New York and New Jersey Harbor Deepening Channel Improvements Navigation Study

Final Integrated Feasibility Report and Environmental Assessment



April 2022





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U.S. Army Corps of Engineers

New York District

April 2022

Executive Summary

This New York and New Jersey Harbor Deepening Channel Improvements (NYNJHDCI) Integrated Feasibility Report and Environmental Assessment documents the U.S. Army Corps of Engineers (USACE) feasibility study planning process for navigation improvements to the existing New York and New Jersey Harbor Deepening Project and documents compliance with the National Environmental Policy Act (NEPA) as incorporated into the planning process.

The New York and New Jersey Harbor Navigation Study of December 1999 that resulted in the completed Harbor Deepening Project's channels – the main navigation channels in the Port of New York and New Jersey that support the Port's container terminals – was authorized by Section 435 of the Water Resources Development Act of 1996 (Pub. L. No. 104-303). Construction of the project was authorized in the year 2000 and completed in 2016. The completed Harbor Deepening Project's channels are maintained at +50 feet mean lower low water (MLLW) and +53 feet MLLW in Ambrose Channel. The Port of New York and New Jersey is the busiest container port on the East Coast and the second busiest container gateway in the United States. The Port of New York and New Jersey is typically the first port of call for the largest container vessels calling on the U.S. East Coast (Port Authority of New York and New Jersey, 2020).

The completed Harbor Deepening Project's channels were designed for the vessel the Regina Maersk (1,044 feet long, 140 feet wide, has a static draft of 46 feet, and a capacity to carry 6,400 twenty-foot equivalent units (TEUs)). The fleet of container vessels regularly calling on the Port of New York and New Jersey now includes vessels that are over 160 feet longer, 17 feet wider, have additional TEU capacity, and are up to 4 feet deeper (when fully loaded) with twice as much sail area/freeboard than the Regina Maersk. These vessels are depth constrained at the existing channel depth and experience maneuverability inefficiencies within the existing channels. Recent growth in the volume of trade and the engineering capabilities of new vessels has facilitated the persistence of growth such that the vessels calling the Port of New York and New Jersey are larger than the Regina Maersk design vessel of the 1999 study. As a result, the completed Harbor Deepening Project's channel dimensions which are based off the Regina Maersk have been superseded. The superseding of the channel dimensions has a significant adverse effect on the economics and design of the completed Harbor Deepening Project's channels and their usage. Pursuant to Section 216 of the Rivers and Harbors Act of 1970, the NYNJHDCI study evaluates proposed modifications to the completed Harbor Deepening Project's channels and bends.

In March 2018, the New York District completed an Initial Appraisal Report for Compliance with Section 216 of the Rivers and Harbors Act of 1970 to determine if there is a federal interest to undertake modifications to the completed Harbor Deepening Project's 50-foot channels. The Initial Appraisal Report states that the accelerating expansion of the volume of trade and the resulting fleet transition to larger vessels that has taken place since the 50-foot federal navigation project was authorized has led to the existing project's channel's dimensions being unsuitable for the current needs of the Port of New York and New Jersey. This has occurred sooner than was anticipated by the 1999 study that had used the specifications from the design vessel of the *Regina Maersk*.

The need for this feasibility level investigation arises from inefficiencies currently experienced by commercial vessels in the harbor where a significant share of the current fleet's vessels exceeds the maximum dimensions of the existing federal navigation channel¹. These inefficiencies, especially those caused by channel depth, are projected to continue in the future as vessel sizes increase to meet requirements for operational efficiencies and environmental compliance.

Utilizing the USACE Planning Process as specified in Engineer Regulation 1105-2-100, plan formulation was conducted with a focus on achieving the federal objective of water and related land resources project planning, which is to contribute to the Nation's national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other federal planning requirements. Plan formulation also considers all effects, beneficial or adverse, to each of the four evaluation accounts identified in the Principles and Guidelines (1983): national economic development, environmental quality, regional economic development, and other social effects.

This NYNJHDCI study's purpose is to determine if there is a technically feasible, economically justified, and environmentally acceptable recommendation for federal participation in a navigation improvements project in the New York and New Jersey Harbor. A navigation improvements project would improve the efficiency and sustainability of the fleet calling at the Port of New York and New Jersey. Based on a forecast of the future fleet, the study team which includes the Deep Draft Navigation Planning Center of Expertise has determined the design vessel for this study is equivalent to the *Maersk Triple E Ultra Large Container Vessel Class²* (1,308 feet long, 193.5 feet wide, has a static draft of 52.5 feet, and a capacity to carry 18,000 TEUs). USACE considered a range of nonstructural and structural measures that have the potential to improve navigation efficiencies within the New York and New Jersey Harbor. These measures include, but are not limited to, channel widening, channel deepening, bend easing, improving vessel scheduling, relocating navigation aids, and increasing tugboat assistance. Through an iterative planning process involving the incremental evaluation of deepening and efficiency components, a focused array of alternatives was identified, evaluated, and compared.

The Recommended Plan is deepening the pathways to Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal by 5 feet to a maintained depth of -55 feet MLLW³. The Recommended Plan involves deepening Ambrose Channel, Anchorage

¹ An estimated 360 vessel calls in 2020 were by vessels with a design draft greater than the current channel depth.

² The design vessel would also be classified as a "Super Ultra Large Container Vessel" (SULCV) by the Vessel Traffic Service New York User's Manual and Title 33 CFR Part 161

³ The maintained depth, authorized channel level, and total (dredged) depth of the various channels may differ. The authorized channel level is used herein as it is defined in Engineer Regulation 1110-2-1613, and reflects the loaded summer salt water draft of the design vessel together with gross underkeel clearance (including allowances for squat, salinity, wave motion, and safety clearance). Maintained depth is understood in relation to the authorized channel level. The maintained depth only differs from the authorized channel level in areas in which the channel bottom is composed of rock or otherwise hard material. In rock-bottomed or hard-bottomed areas, an additional 2 feet of safety clearance is required. The total (dredged) depth of the channel is the sum of the authorized channel level and the dredging tolerance (paid overdepth). When 'maintained depth' is used in the text, it refers to the depth of the channels north of Ambrose Channel; the Ambrose Channel is maintained at a depth three feet deeper than the 'maintained depth' referenced in this report to account for additional safety clearance needed in the open water.

Channel, the Kill Van Kull, Newark Bay Channel, South Elizabeth Channel, and Elizabeth Channel, and Port Jersey Channel. This includes the additional width required for structural stability and for the navigation of the design vessel to transit from sea to Elizabeth Port Authority Marine Terminal and Port Jersey Port Authority Marine Terminal. Channel configurations were designed to avoid and minimize environmental and cultural resource impacts while still meeting navigation safety requirements. Consistent with current New York District practice, the Port Jersey Channel is anticipated to be maintained by dredging every 10 years (about 7,400 cubic yards), the Anchorage Channel every seven years (about 5,300 cubic yards), and all other channels together in a single contract every three years (about 91,000 cubic yards).

USACE is committed to beneficially placing the dredged material that would be generated as a result of implementing any project recommended in this study (see 33 U.S.C. §2326). Accordingly, the Recommended Plan assumes material will be placed at the least cost environmentally acceptable location. This includes beneficially using dredged material by placing it upland, at the Historic Area Remediation Site, or on a reef consistent with the current 2008 Dredged Material Management Plan. USACE will develop a supplemental project-specific Dredged Material Management Plan during Preconstruction Engineering and Design to identify the full array of opportunities that coincide with the production of the dredged material.

