Williams | Northeast Supply Enhancement

ALTERNATIVES

- RESOURCE REPORT 10 -

Williams consistently collaborates with community members, landowners and organizations to consider the most responsible project route.

MARCH 2017

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RESOURCE REPORT 10 – ALTERNATIVES

INFORMATION	Data Sources[a]	Found in Section
Full FERC Filing Requirements		
1. Discuss the "no action" alternative and the potential for accomplishing the proposed objectives through the use of other systems and/or energy conservation. Provide an analysis of the relative environmental benefits and costs for each alternative.	D	See Sections 10.2 and 10.3
2. (2) Describe alternative routes or locations considered for each facility during the initial screening for the project. (i) For alternative routes considered in the initial screening for the project but eliminated, describe the environmental characteristics of each route or site, and the reasons for rejecting it. Identify the location of such alternatives on maps of sufficient scale to depict their location and relationship to the proposed action, and the relationship of the pipeline to existing rights-of-way. (ii) For alternative routes or locations considered for more in-depth consideration, describe the environmental characteristics of each route or site and the reasons for rejecting it. Provide comparative tables showing the differences in environmental characteristics for the alternative and proposed action. The location of any alternatives in this paragraph shall be provided on maps equivalent to those required in paragraph (c)(2) of this section.	A, B, D, I, L, W, X, LL	See Sections 10.4, 10.5, 10.6 and 10.7
Additional Information Often Missing and Resulting in Data Requests		
1. Ensure that project objectives that serve as the basis for evaluating alternatives are consistent with the purpose and need discussion in Resource Report 1.	D	See Section 10.1
2. Identify and evaluate alternatives identified by stakeholders.	D	See Sections 10.4, 10.5, and 10.6
3. Clearly identify and compare the corresponding segments of route alternatives and route variations to the segments of the proposed route that they would replace, if adopted.	D	See Section 10.6.2

[a] Data Source Definitions:

A = Aerial Photographs
B = Agency Consultation
D = Applicant
I = County/Municipal Agencies
L = Field Surveys
W = Natural Resource Conservation Service
X = Natural Resources Conservation Service Soil Survey Geographic Database (SSURGO)
LL = U.S. Department of Transportation

RESPONSES TO THE FERC COMMENTS DATED 8/19/2016 REGARDING DRAFT RESOURCE REPORT 10

Comment:	Response/Information Location:
5. Regarding the purpose and need for the NESE Project described in Section 1.1.1: a. Ensure that the purpose and need statements included in Resource Report 1, Resource Report 10, and Transco's application are consistent	This has been addressed in both Resource Report 1, and Resource Report 10.
27. Transco states that it is evaluating alternative configurations of its system to meet the purpose and need of the NESE Project. Among any other system alternatives that Transco is considering, evaluate whether the purpose and need of the NESE project could be met by expanding existing Compressor Station 205 rather than constructing proposed Compressor Station 206. More specifically, address the following a. If Transco has determined that expansion of Compressor Station 205 could not meet the purpose of the NESE Project due to hydraulic constraints, engineering limitations, or other technical factors, provide a detailed discussion of those constraints, limitations, or other technical factors. b. If expansion of Compressor Station 205 is a technically feasible alternative provide a detailed analysis comparing the environmental impacts of constructing new Compressor Station 206. This comparative analysis should include, but not be necessarily limited to, the following factors i. Construction and operation land requirements. ii. Construction and operation impacts on forested land, wetlands, and waterbodies. iii. Number of residences within 0.5 mile of the compressor building. iv. Distance and direction to the nearest residence, church and school from the compressor building. v. Other special land uses within 0.5 mile of each site (e.g., parks, conservation areas). vi. Other environmental and non-environmental factors that Transco believes are pertinent to the alternatives analysis.	See Section 10.4.2
28. Provide the same analysis described in item 27 above for expanding existing Compressor Station 207 rather than constructing proposed Compressor Station 206.	See Sections 10.4.2 and 10.4.3
29. Provide the same analysis described in item 27 above for a combination of expanding existing compressor Stations 205 and 207 rather than constructing proposed Compressor Station 206.	See Section 10.4.2.2
30. Provide a more detailed explanation of the key hydraulic modeling inputs and system optimization elements that determined the locations for the proposed pipeline loops and the MP range for Compressor Station 206.	See Section 10.4

RESPONSES TO THE FERC COMMENTS DATED 8/19/2016 REGARDING DRAFT RESOURCE REPORT 10

Comment:	Response/Information Location:
31. Section 7 discusses four alternative locations for proposed Compressor Station 206, and Table 7.1-1 identifies the comparative environmental information that Transco will provide in draft Resource Report 10. Include in this discussion an analysis of the following two additional alternative sites: a. Alternative 5, generally described as the wooded area immediately north of Alternative 3; and b. Alternative 6, generally described as the wooded area approximately 5 miles to the northeast of Alternative 3, at the location where Transco's two existing pipelines within the Mainline system separate for a short distance. Alternative 6 is generally bounded by an electric transmission corridor to the southwest, an electric transmission and railroad corridor to the southeast, Route 1 to the northwest and commercial development to the northeast.	See Section 10.7.1
32. Provide a detailed analysis comparing the environmental impacts of utilizing electric-driven compressors at proposed Compressor Station 206 to the environmental impacts of using natural gas-fired compressors as proposed. This comparative analysis should include, but not necessarily be limited to, the following factors: a. A description of non-jurisdictional facilities that may be required, such as electric transmission lines or electric substations. b. Construction and operation land requirements, including for any non-jurisdictional facilities that may be required. c. Construction and operation impact on forested land, wetlands and waterbodies. d. General characterization of operational noise. e. General characterization of air emissions from facility operations. f. General characterization of regional air emissions associated with generating the electricity needed to power the electric driven compressors. g. Other environmental and non-environmental factors that Transco believed are pertinent to the alternatives analysis.	See Section 10.4.2.3
33. Discuss the technical feasibility of combining the proposed HDD that extends from MP11.5 to 11.8 of the Madison Loop, with the Morgan Shore HDD that extends from MP12.0 to 12.5 (i.e., resulting in an approximate 1-mile-long HDD). Discuss other engineering elements and other factors to consider in combining the two HDDs.	See Section 10.4.3.1

RESPONSES TO THE FERC COMMENTS DATED 8/19/2016 REGARDING DRAFT RESOURCE REPORT 10

Comment:	Response/Information Location:
34. If combining the two HDDs described above is technically feasible, provide a detailed analysis comparing the environmental impacts associated with the combined HDD alternative to the environmental impacts associated with installing two separate HDDs as proposed. This comparative analysis should include, but not necessarily be limited to, the following factors: a. HDD lengths. b. HDD durations. c. Relative risk of HDD failure (i.e., unable to utilize the HDD method). d. Construction and operation impact on forested lands, wetlands, and waterbodies. f. Number of noise sensitive areas within 0.25 mile of each drill entry and exit point. Other environmental and non-environmental factors that Transco believes are pertinent to the alternatives analysis.	N/A
35. The FERC staff understands that Transco may propose to use different methods to install the Raritan Bay Lateral based, in part, on the technical feasibility of each method, and would identify the MP range(s) for which each method would be proposed. Provide a discussion and analysis comparing the environmental impacts of the various trenching methods that could potentially be used to install the Raritan Bay Lateral assuming a 1-mile unit length. This comparative analysis should include, but not necessarily be limited to, the following factors: a. Water depth limitations b. Equipment availability c. Estimated trenching speed (feet per hour). d. Trench slope e. Excavation depth (feet) f. Trench top width (feet) g. Trench top plus sediment placement width (feet) h. Equipment size (feet) i. Equipment weight (tons) j. Seabed impact due to trenching (acres) k. Sediment displaced (cubic yards) l. Relative extent of suspended sediment plume – bottom layer. m. Relative extent of sedimentation n. Relative duration of construction o. Relative construction cost.	See Table 10.8-1

RESPONSES TO FERC COMMENTS DATED 1/17/2017 REGARDING DRAFT RESOURCE REPORT 10

Comment:	Response/Information Location:
130. Provide a table identifying any locations where Transco modified its original proposal in response to landowner concerns, and summarize the nature of the modification.	See Section 10.6.1
131. In response to comments, evaluate the feasibility of reducing impacts on forested land between Silver Spring Road and approximate MP 1682.2 of the Quarryville Loop.	See Section 10.6.1
132. In Section 10.4.1, provide an analysis utilizing desktop resources comparing the environmental impacts of the planned Quarryville Loop to a looping-only alternative that would begin at existing Compressor Station 195. Provide a map depicting each alternative. This analysis should include, but not necessarily be limited to, the following factors: a. the length of pipeline (miles); b. construction and operation land use requirements assuming a standardized width for construction and operational rights-of-way (acres); c. construction and operation impacts on forest assuming a standardized width for construction and operational rights-of-way (acres); d. construction and operation impacts on wetlands assuming a standardized width for construction and operational rights-of-way (acres); e. number of waterbody crossings, and probable crossing methods for any major waterbodies; f. number of residences within 50 feet of the construction workspace; g. number and crossing length (mile) of any local, state, or federal lands, parklands, or recreational lands crossed; and h. other factors that Transco believes are relevant to the analysis.	See Section 10.4.1 and Table10.4-1.

RESPONSES TO FERC COMMENTS DATED 1/17/2017 REGARDING DRAFT RESOURCE REPORT 10

Comment:	Response/Information Location:
133. Section 10.4.2.1 briefly discusses the location and length of pipeline looping that would be required to avoid construction and operation of Compressor Station 206. Recognizing that these alternatives involve different types of facilities, provide an analysis utilizing desktop resources comparing the environmental impacts of planned Compressor Station 206 to a looping-only alternative that would begin at existing Compressor Station 205. Provide a map depicting each alternative. This analysis should include, but not necessarily be limited to, the following factors: a. the length of pipeline (miles); b. construction and operation land use requirements assuming a standardized width for construction and operational rights-of-way for the pipeline (acres); c. construction and operation impacts on forested land and wetlands assuming a standardized width for construction and operational rights-of-way for the pipeline (acres); d. number of waterbody crossings and probable crossing method for any major waterbodies; e. number of residences within 50 feet of the construction workspace; f. number of road crossings; g. number and crossing length (mile) of any local, state, or federal lands, parklands, or recreational lands crossed; h. general characterization of air and noise emissions; and i. other factors that Transco believes are pertinent to the analysis.	See Section 10.4.2.1 and Table10.4-2.

RESPONSES TO FERC COMMENTS DATED 1/17/2017 REGARDING DRAFT RESOURCE REPORT 10

Comment:	Response/Information Location:
134. Section 10.4.2.3 briefly discusses the potential to utilize electric motor-driven compression at Compressor Station 206 and indicates that this alternative would require at least 3 miles of new electric transmission line and a substation at the compressor station site. Provide an analysis utilizing desktop resources comparing the environmental impacts of a natural gas-fired compressor station to an electric motor-driven compressor station. Provide a map depicting the route of the new electric transmission line. This comparative analysis should include, but not necessarily be limited to, the following factors: a. a description of the non-jurisdictional facilities that may be required, such as electric transmission lines or electric substations; b. construction and operation land requirements, including for any non-jurisdictional facilities that may be required; c. construction and operation impacts on forested land and wetlands; d. general characterization of operational noise; e. general characterization of air emissions from facility operations; f. general characterization of regional air emissions associated with generating the electricity needed to power the electric-driven compressors; and g. other factors that Transco believes are pertinent to the alternatives analysis.	See Section 10.4.2.3 and Table10.4-3
135. Section 10.4.3 briefly addresses the potential for combining Madison Loop HDD Segment 3 and the Morgan Shore Approach HDD. Further explain and clarify Transco's stated reasons for not considering this to be a viable alternative.	See Section 10.4.3
136. In Section 10.4.1.1, further quantify the deterioration of pressure at delivery points that would result if Transco added sufficient compression at Compressor Station 207 to avoid the need for the Madison Loop and the RBL.	See Section 10.4.3.

RESPONSES TO FERC COMMENTS DATED 1/17/2017 REGARDING DRAFT RESOURCE REPORT 10

Comment:	Response/Information Location:
137. Regarding the RBL route alternatives discussed in Section 10.6.2.2: a. Provide further discussion, including literature citations, regarding the rate at which the Sandy Hook Channel is migrating northward towards the existing Lower New York Bay Lateral and RBL Alternative 1; b. Identify any of the RBL route alternatives that were proposed for consideration by regulatory agencies or other groups, and identify those agencies and/or groups; c. Revise Table 10.6-1 and the associated discussion to include: i. the correct onshore and offshore lengths of RBL Alternative 4 as the values provided do not add up to the total length of the alternative; ii. the length (in miles) of offshore trenching associated with each alternative; iii. the estimated volume of sediment that would be excavated during offshore trenching for each alternative; iv. the duration (in days) of offshore construction (trenching, HDD installation) associated with each alternative; and v. the number of HDDs associated with each alternative.	a. See Section 10.6.2.3 b. See Section 10.6.2.4 c. See Table 10.6-1

RESPONSES TO FERC COMMENTS DATED 1/17/2017 REGARDING DRAFT RESOURCE REPORT 10

Comment:	Response/Information Location:
138. Revise Section 10.7.1.1 to further evaluate Compressor Station 206 Sites 2, 3, 5, and 6. More specifically, utilize desktop resources and provide a table that compares the environmental impacts associated with each alternative. This comparative analysis should include, but not necessarily be limited to, the following factors: a. size of each parcel (acres); b. availability of each parcel (if known); c. length of any associated discharge/suction pipelines (feet); d. length of any permanent access roads; e. construction and operation land requirements (acres), including for any discharge/suction pipelines and non-jurisdictional facilities that may be required; f. construction and operation impacts (acres) on forested land, wetlands, prime farmlands, and waterbodies; g. Permanent and Temporary Wetland Transition (50-foot) Area impacts (acres); h. Vernal Pool impacts (acres); i. National Hydrology Dataset Waterbody impacts (stream length in feet); j. Waterbody Buffer (50-foot) impacts (acres); k. Flood Hazard Area impacts (acres); l. Delaware and Raritan Canal Stream Corridor impacts (acres); m. Natural Heritage Program Rare Plant Habitat impacts (acres); n. construction and operation impacts (acres) on local, state, or federal lands; o. construction and operation impacts (acres) on special land uses such as parks, recreational areas, Green Acres properties, etc.; p. number of residences within 0.25 mile of the site center; q. distance and direction to the nearest Noise Sensitive Area; and r. other factors that Transco believes are pertinent to the alternatives analysis.	See Section 10.7.1.1 and Table 10.7-1

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TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

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LIST OF ACRONYMS

ATWS	additional temporary workspace
ARRA	American Recovery and Reinvestment Act
bgs	below ground surface
BOEM	Bureau of Ocean Energy Management
Btu	British thermal units
Certificate	Certificate of Public Convenience and Necessity
CO_2	carbon dioxide
ConEd	Consolidated Edison, Inc.
CP	cathodic protection
CZMA	coastal zone management area
dBA	A-weighted decibel
d/b/a	doing business as
DOE	U.S. Department of Energy
Dth/d	dekatherms per day
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
HAP	hazardous air pollutant
Harbor Ops	Harbor Safety, Navigation and Operations Committee of the Port of New York and New Jersey
HARS	Historic Area Remediation Site
HDD	horizontal directional drill
hp	horsepower
hr	hour
ISO	International Organization for Standardizations
HVDC	high-voltage direct current
LNG	liquefied natural gas
LNYBL	Lower New York Bay Lateral
MAOP	maximum allowable operating pressure
MMscf	million standard cubic feet
MMscfd	million standard cubic feet per day
MP	milepost
M&R	metering and regulating
MW	megawatt
NESE	Northeast Supply Enhancement Project

NGO	Non-governmental agency
NHP	Natural Heritage Program
NJDEP	New Jersey Department of Environmental Protection
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NOx	oxides of nitrogen
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NYCDEP	New York City Department of Environmental Protection
NYISO	New York Independent System Operator
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSERDA	New York State Energy Research and Development Authority
PJM	PJM Interconnection LLC
Project	Northeast Supply Enhancement Project
psig	pounds per square inch
RDL	Rockaway Delivery Lateral
RR	Resource Report
RTO	regional transmission organization
ROW	right-of-way
SO_2	sulfur dioxide
Transco	Transcontinental Gas Pipe Line Company, LLC
USACE	U.S. Army Corps of Engineers
USCG	United States Coast Guard
Williams	Williams Partners L.P.

10 ALTERNATIVES

10.1 Introduction

Resource Report (RR) 10 describes the alternatives that have been considered or are under consideration for the proposed Northeast Supply Enhancement (NESE) Project (Project). This RR discusses the No Action Alternative, which encompasses energy conservation measures; alternative energy sources; alternatives for supplying natural gas, including alternative natural gas transmission systems; route alternatives; compressor station and compressor station site alternatives; compression alternatives; and construction method alternatives. The information contained in this RR was obtained from field surveys, desktop reviews of available literature, stakeholder input, and publicly available information regarding existing pipeline infrastructure. The following sections provide analyses and discussions commensurate with the scale of individual Project components and their overall environmental impact. Any information pending in this RR will be submitted in a supplemental filing as noted *in grey italics with the anticipated filing date*.

Transcontinental Gas Pipe Line Company, LLC (Transco), a subsidiary of Williams Partners L.P. (Williams), prepared this RR to support its application to the Federal Energy Regulatory Commission (FERC *or* Commission) for a Certificate of Public Convenience and Necessity (Certificate) for the Project. The Project supports National Grid's long-term growth, reliability, and flexibility beginning in the 2019/2020 heating season. Transco is proposing to expand its existing interstate natural gas pipeline system in Pennsylvania and New Jersey and its existing offshore natural gas pipeline system in New Jersey and New York waters. The Project capacity is fully subscribed by two entities of National Grid: Brooklyn Union Gas Company (d/b/a [doing business as] National Grid NY) and KeySpan Gas East Corporation (d/b/a National Grid), collectively referred to herein as "National Grid."

To provide the incremental 400,000 dekatherms per day (Dth/d) of capacity, Transco plans to expand portions of its system from the existing Compressor Station 195 in York County, Pennsylvania, to the Rockaway Transfer Point in New York State waters. As defined in executed precedent agreements with National Grid, the Rockaway Transfer Point is the interconnection point between Transco's existing Lower New York Bay Lateral (LNYBL) and existing offshore Rockaway Delivery Lateral (RDL). Table 10.1-1 lists the pipeline facilities associated with the Project. Figure 1A-1 in Appendix 1A shows the overall Project location and facilities.

Table 10.1-1
Summary of Pipeline Facilities

Facility	Size	Onshore/ Offshore	State	County	Length (miles)
Quarryville Loop	42-inch-diameter pipeline	Onshore	Pennsylvania	Lancaster County	10.17
Madison Loop	26-inch-diameter pipeline	Onshore	New Jersey	Middlesex County	3.43
Raritan Bay Loop	26-inch-diameter pipeline	Onshore	New Jersey	Middlesex County	0.16
Raritan Bay Loop	26-inch-diameter pipeline	Offshore	New Jersey	Middlesex County	1.86
Raritan Bay Loop	26-inch-diameter pipeline	Offshore	New Jersey	Monmouth County	4.09
Raritan Bay Loop	26-inch-diameter pipeline	Offshore	New York	Queens County	6.44
Raritan Bay Loop	26-inch-diameter pipeline	Offshore	New York	Richmond County	10.94

A description of the Project facilities is provided below. Note that the mileposts (MPs) provided below for the onshore pipeline facilities correspond to the existing Transco Mainline and Lower New York Bay Lateral.[1] The offshore pipeline facility MPs are unique to the Raritan Bay Loop. The starting MP for the Raritan Bay Loop corresponds to MP12.00 of the Lower New York Bay Lateral, and the end MP corresponds to the Rockaway Transfer Point.

Onshore Pipeline Facilities

Quarryville Loop

- 10.17 miles of 42-inch-diameter pipeline from MP1681.00 near Compressor Station 195 to MP1691.17 co-located with the Transco Mainline in Drumore, East Drumore, and Eden Townships, Lancaster County, Pennsylvania. Once in service, the Quarryville Loop will be referred to as Mainline D.

Madison Loop

- 3.43 miles of 26-inch-diameter pipeline from Compressor Station 207 at MP8.57 to MP12.00 southwest of the Morgan meter and regulating (M&R) Station on the Lower New York Bay Lateral in Old Bridge Township and the Borough of Sayreville, Middlesex County, New Jersey. Once in service, the Madison Loop will be referred to as Lower New York Bay Lateral Loop F.

[1] Also referred to as Lower Bay Loop C.

Raritan Bay Loop

- 0.16 mile of 26-inch-diameter pipeline from MP12.00 west-southwest of the Morgan M&R Station to the Sayreville shoreline at MP12.16. Additionally, a cathodic protection (CP) power cable will be installed from a rectifier located at the existing Transco Morgan M&R Station near MP12.10 and extending to a connecting point on the proposed 26-inch-diameter pipeline at MP12.00. The approximately 545-foot-long power cable will be installed by horizontal directional drill (HDD).

Offshore Pipeline Facilities

Raritan Bay Loop

- 23.33 miles of 26-inch-diameter pipeline from MP12.16 at the Sayreville shoreline in Middlesex County, New Jersey, to MP35.49 at the Rockaway Transfer Point in the Lower New York Bay, New York, south of the Rockaway Peninsula in Queens County, New York. Additionally, a 1,831-foot-long CP power cable will be installed via HDD from a rectifier at the existing Transco Morgan M&R Station near MP12.10 to an offshore anode sled located approximately 1,200 feet north of MP12.32. Once in service, the Raritan Bay Loop will be referred to as Lower New York Bay Lateral Loop F.

Aboveground Facilities

New Compressor Station 206

- Construction of a new 32,000 ISO (International Organization for Standardizations) horsepower (hp) compressor station and related ancillary equipment in Franklin Township, Somerset County, New Jersey, with two Solar Mars® 100 (or equivalent) natural gas-fired, turbine-driven compressors.

Modifications to Existing Compressor Station 200

- Addition of one electric motor-driven compressor (21,902 hp) and related ancillary equipment to Transco's existing Compressor Station 200 in East Whiteland Township, Chester County, Pennsylvania.

Modifications to Existing Mainline Valve Facilities

- **Existing Valve Site 195-5** – Installation of a new mainline valve, launcher/ receiver, and tie-in facilities at the start of the Quarryville Loop (MP1681.00).
- **Existing Valve Site 195-10** – Installation of a new mainline valve, launcher/ receiver, and tie-in facilities at the end of the Quarryville Loop (MP1691.17).
- **Existing Valve Site 200-55** – Installation of a new mainline valve, launcher/ receiver, and tie-in facilities at the start of the Madison Loop (MP8.57).

New Mainline Valve Facilities

- **Proposed Valve Site 195-8** – Installation of a new intermediate mainline valve for the Quarryville Loop (MP1687.86).
- **Proposed Valve Site 200-59** – Installation of a new mainline (isolation) valve for the Madison Loop (MP11.90).

If the Commission issues a Certificate for the Project and Transco obtains the applicable permits and authorizations, Transco anticipates that construction of the Project will begin 3rd quarter of 2018 to meet an in-service date in the 3rd quarter of 2019.

10.2 No Action Alternative

Under the No Action Alternative, the Project, as described in RR 1, and briefly summarized in Section 10.1, would not be constructed or operated. The potential environmental impacts of construction and operation of the Project, as described in RRs 2 through 9, would not occur; however, this alternative would not meet the purpose and need for the Project.

The No Action Alternative would prevent Transco from providing 400,000 Dth/d of incremental firm transportation capacity to National Grid at the Rockaway Transfer Point to supply its existing service territory, which is needed beginning in the 2019/2020 heating season. In addition, the No Action Alternative would delay or even preclude realization of the benefits of the Project, as described in RR 1, including;

- expanded infrastructure to meet the needs of National Grid’s residential, commercial, and industrial customers;
- increased reliability of the natural gas transportation system serving New York City and the region;
- the reduction of harmful air emissions; and
- the provision of a flexible and affordable energy source that will serve as a bridge fuel as renewable energy sources are developed.

National Grid is currently the major local distribution company in Brooklyn, Queens, Staten Island, and portions of Long Island. As system demand is expected to exceed incremental peak day supply capacity in the New York City area beginning in the 2019/2020 heating season, selecting the No Action Alternative would lead to a lack of available natural gas to satisfy National Grid's projected demand. To address these shortages, consumers would be required to reduce their energy consumption through conservation measures.

10.2.1 Energy Conservation Alternatives

Energy conservation initiatives could potentially decrease the projected demand in the region. Beginning during the energy crisis of the 1970s, numerous aggressive energy conservation programs were developed in the U.S. The following sections summarize different energy conservation measures and the viability of energy conservation measures to meet the end-user demand in National Grid's service territory.

10.2.1.1 National Conservation Programs

The Energy Policy and Conservation Act, as amended, partly guides federal energy conservation efforts. Title III of this act outlines energy-efficiency programs such as the ENERGY STAR® labeling system for consumer products, incentives for states that enact energy conservation plans, and grants for industrial facilities that implement recoverable waste energy programs. The Energy Policy and Conservation Act, as amended, establishes energy efficiency standards for building codes and provides incentives for upgrading existing buildings.

The 2009 American Recovery and Reinvestment Act (ARRA) provided more than $16 billion for the U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy. Funding supported the Weatherization Assistance Program, Energy Efficiency and Conservation Block Grants, the Energy Efficient Appliance Rebate Program and ENERGY STAR®, and various alternative fuel programs for both transportation and energy production. A total of 141 energy-efficiency projects were funded at a cost of $768.7 million in New York State as part of ARRA (DOE 2010). Many of these programs are ongoing and continue to provide energy-efficiency measures to businesses and residences. Federal tax rebates and credits are also available for certain energy-efficiency measures such as energy-efficiency improvements in the building envelope of existing homes and high-efficiency heating, cooling, and water-heating equipment.

Additionally, the 2015 White House Clean Power Plan (Federal Register 2015a) set standards to reduce carbon dioxide (CO_2) emissions by 32% from 2005 levels by 2030. The

Clean Power Plan encourages states to make use of energy-efficiency programs in order to meet these emissions reductions.

While these energy-efficiency programs have key goals of reducing energy consumption and have resulted in energy conservation in New York State, the impacts on the Project target region are unclear. An analysis of energy-consumption reductions as a result of the aforementioned energy conservation programs on a national scale has yet to be completed and, therefore, the projected value of these programs can only be approximated. As such, consideration of state-specific energy conservation programs is more appropriate for the purposes of this RR.

10.2.1.2 State Conservation Programs

Multiple energy-efficiency programs such as the Regional Economic Development and Greenhouse Gas Reduction Program, EmPower New York, and the Multifamily Performance Program are available in New York State. In 2014, the New York State Energy Research and Development Authority (NYSERDA) published a report, *Energy Efficiency and Renewable Energy Potential Study of New York State* (NYSERDA 2014), presenting the potential for increased adoption of energy efficiency in the state between 2013 and 2032. The study asserted that significant energy savings are possible over the course of the study period and that a statewide 6% reduction in the forecasted natural gas load by 2020 and an 11% reduction by 2030 would be possible if the full achievable potential efficiency for natural gas is realized. However, the report acknowledges that despite potential energy savings as a result of natural gas efficiency programs, the baseline demand for natural gas is still anticipated to increase as many customers continue to convert from heating oil to natural gas as a result of cost and/or regulations phasing out the use of No. 6 and No. 4 fuel oil (see Section 1.1.1 of RR 1 for additional detail). Additionally, energy conservation cannot replace fuel oil No. 4.

10.2.2 No Action Alternative Conclusion

Under the No Action Alternative, the purpose and need for the Project would not be met, and Transco would not be able to provide 400,000 Dth/d of incremental firm transportation capacity to National Grid at the Rockaway Transfer Point to supply its existing service territory, which is needed beginning in the 2019/2020 heating season. The development and implementation of additional conservation measures may have some effect on energy demand; however, the magnitude of energy conservation necessary to equal the capacity proposed for this Project will not be attained in the near-term via current proven methods. Long-term increases in natural gas peak demand from market growth and from residents converting from oil to gas, would more than offset the implementation of energy conservation programs. The No Action Alternative would force National Grid to seek other natural gas transportation services and depend on other, future development projects with unpredictable schedules and undetermined environmental impacts.

10.3 Energy Source Alternatives

Transco evaluated the potential for other energy sources to meet the purpose and need of the Project. Energy sources were separated into two broad categories: renewable energy sources (biofuel/biomass, hydroelectric, solar, tidal, and wind) and traditional energy sources (coal, nuclear, and oil). In order to be a viable alternative, another energy source must meet three criteria:

- Capable of providing the equivalent energy supplied by the 400,000 Dth/d of natural gas to the Rockaway Transfer Point, as required by National Grid;
- Available in time to alleviate the peak demand projected to begin in the 2019/2020 heating season; and
- Able to meet the criteria above with an environmentally superior alternative relative to the Project.

10.3.1 Renewable Energy Sources

Biofuel and Biomass

In New York State, the production of biofuels generally declined between 1999 and 2013 from 153.2 trillion British thermal units (Btu) to 96.9 trillion Btu (NYSERDA 2016). In 2013, these biofuels accounted for 2.6% of total energy consumption in the state (including transportation). While wood is sometimes used for residential home heating and limited electricity generation, the majority of biofuel consumption is in the transportation sector (i.e., fuel additives). Even if biofuel consumption increased to 1999 levels, the energy source constitutes only a fraction of the overall usage in New York and lacks adequate infrastructure and demand to be considered a viable alternative to the Project in the target service territory. In particular, the Project would provide up to approximately 146 trillion Btu per year, equivalent to the amount of biofuel produced and consumed throughout the entire state in 1999.

The use of landfill and municipal waste biomass to generate “biogas” (i.e., methane) has been identified as another potential alternative energy source for the New York City area. Four facilities in the vicinity of New York City are enrolled in the U.S. Environmental Protection Agency's (EPA) Landfill Methane Outreach Program – the Al Turi, Brookhaven, Fresh Kills, and Oceanside landfills (EPA 2016a). While the operational and proposed biomass facilities would continue to contribute to the overall supply of energy for the region, the potential quantity of natural gas that could be generated by such facilities in the service territory would be insufficient to meet the projected need of the service territory. For example, the Fresh Kills landfill in Staten Island, New York, has been operating for more than 30 years, providing 1,705 million standard cubic feet (MMscf) of pipeline-quality gas in 2014, equivalent to 5.0 MMscf per day (New York State Department of Environmental Conservation [NYSDEC] 2017).

New York City has partnered with National Grid to further develop the Newtown Creek Wastewater Treatment Plant as a source of gas fuel (New York City 2015). Expected to be in service in fall 2017, the plant would inject enough purified digester gas into National Grid's distribution system to heat up to 5,200 homes in the Project's service territory (Brooklyn Union Gas Company 2016;National Grid 2014). This is equivalent to approximately 370,000 dekatherms per year, or approximately 1,000 Dth/d.[2] The energy production potential for biogas throughout New York State is estimated to be 12,121 MMscf per year,[3] or 33.2 MMscf per day (MMscf/d) (American Biogas Council 2015), compared with the Project's proposed incremental delivery of 400 MMscf/d to the service territory alone.

The current production of biofuels or biomass energy in the region is not sufficient to supply the energy equivalent of 400,000 Dth/d of natural gas to the Rockaway Transfer Point, as required by National Grid. In addition, production of new sources of biofuels or biomass, and the infrastructure to deliver the supply is not likely to be completed in the timeframe needed to alleviate the peak demand projected for the 2019/2020 heating season. Therefore, biofuel and biomass sources are not a feasible alternative to the Project.

Hydroelectric (Conventional)

While 15% of the electric power generated in New York State as a whole is from conventional hydro-power (i.e., excluding hydrokinetic devices but including pumped storage), only 1% of the power

2 Assumes a single-family home uses an average of 711 therms per year of natural gas.

3 Assumes 99 megawatt-hours of energy is generated from 1,000,000 cubic feet of natural gas (U.S. Energy Information Administration [EIA] 2016). This estimate conservatively accounts for average power plant steam generator and transmission efficiencies of approximately 33% in 2014. In comparison, older gas-fired residential furnaces have efficiencies of more than 50%, while all residential furnaces manufactured after 2015 have efficiencies of 80% or greater (U.S. Department of Energy [DOE] n.d, 2015).

generated in the Lower Hudson Valley is from hydroelectric sources, and none of the power in the New York City or Long Island areas is reported to be hydroelectric (New York Independent System Operator [NYISO] 2015). While New York City has proposed a hydroelectric plant at the Cannonsville reservoir (New York City Department of Environmental Protection [NYCDEP] 2014), the 14 megawatt (MW) system would be equivalent to only approximately 3.4 MMscf/d of natural gas. Hydroelectric power may be imported into the Project's service territory, e.g., under New York State's Energy Highway initiative to increase in-state transmission capabilities (NYISO 2015), and the proposed Champlain Hudson Power Express, high-voltage direct current cable could be a 1,000 MW source of electricity for the New York metropolitan area, partly from hydroelectric facilities in Quebec, Canada (U.S. Department of Energy Docket No. PP-362).

However, these electric transmission projects, which would require hundreds of miles of land-based and/or in-water transmission lines, would cause adverse environmental impacts of their own. Moreover, while these potential electric power lines and cables could provide additional hydroelectric energy to the New York City area, they would not provide the fuel necessary for current or future natural gas heating systems in the National Grid service territory, nor would they provide an additional conduit for natural gas to enhance the reliability of the existing system. In order to access and use the electricity generated by hydroelectric power, in-home natural gas energy systems and appliances may require conversion. Therefore, hydroelectric power is not considered a suitable alternative to the Project.

Solar

As of 2012, New York's wholesale electricity markets were adjusted to integrate grid-scale solar energy production. Currently, one grid-scale solar project is in operation in New York—the Long Island Solar Farm, which is a 32 MW facility located at the Brookhaven National Laboratory (NYISO 2015). While solar power provided only approximately 0.2% of New York State's energy in 2013 (NYSERDA 2016), the increase in the solar capacity within New York City itself has been rapid over the last several years, from 12 MW in June 2012 to 75 MW as of April 2016 (City University of New York 2012; New York City 2015). In addition, the city forecasts that 350 MW of solar capacity will be installed on public and private buildings by 2025 (New York City 2015).

This growth could bring additional energy that is needed to supply the service territory. However, 350 MW would offset the equivalent of only 43 MMscf/d of natural gas, assuming operation at 50% capacity,[4] compared with the Project's proposed 400 MMscf/d. Further, solar

[4] See footnote 2 above.

energy is least available during the winter months, when demand for natural gas is highest. The timeline for the 350 MW solar capacity goal is more than five years after the Project's proposed in-service date; thus, solar power would not be able to meet the short-term demands addressed by the Project. Finally, solar energy cannot offset the need for fuel in natural gas heating systems, nor will it enhance the reliability of the natural gas delivery system for the service territory. In order to access and use the electricity generated by solar power, in-home natural gas energy systems and appliances may require conversion. For these reasons, solar energy is not a feasible alternative to the Project.

Tidal (Hydrokinetic)

"Hydrokinetic" devices such as submersible turbines may be used to harness power from tidal currents without the need for pumps or dams. The potential for tidal power projects to supply energy to the region has been studied over the years, and FERC established a pilot program to foster their development. In January 2012, FERC issued its first pilot project license for the Roosevelt Island Tidal Energy Project (Docket No. P-12611), rated at 1.05 MW (FERC 2012). Roosevelt Island Tidal Energy turbines were installed in the East River and monitoring is ongoing. Little advancement has been made in providing hydrokinetic energy to the service territory. For example, a third extension to the FERC preliminary permit for the Wards Island Tidal Power Project was denied in April 2013 because of the lack of progress (Docket No. P-12718), and the East River Tidal Energy Project was withdrawn in December 2014 because the owner, Oceana Energy Company, did not see "the political, economic, and energy environment as conducive" for deploying their submersible turbines in the United States (Docket No. P-12665).

In 2011, with a potential to generate up to 300 MW of power, the Astoria Tidal Energy Project was the only commercial-scale hydrokinetic project in the region to receive a preliminary FERC permit (Docket No. P-13730). While a December 2013 progress report to FERC was optimistic about further development of the project, no activity has been documented on the FERC docket since then. Further, the owner of the Astoria Tidal Energy Project is New York Tidal Energy Company, a subsidiary of Oceana Energy Company. As indicated above in reference to the East River Tidal Energy Project, the Oceana Energy Company does not consider conditions favorable for installing hydrokinetic devices in the United States at this time.

