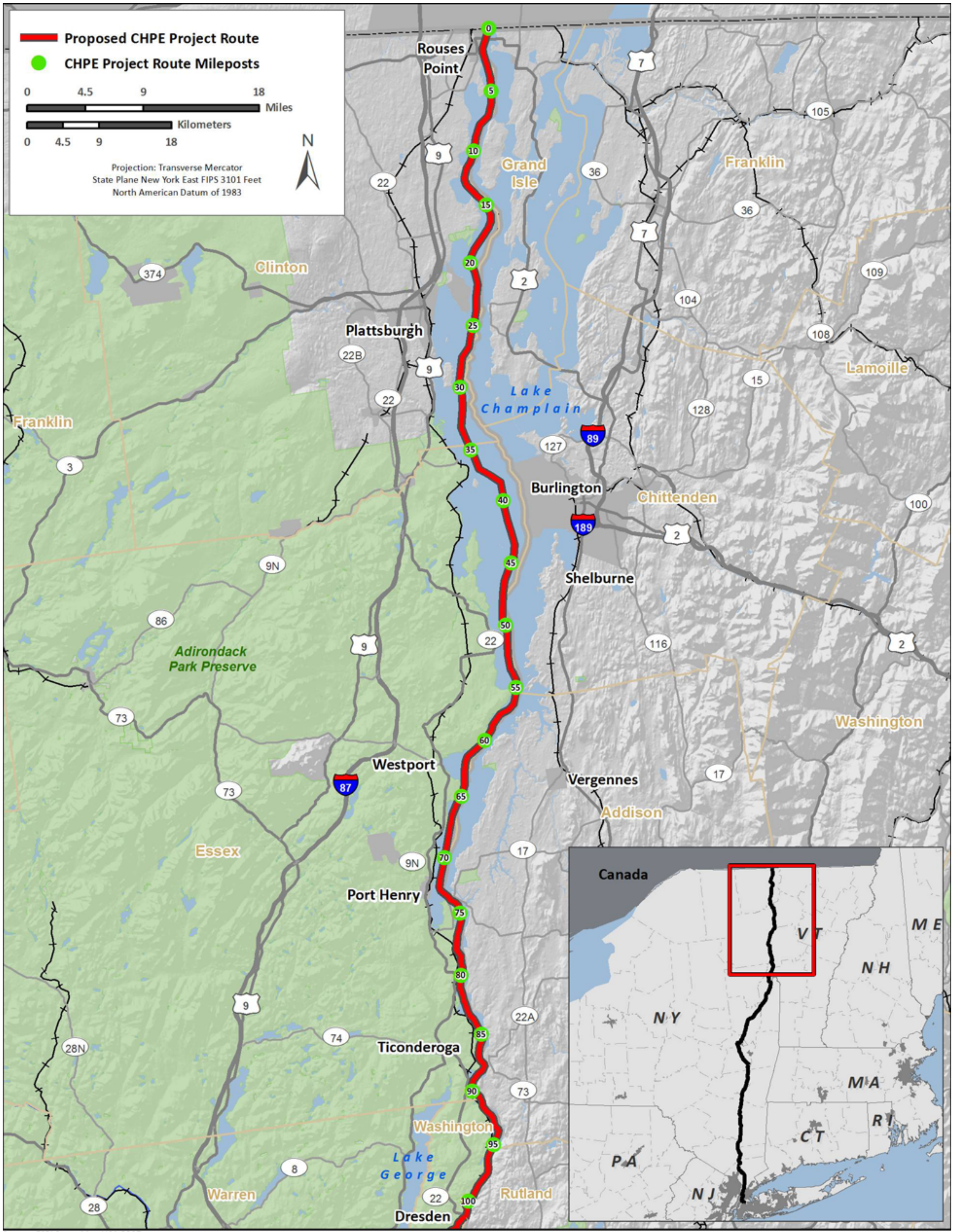
The proposed CHPE Project would include construction, operation, and maintenance of an approximately 336-mile (541-km)-long, 1,000-MW, high-voltage electric power transmission system that would have both aquatic (underwater) and terrestrial (and primarily underground) portions of the transmission line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

For the purposes of understanding the various environmental settings associated with the proposed CHPE Project, and to facilitate the analysis in the DOE Draft 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.**

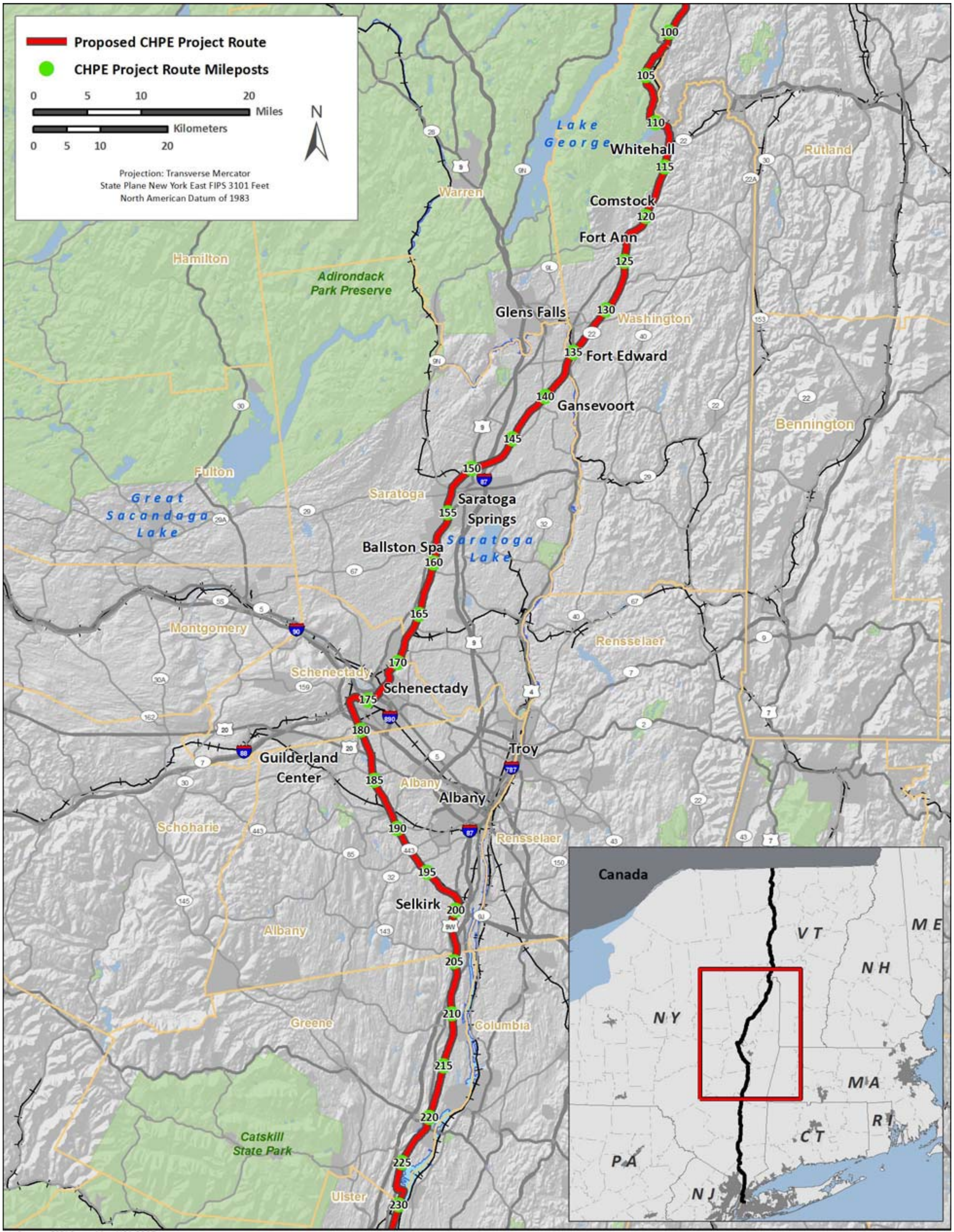
The four segments are shown on **Figures 2-1** through **2-4**, respectively. From the U.S./Canada border, the HVDC transmission line would be located in the bed of Lake Champlain for approximately 101 miles (163 km), from near Champlain, New York, to Dresden, New York. This portion of the route composes 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 until the transmission line would enter the Hudson River at the town of Catskill, New York (see **Figure 2-2**).



Source: ESRI StreetMap USA 2007

Figure 2-1. Lake Champlain Segment



Source: ESRI StreetMap USA 2007

Figure 2-2. Overland Segment

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 Stony Point, New York, where the transmission line would be routed upland along the CSX railroad ROW and the U.S. Route 9W roadway ROW between MPs 295 and 303 (see **Figure 2-3**). The transmission line would be buried underground through this entire stretch before reentering the Hudson River. The transmission line would 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.

The ***New York City Metropolitan Area Segment*** begins at Spuyten Duyvil 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 2-4**). 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 proceed to the southeast to the site of the ConEd Charles Poletti Power Plant complex in Astoria, Queens, New York, at MP 332.

2.2 Action Area

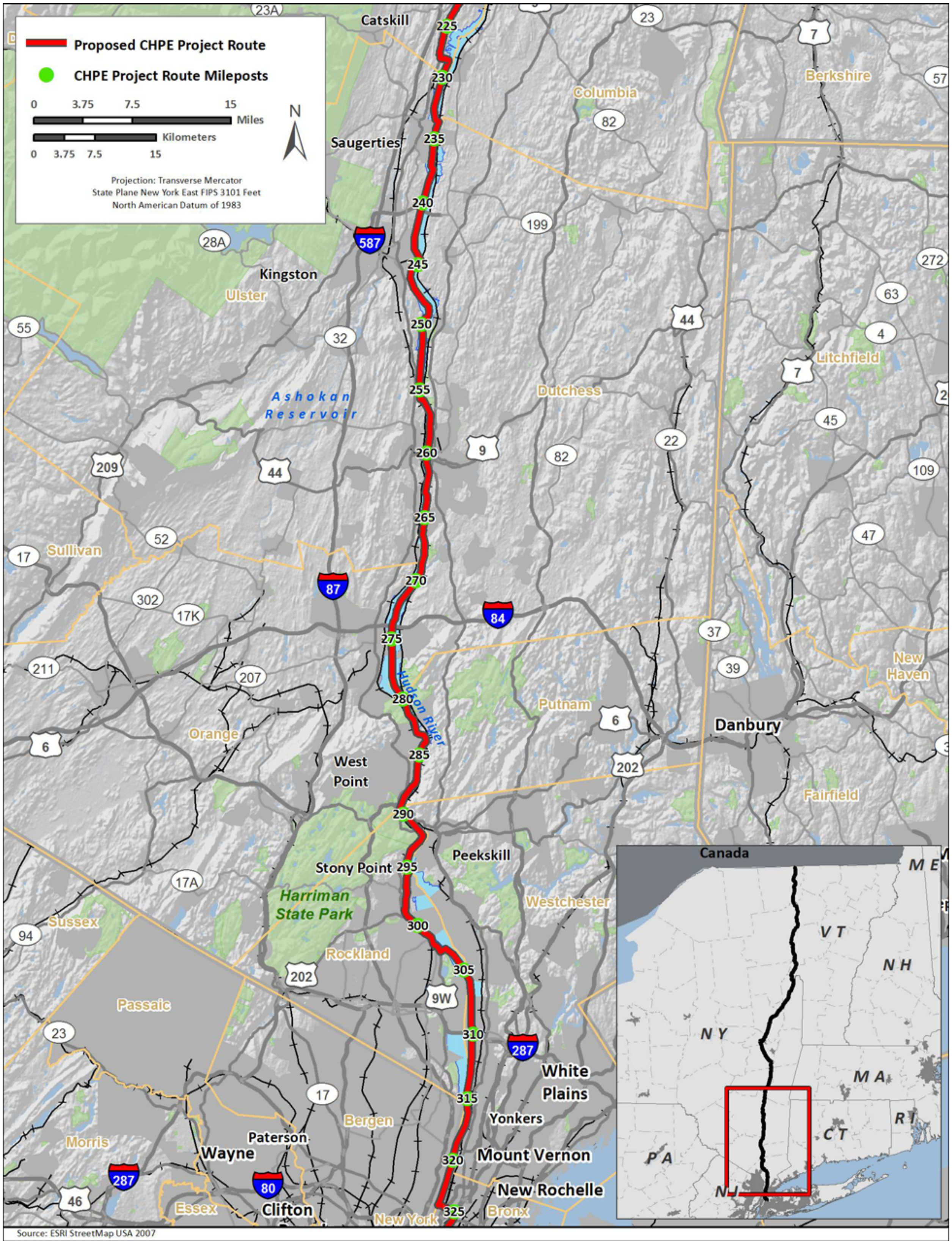
The Action Area is defined in 50 CFR Part 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The Action Area for aquatic ESA-listed species for the proposed CHPE Project includes the aquatic habitats that occur below the mean high tide line for the route segment affected. This takes into account the footprint of the proposed CHPE Project area, including the distance that sediment plumes can travel in the aquatic portions, and the distance that each fish species can travel through the entire body of water associated with a segment. Aquatic ESA-listed species occur only in the Hudson River and New York City Metropolitan Area segments (see **Section 3.1**). For this BA, the Action Area for the Hudson River Segment is the Hudson River from Catskill, New York south to Spuyten Duyvil, and for the New York City Metropolitan Area Segment, it is the East and Harlem rivers. The Action Area for terrestrial protected and sensitive species along the terrestrial portions of the proposed CHPE Project is 100 feet (30 meters) on either side of the transmission line.

2.3 Descriptions of Construction Methods

The following subsections describe the specific engineering details of the transmission system as approved by the NYSPSC Certificate for the proposed CHPE Project issued to the Applicant (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 Lake Champlain and Hudson River segments would be cross-linked polyethylene (XLPE) HVDC cables rated at 300 to 320 kV. An armored layer of galvanized steel wires embedded in bitumen provides additional protection for the aquatic transmission cables (see **Figure 2-5**). The first step in the installation of the aquatic transmission cables would involve conducting a pre-installation route clearance operation. During this operation or the pre-lay grapnel run, to occur in the fall preceding installation the following year, the route is cleared of debris, such as logs and out-of-service cables, by dragging a grapnel along the route. Following debris removal, 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



Source: ESRI StreetMap USA 2007

Figure 2-3. Hudson River Segment

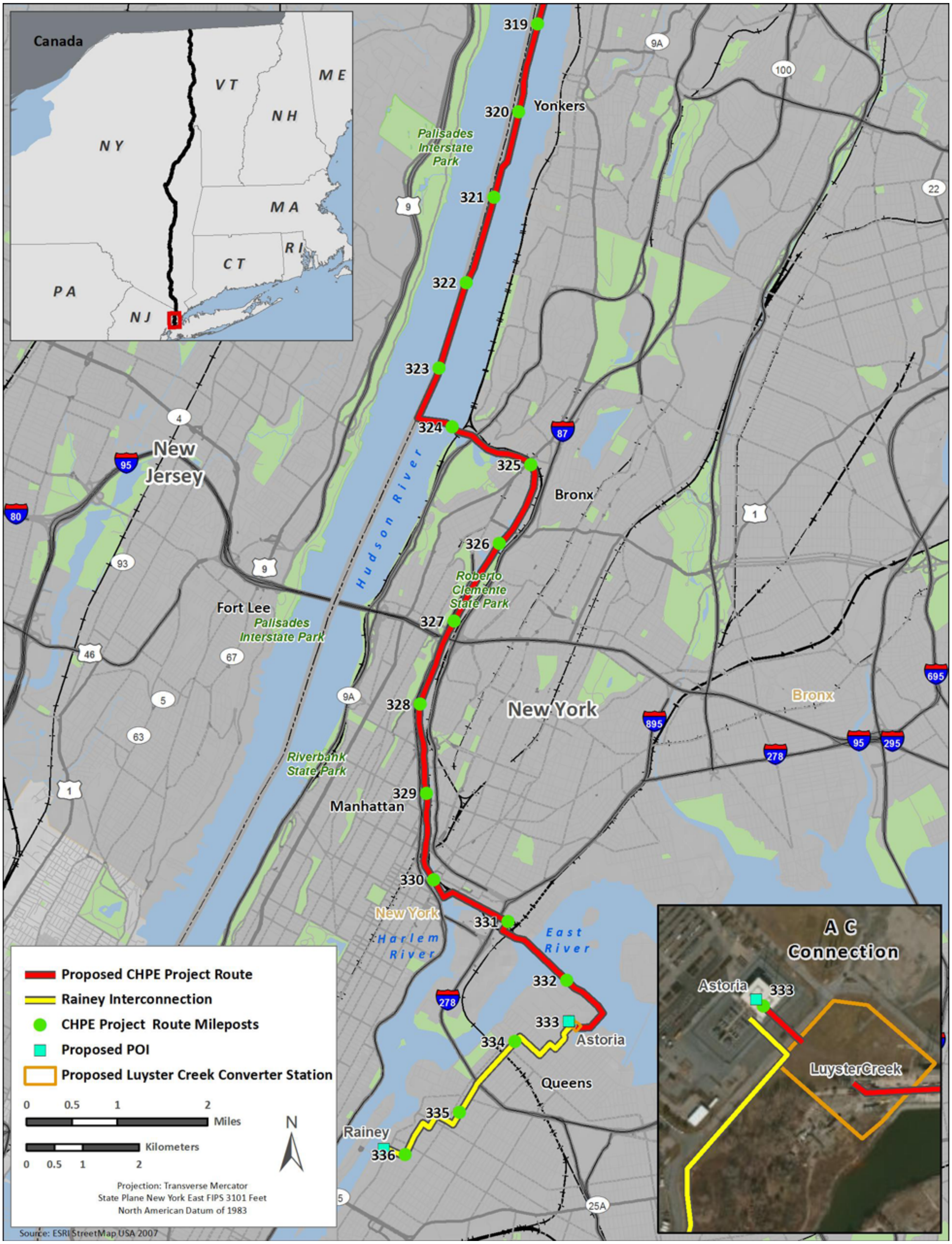
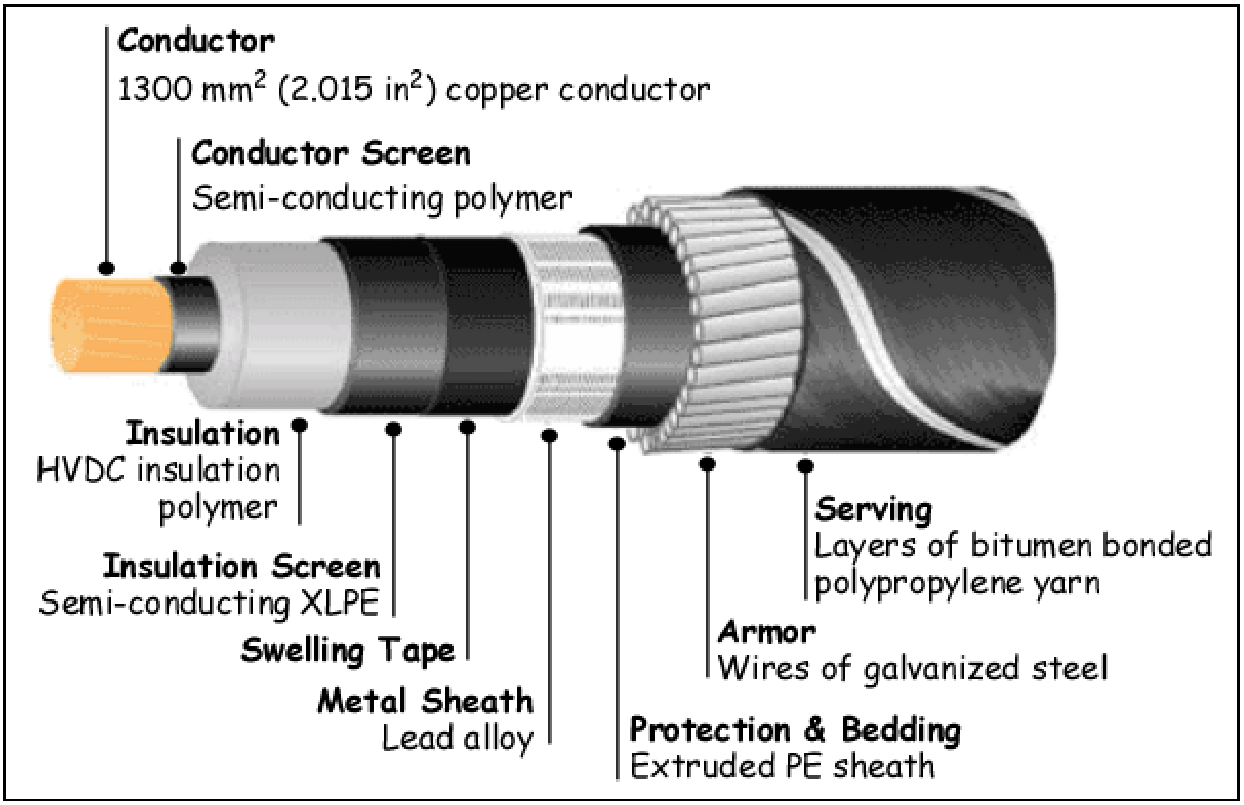


Figure 2-4. New York City Metropolitan Area Segment



Source: Cross-Sound Cable Company 2012

Figure 2-5. Example Aquatic HVDC Transmission Cable Cross-Section

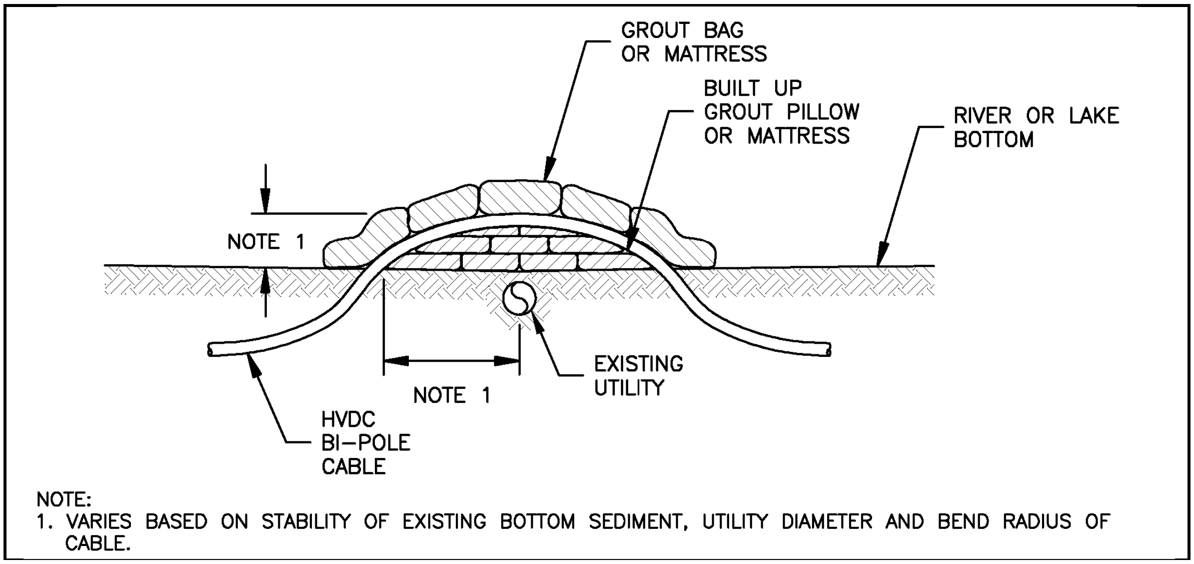
available marine construction equipment, soil types and depth to bedrock, existing utilities, and the types of marine activities occurring and their potential threat to cable integrity (TDI 2010).

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 2012c) (see **Figure 2-6**). The concrete mats would be 40 feet (12 meters) long, 8 feet wide (2.4 meters), and 9 inches (23 cm) thick. 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.

2.3.2 Horizontal Directional Drilling

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 certain environmentally sensitive areas such as wetlands or streams where deemed necessary, under roadway or railway crossings where trenching is not possible, and wild blue lupine (*Lupinus perrenis*) habitat.

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 2-7**). For each proposed HDD location, two separate drill holes would be required, one for each cable. During



Source: CHPEI 2012c

Figure 2-6. Representative Schematic of Protective Measures for Aquatic Transmission Cables

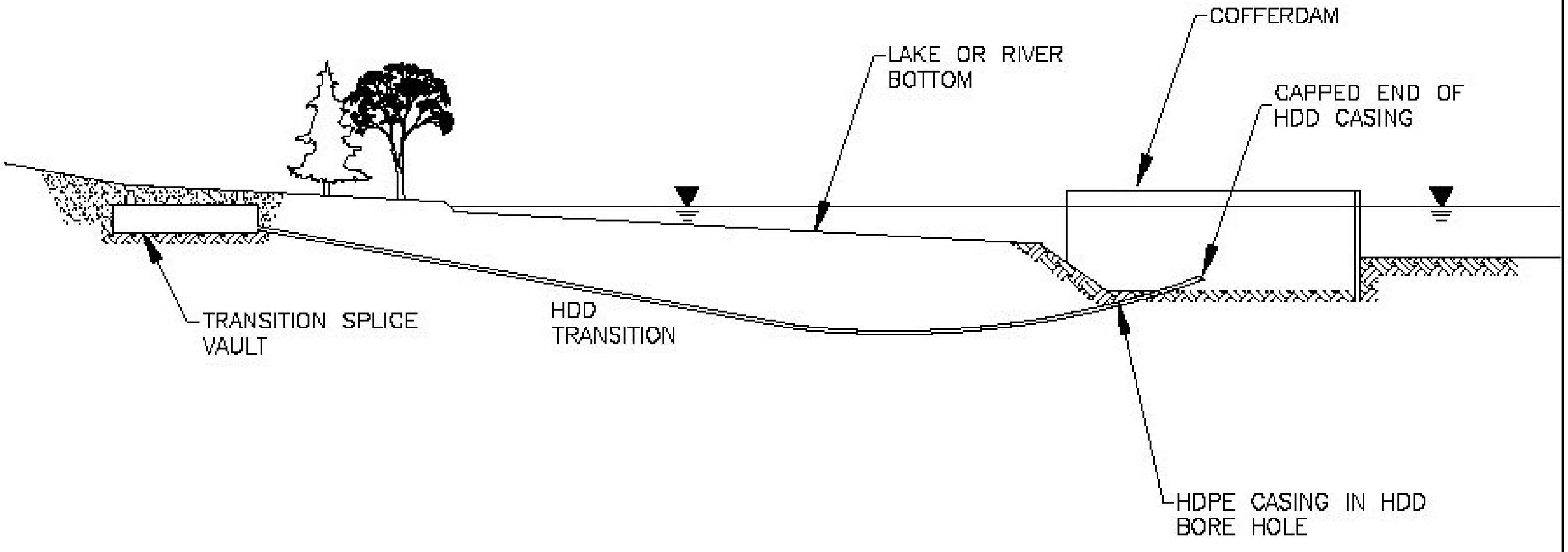
installation, a drill rig would be placed on shore behind a temporary fluid return pit and a 40-foot (12-meter) drill pipe with a cutting head would be set in place to begin the drilling process. As the initial pilot borehole is drilled, slurry composed of water and bentonite would then be pumped into 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 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 (see **Attachment 1**). 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.

NOTES:

1. COFFERDAM TO BE UTILIZED WHERE NECESSARY TO STABILIZE BOTTOM SEDIMENT AT HDD TERMINUS OTHER ALTERNATIVES PROVIDING EQUIVALENT ENVIRONMENTAL PROTECTION MAY BE EMPLOYED WHERE BOTTOM CONDITIONS DO NOT PERMIT DRIVEN PILES.
2. PILES SHALL BE REMOVED OR CUT BELOW THE MUD LINE. AT COMPLETION OF CABLE INSTALLATION IN COORDINATION WITH THE BMP REQUIREMENTS.
3. COFFERDAM WILL EXTEND ABOVE THE WATERLINE IN SHALLOW WATER. EXPOSED STRUCTURE WILL BE MARKED BY BUOYS AND OTHER NAVIGATION AIDS. A NOTICE TO MARINERS WILL BE ISSUED WHEN APPROPRIATE.
4. COFFERDAMS IN DEEP WATER NOT BE EXTENDED TO THE WATER SURFACE. EACH INSTALLATION WILL BE MARKED BY BUOYS AND OTHER NAVIGATION AIDS. A NOTICE TO MARINERS WILL BE ISSUED WHERE APPROPRIATE.



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

Figure 2-7. Example HDD Techniques

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.

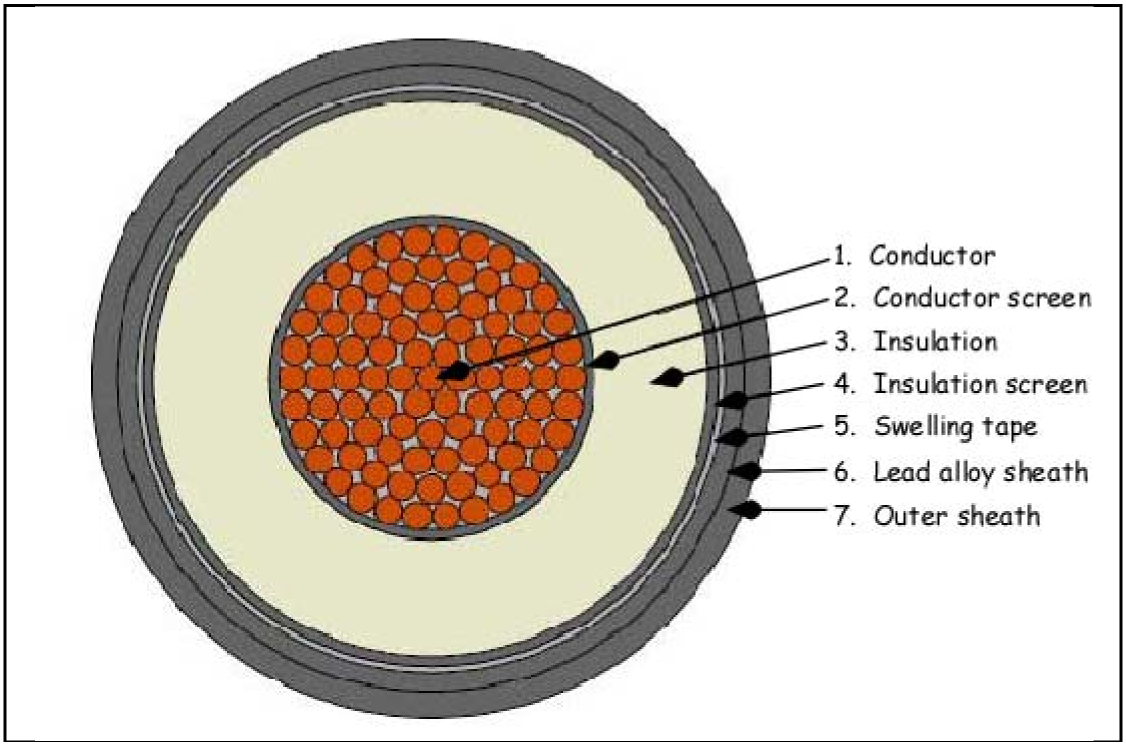
HDD could also be used to install the transmission cables beneath other sensitive areas such as wetlands, streams, and existing infrastructure along the terrestrial portions of the proposed CHPE Project route, and in special circumstances to avoid obstacles along the CHPE Project route, such as road 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 2-8**). The underground transmission cables would have an outside diameter of 4.5 inches (11 centimeters [cm]), and each cable would weigh approximately 20 pounds per foot (lb/ft) (30 kilograms per meter [kg/m]) (TDI 2010). A protective cover of HDPE, concrete, or polymer blocks would be placed directly above the low thermal resistive backfill material.

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 2012h).

The proposed CHPE Project would be in the existing ROW of both the CP and CSX railway systems between MPs 112 and 228, MPs 295 and 301, and MPs 330 and 331. The Applicant has stated that drafts of Occupancy Agreements for easements along the railroad corridor have been exchanged with both 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.



Source: CHPEI 2012b

Figure 2-8. Example Terrestrial HVDC Transmission Cable Cross-Section

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. 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 2012a).

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 (SF6) gas-insulated substation that serves as the primary POI 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. 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. 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).

2.3.7 Astoria to Rainey Interconnection

CHPEI would also construct a 345-kV HVAC cable circuit from the ring bus 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 2-4**). 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 degrees Fahrenheit (°F) (0 degrees Celsius [°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 2012p). 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 (V/m) or kilovolts per meter (kV/m). 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 2-8**) 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.

Like electric fields, 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 2-9** 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. Lake sturgeon 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 to 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.

2.5 Construction and Schedule

The Applicant anticipates that the initial permitting phase of the proposed CHPE Project would continue through mid-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 2012o).

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 2012m

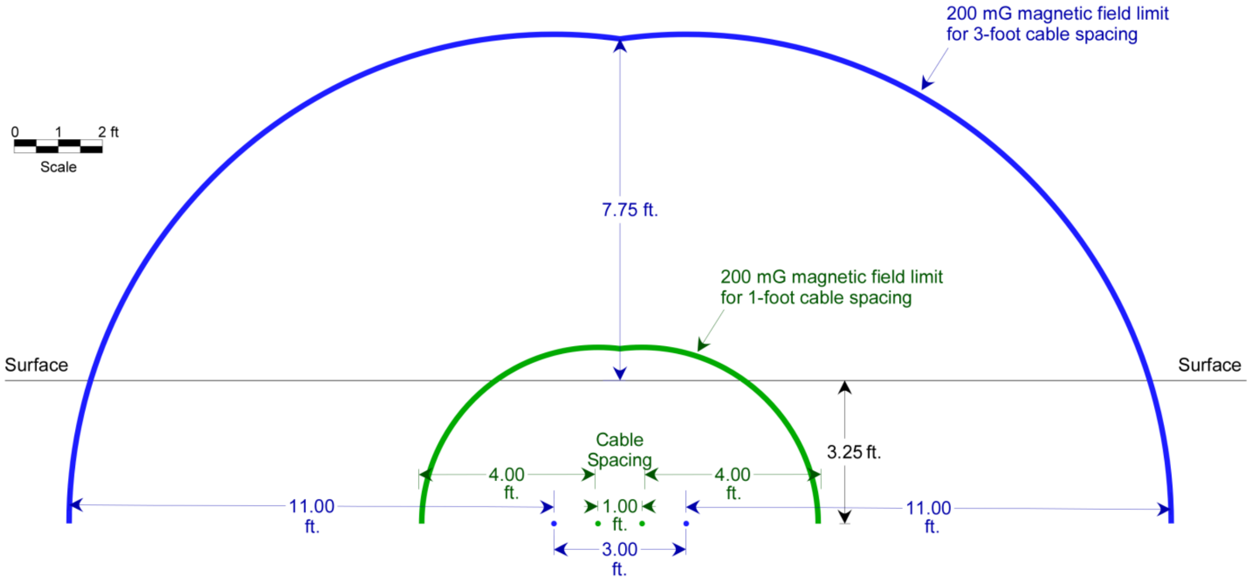


Figure 2-9. 200-mG Magnetic Field Strengths with Cable Spacings of 1 Foot and 3 Feet

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). 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.

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 2-10**). In areas of extensive debris or suspect areas, a second stage clearing would be performed with a de-trenching grapnel. This grapnel provides penetration of up to 3 feet (0.9 meters) into the riverbed.

Source: Kingbird 2014

Figure 2-10. Example of Grapnel Used for Debris Removal

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.

Following debris removal, 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, lain on the surface over bedrock or utility line crossings and covered with concrete mats (total of 3.0 miles [4.8 km]), or blasting of 460 feet 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 trench dimensions of the shear plow (mechanical blade proposed to be used in Lake Champlain south of Crown Point [MP 74]) would be approximately 0.8 feet (0.2 meters) wide and 4 to 8 feet (1.2 to 2.4 meters) deep.

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 the laying of cable. The plowing process would be conducted using either 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.

Burial depths could vary in response to site-specific factors (e.g., presence of existing infrastructure or archaeological resources, environmental concerns, localized geological or topographical obstacles) 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, 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, grout mattresses), protective cable ducts, or other low-impact protective armoring (TDI 2010). Aquatic transmission cables would cross under a cable ferry crossing in Lake Champlain. The Ticonderoga–Larrabee Point Ferry, which would be crossed at the proposed CHPE Project route near MP 86, uses two parallel, steel guidance cables that are lifted by steel sheaves to pull the ferry along the cables. The guidance cables rest along the bottom of the lake when they are not in use and typically are replaced every 4 years. The guidance cables would be temporarily removed from the lakebed prior to the installation of the transmission cables, which could put the ferry temporarily out of service. After installation and burial of the transmission cables, the guidance cables would be put back in place over the top of the transmission cables. Installation of the cables would be coordinated with the ferry operator to minimize impacts on ferry operations.

The burial depth for the area of rock excavation in the Harlem River is stated in the USACE Public Notice as being 6 feet 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 could require an increase in the number of boreholes to be drilled in order to get the powder factor (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**).

Table 2-2. Underwater Construction Windows

CHPE Milepost	Location	Construction Window	Primary Construction Method	Species Lifestage Protected
Lake Champlain				
0 to 73	U.S./Canada Border to Crown Point	May 1 to August 31	Jet Plow	N/A: No Aquatic Federally Protected Species in Lake Champlain.
73 to 101	Crown Point to Dresden	September 1 to December 31	Shear Plow	N/A: No Aquatic Federally Protected Species in Lake Champlain.
Hudson River				
228 to 245	Cementon (Catskill) to New Hamburg	August 1 to October 15[a]	Jet Plow	*Shortnose sturgeon:* spawning adults, eggs, and larvae (spring); adults and juveniles (early summer). *Atlantic sturgeon:* spawning adults, eggs, and larvae and early juveniles (spring and early summer).
269 to 295	New Hamburg to Stony Point	September 15 to November 30	Jet Plow	*Shortnose sturgeon:* adults and juveniles (summer). *Atlantic sturgeon:* adults, eggs, larvae, and juveniles (spring and summer); early juveniles (winter).
303 to 324	Clarkstown to Harlem River	July 1 to October 31	Jet Plow	*Shortnose sturgeon:* adults and juveniles (winter and early summer). *Atlantic sturgeon:* early juveniles (winter and spring).
Harlem and East Rivers				
324 to 330	Harlem River	May 31 to November 30	Jet Plow	Proposed blasting would avoid sturgeon spawning migration.
331 to 331	East River	May 15 to November 30	HDD	N/A

Source: Bain 1997, NYSPSC 2013

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.

The blasting program in the Harlem River is estimated to take up to 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) 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 for each blast with clearance of the vicinity as required by the local fire marshal and harbormaster.

The blast events are anticipated to have duration of only a few seconds, but they would be preceded by warnings and clearings of the area prior to and after the blast for inspections, all of which may last approximately two 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 per second at a distance of 200 feet from the trench, 1 inch per second at a distance of 75 feet, 2 inches per second at 50 feet, and 4 inches per second at 30 feet. Peak water pressures are predicted to be 10 pounds per square inch (psi) at 200 feet, 30 psi at 75 feet, 50 psi at 50 feet, and 85 psi at 30 feet from the trench.

Following clearance by the blaster, mucking of blasted trench materials would be done 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 is 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 and covered with sand layer. Thereafter, 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 work windows were subsequently supplemented through consultation with NMFS. These established work windows and time of year restrictions (see **Table 2-2)** were developed in part to avoid impacts on overwintering, spawning migrations, spawning activity, and larval stages of ESA-listed fish species. Spawning seasons for ESA-listed fish species in the Hudson River Segment are April through May for shortnose sturgeon and May through June for Atlantic sturgeon. 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 ESA-listed fish species during spawning migrations, which are vital and sensitive stages of their lifecycle.

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 2010b):

- 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 2010b).

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 stream bed.
- *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 NYSDPS stream width classification, 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* (NYSDPS 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 2010a).

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 2010a).

2.5.4 Operations and Maintenance

The proposed CHPE Project has an expected life span of 40 years or more (CHPEI 2012a). 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 2010a).

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 (ROV) jetting device (CHPEI 2010a).
- *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 2010a).

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 plan would be subject to applicable Federal and state regulations in place at that time.

2.6 Impact Minimization and Conservation 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. The Applicant would develop a Environmental Management and Construction Plan (EM&CP), which documents environmental and construction management procedures and plans to be implemented during the proposed CHPE Project construction activities and during facility operation. In addition, the Applicant has proposed to employ a number of specific measures to minimize environmental impacts as part of its filings with the NYSPSC and the USACE. These impact reduction measures, collectively referred to as BMPs, have been proposed by the Applicant for use during construction and operations to protect environmental, agricultural, cultural, and other potentially sensitive resources along the proposed CHPE Project route. These BMPs have been incorporated into the Certificate and will be incorporated into the final EM&CP (NYSPSC 2013). The Applicant-proposed measures have been taken into account in the environmental analyses conducted for the DOE Draft EIS and this BA. These measures include development of a Spill Prevention, Control, and Countermeasures (SPCC) Plan; time of year work restrictions; water quality monitoring; biological studies; work site restoration; and inspection and reporting. A listing of specific BMPs proposed by the Applicant as part of the proposed CHPE Project and considered in the EIS evaluation is provided in Appendix G of the Draft EIS (DOE 2013). The Certificate includes 165 attached conditions, some of which require measures to reduce, avoid, or measure environmental impacts. Specific measures that apply to ESA-listed species are presented as follows. A final EM&CP would be developed in consultation with NYSDPS, NYSDEC, and NMFS as the project design is advanced prior to construction.

2.6.1 Applicant-Proposed Measures and BMPs for Aquatic ESA-listed Species

The Applicant has proposed measures to avoid or minimize impacts on aquatic ESA-listed species and their occupied habitats in the Hudson River and New York City Metropolitan Area segments. Additionally, the NYSPSC Certificate requires the Applicant to undertake a series of pre- and post-installation compliance monitoring studies: benthic and sediment monitoring; bathymetry, sediment, temperature, and magnetic field; and Atlantic sturgeon pre-installation and post-energizing hydrophone. The Atlantic sturgeon study would document the species' movements in relation to cable operation. 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 natural resources agencies.

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 following measures have been proposed by the Applicant to avoid or minimize impacts on aquatic ESA-listed species:

- The Applicant would continue to work closely with Federal and state agencies to establish measures prior to construction starting to avoid or minimize impacts on aquatic threatened and endangered species along the proposed CHPE Project route.
- All in-water work would be conducted within applicable time windows as agreed to by the NYSDEC, NYSDOS, NYSDPS, and NMFS Habitat Conservation Division, including location-specific dredging windows in the Hudson River Estuary intended for the protection of aquatic threatened and endangered species. As a conservation measure, the Applicant worked with the NYSDEC to establish periods when sensitive species would be using different segments of the Hudson River. The Applicant has proposed construction windows to avoid impacts on spawning migrations, spawning activity, and larval stages of ESA-listed fish species (see **Table 2-2**). NYSDOS has conditionally concurred with these construction windows as part of its CMP consistency certification for the proposed CHPE Project. Restricting construction activities to timing windows protects ESA-listed fish species from construction activities during spawning migrations, which are the most vital and sensitive portions of their lifecycle.
- 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 Significant Coastal Fish and Wildlife Habitats (SCFWHs), which contain important breeding habitat for protected and sensitive species (see Attachment A). 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 total suspended solids (TSS) would be calculated after the installation specifications have been set as part of the construction design phase. Proposed areas where construction modifications could occur would be identified in Plan and Profile drawings included in the EM&CP.
- HDD would be used where the cables enter and exit bodies of water to avoid or minimize effects on shoreline and shallow water habitats.
- A closed environmental (clamshell) bucket dredge would be used to minimize sediment suspension at mechanical dredging sites for fine-grained (silty) sediments.
- A sheet pile cofferdam installed using a vibratory hammer would be positioned to enclose the HDD exit point work site before commencing mechanical dredging to create the exit 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.
- 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.

- Commencement of in-river work north and south of the Haverstraw Bay SCFWH would occur between high tide and ebb tide to avoid or minimize impacts of resuspended sediments on Haverstraw Bay, which contains important habitat for protected and sensitive species.
- The Environmental Inspector would have the authority to modify or suspend construction if any aquatic threatened and endangered species would be impacted in any way by construction activities.
- Most designated trout streams are anticipated to be crossed using the HDD method, thereby avoiding disturbance to these streams.
- In the event that the Applicant unexpectedly encounters any rare, threatened, or endangered species during the preconstruction, construction, or operation and maintenance phases of the CHPE Project, the following measures would be implemented:
    - The Applicant would temporarily halt construction activities, excepting any activity required for immediate stabilization of the area, to avoid or minimize the impacts on the species or habitat.
    - The Environmental Inspector would identify the area of the sighting or encounter and record GPS locations of the likely habitat boundary or the sighting location of any aquatic threatened and endangered species.
    - Any unanticipated sightings of threatened and endangered species or observation of rare, threatened, and endangered plants would be reported as soon as possible to NYSDPS staff, NYSDEC, USFWS, or NMFS (as appropriate). Reporting of all takes of listed species of sturgeon should be directed to incidental.take@noaa.gov and the NMFS Protected Resources Division (PRD) should be contacted (Bill Barnhill, william.barnhill@noaa.gov; 978-282-8460). The Applicant would consult with applicable resource agencies for measures to avoid or minimize impacts on aquatic threatened and endangered species and their occupied habitat. Construction activities in the area would resume once protective measures, developed in consultation with NYSDPS staff, NYSDEC, or USFWS, are implemented.
- Any sightings of sturgeon would be reported to the New York Natural Heritage Program (NYNHP), USFWS, and NMFS as soon as possible. Reporting of all takes of listed species of sturgeon should be directed to NMFS PRD. A Standard Operating Procedures Manual would be prepared to outline the monitoring and reporting methods to be implemented during proposed CHPE Project construction. This manual would be coordinated with and reviewed by NMFS PRD.
- If new aquatic threatened and endangered species-occupied habitat is identified, the EM&CP would be updated to show the new occupied habitat(s), and consultation with appropriate Federal or state agencies would commence.
- All personnel associated with the project would be advised of the potential presence of aquatic threatened and endangered species and the need to avoid collisions. All construction personnel would also be updated on the locations of any new aquatic threatened and endangered species or occupied habitats that are identified. These areas would be reported to the applicable resource agencies.
- All vessel crew members and contractors would participate in a fisheries training for aquatic protected species presence and emergency procedures in the unlikely event an animal is struck by a vessel. The emergency procedure would be provided as part of the EM&CP. Both the training

program and applicable parts of the EM&CP would be coordinated with and reviewed by NMFS PRD.

- All construction personnel would be responsible for observing water-related activities for the presence of these species.
- 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.
    - Require that vessels, equipment, and materials be inspected for, and cleaned of, any visible vegetation, algae, organisms, and debris before bringing them to the proposed CHPE Project area.
    - Train transmission system contractors and subcontractors on the various cleaning or decontamination methods to be used on a site-by-site basis for the proposed CHPE Project.
    - 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.
- All construction personnel would be advised that there are civil and criminal penalties for harming, harassing, or killing aquatic species that are protected under the ESA.
- All vessels associated with the construction 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.
- 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.
- Any collision with or injury to a protected species would be reported immediately to the NMFS Protected Resources Division.

2.6.2 Applicant-Proposed Measures and BMPs for Terrestrial ESA-listed Species

The Applicant has proposed mitigation measures and BMPs applicable to all threatened and endangered species and their occupied habitats. Additionally, measures developed through consultation with agencies including the NYSDEC, NYNHP, and USFWS would be included, if applicable. Specific measures meant to avoid impacts on threatened and endangered species and their occupied habitats include the following:

- All known threatened and endangered species, occupied habitats, and locations where rare, threatened, and endangered plants have been observed, based on the field surveys and available data, would be clearly marked on the construction drawings. The construction drawings would be provided to the NYSDEC, NYNHP, NYSDPS, and USFWS for review of mapped occupied habitat areas and locations where rare, threatened, and endangered plants have been observed.
- Locations of threatened and endangered species or their habitat and rare, threatened, and endangered plants would be treated as confidential. All documents or plans containing specific

location information would be marked as such. Appropriate training would be provided to employees and contractors regarding the confidential nature of this information.

- Construction personnel would be trained to identify known and potential threatened and endangered species; rare, threatened, and endangered plants; and significant natural communities that could be encountered, when possible, and the identification and protection measures that are included in the construction plan.
- The Environmental Inspector would be responsible for ensuring that prescribed protection measures are appropriately used during construction.

Federally listed species that have the potential to be affected by construction of the terrestrial portions of the transmission cable include the Karner blue butterfly (*Lycaeides melissa samuelis*) and Indiana bat (*Myotis sodalis*). Measures designed specifically to avoid impacts on the Karner blue butterfly and Indiana bat are as follows:

Karner blue butterfly. The following measures would be implemented to protect the Karner blue butterfly and its habitat, per the Applicant's *Karner Blue Butterfly Impact Avoidance and Minimization Report* (CHPEI 2012k). These measures have also been written to address the state-listed frosted elfin butterfly (*Callophrys irus*), which has habitat similar to the Karner blue butterfly.

Prior to construction, a qualified biologist would conduct surveys for the presence of Karner blue and frosted elfin butterflies, in accordance with the USFWS and NYSDEC guidance document *Karner Blue Butterfly* (Lycaeides melissa samuelis) *Survey Protocols Within the State of New York* (USFWS and NYSDEC 2008). These protocols include guidance on the following:

- Prior to construction, the boundaries of all wild blue lupine (*Lupinus perennis*) patches within or immediately adjacent to construction workspaces or access routes would be clearly flagged in the field, and the Applicant would conduct a walk-through to discuss and review measures to avoid impacts.
- Disturbance or access through all flagged lupine patches would be prohibited.
- Contractors and construction crews would be trained on the locations and identification of the host plant, wild blue lupine, for the Karner blue butterfly and frosted elfin. Construction personnel would be trained and instructed to avoid trampling or destruction of wild blue lupine plants.
- Wild blue lupine is an early successional species that could regenerate following a variety of different environmental disturbances. If any previously unknown (i.e., unflagged) areas containing wild blue lupine are encountered during preconstruction environmental inspection, construction, or restoration, the Environmental Inspector would delineate the boundary of the habitat with flagging in the field, and would collect Global Positioning System (GPS) data mapping its location.
- The Applicant would notify NYSDPS, NYSDEC, and USFWS as soon as possible (within 48 hours) if any previously unidentified habitats containing wild blue lupine are discovered during pre-construction environmental inspection, construction, or restoration. If additional protective measures are necessary to protect the Karner blue butterfly, frosted elfin butterfly, or occupied habitat (i.e., grasses and nectar within approximately 650 feet [200 meters] of lupine patches within or immediately adjacent to construction workspaces and access routes) for these species, the Applicant would temporarily cease any vegetation clearing, construction, ground-disturbing, or vegetation management activities in the area, excepting any activities that could be necessary for immediate stabilization of the work site, until protective measures can be

implemented. Work would only resume once NYSDEC and USFWS have been notified and recommended protective measures to avoid or minimize impacts on threatened and endangered species and occupied habitat have been implemented.

During operation of the transmission line, any vegetation management, emergency repairs, or other operational maintenance activities required within Karner blue butterfly and frosted elfin lupine habitats would be implemented in accordance with ongoing consultations between the Applicant and USFWS and NYSDEC, and the results of those consultations will be included in the EM&CP. At a minimum, the EM&CP would include the following measures to avoid and minimize impacts on Karner blue butterfly and its habitat.

- No herbicides or pesticides would be used within occupied Karner blue butterfly and frosted elfin nectar habitat, except as approved by the USFWS and NYSDEC. To minimize the impact of herbicides on Karner blue butterfly and its food plants, applications would be limited to spot application with hand-operated equipment, using personnel certified or experienced in pesticide applications and trained to identify the butterfly and lupine.
- For emergency repairs in areas where the cable was installed by HDD under Karner blue butterfly habitat, the cable would be pulled from the entry or exit locations and repaired to avoid impacts on the butterfly and its habitat. In areas where the cables are installed in trenches adjacent to nectar patches, repair crews would employ the same protocols adhered to during installation to avoid impacts (e.g., training of personnel to identify and flag habitat boundaries to be avoided).

Indiana Bat and Northern Long-eared Bat. During the preconstruction survey, the contractors would identify and avoid large live or dead trees with peeling bark, including large specimens of shagbark hickory (*Carya ovata*), with the potential to serve as maternity or roost trees and these would be marked. Potential roost trees identified within the construction limits would be avoided where possible during construction activities. Tree removal would occur between October and March.

Unexpected Encounters. In the event that the Applicant unexpectedly encounters any rare, threatened, or endangered species during the preconstruction, construction, or operation and maintenance phases of the proposed CHPE Project, the following measures would be implemented:

- Areas of threatened and endangered species occupied habitat and locations of rare, threatened, and endangered plants along the terrestrial portions of the proposed CHPE Project route would be flagged in the field.
- The Environmental Inspector would identify the area of the sighting or encounter; flag the boundaries of the newly identified occupied habitat or locations where the threatened or endangered species or rare, threatened, or endangered plant were observed; and record GPS locations of the likely habitat boundary or the sighting.
- Any unanticipated sightings of threatened or endangered species or observations of rare, threatened, or endangered plants would be reported as soon as possible to NYSDPS, NYSDEC, or USFWS. The Applicant would consult with applicable resource agencies for measures to avoid or minimize impacts on plants or animals.
- If threatened or endangered species or threatened or endangered plants are discovered during construction activities, the Applicant would temporarily halt construction activities in the vicinity of the discovery, excepting any activity required for immediate stabilization of the area, to avoid or minimize the impacts on the species or habitat. Construction activities in the area would resume once protective measures, developed in consultation with NYSDPS, NYSDEC, and USFWS, are implemented.

- If new threatened or endangered species and occupied habitat are identified or threatened or endangered plants are observed and verified, construction plans would be updated to show the new threatened or endangered species, occupied habitat, or threatened or endangered plant species. These newly occupied areas would also be flagged in the field.
- Construction personnel would be updated on the locations of any new threatened and endangered species or occupied habitats or locations of threatened or endangered plants that are identified. These areas would be reported to the applicable natural resource agencies.

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3. Federally Listed Species and Designated Critical Habitat

DOE obtained a list from the USFWS of threatened, endangered, proposed, and candidate species that could occur within or near the proposed CHPE Project area by querying the Information, Planning, and Conservation System part of the Environmental Conservation Online System run by USFWS (USFWS 2013a). NMFS provided similar information for species managed by their agency in the form of a letter to DOE. No federally listed species were identified as being present in Lake Champlain; therefore, aquatic species in Lake Champlain are not addressed further in this document.

The 13 aquatic and 7 terrestrial ESA-listed species identified by the USFWS and NMFS as potentially occurring within or near the proposed CHPE Project area and 2 terrestrial species proposed for listing under the ESA in October 2013 that potentially occur in the project area were assessed for this BA (see **Sections 3.1** and **3.2**). Of these, the shortnose sturgeon (*Acipenser brevirostrum*), five distinct population segments (DPSs) of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), Indiana bat (*Myotis sodalis),* northern long-eared bat (*Myotis septentrionalis*)*,* and Karner blue butterfly (*Lycaeides melissa samuelis*) occur in the proposed CHPE Project area, and the status of those species and potential effects of the proposed CHPE Project on them are analyzed in detail in **Section 5**. The proposed CHPE Project would have no effects on other listed species for a variety of reasons as discussed below, including lack of an established record within the proposed CHPE Project area, and those species are not considered further in **Sections 4 and 5**. Neither the NMFS nor the USFWS have designated or proposed designated critical habitat in the Action Area for any species potentially affected by the proposed CHPE Project as discussed in each following subsections; therefore, DOE concludes that the proposed CHPE Project would have no effect on designated or proposed to be designated critical habitat.

3.1 Aquatic Species

The USFWS has jurisdiction over the West Indian manatee (*Trichechus manatus*), dwarf wedgemussel (*Alasmidonta heterodon),* and sea turtles on nesting beaches, while NMFS has jurisdiction over the large whale species and sea turtles in the water. The federally listed aquatic species that could occur in the proposed CHPE Project area are identified in **Table 3-1**. Marine mammals are discussed in **Section 3.1.1**, marine reptiles in **Section 3.1.2**, fish in **Section 3.1.3**, and aquatic invertebrates in **Section 3.1.4**. There is no designated or proposed designated critical habitat within the proposed CHPE Project area for any of the aquatic species.

3.1.1 Marine Mammals

Six marine mammal species listed under the ESA have made rare appearances in the Hudson River or New York City Metropolitan Area segments: five large whale species: the North Atlantic right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeagliae*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*); and one sirenian, the West Indian manatee (*Trichechus manatus*) (see **Table 3-1**). Under the ESA, all whale species fall under the jurisdiction of NMFS, while the West Indian manatee is managed by USFWS.

Historic unconfirmed, records of large whales up the Hudson River have been reported as far north as Troy (Kiviat and Hartwig 1994). However, large whales are uncommon in the Hudson River; individual large whales could be found occasionally at the river mouth. Typically, large whales, which include ESA-listed species, occur in offshore waters of the New York Bight. Wide-ranging movements have been documented for some individual manatees. One manatee was sighted in various waters of the northeastern United States during July and August 2006. This individual traveled up the Hudson River to

Table 3-1. Likelihood of Occurrence of Aquatic ESA-Listed Species within the Segments of the Proposed CHPE Project Area

Common Name	Scientific Name	ESA Status	Critical Habitat		Possible Occurrence in Each Segment			
			Designated for Species?	Located Within or Adjacent to Proposed Action Area?	Lake Champlain	Overland	Hudson River	New York City Metropolitan Area
Marine Mammals								
Fin whale	*Balaenoptera physalus*	E	N	N	N	N/A	N	N
Humpback whale	*Megaptera novaeangliae*	E	N	N	N	N/A	N	N
North Atlantic right whale	*Eubalaena glacialis*	E	Y	N	N	N/A	N	N
Sei whale	*Balaenoptera borealis*	E	N	N	N	N/A	N	N
Sperm whale	*Physeter macrocephalus*	E	N	N	N	N/A	N	N
West Indian manatee	*Trichechus manatus*	E	Y	N	N	N/A	N	N
Marine Reptiles								
Green sea turtle	*Chelonia mydas*	T[1]	Y	N	N	N/A	N	Y[3]
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	N	N	N	N/A	N	Y[3]
Leatherback sea turtle	*Dermochelys coriacea*	E	Y	N	N	N/A	N	Y[3]
Loggerhead sea turtle	*Caretta caretta*	T[2]	N	N	N	N/A	N	Y[3]
Fishes								
Shortnose sturgeon	*Acipenser brevirostrum*	E	N	N	not expected	N/A	Y	Y[3]
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	T[4], E[5,6,7,8]	N	N	not expected	N/A	Y	Y
Aquatic Invertebrates								
Dwarf wedgemussel	*Alasmidonta heterodon*	E	N	N	not expected	N	N	N

Table Key: E = Federally listed as endangered; T = Federally listed as threatened, Y = Yes, N = No; N/A = Not Applicable

Notes:

1. Since the nesting areas for turtles encountered at sea often cannot be determined, a conservative approach to management requires the assumption that all greens in the Gulf of Mexico are endangered.
2. There are nine DPSs for this species; the Northwest Atlantic DPS is the most likely to occur in waters offshore of Action Area.
3. Not likely, but conservatively assumed to be present in the Action Area.
4. Gulf of Maine DPS.
5. New York Bight DPS.
6. Chesapeake Bay DPS.
7. Carolina DPS.
8. South Atlantic DPS.

the Harlem River and was also sighted off Cape Cod, Massachusetts, and in Bristol Harbor, Rhode Island (Hamilton and Puckett 2006). **Based on available occurrence records, it is unlikely that ESA-listed marine mammal species would occur in either the Hudson River or New York City Metropolitan Area segments; therefore, DOE concludes that the proposed CHPE Project would have no effect on the North Atlantic right whale, humpback whale, fin whale, sei whale, sperm whale, and the West Indian manatee, and those species are not discussed further in this BA.**

3.1.2 Marine Reptiles

Four sea turtle species occur seasonally during warmer months (June through mid-November) in the offshore waters of New York Bight (i.e., the bend in the shoreline from the New Jersey coast to Long Island). These are the leatherback (*Dermochelys coriacea*) (endangered), loggerhead (*Caretta caretta*) (threatened), Kemp's ridley (*Lepidochelys kempii*) (endangered), and green (*Chelonia mydas*) (threatened) (see **Table 3-1**). NMFS and the USFWS share jurisdiction for sea turtles, with NMFS having lead responsibility for the conservation and recovery of sea turtles in the marine environment and USFWS for turtles on nesting beaches. These four sea turtle species are less frequently documented in the bays and harbors of the western portion of Long Island Sound when compared to the eastern portion (CHPEI 2012j). Due to known sea turtle presence in western Long Island Sound, which access the East River water passage between Upper New York Harbor/Manhattan and Long Island Sound, transient sea turtles could occasionally occur in the East River from June through October (Kurkal 2009). However, they are generally considered extralimital in the East River, and would likely occur only as occasional transients (NMFS 2014). Based on the limited upriver sightings of listed sea turtles (NMFS 2011a), these species are unlikely to occur in the Hudson River Segment or the Harlem River. In 2010, a deceased, propeller-cut Kemp's ridley sea turtle was recovered from the beach at Verplanck, New York. This is the only the second reported sea turtle recovered in the lower Hudson River (NMFS 2011a); a propeller-cut Kemp's ridley was also recovered near Yonkers in 1995 (NYSDEC 2007, NYSDEC 2010). **Based on the lack of upriver sighting records, it is unlikely that any sea turtles would occur in either the Hudson River or New York City Metropolitan Area segments; additionally, the transmission line would be installed under the East River via HDD, thereby not affecting aquatic species in the East River. DOE therefore concludes that the proposed CHPE Project would have no effect on the leatherback, loggerhead, Kemp's ridley, and green sea turtles, and those species are not discussed further in this BA.**

3.1.3 Fishes

Under the authority of the ESA, USFWS and NMFS are responsible for the protection and recovery of endangered and threatened fish species. NMFS has jurisdiction over most marine fish and anadromous fish (i.e., fish that are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn) listed under the ESA, while USFWS has jurisdiction over freshwater fish species. The only ESA-listed species that have the potential to occur in the proposed CHPE Project area are the shortnose sturgeon and the Atlantic sturgeon. These fish species could be encountered in the Hudson River and New York City Metropolitan Area segments. NMFS has jurisdiction over all the listed fish species that could be affected by the proposed CHPE Project. Details on the life history and occurrence patterns of these species are discussed in the following sections.

Shortnose Sturgeon

The following description of the shortnose sturgeon comes primarily from the following sources, which are incorporated by reference.

- *Recovery Plan for the Shortnose Sturgeon (NMFS 1998)*

- *A Biological Assessment of Shortnose Sturgeon (Acipenser brevirostrum) (SSSRT 2010)*
- *Biological Assessment for the Tappan Zee Hudson River Crossing Project (FHWA 2012)*
- *Biological Opinion for the Tappan Zee Bridge Replacement Project (NMFS 2013a)*
- *Biological Opinion for Continued Operations of Indian Point Nuclear Generating Unit Nos. 2 and 3 (NMFS 2013b).*

Status. The shortnose sturgeon was listed as endangered in 1967 under the Endangered Species Preservation Act that pre-dated the ESA (32 *Federal Register* 4001). NMFS manages the species and recognizes 19 separate populations of shortnose sturgeon. Individuals occurring in the proposed CHPE Project area belong to the endangered Hudson River population, which is the largest population of shortnose sturgeon, with an estimated 65,000 individuals (USFWS 2009). There is no designated or proposed designated critical habitat for the shortnose sturgeon, so the DOE concludes that the proposed CHPE Project would have no effect on critical habitat (NOAA 2013, USFWS 2014).

Behavior and Life History. The shortnose sturgeon primarily occurs in freshwater rivers and coastal estuaries. The species is considered freshwater amphidromous, meaning its use of marine waters is limited to the estuaries of its home rivers (Bain 1997). Spawning occurs in upper freshwater areas, while feeding and overwintering activities could occur in both freshwater and saline habitats (NMFS 1998, SSSRT 2010). While the shortnose sturgeon does not undertake the significant marine migrations seen in the Atlantic sturgeon, telemetry data indicate that shortnose sturgeons do make localized coastal migrations. For example, one individual tagged in the Hudson River was recaptured in the Connecticut River (Welsh et al. 2002).

The shortnose sturgeon is a long-lived species (30 to 40 years) that matures at late ages (males attain sexual maturity at 6 to 10 years of age, while females do so between 7 and 13 years) (NMFS 1998). Males spawn approximately every 2 years, while females spawn every 3 to 5 years. Generally, shortnose sturgeons spawn in sand- to boulder-sized substrate in April to May. Studies indicate that the spawning period lasts from a few days to several weeks and begins when freshwater temperatures increase from 46 to 48 °F (8 to 9 ºC), early April through May (NYSDEC 2013a, Dovel et al. 1992). Larvae tend to drift downstream and are generally found between Albany and Poughkeepsie, New York (NatureServe 2013, NYNHP 2010a). Larvae can be found upstream of the saltwater wedge (i.e., a wedge-shaped intrusion of salty ocean water into a tidal river; it slopes downward in the upstream direction, and salinity increases with depth) in the Hudson River estuary and are most commonly found in deep waters with strong currents, typically in the channel (Dovel et al. 1992, Bain 1997). Most activity of larvae, juveniles, and adults appears to occur at night (NatureServe 2013). Juvenile shortnose sturgeons in the Hudson River typically use the same deep channel habitats throughout the tidal reach as adults (Bain 1997).

In northern rivers (e.g., the Hudson River), the shortnose sturgeon feeds in fresh water during summer and over sand-mud bottoms in the lower estuary during fall, winter, and spring (NMFS 1998). Shortnose sturgeons are bottom feeders; their mouths are designed to suck up prey from the river bottom. Juveniles eat available benthic crustaceans and insects. Adults in fresh water feed on mollusks, crustaceans, and insect larvae depending on availability, and, in estuaries, their primary foods are polychaete worms, crustaceans, and mollusks (NatureServe 2013).

Distribution and Habitat. In New York State, the shortnose sturgeon is found in the Hudson River from the Federal Dam at Troy downriver to the southern tip of Manhattan, over a large portion of the fresh and brackish reaches in deep channel habitats (Bain 1997, Bain et al. 2000). All life stages occur in the lower Hudson River. Non-spawners use overwintering habitat concentrated in brackish waters of the lower Hudson River while spawners (in the upcoming spring) overwinter in a single concentration in deep channel habitats further upstream (Bain 1997). Adults migrate upriver from their middle Hudson River overwintering areas to freshwater spawning sites north of Coxsackie, New York when water temperatures reach 46 to 48 °F (8 to 9 ºC) (NYSDEC 2013a, Dovel et al. 1992).

Shortnose sturgeon have been found in waters with temperatures as low as 36 to 37 °F (2 to 3 ºC) and as high as 93 °F (34 ºC) (Dadswell et al. 1984). Water temperatures above 82 °F (28 ºC) are thought to adversely affect shortnose sturgeon. Shortnose sturgeon are known to occur at depths of up to 98 feet (30 meters) but are generally found in waters less than 66 feet (20 meters) (Dadswell et al. 1984). Adults occur in both freshwater and upper tidal saline areas all year. Juveniles (age of 3 to 10 years) generally occur at the saltwater/freshwater interface (i.e., salt front) (Dovel et al. 1992).

Spawning grounds extend from below the Federal Dam at Troy downriver to around Coeymans, New York (Dovel et al. 1992). Spawning typically occurs at water temperatures between 50 and 64 °F (10 and 18 °C) (generally early April through May). Shortnose sturgeon eggs are expected to hatch in 8 to 13 days and embryos gradually disperse downstream over much of the Hudson River estuary. Shortnose sturgeon larvae captured in the Hudson River were associated with deep waters and strong currents (Hoff et al. 1988 as cited in Bain 1997). Juvenile shortnose sturgeon are predominantly found in deep channels in mid-river region in the mid-summer (Hoff et al. 1998 and Pekovitch 1979 as cited in Bain 1997). After spawning, adults disperse quickly down river into their summer range. The broad summer range occupied by adult shortnose sturgeon extends from just south of Catskill, New York, downriver to the Palisades area near the border of New York and New Jersey. Similar to non-spawning adults, most juveniles occupy the broad region of Haverstraw Bay by late fall and early winter (Dovel et al. 1992). Migrations from the summer foraging areas to the overwintering grounds are triggered when water temperatures fall below approximately 46 °F (8 °C), which typically occurs in late November (NMFS 1998). Juveniles are distributed throughout the mid-river region during the summer and move back into the Haverstraw Bay region during the late fall.

From late fall to early spring, adult shortnose sturgeon concentrate in a few overwintering areas. Reproductive activity the following spring determines overwintering behavior. The largest overwintering area is just south of Kingston, New York, near Esopus Meadows (Dovel et al. 1992). The fish overwintering at Esopus Meadows are mainly spawning adults. Captures of shortnose sturgeon during the fall and winter from Saugerties to Hyde Park (greater Kingston reach), indicate that additional smaller overwintering areas may be present (Geoghegan et al. 1992). An overwintering site in the Croton-Haverstraw Bay area has also been confirmed (Geoghegan et al. 1992, Dovel et al. 1992). Fish overwintering in areas below Esopus Meadows are mainly thought to be pre-spawning adults. Typically, movements during overwintering periods are localized and fairly sedentary. The shortnose sturgeon prefers deep channel habitats during the winter season.

There have been no documented captures of shortnose sturgeon in the East River; however, shortnose sturgeon have been captured near the confluence of the East River and New York Harbor. As there have been no documented captures of shortnose sturgeon in the area where the East River converges with Long Island Sound, it is unknown whether these fish traveled through the East River and through Long Island Sound (the most direct route) or exited New York Harbor into the Atlantic Ocean and swam around southern Long Island and back into Long Island Sound. Based on this information, although the East River is not expected to be a high use area for shortnose sturgeon, occasional transient shortnose sturgeon could be present in the East River (NMFS 2014).

Shortnose sturgeon eggs and larvae are limited to the low salinity waters near spawning grounds, and young of the year are also restricted to areas of low salinity. The shortnose sturgeon spawning grounds in the Hudson River are greater than 125 miles [48 km] upstream from the Harlem and East rivers. In addition, given higher salinity of the Harlem and East rivers, eggs, larvae, and young-of-year (YOY) is not present in these waterbodies (NMFS 2014).

Threats. Throughout the shortnose sturgeon's range, habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges) and mortality (resulting, for example, from impingement on cooling water intake screens, dredging and incidental capture in other fisheries) are the principal threats to survival (NMFS 1998).

Atlantic Sturgeon

The following description of the Atlantic sturgeon comes primarily from the following sources, which are incorporated by reference.

- *Status Review of Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) (ASSRT 2007)*
- *Biological Assessment for the Tappan Zee Hudson River Crossing Project (FHWA 2012)*
- *Biological Opinion for the Tappan Zee Bridge Replacement Project (NMFS 2013a)*
- *Biological Opinion for Continued Operations of Indian Point Nuclear Generating Unit Nos. 2 and 3 (NMFS 2013b).*

Status. Although as a species the Atlantic sturgeon is not listed as threatened or endangered, there are five DPSs that are listed: threatened Gulf of Maine DPS, endangered New York Bight DPS, endangered Chesapeake Bay DPS, endangered Carolina DPS, and South Atlantic DPS. Individuals from any of these five DPSs could occur in the proposed CHPE Project area (Colligan 2012). Based on genetic sampling of Atlantic sturgeon captured within the Hudson River, three DPSs are most likely to occur in the Hudson River (ranked largest to smallest): New York Bight DPS, Gulf of Maine DPS, and Chesapeake Bay DPS (NMFS 2013b, 77 *Federal Register* 5880). Based on the previously mentioned genetic sampling, the majority of Atlantic sturgeon in the Hudson River are likely to be of the New York Bight DPS. In the New York Bight DPS, there are two known spawning populations: those in the Hudson and Delaware rivers. Currently, the existing spawning population in the Hudson River is estimated to have 870 adults spawning each year (600 males and 270 females), and there is no indication that the population is increasing (77 *Federal Register* 5880). There is no designated or proposed designated critical habitat for any of the five DPSs that could occur in the proposed CHPE Project area, so the DOE concludes that there is no effect of the proposed CHPE Project on critical habitat. Herein, referral to Atlantic sturgeon refers to multiple DPSs.

Behavior and Life History. Atlantic sturgeon are long-lived (approximately 60 years), late-maturing, estuarine-dependent, anadromous fish (i.e., adults spawn in fresh water in the spring and early summer and migrate into estuarine and marine waters where they spend most of their lives). In the Hudson River, the Atlantic sturgeon matures at 11 to 21 years (ASSRT 2007). Males spawn approximately every 1 to 5 years and females every 2 to 5 years.

Eggs are deposited on hard-bottom substrate (e.g., cobble, coarse sand, and bedrock) (Greene et al. 2009). After hatching, larval fish move downstream at night and seek refuge during the day. As larval fish make their way downstream, they grow and become more tolerant of brackish and saline waters, and eventually reside entirely in estuarine waters (for 2 to 6 years) until they reach sub-adulthood and move into the open ocean (Bain 1997). Locations of sonic-tagged juvenile sturgeons revealed that individuals are found most often in dynamic mud habitat (ASMFC 2008). When juveniles begin to emigrate they travel widely along the Atlantic Coast and its estuaries.

Atlantic sturgeons are bottom-feeders that suck food into their mouths. Diets of adult and migrant sub-adult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish (e.g., sand lance). Juvenile Atlantic sturgeon feed on aquatic insects, insect larvae, and small invertebrates (ASSRT 2007). Adults feed primarily on benthic worms (e.g., polychaetes), crustaceans, and mollusks (NOAA 2013).

Distribution and Habitat. Spawning generally occurs between May and July in the Hudson River (Bain 1997, Bain et al. 2000). Male sturgeons begin upstream spawning migrations when waters reach approximately 43 ºF (6 ºC), and remain on the spawning grounds throughout the spawning season. Females begin spawning migrations when temperatures are warmer at 54 to 55 ºF (12 to 13 ºC), make rapid spawning migrations upstream, and quickly depart following spawning (Greene et al. 2009). Spawning likely occurs in multiple sites within the Hudson River in the vicinity of the proposed CHPE Project from MPs 254 to 269 (Dovel and Berggren 1983, Van Eenennaam et al. 1996, Kahnle et al. 1998, Bain et al. 2000). Spawning sites in a given year can be influenced by the position of the salt wedge (where the salt water from the estuary meets the fresh water of the river) (Dovel and Berggren, 1983, Van Eenennaam et al. 1996, Kahnle et al. 1998). The area around Hyde Park (MP 254) has consistently been identified as a spawning area through scientific studies and historical records of the Hudson River sturgeon fishery. Habitat conditions near Hyde Park site are fresh water year-round with bedrock, silt, and clay substrates and water depths of 40 to 80 feet (12 to 24 meters) (Dovel and Berggren 1983, Van Eenennaam et al. 1996, Kahnle et al. 1998, Bain et al. 2000). A spawning site near New Hamburg near MP 266 has also been identified based on tracking data; has clay, silt, and sand substrates; and is approximately 70 to 90 feet (2l to 27 meters) deep (Bain et al. 2000, NMFS 2014). Larvae are expected to occur from June through August in the vicinity of the spawning area (Bain et al. 2000).

Juvenile Atlantic sturgeon have been recorded in the Hudson River between approximate MPs 245 (near Kingston, New York) and 295 (north of Haverstraw Bay), which includes some brackish waters; however, larvae must remain upstream of the salt wedge because of their low salinity tolerance (Dovel and Berggren 1983, Kahnle et al. 1998, Bain et al. 2000). Catches of immature sturgeon (age 1 and older) suggest that juveniles use the estuary from Kingston to the Tappan Zee Bridge (MPs 245 to 310). Seasonal movements are apparent with juveniles occupying waters from MPs 270 to 295 during summer months and then moving downstream as water temperatures decline in the fall, primarily occupying waters in the vicinity of the proposed CHPE Project from MPs 290 to 324 (Dovel and Berggren 1983, Bain et al. 2000). Based on river-bottom sediment maps (Coch 1986), most juvenile sturgeon habitats in the Hudson River have clay, sand, and silt substrates (Bain et al. 2000). Newburgh and Haverstraw Bays in the Hudson River are areas of known juvenile sturgeon concentrations. Sampling in spring and fall revealed that highest catches of juvenile Atlantic sturgeon occurred during the spring in soft-deep areas of Haverstraw Bay, even though this habitat type composed only 2 percent of the available habitat in the bay. Overall, 90 percent of the total 562 individual juvenile Atlantic sturgeon captured during the course of this study came from Haverstraw Bay (Sweka et al. 2007). At around 3 years of age, Hudson River juveniles exceeding 28 inches (70 cm) in length begin to migrate to marine waters (Bain et al. 2000, NMFS 2014). It has also been reported that older juveniles and post-spawn adult sturgeon congregate in deepwater habitat during the summer in the Hudson River (Bain et al. 2000). Sonic-tagged spawning adults were detected in the river as early as April and as late as October (ASMFC 2008).

Atlantic sturgeon are known to occur in the East River (NMFS 2014). After emigration from the natal estuary, sub-adults and adults travel within the marine environment, typically in waters less than 164 feet (50 meters) in depth, using coastal bays, sounds, and ocean waters. Satellite-tagged adult sturgeon from the Hudson River concentrate in the southern part of the Mid-Atlantic Bight at depths greater than 66 feet (20 meters) during winter and spring, and in the northern portion of the Mid-Atlantic Bight at depths less than 66 feet (20 meters) in summer and fall (Erickson et al. 2011). Atlantic sturgeon adults and sub-adults that are not spawning live in coastal and estuarine conditions, generally in shallow water (33 to 164 feet [10 to 50 meters]) in nearshore areas dominated by gravel and sand (Greene et al. 2009).

Threats. Unintended catches of Atlantic sturgeon in fisheries, vessel strikes, poor water quality, water availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon (77 *Federal Register* 5880, 77 *Federal Register* 5914).

3.1.4 Aquatic Invertebrates

The dwarf wedgemussel (*Alasmidonta heterodon*) is an endangered freshwater mollusk species that occurs in New York State. Its extent is limited to a small area within the upper Delaware River watershed in Sullivan and Delaware counties, and in one of its major downstream tributaries, the lower Neversink River in Orange County (NatureServe 2013, NYSDEC 2013b). **Since the dwarf wedgemussel does not occur in the proposed CHPE Project area, DOE has concluded that the proposed CHPE Project would have no effect on this species**.

3.2 Terrestrial Species

Under the authority of the ESA, USFWS is responsible for the protection and recovery of endangered and threatened terrestrial species. The terrestrial species that are federally listed, or are proposed for Federal listing, that have previously been identified in the vicinity of the proposed CHPE Project area are identified in **Table 3-2**. There is no designated or proposed designated critical habitat for any of these species within the proposed CHPE Project area.

3.2.1 Indiana Bat

Status. The Indiana bat was officially listed as an endangered species on March 11, 1967 (32 *Federal Register* 4001). Critical habitat was designated for the species on September 24, 1976 (41 *Federal Register* 14914). Thirteen hibernacula, including eleven caves and two mines in six states, were listed as critical habitat; however, there is no designated or proposed designated critical habitat for this species in New York State. The following description of the Indiana bat comes primarily from the following sources, which are incorporated by reference.

- *Indiana Bat Recovery Plan (USFWS 1983)*
- *Revised Draft Recovery Plan for the Indiana Bat (USFWS 2007)*
- *Indiana Bat Five-Year Review (USFWS 2009)*
- *Biological Opinion on the Effect of Proposed Activities on the Fort Drum Military Installation (2012-2014) in the Towns of Antwerp, Champion, Leray, Philadelphia, and Wilna, Jefferson County and the Town of Diane, Lewis County, New York on the Federally-Endangered Indiana Bat (*Myotis sodalis*) (USFWS 2012a)*
- *Biological Assessment, Indiana Bat (*Myotis sodalis*), St. Lawrence Windpower Project, Jefferson County, New York* (Young et al. 2010).

Behavior and Life History. The Indiana bat is a temperate, insectivorous, migratory bat that hibernates in caves and mines in the winter (typically October through April) and summers in wooded areas. It is a medium-sized bat 1.5 to 2 inches long, having a wingspan of 9 to 11 inches (23 to 28 cm), and weighing approximately only one-quarter of an ounce. It has brown to dark-brown fur and the facial area often has

Table 3-2. Likelihood of Occurrence of Terrestrial ESA-Listed Species within the Segments of the Proposed CHPE Project

Common Name	Scientific Name	Federal Status, State Status	Possible Occurrence in Each Segment			
			Lake Champlain	Overland	Hudson River	New York City Metropolitan Area
Mammals						
Indiana bat	*Myotis sodalis*	E	Y	Y	Y	N
Northern long-eared bat	*Myotis septentrionalis*	PE	Y	Y	Y	Y
Birds						
Piping plover	*Charadrius melodus*	T	N	N	N	Y
Roseate tern	*Sterna dougallii dougallii*	E	N	N	N	Y
Red knot	*Calidris canutus rufa*	PT	N	N	N	Y
Reptiles						
Bog turtle	*Clemmys muhlenbergii*	T	N	Y	Y	Y
Invertebrates						
Karner blue butterfly	*Lycaeides melissa samuelis*	E	N	Y	N	N
Plants						
Northern wild monkshood	*Aconitum noveboracense*	T	N	N	N	N
Small whorled pogonia	*Isotria medeoloides*	T	N	N	N	N

Table Key: E = Federally listed as endangered; PE = Proposed species for listing as endangered; T = Federally listed as threatened; PT = Proposed species for listing as threatened; Y = Yes; N = No

a pinkish appearance. The Indiana bat feeds primarily on aquatic and terrestrial insects. Diet varies seasonally and variations exist amongst different ages, sex, and reproductive status (USFWS 1999). Indiana bats forage in closed to semi-open forested habitats and forest edges located in floodplains, riparian areas, lowlands, and uplands.

In Illinois, Gardner et al. (1991) found that forested stream corridors, and impounded bodies of water, were preferred foraging habitats for pregnant and lactating Indiana bats, which flew up to 1.5 miles (2.4 km) from upland roosts to forage. They forage between dusk and dawn and feed exclusively on flying insects, primarily moths, beetles, and aquatic insects. Riparian habitat is occupied by Indiana bats from mid-April to mid-September. Romme et al. (1995) cite several studies which document that Indiana bats also forage in upland forests.

Distribution and Habitat. During winter, Indiana bats are restricted to suitable underground habitats known as hibernacula. The majority of hibernacula consist of limestone caves, but abandoned underground mines, railroad tunnels, and even hydroelectric dams can provide winter habitat throughout the species' range (USFWS 2007). Hibernacula with stable or growing populations of Indiana bats have stable low temperatures that allow the bats to maintain a low rate of metabolism and conserve fat reserves through the winter. Hibernacula in the vicinity of the project include those in Ulster County (Priority 1: site that is essential to long term conservation of the species and containing a population of 10,000 bats), Essex County (Priority 2: site of geographic or regional importance to the species that has between 1,000 and fewer than 10,000 bats), Warren County (Priority 3: site with between 50 and fewer than 1,000 bats), and Columbia County (Priority 4: site with a population of fewer than 50 bats) (USFWS 2007).

Spring emergence occurs when outside temperatures have increased and insects (forage) are more abundant (Richter et al. 1993). Female Indiana bats emerge from hibernation in late March or early April, followed by the males. The period after hibernation but prior to migration is typically referred to as staging. Spring staging occurs when some bats remain close to the cave for a few days before migrating to summer habitats. Others head directly to summer habitat. Most populations leave their hibernacula by late April.

Potential summer habitat occurs throughout much of New York State. At least 39 documented maternity colonies have been identified in Cayuga, Columbia, Dutchess, Essex, Jefferson, Onondaga, Orange, Oswego, and Ulster counties. Male bats disperse throughout the range and roost individually or in small groups. In contrast, reproductive females form larger groups, referred to as maternity colonies, in which they raise their offspring. Non-reproductive females roost individually or in small groups and occasionally are found roosting with reproductive females.

Summering Indiana bats (males and females) roost in trees in riparian, bottomland, and upland forests. Roost trees generally have exfoliating bark which allows the bat to roost between the bark and bole of the tree. Cavities and crevices in trees also may be used for roosting. A variety of tree species are used for roosts including, but not limited to, silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), shagbark hickory (*Carya ovata*), shellbark hickory (*Carya laciniosa*), bitternut hickory (*Carya cordiformis*), green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), eastern cottonwood (*Populus deltoides*), northern red oak (*Quercus rubra*), post oak (*Quercus stellata*), white oak (*Quercus alba*), shingle oak (*Quercus imbricaria*), slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), and sassafras (*Sassafras albidum*) (Rommé et al. 1995). Structure is probably more important than the species in determining if a tree is a suitable roost site. Tree species which develop loose, exfoliating bark as they age and die are likely to provide roost sites. Exposure of trees to sunlight and location relative to other trees are important to suitability (USFWS 1999).

During the fall breeding season, female bats can number from 50 to 100 individuals in a single tree (NYSDEC 2012b). Maternity colonies use a minimum of 8 to 25 trees per season (Callahan et al. 1997, Kurta et al. 2002). On the average, Indiana bats typically switch roosts every 2 to 3 days with reproductive condition of the female, roost type, weather conditions, and time of year affecting switching behavior (Kurta et al. 2002, Kurta 2005).