Dredging will be carried out by multiple kinds of water-based dredges and limited blasting. There is not expected to be considerable noise generated by the blasting itself, as the overlying water column deadens the sound. Drilling of the blasting holes, along with mechanical dredging, is more likely to generate discernible noise than the blasting itself. During the initial construction, the north of Staten Island community was concerned about blasting and harbor dredging impacts in the Kill Van Kull portion of the project on their community. For the Recommended Plan, it is anticipated that the drilling/blasting/dredging phase within the Kill Van Kull will be seven years in duration. As was undertaken during the initial Harbor Deepening Project's construction, extensive monitoring and protection measures will be required from the dredging companies contracted to implement this work. Also, following the protocol established during the initial construction, coordination will occur with the public and stakeholder groups during the Preconstruction Engineering and Design phase, when more details about the project become available, to further discuss appropriate measures. If unforeseen adverse impacts to the north shore community of Staten Island and/or across the Kill van Kull on the shoreline community of Bayonne, related to the construction emerge, the appropriate adaptive measures will be coordinated with the affected stakeholders and implemented.

The Recommended Plan will not significantly adversely impact public health or safety, the quality of the human environment, threatened and endangered species, or state species of special concern. The study area encompasses subtidal habitats of varying depths, ranging from shallow subtidal shoals to deeper channel habitats. The navigation channel provides deeper open-water and deep-water benthic habitats. Within New York State the regulated habitat includes the "Littoral Zone" (defined as extending seaward from shore to a depth of six feet at mean lower low water), which has no impacts. In New Jersey, the regulated habitat is called the "Intertidal and Subtidal Shallows", and is defined as extending seaward to a depth of four feet below mean lower low water. The proposed project will impact approximately 0.53 acres of these New Jersey-regulated subtidal shallows. The District will implement compensatory mitigation for

these impacts, while also incorporating into the mitigation plan any benefits of the channel improvements. Such benefits could include the creation or expansion of deep-water areas beneficial to other essential fish habitat species, such as migratory finfish. The current plan for meeting the project's compensatory mitigation is restoring a portion of the Sea Bright Offshore Borrow Area by placing suitable grain size sediment within areas that were previously excavated for beach nourishment projects. Further refinements to the mitigation plan will occur in Preconstruction Engineering and Design.

The project will produce temporary localized emissions from the diesel-powered dredging equipment and marine vessels working on the project. These emissions will be fully offset by reductions occurring in the same airshed and during the same time period as the work, as specified by the General Conformity regulations and by procedures established by the Regional Air Team. Therefore, there will be no anticipated net increase of emissions and no significant impacts from the project. The New York District's draft Finding of No Significant Impact is in Appendix A10.

The Draft Integrated Report was prepared to assess the environmental effects of the project consistent with NEPA and other applicable regulations and requirements and was made available for public review. During the public review period of the Draft Integrated Report, the document was made available to government agencies, elected officials, civic and interested groups, and the general public. Two virtual public information sessions occurred on December 3, 2020 in order to provide members of the public an opportunity to offer oral comments on the findings of the EA. Written comments were also accepted. After the public comment period on the Draft Environmental Assessment closed, a Final Integrated Report was prepared. This Final Integrated Report includes the comments and responses on the Draft Environmental Assessment, as well as any necessary revisions to the Environmental Assessment to address the comments. After public comments were received and considered, a determination of the significance of the impacts was made.

At current prices (October 2021 price level and 2.25% discount rate), the Recommended Plan has an estimated project first cost of \$5,563.9 million, provides an estimate of \$188.7 million in average annual equivalent net benefits, and has a benefit-cost ratio of 1.8. The costs for the value of lands, easements, rights-of-way, and relocations are estimated to be \$1,315.1 million. In accordance with 33 U.S. Code § 2211, the relocations are cost shared with the utility owners. Accordingly, an estimated \$662.9 million of lands, easements, rights-of-way, and relocations is to be borne by the non-federal sponsor and an estimated \$652.1 million is to be borne by the utility owners. The non-federal share of the Recommended Plan costs is estimated to be \$3,439.3 million. The non-federal sponsor, The Port Authority of New York and New Jersey, has indicated their support for the Recommended Plan.



Executive Summary Figure 1: Recommended Plan Footprint



Executive Summary Figure 2: Recommended Plan – Inner Harbor



Executive Summary Figure 3: Containership Size Comparison Source: The Geography of Transport Systems

Pertinent Data

Recommended Plan Features

The Recommended Plan is deepening the pathways from sea to Elizabeth Port Authority Marine Terminal and Port Jersey Port Authority Marine Terminal by 5 feet to a maintained depth of -55 feet mean lower low water (MLLW). The Recommended Plan involves deepening Ambrose Channel, Anchorage Channel, the Kill Van Kull, Newark Bay Channel, South Elizabeth Channel, Elizabeth Channel, and Port Jersey Channel. The following table displays the proposed maintained depth, proposed authorized channel level, and proposed total depths for all channels.

	Proposed Authorized Channel Level ^a [ft MLLW]	Required Dredging Depth ^b [ft MLLW]	Quantity to be Dredged (cy)
Ambrose Channel	58	58	6,389,000
Anchorage Channel	55	55	3,800,000
Port Jersey Channel	55	57°	3,003,000
Kill Van Kull	55	57 ^c	4,451,000
Newark Bay	55	57 ^c	14,148,000
South Elizabeth Channel	55	57°	423,000
Port Elizabeth Channel	55	57°	1,024,000
Total Quantity Dredged			33,238,000

^a This includes the summer saltwater draft, squat, salinity, wave motion, and safety clearance. The channels will be maintained at this depth.

^b Required dredging depth / design depth that is needed for initial construction which includes any additional safety clearance needed for hard bottom.

^c Includes required 2 feet for hard or rock bottom which must be blasted for initial deepening.

"Maintained" depth is used as it is defined in Engineering Manual 1110-2-1613. "Maintained" depth only differs from authorized depth in areas in which the channel bottom is composed of rock or otherwise hard material. In rock bottom or hard-bottomed areas, an additional 2 feet of safety clearance is required, which is then allowed to fill in with softer maintenance materials and be maintained in the same manner as softer bottom channels. Total depth is the depth of construction and is the sum of the authorized channel level and dredging tolerance (paid overdepth).

The Recommended Plan assumes material will be placed at the least cost environmentally acceptable location. This includes beneficially using dredged material by placing it upland, at the Historic Area Remediation Site, or on a reef consistent with the current 2008 Dredged Material Management Plan.

Construction

The project assumes a construction start date of October 2024 with an overall duration of about 16 years, ending June 2040. Construction years are assumed for the economics evaluation in this study and are subject to report approval and project approval and funding requirements, including federal and non-federal funds.

Real Estate Requirements

U.S. Army Corps of Engineers projects require that the non-federal sponsor provide the lands, easements, rights-of-way and relocations necessary for a project¹. The costs for the value of lands, easements, rights-of-way, and relocations are estimated to be \$1,315.1 million. In accordance with 33 U.S. Code § 2211, the relocations are cost shared with the utility owners. Accordingly, an estimated \$662.9 million of lands, easements, rights-of-way, and relocations is to be borne by the non-federal sponsor and an estimated \$652.1 million is to be borne by the utility owners. The lands, easements, rights-of-way, and relocation costs includes acquiring 0.17 acres in fee, 1.00 acre for temporary work easements, and 0.25 acres for a temporary road easement. It also includes the relocation of 12 utility lines.

Project Cost

Project first cost is the constant dollar cost at the current price level and is the cost used in the authorizing document for a project. The project first cost for the Recommended Plan is estimated to be \$5,563.9 million. Associated costs are the costs of deepening the berths (Local Service Facilities) needed to realize benefits and are estimated at \$85.3 million. Associated costs are a non-federal sponsor responsibility and are not included in the project cost but are counted as an economic cost in the benefit-cost analysis. Interest during construction represents the opportunity cost of capital incurred during the construction period and is considered an economic cost, 2.25% discount rate, and construction duration with contingency. Total economic costs are estimated at \$7,198.6 million.