No other projects have been proposed near the service territory since the projects described above (FERC 2016a). Finally, in the event that sufficient hydrokinetic power came into service, in order to access and use the electricity generated by hydrokinetic power, in-home natural gas energy systems and appliances may require conversion. As such, tidal energy cannot be expected to provide a significant amount of energy to the service territory in the near future and therefore is not a feasible alternative to the Project.

Wind

In New York State, wind energy production has increased to 33.7 trillion Btu in 2013 (NYSERDA 2016), which is approximately 1.3% of total non-transportation-related energy consumption in the state. In 2015, statewide nameplate capacity for wind power was 1,746 MW, and an additional 2,300 MW is proposed for interconnection with the New York State grid (NYISO 2015). However, all of the utility-scale wind projects are outside of the Project's service territory. Additional electric transmission lines would have to be installed to deliver the additional power to New York City and Long Island. Efforts such as the New York State Energy Highway initiative may facilitate the relatively rapid development of such transmission lines (DOE 2015), but these long-distance projects, whether in-state or out-of-state, would cause adverse environmental impacts of their own.

The Long Island – New York City Offshore Wind Project is currently planned to provide up to 350 MW of power to the Project's service territory, with the potential to expand by an additional 700 MW of installed capacity (NYSERDA 2010a). The proposed offshore wind project would be located approximately 16 miles southeast of the Rockaway Peninsula. In March 2016, after more than four years of review, the Bureau of Ocean Energy Management (BOEM) announced the designation of the Wind Energy Area that would potentially be leased for the offshore wind project (BOEM 2016). In October 2016, the BOEM published a Final Sale Notice for a Wind Energy Area approximately 12 nautical miles (nm) off the coast of Long Beach, New York and totaling roughly 80,000 acres. BOEM held an auction for the lease on December 15-16, 2016, and the provisional winner of the sale was Statoil Wind US, LLC. Statoil is now exploring the potential for developing a wind farm to supply New York City and Long Island with an additional source of electricity generation (BOEM n.d.; NYSERDA 2017). However, development of an offshore wind project would likely not occur before 2023, almost four years beyond the proposed in-service date for the Project (New York State Department of Public Service [NYSDPS] 2016). Considering the potential environmental impacts in the marine environment, and the distance to connect the turbines to the onshore environment, environmental impacts are not anticipated to be less than the proposed Project.

In January 2017, the Long Island Power Authority approved the South Fork Wind Farm, a 90 MW wind farm 30 miles southeast of Montauk off the coast of Long Island. The installation will be the first development on a parcel that could potentially host 1,000 MW of offshore wind with space for approximately 200 turbines (NYSERDA 2017; New York Times 2017).

The combination of proposed onshore and offshore wind energy projects in New York State identified above (3,000 MW) is equivalent to 363 MMscf/d of natural gas.[5] While this energy capacity approaches the level of energy that would be provided by the Project, all of the projects are unlikely to be constructed by the proposed in-service date of the Project, or to supply the Project's service territory. Additionally, wind energy would not provide fuel to consumers with existing natural gas systems and would not enhance the reliability of the natural gas delivery system for the service territory. In-home natural gas energy systems and appliances may require conversion for the delivery and use of the electricity generated by wind power. Further, wind power depends on another energy source (e.g., natural gas turbines) as a backup energy supply due to the variability of wind power. Therefore, while utility-scale wind facilities in New York have the potential to address a substantial portion of the service territory's energy needs, wind power is not a suitable alternative to the Project.

10.3.2 Traditional Fuel Sources

Coal

The availability of coal makes it a viable alternative to natural gas for electricity generation but is not as clean-burning or efficient. Combustion of coal for energy production emits more criteria pollutants (e.g., sulfur dioxide, nitrogen oxide, carbon monoxide, and particulate matter) and greenhouse gasses (e.g., CO_2) than combustion of natural gas. Such pollutants are considered a major contributor to acid rain and climate change, which is causing ecological and economic consequences. In 2012, the electric power sector was the largest contributor of total greenhouse gas emissions in the U.S. (EPA 2016b). In 2015, coal-powered energy sources produced 71% of the energy sector's CO_2 emissions, compared with natural gas (27%), and petroleum (1%) (EIA 2016). Emissions from coal-burning entities also are the primary source of airborne mercury deposition in the U.S., releasing an estimated 40% of the controllable emissions in the country, far greater than any other source category (Milford and Pienciak 2009).

[5] See footnote 2 above

Coal-fired electricity plants are being retrofitted with emission-control measures that greatly reduce the level of emitted pollutants. Proposed new regulations would require further measures to reduce criteria pollutants and greenhouse gas emissions. Additionally, New York has implemented a regional strategy, the Regional Greenhouse Gas Initiative, an agreement among nine eastern states to reduce carbon emissions from power plants through 2020 (NYISO 2015). However, the timeline for implementation of these guidelines and for a regional transition to cleaner-burning coal is uncertain. In addition, energy planning think tanks have begun to study the economic burden of retrofitting existing plants. A study by Synapse Energy found that the retrofits on plants imposed by the Clean Power Plan would be cumbersome and costly and could potentially cause energy from coal sources to become uneconomic as operating costs increase throughout 2030 (Synapse Energy 2015). Even in the absence of the Clean Power Plan, existing coal-fired plants are expected to be retired in the near-term future because power plant operators are being forced to either incur costs undertaking retrofits and upgrades or receive less revenue from lower levels of operation (EIA 2016).

While coal remains a viable option for serving the energy needs of certain customers, it may indirectly result in adverse economic effects on energy customers and may result in greater environmental impacts than the generation of energy from natural gas. Therefore, coal is not a suitable alternative to the Project.

Oil (Petroleum)

Petroleum oil is a potential alternative to the Project because fuel oil can be used both as a direct heating fuel and for electricity generation in the service territory. Liquids (including petroleum) accounted for approximately 40% of the total energy consumption in New York State in 2007 but less than 25% of the total energy consumed in the residential, commercial, and industrial sectors (NYSERDA 2010b). For example, twice as many electricity-generating plants in Brooklyn and Queens use natural gas than fuel oil as their primary fuel. In the home heating market, recent developments in the efficiency of home heating units have favored a shift from oil to natural gas in the service territory. Additionally, recent regulations are phasing out the use of fuel oil No. 4 and No. 6 in the service territory, in an effort to reduce air pollutants.

For example, between 1999 and 2013, the annual residential consumption of natural gas in Kings and Queens counties increased while the use of fuel oil as a heating source decreased (NYSERDA 2016 [see Table 10.3-1]).

Table 10.3-1
Estimated Annual Residential Energy Consumption Changes, 1999-2013

County	Natural Gas (MMscf)		Distillate Fuel Oil (MBbl)	
	1999	2013	1999	2013
Kings	41,000	53,000	2,284	1,088
Queens	41,500	46,900	2,575	1,467

Source: NYSERDA 2016

Key:
MBbl = 1,000 barrels
MMscf = Million standard cubic feet

In conjunction with regulatory requirements and population growth, heating fuel conversion has led to a projected 0.12% annual increase in natural gas use in New York State's residential market between 2009 and 2019 (NYS Energy Planning Board 2009). Between 2000 and 2010, population growth in New York City was equivalent to the state's overall growth of 2.1% (Mackun and Wilson 2011).

Increased use of fuel oil would result in environmental impacts associated with transportation and burning of the petroleum products. In terms of transportation, these impacts may include increased vessel traffic and risk of in-water oil spills for product transported by ship or additional petroleum pipeline facilities that would have similar or greater impacts as the proposed Project. Additionally, as discussed in RR 1, Chapter 2 of Title 1 of the Rules of the City of New York were amended "prohibiting the use of fuel oil grade numbers (Nos.) 4 and 6 in heat and hot water boilers and burners" (NYCDEP 2012). As a result, the use of fuel oil No. 4 is to be phased out by 2030. As of June 30, 2015, fuel oil No. 6 was phased out as a primary heating oil. Therefore, oil is not a suitable alternative to the Project.

Nuclear

As with coal, nuclear power itself is not a source of home heating fuel but instead could be used as a source of additional electricity generation. Nuclear power is an abundant source of energy for the state and may be considered environmentally viable in terms of limiting air emissions of criteria pollutants. However, cost considerations, waste disposal issues, and potential public safety concerns make development plans for new facilities, or re-licensing of existing facilities, difficult to implement. As a result, an unfavorable regulatory climate exists in which the probability of a new nuclear facility coming on-line in time to serve new and continued energy demands is low.

Currently, four nuclear facilities operate within New York State: the R. E. Ginna Nuclear Power Plant; the Nine-Mile Nuclear Generating Station; the Indian Point Energy Center; and the James A. FitzPatrick Nuclear Power Plant. The Indian Point Energy Center is located closest to New York City. In 2012, nuclear sources generated approximately 427.3 trillion Btu, approximately 19% of the electricity generated in New York State (EIA 2016; EIA 2012).

The R.E. Ginna Nuclear Power Plant received a renewed license in 2004 and is currently licensed through 2029 (U.S. Nuclear Regulatory Commission [NRC] 2016a). The Nine-Mile Nuclear Generating Station's Unit 1 and Unit 2 received a renewed license in 2006; Unit 1 is currently licensed through 2029, while Unit 2 is licensed through 2046 (NRC 2016b; NRC 2016c). Although these facilities will have active licenses during the same time period served by the Project, they would be unlikely to provide power to the Project area, and the need for the Project would still exist.

The FitzPatrick Plant located in Oswego, New York, may close in 2017, despite the assurances of financial support, due to incompatibility of timelines and the re-licensing process. The Indian Point facility is currently being considered for re-licensing, but this is a lengthy process that can take upwards of ten years. A second supplement to the Indian Point Supplemental Final Environmental Impact Statement is expected in 2017. While re-licensing is being pursued, the plant can still run despite the expiration of its licenses in 2013 and 2015 (Anderson 2015). Recent opposition from the Governor of New York State, Andrew M. Cuomo and NYSDEC limits the likelihood of successful re-licensing. The governor's administration has requested that the NRC decline a new license to operate, based on aging infrastructure, security, and public health risks. NYSDEC has also issued a recommendation to deny the license, and the New York State Department of State (NYSDOS) officially denied the Coastal Zone Management Act (CZMA) coastal consistency assessment. However, the New York Appellate Court found the facility should be grandfathered in under the CZMA and did not need a coastal consistency determination (Anderson 2015). The NRC will provide a decision on whether Indian Point will be re-licensed pending its evaluation of the Supplemental Final Environmental Impact Statement, expected to be released in 2017.

Because of the lack of planned upgrades to nearby facilities, difficulties and uncertainties in renewing the licensing of existing infrastructure and developing new nuclear facilities, and the fact that additional nuclear energy would not preclude the need for natural gas in the target area, nuclear energy was deemed to be unsuitable as an alternative to the Project. In addition, in-home natural gas energy systems and appliances may require conversion for the delivery and use of the electricity generated by nuclear power.

10.3.3 Energy Source Alternatives Conclusion

Following a review of energy source alternatives to meet the purpose and need of the Project, no other energy source would satisfy the increased demand for natural gas in the service territory. Electrical energy produced by traditional energy sources, such as coal-fired plants or nuclear plants, are not viable alternatives. Primarily because of environmental concerns, the capacity of these energy sources is not increasing, and the timeline to permit new facilities is not expected to be sufficient to meet the projected energy demand in the service territory within the timeframe proposed. Current regulations are phasing out fuel oil No. 4 and No. 6, due to emission rates of nitrogen oxides and sulfur dioxide. Therefore, increasing the use of fuel oil to meet the projected energy demand in the service territory would not be viable. Sufficient renewable energy sources are not currently available and cannot be available on a timely basis for large-scale application to the point where they would be viable energy alternatives to the Project. In addition, in-home natural gas energy systems would require conversion for the delivery and use of the electricity generated by the alternative energy sources discussed above. For these reasons, and because no other energy source would directly satisfy the increased demand for natural gas in the service territory, other traditional and renewable energy sources are not considered viable alternatives to satisfying the Project's purpose and need.

10.4 Transco System Design Analysis and Alternatives

The subsections below describe Transco's existing system and hydraulic constraints that form the basis for the design of the proposed Project and the operational requirements on the Transco system when considering a project in a given area. Transco system alternatives incorporate the results of the hydraulic analysis and the design requirements.

Transco System Design

Transco's system is designed and operated to meet the coincidental maximum day firm quantities of its customers. This design is based upon customers' Delivery Point Entitlements as recorded in the Compliance Filing, CP89-484 as amended. Because firm contractual demands, natural gas temperatures, and ambient temperatures vary by month and season, multiple design scenarios are applicable to the existing Transco system.

For design purposes, the Transco system is divided into three main areas: the Production Area, Southern Market Area, and Northern Market Area. The Project path spans portions of the Southern Market Area and the Northern Market Area; therefore, models for both of these areas were used in designing the Project facilities.

The Southern Market Area begins at the suction side of Compressor Station 65 in Louisiana and continues to the discharge side of Compressor Station 200 in Pennsylvania. The Southern Market Area is designed with the following three scenarios: a summer scenario, a winter average scenario, and a winter peak scenario. The summer scenario is defined as the highest monthly load for each customer during the summer period (April through October). The winter average scenario is defined as the highest monthly load for each customer during the winter shoulder months (November or March). The winter peak scenario is defined as the highest monthly load for each customer during the winter months (December through February).

The Northern Market Area for the Transco system consists of two major components, the Transco Mainline and the Leidy line. The Transco Mainline begins at the suction side of Compressor Station 180 in Virginia and continues through Compressor Station 200. The natural gas flow continues to Compressor Station 205 where a portion of the flow supplies the Trenton Woodbury Lateral and the remainder supplies the New Jersey/New York area. The Leidy line starts at the Leidy storage area in Pennsylvania and continues eastward through the Centerville regulator station where the natural gas stream splits; a portion flows to New York through Caldwell lines and the remainder flows to Compressor Station 205. The major laterals that are included in the Northern Market Area include the Marcus-Hook Lateral, Trenton-Woodbury Lateral, LNYBL, Long Island Extension, and the Paterson Lateral. Part of the Northern Market Area model overlaps with the Southern Market Area model from Compressor Station 180 to Compressor Station 200.

The design of the Northern Market Area is based on a winter peak scenario that takes into account two delivery shifts, recognizing that the customers have the right to move the natural gas within the limits of their Delivery Point Entitlements. The Northeast Shift assumes that each shipper's firm contract volume is moved to the most downstream northeastern point on Transco's system within the limits of the shipper's Delivery Point Entitlements. The Southeast Shift assumes that each shipper holding capacity on the Trenton-Woodbury Mainline loop around Philadelphia, Pennsylvania, is loaded to its maximum volume within the limits of the shipper’s Delivery Point Entitlements. Furthermore, the design is based on contract flows that alternate between six-hour intervals during which firm customers are taking 120% of their full contractual entitlements and 80% of their full contractual entitlements.

Control Points

Control points are set points along a pipeline route that normally include the start and end points for the pipeline. These points dictate the routing options of a pipeline. Engineering of the Project design requires considering a number of system constraints, including temperatures, pressures, volumes, geography, and environmental conditions throughout the transport of natural gas along the pipeline.

Transco's gas delivery points into New York City include facilities at 72nd Street in Manhattan, 134th Street in Manhattan, and the Narrows M&R Facility on Staten Island. Transco's facilities in Manhattan provide service to Consolidated Edison but do not connect to, or service, National Grid directly. The Narrows M&R Facility is a delivery point to National Grid, and the recent New York Bay Expansion Project has brought the Long Island Extension pipeline from Staten Island to Brooklyn up to National Grid's capacity. In addition, the Brooklyn Regulating Facility, which interconnects with National Grid at Shore Road in Brooklyn, does not provide natural gas to the areas needed. Further, the existing National Grid system design does not support transfer of gas from this area of Brooklyn to the customers serviced by gas delivered at the Rockaway Transfer Point to the extent necessary. None of these delivery points would meet the Project requirement of delivering natural gas to National Grid at the Rockaway Transfer Point. These conditions eliminate the two Manhattan, the Staten Island, and the Brooklyn delivery points described above from consideration as control points for the Project.

Using hydraulic modeling to identify control points ensures pipeline integrity and efficiency by allowing for the maintenance of pipeline flows and pressures as natural gas is transferred and received between several points on the system. The control points for the Project were established based on hydraulic modeling to determine the system constraints along the existing Transco Mainline and the modifications necessary to transport the 400,000 Dth/d required by the Project.

To be a viable system alternative to the proposed Project, any potential system alternative must meet the following criteria:

- Capable of transporting up to 400,000 Dth/d of natural gas to the Rockaway Transfer Point, as required by National Grid, without negatively impacting service to existing customers;

- Capable of being constructed in time to meet the peak demand projected for the 2019/2020 heating season; and
- Able to meet the criteria above with an environmentally superior alternative relative to the Project.

The Precedent Agreements with National Grid require Transco to provide the requested incremental capacity from Compressor Station 195. Based on hydraulic modeling, Transco identified three distinct segments on its system that will require upgrades to achieve the Project purpose and need:

- Compressor Station 195 to Compressor Station 205
- Compressor Station 205 to Northern Market Area
- Compressor Station 207 to Rockaway Transfer Point

Discussions of each of these segments are presented in Sections 10.4.1, 10.4.2, and 10.4.3.

10.4.1 Compressor Station 195 to Compressor Station 205 Segment

Hydraulic modeling indicated that to provide 400,000 Dth/d of natural gas to the Rockaway Transfer Point, as required by National Grid, additional Project facilities are needed to facilitate the transmission of existing and incremental Project volumes from Compressor Station 195 to the Market Area downstream of Compressor Station 205 without materially degrading the transportation service (i.e., delivery pressure) at existing delivery points. Relying solely on horsepower at Compressor Station 195 is not an alternative because Compressor Station 195 currently discharges at the maximum allowable operating pressure (MAOP) of the existing pipeline, and the pressure drop resulting from the incremental Project volumes downstream of Compressor Station 195 would result in significant deterioration of pressures at delivery points on the mainline, absent additional downstream facilities. Therefore, Transco determined that looping downstream of Compressor Station 195 is necessary to meet the Project purpose and need. Viable solutions would include either looping alone ("Looping-Intensive Alternative", [see Section 10.4.1.2]), or a combination of looping and increased compression (see Table 10.4-1).

Transco has proposed the Quarryville Loop and increased compression at Compressor Station 200 to provide for the transmission of the existing and incremental Project volumes from Compressor Station 195 to the downstream side of Compressor Station 205. Transco designed the Project to minimize the amount of facilities required and to minimize environmental impacts to the extent practicable.

Transco sited the Quarryville Loop downstream of Compressor Station 195 east of the Susquehanna River to avoid potential impacts associated with a major river crossing. To minimize impacts to existing delivery points, the loop has to be sited west of MP1711.66. Establishing the loop farther east from the currently proposed location of the Quarryville Loop would cross through more densely populated areas with expected increases in environmental and landowner impacts. Shifting the Quarryville Loop farther to the east could also require deviations from the existing right-of-way (ROW) corridor to avoid constraints from development. In addition to the Quarryville Loop, Transco determined that to meet the Project purpose and need, increased compression would be necessary at Compressor Station 200 to maintain downstream delivery pressures while transporting the incremental Project design volumes.

System alternatives considered for this segment from Compressor Station 195 to Compressor Station 205 include installing additional compression to existing facilities (see Section 10.4.1.1) and installing additional looping (see Section 10.4.1.2). A comparison of the environmental impacts of the Project (Quarryville Loop and additional compression at Compressor Station 200) and an alternative to provide additional looping to minimize or eliminate the addition of compression is provided in Table 10.4-1.

10.4.1.1 Compression-Intensive Alternative

Transco considered a compression-intensive alternative to eliminate the need for the construction of pipeline looping between Compressor Station 195 and Compressor Station 205 (e.g., the Quarryville Loop). Transco found that a compression-only alternative that meets the Project purpose is not possible. Additional horsepower at Compressor Station 195 is not a viable alternative to the Quarryville Loop because Compressor Station 195 currently discharges at the MAOP of the existing pipeline. Adding additional compression at Compressor Station 200 (in excess of the compression that is proposed) is not a feasible alternative because the pressure drop resulting from the incremental Project volumes downstream of Compressor Station 195 would result in significant deterioration of pressures at delivery points on the mainline upstream of Compressor Station 200 absent additional downstream facilities. As such, the compression-intensive alternative was removed from further consideration as a system alternative.

10.4.1.2 Looping-Intensive Alternative

Transco considered constructing more pipeline looping as an alternative to the proposed incremental compressor unit addition at Compressor Station 200. If the incremental compression were not installed at Compressor Station 200, a minimum of 19.97 miles of additional 42-inch-diameter pipeline loop upstream of Compressor Station 200 would be required in addition to the proposed Quarryville Loop. This would increase the 42-inch pipeline loop length to a minimum of 30 miles between Compressor Station 195 and Compressor Station 200 in York and Chester counties, Pennsylvania. Figure 10A-1 depicts the approximate location of the looping pipeline that would be required east of the Quarryville Loop to achieve the looping intensive alternative.

For purposes of this comparison, Transco assumed the additional pipeline length would be co-located with the existing ROW. Land use in the area of the additional 19.97 miles of looping is characterized as residential, rural residential, agriculture land, and forested. The additional looping route would traverse approximately 14 miles of agricultural land and rural residential areas from approximately MP1691.06 to MP1704.75 of the existing mainlines. From approximately MP1704.75 to MP1705.30, the pipeline would traverse a residential neighborhood. The pipeline would then traverse a light commercial/industrial area from MP1705.30 to MP1705.92 and another residential neighborhood from MP1705.92 to MP1706.49. From MP1706.49 to MP1706.88, the pipeline would be located along the edge of forest, in agricultural land, before traversing a forested area from MP1708.46 to MP1710.43. The remaining 0.60 mile of the pipeline would cross a low-density residential neighborhood before terminating at or near MP1711.03.

The construction of the additional 19.97 miles of 42-inch-diameter pipeline loop would result in substantively greater environmental disturbance and landowner impacts over the short and long term than the proposed unit addition at Compressor Station 200; therefore, this alternative was eliminated from further consideration.

Table 10.4-1 provides a comparison of the environmental impacts of the Project (Quarryville Loop and increased compression at Compression Station 200) and an alternative to provide additional looping only.

Table 10.4-1
Comparison of the Environmental Impacts of the Quarryville Loop/Modification to Compressor Station 200 and the Looping-Intensive Alternative

Factor	Unit	Quarryville Loop and Compressor Station 200[a]	Looping-Intensive Alternative[b]
Length of pipeline	Miles	10.17	30.14
Construction ROW requirements[c]	Acres	226.71	428.32
Operation ROW requirements[c]	Acres	30.96	143.41
Construction impacts on forested land	Acres	7.14	52.20

Table 10.4-1
Comparison of the Environmental Impacts of the Quarryville Loop/Modification to Compressor Station 200 and the Looping-Intensive Alternative

Factor	Unit	Quarryville Loop and Compressor Station 200[a]	Looping-Intensive Alternative[b]
Operation impacts on forested land	Acres	1.69	25.66
Construction impacts on wetlands (NWI)	Acres	0.04	4.31
Operation impacts on wetlands (NWI)	Acres	0.00	2.23
Number of waterbody crossings (NHD)	Count	0	0
Number of stream crossings (NHD)	Count	14	31
Number of residences within 50 feet of construction workspace	Count	8	37
Number of any local, state, or federal lands, parklands, or recreational lands crossed	Count	4	34
Local, state, or federal lands, parklands, or recreational lands crossed during construction	Acres	35.10	72.89
Local, state, or federal lands, parklands, or recreational lands crossed during operation	Acres	3.70	24.46

Sources: USFWS 2016; USGS 2016; and Sources for Federal, State, and Local Lands and Recreation Lands are provided in RR 8.

[a] Includes upgrades to Compressor Station 200 and the Quarryville Loop and all appurtenant facilities.
[b] The looping-intensive alternative includes impacts associated with the Quarryville Loop and the additional looping required under this alternative.
[c] Assumes a construction ROW width of 100 feet and an operational ROW of 50 feet

Key:
NHD = National Hydrographic Database
NWI = National Wetland Inventory
ROW = Right-of-way

10.4.2 Compressor Station 205 to Market Area Segment

Hydraulic modeling indicated that to provide 400,000 Dth/d of natural gas to the Rockaway Transfer Point, as required by National Grid, additional Project facilities are needed in the Market Area north of Compressor Station 205. The segment of the Transco system downstream of Compressor Station 205 is primarily designed to facilitate the transmission of natural gas from Compressor Station 205 and the Leidy Line to delivery points in the Market Area north of Compressor Station 205. In order to be considered feasible facility alternatives, proposed Project facilities in this segment must be capable of transporting the incremental 400,000 Dth/d Project capacity in addition to the existing volumes without resulting in materially degrading the transportation service at existing delivery points. Transco has proposed the construction of Compressor Station 206 to meet these requirements.

System alternatives considered for the segment from Compressor Station 205 to the Market Area include a looping only alternative (see Section 10.4.2.1), and increasing compression at existing Compressor Station 205 and/or Compressor Station 207 (see Section 10.4.2.2). In addition, Transco evaluated the use of electric motors for Compressor Station 206 rather than gas turbines (see Section 10.4.2.3).

10.4.2.1 Looping-Intensive Alternative

Transco considered a pipeline looping-intensive alternative to achieve the facility upgrade requirements in the Compressor Station 205 to the Market Area segment that would eliminate the need to install Compressor Station 206. A pipeline looping-intensive alternative for this segment would require 15.31 miles of 42-inch pipeline from Compressor Station 205 to approximately MP1788.20 in Middlesex County, New Jersey (see Figure 10A-2).

For purposes of this comparison, Transco assumed the additional pipeline length would be co-located with the existing ROW. Land use in the area of this loop is highly urbanized and contains several dense, residential neighborhoods. The mileposts provided in the description below are approximate. This alternative passes through an existing business complex parking lot at MP1774.48 and a large subdivision between MP1775.00 and MP1775.41. Based on a review of existing resources, Transco anticipates that an HDD would be required from MP1775.00 to MP1776.50 to avoid a densely populated subdivision; open trenching a waterbody (Stony Brook) three separate times; and open trenching associated with floodways.

New Jersey Department of Environmental Protection (NJDEP) mapped wetlands would be crossed from MP1776.73 to MP1777.66. The pipeline would traverse another residential area from MP1777.66 to MP1778.08. The pipeline would then traverse directly through an apartment complex from MP1778.55 to MP1778.75. In order to avoid the apartment complex, the pipeline would have to be routed away from the existing ROW. Mapped wetlands would be crossed from MP1780.19 to MP1781.11, and from MP1782.01 to MP1783.11. The pipeline would then traverse multiple subdivisions within Kendall Park and be within 50 feet of residences and backyards from MP1783.18 to MP1786.14. At MP1787.90, due to 25-foot offset requirements and land requirements for construction and operation, the pipeline would be installed approximately 15 feet from eight multi-family apartment buildings within an apartment complex.

Table 10.4-2 provides a comparison of the environmental impacts of the Project (Compressor Station 206) and the alternative of pipeline looping only.

Table 10.4-2
Comparison of the Environmental Impacts of Compressor Station 206 and the Looping-Intensive Alternative

Factor	Unit	Compressor Station 206	Looping-Intensive Alternative
Length of pipeline	Miles	N/A	15.31
Construction ROW[a]	Acres	22.35	185.73
Operation ROW[a]	Acres	16.73	45.88
Construction impacts on forested land	Acres	11.68	51.23
Operation impacts on forested land	Acres	7.64	18.69
Construction impacts on wetlands (NWI)	Acres	4.24	39.89
Operation impacts on wetlands (NWI)	Acres	2.77	10.63
Number of waterbody crossings (NHD)	Count	0	0
Number of stream crossings (NHD)	Count	0	32
Number of residences within 50 feet of construction workspace	Count	0	115
Number of any local, state, or federal lands, parklands, or recreational lands crossed	Count	0	30
Local, state, or federal lands, parklands, or recreational lands crossed during construction	Acres	0	58.28
Local, state, or federal lands, parklands, or recreational lands crossed during operation	Acres	0	14.51

Sources: USFWS 2016, and USGS 2016; Sources for Federal, State, and Local Lands and Recreation Lands are provided in RR 8.

[a] Assumes a construction ROW width of 100 feet and an operational ROW of 25 feet on the outermost existing Transco Mainline. The additional 25 feet of permanent ROW overlaps with existing, maintained Transco ROW and was therefore not included in this impact analysis.

Key:
NHD = National Hydrographic Database
NWI = National Wetland Inventory
ROW = Right-of-way

The primary environmental benefit of implementing a looping-intensive alternative would be the elimination of potential long-term air and noise impacts that will be associated with operation of Compressor Station 206. However, through proper design, the proposed Compressor Station 206 alternative results in far fewer environmental impacts than would be anticipated with a looping-intensive alternative. The majority of noise-generating equipment at Compressor Station 206 will be enclosed within a building (i.e., the building that houses the compressor station turbines and compressors) and the compressor station building will be acoustically designed to ensure that noise levels at the fence line of the compressor station do not exceed established noise thresholds (see RR 9, Section 9.3 for details regarding noise thresholds and impacts).

Transco conducted an air quality analysis to quantify effects of the proposed Compressor Station 206 and will implement best available control technologies to reduce emissions. Transco will acquire the necessary permits to ensure that the operation of the compressor station meets air quality standards (see RR 9, Section 9.2.4 for details regarding air quality effects).

Based on the increased environmental impacts resulting from construction of 15.31 miles of looping pipeline and the overall population density, a pipeline looping-intensive alternative from Compressor Station 205 to the Market Area segment was not selected as the preferred alternative.

10.4.2.2 Expansion of Existing Compressor Station Facilities

As alternatives to constructing a new compressor station, Transco considered the expansion of existing Compressor Station 205; the expansion of existing Compressor Station 207; and a combination of modifications to both Compressor Station 205 and Compressor Station 207 as discussed below.

Compression Addition at Compressor Station 205

The purpose of adding compression at an existing compressor station is to offset the pressure drop associated with transporting the additional volume of natural gas flowing through the pipeline because of an expansion project. Discharging at the MAOP helps to minimize the negative impact of pressure loss that occurs as natural gas travels to downstream facilities and delivery points. To maintain a maximum discharge pressure at Compressor Station 205, the installation of an additional 45,000 hp of compression would be required. Although this alternative would allow the compressor station to discharge at the MAOP of the downstream pipeline, pressure drop associated with the incremental Project capacity would still result in the material degradation of delivery pressures downstream of Compressor Station 205; hence, simply adding compression at Compressor Station 205 is not a viable alternative. In order to mitigate the incremental pressure drop, an additional 6.8 miles of 42-inch-diameter of pipeline looping would also be required, beginning at Compressor Station 205 (MP1773.40) and ending at approximately MP1780.2, resulting in greater environmental disturbance and landowner impacts. For these reasons, adding compression solely at Compressor Station 205 was eliminated from further consideration.

Compression Addition at Compressor Station 207

Adding an additional 25,000 hp of compression at existing Compressor Station 207 would be sufficient to overcome the reduced suction pressure that Compressor Station 207 would experience as a result of delivering the additional natural gas for this Project. This would allow for existing and new deliveries to be made downstream of Compressor Station 207 on the Lower Bay Loop C. However, the addition of the incremental 400,000 Dth/d of capacity to the system would cause significant pressure degradation upstream of Compressor Station 207 on the LNYBL and on Transco's Mainline downstream of Compressor Station 205 at delivery meters connected to lines A and E, which are not compressed by Compressor Station 207. Compressor Station 207 currently provides compression only for volumes on the Lower Bay Loop C and the LNYBL downstream of the facility; therefore, the addition of compression, of any amount, at Compressor Station 207 alone would be insufficient to counteract the pressure degradation upstream of the facility. For these reasons, adding compression solely at Compressor Station 207 was eliminated from further consideration.

Compression Addition at Both Compressor Station 205 and Compressor Station 207

In addition to evaluating adding compression capacity at Compressor Station 205 and Compressor Station 207 individually, Transco also evaluated an alternative in which compression would be added at both compressor stations. Adding additional compression at both Compressor Station 205 and Compressor Station 207 is not a viable alternative to the construction of Compressor Station 206 because no combination of compression at Compressor Station 205 and Compressor Station 207 alone would be sufficient to meet the hydraulic requirements of the Project. As described above, even if horsepower were added at Compressor Station 205 to allow the compressor station to discharge at the MAOP of the downstream pipeline, downstream delivery pressures would be significantly degraded due to the increased pressure drop associated with the incremental Project volumes. The increased pressure drop associated with the incremental Project volumes would occur downstream of Compressor Station 205 on Transco Mainlines A, C and E. Additional horsepower at Compressor Station 207 could be used to mitigate the pressure degradation on Lower Bay Loop C but could not mitigate the increased pressure drop on Mainlines A and E because Compressor Station 207 does not compress Transco Mainlines A and E. For these reasons, adding compression at Compressor Station 205 and Compressor Station 207 was eliminated from further consideration.

10.4.2.3 Electric Motor-Driven Compression at Compressor Station 206

Transco evaluated the feasibility and related environmental impacts of using electric motor-driven compression at Compressor Station 206. This included consideration of the compressor station hydraulic design conditions, extensive engineering requirements, planned operational characteristics, and environmental impacts, including the construction footprint, air emissions, and noise impacts. Other factors include the footprint required for additional electric transmission facilities and the regional emissions associated with operation. Based on Transco's engineering evaluation, electric motor-driven compression at Compressor Station 206 would require additional aboveground power grid infrastructure, including high voltage power lines and a substation, to provide at least an additional 22,000 kilowatts of power.

For this evaluation, Transco developed a possible route for the transmission line based on aerial photography. This route is provided for illustrative purposes only, and does not represent input from the local utility provider. The route for the transmission line extends from the nearest electrical substation to the proposed Compressor Station 206 site. Transco sought to avoid residences and to co-locate the line adjacent to existing roadways or other ROWs, where appropriate. The route would begin at the existing substation off Ridge Road, approximately 2.5 miles south of the proposed Compressor Station 206 location. The route extends west approximately 0.5 mile co-located with Ridge Road and existing electric transmission infrastructure. The route then extends north-northeast, avoiding residences, to New Jersey Route 27 and is co-located with Route 27 for approximately 1.5 miles before reaching Transco's existing mainline. At that point, the route turns west and is co-located with the mainline until terminating at the proposed Compressor Station 206 site.

This additional electrical infrastructure would increase the environmental footprint associated with the Compressor Station (see Table 10.4-3 and Figure 10A-3).

Table 10.4-3
Comparison of the Environmental Impacts of Natural Gas and Electric Motor-Driven Compressor Alternatives at Compression Station 206

Factor	Unit	Compressor Station 206 – Natural Gas	Compression Station 206 – Electrical and Associated Infrastructure Required[a]
Length of transmission line	Miles	N/A	3.89
Footprint of substation[b]	Acres	N/A	0.40
Construction land requirements[c]	Acres	22.35	69.97
Operation land requirements[c]	Acres	16.73	40.73
Construction impacts on forested land	Acres	11.68	31.71

Table 10.4-3
Comparison of the Environmental Impacts of Natural Gas and Electric Motor-Driven Compressor Alternatives at Compression Station 206

Factor	Unit	Compressor Station 206 – Natural Gas	Compression Station 206 – Electrical and Associated Infrastructure Required[a]
Operation impacts on forested land	Acres	7.64	15.75
Construction impacts on wetlands (NWI)	Acres	4.24	19.51
Operation impacts on wetlands (NWI)	Acres	2.77	10.26
Number of waterbody crossings (NHD)	Count	0	0
Number of stream crossings (NHD)	Count	0	9
Number of residences within 50 feet of construction workspace	Count	0	43
Number of road crossings	Count	0	10
Number of any local, state, or federal lands, parklands, or recreational lands crossed	Count	0	10
Local, state, or federal lands, parklands, or recreational lands crossed during construction	Acres	0	4.19
Local, state, or federal lands, parklands, or recreational lands crossed during operation	Acres	0	2.08

Sources: NJDEP 2016; USGS 2016; Sources for Federal, State, and Local Lands and Recreation Lands are provided in RR 8.

[a] Note that the non-jurisdictional facilities associated with the electric motor-driven compression alternative does not represent input from the local utility company and is only presented to provide an estimate of the types of impacts that would occur.

[b] These numbers are estimates only, an actual substation size would be determined by the electric company

[c] Assumes a construction ROW width of 100 feet and an operational ROW of 50 feet

Key:
N/A = Not applicable

Transco concluded that natural gas turbine-driven compression at Compressor Station 206 is highly preferable for system reliability. Approximately 83% of the installed compression on Transco's system in the state of New Jersey is driven by electric motors. Consequently, in the event of a regional utility power outage, a significant amount of this compression would be unavailable, hindering the ability of the Transco system to make deliveries. Installing natural gas-powered compression at Compressor Station 206 increases system reliability through fuel diversity, which is particularly important in this location.