Very little research has focused on the use of travel corridors by Indiana bats. Most information pertaining to bat movements and travel corridors is incidental to other portions of a study and general observations. However, Murray and Kurta (2004) showed that Indiana bats increased commuting distance by 55 percent to follow tree-lined paths rather than flying over large agricultural fields, some of which were at least 0.6 miles (1 km) wide. Apparently, suitable forest patches might not be available to Indiana bats unless they are connected by a wooded corridor; however, we do not know the maximum size of an opening Indiana bats can cross. There are numerous observations of Indiana bats crossing interstate highways and open fields. In New York State, Indiana bats tracked from hibernacula to spring and summer roosts have crossed I-81, the Hudson River, I-87, and other highways. These crossings primarily occurred during the initial migration from hibernacula to spring and summer habitats, rather than during nightly foraging bouts.

While little is known about behavior during dispersal, evidence from radio-tracking studies in New York and Pennsylvania indicate that Indiana bats are capable of dispersing at least 30 to 40 miles (48 to 64 km) in one night (Young et al. 2010). It appears as if Indiana bat dispersal from hibernacula to summer habitat is fairly linear and short-term but in the fall is more dispersed and varied. Some studies have shown that Indiana bats travel between 9 and 17 miles (15 and 27 km) from a roost site to a hibernaculum cave where swarming is occurring. In addition, males and females display different dispersal behavior. Females appear to move quickly between the hibernacula and maternal colonies, while males will commonly remain near the hibernacula. While it is unknown, it is likely that Indiana bats dispersing to and from hibernacula follow more meandering routes that may be habitat-related and do not fly at high altitudes, in highly linear paths, or long distances (more than 50 miles [80 km]) non-stop (USFWS 2007).

Threats. The primary threats to Indiana bats in New York State at this time are White-nose Syndrome (WNS), energy development (e.g., wind power), and residential and commercial development that fail to incorporate measures to maintain suitable Indiana bat habitat, and avoid and minimize impacts on maternity colonies and swarming bat populations. Over the long term, from 1965 to 2001, there has been an overall decline in Indiana bat populations and winter habitat modifications have been linked to changes in populations at some of the most important hibernacula. Summer habitat modification is also suspected to have contributed to the decline of bat populations; however, it is difficult to generalize how forest management or disturbance may affect Indiana bats. The *Indiana Bat Draft Recovery Plan* (USFWS 2007) provides a comprehensive summary of Indiana bat life history, which is incorporated by reference.

Lake Champlain Segment

In the Lake Champlain Segment, the Indiana bat could potentially occur in Essex and Clinton counties. The Indiana bat is likely to occur in Essex County during both the summer and winter due to the presence of the one known hibernaculum (location chosen for hibernation) in Essex County (USFWS 2007). The Indiana bat could occur in Clinton County during the summer, due to the presence of the nearby Essex County hibernaculum.

Indiana bats can travel hundreds of miles after dispersing from hibernacula in the spring, which could bring this species into the range of the Lake Champlain Segment. Groups of female bats form maternity colonies in the crevices of trees or under the loose bark of dead trees. During the fall breeding season, female bats can number from 50 to 100 individuals in a single tree (NYSDEC 2012b). Maternity colonies typically roost during the day, but little is known about the foraging or roosting behavior of Indiana bats at night (Murray and Kurta 2004).

Bat roost and maternity colonies could be associated with a variety of forested community types adjacent to the Lake Champlain construction corridor, including Appalachian oak-hickory, beech-maple mesic, floodplain, and hemlock-northern hardwood forests. Large live and dead trees with peeling bark, including shagbark hickory, with the potential to serve as maternity or roost trees were identified along the project route (CHPEI 2012b). Bats forage on flying insects along river and lake shorelines, in the crowns of trees in floodplains, and in upland forests. Indiana bats prefer to forage and travel along the forest-air interface of the forest canopy or along forest edges/hedgerows (USFWS 2007). Roosting and foraging habitat for Indiana bats could occur adjacent to the transmission line route in the Lake Champlain Segment.

Overland Segment

According to the USFWS, Indiana bats are present in such low numbers that it is unlikely that they would be present in Saratoga, Albany, and Schenectady counties (USFWS 2012b). In the Overland Segment, the Indiana bat could occur in Washington County during the summer due to the presence of known hibernacula in nearby Warren and Essex counties (CHPEI 2012j). The summer range of this species extends well beyond the wintering locations since the animals disperse to breeding areas and other habitats to feed and raise their young. In the immediate vicinity of the road and railroad ROWs, much of the habitat consists of disturbed open lands and secondary forest lacking suitable habitat for bat roosts; however, a few areas do have large shagbark hickories or other large trees that could support summer bat colonies (NYNHP 2010b).

Hudson River Segment

In the Hudson River Segment, the Indiana bat could occur in Ulster County during both the summer and winter due to the presence of the known hibernaculum in Ulster County. The Indiana bat could occur in Greene, Dutchess, Orange, Putnam, Rockland, and Westchester counties during the summer due to the presence of the nearby Ulster County hibernaculum (CHPEI 2012j). In the immediate vicinity of the roadway and railroad ROWs in Rockland County, much of the habitat consists of disturbed open lands and secondary forest lacking suitable habitat for bat roosts; however, a few areas do have large shagbark hickories or other large trees that could support summer bat colonies (NYNHP 2010b, CHPEI 2012e).

3.2.2 Northern Long-Eared Bat

Status. On October 2, 2013, the USFWS announced its proposal to list the northern long-eared bat (*Myotis septentrionalis*) as endangered under the ESA and the initiation of a 12-month finding toward a final status determination. The USFWS reported that no critical habitat for the species was determinable. There are limited data on population trends for the northern long-eared bat; however, all reported occurrences of the species are marked by small populations that are in decline (Schmidt 2003, 78 *Federal Register* 61046).

Pursuant to Section 7(a)(4) of the ESA, Federal action agencies are required to confer with the USFWS if their proposed action is likely to jeopardize the continued existence of the northern long-eared bat (50 CFR 402.10[a]). Action agencies may also voluntarily confer with the USFWS if a proposed action may affect a proposed species. Species proposed for listing are not afforded protection under the ESA; however, as soon as a listing becomes effective, the prohibition against jeopardizing its continued existence and "take" applies regardless of an action's stage of completion. DOE is addressing potential effects on the northern long-eared bat at this time to avoid unnecessary delays in the proposed CHPE Project should the species be listed in the future.

Behavior and Life History. The northern long-eared bat is medium-sized, averaging between 3 and 3.7 inches (7.62 and 9.4 cm) in length with a wingspan that measures between 9 and 10 inches (23 and 26 cm) (Caceres and Barclay 2000). Females of this species are generally larger and heavier than the males (Caceres and Pybus 1997). As its name suggests, this bat is distinguishable from other *Myotis* species by long ears that extend beyond the tip of its nose when laid forward, a long, narrow, and sharp-pointed tragus, and a calcar (cartilage spur at ankle) that lacks a keel (Caceres and Barclay 2000, USFWS 2013b). This species has medium to dark brown fur on its back, dark brown ears and wing membranes.

The diet for the northern long-eared bat is diverse and varied according to season and geographical occurrence. Generally, the diet will consist of moths, flies, leafhoppers, beetles and caddisflies, and spiders. Bats will catch insects by hawking (catching in flight) and gleaning (emitting a high-frequency echolocation call) to find prey (Henderson and Broders 2008). The gleaning call of the northern long-eared bat is the highest frequency of any bat species, and is higher than the hearing frequency of many moth species, thereby giving it a foraging advantage within its feeding habitat.

Breeding for this species begins in late summer or early fall when males begin swarming near hibernacula. Following fertilization, pregnant females migrate to summer areas where they roost in small colonies of between 30 and 60 bats, although larger maternity colonies have been observed. Like the Indiana bat, the female northern long-eared bat will nest under the loose dead bark of trees such as shagbark hickory, which is found in the CHPE Project area. There is also documentation of this species roosting in manmade structures such as buildings and barns. Females in a maternity colony generally give birth to one pup, and will all give birth at around the same time of year, from late May to late July, depending on where the colony is located within the its home range. Young bats begin to fly and explore approximately 4 week following birth. Adult northern long-eared bats live up to 19 years (USFWS 2013b).

Distribution and Habitat. The range of this species includes much of the eastern and north central United States, and all Canadian provinces for the Atlantic Ocean west to the southern Yukon Territory and eastern British Columbia (USFWS 2013b). This species has been observed year-round throughout New York State (USFWS 2013f).

Habitat use changes over the course of the year and varies based on sex and reproductive status. Reproductive females often use different summer habitat than males and non-reproductive females. Generally, summer and winter ranges for this species will be identical, but the habitat types used within those ranges will differ. Potential summer habitat occurs throughout much of New York State. Maternity colonies are formed in roost trees and are more widely distributed and numerous than are major hibernacula. Northern long-eared bats overwinter in multi-species hibernacula that are typically caves or abandoned underground mine shafts with deep crevices (Caceres and Pybus 1997, Caceres and Barclay 2000). In these hibernacula, this species will usually comprise less than 25 percent of the total number of individuals (Caceres and Pybus 1997). Northern long-eared bats have been observed in 58 hibernacula in mines, caves, and tunnels in New York.

Edge habitat is important for northern long-eared bats as they migrate and forage (WDNR 2013). Bats will migrate from hibernacula to summer roosts, or fly from their roosts to feeding grounds following the habitat edges to maintain protection from wind and predation. Additional to the protection that edge habitat provides, this behavior may also allow bats more feeding opportunities because food is more abundant around edge habitat. Commuting along edge habitat may assist the bats with navigation and orientation through use of linear edges as landmarks.

Threats. Most mortalities in this species occur during the juvenile stage (Cyceres and Pybus 1997). The predominant threat affecting population declines of this species is WNS, an emerging infectious fungal disease that depletes fat stores, reduces responsiveness to human disturbance, and results in a lack of immune response during hibernation and uncharacteristic dispersing from hibernacula during the day in mid-winter (WNS Session 2008). As indicated for the Indiana bat, northern long-eared bat populations are declining with the destruction and modification of their summer and winter habitats. Access to hibernacula may be restricted by doors or gates intended to exclude humans. Also, the thermal regime typical of these habitats may be adversely altered by mining activities, or hibernacula in mines may be destroyed altogether with mine passage collapses. Additionally, habitats are subject to adverse impacts from development activities (industrial, commercial, and residential) on overwintering, roosting, and feeding bats.

Occurrence in the Proposed CHPE Project Area. The northern long-eared bat occurs in every county in New York State. Based upon this species' habitat preferences during winter and summer, it may be assumed that these bats would occur in similar or the same areas indicated for the Indiana bat (and more) along the proposed CHPE Project route.

3.2.3 Piping Plover

Status. Recent surveys have estimated the Atlantic Coast population at approximately 800 breeding pairs, about 200 of which nest in New York State. The piping plover (*Charadrius melodus*) was federally listed as threatened in the Northeast Region on December 11, 1985 (50 *Federal Register* 50726). There is no critical habitat designated for the Northeast population.

Behavior and Life History. This pale shorebird with orange legs is the color of dry beach sand. The species weighs 1.5 to 2.25 ounces (43 to 64 grams) and is 5.5 inches (14 cm) long. Piping plovers are seen singly or in small flocks.

The piping plover is one of the first shorebirds to arrive in the New York Bight area for breeding, starting from early to mid-March; piping plovers have been observed as early as March 11 in New York State (USFWS 1996). Nests are placed on open, generally grassless sand beaches or dredged spoil areas, well above the high tide mark. Piping plover and least tern nest in the same areas. Piping plovers forage on beaches and dunes where they feed on marine worms, insect larvae, beetles, crustaceans, mollusks, and other small marine animals and their eggs (62 *Federal Register* 59605). By early September, all but a few stragglers have departed for their wintering areas.

Distribution and Habitat. Piping plovers breed on dry, sandy beaches or in areas that have been filled with dredged sand, often near dunes in areas with little or no beach grass. They occur along the Atlantic Coast from southwestern Newfoundland and southeastern Quebec south to North Carolina, and on inland beaches from eastern Alberta and Nebraska to Lake Ontario.

The sand spits extending into Lower New York Bay from Long Island (Breezy Point) and New Jersey (Sandy Hook) have supported some of the highest nesting concentrations for piping plover in the region. Other important nesting beaches for piping plover include Jones Beach Island West (Hempstead Bay), Jones Beach Island East (Great South Bay), and Westhampton Beach (Moriches Bay) on Long Island; and Holgate (Barnegat Bay), Little Beach Island (Brigantine Bay and Marsh Complex), and Cape May Meadows (Cape May) in New Jersey (62 *Federal Register* 59605).

Threats. Coastal development, recreational activities, and disturbance by off-road vehicles have reduced the available suitable breeding habitat for these birds.

Occurrence in the Proposed CHPE Project Area. Piping plovers are present in the Lower New York Bay during March through September, where they breed on Long Island's sandy beaches in Queens and in the harbors of northern Suffolk County (NYSDEC 2012b). However, no potential breeding habitat has been identified along the proposed CHPE Project route. The tidal area at the landfall for cables connecting to the Luyster Creek converter station is also unlikely to support foraging piping plovers. Although some mud and wrack may be exposed during low tide below the rip-rap slope at this location, which could be used by feeding shorebirds, the habitat is marginal and within a largely urban landscape; therefore, it is unlikely that this particular area would be used for foraging. **Since the piping plover does**

not occur in the proposed CHPE Project area, DOE has concluded that the proposed CHPE Project would have no effect on this species.

3.2.4 Red Knot

Status. On September 30, 2013, USFWS announced its proposal to list the red knot (*Calidris canutus rufa*) as threatened under the ESA. Currently, no critical habitat has been designated for the species. Recent survey data indicate that populations have declined by approximately 75 percent since the 1980s, with the steepest declines in the 2000s (USFWS 2013c, 78 *Federal Register* 60024).

Behavior and Life History. Red knots are birds that have an average body length of between 10 and 11 inches (25 and 28 cm) and a wingspan of up to 20 inches (51 cm) (USFWS 2013d). The plumage (i.e., feathers) of this species varies in between sexes in the spring and varies between spring and winter (Harrington 2009). During spring, feathers from the crown to the rump are ashy gray mottled and barred with black. The sides, throat and chest feathers are cinnamon, and the undertail is white barred with black. Although similar to the color pattern of the male, female spring plumage is lighter in color. Winter plumage becomes more uniformly pale and gray, and is similar for both sexes.

Red knots form monogamous breeding pairs. Females usually lay 4-egg clutches in nests built on dry, rocky arctic tundra at high elevations. Nests are built around clumps of lichens and scant vegetation, and among rocky outcroppings on hills and ridges. Eggs are laid in June and July and both parents incubate the eggs for a period of about 21-22 days until they hatch. The young take flight approximately 18 days after hatching (SMS 2010).

During its migrations, this species feeds along the sand and muddy shorelines where intertidal invertebrates may easily be found and consumed (Harrington 2009). The primary food items for red knot in non-breeding habitats include blue mussel, spat (mussel juveniles), clams, snails, polycheate worms, insect larvae and crustaceans (USFWS 2013e). During the spring breeding season, red knots primarily feed on the eggs of horseshoe crabs, mussels, and spat.

Distribution and Habitat. The red knot is the longest-distance migratory bird in the animal kingdom, flying up to 9,300 miles during its northern migration to its breeding grounds in the Canadian Arctic in the spring and again during its southern migration to Tierra del Fuego in the fall (USFWS 2013e). Because their flights can extend for thousands of miles between stopovers, these birds are dependent upon seasonally abundant resources at the various habitats located along their migratory routes to build up and maintain fat reserves that will be used for the next long-distance flight (USFWS 2013c). The red knot migrates and winters in large flocks of hundreds of birds and uses spring and summer stopover areas along the Atlantic and Gulf coasts (USFWS 2013e). In New York State, the species is known to occur in Queens, Kings, Nassau, and Suffolk counties (USFWS 2013d).

Threats. This species is considered to be especially sensitive to climate change impacts that cause habitat loss from sea level rise; loss of nesting habitat from warmer arctic temperatures that alter the condition of vegetation; and asynchronies between the timing of their annual breeding, migration, and wintering cycles with the windows of peak food availability (USFWS 2013e). Additionally, since this species flocks in such large numbers, its population is subject to decline from singular catastrophic events such as storms or oil spills (USFWS 2013e).

Occurrence in the Proposed CHPE Project Area. The New York City Metropolitan Area Segment of the proposed CHPE Project route transverses northern Queens County in New York. Although specific data on occurrences of the red knot in Queens County New York are unavailable, no impacts on beach or shoreline habitat where this species may stop over to feed are anticipated from the construction and operation of the transmission line or converter station. **Since the typical stopover and feeding habitat of the red knot does not occur in the proposed CHPE Project Area, DOE has concluded that the proposed CHPE Project would have no effect on this species.**

3.2.5 Roseate Tern

Status. The roseate tern population is estimated to have fallen by 75 percent since the 1930s. Recent survey data indicate that 87 percent of the birds in New York nest in only one colony at Great Gull Island. Recent occurrences of roseate terns have been documented in Queens and Nassau counties (CHPEI 2012j). The roseate tern (*Sterna dougalli dougalli*) was federally listed as endangered on November 2, 1987 (52 *Federal Register* 42064).

Behavior and Life History. The roseate tern is a graceful bird, 14 to 17 inches (36 to 43 cm) long, with a wingspan of about 30 inches (76 cm). It resembles the common tern. Its back and upper wings are a light pearly-gray, while its underparts are white.

Roseate terns arrive to breed in New York in late April or early May and are always found nesting with common terns. Nests are built in sand, shell, or gravel, within dense grass clumps or under boulders or riprap. Both adults incubate the eggs for about 23 days, and the young fledge in 22 to 29 days. One brood per season is typical, although two broods are sometimes produced. Migration begins in late summer.

Roseate terns in the northeastern United States breed in only a few scattered colonies on sandy beaches along the Atlantic coast, and winter primarily in northern South America. Birds arrive at the breeding grounds in late April or early May and remain until late July, when they begin staging for migration to the wintering grounds in late summer (Spendelow 1995). Roseate terns feed offshore on small schooling fish, such as sand lance.

Distribution and Habitat. In the New York City area, this species breeds primarily in a few colonies on Long Island, with additional nesting sites at Breezy Point in Queens (USFWS 1997). Recent survey data indicate that 87 percent (more than 1,000 nesting pairs) of roseate terns in New York nest in only one colony at Great Gull Island (NYSDEC 2013c).

Threats. Threats to roseate tern populations include vegetational changes within the breeding areas, competition with gulls for suitable nesting areas, and predation. The increased presence of humans has contributed to higher predation rates. Predators, such as raccoons (*Procyon lotor*), find tern nests when they are attracted to the garbage left behind by careless beach users.

Occurrence in the Proposed CHPE Project Area. Recent occurrences of roseate terns have been documented in Queens County (CHPEI 2012j). No impacts on sand beach habitat are expected from construction of the transmission line or converter station and no breeding colonies for roseate tern have been identified in the immediate vicinity of the transmission line route**. Since the roseate tern does not occur in the proposed CHPE Project area, DOE has concluded that the proposed CHPE Project would have no effect on this species.**

3.2.6 Bog Turtle

Status. The bog turtle (*Clemmys muhlenbergii)* was federally listed as threatened on November 4, 1997 (62 *Federal Register* 59605). Based upon documented losses of bog turtles and their habitat, the northern population has declined by at least 50 percent, with most of the documented decline occurring over the past 30 years. Significant declines are likely to have occurred prior to this due to the filling and draining of wetlands. As of 2007, bog turtles have been documented at approximately 608 individual sites (element occurrences) (see **Table 3-3**), ranging in quality from good to poor, within the northern range. These represent individual wetlands, or in some cases road crossing sightings, where the species has been confirmed. These sites or occurrences are not equivalent to the "population analysis sites" (PAS) or sub-populations referred to in the *Bog Turtle Recovery Plan, Northern Population*.

Table 3-3. Bog Turtle Occurrences in Its Northern Range

State	Counties of Occurrence	Number of Extant Occurrences
Connecticut	1	19
Delaware	1	15
Maryland	4	82
Massachusetts	1	4
New Jersey	11	212
New York	11	62
Pennsylvania	15	214
TOTAL	**44**	**608**

Source: USFWS 2010a

Behavior and Life History. Bog turtles are small, semi-aquatic turtles that primarily inhabit open wet meadows and calcareous bogs, which can be isolated or part of a larger wetland complex. The northern population of the bog turtle occurs in seven states ranging from Massachusetts to Maryland. Critical habitat has not been designated for this species. The current environment, impacts of human activities, and current status of the bog turtle have been described in detail in the following reports, which are incorporated here by reference.

- *Bog Turtle (Clemmys muhlenbergii) Northern Population 5-year Review Summary and Evaluation (USFWS 2008a)*
- *Biological Opinion. Effects of the Implementation of Habitat Restoration Practices by the Natural Resources Conservation Service on the Northern Population of the Bog Turtle (USFWS 2010a)*
- *Bog Turtle (Clemmys muhlenbergii) Recovery Plan, Northern Population (USFWS 2001).*

The bog turtle is the smallest member of the genus *Clemmys*, with the upper shell of adults measuring 3 to 4.5 inches (7.5 to 11.4 cm). The large, conspicuous bright orange, yellow, or red blotch on each side of the head is a distinguishing characteristic of the species. Bog turtles are semi-aquatic and only active from April to mid-October in the northern part of their range and hibernate from October to April, often just below the upper surface of frozen mud or ice. Their varied diet consists of slugs, beetles, lepidopteran larvae, caddisfly larvae, snails, nematodes, millipedes, fleshy pondweed seeds, sedge seeds, and carrion.

Distribution and Habitat. Bog turtles typically inhabit shallow spring-fed fens, sphagnum bogs, swamps, marshy meadows, and pastures with soft muddy areas. These emergent wetlands are usually a mosaic of shallow water, soft muddy bottoms, low grasses and sedges, and interspersed wet and dry pockets. Spring-seeps often form a network of small rivulets in the wetland. The open canopy of these wetlands provides sunlight for basking and nesting, and is essential for continued use by bog turtles. The shallow water and deep mucky soils are crucial bog turtle habitat components.

Bog turtle habitats are sustained primarily by groundwater, although surface water also contributes to wetland maintenance. Bog turtles depend upon relatively stable, year-round supplies of clean groundwater to support their food base, brumation (hibernation) and aestivation areas, and their nesting habitat. Soft substrates and slow-moving water both above and below the surface protect the bog turtles against freezing and overheating. Bog turtles inhabit sub-climax seral wetland stages and are dependent on riparian systems that are unfragmented and sufficiently dynamic to allow the natural creation of meadows and open habitat to compensate for the closing over of habitats caused by ecological succession. Succession of many wetlands from open-canopy fens to closed-canopy red maple (*Acer rubrum*) swamps contributes to the loss of bog turtle habitat.

Bog turtles are known to use streams as travel corridors and avenues for dispersal into new unoccupied wetlands. Movement of bog turtles between wetlands usually occurs along interconnecting water courses, but turtles have also been observed traveling overland through cornfields and pine plantations, across roads (especially those adjacent to or within wetlands), and through other terrestrial habitats.

Threats. Primary threats to the bog turtle are loss, fragmentation, and degradation of its fragile, early successional wet meadow habitat, and collection for the wildlife trade (USFWS 2008a). Direct habitat loss or degradation has occurred from the draining, ditching, dredging, or filling of suitable sites for agricultural use, development, and pond or reservoir construction. The proximity of many remaining bog turtles to roadways and population centers exposes these populations to increased predation, road kills, pollution, and establishment of invasive native or exotic plant species that pose a significant indirect threat to the species. Spread of exotic invasive vegetation, including common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), multiflora rose (*Rosa multiflora*), and reed canary grass (*Phalaris arundinacea*), degrades bog turtle habitat in many locations. The eggs and young of bog turtles are particularly vulnerable to predators such as raccoon, opossum, skunk, fox, snapping turtle, water snake, and larger birds. Populations of many of these predators are elevated in areas of high human activity.

Overland Segment

Freshwater wetland and upland habitats have the potential to be impacted along the underground transmission line corridor in Washington, Saratoga, Schenectady, and Albany counties. Historic records of bog turtles occur in Albany County; however, according to data from the NYNHP, no historic records of bog turtles in their database occurred within 0.25 miles (0.4 km) of the proposed CHPE Project route (CHPEI 2012j). Although suitable bog turtle habitat associated with open-canopy red-maple hardwood swamps, sedge meadows, and fens could be present along the proposed transmission line corridor in this county, no recent records suggest that bog turtles are likely to occur. Additionally, because the construction corridor consists primarily of previously disturbed brush and edge habitat associated with the railroad, the likelihood of bog turtle occurring in the proposed CHPE Project area is extremely low.

Hudson River Segment

In the Hudson River Segment, the bog turtle could occur in Rockland County. However, according to data from the NYNHP, no historic records of bog turtles in their database occur within 0.25 miles (0.4 km) of the proposed transmission line route in the Hudson River Segment. This species is also listed in Dutchess, Orange, Putnam, Ulster, and Westchester counties; however, this portion of the segment is entirely aquatic and does not contain suitable habitat for the bog turtle.

Since the bog turtle does not occur in the proposed CHPE Project area, DOE has concluded that the proposed CHPE Project would have no effect on this species.

3.2.7 Karner Blue Butterfly

Status. The Karner blue butterfly was federally listed as endangered December 14, 1992 (USFWS 2012c). No critical habitat has been designated for the Karner blue butterfly. The current environment, impacts of human activities, and current status of the Karner blue butterfly have been described in detail in the following reports, which are incorporated here by reference.

- *Karner Blue Butterfly (Lycaeides melissa samuelis) Recovery Plan (USFWS 2003)*
- *Karner Blue Butterfly (Lycaeides melissa samuelis). 5-year Review: Summary and Evaluation (USFWS 2012c).*

Behavior and Life History. The Karner blue butterfly is a small butterfly having a wingspan of 0.9 to 1.3 inches (22 to 32 millimeters). The female's wings are dark-blue or grayish-brown dorsally, with an irregular band of orange inside a narrow black border on the upper wings. The dorsal side of the male's wings has a narrow black margin and is light blue or silvery-blue in color. The Karner blue butterfly is a bivoltine species, meaning that two generations are produced per year. Eggs that have overwintered hatch in mid- to late-April. The larvae feed on wild lupine for approximately 3 weeks prior to pupating. Adult butterflies begin emerging in late-May or early-June in most years.

The Karner blue butterfly is highly specialized on the larval host plant, wild blue lupine (*Lupinus perrenis*). Two generations occur per year. One generation hatches from overwintering eggs and emerges from May to June. These adults lay eggs to produce the second generation, which emerges from mid-July to mid-August (NYSDEC 2013d). Natural habitat for Karner blue butterflies includes pine barrens, oak savannahs, and openings in oak woodlands (NYNHP 2010b).

Distribution and Habitat. Lupine tends to grow in sandy soils. These plants historically occurred in savanna and barrens habitats typified by dry, sandy soils, and now occur in remnants of these habitats, and in other locations such as roadsides, military bases, and some forest lands. Though wild lupine is essential for the larvae, adult Karner blue butterflies also use many nectar plants. Ideal habitat contains numerous nectar species that bloom at various times throughout the summer, thus ensuring an ample supply of nectar during both flights.

The Karner blue butterfly was once found in a narrow north-to-south band stretching from eastern Minnesota to Maine. Karner blue butterflies are currently found in Minnesota, Wisconsin, Indiana, Michigan, New York, New Hampshire, and Ohio, and are considered extirpated from Iowa, Illinois, Pennsylvania, Massachusetts, Maine, and the Canadian province of Ontario. Within their restricted range, Karner blue butterflies now also occur in man-made openings along ROWs, at airports and in sandy old fields wherever wild blue lupine is present. Karner blue butterflies are found in the Hudson Valley sand belt extending from near Albany to Glens Falls (NYSDEC 2013d).

The NYSDEC has identified 70 Karner blue butterfly localities and 56 subpopulations in the Glacial Lake Albany Recovery Unit. Of those, 43 subpopulations are within the three recovery areas: 7 in the Albany Pine Bush, 27 in Saratoga Sandplains, and 9 in Saratoga West. Of these 43 subpopulations, only 15 are anticipated to have more than 10 butterflies in the annual index counts (USFWS 2003). Distribution of the Karner blue butterfly has not changed significantly in New York although it has contracted somewhat within the counties that are occupied as small outlying populations mapped in 1989 disappeared. This is especially true in Warren County where the NYSDEC is attempting to restore the Queensbury Sandplains Karner blue butterfly metapopulation, a state recovery site. There is one less county (Schenectady County) with Karner blue butterflies in 2011 compared to 1992; however, this resulted in the loss of only one small site (USFWS 2012c).

Threats. The primary limiting factors are loss of habitat through development, and canopy closure (succession) without a concomitant restoration of habitat. A shifting geographic mosaic that provides a balance between closed and open-canopy habitats is essential for the maintenance of large viable populations of the Karner blue butterfly.

Overland Segment

Portions of the Overland Segment in Albany, Schenectady, and Saratoga counties are within an area containing suitable habitat and known to be inhabited by the Karner blue butterfly. The NYNHP has records of Karner blue butterflies within 0.25 miles (0.4 km) of the proposed CHPE Project in Wilton and Saratoga Springs in Saratoga County (CHPEI 2012j). Lupine and nectar patches were identified and mapped along the CP Railroad ROW portion of the segment (MPs 112 to 177). During follow-up presence/absence surveys, two Karner blue butterflies were observed in lupine patches in the segment crossing through the Town of Wilton in Saratoga County (CHPEI 2012k).

3.2.8 Small Whorled Pogonia

Status. The small whorled pogonia (*Isotria medeoloides*) was federally listed as threatened in October 6, 1994 (59 *Federal Register* 50852).

Distribution and Habitat. Small whorled pogonia inhabits semi-open second-growth deciduous forests or older hardwood stands of beech, birch, maple, oak, and hickory that have an open understory. Occasionally it occurs in pine or hemlock woods. Typically it prefers acidic and mesic soils, often on slopes near small streams (NatureServe 2013, USFWS 2008b). Small whorled pogonia was rediscovered in Schunnemunk Mountain State Park in Orange County, New York in 2010 by a NYNHP botanist. Botanists have spent decades looking for small whorled pogonia throughout New York, where it had been collected only five times, from 1887 to 1923, in five different counties: Washington, Ulster, Rockland, Nassau and Suffolk. Orange County is now added to the list of counties where it grows (NYSOPRHP 2010).

Hudson River Segment

In the Hudson River Segment, the small whorled pogonia could occur in Orange County. However, there is no information to suggest that the species occurs within the proposed Project area in the Hudson River Segment. The Schunnemunk Mountain State Park is located over 3 miles from the proposed CHPE Project region of influence (ROI) (the Hudson River in the Hudson River Segment) in Orange County, and this portion of the ROI is entirely aquatic and does not contain suitable habitat for the small whorled pogonia.

Since the small whorled pogonia does not occur in the proposed CHPE Project area, DOE has concluded that the proposed CHPE Project would have no effect on this species.

3.2.9 Northern Wild Monkshood

Status. The northern wild monkshood (*Aconitum noveboracense*) was federally listed as threatened on April 26, 1978 (43 *Federal Register* 17910).

Distribution and Habitat. Northern wild monkshood is an herbaceous perennial that inhabits cool sites such as stream sides or shaded cliff sides. The northern wild monkshood is federally listed in Ulster County. This portion of the Hudson River Segment in Ulster County is entirely aquatic. As such, suitable habitat for this species does not exist in the proposed CHPE Project area.

Since the northern wild monkshood does not occur in the proposed CHPE Project area, DOE has concluded that the proposed CHPE Project would have no effect on this species.

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4. Environmental Baseline Conditions

4.1 Aquatic Environment

The current environment and impacts of human activities in the Action Area, specifically the Hudson River and its estuary, and current status of the ESA-listed species in the area (see also **Section 3.1)**, have been described in detail in the following reports, which are incorporated here by reference.

- *Recovery Plan for the Shortnose Sturgeon (NMFS 1998)*
- *A Biological Assessment of Shortnose Sturgeon (Acipenser brevirostrum) (SSSRT 2010)*
- *Biological Opinion on the Issuance of a Permit to Evaluate Shortnose Sturgeon Populations in the Hudson River (Number 16439) (NMFS 2011b).*
- *Biological Assessment for the Tappan Zee Hudson River Crossing Project (FHWA 2012)*
- *Biological Opinion for the Tappan Zee Bridge Replacement Project (NMFS 2013a)*
- *Biological Opinion for Continued Operations of Indian Point Nuclear Generating Unit Nos. 2 and 3 (NMFS 2013b)*

4.1.1 Hudson River Segment and Estuary – Current Environment

The Hudson River is 315 miles (507 km) long from its source at Lake Tear of the Clouds in the Adirondacks to the mouth at the Battery in New York City. The Hudson River is tidal for 153 miles (246 km) from the mouth to the Federal Dam at Troy. Salt water travels about 60 miles (97 km) up the river to Newburgh, New York. Habitat features within the Hudson River Segment include the channel (deep open water portion of the river), flats (expanses of mud or sand in river shallows), bays (coves along the shoreline), and wetlands (plant communities that develop in shallow water habitat (Stanne et al. 1996). The aquatic portions of the New York City Metropolitan Area Segment occur in the New York-New Jersey Harbor Estuary and extend in the Harlem and East rivers from the Hudson River to Astoria. Both the Harlem and East rivers have undergone significant modifications, such as channelization, bulk heading, upland filling, and urbanization.

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.

Current conditions along the aquatic portions of the Project's transmission cable route were evaluated during a marine route survey in the spring of 2010 that collected route-specific bathymetric, side-scan sonar and geotechnical data for a 300-foot (91-meter)-wide corridor along the proposed CHPE Project route. The marine route survey included geophysical, sediment, and benthic surveys (CHPEI 2012g) as described in the following:

- Geophysical surveys were conducted to investigate existing bottom features in the lakes, rivers, and canals along the proposed route. Surveys were conducted using multi-beam bathymetry, side-scan sonar, magnetometer, and sub-bottom profile.
- The sediment survey was conducted to collect information on the existing sediment type and quality along the proposed route.

- The benthic survey was conducted to augment existing benthic community data. These data sets are being used to assess potential impacts associated with the installation of the proposed underwater transmission cable.

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 few 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 have also been used to supplement these interpretations. These data represent general trends and are not meant for finescale interpretation (Bell et al. 2006).

Sediment cores were collected approximately every 2 to 3 miles throughout the aquatic portion of the transmission line route. The Coxsackie Landing to Kingston section of the Hudson River (north of where the transmission line enters the Hudson River to MP 245) contained the largest variety of sediment types found along the Hudson River. The surficial sediments ranged from well-mixed sand and gravel with cobbles to soft silt/clay. Sediments below the river bottom ranged from soft silt/clay to dense glacial till. One core at approximate MP 234 consisted of medium to coarse sand and fine to coarse gravel with pebble-cobble in surficial sediments. In the Kingston to Peekskill Bay portion (MP 245 to MP 292), the surficial sediments consisted of very soft unconsolidated silts except at MP 284 (taken north of Garrison), where the upper 4 inches of sediment consisted of gravel and pebbles in a silt matrix. Sediments below the river bottom here in all cases consisted of soft silt/clay. In general in the Peekskill Bay to Spuytin Duyvil portion (MP 292 to MP 324), the surficial sediments consisted of very soft silts and clays, with occasional lenses of fine shell hash. Surface sediments in the Harlem River portion of the CHPE Project route are a mixture of sand, gravel, and cobble. Sediments are coarse and several rock outcrops exist in the northern portion of the Harlem River traversed by the CHPE Project route, while finer sediments dominate downstream (CHPEI 2012g). Surface sediments in the East River are coarser, with occurrences of exposed bedrock due to swift currents removing sediments and blasting to create the navigation channel (CHPEI 2012f). Contaminant loads of sediments are detailed in CHPEI (2012i).

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. No shellfish beds have been recorded between approximate 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 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.

The proposed CHPE Project transmission line would intersect one SCFWH within the Overland Segment (Catskill Creek) and four SCFWHs within the Hudson River and New York City Metropolitan segments. From north to south, the proposed route would cross the following SCFWHs in the Hudson and Harlem rivers (see **Attachment 1** for mapped SCFWH along the project route):

- 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 MP 325).

The Kingston-Poughkeepsie Deepwater Habitat SCFWH provides spawning habitat for Atlantic sturgeon which could occur through July, meaning that Atlantic sturgeon larvae could occur in this SCFWH through August. It also provides wintering habitat for shortnose sturgeon and Atlantic sturgeon. Both Atlantic and shortnose sturgeon could occur in the Esopus Estuary SCFWH in the waters north and south of the Esopus Creek mouth. The adjacent deepwater area of the Hudson River serves as post-spawning and wintering habitat for shortnose sturgeon. The deep areas of the Hudson Highlands SCFWH are used as migrational routes by Atlantic sturgeon and shortnose sturgeon and are important nursery areas and summering areas for juvenile Atlantic sturgeon and summering areas for post-spawn adults. It might also be an overwintering ground for Atlantic sturgeon. Adult Atlantic sturgeon and shortnose sturgeon migrate through the Lower Hudson Reach SCFWH (NYSDOS 2014).

The benthic macroinvertebrates of the Hudson River form a well-documented and diverse community that includes approximately 300 species of annelids, mollusks, crustaceans, and insects. Benthic communities vary in distribution in the Hudson River depending on bottom type (i.e., hard or soft substrate), salinity, submerged aquatic vegetation (SAV), and location along the river. Freshwater snails, clams, chironomids, and insects are present north of Kingston, whereas there is a mixture of freshwater and marine organisms between Stony Point and Poughkeepsie. South of Poughkeepsie, the benthos are dominated by estuarine worms and crustaceans. In the middle Hudson River, the benthic macroinvertebrate community underwent substantial decline in recent years due to the invasion of the nonnative zebra mussel (*Dreissena polymorpha*) in the early 1990s (Strayer 2006); however, with the observed long-term decline in invasive zebra mussels in the Hudson River watershed, parts of the ecosystem appear to be recovering toward pre-invasion levels, including benthic animals such as native mussels and clams (Strayer et al. 2011). The predominant crustaceans in the lower Hudson River estuary include grass shrimp (*Palaemonetes*), sand shrimp (*Crangon septemspinosa*), and blue crab (*Callinectes sapidus*) (Levinton and Waldman 2011). Historically, the Hudson River estuary also supported a commercial-scale oyster fishery. Benthic mapping and sampling efforts have revealed several historic oyster reefs near the Tappan Zee reach and live oysters in this area and Haverstraw Bay (Bell et al. 2006). Restoration efforts for oysters are also currently ongoing.

The benthic macroinvertebrate community collected during the spring 2010 marine route survey (CHPEI 2012g) of the Harlem and East rivers was typical of the existing benthic communities in an urbanized estuary. In sum, 29 taxa were found in the East River compared to 16 in the Harlem River. Annelids and arthropods composed the majority of the East River samples, with pollution-tolerant taxa dominating the samples obtained near the Polletti landfall. The Harlem River was dominated by the polychaetes, *Scolecolepides viridis*, Capitelledae, and *Streblospio benedictii*. Many of the benthic species identified in the two rivers are important food sources for shortnose and Atlantic sturgeon (see **Section 3.1.3**).

The USEPA has designated SAV as "special aquatic sites" under Section 404(b)(l) of the Federal Clean Water Act due to its important role in the marine ecosystem for spawning, nursery cover and forage areas for fish and wildlife. More than 20 species of aquatic plants, both native and invasive, occur in the

Hudson River, with native water celery (*Vallisneria americana*) and the exotic water chestnut (*Trapa natans*) as the predominant SAV species. 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). 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. SAV occurs in the tidal Hudson River on shallow shoals in depths less than 10 feet (3 meters) and covers approximately 6 percent of the river with the greatest coverage occurring in the mid-Hudson, from Kingston to Hudson and lower coverage south of Hyde Park (Findlay et al.2006). SAV provides valuable nursery, forage and refuge habitat for a variety of fish including summer flounder, striped bass, bluefish, American shad, alewife, and blueback herring. SAV in the Hudson River has been shown to contribute to primary production and habitat for benthic and fish species in the river (Findlay et al. 2006, Strayer 2006). SAV is generally found in water depths of less than 10 feet (3 meters) and adult shortnose sturgeon have been observed feeding in heavily vegetated, muddy backwater areas that contain SAV (Gilbert 1989); however, the proposed CHPE Project transmission line would generally be installed in deeper waters, minimizing the potential for impact on SAV. SAV is not common in the Hudson River from the Newburgh area south to Haverstraw Bay, perhaps due to higher turbidity (Findlay et al. 2006). Additionally, the transmission line would not traverse any existing mapped SAV beds (NYSDEC 2014). Mapped *Vallisneria* sp. and *Trapa* sp. are presented in Attachment 1.

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).

4.1.2 Hudson River Segment and Estuary – Anthropogenic Activities

The Hudson River Estuary has undergone numerous environmental changes. These changes have included channel maintenance by dredging; wholesale dumping of industrial and domestic wastes; scattered in-basin urbanization and shoreline development; deforestation of the watershed and an increase in agriculture; and water removal for commercial, industrial, and agricultural needs. In addition, the biota of the river has supported commercial and recreational harvesting, exotic species have become established, and habitats have become fragmented, replaced, undergone changes in extent, or isolated. NMFS (2012) has acknowledged that it is difficult to quantify the number of shortnose sturgeon that may be killed in the Hudson River each year due to anthropogenic sources; however, as noted in **Section 3.1**, the Hudson River population is the largest of the shortnose sturgeon populations. The numbers of shortnose and Atlantic sturgeon taken incidentally in commercial and recreational fisheries is not known. Dams, dredging, land use activities, and shipping are habitat-altering activities for sturgeon species. Hydroelectric dams may alter shortnose and Atlantic sturgeon habitat by varying river flows or temperatures necessary for successful spawning or migration and causing mortalities to fish that become entrained in turbines. Sturgeon species also are susceptible to impingement (adult fish) or entrainment (larval fish) on cooling water intake screens of power plants in these species' ranges (e.g., Dadswell et al. 1984, NMFS 1998). Due to the importance of benthic habitat to shortnose and Atlantic sturgeon, dredging modifies shortnose feeding areas, disrupts spawning migrations, and fills spawning habitat with resuspended fine sediments. Dredges also can cause mortality of sturgeon. Land use activities also have the capacity to fill spawning habitat with sediments if those activities release sand and silt into the river. In-water or nearshore construction projects can interfere with normal shortnose sturgeon migratory movements and disturb sturgeon concentration areas. For example, the NMFS noted that is likely that the construction of the existing Tappan Zee Bridge (built prior to the ESA) resulted in some disturbance to aquatic communities and may have affected individual shortnose and Atlantic sturgeon. NMFS acknowledged, however, that given the extremely small benthic footprint of the bridge compared with the size of the Hudson River estuary, it is unlikely that this loss of habitat has had significant impacts on shortnose or Atlantic sturgeon (NMFS 2013b).

Sources of contamination in the Action Area include atmospheric loading of pollutants, storm water runoff from coastal development, groundwater discharges, and industrial development. Point source discharges and compounds associated with discharges (e.g., contaminants, including toxic metals, polychlorinated aromatic hydrocarbons, pesticides, and polychlorinated biphenyls [PCBs]) contribute to poor water quality and may also impact the health of sturgeon populations. In 1983, the USEPA listed the Hudson River on its Superfund National Priority List. The possible effects of contaminants on ESA-listed fish species is discussed in **Section 5.1**. Water quality within the Hudson River varies based on land use. The most notable water quality problem in the Hudson River is reflected in the PCB-contaminated sediments, which primarily resulted from historic PCB discharges from the Fort Edward area associated with General Electric manufacturing facilities.

4.2 Terrestrial Environment

4.2.1 Overland Segment

The Overland Segment occurs partially in the Champlain Valley, which is between boreal forest and broadleaf deciduous climatic zones in North America. Forests in the Overland Segment are characterized by conifers such as hemlock (*Tsuga canadensis*) and pine (*Pinus* spp.); and deciduous species such as birch (*Betula* spp.), American beech (*Fagus grandifola*), maple (*Acer* spp.), and, to a lesser extent, oak (*Quercus [Q.]* spp.). The Champlain Valley represents the northern extent of the range of tree species such as shagbark hickory (*Carya ovata*), red and white oak (*Q. rubra* and *Q. alba*), and hop hornbeam (*Ostrya virginiana*). Conifer or pine-dominated forests tend to be in less favorable habitats with poorer soils, whereas deciduous forest stands are found in locations with good soils. Coniferous habitats include transitional areas between the mountains of the Adirondacks and the Champlain Valley. Important grassland habitat in agricultural areas includes old fields, upland meadows, hayfields, and shrub-dominated fields (NYSDEC 2012c).

Forested habitat in the Adirondacks includes beech-maple forests, hemlock-northern hardwood forest, and spruce-fir (composed of red spruce [*Picea rubens*] and balsam fir [*Abies balsamea*]). Other forested habitats of the Hudson River Valley in Albany County potentially within and along the Overland Segment include red maple- (*Acer rubrum*) black gum (*Nyssa sylvatica*) swamp, chestnut-oak forest (chestnut oak [*Q. montana*] and red oak [*Q. rubra*]), Appalachian oak-hickory forest, and pitch pine-oak-heath rocky summit. Important grassland habitat in agricultural areas includes old fields, upland meadows, hayfields, and shrub-dominated fields (NYSDEC 2012c).

Because the transmission cables would be installed underground along the existing ROWs for New York State Route 22, city streets in Schenectady, Alpha Road in Catskill, and the CP and CSX railroads, forested habitat along the ROI most commonly exists as successional or shrubby forest edge or urban areas. The proposed CHPE Project route would cross several streams and rivers via dry crossing methods, HDD or attachment to bridges; however, some riparian habitat is expected to occur within the ROI.

The Saratoga Sand Plains Wildlife Management Area is present along the Overland Segment in the Town of Wilton. This area includes deepwater wetlands, rare pine barren vernal ponds, ephemeral wetlands in open areas, and oak-pine savannah, which provide habitat for a wide variety of species, including the Karner blue butterfly (*Lycaeides melissa samuelis*).

In spring 2010, surveys of the Overland Segment were completed to identify areas with suitable habitat for the Karner blue butterfly. Lupine and nectar patches were identified and mapped along the CP Railroad ROW portion of the segment (MPs 112 to 177). No lupine patches were found within surveyed areas further south in the CHPE Project corridor along the CSX Railroad portion of the route in Schenectady County, and, because the species' lifecycle depends on the lupine flower, it was determined that this area is unlikely to support nectaring adult Karner blue butterfly. The Applicant has coordinated with NYSDEC regarding the delineation of lupine/nectar areas along the CP Railroad ROW (CHPEI 2012k).

During follow-up presence/absence surveys, two Karner blue butterflies were observed in lupine patches in the segment crossing through the Town of Wilton in Saratoga County. The NYSDEC and USFWS indicated that lupine patches where Karner blue butterflies have been observed, and any patches within 656 feet (200 meters) of these patches, should be considered occupied. The Applicant has elected to consider all mapped lupine patches to be occupied (CHPEI 2012k).

4.2.2 Hudson River Segment

Upland habitat types within and along the terrestrial section of the proposed CHPE Project within the Hudson River Segment, from Stony Point through Clarkstown, New York, contain urban areas, successional northern hardwoods, old fields, shrublands, and reverting farmland. It could also include red maple-black gum swamp, chestnut-oak forest, Appalachian oak hickory forest, and pitch pine-oak heath rocky summit (NYSDEC 2012c). The majority of the terrestrial habitat is disturbed.

4.2.3 New York City Metropolitan Area Segment

The terrestrial portion of the proposed CHPE Project in the New York City Metropolitan Area Segment traverses through the Boroughs of the Bronx and Queens. The habitat along the ROI within these boroughs is primarily disturbed. The disturbed habitat that occurs within the ROI includes urban areas, successional old fields or shrublands, mowed lawns, or vacant lots (USFWS 1997, Edinger et al. 2002). The terrestrial Action Area is primarily developed, consisting of commercial, industrial, transportation, utility, and residential land uses. The proposed Luyster Creek HVDC Converter Station would be constructed on an undeveloped parcel within the Charles Poletti Power Plant complex. The proposed site consists of open space and forested land adjacent to existing power-generating facilities and electrical substations.

5. Potential Effects on Federally Listed Species

As discussed in **Section 1**, the DOE has the responsibility under the ESA to determine whether or not the proposed CHPE Project would adversely affect federally listed endangered and threatened species and species proposed for listing and their designated or proposed designated critical habitat.

Potential impacts on ESA-listed species could occur during proposed CHPE Project installation and operation for aquatic and terrestrial species (**Sections 5.1** and **5.2**, respectively). As noted in **Section 3**, there is no designated or proposed designated critical habitat in the proposed CHPE Project area. The Applicant has proposed measures to reduce potentially adverse impacts on ESA-listed species during construction and operations; these are described in **Section 2.5**. DOE's determinations of effects are discussed throughout **Section 5** and summarized in **Section 7**. **Section 6** presents a cumulative effects analysis of the proposed CHPE Project combined with other reasonably foreseeable actions on protected species.

Table 5-1 presents a summary of the impacts on aquatic and terrestrial protected species, which are discussed in detail in the rest of this section.

Table 5-1. Summary of Impacts on Federally Listed Species by Resource Area

Resource Area	Description of Impacts
Aquatic Resources	
Sediment	Localized temporary disturbance to approximately 569 acres (230 hectares) of river bottom in the Hudson and Harlem rivers, resulting in habitat degradation, avoidance, or loss. The jet plow would create a trench 2 feet (0.4 meters) wide and 7 to 8 feet (2.1 to 2.4 meters) deep. Suspended sediment and resettlement of such would result in negligible additional sediment disturbance compared to the available surrounding habitat.
Turbidity	Water jetting would result in a temporary increase in suspended sediment levels of less than 200 milligrams per liter (mg/L) in the Hudson and Harlem rivers.
Benthic communities and shellfish	Negligible reductions in benthic shellfish and infaunal organisms that serve as prey for shortnose and Atlantic sturgeon would occur in habitat adjacent to the transmission line from jet plow and concrete mat installation. Concrete mats would cover approximately 2.5 percent of the total aquatic portion of the transmission line in the Hudson and Harlem rivers. Benthic recovery and recolonization of impacted areas along the installation route would be expected to begin to occur within months after construction activities have ceased. The fleet of four vessels would maintain idle speeds (less than 4 knots) during installation, and have a draft less than 12 feet (4 meters), which would provide sufficient clearance from the waterbody bottoms and for the lower benthos layers in the Hudson and Harlem rivers.
SAV	No impacts as the transmission line would be buried in deeper waters and would not cross any NYSDEC-mapped SAV beds.
SCFWH	Transmission line route would avoid 18 of 22 SCFWHs in the Hudson and Harlem rivers in the proposed CHPE Project area. Construction windows would avoid or minimize impacts on sturgeon spawning in SCFWHs. Approximately 1.0 miles (1.6 km) of concrete mats would cover 1.0 acres (0.4 hectares) in SCFWHs, or less than 0.01 percent of the area of the affected SCFWHs.

Resource Area	**Description of Impacts**
Aquatic Resources (continued)	
Noise	Expected underwater noise levels from construction activities would be above the NMFS threshold of 150 dB re 1 µPa rms for behavioral impacts on fish, but impacts would be expected to be localized. No injury or physiological impacts would be expected.
Blasting	Sturgeon eggs and larvae are not expected to occur in the Harlem River and the presence of adults is expected to be rare. As such, the potential for blasting in the Harlem River to adversely affect sturgeon is so low, it is discountable.
Vessel strikes	Construction vessels proposed for use during transmission line installation would have relatively shallow drafts, and sturgeon are generally found within 3.3 feet (1.0 meter) of the bottom in the deepest available water. Therefore, the chance of vessel-related mortalities to fish is expected to be low.
Magnetic and electric fields	The estimated magnetic field levels at the riverbed surface directly over the transmission line centerline were calculated to be less than 162 mG at a burial depth of 3.25 feet (1.0 meter). This substantially less than the greater than 10,000 mG magnetic fields that resulted in behavioral impacts on sturgeon in laboratory tests.
Temperature	The predicted increase in temperature change in the water column would be less than 0.01°F (0.004 °C) for burial in sediment, with temperatures subject to a 9 °F (5 °C) increase at distance of 0.6 feet (0.2 meters) below the sediment surface. Temperature increases of less than 0.3 °F (0.2 °C) would be expected in the water column over concrete mats. Temperatures are expected to be within the range of tolerance for sturgeon eggs and larvae. While temperature tolerances for adult and juvenile sturgeon are not fully known, these life stages are mobile and could avoid the area. The area that would be affected would be negligible compared to the available surrounding habitat.
Decommissioning	The transmission line would be de-energized and abandoned in place, which would not result in any impacts on listed species.
Terrestrial Resources	
Habitat	In total, approximately 236 acres (96 hectares) of existing fringe forest cover could be temporarily disturbed and 48 acres (19 hectares) permanently converted to managed grasses or shrub habitat along the entire CHPE Project route to accommodate proposed construction corridors and any necessary additional workspace. In general, there is limited availability of suitable summer roost trees within and adjacent to the impact area for Indiana bats.
Disturbance (noise, vibrations, and dust)	Increased noise, vibrations, and dust created by construction equipment within the proposed CHPE Project area could disturb protected species in nearby forests. However, the areas impacted are railroad and road ROWs subject to disturbances from trains and industrial activities. The wildlife that occurs in the area is generally habituated to noise and regular disturbance.
Magnetic fields and heat	Some protected species would detect the magnetic field and heat generated by the transmission line during operations; however, there is no evidence to suggest that such projected for the proposed CHPE Project transmission line would result in any effects, or that these effects would be adverse. Buried cables, such as those proposed for the CHPE Project, would have no electric fields at the ground surface and the constant magnetic field (less than 162 mG at the surface above the transmission line) would decrease substantially within 50 feet (3 meters) from the transmission line centerline. As such, the predicted magnetic field and heat associated with the transmission line would not result in any adverse effects on the health, behavior, or productivity of animals.

Sources: CHPEI 2012e, NMFS 2013a, WHO 2012

5.1 Shortnose Sturgeon and Atlantic Sturgeon

Based on the analysis in this section, and the discussion of cumulative effects presented in **Section 6**, **DOE has concluded that any effects on the shortnose sturgeon and Atlantic sturgeon would be insignificant or discountable, and that the proposed CHPE Project may affect, but is not likely to adversely affect, those species** (see **Table 5-2**).

Table 5-2. Determination of Effect under the ESA for Federally Listed Aquatic Species in the Proposed CHPE Project Area

Common Name	Scientific Name	ESA Status	Determination of Effect
Shortnose sturgeon	*Acipenser brevirostrum*	T	May affect, but not likely to adversely affect
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	T[1], E[2,3,4,5]	May affect, but not likely to adversely affect

Table Key: E = Federally listed as endangered; T = Federally listed as threatened.

Notes:

1. Gulf of Maine DPS.
2. New York Bight DPS.
3. Chesapeake Bay DPS.
4. Carolina DPS.
5. South Atlantic DPS.

Construction Impacts

As described below, sediment disturbance, temporary increases in turbidity and associated water quality degradation, sediment redeposition, noise and vibration, vessel strikes, and accidental release of hazardous materials would have an insignificant effect on shortnose and Atlantic sturgeon.

The Applicant consulted with NYSDEC, NYSDOS, and NMFS to identify construction windows that avoid periods when sensitive species would use different areas of the Hudson River. **Table 2-2** illustrates the life history stages of shortnose and Atlantic sturgeon that would be avoided based on the construction windows.

The construction window is from August 1 to September 14 for the area between Catskill (MP 228) and Kingston Point (MP 245) and from September 14 through October 15 for the area between Kingston Point (MP 245) and New Hamburg (MP 269). Shortnose sturgeon spawning is expected to be complete by the end of May and eggs and larvae are not expected to occur in the area by the end of June. Atlantic sturgeon are expected to spawn in the area from May through July between Kingston Point and New Hamburg. Atlantic sturgeon larvae are expected to be in this area through August. As such, spawning adults, eggs, and larvae of Atlantic sturgeon would be avoided. In the mid-summer the largest numbers of juvenile shortnose sturgeon are expected to occur in the mid-river regions and would be avoided by this construction window. This construction window would avoid most of the time period when early juvenile Atlantic sturgeon are expected to occur from Kingston through Peekskill from July through September.

The construction window is September 15 to November 30 for the area from New Hamburg to Verplanck (MP 295). Shortnose sturgeon spawning is expected to be complete by May and eggs and larvae are expected to be absent by June. Atlantic sturgeon spawning is expected to be finished in this area by the end of July and sturgeon eggs and larvae are expected to be absent by the end of August. By the fall, juvenile shortnose sturgeon are expected to occupy Haverstraw Bay, which is being avoided by construction (Bain 1997). The transmission line avoids Haverstraw Bay, which is an important nursery area and overwintering area for shortnose and Atlantic sturgeon. The construction window is July 1 to October 31 for the area from Clarkstown (MP 303) to the Harlem River (MP 324). Adult shortnose and Atlantic sturgeon could transit through this area during this construction window.

Both Atlantic sturgeon and shortnose sturgeon larvae and YOY juveniles must remain upstream of the salt wedge because of their low salinity tolerance. This was the basis for concluding that both shortnose and Atlantic sturgeon larvae (YOY) entrainment was very unlikely to occur at the Indian Point Nuclear Generating Station (units 2 and 3) located near MP 293 because the position of the salt front is upstream of the plant (NMFS 2013b). During the 2011 and 2012 Hudson River Estuary Monitoring Program, the salt front location during September through November was generally in the Tappan Zee to West Point reach, and no YOY sturgeon were captured downstream of MP 286 near West Point (ASA 2012, 2013); therefore jet plow encounters with YOY sturgeon south of approximately MP 286 would be unlikely due to the salt front position during the transmission line construction window.

The Applicant has proposed that the transmission line would enter the Hudson River in Catskill, New York, bypassing the Inbocht Bay and Duck Cove SCFWHs. The line would exit the Hudson River north of Haverstraw Bay, in Stony Point, New York, to avoid the high-value Haverstraw Bay SCFWH. These SCFWHs were included in "exclusion zones" of highly sensitive areas identified by NYSDEC and avoided by the proposed CHPE Project transmission line. The route also avoids traversing 18 of the 22 SCFWHs in the Hudson River.

Sturgeon Swimming Capabilities. While avoiding most SCFWHs and restricting construction activities to the specific construction windows provided in **Table 2-2** protects spawning adults, eggs, and larvae from April through August, installation activities could occur where juveniles are expected to occur. However, juveniles are expected to be able to avoid the jet plow.

Even though juvenile sturgeon might occur in the construction area during the construction window, the potential for an interaction with the jet plow is expected to be discountable. Juvenile sturgeon are not expected to be entrained by the jet plow because the water intake would be located near the surface of the water column and attached to a construction barge or other vessel. As the early life stages for benthic and demersal fish, such as Atlantic and shortnose sturgeon, are generally near the river bottom, the risks of entrainment of these species is anticipated to be minimal. This is especially true for sturgeon as winter approaches, and they move toward and congregate in deep holes during October and November (ASMFC 2012). Given the location of the intake near the water surface and the fact that egg and larval forms of sturgeon have matured into mobile juvenile life stages by the middle of September, jet plow impingement or entrainment is not expected to occur.

Furthermore, juvenile sturgeon are expected to have the ability to avoid the jet plow, which is related to their swimming ability. Installation of the transmission line via jet plow will proceed at rate of 1 to 3 miles (1.6 to 4.8 km) per day. At this pace, the jet plow is moving at a rate of 0.06 to 0.2 feet/second (less than 6 cm/second). YOY sturgeon would need to be capable of swimming at speeds greater than 0.2 feet/second (6 cm/second) to avoid the jet plow. By September, juvenile shortnose and Atlantic sturgeon can range from 3.9 inches (10 cm) in length to as large as 11.7 inches (30 cm). Sturgeon demonstrated their ability to avoid intake speeds of 1.0 foot/second (30 cm/second) at Indian Point intake (5 times the maximum jet plow speed). Based on Deslauriers and Kieffer (2012), sturgeon should be able to attain swimming speeds of 1.5 times their body length per second. A 3.9-inch (10-cm) sturgeon is capable of swimming approximately 0.5 feet/second (15 cm/second). Therefore, during the September through November period, Entergy (2012) concluded from this analysis and other supporting data that sturgeon 7.5 inches (19 cm) or larger could out-swim a 1.0 foot/second (30 cm/second) velocity intake, and a sturgeon of 5.9 inches (15 cm) or larger could outswim a 0.6 feet/second (18 cm/second) velocity intake.

In its Biological Opinion for Indian Point, NMFS (2013b) reviewed swimming speed analyses by Kynard et al. (2005), Boysen and Hoover (2009), Hoover et al. (2011), Deslauriers and Kiefer (2012), and Entergy (2012) to conclude that yearling sturgeon and older could escape intake velocities of 1.0 foot/second (30 cm/second), which is more than 5.0 times the fastest expected jet plow speed. In its analysis, NMFS (2013) noted that even smaller white sturgeon juveniles (3.1 to 3.5 inches [8 to 9 cm]) exhibited the ability to swim at speeds in the range of 1.3 to 1.5 feet/second (39 to 45 cm/second), as demonstrated in studies by Boysen and Hoover (2009) to assess the ability of small white sturgeon to avoid hydraulic dredge flow fields. Using more likely scenarios of larger sturgeon and slower jet plow speeds it is clear that sturgeon would avoid jet plow installation in the September through November construction window.

Benthic Surveys. The Applicant has agreed to a series of pre- and post-installation compliance monitoring studies in the aquatic portions of the transmission line route, including benthic and sediment monitoring, bathymetry and sediment temperature studies, and magnetic field surveys (NYSPSC 2013). The Applicant has also proposed Atlantic sturgeon pre-installation and post-energizing hydrophone surveys in the Hudson River. In addition, transmission line installation and burial in the Hudson and Harlem rivers would temporarily disturb or alter the sediment and bottom substrates. The bulk of the sediment disturbed would resettle in the trench created by the jet plow, and natural processes that control scour and deposition would be expected to re-establish the original bottom contours along the transmission line route. Post-installation bathymetric surveys would be used to monitor recovery of the bottom substrate. The energized transmission cables would also have the potential to impact magnetic fields in the vicinity of the cable and dissipate heat to the surrounding substrate. Monitoring would provide the measurement of the magnetic field and sediment temperature for comparison with modeling predictions and conditions prior to cable operation. Benthic recovery and recolonization of impacted areas along the installation route would be expected to begin to occur within months after construction activities have ceased. Additional details on the pre- and post-installation environmental surveys are provided in **Section 2.5**.

Analyses of impacts on sturgeon for each phase or type of construction activity that could result in impacts: sediment disturbance, turbidity, contaminated sediments, concrete mats, noise, blasting, vessel strikes, and accidental spills, are presented below.

Sediment Disturbance

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 of 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 (4.5 meters). 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.

Installation of the proposed aquatic transmission line would result in up to 569 acres (230 hectares) of riverbed disturbance in the Hudson and Harlem rivers, which is approximately 0.9 percent of the total surface area of the Hudson River (533 acres [216 hectares]) and 10 percent of the total surface area of the Harlem River (36 acres [15 hectares]) rivers in the vicinity of the proposed CHPE Project. This represents the acreage within a 50-foot construction corridor along the transmission line route and includes trenching and the adjacent area where a substantial majority of sediment from the trench would settle. For the Hudson River Segment, the depth of the transmission line trench would be approximately 7 feet (2.1 meters) with 1 foot (0.3 meters) or less of horizontal separation between the two cables, which would be collocated in the same trench. The transmission line would be buried 8 feet (2.4 meters) in sediment in the Harlem River. The primary installation method in the Hudson River Segment is proposed to be water jetting technology, which has been shown to minimize impacts on marine habitat and excessive dispersion of bottom sediments relative to dredging activities. The bottom area directly disturbed by water jetting or mechanical plowing varies, depending upon sediments and depth of installation, but would range from 12 to 16 feet (3.6 to 4.9 meters) in width. Water jetting for the proposed CHPE Project is anticipated to create sediment plumes that would be short-lived and remain fairly close to their source.

Barge positioning, anchoring, anchor cable sweep, and the pontoons on the jet plow could result in additional sediment 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 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, where cable is spliced, and possibly along the 460-foot length of bedrock trenching in the Harlem River (MP 324.5). The collective length of all work areas where anchors may be deployed and potentially result in impacts on benthic habitat is projected to be less than 1 percent of the approximately 197-mile (317-km) marine portion of the installation route. Once stabilized following deployment, the anchors would have a total impact area of approximately 15 square feet (1.4 square meters) per deployment. Spud anchors would be used during the installation of the cofferdam and cable landing at the water-to-land transition. Each barge would include two spud anchors with 3-foot (0.9-meter) diameters. Anchors also 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 and non-significant.

Riverbed disturbance would also include the redeposition of suspended sediment. The estimated thickness of the sediment as it settles back to the riverbed would not be expected to 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 increase 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 on fish 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, such as shortnose and Atlantic sturgeon, deposit demersal eggs that remain on the bottom until larval hatching; some of these eggs, if present, could be smothered as well. Redeposition of sediments causes larval mortality by clogging gill tissues and through gill abrasion (Reine et al. 1998). For example, 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, in areas where deposition of suspended sediments could impact demersal fish eggs, and larvae, the Applicant has proposed to avoid construction during the early spring via the use of construction windows (see **Table 2-2**), which would avoid or minimize the potential impacts associated with sediments covering these eggs. Additionally, the total area that would be impacted by 0.2 to 0.4 inches

(5 to 10 millimeters) of sediment redeposition in the lower Hudson River is approximately 32 acres (13 hectares), representing approximately 6 percent of the total area of disturbance for the transmission line installation in the Hudson River. As such, the impact of redeposition would be insignificant compared to the impact of sediment disturbance from jet plowing.

The impacts of sedimentation on benthic invertebrates could include smothering, toxicity from exposure to anaerobic sediments, reduction of filtering rates, toxicity from exposure to anaerobic sediments, reduced light intensity, and physical abrasion (Berry et al. 2003). 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.

The proposed CHPE Project would have temporary localized effects on the following SCFWHs in the Hudson and Harlem rivers (**Attachment 1** provides a mapbook of the SCFHWs and other resources along the transmission line route):

- 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 MP 325).

The Kingston-Poughkeepsie Deepwater Habitat SCFWH provides wintering habitat for shortnose sturgeon and Atlantic sturgeon. Both Atlantic and shortnose sturgeon are found in the Esopus Estuary SCFWH in the waters north and south of the Esopus Creek mouth. Construction and the temporary impacts would occur August 1 through October 1 and would avoid impacts on sturgeon at these two SCFWHs. The adjacent deepwater area of the Hudson River serves as post-spawning and wintering habitat for shortnose sturgeon. The deep areas of the Hudson Highlands SCFWH are used as migrational routes by Atlantic sturgeon and shortnose sturgeon and are important nursery areas and summering areas for juvenile Atlantic sturgeon and summering areas for post-spawn adults. Construction and the temporary impacts would occur September 15 through November 30 and impacts would largely be avoided on sturgeon at this SCFWH. The Lower Hudson Reach SCFWH is used by adult Atlantic sturgeon and shortnose sturgeon during migration. Transmission line installation activities would avoid the Haverstraw Bay SCFWH, which is a major nursery and overwintering area for Atlantic sturgeon. Shortnose sturgeon also overwinter in the Haverstraw Bay SCFWH. In recognizing the importance of Haverstraw Bay and its SCFWH as important habitat for fish nurseries (including for shortnose and Atlantic sturgeon), the Applicant has proposed an approximately 8-mile (13-km) overland bypass of Haverstraw Bay through the Town of Stony Point, Town and Village of Haverstraw, and the Town of Clarkstown.

Impacts on Sturgeon Spawning Habitat. Sediment disturbances from jet plowing, anchoring, cofferdam construction, dredging, and sediment redeposition, as described, 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. During the marine survey conducted by the Applicant in 2010, only two sediment cores in the Hudson River contained cobble or gravel in surficial sediments, located at approximate MP 234 in shortnose sturgeon spawning habitat (CHPEI 2012g). As such, physical impacts on sturgeon habitat from sediment disturbance are expected to be negligible. Because cobble and gravel are not common within the transmission line route and rock outcroppings would be avoided wherever possible, the effects on sturgeon spawning habitat are expected to be negligible. Pre-installation hydrographic surveys would be conducted prior to debris removal would provide additional information on the sediments being disturbed. Upon completion of in-water activities in a given area, estuarine depositional processes would, over time, return the benthic habitat to its pre-construction condition. The temporary disturbance of an area would represent a minor fraction of similar adjacent habitat in the Hudson River, and for these reasons, impacts on sturgeon spawning habitat from sediment disturbance are expected to be insignificant.

Impacts on Sturgeon Prey. Sediment disturbances from jet plowing, anchoring, cofferdam construction, dredging, and sediment redeposition would result in a short-term loss of benthic organisms and shellfish that serve as forage for Atlantic and shortnose sturgeon. These impacts result from crushing, killing, or displacing benthic organisms. The temporary sediment disturbance in benthic habitat which supports benthic prey items for shortnose and Atlantic sturgeon would remain usable as potential shortnose and Atlantic sturgeon foraging habitat. Temporary and localized reductions in available benthic food sources are anticipated, since some mortality of benthic infaunal organisms that serve as prey for shortnose and Atlantic sturgeon would occur. The majority of these impacts would occur within the 50-foot (15-meter) project corridor as a result of jet plowing. Mortality of invertebrates is expected to be greatest within the 2-foot (0.6-meter) wide trench, but could also occur to either side of the trench, particularly near the trench where greater concentrations of sediment are expected to settle. The temporary disturbance of an area would represent a minor fraction of similar adjacent habitat in the Hudson River. Only a small portion (0.9 percent of the Hudson River and 10 percent of the Harlem River in the vicinity of the proposed CHPE Project) of sturgeon feeding habitat would be affected by sediment disturbance associated with the transmission line.

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. Upon completion of in-water activities in a given area, estuarine depositional processes would, over time, return the benthic habitat to its pre-construction condition. Functional communities would be expected to recolonize these areas over time. Complete 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). 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.

Because the habitat disturbance would affect a relatively small amount of the river, and because of the temporary nature of the disturbance, installation of the transmission line is expected to result in negligible reductions in benthic shellfish and infaunal organisms that serve as prey for shortnose and Atlantic sturgeon. As such, impacts on benthic resources which serve as sturgeon prey from sediment disturbance are expected to be insignificant.

Turbidity

Impacts from debris removal and transmission line installation, including anchor impacts, in the Hudson River, would include localized increases in turbidity and associated water quality degradation, downstream sediment resuspension during cable installation. However, the Hudson River already typically experiences periods of naturally occurring increases in suspended sediments from storm events.

During jet plowing, 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 (depending on particle size), with 20 to 30 percent of suspended sediment traveling outside the footprint of the area directly impacted by the cable plow (HTP 2008). Smaller sediment particles would remain suspended longer, and thus be transported farther from the original site of deposition. The extent of the turbidity plume generated would depend on the amount of sediment disturbed, the grain size, and the mass of the disturbed sediment particles, along with construction methods and ambient riverine conditions. Sediment concentrations in the plume can be initially high, and rapidly decrease with distance.

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) 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.

TSS levels would be approximately 15 mg/L or less at 9 hours following installation, 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., 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. 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 nursery and overwintering habitat for shortnose and Atlantic sturgeon. The Applicant has proposed that commencement of in-river work immediately outside the Haverstraw Bay SCFWH would occur during the high, or flood, tide condition to avoid or minimize impacts of resuspended sediments in Haverstraw Bay, which contains important habitat for ESA-listed fish species.

Transmission line installation would avoid 18 of 22 SCFWHs in the Hudson and Harlem rivers in the proposed CHPE Project area. As described, the maximum concentrations of TSS as a result of jet plowing are expected to reach 200 mg/L and the discernible turbidity plume is expected to have temporary and localized impacts on water quality. The effects would be further minimized within the SCFWHs because the Applicant is proposing measures to reduce turbidity in SCFWHs by reducing jetting speed and jetting pressure. Additionally, turbidity plumes are not expected to extend over long distances and are not expected to result in any type of barriers to fish movement in any area of the river and more specifically in SCFWHs because of these measures. Cable installation could temporarily disturb the substrate within the Hudson River; however, this disturbance is expected to occur over a short time period in any one location given the speed at which water jetting occurs and would be localized to the immediate area of the water jetting device or conventional dredge trenching operations (see the more detailed discussion under *Sediment Disturbance*). With the exception of areas that would require installation of concrete mats or rip-rap to cover portions of the transmission line that cannot be buried (e.g., on bedrock or when crossing over existing utility lines) (see *Use of Concrete Mats to Cover the Transmission Line* subsection below), no losses of habitat or permanent impacts are expected from cable installation.

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 (NMFS 2014).

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 Applicant proposes 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 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.

Impacts on Sturgeon. As described, the sediment plume is expected to be relatively localized given the depth and width of the Hudson River (i.e., it is not expected to consume the entire river). While the plume is 500 feet (152 meters) wide (defined at the edges by TSS concentrations of 15 mg/L above background), maximum concentrations would range from 80 to 200 mg/L above background only in the water column immediately above the sediment bed where the jet plow would be operating. Based on the localized and temporary nature of any sediment suspension (i.e., the plume would persist for 9 hours, given 24-hour per day installation operations), no hindrance of sturgeon movements is expected during underwater cable installation. Turbidity associated with anchors, installation of sheet pile, and dredging, is expected to be less.

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. Common impacts on fishes can be classified as biological/physiological or behavioral. Biological/physiological impacts include abrasion of gill membranes resulting in a reduction in the ability to absorb oxygen, decrease in dissolved oxygen concentrations in the surrounding waters, and effects on growth rate. Behavioral responses by fishes to increased suspended sediment concentrations include impairment of feeding, impaired ability to locate predators, and reduced breeding activity. Fish larvae are more sensitive to suspended sediments than eggs, juveniles, or adult fish (Berry et al. 2003). Adult and juvenile fish might leave the area to avoid an increase in turbidity. Fish, however, are mobile and generally avoid unsuitable conditions in water, such as large increases in suspended sediment and noise (Clarke and Wilber 2000). Juvenile and adult shortnose and Atlantic sturgeon are highly mobile and would be able to move into adjacent areas away from construction-related activities (as described under *Sturgeon Swimming Capabilities*).

Shortnose and Atlantic sturgeon are found in turbid waters (Dadswell et al. 1984) and feed on benthic invertebrates and are, therefore, tolerant of suspended sediment at the levels that are temporarily generated by marine construction activities (NMFS 2013a). NMFS concluded that the effect of suspended sediment concentrations in the range of 10 to 350 mg/L from construction activities for a marina project in the Haverstraw Bay region would not be significant to shortnose sturgeon. It is anticipated that the impact of suspended sediment would be similarly insignificant for the closely related Atlantic sturgeon. Citing the literature, NMFS indicated that the concentrations of total suspended sediments that would be expected to show adverse impacts on fish would be 580.0 mg/L for the most sensitive species, with 1,000 mg/L being more typical (FHWA 2012). Given that water jetting and other activities associated with installation of the CHPE transmission line would result in suspended sediment levels of less than 200 mg/L, impacts on sturgeon are expected to be negligible.

Furthermore, increases in turbidity associated with jet plowing, cofferdam installation, and anchoring would be temporary and would occur outside of spawning season. As such, temporary increases in turbidity are expected to have no effect on sturgeon spawning habitat. Temporary increases in turbidity could occur when juvenile sturgeon occur in the Hudson River from Kingston to Peekskill. As described, juvenile sturgeon are expected to be able to outswim the jet plowing operations. Any effects of behavior modification and habitat avoidance would be insignificant because increased turbidity would be very temporary and because there would be a substantial amount of other, non-affected habitat that could be used by these highly mobile species.

Impacts on Sturgeon Prey. Increased turbidity could reduce light levels in aquatic habitats and temporarily impact water pH and reduced dissolved oxygen levels. The aquatic habitats directly affected by cable installation would primarily be confined to the footprint of the jet and shear plows. Reductions in benthic infaunal organisms that serve as prey for shortnose and Atlantic sturgeon would occur associated with the turbidity plume. However, the greatest effects on benthic organisms would be from the direct effects of sediment disturbance associated with jet plowing. See *Sediment Disturbance* (above) for a discussion of impacts on benthic organisms associated with disturbance of the riverbed from jet plow operations. The impacts associated with the turbidity plume would be temporary (occurring for up to approximately 9 hours at a given point while the jet plow is in operation). The maximum turbidity concentrations would be limited to the 50-foot (15-meter)-wide active construction corridor where sediment disturbance would be greatest and the area immediately around and approximately 500 feet (152 meters) downstream of the active transmission line installation work zone (where the Applicant is required to monitor TSS levels), depending on currents and tides. The NYSPSC Certificate for the proposed CHPE Project requires that a water quality monitoring plan be carried out as part of pre-installation trials of the jet plows, and that suspended sediment levels be monitored during transmission line installation to ensure that the 200 mg/L suspended sediment guideline is not exceeded within 500 feet (152 meters) of the installation operation (NYSPSC 2013). Because benthic organisms are adapted to the harsh and turbid conditions of the Hudson River and because the persistence of the turbidity plume would be temporary, impacts on sturgeon and their prey associated with turbidity would be negligible.

Contaminated Sediments

Contaminants that occur in the sediments could be mobilized and become bioavailable as a result of sediment disturbance during installation of the transmission line. If contaminated sediments became bioavailable or biotransferred within food chains, impacts might occur, such as behavioral alterations, deformities, reduced growth, reduced fecundity, reduced egg viability, and reduced survival of larval fish (Sindermann 1994). Several characteristics of shortnose and Atlantic sturgeon (e.g., long lifespan, extended residence in estuarine habitats, benthic predation) predispose the species to long-term and repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell et al. 1984). However, as discussed below, water quality modeling predicted that no exceedances of Section 401 certificate water quality standards would occur. Water quality sampling and monitoring would be conducted during jet plow and shear plow pre-installation trials and during cable installation. Contaminants modeled in the upper Hudson River were arsenic, cadmium, mercury, benz(a)anthracene, pyrene, 4,4-DDE, copper, lead, phenanthrene, and PCBs. Contaminants modeled in the lower Hudson River were 4,4-DDE, copper, lead, phenanthrene, PCB, naphthalene, fluorine, nickel, dioxin, and acenaphthene.

To avoid the area associated with the Upper Hudson River PCB Dredging Project and the sensitive habitats found in the upper portion of the Lower Hudson River, the transmission cables would be buried in railroad ROWs from south of Lake Champlain to Catskill, New York. Bypassing this portion of the Hudson River would avoid resuspending sediments with high levels of PCBs, thereby avoiding or minimizing the potential for bioavailability to fish. Water quality modeling for the proposed transmission cable installation indicates that concentrations of 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 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 2012a).

Impacts from the resuspension of contaminated sediments on sturgeon and sturgeon prey are expected to be insignificant. The Section 401 Water Quality Certification water quality standards are not expected to be exceeded. Water quality sampling and monitoring would be conducted during jet plow pre-installation trials and during cable installation. If water quality certificate standards are exceeded, additional water quality sampling would take place at the location of the exceedance.

Use of Concrete Mats to Cover the Transmission Line

Installation of transmission lines via jet plowing might not be feasible in areas of exposed bedrock and over existing submerged lines in the Hudson River Segment. In such areas, concrete mats or rip-rap would be installed to help protect the transmission line. Concrete mat coverage would be small relative to the total available habitat for ESA-listed fish species in the Hudson and Harlem rivers. Approximately 1.8 miles (2.9 km) and 1.7 acres (0.7 hectares) of concrete mats would be installed in the 88-mile (142-km) aquatic portion of the project route in the Hudson River. Approximately 0.6 miles (1.0 km) and 0.6 acres (0.2 hectares) of concrete mats would be installed in the 6-mile (10-km) aquatic portion in the Harlem River. This represents approximately 2.5 percent of the aquatic portion of the entire aquatic portion of the transmission line route in the Harlem and Hudson rivers and approximately 0.4 percent of the total area of disturbance for the aquatic portion of the transmission line in the Hudson and Harlem rivers. Of the total to be installed in the Hudson River, approximately 1.0 mile (1.6 km) and 1.0 acre (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 approximate locations of the concrete mats are presented in **Attachment 1**. Because the area of concrete mat coverage would be small relative to the total available habitat for ESA-listed fish species in the Hudson and Harlem rivers, impacts are expected to be insignificant.

The majority of the concrete mats would be associated with existing infrastructure areas. As stated, the majority of the survey corridor is composed of 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 2012g). Only one sediment core contained cobble gravel in surficial sediments; this was located at approximate MP 234 in shortnose sturgeon spawning habitat. As such, physical impacts on sturgeon habitat from concrete are expected to be negligible. Because cobble and gravel are not common within the transmission line route, the effects on sturgeon spawning habitat are expected to be negligible. Pre-installation hydrographic surveys would be conducted prior to debris removal and would provide additional information on the sediments being disturbed.

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 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 2012p).

Placement of concrete mats would bury the benthic community, including potential prey for Atlantic and shortnose sturgeon. Although individuals among the existing benthic communities might be impacted, installation of the concrete mats would not preclude the survival of benthic infaunal species and shellfish. Shortnose and Atlantic sturgeon would be able to use adjacent areas for foraging and other activities. Installation of these materials could cause a permanent change in benthic habitat from soft sediments to the hard substrate of the concrete mats within the footprint of the concrete mats. The concrete mats would extend up to 9 inches (23 cm) above the river bottom. Concrete mats provide hard substrate habitat, and gaps in the mats provide velocity refuge and cover for aquatic invertebrates and small fishes (Fischenich 2003), possibly including benthic prey for shortnose and Atlantic sturgeon. Where concrete mats would be installed, habitat could be permanently altered, but the area requiring concrete mats is very small relative to the available habitat for shortnose and Atlantic sturgeon. 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. It is likely that some sediment would accumulate on the concrete mats, resulting in some benthic habitat re-colonization. New and 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). 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).

In addition, the concrete mats would be used on top of bedrock or areas disturbed by previous utility line placement activities and the presence of existing habitat could already be low. For this reason and that the extent of the route where concrete mats would be installed represents only 2.5 percent of the entire aquatic transmission line route, the changes resulting from their use are not expected to be significant. The mats could change the river bottom topography over limited areas and alter local hydraulic conditions so that some sediment deposition or scouring could occur around the mats or rip-rap. However, the overall change in bottom topography would be insignificant because the concrete mats would extend only a short height above the river bottom and functional benthic habitat is expected to develop.

Recolonization and community composition is dependent upon numerous factors such as the stability of disturbed areas, the tolerance of organisms to physical changes, and the availability of recruits. 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). 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 communities recolonizing the new hard bottom created by the mats are expected to be similar to pre-construction conditions. Results of monitoring in 2010 of the Long Island Replacement Cable (completed in fall 2008) suggested that concrete mats were not a major disturbance to benthic communities. That monitoring revealed that benthic macroinvertebrate assemblages did not differ significantly in overall abundance, species richness, or community composition between the control and impacted sites. Furthermore, no major seasonal differences in the macroinvertebrate communities were observed. 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). The placement of the concrete mats would be very limited and generally sporadic in the Hudson River, and, therefore, would not appreciably impact sturgeon foraging or migration (Scenic Hudson and Riverkeeper 2013). It is important to note that even in areas where such protective covering may extend some distance, the width of the covering would only extend over a small ROW in the vicinity of the proposed aquatic transmission cable, leaving ample undisturbed foraging habitat available on either side. Because habitat is expected to recover, no impacts on overwintering habitat are expected. Furthermore, the Haverstraw Bay is being avoided, which is important overwintering habitat for both shortnose and Atlantic sturgeon.

The use of concrete mats would be expected to have insignificant impacts on sturgeon spawning substrate, foraging habitat, or overwintering area because of the very small area to be affected and the only minor long-term changes expected to occur. A pre- and post-energizing benthic monitoring program would be developed in accordance with Condition 163 of the NYSPSC Certificate for the proposed CHPE Project to evaluate impacts of construction on benthic communities (NYSPSC 2013) see **Section 2.5** for additional details on this program).

Noise

Continuous noise associated with vessels and machinery would result from the installation of the transmission line under all proposed installation methods and the vibratory installation of the sheet piles that compose the cofferdams. 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).

Few measured data on hearing in sturgeon species are available; however, initial studies measuring responses of the ear using physiological methods suggest that a species of *Acipenser* might be able to detect sounds from below 100 Hertz (Hz) to as much as 1,000 Hz (Popper 2005). Following are the NMFS criteria for physiological impacts on fish:

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

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 2013a). 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 rise to the level of "take" (i.e., harm or harassment), but that there is the potential, upon exposure to noise at this level, to experience some behavioral response.

Underwater noise generated by dynamic positioning cable-laying vessels with an assumed source level of 177 dB re 1 µPa while thrusters were in use, 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, and recreational boats) already operating in the area (JASCO 2006). See **Table 5-3** for a summary of typical underwater source pressure levels for various vessel types. 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. Therefore, physiological impacts or injury are expected to occur from the cable-laying barge.

