



Queensboro Development, LLC
Article VII Application

Exhibit 3

Alternatives

Prepared Pursuant to 16 NYCRR § 86.4

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
Exhibit 3: ALTERNATIVES ANALYSIS	3-1
3.1 Introduction.....	3-1
3.2 Purpose and Need.....	3-3
3.3 Project Parameters and Overall Alternatives Methodology	3-5
3.4 Summary of Alternatives.....	3-7
3.5 No Action Alternative	3-8
3.6 Landfall Alternatives	3-9
3.6.1 Selection Criteria.....	3-9
3.6.2 Preferred Alternative: Ravenswood Site.....	3-10
3.6.3 Alternative L-1: Brooklyn.....	3-10
3.6.4 Comparison and Selection	3-11
3.7 Submarine Route Alternatives and Variants	3-13
3.7.1 Selection Criteria.....	3-13
3.7.2 Preferred Alternative: Single HVDC Submarine Cable Corridor	3-14
3.7.3 Alternative S-1: East Side of Upper and Lower New York Bay	3-14
<u>3.7.3.1 Alternative S-1 Variant</u>	<u>3-15</u>
3.7.4 Alternative (Variant) S-2.....	<u>3-16</u>
3.7.5 Alternative (Variant) S-3.....	<u>3-16</u>
3.7.6 Alternative (Variant) S-4.....	<u>3-17</u>
3.7.7 Comparisons and Selection	<u>3-17</u>
3.8 Ravenswood Site Configuration/Converter Stations	<u>3-20</u>
3.8.1 Selection Criteria.....	<u>3-20</u>
3.8.2 North Converter Building (Preferred).....	<u>3-20</u>
3.8.3 North and South Converter Building (Alternative).....	<u>3-21</u>

3.9	Alternative Technologies	<u>3-21</u>
3.9.1	HVAC vs. HVDC	<u>3-21</u>
3.9.2	Alternative Submarine Cable Installation Techniques	<u>3-22</u>
3.9.2.1	Placement on the Seabed	<u>3-22</u>
3.9.2.2	Submarine Cable Burial Methods.....	<u>3-23</u>
3.9.2.3	Comparison and Selection	<u>3-33</u>
3.9.3	Alternative Infrastructure Crossing Methods.....	<u>3-34</u>
3.9.4	Landing Methods	<u>3-36</u>
3.9.5	Alternative Materials	<u>3-39</u>

TABLES

Table 3.4-1:	Summary of Alternatives	3-7
Table 3.9-2:	Preferred Submarine Cable Installation Alternatives	<u>3-24</u>

FIGURES [EMBEDDED]

Figure 3.1-1:	Project Overview.....	3-3
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FIGURES [ATTACHED]

Figure 3.7-1	Alternative Routes
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EXHIBIT 3: ALTERNATIVES ANALYSIS

3.1 Introduction

Queensboro Development, LLC (the “Applicant”), a wholly owned indirect subsidiary of Rise Light & Power, LLC, proposes to develop the Queensboro Renewable Express offshore transmission system (the “Queensboro Renewable Express”). Certain parts of the Queensboro Renewable Express, specifically the Queensboro Offshore Infrastructure – New York State Waters and the Queensboro Onshore Infrastructure (both as defined below), are subject to the jurisdiction of the New York State Public Service Commission (“NYSPSC” or “Commission”) and will require certain approvals, including a Certificate of Environmental Compatibility and Public Need (“CECPN”) under Article VII of the New York State Public Service Law (“PSL”).

The Queensboro Renewable Express is proposed as a ± 400 kilovolt (“kV”) merchant transmission facility that is designed to be mesh-ready with the capacity to deliver approximately 2.62 gigawatts (“GW”) of wind energy generated in a Host Bureau of Ocean Energy Management (“BOEM”) Lease Area(s) located in the federal waters of the Outer Continental Shelf (“OCS”) into the New York Independent System Operator (“NYISO”) Zone J at the site of the Ravenswood Generating Facility (“Ravenswood Site”) in New York City. The Queensboro Renewable Express will be interconnected to the 345 kV Rainey Substation and the 138 kV Vernon Substation, which are owned and operated by Consolidated Edison Company of New York, Inc. (“Con Edison”).

The Queensboro Renewable Express will be configured as two discrete high voltage direct current (“HVDC”) symmetric monopole circuits, defined as “Queensboro Circuit A” and “Queensboro Circuit B,” which will be installed within a single submarine cable corridor (“HVDC Submarine Cable Corridor”).

Each circuit will consist of:

1. Queensboro Offshore Infrastructure – OCS/New Jersey State Waters. Offshore infrastructure consisting of: (i) platform(s) to be located in a Host BOEM Lease Area located in the federal waters of the OCS, which will consist of either a combined or separate HVDC converter and alternating current (“AC”) collector mesh-ready platform, and (ii) an HVDC conductor cable assembly bundled with a fiber optic communications

cable, installed in a discrete trench within the HVDC Submarine Cable Corridor and traversing from the offshore platform(s) through the federal waters of the OCS, then into New Jersey State waters for approximately 6.1 miles (5.3 nautical miles), to the boundary of New York State waters, with an additional 3.6 mile (3.2 nautical mile) segment within New Jersey State waters in the Upper New York Bay.

2. Queensboro Offshore Infrastructure – New York State Waters. An HVDC conductor cable assembly bundled with a fiber optic communications cable, installed in a discrete trench within the HVDC Submarine Cable Corridor and traversing approximately 18.5 miles (16.1 nautical miles) within the boundaries of New York State waters between Lower New York Bay and a cable landfall location at the Ravenswood Site in Queens, New York (“Ravenswood Site Landfall”).
3. Queensboro Onshore Infrastructure – New York State. An HVDC conductor cable with a fiber optic communications cable, installed in underground cable trenches at the Ravenswood Site (“HVDC Terrestrial Cable Corridor”), and an onshore HVDC Converter Station and new substation equipment located on the Ravenswood Site, that will interconnect via underground HVAC Cables to the NYISO bulk electric system at the existing Rainey and Vernon Substations owned and operated by Con Edison and located adjacent to the Ravenswood Site.

The portions of the Queensboro Renewable Express described in numbered paragraph 2 and 3 above (the Queensboro Offshore Infrastructure – New York State Waters and Queensboro Onshore Infrastructure) are subject to Article VII review and are referred to herein as the “Project.” See Figure 3.1-1, below.

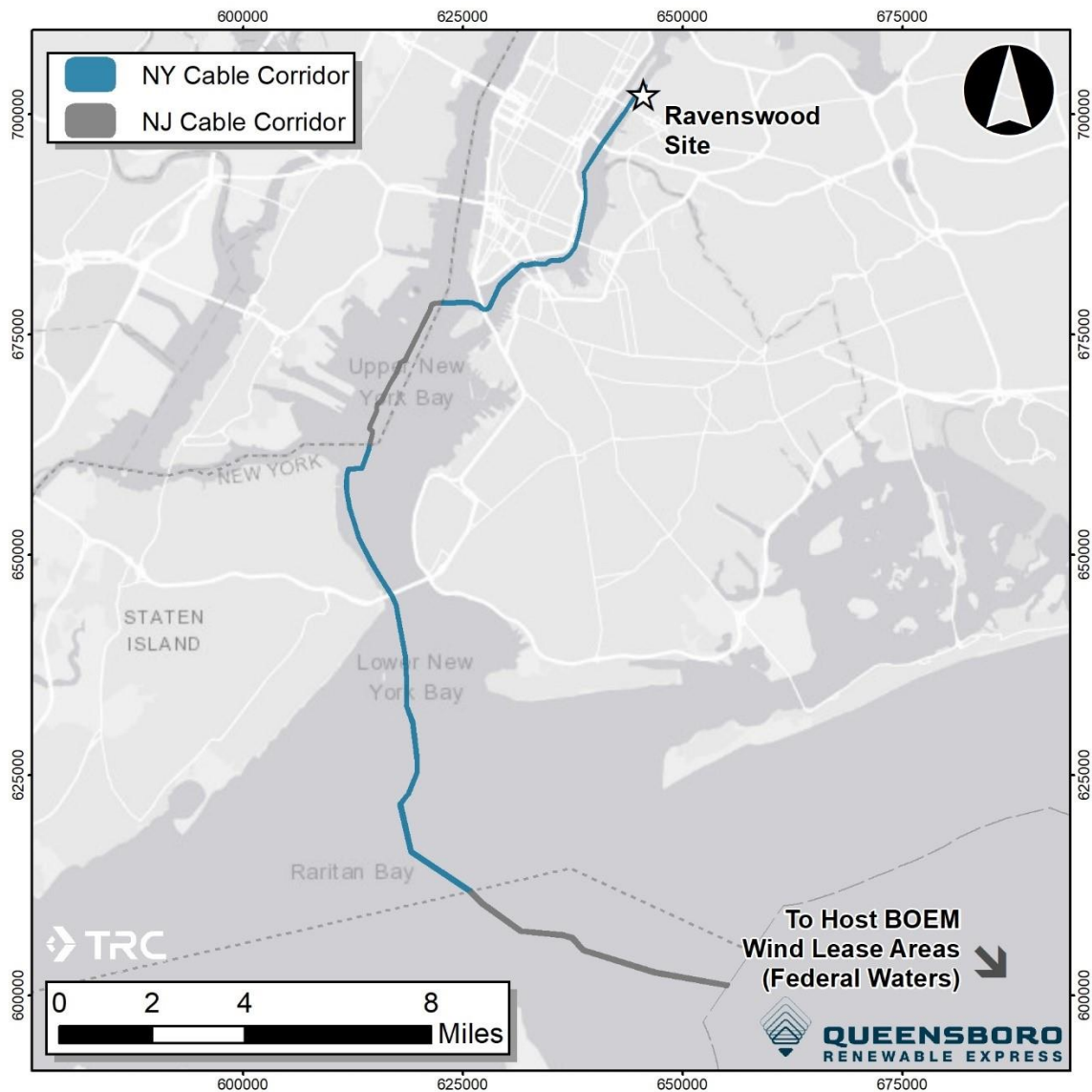


Figure 3.1-1: Project Overview

This Exhibit addresses the requirements of 16 NYCRR § 86.4, including explanation of alternative routes and alternate methods of fulfilling energy requirements with comparative advantages and disadvantages.

3.2 Purpose and Need

The purpose of the Queensboro Renewable Express transmission facility is to: (i) transmit electricity generated by offshore wind facilities located in a Host BOEM Lease Area(s) to points

of interconnection (“POI”) located in NYISO’s Load Zone J in Queens, New York; and (ii) facilitate the retirement of existing fossil fueled generation at the Ravenswood Site.