To estimate the general characterization of regional air emissions associated with generating the electricity needed to power the electric driven compressors, Transco referenced readily available emission data published by PJM Interconnection LLC (PJM 2016), which is the regional transmission organization (RTO) that manages and coordinates the movement of wholesale electricity in all, or parts of 13 states (Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia) and the District of Columbia.

PJM calculates emission factors for all generators in the PJM region on an annual basis, using PJM generation data and emission data from a number of publicly available sources including:

- EPA unit-level annual emissions from Continuous Emission Monitoring Systems for generators in the acid rain program,
- EPA Emissions & Generation Resource Integrated Database (eGRID) emission rate, and
- Fuel-type default factors.

Table 10.4-4 presents a comparison of the calendar year 2015 PJM system average for nitrogen oxide (NO_x), sulfur dioxide (SO_2), and carbon dioxide (CO_2) emission rates and the proposed natural gas powered turbines for Compressor Station 206. Annual emissions estimates presented below are based on 22,000 Kwh and 8,760 hours/year, representing an annual power demand of 192,720 Mw.

Table 10.4-4
Comparison of Regional Air Emissions associated with Electric Generation vs. the Proposed Natural Gas Powered turbines

Emission Factors	NOx	SO2	CO2
	lb/MWh		
Marginal On-Peak	1.8	3.34	1,647
Marginal Off-Peak	1.46	3.46	1,541
2015 PJM System Average [a]	0.78	1.61	1,014
Compressor Station 206 Natural Gas Turbines [b]	0.26	0.04	1,526.80
Annual Emission Estimates	**Tons per Year (TPY)**		
Marginal On-Peak	173.45	321.84	158,705
Marginal Off-Peak	140.69	333.41	148,491
2015 PJM System Average [1]	75.16	155.14	97,709
Compressor Station 206 Natural Gas Turbines [2]	22.74	3.1	130,943

[a] PJM values represent system average
[b] Potential to emit as calculated and presented in RR 9

As indicated in the table above, regional emission estimates from the proposed Compressor Station 206 are expected to be lower than emissions resulting from the equivalent electric generation from the PJM power grid.

In addition to the resources analyzed in Table 10.4-3 above, Transco also considered the noise- and air-related effects of using natural gas turbine-driven versus electric motor-driven compressors for Compressor Station 206. Electric motor-driven compressors typically produce less noise relative to natural gas turbine-driven compressors due to the absence of a combustion air inlet and exhaust noise. However, as described above in Section 10.4.2.1, the anticipated sound level during operation of Compressor Station 206 will be equal to, or lower than 55 dBA at nearby noise sensitive areas. As such, the sound levels produced by operation of natural gas turbine-driven compressors at Compressor Station 206 will meet the FERC sound level requirements.

Each Solar Mars® 100 unit will be equipped with Solar's SoLoNOx dry low NO_x combustor technology, selective catalytic reduction to reduce NO_x and an oxidation catalyst system to reduce CO and hazardous air pollutant (HAP) emissions. Based on these parameters, Transco conducted an air quality SCREEN analysis for Compressor Station 206 (see RR 9), demonstrating that the total concentration for all criteria pollutants will be less than the applicable National Ambient Air Quality Standards. Transco has applied for the necessary construction and operating permits to ensure the safe and compliant operation of the compressor station. See RR 9 for further discussion regarding air quality effects related to Compressor Station 206.

Transco determined the electric motors are not a preferred alternative for Compressor Station 206 because of the lack of a nearby electrical power source, the increased impacts associated with the installation of new electrical transmission lines, and concerns about system reliability. With respect to air quality effects of the electric compression alternative, and as indicated in the table above, emission estimates from the proposed Compressor Station 206 are expected to be lower than emissions resulting from the equivalent electric generation from the PJM power grid.

10.4.3 Compressor Station 207 to Rockaway Transfer Point Segment

The segment of the Transco system downstream of Compressor Station 207 is primarily designed to facilitate the transmission of natural gas from south of Compressor Station 207 to delivery points downstream of Compressor Station 207 and on the LNYBL. For the segment between Compressor Station 207 and the Rockaway Transfer Point, Transco evaluated multiple system alternatives that would provide the incremental Project capacity. To be considered a feasible facility alternative, the Project facilities in this segment must be capable of transporting the incremental 400,000 Dth/d Project capacity in addition to meeting existing firm shipper entitlements without causing material degradation of delivery pressures at existing delivery points.

Transco has proposed the Madison Loop and Raritan Bay Loop to meet the hydraulic requirements of the Project.

System alternatives considered for the segment from Compressor Station 207 to the Rockaway Transfer Point include combining the Lockwood Marina HDD and the Morgan Shore Approach HDD (see Section 10.4.3.1), and a compression-intensive alternative (see Section 10.4.3.2). Specific pipeline alternatives considered for the Raritan Bay Loop are discussed in Section 10.6.2.

10.4.3.1 Combined HDD Alternative

Transco evaluated an alternative pipeline configuration to combine the easternmost HDD on the Madison Loop (e.g., the Lockwood Marina HDD) and the Morgan Shore Approach HDD. Transco does not consider this a viable alternative for three reasons: (1) Transco plans to place a mainline valve as close as possible to the shoreline as an additional safety measure for the existing Class 3 and HCA locations. A mainline valve must be installed where the pipeline is near to the surface and not in a deep HDD portion. This location has been identified near the junction of the Madison Loop and Raritan Bay Loop. Combining the Morgan Shore Approach HDD with the Lockwood Marina HDD would require the valve to be located farther inland, away from the intended location near the shoreline. (2) Transco is currently proposing to integrate CP for the Raritan Bay Loop by installing a power cable and anode sled, which would also be installed via HDD from the start of the Raritan Bay Loop. Relocating the start point of the Morgan Shore Approach to the west would prevent the CP cable from being integrated into the pipeline system at the beginning of the Raritan Bay Loop near the shoreline and would require additional CP length installed to connect to the pipeline approximately 0.5 mile to the west. (3) While the conceptual length of approximately 1 mile of the combined HDD may be technically feasible in the expected soil conditions, numerous factors lead Transco to pursue the two separate HDDs. Specifically, Transco identified increased risks associated with the added duration of offshore assets, increased workspaces and logistically issues needed for the increased length of pullback string offshore, added offshore pit volume excavation and associated increased drilling fluid volume offshore, and increased horizontal curvature into the HDD alignment to maneuver the pipeline between the entry and exit pits.

10.4.3.2 Compression-Intensive Alternative

Transco considered two compression-intensive alternatives to the Madison and Raritan Bay Loops. First, Transco considered whether adding additional compression at Compressor Station 207 alone would be an alternative to the construction of the Madison and Raritan Bay Loops and found that it is not a feasible hydraulic design alternative. Adding additional horsepower at Station 207 alone is not a feasible alternative because, even if Compressor Station 207 discharges at the MAOP of the pipeline, the increased pressure drop caused by the Project volumes would not allow for the existing and incremental Project volumes to be delivered without additional facilities downstream of Compressor Station 207.

While upgrading Compressor Station 207 alone is not an option, the Project objectives could be met by a compression-intensive alternative including a new compressor station downstream of Compressor Station 207. This alternative would consist of increasing the horsepower at Compressor Station 207 from 26,400 hp to 52,900 hp in combination with the construction of a new offshore compressor station platform in Lower New York Bay at MP35.49, just upstream of the Rockaway Transfer Point.

Transco's modeling determined that an offshore compressor station in the Lower New York Bay would require approximately 180,000 ISO hp of compression, which could be provided by six Solar Titan 250 compressor units (30,000 ISO hp each) or an equivalent amount of electrical compression. Constructing a large offshore compressor station in the offshore environment would result in permanent impacts on marine traffic, conflicts with commerce, the construction of a large permanent offshore structure, and greater long-term impact to existing offshore natural resources. Due to the amount of horsepower required, operating the offshore compression alternative would also result in significantly greater air emissions than the proposed looping.

In addition to the increased impacts, an offshore compressor station would also be less reliable than the proposed loops because it would be vulnerable to outages due to storms, marine accidents, or third-party damage. Furthermore, an outage on the Lower Bay Loop C or LNYBL downstream of Compressor Station 207 would result in complete disruption of deliveries to the Rockaway Transfer Point, whereas the operation of the proposed Raritan Bay Loop and the LNYBL would allow natural gas to be delivered in case of an outage on the adjacent line. For the reasons listed above, Transco has rejected the compression-intensive alternative as a viable alternative to the Project and construction of the pipeline facilities.

10.4.4 Transco System Alternatives Conclusion

Using hydraulic modeling, Transco was able to evaluate where additional compression and looping would be required to provide 400,000 Dth/d of natural gas to the Rockaway Delivery Point, as required by National Grid. Transco evaluated alternatives for compression-intensive or looping-intensive for three segments: Compressor Station 195 to Compressor Station 205; Compressor Station 205 to Market Area; and Compressor Station 207 to Rockaway Transfer Point. Based on the analysis provided, these alternatives to the proposed Project would not meet the Project purpose and/or result in more environmental impacts.

10.5 Third-Party System Alternatives

Non-Transco system alternatives would make use of other existing or proposed natural gas facilities to meet the stated objectives of the Project. A system alternative would make it unnecessary to construct all or part of the Project, although some modifications or additions to an existing or proposed system may be necessary. These modifications could result in environmental and/or socioeconomic impacts that could be less than, similar to, or greater than those associated with the Project. The reason for identifying and evaluating third-party system alternatives is to determine whether potential environmental impacts associated with the siting and operation of the Project could be avoided or reduced by using another system. As presented in Sections 10.3 (alternative Energy Sources) and 10.4 (Transco System alternatives) above, in order to be a viable alternative, potential system alternatives must meet the following criteria:

- Capable of transporting up to 400,000 Dth/d of natural gas to the Rockaway Transfer Point, as required by National Grid, without negatively impacting service to existing customers;
- Capable of being constructed in time to meet the peak demand projected for the 2019/2020 heating season; and
- Able to meet the criteria above with an environmentally superior alternative relative to the Project.

Transco considered two viable system alternatives: (1) using or expanding existing third-party transmission pipelines to reroute and deliver an equivalent amount of natural gas to the Rockaway Transfer Point and (2) using proposed liquefied natural gas (LNG) facilities to deliver an equivalent amount of natural gas to the Rockaway Transfer Point to meet the purpose of the Project. These system alternatives are discussed in Sections 10.5.1 and 10.5.2, respectively.

10.5.1 Existing Pipeline Systems

Table 10.5-1 summarizes the existing interstate pipelines that serve the region (i.e., the downstate New York–northern New Jersey market), their capacities, and average operating pressures. Figure 10A-4 identifies the locations of the major interstate pipelines serving the region and the major local distribution systems. Three regional interstate natural gas transmission systems offer direct access to New York City: Iroquois Gas Transmission, Texas Eastern Transmission, and the Transcontinental Gas Pipe Line. Other pipelines discussed in this section serve the Northeast, but new pipeline would be required for each of these to deliver natural gas to the service territory. Each of these pipelines and their potential suitability as an alternative means of providing up to 400,000 Dth/d of natural gas delivery to the National Grid system at the Rockaway Transfer Point beginning with the 2019/2020 heating season are discussed in the sections below. Mileage estimates required for system alternatives to deliver natural gas to the Rockaway Transfer Point were based on the point on the existing systems nearest to the Rockaway Transfer Point.

Table 10.5-1
Third-Party Interstate Pipeline Systems Serving the Region

Pipeline	Average psig	Pipeline Capacity in the Region as of 2015 (MMscf/d)	Facility (Pipeline or M&R) Location Closest to Rockaway Transfer Point
Algonquin Natural Gas Transmission	750	1,475	Morristown, NJ
Columbia Gas Transmission	650	261	East Hanover, NJ
Millennium Pipeline[a]	N/A	525	New City, NY
Texas Eastern Transmission	1,102	1,500	Staten Island, NY
Iroquois Gas Transmission	1,440	520	Hunts Point, NY
Tennessee Gas Pipeline	800	377	Palisades, NJ

Sources: Capacity from EIA 2015. Pressures and capacities from EIA 2009.

[a] The Millennium Pipeline was placed into service in 2008. Therefore, average pressure in the region as of 2007 is not available for these systems.

Key:
MMscf/d = One million standard cubic feet per day.
N/A = Not available
psig = Pounds per square inch

10.5.1.1 Algonquin Natural Gas Transmission System

The Algonquin natural gas transmission system is an approximately 1,100-mile long interstate pipeline system interconnecting with the Texas Eastern system in New Jersey and the Maritimes & Northeast system in Massachusetts to bring natural gas supplies to the greater New

England area. At its eastern terminus, Algonquin's HubLine in Massachusetts Bay is tied into the Northeast Gateway Deepwater Port LNG facility, addressing the need for additional natural gas supplies for the greater Boston area. The location of the Algonquin system and its interconnects with other systems make it suitable for providing natural gas supplies to the New England market but preclude it from feasibly addressing the purpose and need for this Project. The current Algonquin system has no direct connection to the National Grid system in New York City, and its closest pipeline facility—near Morristown, New Jersey—is more than 30 miles from the proposed interconnect with National Grid (see Figure 10A-4) and is separated from the Rockaway Transfer Point by the urban New York/New Jersey metropolitan area.

Access to the Rockaway Transfer Point from the closest existing M&R station in Morristown, New Jersey, would require substantive system upgrades and infrastructure changes to the existing Algonquin system. Without considering the need for additional looping or compression on the Algonquin system to handle the increased volumes, expansion of the Algonquin system would include, at a minimum, approximately 20 to 30 miles of new onshore pipeline on new ROW through New Jersey and New York, with mileage depending on whether a shore approach was via Staten Island or New Jersey. Additionally, expansion of the Algonquin system would require an offshore pipeline similar to the Project.

Expansion of the Algonquin pipeline system to address the purpose and need for the Project would require constructing substantially more miles of pipeline on new ROW than the Project, resulting in more extensive impacts within densely developed residential and commercial areas of New Jersey and New York. This extensive construction would result in greater impacts and would likely result in timeline delays for the in-service date, and thus it does not meet the identified criteria and is not considered a viable alternative to the proposed Project.

10.5.1.2 Columbia Gas Transmission System

The Columbia Gas Transmission system is among the largest interstate natural gas pipeline systems operating in the northeastern United States, with nearly 12,000 miles of pipeline, much of which is located in the Appalachian region. The system interconnects with the Columbia Gulf Transmission system in Kentucky and delivers natural gas to ten states in the Northeast, including New York.

As with the current Algonquin system, the Columbia system has limited connectivity to the New York City markets, and its closest M&R station lies in East Hanover, New Jersey (see Figure 10A-4). To meet the objectives of the Project, the Columbia system would require a substantial system expansion to provide natural gas to National Grid, including onshore construction of new pipelines through New Jersey and New York City, and an HDD crossing of the Narrows. The existing Columbia Gas Transmission line is more than 30 miles to the northwest of the proposed connection point and it would require extensive construction through densely developed residential and commercial areas of New Jersey and New York to meet the purpose and need of the Project, thereby creating substantial socioeconomic and environmental impacts.

Expansion of the Columbia Gas Transmission system to address the purpose and need for the Project would result in greater impacts than the Project, and also would result in timeline delays for the in-service date; thus, it does not meet the identified criteria and is not a viable alternative to the Project.

10.5.1.3 Millennium Pipeline

The Millennium Pipeline system is relatively new, having been built in 2008 to replace the Columbia system in southern New York. The system receives supplies from the Empire State pipeline system in southwest-central New York and transports these to the New York City market. While the pipeline system lies entirely within New York State, it is still regulated by FERC as an interstate pipeline. The Millennium pipeline system ties in with the Algonquin system near Rockland, New York, and terminates shortly thereafter.

The Millennium Pipeline system’s closest M&R station is in New City, New York, more than 30 miles to the north and slightly east of the Rockaway Transfer Point. Expansion of the Millennium pipeline system would require constructing a new pipeline through dense residential and commercial areas of New York City. Additionally, substantial system upgrades to accommodate the additional 400,000 Dth/d of natural gas delivery would be needed (see Figure 10A-4).

Expansion of the Millennium Pipeline system to address the purpose and need for the Project would result in greater socioeconomic and environmental impacts than the Project and would result in timeline delays for the in-service date, and so it does not meet the identified criteria and is not a viable alternative to the proposed Project.

10.5.1.4 Tennessee Gas Pipeline

The Tennessee Gas Pipeline system is an extensive interstate pipeline system consisting of approximately 13,600 miles of pipeline bringing incremental natural gas supplies from the Gulf, Appalachian, and Canadian regions into the Midwest and Northeast. As with the Algonquin system, the Tennessee system is a key supplier of natural gas to the New England region, crossing from northern Pennsylvania through southern New York and into Connecticut.

The Tennessee Gas Pipeline system's closest M&R station in Palisades, New Jersey, is approximately 40 miles north of the Rockaway Transfer Point (see Figure 10A-4). To address the purpose and need of the Project, major system upgrades would be needed, including constructing a new pipeline through densely developed residential and commercial areas in New York City and constructing offshore pipeline in high vessel-transit areas.

Expansion of the Tennessee Gas Pipeline system to address the purpose and need for the Project would result in greater impacts than the Project and would result in timeline delays for the in-service date, and thus does not meet the identified criteria and is not a viable alternative to the proposed Project.

10.5.1.5 Iroquois Gas Transmission System

Only three regional interstate natural gas transmission systems offer direct access to New York City: Iroquois Gas Transmission, Texas Eastern Transmission, and Transco. In contrast to all of the other regional systems, the Iroquois system provides a link to Canadian natural gas supplies through an interconnection with TransCanada Pipelines in northern New York. The Iroquois system monitors deliveries into the New York City metropolitan area through three M&R facilities in the region (see Figure 10A-4). Two M&R facilities (South Commack and Northport) are located in Suffolk County and provide supplies to National Grid's Long Island system. The third station, located near Hunt's Point in the Bronx, delivers supplies directly to Con Edison's (ConEd) New York City system.

Although the use of the Iroquois system (as of 2007) was not at full capacity, this does not necessarily indicate that there is unreserved capacity on a long-term basis that would be available to meet the purpose of this Project, as the low average utilization may be a result of seasonal variations in demand (EIA n.d.).

Expansion of the Iroquois system from the closest M&R facility in Hunt's Point to the Rockaway Transfer Point would necessitate installing an approximately 40-mile pipeline, about half of which would be sited in densely developed residential and commercial areas in Brooklyn and Queens as well as 3 miles of offshore pipeline. Alternately, expansion of pipelines from either of the two M&R facilities in Suffolk County would result in approximately 40 miles of new ROW through highly urbanized areas of Long Island and New York City and 3 miles of offshore pipeline, greatly increasing environmental and socioeconomic impacts. Given that the Project will be able to minimize environmental and socioeconomic impacts by co-locating within an existing ROW, these impacts are minimal compared with the extensive impacts that would result from construction of a new ROW within the densely developed residential and commercial areas of Brooklyn, Queens, and Suffolk County.

Expansion of the Iroquois Gas Transmission pipeline system to address the purpose and need for the Project would result in greater impacts than the Project and would result in timeline delays for the in-service date, and thus does not meet the identified criteria and is not a viable alternative to the proposed Project.

10.5.1.6 Texas Eastern Transmission

Texas Eastern is a long-haul interstate transmission pipeline system offering direct access to New York City. The Texas Eastern system consists of approximately 8,700 miles of pipeline that delivers natural gas from the Gulf Coast and Texas into the New York City metropolitan area (see Figure 10A-4).

The expansion of the Texas Eastern pipeline to the tie-in to the Rockaway Transfer Point would be possible from the terminus of the Texas Eastern pipeline on Staten Island. However, this would require constructing a new pipeline through densely developed residential and commercial areas on Staten Island and approximately 15 miles of offshore pipeline. It is expected that this expansion would have greater environmental and socioeconomic impacts than that resulting from the Project. Additionally, expansion from the Staten Island terminus may include potential impacts on estuarine and freshwater wetlands on the western side of Staten Island that are part of the New York State Forever Wild Program. Forested upland parks on Staten Island may also be impacted by such an expansion. Additional upgrades upstream on the Texas Eastern system, such as pipeline looping and the addition of compression that would also result in impacts, may also be needed to allow the delivery of the natural gas volumes required by the Project. Expansion of the Texas Eastern system to address the purpose and need for the Project would result in greater impacts than the Project and would result in timeline delays for the in-service date, and thus does not meet the identified criteria and is not a viable alternative to the proposed Project.

10.5.2 Proposed LNG Facilities

In the past 10 to 15 years, growing energy demand has resulted in LNG being considered economically viable as a new natural gas supply for the region. However, the recent expansion of natural gas production in the Utica and Marcellus Shale formations, as well as other formations throughout the U.S., have created an oversupply situation in the U.S., which is now driving the development of LNG export facilities (versus the construction of import facilities). LNG is also viewed as a potential new source of natural gas to serve high-demand areas along the coasts, including Massachusetts, Connecticut, Rhode Island, New Jersey, and New York, particularly considering the constraints on the pipeline transportation systems that occur throughout the northeastern U.S. On January 28, 2015, NYSDEC announced the adoption of regulations that would enable the permitting of new LNG facilities in New York. These new regulations reflect some of the nation's most stringent associated with LNG permitting (NYSDEC 2015).

According to FERC, only one LNG facility was planned or proposed in the vicinity of the Project's service territory as of April 18, 2016 (FERC 2016b). The Liberty Natural – Port Ambrose LNG facility was intended to serve as a deepwater import station for LNG and was to be located in the federal waters of the Atlantic Ocean off the coasts of New York and New Jersey. However, on November 12, 2015, New York Governor Andrew M. Cuomo denied the Liberty Natural – Port Ambrose deepwater port license application. The application denial was based on concerns related to security risks, impacts of extreme weather events, disruption of commercial navigation and fishing activities, and potential interference with a proposed offshore wind energy project (State of New York Executive Chamber 2015). As a result, Liberty Natural withdrew its license application and terminated the federal review process thereby ending any further actions and future development of the project (Federal Register 2015b).

Currently, no other planned or proposed LNG facilities have been identified in the region that could meet the Project purpose and need.

10.5.3 System Alternatives Conclusion

The expansion of any other existing pipeline systems would require additional pipeline as well as additional system upgrades such as added looping and/or compression. Many of the existing systems would require new pipe to be installed through highly developed areas in New York City and the surrounding suburbs and/or sensitive natural resources in order to tie into the service territory. A significant portion of the Project will occur offshore or will be co-located onshore within existing pipeline ROW and will thus avoid the densely developed areas of New York, New Jersey, and Pennsylvania, as discussed above. Moreover, no LNG facilities are currently being proposed that could meet the Project needs, so expansion or connection to LNG facilities is a nonviable option. Because of the geographic, economic, regulatory, environmental, public safety, and security concerns associated with expanding existing systems and their inability to meet the in-service timeline, none of these system alternatives present an environmental advantage to the Project and would not meet the purpose and need established for the Project.

Because the Project will provide the required volumes of natural gas to serve the peak demand projected to begin in the 2019/2020 heating season in National Grid's service territory while reducing environmental and socioeconomic impacts, Transco has deemed it the preferred alternative.

10.6 Pipeline Route Alternatives

Transco considered various route alternatives for both the onshore and offshore pipeline facilities, presented in Section 10.6.1 and 10.6.2, respectively. A route alternative is considered a linear segment of pipeline that follows an alignment separate from the proposed pipeline alignment. Transco evaluated alternatives to determine if the Project's purpose and need could be met while avoiding or minimizing potential adverse environmental impacts to the greatest extent practicable, and be consistent with the Commission's guidelines as set forth in 18 Code of Federal Regulations 380.15.

10.6.1 Onshore Pipeline Route Alternatives

When identifying routing alternatives for the onshore pipeline facilities, Transco attempted to co-locate the Project facilities with existing utility corridors and ROWs. The use of co-location as a principal design element, which is consistent with the Commission's guidelines, stresses the corridor concept and complements the existing land use characteristics in the Project area. Siting pipeline facilities along existing corridors reduces the need to establish new corridors in previously undisturbed areas and for onshore pipelines, minimizes the number of affected landowners.

Transco defines co-locating as siting a pipeline ROW within an existing ROW or easement or that abuts an existing ROW or easement. Typically, deviations from these corridors result in additional construction impacts, additional installation costs, and additional operating procedures (e.g., two separate ROWs to maintain instead of one). Pipeline loops are usually shorter and more efficient hydraulically than deviations because of their placement adjacent to the existing pipeline. The proposed routes of the Quarryville and Madison Loops are co-located with existing Transco pipeline ROWs.

Transco considered requests for route modifications and requests for the evaluation of different alternatives for both pipeline facilities and additional temporary workspaces (ATWSs) by landowners and stakeholders, including regulatory agencies, through outreach (see Volume 3, Agency Correspondence). In response to comments, Transco also evaluated the feasibility of reducing impacts on forested land between MP1681.94 (Silver Spring Road) and MP1682.18 of the Quarryville Loop. ATWS LA-011 was removed per landowner request, and negotiations with the landowner are ongoing.

At this time, Transco has not identified any factors that would necessitate alternative routing on the Quarryville and Madison Loops and, as such, no route alternatives have been considered.

10.6.2 Offshore Pipeline Route Alternatives

Transco considered a number of route alternatives for the offshore segment of the Raritan Bay Loop within the area that would connect the tie-in at MP12.00 of the LNYBL, downstream of Compressor Station 207, and to Rockaway Transfer Point. Transco identified eight routing alternatives, including seven offshore, and one predominately onshore alternative.

As shown on Figure 10A-5, each alternative was developed to either take advantage of existing infrastructure, avoid specific environmental resources or engineering constraints either identified by Transco or resource agencies, or optimize crossings of existing navigation channels. These considerations were also used to evaluate the alternatives, and determine the route that minimizes logistical and engineering, and environmental constraints, and also minimizes conflicts with other marine uses/users.

Criteria used to evaluate the alternatives are described in more detail in Sections 10.6.2.2 (Logistical and Engineering Constraints), 10.6.2.3 (Environmental Constraints) and 10.6.2.4 (Marine Uses/Users Conflicts). A discussion of each of the siting alternatives is presented in Section 10.6.2.4. Table 10.6-1 presents a summary comparison of the siting alternatives.

10.6.2.1 Control Points

The overriding consideration in the siting, permitting, construction, operation, and maintenance of the Raritan Bay Loop is ensuring protection of public health, safety, and the environment. Other considerations, including regulatory compliance, environmental factors, engineering design feasibility, and construction feasibility are critical in identifying and evaluating alternatives. Siting requires balancing a variety of considerations. Some factors are constraints that prevent the siting of a pipeline in a specific area offshore within Raritan and Lower New York Bay, while other factors influence route selection and require the application of best professional judgment.

Before applying siting criteria, Transco first defined a siting envelope as defined by two control points within which alternatives to the proposed Raritan Bay Loop could be identified. The siting envelope was built based on National Grid's need for an additional 400,000 Dth/d of incremental firm transportation capacity delivered to the Rockaway Transfer Point (see RR 1, Section 1.1.1). The Rockaway Transfer Point therefore, served as the primary control point for the Raritan Bay Loop. Based on the design of Transco's existing pipeline infrastructure, a tie-in to the Transco system at existing MP12.00 of the LNBYL, downstream of Compressor Station 207, was identified as the only practicable control point to define the siting envelope (see Section 10.4 above for a discussion of Transco's system).

While any number of routing alignments could be created between the two control points for the offshore portion of the project, Transco identified eight unique routing alternatives (described below) between the tie-in at existing MP12.00 and the Rockaway Transfer Point that present the range of potential alignments considered available to Transco (see Figure 10A-5).

Following preliminary screening of siting alternatives, Transco identified two feasible alternatives: Alternative 6 and 8. A secondary screening process was conducted to evaluate these two alternatives, as discussed in Section 10.6.2.5. Ultimately, Transco selected Alternative 6 as the preferred route for the Raritan Bay Loop.

10.6.2.2 Siting Criteria: Logistical and Engineering Constraints

A number of user logistical and engineering constraints exist within Raritan Bay and the Lower New York Bay that directly affect the design of the Project. Transco considered the following criteria, which reflect constraints that would be problematic for construction of a pipeline, and result in increased time and associated impacts for in-water construction.

Anchorage Areas

Anchorage areas are areas designated for anchorage of deep-draft vessels. Transco consulted with the United States Coast Guard (USCG) Harbor Safety Navigation and Operations Committee Energy Subcommittee (Harbor Ops Energy Subcommittee), and the U.S. Army Corps of Engineers (USACE) regarding user conflicts and regulatory requirements within designated anchorage areas to better understand the logistical and engineering constraints.

According to Harbor Ops Energy Subcommittee and the USACE, the presence of the pipeline in anchorage areas should be avoided to the extent possible, but, if necessary, a pipeline sited in these areas would be required to be buried at greater depths below the seafloor to limit the potential for an anchor and pipeline interaction. The requirements for deeper pipeline burial restricts the number of options for the construction vessel and pipeline lowering method that may be used. USACE would require that the minimum depth of cover be 7 feet over the pipeline in designated anchorage areas, while outside of designated anchorage areas, a minimum depth of cover of 4 feet would be required from the top of the pipeline.

Due to the greater trench width and increased volume of dredged material and associated water quality impacts generated in the excavation of a deeper trench, the impacts on the marine environment will increase as the depth of cover requirements increase. In addition, with deeper excavation depths, construction duration is expected to increase, resulting in increased offshore vessel emissions during construction and a longer duration of marine user conflicts during construction. Since both construction and environmental impacts would increase with presence in an anchorage area and the need for a deeper trench, Transco considered siting alternatives that would minimize the pipeline crossing length in anchorage areas to the extent possible. Figure 10A-6 shows the constraints described above.

Submarine Cable/Utilities

The presence of cables, pipelines, or other linear utilities present seabed obstructions that impose installation risks during pipelay, pre-trenching, and post-burial operations. Crossings of these facilities increase both construction and environmental impacts as additional workspace and/or excavation is required to ensure the integrity of existing infrastructure. The presence of buried utilities also place high demands on the accuracy and positioning of construction equipment, including HDD equipment, and operations.

In addition, routing alternatives were considered in terms of the crossing angle of the submarine cables and utilities. Ideal utility crossing angles are as close to perpendicular as possible, which reduces the overall distance of the crossing and minimizes disturbance of the existing utility. The crossing angle facilitates a reduction in crossing length and allows reduced construction times, which in turn minimizes potential conflict within the active navigation area and reduces the potential for affecting active utilities. Figure 10A-6 shows the constraints described above.

Navigation Channels

The presence and orientation of active navigation channels creates greater logistical coordination during construction and also creates conflict with active use of the channel. Transco considered siting alternatives that would minimize the impact on navigation channels to the extent practicable. Routing alternatives were considered in terms of the crossing angle of the navigation channel. Ideal navigation channel crossing angles are as close to perpendicular as possible, which reduces the overall distance of the crossing and minimizes the duration of construction within the channel. Figure 10A-6 shows the constraints described above.

10.6.2.3 Siting Criteria: Environmental Constraints

In addition to the logistical and engineering constraints, a number of environmental constraints exist within Raritan Bay and the Lower New York Bay, as identified through literature review, agency outreach, and Transco's experience operating the LNYBL. Transco considered the following constraints when selecting a preferred alternative for the Raritan Bay Loop.

Metocean Conditions

Prevailing meteorological and oceanic conditions, including subsea currents that could cause erosion and/or depositional processes, can affect the seafloor near the pipeline. Of particular concern is the Sandy Hook dynamic shoreline. The National Oceanic and Atmospheric Administration (NOAA)-designated Sandy Hook dynamic shoreline introduces constructability and technical issues associated with pipeline installation in the environment around Sandy Hook. Sandy Hook is a sand spit approximately 10 miles long and is growing northward via littoral drift (Caldwell 1966). Sandy Hook's primary recreational beach spit has eroded at rates of 10 meters per year since 1953 and 23 meters per year in the 1970s (Allen 1981; NPS n.d.). Sediment sinks along the longshore sediment transport result when sediment is diverted from the longshore current either onshore causing shoreline accretion or when diverted offshore creating shoreline erosion. Allen (1981) used aerial photographs taken from 1953 to 1976 to track shoreline accretion, compared those estimates to dredging records of the shipping channel and conducted nearshore field measurements of sediment movement, in addition to utilizing sediment transport computer models to confirm the longshore transport rates. This showed a beach growth of approximately 139,000 cubic meters per year and suggested an offshore transport of 167,000 cubic meters per year. However, the growth of the spit is slowed by the dredging of the Sandy Hook Channel, located immediately north and east of Sandy Hook. Figure 10A-6 shows the constraints described above.

Sand waves in this vicinity suggest a dynamic environment, and the strong bottom currents in this area and changing sediment deposition pattern could lead to pipeline exposure and spanning. As such, avoiding Sandy Hook would minimize construction challenges and enhances the long-term integrity of the pipeline related to maintaining adequate cover during backfilling activities and operation.

Geological Hazards and Mapped Obstructions

Other geological hazards that can be problematic for construction of the pipeline include seafloor gradients, varying water depth, and the presence of glacial drift, which can include boulders (outcropping rocks) and/or rocky substrates. Seafloor gradients (resulting from the presence of borrow pits as well as related to existing natural seafloor contours) can introduce spans to pipelines, raise concerns about pipeline instability, and can be a contributing factor for instability of the sediments on the slope itself. The presence of boulders and rocky substrates from glacial drift can also cause spans, reduce pipe embedment, reduce pipeline slope stability, reduce or prevent trenching and burial, and damage pipeline coatings.

Transco also identified the presence of shipwrecks, National Register of Historic Places (NRHP) mapped resources, and other marine obstructions; however, these factors did not differentiate between Transco's identified alternatives. Figure 10A-6 shows the constraints described above.

Shellfish Beds

Based on review of available data and state agency communications (see RR 3), shellfish beds are prevalent throughout much of Raritan Bay, Lower New York Bay, and the Atlantic Ocean near the Rockaway Peninsula. Current and/or future harvest of these shellfish resources is conditionally permitted in several areas within both New York and New Jersey waters. While it is not possible to avoid these resources, Transco looked to minimize impacts to the extent practicable.

In addition Transco identified sport fishing grounds crossed by the routes. However, as Transco will coordinate with maritime and fishing community, the presence of these fishing grounds did not differentiate between Transco's identified route alternatives. Figure 10A-6 shows the constraints described above.

10.6.2.4 Siting Criteria: Marine Uses/User Conflict

To further understand the marine uses and user concerns within Raritan and Lower New York Bays, Transco consulted with several permitting agencies and stakeholders. Initially, Transco consulted with the USACE (New York District), the USCG and Harbor Ops Energy Subcommittee, NYSDEC, the NJDEP, the Port Authority of New York and New Jersey, NOAA Fisheries Services, NYSDOS, NY/NJ Baykeeper, Clean Ocean Action, the Natural Resources Defense Council (NRDC), and Bayshore Watershed to introduce the Project, discuss design goals, and to gain insight to agencies, stakeholders, and non-governmental organizations (NGOs) that may have an interest in the Project. See Volume 3, Agency Correspondence, for a complete compilation of consultations.

As the Project design evolved, Transco routinely consulted with the USACE and Harbor Ops Energy Subcommittee to discuss the conditions associated with alternatives to traversing anchorage areas. Transco also regularly consulted with NYSDEC's Marine Resources Group to discuss impacts on shellfish resources. Alternative 8 was specifically identified and presented by NYSDEC with the intent of reducing impacts on shellfish areas of concern.

10.6.2.5 Preliminary Siting Alternatives

Transco considered the logistical and engineering constraints, environmental constraints, and marine uses and user conflicts described above when evaluating alternatives for the offshore segment of the Raritan Bay Loop. The potential impacts associated with each alternative are discussed below and summarized in Table 10.6-1.

Six of the eight routes were eliminated due to a combination of engineering, environmental, and marine user conflict constraints. These six are discussed in this section. Further analysis was required to differentiate the two remaining alternatives (Alternative 6 and Alternative 8), and these are discussed in Section 10.6.2.6.