	ACCOUNT	
01	LANDS AND DAMAGES	\$10.98 million
02	RELOCATIONS ¹	\$1,304.10 million
06	FISH & WILDLIFE FACILITIES	\$13.86 million
12	NAVIGATION PORTS & HARBORS	\$3,489.68 million
19	BUILDINGS, GROUNDS & UTILITIES	\$31.50 million
30	PLANNING, ENGINEERING & DESIGN	\$532.31 million
31	CONSTRUCTION MANAGEMENT	\$181.47 million
Tot	al Project First Costs	\$5,563.90 million
12	Navigation Aids ²	\$0.00 million
12	Local Service Facilities ³	\$85.27 million
	Interest During Construction ⁴	\$1,549.41 million
Tot	al Economic Cost	\$7,198.58 million

Fiscal Year 2022 Price Level and discount rate of 2.25%

¹In accordance with 33 U.S. Code § 2211, the relocations are cost shared with the utility owners.

² Responsibility of another Federal Agency (i.e. U.S. Coast Guard)

³ Associated financial costs not part of the recommended Federal project but are necessary non-Federal responsibility

⁴ Represents the opportunity cost of capital incurred during the construction period. Calculated using the construction duration with contingency (24 years)

¹ Any conclusion or categorization that an item is a utility or facility relocation to be performed by the non-federal sponsor as part of its lands, easements, rights-of-way, and relocations responsibilities is preliminary only. USACE will make a final determination of the relocations necessary for the construction, operation or maintenance of the project after further analysis and completion and approval of a Final Attorney's Opinion of Compensability for each of the impacted utilities and facilities.

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Acronyms

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AAEQ	Average Annual Equivalent Benefits	
APM	A.P. Moller	
BA	Biological Assessment	
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	
CY	Cubic yard	
EPAMT	Elizabeth – Port Authority Marine Terminal	
EQ	Environmental Quality	
USFWS	Fish and Wildlife Service	
GCT	Global Container Terminal	
HARS	Historic Area Remediation Site	
HTRW	Hazardous, Toxic, And Radioactive Wastes	
IPCC	Intergovernmental Panel on Climate Change	
LERR	Lands, Easements, Rights-of-way and Relocations	
MLLW	Mean Lower Low Water	
MSA	Metropolitan Statistical Area	
NED	National Economic Development	
NEPA	National Environmental Policy Act	
NJDEP	New Jersey Department of Environmental Protection	
NMFS	National Marine Fisheries Service	
NOAA	National Oceanic and Atmospheric Administration	
NYNJHDCI	New York and New Jersey Harbor Deepening Channel Improvements	
NYSDEC	New York State Department of Environmental Conservation	
PCB	Polychlorinated biphenyl	
PJPAMT	Port Jersey – Port Authority Marine Terminal	
PPB	Parts Per Billion	
PPM	Parts Per Million	
PPT	Parts Per Trillion	
PPX1	Post Panamax Generation 1 (nominal capacity of 5,000-7,000)	
PPX2	Post Panamax Generation 2 (nominal capacity of 7,000-10,000)	
РРХЗ	Post Panamax Generation 3 (nominal capacity of 10,000 – 14,000 twenty-foot equivalent units)	
PPX4	Post Panamax Generation 4 (nominal capacity of 14,000 + twenty-foot equivalent units)	
RED	Regional Economic Development	
SBOBA	Sea Bright Offshore Borrow Area	
SULCV	Super Ultra Large Container Vessels	
TEU	Twenty-foot Equivalent Units	
ULCV	Ultra Large Container Vessel	
USACE	United States Army Corps of Engineers	
U.S.C.	United States Code	
USEPA	U.S. Environmental Protection Agency	

New York and New Jersey Harbor Deepening Channel Improvements Final Integrated Feasibility Report and Environmental Assessment

Chapter 1: Introduction

1.1: Integrated Feasibility Report and Environmental Assessment

This New York and New Jersey Harbor Deepening Channel Improvements (NYNJHDCI) Final Integrated Feasibility Report and Environmental Assessment (final integrated report) documents the U.S. Army Corps of Engineers (USACE) feasibility study planning process for channel improvements to the existing Harbor Deepening Project and documents compliance with the National Environmental Policy Act (NEPA) as integrated into the planning process.

The existing Harbor Deepening Project consists of the main navigation channels in the Port of New York and New Jersey that support the Port's container terminals. The navigation channels extend from the Atlantic Ocean through the Port of New York and New Jersey to the marine terminals that are called on by commercial deep-draft vessels. The Harbor Deepening Project is authorized by Section 435 of the Water Resources Development Act of 1996 (Pub. L. No. 104-303) to a depth of -50 feet at mean lower low water (MLLW) or greater. The Harbor Deepening Project has been constructed and is maintained at -50 feet MLLW and -53 feet MLLW in Ambrose Channel. The Port of New York and New Jersey is the busiest container port on the East Coast and the second busiest container gateway in the United States. The Port of New York and New Jersey is typically the first port of call for the largest container vessels calling on the U.S. East Coast.

The fleet of container vessels regularly calling on the Port of New York and New Jersey includes vessels that are depth constrained at the existing channel depth and experience maneuverability inefficiencies at the existing channel width. Continued growth in vessel sizes calling at the Port of New York and New Jersey has resulted in the Port receiving vessel calls larger than the *Regina Maersk* design vessel of the 1999 study. As a result, the existing Harbor Deepening Project's channel dimensions which are based off the *Regina Maersk* have been superseded. The superseding of the channel dimensions has a significant adverse effect on the economics and engineering design of the existing Harbor Deepening Project. Pursuant to Section 216 of the Rivers and Harbors Act of 1970 the NYNJHDCI study evaluates proposed modifications to the existing Harbor Deepening Project.

1.2: Study Purpose, Scope and Need for Action*

The purpose of the NYNJHDCI study is to determine if there are technically feasible, economically justifiable, and environmentally acceptable recommendations for federal participation in a navigation improvement project for the New York and New Jersey Harbor. A navigation improvement project would improve the efficiency of the fleet calling at the Port of New York and New Jersey and the sustainability of the regionally critical Port.

The existing federal navigation channel was designed for the *Regina Maersk* (1,044 feet long, 140 feet wide, has a static draft of 46 feet, and a capacity to carry 6,400 Twenty-foot Equivalent Units (TEUs)). The vessels routinely calling the harbor today are longer, wider, and have drafts deeper than the existing channel design vessel. These larger vessels have a greater risk of grounding, collision, or marine casualty, and have therefore resulted in pilot and U.S. Coast

Guard imposed restrictions and limitations to operation within the harbor. Chapter 4 of this report and Appendix C provide additional detail about the chosen design vessel and fleet forecast.

The need for this investigation arises from inefficiencies currently experienced by commercial vessels in the harbor where a significant share of the current fleet exceeds the capacity of the existing federal navigation channel. These inefficiencies are projected to continue in the future as vessel sizes are expected to increase.

Deep draft navigation is one of the U.S. Army Corps of Engineer's primary mission areas. As stated in 33 (United States Code) U.S.C. 540, "[f]ederal investigations and improvements of rivers, harbors, and other waterways shall be under the jurisdiction of and shall be prosecuted by the Department of the Army..." Making channel improvements will yield national economic development benefits. Contributions to national economic development are increases in the net value of the national output of goods and services, expressed in monetary units, and are the direct net benefits that accrue in the planning area and the rest of the Nation.

The USACE determined that the current study will focus its analysis on the existing federal -50foot MLLW navigation channels in the New York and New Jersey Harbor and immediately adjacent areas. Evaluating additional anchorages is outside the scope of this study and the anchorages are evaluated in a separate study, the *New York and New Jersey Harbor Anchorages Final General Evaluation Report* (USACE, 2019d). This NYNJHDCI study will determine whether there is a technically feasible, economically justifiable, and environmentally acceptable recommendation for federal participation in a navigation improvement project in the New York and New Jersey Harbor. The period of analysis for this study is 2040 through 2089, representing an estimate of the first 50 years following the completed design and construction of a navigation improvement project.

The scope and extent of environmental impacts presented in this report are based on improvements to the navigation channels. These improvements would likely increase efficiency at the adjacent ports. If these improvements translate to future landside changes (e.g. increase in truck traffic) requiring additional environmental impact consideration, any analysis and assessment, as well as any necessary mitigation, will be the responsibility of the local sponsor, The Port Authority of New York and New Jersey.