This proposed Project supports multiple important State policies. The New York State Climate Leadership and Community Protection Act (“Climate Act”) mandates that the State reduce greenhouse gas (“GHG”) emissions so that, in 2030, such emissions are no greater than 60% of 1990 statewide GHG emission levels. The Climate Act further requires that, by 2050, statewide GHG emissions be no greater than 15% of the 1990 levels. Under the Climate Act, the NYSPSC must establish programs to achieve certain electricity sector targets. These targets are designed to (i) ensure that sufficient renewable energy resources serve at least 70% of the State’s load by 2030 and (ii) provide for zero emissions from electrical demand by 2040. Furthermore, in October 2020, the Commission amended its 2018 Clean Energy Standard to incorporate the Climate Act mandates and further specified that a minimum of 9 GW of energy be generated by offshore wind by 2035.

In January 2022, Governor Hochul committed to invest in offshore wind, which is expected to result in the development of over 4.3 GW of energy, or half of New York’s 2035 goal. As a result, the NYSPSC issued an Order focusing on the integration of offshore wind generation into New York’s power grid. Among other things, this Order directed that future solicitations by New York State Energy Research and Development Authority (“NYSERDA”) for offshore wind renewable energy credits (“OWRECs”) require a mesh-ready transmission system to allow the potential for multiple projects to interconnect and create an offshore network for delivery into Load Zone J. The Order further directed that such future procurements require that HVDC transmission be used, where appropriate, to preserve maximum efficient use of constrained cable corridors. At the same time, Governor Hochul introduced a policy target of retiring and replacing fossil generating units in New York City. NYSERDA incorporated the Governor’s policy requirements into its 2022 OREC Request for Proposals (“RFP”) released on July 27, 2022.¹

¹ The Applicant anticipates entering into a commercial partnership with one or more Host BOEM Lease Area leaseholders, and further anticipates that the Project will be submitted in response to NYSERDA’s 2022 OREC RFP, due in January 2023.

With the Queensboro Renewable Express, the Applicant is proposing to construct two discrete submarine HVDC Cables in a single cable corridor in New York State waters from one or more Host BOEM Lease Area(s) to two POIs located in NYISO's Load Zone J. The proposed Project is designed to be mesh-ready and will result in the delivery of approximately 2.62 GW of renewable offshore wind energy into New York City.

The Project is an important element in addressing the State's legislative and policy goals for renewable energy. The Queensboro Renewable Express will: (i) result in the efficient delivery of nearly one-third of the 9 GW goal included in the modified Clean Energy Standard via HVDC transmission while minimizing the use of available cable corridors; (ii) establish a mesh-ready transmission system from a Host BOEM Lease Area(s) into Load Zone J; (iii) strengthen reliability and provide for redundancy; and (iv) facilitate the retirement of existing fossil fuel generation in New York City. Installation of the Project will create only localized, temporary, and minor disruption to lands, roads, communities, and rights-of-way.

Each of the two circuits is designed to replace existing fossil fuel generating units at the Ravenswood Site. Through the NYISO interconnection process, Capacity Resource Interconnection Service ("CRIS") rights assigned to these units will be transferred to each circuit to minimize interconnection costs and facilitate the planned retirement of existing fossil fuel generating units. The replacement of these units at the Ravenswood Site with offshore wind facilities is directly responsive to the Governor's January 2022 fossil retirement goals and will assist NYSERDA and the Commission in meeting the goals of the Climate Act.

3.3 Project Parameters and Overall Alternatives Methodology

In furtherance of the Project's dual purpose to transmit wind energy from the OCS into NYISO Zone J and to facilitate the retirement of existing fossil-fueled generating facilities at the Ravenswood Site, the Applicant established overall Project criteria to guide both Project design and the evaluation of alternatives. These Project criteria seek to:

- Maximize the ability to provide export and NYISO Zone J injection capacity for multiple offshore wind energy projects in a dedicated and pre-planned single corridor in the waters between the OCS boundary and the landfall, reducing the number of new offshore wind

transmission corridors needed to reach the State's offshore wind goal of 9,000 MW by 2035.

- Facilitate the retirement of existing fossil-fueled generation at the Ravenswood Site and repurpose the associated land and infrastructure as a renewable energy hub.
- Maximize the use of properties controlled by the Applicant or its affiliates that are or were used for energy-related purposes, including the Ravenswood Site and underground infrastructure connecting it to the adjacent Rainey and Vernon Substations.
- Minimize distance between Converter Stations and POIs, and thus minimize the need to obtain new rights-of-way or acquire other property rights.
- Minimize the costs associated with transmission system upgrades by transferring CRIS rights currently in use by existing fossil fuel generation at the Ravenswood Site to new offshore wind energy. Locating the delivery of offshore wind energy at the same location as the existing fossil generation that currently hold the CRIS rights avoids the need to build additional support infrastructure for new offshore wind power injections.

Given these design criteria and the overall Project objectives, the Applicant selected: (i) the Ravenswood Site for the location of onshore Project components including the HVDC Cables, the HVDC Converter Stations, and the HVAC Cables; and (ii) the adjacent Rainey 345 kV Substation and Vernon 138kV Substation as the Project's POIs.

Numerous factors support this determination. Chief among them, the Ravenswood Site is a previously disturbed industrial site, historically devoted to energy uses and large enough to accommodate the Project's onshore components; and the Applicant controls the Ravenswood Site, through its affiliate, which owns and operates the existing Ravenswood Generating Facility. The site has access to both (i) the Rainey Substation (which currently holds interconnection positions for Unit 30 and the simple cycle peaking units) via existing tunnels and utility corridors, and (ii) the Vernon Substation (with interconnections for Units 10, 20 and 40). As a result, the Project will require neither new onshore rights-of-way nor related costly onshore transmission upgrades. Notably, the use of the Ravenswood Site for the Project's onshore components is permitted as of right under the zoning ordinance; conforms to the historical use of the site and its immediate surroundings; and avoids the environmental impacts associated with greenfield development.

In sum, by incorporating the Ravenswood Site and adjacent POIs into its design, the Project will significantly reduce environmental impacts, disruption to neighboring communities, capital costs, and viability risks.

3.4 Summary of Alternatives

The Applicant analyzed alternatives to connect the Project from its entry into New York State jurisdictional waters to the proposed onshore facilities at the Ravenswood Site for interconnection into NYISO Zone J at the Rainey and Vernon Substations. These analyses included studies of landfall alternatives, alternate routes, converter station configurations, and technologies. Concept alternatives were evaluated using desktop assessments, engineering studies, professional engineering, and vendor consultations together with field work. Analysis of Project route alternatives included geographic information system data analysis, field surveys, federal and state agency consultations, and technical studies.

Alternatives identified for the Project are listed in Table 3.4-1 below. This table also indicates where in this Exhibit the analysis is described in detail.

Table 3.4-1: Summary of Alternatives		
Alternative	Description	Location in Exhibit
Alternative Landfalls		
Preferred Alternative	Ravenswood Site	Section 3.6.2
L-1	Brooklyn Landfall	Section 3.6.3
Alternative HVDC Cable Routes		
Preferred Alternative	Single HVDC Submarine Cable Corridor	Section 3.7.2
Submarine (S)-1	East Side of Upper and Lower New York Bay	Section 3.7.3
<u>S-1 Variant</u>	<u>East Side of Upper and Lower New York Bay</u>	<u>Section 3.7.3.1</u>
S-2	Buttermilk Channel	Section 3.7.4
S-3	West of Governors Island	Section 3.7.5
S-4	Restricted Naval Area Route Deviation	Section 3.7.6

Table 3.4-1: Summary of Alternatives

Alternative	Description	Location in Exhibit
Alternative Converter Station Arrangement		
Preferred Alternative	A single converter building (North Converter Building) on the Ravenswood Site, housing HVDC Converter Stations for both Circuits A and B	Section 3.8.2
North and South Converter Building Alternative	Two converter buildings on the Ravenswood Site, with the North Converter Building housing the HVDC Converter Station for Circuit A, and a South Converter Building, housing the HVDC Converter Station for Circuit B.	Section 3.8.3
Alternative Technology		
HVAC Cables	Use of Alternating Current Cable System	Section 3.9.1
HVDC Cables	Use of Direct Current Cable System, use of alternative HVDC voltages	Section 3.9.1
Installation Methods	Alternative submarine cable installation methods	Section 3.9.2
Crossing Methods	Methods for crossing submerged infrastructure	Section 3.9.3
Landing Methods	Alternative cable landfall methods	Section 3.9.4
Materials	Alternative cable/onshore infrastructure materials	Section 3.9.5

3.5 No Action Alternative

Under the No-Action Alternative, the Project would not be built. As a result, the following significant Project benefits would not be realized:

- The Project’s energy delivery opportunity, unique in its capability of injecting up to 2.62 GW of offshore wind energy into NYISO Zone J with interconnections at the Rainey and Vernon Substations where there is existing capacity;
- An important means of meeting the State of New York’s policies for importing 9 GW of offshore wind energy to the NYISO electric grid by 2035 and for retiring and redeveloping aging fossil fuel generating facilities by 2030; and
- The substantial benefits to area residents and nearby Environmental Justice (“EJ”) and disadvantaged communities resulting from retiring Ravenswood Units 10, 20, and 30.

At the same time, the No-Action Alternative would impose additional burdens, requiring that multiple submarine cable corridors and/or multiple cable landings for offshore wind energy in Zone J be identified and built.

For these reasons, the No-Action Alternative is not a reasonable alternative for this Project.

3.6 Landfall Alternatives

3.6.1 Selection Criteria

Given the Applicant's proposed use of the Ravenswood Site for the location of the Project's HVDC Converter Stations and related onshore components, the Applicant evaluated two potential landfalls for the Project's submarine cable—the Ravenswood Site and a location approximately 0.5 miles southeast of Fort Hamilton near Dyker Heights, Brooklyn, New York.

In the first alternative examined, the Project's transmission cables would remain entirely submarine from their point of entry into New York State waters until transitioning to land at the Ravenswood Site.

In the second alternative, the submarine cables would transition to land in Brooklyn, New York between Fort Hamilton and Belt Parkway/Shore Parkway Exit 4 (14th Avenue, Bay 8th Street). The onshore HVDC cables would thereafter traverse approximately 14.3 miles from the landfall through Brooklyn and Queens streets and neighborhoods until arriving at the HVDC Converter Stations on the Ravenswood Site.

These potential landfalls and their associated routes were then evaluated using the following criteria:

- Minimize environmental impacts associated with cable installation;
- Minimize acquisition of private property rights;
- Minimize disruption to local residents and traffic patterns;
- Minimize installation constraints and complexity, including those associated with construction through densely populated neighborhoods and commercial areas;

- Minimize the co-location of Project components in existing onshore transportation and utility rights-of-way; and
- Maximize proximity to proposed HVDC Converter Stations.

3.6.2 Preferred Alternative: Ravenswood Site

As depicted on Figure 3.1-1 above, Project Overview, the preferred transmission line configuration consists of two HVDC circuits installed in a single submarine cable corridor from the New York State line in Lower New York Bay to a landfall at the Ravenswood Site. The two submarine HVDC Cables will transition to land at the bulkhead located on the northern portion of the Ravenswood Site where they will be routed through conduits from the riverbed through the bulkhead into covered pre-cast cable trenches below grade on the Ravenswood Site before terminating at the HVDC Converter Stations. (The Applicant's evaluation of submarine route alternatives/variants, all making landfall at the Ravenswood Site, is set forth in Section 3.7, below).