Table 10.6-1
Comparison of Alternative Routes for the Raritan Bay Loop

Factor	Unit	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8	
		NJ	NY	NJ	NY	NJ	NY	NJ	NY	NJ	NY	NJ	NY	NJ	NY	NJ	NY
Total Length	Miles	17.85	4.20	14.12	7.81	13.76	8.26	1.94	20.42	1.94	23.52	6.11	17.38	26.93	3.61	6.02	17.40
Offshore Length	Miles	17.69	4.20	13.96	7.81	13.60	8.26	1.82	20.42	1.82	23.52	5.95	17.38	9.45	3.61	5.86	17.40
Onshore Length[a]	Miles	0.16	0.0	0.16	0.0	0.16	0.0	0.16	0.0	0.16	0.0	0.16	0.0	17.49	0.00	0.16	0.0
Number of HDDs	Count	3		2		2		2		2		2		2		2	
Roadways Crossed	No.	3	-	3	-	3	-	3	-	3	-	3	-	186	-	3	-
Anchorage Zones Crossed	Miles	0	0	5.45	0	5.45	0	0	0.77	0	0	0	0.76	3.15	0	0	1.70
Submarine Cable/Utility Crossings[b]	No.	4	0	3	0	3	0	1	2	1	2	1	1	8	0	1	1
Navigation Channels Crossed	No.	3	0	3	0	3	0	0	3	0	3	1	2	1	0	0	3
Areas of outcropping Rocks within 1,000 feet of Pipeline	No.	3		3		2		0		7		3		1		3	
Wrecks within 0.5 mile of Pipeline[c]	No.	3	0	3	1	3	1	0	5	0	4	1	2	5	1	1	2
Cultural Resources (NRHP) within 1 mile of Pipeline	No.	1	0	0	1	0	1	0	2	0	1	1	2	5	0	1	2
AWOIS and ENC Offshore Obstructions within 0.5 mile of Pipeline[c]	No.	4	1	3	1	2	1	0	13	0	11	2	3	7	1	2	5

Table 10.6-1
Comparison of Alternative Routes for the Raritan Bay Loop

Factor	Unit	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8	
		NJ	NY	NJ	NY	NJ	NY	NJ	NY	NJ	NY	NJ	NY	NJ	NY	NJ	NY
NJDEP Hard Clam Relative Abundance - Low	Miles	1.56	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
NJDEP Hard Clam Relative Abundance - Moderate	Miles	0.19	-	2.02	-	2.02	-	0.0	-	0.0	-	0.0	-	0.22	-	0.0	-
NJDEP Hard Clam Relative Abundance - High	Miles	11.25	-	7.29	-	7.29	-	1.86	-	1.86	-	1.92	-	0.0	-	1.92	-
NJDEP Surf Clam Relative Abundance	Miles	2.59	-	2.28	-	2.26	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-
NJ and NY Sport Fishing Areas[d]	Miles	1.62	0.62	1.40	0.62	1.10	0.88	1.10	0.88	0.0	0.44	0.99	0.82	7.04	0.36	0.99	0.82

Source: U.S. Department of Commerce 2014; NJDEP 2000; USGS 2012.

[a] Pipeline length includes 0.16 mile onshore (HDD entry point to the shoreline).

[b] Existing linear infrastructure crossed includes Neptune Cable and Long Island Power Authority transmission lines. Other active or inactive cables may be crossed by the above routes. Evaluation currently ongoing.

[c] Obstructions/wrecks were taken from the AWOIS database.

[d] Data layer is taken from NJ metadata but includes areas in NY that have been included in this table. Length reported reflects distance crossed by the alternative route centerlines and not the Project workspaces.

Key:
AWOIS = Automated Wreck and Obstruction Information System
ENC = Electronic Navigation Chart
HDD = horizontal directional drill
NRHP = National Register of Historic Places

Alternative 1

Alternative 1 (see Figure 10A-7) is sited parallel to, or nearly so, to the existing 26-inch Transco LNYBL pipeline to optimize co-location of existing Transco facilities. Consistent with the current LNYBL alignment, Alternative 1 was configured to cross the intersection of the Raritan Bay, Chapel Hill, and Sandy Hook channels (via HDD) to minimize individual channel crossings and impacts on navigation in Raritan Bay. Alternative 1 also is located south of and outside of designated anchorage areas and avoids the need to cross the Neptune Cable, a buried high-voltage direct current electric cable line that runs between New Jersey and New York. This cable generally follows the alignment of Transco's existing LNYBL system. Alternative 1 passes just north of the NOAA-designated Sandy Hook dynamic shoreline. Transco anticipates that construction of the route would require a total of three HDDs, two of which would be water-to-water HDDs.

Transco did not select this alternative because the currents north of Sandy Hook are actively eroding the Sandy Hook channel northwards and could result in complications related to the installation and maintenance of the pipeline. Furthermore, Transco did not select this alternative for the following additional reasons:

- The need for two water-to-water HDDs increases construction duration and risk.
- The need for an HDD at the intersection of the Sandy Hook, Chapel Hill, and Raritan Bay channels increases the time needed for in-water construction; the HDD staging areas would be subject to more dynamic sea conditions north of Sandy Hook; and the increased length of the HDD introduces additional construction risks.
- The route's proximity to the existing LNYBL pipeline and Neptune Cable introduced engineering constraints, and increases the risks associated with construction and safety. Transco's LNYBL is a primary source of natural gas in National Grid's distribution system, and disruption of the existing service would have significant consequences for National Grid's ability to maintain its base service load.

Alternative 2

Alternative 2 (see Figure 10A-8) was developed to reduce construction risk by (1) reducing immediate proximity to the existing LNYBL; (2) proposing two trenched channel crossings of the Raritan and Chapel Hill navigation channels instead of a long HDD at the convergence of three channels; and (3) avoiding the area north of Sandy Hook, which is a dynamic environment and subject to scour. This route was developed in response to analysis, which indicated co-locating with the existing LNYBL would result in engineering constraints and construction risks that could otherwise be avoided. Alternative 2 is sited north of the LNYBL and is not co-located with the existing pipeline; instead, the offset of Alternative 2 ranges from approximately 232 to 6,889 feet north of the LNYBL. By proposing two open-cut navigation channel crossings, Alternative 2 would require only one water-to-water HDD and one land-to-water HDD.

Alternative 2 crosses designated anchorage areas for 5.45 miles, which was the primary reason the route was not selected as the preferred alternative. During preliminary meetings, the USACE noted that a cover depth of 7 feet is required for burial of the pipeline in anchorage areas. To achieve burial depth of 7 feet, Transco would need to excavate trench depth to approximately 10.5 feet, resulting in an estimated 185% increase in area and volume relative to the standard 4-foot cover depth. Additionally, in-water construction time would almost double as depth of cover increased from 4 feet to 7 feet. Given the increases in dredged materials volume and in-water construction duration, the impacts on water quality, sediment disturbance, emissions, and the potential to impact navigation and commerce would greatly increase.

Furthermore, Transco did not select this alternative because it crosses the Raritan Bay and Ambrose Channel, as well as the Neptune Cable, at angles that are not ideal and could result in greater long-term impacts on navigational traffic and subsea cables.

Alternative 3

Alternative 3 (see Figure 10A-9) was developed to reduce risk near existing infrastructure by shifting the proposed line farther away from the Neptune cable from north of Sandy Hook to near the Rockaway Transfer Point. In addition to increasing separation, Alternative 3 avoids the need to simultaneously HDD the Ambrose Channel and Neptune Cable.

Alternative 3 crosses designated anchorage areas for 5.45 miles, which was the primary reason that this alternative was not selected. As stated previously, deeper burial would be required in these areas, and water quality impacts, sediment disturbance, emissions, and long-term impacts on navigation and commerce would increase. Furthermore, Transco did not select this alternative because Alternative 3 also crosses the Raritan Bay Channel, Ambrose Channel, and the Neptune Cable at angles that are not ideal and could result in greater impacts on navigational traffic and subsea cables.

Alternative 4

Alternative 4 (see Figure 10A-10) was designed to reduce conflicts with, and crossings of, anchorage areas. Alternative 4 is 22.36 miles in length. The route includes two HDD installations and two open-cut crossings of navigation channels. The presence of the sloping seafloor gradients (i.e., borrow pit) on the east side of Ambrose Channel would require an extension of the length of the HDD to allow for a stable working area. Placement of the pipeline in proximity to borrow pits could also contribute to both construction and operational safety concerns related to vessel traffic accessing the borrow sites.

Alternative 4 was not selected as the preferred alternative largely based on the engineering difficulties associated with the crossings of the Ambrose Channel. Furthermore, Transco did not select this alternative because of the following additional reasons:

- The crossing of the Raritan Bay Channel is not at an ideal angle.
- East of the Ambrose Channel bottom topography is more sloping (between MP25.85 and MP27.12 the seafloor elevation varies as much as 9 feet), introducing constructability and engineering challenges.
- East of the Ambrose Channel, the pipeline route has a greater potential to intersect areas of glacial drift, which would introduce rocky substrates that are not conducive to Transco's preferred installation methods.

Alternative 5

Alternative 5 (see Figure 10A-11) was developed as an alternative to reduce navigation conflicts and entirely avoid anchorage areas. This alternative is 25.46 miles long and includes two HDD installations but would require only a single open-cut of a navigation channel. Alternative 5 would require a much longer water-to-water HDD, with platforms located at the edge of a borrow pit (i.e., sloping seafloor gradient) at the convergence of a high-volume vessel-traffic area, on the west side of the Chapel Hill Channel and east side of the Ambrose Channel. The need for HDD platforms in the vicinity of the borrow pits would result in increased construction risks due to the high volume of vessel traffic in the surrounding area as well as site stability concerns related to the depth of the borrow pit in relation to the surrounding seafloor, an approximate difference of 20 feet. In addition to construction risks, the difference in seafloor elevations could lead to operational concerns such as the introduction of pipeline spans and stress on the pipeline.

Alternative 5 is in the vicinity of seven areas of outcropping rocks located within 1,000 feet of the route. The presence of outcropping rocks within the immediate vicinity of Alternative 5 poses engineering and constructability challenges for the reasons discussed in Section 10.6.2.1.

Alternative 5 was not selected as the preferred option for the reasons described above and had no clear advantages over any of the other alternatives. Furthermore, Transco did not select this alternative because of the following additional constraints:

- Vessel traffic at the Narrows and the upper portion of Lower New York Bay is extremely high.
- Proximity to the Narrows will introduce greater currents, which could increase construction risk.
- The pipeline is approximately 2 miles longer than most of the presented alternatives, increasing the duration of construction and associated impacts.

Alternative 7

Alternative 7 (see Figure 10A-12) was developed to reduce the length of in-water pipeline. Alternative 7 is 30.55 miles long but, unlike Alternatives 1 through 6, and Alternative 8, this alternative would establish a new onshore ROW and would be co-located with New Jersey Route 35 for 17.37 miles, from the Morgan M&R Station to the Atlantic shoreline of New Jersey. The installation of the onshore portion of Alternative 7 would necessitate crossing areas of significant residential and commercial development and would affect many residents, including 937 residences within 250 feet of the preferred route. Alternative 7 would also include a shore-to-water HDD to avoid impacts on the Highlands Reach, Sandy Hook, and the Gateway National Recreation Area. Once offshore, Alternative 7 would cross approximately 3.15 miles of designated anchorage area, then curve north, avoiding National Park Service waters to the east and a Historic Area Remediation Site. Alternative would cross the Ambrose Channel via HDD.

Alternative 7, which was developed as an alternative to crossing the Raritan Bay, was not selected as the preferred alternative for multiple reasons, including the significant increase in impacts on urbanized land associated with the need for more than 17 miles of additional onshore pipeline, and the crossing of 3.15 miles of designated anchorage areas. As stated previously, deeper burial would be required in these areas, and water quality impacts, sediment disturbance, emissions, and long-term impacts on navigation and commerce would increase.

Furthermore, Transco did not select this alternative because of the following additional constraints:

- Alternative 7 would disrupt traffic patterns throughout the duration of onshore construction, which would likely extend over multiple years.
- Alternative 7 includes 186 road crossings.
- Substantive increases in noise impacts would occur because of the proximity of the route to local residences and businesses.
- Alternative 7 is approximately 5 to 8 miles longer than all other presented alternatives, increasing the duration of construction and associated impacts.

10.6.2.6 Final Route Selection

The two remaining alternatives, Alternative 6 (see Figure 10A-13) and Alternative 8 (see Figure 10A-14) minimize the length of the route crossing designated anchorage areas while (1) providing preferable crossing angles for both the Neptune cable and the Raritan Bay and Chapel Hill navigation channels, and (2) avoiding constructability challenges near Ambrose Channel. These two routes are similar, with only slight differences in the length of the pipeline crossing in Raritan Bay. As such, Alternatives 6 and 8 were determined to be suitable from an engineering constraints standpoint. Table 10.6-2 presents a final comparison of these two alternatives.

While Alternative 6 traverses less anchorage area, NYSDEC indicated that Alternative 6 crosses sections of a NYSDEC hard clam transplantation program harvest area that is reported to be especially productive, compared with the sections of the harvest area crossed by Alternative 8 (see Volume 3, Agency Consultation). However, the latest available data on hard clam density and abundance for areas in New York crossed by Alternatives 6 and 8 are limited to anecdotal shellfish harvester reports and grab sampling at limited locations associated with hard clam quahog parasite unknown (QPX) disease-monitoring surveys. Therefore, per NYSDEC recommendations in a letter dated October 5, 2016, Transco conducted offshore sediment sampling in late 2016 along both of these alternative routes to characterize the sediment chemistry (especially contaminant levels), benthic communities, and geotechnical properties for the two routes. The results were compared to more clearly assess the potential for Project-related impacts on shellfish resources along the two route alternatives. See the Project's Offshore Sampling and Analysis Plan/Quality Assurance Project Plan in Appendix 1C to RR 1 for further details on the sediment sampling methodologies and lab analysis procedures, which were reviewed by NYSDEC before beginning sampling.

Transco conducted an initial statistical analysis of hard clam (*Mercenaria mercenaria*) counts found during the benthic sampling within the NYSDEC transplantation program area (MP14.00 to MP21.00) in order to determine if hard clam densities along Alternative 8 would be significantly different than densities along Alternative 6. As discussed below, the results indicate that the hard clam densities along these two route alternatives are not statistically different. In addition, a larger average number of hard clams were collected at sampling sites along Alternative 8.

Tables 10.6-3 and 10.6-4 below present the results for hard clams identified at the selected stations collected along Alternative 6 and Alternative 8, respectively (see Figure 1 in Appendix 1D of RR 1). Hard clams were partitioned into two length groups; less than 25 millimeters (mm) (<25 mm) and greater than 25 mm. (>25 mm). Of the 213 clams collected along Alternative 6, 158 (74%) were <25 mm, and 64 (26%) were greater than >25 mm. Along Alternative 8, 488 total individuals were collected, with 423 (86%) being <25 mm and 65 (14%) being >25 mm. Table 10.6-5 presents summary statistics for the sample pool from each route alternative.

Transco applied a Kruskal-Wallis statistical test of total counts to see if the median hard clam populations from the two alternatives were statistically different from each other within the transplant program area. A two-sample t-test was also applied to evaluate the potential difference in sampled population means for the two route alternatives.[6] The results of these tests show no statistical difference (alpha=0.5) in medians (KW test) or means (two sample t-test) of the hard clam populations along Alternative 6 and Alternative 8.

Transco also considered the percentages of silt/clay in the surface grab samples and contaminant levels in the upper 3 feet of shallow core samples collected along Alternative 6 and Alternative 8 within the NYSDEC hard clam transplant program harvest area. A representative summary of these characteristics for the two route alternatives is presented in Appendix 1D of RR 1. These results indicate that a greater average percentage of fine sediment and higher average levels of contaminants are present along Alternative 8 compared to Alternative 6. This suggests that installation of the pipeline along Alternative 8 would cause larger sediment plumes with higher levels of re-suspended contaminants than installation along Alternative 6 assuming equal areas of disturbance. These results were shared with NYSDEC during a meeting on

[6] The t-test assumes a normal population distribution, while the Kruskal-Wallis test assumes a non-normal distribution. Based on a Kolmogorov-Smirnov test, the sample sets exhibited non-normal distributions, so the Kruskal-Wallis test is considered more appropriate than the t-test in this case.

February 16, 2016. The potential impacts associated with the two alternatives are summarized in Tables 10.6-2, 10.6-3, 10.6-4, and 10.6-5. A discussion of the two route alternatives is provided below.

Alternative 6

The Raritan Bay Loop Alternative 6 reflects 16 months of stakeholder input and siting work and is Transco's preferred alternative. Alternative 6 is 23.49 miles long and is sited to avoid significant long-term conflicts with commercial vessel traffic, allow for a secure crossing at the Ambrose Channel, and minimize impacts with anchoring in Raritan Bay. The route includes two HDD installations and two open-cut crossings of navigation channels at nearly perpendicular angles.

Alternative 6 crosses approximately 0.76 mile of designated anchorage areas in New York. As previously stated, the USACE indicated that a minimum depth of cover of 7 feet over the pipeline in designated anchorage areas will be required, while outside of designated anchorage areas the minimum depth of cover is 4 feet over the pipeline. Impacts on the marine environment increase as the depth of cover requirements increase. Although the Alternative 6 route is slightly longer than Alternative 8, the pipeline crossing length in anchorage areas is less.

The results of the benthic grab survey show no statistical difference in hard clam density (95% confidence) between Alternative 6 and Alternative 8 within the NYSDEC transplantation program harvest area (see Appendix 1D of RR 1). As Alternative 8 crosses 0.94 additional miles of the designated anchorage area, and the additional burial depth requirement associated with traversing anchorage areas results in increased water quality impacts (due to greater sediment disturbance, higher percentage of silt/clay, and higher concentrations of contaminants), Alternative 6 was selected as the preferred alternative.

Alternative 8

As described above, Alternative 8 was developed in response to NYSDEC concerns specific to areas believed to contain high abundances and densities of hard clam. This alternative is 23.42 miles long and is similar to the preferred Alternative 6. Alternative 8 minimizes the crossing length of areas considered by NYSDEC to be valuable based on qualitative data, including historic reports from clam harvesters. Like Alternative 6, this route crosses a NYSDEC hard clam transplantation program harvest area. Although this area is not currently harvested, NYSDEC has indicated that harvest may resume in the future.

As described above, the benthic grab survey show no statistical difference in shellfish density (95% confidence) in hard clam density between Alternative 6 and Alternative 8 (see Table 10.6-5). However, as Alternative 8 crosses designated anchorage areas for 1.70 miles, approximately 0.94 mile longer than the preferred alternative, Alternative 8 would require a greater depth of cover over a longer portion of the pipeline, which would result in greater water quality impacts (due to greater sediment disturbance, higher percentage of silt/clay, and higher concentrations of contaminants), more vessel emissions, and an increased potential for long-term impacts on navigation and commerce. Therefore, Alternative 8 was not selected as the preferred alternative.

Table 10.6-2
Final Comparison of Alternatives 6 and 8 for the Raritan Bay Loop

Factor	Unit	Alternative 6		Alternative 8	
		NJ	NY	NJ	NY
Total Length	Miles	6.11	17.38	6.02	17.40
Offshore Length	Miles	5.95	17.38	5.86	17.40
Onshore Length	Miles	0.16	0.00	0.16	0
Number of HDDs	Count	2	0	2	0
Anchorage Zones Crossed	Miles	0	0.76	0	1.70
Offshore Trenching Length (includes pre- and post-lay trenching)	Miles	4.72	17.38	4.75	17.40
Estimate volume of sediment excavated during offshore trenching[a]	Cubic yards	154,262	524,179	154,409[b]	604,810[b]
Duration of offshore construction	Days	260		277	

[a] Includes volume of sediment excavated as part of the anode sled installation.

[b] The increase in sediment volume is due to the fact that Alterative 8 crosses an additional 0.94 miles of designated anchorage areas. A greater depth of cover (7 feet) is required in anchorage areas and, as such, the total trench depth and relative volume of sediment increases.

Table 10.6-3
Hard Clam Counts – Alternative 6 Stations

Station	<25 mm	>25 mm	Total
7	0	0	0
8	32	0	32
9	0	0	0
10	21.3	3	24.3
11	7.1	1	8.1
12	0	8	8
13	10.9	9	19.9
14	0	2	2

Table 10.6-3
Hard Clam Counts – Alternative 6 Stations

Station	<25 mm	>25 mm	Total
15	16	3	19
16	0	0	0
17	0	0	0
18	0	8	8
19	0	7	7
20	0	3	3
21	0	3	3
22	64	2	66
23	6.4	0	6.4
24	0	1	1
25	0	1	1
26	0	1	1
27	0	1	1
28	0	2	2
Total	**157.7**	**55**	**212.7**
Percent of Total	**74%**	**26%**	

Table 10.6-4
Hard Clam Counts - Alternative 8 Stations

Station	<25 mm	>25 mm	Total
70	0	0	0
71	25.6	3	28.6
72	128	1	129
73Alt	114.7	3	117.7
74	81.6	1	82.6
75	0	8	8
76	8	6	14
77	31.5	11	42.5
78	6.4	4	10.4
79Alt	0	4	4
80	0	0	0
81	0	1	1
82	16	13	29
83Alt	0	0	0
84Alt	0	1	1
85	3.6	1	4.6

Table 10.6-4
Hard Clam Counts - Alternative 8 Stations

Station	<25 mm	>25 mm	Total
86Alt	0	2	2
87	7.6	6	13.6
Total	**423**	**65**	**488**
Percent of Total	**86%**	**14%**	

Table 10.6-5
Descriptive Statistics for Hard Clam Counts for Alternatives 6 and 8

Route	Total	N	Mean	Std Dev.	Size Ratio[1]
8	488	18	27.1	40.7	6.5:1
6	212.7	22	9.7	15.4	2.8:1

Note:
[1] Ratio of individuals <25 mm to >25 mm

10.7 Aboveground Facility Alternatives

Transco conducted a detailed hydraulic analysis, as discussed above in Section 10.4, to determine the need for additional compression to meet the Project's purpose of supplying 400,000 Dth/d of capacity to the Rockaway Transfer Point. Based on the results of the hydraulic analysis, Transco identified the need for additional compression at one existing compressor station in Pennsylvania (Compressor Station 200) and for one new compressor station in New Jersey (Compressor Station 206). Because the modifications to Compressor Station 200 will occur within the existing facility fence line, Transco is not proposing any alternative locations for the Compressor Station 200 modifications. The following sections include a description of the various alternatives Transco has evaluated with respect to Compressor Station 206.

10.7.1 Compressor Station 206 Alternatives

Transco used a multi-tiered approach to identify the most suitable site for Compressor Station 206. The siting criteria of engineering constraints, site availability, and natural resources, feed into the tiers outlined below. Recognizing that Compressor Station 206 must be sited in a more urban location based on the results of the system alternatives analyzed, Transco undertook an exhaustive study to identify and evaluate potential compressor station locations.

Siting Envelope

Transco first defined a siting envelope for the location of the compressor station that consisted of two principal steps: (1) identifying through the hydraulic analysis that portion of the existing pipeline system and range of MPs where compression is required, and, (2) finding a suitable property within approximately 0.5-mile of the existing Transco Mainline that could feasibly accommodate a 32,000 ISO hp compressor station (see Figure 10A-15).

The hydraulic analysis that Transco conducted identified the segment of its mainline in New Jersey where the new 32,000 ISO hp Compressor Station 206 needed to be sited to optimize Transco's ability to transport the incremental 400,000 Dth/d Project capacity, in addition to the existing firm shipper entitlements, without resulting in material degradation of delivery pressures at existing delivery points. The results of this analysis confirmed that in order to meet these objectives, the new Compressor Station 206 must be located between MP1780.00 and the Milltown regulator station at MP1790.84.

The hydraulic analysis concluded that locating Compressor Station 206 upstream of MP1780.00 would result in material pressure degradation at existing downstream delivery points. Further, any compressor station location upstream of MP1780.00 would be too close to existing Compressor Station 205, making it difficult to coordinate the operation of the two compressor stations.

The location of Compressor Station 206 cannot be sited farther downstream of the Milltown regulator station at MP1790.84 because this is a system intersection point: It is the location where the Transco Mainline C line diverges from Transco Mainlines A and E and extends to Compressor Station 207 and the LNYBL. If Compressor Station 206 were to be sited downstream of the Milltown regulator station, Transco Mainline C could not be compressed, resulting in material degradation of delivery pressures at meter stations on Transco Mainline C between the Milltown regulator and Compressor Station 207. Further, additional horsepower would be required at Compressor Station 207 to maintain delivery pressures downstream of the compressor station.

Connecting the new compressor station to the existing system will require suction and discharge piping. Construction of this piping would require an approximately 105-foot-wide construction ROW and a 75-foot permanent ROW. Therefore, Transco searched for sites within 0.5 mile of the existing mainline in order to reduce the length of piping, thereby minimizing the amount of associated construction and operational workspace and associated impacts.

Additionally, as pipelines greater than 1,000 feet in length require pigging with internal inspection devices, siting the compressor station more than 1,000 feet from the mainline would require Transco to construct a new pig launcher and pig receiver with a valve setting at the location where the piping intersects the mainline and at the compressor station site. Installing a pig launcher and receiver would require an approximate 200-foot by 200-foot permanent footprint at the interconnection point with the mainline, whereas the valve setting itself would only require a footprint of approximately 80 feet by 120 feet.

Transco searched for potential sites between MP1780.00 and MP1790.84 that are within 0.5-mile of the existing Transco Mainline and are at least 10 acres in area, the minimum area needed to construct a 32,000 ISO hp compressor station and related ancillary equipment. Based on these factors, Transco identified 41 potential sites, which were then evaluated against the Tier 1 siting criteria described below (see Figure 10A-15 for the sites initially identified by Transco).

Siting Criteria - Tier 1

After defining the siting envelope that would preclude construction of a compressor station, Transco applied Tier 1 siting criteria to the 41 sites depicted in Figure 10A-15:

- **Parcel availability.** Transco researched these parcels to determine if they were available for purchase. In order to search as broadly as possible, this list initially included parcels encumbered by Green Acres or owned by the New Jersey Department of Transportation even though these parcels are actively committed to an alternative use and therefore would not be readily available for acquisition. Transco also considered parcels containing existing structures. See Figures 10A-16, 10A-17, and 10A-18.
- **Parcel configuration.** The parcel needs to be configured such that it could accommodate an approximate 600-foot by 700-foot footprint, the minimum size required to accommodate a 32,000 ISO hp compressor station and related ancillary equipment. See Figure 10A-19.

After applying the Tier 1 siting criteria, Transco determined that 21 of the 41 sites would not be suitable for development of a compressor station due to lack of availability or issues related to parcel configuration such as size and shape. As such, a total of 20 sites were analyzed further under Tier 2. Figure 10A-20 details the sites remaining within the siting envelope that met the Tier 1 siting criteria.

Siting Criteria - Tier 2

After defining the siting envelope and applying Tier 1 constraints, Transco applied the following Tier 2 siting criteria to 20 remaining parcels:

- **NJDEP Wetlands and Transition Areas.** Transco evaluated these sites to avoid or minimize impacts on NJDEP-mapped wetlands and NJDEP-mapped wetland transition areas/buffers. Figure 10A-21 shows the required 600-foot by 700-foot compressor station footprint and NJDEP mapped wetlands.

Transco considered the presence of wetlands on these sites and sought to reduce impacts to wetlands and waterbodies to the extent practicable and in consideration of the New Jersey Freshwater Wetland Protection Act Rules (N.J.A.C. 7:7A). Based on this analysis, five parcels with the least potential impact on wetlands based on a review of NJDEP wetland mapping were carried forward. Figure 10A-22 details the sites remaining within the siting envelope that were not eliminated through the Tier 1 and Tier 2 siting analysis identified above. The following section presents Transco's evaluation of these five potential sites utilizing desktop resources to compare the environmental impacts associated with each alternative. See Table 10.7-1 below.

10.7.1.1 Compressor Station 206 Site Alternatives

Potential Sites

Five potential sites remained after application of the compressor station siting criteria described above (see Table 10.7-1 and Figures 10A-23 through 10A-27). For the purposes of comparison, Transco evaluated the criteria described in Table 10.7-1 against standardized temporary and permanent footprints to identify a preferred site for Compressor Station 206. Transco applied the standard 600 by 700 foot temporary construction workspace and 8 acre permanent facility footprint to each of the remaining five sites.

Transco used various methods to identify and evaluate the presence of wetland and waterbody features at each of the five sites. Transco conducted a remote sensing exercise to identify the presence of wetlands and waterbodies at each of the five sites. Transco augmented those results with field-collected data for Sites 1, 2, and 3. Additionally, Transco evaluated the proximity of the five sites in relation to the Delaware and Raritan Canal stream corridor. The five sites fall within Zone B of the Delaware and Raritan Canal Commission Revise Zone. However, projects are exempt from Commission review and approval if the project is not a governmental project, and that does not require a municipal permit or approval. Therefore, Delaware and Raritan Canal Stream Corridor impacts were not included as part of this analysis.

Site 1

Site 1 is a 69.74-acre lot in Franklin Township in Somerset County, New Jersey (see Figure 10A-23). It is located approximately 0.5-mile east of the Trap Rock Quarry and just west of New Jersey Route 27. Site 1 is zoned for agricultural use but is entirely forested.

Although no mapped National Wetland Inventory (NWI) wetlands were located within the property, the results of Transco's remote sensing analysis indicated the presence of wetlands on-site (see Appendices 2E and 2F of RR 2 for remote-sensing methodology, and Table 10.7-1 for results). Field surveys also indicated the presence of wetlands on-site. NJDEP regulates activities within wetland transition areas (buffers around wetlands). These transition areas range in width from 0 to 150 feet depending on the value of the wetland. Transco assumed a conservative approach and applied a 150-foot buffer to the outer most edge of all identified wetlands.

Through the field survey, Transco also identified a mapped tributary to Carters Brook located along the northern portion of the site. The tributary has a flood hazard area and mapped 100-year floodplain. Additional unmapped tributaries are also located throughout the site. Based on NJDEP standards, these tributaries would be classified as category 2, non-trout waters, and therefore would require a 50-foot riparian buffer.

Due to the presence of wetlands, tributaries, and an associated 100-foot buffer from the extent of the mapped floodplain, construction of a compressor station at this site would result in substantial impacts on wetlands, waterbodies, and their associated buffers. Therefore, the site was not carried forward for further consideration.

Site 2

Site 2 is a 37.93-acre undeveloped lot located in Franklin Township in Somerset County, New Jersey (see Figure 10A-24). The site is located less than 0.5-mile east of the Trap Rock Quarry, abutting New Jersey Route 27 to the east. Site 2 is zoned for agricultural uses but is entirely forested.

Although a few mapped NWI wetlands were depicted on the east side of the property, Transco's remote sensing analysis identified additional on-site wetlands (see Appendices 2E and 2F of RR 2 for remote-sensing methodology, and Table 10.7-1 for results). Further, field surveys conducted by Transco also indicated the presence of extensive wetlands on-site. Transco also applied a 150-foot buffer to these wetlands, as described above, to identify the maximum extent of wetland transition areas that would be required around on-site wetlands.

The field surveys also identified a mapped waterbody, Carters Brook, located along the southeast side of the site. Carters Brook has a flood hazard area and mapped 100-year floodplain. In addition, unmapped tributaries were identified throughout the site. Based on NJDEP standards, these tributaries would classified as category 2, non-trout waters, and therefore would require a 50-foot riparian buffer.

Due to the presence of on-site wetlands, Carters Brook, unmapped tributaries, and the associated wetland and waterbody buffers on these features, there is not sufficient space within the site to accommodate the construction of the compressor station without substantial impacts to these environmental resources. As such, Site 2 was not carried forward for consideration.

Site 3

Site 3 is a 52.34-acre largely undeveloped lot located in Franklin Township in Somerset County, New Jersey (see Figure 10A-25). It is zoned for rural residential use but is largely forested. NWI mapping for Site 3 shows wetlands on the eastern side of the property, however, the remote sensing exercise did not indicate the presence of any on-site wetlands. Transco conducted a field survey that did, however, identify wetlands along the perimeter of the site. Transco also applied a 150-foot buffer to these wetlands, as described above, to identify the maximum extent of wetland transition areas that would be required around on-site wetlands. As the wetlands are generally restricted to the perimeter of the site, the site allows for the construction of the compressor station and associated storm water management system while minimizing impacts on regulated and sensitive environmental resource areas, including wetlands, waterbodies, and any associated buffers.

Site 3 was previously identified as having potential groundwater contamination on a small portion of the site. A Phase I Environmental Site Assessment of Site 3 was conducted in June 2016 (EcolSciences 2016a). The report indicated that one National Priorities List (NPL) site, Higgins Farm NPL site, is located immediately adjacent (west) to the property and is impacting the groundwater on the northwestern edge of Site 3. The report also included details from the most recent (March 11, 2016) monitoring report, Semi-Annual Groundwater Monitoring Report, Quarters 3 and 4, 2015 Higgins Farm NPL site, Franklin Township, New Jersey, which indicated that the groundwater contamination is more than 50 feet below ground surface, within the diabase aquifer of the early Mesozoic rock basins of the Piedmont Physiographic Province possibly contaminating surrounding soils (Herman et al. 1998).

Higgins Farm NPL site has an active groundwater extraction and treatment system with several groundwater extraction wells installed around its perimeter, and four additional groundwater monitoring wells are located on Site 3. The groundwater treatment system limits further migration of contaminated groundwater, while actively reducing contaminant levels. The Phase I report indicates that the groundwater is actively managed and therefore soil contamination potential is reduced (EcolSciences 2016a).

Transco conducted a Phase I Environmental Site Assessment and Phase II Investigation in Fall 2016. The Phase II included a geophysical survey to locate potential underground storage tanks and other buried features and collection of soil and groundwater samples to evaluate subsurface conditions. The geophysical survey did not reveal any targets of interest. Data obtained from soil and groundwater samples did not indicate the presence of contamination that may pose a risk or impact the Project (EcolSciences 2016).

The Higgins Farm NPL site is not likely to pose a concern for Site 3, given that the extent of groundwater contamination is known, being actively monitored, collected, and treated; monitoring by the EPA is ongoing; the depth of contamination is deeper than would be required by proposed facilities, and the location that the pipeline and compressor station would tie into is at the southern tip of the property, which is outside the contaminated groundwater plume. Construction and operational workspaces are also outside the contaminated groundwater plume.

Site 3 allows for the construction of the compressor station, ancillary equipment, and associated storm water management system while minimizing impacts on regulated and sensitive environmental resource areas as well as on residential areas. As such, Site 3 is Transco's proposed site for Compressor Station 206. Since site selection, Transco has refined the placement for the compressor station footprint and workspaces within the site and has identified the location for the access road and tie-in facilities that are required for development of the compressor station and connection with the Transco Mainline system. The impacts presented in RRs 1 through 9 describe those associated with this refined compressor station footprint and requirements.

Site 8

Site 8 is a 41.02-acre lot located in Township of South Brunswick in Middlesex County, New Jersey (see Figure 10A-26). Through a title search, Transco obtained a property boundary plat that indicates the site contains 7.66 acres of conservation restriction/easement. The property plat also included a copy of the NJDEP Letter of Interpretation (file number 1808-05-0002.1 FWW05001) indicating the presence of wetlands and transition areas. Transco's remote sensing analysis also identified on-site wetlands (see Appendices 2E and 2F of RR 2 for remote sensing methodology, and Table 10.7-1 for results). Transco also applied a 150-foot buffer to these wetlands, as described above, to identify the maximum extent of wetland transition areas that would be required around on-site wetlands.

Further, Site 8 is not contiguous with Transco's existing mainline, and would require a minimum of 2,000-feet of suction and discharge piping to tie into the mainline. As discussed above, pigging equipment is required on piping more than 1,000 feet long (see Table 10.7-1 below). Due to the location of Site 8 relative to the mainline, increased impacts associated with the launch/receiver facility to forested wetlands and/or residential areas would occur. As such, Site 8 was not carried forward for consideration.

Site 27

Site 27 is a 25.96-acre lot located in the township of Franklin Township in Somerset County, New Jersey (see Figure 10A-27). Transco's remote sensing analysis identified on-site wetlands and waterbodies (see Appendices 2E and 2F of RR 2 for remote sensing methodology, and Table 10.7-1 for results). Transco also applied a 150-foot buffer to identified wetlands, as described above, to identify the maximum extent of wetland transition areas that would be required around on-site wetlands.

Additionally, 21 residences are within 0.25-mile of the site. Transco would also need to route suction and discharge piping on the parcel directly south of Site 27. Due to the location of Site 27 relative to the mainline, increased impacts associated with the launch/receiver facility to forested wetlands and their wetland transition areas and/or residential areas would occur. The valve setting would be located less than 0.10-mile from an existing residence. As such, Site 27 was not carried forward for consideration.