1.3: Study Authority

The study authority for the 1999 Port of New York-New Jersey Harbor Navigation Study (1999 study) is Section 435 of the Water Resources Development Act of 1996 (Pub. L. No. 104-303), which reads:

SEC. 435 PORT OF NEW YORK-NEW JERSEY NAVIGATION STUDY

The Secretary shall conduct a comprehensive study of navigation needs at the Port of New York-New Jersey (including the South Brooklyn Marine and Red Hook Container Terminals, Staten Island, and adjacent areas) to address improvements, including deepening of existing channels to depths of 50 feet or greater, that are required to provide economically efficient and environmentally sound navigation to meet current and future requirements. The study conducted pursuant to Section 435 above resulted in a USACE Chief's Report dated 2 May 2000, recommending a channel at a depth of -50 feet MLLW in the harbor based on the *Regina Maersk* as the design vessel. The recommended plan was authorized for construction in Section 101(a)(2) of Water Resources Development Act of 2000 (Pub. L. No. 106-541). Construction of the resulting 50-foot Harbor Deepening Project was completed in 2016.

In March 2018, an Initial Appraisal Report, *Compliance with Section 216 of the Rivers and Harbors Act of 1970* was completed to determine if there is potential federal interest to undertake modifications to the existing 50-foot federal navigation project. The Initial Appraisal Report states that the accelerating expansion of the volume of trade and the resulting fleet transition to larger vessels that has taken place since the 50-foot federal navigation project was authorized has led to the existing project's channel's dimensions being unsuitable for the current needs of the Port of New York and New Jersey. This has occurred sooner than was anticipated by the 1999 study that had used the specifications from the design vessel of the *Regina Maersk*. This fact has a material effect on the economics and engineering design of the existing 50-foot federal navigation channels. The Initial Appraisal Report found "a comparison of these facts with the requirements of Section 216 indicates that all of the requirements of Section 216 have been meet." The Initial Appraisal Report made the recommendation to "investigate and determine if there is a Federal interest in continuing the project with the preparation of cost-shared feasibility report for analyzing alternatives to address the identified problems though possible modifications of the project."

The NYNJHDCI study is a result of the approved Initial Appraisal Report. Section 216 of the Rivers and Harbors Act of 1970 limits the analysis of the NYNJHDCI study to the constructed 50-foot Harbor Deepening Project.

1.4: Non-Federal Sponsor

A Feasibility Cost Sharing Agreement was executed on 22 July 2019 with The Port Authority of New York and New Jersey as the non-federal sponsor. The NYNJHDCI study is cost shared 50% federal and 50% non-federal.

1.5: Existing Harbor Deepening Project

The existing 50-foot federal navigation channels¹ – constructed during the Harbor Deepening Project – resulted from the recommendations made in the 1999 study. The project consists of the federal channels that lead to the container terminals in the Port of New York and New Jersey from the Atlantic Ocean. The federal channels are used by and designed for the deep-draft commercial vessels calling on the facilities within the Port of New York and New Jersey.

¹ The maintained depth and authorized depth of the various channels may differ. The maintained channel depth is designed to permit the safe and efficient transit of a loaded design vessel at any phase of the tide. The determination of the navigation channel depth is based upon the loaded static summer salt water draft of the design vessel, plus allowances for various underkeel clearances such as ship squat, water density, ship response to waves, and safety clearance. The authorized channel depth differs from the maintained channel depth in channels with rock or otherwise hard bottom. In such channels, an additional 2 feet of safety clearance is required at initial construction; the channels are then allowed to fill in to the maintained channel level.

Container vessels, tankers, car carriers, and other bulk goods carriers make up the majority of the deep-draft commercial vessels using these channels. Among these vessels, container vessels are the most depth-limited and are most constrained by the configuration of the channels.

Maps of the constructed project are provided in Figure 1 and Figure 2 and are constructed as authorized federal channel dimensions organized in Table 1. All container traffic enters the New York Harbor north through the Ambrose Channel, which is maintained at a federally-authorized depth of -53 feet MLLW. After the Ambrose Channel, vessels continue north and enter the Anchorage Channel which has an authorized depth of -50 feet MLLW, and provides access west to the Kill Van Kull, northeast to the Bay Ridge Channel, and west to the Port Jersey, just north of the Kill Van Kull channel. The Kill Van Kull channel has an authorized depth of -50 feet MLLW (-52 feet MLLW in rock or otherwise hard material), and provides access to the facilities along Newark Bay and the Arthur Kill channels. From the Kill Van Kull, vessels sail north into the Newark Bay Channel, which has an authorized depth of -50 feet MLLW (-52 feet in rock or otherwise hard material) or continue west to the Arthur Kill channel. The Arthur Kill has an authorized depth of -50 feet MLLW (-52 feet in rock or otherwise hard material) to Howland Hook. The Newark Bay Channel provides access west to the Elizabeth and South Elizabeth Channels, from which the vessels reach the port facilities at Port Newark and Port Elizabeth channels.



Figure 1: Constructed 50-Foot Harbor Deepening Project



Figure 2: Constructed 50-Foot Harbor Deepening Project, Inner Harbor

	Maintained Channel Depth ª ft MLLW	Authorized Channel Depth ^b ft MLLW
Ambrose Channel	53	53
Anchorage Channel	50	50
Port Jersey	50	52
Kill Van Kull	50	52
Newark Bay	50	52
South Elizabeth	50	52
Port Elizabeth	50	52
Arthur Kill	50	52

Table 1: Existing Authorized and Constructed Harbor Deepening Project Channel Dimensions

^aMaintained channel level includes the summer salt water draft, squat, salinity, wave motion, and safety clearance. The channels will be maintained at this depth.

^bThe authorized channel level includes additional safety clearance needed for hard bottom

The existing 50-foot Harbor Deepening Project specifically authorized deepening the following channels: Ambrose Channel, Anchorage Channel, Bay Ridge Channel, the Kill Van Kull, the Newark Bay Channels, Port Jersey Channel, and the Arthur Kill to Howland Hook. The channels were deepened to -50 feet MLLW except in areas of rock or otherwise hard material where they were deepened to -52 feet MLLW, with the exception of the Ambrose Channel, which was deepened to -53 feet MLLW. All channels are maintained at -50 feet MLLW with the exception of Ambrose Channel, which is maintained at -53 feet MLLW, due to the wave action that occurs in the Ambrose Channel. The Bay Ridge Channel deepening was deferred.

1.5.1: Recent Construction History

In this section we give a brief history of the recent prior pertinent authorizations behind construction of the existing federal channels.

Ambrose & Anchorage Channels

• Section 101(a)(2) of the Water Resources Development Act of 2000 authorized deepening of the Ambrose Channel for its entire length to a depth of -53 feet MLLW and deepening the Anchorage Channel to a depth of -50 feet MLLW (-52 feet MLLW in rock or otherwise hard material) from the Narrows to 1,000 feet passed its juncture with Port Jersey Channel.

Kill Van Kull and Arthur Kill to Gulf Port Reach

- Section 301(a)(12) of the Water Resources Development Act of 1996 re-authorized the 45-foot project in the Kill Van Kull and Newark Bay at a higher cost in accordance with Section 902 of Water Resources Development Act of 1986.
- Section 301(b) of the Water Resources Development Act of 1996 authorized a further deepening of the Arthur Kill to Gulfport not to exceed -45 feet MLLW.
- Section 301(a)(11) Water Resources Development Act of 1999 re-authorized the deepening of Arthur Kill to Howland Hook to -41 feet MLLW and -40 feet MLLW to Gulfport in accordance with the 23 July 1999 report.
- Section 101(a)(2) of the Water Resources Development Act of 2000 authorized the deepening of the Kill Van Kull and the Arthur Kill to a depth of -50 feet MLLW (-52 feet MLLW in rock or otherwise hard material). The Kill Van Kull was authorized to be deepened from its juncture with Anchorage to the Arthur Kill, and the deepening of the Arthur Kill was authorized from its juncture with the Kill Van Kull Channel and Newark Bay to the southernmost berth at the Howland Hook Marine Terminal.