3.6.3 Alternative L-1: Brooklyn

As depicted on Figure 3.7-1 (attached), the Applicant evaluated an approximately 14.8-mile combined submarine and terrestrial cable route alternative that incorporates portions of an alternative submarine route (Alternative S-1) from the New York State waters boundary to a location in the northern part of Gravesend Bay, where it deviates from Alternative S-1 to its point of landfall, between Fort Hamilton and Belt Parkway/Shore Parkway Exit 4 (14th Avenue, Bay 8th Street) in Brooklyn. This landfall is designated as Alternative L-1 on Figure 3.7-1 (attached).

After making landfall at Alternative L-1, a terrestrial cable route would continue underground through approximately 14.3 miles of Brooklyn and Queens neighborhoods, utilizing existing utility corridors in public rights-of-way, to the extent practicable. The route crosses through the Bay Ridge and Sunset Park neighborhoods, primarily along 5th Avenue. The alternative route then continues east of I-278, before proceeding northeast through the Fort Greene, Clinton Hill, and Williamsburg neighborhoods, where it crosses I-278 and turns north through the Greenpoint neighborhood. The terrestrial route then crosses Newtown Creek into Queens near Hunter's Point to avoid the Long Island City railyard and follows 21st Street and 37th Avenue into the Ravenswood Site.

3.6.4 Comparison and Selection

After evaluation and comparison of the Ravenswood Site Landfall and Alternative L-1 Landfall in Brooklyn, the Applicant determined that the Ravenswood Site Landfall was the only viable alternative. When compared to Alternative L-1, the Ravenswood Site Landfall minimizes/avoids environmental impacts, the acquisition of property rights, disruption to traffic patterns and local residents, installation constraints and complexity, and potential conflicts with existing transportation and utility infrastructure assets. At the same time, the Ravenswood Site Landfall optimizes the proximity of the landfall to the HVDC Converter Stations.

The Applicant examined the landfall sites and their associated cable routing by comparing: (i) the potential impacts to waterbodies with those of a land route, and (ii) the practical and constructability of a land route(s) for two circuits (especially in a densely developed location such as New York City) with the constructability of a submarine corridor for two circuits. The Applicant recognizes that there could be a wide variety of possible corridors that combine both land and water, but the above two considerations would apply in all such cases.

The Applicant's analysis of the potential environmental impacts of the Project's submarine route making landfall at the Ravenswood Site is presented in Exhibit 4 of this Application. In summary, potential impacts to waterbodies and marine uses can largely be avoided or minimized, and in any event, are temporary, localized, and confined to the construction period or to repair activities required during operation. Potential onshore impacts will also occur primarily during the construction period and will be limited to the Ravenswood Site and its immediate area.

Potential onshore impacts associated with landfall Alternative L-1 would also occur mostly during the construction period; however, these impacts were anticipated to be greater than those associated with the Ravenswood Site landfall. These impacts include disturbance to public and private property, disruption to residents and businesses along the route, potential conflicts with numerous existing underground utilities in a dense urban environment, and interference with vehicular and pedestrian traffic patterns on public roadways. Additionally, onshore construction is slower than in-water construction and, thus, construction related impacts would last longer.

The issue of feasibility and constructability provides a key contrast between land and water-based routes for the Project. Underwater cable installation using the Applicant's proposed technologies is feasible and environmentally compatible. Terrestrial cable installation, while feasible, can be problematic depending on site-specific conditions, especially when constructing in urban environments such as New York City. It is important to note that the existence of even one infeasible segment of a land route (e.g., routing through an area heavily used by motor vehicles or constrained by existing underground utilities) can compromise the entire land route, and, as such, limits alternatives.

Given these concerns, Alternative L-1 was determined not to be reasonable and was removed from consideration. Among other things, its proposed landfall would enter a publicly accessible shoreline area, the Brooklyn Waterfront Greenway, owned by the City of New York and then proceed immediately underground through the Ben Vitale Ballfields, an area containing four municipal ballparks, and Dyker Beach Park. Similar limitations exist both north and south of the Alternative L-1 landfall location. The installation of the transmission line, which would likely involve open cut trenching through that area, would be highly disruptive to park users and neighborhood residents during the many months of construction in that area. This route would also require horizontal directional drill bores under the Belt Parkway with entry and exit points located in the baseball fields and the Brooklyn Waterfront Greenway. Additional concerns weighing against this alternative include the following:

- The length of Alternative L-1's land route through the streets of Brooklyn and Queens would be approximately 14 miles. Constructing two buried, terrestrial transmission circuits through the streets of Brooklyn and Queens of such length would require the installation of multiple duct banks in already densely developed neighborhoods and streets with a variety of current and historic underground utilities that the Project would need to navigate around.
- The terrestrial route from the Alternative L-1 landfall to the Ravenswood Site would entail the acquisition of a greater number of distinct property rights from multiple property owners, including the City of New York and NYSDOT, as compared to the Preferred Alternative.

- Construction activities related to the terrestrial route would require extensive excavation in public streets or rights-of-way as well as closure of such streets to vehicular and pedestrian traffic. In the densely populated areas traversed by the terrestrial route between the Alternative L-1 landfall and the Ravenswood site, these activities would be highly disruptive to traffic patterns and neighborhood residents for many months, if not years.
- The terrestrial route contemplates co-location with, and crossings of, a great number existing transportation and utility infrastructure on land. The number of such infrastructure crossings are far greater than those inherent in the proposed submarine route. As a result, the terrestrial route would require a greater engineering design effort and more complex construction methods; it would also require greater coordination with infrastructure owners, including shutdowns of services such as railroads, mass-transit tracks, fuel pipelines, gas service, and other electrical and communications cables for the duration of construction in the vicinity.

3.7 Submarine Route Alternatives and Variants

3.7.1 Selection Criteria

Potential submarine cable routes were identified and evaluated using the following criteria. An ideal submarine cable route would:

- Minimize overall cable length;
- Avoid or minimize impacts to sensitive terrestrial and aquatic resources;
- Avoid or minimize impacts to known submerged cultural resources;
- Minimize potential for navigational conflicts or impacts to vessel traffic, vessel FNP anchorages or mooring areas, and FNP channels during construction or maintenance;
- Avoid charted shipwrecks and munitions and explosives of concern/unexploded ordinance (“MEC/UXO”);
- Avoid areas of intense commercial and recreational fishing;

- Maximize siting of the cable routes in areas of softer sediments (sands, muds) to allow use of self-propelled cable burial installation tools, requiring less energy to operate and avoiding excessive sediment disturbance during installation than other methods;
- Use cable turning points (sometimes referred to as alter courses) that meet typical installation capabilities of cable installers;
- Be of sufficient width to allow for repairs;
- Avoid sand waves, steep gradients, and areas of high sediment mobility;
- Consider interaction with existing subsea infrastructure such as cables, pipelines, and tunnels; and
- Minimize the potential for conflicts with crossing established dump sites, extraction sites, and municipal water intakes.

3.7.2 Preferred Alternative: Single HVDC Submarine Cable Corridor

The preferred transmission line configuration consists of two HVDC circuits installed in a common submarine cable corridor (the “HVDC Submarine Cable Corridor”) from the New York State line in Lower New York Bay (in Swash Channel, next to Romer Shoal) to the Ravenswood Site. The Project corridor extends through Lower New York Bay, the Narrows, Upper New York Bay (including a stretch in New Jersey State waters), and the East River, with a total distance of approximately 18.5 miles in New York State waters and approximately 3.6 miles in New Jersey State waters in Upper New York Bay. The two HVDC Cables will transition to land at the bulkhead located on the northern portion of the Ravenswood Site where they will be drawn through Landfall Transition Conduits to pre-cast cable trenches below grade at the Ravenswood Site before terminating at the Converter Stations.

The Preferred Alternative is described in more detail in Exhibit 2 and illustrated in Figure 2.1-2. It is also shown on Figure 3-7.1 (attached), Alternative Routes.

3.7.3 Alternative S-1: East Side of Upper and Lower New York Bay

Alternative S-1 (Figure 3.7-1 [attached]) is an approximately 25.3-mile submarine cable corridor that enters New York State waters at a point east of the Preferred Alternative and then continues

along a more easterly route, traversing the east side of Upper and Lower New York Bay and the Brooklyn/Queens side of the East River.

The Alternative S-1 parallels the north and east side of the Ambrose Channel within New York State waters, ~~north and east of proximate to~~ Equinor's ~~proposed~~ anticipated Empire Wind 1 ~~cable corridor~~ cables, as set forth in that project's January 2024 Environmental Management and Construction Plan ("EM&CP"), subsequently approved by NYSPSC. At the south side of Gravesend Anchorage (Anchorage 25), the corridor turns east and then north to follow the landward and northern sides of the FNP anchorage.

Once north of the FNP anchorage, the Alternative S-1 turns north to cross the 3,700-foot-wide charted cable area at the Narrows and then passes under the Verrazano-Narrows Bridge at a distance of approximately 560 feet from the bridge's eastern pylon. North of the bridge, the corridor crosses charted cable and pipeline areas while paralleling the Anchorage Channel before crossing Bay Ridge Channel and entering Anchorage 21C. The corridor follows the western edge of Anchorages 21C and 21B. At the north end of Anchorage 21B, the corridor enters Buttermilk Channel, traversing the channel to its intersection with the East River FNP channel. In contrast to the Preferred Alternative, which remains primarily on the Manhattan (western) side of the East River, the Alternative S-1 corridor follows the along the river's Brooklyn-Queens (southeastern) side until it makes landfall at the Ravenswood Site.

3.7.3.1 Alternative S-1 Variant

On May 23, 2025, the Applicant filed a letter of intent to supplement the Application with a description and analysis of a variant of Alternative S-1 ("the S-1 Variant"):

The S-1 Variant is a total of 26.4 miles in length and follows a similar route to Alternative S-1 from the Federal Waters boundary through the New York State Waters of the Atlantic Ocean, Lower New York Bay, and the Narrows. In Upper New York Bay, the S-1 Variant continues north along a path similar to Alternative S-1 until it approaches Anchorage 21C. There, the Alternative S-1 follows the east side of Anchorage 21C, then routes through portions of Anchorages 21B and 21A, whereas the S-1 Variant would remain in the Bay Ridge Channel, proximate to the Empire

Wind 1 cables until it reaches Brooklyn's 39th Street Pier,² then it would turn northwest to cross Bay Ridge Channel before entering Anchorage 21A. From this point, the S-1 Variant turns north to cross Buttermilk Channel, along a portion of Alternative S-2. The S-1 Variant would then continue past Governor's Island on the south side and on the west side, where it would follow Alternative S-3. The S-1 Variant would join the Preferred Alternative on the north side of Governor's Island at a point just west of the East River FNP Channel. From this point northward, the S-1 Variant would follow the Preferred Alternative cable corridor to the Ravenswood Landfall. An overview map of the S-1 Variant is shown in Figure 3.7-1 [attached].