Table 10.7-1
Compressor Station 206 Site Alternative Comparison

Site Alternative[a]	Unit	1	2	3	8	27
Parcel size	acres	69.74	37.93	52.34	41.02	25.96
Parcel availability	-	Vacant	Vacant	Vacant	Vacant	Vacant
Construction workspace[a]	acres	9.64	9.64	9.64	9.64	9.64
Operation workspace	acres	8.00	8.00	8.00	8.00	8.00

Table 10.7-1
Compressor Station 206 Site Alternative Comparison

Site Alternative[a]	Unit	1	2	3	8	27
Approximate Tie-In Pipe Length	feet	789	446	840	1,972	509
Number of Access Roads Required	count	1	1	1	1	1
Length of Access Road	feet	1,598	67	3,394	632	117
Temporary Impacts Forested Land	acres	9.64	9.64	7.66	9.58	9.64
Permanent Impacts Forested Land	acres	8.00	8.00	6.42	7.95	8.00
Temporary Impacts Remotely Sensed Wetlands[a,b]	acres	2.30	2.53	0.00	0.16	1.55
Permanent Impacts Remotely Sensed Wetlands[a,b]	acres	1.47	2.04	0.00	0.16	1.46
Temporary Impacts Remotely Sensed Wetland Transition Area (150-foot)[c]	acres	5.40	3.02	1.10	4.13	4.57
Permanent Impacts Remotely Sensed Wetland Transition Area (150-foot)[c]	acres	4.59	2.74	0.65	3.42	4.05
Temporary Impacts Remotely Sensed Waterbodies[a]	acres	0.00	0.06	0.00	0.07	0.00
Permanent Impacts Remotely Sensed Waterbodies[a]	acres	0.00	0.06	0.00	0.07	0.00
Permanent Impacts Remotely Sensed Waterbody Buffer (50-foot)	acres	0.00	0.45	0.00	0.37	0.00
Temporary Impacts Remotely Sensed Waterbody Buffer (50-foot)	acres	0.00	0.36	0.00	0.28	0.00
Temporary Impacts NHD Waterbody	acres	0.00	0.00	0.00	0.09	0.00
Permanent Impacts NHD Waterbody	acres	0.00	0.00	0.00	0.08	0.00
Temporary potential NJDEP Vernal pool habitat[e]	acres	0.00	0.00	9.38	9.65	0.00
Permanent potential NJDEP Vernal pool habitat[e]	acres	0.00	0.00	7.91	8.01	0.00
Temporary Impacts FEMA Floodplain	acres	0.00	0.00	0.00	0.00	0.00
Permanent Impacts FEMA Floodplain	acres	0.00	0.00	0.00	0.00	0.00
Temporary Impacts FEMA Floodplain Buffer (100-foot)	acres	0.03	0.00	0.00	0.00	0.00
Permanent Impacts FEMA Floodplain Buffer (100-foot)	acres	0.00	0.00	0.00	0.00	0.00
Temporary Impacts Threatened and Endangered Species Habitat[d]	acres	0.00	0.00	0.00	0.00	0.00
Permanent Impacts Threatened and Endangered Species Habitat[d]	acres	0.00	0.00	0.00	0.00	0.00
Temporary Impacts NHP Rare Plant Habitat	acres	0.00	0.00	0.00	0.00	0.00
Permanent Impacts NHP Rare Plant Habitat	acres	0.00	0.00	0.00	0.00	0.00
Temporary Impacts Prime Farmland[f]	acres	9.64	0.00	9.64	9.64	9.64

Table 10.7-1
Compressor Station 206 Site Alternative Comparison

Site Alternative[a]	Unit	1	2	3	8	27
Permanent Impacts Prime Farmland[f]	acres	8.00	0.00	8.00	8.00	8.00
Local, State, or Federal Lands	acres	0.00	0.00	0.00	0.00	0.00
Impacts to Parks, Recreation areas, Green Acres Property	acres	0.00	0.00	0.00	0.00	0.00
Number of Residences within 0.25 of Site center	count	0	1	0	18	21
Distance to Nearest Noise Sensitive Area	feet	4,038	2,672	5,465	642	1,090
Direction to Nearest Noise Sensitive Area	-	ESE	ENE	NNW	ESE	ESE

[a] Impact acreages reported in this table reflect those associated with the basic 600 by 700 foot construction workspace and 8 acre operational footprint.

[b] Field visits to evaluate wetlands were conducted at Sites 1, 2, and 3. Remotely sensed data also includes field delineated wetlands on sites 1, 2 and 3

[c] Assumed the most conservative buffer for the State of New Jersey of 150 feet.

[d] No critical habitat for state or federally listed threatened or endangered species is present on each of the five sites. The following layers were examined using the NJ-GeoWeb: Landscape Project – SBH – Piedmont Plains; Natural Heritage Priority Sites; and Natural Heritage Grid Map. Although sites contain forest and the potential exists for protected species, no positive confirmation of species resulted from the NJ-GeoWeb search.

[e] Data from NJDEP recognizes the area where these features exist as a general “potential vernal habitat area.” This does not necessarily suggest that these features are or contain vernal pools. During field surveys at Site 3, vernal pools were not identified within delineated wetland complexes at Compressor Station 206

[f] Prime farmland acreages are based on soil survey geographic database (SSURGO) mapping and do not reflect current land use.

Key:
FEMA = Federal Emergency Management Agency
N/A = Not applicable
NHP = National Heritage Preservation
NHD = National Hydrography Dataset
TBD = To be determined

Conclusion

Based on the above evaluation of the potential sites detailed above, Transco selected Compressor Station Site 3 as the preferred site alternative.

10.8 Construction Alternatives

10.8.1 Onshore Construction Alternatives

Transco will use conventional construction techniques to ensure safe and reliable transmission facilities, consistent with Commission and U.S. Department of Transportation specifications and applicable safety standards and regulations in-place at the time of construction, as discussed in RR 1, Section 1.4. As such, Transco is not evaluating additional alternative construction methods.

10.8.2 Offshore Construction Alternatives

Offshore pipeline installation methods have been well-established for quite some time, and modern technology has made it possible to lay pipeline in shallow waters as well as deep sea areas. In all offshore pipeline construction, various types of barges play a key role, including moored pipelay barges using an S-configuration and pipe barges (see RR 1, Section 1.4.3, for a description of proposed offshore construction methods). Welding and lowering the pipeline through the water column are well-established practices. The following is an evaluation of the possible subsea lowering, trenching, and sensitive resource area crossing alternatives for the Raritan Bay Loop.

As stated in RR 1, Transco is considering using a barge-mounted clamshell dredge to excavate the three offshore HDD entry/exit pits, Raritan Bay Channel, and Chapel Hill Channel. In addition, Transco is also considering the use of a barge-mounted backhoe for these areas as well as a hopper dredger for the Raritan Bay Channel, and Chapel Hill Channel crossings. As an alternative to the use of hand jets, Transco is considering the use of a mass flow excavator to excavate the area needed for placement of the subsea tie-in skid and spool pieces. For the remaining areas, Transco's current proposed pipeline lowering method is the post-lay jet sled. Transco is also considering using post-lay subsea ploughing, which involves passive displacement of sediment by a plough as it is pulled forward. However, a limited number of ploughs are commercially available for large-diameter pipeline construction within U.S. waters.

In addition to the considerations related to the evaluation of the subsea lowering, trenching, and sensitive resource-crossing alternatives discussed below, Transco will adhere to the Merchant Marine Act of 1920, also known as the Jones Act. Compliance with the Jones Act prevents foreign-built or foreign-flagged vessels from engaging in coastal trade within the United States. As such, the construction methods and vessels discussed below may be precluded from use, as the number of companies with U.S.-flagged vessels that own and operate the equipment discussed below is limited.

10.8.2.1 Pipeline String-and-Tow Alternative

The string-and-tow method has been used for short offshore pipeline installations when appropriate conventional pipelay barges are difficult to obtain. The capability and availability of marine equipment and local marine contractors for the string-and-tow method are significant in making this method practical.

This method involves stringing or welding sections of pipe onshore at a site with shoreline access. Each string or segment of pipe is lined up, welded, fitted with pulling heads on each end, tested, coated, and placed on rollers in a launchway to prepare them to be towed offshore.

Before towing the pipeline string offshore, arrangements with federal and local agencies would ensure that impacts on local commercial and recreational marine traffic and activity are minimized.

Marine towing vessels would be used to ensure a safe tow to the offshore location. Cables would be attached to the pulling heads on each end of the pipeline string and attached to towing vessels. The lead towing vessel would pull the string offshore while other towing vessels would stabilize the pipeline by keeping the string in tension and on course. The pipeline string would be towed to its proper location in the construction workspace. At this location the pipe string would be laid on the sea bottom and, if necessary, secured to the seabed to prevent movement. If needed, subsequent pipe strings would be towed and laid end-to-end on the bottom. After all pipe strings were laid on the bottom, an above-water tie-in barge would join the pipeline segments. This barge would be towed into place and moored alongside the submerged pipeline segments to lift the ends and weld them together. After the segments are welded together, the joint would be tested, coated, and then lowered back to the seafloor. Special care would be used during the lifting of the segment's ends to ensure that the pipeline is not over-stressed. All pipeline segments would be joined in this manner.

Using this method for the Project would be difficult because the workspace needed onshore close to the Raritan Bay Loop that would be used to weld the multiple sections of pipe is limited. Additionally, lengthy sections of pipe would need to be towed to the offshore site via numerous material barges, which could result in delays and substantive vessel congestion within and around the navigation channels located in the Project area. A typical pipelay barge would avoid these potential difficulties. For these reasons, and because Transco expects pipelay barge equipment to be available for the Project, the string-and-tow alternative was not selected.

10.8.2.2 Subsea Pipeline Trenching Alternatives

Because of the proximity to shore and the relatively shallow depth of the water to be traversed by the pipeline, the entire pipeline will be buried in a subsea trench. The pipeline will be installed a minimum of 4 feet below the seafloor, with deeper depths required in navigation channels and anchorage areas. In general, the pipeline can be buried by either pre- or post-trenching of the seabed. Pre-trenching involves trenching before pipeline lay and is used to account for water depth limitations and requirements for achieving adequate depth of cover based on permit requirements. Post-trenching means that the trenching equipment would remove sediment from the area surrounding the pipeline while lowering is taking place. Transco is evaluating four alternative construction techniques for the installation of the pipeline: pre-lay clamshell dredge, post-lay subsea jet sled, and post-lay subsea plough. Based on factors such as equipment availability, Jones Act compliance, and construction duration, Transco has determined that a mix of lowering and installation techniques would be required for the Project (see Table 10.8-1). However, Transco is still determining the installation techniques that will be used. The following is a description of each alternative trenching technique, the potential impacts and benefits of using each, and the rationale for each method's use according to pipeline component. *(Transco will provide details regarding its selected installation plan in the 2nd quarter of 2017).*

Pre-Lay Clamshell Dredge

A pre-lay clamshell dredge would excavate a trench using a mounted cable crane and mechanical bucket system. A clamshell dredge is suitable for silt, sand, or rubble substrate. If material from the dredge activity is stored upon a barge for backfill, efficient filling of the barge requires that the majority of water entrained in the excavated sediment must be drained before storing onboard the barge. This process results in a roughly ten-fold increase in the amount of sediment released into the water column compared with the clamshell dredge alone (Palermo et al. 2008). However, the rate of clamshell dredge operation is very slow compared with the jet sled. In order to minimize the duration of the in-water construction activities and disturbances, Transco does not consider it feasible to use a clamshell dredge to excavate the entirety of the offshore trench. However, Transco will use a clamshell dredge to excavate portions of the trench in shallow waters or in areas requiring deeper burial depths.

Table 10.8-1
Comparison of Subsea Pipeline Trenching Alternatives

Consideration	Jet Sled[a]	Plough[b]	Mechanical Trencher[c]	Clamshell Dredger[d, e]	Mass Flow Excavator[f]	Backhoe Dredger[g]	Hopper Dredger[h]	Comment
Application Pre-Lay or Post-Lay	Post-Lay Only	Post-Lay Only	Post-Lay Only	Pre and Post-Lay	Pre and Post-Lay	Pre and Post-Lay	Pre and Post-Lay	
Water Depth Limitation(s)	Min. 10 feet	Min. 10 feet	Min. 10 feet	None	Min. 10 feet	Max 10 feet	Min 10 feet	
Equipment Availability (current 2017 market)[i]	Three units	One unit	None identified	Multiple	Three units	Three units	Three units	Jones Act compliant equipment only, subject to other commitments at the time of execution in 2018
Typical Equipment Size (length x width x height)	15 x 7 x 7 feet	70 x 70 x 30 feet	70 x 90 x 20 feet	200 x 70 x 9.5 feet	12 x 6 x 6 feet	120 x 60 x 9[j]	315 x 70 x 12	Actual equipment size, not the vessel it is deployed from
Equipment Weight (submerged; tons)	3-10	15-150	30-200	30-200	1-6	30-200	30-200	
Material Deposit Location	90% dispersed	Side cast with 10% dispersed	Side cast with 10% dispersed	Side cast or scow with 25% dispersed	100% dispersed	Side cast or scow with 30% dispersed	Side cast or scow	
Seabed Impact (acres)	50.24	139.12	*TBD*	60.61	*TBD*	*TBD*	*TBD*	Method may only be suitable for part of the route
Sediment Displaced (yd^3)	75,406	131,965	*TBD*	608,409	*TBD*	*TBD*	*TBD*	Method may only be suitable for part of the route
Estimated Trenching Speed	76 ft/hour	37 ft/hour	*TBD*	417 cubic yards/hour	150 cubic yards per hour	*TBD*	*TBD*	Trench speed is an average over multiple passes

Table 10.8-1
Comparison of Subsea Pipeline Trenching Alternatives

Consideration	Jet Sled[a]	Plough[b]	Mechanical Trencher[c]	Clamshell Dredger[d, e]	Mass Flow Excavator[f]	Backhoe Dredger[g]	Hopper Dredger[h]	Comment
Trench Slope (cutting angle)	2:1 cut	2:1 + 3:1	2:1 + 3:1	2:01	10:01	1:01	12:01	Minimum slope is dependent on sediment type and currents
Excavation Depth (feet)	min. 4ft - max. 7ft	min. 4ft - max. 7ft	min. 4ft - max. 7ft	6.5ft - 10.5ft	min. 4ft - max. 7ft	min. 4ft - max. 7ft	min. 4ft - max. 7ft	Trench depth may have to be achieved in multiple passes
Trench Top Width (feet)	26	30	*TBD*	59-91	*TBD*	*TBD*	*TBD*	*TBD*
Trench op + Sediment Placement Width (feet)	26	72	*TBD*	59-91	*TBD*	*TBD*	*TBD*	*TBD*
Suspended Sediment Plume – Surface Layer	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*
Suspended Sediment Plume – Bottom Layer	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*
Extent of Sedimentation	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*
Construction Cost[k]	Lower	Higher	NA	NA	NA	NA	NA	NA

Table 10.8-1
Comparison of Subsea Pipeline Trenching Alternatives

Consideration	Jet Sled[a]	Plough[b]	Mechanical Trencher[c]	Clamshell Dredger[d, e]	Mass Flow Excavator[f]	Backhoe Dredger[g]	Hopper Dredger[h]	Comment
Construction Period and Duration of Impacts	Shorter	Longer	Unknown	Longest	Longest	Longest	Longest	

Key:

Additional information regarding the subsea pipeline trenching methods will be provided in a supplemental filing in the 2nd quarter of 2017.

[a] Jet sled equipment based on information received from LL&G.

[b] Plough equipment based on information received from IHC, Saipem.

[c] Mechanical trencher equipment based on information received from IHC, Allseas.

[d] Clamshell dredger equipment based on information received from NY Bay Dredgers.

[e] Actual trench will be excavated for post-lay operation. Pre-lay information is for comparison only.

[f] Mass Flow Excavator equipment data based on information from *TBD*

[g] Back-Hoe Dredger equipment data based on information from James Fisher

[h] Hopper Dredger equipment data based on information from IHC

[I] Availability based on current bidder proposals

[j] Size refers to equipment size and does not reflect barge size

[k] Cost comparison not applicable because they are not used for trenching applications

Post-Lay Subsea Jet Sled

Transco is considering the use of a jet sled to lower the pipe to the Project-defined depths. It is a system comprising surface liquid pumps, surface air pumps, hoses, tow rigging, and the jet sled itself. The jet sled is deployed overboard from the Project asset and straddles the pre-installed pipeline. Surface liquid pumps then send pressurized seawater through a series of nozzles located throughout the jet sled. This process emulsifies the sediments. Air lift features on the jet sled then disperse the fluidized sediments upward and the pipe is lowered while the jet sled traverses along the pipeline route. Steering is normally accomplished by vessel offset or tow angle of the vessel or by articulated steering. A jet sled is not equipped with any cutting edges, digging arms, or excavating tools.

Material excavated in this manner cannot be directed but, rather, is dispersed and is unlikely to be completely recovered for backfill in most instances. Differing jet sled designs and/or soil conditions may warrant the need to make multiple passes down the pipeline route in order to achieve the Project-defined depth requirements. When jetting is used, all material is not immediately recovered at the time of installation but occurs over time by migrating natural fill material through natural sediment transport processes. Additional backfill may be required to restore the seabed to pre-existing conditions in areas where natural infill is inadequate.

Post-Lay Subsea Plough

A post-lay subsea plough (ploughing) involves passive displacement of sediments by a plough as it is pulled forward by an onboard winch system. The vessel is stationary while the onboard winch system pulls the plough towards the vessel. Steering is normally accomplished by vessel offset or tow angle of the vessel or by articulated steering. The post-lay subsea plough has the potential to minimize environmental impacts; however, there are a limited number of ploughs that are currently commercially available for large-diameter pipeline construction within U.S. waters and it is an unlikely alternative.

Transco has identified one plough that is potentially available for use of the pipeline lowering, however, in its current configuration (i.e., equipment design limit) the maximum burial depth that would be achievable is 4 feet and only in ideal soil conditions.

Subsea Mechanical Trencher

A mechanical trencher is an additional pipeline-lowering method that may be used to lower the pipeline. The mechanical trencher would likely be a track-mounted, self-propelled system that would straddle and lift the pipeline with claws. Rotating cutting heads would be lowered underneath to create a trench, and the pipe would settle to the bottom of the trench under its own weight behind the mechanical trencher as it advances. Excavated material would be pumped through pipes on the trencher and side-cast along the trench. Additional backfill may be required to restore the seabed to preexisting conditions in areas where natural infill is inadequate. However, to maintain compliance with Jones Act requirements, Transco's ability to use a mechanical trencher is limited to U.S. flagged vessels and as such has not been considered further.

Mass Flow Excavator

The mass flow excavator is deployed from a barge crane and uses a combination of water jetting and suction to move sediment. While Transco does not consider the mass flow excavator appropriate for installation of the majority of the Project, the mass flow excavator is considered ideal for smaller scale excavations such as excavation of the areas needed for the subsea tie-in skid. Additionally, sediment excavated with the mass flow excavator would be side cast.

Backhoe Dredger

Transco is also considering the use of a backhoe dredger in shallow water areas (approximately water depths of 10 feet or less) as an alternative to the clamshell dredge for excavation and backfill. The backhoe dredger would be deployed from a shallow water barge.

Hopper Dredger

Transco is considering the use of a hopper dredger to dredge the Raritan Bay and Chapel Hill Channel crossings as an alternative to the clamshell dredge. The hopper dredger is equipped with suction pump and hose, which removes sediment and stores the dredged sediment in a hopper for later placement. Hopper dredgers are commonly used as part of channel maintenance projects.

10.8.2.3 Crossing Techniques in Sensitive Resource Areas

Typically, Transco would construct a pipeline using industry standards such as open-cut trench-installation techniques as discussed above and in RR 1, Section 1.4.3.1. However, in sensitive resource areas, including the Morgan Shore Approach and the Ambrose Channel crossing, HDD is Transco's preferred alternative. HDD allows trenchless construction across an area by drilling a hole below the conventional pipeline depth and pulling the pipeline through the pre-drilled hole.

The Morgan Shore Approach would require crossing an active New Jersey Transit commuter railway as well as the New Jersey shoreline and Highway 35. The use of the open-cut method across the active railway and highway located in this area is not a feasible option. It would require closing the railway and highway for the time of the crossing. This would result in substantive socioeconomic impacts because the railway and roadway provide transportation for commuters traveling into New York City and the local area. By open-cutting the railway, passengers would be forced to find alternative means of transportation into and out of New York City, creating impacts on alternative transportation systems. An HDD is the only feasible means of installing the pipeline beneath the New Jersey Transit commuter railway, Highway 35 and the New Jersey shoreline.

Although a clamshell dredge will be used in the Raritan Bay and Chapel Hill Channel crossings, the use of this construction method is not possible for the Ambrose Channel crossing. Ambrose Channel is the main shipping channel in and out of the Port of New York and New Jersey and thus is a highly active navigational channel. As such, the USCG does not allow construction directly in the channel and, as a result, Transco's preferred method to cross the Ambrose Channel is via HDD.

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__________. 2016b. R. E. Ginna Nuclear Power Plant. http://www.nrc.gov/info-finder/reactors/ginn.html. Accessed October 19, 2016.

__________. 2016c. Nine Mile Point Nuclear Station Unit 1. http://www.nrc.gov/info-finder/reactors/nmp1.html. Accessed October 19, 2016.

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TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

APPENDICES TO RESOURCE REPORT 10

ALTERNATIVES

NORTHEAST SUPPLY ENHANCEMENT PROJECT

MARCH 2017

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

APPENDIX 10A TO RESOURCE REPORT 10

FIGURES

NORTHEAST SUPPLY ENHANCEMENT PROJECT

MARCH 2017

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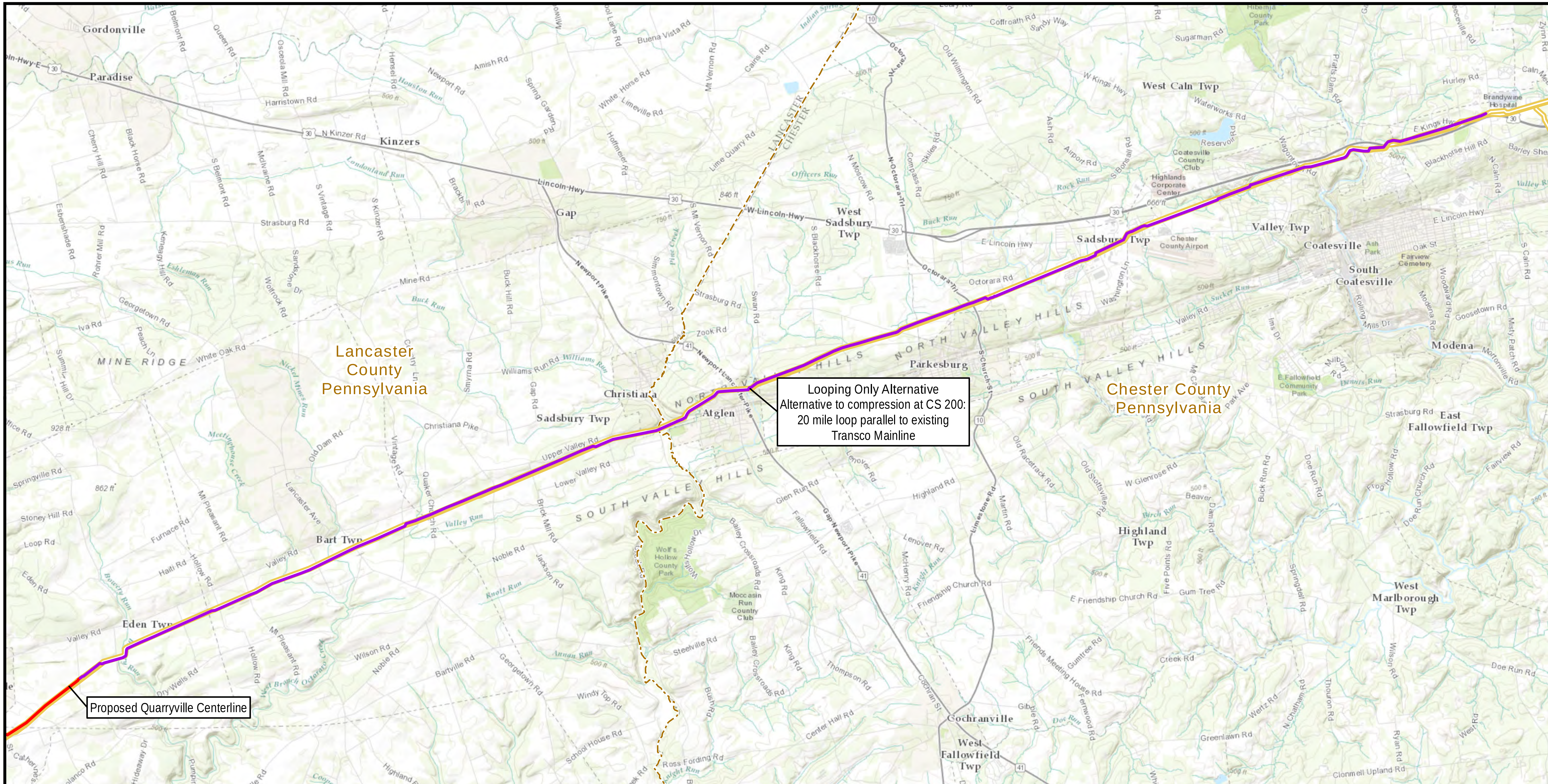


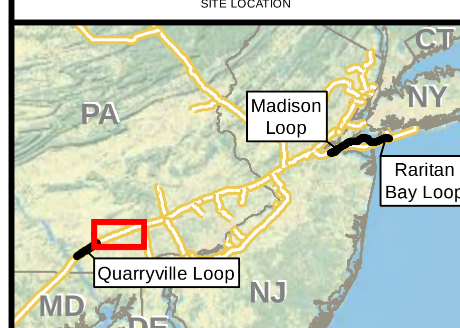
Legend

- Looping Only Alternative
- Proposed Pipeline: Quarryville Loop
- Existing Transco Pipeline
- County Boundary

N

0 1 2
Miles

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-1

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/20/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
LOOPING-ONLY ALTERNATIVE
NORTHEAST SUPPLY ENHANCEMENT PROJECT
PENNSYLVANIA

Williams

DRAWN BY: CE	DATE: 3/20/2017	ISSUE FOR BID: N/A	SCALE: 1:80,000
CHECKED BY: MK	DATE: 3/20/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-1	SHEET 1 OF 1
WO: 1000891		4:07 PM 3/20/2017	

Data Sources: Williams 2017; E&E 2017; ESRI 2012, 2017.

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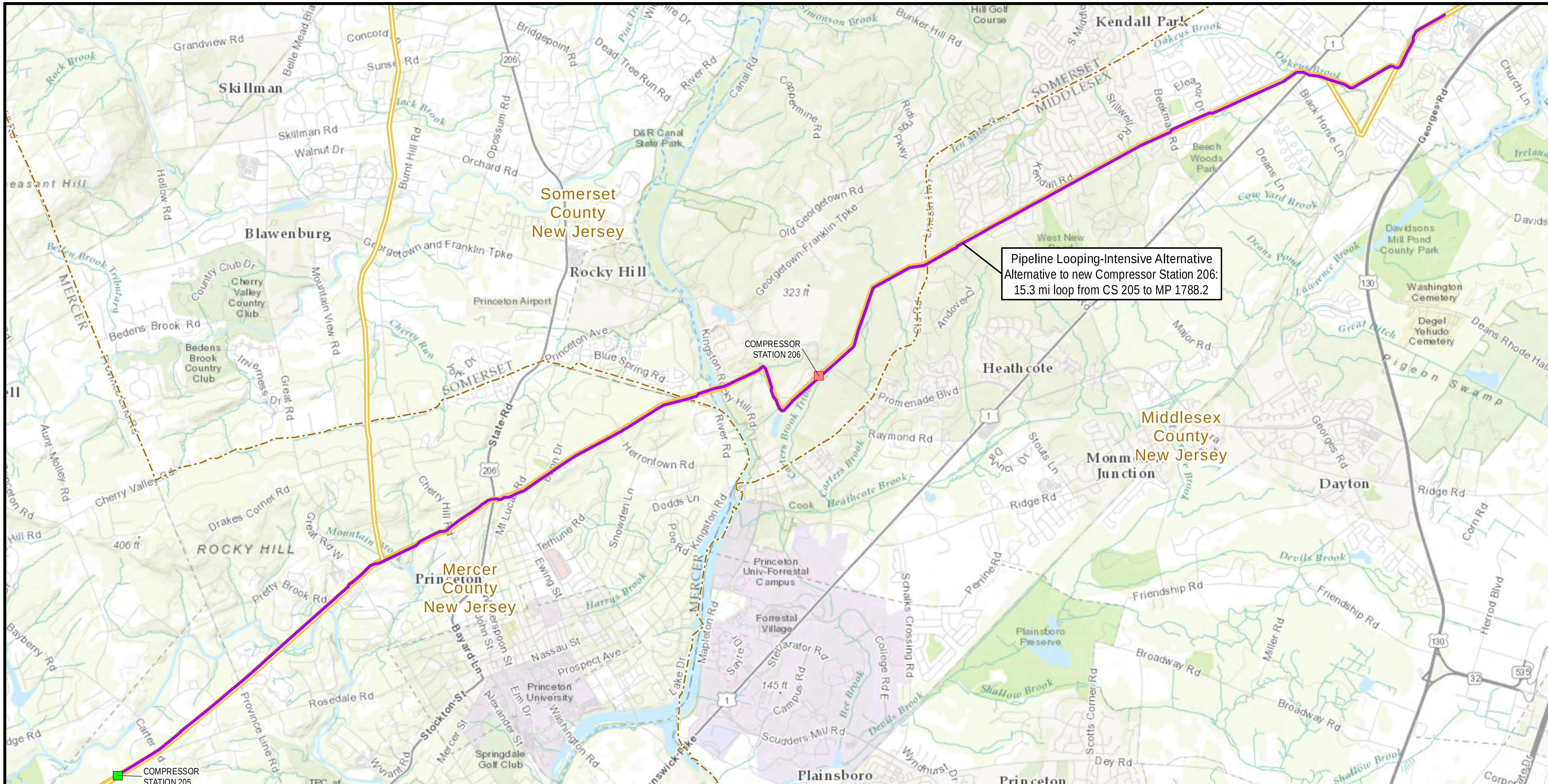


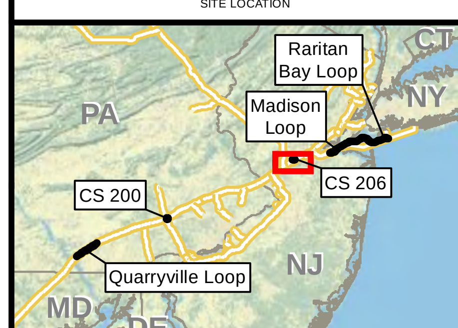
Legend

- Existing Compressor Station
- Proposed Compressor Station
- Pipeline Looping-Intensive Alternative
- Existing Transco Pipeline
- County Boundary

N

0 1 2
Miles

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-2

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
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TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
PIPELINE LOOPING-INTENSIVE ALTERNATIVE
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams.

DRAWN BY: CE	DATE: 3/20/2017	ISSUE FOR BID: N/A	SCALE: 1:57,404
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WO: 1000891		4:18 PM 3/20/2017	

Data Sources: Williams 2017; E&E 2017; ESRI 2012, 2017.

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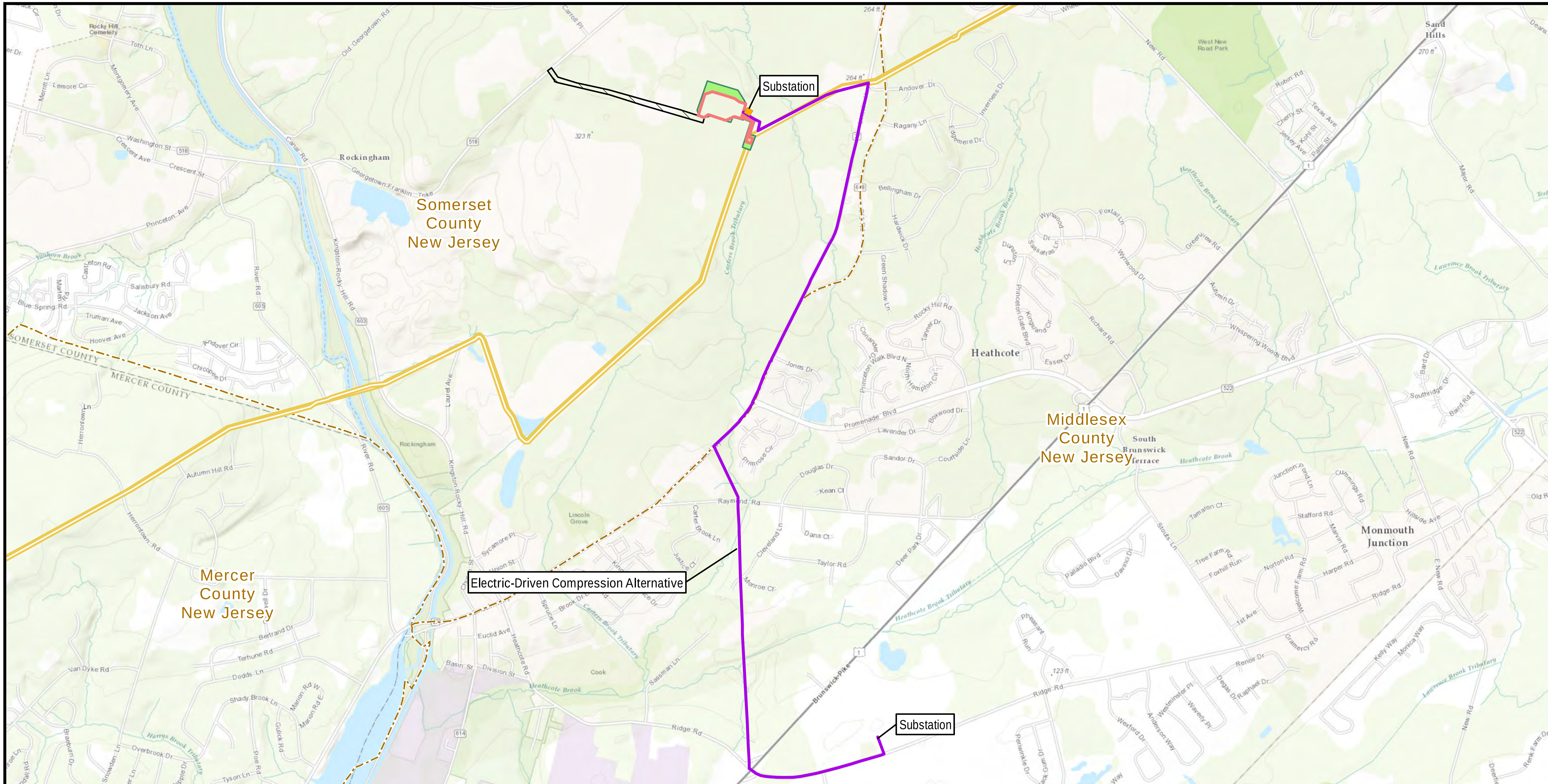


Legend

- Electric-Driven Compression Alternative
- Existing Transco Pipeline
- Electric-Driven Compression Substation
- County Boundary

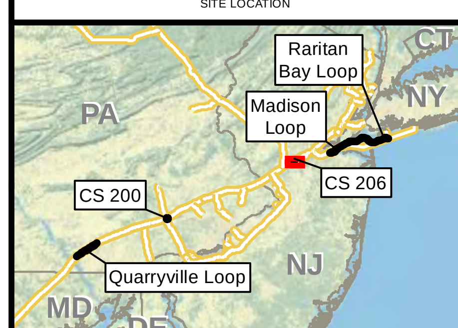
Proposed CS 206 Workspaces

- Permanant Workspace
- Permanent Access Road
- Temporary Workspace

N

0 0.25 0.5
Miles

SITE LOCATION



DRAWING NO.

REFERENCE TITLE

10A-3

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
ELECTRIC-DRIVEN COMPRESSION ALTERNATIVE
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams.

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/20/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

DRAWN BY: CE DATE: 3/20/2017 ISSUE FOR BID: N/A SCALE: 1:23,164

CHECKED BY: MK DATE: 3/20/2017 ISSUE FOR CONSTRUCTION: N/A Project features ver14

APPROVED BY: DATE: DRAWING NUMBER: FIGURE 10A-3 SHEET 1 OF 1

WO: 1000891 4:19 PM 3/20/2017

Data Sources: Williams 2017; E&E 2017; ESRI 2012, 2017.