Table 5-3. 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)

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

Behavioral responses could range from a temporary startle to avoidance of an area affected by noise from a project. Noise modeling of a dynamic positioning cable-laying vessel assumed a source level of 177 dB re 1 μPa while thrusters were in use. This 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 vessel (JASCO 2006). This is an average, based on a range from 853 to 1,640 feet (260 to 500 meters). Based on this information, back calculating the distance to the 150 dB rms SPL isopleth indicates a radial distance of 100 feet (33 meters) from the cable-laying ship during dynamic positioning. 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 2 stern thrusters). Based on such and the worst-case scenario distance to the 120 dB re1 μPa rms isopleth of 3.7 miles (6 km), the backcalculated distance to the 150 dB re 1 μPa isopleth is approximately 450 feet (137 meters). This is considered the worst-case noise scenario for all sources of noise associated with cable installation. Noise from the work boat and from vibratory sheet pile installation would have a smaller distance where behavioral effect can occur. The width of the Hudson River at Magazine Point near West Point is approximately 1,300 feet (396 meters). This is one of the narrowest areas along the transmission line route that a sturgeon would transit. Based on a worst-case scenario zone of behavioral effects of 450 feet (137 meters) on either side of the transmission line, sturgeon would still have corridors of approximately 200 feet (61 meters) on either side of the transmission line to transit. However, these narrow points only occur in several locations. The average width of the lower Hudson River is approximately 4,900 feet (1,494 meters) and the average zone of passage would be more than 2,000 feet (656 meters) on either side of the transmission line. Installation of the line would not be scheduled during sturgeon spawning migration and would avoid behavioral effects on spawning adults and larvae. Additionally, cable installation would progress at a rate of 1 to 3 miles (1.6 to 4.8 km) per day. Therefore, it is not expected to create any choke points at narrow parts of the river for prolonged periods of time. It is assumed that dynamic positioning would be used most of the time during transmission line installation; however, as noted, impacts would be localized (i.e., very close to the vessel).

Noise propagation was also modeled for a single workboat, such as a 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). Based on this information, back calculating the distance to the 150 dB rms SPL isopleth indicates a radial distance of approximately 7 feet from the workboat. Therefore, the area where behavioral effects associated with the workboat is a much smaller area than the area for a cable-laying ship.

As described under *Sturgeon Swimming Capabilities*, sturgeon have the ability 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, and because the Hudson River is 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 (Popper and Hastings 2009). Fish in the action area experience an acoustic environment that is generally highly energetic under “normal” conditions. The ambient sound levels in the lower estuary are produced by the high volume of existing commercial shipping traffic within the tidal Hudson River and New York Harbor, and these do not appear to affect the behavior or migration of sturgeon that bypass this active region each year. As the Hudson River is subject to substantial commercial and recreational vessel noise under these conditions, any incremental sound associated with vessel traffic related to the cable installation is not expected to affect sturgeon. Additionally, the construction windows have been developed to avoid impacts on sensitive life stages of sturgeon.

Noise from cofferdam installation and rock drilling is also not expected to result in injury to fish and is only considered to be a behavioral response. Sheet pile cofferdams would be installed with a vibratory hammer. A pair of sheets would take 30 to 120 minutes for installation. Vibratory installation noise levels have been measured at 170 to 185 dB re 1 µPa peak SPL at 33 feet, 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 and dropped to 106 to 130 dB re 1 µPa at 2,500 feet. NMFS (2014) indicates that the footprint of an area where noise greater than 150 dB re 1 µPa rms SPL is experienced is within 33 feet (10 meters) of the sheet pile being installed and it is extremely unlikely that the behavior of any individual sturgeon would be affected by noise associated with the installation of sheet piles with a vibratory hammer. Even if a sturgeon was within 33 feet (10 meters) of the pile being installed, the behavioral response would, at most, be limited to movement outside the area where noise greater than 150 dB re 1 µPa rms SPL would be experienced (i.e., moving to an area at least 33 feet (10 meters) from the pile (NMFS 2014). Cofferdam construction would be limited to the three HDD water-to-land transition locations in the Hudson River at Catskill, Stony Point, and Clarkstown. The narrowest location is at Catskill, where the Hudson River is 3,450 feet (1,052 meters) wide. If it is assumed that the area where behavioral effects occur is 33 feet (10 meters) from the sheet pile installation, the smallest zone of passage during sheet pile installation would be approximately 3,400 feet (1,037 meters).

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 (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, where the presence of adult sturgeon is expected to be rare.

Generally, construction is being scheduled to avoid impacts on spawning migrations, spawning activity, and larval stages of shortnose and Atlantic sturgeon. Noise impacts associated with transmission line installation would be either temporary or intermittent and localized and would have an insignificant effect on ESA-listed fish species. After installation activities have been completed, any displaced shortnose and Atlantic sturgeon would likely return to the area. The Applicant's proposed construction windows (see **Table 2-2**) would avoid noise impacts from proposed construction activities to Atlantic sturgeon and shortnose sturgeon during their spawning migration, which is the most vital and sensitive portions of their lifecycle.

Equipment proposed to be used for the bathymetric pre- and post-installation surveys includes a high-resolution side-scan sonar system with a dual frequency (100 and 500 kiloHertz) towfish. These frequencies are much higher than the range that sturgeon can detect. Vessel noise or the side-scan sonar could result in avoidance of the immediate survey area, but this would be a temporary and short-term effect for only the immediate area between the research vessel and the river bottom. If any behavioral effects occur, they are expected to be insignificant.

Blasting

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 to 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 may influence fish mortality related to blasting. Underwater explosions can result in structural abnormalities and mortality of fish eggs. Mortality decreased with distance with 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). Sturgeon eggs and larvae are not expected to occur in the Harlem River and the presence of adults is expected to be rare. As such, the potential for blasting in the Harlem River to adversely affect sturgeon is so low, it is discountable.

Vessel Strikes

The Hudson River cable installation vessel would consist of one dynamic positioning 100- by 300-foot (33- by 99-meter)-cable-laying deck barge with a 12-foot (4-meter) draft. The barge would be outfitted with a 3,500 horsepower, Class II dynamic positioning system and three static cable holding tanks – one static tank for fiber and two additional static tanks each capable of holding 34 miles (55 km) of HVDC cable and various equipment for tensioning and handling the cable during installation. Based on anticipated installation conditions, the cable-laying barge would be equipped with 6 azimuthing thrusters. Additional vessels anticipated as part of the proposed cable installation for the Hudson River would include the following:

- 60-foot (18-meter) support/supply tug: typically, minimum of 1,000 HP (9- to 16-foot [2.7- to 4.9-meter] draft)
- 58-foot (18-meter) crew boat (4-foot [1.2-meter] draft)
- 26-foot (8-meter) outboard powered work skiff (2-foot [0.6-meter] draft)
- 40-foot (12-meter) with support systems sufficient for three divers (4-foot [1.2-meter] draft).

The type and number of vessels could be subject to change based on vessel availability, personnel availability, installation location, and schedule. Each vessel employed would travel into water depths consistent with their purposes (i.e., crew boats to local servicing yards and installation barge principally along the alignment/approved commercial dockage). All vessels would operate fully in compliance with safe navigational practices.

The installation barge would principally reside on the installation route and would make approximately two round trips between the mobilization and demobilization ports. It would also make about six trips to and from the local cable-loading ports and in cases where it is deemed prudent return to shore due to weather conditions. At all other times, the cable lay barge’s transit route would typically follow the proposed transmission line alignment within the Hudson River.

The Applicant anticipates that crew boats would make multiple daily trips to and from a nearby marina to transport personnel and supplies to the installation barge (approximately three to six round trips per day). Other vessels such as the skiff and the dive boat might also make daily trips between the marina and the installation barge (possibly one round trip per day). The frequency of vessel trips is subject to change. However, the estimates provided are indicative of what is currently anticipated. Support and supply vessels would transit in the navigable channels. Transit routes would vary based on the location of applicable marine-based staging yards (e.g., docking areas, equipment yards) along the route, but the yards would generally be no more than 50 miles (81 km) from the location of the installation barge.

Vessel speeds in the construction area would be consistent with “no wake” requirements, and in all cases would be less than 4 knots. During transmission line installation, the cable-laying barge would operate at

0.07 knots inside the construction area (i.e., the aquatic construction zone with a nominal 50-foot [15-meter] width centered along the cable alignment). The Applicant anticipates the vessel speeds outside the construction area to be in the following ranges:

- Lay barge under tow: 5 to 6 knots
- Support/Supply tug: 6 to 10 knots
- Crew boat: 12 knots or in conformance with general navigational practices/rules
- Outboard-powered work skiffs: 12 knots or in conformance with general navigational practices/rules
- Dive boat: 12 knots, assuming a vessel similar to a crew boat.

Specific details on numbers and types of vessels, transit routes, and numbers of trips would be further defined as part of the EM&CP to be submitted by the Applicant.

A similar number or fewer vessels would be used during debris removal as would be used during installation. 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. Transit speeds would be no faster than 8 to 12 knots depending on weather, currents, and barges in tow. 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.

Pre-installation surveys would be conducted prior to debris removal and post-installation bathymetric surveys would be conducted 1 and 3 years after installation and, if necessary, 5 and 8 years after transmission line installation. Surveys would be conducted outside of spawning season in the 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, meaning that it would be a height above the riverbed that would allow clearance for sturgeon above the riverbed.

Large vessels with deep drafts (up to 40 to 45 feet [12 to 14 meters]) relative to smaller vessels (less than 20 feet [5 meters]) have been implicated in vessel collisions with demersal fishes and fishes that prefer to feed along the bottom but also occur in the water column (e.g., sturgeon), even in deep water (Brown and Murphy 2010). However, vessel strikes 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 Atlantic sturgeon (NMFS 2013a). Vessel strikes are not considered to be a significant threat in the Hudson River (NMFS 2014). 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, and sturgeon are generally found within 3.3 feet (1.0 meter) of the bottom in the deepest available water, the chance of vessel-related mortalities to fish is expected to be low.

Although Atlantic and shortnose sturgeon are demersal fishes and spend most of their time at the bottom of the water column, it should be noted that Atlantic sturgeon in the Suwannee River (Florida) have been reported to jump out of the water, and, during jumping episodes, individuals are located at or near the surface of the water, where they are more vulnerable to strikes (Brown and Murphy 2010). The Applicant has proposed measures to minimize impacts from construction vessels on shortnose and Atlantic sturgeon, including that all vessels associated with the proposed construction project would operate at "no wake/idle" speeds (less than 4 knots) at all times in the construction area and in-water depth areas where the draft of the vessel provides less than a 4-foot (1.2-meter) clearance from the bottom (see **Section 2.5**). 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 shortnose and Atlantic sturgeon 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 (see **Table 2-2**), avoiding this vital and sensitive portions 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), and the Hudson River has a maintained depth of at least 32 feet (10 meters) in its navigation channel. Additionally, reduced vessel speeds would help to avoid vessel strikes for sturgeon near the surface. As such, the possibility of a vessel striking shortnose or Atlantic sturgeon during cable installation or bathymetric surveys is discountable.

Accidental Spills

Minor releases of hydrocarbons (e.g., diesel fuel and lubricants) could result in impacts on ESA-listed fish species. During installation of the aquatic transmission line, approximately four vessels, such as a cable vessel, survey boat, crew boat, and tugboat with barge, would be employed. Each of these vessels contains fuel, hydraulic fluid, and potentially other hazardous materials and, therefore, has the potential for spills. The impacts of hydrocarbons are caused by either the physical nature of the oil (physical contamination and smothering) or by its chemical components (toxic effects and bioaccumulation). It is anticipated that the immediate response reaction of fish to water contaminated with hydrocarbon would be avoidance. Oil has the potential to impact spawning success because of the physical smothering and the toxic effects on eggs and larvae (USFWS 2010b). Minor releases of hydrocarbons could also affect the food sources of ESA-listed fish. Benthic communities could also be affected by clean-up operations or through physical damage to the habitats in which plants and animals live. This could, in turn, decrease the foraging ability of ESA-listed fish species. A Spill Prevention Plan, which would include Applicant-proposed BMPs such as construction crews having sufficient supplies of absorbent and barrier materials available to contain and clean up hazardous materials in the event of such a spill, would be implemented to prevent or mitigate this impact so that it would be an insignificant effect on shortnose and Atlantic sturgeon.

Operations, Maintenance, and Emergency Repair Impacts

Increased temperature, magnetic fields, and a weak induced electric field generated from the magnetic field would have insignificant effects on shortnose sturgeon and Atlantic sturgeon for the reasons discussed below. Maintenance activities would have no effect on ESA-listed fish species, because the proposed transmission line would be maintenance-free. Emergency repair activities also would have insignificant effects on shortnose sturgeon and Atlantic sturgeon. During emergency repairs of the proposed aquatic transmission line, the cables would be brought to the surface for repair, a new section of line would be spliced in, and the line would be reburied. Sediment disturbance resulting in temporarily increased turbidity, decreased water quality due to disturbance of contaminated sediments, and noise would be insignificant effects on shortnose sturgeon and Atlantic sturgeon. These impacts would be similar to those described for construction and installation activities, but on a smaller scale and over a shorter duration. The Applicant has proposed similar measures to employ during emergency repairs (see **Section 2.5**).

The Applicant has conducted discussions with NYNHP, NYSDEC, and NMFS to gather additional information and to develop recommendations for the avoidance and minimization of potential impacts on ESA-listed aquatic species, including federally listed fish species, during operations, inspection, and emergency repairs of the proposed aquatic transmission line. The Applicant has proposed measures to minimize impacts on aquatic species during emergency repairs that are similar to those proposed for construction activities (see **Section 2.5**). As specified in the proposed CHPE Project's Certificate of Environmental Compatibility and Public Need (Condition 163) issued by NYSPSC, the Applicant would conduct a series of post-energizing studies, including benthic macroinvertebrate and sediment sampling; bathymetry, sediment temperature, and magnetic field surveys; and Atlantic sturgeon hydrophone surveys, for use in post-installation compliance monitoring (NYSPSC 2013). The Atlantic sturgeon study would document the species' movements in relation to cable operation. All studies would be developed in consultation with appropriate resources agencies. The Applicant also has proposed to establish the Hudson River and Lake Champlain Habitat Enhancement, Restoration, and Research/Habitat Improvement Project Trust. The purpose of the Trust would be the "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 the short-term adverse aquatic impacts and potential long-term aquatic impacts and risks to these water bodies from Facility construction and operation."

Magnetic and Electric Fields

The proposed aquatic transmission cable would emit magnetic fields; however, electric fields are not anticipated due to cable shielding and burial. In addition, a weak induced electric field would be generated from that magnetic field and this induced electric field can be detected by certain aquatic organisms. Information on the effects of magnetic and electric fields on aquatic species, including shortnose and Atlantic sturgeons is limited (Fisher and Slater 2010, Cada et al. 2011). Available evidence indicates that the magnetic fields that would be generated during operation of the proposed transmission line may be detected and avoided by shortnose sturgeon and Atlantic sturgeon, but the implications of these responses are unknown.

Magnetic Fields. For the Hudson River Segment, the depth of the trench would be approximately 7 feet (2.1 meters). For the Harlem River in the New York City Metropolitan Area Segment, the depth of the trench would be approximately 8 feet (2.4 meters). There would be 1 foot (0.3 meters) or less of horizontal separation between the two cables, which would be collocated in the same trench, in both segments. Because the magnetic field is strongest at the transmission line and declines rapidly with distance, deeper burial would reduce the magnetic field, but not eliminate it entirely (CMACS 2003, Normandeau et al. 2011). In addition, placing the cables in close proximity to each other allows the magnetic field of each of the bipoles to cancel each other out, further lowering the magnetic field. The shielding around the cables would render the electric field produced by the transmission line inconsequential. In areas where concrete mats would be placed over the cables because target cable burial depths cannot be achieved, magnetic field levels in the water column would also be reduced (Normandeau et al. 2011). The estimated magnetic field levels at the riverbed surface directly over the transmission line centerline were calculated to be less than 162 mG at a burial depth of 3.25 feet (1.0 meter) and a cable spacing of 1 meter (CHPEI 2012i, CHPEI 2012m). The greater depths proposed for the transmission line would further reduce magnetic field levels at the sediment surface. The magnetic field emitted by the proposed aquatic transmission line has the potential to affect the way the natural magnetic field of the Earth is sensed by animal species, and this modified magnetic field could occur continuously within approximately 10 feet (3 meters) of the cable (CHPEI 2012l).

Demersal fish, such as sturgeon, are more likely to be exposed to higher magnetic field strengths, which are closer to the lake 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). Sturgeons are electrosensitive and use electric signals to locate prey. However, information on the impacts of magnetic fields on fish is limited. A number of fish species, including sturgeons, 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 (Fisher and Slater 2010, Cada et al. 2011). However, lake sturgeon 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).

Experiments were conducted to test the responses of freshwater sturgeon (i.e., sterlet sturgeon [*Acipenser ruthenus*] and Russian sturgeon [*Acipenser gueldenstaedtii*]) to AC-generated electromagnetic fields. These freshwater sturgeon species exhibited temporarily altered swimming behaviors in response to AC-generated electromagnetic fields that ranged from 35,100 mG to 1,657,800 mG. Lake sturgeon (*Acipenser fulvescens*) exhibited temporarily altered swimming behaviors in response to AC-generated electromagnetic fields that ranged from 35,100 mG to 1,657,800 mG (Cada et al. 2011). Juvenile lake sturgeon displayed temporarily altered swimming behavior when exposed to variable magnetic fields using an AC electromagnet (maximum value of the field at full power was approximately 1,657,800 mG) suggesting a momentary attraction to the variable magnetic field (Cada et al. 2012). Bottom-dwelling demersal fish (such as the shortnose and Atlantic sturgeon) would be exposed to higher field strengths adjacent to the proposed transmission line along the riverbed surface (Normandeau et al. 2011). However, the electromagnetic fields in those studies were much more intense than the magnetic fields that would be produced by the proposed transmission line, which would be less than 162 mG at the sediment-water interface or 600 mG at the surface of a concrete mat directly above the buried transmission cables, which are orders of magnitude weaker than the fields that triggered a reaction in the before-mentioned freshwater sturgeon species.

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).

Laboratory experiments that indicate that magnetic fields can affect the behavior of adult fish and the development of eggs and larvae used exposures orders of magnitude higher than the magnetic field strengths of those expected from the proposed CHPE Project transmission line. Therefore, the negligible increase in magnetic field associated with the CHPE transmission line is expected to have no effects (short-term or long-term) on eggs, larvae, or adults.

Magnetic fields associated with the operation of the transmission line could impact shellfish and benthic organisms that serve as sturgeon prey. 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) or 600 mG above concrete mats. 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). 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 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). Monitoring surveys conducted for the Long Island Transmission Line Project revealed recolonization of concrete mats to preconstruction conditions within 2 years. Therefore, no impacts (short-term or long-term) of magnetic fields on sturgeon prey are expected. A pre- and post-energizing benthic monitoring program would be developed in accordance with Certificate Condition to evaluate operational impacts on benthic communities (NYSPSC 2013).

Induced Electric Current. The movement of charges in a magnetic field can cause an induced electric current. 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 x 10^{-5} millivolts/cm (mV/cm); a fish moving north to south at the same rate would incur an induced electric current of 67 x 10^{-5} mV/cm. The maximum induced electric current associated with water or a fish moving parallel to the transmission cables at a rate of 1.38 feet (0.42 meters) per second (0.8 knots) would be a 11.5 x 10^{-5} mV/cm over that produced by the geomagnetic field at 1 foot (0.3 meters) above riverbed at the centerline of the cables. The induced electric field would decrease to 2.8 x 10^{-5} mV/cm or less at 10 feet (3 meters) from the cable system and continue to decrease with distance from the centerline. 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 x 10^{-5} mV/cm [the maximum induced electric field]/67 x 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 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 with field intensities of 0.6 mV/cm or greater, the response was to avoid the source (Basov 1999).

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 increase (17 percent) over 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 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). Furthermore, fish responses to induced currents have been identified as searching for the source and beginning active foraging, or avoiding the source. In addition, more recent experiments indicated that sturgeon use both electrosense and olfactory cues to search for prey (Zhang et al. 2012).

While there is no known literature on the effects of induced electric currents on shellfish and benthic organisms, effects are expected to be negligible. The increase in induced electric current is negligible and is only 17 percent higher than an induced electric current from the naturally occurring geomagnetic field. Additionally, only the area directly above the transmission line is expected to be affected. 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 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). Monitoring surveys conducted for the Long Island Transmission Line Project revealed recolonization of concrete mats to preconstruction conditions within 2 years. Therefore, no impacts (short-term or long-term) of magnetic fields on sturgeon prey are expected. A pre- and post-energizing benthic monitoring program would be developed in accordance with Certificate Condition 163 to evaluate operational impacts on benthic communities (NYSPSC 2013).

Thermal Impacts

Increases in temperature associated with the operation of the proposed aquatic transmission line at the sediment-water interface would have an insignificant effect on Atlantic and shortnose sturgeon, which as demersal species, would occur close to the bottom of the river bed. Although there would be some change in temperature in the sediment immediately surrounding a cable, the depth of the cable's burial and insulating factors of the cable would minimize impacts on the benthic habitats in the immediate vicinity. The cables would produce heat during operation, but it would dissipate with depth so in the top 6 inches (15 cm) of the sediment, where most benthic infauna occur, there would be a negligible temperature increase (CHPEI 2012a). 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 8 inches (0.2 meters) below the riverbed surface (CHPEI 2012p). However, these estimated rises in riverbed surface temperature and the increase in the water column are an overestimation of the natural condition because they do not taken into account the cooling effect from the natural flow of the Hudson River. The predicted amount of local heat generation would not pose a physical barrier to fish passage, and would allow benthic organisms to colonize and demersal fish species (including demersal eggs and larvae) to use surface sediments without being affected. Impacts on reproduction or feeding are not anticipated, and therefore, impacts on fish would also be negligible (CHPEI 2012c, CHPEI 2012l). The small increase in riverbed and water column temperature is considered to be within normal ranges of variation and no residual effects are predicted (SSE 2009). The potential increase in temperature associated with operation of the transmission line when buried using jet plowing techniques in at least 7 feet (2.1 meters) of sediment in the Hudson and Harlem rivers would be within the normal temperature range of all life stages of shortnose and Atlantic sturgeon.

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 the seasonal 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 sturgeon.

Ambient water temperatures in the Hudson and Harlem rivers range from 32 °F (0 °C) in January to a maximum of 81 °F (27 °C) in July. Atlantic sturgeon spawn in in water temperatures of 55 °F to 79 °F (13 °C to 26 °C) (ASMFC 2012, Bain et al. 2000, Van Eenennaam et al. 1996). Adult sturgeon have been found in water temperatures as high as 91 °F (33 °C). While beyond this, temperature tolerances for adult and juvenile sturgeon are not fully known, these life stages are mobile and have the ability to avoid the narrow area directly above the transmission line. Atlantic sturgeon eggs have been found to tolerate temperatures from 59 °F to 75 °F (15 °C to 24°C), and larvae tolerate temperatures from 37 °F to 82 °F (3 °C to 28°C) (ASMFC 2012). The potential increase in water temperature associated with operation of the transmission line when buried with concrete mats and when combined with the ambient temperature ranges of the Hudson and Harlem rivers would be within the normal temperature range of all life stages of shortnose and Atlantic sturgeon (Bain et al. 2000). Therefore, no effects on any life stage of sturgeon are expected as a result of the negligible increase in water temperature directly above the transmission line.

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 8 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 2012l, CHPEI 2012p). 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). Under normal conditions, near-surface sediments (0 to 2 inches [0 to 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). As mentioned under construction impacts, monitoring surveys conducted for the Long Island Transmission Line Project revealed colonization of concrete mats used during the project. It is anticipated that a similar situation would take place for the proposed CHPE Project. Therefore, the small increase in riverbed temperature in a localized area immediately over the transmission line is considered to be within normal ranges of variation and would not significantly result in long-term effects on the forage base for sturgeon (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).

Any negligible amount of local heat generated by operation of the proposed CHPE Project transmission line would not pose a physical barrier to ESA-listed fish passage, would only occur directly adjacent to the transmission line, and would allow benthic organisms to recolonize and demersal fish species (including demersal eggs and larvae) to utilize surface sediments without being affected. Impacts on reproduction or feeding are not anticipated, and, therefore, effects on ESA-listed fish would be insignificant (CHPEI 2012c, CHPEI 2012l).

No impacts on ESA-listed species 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.

5.2 Terrestrial Species

The following subsection presents a discussion of potential impacts on terrestrial threatened and endangered resources includes an analysis of impacts and a determination of impact duration and severity. Included in the discussion are elements of the project description that would both produce impacts and are proposed to minimize potential impacts. Impacts on terrestrial species are summarized in **Table 5-1**. Measures for minimizing potential environmental impacts on terrestrial biological resources are listed in **Section 2.5**.

Based on the analysis in this section, and the discussion of cumulative effects presented in **Section 6**, **DOE has concluded that any effects on the Indiana bat and Karner blue butterfly would be insignificant or discountable, and that the proposed CHPE Project my affect, but is not likely to**

adversely affect, those species. **Table 5-4** provides a summary of potential impacts on threatened and endangered terrestrial species potentially resulting from the proposed CHPE Project.

Table 5-4. Determination of Effect under the ESA for Federally Listed Terrestrial Species in the Proposed CHPE Project Area

Common Name	Scientific Name	ESA Status	Determination of Effect
Mammals			
Indiana bat	*Myotis sodalis*	E	May affect, but not likely to adversely affect
Northern long-eared bat	*Myotis septentrionalis*	PE	May affect, but not likely to adversely affect
Invertebrates			
Karner blue butterfly	*Lycaeides melissa samuelis*	E	May affect, but not likely to adversely affect

Table Key: E = Federally listed as endangered; PE = Proposed species for listing as endangered.

5.2.1 Indiana Bat and Northern Long-Eared Bat

Construction Impacts

Suitable roosting and foraging habitats for the Indiana bat and northern long-eared bat occur within and adjacent to the proposed CHPE Project area. These habitats could support spring staging and migration, summer roosting, maternity, fall migration, or fall swarming periods of Indiana bats within or near the project area. However, there are no hibernacula within the project area and no habitat containing roost trees would be removed within 20 miles (32 km) of Priority 1 or 2 Indiana bat hibernacula. The closest Priority 1 or 2 hibernacula from the proposed CHPE project route are approximately 5 miles from areas where the transmission line would be buried in Lake Champlain or the Hudson River. The project route does not go through any forested areas along these portions of the route; therefore, no trees would be removed in these areas. The hibernacula in Ulster County are greater than the 20 miles (32 km) from the terrestrial portion of the proposed transmission line. The closest Priority 1 or 2 hibernacula to terrestrial portions of the proposed CHPE Project Route, where trees could be removed, would be the Barton Hill Mine hibernaculum in Essex County, approximately 25 miles (38 km) away from proposed CHPE Project route MP 101, where the transmission line exits Lake Champlain near Dresden in Washington County. The Cheever Mine hibernaculum in Essex County (located within 1 mile [1.6 km] of Lake Champlain) and the Indian Oven hibernaculum in Columbia County are Priority 4 with only 3 and 5 bats observed, respectively. The hibernaculum in Warren County is Priority 3 with 60 to 135 bats estimated (USFWS 2007). These hibernacula have less than 150 bats recorded in areas where the transmission line generally would be buried under Lake Champlain or the Hudson River.

Potential effects associated with construction could range from disturbance to injury or mortality if bats are roosting in trees while they are felled, and habitat loss or decreases in the quality of remaining habitat in the Action Area. Factors that might lead to reduced habitat quality include habitat fragmentation and increased human disturbance (e.g., noise and dust). However, because of the substantial distance from Priority 1 and 2 hibernacula, these effects are expected to be insignificant.

Disturbance and Displacement

Construction of the proposed CHPE Project could create short-term disturbances that could affect bats in the area. If roosting bats or individuals flying through their home range are disturbed or displaced due to construction activities, then the potential exists for harassment or harm to occur. Large-scale construction projects create noise, dust, and vibration type effects that may result in disturbance to individual animals. Heavy machinery movement and vehicles have a greater potential for generating noise, dust, and vibrations. These types of disturbances are variable, transient, and temporary in nature as the construction changes locations and are influenced by environmental conditions at any given time or location. Adjacent roost trees could be subject to these temporary disturbances. Applicant-proposed BMPs (see **Section 2.5**) would be implemented to minimize potential construction impacts, such as dust and erosion, but little can be done to minimize impacts from noise (apart from use of improved mufflers) and vibrations from the heavy construction equipment on the Indiana bat. However, given the temporary and variable nature of construction activities, these impacts and behavioral responses to the disturbances would be insignificant for the reasons discussed below. In addition, the Proposed CHPE Project would be located along and within existing active railroad and highway ROW where existing noise levels are elevated compared to adjacent areas.

In several studies bats have displayed some resilience to disturbance type impacts. In the original Indiana Bat Recovery Plan (USFWS 1999), the USFWS concluded that the bat may be a more adaptable species than originally thought when it was listed as an endangered species. Maternity colonies have been found along the edge of woodlots and active agricultural fields, in heavily logged and grazed open woodlots, in pastures, and even in an active pig-lot (Brack et al. 2002).

Indiana bats and northern long-eared bats may change foraging areas and seek foraging habitats that are farther away from the construction area. Indiana bats exhibit strong site fidelity to their summer colony areas and foraging habitat (Kurta et al. 2002, USFWS 1999). It is not known how long or how far Indiana bats would search to find new habitat if their traditional habitat is lost or degraded. However, there are observations in the literature of Indiana bat tolerance to disturbance (USFWS 2008c) and it is unknown whether Indiana bats would shift or abandon their foraging areas as a result of the proposed construction actions.

Construction Noise. Increased noise created by construction equipment within the proposed CHPE Project area could disturb bats day-roosting in nearby forests during spring, summer, and autumn. This potential disturbance would be short-term and noise would not be generated throughout the entirety of the project area during construction. There are several factors that determine the response from individuals or colonies of bats. Although noise levels associated with construction would likely continue for more than a single day, the bats roosting within or close to these areas are not expected to shift their focal roosting areas farther away given the current level of disturbance from the active railroad ROW being used for the proposed CHPE Project transmission line. Additionally, there is limited availability of suitable summer roost trees within and adjacent to the impact area.

Construction activities along the Lake Champlain Segment would generally occur at distances greater than 500 feet (152 meters) from land. However, in a few places, construction would occur closer to shore. At this distance, the noise level would be approximately 83 to 89 dBA. With an average installation rate of 1.5 miles (2.4 km) per day, noise levels would be increased over baseline for only a few hours at any one location. Gardner et al. (1991) suggested that noise and exhaust emissions from machinery could disturb colonies of roosting bats, but such disturbances would have to be severe to cause roost abandonment. Callahan (1993) noted that the likely cause of the bats in his study area abandoning a primary roost tree was disturbance from a bulldozer clearing brush adjacent to the tree. There are many examples of Indiana bats tolerating noise. During a previous study, a primary Indiana bat roost tree containing as many as 45 bats was found along Interstate (I)-81. This maternity colony was apparently not affected by noise created by vehicles traveling north and south on I-81. Given the current level of disturbance from the actively used railroad ROW and the limited availability of suitable summer roosting habitat within and adjacent to the impact area, Indiana bats and northern long-eared bats are not likely to become displaced or abandon roosting areas.

Construction Dust. The creation of airborne dust by construction equipment is likely to occur with all projects involving earthmoving. Dust likely would be created during the spring, summer, and fall when Indiana bats are roosting in adjacent forested habitats and possibly foraging throughout the project corridor. Any potential effects from dust would be very local within and immediately adjacent to the corridor. However, contractors would implement dust-control strategies (i.e., watering down disturbed soil) during construction activities. Given the amount of available foraging and drinking areas versus the area likely to be impacted by construction dust, and the measures to minimize dust, no impacts on bats are anticipated.

Habitat Loss. Vegetation removal could result in loss of habitat. In the immediate vicinity of the road and railroad ROWs, much of the habitat consists of disturbed open lands and secondary forest lacking suitable habitat for bat roosts. Forested or open woodland habitats occur alongside the proposed underground transmission line in Washington County; however, vegetation clearing would be conducted within the railroad ROW. In total, approximately 236 acres (96 hectares) of existing fringe forest cover could be temporarily disturbed and 48 acres (19 hectares) permanently converted to managed grasses or shrub habitat along the entire CHPE Project route to accommodate proposed construction corridors and any necessary additional workspace (CHPEI 2012e). Acreages of tree removal by county are provided in Table 5-5. Tree removal would be limited to an October to March timeframe to avoid impacts on the Indiana and northern long-eared bats. There are few large trees within the construction corridor. In general, there is limited availability of suitable summer roost trees within and adjacent to the impact area. However, because of the distance from Priority 1 and 2 hibernacula, these effects are expected to be insignificant. During the preconstruction survey, the contractors would identify large live or dead trees with peeling bark, such as shagbark hickory, which could serve as maternity or roost trees. These trees would be avoided where possible.

Table 5-5. Acreages of Tree Removal from the Proposed CHPE Project

ROUTE	Route ID	County	Temporary Impacts (Acres)	Permanent Impacts (Acres)
Dresden to Whitehall	Route 22	Washington	26.8	8.1
Whitehall to Schenectady	CP Railroad ROW	Washington	36.7	3.3
Whitehall to Schenectady	CP Railroad ROW	Saratoga	75.7	11.5
Whitehall to Schenectady	CP/CSX Railroad ROW	Schenectady	29.4	6.9
Schenectady to Cementon	CSX Railroad ROW	Albany	45.3	12.7
Schenectady to Cementon	CSX Railroad ROW	Greene	18.8	4.5
Haverstraw Bay Bypass	CSX Railroad ROW	Rockland	3.7	0.9
Total			**236.2**	**47.8**

Source: CHPEI 2012e

Foraging Habitat. Indiana bats and northern long-eared bats in the Action Area could be affected by the loss of forest habitat and increase in edge habitats. While Indiana bats would have alternative foraging habitat available within the proposed CHPE Project area, they might have to shift or expand their foraging ranges into areas previously unused by them to make up for the loss of foraging habitat. Northern long-eared bats rely upon and prefer edge habitat for safe foraging and movements to and from their roost trees to feed. Therefore the increase in edge habitat may benefit this species. The impact of shifting flight patterns and foraging areas on individual bats would vary. Recovery from the stress of hibernation and migration might be slower as a result of the added energy demands of searching for new foraging habitat especially in an already fragmented landscape such as this one where forested habitat is limited.

Roosting Habitat. No habitat containing roost trees is expected to be removed within 20 miles (32 km) of Priority 1 or 2 Indiana bat hibernacula. Most of the vegetation that would be impacted along the overland portions of the transmission line consists of previously disturbed herbaceous or shrubby cover within the existing railroad ROW. The major effect on roosting habitat is expected to be the loss of potential future roost sites, rather than immediate effects of loss of roosting habitat. During the preconstruction survey, the contractors would identify large live or dead trees with peeling bark, such as shagbark hickory, which could serve as maternity or roost trees. These trees would be avoided where possible. BMPs, such as site-specific prescriptions for clearing and selective retention of vegetative buffer zones would further reduce effects (see **Section 2.5** for other Applicant-proposed measures to avoid or minimize impacts).

Travel Corridors. The use of hedgerows and tree-lined fence rows by bats within the proposed CHPE Project corridor is unknown. These linear features may provide travel corridors for Indiana bats and northern long-eared bats within the proposed CHPE Project area. As a result of loss of forest, Indiana bats and northern long-eared bats may alter current flight paths between roosting and foraging habitat, which may increase their overall flights or they may fly over the corridor and continue to use previous foraging areas. However, the northern long-eared bat prefers to fly along edge habitat to reach foraging habitats; therefore, the increase in forest edge may benefit this species. A study in Michigan found that Indiana bats increased their commuting distance by 55 percent to follow tree-lined paths, rather than flying over large agricultural fields (Murray and Kurta 2004). However, the open habitat crossed along those tree-lined corridors was at least 0.6 miles (1 km) wide. The CHPE Project would widen primarily existing open corridors along railroad and road ROWs by up to 20 feet.

Summary of Construction Impacts

In summary, when considering the combination of all potential impacts (e.g., noise, dust, and habitat loss), the proposed CHPE Project may affect, but is not likely to adversely affect, the Indiana bat and the northern long-eared bat. Temporary and small scale reductions in foraging or roosting opportunities for Indiana bats could occur along the project corridor. Indiana bats might change roosting or foraging areas and seek roosts and foraging habitats that are farther away from the active disturbance area, but these changes in behavior would be very short term. In addition, there are observations of Indiana bat tolerance to disturbance in the literature and it cannot definitively be established that Indiana bats would shift or abandon their roosts or foraging areas as a result of construction activities. In general, there is limited availability of suitable summer roost trees within and adjacent to the impact area. The Applicant would identify and, where possible, avoid impacts on large live or dead trees with peeling bark, including shagbark hickory, which could serve as maternity or roost trees for Indiana bats and northern long-eared bats, and continue to consult with USFWS for recommendations regarding avoidance of any potential impacts on Indiana bats.

Operations and Maintenance Impacts

Vegetation Control

Most of the vegetation that would be impacted along the overland portions of the transmission line ROW consists of previously disturbed herbaceous or shrubby cover within the existing railroad ROW. During operations, vegetation management in the transmission line ROW would be restricted to vegetation clearing on an as-needed basis to maintain heights of woody vegetation to less than 20 feet (6 meters) and conduct repairs or maintenance along the transmission line. Mowing would be completed during the day when Indiana bats are roosting in adjacent trees. Potential effects from mowing on Indiana bats include noise and dust. Noise created by mowing could affect roosting bats in adjacent forests but, as discussed, several colonies of bats have been found near mowed ROWs of major roads and appear to not be affected by noise created by mowing and traffic. In addition, noise created by mowing would be experienced by roosting or foraging bats for a very short duration because mowers would pass quickly by any area having bats. Dust created by mowing would also be present in areas occupied by Indiana bats for a very short duration.

Magnetic Fields

There have been a limited number of studies performed to ascertain the effect of magnetic fields on terrestrial and aquatic ecosystems, and little or no evidence exists that suggests significant impacts, except for some effects near very strong sources of EMF. Buried cables would have no electric fields at the ground surface (WHO 2012, Normandeau et al. 2011). There would be a constant magnetic field, which would decrease with distance from the cable centerline. The burial of the transmission line at the anticipated depths also reduces electric and magnetic field exposure compared to an overhead transmission system. The burial of the transmission line at the anticipated depths also reduces the EMF exposure compared to an overhead transmission system.

No impacts from magnetic fields would be anticipated from operation of the transmission line. While there is evidence that wildlife can detect electromagnetic fields, research indicates that species behaviors would not likely be affected by relatively small changes in magnetic fields (AUC 2011). Additionally, literature suggests that electromagnetic fields associated with transmission lines do not result in any adverse effects on the health, behavior, or productivity of animals (Exponent 2009). Indiana bats may be able to detect magnetic fields; however, there is no evidence to suggest that the fields result in any effects, or that these effects are adverse. Buried cables, such as those proposed for the CHPE Project, would have no electric fields at the ground surface and the constant magnetic field would decrease with distance from the cable centerline (WHO 2012). The predicted magnetic field level for the proposed CHPE Project would be 77 mG at 7 feet (2.1 meters) above the ground directly over the transmission line. While there is evidence that wildlife can detect electromagnetic fields, species behaviors would not be affected by relatively small changes in magnetic fields (AUC 2011). Additionally, literature suggests that electromagnetic fields associated with transmission lines do not result in any adverse effects on the health, behavior, or productivity of animals (Exponent 2009). Indiana bats might be able to detect magnetic fields; however, there is no evidence to suggest that the magnetic fields could result in any effects on the species. The burial of the transmission line at the anticipated depths also reduces the EMF exposure compared to an overhead transmission system.

Most of the vegetation that would be impacted along the overland portions of the ROW consists of previously disturbed herbaceous and shrubby cover within the existing railroad ROW. During operations, vegetation along the ROW would primarily be managed by brush hogging/mowing or hand cutting. Potential effects from mowing on Indiana bats include noise and dust. Noise created by mowing could affect roosting bats in adjacent forests but, as discussed, several colonies of bats have been found near mowed ROWs of major roads and appear to not be affected by noise created by mowing and traffic. In addition, noise created by mowing would be experienced by roosting or foraging bats for a very short duration, because mowers would pass quickly by any area having bats. Dust created by mowing would also be present in areas occupied by Indiana bats for a very short duration.

5.2.2 Karner Blue Butterfly

Construction Impacts

Effects on the Karner blue butterfly could occur from vegetation clearing, trenching, and other construction activities associated with the transmission line. Potential effects from vegetation clearing include habitat degradation via trampling, removal, or other disturbances to wild lupine and other vegetation. However, effects on the Karner blue butterfly would be avoided by using HDD through portions of mapped wild blue lupine habitat. A *Karner Blue Butterfly Impact Avoidance and Minimization Report* summarizes the routing and construction activities that would be employed to avoid impacts on occupied and potential habitat containing wild blue lupine and nectar patches (CHPEI 2012k). The Applicant has also developed impact avoidance and minimization measures specifically for Karner blue butterflies and their habitat (see **Section 2.2**). The Applicant would avoid construction within or immediately adjacent to occupied Karner blue butterfly habitat during the adult flight periods (approximately May to August) to avoid mortality of adults. Prior to construction, surveys for the presence of Karner blue butterflies would be conducted in accordance with the USFWS and NYSDEC guidance document, *Karner Blue Butterfly (Lycaeides melissa samuelis) Survey Protocols Within the State of New York* (USFWS and NYSDEC 2008). This would include flagging the boundaries of all lupine patches within or immediately adjacent to construction workspaces or access routes, and training construction personnel on the locations and identification of wild blue lupine to avoid trampling or destruction of wild blue lupine plants. If any previously unknown (i.e., unflagged) areas containing wild blue lupine are encountered, the Applicant would notify NYSDPS, NYSDEC, and USFWS. If additional protective measures are necessary to protect the Karner blue butterfly or occupied habitat for this species, the Applicant would temporarily cease any vegetation clearing, construction, ground-disturbing, or vegetation management activities in the construction area, excepting any activities that could be necessary for immediate stabilization of the work site, until protective measures can be implemented. These measures would avoid the possibility of adverse impacts on Karner blue butterflies and habitat degradation; therefore, direct disturbance is unlikely to occur.

Habitat Loss

The larval host plant of the Karner blue butterfly, wild blue lupine, occurs along portions of the Overland Segment along the railroad ROW in Saratoga, Schenectady, and Albany counties. As a result, portions of the project route have been recorded as being inhabited by adult Karner blue butterflies. Because of the unique association that the Karner blue butterfly has with wild blue lupine, all mapped wild blue lupine colonies are considered occupied. The transmission line would be installed by HDD in these mapped areas to avoid impacts on habitat.

There are approximately 1.0 acre (0.4 hectares) of wild blue lupine habitat and 13.2 acres (5.3 hectares) of nectar habitat within 100 feet (33 meters) of the proposed CHPE Project transmission line route where trenching installation methods would be used (CHPEI 2012q, NYSDEC 2012d). All construction including HDD installation and trenching would avoid direct impacts on all lupine habitat. Approximately 1.8 acres (0.7 hectares) of mapped Karner blue butterfly nectar habitat occurs within the 33-foot (10-meter) construction corridor proposed for the transmission line along the CP Railroad ROW. The final work around boundary would be identified in the EM&CP and fenced in the field to keep all construction activities within it. Following construction activities, the impacted nectar habitat would be restored with seeding of species that would provide nectar sources.

Summary of Construction Impacts

Because measures such as use of HDD and working within seasonal construction windows would be implemented to avoid disturbing potential habitat and prohibit working near that habitat during the period when butterfly adults are active, the proposed CHPE Project may affect, but is not likely to adversely affect, the Karner blue butterfly. In addition, forest-clearing activities could create habitable areas for wild blue lupine plants and subsequently result in beneficial impacts for the Karner blue butterfly.

Operations and Maintenance Impacts

Impacts on the Karner blue butterfly could occur from vegetation clearing and other maintenance activities associated with the transmission line. During operation, limited vegetation management would be conducted along the corridor, primarily to ensure that large woody vegetation does not grow over the cables, or in the event that repairs or other maintenance of the cables is required. However, adverse impacts on the Karner blue butterfly are not anticipated due to implementation of Applicant-proposed avoidance and mitigation measures. During operation of the transmission line, although wild blue lupine habitat would generally be avoided, if any emergency repairs or other operational maintenance activities could be required within Karner blue butterfly and frosted elfin blue lupine habitats, they would be implemented in accordance with ongoing consultations between the Applicant and USFWS and NYSDEC, and the results of those consultations will be included in the EM&CP. No operational impacts would occur in wild blue lupine habitat from mowing or vegetation removal under the Applicant's Proposed Action because the transmission line would installed via HDD methods to a depth of more than 10 feet (3 meters) below mapped lupine habitat, which would be well below root depths for wild blue lupine, and mowing and vegetation removal would not take place in lupine habitat. Lupine typically grows 8 to 24 inches (20 to 61 cm) in height with taproots approximately 12 to 20 inches (30 to 51 cm) (USFS 2014, PlanetNatural 2012).

No herbicides or pesticides would be used within occupied Karner blue butterfly habitat, except as approved by the USFWS and NYSDEC. To minimize the impact of herbicides on Karner blue butterfly and its food plants, applications would be limited to spot application with hand operated equipment, using personnel certified or experienced in pesticide applications and trained to identify the butterfly and lupine.

Heat from the cables in these areas would be dissipated by deep burial and by a cooling system and no effect on vegetation would be anticipated. For emergency repairs in areas where the cables were installed by HDD under Karner blue butterfly habitat, the cables would be pulled from the entry or exit locations and repaired to avoid impacts the butterfly and its habitat. In areas where the cables were installed in trenches adjacent to lupine and nectar patches, repair crews would employ the same protocols adhered to during installation to avoid or minimize impacts (e.g., training of personnel to identify and flag habitat boundaries to be avoided).

During operation of the transmission line, any emergency repairs, or other operational maintenance activities required within Karner blue butterfly habitat would be implemented in accordance with the mitigation plan for this species being developed by the Applicant in consultation with USFWS and NYSDEC. Given these Applicant-proposed avoidance and mitigation measures, proposed CHPE Project operations and maintenance activities may affect but are unlikely to adversely affect the Karner blue butterfly.

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6. Cumulative Effects

Reasonably foreseeable future activities that might occur in the proposed CHPE Project area and an assessment of cumulative effects from such when combined with the proposed CHPE Project are described in Chapter 6 of the CHPE EIS (DOE 2013). State, local, and private activities (i.e., non-Federal activities) that are reasonably certain to occur within the Action Area are provided below. The Proposed Action when combined with other reasonably foreseeable actions would not contribute to cumulative adverse effects on ESA-listed species, largely because the conservation measures proposed as part of the proposed CHPE Project would avoid, minimize, and mitigate any impacts on ESA-listed species resulting from project construction and operation (see **Section 2.5**).

Fisheries. Recreational and commercial fishing activities in state waters may take shortnose and Atlantic sturgeon; however, information on such incidents, including numbers of fish affected, in the Action Area is not available (NMFS 2013b).

NPDES Permits. The State of New York has been delegated authority to issue NPDES permits by the USEPA. These permits authorize the discharge of pollutants into waters in the Action Area from facilities including municipalities for sewage treatment plants and other industrial users.

Haverstraw Water Supply Project. United Water proposes to provide a new water source to meet long-term water supply needs in Rockland County, New York. The proposed Haverstraw Water Supply Project would include the following:

- Water intake structure in the Town of Haverstraw that draws water from the Hudson River
- Water treatment plant near the closed Haverstraw Landfill, that uses reverse osmosis or desalination to remove salt, inorganic compounds, radionuclides, and viruses
- Raw intake water transmission lines between the intake structure and the treatment plant
- New connections from the treatment plant to existing water mains.

Construction of Phase 1, which includes the majority of infrastructure investments, is scheduled to begin in 2013 and be completed by 2015. Phase 2, which would include installation and expansion of process equipment within existing structures, would be in service by 2020; and Phase 3, which would involve additional mechanical equipment and expansion of the water treatment facility, could be in service by 2030. A Draft EIS for the Haverstraw Water Supply Project has been prepared (NYSDEC 2012a). The proposed CHPE Project would be adjacent to the Haverstraw Water Supply Project between MPs 297 and 298. Construction and installation activities could overlap, spatially and temporally, and so it is included in this cumulative impacts analysis.

Redevelopment of Stony Point Waterfront. A site at MP 296 along the Hudson River currently occupied by the Willow Cove Marina and Stony Point Bay Marina in Stony Point is being considered for redevelopment into 300 housing units, new marina with 125 boat slips, yacht clubs, and restaurants (Matsuda 2012).

Luyster Creek Converter Station Site. The Luyster Creek Converter Station Site is surrounded by utility and industrial facilities and uses, such as the Astoria Energy I and II plants, Astoria Generating Station plants, former Charles Poletti Power Plant, and Bowery Bay Wastewater Treatment Plant. The New York Power Authority (NYPA) recently constructed a new substation in Astoria (Astoria Annex Substation) to accommodate new interconnections, including the Astoria Energy II plant and, potentially, the proposed CHPE Project. Astoria Generating Company plans to construct the Luyster Creek Energy Project, which would replace one generating unit at the Astoria Generating Station. Past, present, and reasonably foreseeable uses of this parcel and surrounding areas are for utility and industrial purposes.

ConEd Learning Center. ConEd plans to use a portion of the Luyster Creek parcel for a Learning Center. Currently, ConEd operates a training center in Queens, but a larger facility is needed to meet ConEd's growing needs for training its employees. The Luyster Creek parcel is approximately 21 acres (8 hectares). The Luyster Creek HVDC Converter Station would require approximately 5 acres (2 hectares) in the northeastern portion of the parcel. Through a joint stipulation between ConEd and the Applicant, the Luyster Creek parcel could be developed with both the Luyster Creek HVDC Converter Station and the ConEd Learning Center. Under this stipulation, the HVDC Converter Station and associated facilities would be confined to approximately 5 acres (2 hectares) within a subdivided parcel, and the remainder of the Luyster Creek parcel would be used for the ConEd Learning Center (NYSPSC 2012). Existing setbacks and easements within the Luyster Creek parcel would still be applicable under future development scenarios.

Astoria Energy Project. In 2006, Astoria Energy constructed a natural gas power plant, Astoria Energy I, adjacent to the Charles Poletti Power Plant facility in Astoria, Queens. Astoria Energy I produces 500 MW for ConEd into the NYISO Market (AE 2012). In 2011, Astoria Energy II, LLC, completed construction of the Astoria Energy II 550-MW natural gas-fueled generating facility in Astoria, Queens (NYPA 2011). NYPA has a 20-year power supply contract to purchase generating output from the Astoria Energy II plant for government customers (e.g., schools, hospitals, municipal buildings, and subways and commuter trains). Both Astoria Energy plants are in the vicinity of the site for the proposed Luyster Creek HVDC Converter Station for the proposed CHPE Project. The Astoria Energy II project is now part of the existing condition.

Luyster Creek Energy Project. The Astoria Generating Company, LP, proposes to enhance the existing Astoria Generating Station with a new 440-MW, gas-powered, combined-cycle generating facility in Astoria, Queens. As part of this project, Astoria Generating Company would retire one existing unit and limit emissions from other units at the Astoria Generating Station. It is anticipated that construction could begin in 2013 with operations beginning in 2015, if approvals are granted (USPowerGen 2012). This project is considered in the cumulative impacts analysis because of its proximity to the site for the proposed converter station.

Astoria Rezoning Plan. Surrounding land uses south of 20th Avenue are mixed-use residential and commercial with some open space and recreational. In 2010, the Queens Office of the New York City Department of City Planning presented a rezoning plan for Astoria between Broadway and 20th Avenue. New recommendations for this area of Astoria include replacing existing zoning with districts to encourage predictable development, guiding new housing opportunities towards major corridors and mass transit, and updating commercial overlays for business opportunities (NYCDCP 2010).

Queens East River and North Shore Greenway Master Plan. The Queens East River and North Shore Greenway is a proposed 10.6-mile (17.1-km), urban shared-use trail that is intended to provide shoreline access and improve non-motorized commuting options (NYCDCP and NYS OPRHP 2006). The plan considered the waterfront and surrounding areas in the utility and industrial area surrounding the Luyster Creek Converter Station Site for greenway purposes but noted that access was unlikely because of the publicly inaccessible nature of the existing and planned utility development activities. The North Shore section of the proposed greenway would run along 20th Avenue between Shore Boulevard near Ralph DeMarco Park and Hazen Street and include a shared-use path and bike lanes along the roadway.

7. Conclusions

7.1 Effects Determination for Listed Species

Based on the description of the proposed CHPE Project in **Section 2** of this BA and further described in the associated Draft CHPE EIS (DOE 2013), the status of species and environmental baseline described in **Sections 3** and **4**, and the analysis of potential impacts in **Section 5**, the DOE concludes the following:

- The proposed CHPE Project would have no effect on the North Atlantic right whale, humpback whale, fin whale, sei whale, sperm whale, West Indian manatee, green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, dwarf wedgemussel, piping plover, roseate tern, and bog turtle.
- The proposed CHPE Project may affect, but is unlikely to adversely affect, the shortnose sturgeon or any DPS of Atlantic sturgeon. Sediment disturbance, temporary increases in turbidity and associated water quality degradation, sediment redeposition, noise and vibration, vessel strikes, and accidental releases of hazardous materials are not expected to have significant effects on shortnose sturgeon and Atlantic sturgeon. Conservation measures such as establishment of construction windows to avoid seasonal periods where sensitive species are using these portions of the rivers would avoid or minimize to insignificant levels adverse effects on federally listed sturgeon species.
- The proposed CHPE Project may affect, but is unlikely to adversely affect, the Indiana bat or the northern long-eared bat. Although Indiana bats and northern long-eared bats may temporarily change roosting or foraging areas and seek roosts and foraging habitats that are farther away from active construction areas, there are observations in the literature of Indiana bat tolerance to disturbance and it cannot definitively be established that Indiana bats or the northern long-eared bats would shift or abandon their roosts or foraging areas. In general, there is limited availability of suitable summer roost trees within and adjacent to the impact area. Potential roost trees identified within the construction limits would be avoided where possible during construction activities. Tree removal would occur between October and March. Avoiding potential maternity or roost trees for Indiana bats and northern long-eared bats and other measures identified through ongoing consultation with USFWS would avoid or minimize to insignificant levels adverse effects on Indiana bats and northern long-eared bats.
- The proposed CHPE Project may affect, but is unlikely to adversely affect, the Karner blue butterfly. Measures would be implemented to avoid disturbing potential habitat and prohibit working near that habitat during the period when adults are active. Therefore, effects on the Karner blue butterfly from vegetation clearing, trenching, and other construction activities associated with the transmission line, such as habitat degradation via trampling, removal, or other disturbances to wild lupine and other vegetation, are unlikely. Direct and indirect adverse effects on the Karner blue butterfly would be discountable or insignificant.

7.2 Effects Determination for Critical Habitat

There is no designated or proposed designated critical habitat for the shortnose sturgeon, any DPS of Atlantic sturgeon, Indiana bat, northern long-eared bat, or Karner blue butterfly in the proposed CHPE Project area. As a consequence, there would be no effect on critical habitat.

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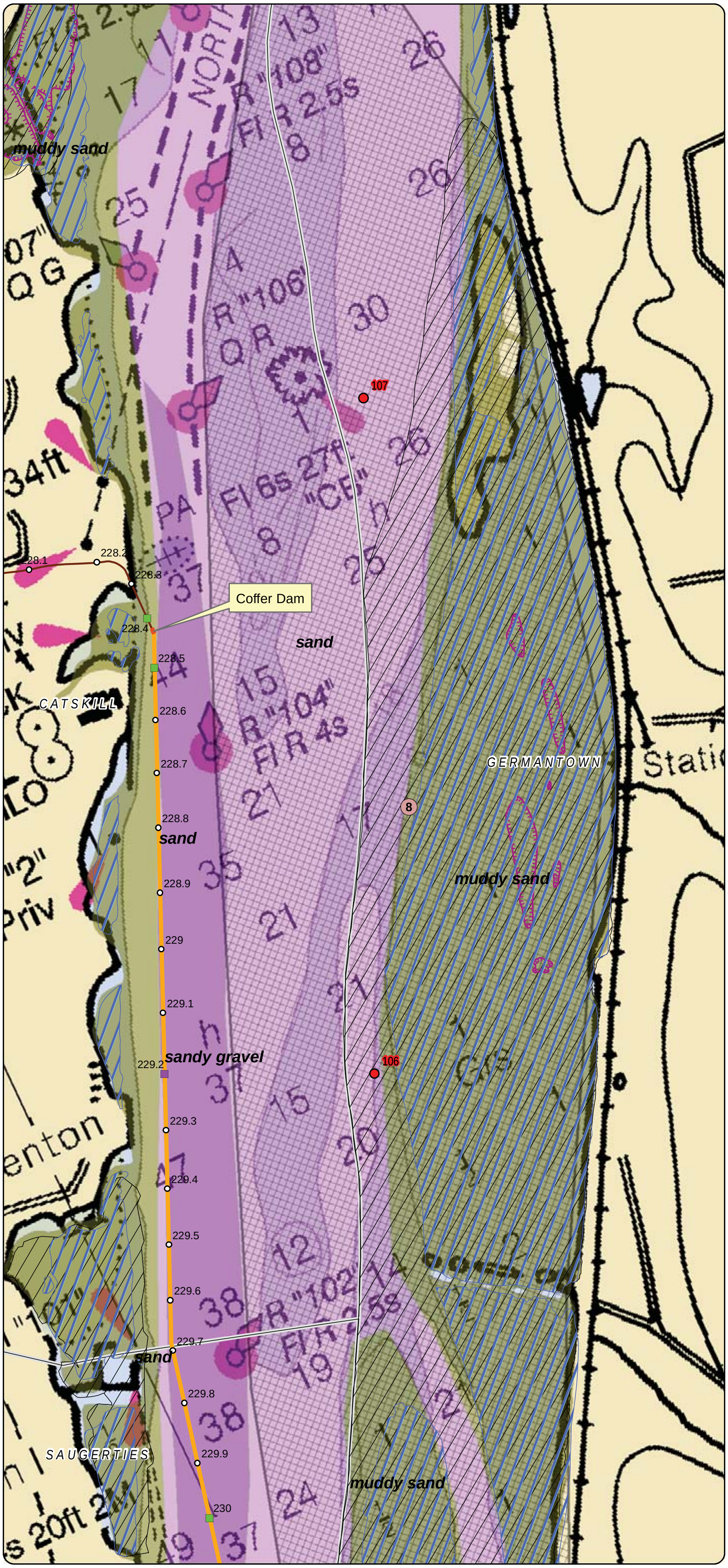
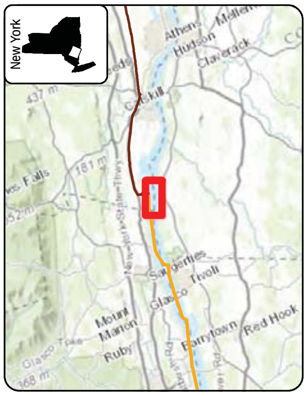
ATTACHMENT 1

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

N

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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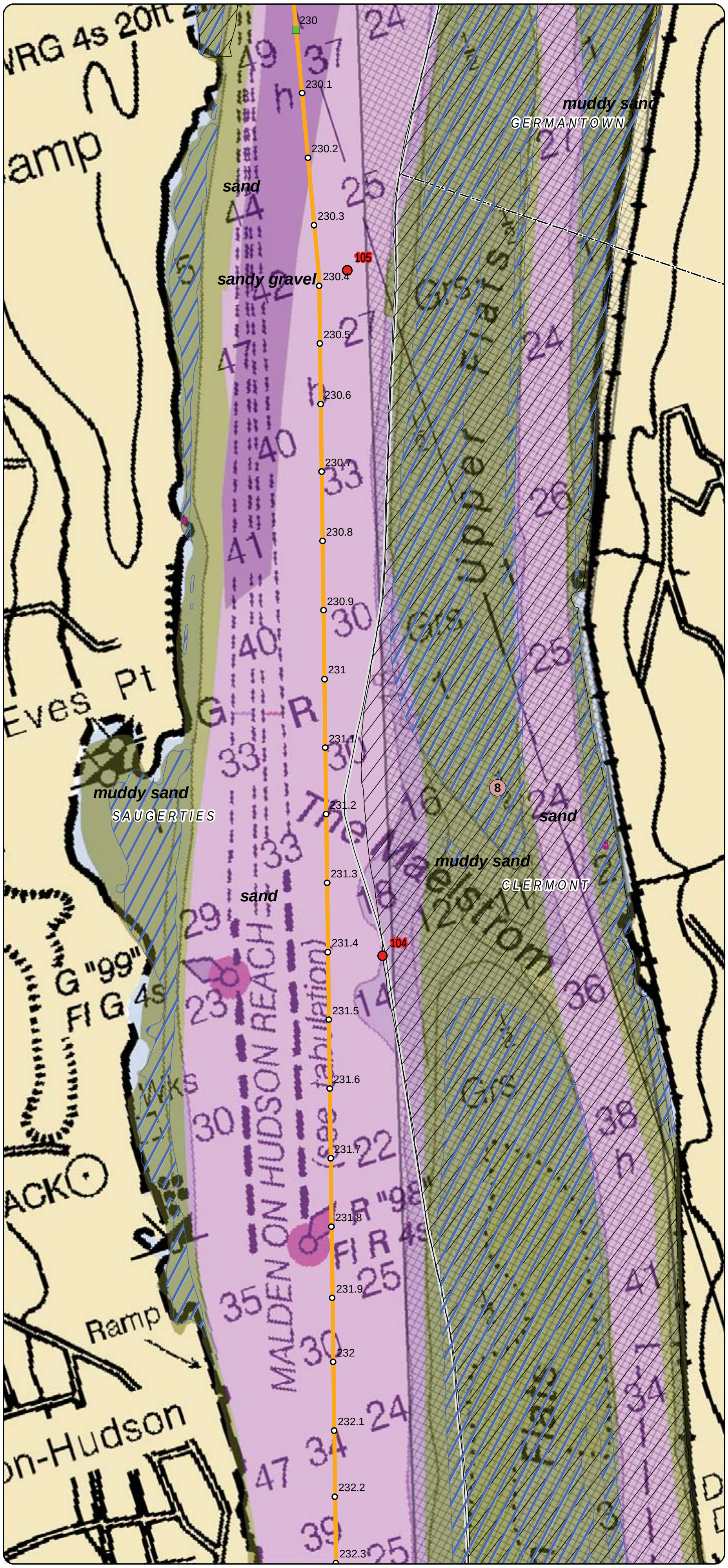

LEGEND

- ● 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

N

0 750

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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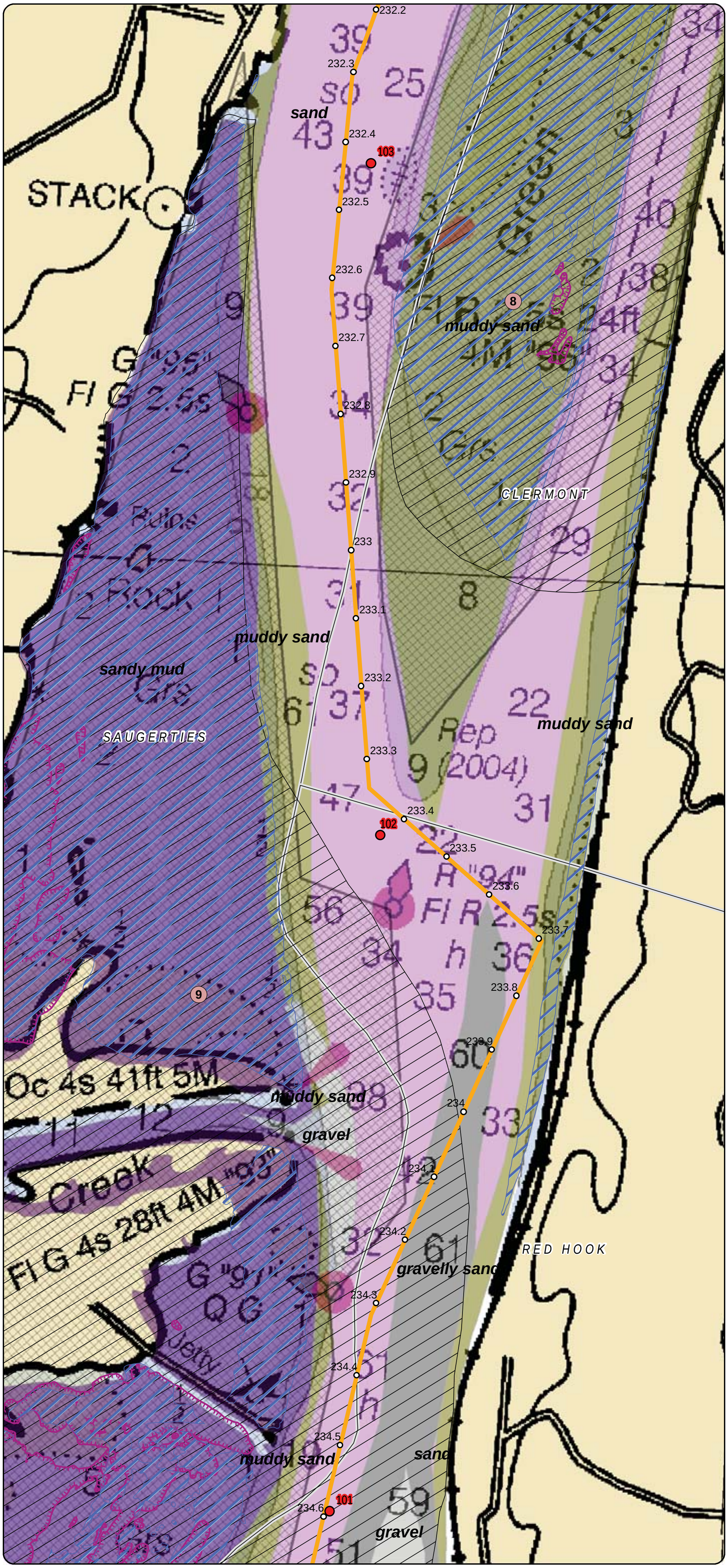

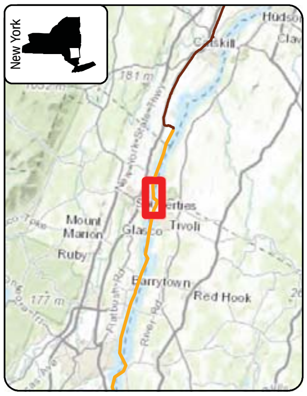

LEGEND

- 🔴 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

N

0 750

Feet

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 | EA & 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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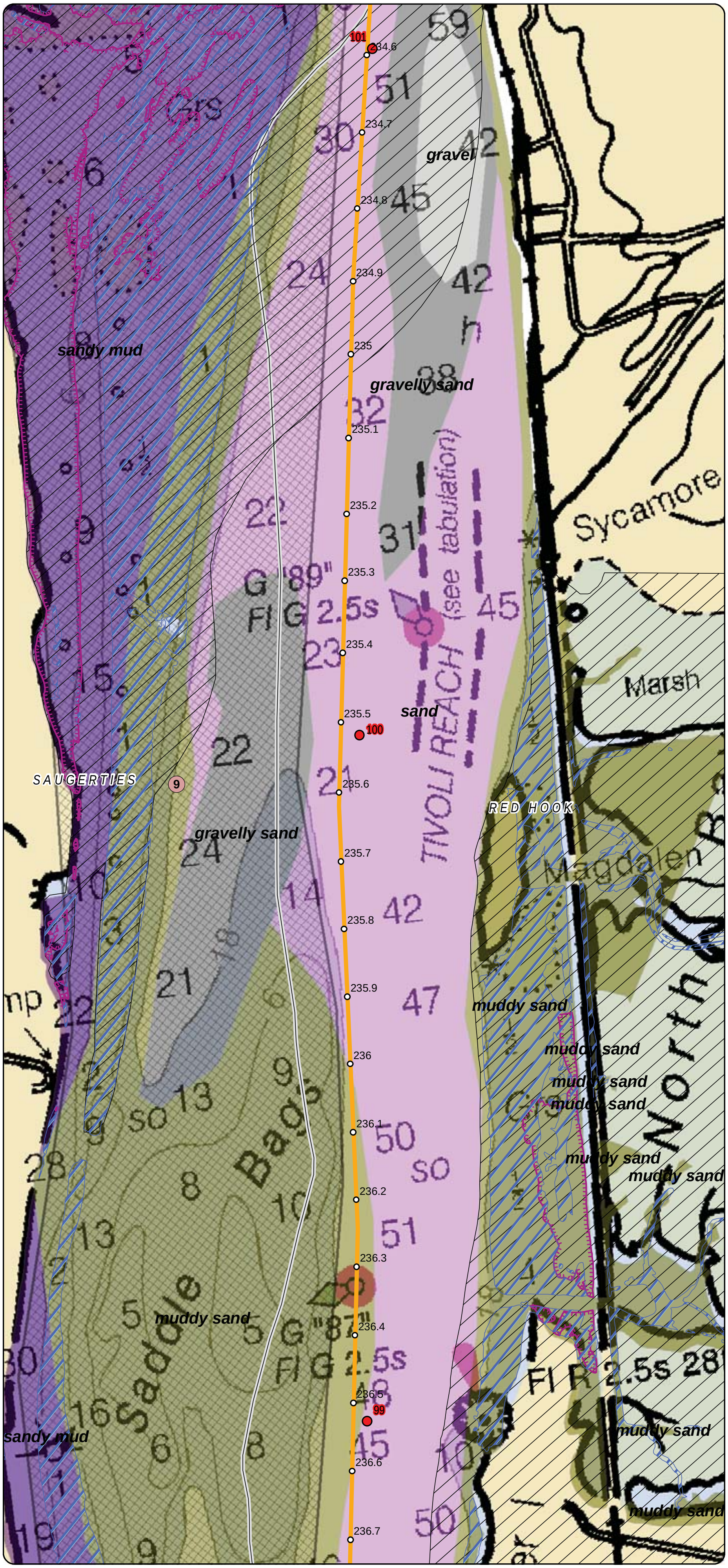

LEGEND

● 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

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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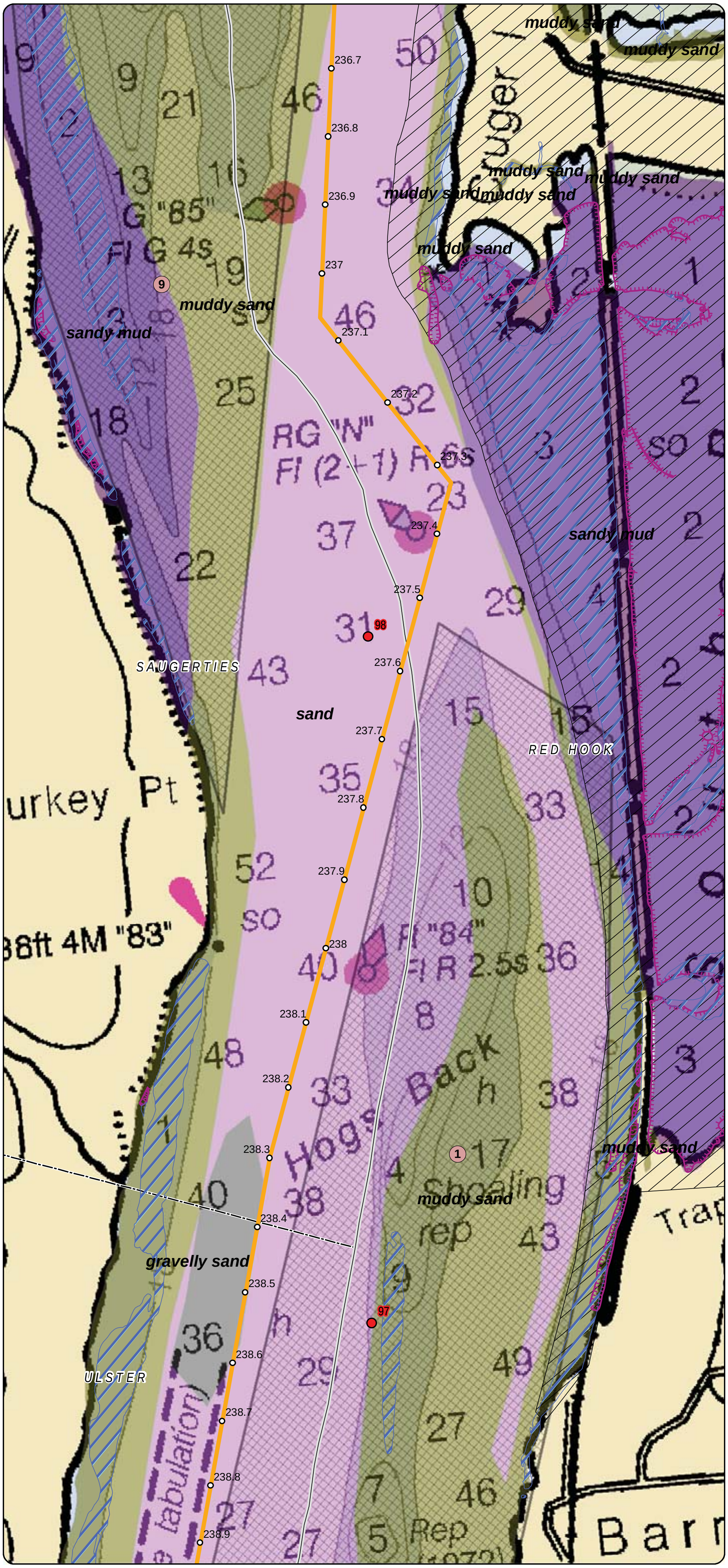

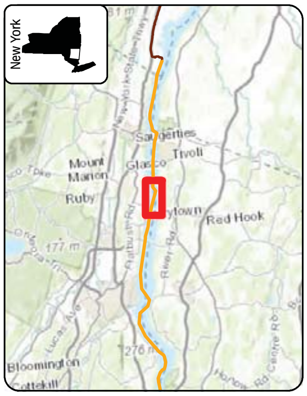

LEGEND

- ● 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

N

0 750
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

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

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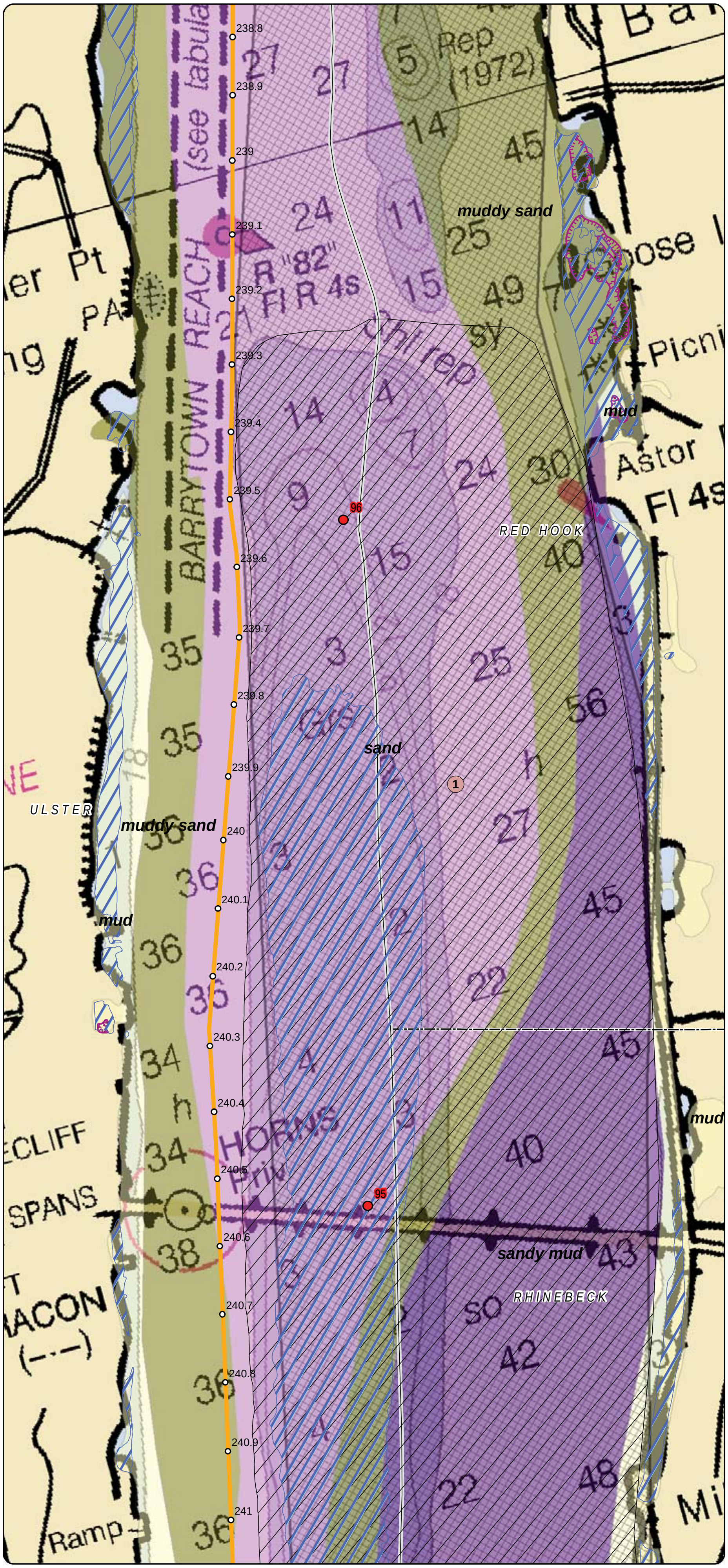

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 6 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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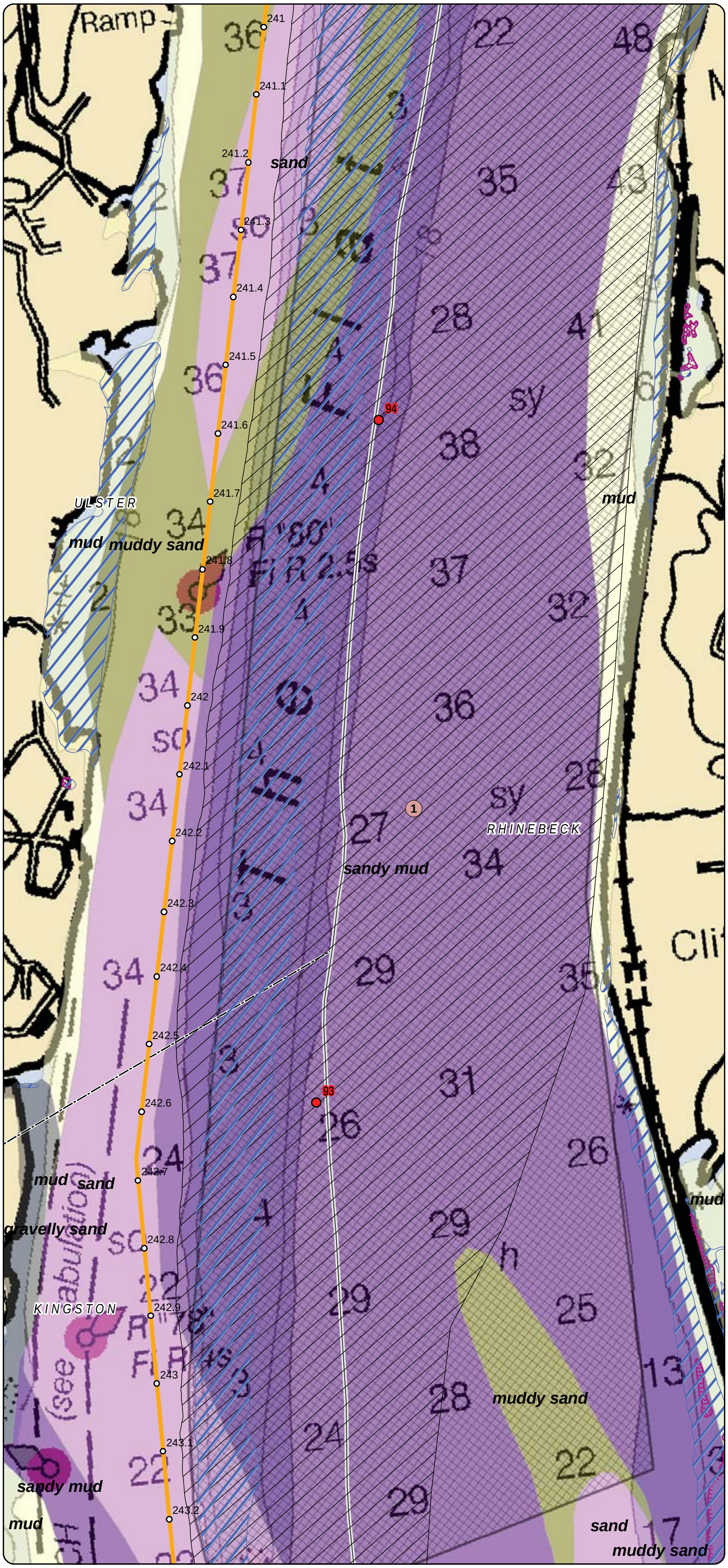

LEGEND

- ● 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
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- ▨ 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

N

0 750

Feet

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 7 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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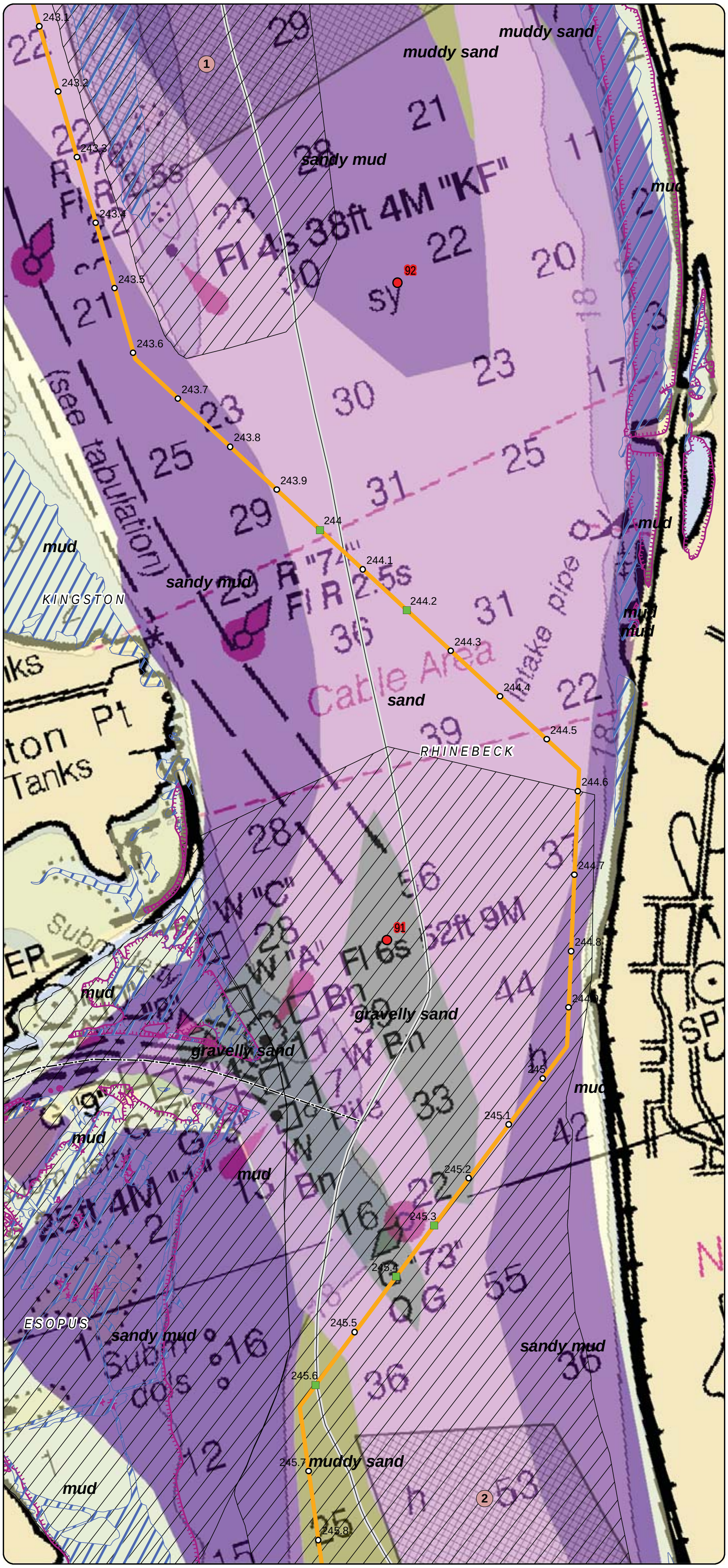

LEGEND

- ● 1 Hudson River Miles
- ■ Potential Mattress (Rock or Stiff Soils)
- 🟩 Potential Mattress (Utility Crossings)
- ○ 1 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 8 of 43