3.7.4 Alternative (Variant) S-2

Alternative S-2 (Figure 3.7-1 [attached]) is a short alternative submarine route variant that follows the Preferred Alternative route corridor from the New York State waters boundary in Lower New York Bay to a point in New Jersey State waters approximately 0.4 miles southeast of the Statue of Liberty. From there, the Alternative S-2 corridor departs from the Preferred Alternative route corridor, turning eastward across the Anchorage Channel, paralleling the east side of Governors Island, and continuing northeast through the Buttermilk Channel. At this point (at or near the Brooklyn Bridge), Alternative S-2 rejoins the Preferred Alternative route corridor.

3.7.5 Alternative (Variant) S-3

Alternative S-3 (Figure 3.7-1 [attached]) is a short alternative submarine route variant that follows the Preferred Alternative route corridor from the New York State waters boundary in Lower New York Bay to the same point in New Jersey state waters as Alternative S-2, approximately 0.4 miles southeast of the Statue of Liberty. At this point, the Alternative S-3 corridor departs from the preferred route corridor, turning eastward for approximately 0.4 miles (crossing the Anchorage Channel and paralleling the Alternative S-2 variant). This alternative route then continues north for approximately 1.3 miles, keeping to the west side of Governors Island before rejoining the preferred route corridor between Governors Island and the Battery.

² Between the Federal Waters boundary and the south end of Bay Ridge Channel, the S-1 Variant corridor is proposed to be located on both sides of the proposed Empire Wind 1 cables, as presently depicted in the approved Empire Wind 1 EM&CP. From that point north, the S-1 Variant corridor would be located on the west side of the Empire Wind 1 cables.

3.7.6 *Alternative (Variant) S-4*

Alternative S-4 (Figure 3.7-1 [attached]) is a 0.8-mile route alternative submarine route variant that departs from the Preferred Alternative route corridor to avoid the charted restricted naval area associated with the now-closed Naval Station New York on Staten Island, which operated until 1994. This Alternative could be used if the USCG or USCACE-NYD determine that the Project route cannot pass through the charted restricted naval area.

3.7.7 *Comparisons and Selection*

The Preferred Alternative route corridor represents the alternative that best satisfies the selection criteria and minimizes potential impacts to aquatic resources, water quality, and navigation, as further described in Exhibits 4 and E-6. However, the S-1 Variant incorporates additional stakeholder feedback received following the initial submittal of this Application and remains under consideration as a reasonable alternative. Many of the ecological factors considered (e.g., endangered species, essential fish habitats, fisheries, marine mammals and turtles, shellfish and benthic macro invertebrates) are similar among all submarine cable corridors evaluated because they traverse the same waterbodies.

The differences between the Preferred Alternative cable corridor and the alternative cable corridor options are described below.

- **Alternative S-1:** This alternative was determined not to be reasonable and was therefore removed from consideration.
 - Alternative S-1 would parallel Equinor's Empire Wind 1 project on the eastern flank of the Ambrose Channel through the Narrows. Even if both projects are approved and can feasibly exist in the same area, there is the potential for cumulative impacts to this area arising from cable installation activities and a wider overall corridor would be required to accommodate both projects. However, co-location of cables in a corridor has more recently been identified by the maritime community as a preference for the siting of submarine power cables and a recommended strategy for optimizing submarine real estate in constrained areas like the New

York Harbor.³ The Preferred Alternative route lies to the west of Ambrose Channel, significantly minimizing an area that does not currently host any offshore wind-related transmission cables. It is anticipated, however, that this area may be subject to future cable installation campaigns as a result of the potential for adverse cumulative impact, ongoing New York City Public Policy Transmission Need solicitation (issued in April 2024).

- From the Gravesend Anchorage area to the eastern approach to the Narrows, the seabed is mobile. Good industry practice for cable installation requires that cables be buried in the non-mobile substrate, below recorded sand-waves. Due to the presence of subsea sand waves in this area, additional cable burial depth (greater than 15 feet) may be necessary to place the cable below the sand waves. This deeper cable burial requirement would have greater impacts to water quality and aquatic organisms.
- **Alternative S-2:** This alternative route variant was determined not to be reasonable and was removed from consideration. While levels of marine traffic are anticipated to be marginally lower in the area of Alternative S-2 (i.e., in the Buttermilk Channel) as compared to the Preferred Alternative, this variant raised the following concerns:
 - The Harbor Safety, Navigation, and Operations Committee for the Port of New York and New Jersey (“Harbor Operations Committee”) advised that this deviation was less preferable than the Preferred Alternative because of Buttermilk Channel’s proximity to port and pier facilities.

³ The April 2023 cable routing workshop held by the New York State Offshore Wind Maritime Technical Working Group considered co-location of cables within the same corridor as one of the means for routing cables with as little impact as possible to existing maritime uses, specifically noting: “New projects should be sited within the same corridor as existing projects under development (e.g., Empire Wind).” See New York Offshore Wind Maritime Technical Working Group (M-TWG) Cabling Workshop: Advancing Cable Routing Coordination Workshop Summary at 7-8 (April 2023).

- Marine surveys conducted by the Applicant indicate shallow sub-bottom reflectors that could be indicative of hard bottom or rock. Avoiding hard bottom or rock is one of the corridor selection criteria.
- **Alternative S-3:** This alternative route variant was determined to be reasonable, but less preferable than the Preferred Alternative due to the following concern:
 - Marine surveys conducted by the Applicant indicate that the route runs along and parallel to the side slope of the Anchorage Channel and has a 10 to 16-foot elevation change from the east side of the corridor to the west side. The seabed slope at this location would make it difficult to control the path of a cable burial tool as it would tend to slide down slope, under its own weight, creating an erratic burial path with a high probability for cable damage.
- **Alternative S-4:** This alternative was determined to be reasonable, but less preferable than the Preferred Alternative due to the following:
 - Alternative S-4 is longer than the preferred route, which would increase Project cost, installation time, and the potential for transmission losses. Nevertheless, it remains under consideration in the event that the USCG or USACE-NYD requires the Applicant to avoid the charted restricted naval area.
- **Alternative S-1 Variant:** Following additional input from stakeholders and further review by the Applicant, this variant was determined to be more reasonable than the initial Alternative S-1 and remains under consideration based on continued feedback from the maritime community and other stakeholders.
 - Since the initial Application submission, the Empire Wind EM&CP has been publicly filed and approved by NYPSC. Using the EM&CP drawings submitted by Equinor (Appendix A – Export Cable Plan and Profile Drawings), the S-1 Variant would be co-located within the same general corridor such that it would not conflict with either of the Empire Wind 1 cables. The potential for adverse cumulative impacts would be reduced by the gap in time between the construction of the two projects, allowing opportunity for benthic recovery.
 - Areas of mobile seabed (sand waves) will be avoided to the greatest extent practicable by micro-routing the cables following pre-installation survey. If such

areas of mobile seabed cannot be avoided, Applicant would propose pre-sweeping such areas to level the seabed using a Mass Flow Excavator (“MFE”), as has been proposed by Equinor in the Gravesend Bay area and approved by NYSPSC. The associated Equinor sediment transport study showed that state water quality standards and Total Suspended Solids limits would not be exceeded by such route clearance activity.

- Micro-routing of the S-1 Variant west of Governor’s Island (along the Alternative S-3 route) would be used to avoid major side slopes, mitigating the cable installation concern noted above.

3.8 Ravenswood Site Configuration/Converter Stations

3.8.1 Selection Criteria

Potential locations for the HVDC Converter Stations on the Ravenswood Site were identified and evaluated using the following criteria. Ideal converter station locations within the site would:

- Maximize proximity to a cable landfall;
- Repurpose a seven-acre area of the Ravenswood Site historically occupied by Ravenswood’s simple cycle peaking units (now in the process of retirement); and
- Reduce the need for additional regulatory approvals.

Within the Ravenswood Site, the Applicant has considered two alternate arrangements for the HVDC Converter Stations, as set forth in Section 3.8.2 and 3.8.3 below.

3.8.2 North Converter Building (Preferred)

The preferred arrangement consists of housing both the Queensboro Circuit A and Queensboro Circuit B HVDC Converter Stations in the North Converter Building, a new building that would be constructed on the northern end of the Ravenswood Site (Exhibit E-2, Figure E-2.2-1). This location is approximately seven acres in size and is currently occupied by natural gas turbine peaker units (the “GT Site”), all of which are scheduled to be retired by May 2023 and decommissioned thereafter. The footprint of the GT Site has sufficient space to locate the North

Converter Building and all necessary converter station components. The GT Site offers an opportunity to reuse and repurpose a portion of the Ravenswood Site for renewable energy purposes without relying on retirement and demolition of the existing thermal units.

3.8.3 North and South Converter Building (Alternative)

This alternative provides for an alternate arrangement of the HVDC Converter Stations for Queensboro Circuit A and Queensboro Circuit B. In this arrangement, the North Converter Building will be located on the GT Site and will house the HVDC Converter Station for Queensboro Circuit A. The second converter building (the South Converter Building) would be located in the area of Unit 30, and would house the HVDC Converter Station for Queensboro Circuit B. While there is sufficient space to develop two separately located HVDC Converter Stations in this alternative arrangement, this alternative would require the full demolition of Unit 30 before the South Converter Building could be constructed, which would be subject to additional regulatory approvals and potential schedule delays. This constraint, coupled with the potential for increased environmental impact arising from additional demolition and construction, rendered this alternative less preferable than the preferred North Converter Building alternative.

3.9 Alternative Technologies

3.9.1 HVAC vs. HVDC

The Applicant evaluated two primary technologies for bringing the energy generated by offshore wind generation to landfall in Zone J: High Voltage Alternating Current (“HVAC”) or HVDC cable systems. These technologies were evaluated based on route length, performance, and economic factors. The Applicant determined that HVDC is the preferred solution for the reasons set forth below. In addition, NYSERDA recently required that all proposals into the 2022 OREC RFP be based on HVDC export system design “for all projects where cables will be installed in areas of constraint.” In light of the Applicant’s evaluation and the NYSERDA requirement, HVAC was dropped from further consideration.

There are technical limitations to the lengths of an HVAC network that can be constructed with underground or submarine cable. HVAC cable systems have higher electrical losses than HVDC cable systems. An HVAC system would require three separate cables to transmit the same

amount of energy as one HVDC cable. The distances from offshore wind lease area(s) in federal waters to the Ravenswood Site are such that an HVAC system can only be used with a combination of offshore mid-span compensation stations and satellite stations (i.e., multiple new offshore platforms).

An HVAC system is typically less expensive than an HVDC system. However, given the total length of the cables, the need for mid-span compensation stations and satellite stations, the HVDC solution is competitive with an HVAC system for the Project.

HVDC offers the following additional benefits and flexibility that support transmission networks, particularly complex dense networks such as those in Zone J:

- Fully controllable flow of power from the offshore wind generators to the POI;
- Enhancement of power quality at the POI and the load serviced;
- More efficient than HVAC at transferring power;
- Fewer environmental impacts due to fewer cables than HVAC; and
- Narrower cable corridor required due to fewer cables than HVAC.