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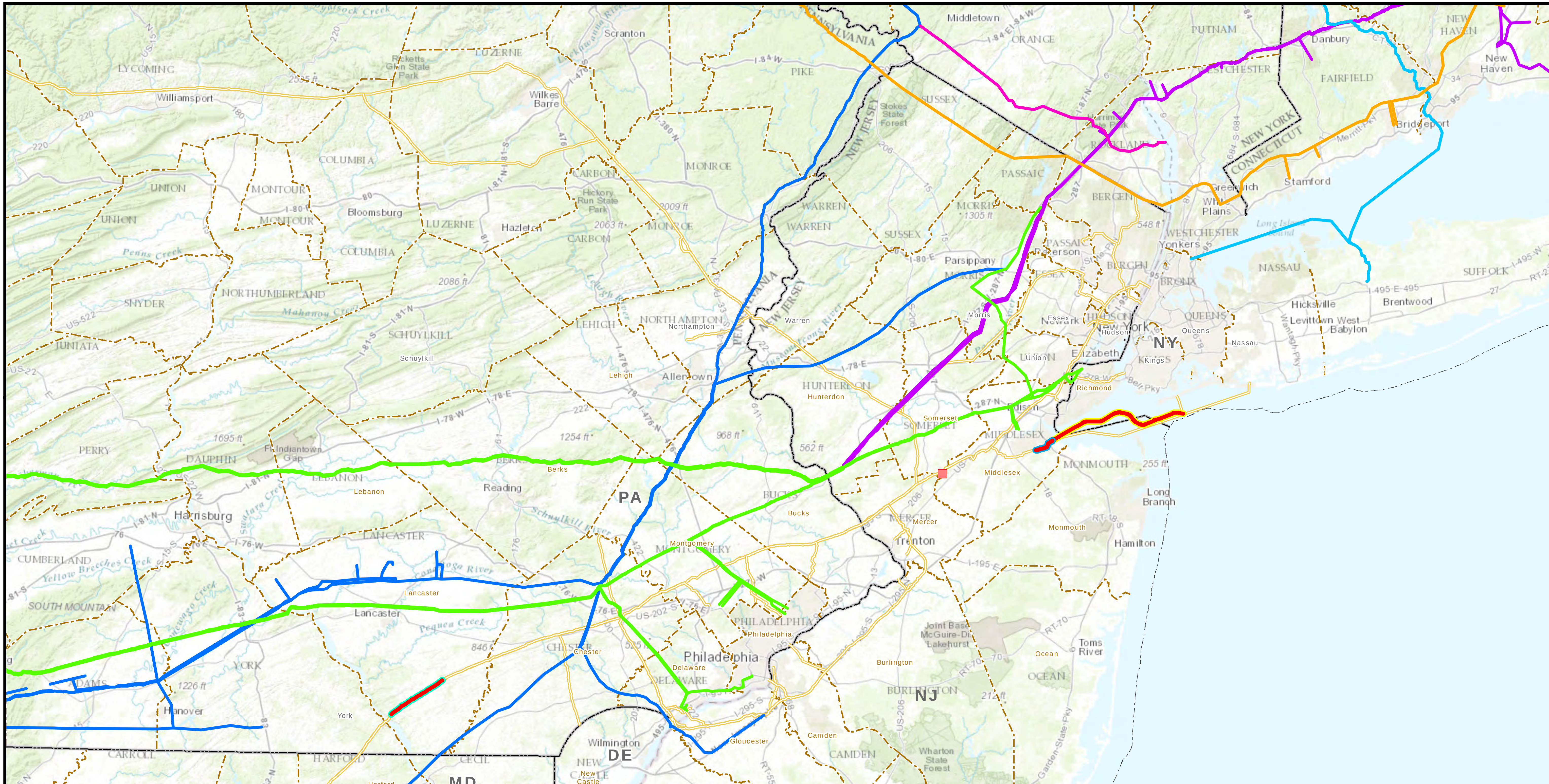

Legend

- Compressor Station 206 Site Alternatives

Regional Pipeline Systems

- Algonquin Gas Transmission Co.
- Columbia Gas Transmission Corp.
- Iroquois Gas Transmission System, L.P.
- Tennessee Gas Pipeline Co.
- Texas Eastern Transmission Corp. (TETCO)
- Millennium Pipeline
- Raritan Bay Loop
- Madison Loop
- Quarryville Loop
- Existing Transco Pipeline
- State Boundary
- County Boundary
- State/Federal Offshore Line

N

0 10 20

Miles

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-4

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
OVERVIEW OF INTERSTATE NATURAL GAS PIPELINES
SERVICING THE REGION
NORTHEAST SUPPLY ENHANCEMENT PROJECT
MARYLAND, DELAWARE, PENNSYLVANIA,
NEW JERSEY, NEW YORK, CONNECTICUT

Williams.

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	11/17/2016	CE	ISSUED FOR FERC DRAFT FILING	1000891	MK	SM
B	3/20/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

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CHECKED BY: MK	DATE: 3/20/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-4	SHEET 1 OF 1
WO: 1000891		4:32 PM 3/20/2017	

Data Sources: Williams 2017; E&E 2017; ESRI 2012; ESRI 2012, 2017; BOEM 2005.

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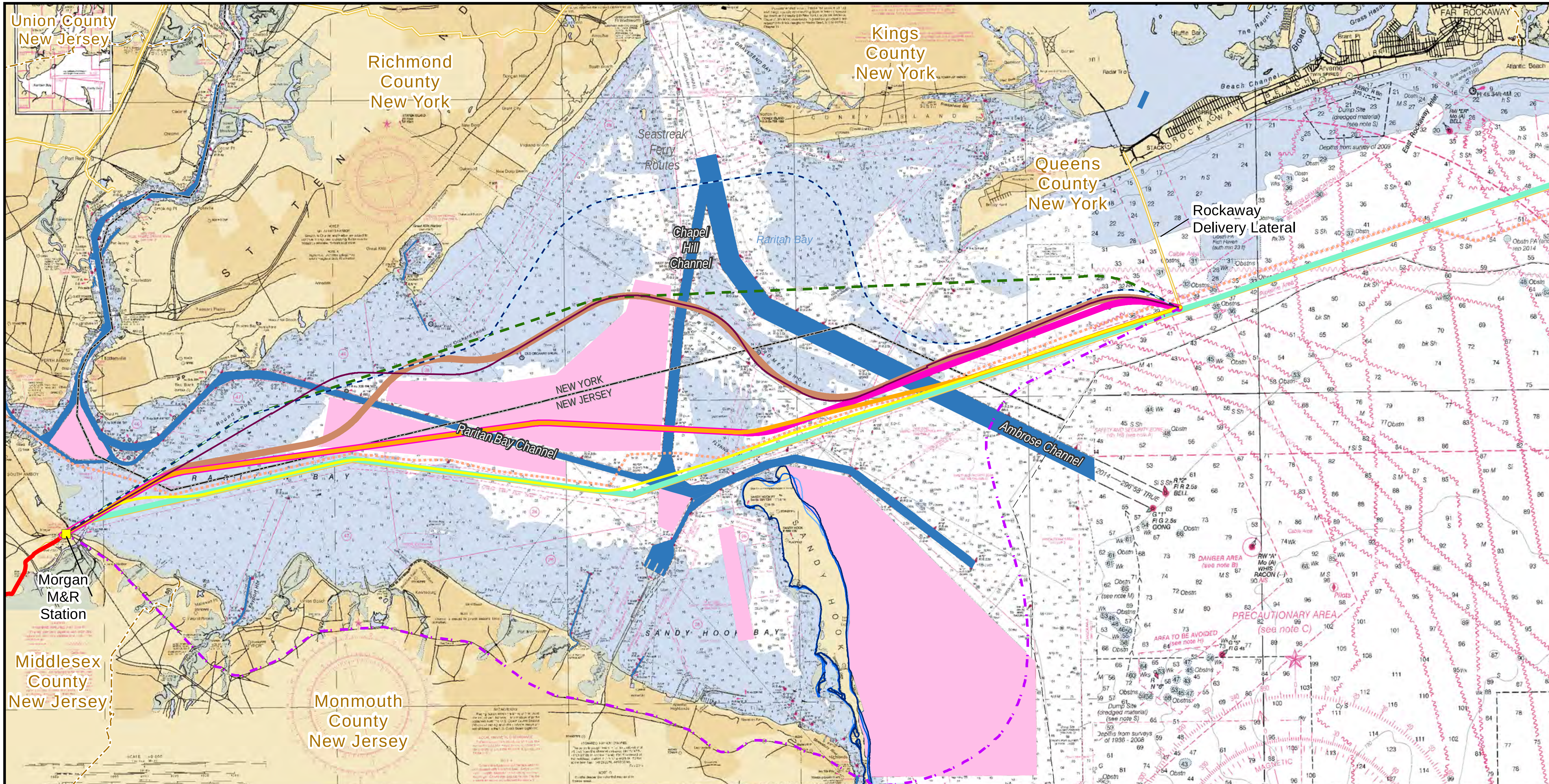


Legend

- Existing Meter & Regulating Station

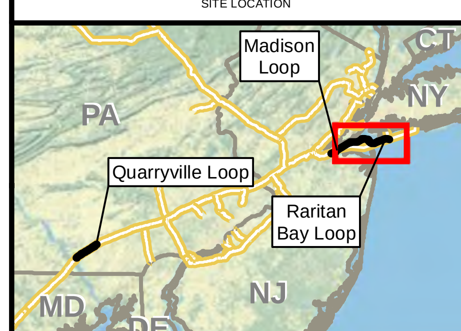
Raritan Bay Alternatives

- Alternative 1
- Alternative 2
- Alternative 3
- Alternative 4
- Alternative 5
- Alternative 7
- Alternative 8
- Alternative 6 (Preferred Raritan Bay Loop)
- Proposed Pipeline: Madison Loop
- Lower NY Bay Lateral line (LNYBL)
- Neptune Cable
- Existing Transco Pipeline
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line
- Sandy Hook Coastline - 2012
- Sandy Hook Coastline - 2007
- Sandy Hook Coastline - 2002
- Maintained Navigation Channel
- Anchorage Areas

N

0 1 2
Miles

SITE LOCATION



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B	3/17/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVES
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams.

DRAWN BY: CE	DATE: 3/17/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
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APPROVED BY:	DATE:	DRAWING NUMBER: 2:12 PM 3/17/2017 FIGURE 10A-5	SHEET 1 OF 1
WO: 1000891			

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016; NJDEP 2002, 2007, 2012.

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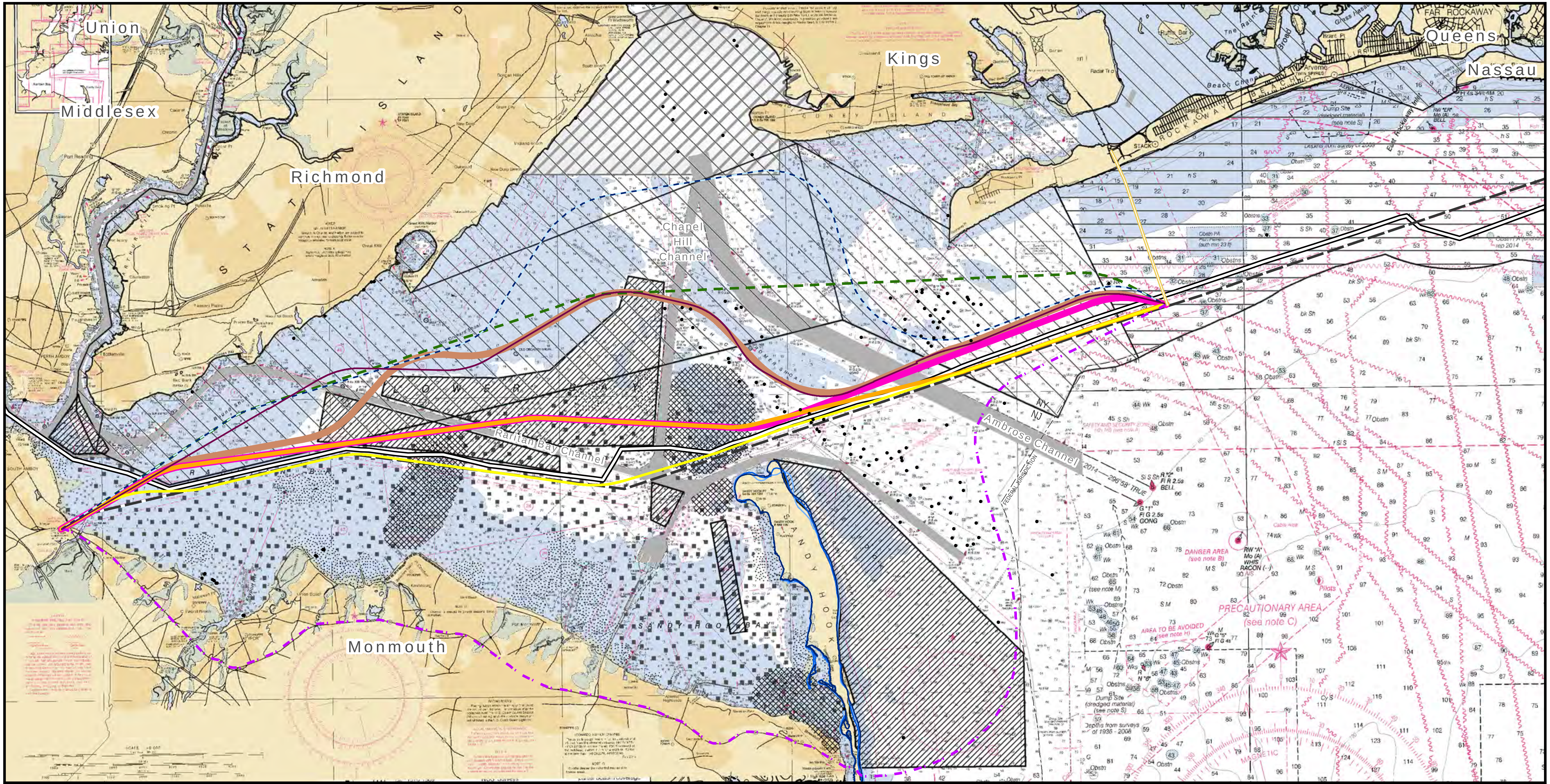


Legend

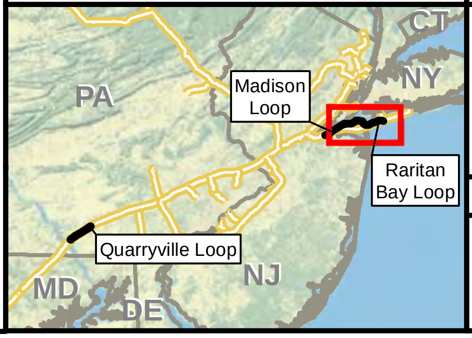
- • Outcropping Rocks
- Raritan Bay Alternatives
  - Alternative 1
  - Alternative 2
  - Alternative 3
  - Alternative 4
  - Alternative 5
  - Alternative 7
  - Alternative 8
  - Alternative 6 (Preferred Raritan Bay Loop)
- Rockaway Delivery Lateral
- Neptune Cable
- Lower NY Bay Lateral line (LNYBL)
- Sandy Hook Coastline - 2002
- Sandy Hook Coastline - 2007
- Sandy Hook Coastline - 2012
- Anchorage Areas
- NJ DEP Surf Clam Relative Abundance (2014)
- NJ DEP Hard Clam Relative Abundance (2014)
  - High
  - Moderate
  - Low
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Mouth of the Hudson River
- Maintained Navigation Channel
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

N

0 1 2

Miles

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-6

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/17/2017	CE	ISSUED FOR FERC DRAFT FILING	1000891	MK	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP - CONSTRAINTS FIGURE
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams

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APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-6	SHEET 1 OF 1
WO: 1000891		2:13 PM 3/17/2017	

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2002, 2007, 2012, 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016; NYS DEC 2015

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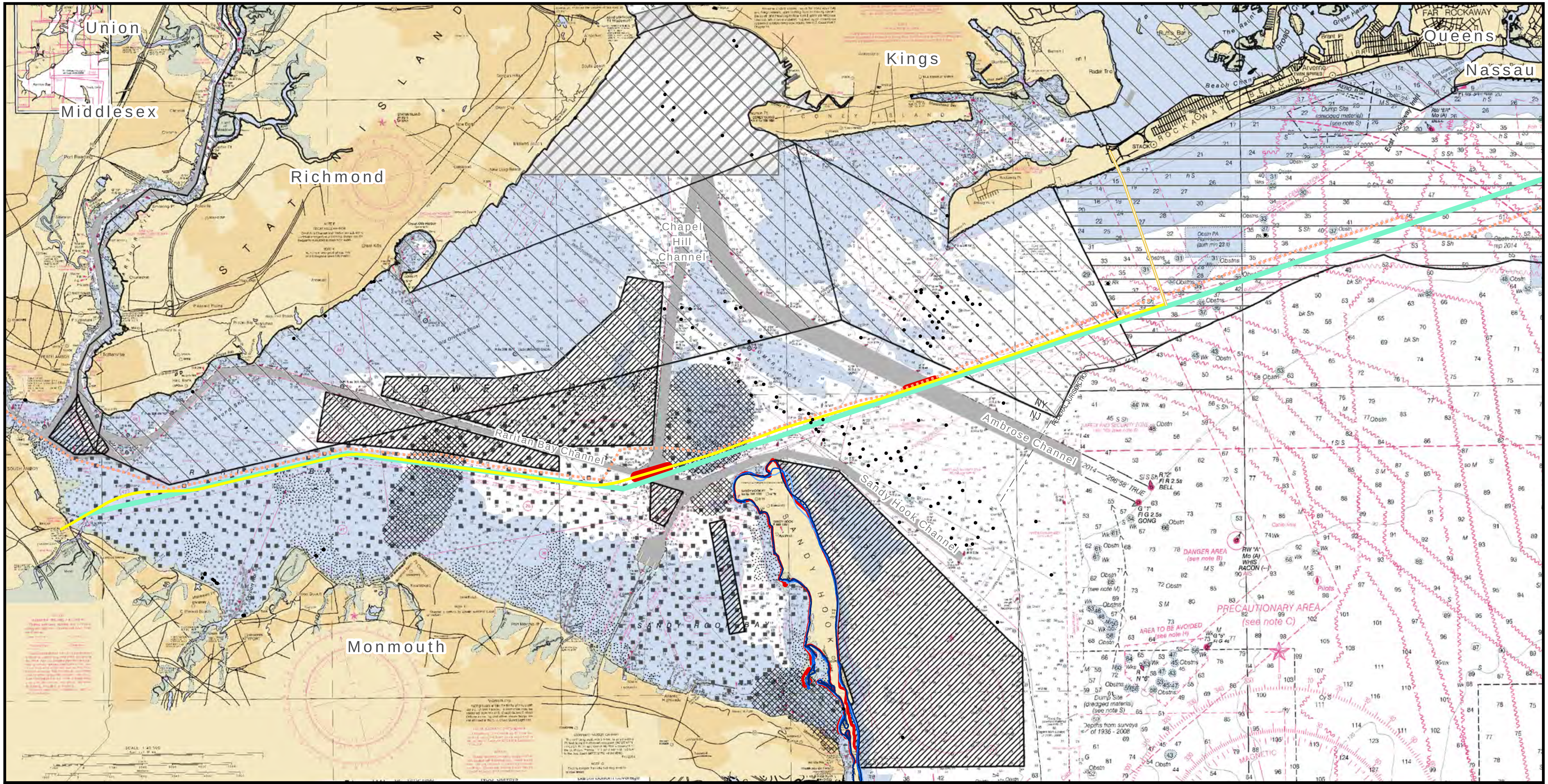


Legend

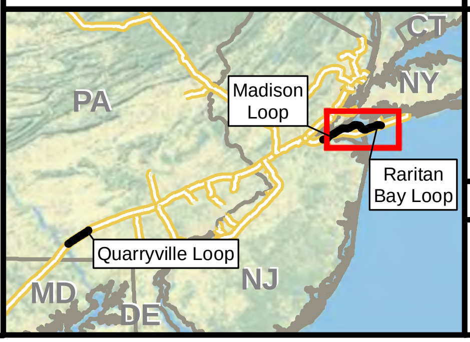
- Outcropping Rocks
- Alternative 1
- Lower NY Bay Lateral line (LNYBL)
- Neptune Cable
- Navigation Channel Crossings
- Sandy Hook Coastline - 2002
- Sandy Hook Coastline - 2007
- Sandy Hook Coastline - 2012
- Rockaway Delivery Lateral
- Sandy Hook
- Anchorage Areas
- NJ DEP Surf Clam Relative Abundance (2014)
- NJ DEP Hard Clam Relative Abundance (2014)
  - High
  - Moderate
  - Low
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Mouth of the Hudson River
- Maintained Navigation Channel
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

N

0 1 2
Miles

Features identified in red highlight constraints.

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-7

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/22/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVE 1
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams

DRAWN BY: CE	DATE: 3/22/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
CHECKED BY: MK	DATE: 3/22/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-7 1:07 PM 3/22/2017	SHEET 1 OF 1
WO: 1000891			

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2002, 2007, 2012, 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016; NYS DEC 2015

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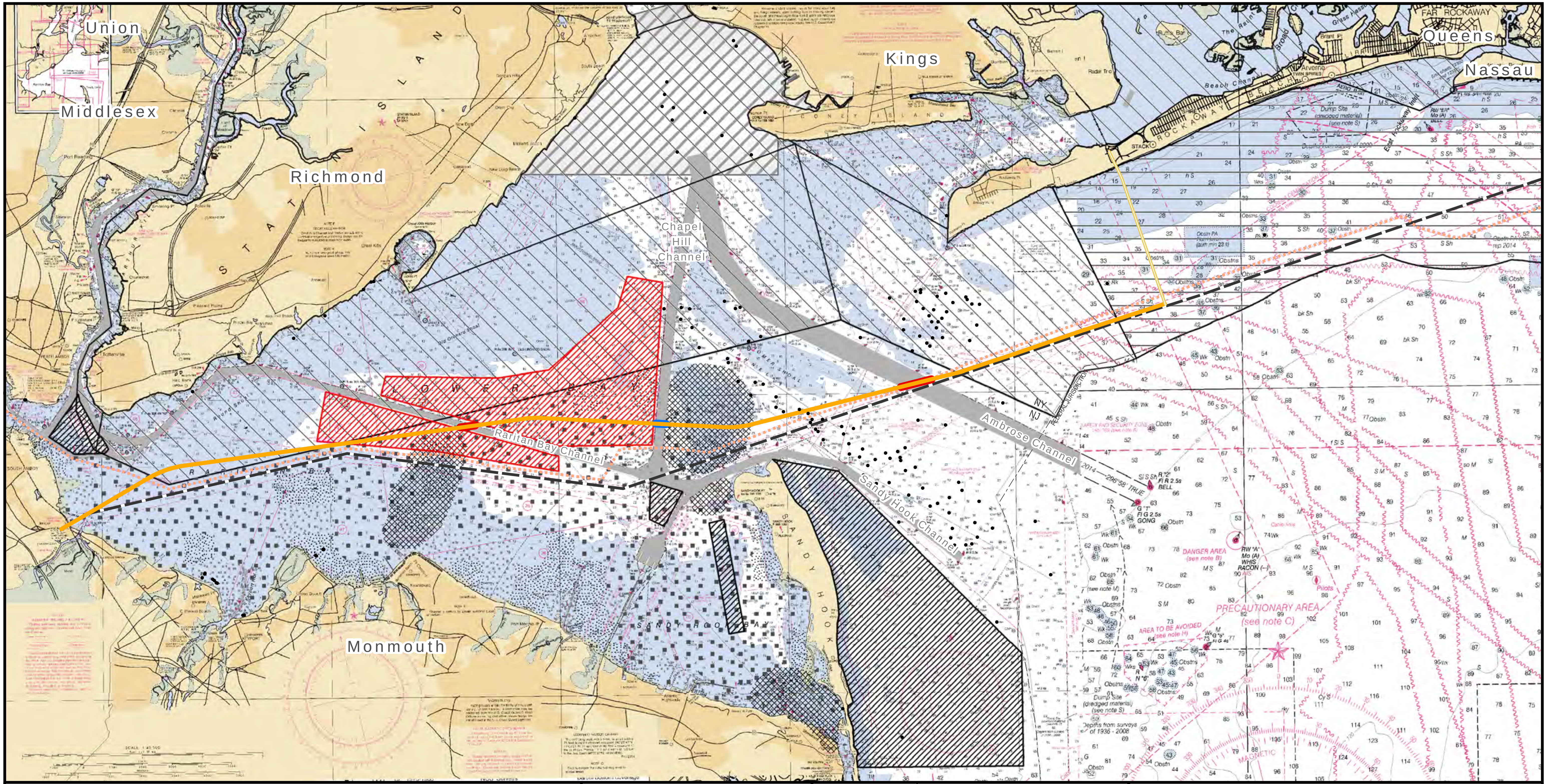


Legend

- Outcropping Rocks
- Alternative 2
- Neptune Cable
- Navigation Channel Crossings
- Chapel Hill Crossing
- Rockaway Delivery Lateral
- Lower NY Bay Lateral line (LNYBL)
- Anchorage Areas Crossed
- Other Anchorage Areas
- NJ DEP Surf Clam Relative Abundance (2014)
- NJ DEP Hard Clam Relative Abundance (2014)
- Moderate
- Low
- High
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Mouth of the Hudson River
- Maintained Navigation Channel
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

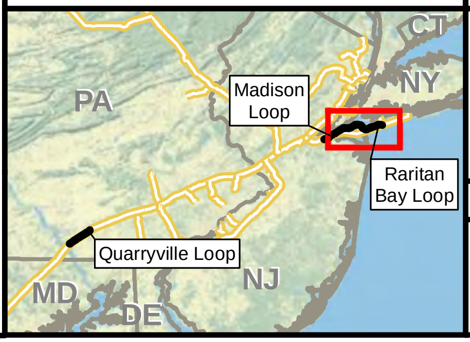
N

0 1 2

Miles

Features identified in red highlight constraints.

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-8

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/22/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVE 2
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams

DRAWN BY: CE	DATE: 3/22/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
CHECKED BY: MK	DATE: 3/22/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
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WO: 1000891		1:07 PM 3/22/2017	

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016; NYS DEC 2015

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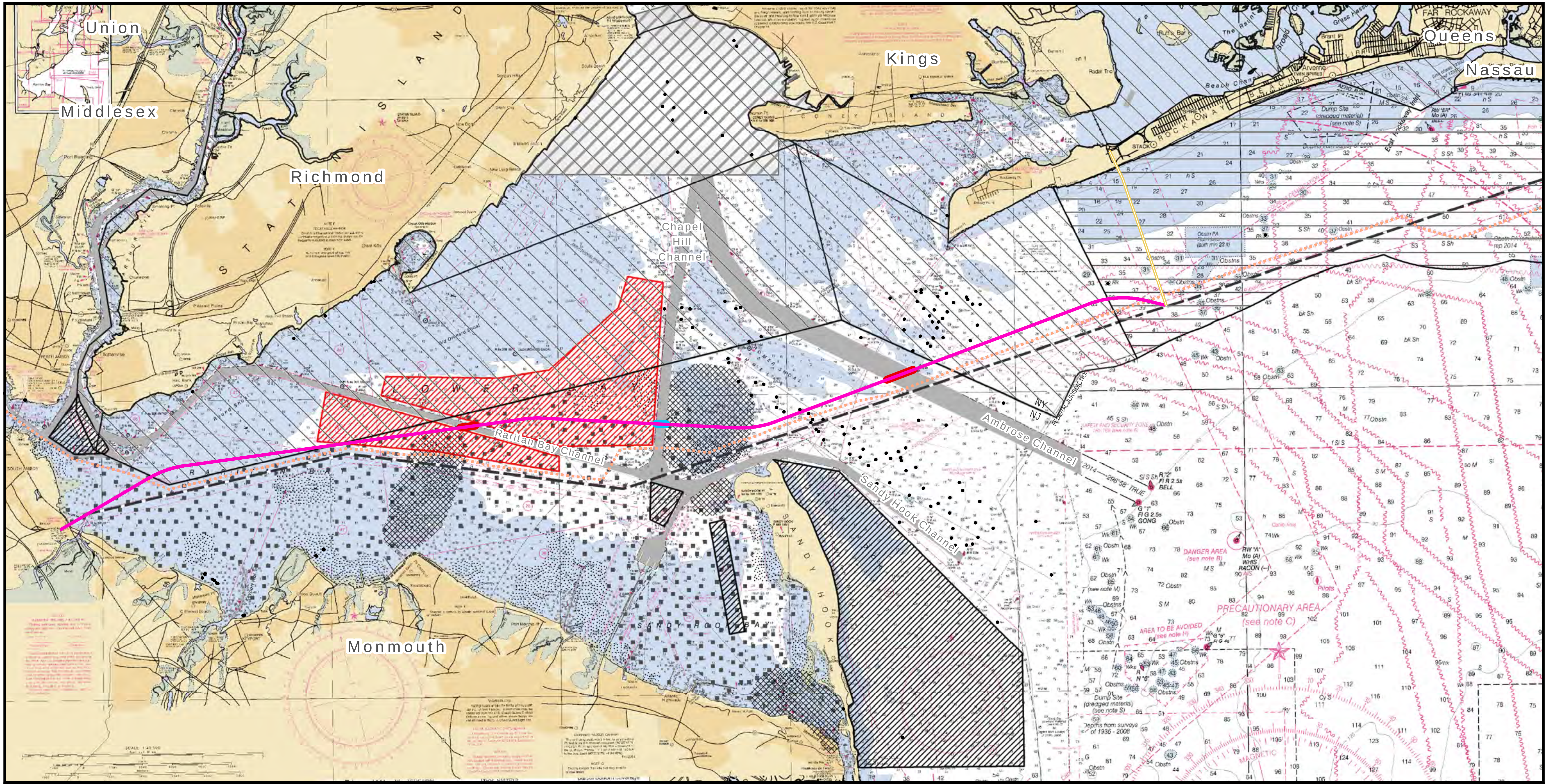


Legend

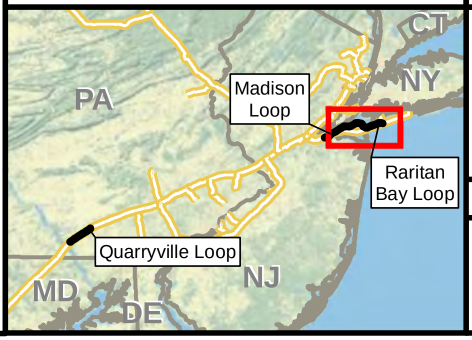
- Outcropping Rocks
- Alternative 3
- Neptune Cable
- Navigation Channel Crossings
- Chapel Hill Crossing
- Rockaway Delivery Lateral
- Lower NY Bay Lateral line (LNYBL)
- Anchorage Areas Crossed
- Other Anchorage Areas
- NJ DEP Surf Clam Relative Abundance (2014)
- NJ DEP Hard Clam Relative Abundance (2014)
- High
- Moderate
- Low
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Mouth of the Hudson River
- Maintained Navigation Channel
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

N

0 1 2 Miles

Features identified in red highlight constraints.

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-9

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
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TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVE 3
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams

DRAWN BY: CE	DATE: 3/22/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
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WO: 1000891		1:08 PM 3/22/2017	

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016; NYS DEC 2015

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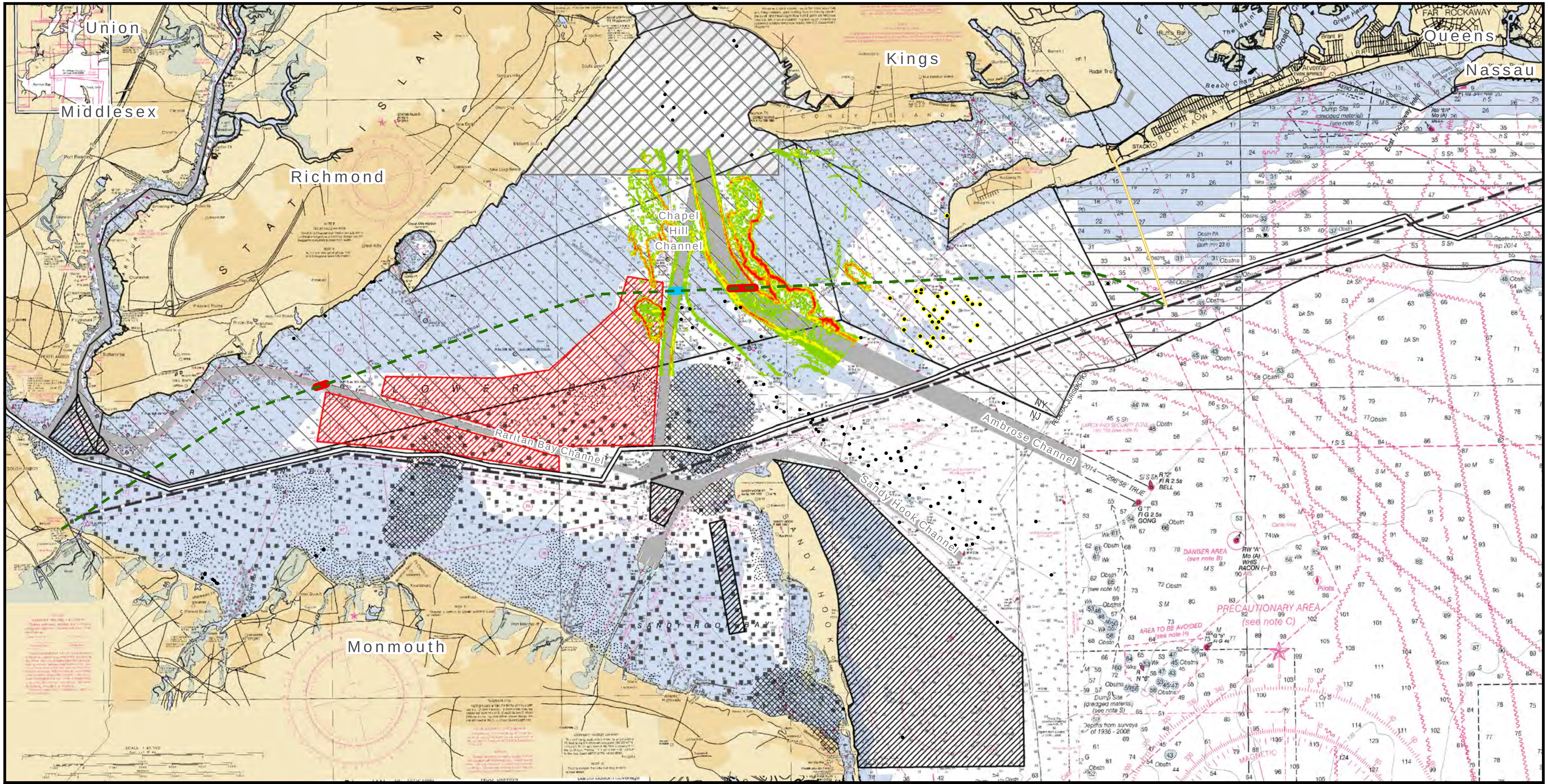


Legend

- Nearby Outcropping Rocks
- Outcropping Rocks
- Alternative 4
- Navigation Channel Crossings
- Chapel Hill Crossing
- Rockaway Delivery Lateral
- Neptune Cable
- Lower NY Bay Lateral line (LNYBL)

Slope (Degrees)

- 0.7 - 2
- 2.1 - 3
- 3.1 - 5
- 5.1 - 11.6

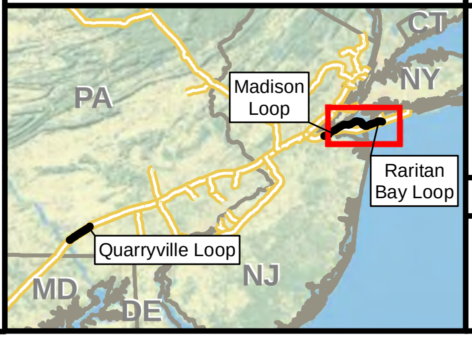
- Anchorage Areas Crossed
- Other Anchorage Areas
- NJ DEP Surf Clam Relative Abundance (2014)
- NJ DEP Hard Clam Relative Abundance (2014)
  - High
  - Moderate
  - Low
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Mouth of the Hudson River
- Maintained Navigation Channel
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

N

0 1 2
Miles

Features identified in red highlight constraints.

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-10

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/22/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVE 4
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams.