Created: 6/18/2014

by: HDR | TETRA & 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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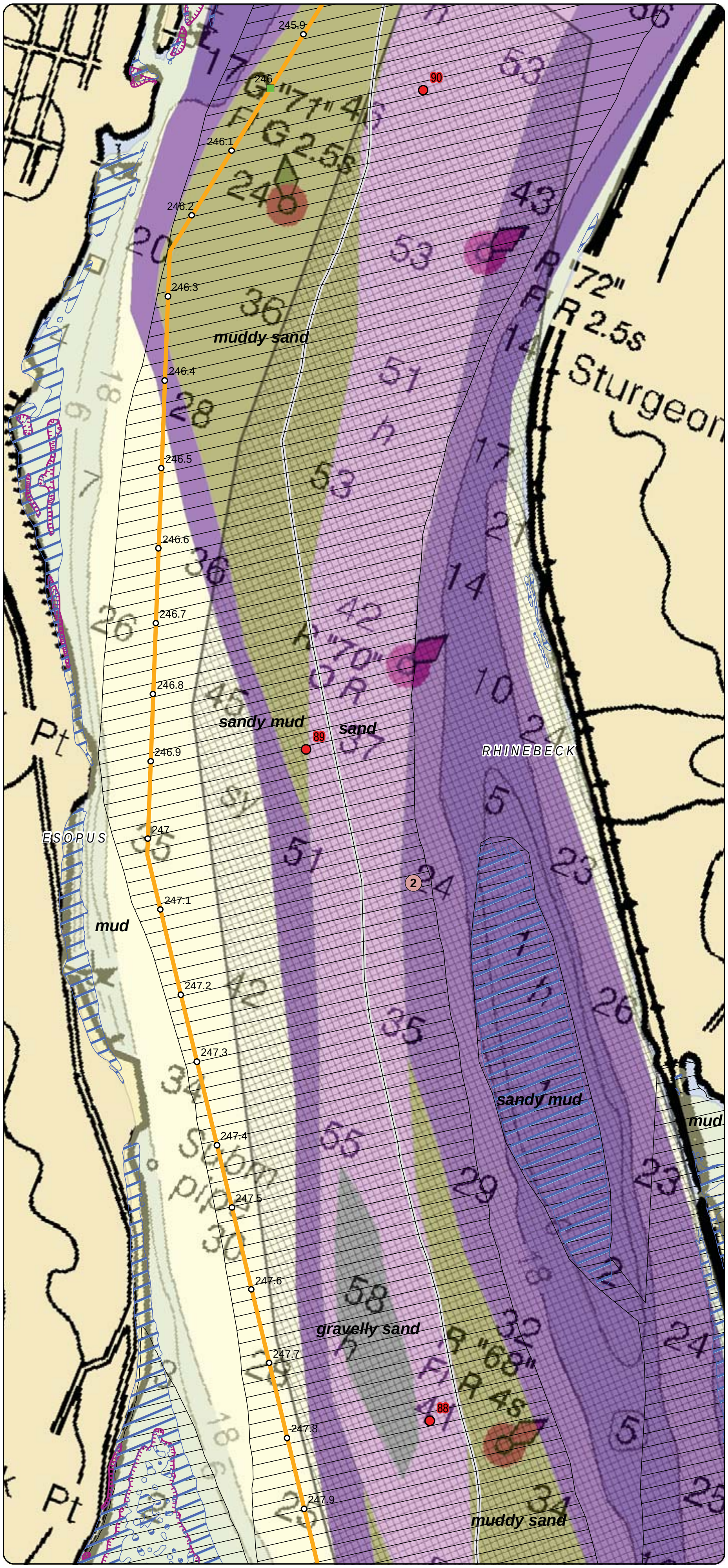

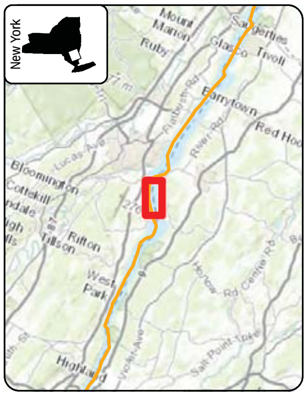

LEGEND

- ● 1 Hudson River Miles
- 🟪 Potential Mattress (Rock or Stiff Soils)
- 🟩 Potential Mattress (Utility Crossings)
- ○ 1 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 9 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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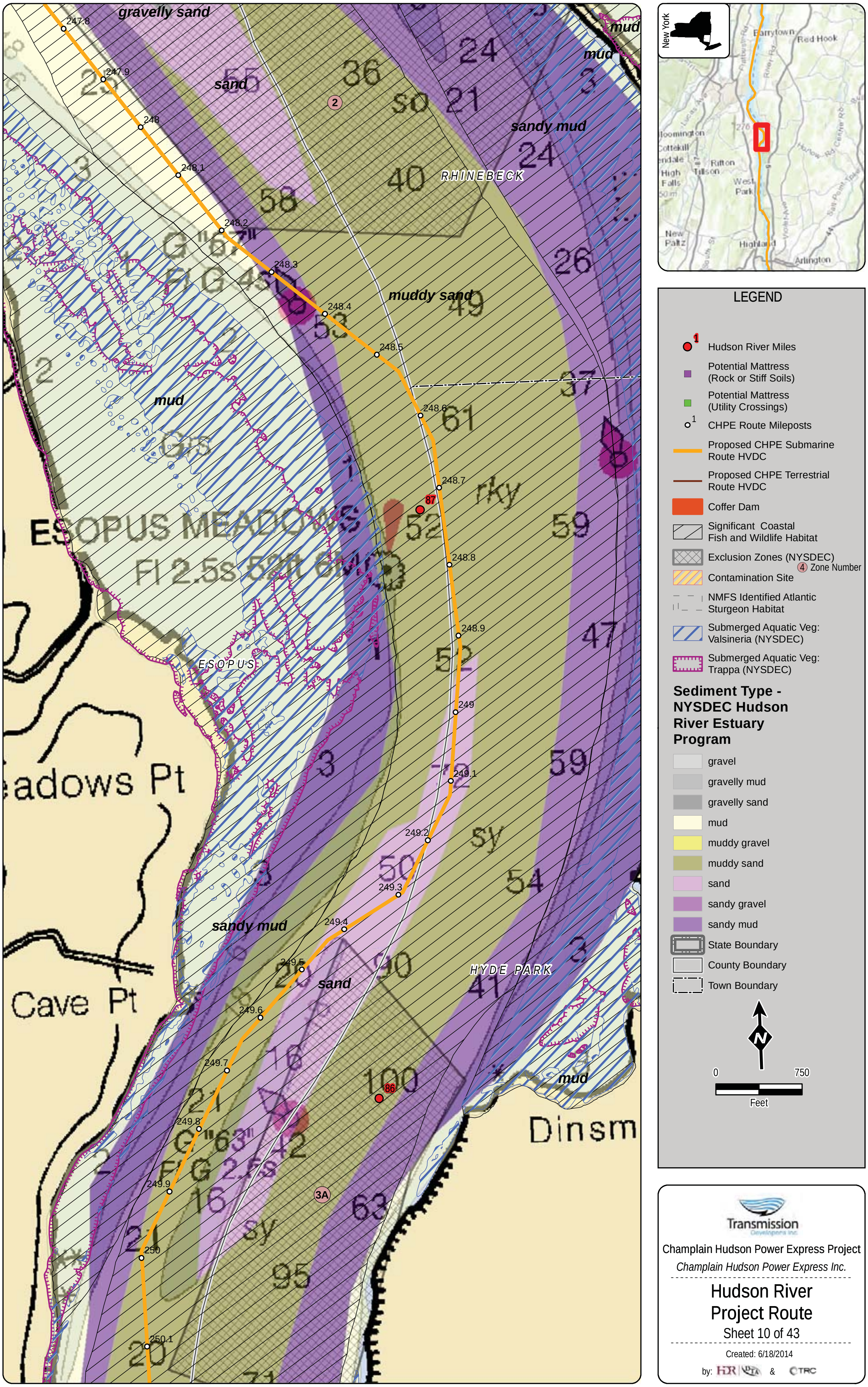

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 10 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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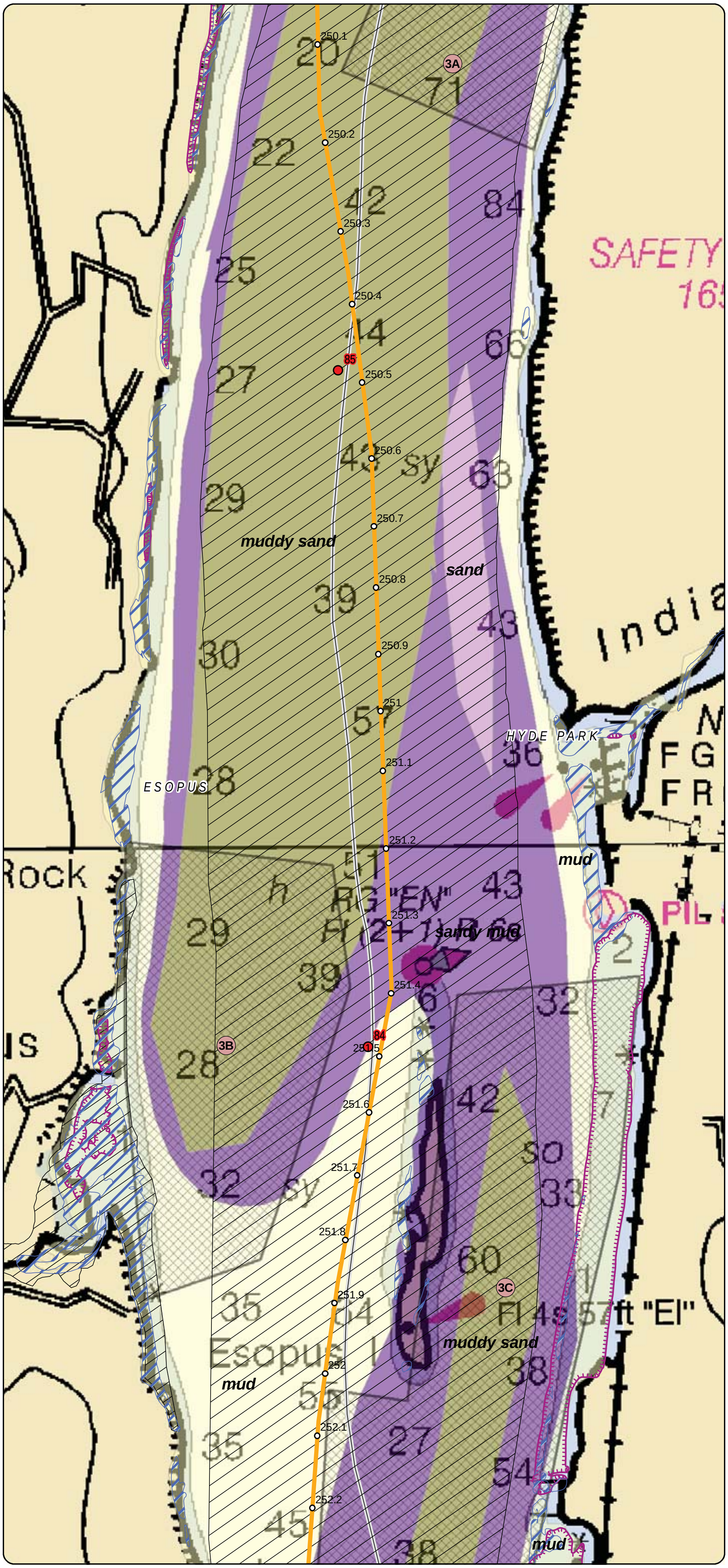

LEGEND

- ● 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 11 of 43

Created: 6/18/2014

by: HDR | TETRA & 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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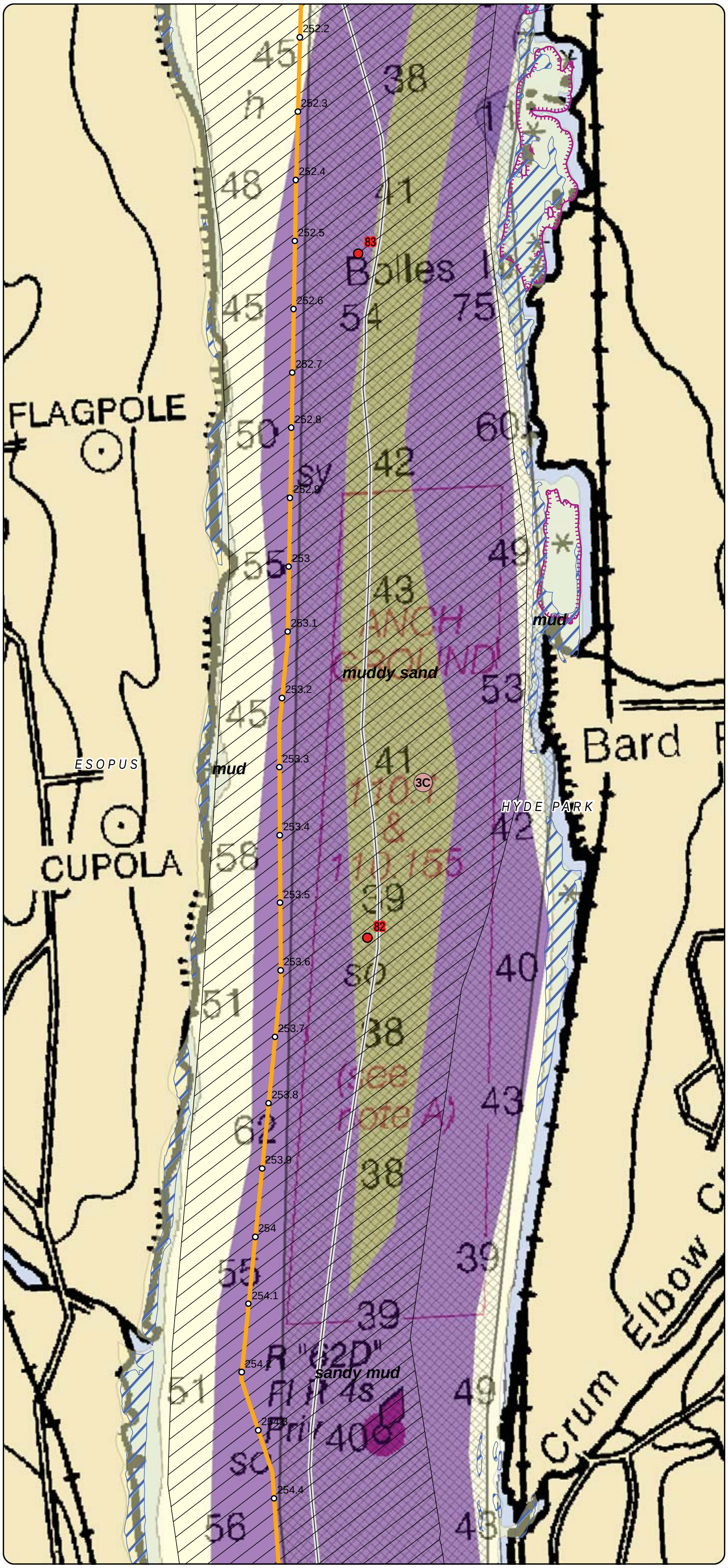

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 12 of 43

Created: 6/18/2014

by: HDR | [illegible] & TRC

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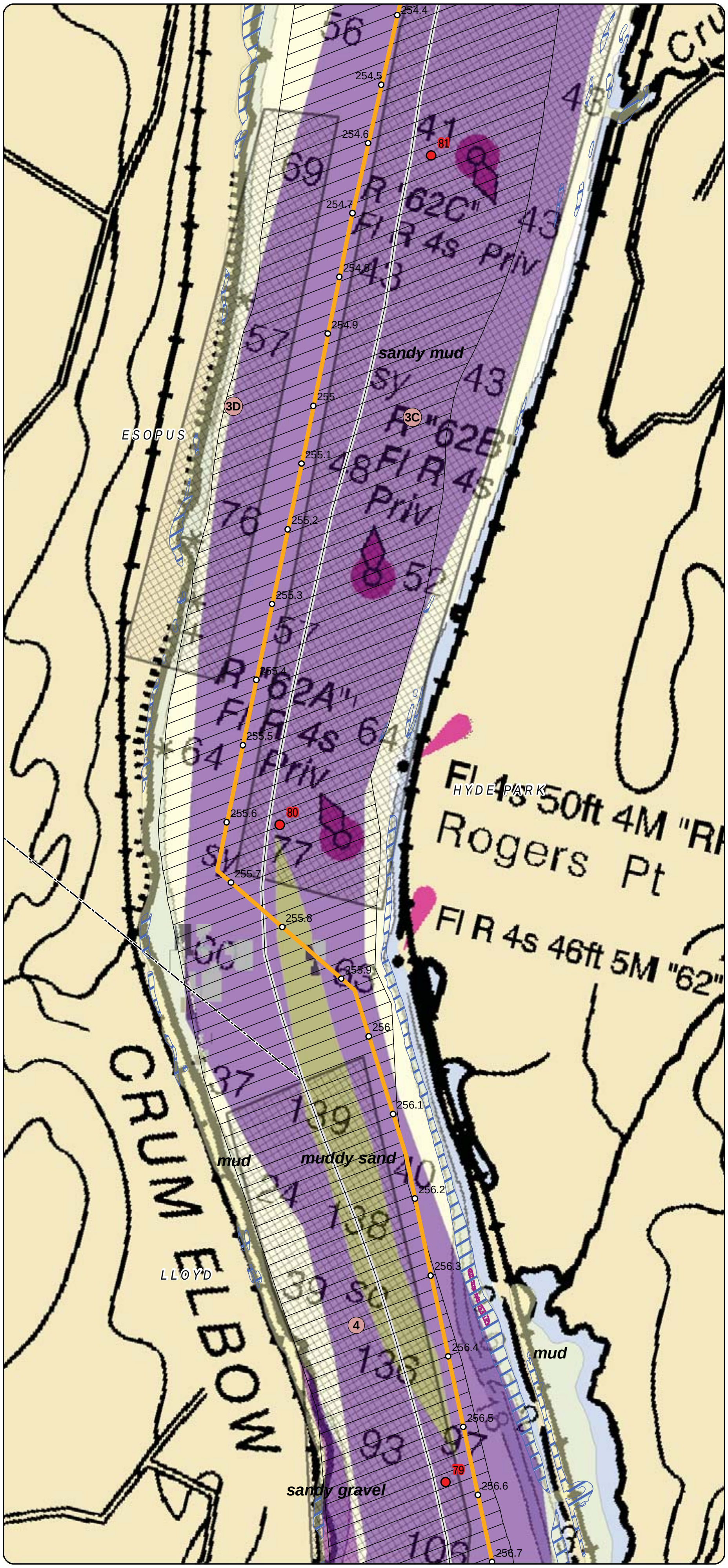
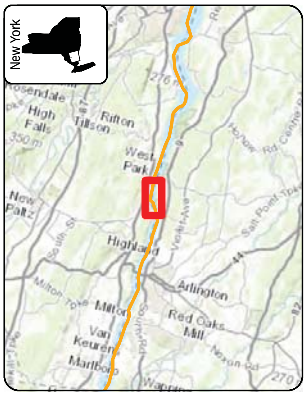
DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

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





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

N

0 750

Feet

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 13 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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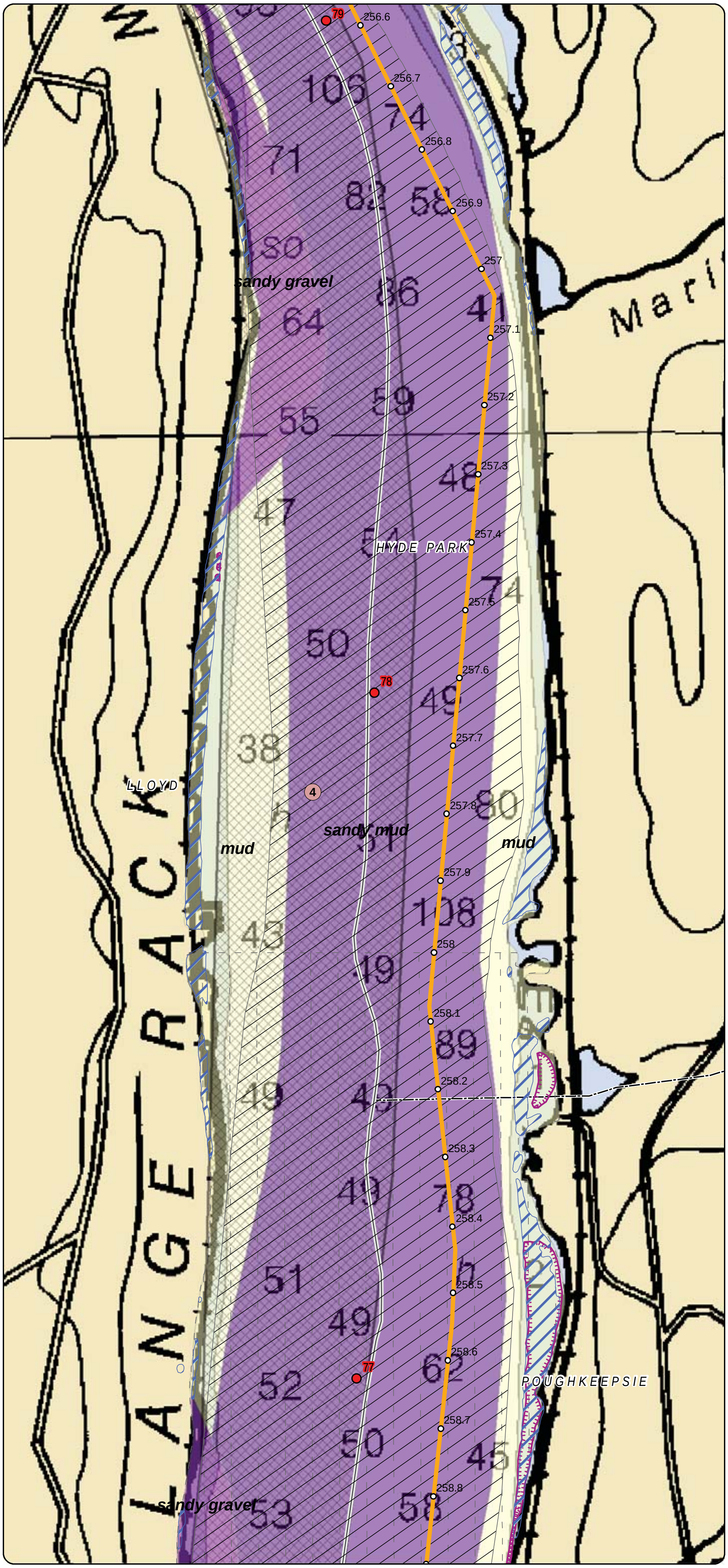

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 14 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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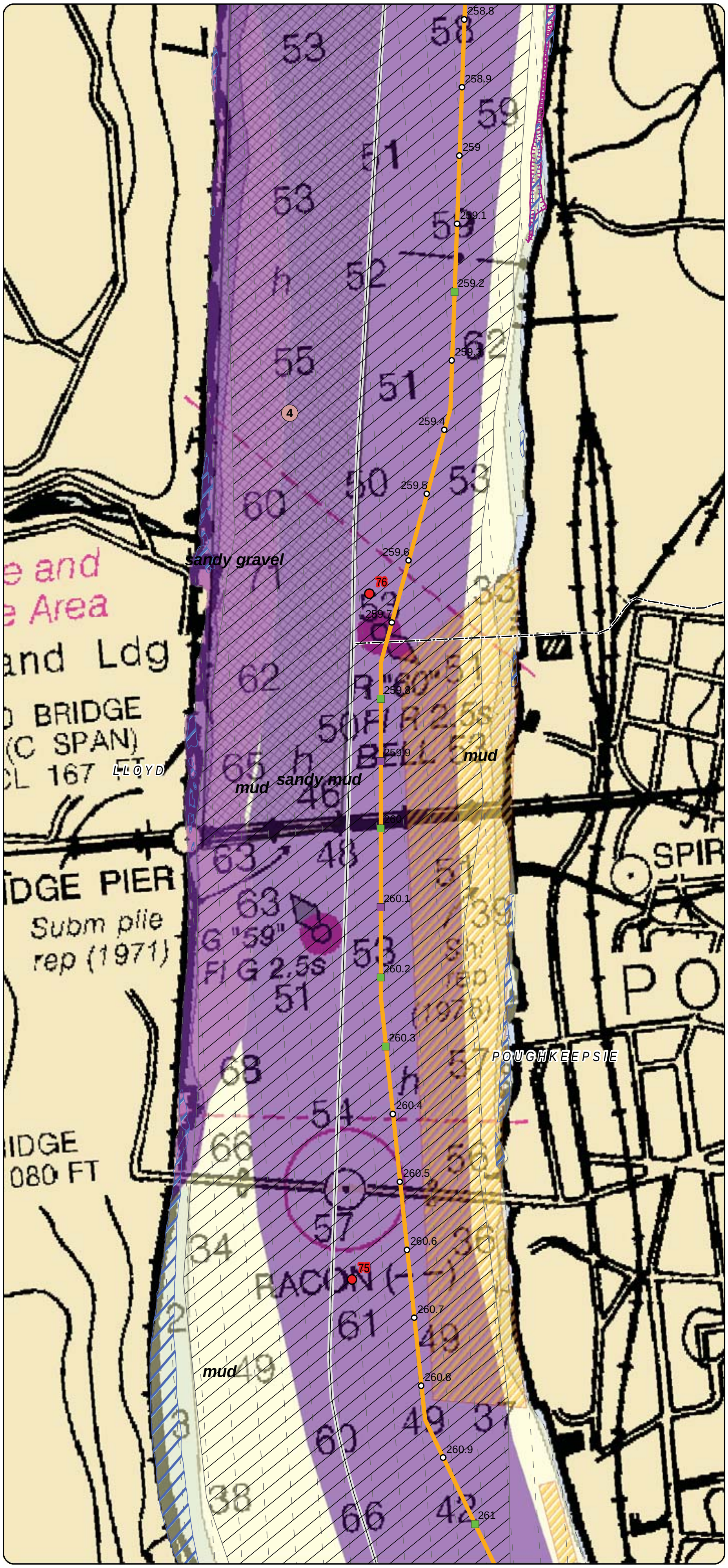

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 15 of 43

Created: 6/18/2014

by: HDR | TETRA & 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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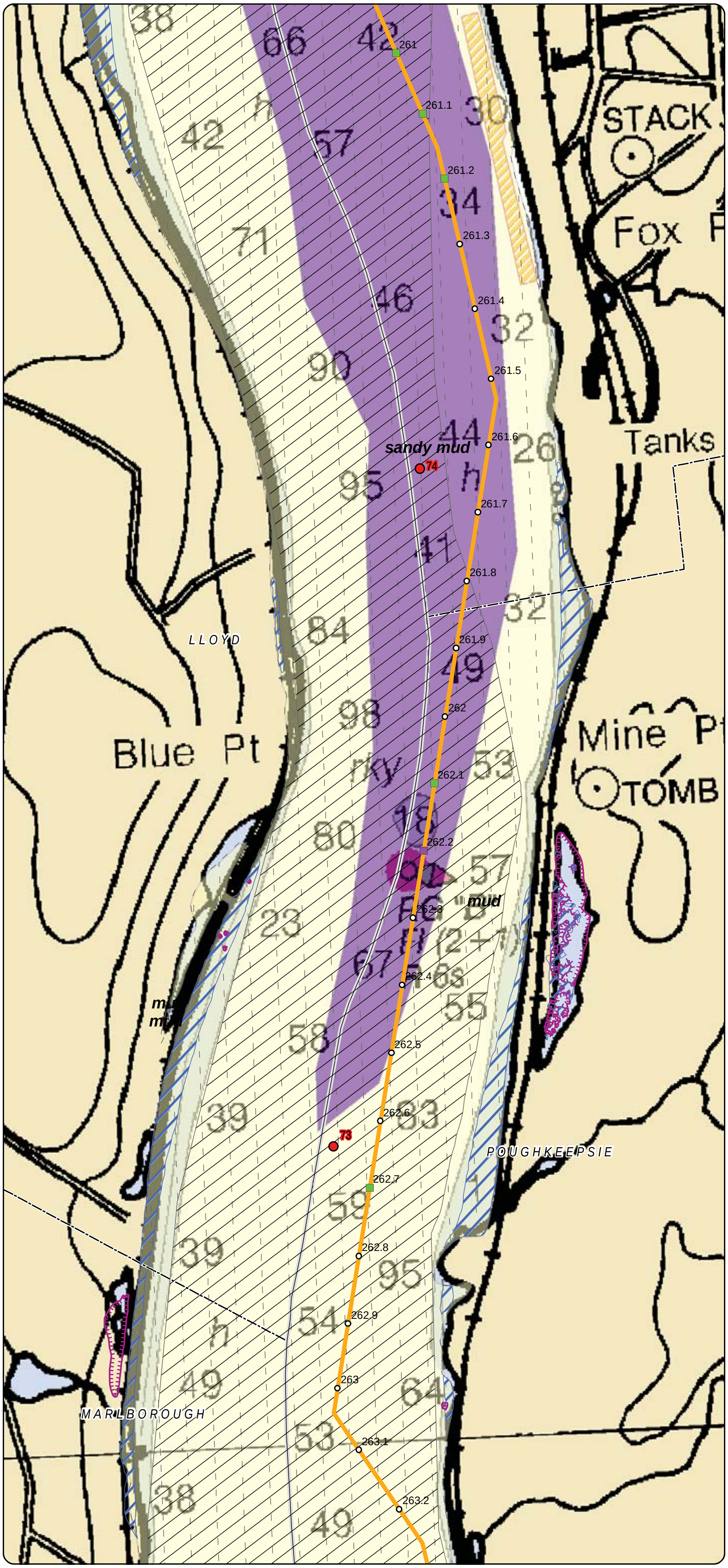

LEGEND

- ● 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 16 of 43

Created: 6/18/2014

by: HDR | TDA & 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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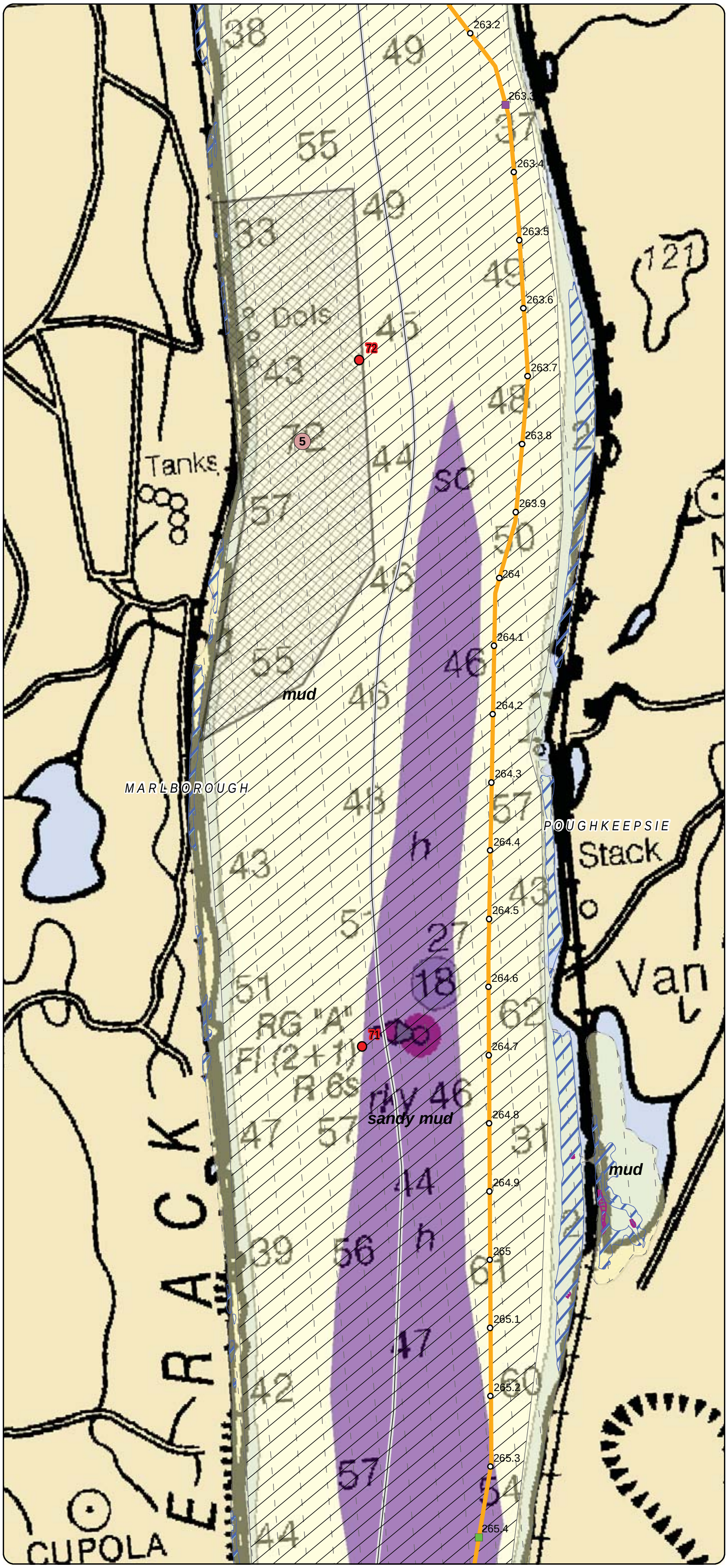

LEGEND

- ● 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 17 of 43

Created: 6/18/2014

by: HDR | TETRA TECH & 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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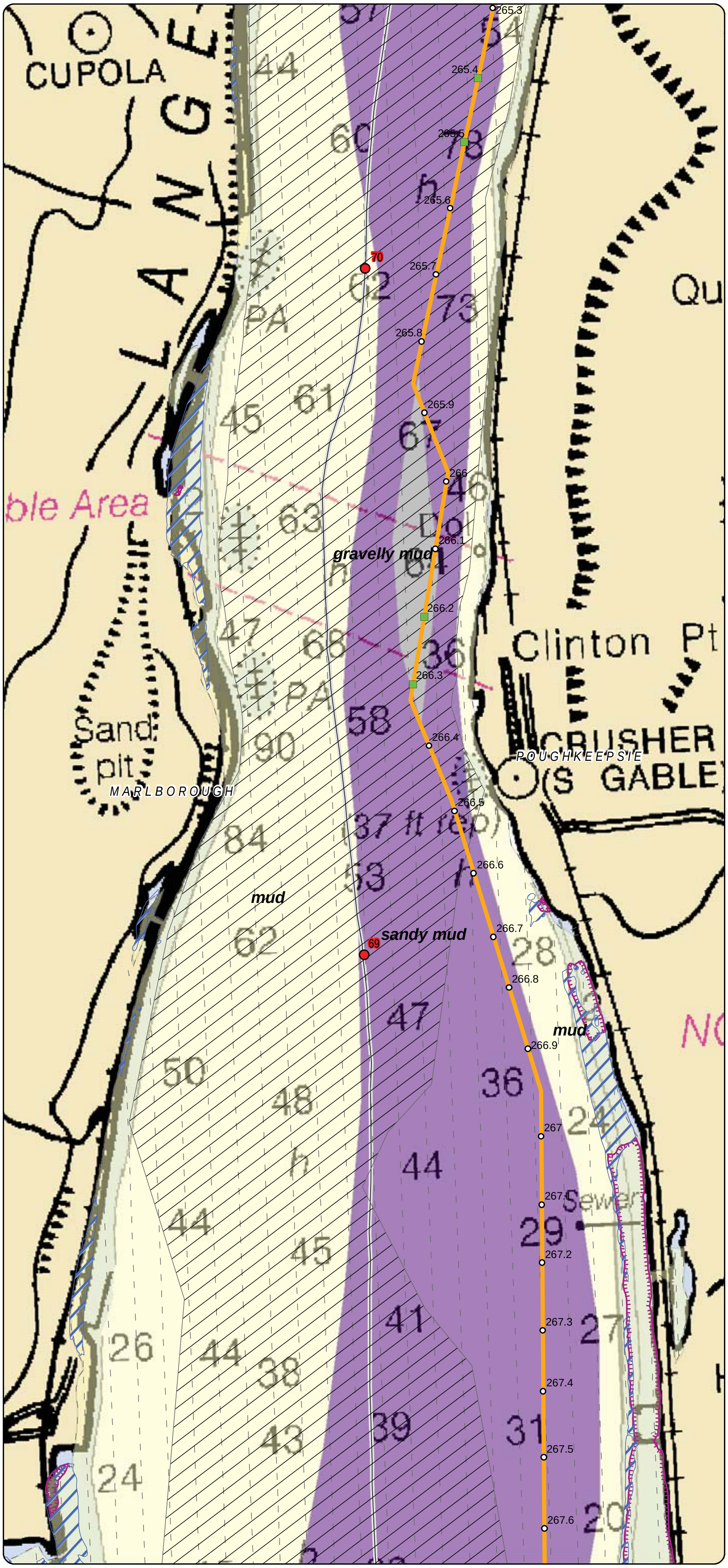

LEGEND

- ● 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 18 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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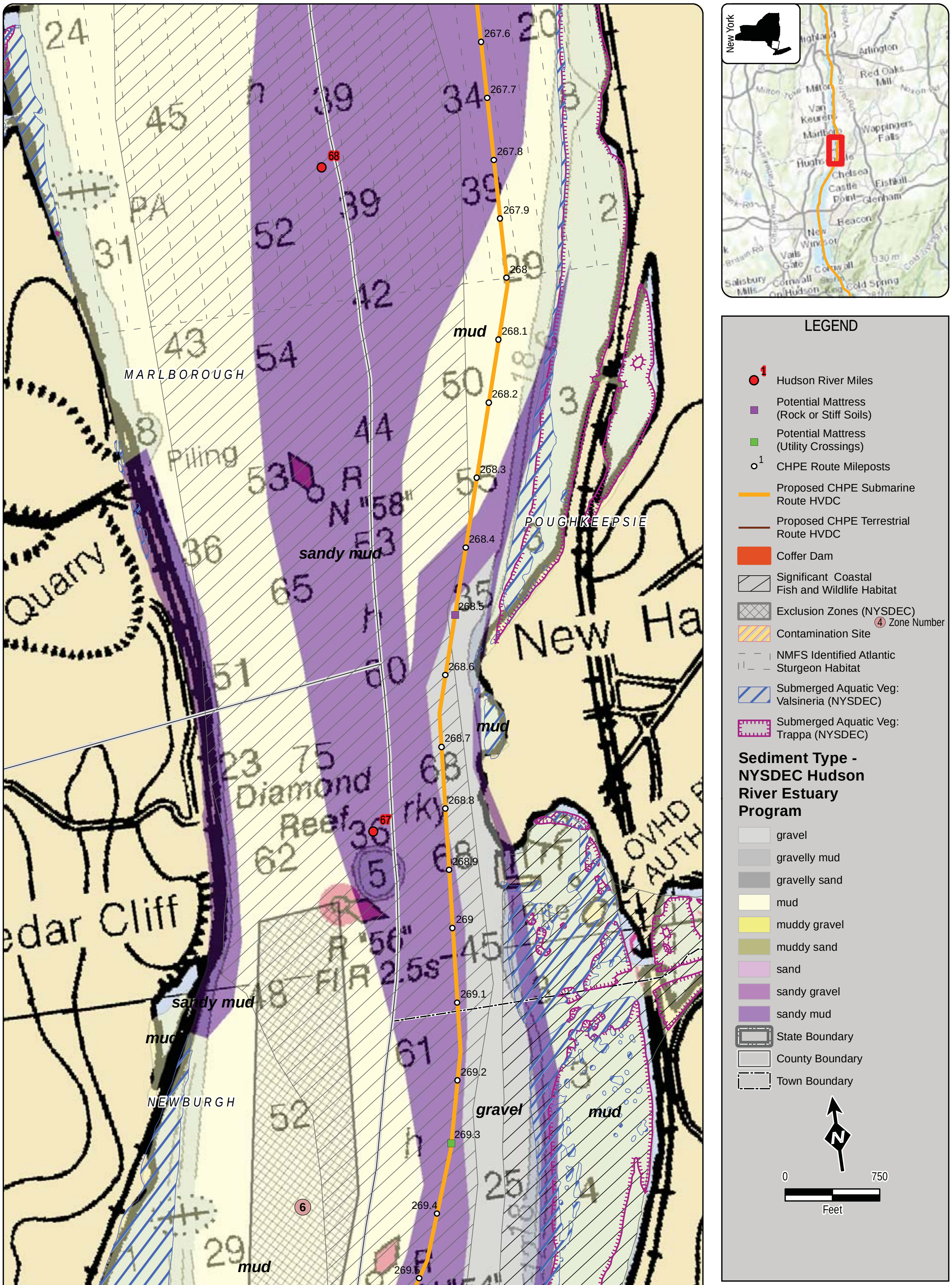

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 19 of 43

Created: 6/18/2014

by: HDR | [illegible] & 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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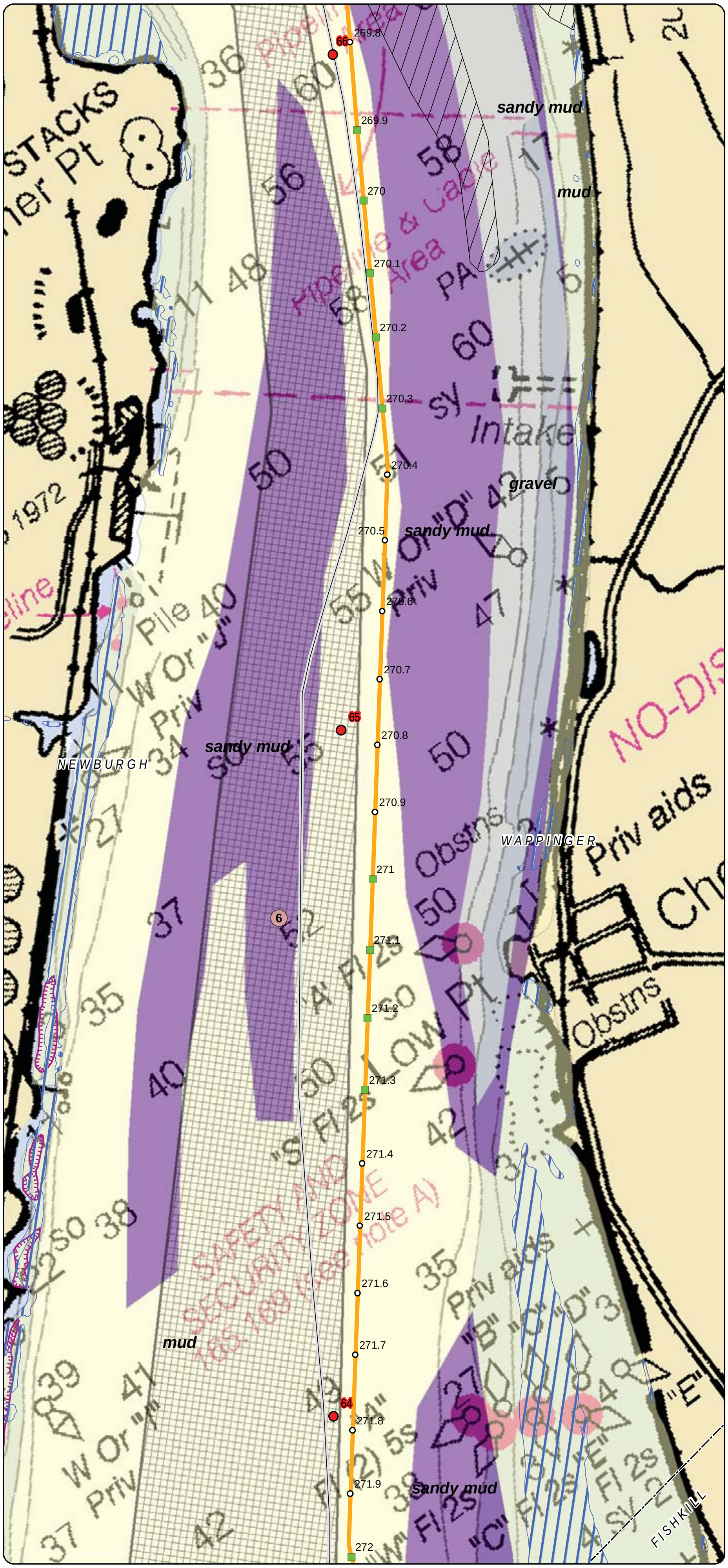

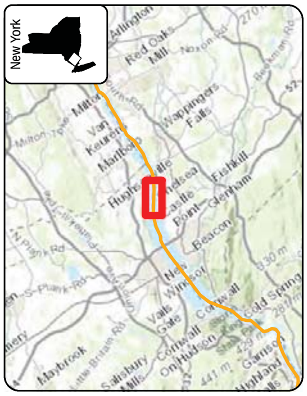

LEGEND

- ● 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 20 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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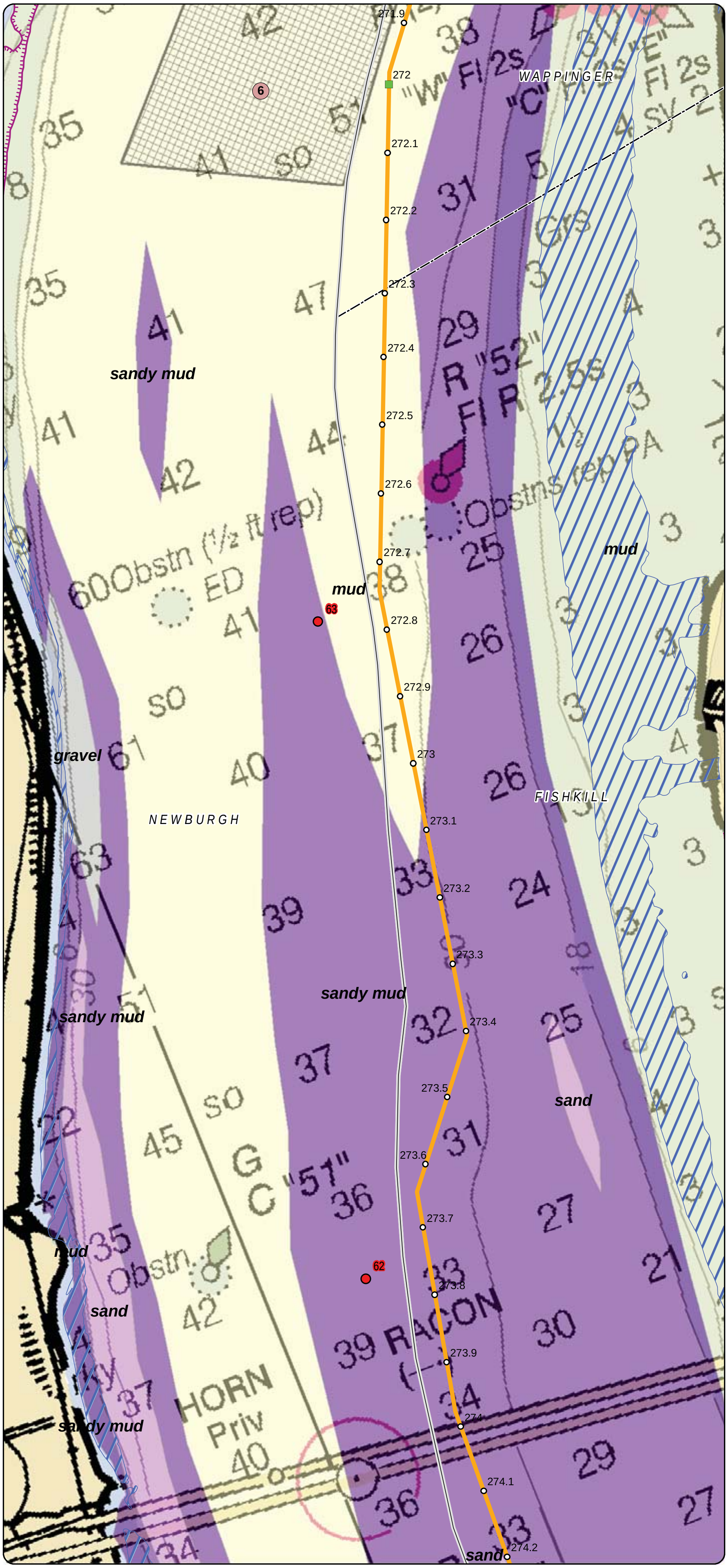

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 21 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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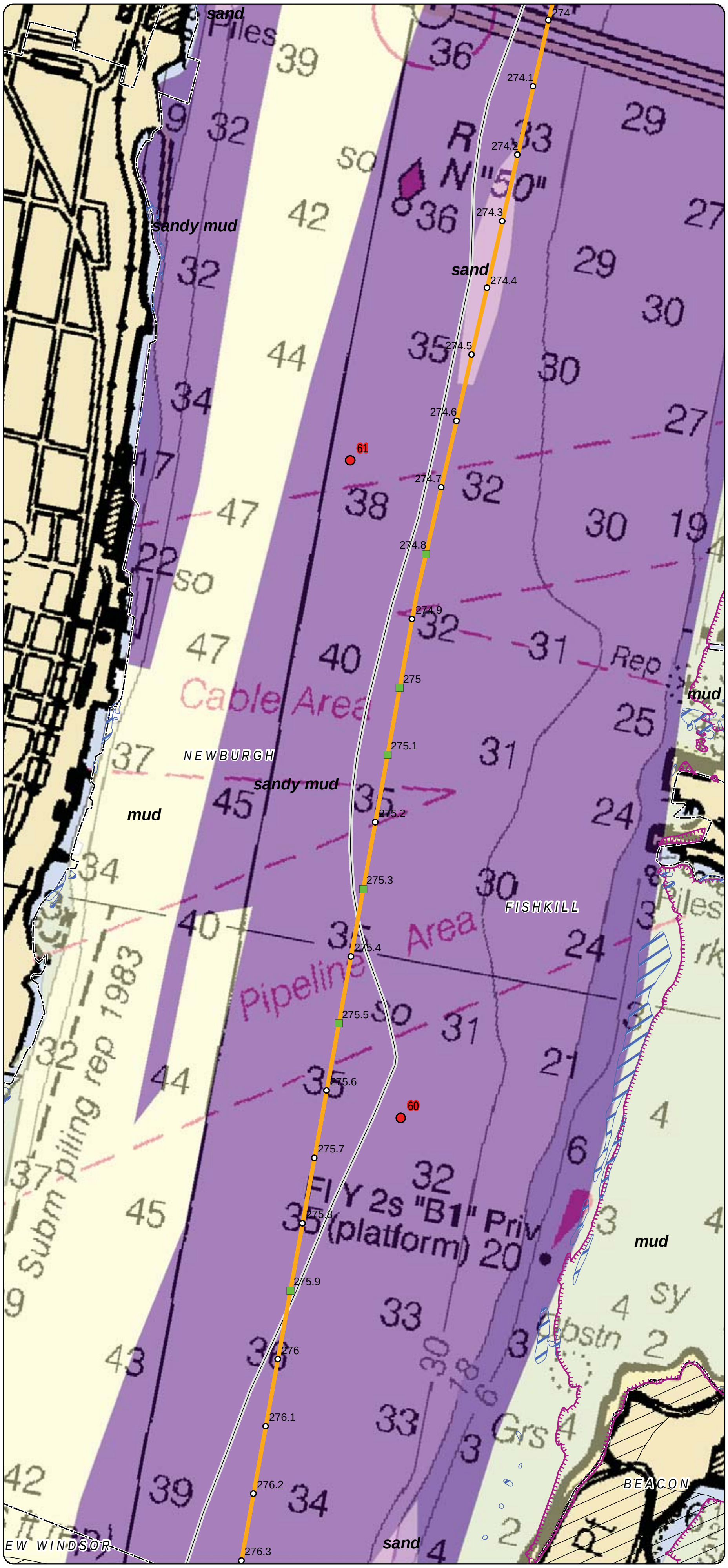

LEGEND

- 🔴 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 22 of 43

Created: 6/18/2014

by: HDR | ESS & 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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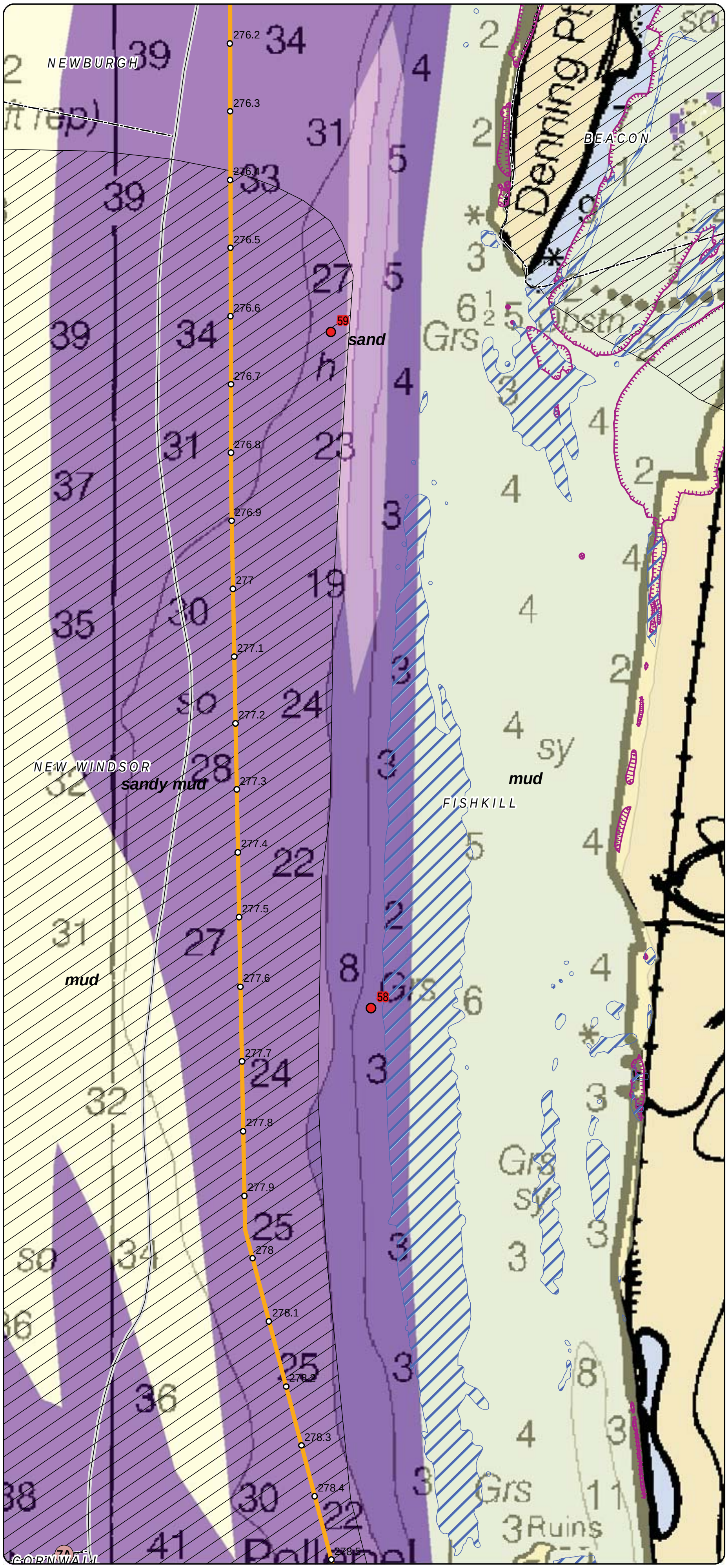

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 23 of 43

Created: 6/18/2014

by: HDR & TRC

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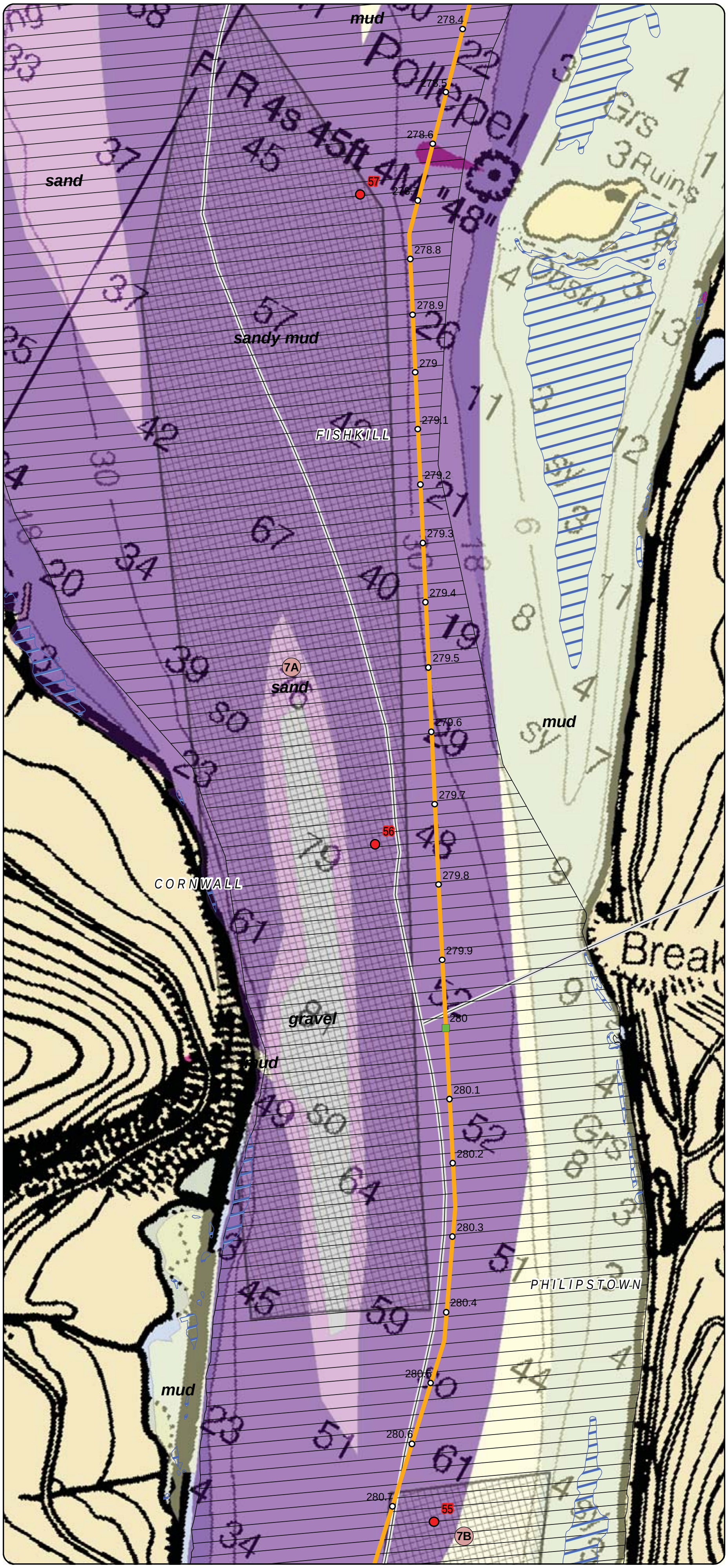
DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

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



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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 24 of 43

Created: 6/18/2014

by: HDR | TRC & 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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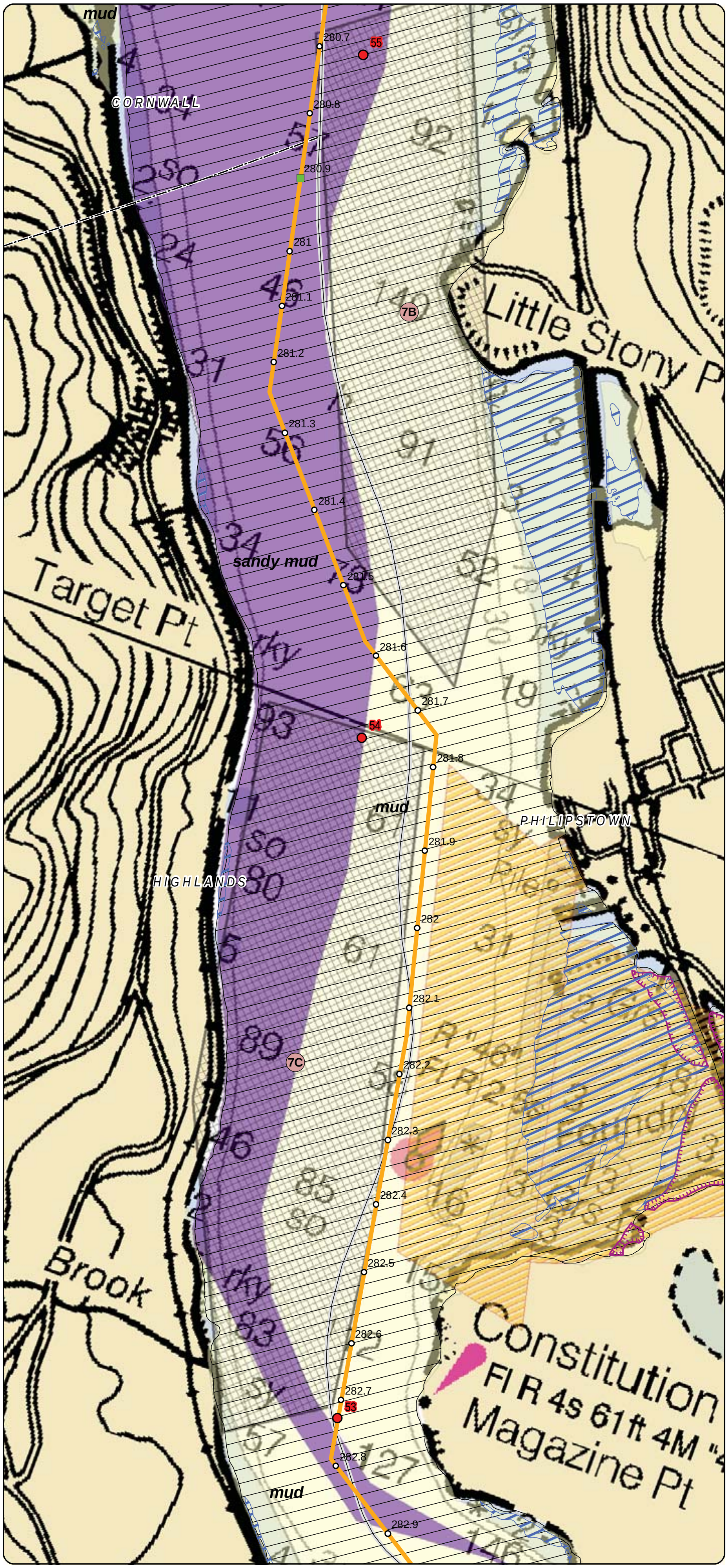

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 25 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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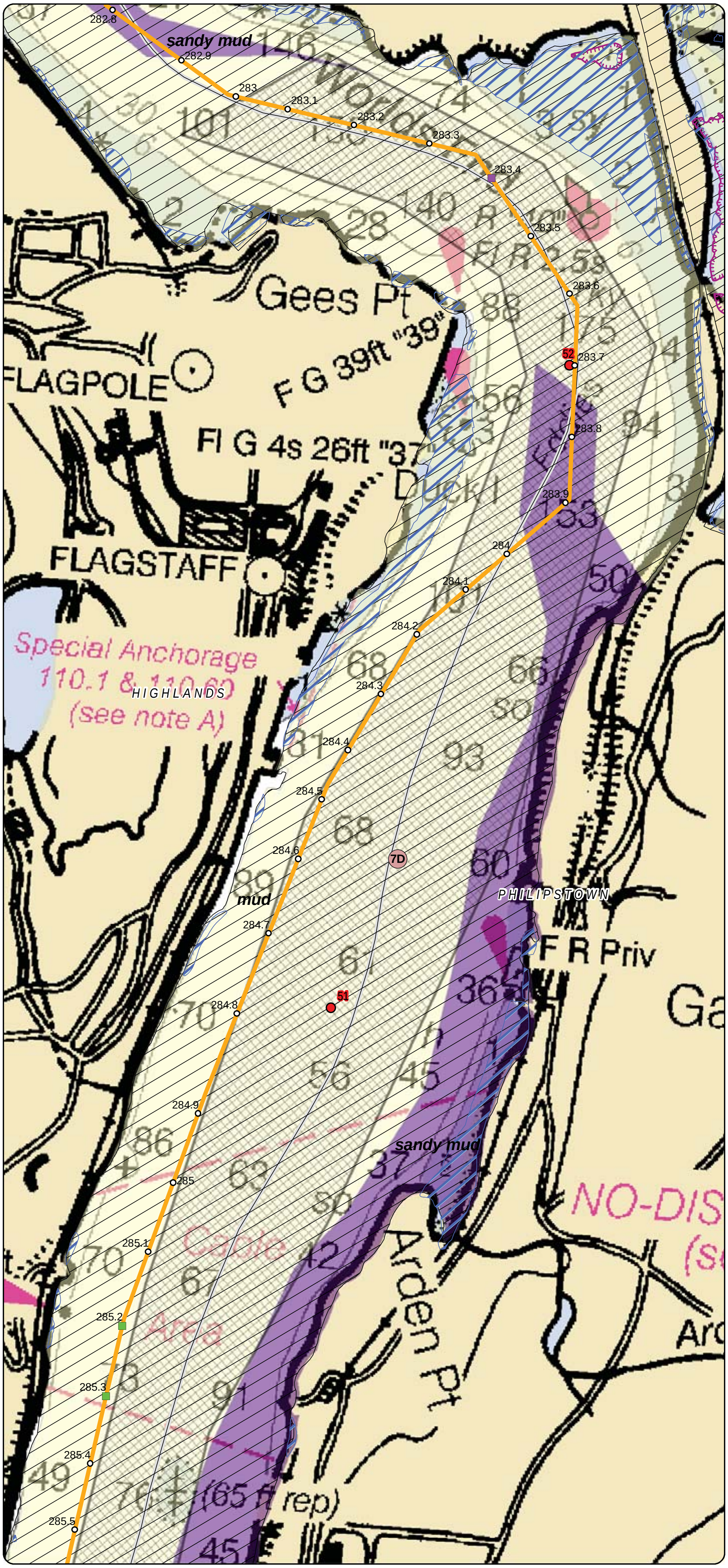

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 26 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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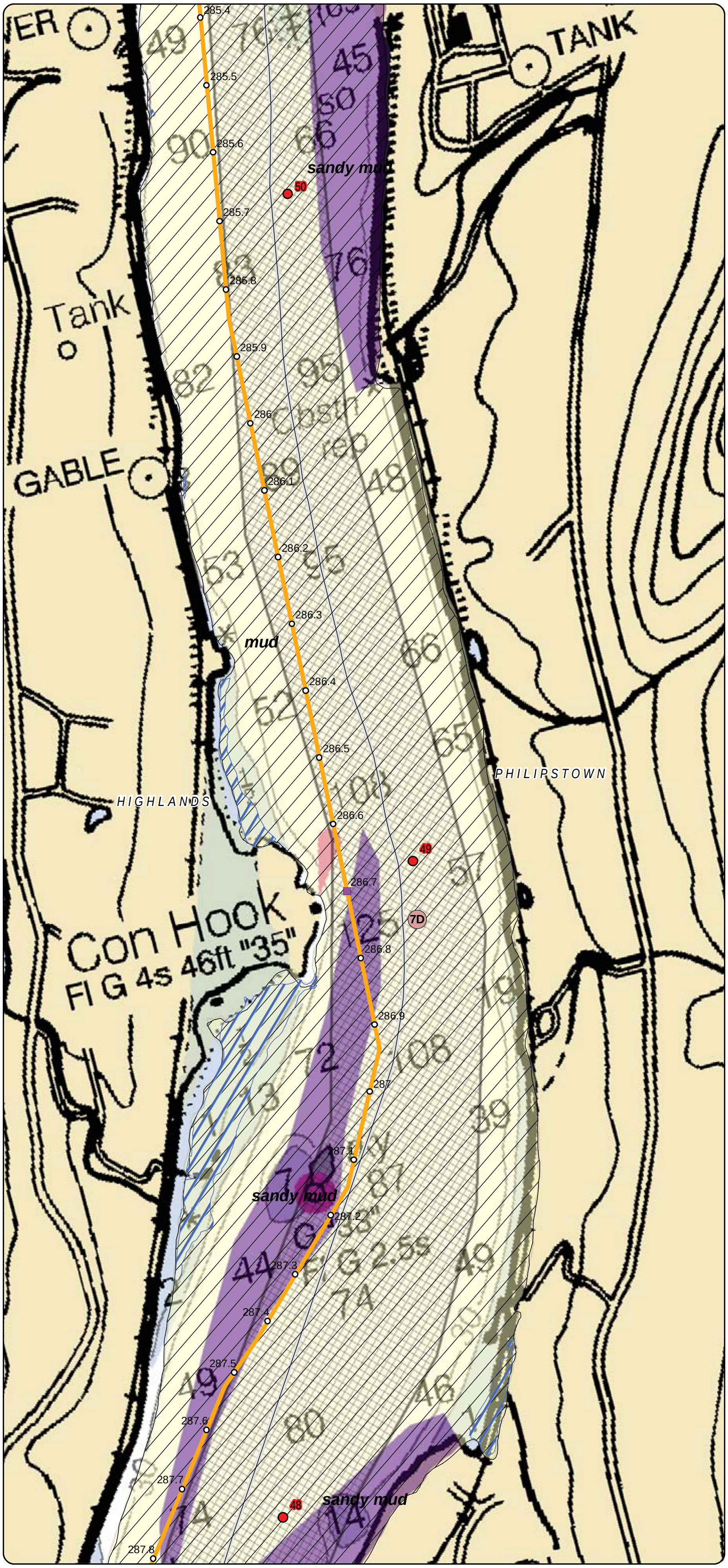

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 27 of 43

Created: 6/18/2014

by: HDR TRC & 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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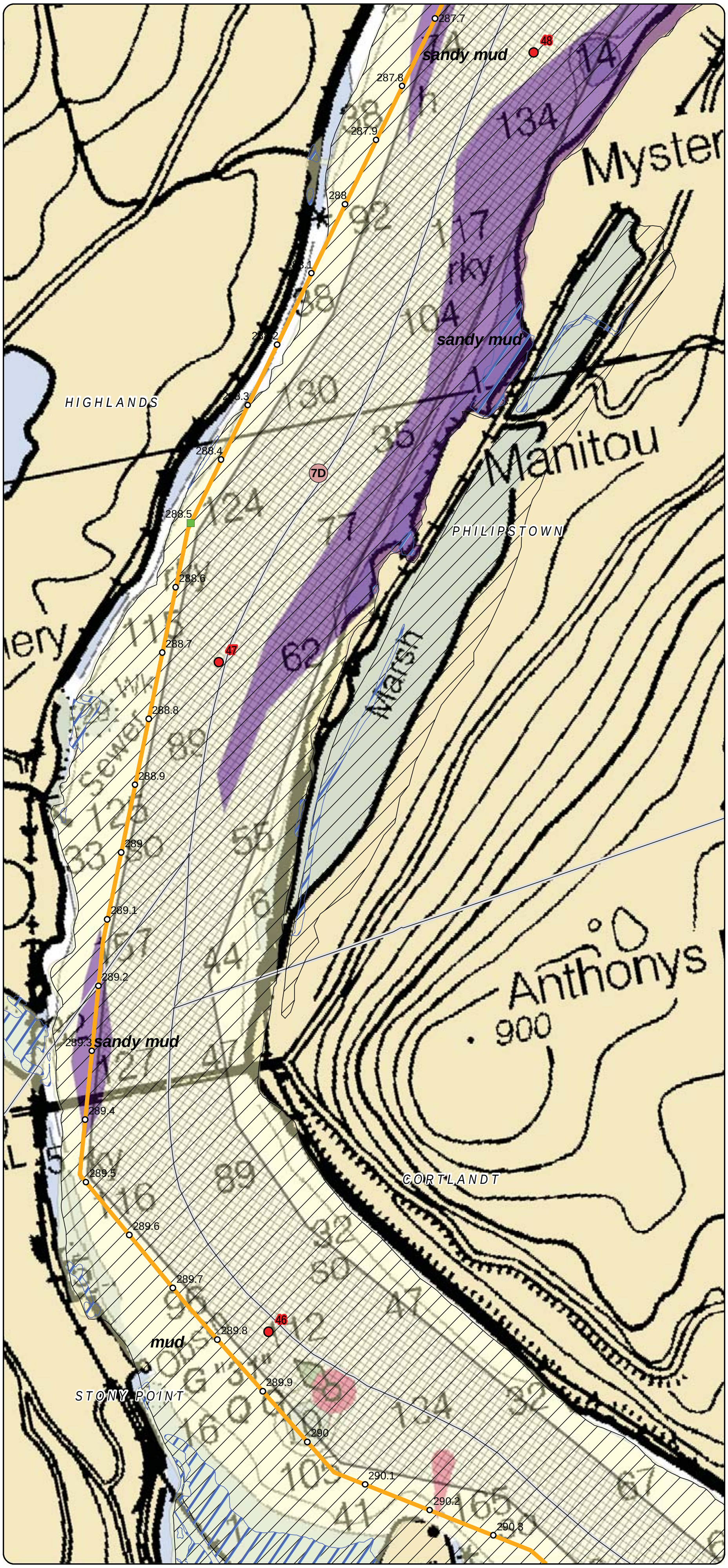

LEGEND

- ● 1 Hudson River Miles
- 🟪 Potential Mattress (Rock or Stiff Soils)
- 🟩 Potential Mattress (Utility Crossings)
- ○ 1 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 28 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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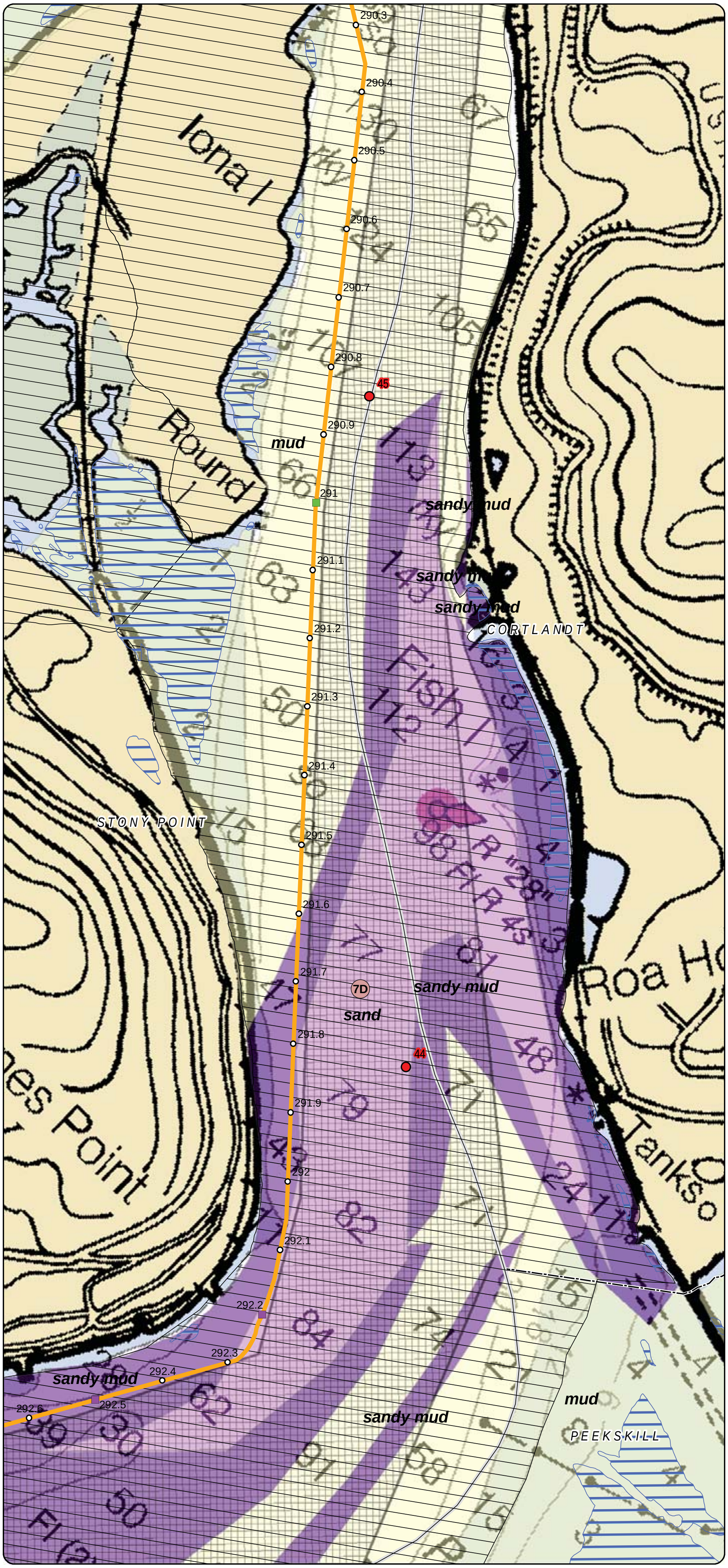

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 29 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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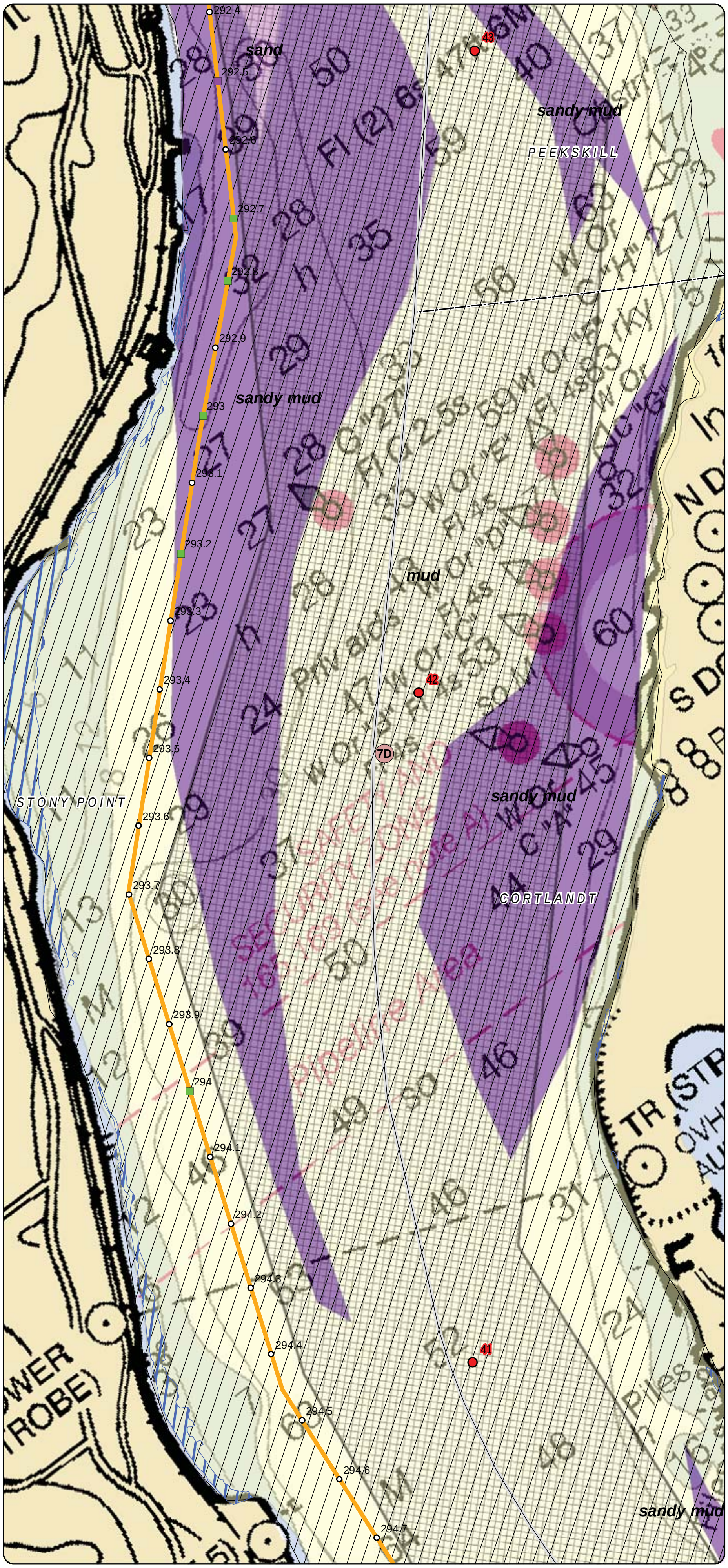

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 30 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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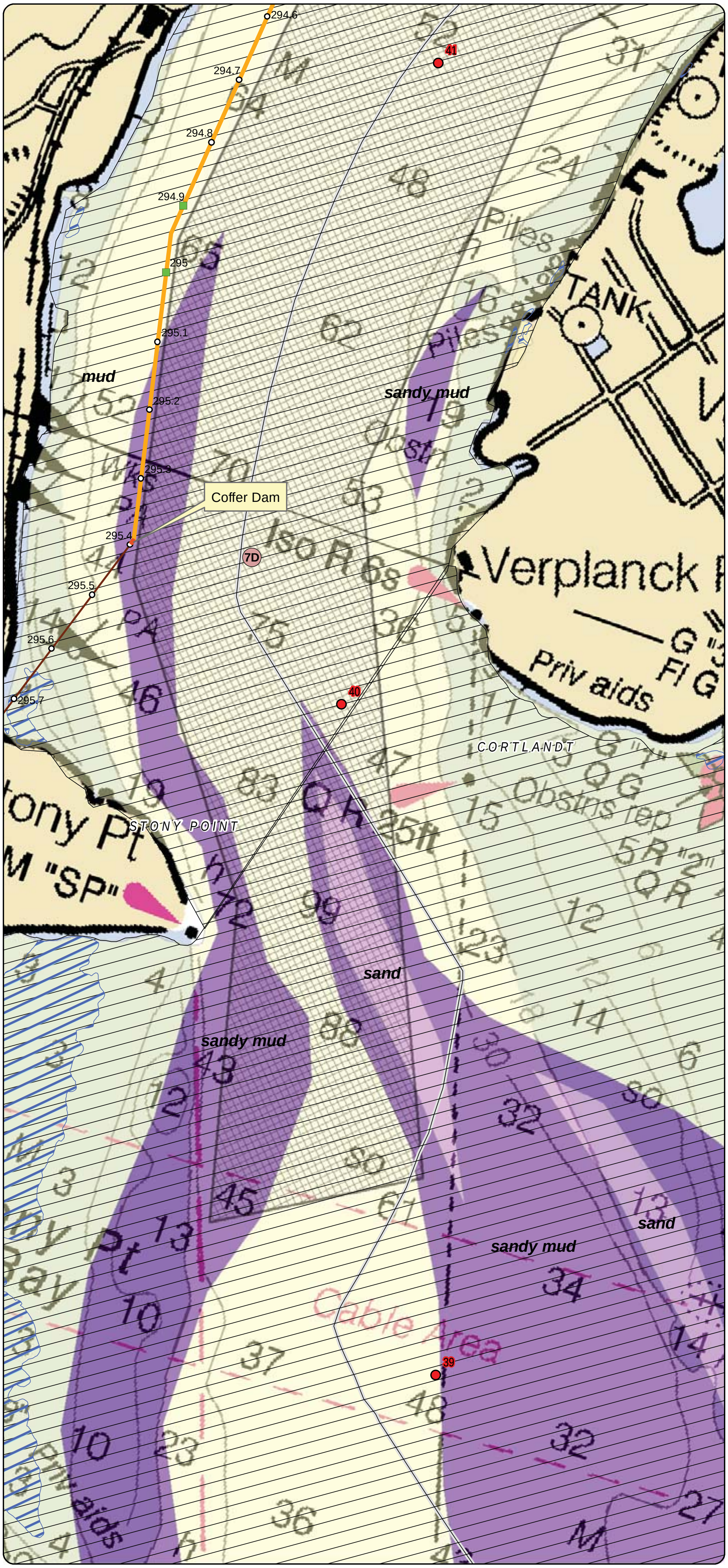