3.9.2 Alternative Submarine Cable Installation Techniques

The Applicant evaluated several alternative methods for offshore cable installation, including placement directly on the seabed and burial beneath the seabed.

3.9.2.1 Placement on the Seabed

Placement of the cable directly on the seabed as the primary method of installation was determined not to be reasonable, and thus discarded as an alternative, for a variety of reasons. Placement directly on the seabed, while less expensive to install than burial, has the increased potential for damage from anchors and/or fishing gear, especially in busy waterways like Lower New York Bay, Upper New York Bay, and the East River. Any construction savings would, over the lifetime of the Project, be more than offset by the increased maintenance costs, increased cable protection requirements, and related downtime.

Further, placement on the seabed is unlikely to be an accepted practice by the NYSPSC, USACE-NYD, and/or BOEM, and is likely to create financing and insurability issues. Accordingly, the proposed Project design allows for placement directly on the seabed with cable protection (e.g., concrete mattresses) only in discrete route sections where the desired cable burial depth cannot be achieved.

Given these concerns, placement on the seabed was determined not to be reasonable and was removed from consideration.

3.9.2.2 Submarine Cable Burial Methods

As described more fully in Exhibit 4 and its Attachments 4-1 (Field Evaluation Report) and 4-3 (Sediment Dispersion Modeling Report), the sediments along the HVDC Submarine Cable Corridor are variable in composition; thus, burial depth requirements are likely to differ along the corridor based on sediment composition and navigational interests. As a result, different construction and installation techniques will be used along the route to install the two submarine HVDC Cables.

Diver-assisted burial tools may be advantageous for fine control under certain limited instances during repair or construction. This method will only be used where no other reasonable technological solution is available. Environmental impacts associated with the use of diver's tools are expected to be localized, minor and temporary because such tools (e.g., hand dredges, air lifts, eductors) are not particularly powerful nor do they move much material.

Suitability of different techniques for installation of the cable is assessed below. Table 3.9-2 includes general comparative observations to aid selection of the preferred installation method. Additional engineering details of how various tools and techniques are to be employed are set forth in Exhibit E-3.

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
General Description	A sledge is dragged along the seabed carrying a jet leg (sometimes called a “stinger”) through which the cable passes. Water jets in the jet-leg fluidize the seabed under and behind the machine into which the cable either settles or is depressed.	A very long jet leg is suspended from a crane on a barge and strapped to the side of the barge. As the barge is maneuvered, water is pumped into the jet leg to fluidize the seabed. The cable is fed down the inside of the jet leg. Changes in depth/tide require un-strapping and adjusting the jet leg.	A trenching ROV is lowered to the seabed where it straddles the cable. The trencher drives along the cable route with motive power from its tracks (like a bulldozer), using on-board pumps to fluidize the seabed under and behind the machine into which the cable is depressed.	A trenching ROV is lowered to the seabed where it straddles the cable. The trencher drives along the cable route with motive power from its tracks (like a bulldozer), using a chain of teeth to carve a trench into which the cable is depressed.	A trenching ROV is lowered to the seabed where it straddles the cable. The trencher drives along the cable route with motive power from its tracks (like a bulldozer), using both water jetting and a chain of teeth to carve a trench into which the cable is depressed.	A trenching ROV is lowered to the seabed where it straddles the cable. The trencher drives along the cable route with motive power from its tracks (like a bulldozer), using a rigid cutting wheel whose circumference is lined with teeth to carve a shallow trench into which the cable is depressed.
Simultaneous Lay and Bury vs. Post-lay Burial	Either, depending on sledge configuration	Simultaneous lay and bury	Post-lay burial	Post-lay burial	Post-lay burial	Post-lay burial

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
Maximum Trench Depth Achievable	15 feet in certain conditions	To size of tool. 15 feet typical; 30-50 feet possible in very soft materials	6-15 feet depending on machine size, water pumps installed and ground conditions	Up to 12 feet	15 feet offered by IHC on Hi-Traq	3 feet (maximum diameter cutter wheel)
Ability to Maintain Narrow Installation Corridor	Reasonable provided towing vessel operates off anchors or a dynamically positioned vessel is used.	Reasonable provided towing vessel operates off anchors or a dynamically positioned vessel is used.	Excellent - highly maneuverable and well controlled trench form.	Excellent - highly maneuverable and well controlled trench form.	Excellent - highly maneuverable and well controlled trench form.	Excellent - highly maneuverable and well controlled trench form.
Obstacle Avoidance & Maneuverability	Poor when operated off anchors; sledge is towed astern of the host vessel occupying significant sea space.	Poor - extensive anchor spread for propulsion.	Excellent - highly maneuverable; can disengage the cable and re-acquire to multi-pass.	Excellent - highly maneuverable; can disengage the cable and re-acquire to multi-pass.	Excellent - highly maneuverable; can disengage the cable and re-acquire to multi-pass.	Excellent - highly maneuverable; can disengage the cable and re-acquire to multi-pass.

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
Effects on Marine Traffic During Construction	Depends on cable lay vessel propulsion. Low effect with dynamic positioning vessel. Higher effect with anchor-propelled cable lay vessel (1,500 foot advisory zone around vessel, burial machine and anchor spread, if anchors used) during construction.	1500 foot advisory zone around vessel and anchor spread during construction.	Low	Low	Low	Low
Ability in Ultra-Soft Seabed	Reasonable - prone to sinkage and self-undermining	Good - weight of tool suspended off barge, but trench quality will be poor.	May need buoyancy tanks to keep ground pressure low, then loses traction to drive forwards.	Unsuitable - Use in hard bottom only.	May need buoyancy tanks to keep ground pressure low, then loses traction to drive forwards.	Unsuitable - Use in rock bottom only.

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
Ability in Sand/Silt	Good	Good	Good	Reasonable if mix of picks and paddles on the chain is correctly configured.	Good	Can marginally deal with pockets of sand/silt if paddles fitted with picks.
Ability in Clay	Poor - plows more than it jets	Reasonable - plows more than it jets; can be fitted with a chain cutter accessory.	Can be reasonable depending on jetting system installed (e.g., high pressure pumps).	Reasonable if mix of picks and paddles on the chain is correctly configured.	Good	Can marginally deal with pockets of clay if paddles fitted with picks.
Ability in Sand over Clay	Poor - plows more than it jets	Good - plows more than it jets; can be fitted with a chain cutter accessory.	Good in multi-pass with changes in jetter configuration between passes.	Reasonable if mix of picks and paddles on the chain is correctly configured.	Good	Can marginally deal with pockets of sand/silt/clay if paddles fitted with picks.

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
Ability in Gravel	Poor - unable to fluidize the gravel	Poor - unable to fluidize the gravel	Marginally suitable provided drawbar pull on jetter from traction can make the jet tool appear to plow.	Reasonable if mix of picks and paddles on the chain is correctly configured.	Reasonable if mix of picks and paddles on the chain is correctly configured.	Poor - unable to transport the gravel
Ability in Mixed Granular Materials	Poor - unable to transport the larger granular materials	Poor - unable to transport the larger granular materials	Marginally suitable provided drawbar pull on jetter from traction can make the jet tool appear to plow.	Reasonable if mix of picks and paddles on the chain is correctly configured.	Reasonable if mix of picks and paddles on the chain is correctly configured.	Poor - unable to transport the gravel
Ability in Rock	Unsuitable – no sediments to fluidize	Can be fitted with a chain cutter accessory which might marginally penetrate soft rock	Unsuitable – no sediments to fluidize	Marginal performance in soft rock.	Marginal performance in soft rock.	Can cut soft and hard rock; latter with excess wear/slow progress. Only tool suitable for rock.

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
Tolerance of Seabed Slopes	Poor - can runaway unless operated strictly up-slope	Reasonable - but requires frequent and arduous adjustments.	Good, provided machine is worked up-slope.	Good, provided machine is worked up-slope.	Good, provided machine is worked up-slope.	Good, provided machine is worked up-slope. Sloping rock unusual and will be slippery.
Tolerance of Seabed Steps	Unable to cross > 2'	Good - depth control is from sea surface/tides.	Unable to cross > 2' (Unless Hi-Traq class machine).	Unable to cross > 2' (Unless Hi-Traq class machine).	Unable to cross > 2' (Unless Hi-Traq class machine).	Unable to cross > 2' (Unless Hi-Traq class machine).
Tolerance of Seabed Sand Waves	Reasonable provided jet leg can modulate to achieve target depth in non-mobile substrate.	Good - depth control is from sea surface/tides and very long sword can be fitted so that burial is in non-mobile substrate.	Poor - Unlikely to be able to jet deep enough to reach non-mobile substrate. (Unless Deep Dig-It class machine and surface water pumps).	Poor - Unlikely to be able to jet deep enough to reach non-mobile substrate. (Unless Deep Dig-It class machine and surface water pumps).	Reasonable with very long hybrid tool (5m/15' class on Hi-Traq) to penetrate non-mobile substrate.	Intolerant. Very rare combination of mobile seabed over exposed rock-head.

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
Trench Form, Spoil Heaps	Reasonably narrow and contained when skilfully operated in optimum sediment conditions, otherwise open 'U' with sediment lost to water column or immediately adjacent the trench depending on particle size.	Reasonable to poor. Large amounts of material to be fluidized and jetting control difficult. Usually results in 'U' trench and sediment in the water column.	Can be excellent with well controlled water pumps and e.g., eductor system to pump spoil out of the trench.	Sharply defined with spoil to either side of trench for natural backfill.	Sharply defined with larger particulate spoil to either side of trench for natural backfill and fines in a slurry remaining in the trench.	Sharply defined with spoil to either side of trench and cable positively depressed to trench bottom; might not naturally backfill and may require rectification (e.g., grout bag or rock placement).
Burial Quality	Good to Reasonable - very sediment type dependent	Reasonable because the trench can be VERY deep albeit poorly formed.	Good to Reasonable in all conditions except gravel, soft rock, hard rock.	Good, provided spoil is sufficiently finely divided that natural backfill occurs.	Good, provided spoil is sufficiently finely divided that natural backfill occurs.	Excellent trench-form but potential for poor backfill - fisheries trawl hazard until rectified.

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
Sediment Loss to Water Column	Proven to be low within NY waters	Reasonable to Poor	Generally good	Generally good since chain cutting produces very small volume of fines and at minimum transport energy.	Generally good since chain cutting produces very small volume of fines and at minimum transport energy and controlled water jetting leaves fines in a slurry in the trench.	Virtually nil when cutting pure rock.
Need for Operational or Burial Adjustments. at Crossings	At initiation and termination=3x water depth; Grade in/out about 100 feet	Significant rectification at initiation and recovery since very difficult to grade the tool in/out.	Can work right up to crossings with third party permissions. Can be "flown" or drive over crossings.	Can work right up to crossings with third party permissions. Can be "flown" or drive over crossings.	Can work right up to crossings with third party permissions. Can be "flown" or drive over crossings.	Can work right up to crossings with third party permissions. Can be "flown" or drive over crossings.
Needs Diver Support	Yes, for cable loading and unloading	Yes, for cable unloading	No - usually self-loading	No - usually self-loading, although diver load is faster/cheaper.	No - usually self-loading, although diver load is faster/cheaper.	No, but diver loading might be advantageous including pick changes in hard rock.