DRAWN BY: CE	DATE: 3/22/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
CHECKED BY: MK	DATE: 3/22/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: 1:08 PM 3/22/2017 FIGURE 10A-10	SHEET 1 OF 1
WO: 1000891			

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016; NOAA NOS SP 1997; NYS DEC 2015

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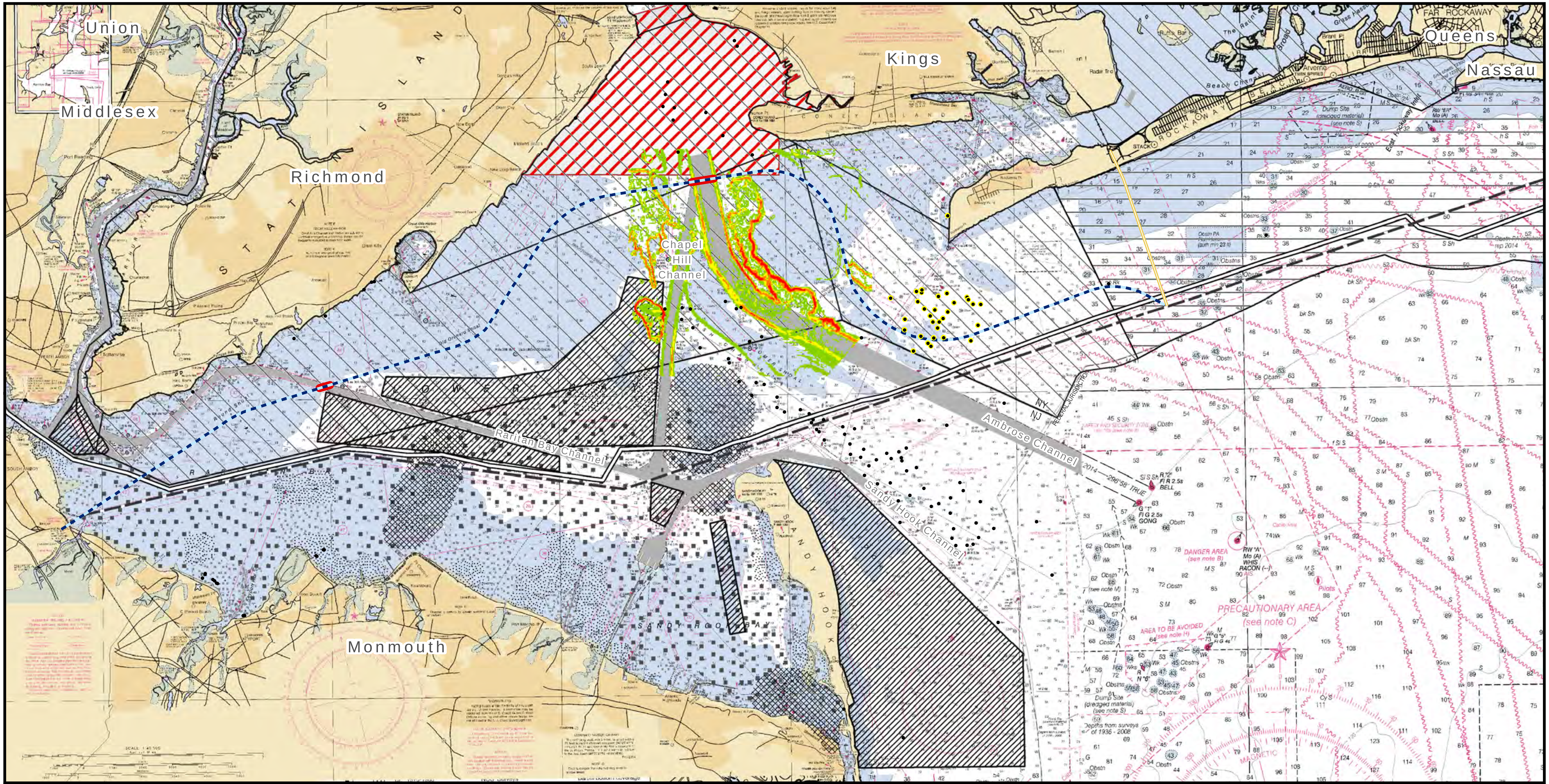


Legend

- Nearby Outcropping Rocks
- Outcropping Rocks
- Alternative 5
- Navigation Channel Crossings
- Rockaway Delivery Lateral
- Neptune Cable
- Lower NY Bay Lateral line (LNYBL)

Slope (Degrees)

- 0.7 - 2
- 2.1 - 3
- 3.1 - 5
- 5.1 - 11.6
- Mouth of the Hudson River
- Anchorage Areas

- NJ DEP Surf Clam Relative Abundance (2014)

NJ DEP Hard Clam Relative Abundance (2014)

- High
- Moderate
- Low
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Maintained Navigation Channel
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

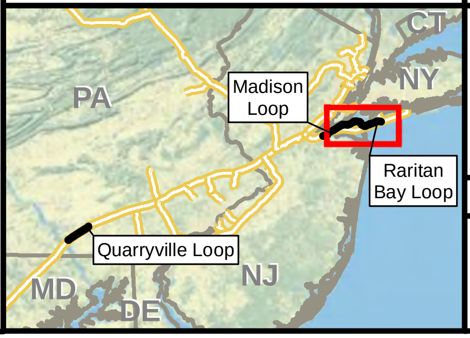
N

0 1 2

Miles

Features identified in red highlight constraints.

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-11

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVE 5
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/22/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

DRAWN BY: CE	DATE: 3/22/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
CHECKED BY: MK	DATE: 3/22/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-11	SHEET 1 OF 1
WO: 1000891		1:08 PM 3/22/2017	

L:\Buffalo\Williams_NYRE\Map\MXDs\ResourceReport\RR10\FINAL\10A-11_RaritanBayLoop_Alt5.mxd

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016, NOAA NOS SP 1997; NYS DEC 2015

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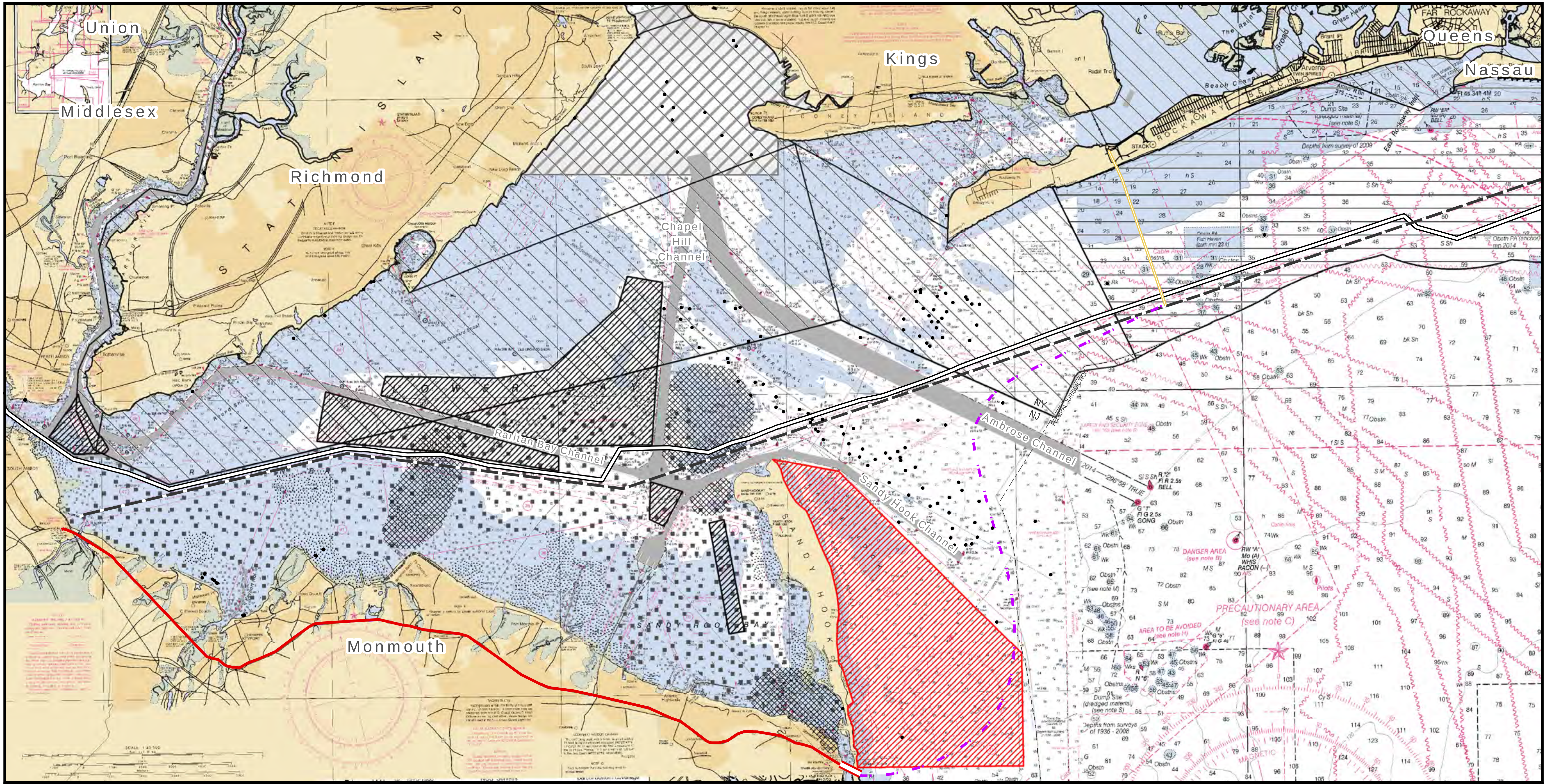


Legend

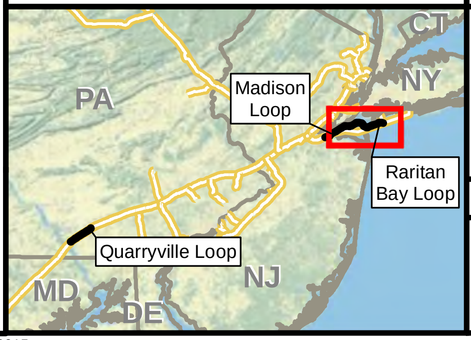
- Outcropping Rocks
- HDD
- Alternative 7 - Onshore
- Alternative 7 - Offshore
- Rockaway Delivery Lateral
- Neptune Cable
- Lower NY Bay Lateral line (LNYBL)
- Anchorage Area Crossed
- Other Anchorage Areas
- NJ DEP Surf Clam Relative Abundance (2014)
- NJ DEP Hard Clam Relative Abundance (2014)
  - High
  - Moderate
  - Low
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Mouth of the Hudson River
- Maintained Navigation Channel
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

N

0 1 2 Miles

Features identified in red highlight constraints.

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-12

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVE 7
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/22/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

DRAWN BY: CE	DATE: 3/22/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
CHECKED BY: MK	DATE: 3/22/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-12	SHEET 1 OF 1
WO: 1000891		1:09 PM 3/22/2017	

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016, NYS DEC 2015

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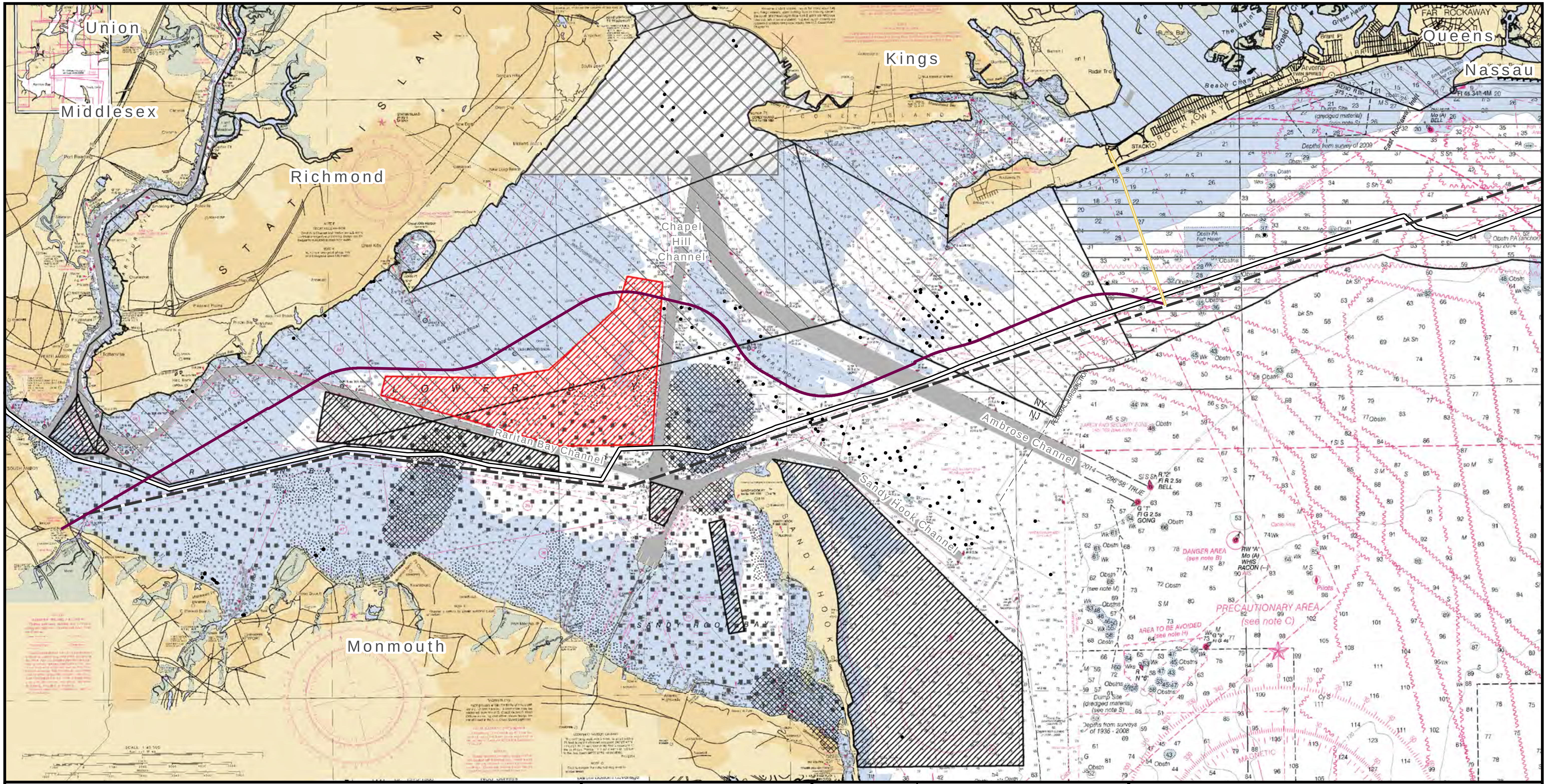


Legend

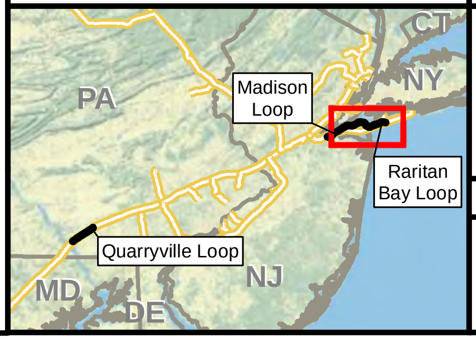
- Outcropping Rocks
- Alternative 6 (Preferred Raritan Bay Loop)
- Rockaway Delivery Lateral
- Neptune Cable
- Lower NY Bay Lateral line (LNYBL)
- Anchorage Area Crossed
- Other Anchorage Areas
- NJ DEP Surf Clam Relative Abundance (2014)
- NJ DEP Hard Clam Relative Abundance (2014)
  - High
  - Moderate
  - Low
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Maintained Navigation Channel
- Mouth of the Hudson River
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

Features identified in red highlight constraints.

N

0 1 2
Miles

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-13

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/22/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVE 6
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams

DRAWN BY: CE	DATE: 3/22/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
CHECKED BY: MK	DATE: 3/22/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: 1:09 PM 3/22/2017	FIGURE 10A-13 SHEET 1 OF 1
WO: 1000891			

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016, NYS DEC 2015

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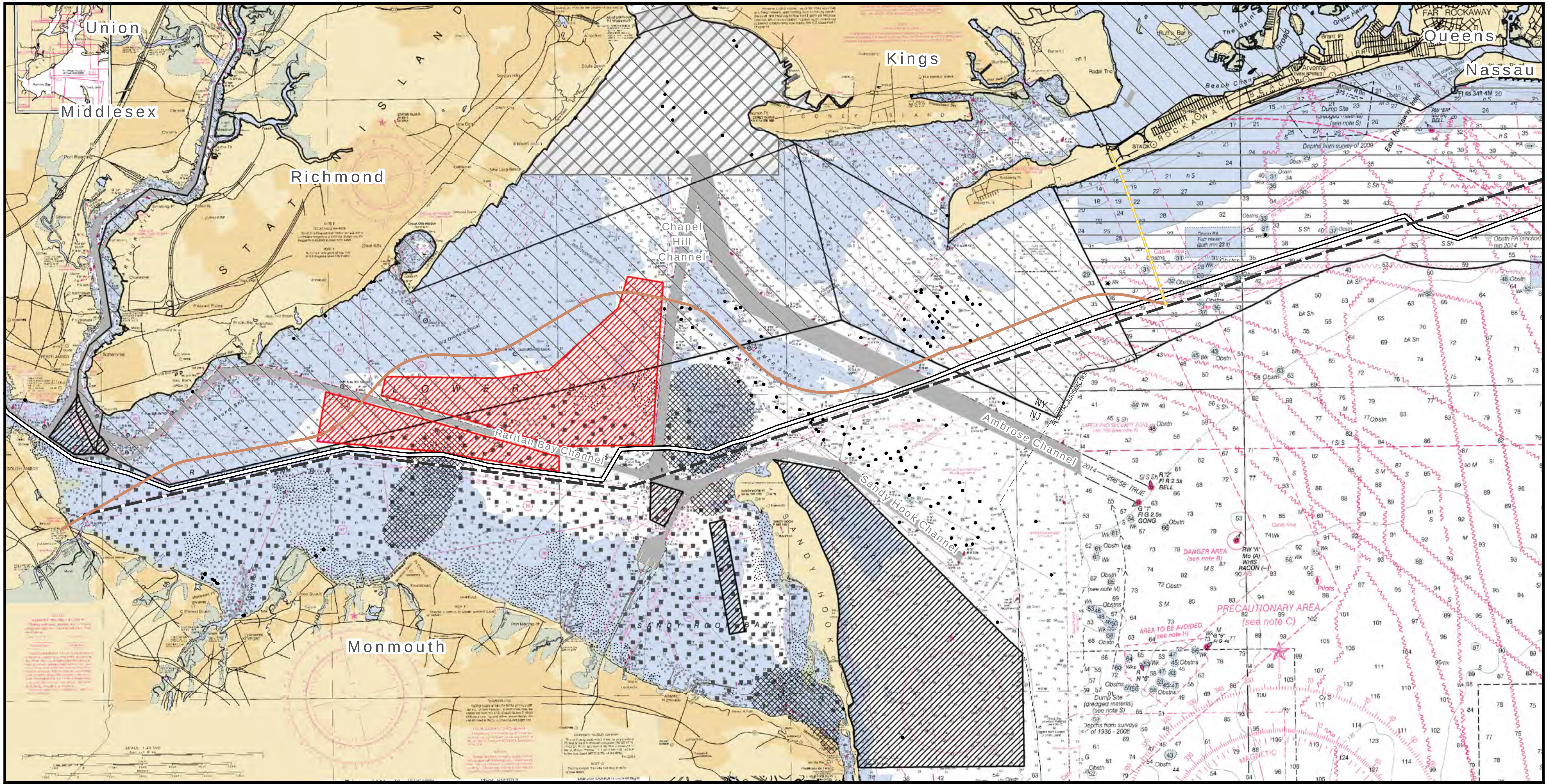


Legend

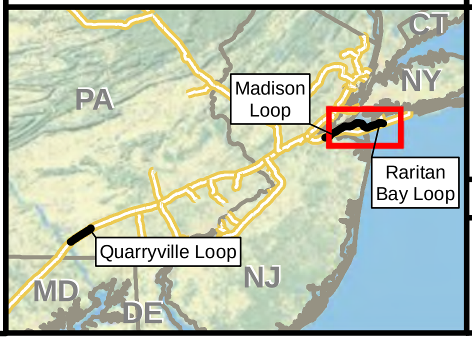
- Outcropping Rocks
- Alternative 8
- Rockaway Delivery Lateral
- Neptune Cable
- Lower NY Bay Lateral line (LNYBL)
- Anchorage Areas Crossed
- Other Anchorage Areas
- NJ DEP Surf Clam Relative Abundance (2014)
- NJ DEP Hard Clam Relative Abundance (2014)
  - High
  - Moderate
  - Low
- NYS DEC Shellfish - Uncertified
- NYS DEC Shellfish - Certified
- Mouth of the Hudson River
- Maintained Navigation Channel
- County Boundary
- NY/NJ Boundary
- State/Federal Offshore Line

N

0 1 2
Miles

Features identified in red highlight constraints.

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-14

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/22/2017	CE	ISSUED FOR FERC FILING	1000891	MK	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
RARITAN BAY LOOP ALTERNATIVE 8
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY AND NEW YORK

Williams.

DRAWN BY: CE	DATE: 3/22/2017	ISSUE FOR BID: N/A	SCALE: 1:117,000
CHECKED BY: MK	DATE: 3/22/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-14	SHEET 1 OF 1
WO: 1000891		1:09 PM 3/22/2017	

Data Sources: Williams 2017; E&E 2017; ESRI 2012; NJDEP 2014; NOAA ENC 2013 (Chart # 12327 and # 12326) Seamless Web Service; NOAA ENC Direct 2016, NYS DEC 2015

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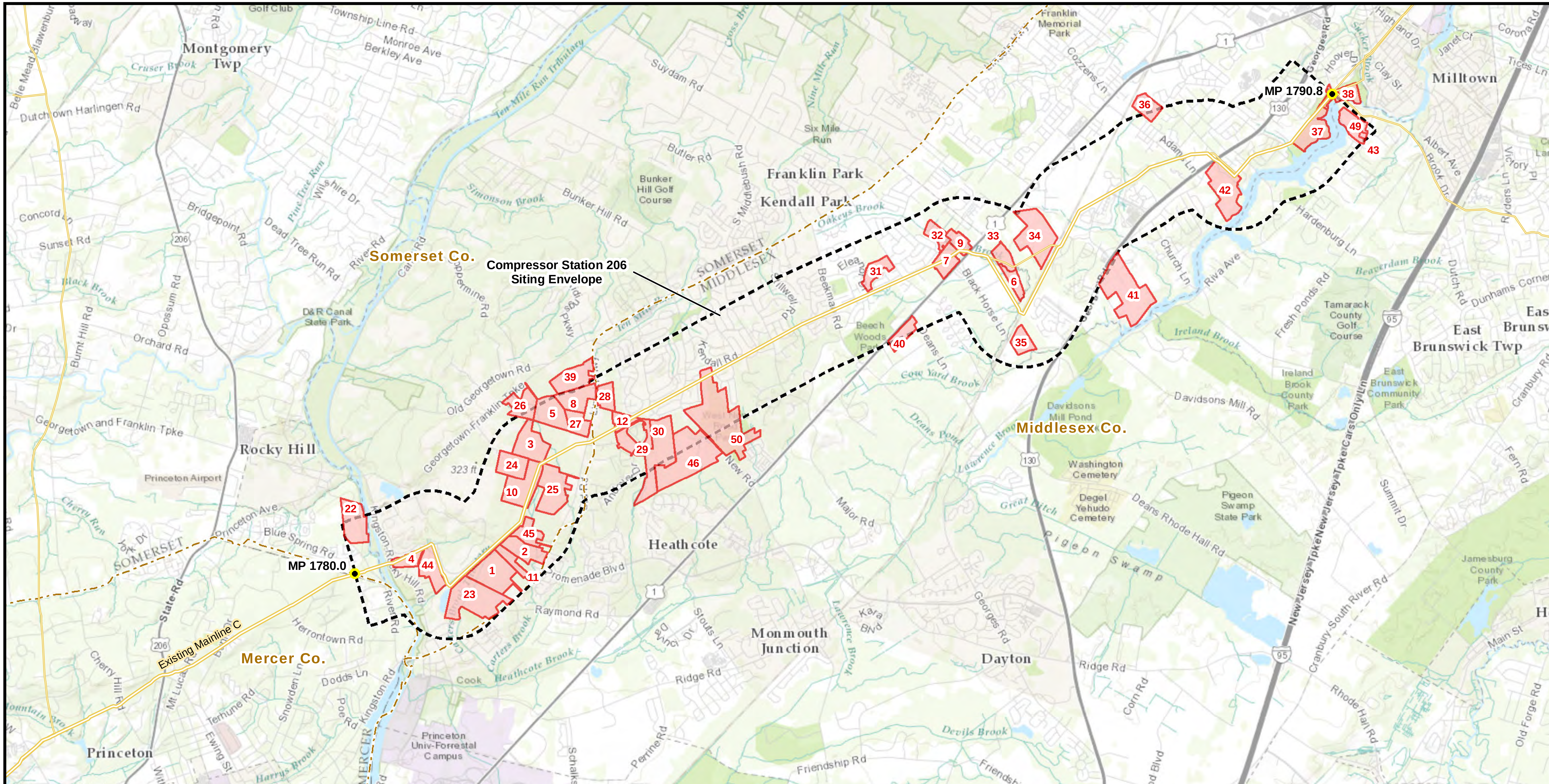


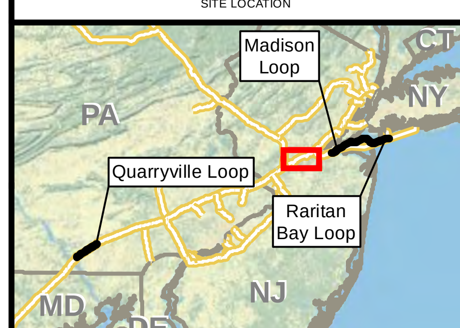
Legend

- Milepost
- Existing Transco Mainline-C
- Other Existing Transco Pipeline
- County Boundary
- Parcels Meeting Intial Siting Criteria
- Compressor Station 206 Siting Envelope (0.5-Mile From Existing Mainline C)

N

0 0.5 1
Miles

SITE LOCATION



DRAWING NO.

REFERENCE TITLE

10A-15

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
COMPRESSOR STATION 206 SITING ENVELOPE
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/20/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

DRAWN BY: MK DATE: 3/20/2017 ISSUE FOR BID: N/A SCALE: 1:58,000

CHECKED BY: AL DATE: 3/20/2017 ISSUE FOR CONSTRUCTION: N/A Project features ver14

APPROVED BY: DATE: DRAWING NUMBER: FIGURE 10A-15 SHEET 1 OF 1

WO: 1000891 4:53 PM 3/20/2017

Data Sources: NJDEP 2017; Williams 2017; E&E 2017; ESRI 2012, 2017.

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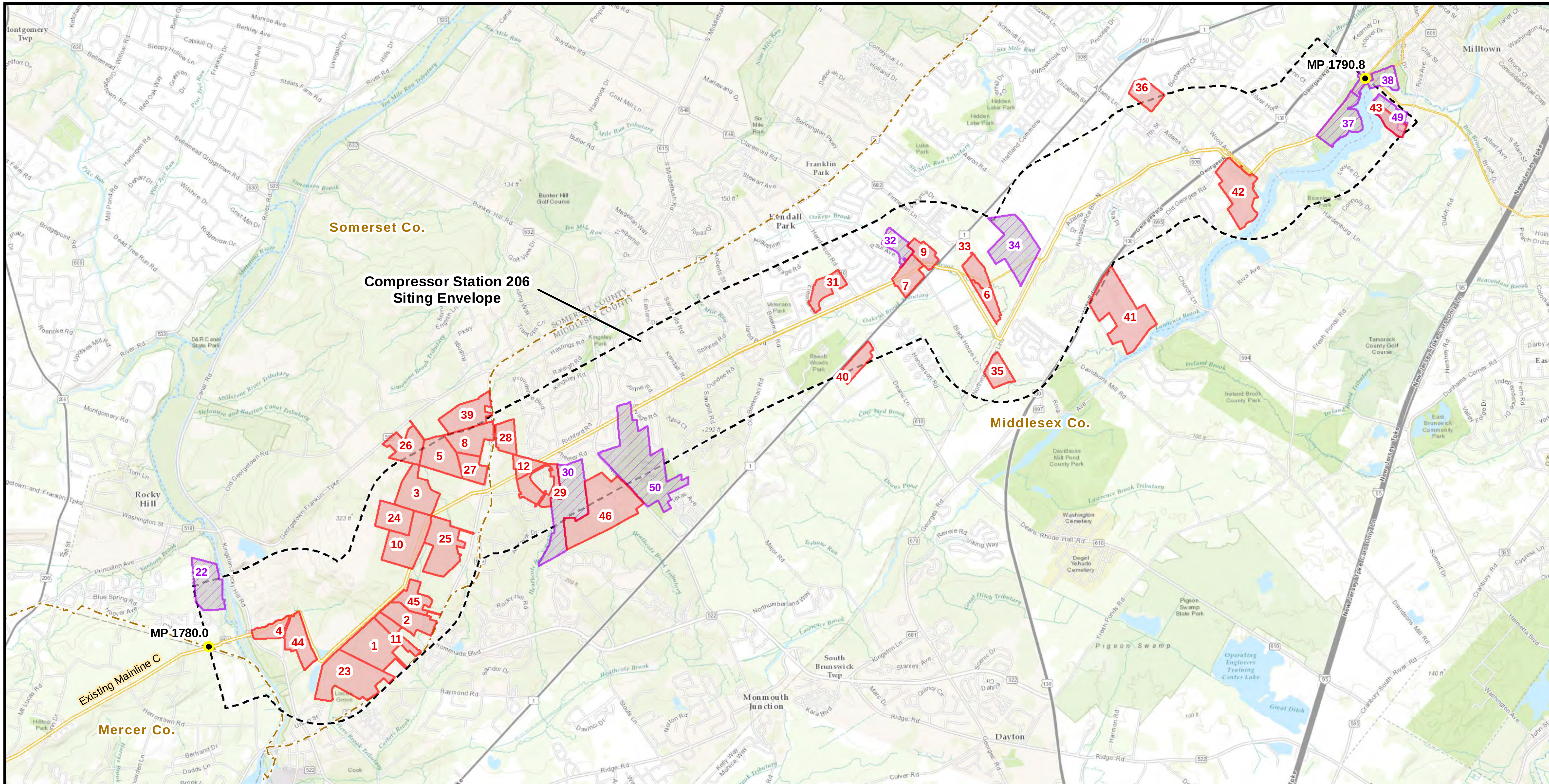

Legend

- Milepost
- Existing Transco Mainline-C
- Other Existing Transco Pipeline
- County Boundary
- Compressor Station 206 Siting Envelope (0.5-Mile From Existing Mainline C)
- Sites Meeting Tier 1 Green Acres Parcel Criteria
- Tier 1 Criteria - Green Acres Parcel

N

0 0.5 1

Miles

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-16

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/20/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
TIER 1 CRITERIA - GREEN ACRES PARCELS
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

DRAWN BY: MK	DATE: 3/20/2017	ISSUE FOR BID: N/A	SCALE: 1:49,000
CHECKED BY: AL	DATE: 3/20/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-16	SHEET 1 OF 1
WO: 1000891		4:53 PM 3/20/2017	

Data Sources: NJDEP 2017; Williams 2017; E&E 2017; ESRI 2012, 2017.

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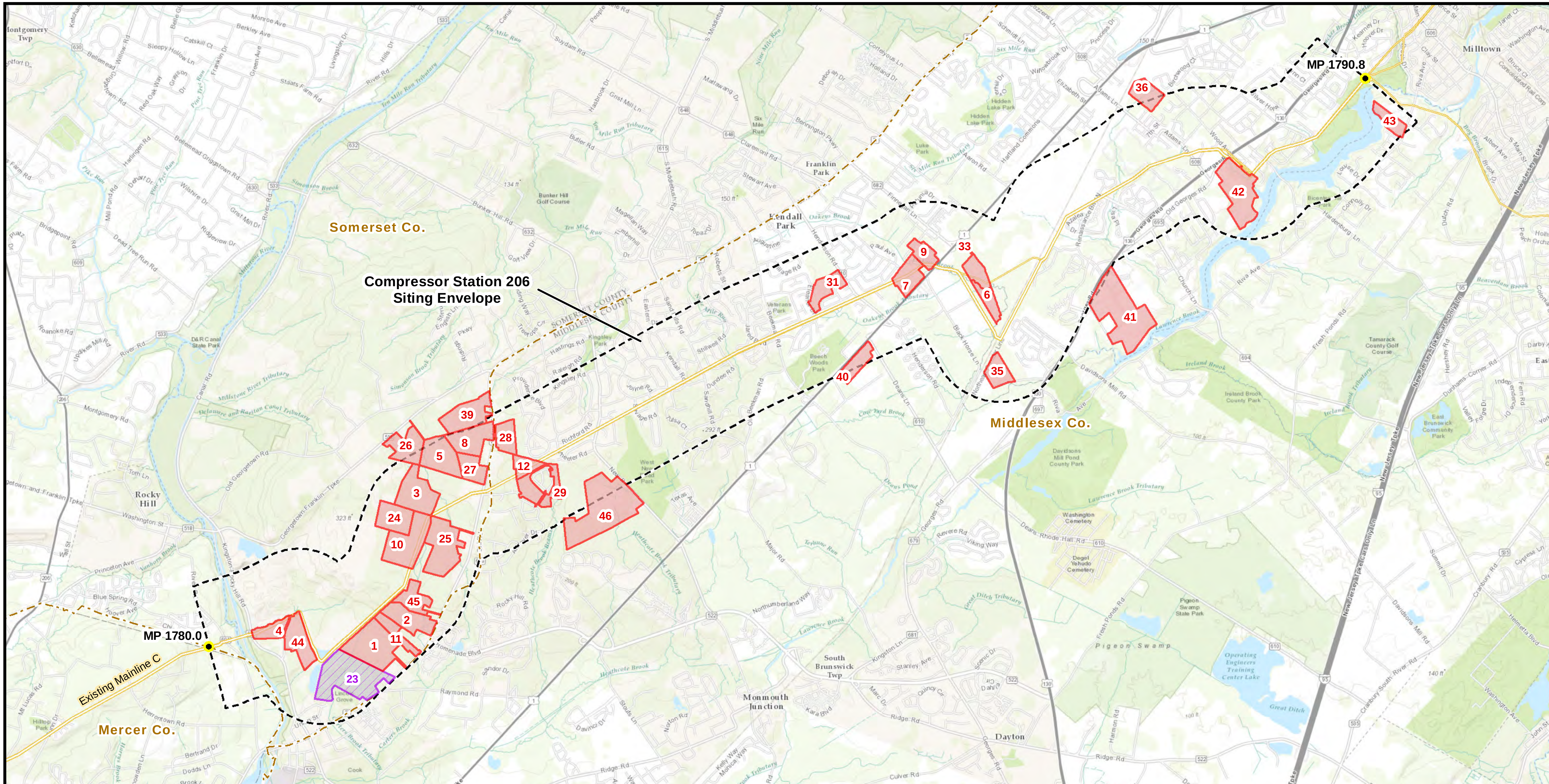

Legend

- Milepost
- Existing Transco Mainline-C
- Other Existing Transco Pipeline
- County Boundary
- Compressor Station 206 Siting Envelope (0.5-Mile From Existing Mainline C)
- Sites Meeting Tier 1 NJ DOT Parcel Criteria
- Tier 1 Criteria - NJ DOT Owned Parcel

N

0 0.5 1
Miles

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-17

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/20/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
TIER 1 CRITERIA - PARCELS OWNED BY NJDOT
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

DRAWN BY: MK	DATE: 3/20/2017	ISSUE FOR BID: N/A	SCALE: 1:49,000
CHECKED BY: AL	DATE: 3/20/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-17	SHEET 1 OF 1
WO: 1000891		4:54 PM 3/20/2017	

Data Sources: NJDEP 2017; Williams 2017; E&E 2017; ESRI 2012, 2017.