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 31 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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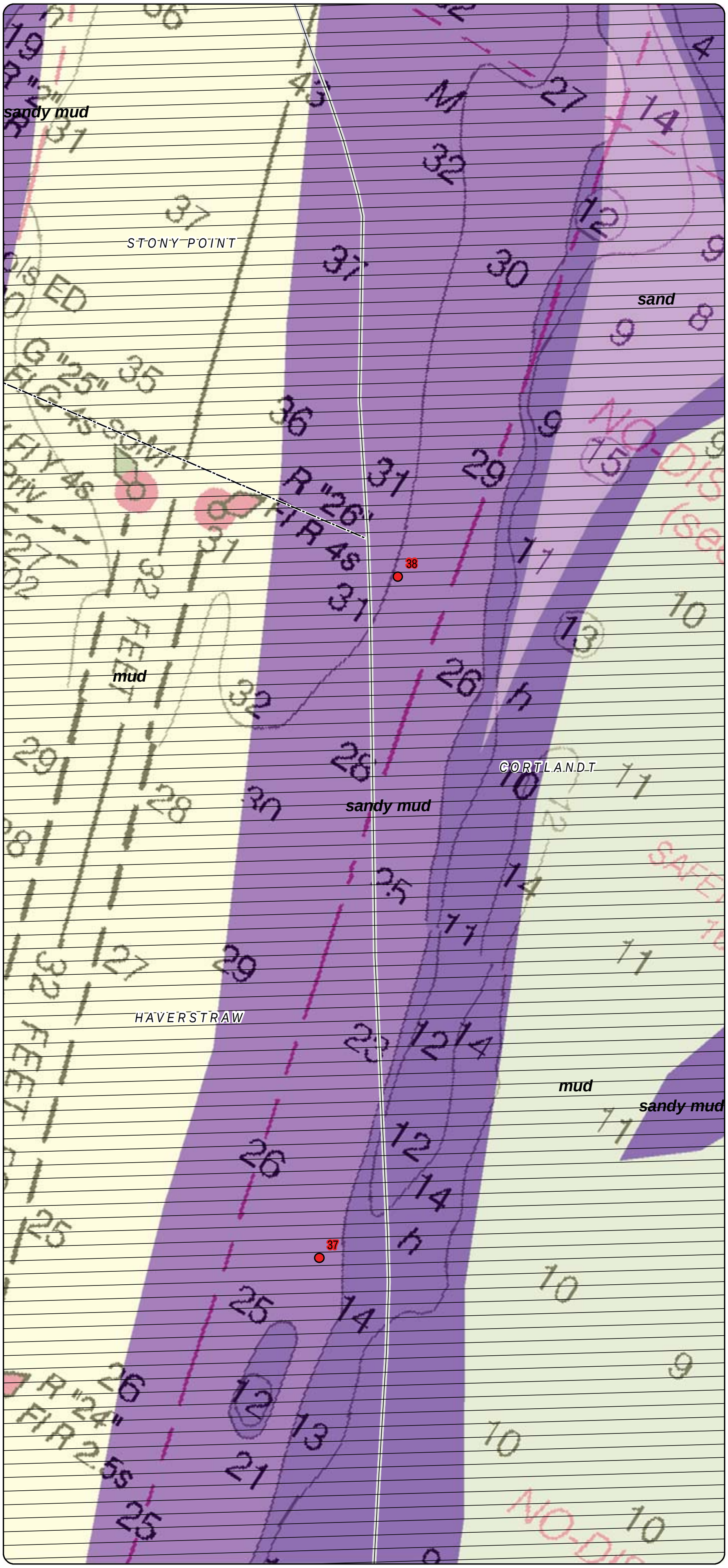

LEGEND

- ● 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

N

0 750

Feet

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 32 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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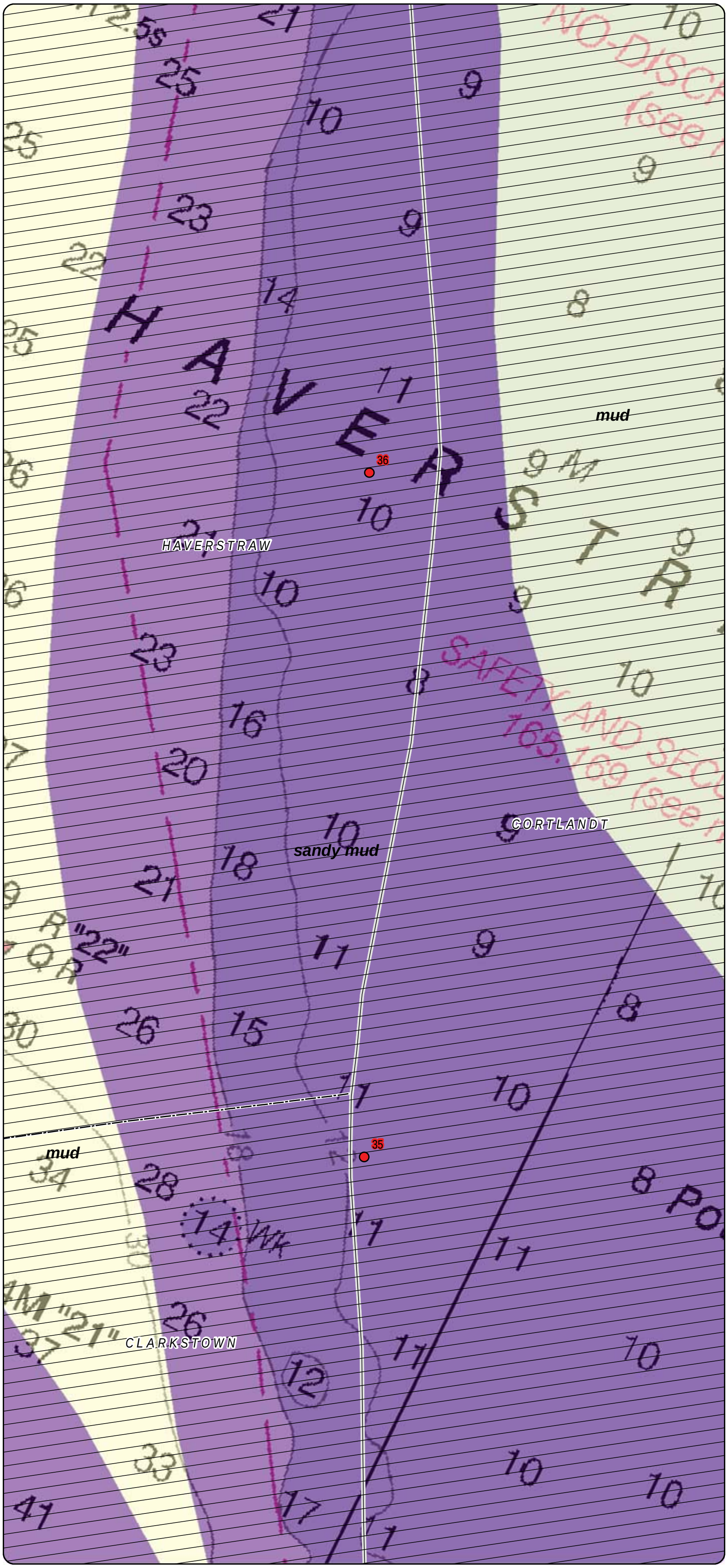
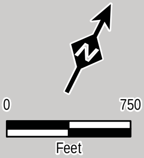


LEGEND

- ● 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



Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 33 of 43

Created: 6/18/2014

by: HDR | [illegible] & 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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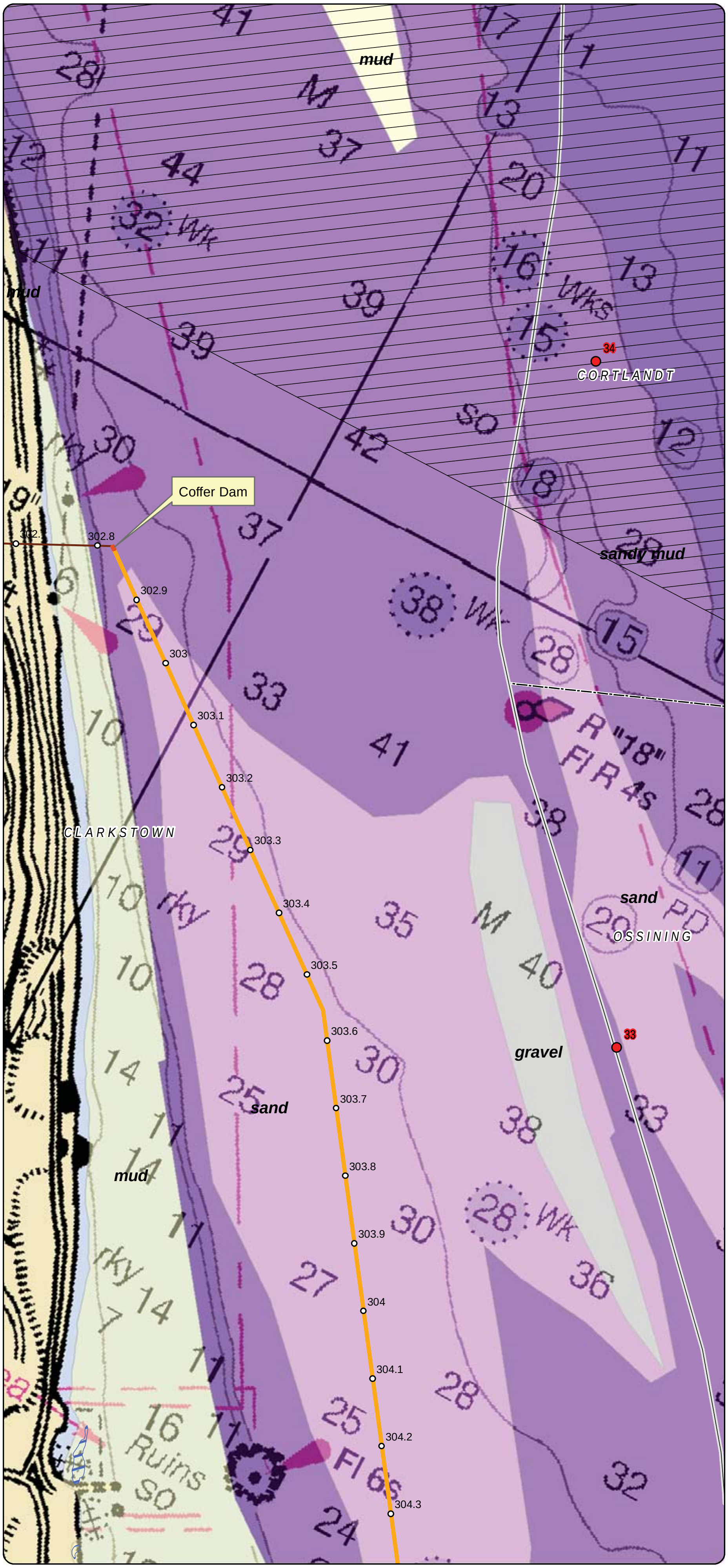

LEGEND

- ● 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 34 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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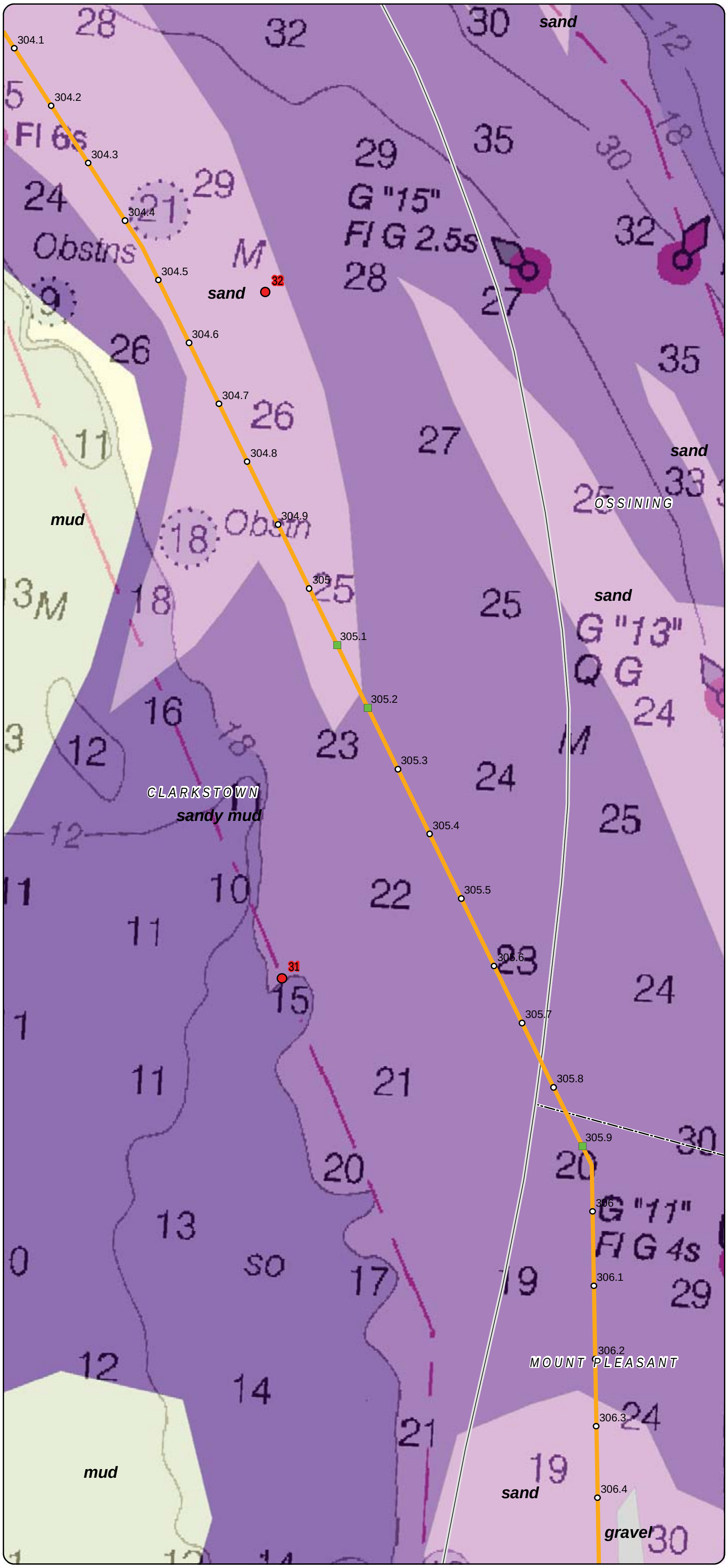

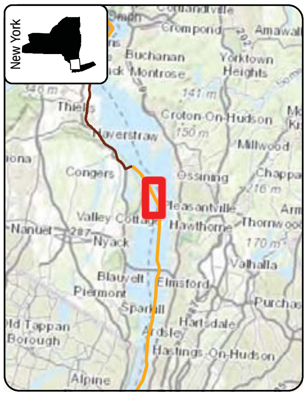

LEGEND

● 1	Hudson River Miles
■	Potential Mattress (Rock or Stiff Soils)
🟩	Potential Mattress (Utility Crossings)
○ 1	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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 35 of 43

Created: 6/18/2014

by: HDR | TETRA TECH & 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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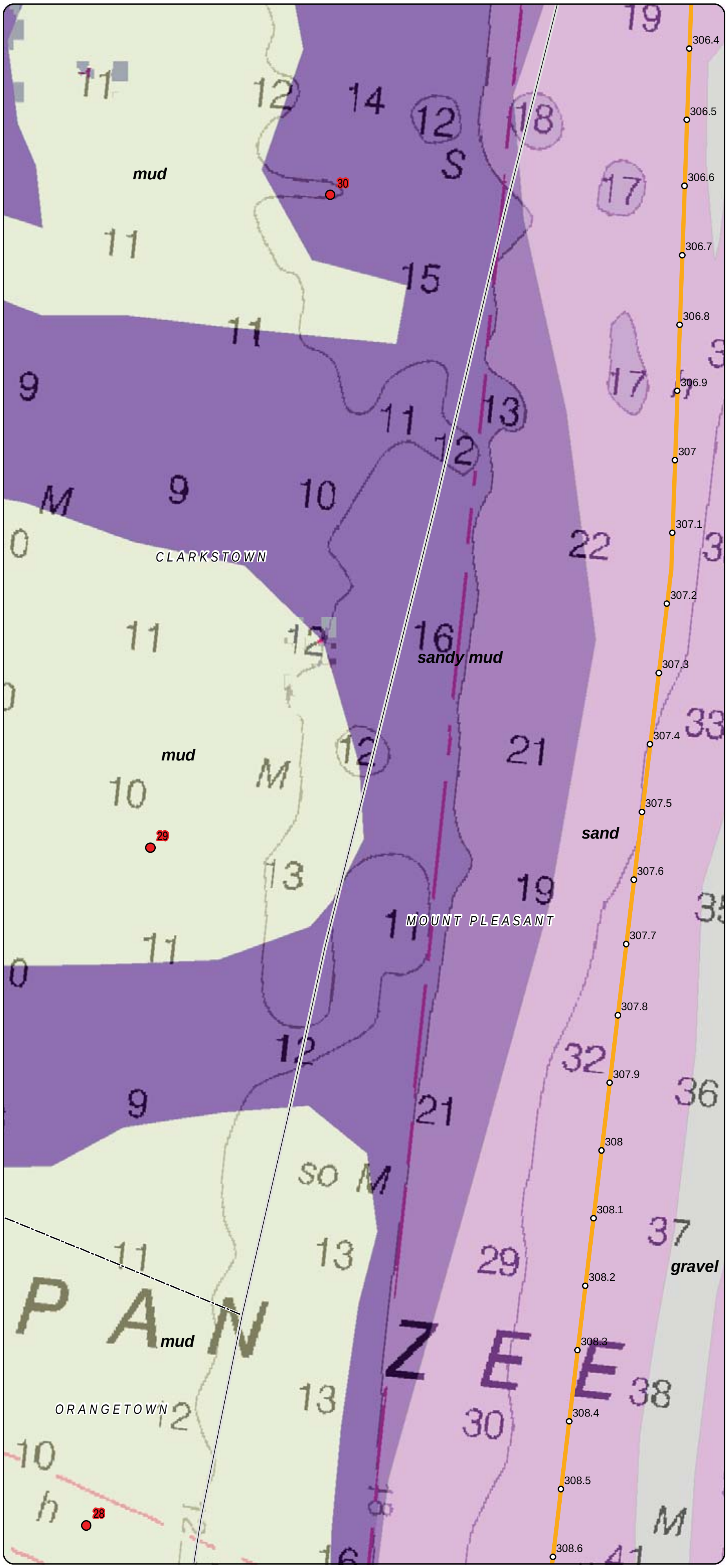

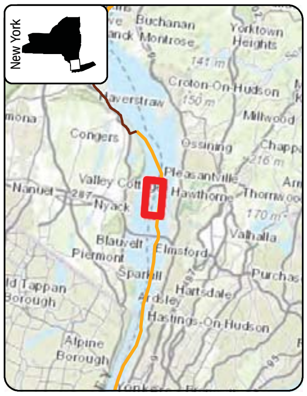

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 36 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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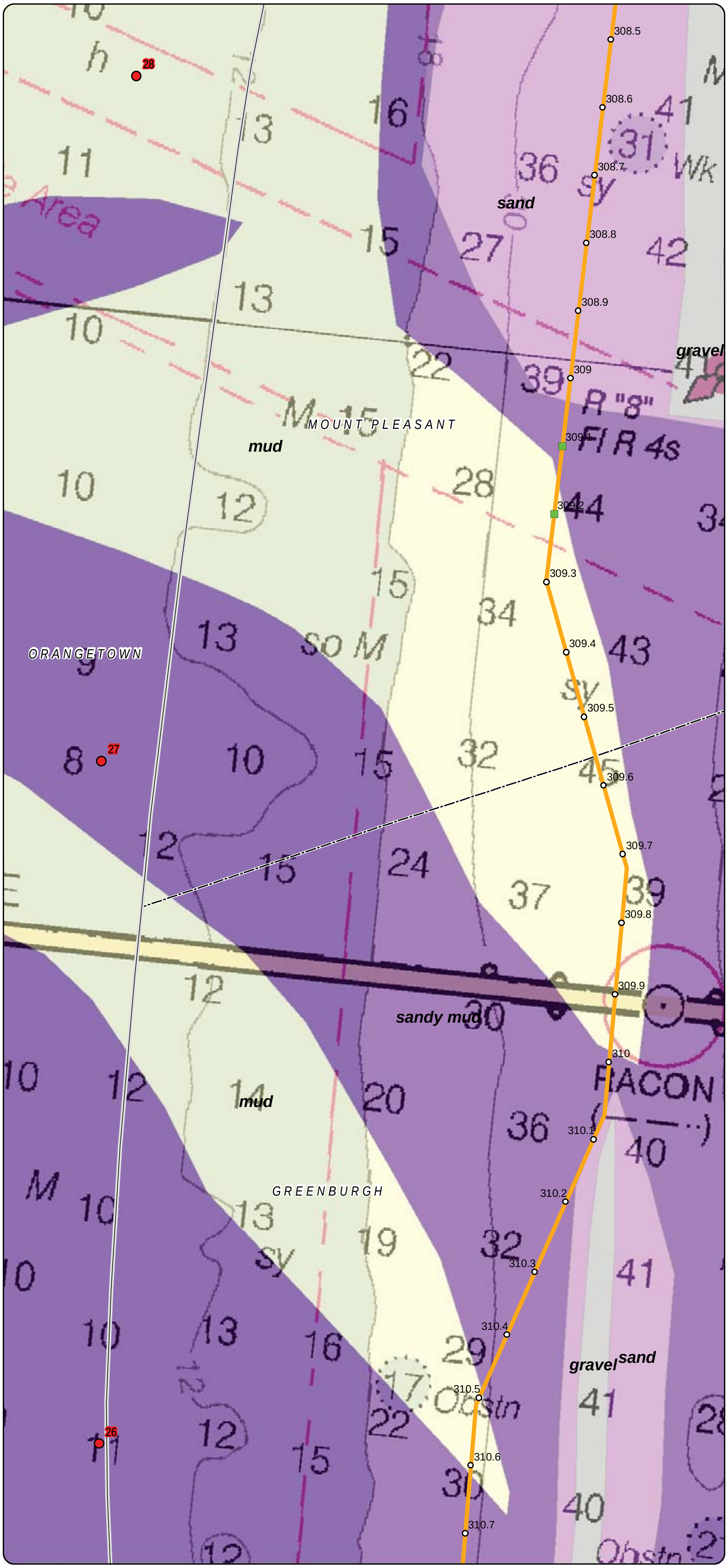

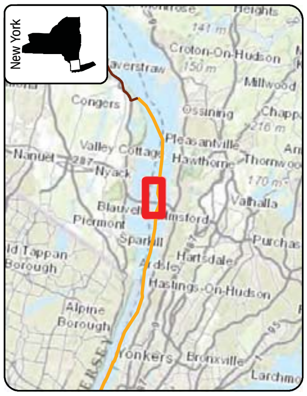

LEGEND

- ● 1 Hudson River Miles
- 🟪 Potential Mattress (Rock or Stiff Soils)
- 🟩 Potential Mattress (Utility Crossings)
- ○ 1 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 37 of 43

Created: 6/18/2014

by: HDR | TETRA & 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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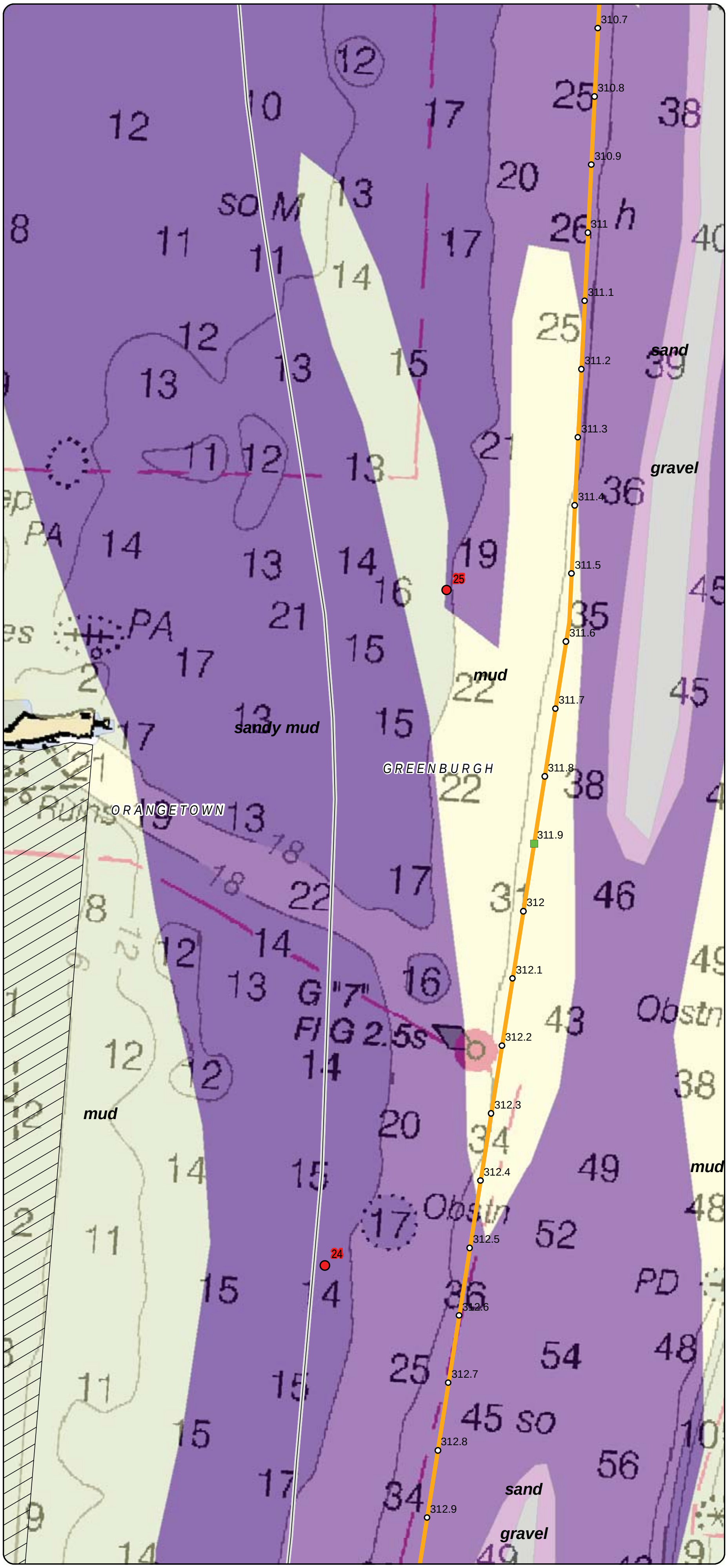

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 38 of 43

Created: 6/18/2014

by: HDR | ETA & 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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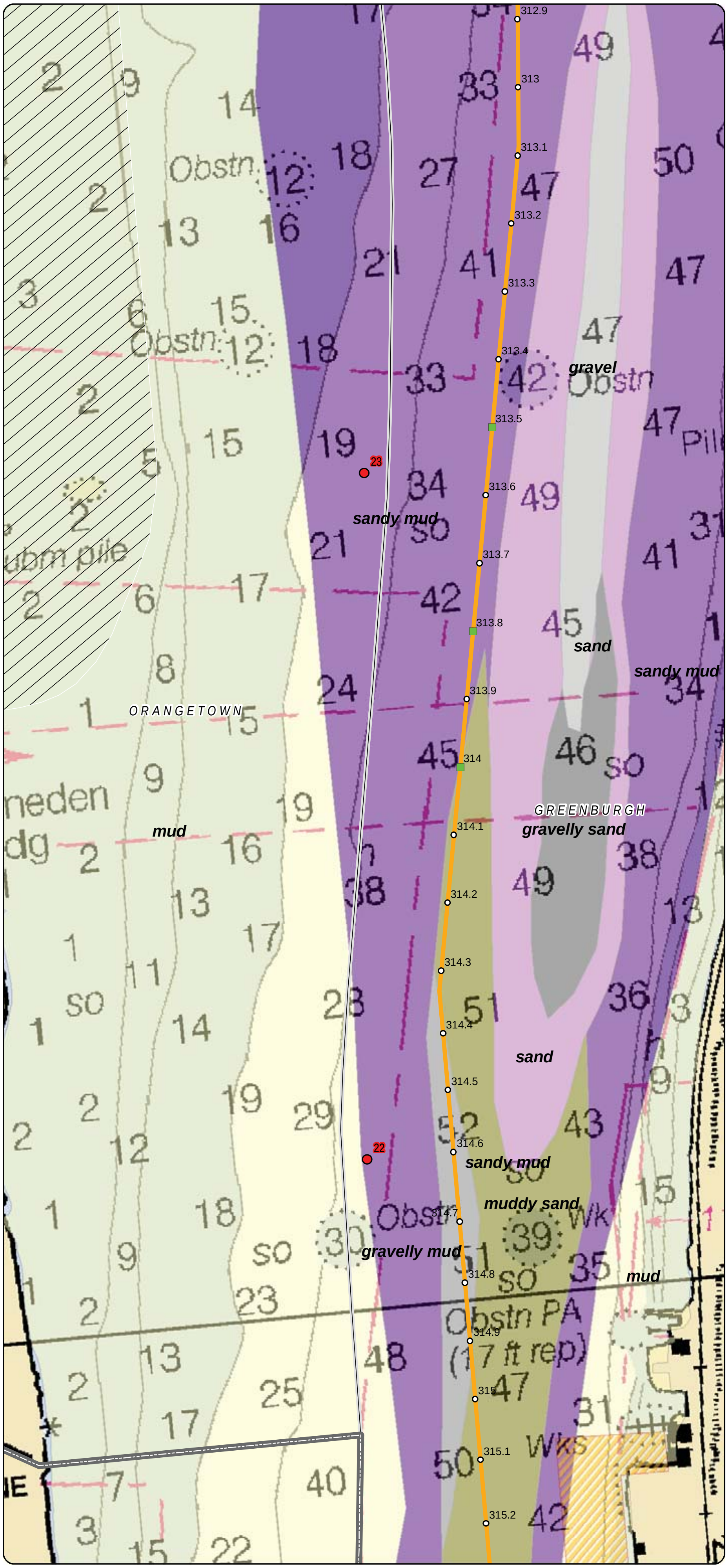

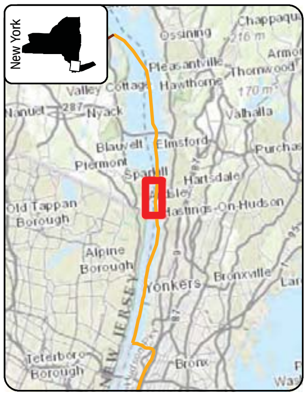

LEGEND

- ● 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

N

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Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 39 of 43

Created: 6/18/2014

by: HDR | DTA & 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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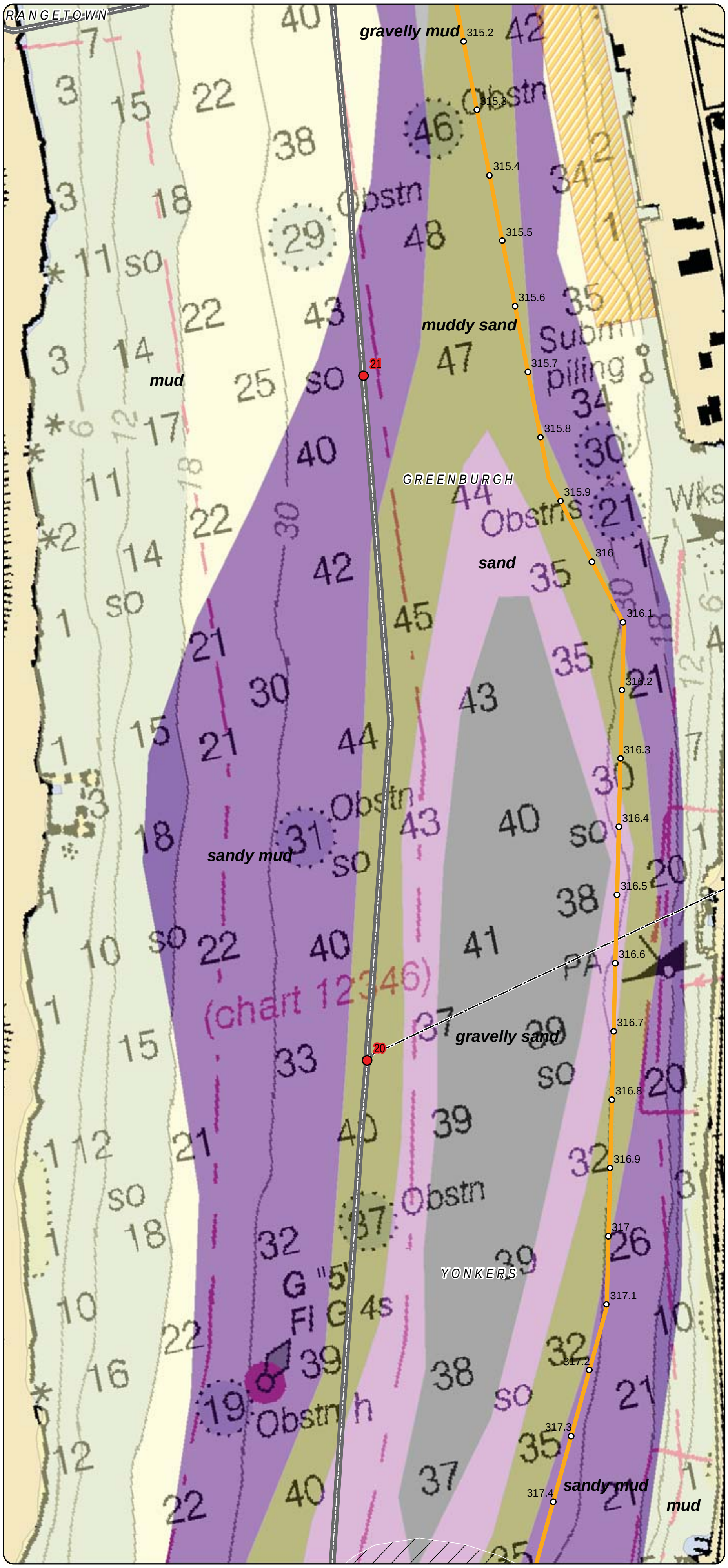

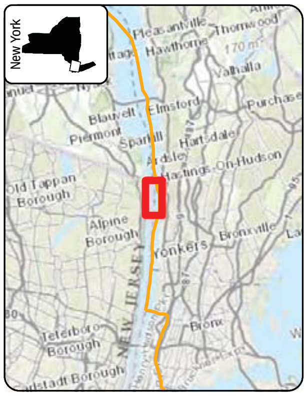

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- ▭ Town Boundary

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Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 40 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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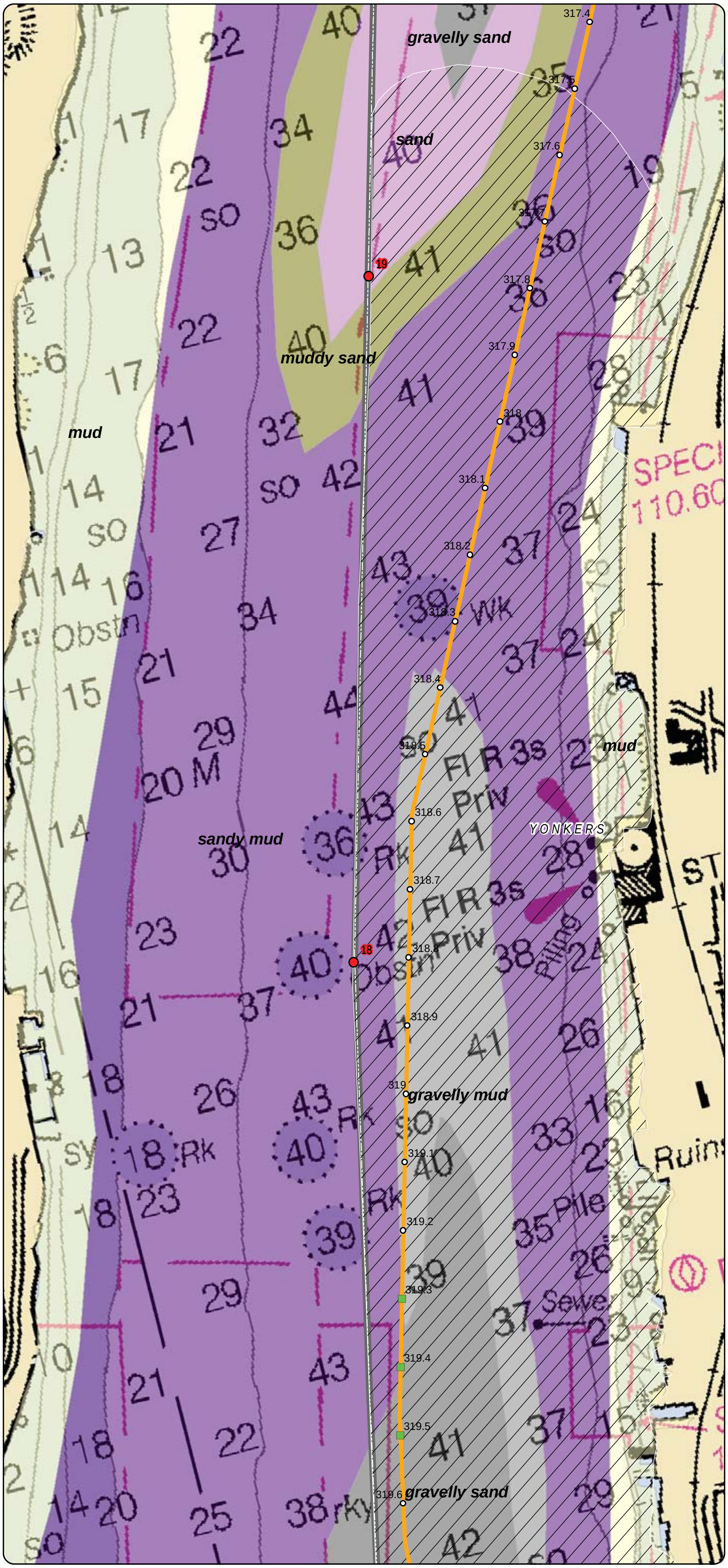

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Sheet 41 of 43

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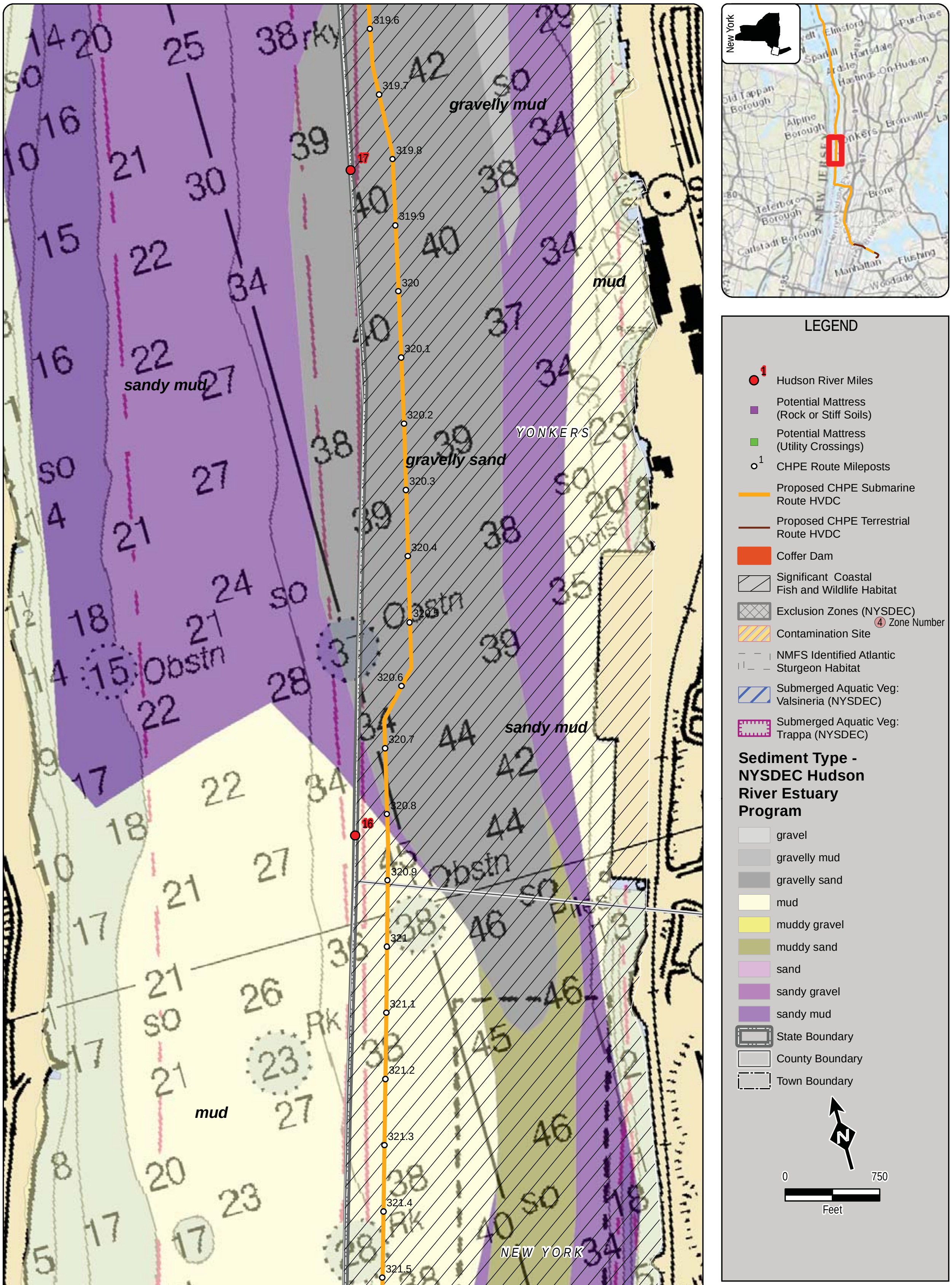

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Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 42 of 43

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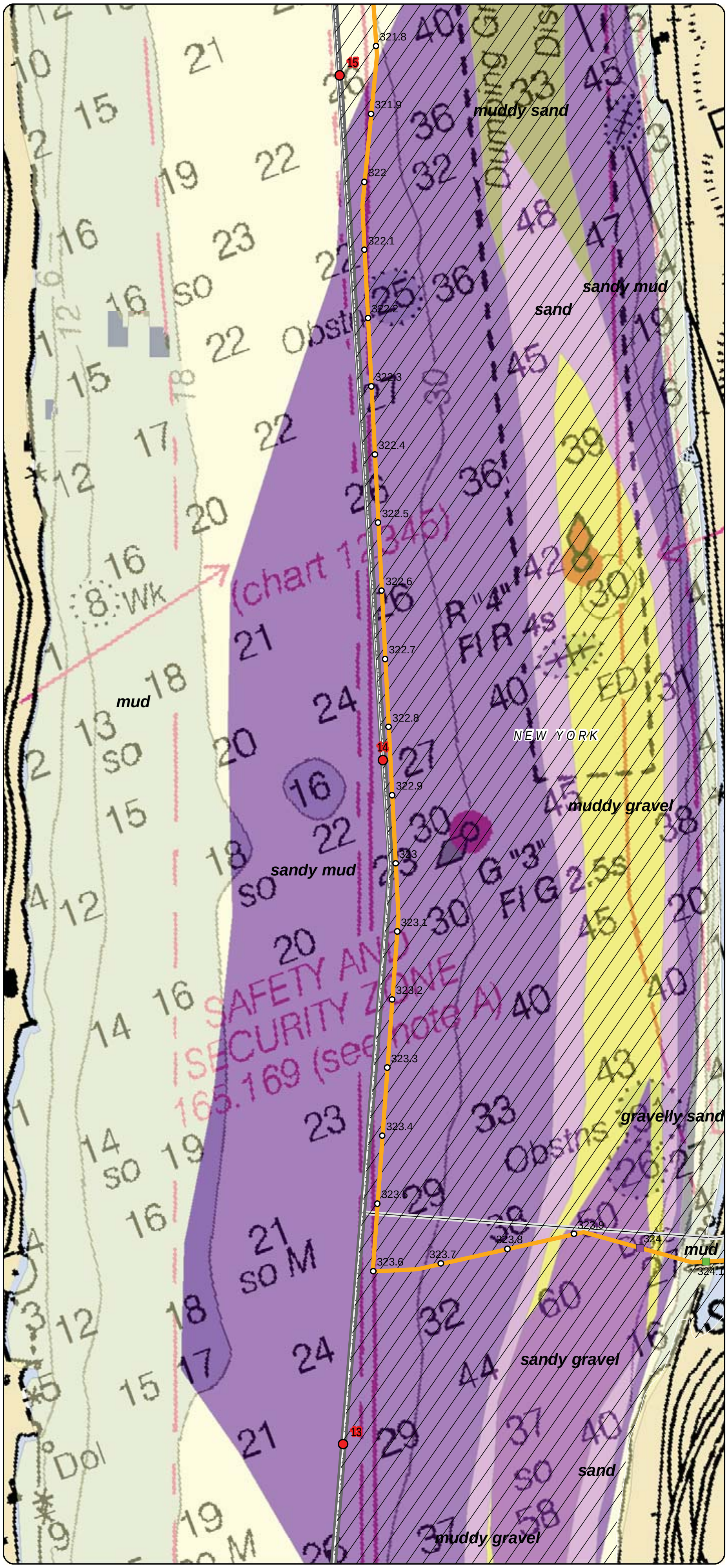

LEGEND

● 1 Hudson River Miles

■ Potential Mattress (Rock or Stiff Soils)

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Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 43 of 43

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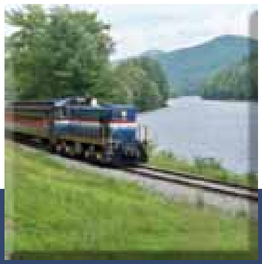

APPENDIX R

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

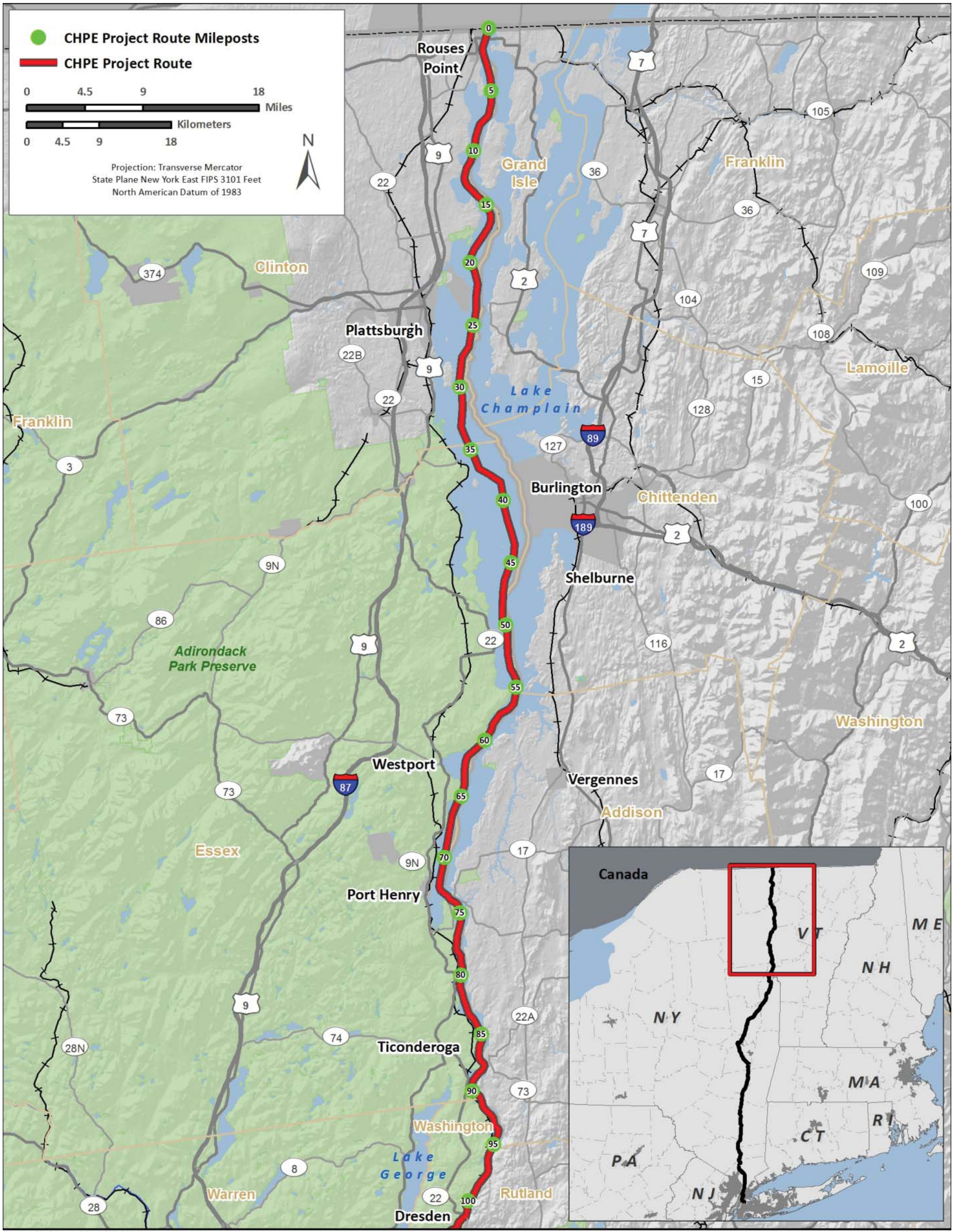
For the purposes of understanding the various environmental settings associated with the proposed CHPE Project, and to facilitate the analysis in the EIS, the transmission line route was divided into four geographically logical segments as follows:

- **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**).

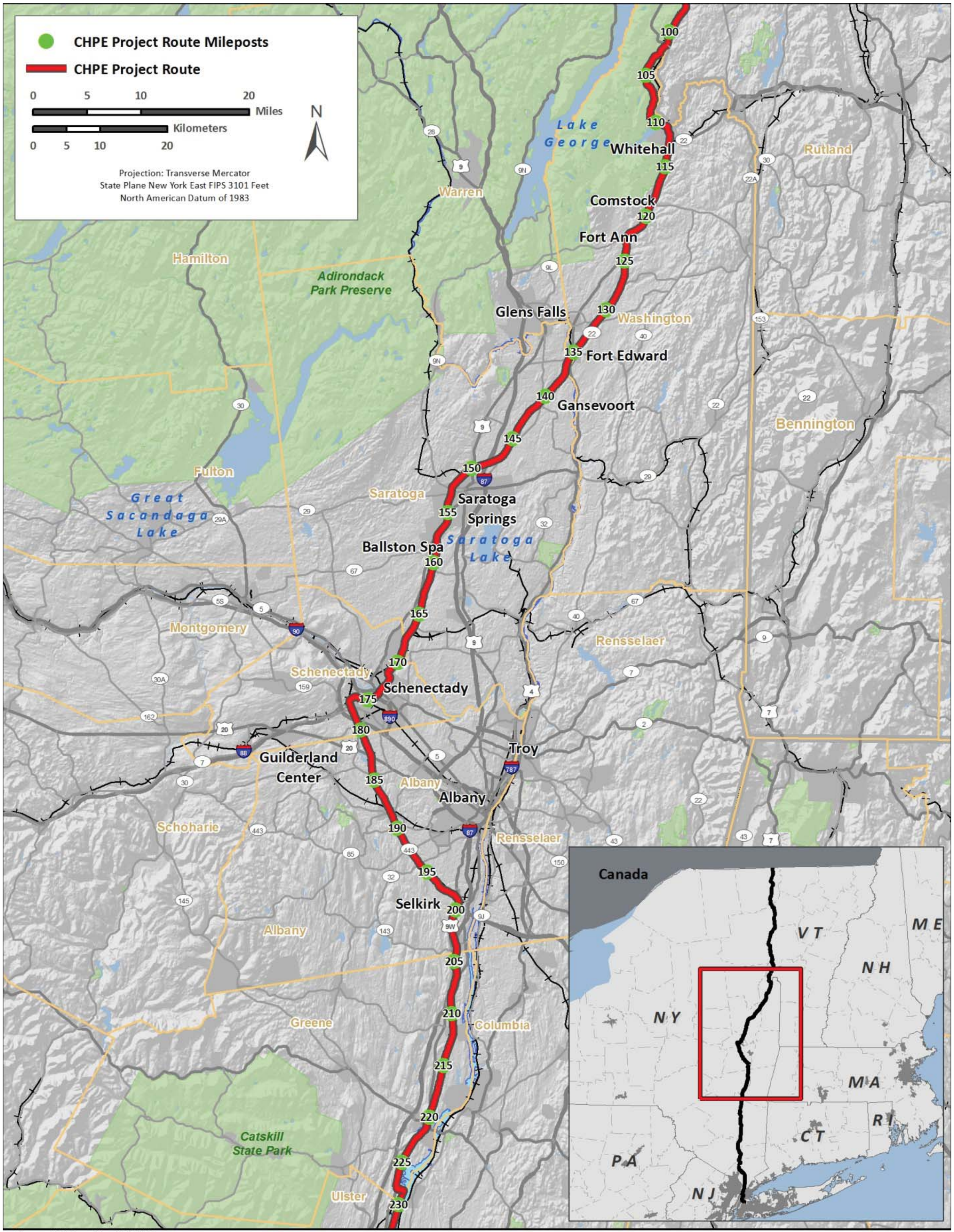
The ***Overland Segment*** begins at the southern end of Lake Champlain at the Town of Dresden, where the HVDC transmission line would exit the water at milepost (MP) 101 and be installed underground in the New York State Department of Transportation (NYSDOT) ROW, the Canadian Pacific (CP) railroad ROW, 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.



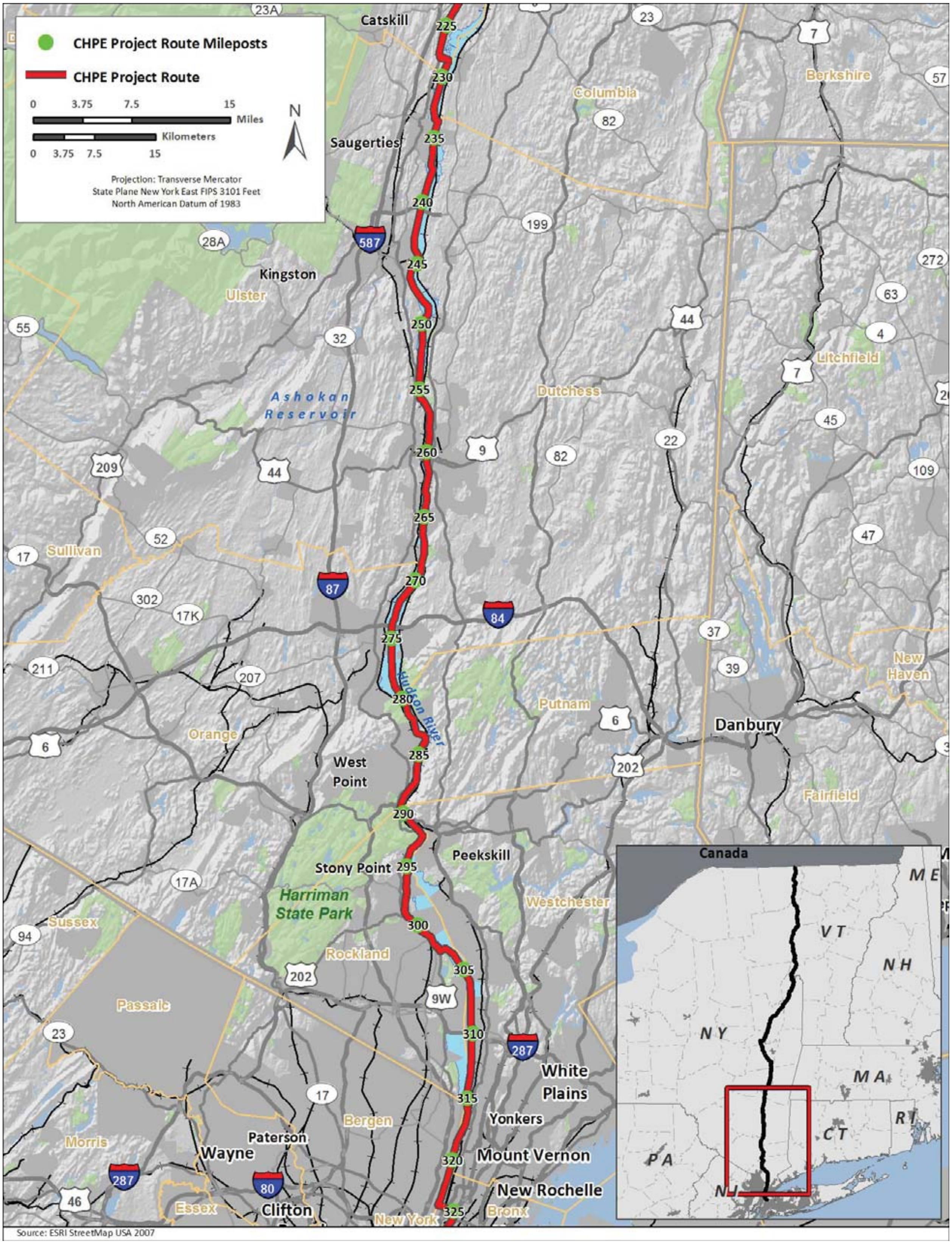
Source: ESRI StreetMap USA 2007

Figure 2-1. Lake Champlain Segment



Source: ESRI StreetMap USA 2007

Figure 2-2. Overland Segment



Source: ESRI StreetMap USA 2007

Figure 2-3. Hudson River Segment

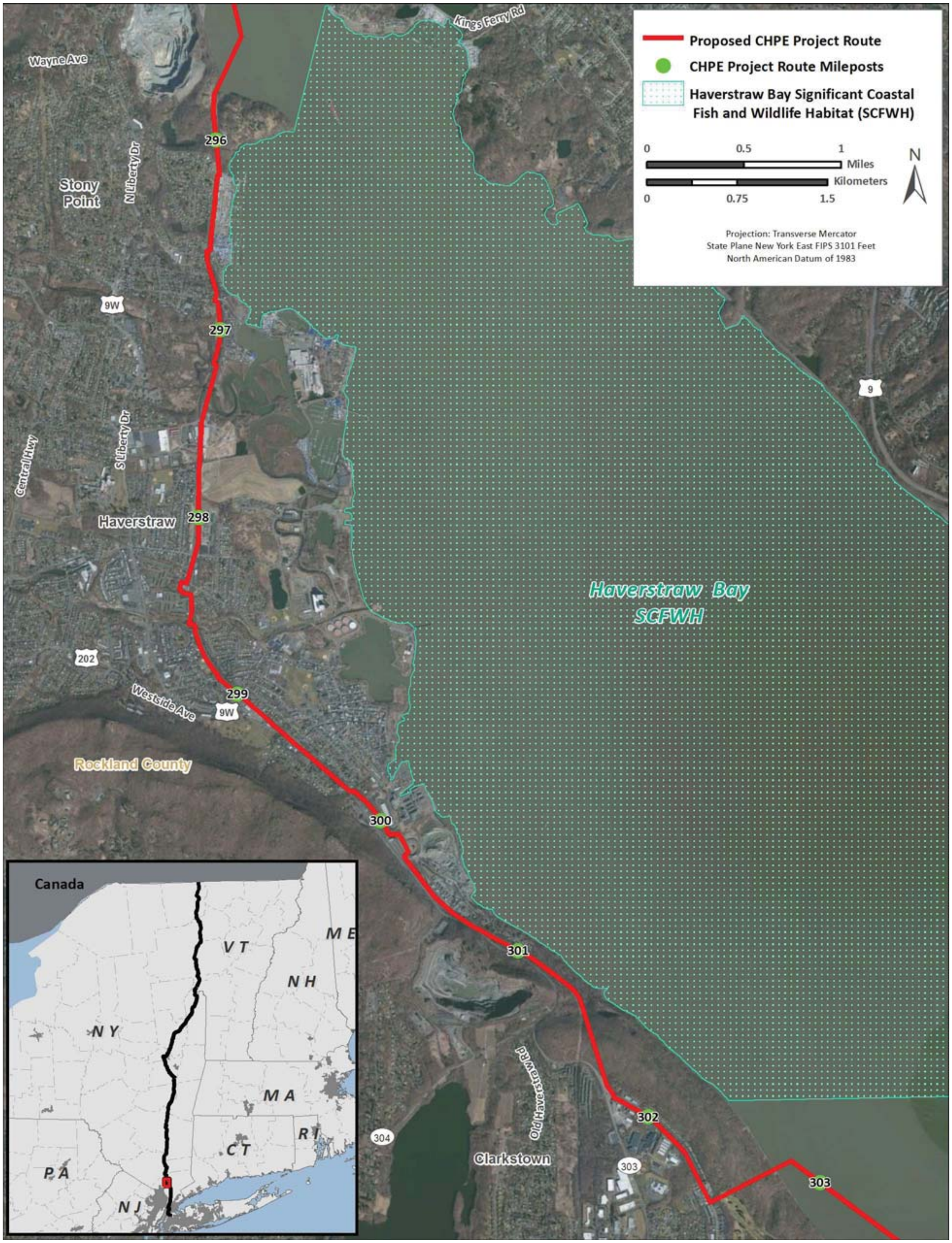


Figure 2-4. Proposed CHPE Project near Haverstraw Bay

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.

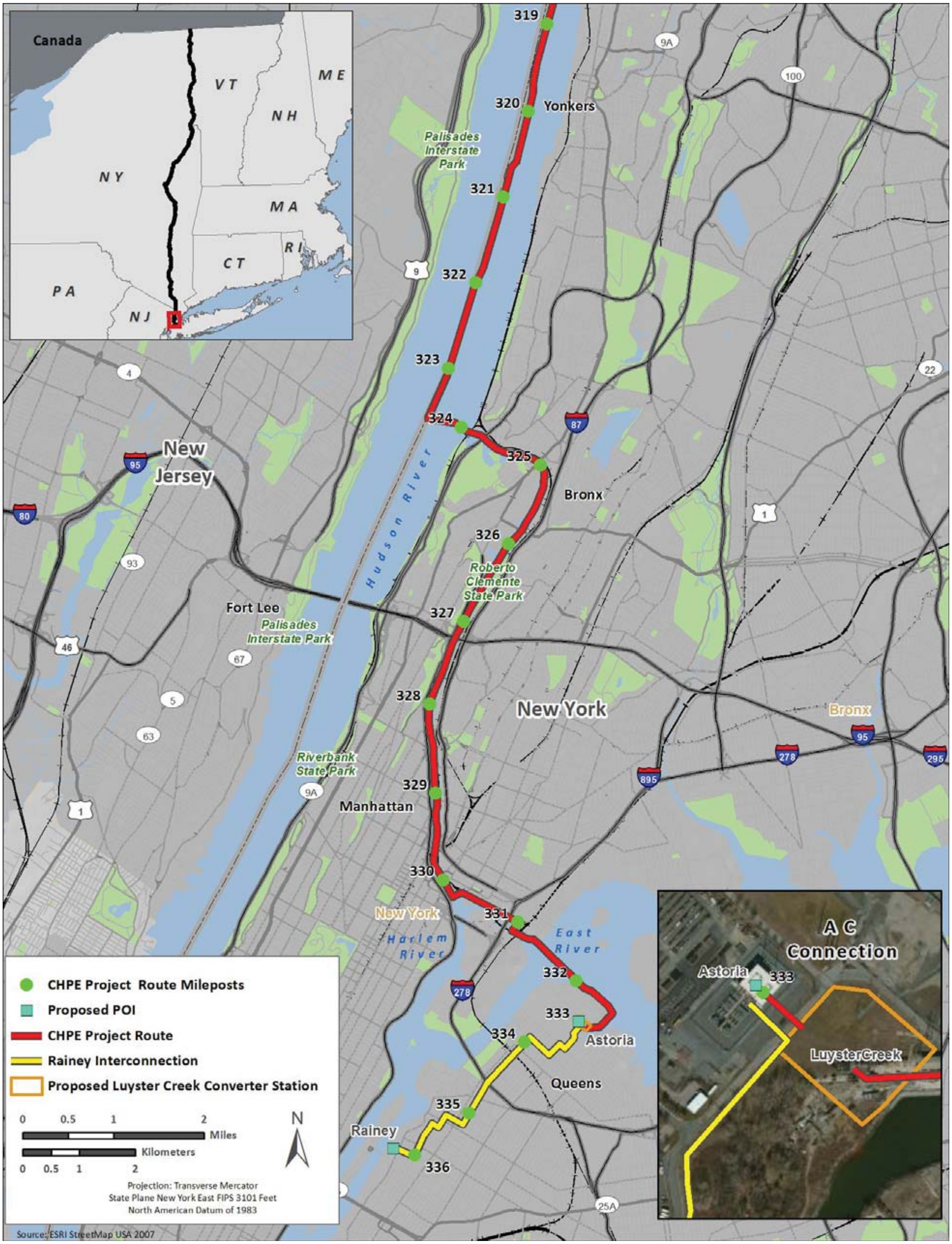


Figure 2-5. New York City Metropolitan Area Segment

- 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

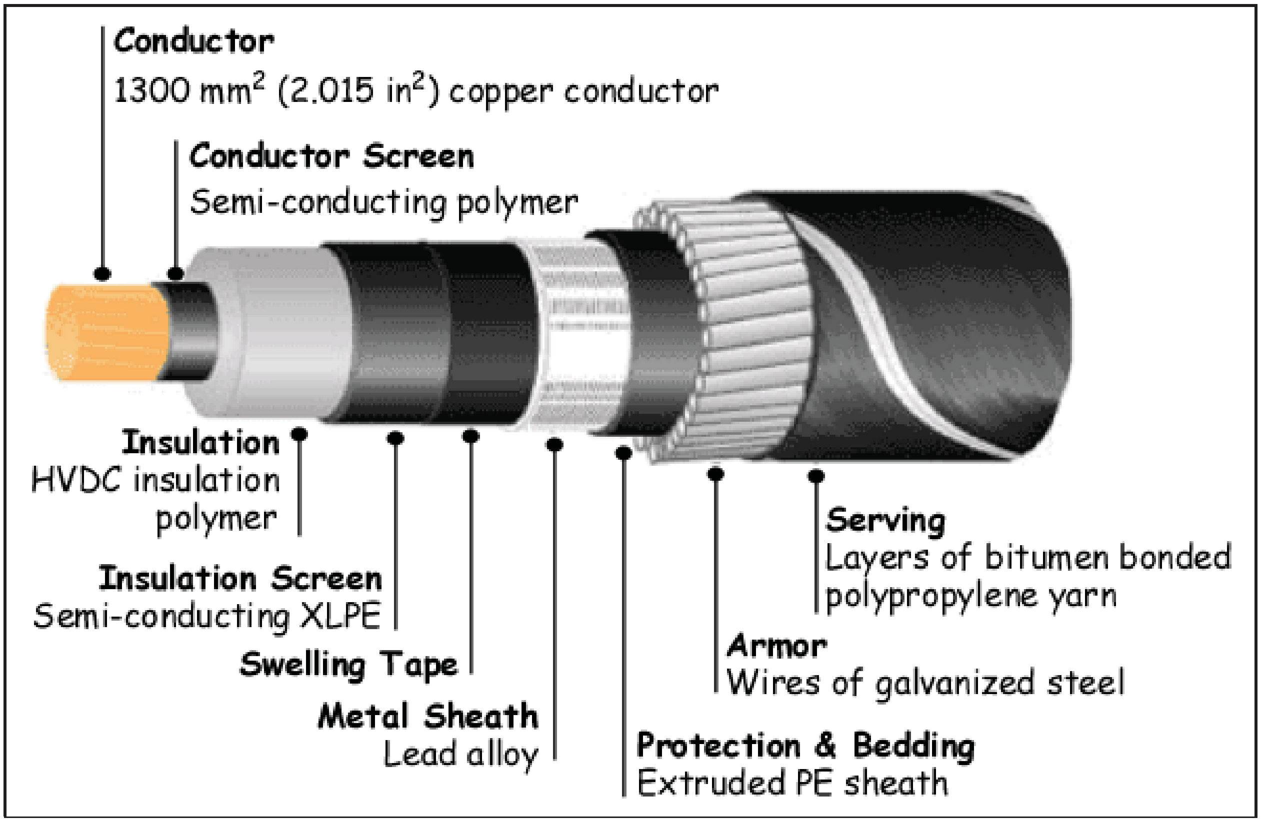
The following subsections describe the specific engineering details of the transmission system as approved by the NYSPSC Order granting the Certificate of Environmental Compatibility and Public Need (Certificate) for the proposed CHPE Project issued to the Applicant in April 2013 (NYSPSC 2013). The following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

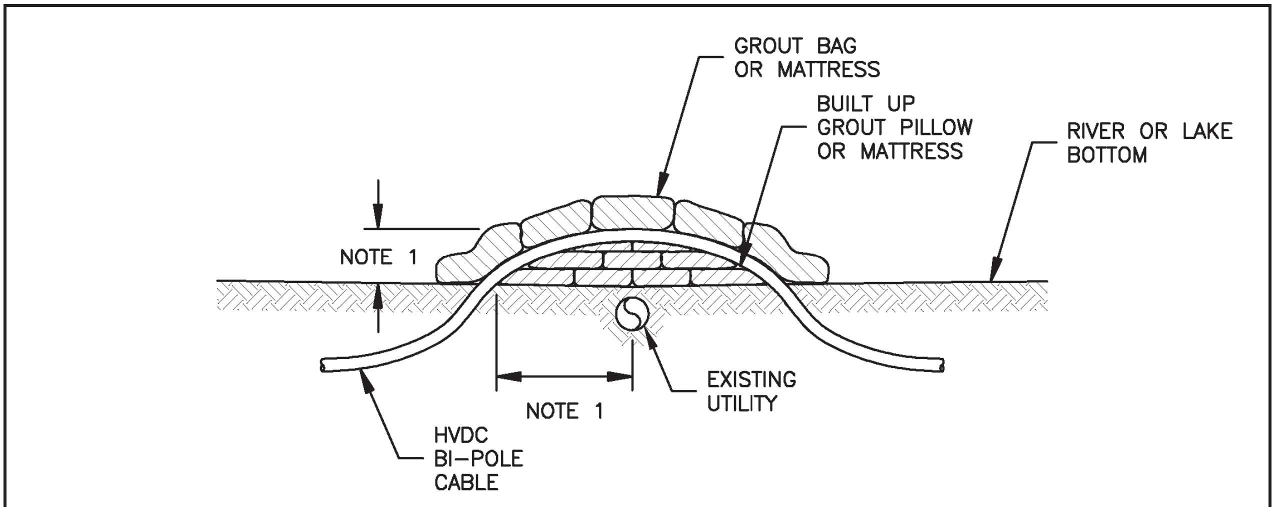
Where the transmission cables cross bedrock (approximately 11 locations in the Hudson River) or an existing utility such as a pipeline or another cable (approximately 66 locations in the Hudson River and 26 locations in the Harlem River), it would be laid over the rock or existing utility and a protective 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



NOTE:
1. VARIES BASED ON STABILITY OF EXISTING BOTTOM SEDIMENT, UTILITY DIAMETER AND BEND RADIUS OF CABLE.

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.

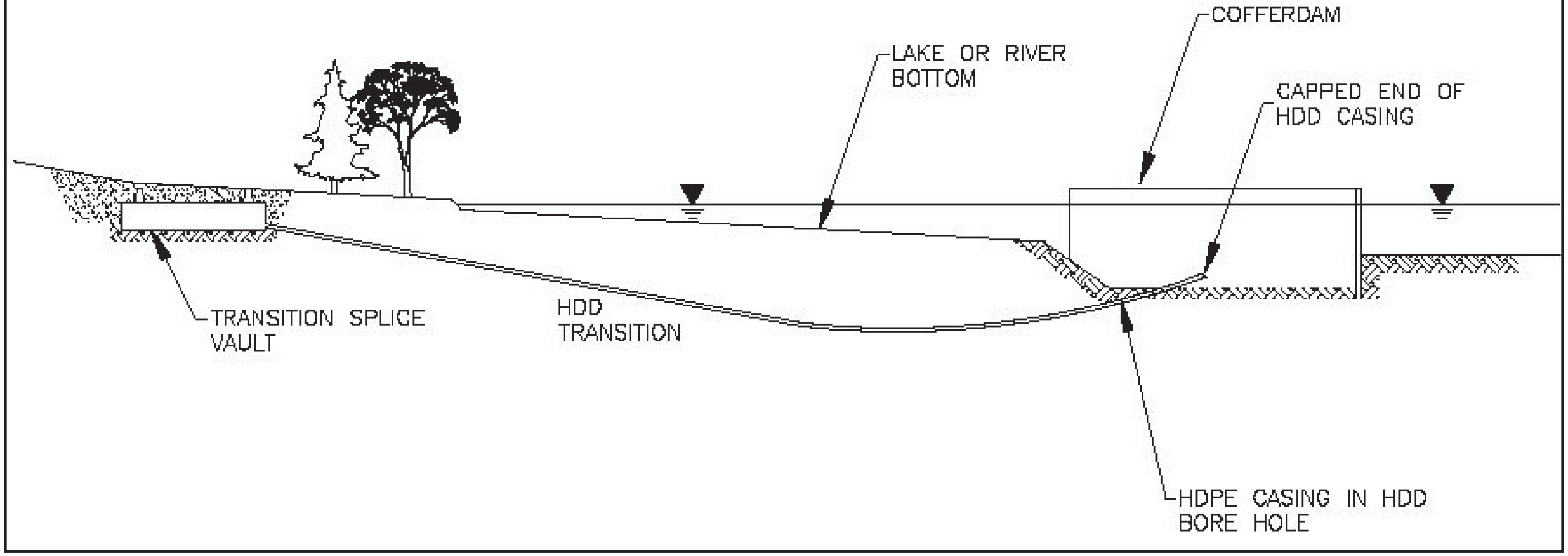
2.3.2 Horizontal Directional Drilling (HDD)

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

NOTES:

1. COFFERDAM TO BE UTILIZED WHERE NECESSARY TO STABILIZE BOTTOM SEDIMENT AT HDD TERMINUS OTHER ALTERNATIVES PROVIDING EQUIVALENT ENVIRONMENTAL PROTECTION MAY BE EMPLOYED WHERE BOTTOM CONDITIONS DO NOT PERMIT DRIVEN PILES.
2. PILES SHALL BE REMOVED OR CUT BELOW THE MUD LINE. AT COMPLETION OF CABLE INSTALLATION IN COORDINATION WITH THE BMP REQUIREMENTS.
3. COFFERDAM WILL EXTEND ABOVE THE WATERLINE IN SHALLOW WATER. EXPOSED STRUCTURE WILL BE MARKED BY BUOYS AND OTHER NAVIGATION AIDS. A NOTICE TO MARINERS WILL BE ISSUED WHEN APPROPRIATE.
4. COFFERDAMS IN DEEP WATER NOT BE EXTENDED TO THE WATER SURFACE. EACH INSTALLATION WILL BE MARKED BY BUOYS AND OTHER NAVIGATION AIDS. A NOTICE TO MARINERS WILL BE ISSUED WHERE APPROPRIATE.



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.