Newark Bay

- Section 301(a)(12) of the Water Resources Development Act of 1996 re-authorized the 45-foot MLLW Kill Van Kull and Newark Bay Channels project at a higher cost in accordance with the Section 902 cap procedures.
- Section 101(a)(2) of the Water Resources Development Act of 2000 authorized deepening the Newark Bay Channel to a depth of -50 feet MLLW (-52 feet MLLW in rock or otherwise hard material from its juncture with the Kill Van Kull to the juncture with the Elizabeth Channel, including deepening the existing Elizabeth, South Elizabeth, and Elizabeth Pierhead Channels to -50 feet MLLW (-52 feet MLLW in rock or otherwise hard material).

Port Jersey Port Authority Marine Terminal

- The Water Resources Development Act of 1999 re-authorized the deepening of the existing channel from -35 to -45 feet MLLW in accordance with the Chief of Engineers report.
- Section 101(a)(2) of the Water Resources Development Act of 2000 authorized the deepening of the Port Jersey Channel to a depth of -50 feet MLLW from its juncture with

Anchorage Channel to the Global Terminal and Military Ocean Terminal at Bayonne Facilities.

Anchorage Areas

• The Chief of Engineers discretionary authority contained in S.D. 17 authorized expanding Red Hook Anchorage by 200 yards by shifting Anchorage Channel 200 yards to the west.

1.6: Prior Studies and Reports

Numerous studies and reports related to the New York and New Jersey Harbor have been conducted. A detailed list of these reports, as well as a historical summary of the federally authorized anchorages in the harbor, can be found in the 2000 New York and New Jersey Harbor Navigation Study Report (USACE, 2000a).

Relevant studies, reports, and authorizations since 2000, are listed below:

- Beneficial Uses of Dredged Material for Habitat Creation, Enhancement, and Restoration in New York New Jersey Harbor (Yozzo et al., 2004)
- Final Environmental Assessment, Elimination of "High Spot C" Obstruction to Navigation within the New York Bight Navigational Precautionary Area – Ambrose Channel (USACE, 2012a)
- New York and New Jersey Harbor Navigation Project, Initial Appraisal Report, Compliance with Section 216 of the Rivers and Harbors Act of 1970 (USACE, 2018a)
- Dredged Material Management Plan for the Port of New York and New Jersey (USACE, August 2008)
- Arthur Kill Ship Wave Study, Interim Draft Report (June 2002)
- Preliminary 18,000 TEU Full Mission Ship Simulation Study Report For the Port of New York / New Jersey Shipping Association (Maritime Institute of Technology and Graduate Studies and Towing Solutions, Inc., 2016)

1.7: Study Area

The NYNJHDCI study area includes the existing 50-foot federal navigation channels and the immediately surrounding areas. The New York and New Jersey Harbor is located between the southeastern-most point of New York State and the northeastern part of New Jersey. The 50-foot federal navigation channels are adjacent to New York City in New York State and the cities of Bayonne, Elizabeth, and Newark in New Jersey. The harbor is located along the upper-middle portion of the Atlantic Seaboard and is often the first port of call on the East Coast for the largest container vessels. The harbor is approximately 190 miles southwest of Boston, Massachusetts and approximately 75 miles northeast of Philadelphia, Pennsylvania. The harbor is formed by the confluence of, among other smaller tributaries, the Hudson River, East River, Raritan River, Jamaica Bay, and Newark Bay, which is itself formed by the confluence of the Hackensack and Passaic Rivers. The network of 50-foot federal navigation channels extends from the Atlantic Ocean into the New York and New Jersey Harbor and the marine terminals of The Port Authority of New York and New Jersey (Figure 1 and Figure 2). A map of the channels and

facilities within the project area is provided in Figure 3. The congressional districts adjacent to the study area are NY-5, NY-7, NY-8, NY-10, NY-11, NJ-6, NJ-8, NJ-10, and NJ-11.

The existing 50-foot Harbor Deepening Project provides access to five terminals:

- 1. Global Container Terminal Bayonne by way of Port Jersey Channel
- 2. A.P. Moller Terminal by way of Newark Bay and South Elizabeth Channels
- 3. Maher Terminal by way of Newark Bay and Elizabeth Channels
- 4. Port Newark Container Terminal by way of Elizabeth Channel
- 5. Global Container Terminal New York by way of the Arthur Kill

The planning area is a geographic space with an identified boundary that includes the area identified in the study authorizing document and the locations of alternative plans which are called project areas in this report. The locations of resources that would be directly, indirectly, or cumulatively affected by alternative plans are often called the affected area.



Figure 3: Facilities within the Project Area

1.8: National Environmental Policy Act Coordination

The National Environmental Policy Act of 1969 (NEPA), Council on Environmental Quality's Guidance Regarding NEPA Regulations, USACE Procedures for Implementing NEPA (Engineer Regulation 200-2-2)), and the Update to the Regulations Implementing the Procedural Provisions

of the National Environmental Policy Act (85 FR 43304) were applied to this study. An Environmental Assessment, which is a concise public document prepared by a federal agency to determine whether the proposed action has the potential to cause significant environmental effects (40 Code of Federal Regulations 1508.9(a), was prepared to:

- provide evidence and analysis sufficient to determine whether an Environmental Impact Statement is required;
- aid the agency's compliance with NEPA when no Environmental Impact Statement is necessary;
- facilitate preparation of an Environmental Impact Statement when one is necessary; and
- serve as the basis to justify a finding of no significant impact.

The Environmental Assessment discusses:

- the need for the proposed action;
- the proposed action and reasonable alternatives;
- the probable environmental impacts of the proposed action and reasonable alternatives; and,
- the agencies and persons consulted during preparation of the EA.

The Environmental Assessment (EA) is integrated in this feasibility report consistent with NEPA statutory requirements. The report reflects an integrated planning process, which avoids, minimizes, and mitigates adverse project effects associated with navigation improvement actions. Sections of the report that satisfy NEPA requirements are marked with an asterisk (*) in the headings

Other federal agencies cooperated and participated in the preparation of this integrated report. The U.S. Coast Guard (USCG), National Marine Fisheries Service (NMFS), and the U.S. Environmental Protection Agency (USEPA) were cooperating agencies, and the U.S. Fish and Wildlife Service (USFWS) was a participating agency.

NEPA interagency meetings were held on November 21, 2019 and October 29, 2020. Stakeholder meetings were held with the Harbor Operations Steering Committee (August 7, 2019) and the Sandy Hook Pilots (February 4 and 20, 2020). A meeting was held on June 15, 2020 with New York State Department of Environmental Conservation (NYSDEC), New Jersey Department of Environmental Protection, and National Marine Fisheries Service (NMFS) to discuss possible mitigation sites.

Correspondence under Section 106 of National Historic Preservation Act of 1966 describing the proposed action and inviting consultation was sent to five federally recognized tribes, the New York State Historic Preservation Office, New Jersey State Historic Preservation Office, the Advisory Council on Historic Preservation, and the New York City Landmarks Commission.

The Draft Integrated Feasibility Report and Environmental Assessment was prepared to assess the environmental effects of the project consistent with NEPA and other applicable regulations and requirements and was made available for public review in December 2020.

Due to stakeholder requests and to account for the holiday season, New York District and The Port Authority of New York and New Jersey as the local sponsor, extended the end of the public comment period to January 19, 2021. This was an extension from the typical 30 days, to a comment period of 75 days. During the public review period of the Draft Integrated Feasibility Report and Environmental Assessment, the document was made available to government agencies, elected officials, civic and interested groups, and the general public. Two virtual public information sessions occurred on December 3, 2020 in order to provide members of the public an opportunity to offer oral comments on the findings of the EA. Written comments were also accepted.

A formal comment letter was received from the USEPA, and a meeting was held on July 29, 2021 to discuss these comments. A Memorandum for Record was prepared following this meeting, and is available in Appendix A8.