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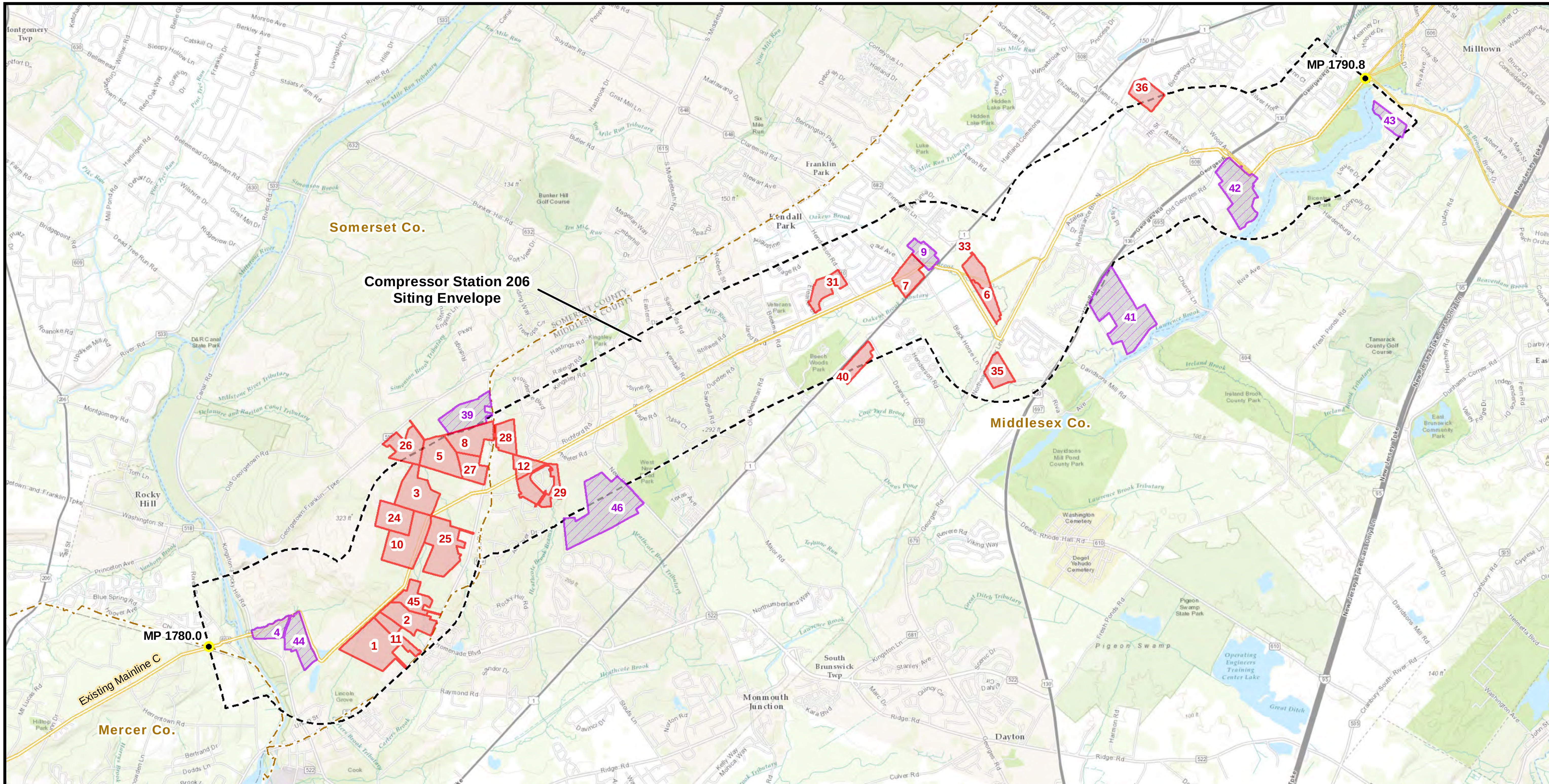

Legend

- Milepost
- Existing Transco Mainline-C
- Other Existing Transco Pipeline
- County Boundary
- Compressor Station 206 Siting Envelope (0.5-Mile From Existing Mainline C)
- Sites Meeting Tier 1 Structure Criteria
- Tier 1 Criteria - Structure/Building on Parcel

N

0 0.5 1
Miles

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-18

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/20/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
TIER 1 CRITERIA - PARCELS WITH STRUCTURES/BUILDINGS
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

DRAWN BY: MK	DATE: 3/20/2017	ISSUE FOR BID: N/A	SCALE: 1:49,000
CHECKED BY: AL	DATE: 3/20/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-18	SHEET 1 OF 1
WO: 1000891		4:55 PM 3/20/2017	

Data Sources: NJDEP 2017; Williams 2017; E&E 2017; ESRI 2012, 2017.

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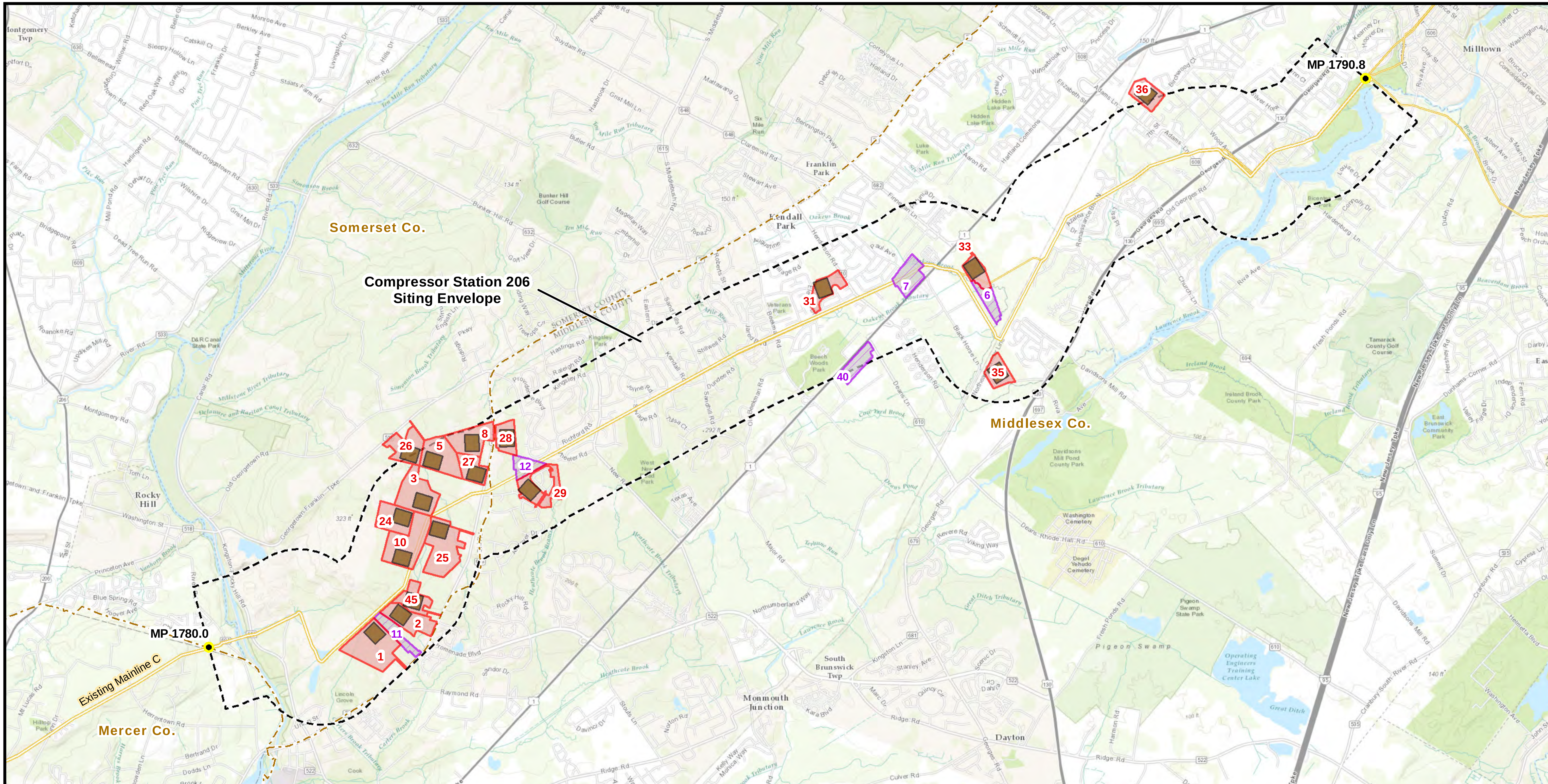

Legend
- Milepost
- Existing Transco Mainline-C
- Other Existing Transco Pipeline
- County Boundary
- Compressor Station 206 Siting Envelope (0.5-Mile From Existing Mainline C)
- Representative Compressor Station Footprint (600 ft x 700 ft)
- Sites Meeting Tier 1 Facility Footprint Criteria
- Tier 1 Criteria - Cannot Fit Facility Footprint

0 0.5 1
Miles

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
10A-19	

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
TIER 1 CRITERIA - SITE CONFIGURATION
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

DRAWN BY: MK	DATE: 3/21/2017	ISSUE FOR BID: N/A	SCALE: 1:49,000
CHECKED BY: AL	DATE: 3/21/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: 11:05 AM 3/21/2017	FIGURE 10A-19 SHEET 1 OF 1
WO: 1000891			

Data Sources: NJDEP 2017; Williams 2017; E&E 2017; ESRI 2012, 2017.

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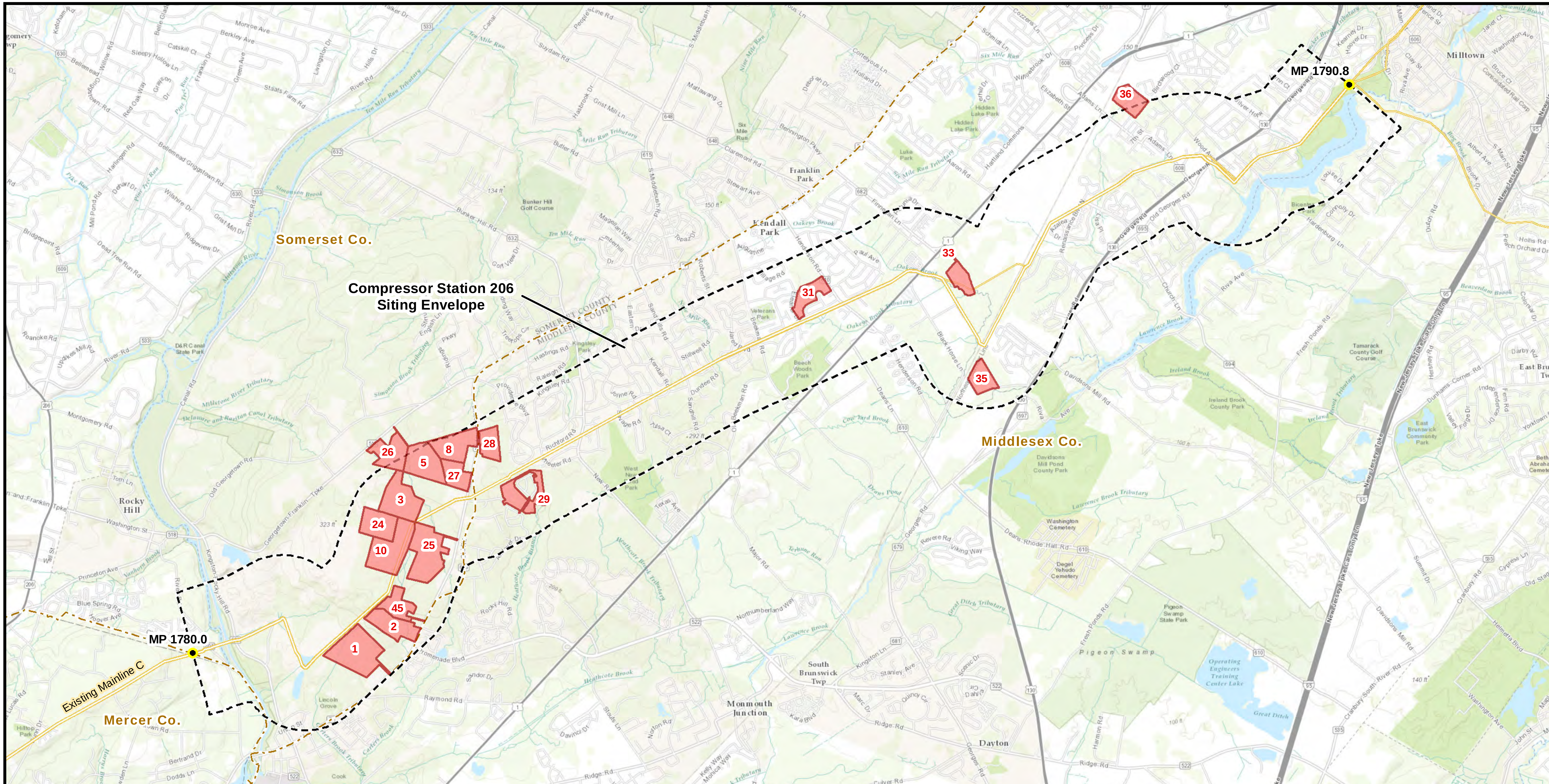

Legend

- Milepost
- Existing Transco Mainline-C
- Other Existing Transco Pipeline
- County Boundary
- Compressor Station 206 Siting Envelope (0.5-Mile From Existing Mainline C)
- Sites Meeting Tier 1 Criteria

N

0 0.5 1
Miles

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-20

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
SITES MEETING TIER 1 SITING CRITERIA
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

DRAWN BY: MK	DATE: 3/21/2017	ISSUE FOR BID: N/A	SCALE: 1:49,000
CHECKED BY: AL	DATE: 3/21/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-20	SHEET 1 OF 1
WO: 1000891		11:05 AM 3/21/2017	

Data Sources: NJDEP 2017; Williams 2017; E&E 2017; ESRI 2012, 2017.

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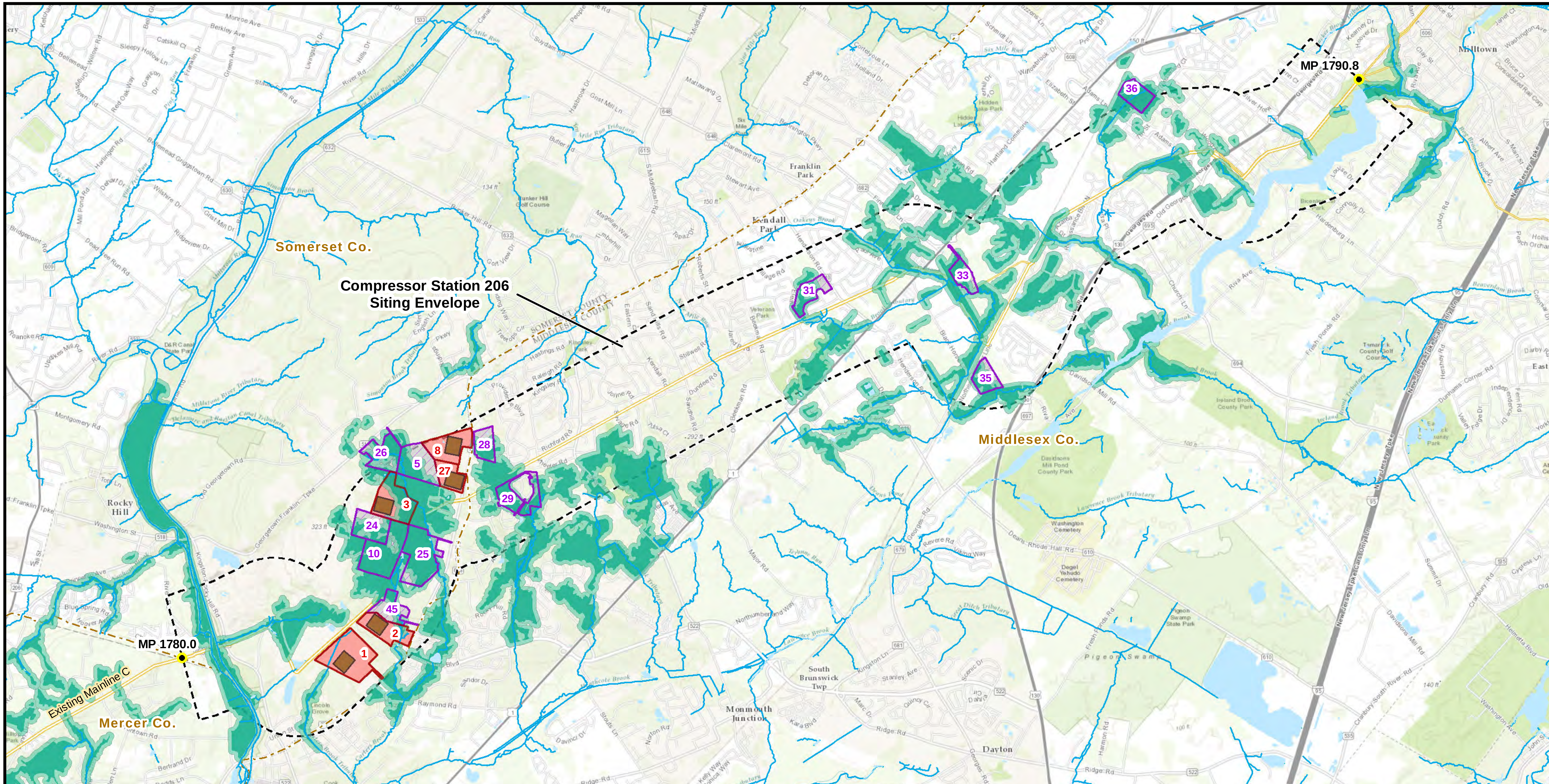

Legend

- Milepost
- Existing Transco Mainline-C
- Other Existing Transco Pipeline
- Compressor Station 206 Siting Envelope (0.5-Mile From Existing Mainline C)
- Representative Compressor Station Footprint (600 ft x 700 ft)
- Sites Meeting Tier 2 Facility Footprint With Wetland Buffer Criteria
- Tier 2 Criteria - Facility Footprint With Wetland Buffer
- County Boundary
- Stream (NHD)
- Waterbody (NHD)
- NJDEP Wetlands (2012)
- NJDEP Wetlands buffer (150-ft)

N

0 0.5 1
Miles

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-21

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
TIER 2 CRITERIA - NJDEP WETLANDS
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

DRAWN BY: MK	DATE: 3/21/2017	ISSUE FOR BID: N/A	SCALE: 1:48,144
CHECKED BY: AL	DATE: 3/21/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-21	SHEET 1 OF 1
WO: 1000891		11:04 AM 3/21/2017	

Data Sources: NJDEP 2012; USGS-NHD 2016; Williams 2017; E&E 2017; ESRI 2012, 2017.

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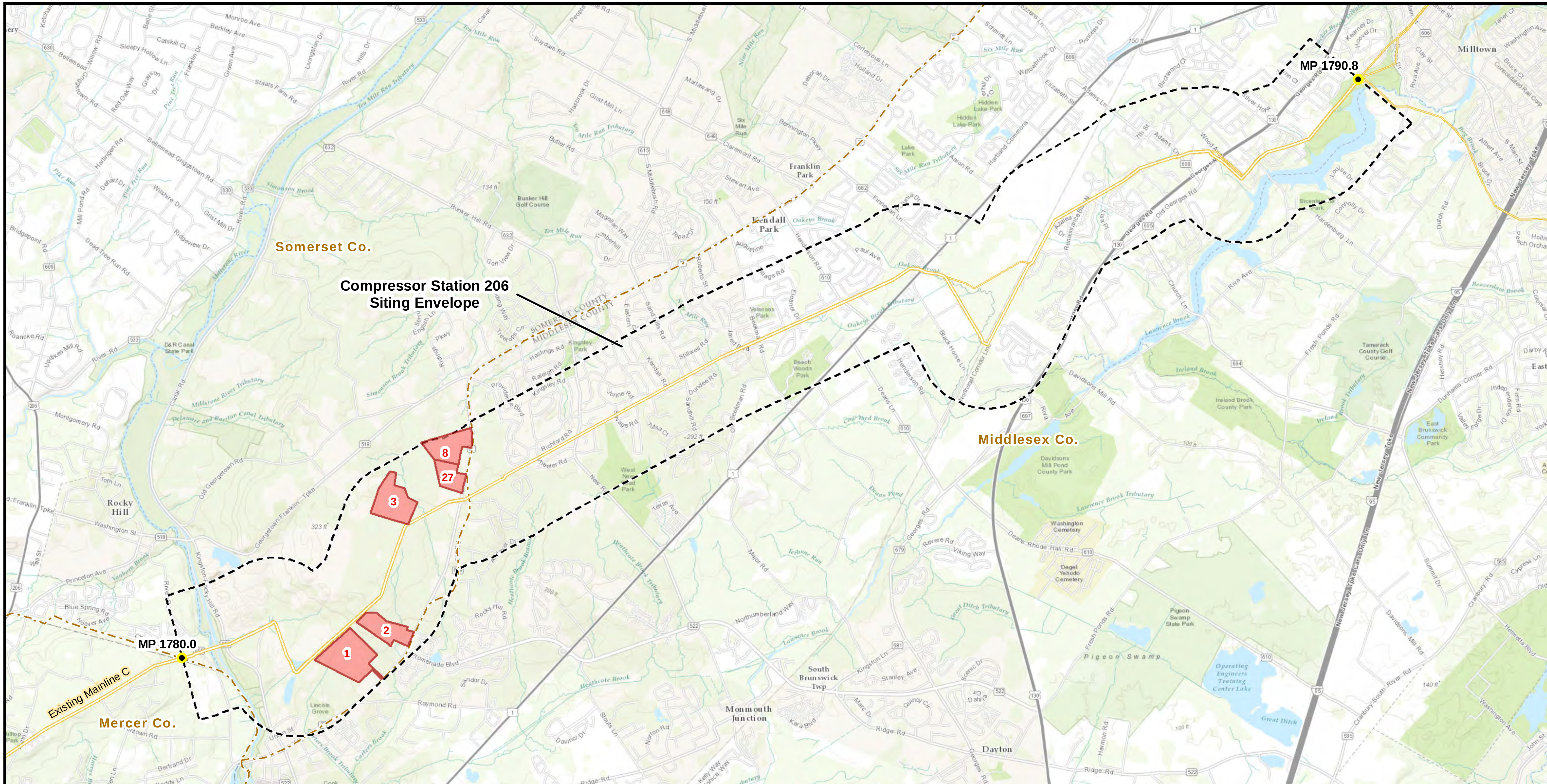

Legend

- Milepost
- Existing Transco Mainline-C
- Other Existing Transco Pipeline
- County Boundary
- Compressor Station 206 Siting Envelope (0.5-Mile From Existing Mainline C)
- Sites Meeting Tier 2 Criteria

N

0 0.5 1
Miles

Data Sources: NJDEP 2012; USGS-NHD 2016; Williams 2017; E&E 2017; ESRI 2012, 2017.

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-22

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
SITES MEETING TIER 2 SITING CRITERIA
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

DRAWN BY: MK	DATE: 3/21/2017	ISSUE FOR BID: N/A	SCALE: 1:48,144
CHECKED BY: AL	DATE: 3/21/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-22	SHEET 1 OF 1
WO: 1000891		11:03 AM 3/21/2017	

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Legend

- Existing Transco Mainline-C
- County Boundary
- Operational Footprint
- Construction Footprint
- Compressor Station Site Option 1
- NJDEP Wetlands (2012)
- NJDEP Wetlands buffer (50-ft)
- Drain Line (Field Surveyed/Remotely Sensed)
- Waterbody/Waterway (Field Surveyed/Remotely Sensed)
- Wetland (Field Surveyed/Remotely Sensed)
- Surveyed/Remote Sensed Wetland Buffer (150-ft)

N

0 500
Feet

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-23

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
COMPRESSOR STATION 206 – SITE 1
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

DRAWN BY: MK	DATE: 3/21/2017	ISSUE FOR BID: N/A	SCALE: 1:6,000
CHECKED BY: AL	DATE: 3/21/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-23	SHEET 1 OF 1
WO: 1000891		11:02 AM 3/21/2017	

Data Sources: NJDEP 2012; Williams 2017; E&E 2017; ESRI 2012, 2017.

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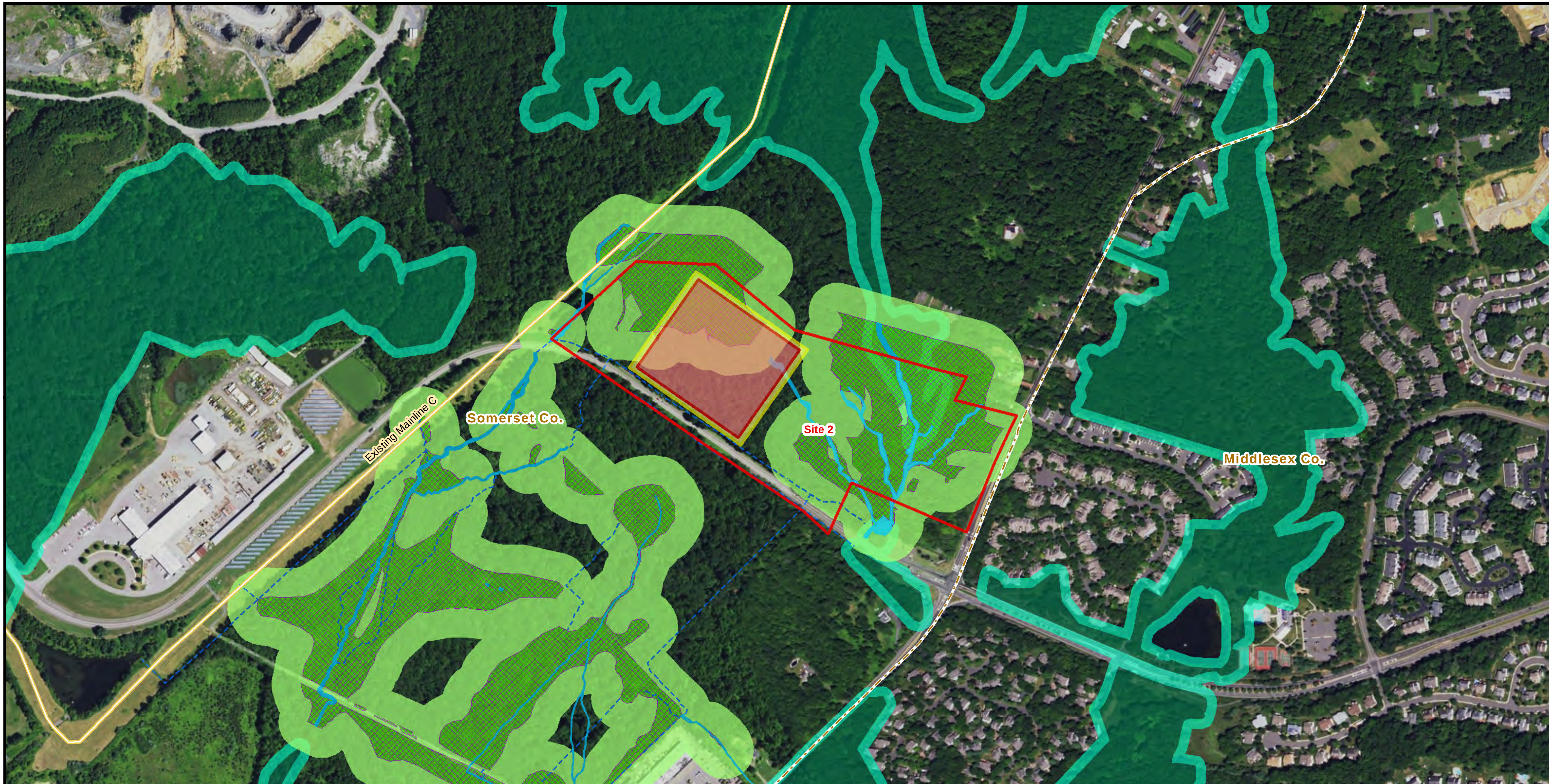


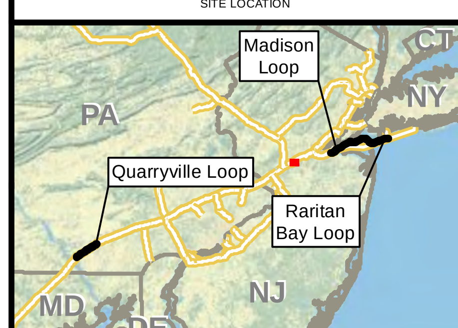
Legend

- Existing Transco Mainline-C
- County Boundary
- Operational Footprint
- Construction Footprint
- Compressor Station Site Option 2
- NJDEP Wetlands (2012)
- NJDEP Wetlands buffer (50-ft)
- Drain Line (Field Surveyed/Remotely Sensed)
- Waterbody/Waterway (Field Surveyed/Remotely Sensed)
- Wetland (Field Surveyed/Remotely Sensed)
- Surveyed/Remote Sensed Wetland Buffer (150-ft)

N

0 500
Feet

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-24

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
COMPRESSOR STATION 206 – SITE 2
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams.

DRAWN BY: MK	DATE: 3/21/2017	ISSUE FOR BID: N/A	SCALE: 1:6,000
CHECKED BY: AL	DATE: 3/21/2017	ISSUE FOR CONSTRUCTION: N/A	Project features ver14
APPROVED BY:	DATE:	DRAWING NUMBER:	SHEET 1
WO: 1000891		11:01 AM 3/21/2017 FIGURE 10A-24	OF 1

Data Sources: NJDEP 2012; Williams 2017; E&E 2017; ESRI 2012, 2017.

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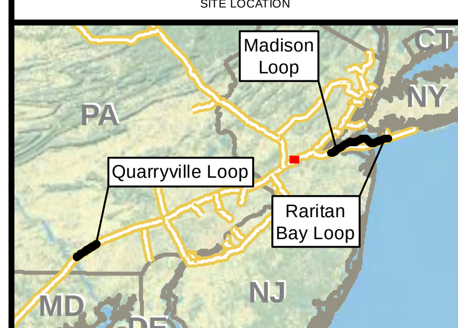
Legend

- Existing Transco Mainline-C
- County Boundary
- Operational Footprint
- Construction Footprint
- Compressor Station Site Option 3
- NJDEP Wetlands (2012)
- NJDEP Wetlands buffer (50-ft)
- Drain Line (Field Surveyed/Remotely Sensed)
- Waterbody/Waterway (Field Surveyed/Remotely Sensed)
- Wetland (Field Surveyed/Remotely Sensed)
- Surveyed/Remote Sensed Wetland Buffer (150-ft)

N

0 500
Feet

SITE LOCATION



DRAWING NO.

REFERENCE TITLE

10A-25

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
COMPRESSOR STATION 206 – SITE 3
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

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WO: 1000891 | 11:01 AM 3/21/2017

Data Sources: NJDEP 2012; Williams 2017; E&E 2017; ESRI 2012, 2017.

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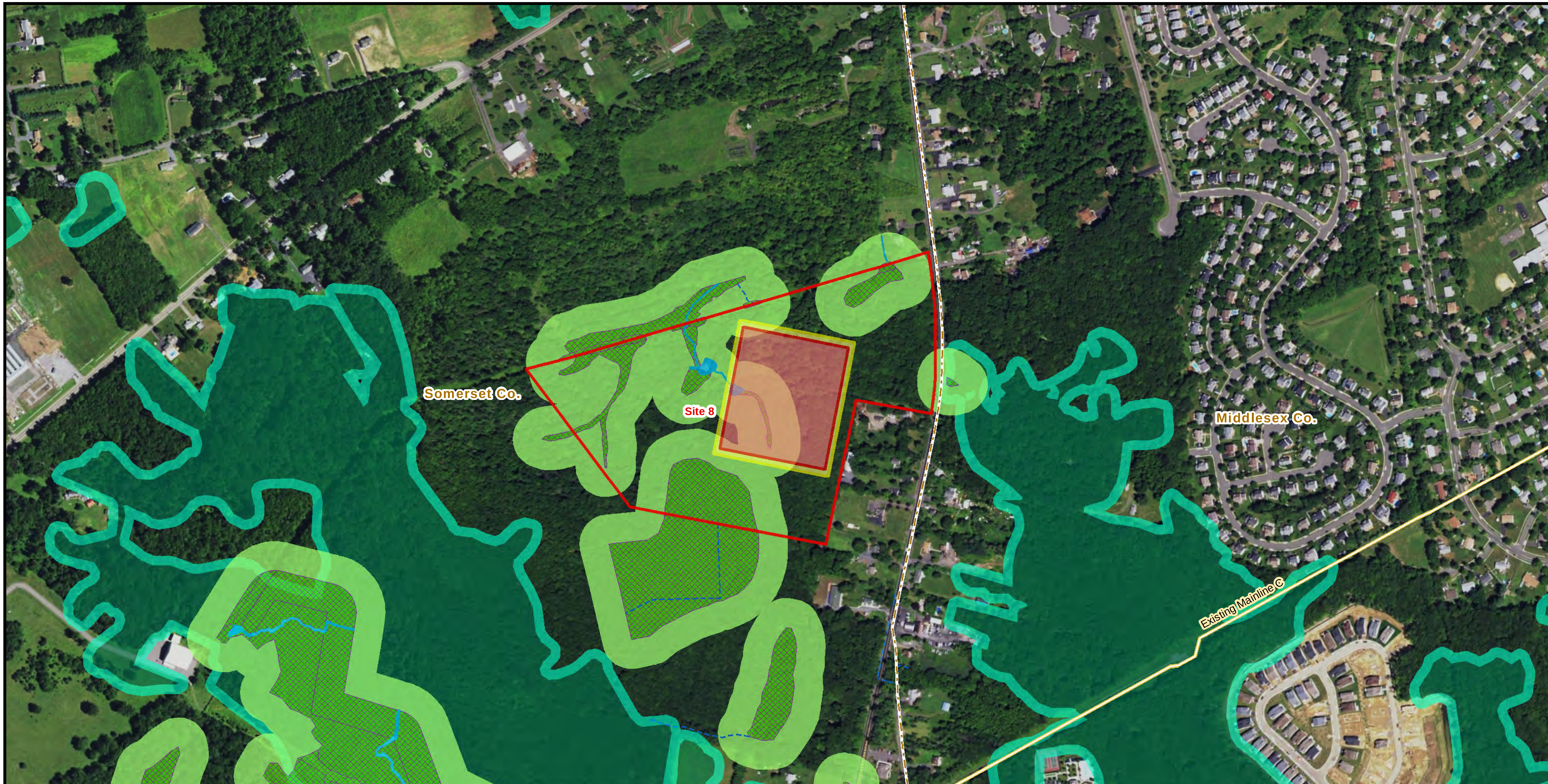


Legend

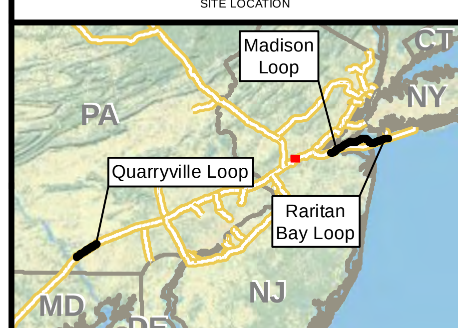
- Existing Transco Mainline-C
- County Boundary
- Operational Footprint
- Construction Footprint
- Compressor Station Site Option 8
- NJDEP Wetlands (2012)
- NJDEP Wetlands buffer (50-ft)
- Drain Line (Field Surveyed/Remotely Sensed)
- Waterbody/Waterway (Field Surveyed/Remotely Sensed)
- Wetland (Field Surveyed/Remotely Sensed)
- Surveyed/Remote Sensed Wetland Buffer (150-ft)

N

0 500

Feet

SITE LOCATION



DRAWING NO.	REFERENCE TITLE
	10A-26

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
COMPRESSOR STATION 206 – SITE 8
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

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APPROVED BY:	DATE:	DRAWING NUMBER: 10:59 AM 3/21/2017 FIGURE 10A-26	SHEET 1 OF 1
WO: 1000891			

Data Sources: NJDEP 2012; Williams 2017; E&E 2017; ESRI 2012, 2017.

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Legend

- Existing Transco Mainline-C
- County Boundary
- Operational Footprint
- Construction Footprint
- Compressor Station Site Option 27
- NJDEP Wetlands (2012)
- NJDEP Wetlands buffer (50-ft)
- Drain Line (Field Surveyed/Remotely Sensed)
- Waterbody/Waterway (Field Surveyed/Remotely Sensed)
- Wetland (Field Surveyed/Remotely Sensed)
- Surveyed/Remote Sensed Wetland Buffer (150-ft)

N

0 500
Feet

SITE LOCATION

DRAWING NO.	REFERENCE TITLE
	10A-27

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.
A	3/21/2017	MK	ISSUED FOR FERC FILING	1000891	AL	

TRANSCONTINENTAL GAS PIPE LINE COMPANY LLC
COMPRESSOR STATION 206 – SITE 27
NORTHEAST SUPPLY ENHANCEMENT PROJECT
NEW JERSEY

Williams

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APPROVED BY:	DATE:	DRAWING NUMBER: FIGURE 10A-27	SHEET 1 OF 1
WO: 1000891		11:00 AM 3/21/2017	

Data Sources: NJDEP 2012; Williams 2017; E&E 2017; ESRI 2012, 2017.

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