Table 3.9-2: Preferred Submarine Cable Installation Alternatives

Final Selection to be Made According to Seabed Conditions, Further Engineering, and Equipment/Contractor Availability

Submarine Cable Installation Technique	Jet Plow	Vertical Injector	Track Laying Jetting ROV-Trencher	Track Laying Chain Cutting ROV-Trencher	Track Laying Hybrid ROV-Trencher	Tractor Wheel Cutter/Trencher
Factors Affecting Suitability	Same Tool handling frame/traction unit with interchangeable tools					
Equipment Availability, Local Content	Available from US based installers	Equipment cheap to fabricate as required. Operational skills are rare.	Several with International Contractors (Europe). At least 52 weeks lead time.	Several with International Contractors (Europe). At least 52 weeks lead time.	New development just out of prototype stage. At least 52 weeks lead time.	A few with International Contractors (Europe). At least 52 weeks lead time.

3.9.2.3 Comparison and Selection

A track laying remotely operated vehicle (“ROV”) is the preferred installation technique for the Project. An ROV with options for different tool packages, including a jetting tool and a cutting tool for mechanical trenching, such that the most efficient and lowest environmental impact tool can be chosen for each segment of the cable system so that the whole length of the cable system can be installed with tailored and graded levels of protection appropriate to the micro-local conditions found.

In addition to an ROV the following installation techniques could be considered for use in the Project under specific conditions:

- **Jet Plow:** A tool with ready local availability that has been used successfully on previous projects in the vicinity.
- **Vertical Injector:** Capable of achieving at least 15 feet burial depth in the non-mobile substrate underneath high amplitude sand waves. Successfully used to install submarine cables in the Delaware River, which was first known use in the US.

The following installation methods were determined to be unreasonable and were rejected from further consideration for the following reasons:

- **Rock Placement:** Surface laying the cables and covering the whole cable system with rocks was rejected because it would result in: (i) the introduction of hard substrate over two swaths that are 18.5 miles long in New York State waters and (ii) a berm profile above current seabed level results, thereby increasing navigational and fishing obstructions and risks of cable snagging during vessel anchorage and ground fishing activities.
- **Mass Flow Excavator:** This installation method was rejected because: (i) it does not provide any certainty that the desired burial depth will be achieved, and (ii) it poses the risk of greater adverse environmental impact, as almost all of the trench contents would be suspended in the water column. While use of a mass flow excavator is reasonable in limited locations (e.g., during a repair or for the mobile seabed areas of the S-1 Variant), it is not reasonable to use for installation over the entire length of the HVDC Submarine Cable Corridor.

- **Free Flying ROV Jetter:** This installation method was rejected because it does not provide any certainty that the target burial depths for the Project will be achieved. Free flying ROV jettors are more commonly used where a shallower target burial depth is desired. Suspended sediment amounts are similar to the jet plow.
- **Slot Displacement Plow:** This installation method was rejected due to the amount of auxiliary protection (and related cost increases) required near infrastructure crossings.
- **‘V’ Displacement Plow:** This installation method was rejected because seabed levelling and open trenching in the close confines of the New York Harbor places too heavy of a load on sediment transport processes. This installation method also poses too high of a navigational hazard during installation as it requires several passes through the same area—a levelling/pre-trenching towed pass, then a cable lay pass, and then a further towed backfill pass.
- **Hydraulic or Mechanical Dredging:** This installation method was rejected because it creates large trenches, which require significant volumes of dredged material disposal and large quantities of clean backfill material that must be placed after the cable is placed in the trench.

3.9.3 Alternative Infrastructure Crossing Methods

The Applicant evaluated several methods for infrastructure asset crossings. As described in detail in Exhibit E-3, there are four broad classifications of methods proposed for the Project's infrastructure asset crossings: direct crossing at depth, crossing at seabed level, no/low contact crossing at seabed level, and crossing abandoned assets. With the exception of abandoned lines, all crossings will be undertaken pursuant to contractual agreements with the infrastructure asset owners. The Applicant has identified the majority of the owners/operators for known and active infrastructure assets that will be crossed by the Project. Future discussions with infrastructure asset owners and regulatory agencies are expected to identify abandoned assets and confirm precise crossing locations, depth of cover over existing buried assets, determination of required separation distance, and protective measures required over the existing asset.

Final selection of the methods to be used will be based upon discussions and agreements with individual asset owners or regulatory agencies and will be described in the EM&CP. Potential crossing methods are as follows:

1. **Direct Crossing at Depth:** Where the infrastructure asset to be crossed is deep beneath the sediment line and sediment over the infrastructure asset is expected to support the new cables at the target burial depth for that location, the submarine HVDC Cable will be installed using the burial tools described in Exhibit E-3, Section E-3.3.1.2 at the target burial depth with no further special actions or crossing engineering required. An example is given in Exhibit E-3, Figure E-3.3-3.
2. **Crossing at Seabed Level:** Where the existing infrastructure asset is installed at or about the Project's target burial depth, the submarine HVDC Cables will be laid above the existing infrastructure asset. During installation, the burial machinery will be placed on deck of the CLV or a support vessel and the Project's submarine HVDC Cable(s) will be laid over the other infrastructure asset at seabed level. Auxiliary protection of the submarine HVDC Cables to the lowest practicable profile above the seafloor is then installed. The preferred protection to promote ease of future removal is segmental concrete mattresses with tapered edges or rock placement in a berm. A typical arrangement is shown in Exhibit E-3, Figure E-3.3-4.
3. **Bridged Crossing at Seabed Level:** Where the existing infrastructure asset is installed at or just below the seabed, the submarine HVDC Cables will be laid above the existing infrastructure asset and both assets will be protected at the crossing location. Project cables that need to cross an existing infrastructure asset without making physical contact will use a bridging material to protect the existing infrastructure asset. Auxiliary protection of the submarine HVDC Cables will be installed to the lowest practicable profile above the seafloor. The preferred protection to promote ease of future removal is segmental concrete mattresses with tapered edges or rock placement in a berm. Refer to Exhibit E-3, Figure E-3.3-5 for a typical cross section illustrating this type of crossing.
4. **Crossing Abandoned Assets:** If the existing infrastructure asset has been determined to be abandoned, then the submarine HVDC Cables will either cross the asset using one of the methods previously described or the abandoned asset will be cut and removed from

the path of the submarine HVDC Cables. The decision to cross over or remove the abandoned asset will be made based on the depth of the abandoned asset and the technical feasibility of removing the asset from the seabed.

The following alternatives exist for the use of concrete mattresses as cable protection measures to support infrastructure crossings.

- *Plain concrete mattresses* are proposed for crossing construction where loads are to be spread into the seabed and subsequently cables laid over and further materials layered over the top. Plain mattresses are also proposed in locations where construction sequencing might have the mattresses placed and then temporarily removed.
- *Froned mattresses or construction materials such as EConcrete®* are proposed for top layers in seabed construction where rapid colonization of structures in a recovering benthos is desired, noting that differing grades and treatments of surface might be deployed to ensure that positive selection is made towards local native species. Such mattresses would be used where mattresses are less likely to be temporarily removed as the added weight of marine growth may interfere with reliable lifting of the mattresses.

In addition to the techniques described above, other crossing techniques such as cast iron “half pipes”, Uraduct®, and clamshell dredging that were not considered suitable for the Project because of their environmental impact or technical limitations. Similarly, surface lay with no additional protection was not considered a reasonable alternative.

3.9.4 Landing Methods

The Applicant evaluated several alternative methods of accessing the Ravenswood Site from the East River to provide a landfall for the submarine HVDC Cables.

- **Landfall Transition Conduits (Preferred Method):** Some sheet piles comprising the existing Ravenswood bulkhead would be temporarily removed and an area behind the bulkhead excavated. A short trench in the East River immediately in front of the Ravenswood Site bulkhead (approximately 100 cubic yards of dredging estimated per circuit) would be excavated. Landfall Transition Conduits would be installed from the

bulkhead to a new sheet pile wall installed landward of the bulkhead. The Landfall Transition Conduits enable the submarine HVDC Cables to be pulled through the bulkhead and change elevation to reach the elevation of the HVDC Terrestrial Cable Corridor. Once cable landing activities are complete, concrete mattresses (approximately 2,700 square feet per circuit) will be placed over the submarine HVDC Cables adjacent to the bulkhead, and the land area excavated for installation of the Landfall Transition Conduit will be backfilled and capped. Further discussion of this preferred method is presented in Exhibit E-3.

- **Horizontal Directional Drill (“HDD”):** A bore could be drilled from the east portion of the Ravenswood Site under the current plant foundations, through the bulkhead, and into the East River. The bore would turn upwards to exit at riverbed level from which a rock-trench would be excavated for the cable. A reamer would be pulled back along the bore and a liner pulled in, either fused together in sections on a barge at East River exit point or floated in from a construction port elsewhere in the vicinity. This technique is not preferred for the Project due to the following concerns:
 - Setback distance: To bore underneath obstructions such as existing foundations and the dockside bulkhead and with a drill launch angle less likely to “skip” on the rockhead and fail to penetrate, the bore start location would have to be setback for a long distance to the east of the bulkhead, requiring a large area of land and resulting in comparatively long lengths of looping cables within the Ravenswood Site. While some mitigation is possible by sinking a shaft to intercept the HDDs, such would be a very complex civil engineering task considering the local water table.
 - Ground Conditions: The ground under the Ravenswood Site has been graded and re-worked with a mixture of materials over the years and is not homogeneous. There is an increased risk of inadvertent drill fluid release in such ground and a risk that any contaminants from historic power plant operations could be released and concentrated in drill fluid which would have to be sequestered, conditioned, and cleaned.
 - Impacts to Navigation: HDD into the water in multiple locations would be required. Perhaps as many as nine bores for the two HVDC Cables (each comprised of a

pair of symmetric monopole conductors and a fiber optic command and control cable) would be required. Multiple marine assets would need to be moored or jacked-up in the vicinity of the Ravenswood Site on the East River for very long periods (multiple months over several years with limited allowable environmental work windows). Drilling operations, in particular the reaming and liner pull-in, require significant equipment in the water, which is likely to obstruct the east channel of the East River at Roosevelt Island for an extended period of time.