This Final Integrated Feasibility Report and Environmental Assessment includes the comments and responses on the Draft EA, as well as any necessary revisions to the EA to address the comments.

Chapter 2: Existing Environmental Conditions*

This chapter describes the existing environmental and socioeconomic conditions found within the Action Area. The Action Area consists of the areas transited by dredging vessels/equipment and the areas under consideration for additional widening and/or deepening. The Action Area includes the area of potential air and water quality impacts. The geographic extent of water quality impacts is dependent upon factors such as the type of dredging equipment, the dredging depth, and environmental conditions such as wind and currents (USACE, 2015).

This chapter has been prepared in accordance with NEPA and the Council on Environmental Quality Regulations for implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations 1500-1508). This section summarizes the existing (baseline) conditions, to provide a sound basis for plan formulation as described in Chapter 4 and the impact analysis that is provided in Chapter 6. The existing conditions are used as the baseline to forecast the changes that would be expected without USACE action to address inefficiencies in the federal navigation system. The topics in this section are structured to mirror the topics presented in Chapter 6, where the future without-project and future with-project alternatives are evaluated and compared.

2.1: Topography and Bathymetry

The project study area is characterized by manmade, landfilled, and/or altered features. The topography of the project study area is level, with an approximate topographic range of 6 to 13 feet above mean sea level. No naturally occurring steep slopes exist along the channels or berthing areas considered under the national economic development plan. The maximum natural grade reported is 1%, as measured from United States Geological Survey maps. Due to these shallow slopes, no slope stability analysis was performed for the existing slopes. Issues related to slope stability were most likely addressed, at the time when the channel was deepened previously. There does not seem to be any slope stability issues currently being experienced. Therefore, it is being assumed that the existing slopes of the channel are stable and if required, the stability of existing channel slopes could be addressed in the PED phase.

Stability analysis of the proposed channel side slopes was performed for the current Harbor Deepening Project by USACE on the Ambrose, Anchorage, Bay Ridge, and Port Jersey Channels using the computer program Slope/W developed by GeoSlope International Ltd, the results of which are discussed in Appendix B-2 of this report. The program considers data such as channel slope profiles, stratigraphy, soil properties, and water properties. The Spencer, Bishop, USACE, and Lowe procedures were used to obtain the lowest factor of safety for the governing cross-section of each slope. The analyses were designed to be conservative: the highest point along each cross-section and the deepest projected dredge depth were selected. The proposed channel slope angles are 1.0V to 3.0H for slopes in soils and 1.0V to 1.0H for slopes in rock. Further stability analysis will be conducted during Preconstruction Engineering and Design phase.

The Upper Bay has a dynamic hydrology due to the variation in tidal velocity, amount of freshwater flow, and bathymetry among the connecting bays (USACE, 1999). The Kill Van Kull and Newark Bay Channels were deepened from -35 feet MLLW to -40 feet MLLW in the late

1980's through the early 1990's (i.e. Kill Van Kull/Newark Bay-40 Deepening). Most of these same channels (i.e. Kill Van Kull/Newark Bay-45) were further deepened to -45 feet MLLW beginning in 1999 and ending in 2004. Deepening the Port Jersey Channel to -41 feet MLLW (Port Jersey-41) began in 2002. These navigation channel deepening projects were authorized before the Harbor Deepening Project and are referred to collectively as predecessor projects. The predecessor projects were authorized as Section 101, Section 102, and Section 202a of the Water Resources Development Act of 1986, Pub. L. No. 99-662.

2.2: Socioeconomics

Socioeconomics is the study of how economic activity affects and is shaped by social processes. The New York-New Jersey City Metropolitan Statistical Area (MSA) was used to analyze the sociologic conditions and regional economic development impact of the proposed project and is summarized below. See Appendix C: Economics, Section 8 for a map of the MSA and detailed analysis.

The MSA had an estimated 2019 population of 19,216,000 and experienced slow population growth over the past 10 years, with a growth rate one-quarter of the national growth rate. Total employment of the population in 2017 was 16,446,000. The largest employment sector of 2017 by number of employees and total annual payroll was health care and social assistance. The next largest sectors included professional, scientific, and technical services; wholesale trade; retail trade; and accommodation and food services. The MSA unemployment rate for 2019 was 4.6%, 0.1% higher than the national unemployment rate. Median income for 2019 within the MSA, \$61,392, is 12% higher than the national median. Approximately 12% of the MSA population meets poverty status, which is less than the national average.

The MSA has a higher minority population than the individual states (New York, New Jersey, and Pennsylvania) and the nation. The largest minority population in 2019 were Black or African American, compromising approximately 18% of the MSA. Additionally, 25% of the MSA identified as Hispanic or Latino compared with 18% nationally. The median age in the MSA is 39.1 years, which is lower than each individual state (New York, New Jersey, and Pennsylvania) but higher than the national median.

2.3: Environmental Justice

Executive Order 12898 directs federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. Consistent with this mandate, an evaluation of the population in the vicinity of the New York and New Jersey Harbor was conducted to determine the potential for the project to adversely affect minority and low-income populations (see Chapter 6 for an in-depth analysis). The North Shore of Staten Island has been designated as an Environmental Protection Agency (USEPA) Region 2 Environmental Justice Showcase Community. The community is working with USEPA to address environmental justice issues. According to USEPA, this designation is because of an increased number of children with elevated lead levels in their blood due to former industrial uses in the area. In addition to the
December 3, 2020 public information sessions, the District met with the USEPA on July 29, 2021 to discuss comments on the draft report, including those related to environmental justice within the North Shore Community of Staten Island. The District also met with the National Resource Protective Association and the North Shore Waterfront Conservancy of Staten Island on September 15, 2021, to discuss topics including environmental justice. The District reached out to the New York City Environmental Justice Association and the New Jersey Environmental Justice Association on September 13, 2021 but has received no response. The team plans to continue engaging environmental justice communities, as necessary, to assess and address their concerns (see section 6.3).

2.4: Geology and Soils

No new explorations were conducted for this study. All geotechnical analysis relied on existing information and historical test borings. The New York-New Jersey Harbor consists of numerous bays, rivers, and channels of complex shape that are connected to the Hudson River – the main element of the harbor complex. Bedrock geology consists of three primary sequences of rock, separated by erosional unconformities, meaning that there is a gap in the rock record where intervening materials have been removed by erosion (Figure 4).

The oldest rock is the hard, crystalline metamorphic Manhattan Schist and Serpentinite present along a north-south trending band that runs from Staten Island north through Port Jersey all the way up along the east side of the Hudson River estuary, reflecting a narrow southward extension of the New England Uplands. This series of rock is known as the Manhattan Prong. Manhattan Schist outcrops in Central Park and Serpentinite outcrops on Todt Hill on Staten Island, forming the highest natural point in New York City (Merguerian, 2008).

The next oldest rocks are the Triassic-aged sedimentary beds of sandstone and shale deposited into the Newark Basin to the west, subsequently intruded by igneous rock, diabase sills, preferentially along and parallel to the sedimentary bedding planes during the Jurassic. The diabase is known as the Palisades Sill. The sedimentary bedrock bedding dip gently to the west. The diabase sills outcrop as harder ridges, such as at the southwest tip of Bayonne, and all along the west side of the Hudson River.

The youngest bedrock was deposited during the Cretaceous, as sheets of sediments deposited on the eastern flank of the hard, Ordovician metamorphics, lying unconformably on them, and sloping to the east. Formations include the Raritan overlain by the Magothy, and are present only in the subsurface at depth within the project area, and believed to underlie the Ambrose Channel.

Newark Bay and the Hudson River and its outlet to the Upper Bay likely formed preferentially in the less resistant, more easily eroded Triassic sandstone and shale bedrock, leaving the harder rock types (Serpentinite and Palisades diabase sill) exposed as highlands.

The maximum extent of glaciation during the Wisconinan age deposited the glacial moraine exposed in Brooklyn. The pre-glacial valleys carved into bedrock were later filled with glacial till, sandy and gravelly outwash, and fine-grained deposits in lakes formed when drainages became blocked. Till commonly mantles the bedrock surface.