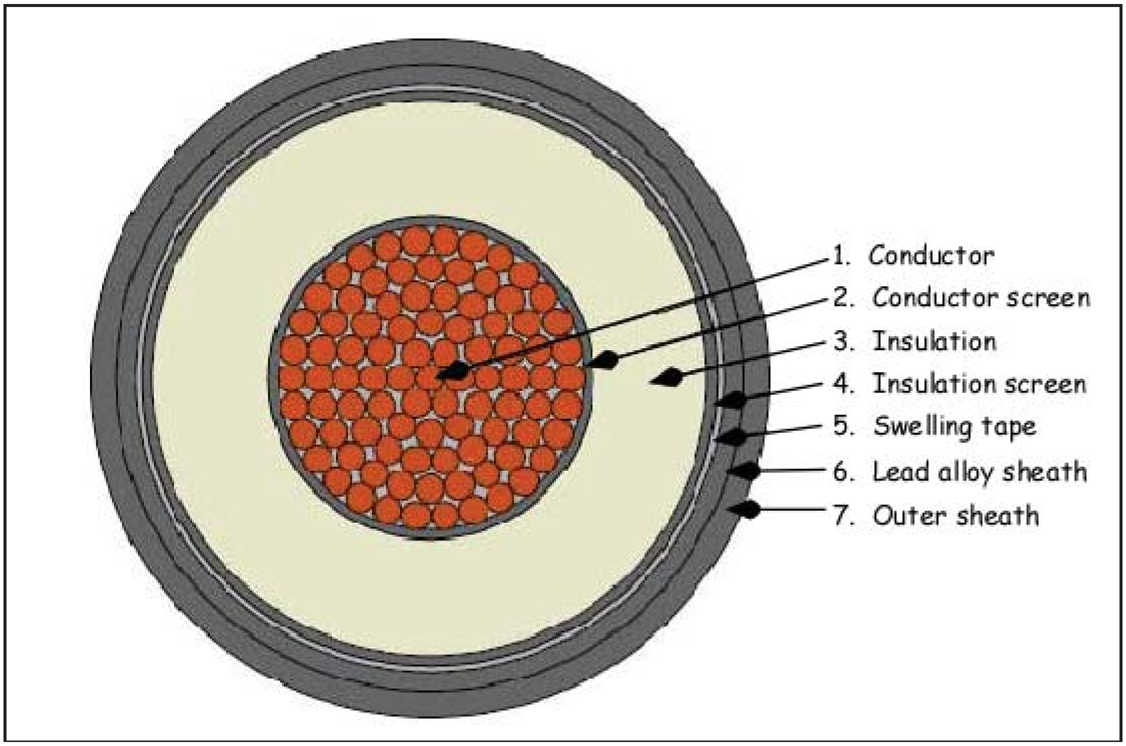
Sheet pile used to construct cofferdams would be installed with a vibratory hammer, and would be installed in pairs with 8 to 10 pairs of sheets installed per day. Each pair of sheets would provide a wall 4 feet (1.3 meters) wide and approximately 50 feet (15 meters) tall. A single pair of sheets can 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

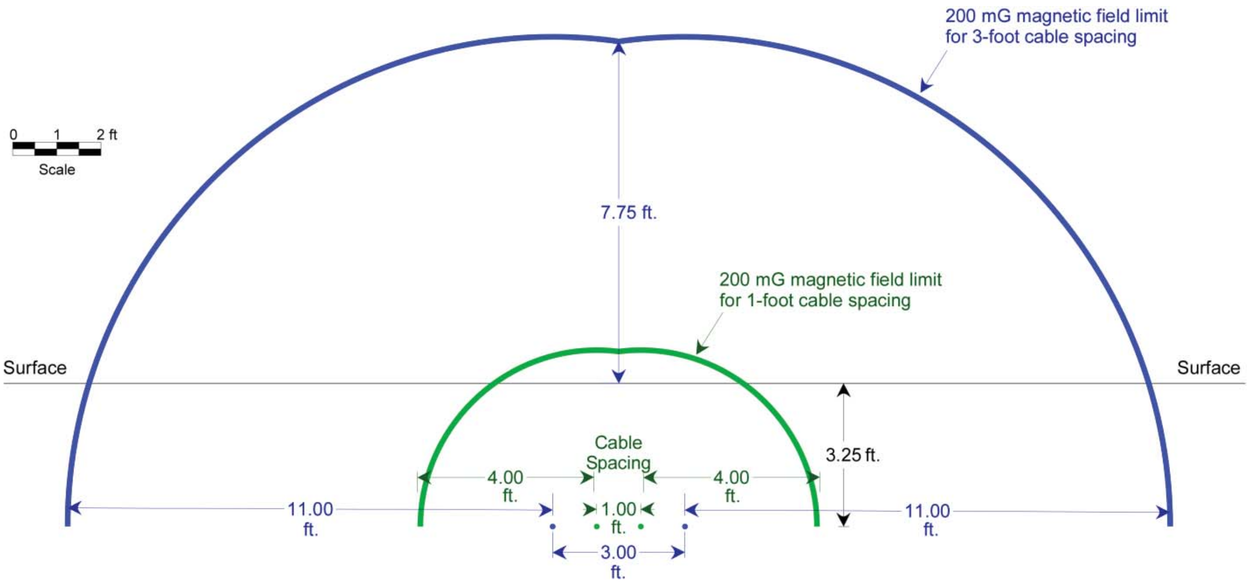


Figure 2-11. 200-mG Magnetic Field Strengths with Cable Spacings of 1 Foot and 3 Feet

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 x 10^{-5} millivolts/cm (mV/cm); a fish moving north to south at the same rate would incur an induced electric current of 67 x 10^{-5} mV/cm. The maximum induced electric current associated with the transmission cables would be 11.5 x 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 x 10^{-5} mV/cm [the maximum induced electric field]/67 x 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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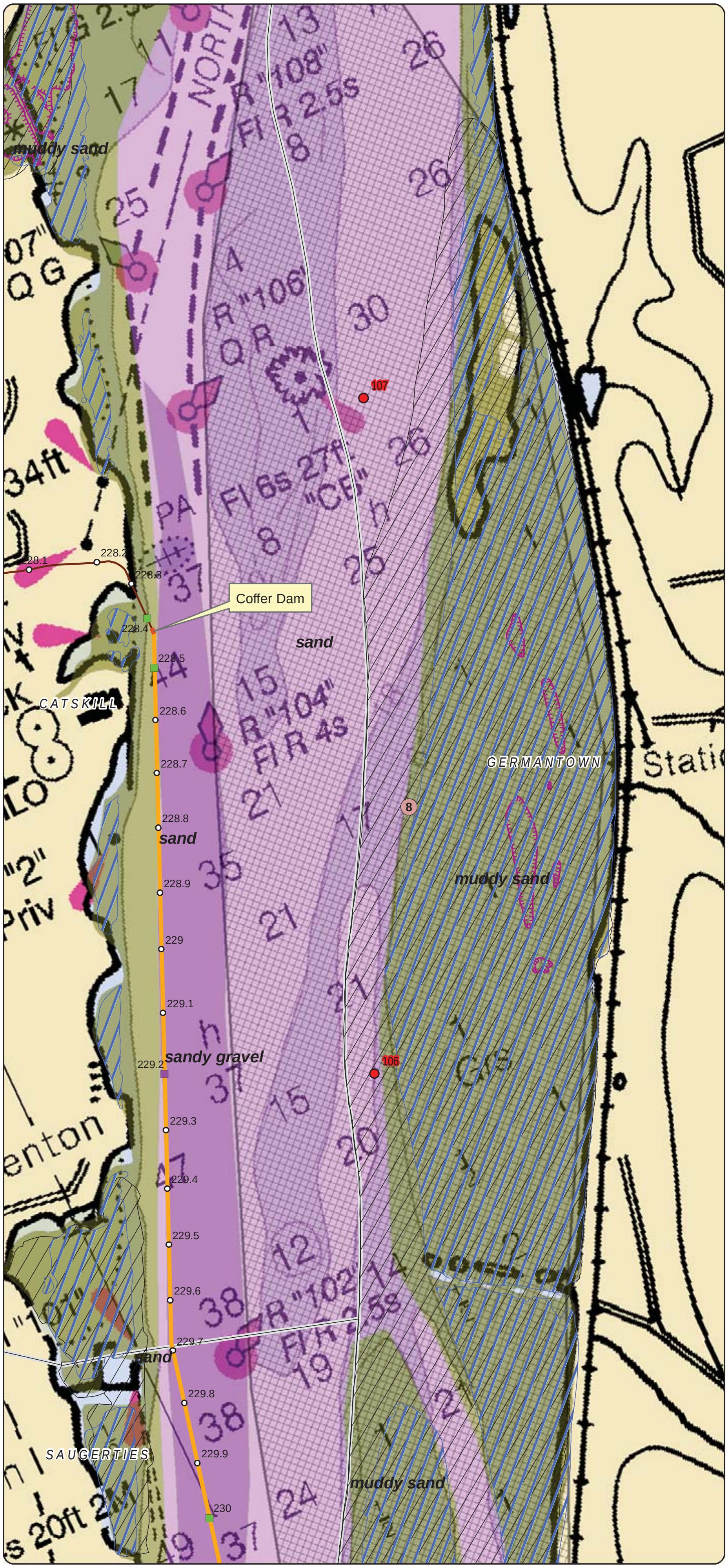
ATTACHMENT 1

RESOURCES ALONG THE PROPOSED CHPE PROJECT ROUTE IN THE HUDSON RIVER



Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 1 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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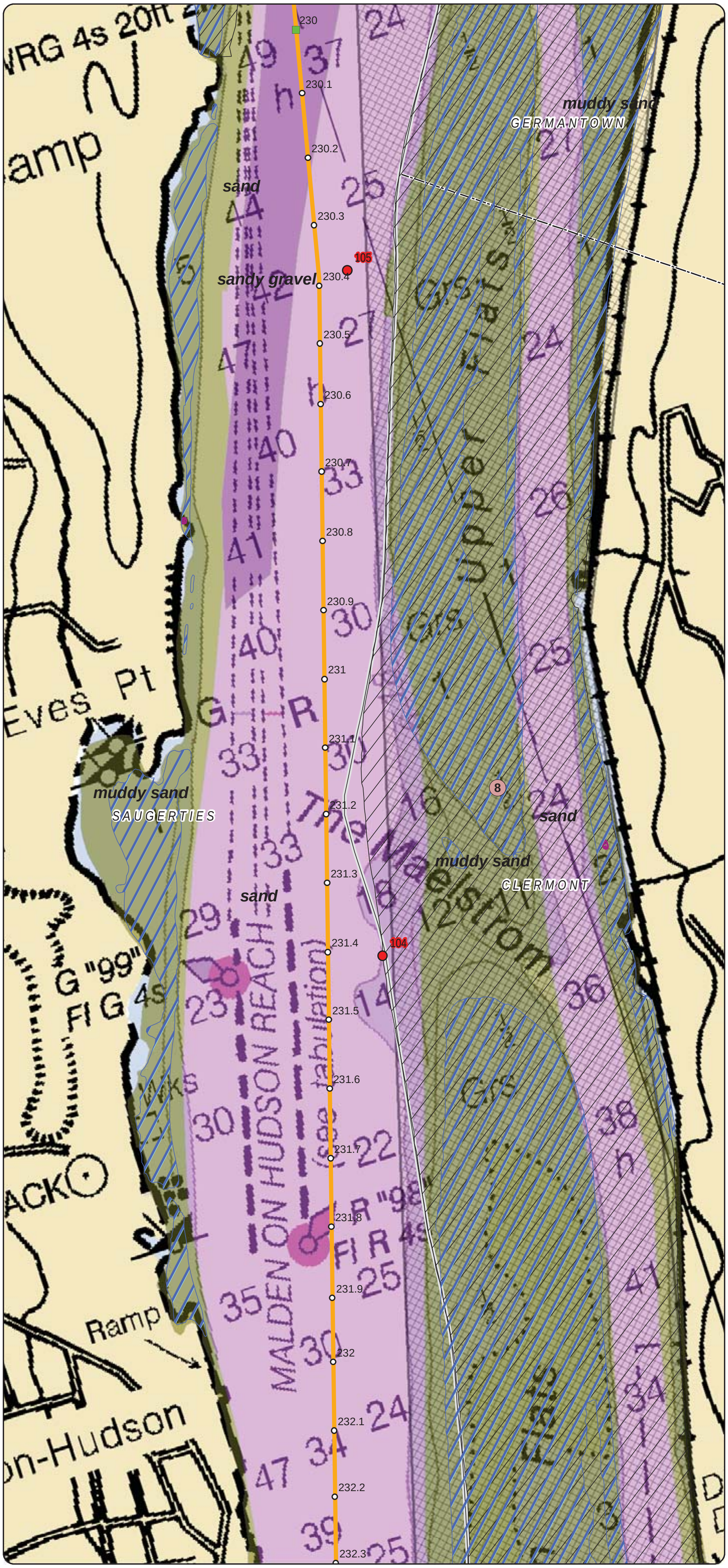

LEGEND

- ● 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

N

0 750

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 | DTA & 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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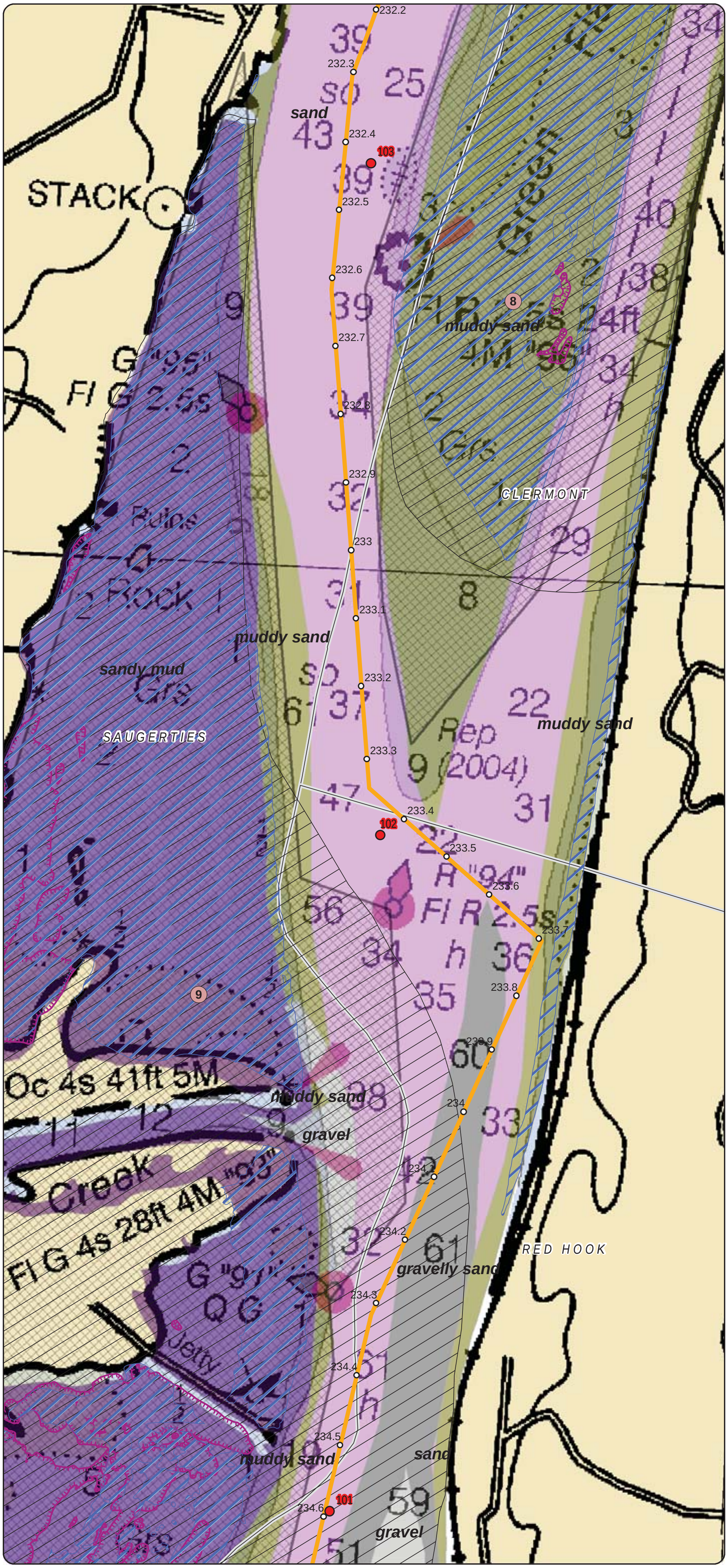

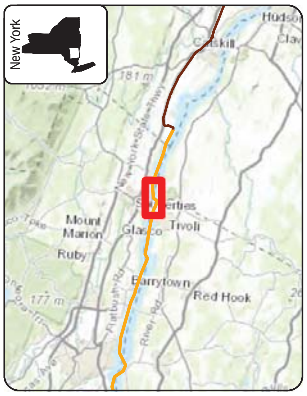

LEGEND

● 1	Hudson River Miles
■	Potential Mattress (Rock or Stiff Soils)
🟩	Potential Mattress (Utility Crossings)
○ 1	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

N

0 750

Feet

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 | TETRA & 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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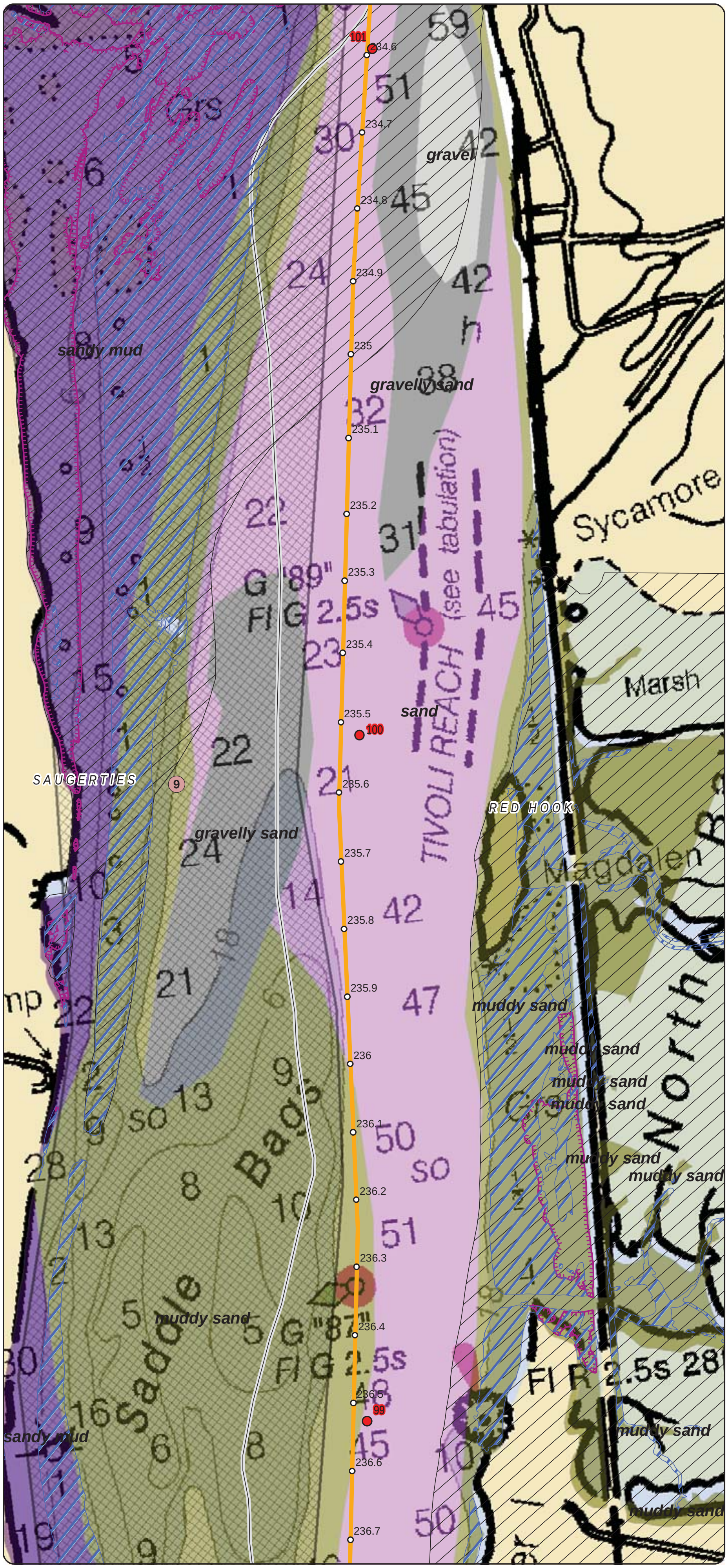

LEGEND

- ● 1 Hudson River Miles
- ■ Potential Mattress (Rock or Stiff Soils)
- 🟩 Potential Mattress (Utility Crossings)
- ○ 1 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

N

0 750
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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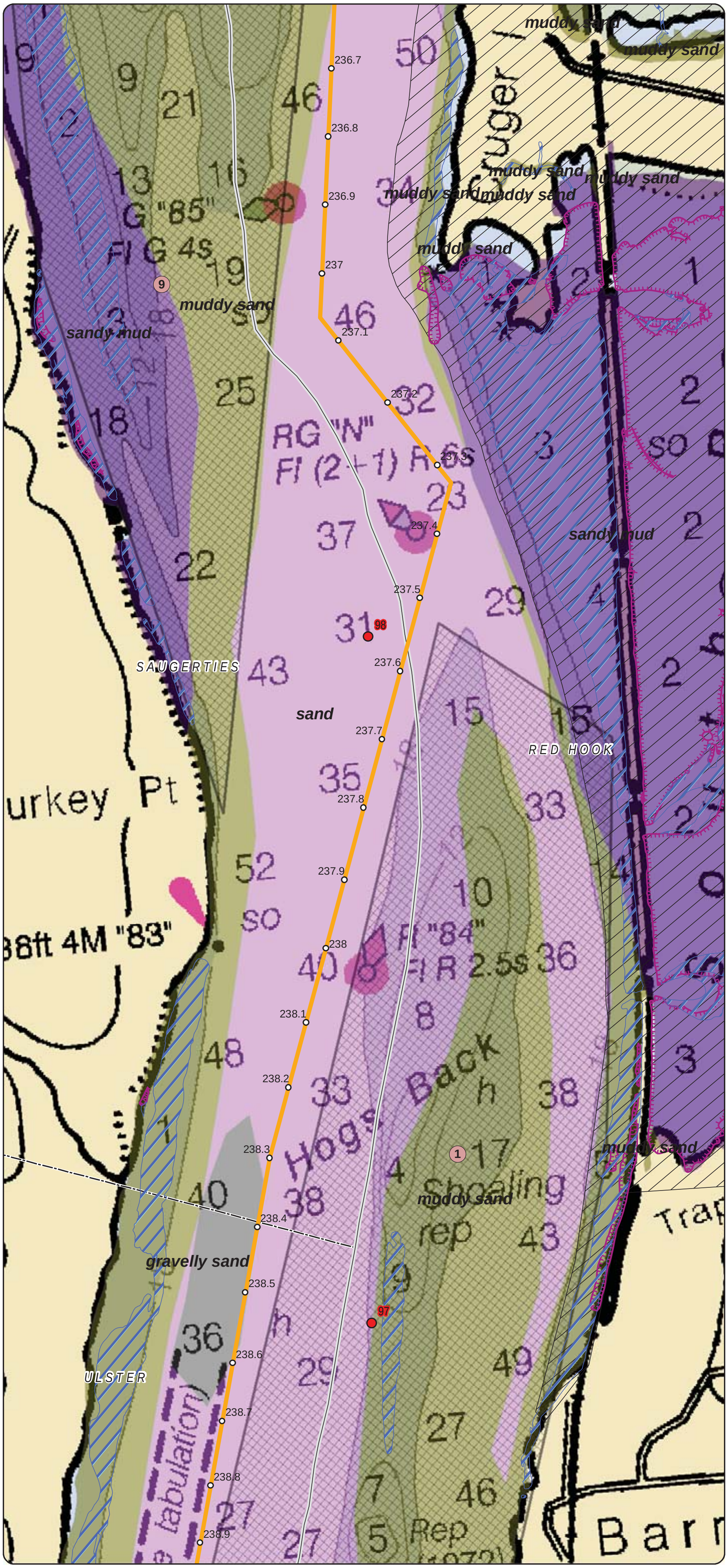

LEGEND

- ● 1 Hudson River Miles
- ■ Potential Mattress (Rock or Stiff Soils)
- 🟩 Potential Mattress (Utility Crossings)
- ○ 1 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

N

0 750

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 | 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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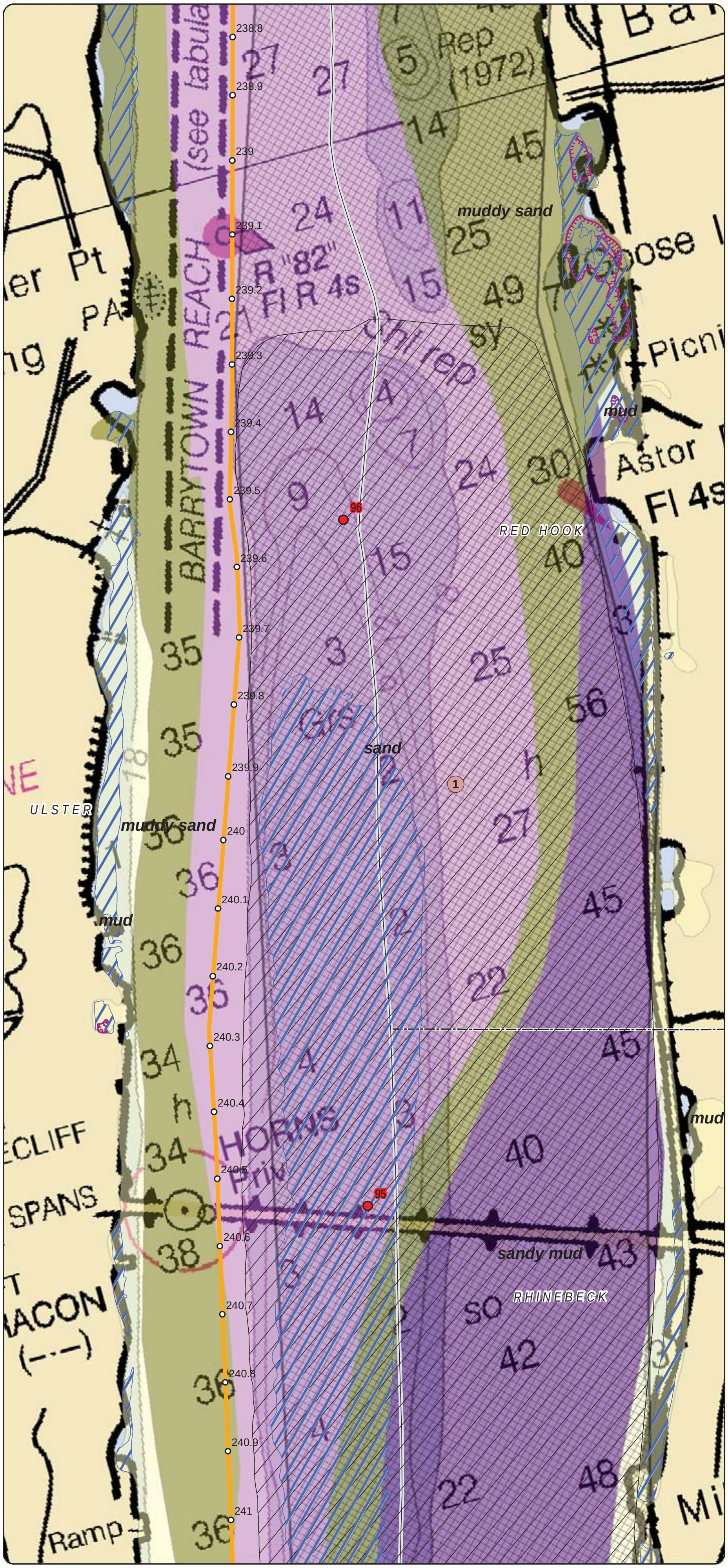

LEGEND

- ● 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 6 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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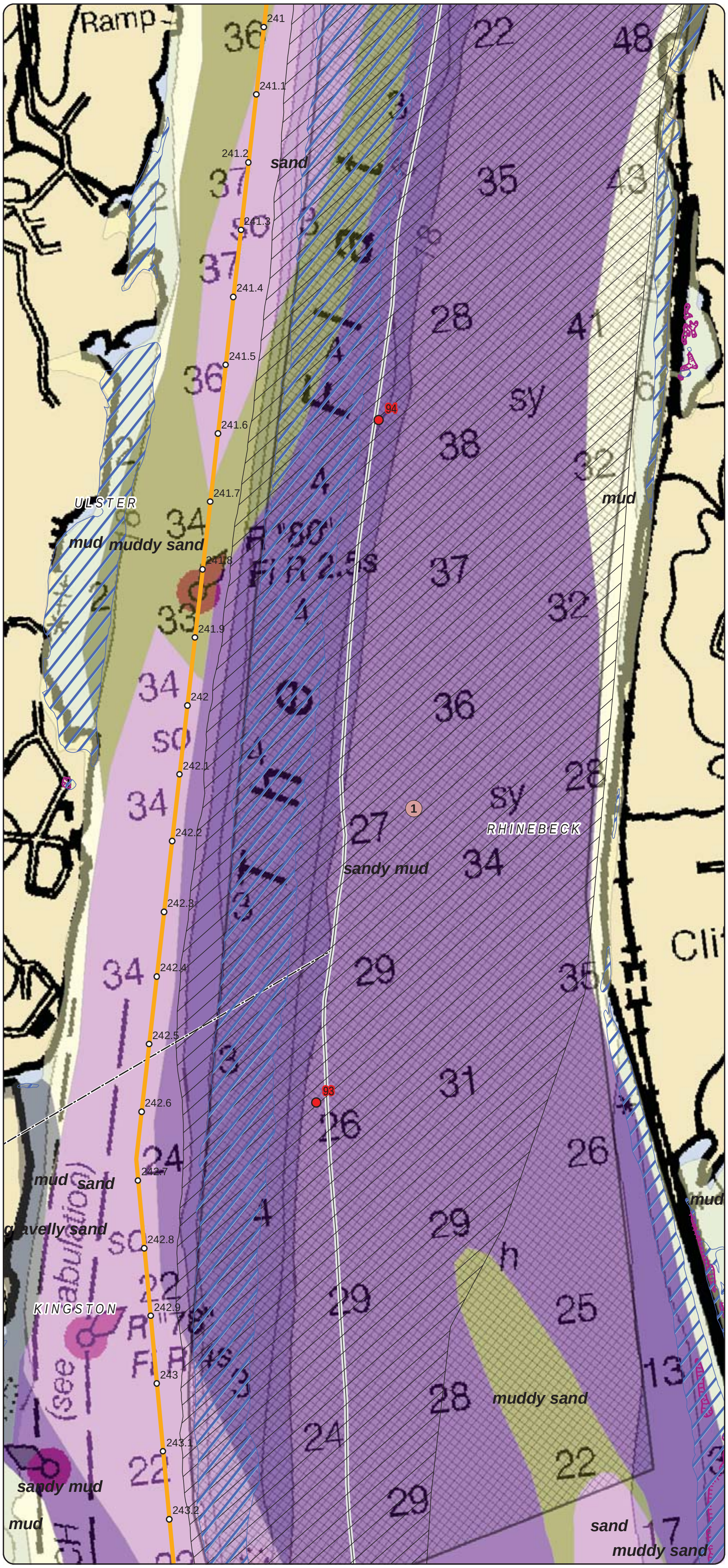

LEGEND

- ● 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 7 of 43

Created: 6/18/2014

by: HDR | ESTA & 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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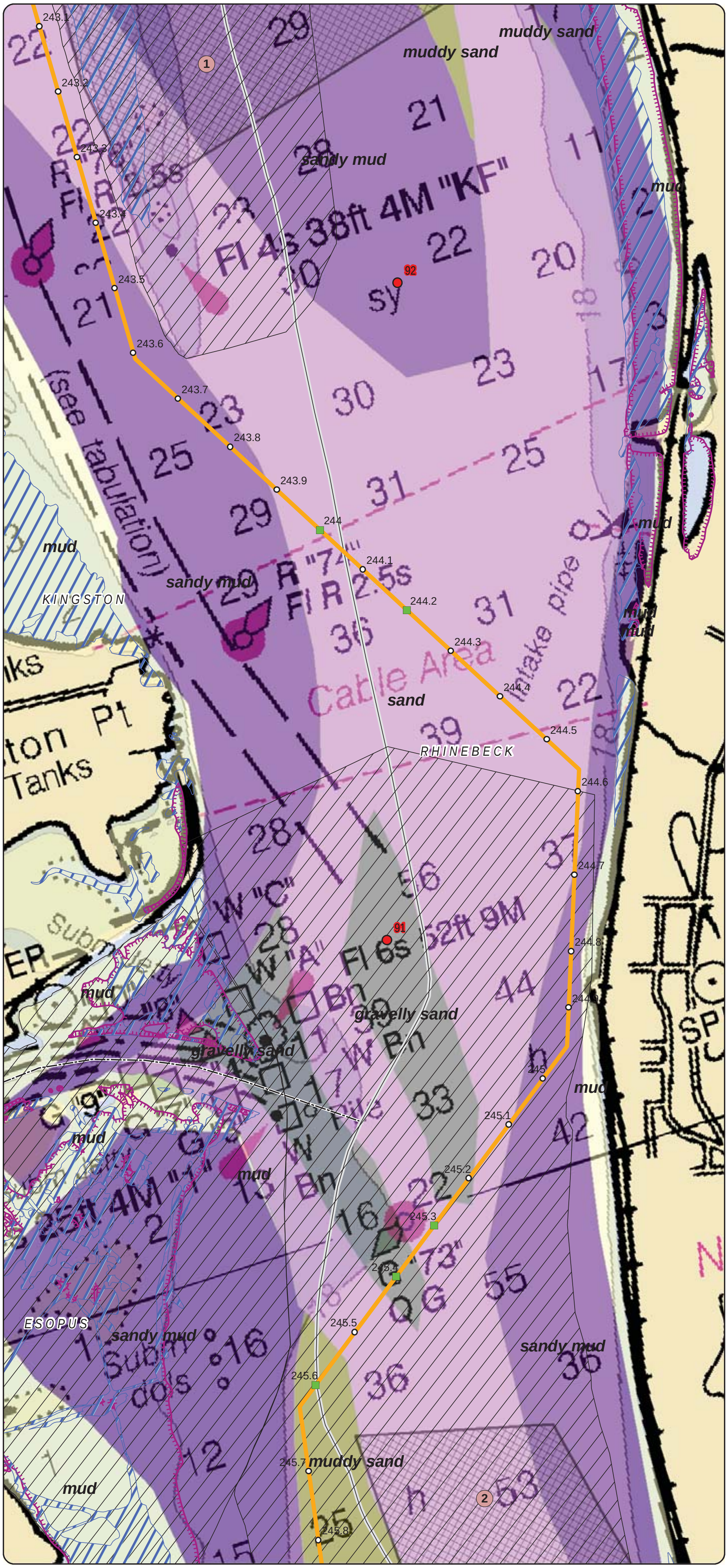

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 8 of 43

Created: 6/18/2014

by: HDR | TA & 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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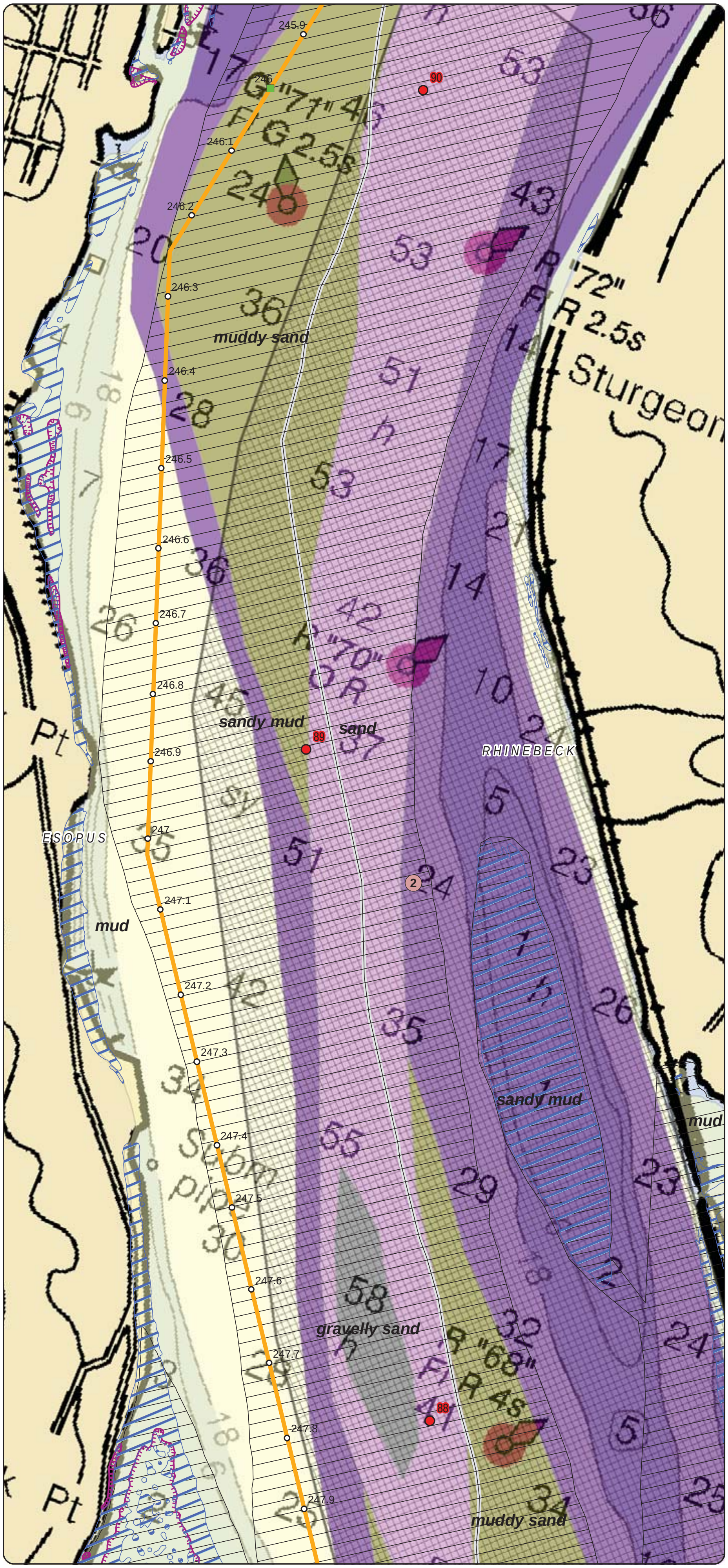

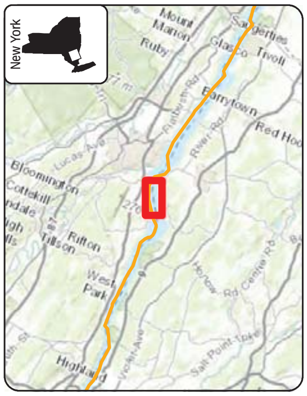

LEGEND

- ● 1 Hudson River Miles
- ■ Potential Mattress (Rock or Stiff Soils)
- 🟩 Potential Mattress (Utility Crossings)
- ○ 1 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 9 of 43

Created: 6/18/2014

by: HDR | Vanasse & 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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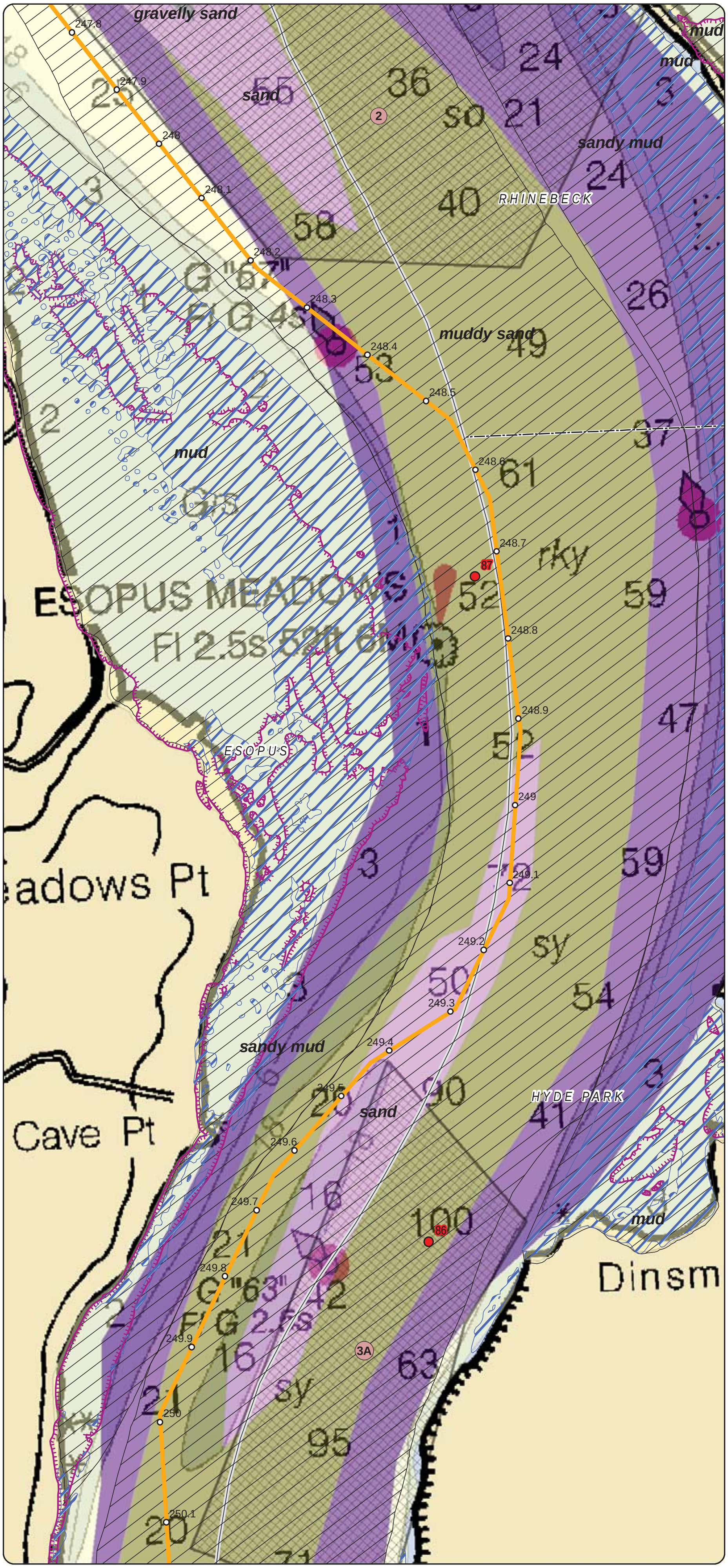

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 10 of 43

Created: 6/18/2014

by: HDR | & TRC

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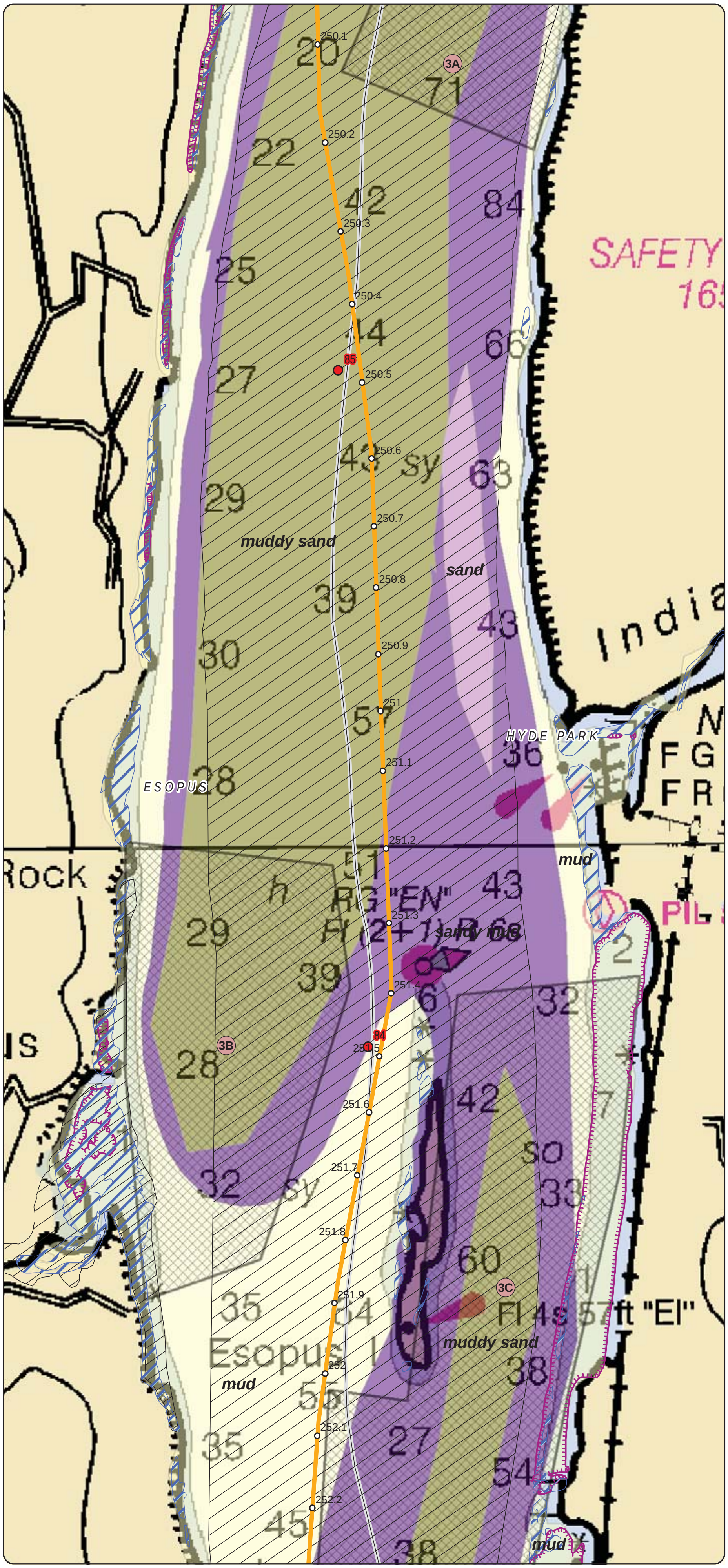
DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

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



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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 11 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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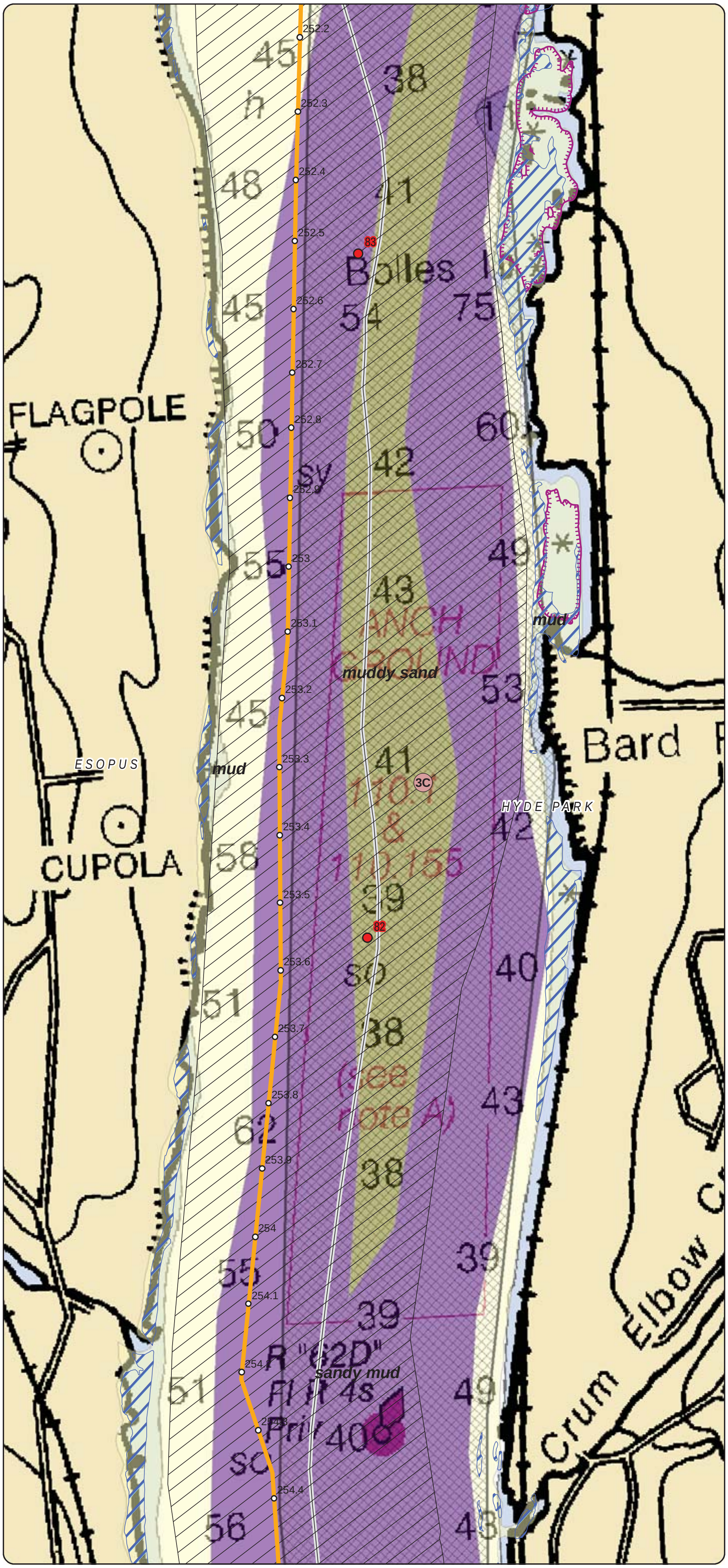

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 12 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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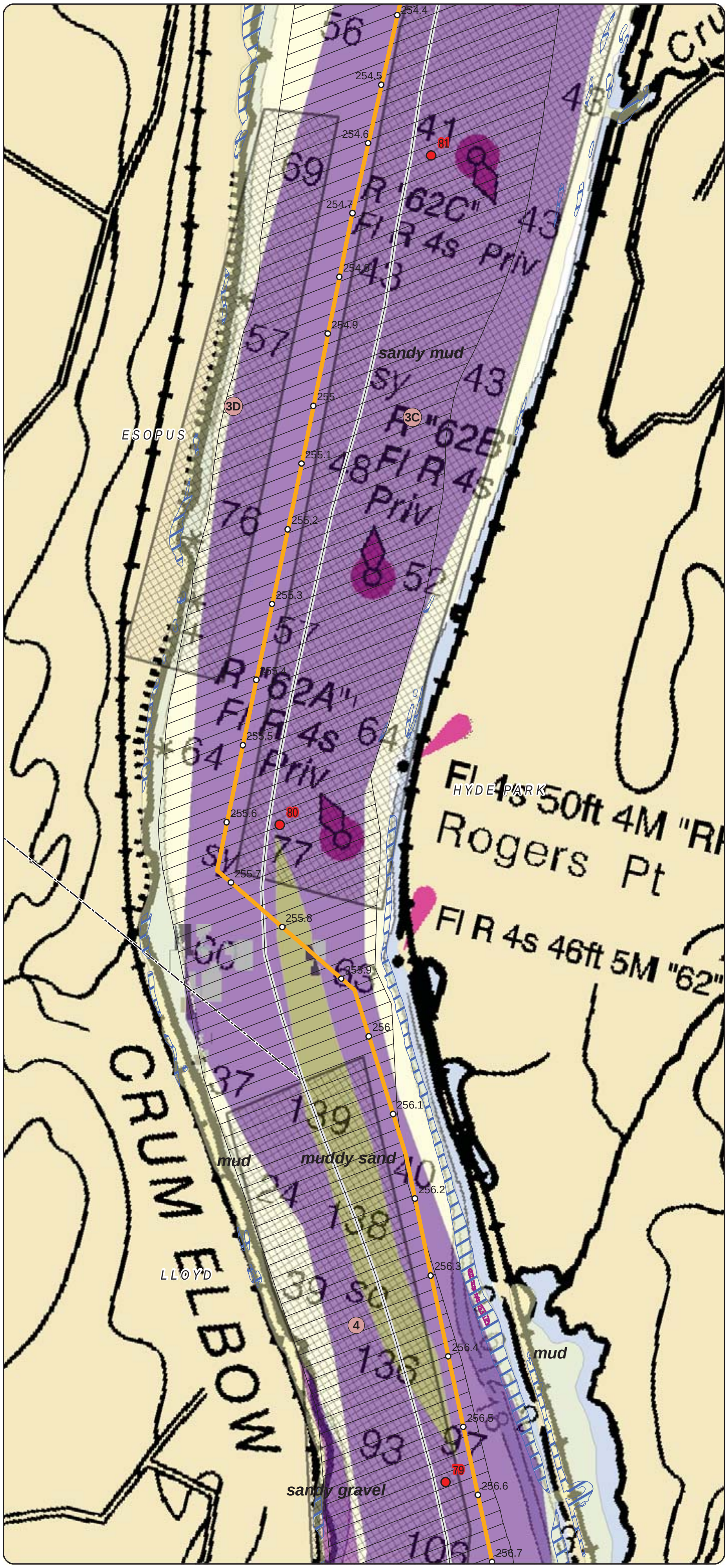

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 13 of 43

Created: 6/18/2014

by: HDR | TETRA TECH & TRC

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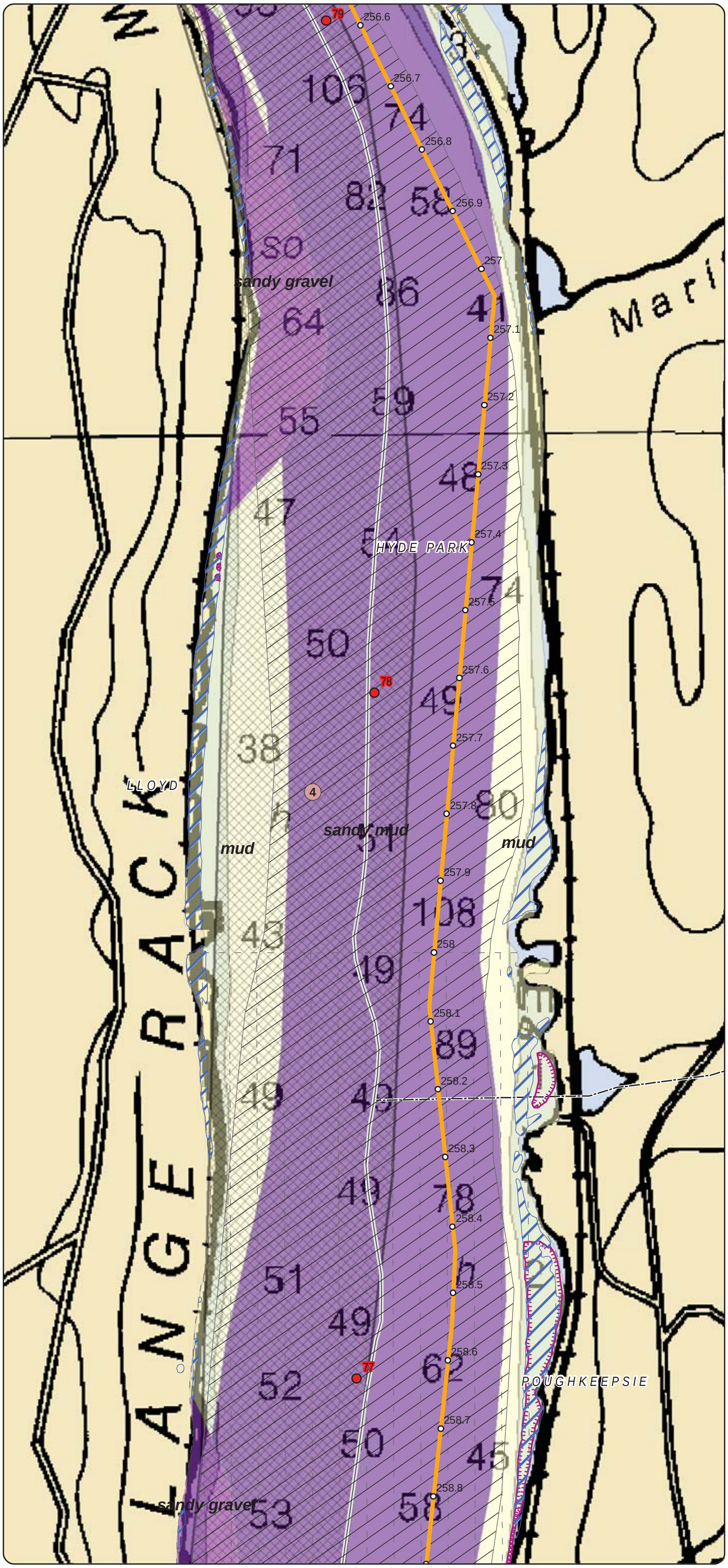
DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NY DOS, NY DEC, TDI, TRC

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



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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 14 of 43

Created: 6/18/2014

by: HDR | DTA & 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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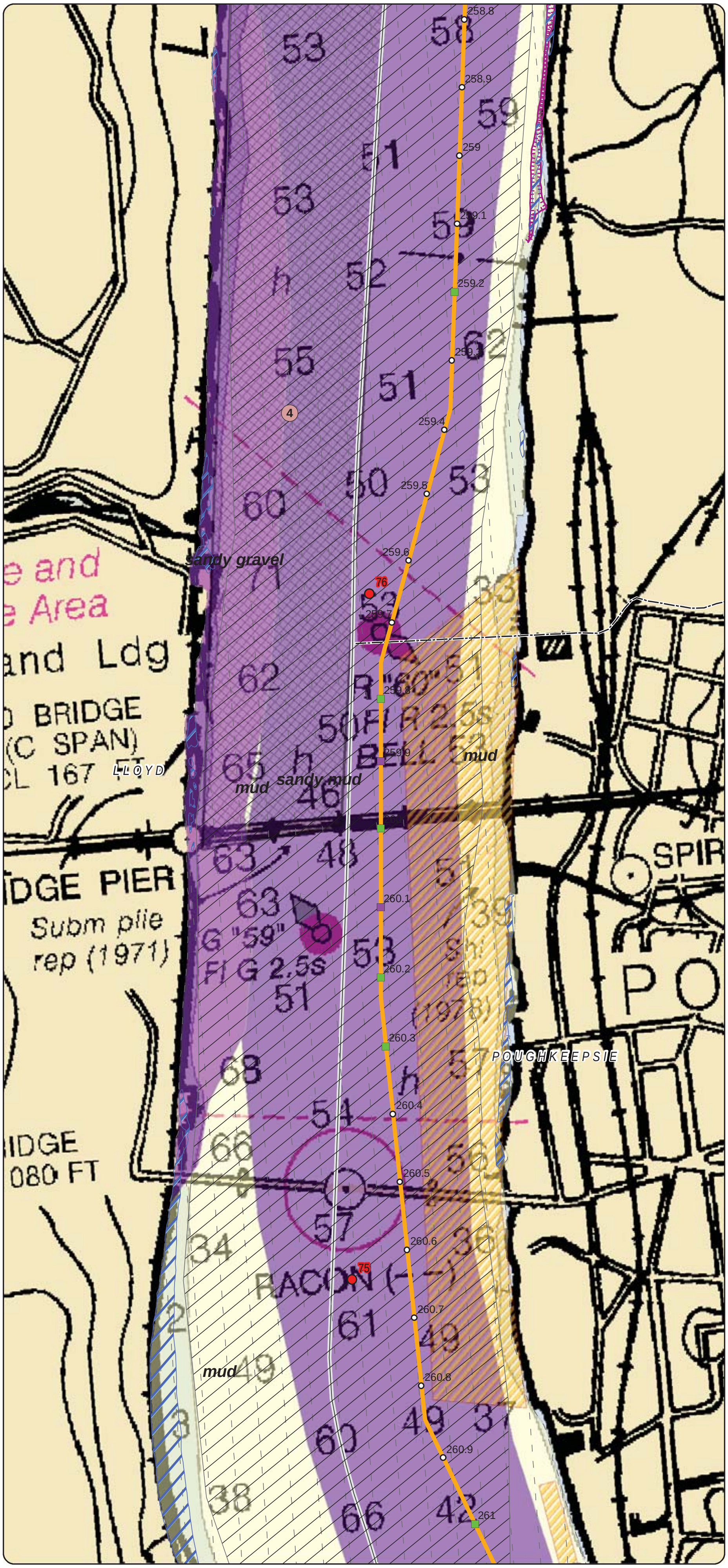
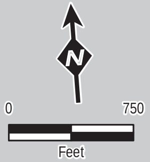


LEGEND

- ● 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



Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 15 of 43

Created: 6/18/2014

by: HDR | DTA & 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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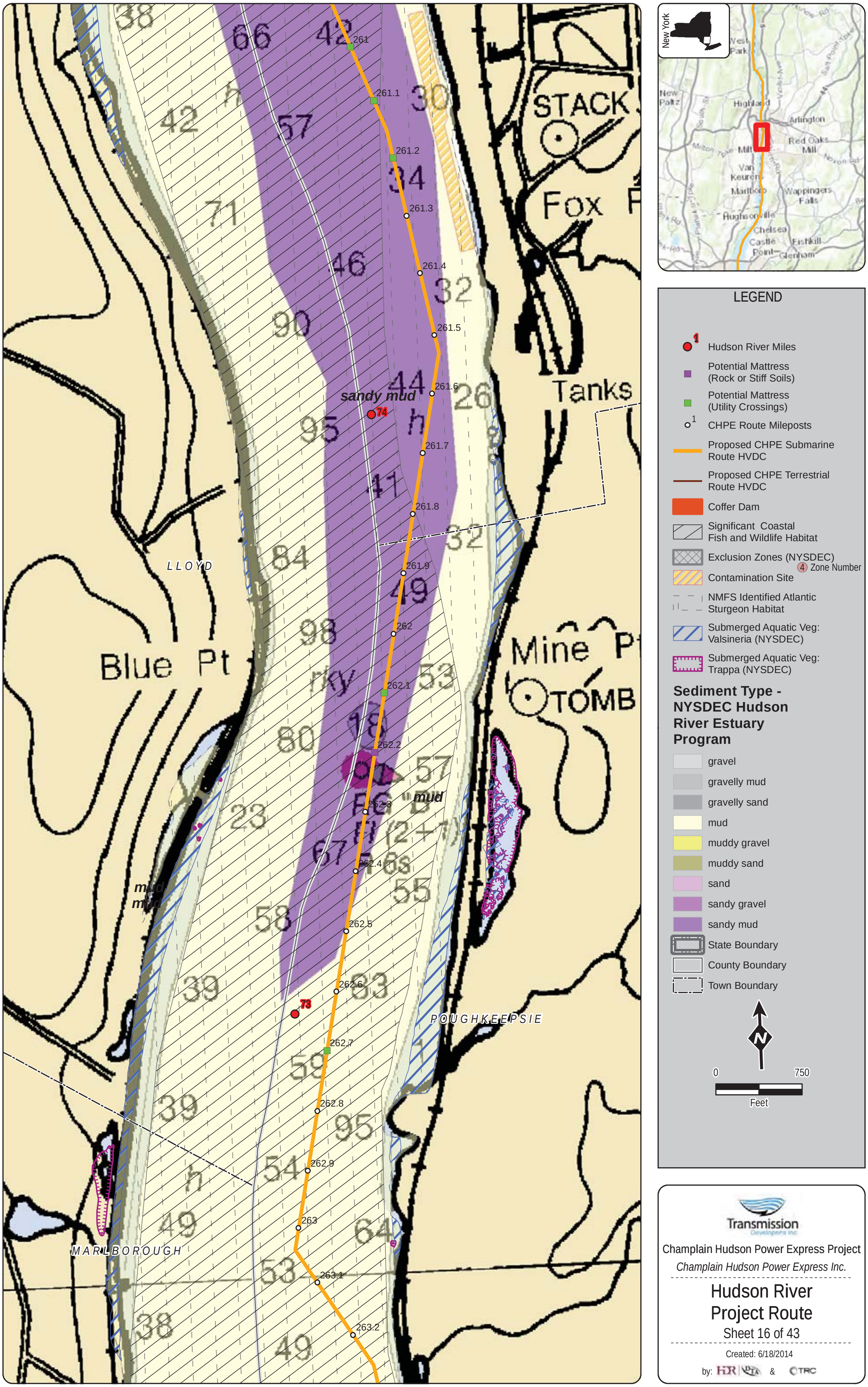

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 16 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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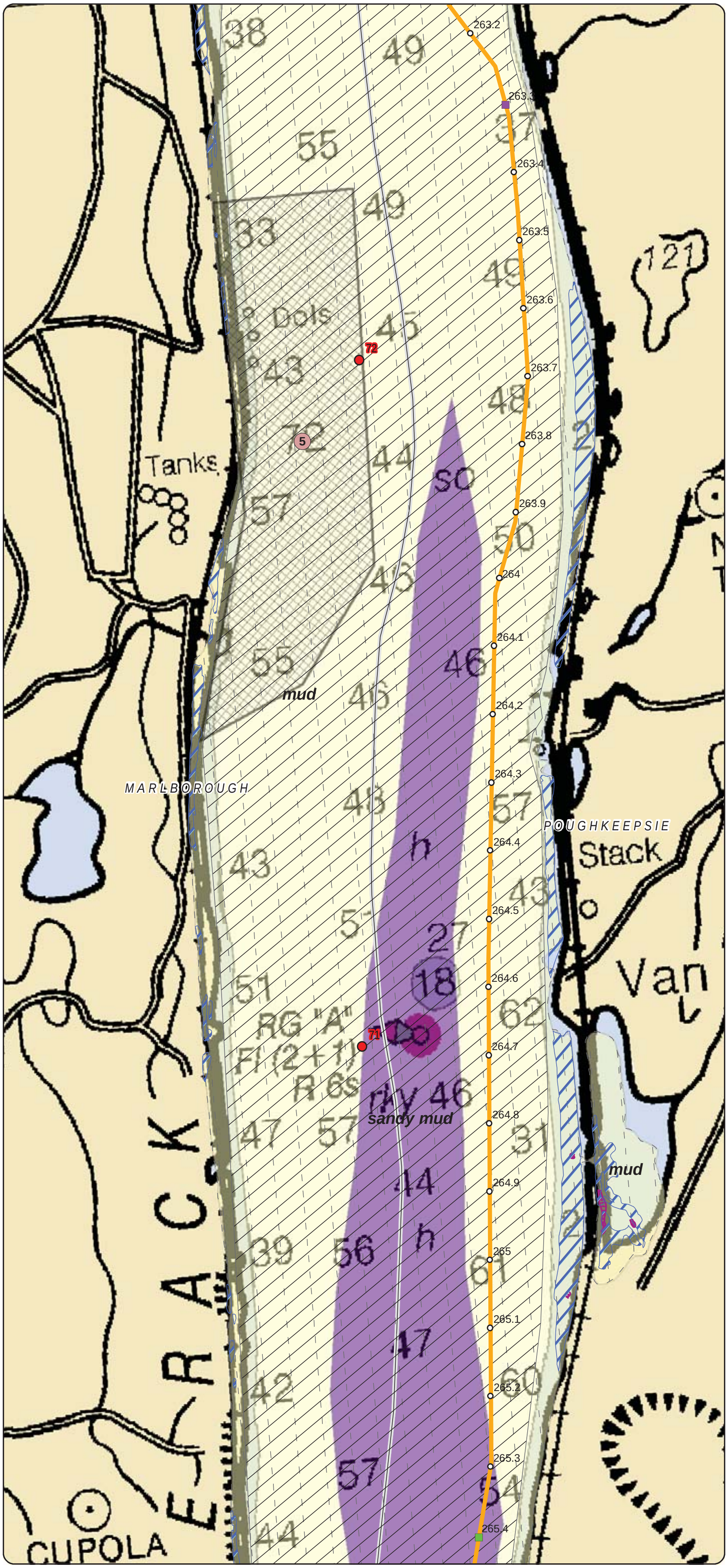

LEGEND

● 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

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▭ 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

N

0 750

Feet

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 17 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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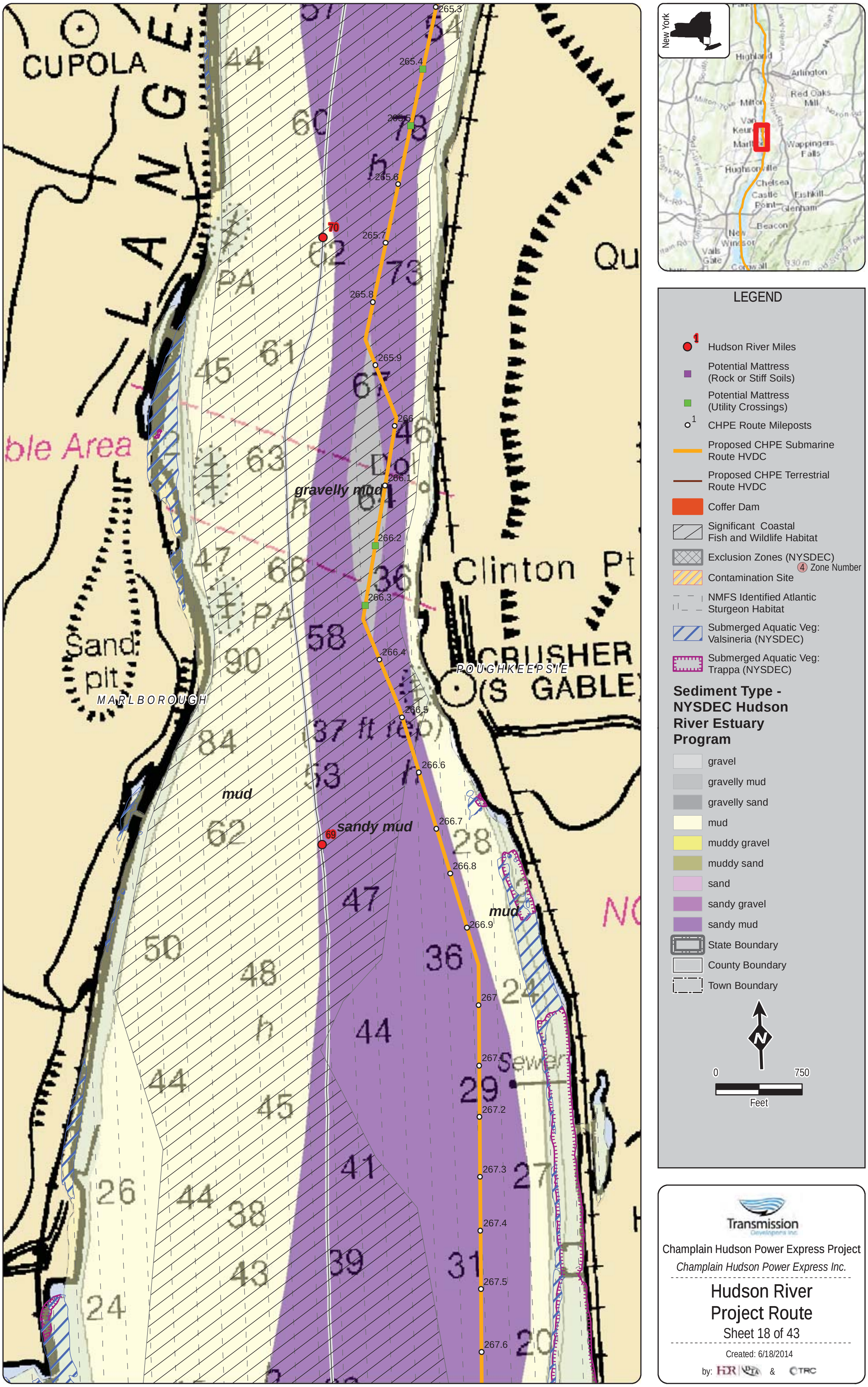

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 18 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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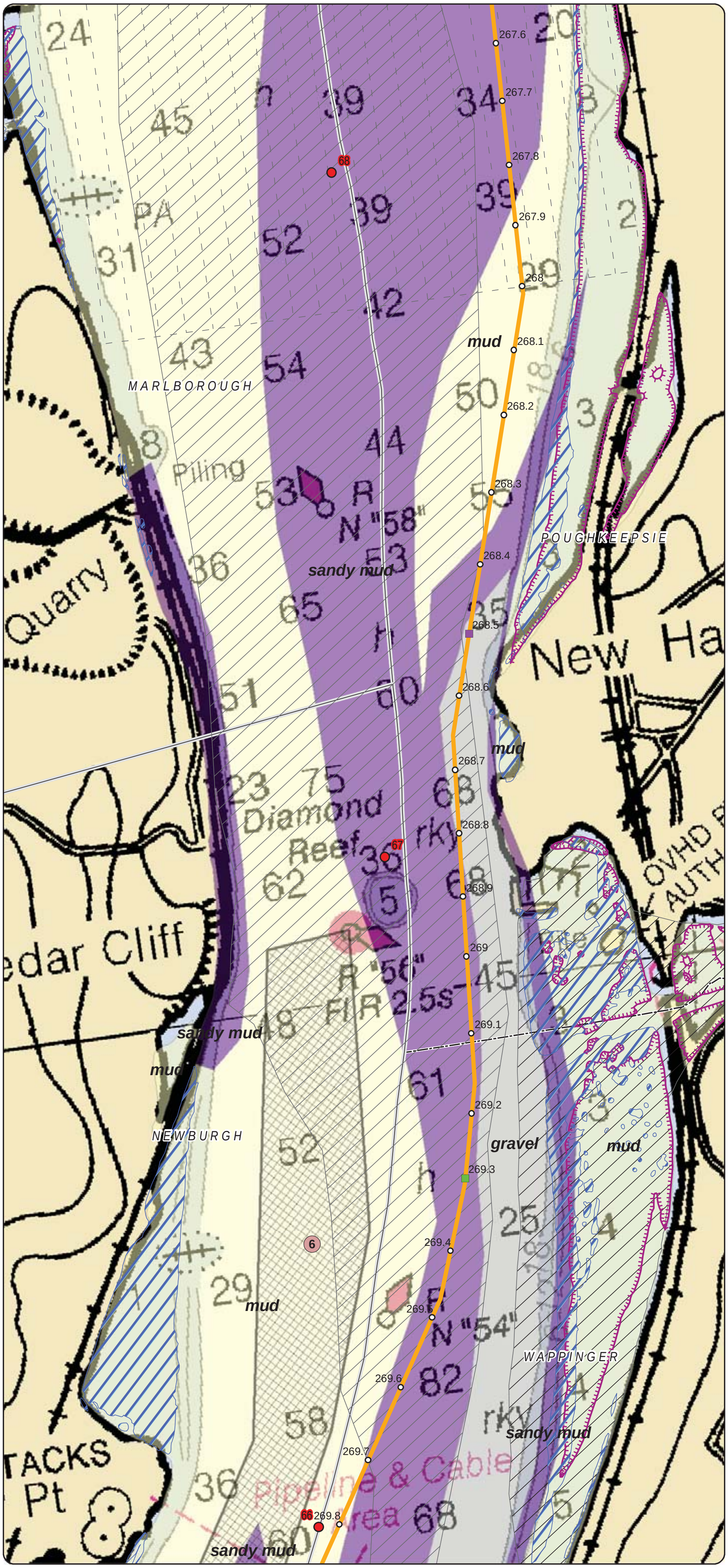

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 19 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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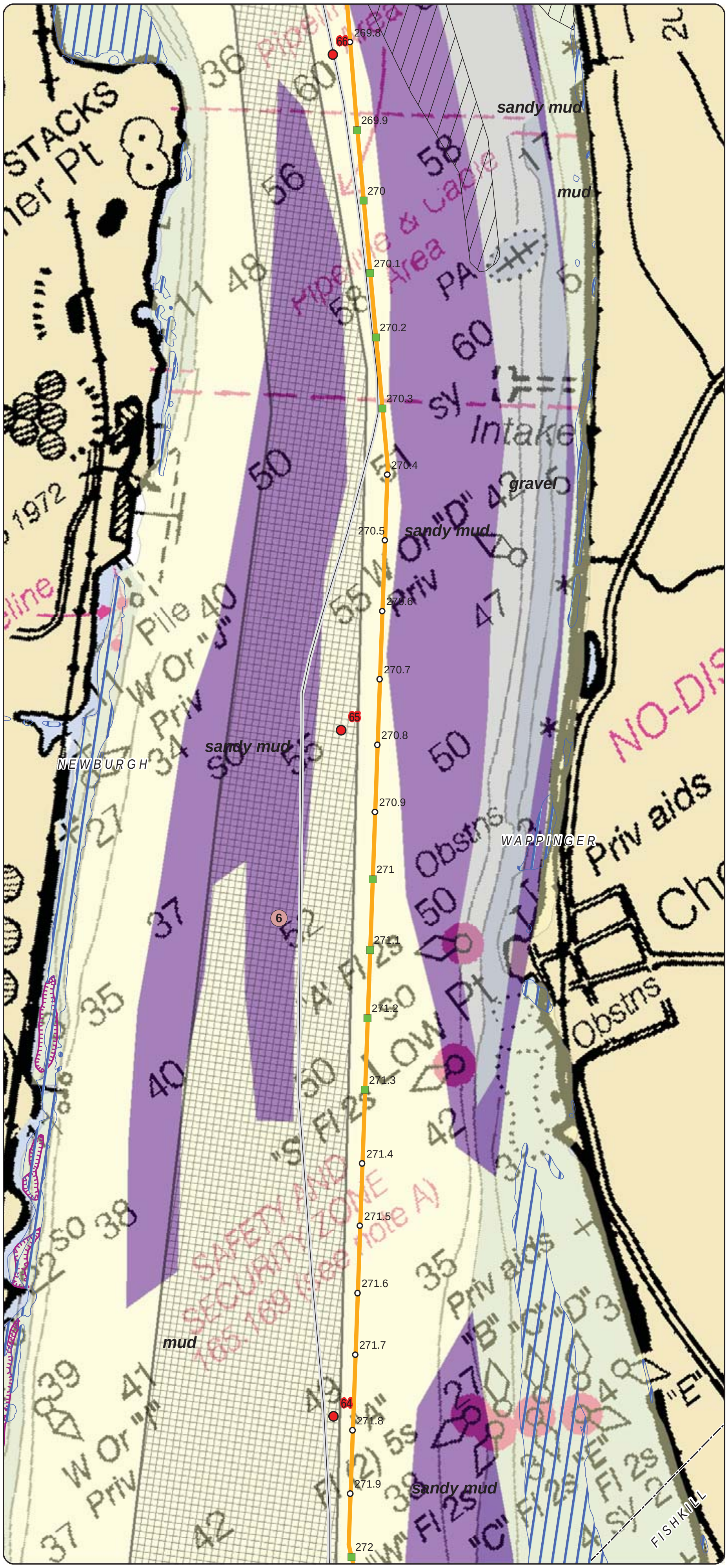
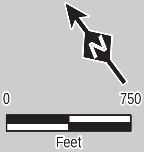


LEGEND

- ● 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



Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 20 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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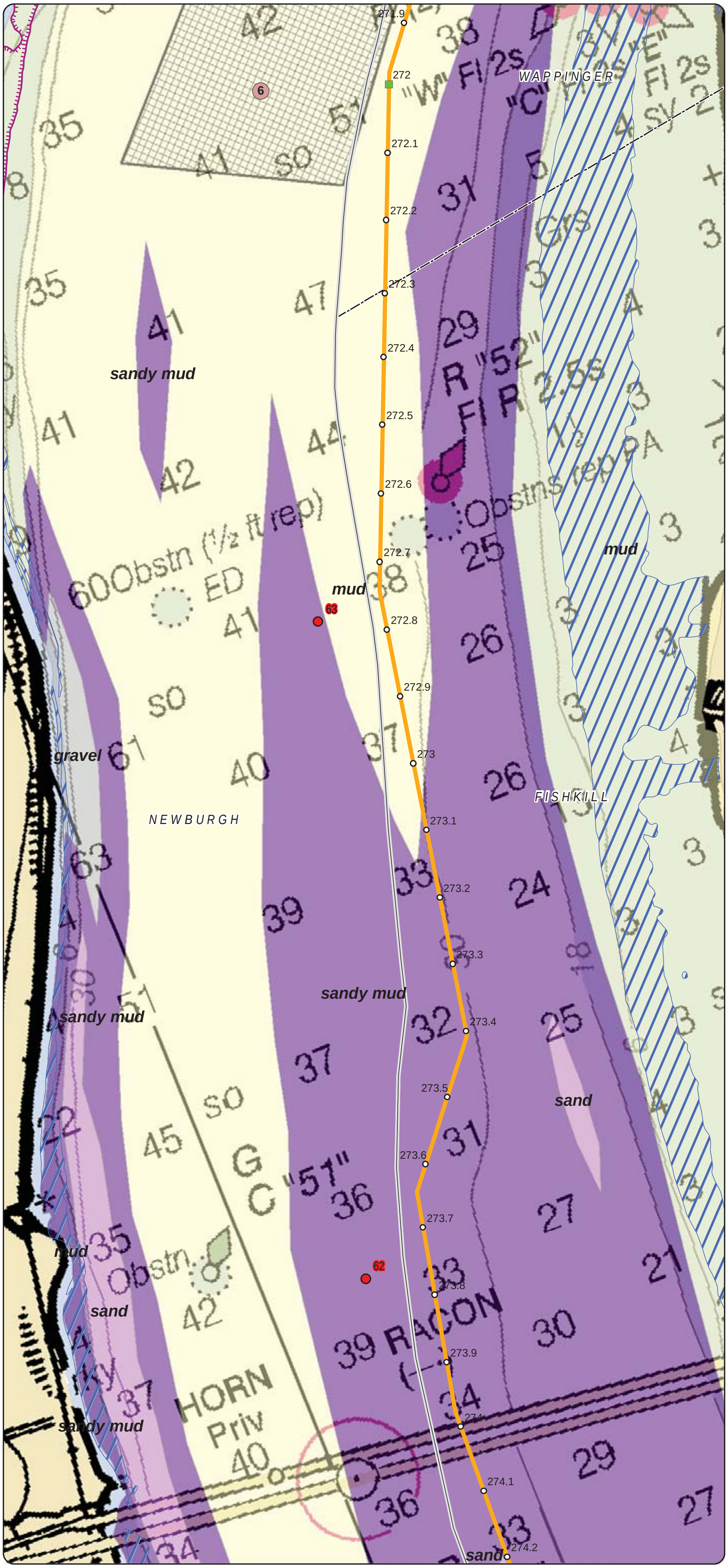

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 21 of 43

Created: 6/18/2014

by: HDR | 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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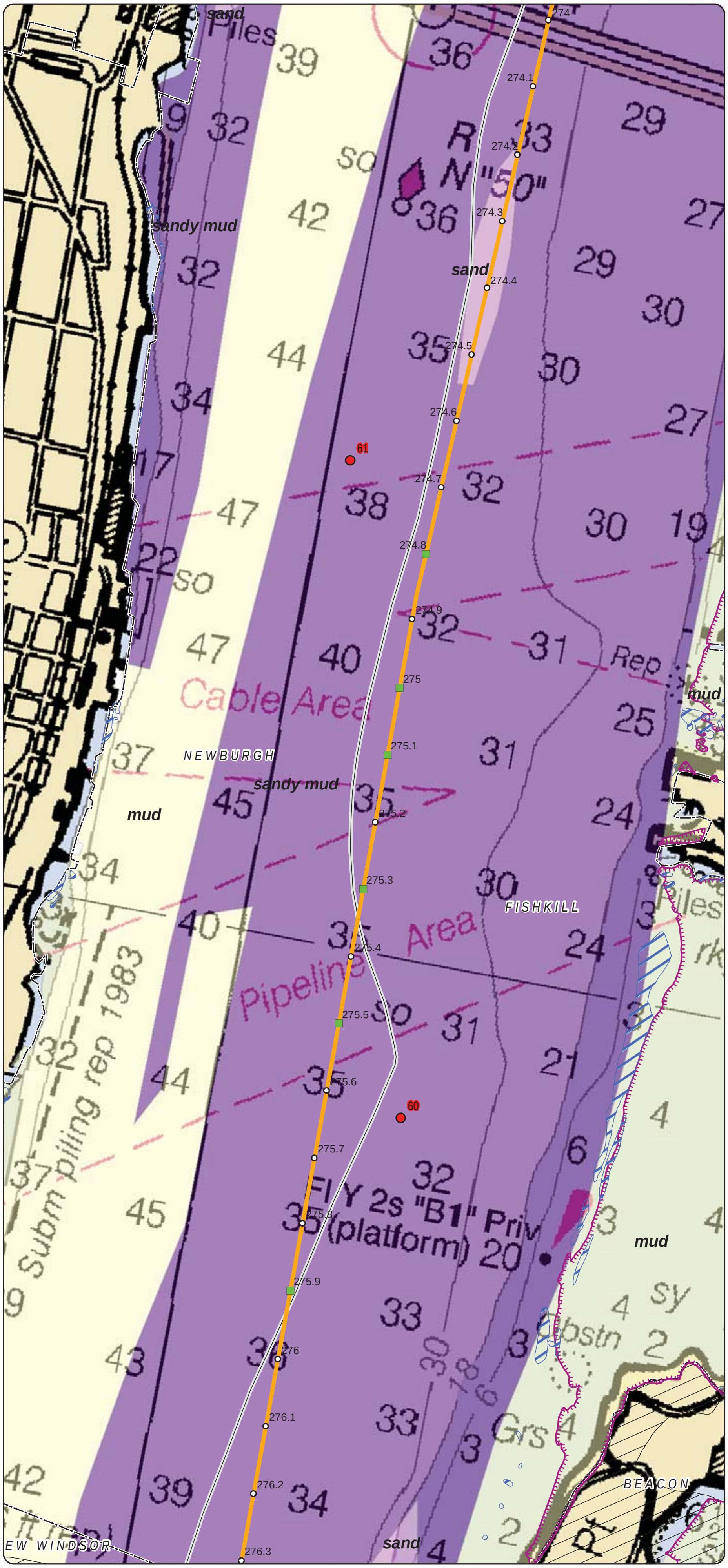

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 22 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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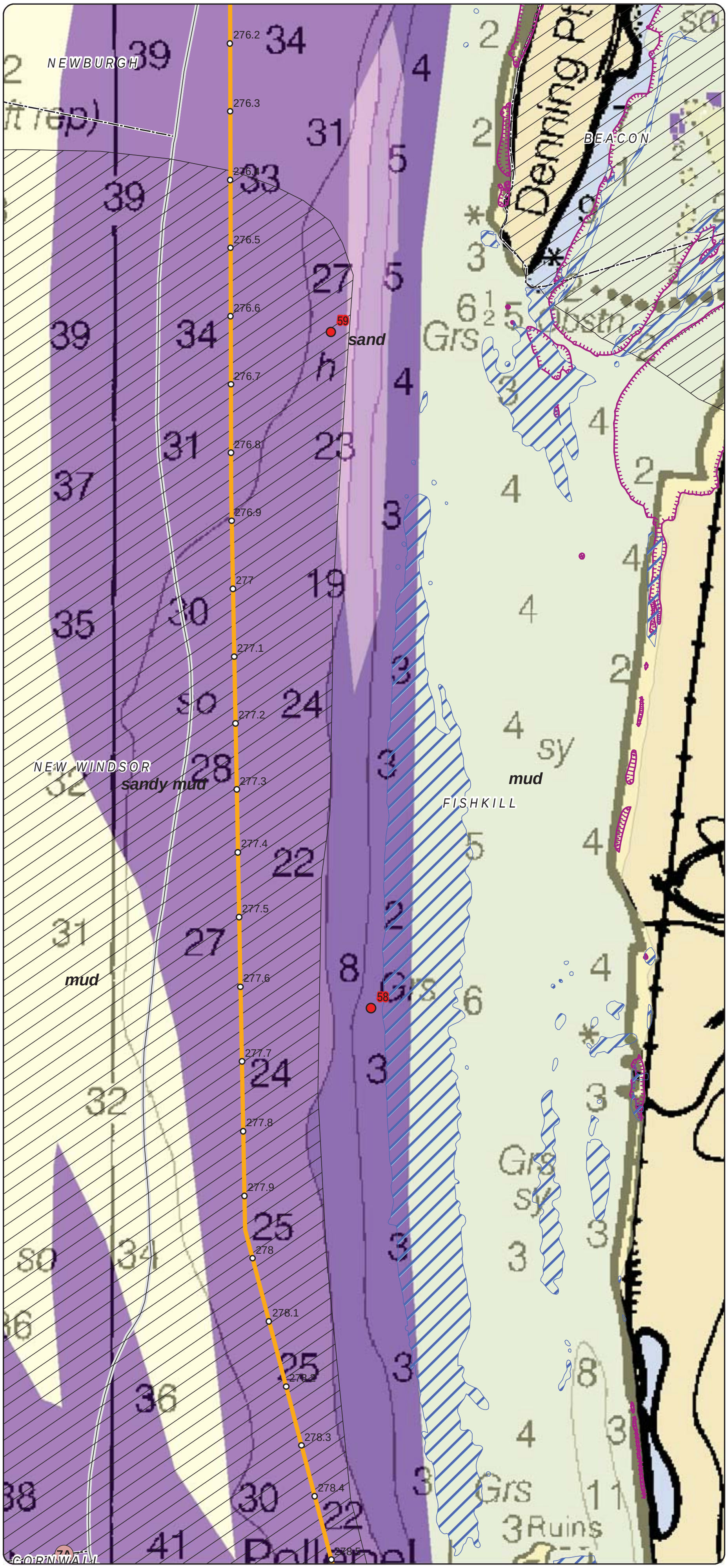

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 23 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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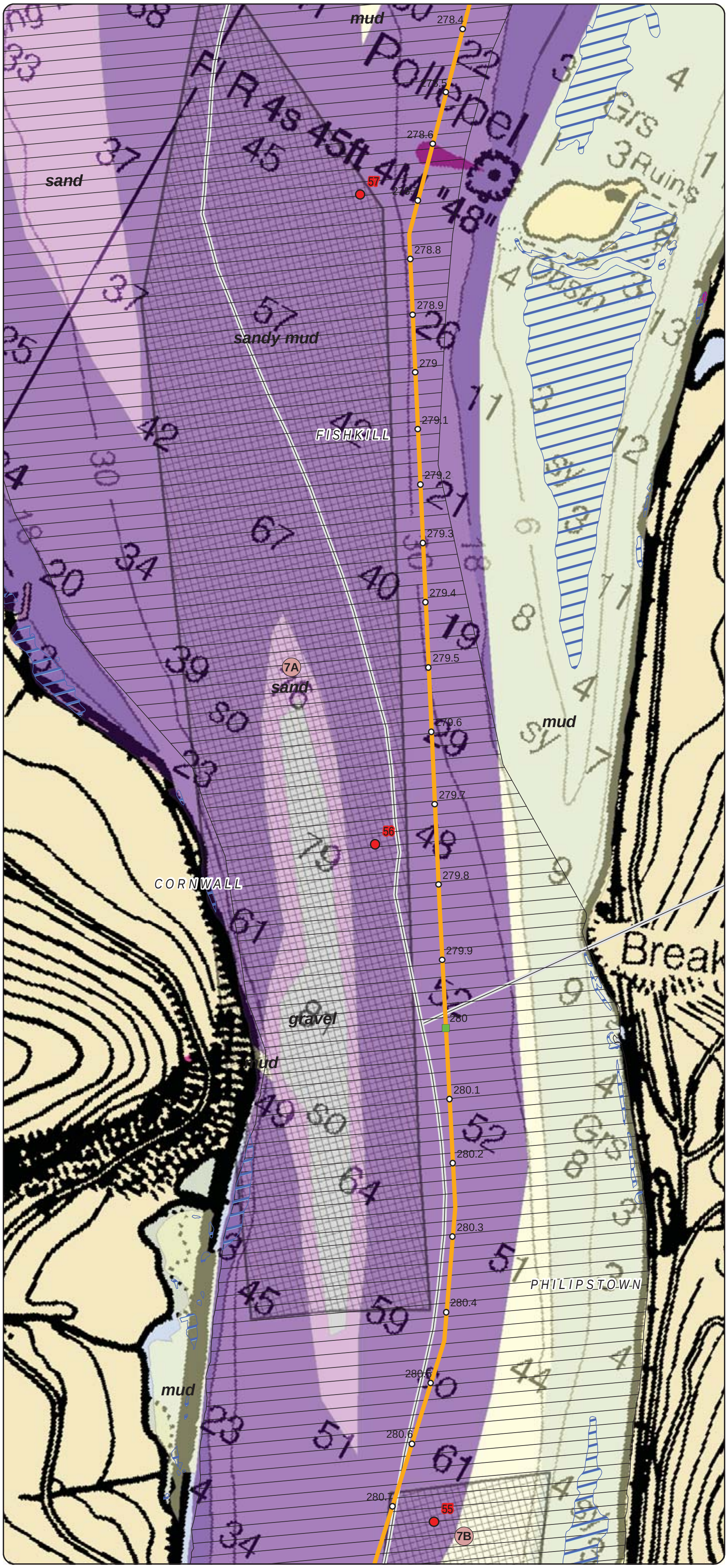

LEGEND

- ● 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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 24 of 43

Created: 6/18/2014

by: HDR | Ecology & Environment & 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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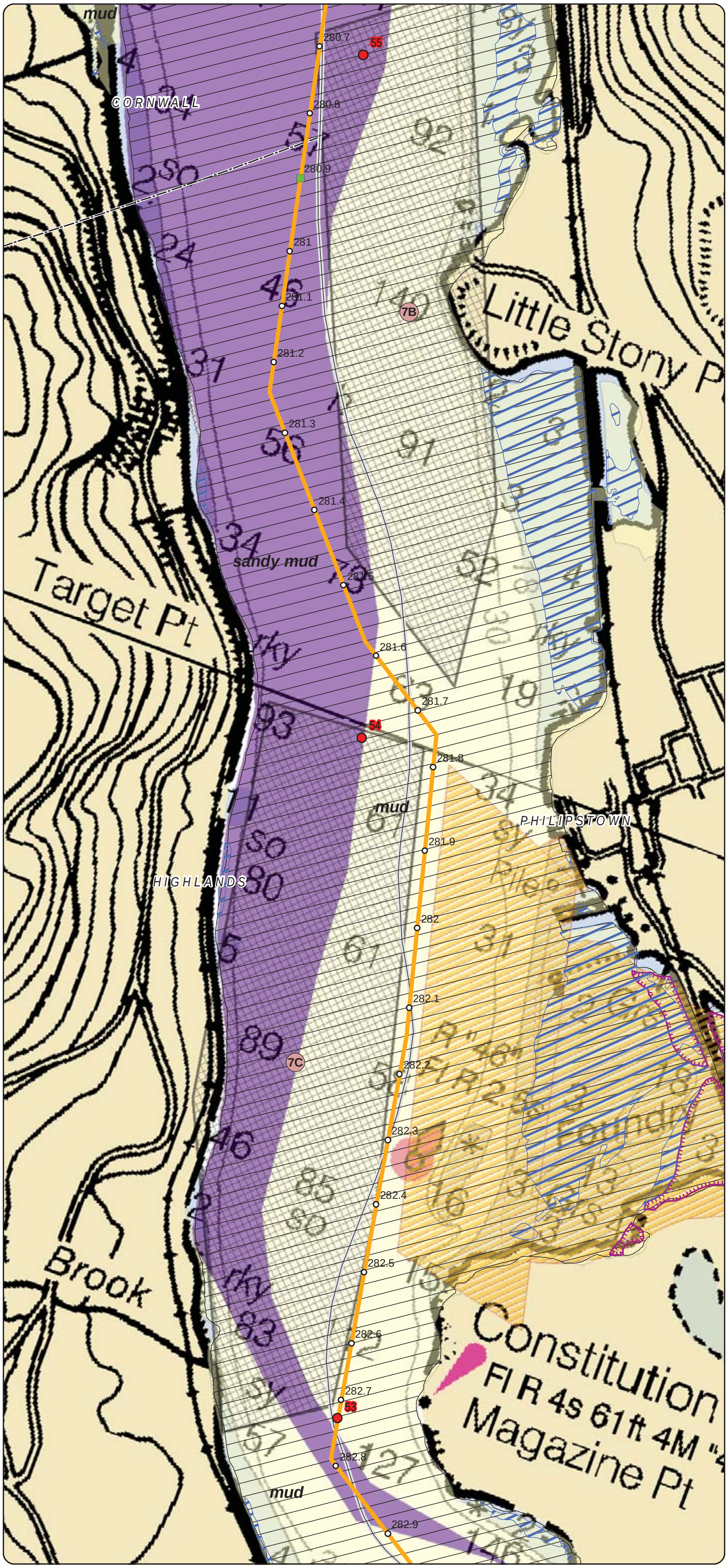