- **Tunneling and Micro-Tunneling:** A shaft could be sunk on the Ravenswood Site through which a tunnel boring machine could be lowered to cut a horizontal tunnel into the East River riverbed. The tunnel could be lined as excavated or a micro-tunneling approach could be employed to drive the tunnel boring head with a liner pipe behind. This technique is not preferred for the Project due to the following concerns relevant to the locality:
 - Water table: Much of the activity for this technique would be below the water table in potentially porous ground, requiring significant de-watering.
 - Ground Conditions: The ground under the Ravenswood Site has been graded and re-worked with a mixture of materials over the years and is not homogeneous. There is an increased risk that any contaminants from historic power plant operations could be released and concentrated in drill fluid which would have to be sequestered, conditioned, and cleaned.
 - Volume of Spoils: Significant spoils material from tunneling operations would need to be either incorporated into grading of the Ravenswood Site or hauled off-site either by road or barge.
 - Riverbed Interface: The underwater civil engineering necessary to interface the tunnel exit under the riverbed to a cable system that is laid close to the riverbed surface in a rock-trench would be complex and time consuming and would have to be opened and closed repeatedly as phased circuit construction is carried out.
 - Impacts to Navigation: Tunneling would require equipment and vessels to occupy the location the planned tunnel exit for long periods of time to support excavation of the exit pit and tunneling operations.

- **Bulkhead Attachment:** Cables could be enclosed in ducts/pipes and attached to the outer face of the Ravenswood Site's sheet pile bulkhead. Fenders or other protection structures would be fabricated and attached to the bulkhead so that docking and allision forces of vessels coming alongside either under control or in an emergency would be passed into the dock in the usual way rather than to the cables, avoiding damage to the cables in their ducts. This technique is not preferred for the Project due to the following concerns:
 - Protrusions: The fenders or crash-structures would protrude into the East River pushing berthed vessels farther into the river, reducing the navigable width of the channel and opportunities for vessels to tie-up alongside.
 - Vessel Hazard: Without significant dredging to further deepen the East River followed by rock-placement fill, the cable ducts would exit at the mudline and be a potential hazard to vessels tying up and dropping anchor at the dock.
 - Cable Bend Radius: The cable system cannot be bent very tightly; therefore, in-water and, in particular, in-air structures that would have to be placed above dock-level would be visually intrusive. Confidential critical energy infrastructure would be on full display and accessible from the river, at risk for disruption.

3.9.5 *Alternative Materials*

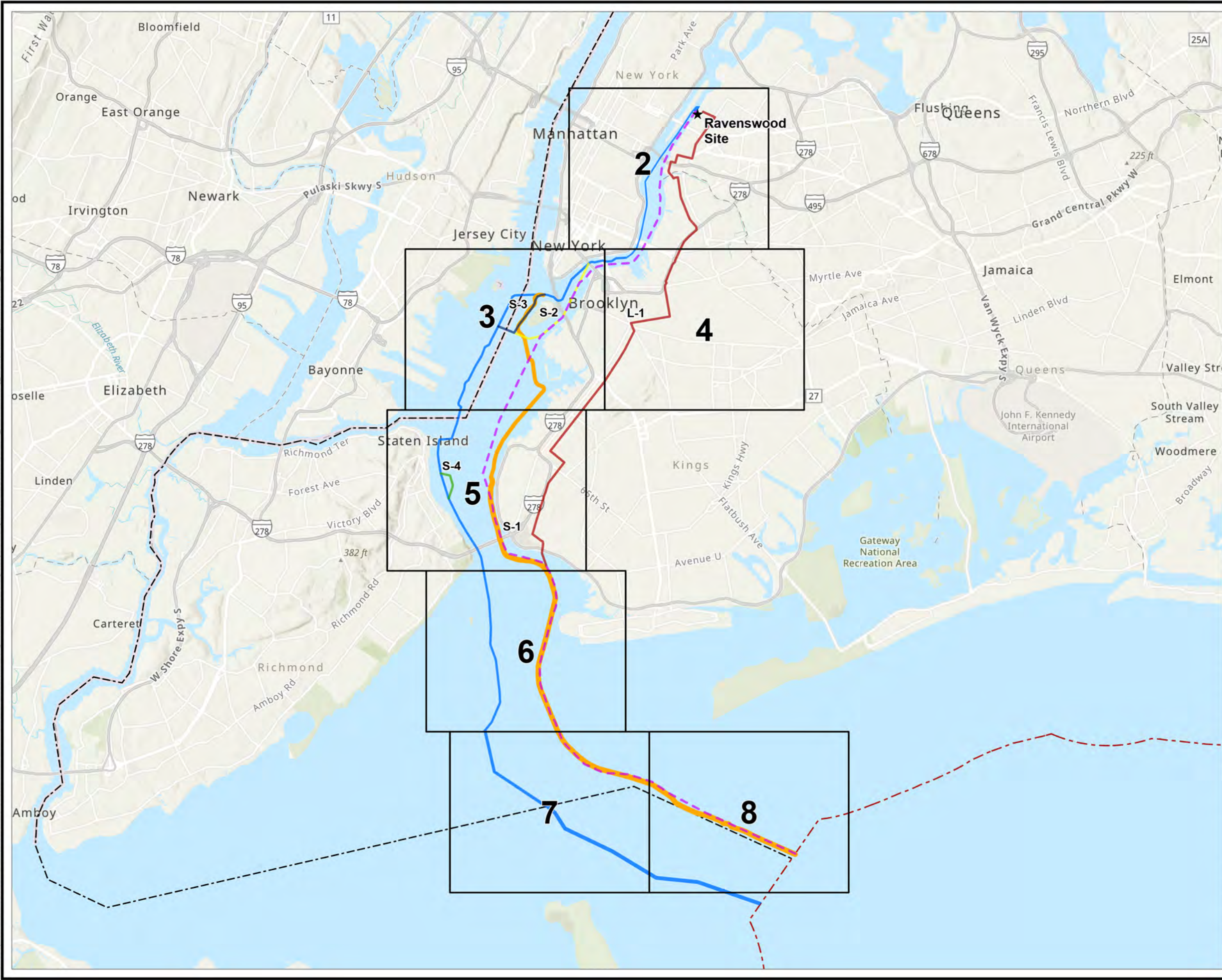
The Applicant evaluated several alternative materials of construction for the cables.

- Extruded polymeric insulation such as Cross Linked Polyethylene ("XLPE") is the preferred type of cable for the Project since it is essentially inert and high performing consuming the smallest amount of dielectric material. Copper conductor material is planned for the Project because a key Project design criteria is to achieve the maximum system capacity with the minimum seabed disturbance (i.e., one trench per HVDC Circuit).
- High pressure oil-filled and oil impregnated paper cables were determined unreasonable and rejected from consideration due to the potential risk of a release of oil from the cables (although oil filled paper cables are unlikely to cause such release if damaged), and the difficulty in recycling and disposing of such cables at the end of their life.

- Aluminum conductor submarine HVDC cable systems were considered unreasonable, and also rejected, because they do not offer sufficient capacity for a single circuit in a single submarine trench in the sediment conditions found in the proposed HVDC Submarine Cable Corridor at the desired burial depth and within the dimensions of aluminum-based cables that can be manufactured globally.

FIGURES

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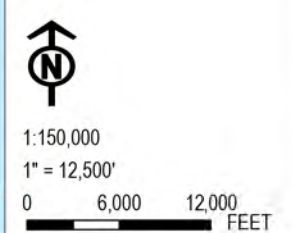


- ★ RAVENSWOOD SITE
- HVDC SUBMARINE CABLE CORRIDOR
- ALTERNATIVE S-1
- ALTERNATIVE S-2
- ALTERNATIVE S-3
- ALTERNATIVE S-4
- ALTERNATIVE L-1
- ALTERNATIVE S-1 VARIANT
- - - FEDERAL WATERS BOUNDARY
- - - NY/NJ STATE WATERS BOUNDARY

DATUM/PROJECTION:
NAD 1983 NEW YORK STATE PLANE EAST,
(FIPS 3101), US FEET

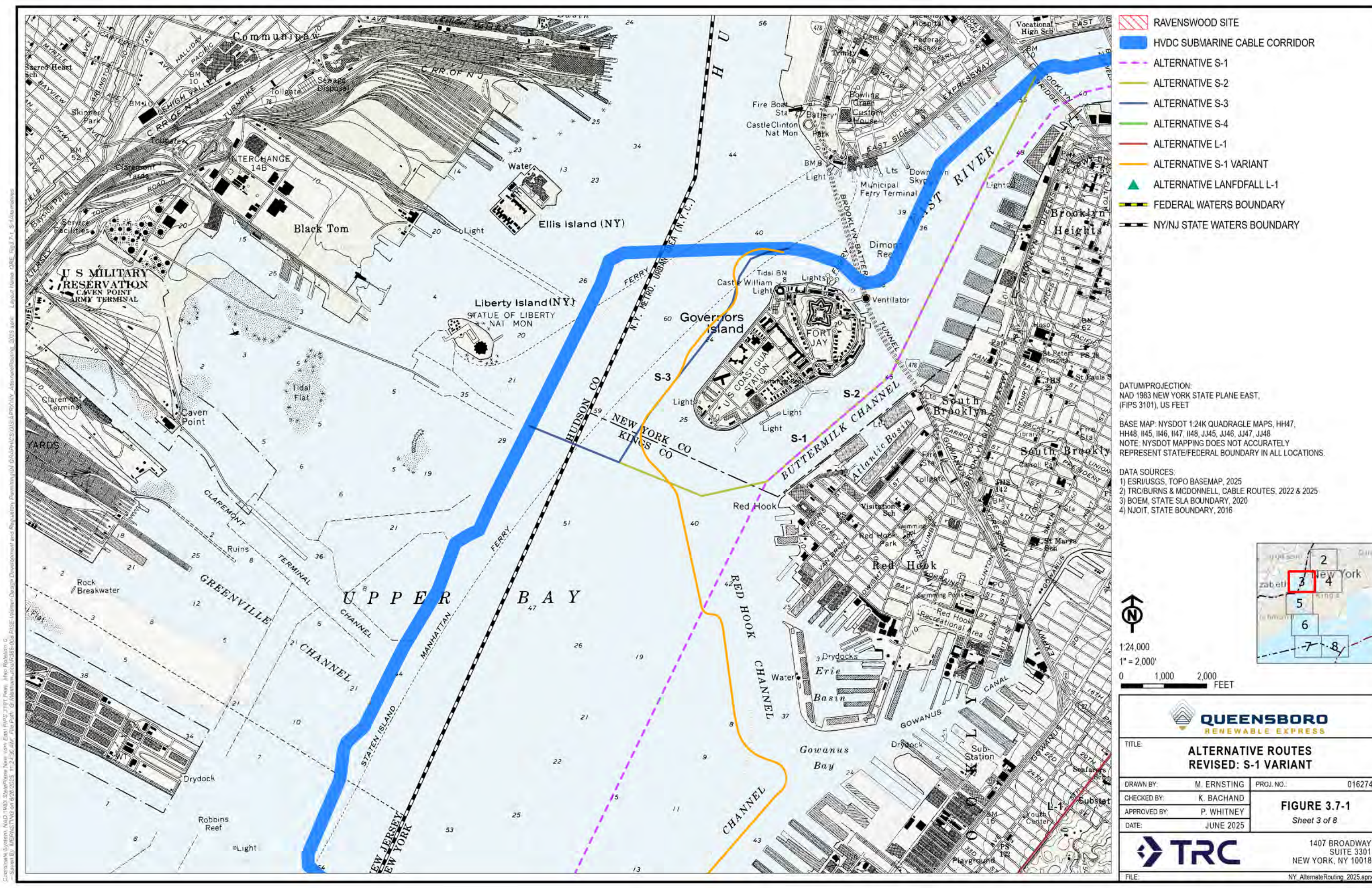
BASE MAP: ESRI/USGS, TOPO BASEMAP, 2025

DATA SOURCES:
1) TRC/BURNS & MCDONNELL, CABLE ROUTES, 2022 & 2025
2) BOEM, STATE SLA BOUNDARY, 2020
3) NJOIT, STATE BOUNDARY, 2016