Figure 4: Bedrock Geology of the Project Area, Composite from USGS National Map Database. Refer to Figure 2 of Appendix B2 for the Legend.

2.4.1: Kill Van Kull

The bedrock underlying the Kill Van Kull, beginning at the east, consists of: serpentinite in the Constable Hook Reach; sandstone of the Stockton Formation westward to Bergen Point (through the Bergen Point East and Bergen Point West Reaches); diabase from Bergen Point to the eastem part of Newark Bay; and shale of the Lockatong Formation, with the arkosic sandstone member of the Lockatong at Shooters Island at the confluence of the Arthur Kill, Kill Van Kull, and Newark Bay. Based upon historical test-boring data, the Stockton and Lockatong Formations have limited outcroppings in the Kill Van Kull channel. Throughout the Kill Van Kull (including the Constable Hook Reach, Bergen Point East Reach, and Bergen Point West Reach), previously blasted, fractured, or moderately weathered bedrock underlies the channel. Dense to very dense sand underlies the Kill Van Kull east of the Bayonne Bridge and through the Bergen Point East Reach (Lewis and Kummel 1950, Lyttle and Epstein 1987, Drake *et al.* 1996, Stanford 1996). Refer to Appendix B2 for a more detailed geologic description and geologic cross-sections.

2.4.2: Newark Bay

Based on historical test-boring data and laboratory test data published by The Port Authority of New York and New Jersey (1996), USACE-New York District (1997b) and on data from one test boring performed by a consultant for USACE, the stratigraphy at Newark Bay is as follows: (1) black organic silt - this stratum of very soft to soft organic sediments extends from approximately -5 to -18 feet MLLW; (2) sand - a layer of loose to medium sand about 12 feet

thick underlies the organic silt, extending from about -18 to -30 feet MLLW; (3) stiff clay and silt - a 45-foot to 60-foot-thick layer of stiff clay and silt or varied silt and clay underlies the sand, from a depth of about -30 feet MLLW to the top of rock; and (4) bedrock - rock at Newark Bay is red shale. The geologic profiles along either side of the existing channel consist of silt (5 to 40 ft. thick) overlying clay, with sand, gravel, cobbles/boulders, and till layers mantling sandstone and shale bedrock. The floor of the existing -50 ft MLLW channel is likely underlain by sandstone bedrock mantled by clay, sand, or till in some locations. Refer to Appendix B2 for a more detailed geologic description and geologic cross-sections.

2.4.3: Port Elizabeth

Based on historical reports prepared for The Port Authority of New York and New Jersey by Gahagan and Bryant Associates, Inc. (1997) and Moffat & Nichol Engineers (1998), the stratigraphy at Elizabeth – Port Authority Marine Terminal is as follows (NY/NJHP, 1998): (1) stiff to very stiff clay - a layer of stiff to very stiff clay with silt extends from a depth of about - 41 feet MLLW (mudline) to about -70 feet MLLW. At some locations, a 1- to 6-foot-thick layer of soft clay was encountered at the mudline; (2) bedrock – the bedrock elevation varies from a depth of about -45 feet MLLW (west section of the channel) to about -80 feet MLLW. The red shale of the Passaic (Brunswick) Formation underlies the Elizabeth Channel. Refer to Appendix B2 for a more detailed geologic description and geologic cross-sections.

2.4.4: Port Jersey Channel

Based on historical borings performed as part of a channel-deepening study (USACE 1998) and also on subsurface information prepared by The Port Authority of New York and New Jersey (Moffat & Nichol International 1998), the stratigraphy of the Port Jersey Channel is as follows: (1) Organic silt/clay: along the centerline of the channel, a soft organic clay/silt layer, typically 5 to 10 feet thick, extends from a depth of about -35 feet MLLW (mudline) to about -45 feet MLLW. Near the channel slopes, this layer is generally at a depth between -10 feet MLLW and -20 feet MLLW and is about 4 to 10 feet thick. The organic layer at the bottom of the channel may have been deposited after the channel was dredged to its design depth (NY/NJHP, 1998); (2) Glacial soils: a red-brown, dense sand/silt layer with Standard Penetration Test (SPT) Nvalues ranging from 9 blows to over 100, but typically about 25; a 5- to 20- feet thick sand layer having N-values mostly above 50, indicative of a dense to very dense material (3) Bedrock: encountered bedrock consisted of gneiss, mica schist, and red shale that were typically slightly weathered, with recoveries ranging from 0% to 40%. A 5-foot-thick layer of decomposed rock was typically present between the glacial till and the bedrock. Based on the bedrock contours provided by USACE (USACE-New York District 1998), bedrock depth varies from -60 feet MLLW and -120 feet MLLW in the northwest to southeast direction within the channel (NY/NJHP 1998). Bedrock underlying the Port Jersey Channel is believed to be Member C of the Manhattan Schist (Lyttle and Epstein 1987). Geology of Upper New York Bay, to the east of the Port Jersey Channel, is believed to be in thrust-fault contact with serpentinite associated with the Hartland Formation (Baskerville 1994, Drake et al. 1996). Refer to Appendix B2 for a more detailed geologic description and geologic cross-sections.

2.4.5: Ambrose Channel

The Ambrose Channel consists predominately of gray to light brown, medium to fine sand, little or no organic content, with gravel in some places (WCFS, 1998a). During performance of past historical test borings, no bedrock was encountered down to their limiting depth of 20 feet below the mudline (WCFS, 1998a). The Magothy Formation is believed to be the geologic unit underlying the Ambrose Channel (Lyttle and Epstein, 1987). Refer to Appendix B2 for a more detailed geologic description and geologic cross-sections.

2.4.6: Soils

Infilling of the project site and portions of the study area began in the late nineteenth century and continued into the 1970s. Over 1,000 acres of wetlands were filled, a 7,000-foot-long channel was created, and the bay shore was bulkheaded. Approximately 1.5 million cubic yards of hydraulically pumped fill from the ship channel were used to fill nearby meadow lands during the construction of Newark Airport. In general, the area reflects human influences on soil development. Soils within the Port Newark/Elizabeth Port Authority Marine Terminal area are classified by the Draft Soil Survey of Union County (Union County Soil Conservation Service, 1991) as Urban Land, Udorthents-waste substratum, and Udorthents-organic substratum. Soils classified as Urban Land are located within areas of which more than 85% of the surface is covered by impervious structures such as pavement and buildings. Portions of these soils that are not covered are so extensively disturbed that natural soil profiles no longer exist. The Udorthents-organic substratum refers to various fill materials overlying tidal marsh deposits; thickness and composition of this fill material varies to a great degree. The marsh soils themselves are high in organic content and are poorly drained, highly compressible, and relatively unstable. The Udorthents-waste substratum refers to deep-to-shallow fill overlying non-earthy wastes.

2.5: Water Resources and Water Quality

The bays, navigation channels, harbor areas, and rivers surrounding the New York and New Jersey Harbor comprise a complicated hydrologic and hydraulic system. Variations in topography, freshwater input, tidal energy, and meteorological forces produce regions of different hydraulic and water quality characteristics. The New York and New Jersey Harbor tidal cycle generally responds to the tide propagating in from the New York Bight, with some amplification and small phase lags between Upper New York Bay and Newark Bay. At subtidal timescales, the wind force, density currents, and variations in freshwater flows become important factors in the harbor circulation, particularly in areas where tidal currents are weak (Oey et al., 1985).

2.5.1: Groundwater

Groundwater occurs in the project area in bedrock, in unconsolidated Cretaceous deposits, and in Pleistocene and Recent deposits. Groundwater in bedrock in the project area generally is stored and transmitted along fractures and joint openings that decrease in size and number with depth. Unfractured rock usually has negligible capacity to store and transmit groundwater. Rock types

occurring in the project area include schist, serpentinite, and interbedded conglomerate, sandstone, siltstone, and shale. Schist, diabase, and serpentinite all generally do not produce enough water to be considered potential groundwater sources. The aforementioned are not considered important aquifers in this area.