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 25 of 43

Created: 6/18/2014

by: HDR | TDA & 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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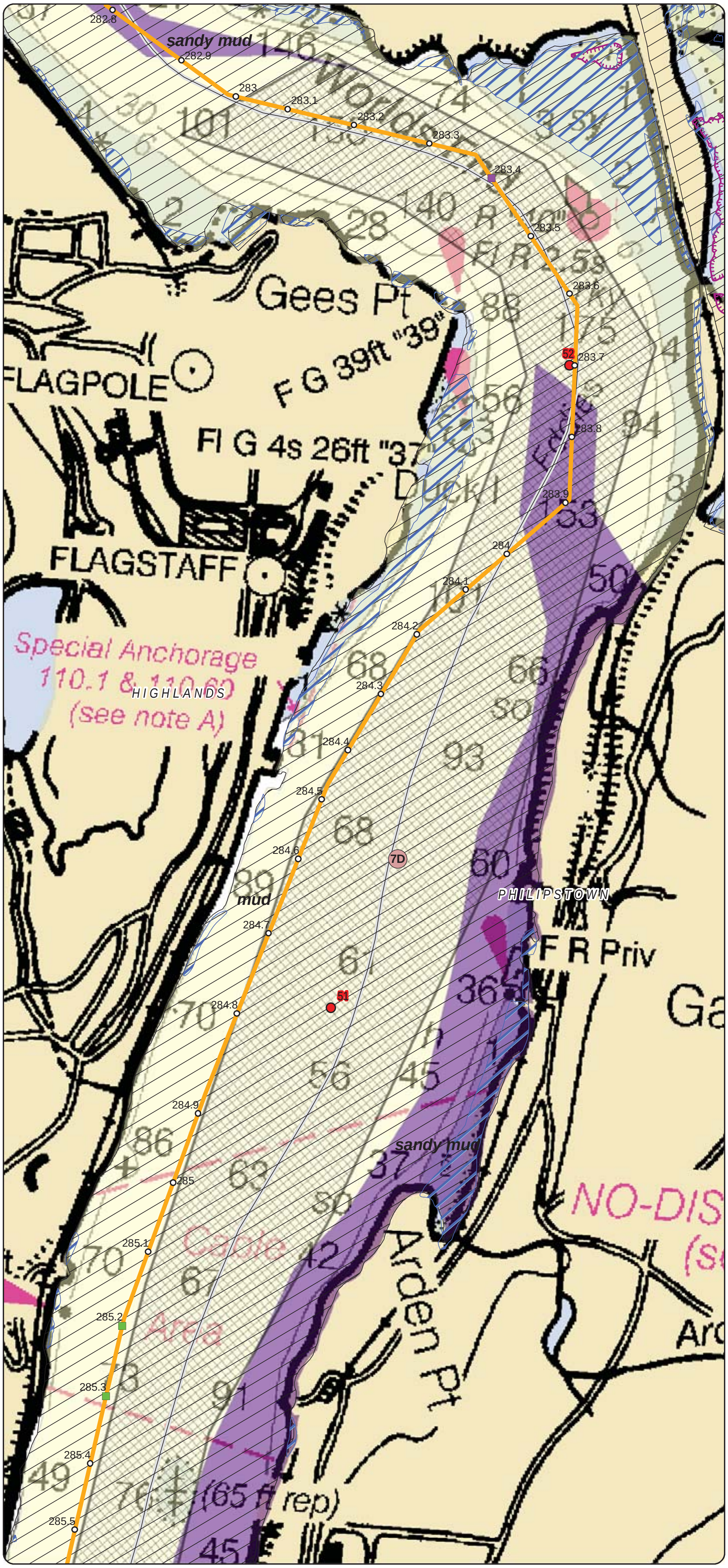

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 26 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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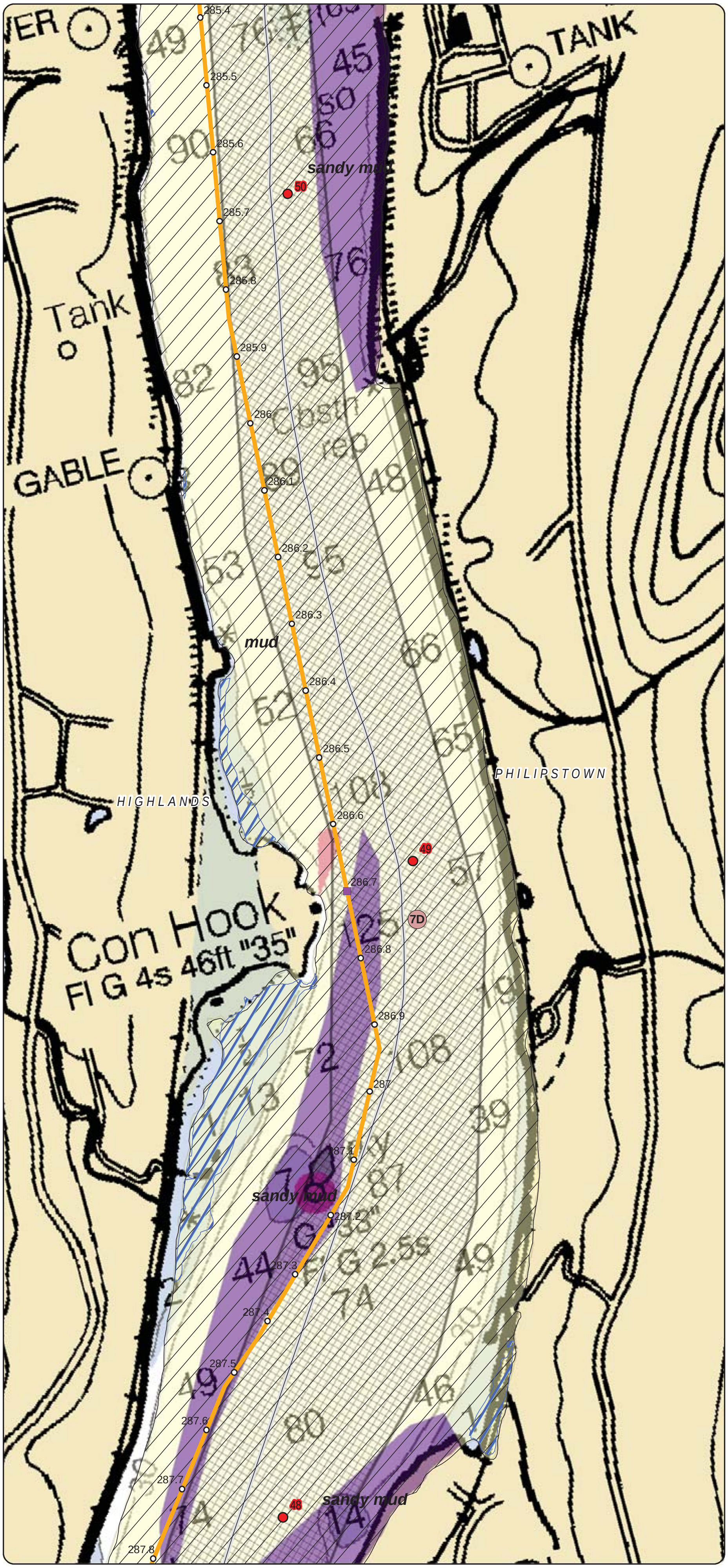

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 27 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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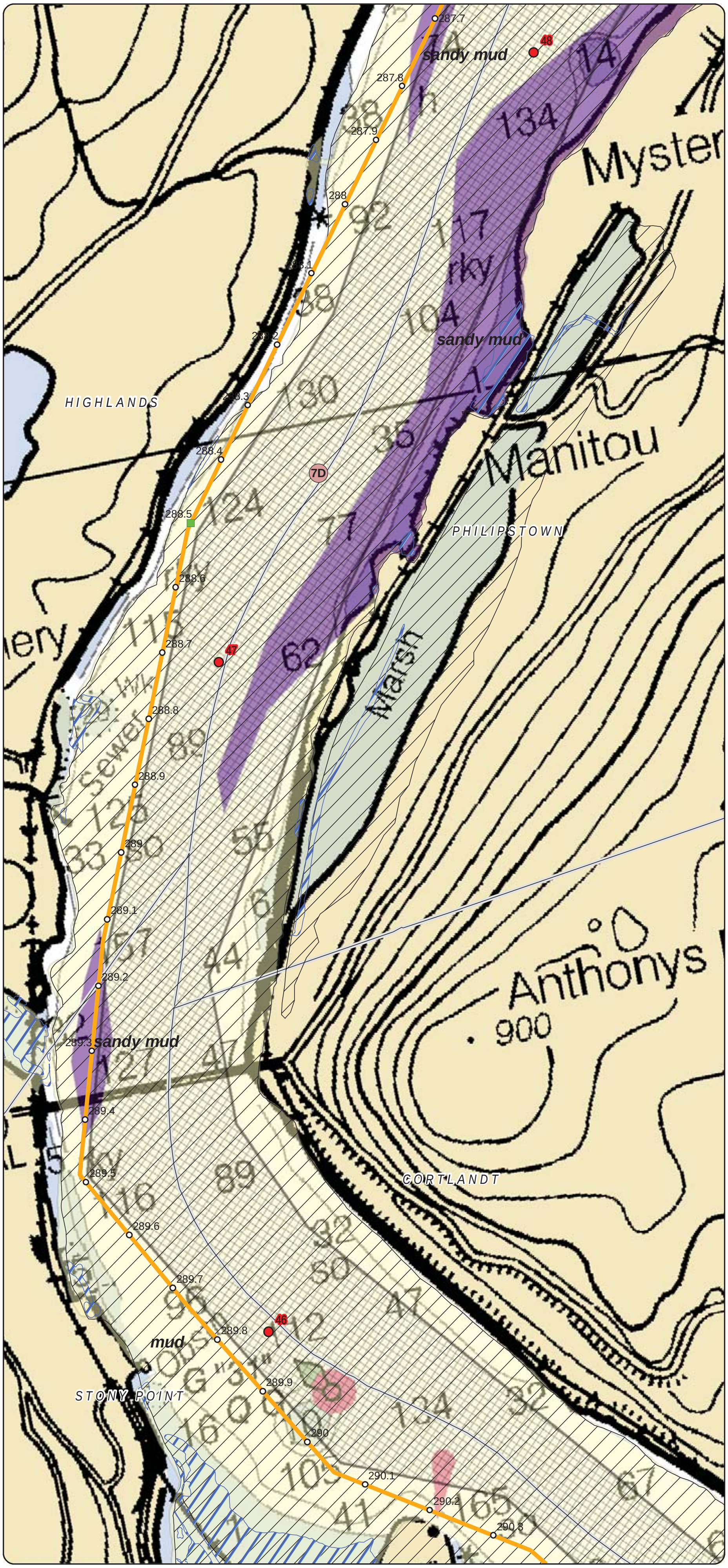

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 28 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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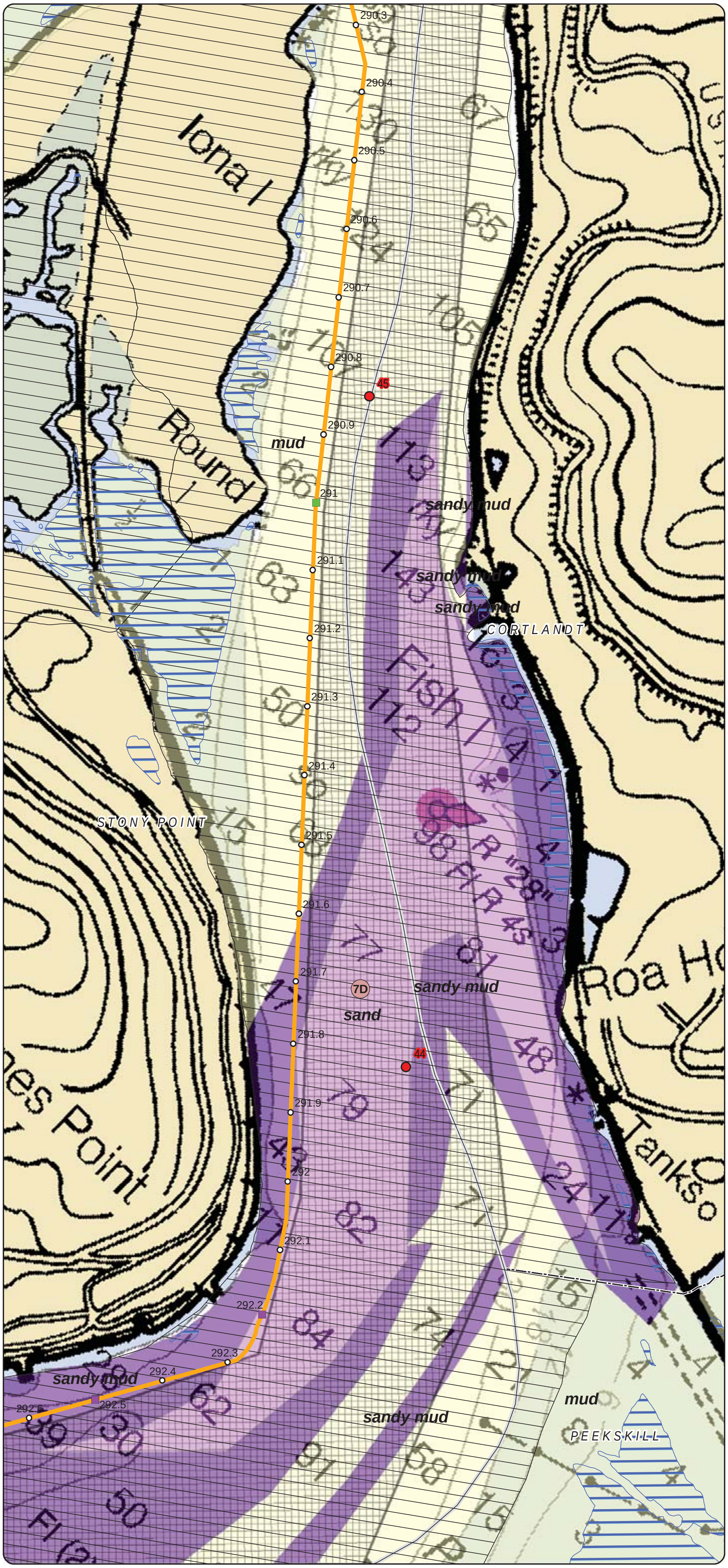

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 29 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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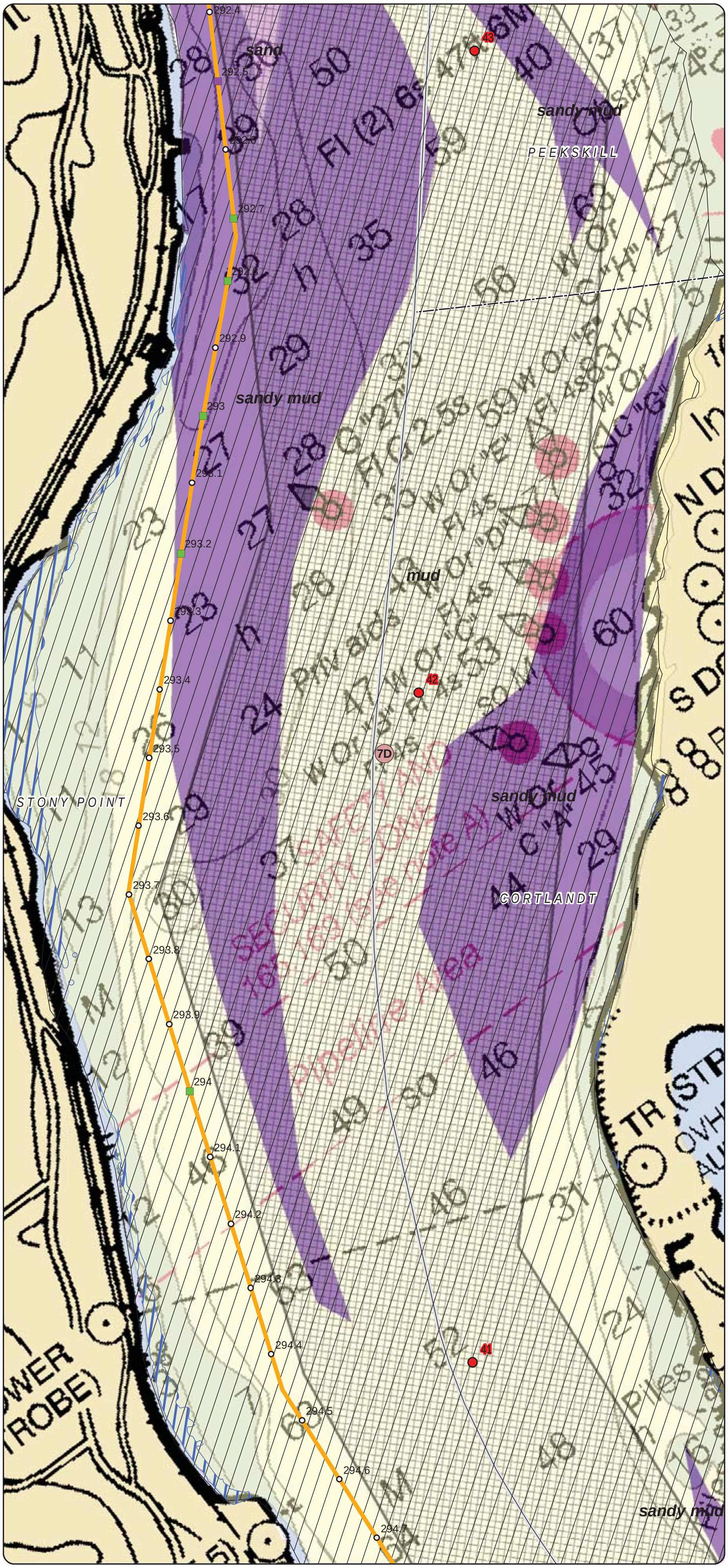

LEGEND

- ● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 30 of 43

Created: 6/18/2014

by: HDR | [illegible] & 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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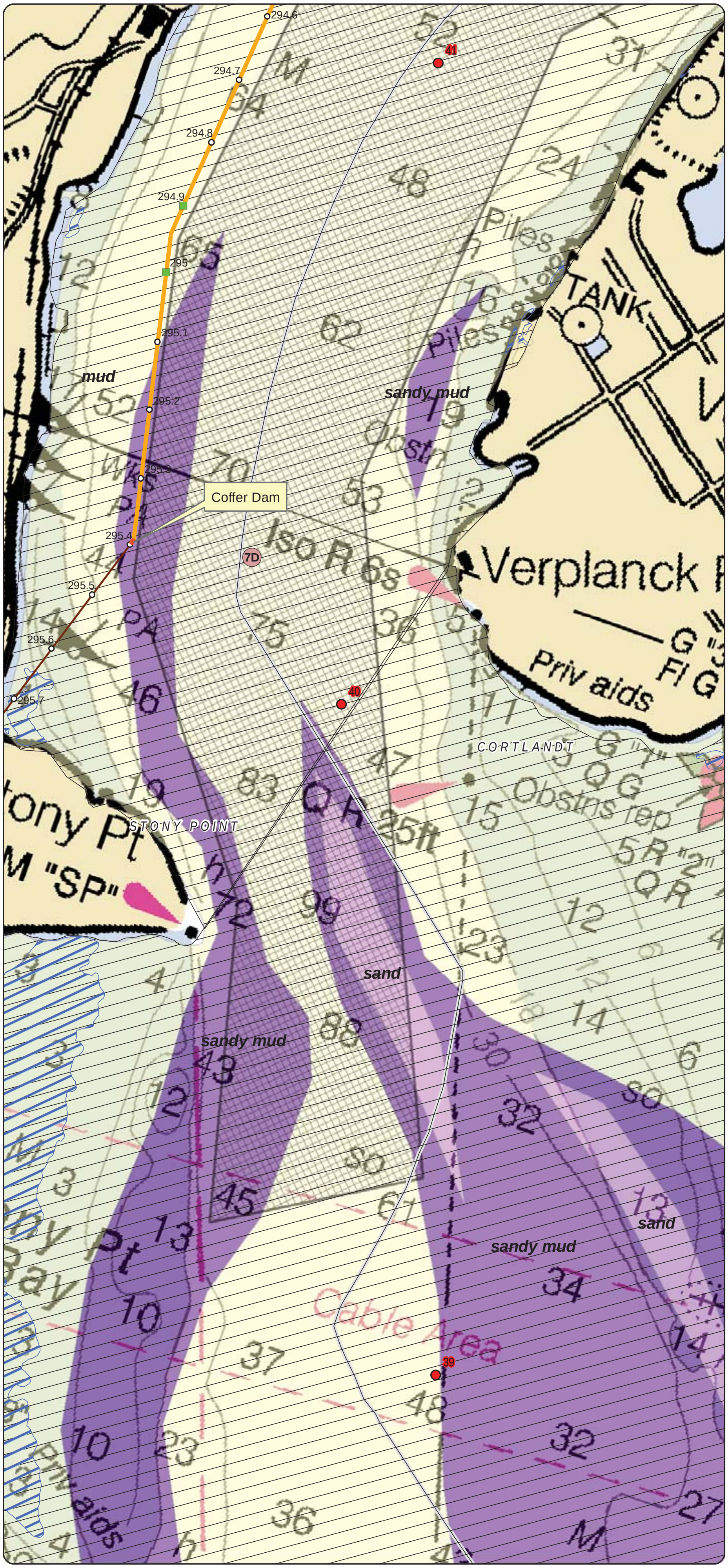

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 31 of 43

Created: 6/18/2014

by: HDR | VHB & 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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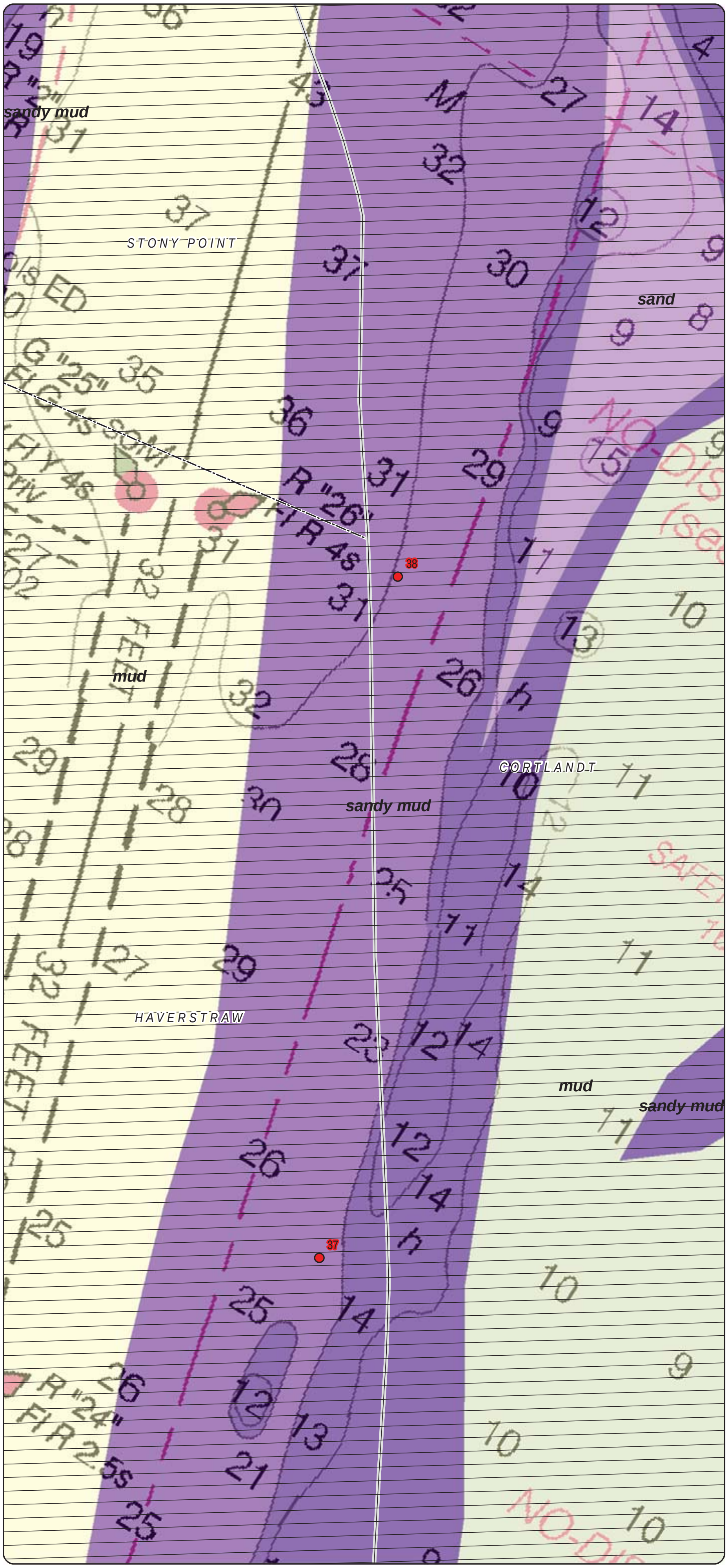
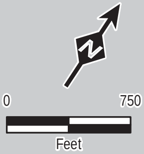


LEGEND

- ● 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



Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 32 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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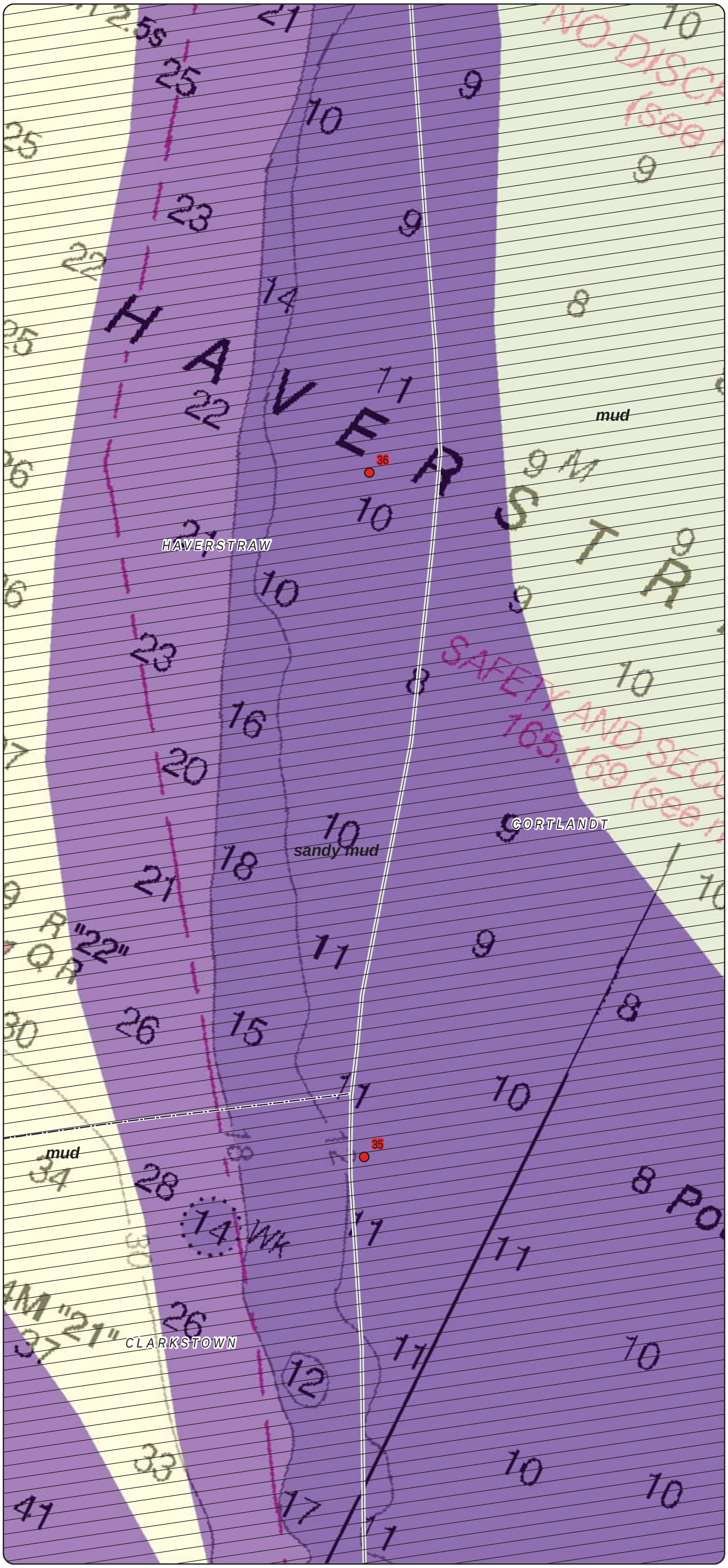

LEGEND

● 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

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 33 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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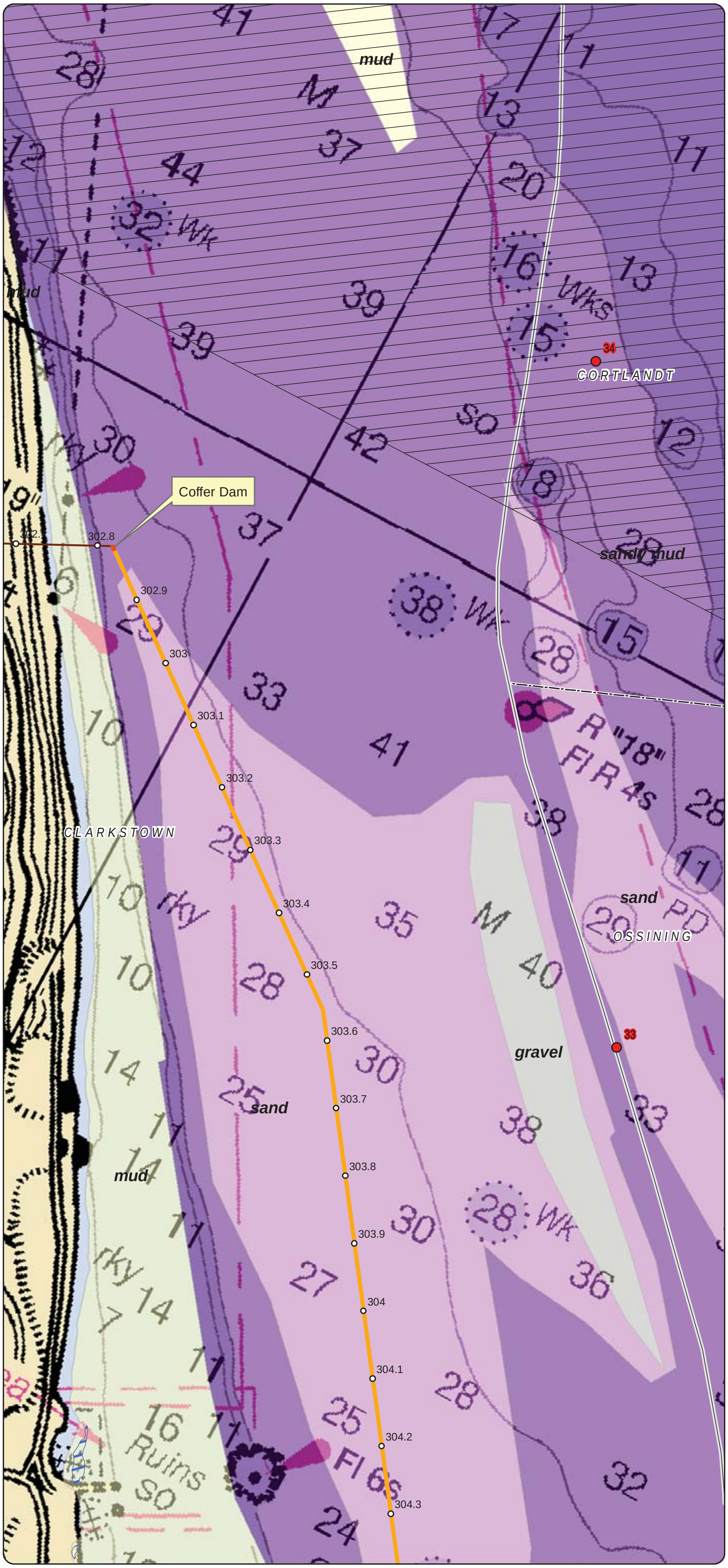

LEGEND

●	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

N

0 750
Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 34 of 43

Created: 6/18/2014

by: HDR | ESA & 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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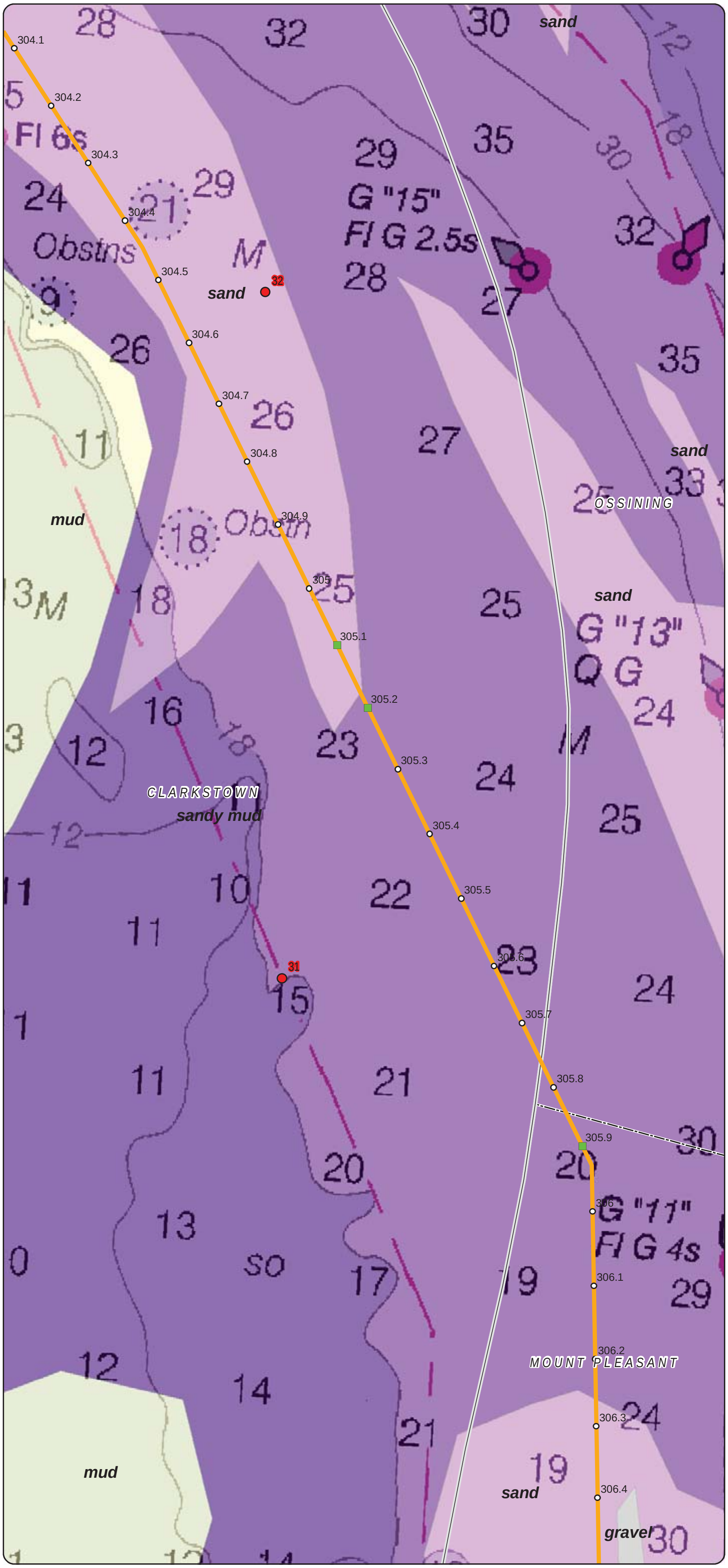

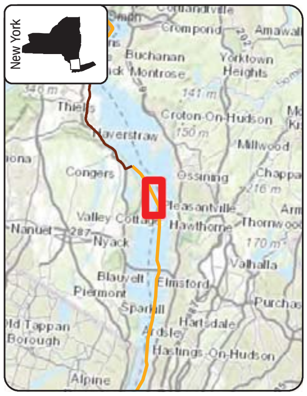

LEGEND

- ● 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
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- ▭ State Boundary
- ▭ County Boundary
- ▭ Town Boundary

N

0 750

Feet

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 35 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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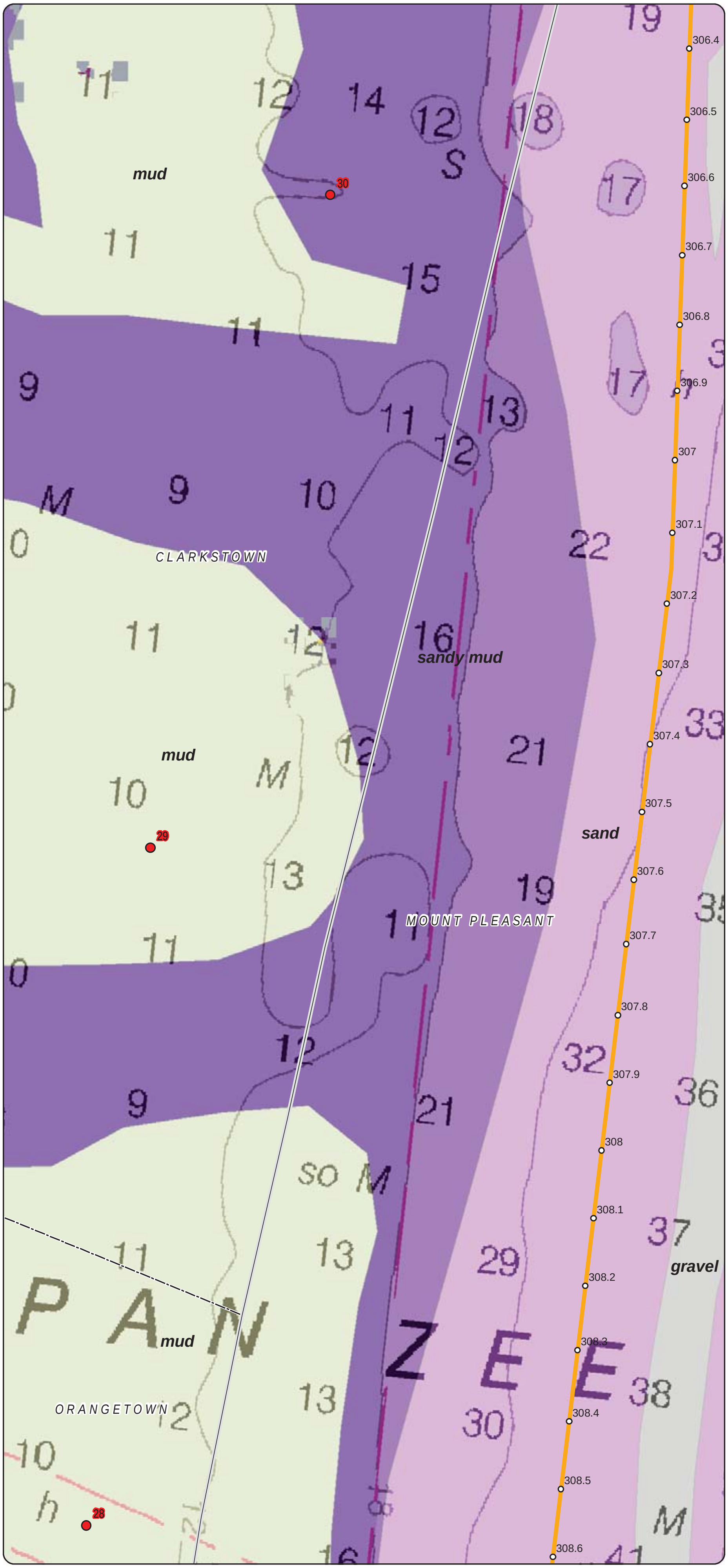

LEGEND

● 1 Hudson River Miles
■ Potential Mattress (Rock or Stiff Soils)
■ Potential Mattress (Utility Crossings)
○ 1 CHPE Route Mileposts
— Proposed CHPE Submarine Route HVDC
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▨ Significant Coastal Fish and Wildlife Habitat
▩ Exclusion Zones (NYSDEC) ④ Zone Number
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Sediment Type - NYSDEC Hudson River Estuary Program

■ gravel
■ gravelly mud
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■ mud
■ muddy gravel
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Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 36 of 43

Created: 6/18/2014

by: HDR | PTA & 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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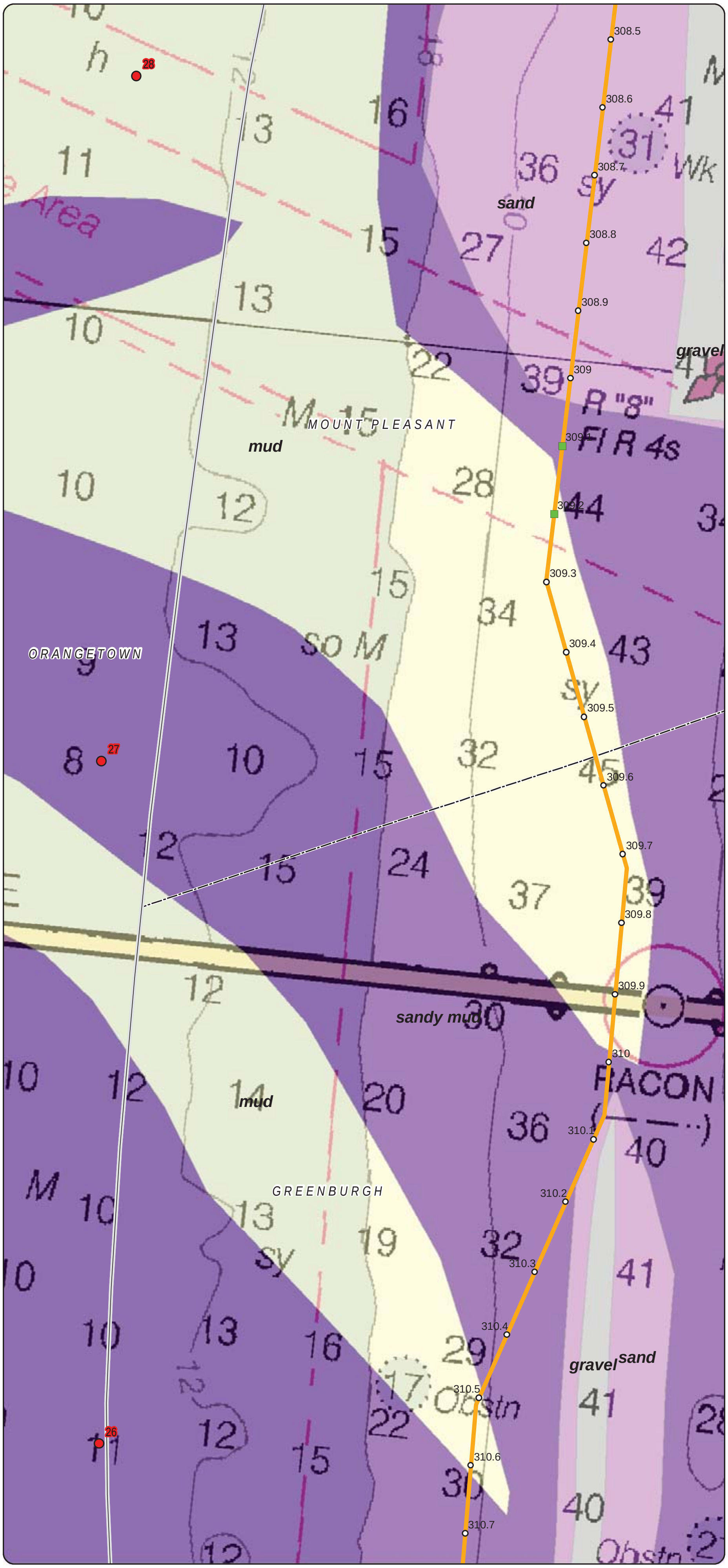

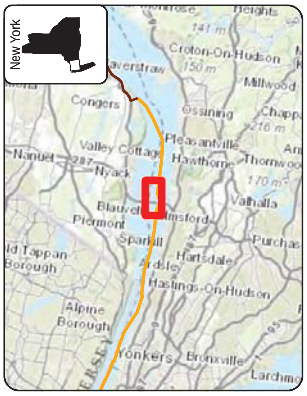

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Transmission Developers Inc.

Champlain Hudson Power Express Project

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Hudson River Project Route

Sheet 37 of 43

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by: HDR | ESTA & TRC

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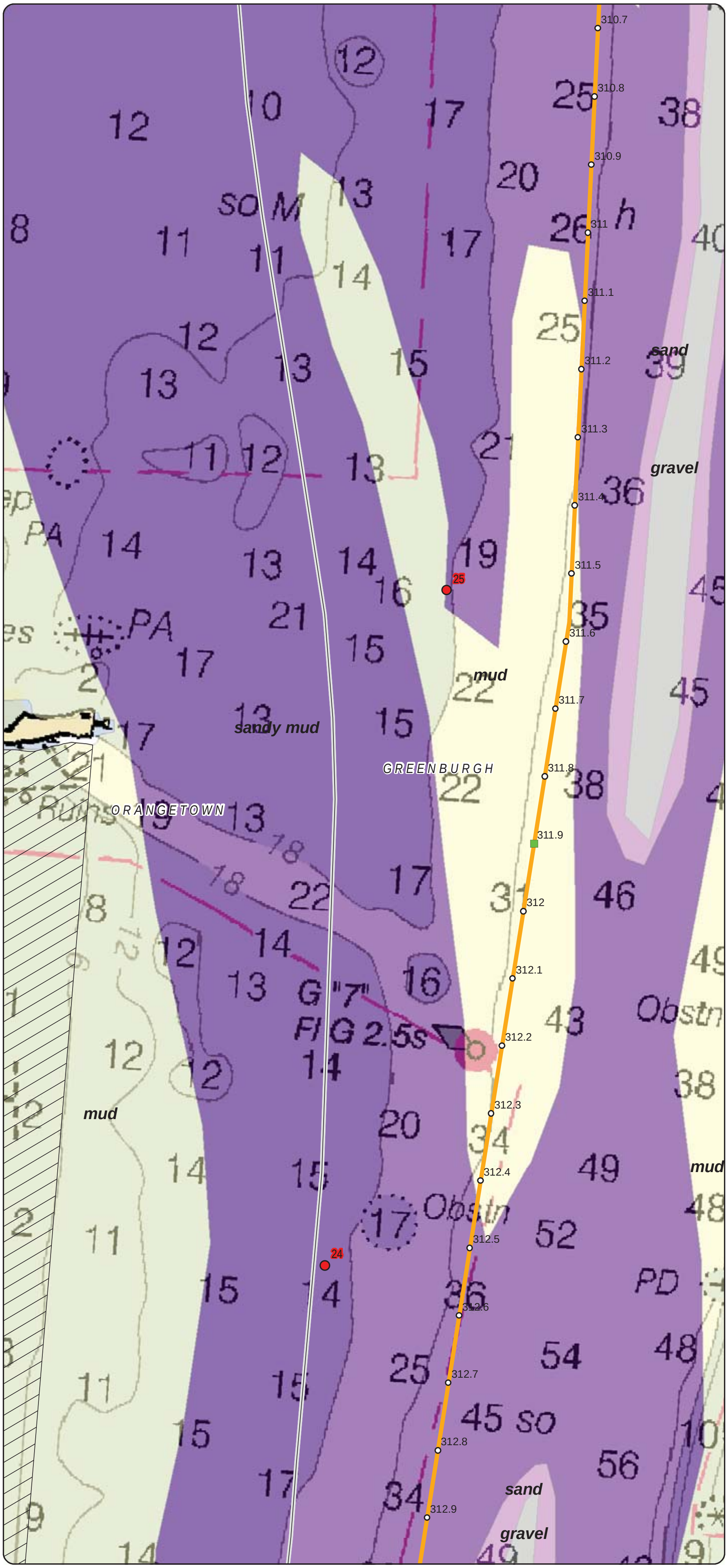

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Hudson River Project Route

Sheet 38 of 43

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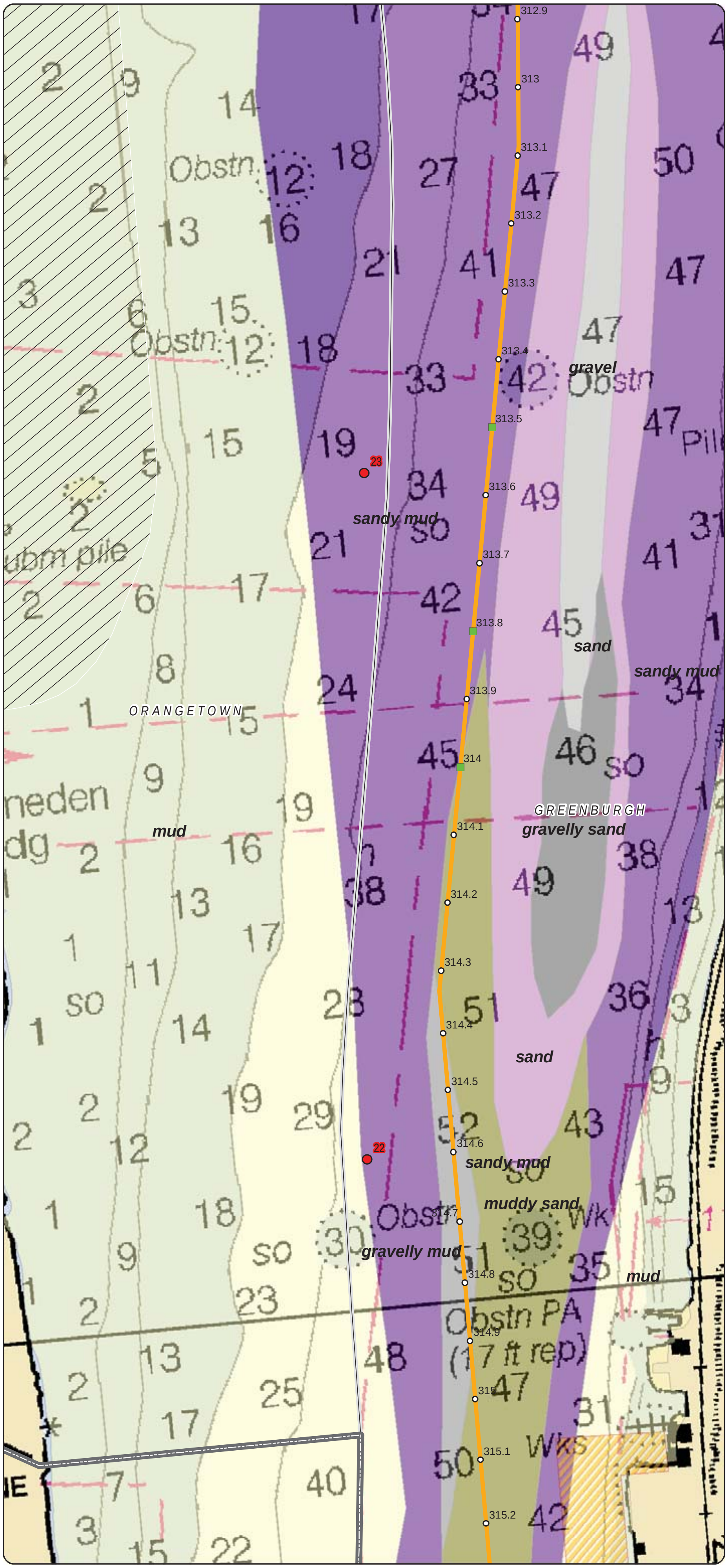

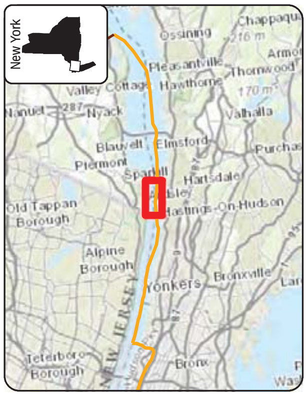

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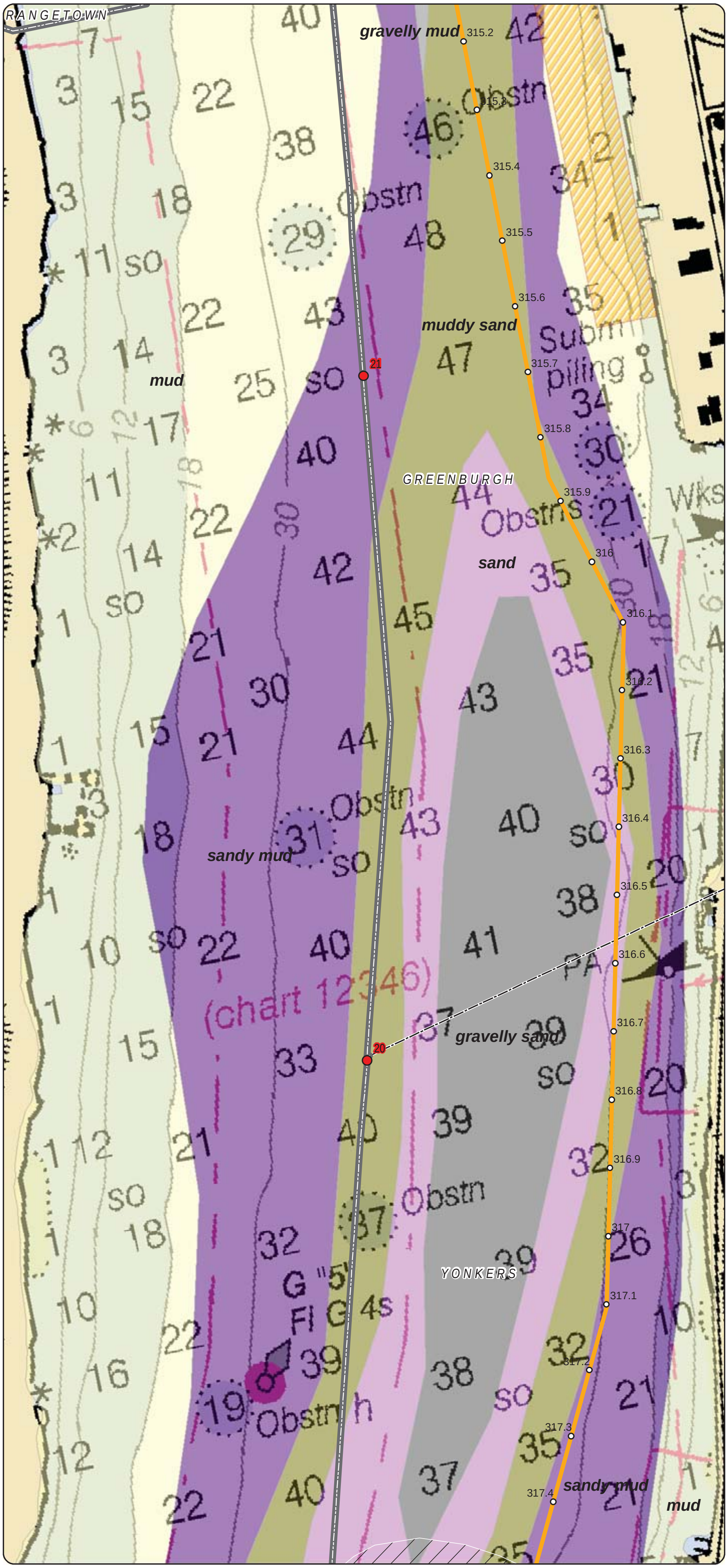

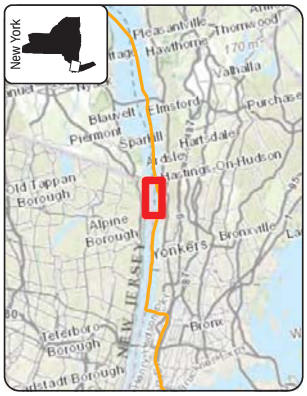

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Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Hudson River Project Route

Sheet 40 of 43

Created: 6/18/2014

by: HDR | [illegible] & TRC

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

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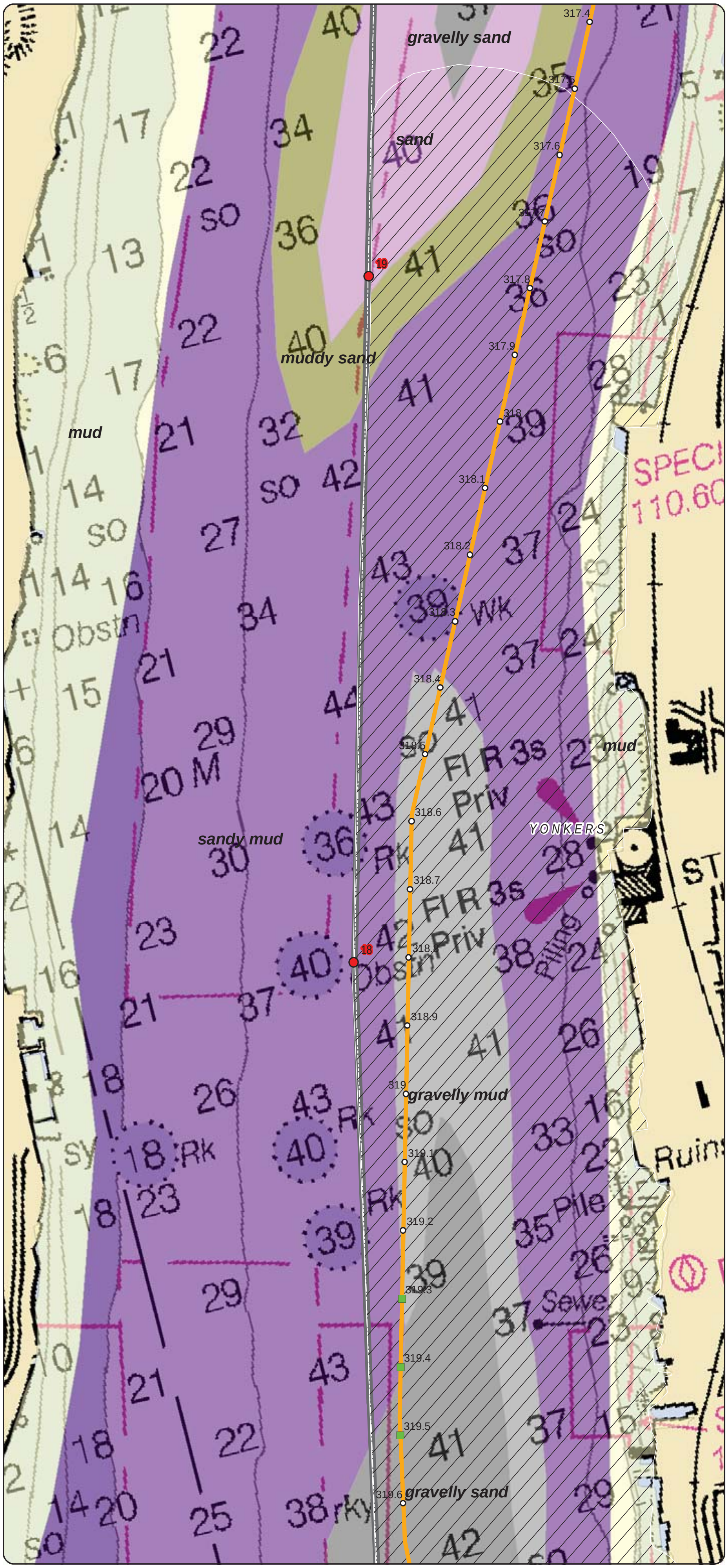

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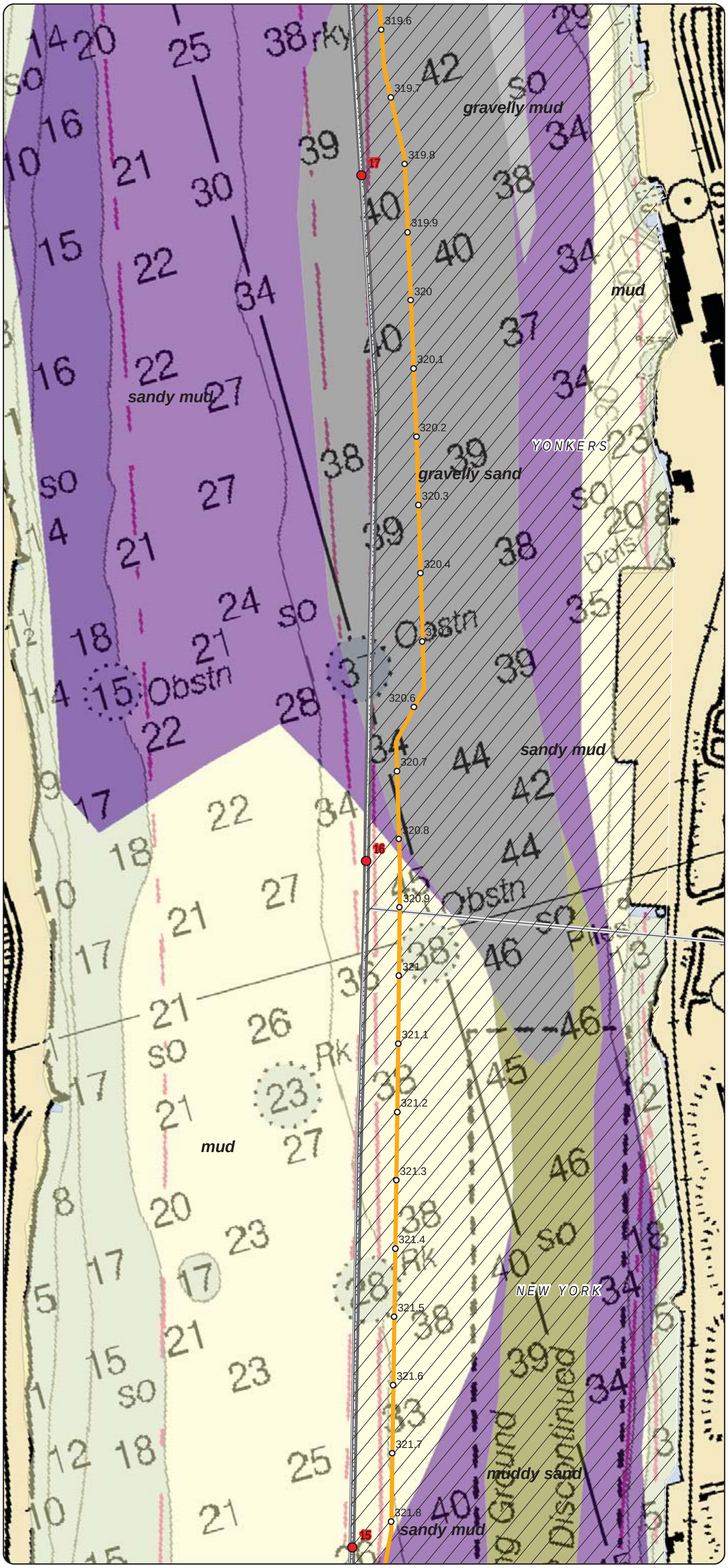

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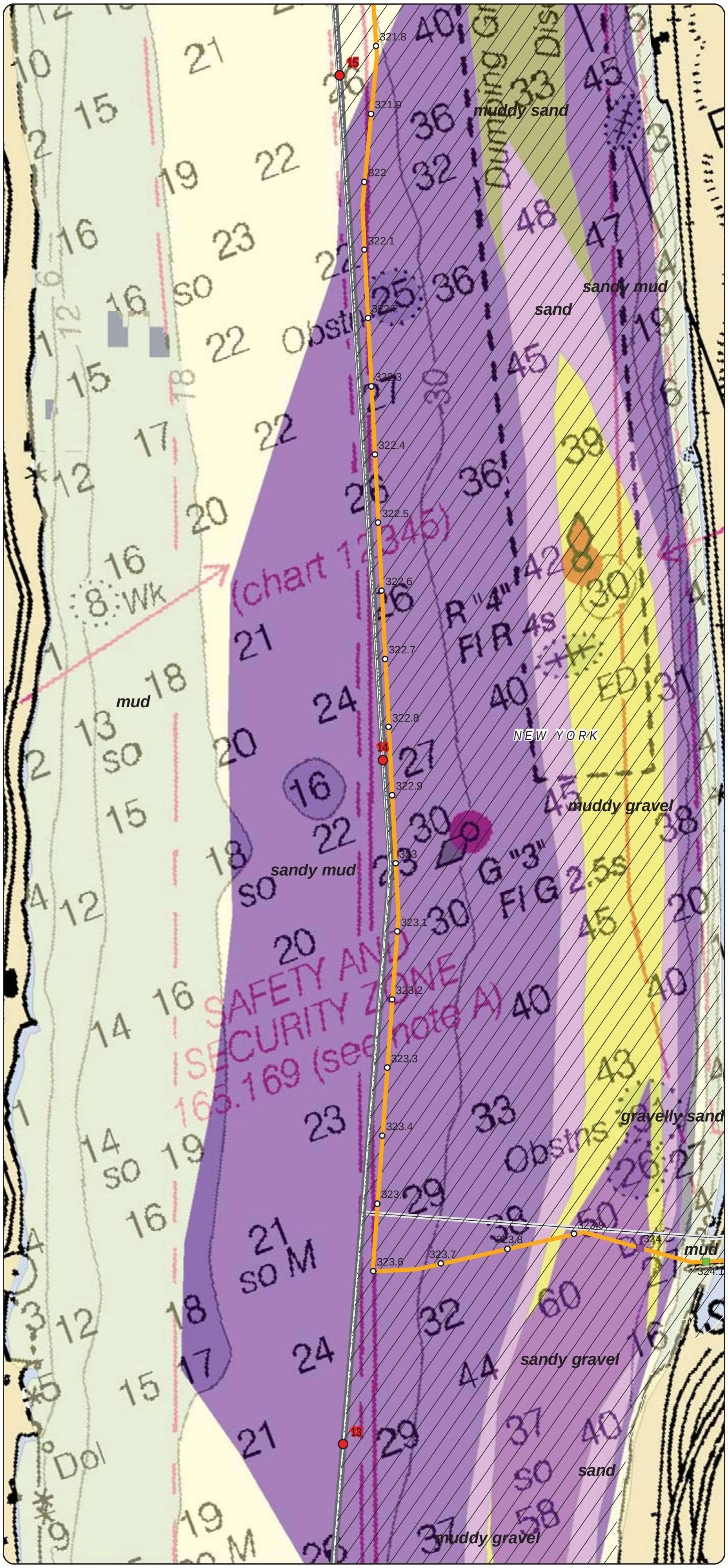

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by: HDR | TRC

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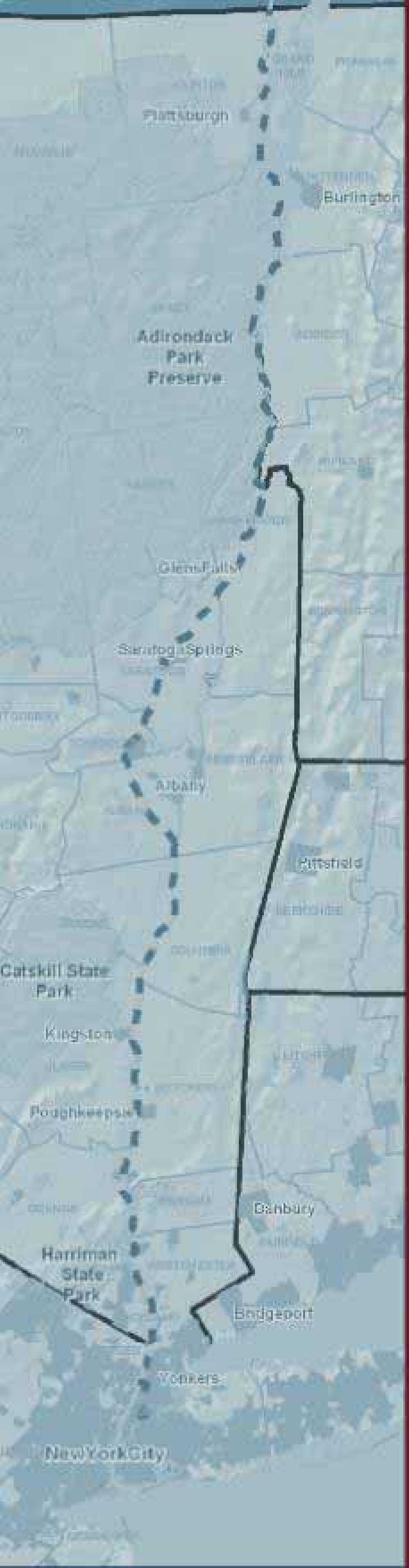
APPENDIX S

Floodplain Statement of Findings



FLOODPLAIN STATEMENT OF FINDINGS

for the

Champlain Hudson Power Express Transmission Line Project

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

May 2014

ACRONYMS AND ABBREVIATIONS

AC	alternating current
BFE	base flood elevation
BMP	best management practice
CFR	Code of Federal Regulations
CHPE	Champlain Hudson Power Express
CP	Canadian Pacific
CSX	CSX Corporation
DC	direct current
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EO	Executive Order
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
HDD	horizontal directional drilling
HVDC	high-voltage direct current
MP	milepost
MSL	mean sea level
MW	megawatt
NEPA	National Environmental Policy Act
NYSPSC	New York State Public Service Commission
ROI	region of influence
ROW	right-of-way

FLOODPLAIN STATEMENT OF FINDINGS

FOR THE

CHAMPLAIN HUDSON POWER EXPRESS TRANSMISSION LINE PROJECT

U.S. Department of Energy

OFFICE OF ELECTRICITY DELIVERY AND ENERGY RELIABILITY

MAY 2014

Summary

This Floodplain Statement of Findings has been prepared by the U.S. Department of Energy (DOE) in support of a potential issuance of a Presidential permit for the proposed Champlain Hudson Power Express (CHPE) Transmission Line Project. The proposed CHPE Project would involve construction of a buried electric power transmission system that would extend from the international border between the United States and Canada at Champlain, New York and run south to New York City metropolitan area electrical market. The transmission line would be constructed with significant portions of the route beneath Lake Champlain and the Hudson, Harlem, and East rivers. This Statement of Findings has been prepared in accordance with 10 Code of Federal Regulations Part 1022. DOE is reviewing the Presidential permit application that, if issued, would authorize the construction, operation, and maintenance of the United States portion of the project. The proposed electric power transmission system route would encounter floodplains designated by the Federal Emergency Management Agency. The Applicant has assessed the potential for adverse effects from the proposed CHPE Project on floodplains and has developed mitigation plans to avoid and minimize adverse effects on human life, property, and natural resources. DOE has determined that the proposed CHPE Project would avoid floodplains to the maximum extent practicable, that appropriate measures to minimize adverse effects on human health and safety and the functions and values provided by floodplains would be taken, and that the project would comply with applicable floodplain protection standards.

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FLOODPLAIN STATEMENT OF FINDINGS
FOR THE
CHAMPLAIN HUDSON POWER EXPRESS TRANSMISSION LINE PROJECT

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FIGURES

1. Proposed CHPE Project Route 3

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1. Introduction

This Floodplain Statement of Findings addresses the proposed Champlain Hudson Power Express (CHPE) Transmission Line Project route that would cross the international border between the United States and Canada and would be buried underground and would run south through Lake Champlain, roadway and railroad rights-of-way (ROWs), and beneath the Hudson, Harlem, and East rivers in New York State to its terminus in the New York City metropolitan area. The U.S. Department of Energy (DOE) has prepared the *Champlain Hudson Power Express Transmission Line Project Environmental Impact Statement* concurrently with this Statement of Findings. Described in this Statement of Findings are (1) a description of the Proposed Action; (2) justification for locating the Proposed Action in a floodplain; (3) description of the project alternatives evaluated in the Environmental Impact Statement (EIS); (4) determination of conformance with applicable floodplain protection standards; and (5) mitigations that would be implemented to avoid, minimize, and offset potential for those adverse effects. An assessment of effects on floodplains was also incorporated into Chapters 3 and 5 of the EIS. Detailed maps depicting the route for the transmission line installation and the construction of associated structures along each segment of the proposed CHPE Project are included in Appendix A of the EIS.

2. Purpose of the Proposed Action

DOE's action is the review of the Applicant's Presidential permit application that may authorize the construction, operation, and maintenance of the United States portion of the proposed CHPE project.

This Statement of Findings has been prepared in accordance with 10 Code of Federal Regulations (CFR) Part 1022, *Compliance with Floodplain and Wetland Environmental Review*, to address those portions of the proposed CHPE Project that would cross Federal Emergency Management Agency (FEMA)-designated floodplains. In accordance with Executive Order (EO) 11988, *Floodplain Management*, this Statement of Findings addresses the action alternatives considered to avoid adverse effects and incompatible developments in floodplains. The DOE requirements for compliance with EO 11988 are set forth in 10 CFR Part 1022. EO 11988 directs Federal agencies to implement floodplain management requirements through existing procedures and guidelines such as those established to implement the National Environmental Policy Act (NEPA), or those developed by individual states, to the maximum extent practicable. Per EO 11988, an agency may locate a facility in a floodplain if the head of the agency finds there is no practicable alternative. If it is found that there is no practicable alternative, the agency must minimize potential harm to the floodplain, and circulate a notice explaining why the action is to be located in the floodplain prior to taking action. Finally, new construction in a floodplain must apply accepted flood proofing and flood protection, which would include elevating structures above the base flood level rather than filling in land.

3. Description of Proposed CHPE Project

The portion of the proposed CHPE Project transmission line to occur within the United States would be owned and operated by the project Applicant, Champlain Hudson Power Express, Inc. The proposed transmission system would be buried underground and would cross the international border from Canada into the United States underwater near the town of Champlain, New York. Plans would involve the construction, operation, and maintenance of a 1,000-megawatt (MW), high-voltage direct current (HVDC), electric-power transmission line along the following four segments as described in Chapter 3 of the EIS: Lake Champlain, Overland, Hudson River, and New York City Metropolitan Area. Both buried aquatic (underwater) and sub-terrestrial (underground) installation of the transmission line would occur along these segments. Construction of a converter station in Astoria, Queens, and approximately 16 cooling stations to service portions of the line installed using horizontal directional drilling (HDD) techniques would be required. The transmission line would extend 336 miles (541 kilometers [km]) south beneath Lake Champlain; run along the CSX Corporation (CSX) and Canadian Pacific (CP) railroad ROWs; along roadway ROWs; and continue beneath the Hudson, Harlem, and East rivers to a proposed new converter station and substation addition (with an approximate footprint of 1.4 acres [0.6 hectares]) to be constructed in Astoria, Queens, where a 3-mile (5-km)-long underground alternating current (AC) cable would extend through city streets to the Rainey Substation, also in Queens.

The 16 cooling equipment stations would be constructed at different locations along the transmission line route. Each cooling station would consist of a 64-square-foot aboveground structure that would house a chiller unit and a pumping system. Each pumping system would circulate chilled water through a closed-loop system alongside the underground HVDC cable to prevent heat accumulation and potential damage. The entire proposed CHPE Project route is shown in **Figure 1**. Detailed maps depicting locations where the proposed transmission line would encounter FEMA-designated floodplains and coastal flood zones can be found in Appendix A of the EIS.

The proposed Luyster Creek HVDC Converter Station in Astoria would convert the electrical power from direct current (DC) to AC and then transmit that power through a buried HVAC cable circuit to the Astoria and Rainey electrical substations and beyond into New York State’s electrical grid.

FEMA defines flood zones by geographic areas according to varying levels of flood risk. A 100-year floodplain is determined based on the area with approximately 1 percent or greater probability of flooding per year and corresponds to either FEMA Zone A (has no established base flood elevation [BFE]) or Zone AE (has an established BFE). The aquatic transmission line would be routed through Lake Champlain and the Hudson, Harlem, and East rivers. With respect to floodplains, these water bodies are classified as a 100-year floodplain by FEMA (Zone AE, also defined as a “High-Risk Area”) (FEMA 2012). Additional information on flood risks and potential for effects on floodplains in the vicinity of the proposed CHPE Project route is provided in Chapter 5 of the EIS.

Based on a review of FEMA Flood Insurance Rate Maps (FIRMs), approximately 11.6 acres (4.7 hectares) of 100-year floodplains associated with rivers, streams, and unnamed tributaries are within the proposed CHPE Project’s region of influence (ROI) (100 feet [30 meters] along either side of the transmission route) for water resources in the Overland Segment of the proposed CHPE Project route between Dresden and Catskill, New York. These floodplains include FEMA Zones A and AE (FEMA 2012).

In the Hudson River Segment between mileposts (MPs) 295 and 303, where the transmission line route exits the Hudson River in Stony Point, New York, the ROI for the terrestrial portion of the route would cross approximately 2.6 acres (1.1 hectares) of FEMA-mapped floodplains associated with rivers, streams, and unnamed tributaries in Stony Point, Haverstraw, and Clarkstown, New York. These floodplains are classified as Zone A (FEMA 2014).

Where the transmission line leaves the Harlem River at MP 330 to traverse 1 mile over land before entering into the East River, it would be in a flood hazard area associated with Bronx Kill. Flood hazard areas include BFEs that identify the flood risk for coastal communities in the New York City metropolitan area affected by Hurricane Sandy in 2012. The BFE for a 1 percent chance of inundation in any given year (flood hazard Zone AE) (i.e., 100-year flood event) is at an elevation of 11 feet (3 meters) above mean sea level (MSL) on the north side of Bronx Kill, with higher values closer to the shoreline (FEMA 2013).

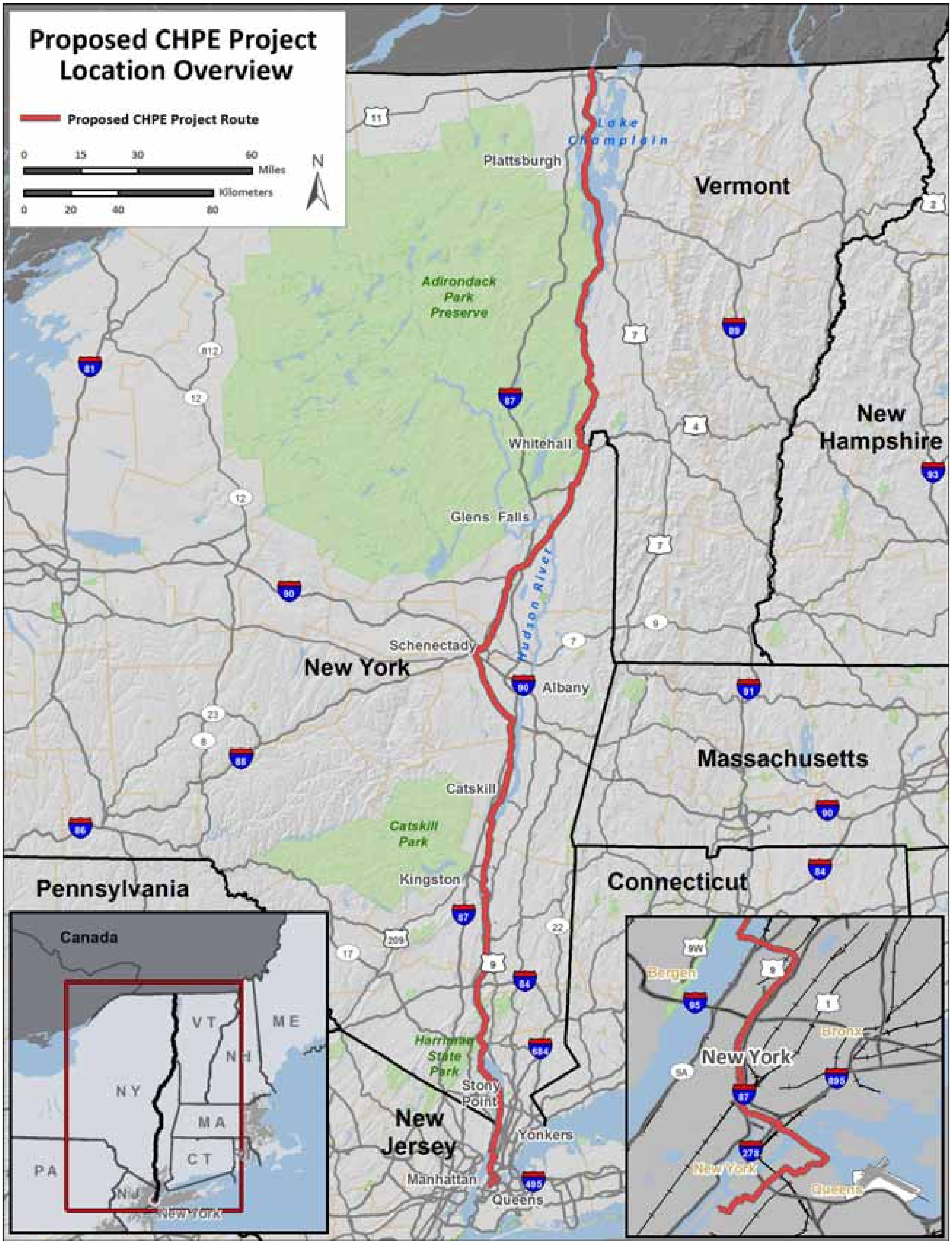


Figure 1. Proposed CHPE Project Route

The transmission line would be routed beneath the East River from the Bronx Borough to Queens, crossing a FEMA Zone VE-designated floodplain before making landfall north of the Luyster Creek HVDC Converter Station. Zone VE is considered a high-risk coastal area, which has a 1 percent or greater chance of flooding and an additional hazard associated with storm waves. The post-Hurricane Sandy BFE for this VE zone is between 16 and 21 feet (5 and 6 meters) above MSL. A portion of the area proposed for the Luyster Creek HVDC Converter Station, which is adjacent to a waterway also referred to as Steinway Creek, is at the confluence of the East River and Long Island Sound. The upland area near the shore, including the converter station site, is designated as Zone AE with a 1 percent flood hazard elevation of 13 feet (4 meters) above MSL. In addition, the Astoria to Rainey interconnection would also cross FEMA Zone AE floodplains prior to the terminus of the transmission line (FEMA 2013).

Of the 16 cooling stations proposed for the CHPE Project, 15 are currently proposed to be sited outside of the 100-year floodplain, and 1 (located at MP 330.6 in the Bronx) could be sited within the 100-year floodplain. This cooling station would be located in flood hazard area FEMA Zone AE (FEMA 2013).

4. Justification for Locating the Project in a Floodplain

The 336-mile transmission line would be installed underground in its entirety. Thus, it is necessary and unavoidable for it to cross floodplains along its route. Approximately 70 percent of the proposed CHPE transmission system would occur beneath major water bodies including Lake Champlain and the Hudson River.

5. Descriptions of the Alternatives Considered

Alternatives considered for the proposed CHPE Project included construction of an overhead transmission route along existing or new transmission system ROWs, or locating the transmission system in other underground ROWs including railroad, highway, and existing transmission line ROWs.

Construction of a new overhead transmission route would offer an opportunity to avoid or minimize impacts on floodplains as it would be possible to span floodplains. Two alternative aboveground transmission routes were considered; however, these alternatives were dismissed from further consideration as being unreasonable because of the difficulty involved with acquiring the new overhead electrical transmission ROWs. Additionally, alternative routes using highway ROWs, existing electric transmission cable ROWs, and constructing the transmission line entirely within railroad ROWs were evaluated but were dismissed as being unreasonable. If determined to be reasonable, these alternative underground routes would also have been located in floodplains similar to those described for the proposed CHPE Project route. Detailed descriptions of CHPE Project alternatives considered but dismissed as unreasonable can be found in Chapter 2 of the EIS.

6. Conformance with Floodplain Protection

As proposed, the CHPE project would conform to applicable state and local floodplain protection standards as described in the *Certificate of Environmental Compatibility and Public Need* issued by the New York State Public Service Commission (NYSPSC) for the proposed CHPE Project (NYSPSC 2013). All structures and facilities would be designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60, *Criteria for Land Management and Use*).

No impacts on floodplains, human life, or property would occur from construction, operation, maintenance, inspection, or emergency repair of the aquatic portions of the proposed CHPE Project. The underground installation and burial of the transmission line within the sediments of aquatic portions of the route would not impact flood flows, flood storage, or cause a flooding hazard. Burial of the proposed transmission line under water bodies would have no impacts on current use, property management, and future plans for development. Therefore, no impacts on floodplains would be anticipated from construction or operation of the proposed CHPE Project transmission line in Lake Champlain, the Hudson River, the Harlem River, or the East River.