TITLE: ALTERNATIVE ROUTES REVISED: S-1 VARIANT		
DRAWN BY:	M. ERNSTING	PROJ. NO.:
CHECKED BY:	K. BACHAND	016274
APPROVED BY:	P. WHITNEY	FIGURE 3.7-1 Sheet 1 of 8
DATE:	JUNE 2025	
		1407 BROADWAY SUITE 3301 NEW YORK, NY 10018
FILE:	NY_AlternateRouting_2025.aprx	

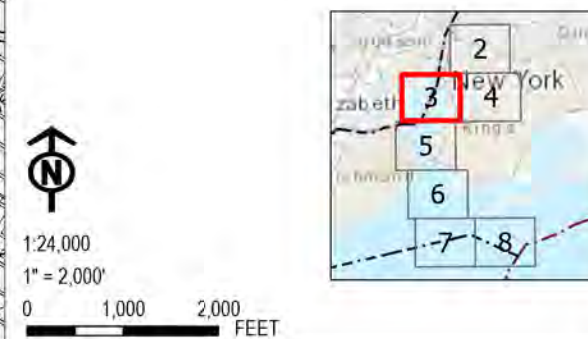


- RAVENSWOOD SITE
- HVDC SUBMARINE CABLE CORRIDOR
- ALTERNATIVE S-1
- ALTERNATIVE S-2
- ALTERNATIVE S-3
- ALTERNATIVE S-4
- ALTERNATIVE L-1
- ALTERNATIVE S-1 VARIANT
- ALTERNATIVE LANFD FALL L-1
- FEDERAL WATERS BOUNDARY
- NY/NJ STATE WATERS BOUNDARY

DATUM/PROJECTION:
NAD 1983 NEW YORK STATE PLANE EAST,
(FIPS 3101), US FEET

BASE MAP: NYSDOT 1:24K QUADRANGLE MAPS, HH47,
HH48, II45, II46, II47, II48, JJ45, JJ46, JJ47, JJ48
NOTE: NYSDOT MAPPING DOES NOT ACCURATELY
REPRESENT STATE/FEDERAL BOUNDARY IN ALL LOCATIONS.

DATA SOURCES:
1) ESRI/USGS, TOPO BASEMAP, 2025
2) TRC/BURNS & MCDONNELL, CABLE ROUTES, 2022 & 2025
3) BOEM, STATE SLA BOUNDARY, 2020
4) NJOIT, STATE BOUNDARY, 2016





TITLE: **ALTERNATIVE ROUTES
REVISED: S-1 VARIANT**

DRAWN BY: M. ERNSTING	PROJ. NO.: 016274
CHECKED BY: K. BACHAND	FIGURE 3.7-1 Sheet 3 of 8
APPROVED BY: P. WHITNEY	
DATE: JUNE 2025	



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FILE: NY_AlternateRouting_2025.aprx

Coordinate System: NAD 1983 StatePlane New York East FIPS 3101 Feet, Map Rotation: 0
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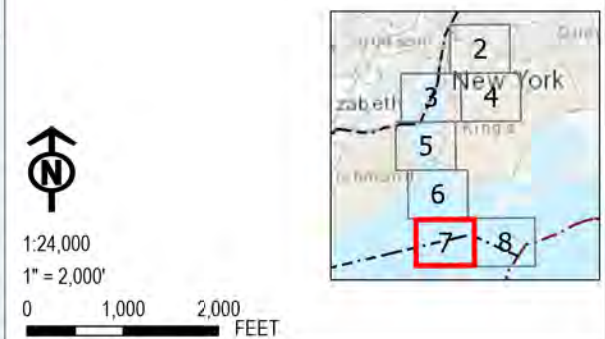


- RAVENSWOOD SITE
- HVDC SUBMARINE CABLE CORRIDOR
- ALTERNATIVE S-1
- ALTERNATIVE S-2
- ALTERNATIVE S-3
- ALTERNATIVE S-4
- ALTERNATIVE L-1
- ALTERNATIVE S-1 VARIANT
- ALTERNATIVE LANFD FALL L-1
- FEDERAL WATERS BOUNDARY
- NY/NJ STATE WATERS BOUNDARY

DATUM/PROJECTION:
NAD 1983 NEW YORK STATE PLANE EAST,
(FIPS 3101), US FEET

BASE MAP: NYSDOT 1:24K QUADRANGLE MAPS, HH47,
HH48, II45, II46, II47, II48, JJ45, JJ46, JJ47, JJ48
NOTE: NYSDOT MAPPING DOES NOT ACCURATELY
REPRESENT STATE/FEDERAL BOUNDARY IN ALL LOCATIONS.

DATA SOURCES:
1) ESRI/USGS, TOPO BASEMAP, 2025
2) TRC/BURNS & MCDONNELL, CABLE ROUTES, 2022 & 2025
3) BOEM, STATE SLA BOUNDARY, 2020
4) NJOIT, STATE BOUNDARY, 2016





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TITLE: ALTERNATIVE ROUTES REVISED: S-1 VARIANT		
DRAWN BY:	M. ERNSTING	PROJ. NO.: 016274
CHECKED BY:	K. BACHAND	FIGURE 3.7-1 Sheet 7 of 8
APPROVED BY:	P. WHITNEY	
DATE:	JUNE 2025	

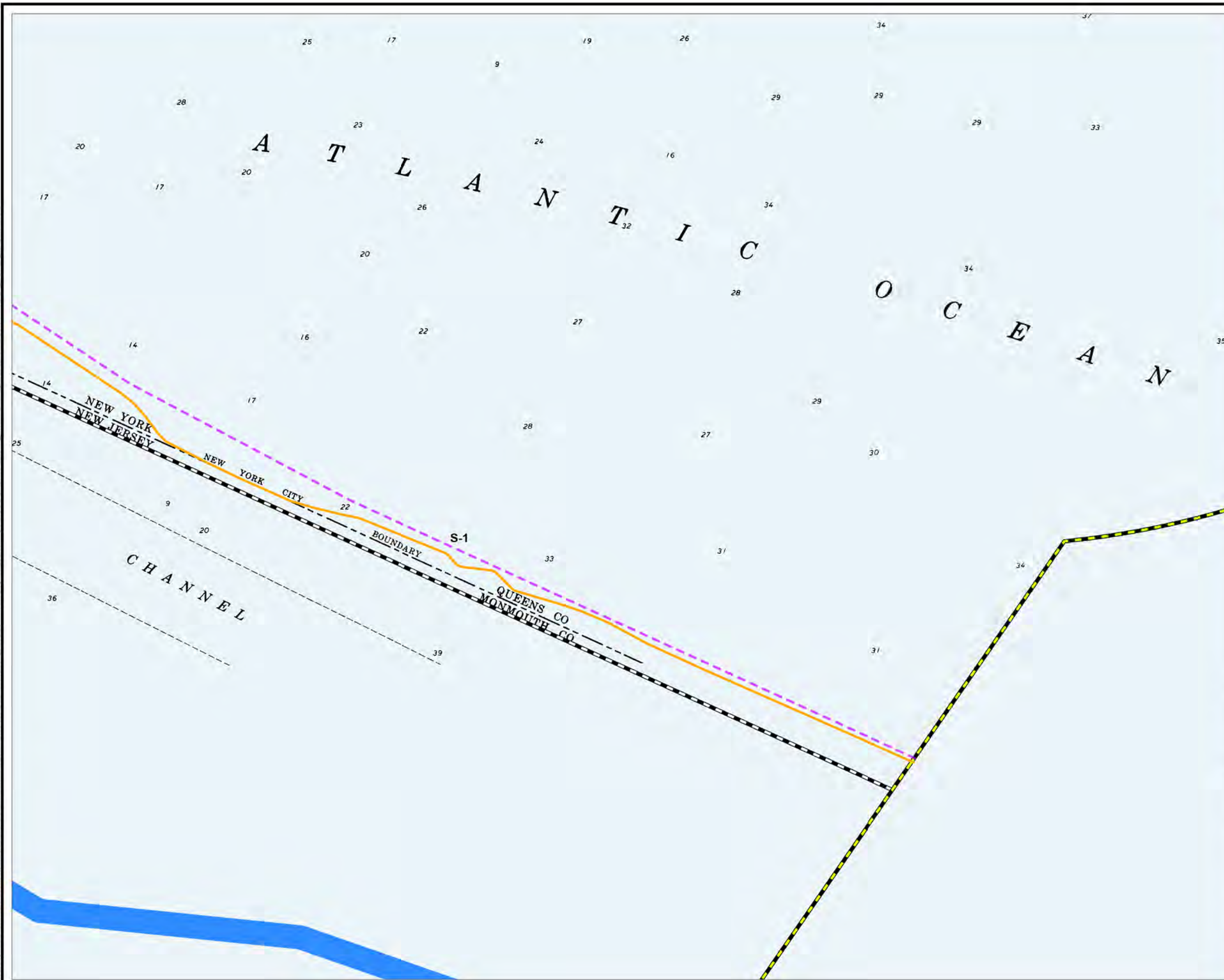


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**RAVENSWOOD SITE**

**HVDC SUBMARINE CABLE CORRIDOR**

**ALTERNATIVE S-1**

**ALTERNATIVE S-2**

**ALTERNATIVE S-3**

**ALTERNATIVE S-4**

**ALTERNATIVE L-1**

**ALTERNATIVE S-1 VARIANT**

**ALTERNATIVE LANDFALL L-1**

**FEDERAL WATERS BOUNDARY**

**NY/NJ STATE WATERS BOUNDARY**

DATUM/PROJECTION:
NAD 1983 NEW YORK STATE PLANE EAST,
(FIPS 3101), US FEET

BASE MAP: NYS DOT 1:24K QUADRANGLE MAPS, HH47,
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NOTE: NYS DOT MAPPING DOES NOT ACCURATELY
REPRESENT STATE/FEDERAL BOUNDARY IN ALL LOCATIONS.

DATA SOURCES:
1) ESRI/USGS, TOPO BASEMAP, 2025
2) TRC/BURNS & MCDONNELL, CABLE ROUTES, 2022 & 2025
3) BOEM, STATE SLA BOUNDARY, 2020
4) NJOIT, STATE BOUNDARY, 2016


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TITLE:
**ALTERNATIVE ROUTES
REVISED: S-1 VARIANT**

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CHECKED BY:	K. BACHAND	FIGURE 3.7-1 Sheet 8 of 8	
APPROVED BY:	P. WHITNEY		
DATE:	JUNE 2025		



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