The terrestrial portions of the proposed CHPE Project would result in temporary impacts on floodplains from construction activities related to burying the cables. Vegetation clearing, ground disturbance, trenching and soil stockpiling, and related construction activity would occur within the floodplains crossed by the proposed CHPE Project. Best management practices (BMPs) that the Applicant has committed to implementing during construction, including use of erosion and sedimentation controls, prohibitions on storing construction equipment or conducting refueling in floodplains, and restoring pre-existing ground contours, would minimize any impacts on flood flows, flood storage, or flood hazards during the construction period. In addition, a number of floodplain crossings would be made using HDD methods that would avoid any direct disturbance within floodplain areas by drilling entirely underground. The complete listing of Applicant-proposed BMPs is provided in Appendix G of the EIS.

No permanent aboveground alterations or new impervious surfaces that could impact flood storage, infiltration, or flooding hazard would result from construction or operation of the underground terrestrial transmission line. Therefore, no impacts from operation and maintenance of the terrestrial portion of the transmission line would be expected.

Aboveground cooling stations would be constructed at 16 locations along the terrestrial portion of the underground transmission line route. Of these, one cooling station with a footprint area of 64 square feet (6 square meters), located at MP 331 in the Bronx Borough, could be located within a designated Zone AE floodplain area where the 1 percent BFE has been established at an elevation of 11 feet above MSL. This cooling station would be associated with a portion of the transmission line that would be installed beneath the Harlem River Rail Yard by HDD. The Harlem River Rail Yard is located within a Zone AE flood area. Supplemental cooling of this specific underground transmission line section would be required to ensure that the cables operate within design parameters. There is no alternative location for the cooling station that would be outside of the designated floodplain. In accordance with the conditions established in the *Certificate of Environmental Compatibility and Public Need* for the proposed CHPE Project (NYSPSC 2013), the cooling station would be constructed such that the ground floor elevation is at or above the 100-year flood elevation level. Therefore, negligible impacts on flood flows, flood storage, or flood hazards would be anticipated.

The Luyster Creek HVDC Converter Station would be constructed and operated within the 100-year floodplain of the East River (see Maps 68 and 69 in Appendix A of the EIS). Based on the Preliminary Work Maps prepared by FEMA as part of an evaluation of flood hazards following Hurricane Sandy (FEMA 2013), the converter station site has a 100-year BFE of 13 feet (4 meters) above MSL. A 500-year (i.e., 0.2 percent) flood event has a BFE of 15 feet at this location. Alternative locations for siting the converter station were considered and are discussed in detail in Chapter 2 of the EIS. Much of the Charles Poletti Power Plant complex is within flood Zone AE, and the proposed Luyster Creek HVDC Converter Station site is currently undeveloped with open space and some vegetation. Use of this area for the proposed converter station site would not interfere with current site operations or plans for future development. Vegetation clearing, grading, and construction activity would occur within this floodplain area. Applicant-proposed measures, including use of erosion and sedimentation controls, restrictions on storing construction equipment, and restoring pre-existing ground contours would minimize any impacts on flood flows, flood storage, or flood hazards during the construction period. A complete listing of Applicant-proposed measures is provided in Appendix G of the EIS.

The 1.4 acres (0.6 hectares) of buildings composing the permanent aboveground converter station and appurtenant facilities would be designed to avoid flood hazard damage and to reduce impacts by grading and raising the first floor above the base flood elevation. In addressing the post-Hurricane Sandy flood elevation recommendations (FEMA 2013), the Applicant has identified that the Luyster Creek HVDC Converter Station first floor would be raised to an elevation greater than the 500-year storm surge impacts plus 2 feet (0.6 meters); or 19 feet (5.8 meters) above MSL. Although this area is subject to tidal influences, it is not a designated floodway. Therefore, no negligible impacts would be expected as a result of constructing and operating the converter station in the floodplain at this location. Additional discussions of impacts on floodplains are provided in Chapter 5 of the EIS.

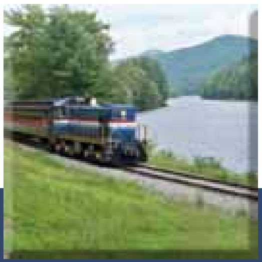
7. Mitigation Plans

In accordance with 10 CFR Part 1022.12(a)(3), measures to minimize the adverse impacts of actions in floodplains, including minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas, must be considered. Impacts on floodplains (including flood storage and flow) would be avoided by installing the transmission line below ground along nearly its entire length. Sub-terrestrial cable installation would be placed at least 3 feet below the ground. Where installed in Lake Champlain, the transmission cables would be placed at least 3 feet beneath the lake bed. Cable installation beneath the Hudson, Harlem, and East rivers would be at least 6 feet below the riverbed. Exceptions to this depth would occur where the transmission line would cross an existing utility infrastructure line at a shallower depth or be placed on the surface and covered with concrete mats when crossing existing infrastructure or exposed bedrock. To avoid increases in erosion and sedimentation into surface waters from land disturbance during construction along the terrestrial portions of the route, the proposed CHPE Project would use temporary and permanent erosion-control measures along the construction corridor, as needed, and would manage construction storm water in accordance with approved Storm Water Pollution Prevention Plans. Following installation of the terrestrial transmission line, the ground surface would be restored to its pre-existing grade and would be revegetated, as appropriate. The one cooling station that would be sited within coastal floodplains in the Bronx would be designed to avoid flood hazard damage by elevating the structure above the established 100-year floodplain (i.e., 1 percent) elevation. In addressing post-Hurricane Sandy flood elevation concerns, the Applicant has identified that the Luyster Creek HVDC Converter Station first floor would be raised to an elevation greater than the 500-year storm surge impacts.

Applicant-proposed measures for storm water management and floodplains are discussed in detail in Appendix G of the EIS.

8. References

FEMA 2012	Federal Emergency Management Agency (FEMA). 2012. “FEMA Floodplain Map Service Center.” Available online: <*http://www.msc.fema.gov/webapp/wcs/stores/servlet/CategoryDisplay?catalogId=10001&storeId=10001&categoryId=12001&langId=-1&userType=G&type=1&future=false*>. Accessed 28 October 2012.
FEMA 2013	FEMA. 2013. “Preliminary Work Map Flood Hazard Data.” Available online: <*http://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=2f0a884bfb434d76af8c15c26541a545*>. Accessed 30 December 2013.
FEMA 2014	FEMA 2014. “Advisory Base Flood Elevation.” Available online: <*https://geopower.jws.com/rockland/ApplicationsPage.jsp#*>. Accessed 3 January 2014.
NYSPSC 2013	New York State Public Service Commission (NYSPSC). 2013. “Champlain Hudson Power Express, Inc., Order Granting Certificate of Environmental Compatibility and Public Need.” Available online: <*http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7bA7142 3C8-B489-4996-9C5A-016C9F334FFC%7d*>. Accessed 18 April 2013.



APPENDIX T

Programmatic Agreement

PROGRAMMATIC AGREEMENT
AMONG
THE U.S. DEPARTMENT OF ENERGY,
AND
THE NEW YORK STATE HISTORIC PRESERVATION OFFICER
FOR
MANAGING HISTORIC PROPERTIES THAT MAY BE AFFECTED
BY
AUTHORIZING THE CONSTRUCTION, OPERATION, CONNECTION AND MAINTENANCE OF THE
CHAMPLAIN HUDSON POWER EXPRESS HVDC TRANSMISSION LINE PROJECT

WHEREAS, pursuant to the authority delegated by the President of the United States under Executive Order 10485, as amended by Executive Order 12038, the U.S. Department of Energy ("DOE") receives and considers applications for permits for the construction, operation, maintenance, and connection of facilities for the transmission of electric energy at the borders of the United States ("Presidential Permit"); and

WHEREAS, Champlain Hudson Power Express, Inc. and CHPE Properties, Inc (collectively "CHPE") have applied to the DOE's Office of Electricity Delivery and Energy Reliability for a Presidential Permit for the Champlain Hudson Power Express HVDC Transmission Line Project ("Project") in accordance with the DOE's applicable administrative procedures at 10 CFR § 205.320 *et. seq.*; and

WHEREAS, the proposed Project would consist of a 1,000-megawatt high-voltage direct current ("HVDC") transmission system extending approximately 333 miles from the United States' border with Canada to a converter station to be constructed in Astoria, Queens, New York; a 3-mile long high-voltage alternating current transmission system extending from the proposed converter station to an existing substation in Astoria; and ancillary facilities (such as temporary work areas, contractor yards, laydown areas, and access roads); and

WHEREAS, construction of the Project will entail installation of buried transmission cables along waterways and within the rights-of-way of existing transportation infrastructure, including railroads and roadways located within the State of New York; and

WHEREAS, Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470f) ("Section 106"), directs federal agencies to take into account the effects of their undertakings on historic properties listed in or eligible for inclusion in the National Register of Historic Places ("National Register") and to afford the Advisory Council on Historic Preservation ("ACHP") a reasonable opportunity to comment; and

WHEREAS, the procedures set forth in 36 CFR Part 800 - Protection of Historic Properties define how federal agencies meet their statutory responsibilities pursuant to Section 106; and

WHEREAS, the DOE has determined that the issuance of a Presidential Permit for the Project is an undertaking, as defined in 36 CFR § 800.16(y), requiring compliance with Section 106 and its implementing regulations; and

WHEREAS, construction of portions of the Project will also require authorization by the U.S. Army Corps of Engineers ("USACE") pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) and Section 404 of the Clean Water Act (33 U.S.C. § 1344), and the USACE and the DOE have agreed that the DOE is the lead federal agency for purposes of compliance with Section 106, in accordance with 36 CFR § 800.2(a)(2); and

WHEREAS, consistent with 36 CFR § § 800.4(a) and 800.16(d), the area of potential effects ("APE") for this undertaking has been defined to include all areas that could be directly or indirectly affected by construction and/or operation of the Project, including ground-disturbing activities associated with installation of the transmission line, construction of the converter station, and ancillary facilities (such as temporary work areas, contractor yards, laydown areas, and access roads); and

WHEREAS, the Project's APE generally includes the geographic area defined in the attached maps and may be further refined through additional engineering assessments; and

WHEREAS, the Project is located within the identified area of interest of four federally recognized Indian tribes, and the DOE has consulted with the Delaware Indian Nation, the St. Regis Mohawk Tribe, the Shinnecock Indian Nation, and the Stockbridge-Munsee Community Band of Mohican Indians on a government-to-government basis in accordance with 36 CFR § 800.2(c)(ii); and

WHEREAS, the DOE has determined that its undertaking associated with the Project has the potential to adversely affect historic properties listed in or eligible for the National Register and have consulted with the ACHP, the USACE, the New York State Historic Preservation Officer (NYSHPO), and federally recognized Indian tribes pursuant to 36 CFR § 800.14 of the regulations implementing Section 106; and

WHEREAS, pursuant to 36 CFR § 800.14(b), the DOE has elected to execute this Programmatic Agreement ("PA"); and

WHEREAS, pursuant to 30 CFR §§ 800.2(c)(2), 800.6(c)(3), and 800.2(c)(4), the Delaware Indian Nation, the St. Regis Mohawk Tribe, the Shinnecock Indian Nation, the Stockbridge-Munsee Community Band of Mohican Indians, CHPE, and USACE (collectively, the "Concurring Parties") have been invited to concur in this PA.

NOW, THEREFORE, the DOE and the NYSHPO (the "Signatory Parties") agree that the Project shall be administered and implemented in accordance with the following stipulations to satisfy the responsibilities of the DOE under Section 106 for all aspects of the Project.

STIPULATIONS

I. APPLICABILITY

DOE, CHPE, and the SHPO shall ensure that the following stipulations are carried out:

A. DOE, CHPE and SHPO will review Undertakings in accordance with the terms of this agreement.

B. This Programmatic Agreement will be in effect for a period of five years from the date of its execution.

C. DOE will send a copy of this Programmatic Agreement to the ACHP upon execution.

II. CULTURAL RESOURCES MANAGEMENT PLAN

A. Within one year following the issuance of the Presidential Permit for the Project, CHPE shall develop a Cultural Resources Management Plan ("CRMP") specifying how historic properties within the Project's APE will be considered and managed and submit the CRMP to the Signatory and Concurring parties.

B. The CRMP will be prepared by or under the supervision of an individual who meets, or individuals who meet, at minimum, the professional qualification standards for archaeology defined in the *Secretary of the Interior's Professional Qualification Standards* (48 FR 44738–44739, September 19, 1983).

C. The CRMP will be prepared with reference to:

1. The ACHP's guidance on conducting archaeology under Section 106 (2009);
2. The ACHP's February 23, 2007 *Policy Statement Regarding the Treatment of Burial Sites, Human Remains, and Funerary Objects*;
3. The NYSHPO's *Human Remains Discovery Protocol* (NYSHPO 2005);
4. The New York Archaeological Council's (NYAC) *Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State* (1994), as adopted by the NYSHPO in 1995;
5. *The Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation* (48 FR 44716-44742, September 29, 1983), as amended and revised;
6. The DOE's *American Indian and Alaska Native Tribal Government Policy* (DOE 2006); and
7. DOE Policy 141.1: *Management of Cultural Resources*.

D. The CRMP will, at minimum, include the following:

1. An introduction explaining the scope and purpose of the CRMP, the regulatory context and basis under which the CRMP is developed, and the organization of the CRMP.

2. A description of the Project, including the Project's setting, principal Project facilities, and proposed methods of construction.

3. A description of the APE for this undertaking, including potential causes and types of Project effects.

4. Maps of the Project's APE.

5. An overview synthesizing and summarizing data on the history and prehistory of the Project area to provide information regarding the nature and character of historic properties within or potentially within the Project's APE and to provide a context in which to evaluate and consider alternative treatment strategies for historic properties.

6. A summary of cultural resources investigations previously conducted within the APE, including those conducted to identify historic properties that may be affected by the Project.

7. An inventory of known or recorded historic and archaeological resources within the APE, including the following information:

   a) Location and description of known or reported resources based on available information, including the nature and type of resource (i.e., historic, prehistoric, or multi-component archaeological site, district, historic building, structure, or object);

   b) Whether cultural resources investigations conducted to identify and/or evaluate historic properties that may be affected by the Project have confirmed the presence or absence of a previously reported archaeological or historic resource; and

   c) Whether a known or reported historic or archaeological resource is listed in or has been previously determined eligible for inclusion in the National Register.

8. The procedures for completing the identification and, if necessary, the evaluation of historic properties (including properties of traditional religious or cultural significance) within the Project's APE that may be affected (directly and/or indirectly) by the Project.

9. The procedures for assessing the Project's effects (if any) on identified historic properties.

10. Procedures and specific management and/or control measures for resolving any adverse effects on identified archaeological sites and/or historic resources within the APE through the consideration of prudent and feasible Project alternatives, modifications, or treatment measures that would avoid, minimize, reduce, or mitigate adverse effects on historic properties listed in or eligible for inclusion in the National Register.

11. The process for identifying, developing, and implementing additional management and treatment measures for historic properties within the APE, as necessary.

12. Procedures for the unanticipated discovery of archaeological resources.

13. Procedures for the unanticipated discovery of human remains, taking into account applicable state and local laws, and

    a) The NYSHPO's *Human Remains Discovery Protocol* (NYSHPO 2005);

    b) The Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001 *et seq.*) (NAGPRA) and its implementing regulations at 43 CFR Part 10;[1] and

    c) The ACHP's 2007 *Policy Statement Regarding the Treatment of Burial Sites, Human Remains, and Funerary Objects.*

14. Measures for the curation and/or repatriation of artifacts and collections removed from state lands consistent with Title 1, Article 5, Section 233 of the New York State Education Law, as applicable.

15. Procedures for training CHPE staff, contractors, and other appropriate personnel in the requirements of the CRMP and their responsibility to protect historic properties.

16. Measures to prevent looting and vandalism of historic properties within the APE during Project construction.

17. Requirements for any post-construction management or monitoring of identified historic properties.

18. Measures for public interpretation of historic properties and cultural values, to the extent prudent and reasonable.

19. Procedures for implementing the CRMP, including the following:

---

[1] Pursuant to 43 CFR Part 10, NAGPRA applies to human remains, sacred objects, and items of cultural patrimony (described as "cultural items" in the statute) located on federal or tribal lands or in the possession and control of federal agencies or certain museums. The Project will not occupy federal or tribal lands. Notwithstanding the limits of NAGPRA's applicability, the principles described in NAGPRA and its implementing regulations will serve as guidance for CHPE's actions should remains or associated artifacts be identified as Native American, and to the extent such principles and procedures are consistent with any other applicable requirements.

a) The specific individuals responsible for coordinating activities conducted under the CRMP, including coordinating consultation and maintenance of relevant records;

b) A dispute resolution process that is consistent with the process described in Section V of this PA;

c) The use of qualified cultural resources professionals to conduct certain activities under the CRMP (see Stipulation II.B, above);

d) Appropriate standards for cultural resources investigations and reporting;

e) A consultation protocol to coordinate with the Signatory and Concurring parties during implementation of the CRMP, including provisions for periodic reporting, and meetings; and

f) Procedures for review of and amendment to the CRMP.

III. CRMP REVIEW AND APPROVAL

A. CHPE will provide a draft CRMP to the following parties (collectively, the "Consulting Parties"):

1. The Signatory Parties;
2. The Concurring Parties;
3. The National Park Service; and
4. The New York State Department of Public Service.

B. The Consulting Parties will be afforded a 30-day review period to provide comments on the draft CRMP.

C. At the conclusion of the 30 day review period, CHPE will provide the DOE with a revised draft CRMP that includes:

1. Documentation of the views of the Consulting Parties;
2. Revisions adopted by CHPE;
3. An explanation of any revisions proposed by the Consulting Parties not adopted by CHPE.

D. Within 30 days of receipt of the revised draft CRMP described in Stipulation III.C of this CRMP, the DOE shall direct CHPE to make any necessary or appropriate revisions to finalize the CRMP.

E. Following DOE's acceptance of the final CRMP, CHPE shall submit the final CRMP along with documentation of the views of the Consulting Parties to the Signatory and Concurring parties.

F. If any of the Signatory or Concurring parties object to the final CRMP, the objecting party will notify the DOE in writing within 30 days of their receipt of the final CRMP. The DOE will consult with the objecting party, CHPE, and with other Signatory and/or Concurring parties, as appropriate, to seek agreement on the CRMP. If consensus is not reached within 30 days, the DOE will notify the ACHP of the objection, provide all pertinent information and request that the ACHP provide its advisory comments within 30 days of receipt of notification in accordance with Stipulation V of this Programmatic Agreement.

IV. INTERIM MEASURES FOR COMPLIANCE

A. Until the CRMP is accepted by the DOE, the DOE will continue to apply 36 CFR §§ 800.4 through 800.6 for all actions taken with regard to the Project.

B. Upon acceptance of the final CRMP, the DOE shall notify the Signatory and Concurring parties to this agreement of its acceptance, and CHPE shall implement the CRMP in lieu the procedures set forth in 36 CFR §§ 800.4 through 800.6.

V. DISPUTE RESOLUTION

A. Except as provided for in Section III.F of this PA, if at any time during implementation of this PA, the Signatory or Concurring parties object to any action or any failure to act pursuant to this PA, they may file written objections with the DOE.

1. The DOE will consult with the objecting party, and with other Signatory and/or Concurring parties as appropriate, to resolve the objection. The DOE may initiate on its own such consultation to resolve any of the DOE's objections to actions taken or products produced by any party pursuant to this agreement.

2. If the DOE determines that the objection cannot be resolved through consultation alone, the DOE will forward all documentation relevant to the dispute to the ACHP and request that the ACHP comment. After receiving all pertinent documentation, the ACHP will either:

   a) Provide the DOE with recommendations, which the DOE will take into account in reaching a final decision regarding the dispute; or

   b) Notify the DOE that it will comment pursuant to 36 CFR §§ 800.7(c)(1) through (c)(3) and Section 110(l) of the National Historic Preservation Act of 1966, as amended, and proceed to comment.

3. The DOE will take into account any ACHP comments provided in response to such a request, with reference to the subject of the dispute, and will issue a decision on the

matter. The DOE's responsibility to carry out all actions under this PA and the CRMP that are not the subject of dispute will remain unaffected.

VI. DURATION, AMENDMENT, AND TERMINATION OF THIS PROGRAMMATIC AGREEMENT

A. This PA shall take effect on the date it has been fully executed by the Signatory Parties and will remain in effect until terminated pursuant to Stipulation VI.C of this agreement. Any amendments to this PA shall take effect on the dates they are fully executed by the Signatory Parties, or such other self-executing dates as may be described in those documents.

B. Any Signatory Party to this PA may request in writing to the other Signatory Parties that this PA be amended. The Signatory Parties will consult in accordance with 36 CFR § 800.14(b) to consider such amendment.

C. Any Signatory Party to this PA may terminate this agreement by providing 30 days written notice to the other Signatory Parties, provided that the Signatory and Concurring parties are consulted during the 30-day notice period in order to seek agreement on amendments or other actions that would avoid termination. In the event of termination, the DOE will comply with 36 CFR Part 800 with regard to individual actions covered by this PA.

EXECUTION of this PA by the Signatory Parties and implementation of the stipulations provided herein evidences that the DOE and USACE have taken into account the effects of this Project on historic properties and afforded the ACHP an opportunity to comment on those effects.

SIGNATORY PARTIES

NEW YORK STATE HISTORIC PRESERVATION OFFICER

BY: Ruth A Pierpont DATE: 6/17/14

Name Ruth Pierpont

Title Deputy Commissioner OPRHP/Deputy SHPO

U.S. DEPARTMENT OF ENERGY

BY: Matthew A Rosenbaum DATE: 5/16/2014

Name MATTHEW A. ROSENBAUM

Title ACTING DIRECTOR NEDD

CONCURRING PARTIES

DELAWARE NATION

BY: DATE:
Name
Title

ST. REGIS MOHAWK TRIBE

BY: DATE:
Name
Title

SHINNECOCK INDIAN NATION

BY: DATE:
Name
Title

STOCKBRIDGE-MUNSEE COMMUNITY BAND OF MOHICAN INDIANS

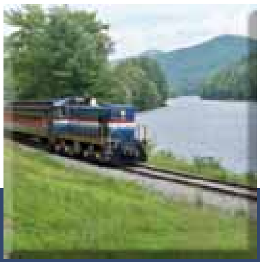
BY: DATE:
Name
Title

CHAMPLAIN HUDSON POWER EXPRESS, INC.

BY: William S. Helmer DATE: June 13, 2014
Name William S. Helmer
Title Executive Vice President and General Counsel

U.S. ARMY CORPS OF ENGINEERS

BY: 16JUN14 DATE: 16 JUNE 2014
Name THOMAS M. CREAMER
Title CHIEF OF OPERATIONS, READINESS, AND REGULATORY FUNCTIONS DIVISION



APPENDIX U

Navigation Risk Assessment

TRANSMISSION DEVELOPERS INC

CHAMPLAIN HUDSON POWER EXPRESS

NAVIGATION RISK ASSESSMENT

Report Reference. P1488_R3472_Rev 0

Issued 11 April 2014

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GLOSSARY

AIS	Automatic Identification System
CHPE	Champlain Hudson Power Express
EIA	Environmental Impact Assessment
GIS	Geographical Information System
HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
MW	Mega Watt
O&M	Operations & Maintenance
SOW	Scope of Work
TDI	Transmission Developers Inc.
USACE	US Army Corps of Engineers
USCG	US Coast Guard

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Transmission Developers Incorporated (TDI) is developing the Champlain Hudson Power Express (CHPE) Project, a high voltage direct current (HVDC) interconnector capable of transferring 1,000 Megawatts (MW) of power between Canada and the USA. The route runs from the US-Canadian border to a new converter station in Astoria, Queens, New York City. The project comprises of two cables and routeing is both terrestrial and marine. The distance totals approximately 336 miles. Approximately 60% of the route (197 miles) will involve underwater (submarine) cables across lake and river sections.

An overview of the route is shown in Figure 1-1.

Figure 1-1 Overview of CHPE route

Source: www.chpexpress.com

Intertek Energy & Water Consultancy Services have been contracted by TDI to conduct a navigation risk assessment for the marine sections of the cable route.

1.2 SCOPE OF WORK

This preliminary report focuses on the navigational risk assessment element of the works for Lake Champlain, Hudson and Harlem River sections of the route.

2 NAVIGATIONAL HAZARD ASSESSMENT

The hazard from ship's anchors is accentuated by proximity to a port or anchorage area where, for navigational reasons such as the traffic density, proximity of obstructions, shallow waters and other vessels, anchors are more likely to be readied for deployment.

It is useful to understand how anchors function and how they are used in practice and therefore explanatory notes are included in **Appendix A** of this report.

The following sections detail the findings of the navigation hazard assessment.

2.1 SHIP TRAFFIC ASSESSMENT (EXCLUDING FERRIES)

Shipping traffic intensity ranged from heavy (Hudson, Harlem & East River) to light (Lake Champlain) as identified from the site visit and the US Coast Guard Pilot book (NOAA, 2012a). This is explored further in the following sections.

2.1.1 Lake Champlain

Most of the region around Lake Champlain is sparsely populated and there is little in the way of heavy industries. Lake Champlain is about 97 miles long from Whitehall to the Canadian border and up to 10 miles wide at its widest part. It has vessel traffic between the ports along its shores and, apart from the ferries, these are mainly small vessels involved in recreational activities.

The controlling depth is approximately 12 feet at low lake level through the main channel to the Canadian border and to the principal ports. Vessel height and, ultimately vessel size, is restricted by the fixed bridge at Crown Point, approximately 32 miles north of Whitehall. This has the least overhead clearance of 75 feet (DOT, 2012).

With the exception of the SPIRIT OF ETHAN ALLEN III, the commercial vessels in Lake Champlain are relatively small in size and few in number. Most of the vessels in Lake Champlain have been observed during the site visit to be private recreational boats such as the ones shown in Figure 2-1.

Figure 2-1 Typical vessels in Lake Champlain

At 140 feet long, the SPIRIT OF ETHAN ALLEN III may have anchors of sufficient weight and size to penetrate the riverbed. However that risk is considered low due to it being a regular vessel in Lake Champlain and the vessel operator's familiarity and knowledge of the area.

All the other vessels carry anchors that are small in size and with short chains. They are unlikely to pose a threat to a buried cable system or one that is installed in sufficiently deep waters. Hence the shipping activity in Lake Champlain is considered a minimal hazard to the CHPE cable system.

2.1.2 Hudson River

The CHPE marine cable route lands just North of Dresden to avoid the PCB contamination area. The marine cable route then re-enters the water again just to the North of Cementon in the Catskill region.

A site visit was conducted to Albany Port to observe the vessels present. This provided a good indication of the vessel types to be encountered in the Upper Hudson River, where the cable system re-enters the river. Table 2-1 details the vessel types observed.

Table 2-1 Vessel types at Albany Port

Vessel type	Number
General Cargo	1
Tug	2
Tender	1
Other (work barge)	3

From the above, it can be seen that there is a higher concentration of commercial vessels in the Hudson River compared to Lake Champlain. Large commercial vessels (barges) were observed using the Hudson River during the site visit. There is an industrial area at Rondout Creek at approximately MP245 where commercial vessel traffic is expected. Barges in the region of 200 to 300 feet in length were observed, with tugs, near Tappan Zee and Yonkers. Vessels up to 600 feet in length were observed in the Lower Hudson River, as shown in Figure 2-3.

Figure 2-2 One of the larger vessels observed in the Hudson River

Vessel sizes in the Hudson River are limited by the bridges and the depths of the navigational channels (obtained from www.hudsonriverpilots.com and Sandy Hook Pilots 2014 Tide Tables).

As the CHPE cable system has been carefully routed to avoid the defined anchorages in the Hudson River, the threat to the cable system will most likely come from emergency anchoring. A probability assessment of the CHPE cable system in the Hudson River has been carried out to determine the likelihood of such an event occurring (see Section 2.4).

2.1.3 Harlem River

The Harlem River is a federally maintained shipping channel. Despite this, vessel size is restricted by the combination of shallow water depths and low bridges. Several of the bridges are swing bridges and can be opened to accommodate larger vessels. However vessels are still restricted by the fixed bridges and any vessel requiring more than 25 feet bridge clearance (NYCDOT, 2004) will not be able to fully navigate along the Harlem River.

Any boat requiring more than 5 feet of clearance will require the Spuyten Duyvil Bridge to swing open. All other movable bridges on the Harlem River provide at least 24 feet of clearance while closed, so boats and ships requiring between 5 and 24 feet of clearance need only have one bridge swing open.

The Harlem River joins the East River in Hell Gate between Wards Island and Manhattan Island, extending northward about 7 miles and connects with the Hudson River through Spuyten Duyvil Creek. The channel through Harlem River is narrow and tortuous. The velocity of the current in the Harlem River is 2 knots or more in the narrower parts of the channel.

Traffic is expected to consist of light commercial and recreational vessels due to the restrictions mentioned above. A rowing club house was observed near Spuyten Duyvil, as shown in Figure 2-3. Barges guided by tugboats also occasionally traverse along the Harlem River.

Figure 2-3 Rowing club house at Spuyten Duyvil, Harlem River

Anchors expected to be carried by such vessels are not envisaged to be particularly large or heavy. However due to the shallow water depths present, a probability assessment to determine the likelihood of an emergency anchoring has been prepared (see Section 2.4).

2.2 FERRY TRAFFIC ASSESSMENT

2.2.1 Lake Champlain

There are 11 ferry boats operated by Lake Champlain Transportation (LCT) at the time of writing and these vessels vary in length between 115 feet and 216 feet. Figure 2-4 and 2-5 show examples of these ferries operated by LCT.

Figure 2-4 LCT Ferry - Raymond C Pecor

Source: www.ferries.com

Figure 2-5 LCT Ferry - Northern Lights

Source: www.ferries.com

The Fort Ticonderoga Cable Ferry crosses the CHPE route with two underwater control cables. When the cable ferry operates, a trench is mechanically cut out of the lake bed by the action of the cables running along the bottom and scour by the prop wash from the assist hip tug's thrusters.

All the other vessel ferries in Lake Champlain are perceived as low risk to the cable system due to the ferry operators' familiarity and knowledge of the area. Hence they are not considered further in this report.

2.2.2 Hudson River

Cross Hudson traffic is mainly by various road and rail bridges along the cable route. However there are commercial ferry operations in the Hudson. One operator is NY Waterway. NY Waterway ferries mostly operate in Manhattan but have ferries operating nearby the CHPE cable route.

The ferry vessels for NY Waterway vary in length between 160 feet and 216 feet. An example of a NY Waterway ferry vessel is shown in Figure 2-6.

Figure 2-6 Example of a NY Waterway ferry vessel

Most of the ferries are also available for private charter on an ad-hoc basis with routes determined by their clients, which could result in the vessels travelling close to the CHPE cable route.

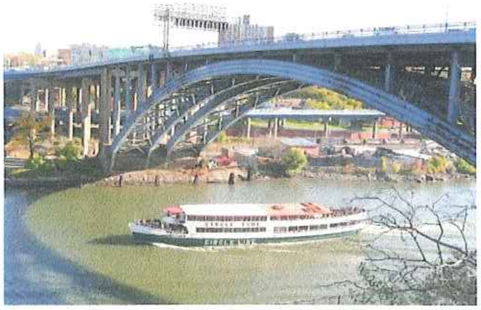
Although the perceived risk from vessel ferries are generally low given the ferry operators enhanced knowledge of the local area, a probability assessment has been carried out for the Hudson River due to the large vessels observed (see Section 2.4). The ferry traffic is captured in the AIS (Automatic Identification System) data used in the probability assessment.

2.2.3 Harlem River

The Harlem River is a narrow waterway with a high concentration of crossing bridges with relatively low clearances. The narrowness and low clearances have made the route unpopular with commercial ferries, although some private ferry services do operate along the Harlem River.

Circle Line Cruises operates sightseeing tours in the Harlem River. Most of the vessels used by them are relatively small with low air draft and require opening of a minimal number of movable bridges on the Harlem River. An example of one of their vessels along the Harlem River is shown in Figure 2-7.

Figure 2-7 Example of Circle Line vessel touring the Harlem River



Although the perceived risk from these vessels are generally low given the vessel operators enhanced knowledge of the local area, a probability assessment has been carried out for the Harlem River due to the shallow waters (see Section 2.4). The vessel traffic is captured in the AIS data used in the probability assessment.

2.3 ANCHORAGES ASSESSMENT

There are various anchorage areas along the CHPE cable route. Some are designated as general and others as special anchorages.

Although the CHPE cable route has been aligned to avoid the designated anchorages, the cable route skirts relatively close to some of the anchorages due to the constrained nature of the rivers. Hence this does not preclude the event of an anchor dragging incident occurring.

Under normal weather conditions, when first deployed, most anchors tend to drag less than 200 feet before engaging (DONG Energy, 2012). However, this is considered conservative for this project as this distance is based on the open seas, where the currents, waves and winds are much stronger. It is anticipated that should an anchor dragging event occur, it would be well below 200 feet.

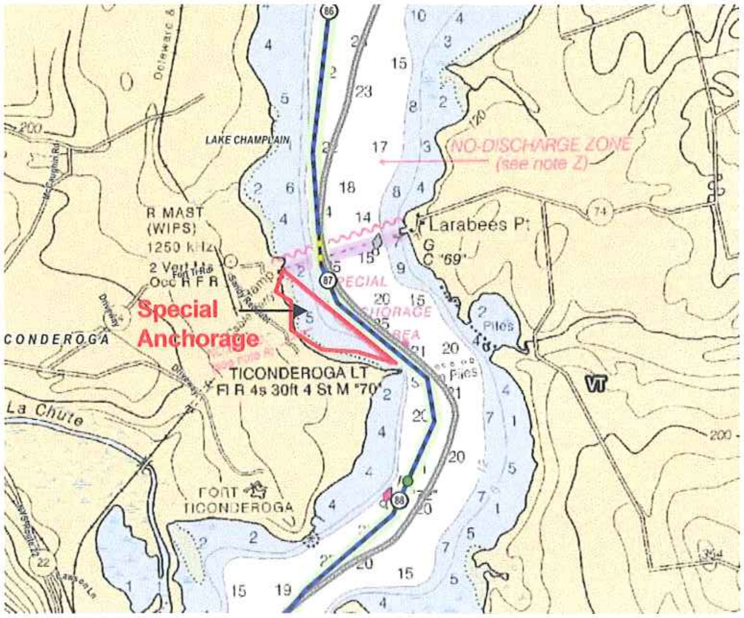
A cautious approach is used in the following sections where anchorages within 200 feet of the CHPE cable route are identified for further analysis.

2.3.1 Lake Champlain

The special anchorage near the Ticonderoga cable ferry has been identified as approximately 200 feet from the CHPE cable route (see red markup in Figure 2-8). This corresponds to approximately MP87 for the CHPE cable route.

Based on the vessel characteristics in Section 2.1.1 where commercial vessels in Lake Champlain are relatively small and few in number and most of the vessels in Lake Champlain are private recreational boats with light anchors and short chains, it is expected that anchor dragging events are rare. If they do occur, they are unlikely to occur for 200 feet. Hence this special anchorage is considered low risk to the cable system.

Figure 2-8 Special anchorage at Ticonderoga (MP87)



2.3.2 Hudson River

The following anchorages have been identified as within 200 feet of the CHPE cable route.

Figure 2-9 Special anchorage at MP253 – 254

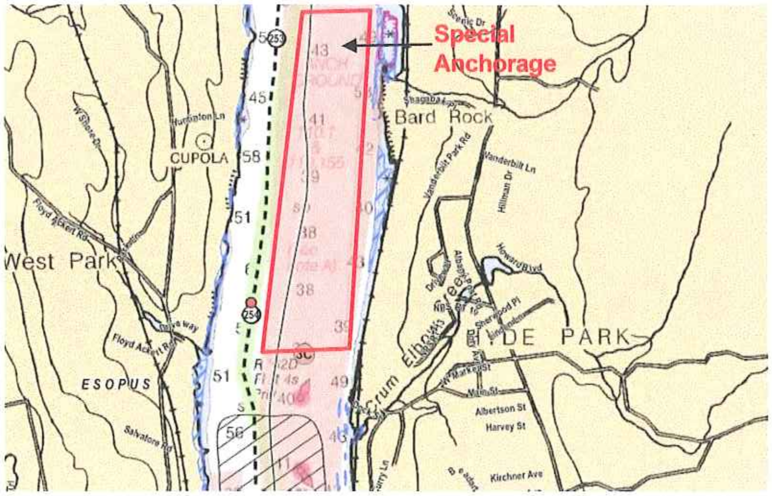


Figure 2-10 Special anchorage at MP316 – 317

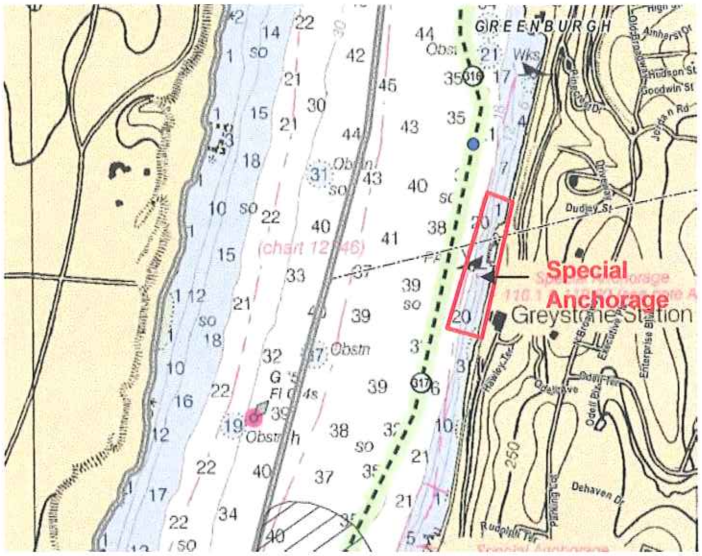


Figure 2-11 Special anchorage at MP318

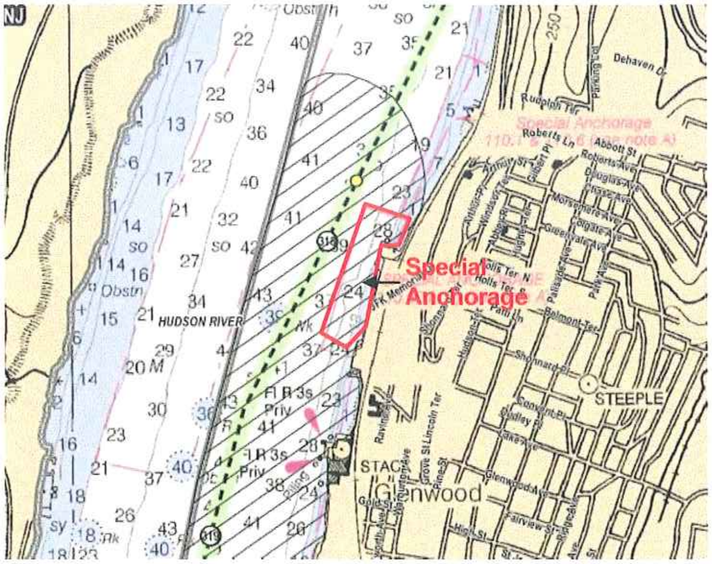
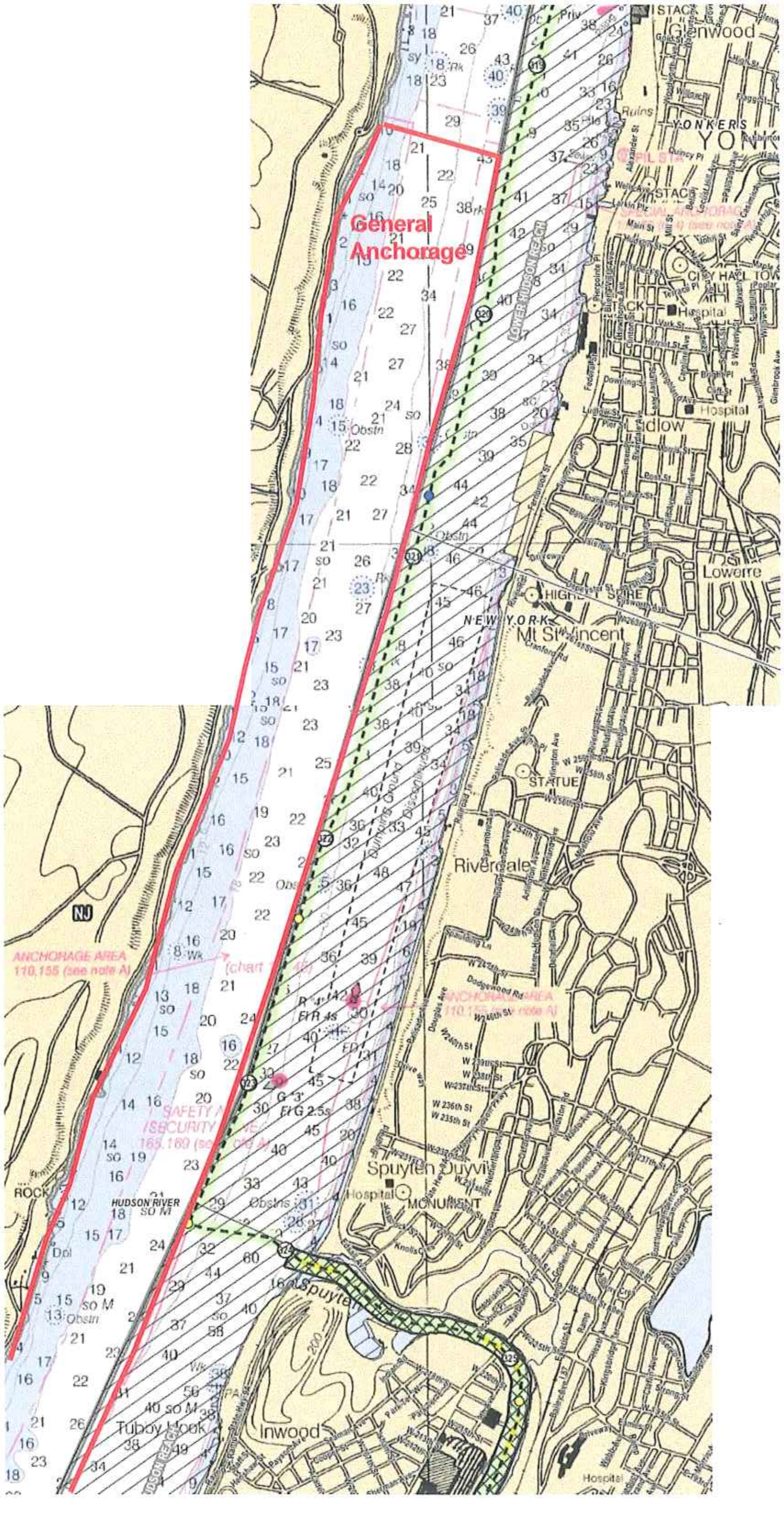


Figure 2-12 General anchorage from MP319.4 - MP323.7



These anchorages present a hazard to the CHPE cable system in terms of an anchor drag.

The anchoring risk has been taken into account in the probability assessment for the Hudson River (see Section 2.4). The vessels in these anchorages have been captured in the AIS data used in the probability assessment.

2.3.3 Harlem River

There are no anchorage areas along the CHPE cable route to the best of Intertek's knowledge.

2.4 EMERGENCY ANCHORING PROBABILITY ASSESSMENT

This section describes the methodology and results used to assess the emergency shipping risk / anchoring risk to the CHPE cable system.

The assessment of the risk to the cable is often best achieved by reference to the fault histories of cable systems in the same area. Fault histories can provide quantitative information on the likelihood of failure per line kilometre per year per hazard. Since the degree of protection afforded to cables has increased over time a fault history can usefully be related to levels of protection, i.e. burial depth. However, this information is hard to come by and is not readily available.

In the absence of cable fault data, Intertek has used a probabilistic technique, described in the Section 2.4.2, to assess the risk of failure.

All relevant factors are assessed for a cable route on a section by section basis and the probabilities generated reflect the risk levels and consequences of interaction with the anchoring hazard.

As the CHPE cable system has been routed to avoid all known anchorages, it was surmised that the anchoring risk to the cable is most likely to originate from emergency anchoring and dragging events.

2.4.1 Use of AIS Data & Vessel Groupings

AIS (Automatic Identification System) is an automatic tracking system used on ships for identifying and locating vessels by electronically exchanging data with other nearby ships and AIS base stations and satellites. It was first developed in the 1990s for collision avoidance among large vessels at sea and became mandatory for most vessels over 300 gross tonnes on international voyages in 2002.

Current US regulations (46 USC § 70114) require the following to be equipped with AIS while operating on the navigable waters of the United States:

- A self-propelled commercial vessel of at least 65 feet overall length
- A vessel carrying more than a number of passengers for hire determined by the Secretary
- A towing vessel of more than 26 feet overall in length and 600 horsepower
- Any other vessel for which the Secretary decides that an automatic identification system is necessary for the safe navigation of the vessel

Many other private vessels in the rivers such will still have AIS fitted for navigational safety reasons. This would cover almost all commercial vessels and the majority of private vessels that would be of risk to the cable.

Information provided by the AIS equipment usually consists of unique identification number for each vessel, vessel name, vessel type, vessel position, course and speed. Other attributes like vessel deadweight tonnage and draught may be filled in by the AIS supplier.

Hence by obtaining AIS data, the vessel traffic intensity along the river can be analysed to determine the concentration of vessel hours. This forms an input into the probability assessment for emergency anchoring.

Historical AIS data along the CHPE cable route for the period of July 2011 was procured from the United States Coast Guard (USCG). This was used to capture the vessel movements during the busiest time of the year so as to provide a worst case scenario in terms of vessel traffic. However due to FOIA Exemptions (b)(7)(E), information such as unique identification numbers and vessel names were removed from the AIS data by USCG to protect the statute and regulations of authorised law enforcement missions.

Furthermore, only AIS data for the Hudson, Harlem and East Rivers were provided. AIS data for Lake Champlain was not provided due to the USCG not having any receivers for Lake Champlain, with coverage described as 'spotty'. Also after reviewing the data, USCG only noted two vessel transmissions in or near Lake Champlain. This reinforces the view in Section 2.1.1 that commercial traffic in Lake Champlain is minimal.

To facilitate easier analysis of the vessel traffic and to avoid becoming inundated with the various vessel classifications, the vessels were grouped into deadweight tonnage bands of 0 – 3 500 tons, 3 500 – 15,000 tons, 15 000 – 40 000 tons, 40 000 tons plus. This allowed a set range of anchor sizes to be used to characterise those carried by shipping fleets in the aforementioned tonnage bands. This is shown below in Table 2-2.

Table 2-2 Typical vessel and anchor weights

Vessel size (deadweight tons)	0 – 3,500	3,500 – 15,000	15,000 – 40,000	40k - plus
Anchor mass (upper end of ship size range)	3,000 kg	5,000 kg	9,000 kg	25,000 kg

Following the processing of the AIS data, the results were produced visually in the form of vessel density heat maps. This allowed areas of heavy vessel traffic near / on the CHPE cable route to be identified. These areas usually denote a higher risk of emergency anchoring events occurring.

2.4.2 Probabilistic Assessment

Intertek have used a probabilistic technique to assess the probability of cable failure from the primary hazard of ship anchoring. This is possible because of the shipping activity and traffic intensities derived from the historical AIS data. The probabilities obtained are of a shipping incident involving emergency anchoring (dragging or dropping) occurring in the vicinity of the CHPE cables. The probabilities will decrease with increase in cable burial depth.

The probabilistic assessment provides perspective, indicating the relative frequency of an event over a period of time. Predictions with regard to mean time before failure are not made and the chance of an incident occurring is the same at any point in the calculated period, i.e. a 1 in 500 year incident could equally occur in year 1 as in year 500.

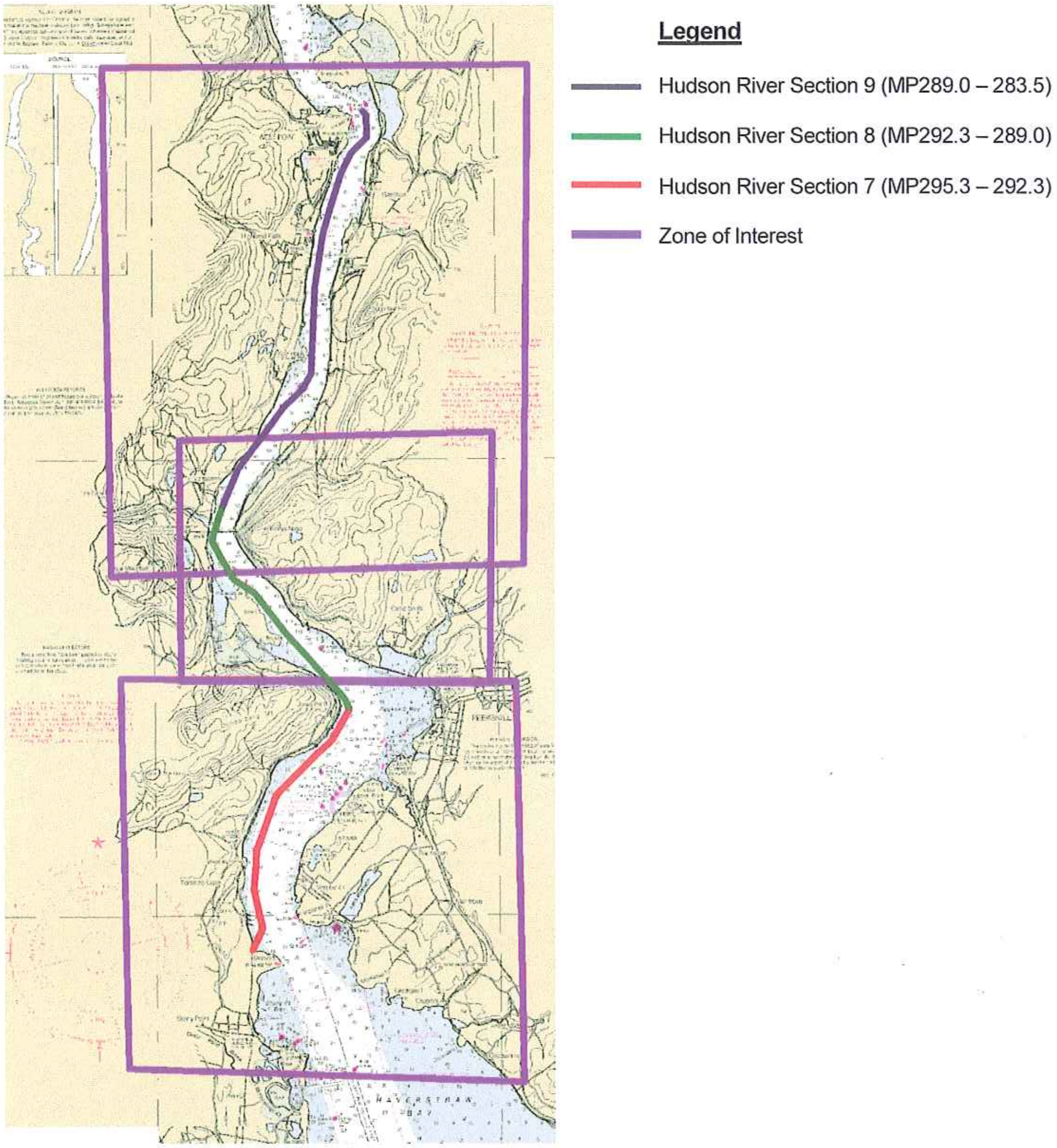
18 sections of the CHPE cable route were assessed based upon the topography of the Hudson, Harlem and East Rivers. Lake Champlain was not assessed due to the lack of AIS data from the USCG and minimal commercial traffic. The 18 sections are listed by their MPs below:

1) East River Section 1 (MP332.5– 331.5)
2) Harlem River Section 2 (MP330.3 – 329.8)
3) Harlem River Section 3 (MP329.8 – 325.0)
4) Harlem River Section 4 (MP325.0 – 324.0)
5) Hudson River Section 5 (MP324.0 – 310.0)
6) Hudson River Section 6 (MP310.0 – 302.9)
7) Hudson River Section 7 (MP295.3 – 292.3)
8) Hudson River Section 8 (MP292.3 – 289.0)
9) Hudson River Section 9 (MP289.0 – 283.5)
10) Hudson River Section 10 (MP283.5 – 280.0)
11) Hudson River Section 11 (MP280.0 – 274.0)
12) Hudson River Section 12 (MP274.0 – 269.0)
13) Hudson River Section 13 (MP269.0 – 260.0)
14) Hudson River Section 14 (MP260.0 – 256.5)
15) Hudson River Section 15 (MP256.5 – 248.5)
16) Hudson River Section 16 (MP248.5 – 245.5)
17) Hudson River Section 17 (MP245.5 – 234.0)
18) Hudson River Section 18 (MP234.0 – 228.5)

These sections enable parts of the cable to be assessed separately according to the vessel traffic intensity in the vicinity of that section. Vessel traffic for each section is unlikely to affect cable parts in other sections during an emergency event due to the shape and topography of the river.

For example, Figure 2-13 shows Hudson River Sections 9, 8 and 7 together with their associated zones of interest. Vessels in the zone of interest for Hudson River Section 9 are unlikely to affect Hudson River Sections 8 and 7 during an emergency event as they are unlikely to be able to navigate around the river bends. The same logic applies for the other river sections.

Figure 2-13 Hudson River Sections 9, 8 and 7 and associated zones of interest



The probabilities are calculated for a range of vessel and anchor sizes. The anchor size for the upper end of the vessel tonnage band is used, as indicated in Table 2-2. The probability of failure of the cable as a consequence of an event caused by emergency anchoring is calculated using the following equation:

$$P_{\text{anchor event}} = K \text{ x } P_{\text{loss}} \text{ x } P_{\text{recovery}} \text{ x } P_{\text{human}} \text{ x } P_{\text{fa}}$$

Where:

$P_{\text{anchor event}}$ = probability of anchor event on the cable (-/year)

K = total number of ship hours in sample box (hr/year)

P_{loss} = probability of engine failure (-/engine hour)

$P_{recovery}$ = probability of failing to recover from a situation within a certain period (-)

P_{human} = probability of anchor operation (-)

P_{fa} = protection factor (-)

- Total number of ship hours in sample box: K

This can be obtained by splitting each zone of interest up into several smaller sample boxes and then interrogating the historical AIS data in each sample box. An example of this is shown in Figure 2-14 below.

The AIS data had readings every 5 mins. Hence by the summation of each reading in the sample box, the total number of ship hours could be determined.

Figure 2-14 Example of zone of interest being divided into sample boxes

The size of the sample box is determined by the anchor dragging distance. In Intertek's experience, under normal weather conditions, when first deployed, most anchors tend to drag less than 200 feet before engaging (DONG Energy, 2012). Hence the size of a sample box is 200 feet.

A vessel does not immediately drop an anchor when it encounters engine problems. It drifts for a period while trying to recover from the engine problem. If unrecoverable, it slows down to approximately 1 knot before dropping an anchor. Anchoring at speeds above 1 knot will most likely lead to vessel structural damage. The period spent drifting will form the zone of interest. This also implies that the CHPE cables will not just be affected by vessels that are directly above it. Vessels in its vicinity must be considered due to the events just described. For a constrained navigational channel like the Hudson River area, the zone of interest will encompass the entire width of the channel. The length of the zone of interest will depend on the areas of the CHPE cables that are being assessed. Each section of the route will have its own zone of interest.

Each zone of interest is split into several sample boxes. Keeping in line with the conservative approach, the sample box which captures the highest density of vessels hours within the zone of interest will be applied to the formula.

As the AIS data procured from the USCG only covered one month in summer (July 2011), the vessel hours were multiplied by 6 to simulate half a year of summer months, which was then added to the same set of vessel hours multiplied by 6 and a factor of 0.8 to simulate half a year of winter months. This provided the results for one annual period.

The factor of 0.8 was to take into account the reduced traffic in the winter months. This was derived from the 2010 freight traffic information obtained from the USACE for the Hudson River (Spuyten Duyvil to Waterford). The volume of freight traffic in terms of tonnage along the river in the winter months were compared with freight traffic in the summer months. On average, the winter months had 20% less freight traffic than the summer months.

This corresponded with Intertek's findings from communications with the Port of Albany Harbour Authority, Hudson River Pilots Association and also with John Vargo, Editor of the magazine "Boating on the Hudson". The commercial traffic on the Hudson River does not vary much season to season. In the summer months, traffic consist of cargo vessels, recreational vessels, fuel transport vessels, ferries and vessels involved in the tourist trade. In the winter months, the ferries and vessels involved in the tourist trade decrease by a considerable amount due to the poor weather and drop in tourist numbers. Cargo vessels also decrease by a certain amount. However, there is a large increase in fuel transport vessel numbers to service the various power plants along the Hudson River due to the increased demand for heating.

Hence this "rebalancing" of the vessel traffic during the winter months by the increase in fuel transport vessels has led to a minimal change in vessel traffic numbers.

Icing up of the Hudson River in the winter has minimal impact on the vessel traffic as the USCG makes daily transits of the river with their icebreakers.

- Probability of engine failure: P_{loss}

This is taken from a report compiled by DNV (Det Norske Veritas) for the Marine & Coastguard Agency (DNV, 2005) for tidal rivers and estuaries around the UK. The value used in the calculations is 0.00015. Due to the lack of suitable data for rivers in the US, this has been applied to the cable route.

- Probability of failing to recover from a situation within a certain period: $P_{recovery}$

Data gathered from various trials in the UK suggest that the probability of failing to take recovery measures in 2 hours is 0.1 for bad weather conditions (Pillay and Vollen, 2004). For analysis purposes, this is applied to the cable route.

- Probability of anchor operation: P_{human}

The anchor will not be dropped in every emergency situation. This depends on the local area, geography and the vessel master's knowledge. The value used in the calculations is 0.3 from DNV (Christensen, 2006).

- Protection factor: P_{fa}

This takes into account the protection offered by soil cover on top of the CHPE cables as well as anchor penetration in soils. The worst case scenario of an unburied cable is 1.

Research previously carried out by Intertek on anchor penetration depths by two of the most common anchor types when fully engaged in different soils have shown that penetration of standard commercial anchors, e.g. Hall or USN stockless anchors into sands will be equivalent to the fluke length multiplied by the sine of the fixed fluke opening angle. In mud, anchor penetration under the same engagement loading could be three times or more than in sand (NCEL, 1983).

For the purpose of this assessment, based on core samples obtained in the previous surveys, very soft high plasticity clay / silt was sampled along the majority of the route.

The range of probabilities of an event from emergency anchoring is shown in Table 2-3 for 7 feet burial in the Hudson River and 8 feet burial in the Harlem River, both in soft sediments.

Table 2-3 Probability of emergency anchor event for CHPE cable sections

Summary event probabilities for emergency anchoring				
Vessel size range (Te DWT)	0 - 3.5k	3.5k-15k	15k - 40k	40k plus
Anchor mass	3,000 kg	5,000 kg	9,000 kg	25,000 kg
Cable Route Section				
P: East River Section 1 (MP332.5 - 331.5)	HDD	HDD	HDD	HDD
Average 1 event per X years, per section	HDD	HDD	HDD	HDD
P: Harlem River Section 2 (MP330.3 - 329.8)	4.21E-05	NA	NA	NA
Average 1 event per X years, per section	23742	NA	NA	NA
P: Harlem River Section 3 (MP329.8 – 325.0)	3.50E-04	NA	NA	NA
Average 1 event per X years, per section	2858	NA	NA	NA
P: Harlem River Section 4 (MP325.0 – 324.0)	6.64E-05	NA	NA	NA
Average 1 event per X years, per section	15056	NA	NA	NA
P: Hudson River Section 5 (MP324.0 – 310.0)	1.65E-03	8.18E-04	3.76E-03	5.67E-07
Average 1 event per X years, per section	608	1222	266	1763668
P: Hudson River Section 6 (MP310.0 – 302.9)	5.52E-04	1.82E-05	2.92E-05	NA
Average 1 event per X years, per section	1810	54870	34294	NA
P: Hudson River Section 7 (MP295.3 – 292.3)	6.33E-03	1.01E-05	1.46E-05	5.67E-07
Average 1 event per X years, per section	158	98765	68587	1763668
P: Hudson River Section 8 (MP292.3 – 289.0)	2.27E-05	8.10E-06	7.29E-06	NA
Average 1 event per X years, per section	44092	123457	137174	NA
P: Hudson River Section 9 (MP289.0 – 283.5)	1.20E-04	6.08E-06	7.29E-06	NA
Average 1 event per X years, per section	8342	164609	137174	NA
P: Hudson River Section 10 (MP283.5 – 280.0)	1.78E-05	6.08E-06	4.86E-06	NA
Average 1 event per X years, per section	56117	164609	205761	NA
P: Hudson River Section 11 (MP280.0 – 274.0)	8.63E-04	2.23E-05	8.75E-05	NA
Average 1 event per X years, per section	1158	44893	11431	NA
P: Hudson River Section 12 (MP274.0 – 269.0)	2.75E-05	1.01E-05	9.72E-06	NA
Average 1 event per X years, per section	36311	98765	102881	NA
P: Hudson River Section 13 (MP269.0 – 260.0)	3.89E-05	8.10E-06	1.46E-05	NA
Average 1 event per X years, per section	25720	123457	68587	NA
P: Hudson River Section 14 (MP260.0 – 256.5)	2.59E-05	1.01E-05	1.22E-05	NA
Average 1 event per X years, per section	38580	98765	82305	NA
P: Hudson River Section 15 (MP256.5 – 248.5)	1.00E-04	8.30E-05	5.10E-05	NA
Average 1 event per X years, per section	9956	12045	19596	NA
P: Hudson River Section 16 (MP248.5 – 245.5)	5.99E-05	1.01E-05	6.08E-04	NA
Average 1 event per X years, per section	16683	98765	1646	NA
P: Hudson River Section 17 (MP245.5 – 234.0)	2.71E-04	6.48E-05	6.08E-04	NA
Average 1 event per X years, per section	3696	15432	1646	NA
P: Hudson River Section 18 (MP234.0 – 228.5)	4.11E-04	3.04E-05	6.08E-04	NA
Average 1 event per X years, per section	2430	32922	1646	NA

The probability figures shown in Table 2-3 are presented in terms of emergency anchor event in a number of years (e.g.1 event in 100 years). N/A appears where vessels of certain tonnage bands are not present along the relevant sections of the route.

3 REMEDIAL PROTECTION METHODS

The principal method of protection for most modern cable systems is burial into the seabed. Burial means that hazardous activities need to penetrate the seabed in order to damage the cable. However, there are instances such as utility crossings or extremely hard soil conditions where burial will not be achievable or is reduced.

In such instances, there are three primary means of remedial protection, as detailed in the following sections. In addition to the remedial protection, periodic surveys should be carried out to check that the cable and remedial protection remain secure.

3.1 CONCRETE MATTRESSES

Concrete mattresses are flexible mats that are made up of numerous concrete blocks bound together with high strength polypropylene rope or steel wire. The flexible nature of concrete mattresses allows them to be laid over a cable and provide stabilisation as well as a physical barrier against dropped objects and dragged anchors.

Figure 3-1 Examples of standard concrete mattresses

Source: www.sps.gb.com

Concrete mattresses are typically deployed in shallow waters, individually or in multiples on a frame and can be guided into position and released by a diver.

Beyond diving limits, they are usually deployed in multiples by a crane on a frame with a remote activated release mechanism and the positioning is monitored by an ROV.

Mattresses are deployed at cable and pipeline crossings, where burial has to be interrupted, to provide stability, separation and protection

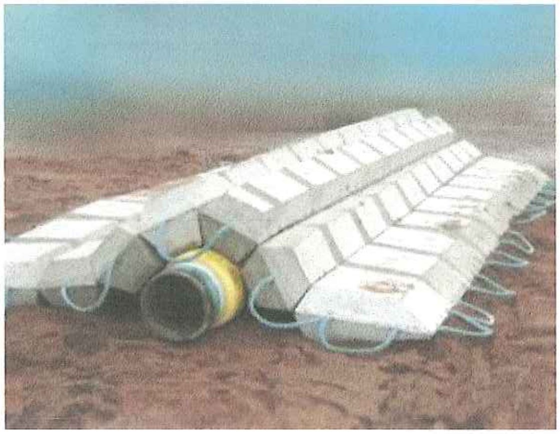
In addition to cable protection, mattresses are routinely used in the oil and gas industry to protect pipelines and umbilicals.

Figure 3-2 Multi mattress deployment

However, standard concrete mattresses are not permanent fixtures and they may be hooked and dragged out of position by trawl / anchor gear, exposing the cable. They act as 'sacrificial' protection in this case. The edges of the standard concrete mattresses may also induce localised scouring of the seafloor in strong current conditions.

Several variations of the concrete mattress exist to deal with specific conditions. For example, tapered edge concrete mattresses have been introduced to improve stability by reducing scouring and also improve over-trawlability, as shown in Figure 3-3.

Figure 3-3 Tapered edge concrete mattress



Source: www.sps.gb.com

Another variation is a concrete shell, shown in Figure 3-4. This design shape allows the concrete shell to be used in trawled areas, as the trawled gear will ride over the shell due to its shape. The shape also reduces scouring of the seafloor around the edges. The curved shape also helps dissipate forces from a dropped / dragged anchor better that the standard mattress.

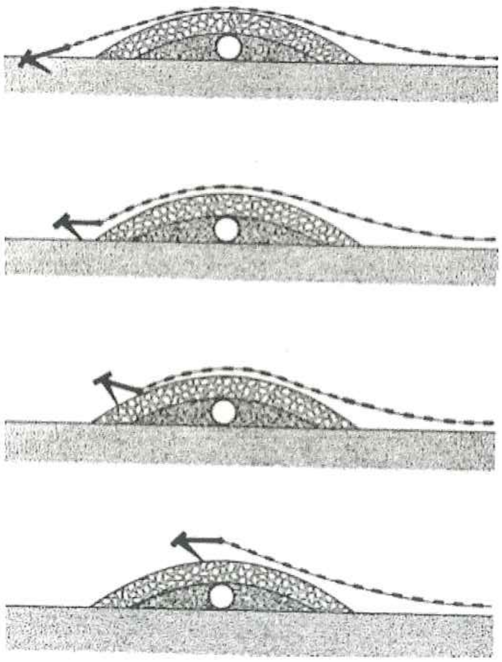
Figure 3-4 Concrete shell

Source: www.armato.se

3.2 ROCK PLACEMENT

Rock placement is another method of cable protection against dropped and dragged anchors, trawling and scouring. The protective cover on top of the cable enables the anchors or fishing gear to slide on top of it without damaging the cable lying beneath. In the worst case scenario it will cut into the rock berm, but the cable will still remain protected. Various model and prototype tests described in the Rock Manual (CIRIA, 2007) confirm that a rock berm initiates an outbalancing force on an anchor and anchor chain, causing a breakout of the anchor to leave the seabed and travel across the rock berm. This is illustrated below in Figure 3-5.

Figure 3-5 Action of anchor on a rock berm

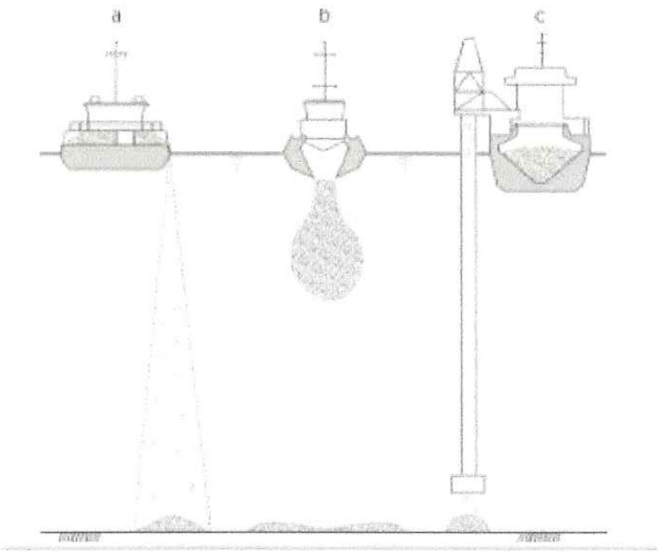


Source: Kuik, 1986

The rock berm also stabilises the cable by preventing any free spanning and protecting the cable from current displacement and scouring.

There are three different rock placement methods which are carried out by different types of vessels. These vessels are shown in Figure 3-6.

Figure 3-6 Different rock placement methods



Source: Kuik, 1986

The type of vessel used will mostly depend on water depth and also the strength of the current. For water depths of 50 m and more, fall pipe vessels (c in Figure 3-6) are recommended due to their ability to place rock with greater precision at those depths.

A variation to rock placement is the use of rock filter bags, as shown in Figure 3-7. The principle is similar to rock placement but instead of dumping rock onto the cable, the rocks are placed into a filter bag and loaded onto a transport vessel. The vessel then places the bag onto the cable to protect and stabilise it. This offers a more targeted placement of rock and reduces the amount of rock required. Some permitting authorities also see rock filter bags as less environmentally intrusive compared to rock placement.

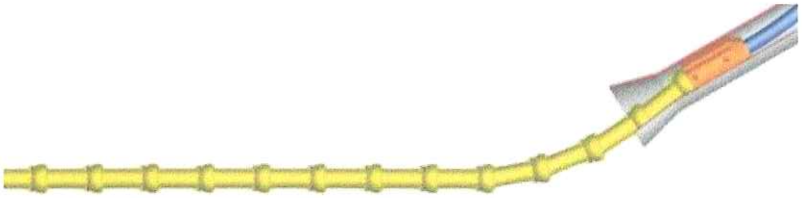
Figure 3-7 Rock filter bags

Source: www.sps.gb.com

3.3 ARTICULATED SHELLS

These are articulated casings which clamp over the cable to provide a protective barrier. They protect the cable from abrasion and dropped objects as well as over bending. They can be manufactured from ductile iron or from polyurethane and are attached to the cable before laying on the seabed. Figures 3-8 and 3-9 show some examples of articulated ducting.

Figure 3-8 Articulated ductile iron shells



Source: www.blueoceanprojects.com

Figure 3-9 Articulated polyurethane shells

Source: www.trelleborg.com

Application of articulated ducting is an industry standard cable protection measure in shallow waters where burial is not possible due to physical or environmental constraints.

4 IMPLICATIONS TO VESSELS

The CHPE cables will be buried for the large majority of the route. However there will be some areas where burial will not be applicable (e.g. crossings with existing cables / pipelines, etc). These areas are localised and will be protected by concrete mattresses, with the exception of the Lake Champlain area where the cables will be surface laid in water depths of 150 feet and greater.

Vessels that drop their anchors either through normal operations or emergency events may have the potential to snag the cables or the protective concrete mattresses in the areas listed above. It may also still be possible to snag a cable that has already been buried should the anchor penetration be greater than the burial depth. This scenario will have the same outcome as that of snagging a surface laid cable.

Commercial fishing vessels also have the potential to snag the cables with their fishing gear (e.g. trawl boards, etc). However only recreational fishing vessels operate in Lake Champlain (no interaction with the river bed) and there is little in the way of commercial fishing in the Hudson River due to high levels of PCB (polychlorinated biphenyl) pollutants in the river. No commercial fishing takes place in the Harlem River. Hence implications to fishing vessels are not considered in this assessment.

The following scenarios cover the safety implications to vessels should an anchor snag occur.

4.1 ANCHOR INTERACTION WITH CONCRETE MATTRESSES

Concrete mattress placed over a cable acts as a protective cover to deflect impact forces and also to stabilise the cable. Most anchors falling onto a concrete mattress will be stopped from penetrating into the river bed and its kinetic energy dissipated / absorbed by the mattress.

For a dragging anchor, it is possible for the anchor to snag onto the edge of the concrete mattress, dragging the mattress away from its location and exposing the cable underneath. As the mattress adds mass to the anchor, the vessel will experience a decrease in dragged movement and may even come to a stop. The protective cover over the cable will need to be replaced to ensure the cable continues to be protected.

In both cases, there are minimal safety implications to the vessel.

4.2 ANCHOR INTERACTION WITH SURFACE LAID AABLE

For a surface laid cable, the chances of an anchor directly hitting the cable is extremely low.

The accident of hitting or cutting a cable does not represent a navigational hazard. Should the cable be cut / exposed, the resulting electrical short can lead to an equipment overload and the tripping of the switchgears, leading to a shutdown of the converter or transformer stations on land. The protection system would de-energize the circuit in a very short time (less than 0.001 second). The vessel involved will suffer no electrical shock due to the high electrical conductivity of water, resulting in a complete earthing of the damaged cable (Sharples, 2011).

The chances of a dragging anchor snagging a cable are significantly higher than a dropped anchor. Should this happen, it is advised by various marine agencies (e.g. International Cable Protection Committee, Maritime and Coastguard Agency in the UK, etc) that for any vessel fouling a cable, the anchor and gear should be slipped and abandoned without attempting to get it clear.

Figure 4-1 Vessel's anchor fouled a power cable

Source: www.maib.gov.uk

Unfortunately there have been instances where this advice was not heeded either due to lack of education or lack of awareness that the anchor has snagged a cable. In the majority of these cases, interaction of ship anchors with cables have led to damaged cables but minimal effects to the ship, for example, a damaged / lost anchor or damaged anchor handling equipment (e.g. windlass motor, brake, etc) (MAIB, 2007) (ICPC, 2009).

There have been no reported incidents where personnel have been injured or a vessel has capsized due to an anchor snagging a cable. However there have been cases where fishing vessels have capsized while attempting to retrieve their fishing gear entangled with cables (MAIB, 1991). As commercial fishing has been discounted for the project area, such instances will not occur.

4.3 OTHER MITIGATION MEASURES

The risks can be further reduced by carrying out an information campaign to inform people of the presence of the cable. This may involve the following:

- Beach / shore warning signposts should be erected where applicable
- Information on the cable position must be given to the issuers of sea charts, e.g. national marine agencies, fishing authorities, etc. It is important to ensure that the submarine power cable is recorded on any chart and registry.

- Existing pipeline and cable operators, harbour authorities, meteorological and hydrographical agencies, military authorities should also be informed of the cable route.
- Carry out dialogue with relevant local stakeholders (e.g. pilots association, marine union workers and their organisations, recreational fishing and yachting clubs, etc). It is important to educate these people on the dangers of trying to recover entangled gear or anchor from a cable by force and the cable owners would prefer to compensate for the lost gear rather than to repair a damaged cable. It can be valuable to provide local stakeholders with free and easy to understand charts showing the position of the cable.
- Regular marine surveys along the cable route should also be carried out to ensure the cable protection is still in place to prevent an anchor snagging event.

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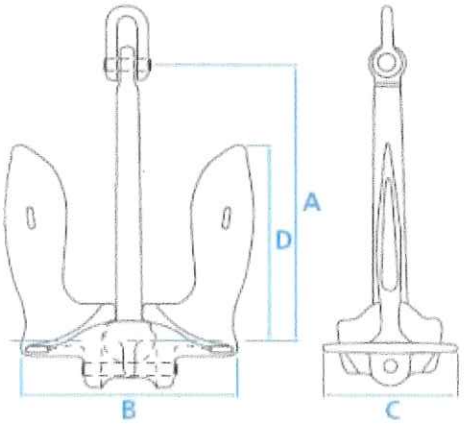
Appendix A Anchor Function & Practice

A.1 Anchor Function & Practice

The bow anchors carried by normal commercial shipping are specified for temporary mooring of a vessel within a harbour or sheltered area when it is awaiting a berth, the tide, etc. The anchors are not designed or specified to hold a ship off a fully exposed coast in rough weather or stop a ship that is moving or drifting. [1] They are specifically designed not to penetrate deeply into stiff soils, which would make them difficult to recover.

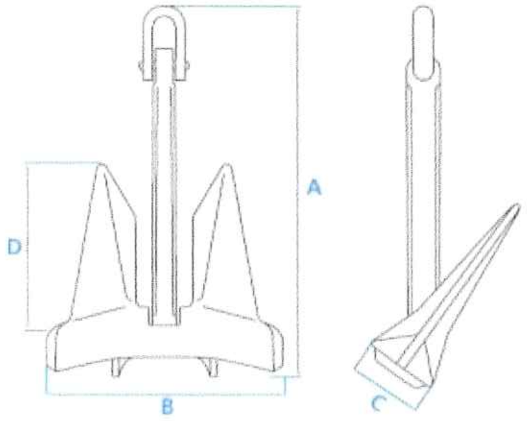
The most common type of anchor on commercial vessels is the stockless anchor, such as the Admiralty pattern or the US Navy pattern which is shown in Figure A1.

Figure A 1 Typical stockless anchor – US Navy pattern



More sophisticated designs, called High Holding Power (HHP) anchors, are increasingly being carried by modern vessels, as shown in Figure A2.

Figure A 2 Typical High Holder Power anchor - AC14 pattern



Both types of anchor contribute to the mooring of a vessel by virtue of their mass and by engaging the seabed. The USN pattern relies more on mass and

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[1] International Association of Classification Societies website – Mooring, Anchoring and Towing Requirements 2005

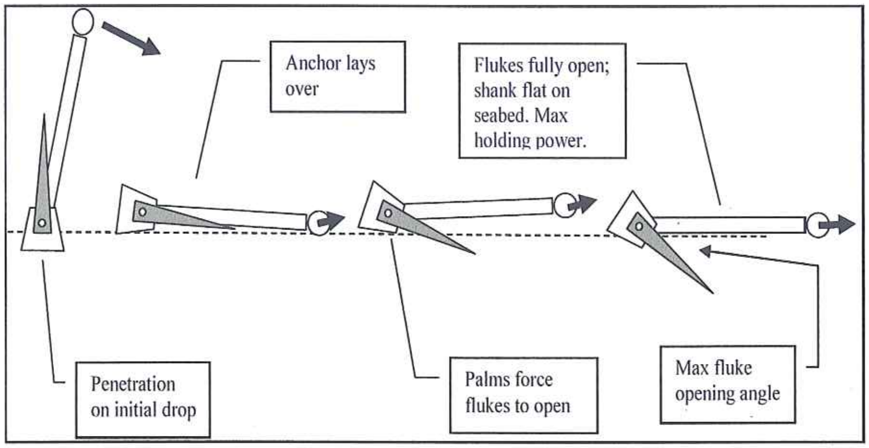
the HHP type penetrates and engages the seabed more efficiently. For the same size vessel an HHP anchor will only be 75% of the mass of the equivalent USN anchor.

The anchor size carried by different vessels is difficult to assess from any single vessel size parameter. Anchors are specified using a combination of vessel's mass, draught, air draft (surface are above the water line), etc, which contribute to the Equipment Number (EN) for the vessel. Calculation of the EN for a range of vessels is impractical within the context of this report.

The operation of an anchor on the seabed during a 'normal' anchoring operation is shown in Figure A3. Although an anchor is said to be 'dropped' anchoring is normally a controlled operation and in fact the anchor may often be lowered slowly to the sea bed using the windlass.

Dropping an anchor risks the anchor crown penetrating too deeply or the chain piling up on the seabed resulting in poor holding power and difficulties in recovery.

Figure A 3 Normal anchor operation



During anchor deployment the vessel will be stopped or stemming the prevailing conditions, falling back on the tide or with the wind as the anchor chain scope (amount of chain paid out) is laid out onto the seabed. The scope will be a fixed amount determined by the depth of water and the prevailing conditions. The vessel will normally be brought up by the weight of the catenary before the full scope is paid out. Usually only one bower (bow) anchor is deployed except in anticipation of very severe weather conditions.

In an emergency situation all necessary means will be used to prevent the vessel grounding or colliding with another object or vessel and this will include deploying one or both anchors. Deploying an anchor whilst a vessel is moving at anything more than a knot (0.5 m/sec) would likely result in failure of the anchor, chain or windlass. To mitigate damage it is generally recommended that an anchor be lowered slowly onto the sea bed, gradually providing drag without putting the equipment (or its operator) at risk. In this situation the anchor and chain could be dragging across the seabed for some distance. If sea room is limited, for example close to a lee shore or channel side, then this degree of finesse may not be possible and the anchor will be allowed to free-fall.

In a dragging situation the normal response is to payout more cable, thereby increasing the mass of the mooring equipment.

Anchors on normal commercial vessels are not designed to engage the seabed deeply. In normal circumstances the anchor flukes will probably not penetrate to their full depth before the mass of chain brings the vessel up. However, in the risk assessment the conservative assumption is made that the anchor flukes will always penetrate to the fullest extent possible in all circumstances.

The maximum penetration depth of an anchor, in 'normal' soils, where the shank and chain do not penetrate below the surface, can be determined by multiplying the fluke length by the sine of the maximum opening angle. Normal soils can be classified as medium to firm sands. Most ships have anchors set up to engage in normal soils for which the maximum opening angles are 45° and 36° for USN and HHP anchors respectively. If softer soils were being encountered regularly the fluke angles would be set to a greater angle to force the anchor to travel deeper.

Anchors are generally of welded or cast construction and, for a particular patented design, have fixed dimensions relative to the mass. The fluke length can be obtained if the mass is known.

A.2 Anchor Penetrations

The depth an anchor will penetrate to will vary.

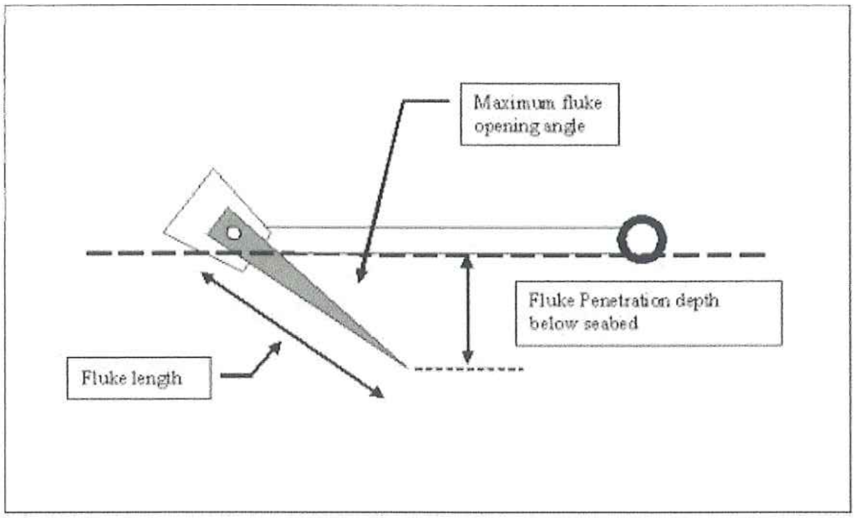
Many permutations are possible and a 'model' anchor size is used to determine a typical embedment depth. The model anchor is normally selected to represent the range of vessel sizes affecting the study area. The selection is subjective to the extent that traffic patterns are only predictable up to a point; vessels outside the normal range may visit randomly and changes in trade can rapidly alter the prevalence of one type of vessel or another.

The "Hall" pattern anchor is used here as a model as this is typical of standard Admiralty or US Navy standard stockless anchors in common use, especially on older vessels. This type of anchor has a relatively long fluke length for its unit mass and a large opening angle, which equates more penetration for a given fluke length.

In determining penetration depth it is assumed that the anchor will always penetrate to its design depth in typical "good holding ground", but no further as per Figure A4. Designated anchorages are normally selected on the basis that they provide 'good holding ground', which generally means a sand bottom.

The maximum anchor penetration depth can be calculated for an anchor using the standard opening angle of the anchor, which for a Hall design anchor is 45°.

Figure A 4 Maximum anchor penetration depth



The penetration depths for two sizes of Hall anchor are shown in Table A1. The penetration of a smaller AC14 High Holding Power (HHP) anchor, which has long flukes but a smaller opening angle is shown for comparison. HHP anchors are more efficient at engaging the seabed and therefore under ship classification rules a smaller HHP anchor can be used in place of a larger standard stockless anchor.

Table A 1 Typical anchor penetration depths in sand

Anchor type	Anchor mass (tons)	Fluke length (mm)	Opening angle (°)	Max penetration (m)
Halls	1.590	900	45	0.636
AC14	1.0	1014	35	0.582
Halls	6.0	1525	45	1.078

The penetrations are based on a 'normal' anchoring operation where the anchor is laid over and gradually pulled into the soil. In emergency deployments (involving a moving vessel) and in dragging situations the anchor is failing to engage the seabed efficiently and will inherently not penetrate to the depths normally achieved.

The penetration of the anchors upon initial deployment is not calculated as there is insufficient data available. However, communications with vessel operators suggest that penetration of an anchor freefalling in water though 10 m (during which distance it will reach terminal velocity) will not exceed the depth of the anchor fluke tip at full penetration in the same substrate i.e. sand.

Anchor drag may appear to be the greatest risk to a cable but it should be noted that an anchor that is dragging, in good holding ground at least, is inherently failing to engage the seabed. Penetration into the seabed is therefore likely to be less than the maximum possible for the particular anchor. The risk increases as the drag speed diminishes and an anchor begins to engage 'normally'; dragging may therefore only be a risk to cable that is not buried or poorly buried.