The Passaic (Brunswick) Formation is an extensive and important aquifer in areas of New Jersey adjacent to the project area (Nemickas, 1976). In the Passaic Formation, the groundwater system consists of a series of alternating tabular aquifers and aquicludes several tens of feet thick and dipping to the northwest at approximately 10 degrees (Carswell, 1976). The water-bearing fractures in each tabular aquifer are fairly continuous, but there is poor hydraulic connection between individual aquifers. The aquifers generally extend downdip for a few hundred feet and are continuous along strike for thousands of feet. Both water-table and artesian conditions exist in the Passaic Formation, with artesian confinement caused by overlying low-permeability silt and clay.

Water quality in the Passaic Formation adjacent to the Kill Van Kull is strongly influenced by Hackensack River and Newark Bay. Water from the Passaic Formation in this area is hard to very hard and highly mineralized. Heavy pumpage has induced recharge of poor-quality water that is high in chloride from these sources (Carswell, 1976).

The Stockton Formation has hydrologic properties similar to those of coarse parts of the Passaic Formation. The Lockatong Formation generally yields considerably smaller quantities of water than the finer-grained part of the Brunswick. Geology is discussed in Section 2.4 and Appendix B2 provides a more detailed geologic description.

2.5.2: Sediment Characteristics

Sediment characteristics vary widely over the project area as a result of the complex flow patterns. Newark Bay sedimentology reflects the deposition of sediments from river input at the northern end, and tidal input at the southern end. Sediments within Newark Bay tend to be a fine-grained combination of silts, clays, and sands, with larger-grained materials present in the southern end of the bay due to materials introduced by tidal activity.

Upper New York Bay has the most complex distribution of sediments. Currents vary substantially, and a high degree of input is biogenic or anthropogenic. Sediments in Upper New York Bay vary from coarse sands and gravels in high-energy areas to fine-grained silts and clays in low-energy areas.

Lower New York Bay sediments in the area just south of the Narrows are characterized by gravelly sands underlying the main channel, with finer-grained sands, clays, and silts to the east and west of the channel. Extensive deposits of sand characterize the northern part of Lower New York Bay.

A variety of contaminants are found in the sediments of the Harbor. Contaminants detected in sediment samples have included: polycyclic aromatic hydrocarbons, pesticides, polychlorinated biphenyl (PCB) congeners, metals, and dioxin/furans. Similar to sediment type, the quality of sediments varies substantially, depending on what area is sampled. Typically, water bodies adjacent to or downstream from areas that have a history of industrial activity, especially prior to the introduction of environmental regulations in the 1970s, show the greatest potential for

contaminated sediments.

Sediment quality has been assessed extensively over the past several decades for contaminant concentrations related to the surrounding, and upgradient, highly urban and industrial operations historically prevalent throughout the study area. Several recent studies and data sources, including those studies with sampling results presented in Table 2 and Table 3, have demonstrated that contaminants of varying concentrations are under 20% average median contamination has trended cleaner in the past few decades and the overall harbor is expected to decrease its median concentration levels as a result of, to name a few examples, natural attenuation recovery processes, historical and recent deepening and maintenance dredging of navigation channels, and following a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial action associated with the Diamond Alkali Superfund Site (NBSA 2019, Lodge et al 2015, and USFWS et al 2020). Some model simulations have also indicated that sediment contaminant levels will continue to decrease over time even if current contaminant loads in Newark Bay were to remain constant (Lodge et al 2015). An operable unit of the Diamond Alkali Superfund Site is located within the project boundary, discussed in more detail in Section 2.16 and Appendix A6. Characterization of dredged material suitability will be performed during the Preconstruction Engineering and Design phase.

				RANGE OF CONCENTRATIONS		
WATERWAY	CHEMICAL	UNITS	SAMPLES	MINIMUM DETECT	MAXIMUM DETECT	
Passaic River – Lower						
17.4 to 8.3 miles		Parts per trillion (ppt)	297	0.02	51,100	
Passaic River – Lower			478	0.02	24.400	
8.3 miles					34,100	
Hackensack River	TCDD		84	0.18	2,990	
Newark Bay			179	0.95	592	
Arthur Kill			73	0.30	347	
Kill Van Kull				5.79	20.2	
Passaic River – Lower			272	0.02	<u></u>	
17.4 to 8.3 miles		Parts per	273	0.02	22.2	
Passaic River – Lower			165	0.04	24.2	
8.3 miles	Moroury		405	0.04	24.5	
Hackensack River	whercury	(nnm)	429	0.01	21,382.50	
Newark Bay		(ppm)	199	0.05	1,320	
Arthur Kill			230	0.02	2,300	
Kill Van Kull			3	0.77	7.70	
Passaic River – Lower		Parts per billion (ppb)	201	0.07	1 271 10	
17.4 to 8.3 miles			231	0.07	1,571.10	
Passaic River – Lower			277	0.21	4 002	
8.3 miles	Total DDT		_,,		+,002	
Hackensack River	TOLATODI		2	13.80	15.30	
NewarkBay			95	1.62	558.14	
Arthur Kill			17	11.70	3,740	
Kill Van Kull			3	15.60	464	
Passaic River – Lower		nnh	348	147.72	622,768	
17.4 to 8.3 miles	Total					
Passaic River – Lower	polycyclic		520	277.40	2.523.200	
8.3 miles	aromatic				_,,	
Hackensack River	hvdro-	664	291	262.50	51,620,000	
NewarkBay	carbons		191	118.10	478,440	
Arthur Kill			193	81.95	189,514	
Kill Van Kull			3	6,780	20,730	
Passaic River – Lower			296	1.25	30.782.26	
17.4 to 8.3 miles				1.20	,	
Passaic River – Lower			482	0.82	28,578.83	
8.3 miles	Total PCB	dqq		0.40		
Hackensack River			320	0.18	2,000,000	
NewarkBay			150	4.53	10,400	
			193	9	5,500	
KIII Van Kull			3	442.09	538.85	

Table 2: Sediment Concentration Ranges by Waterway

Source: USFWS et al 2020, Exhibit 2-1, Concentrations of Select Hazardous Substances Measured in Sediments of the Lower Passaic River/Newark Bay Study Area, 1990-2016 (portion of recreated).

		NUMBER	er deror mangeo i	RANGE OF CONCENTRATIONS	
CHEMICAL	UNITS	OF	MEDIAN	MINIMUM	MAXIMUM
		SAMPLES		DETECT	DETECT
2,3,7,8-TCDD	ppt	254	42.8	0.12	1,710
Arsenic	ppm	254	13.3	1.18	115
Barium	ppm	254	117	5.5	1,260
Cadmium	ppm	254	0.91	0.0592	24.6
Chromium	ppm	254	95.8	3.95	777
Copper	ppm	254	100	1.5	924
Lead	ppm	254	111	2.18	2,190
Mercury	ppm	254	1.48	0.0051	22.1
Nickel	ppm	254	37.9	3.83	282
Silver	ppm	254	1.46	0.0448	12
Zinc	ppm	254	220	8.18	6,810
Bis(2-Ethylhexyl)phthalate	ppb	254	340	96	38,000
Total Petroleum Hydrocarbon	ppm	254	190	6.5	2,900
Total DDT (4,4)	ppb	254	26	0.093	1,800
Total Aroclor PCBs (sum of 9 Aroclors)	ppb	254	140	6.4	2,500
Total PCB Congeners (209)	ppt	254	277,254	2,480	5,030,000
Total Alpha + Gamma Chlordane	ppb	254	4.3	0.039	32

Table 3: Surface Sediment Concentration Ranges in Newark Bay

Source: NBSA 2019, Table 6-1, Phase III Stratified Mean Surface Sediment Concentrations in the NBSA (portion of recreated).

However, it is not anticipated that sediment load concentrations will remain constant based on efforts underway and planned for the connecting waterways and Newark Bay, including the USEPA's remedial investigation and action of the Lower 8.3 miles of the Passaic River planned to reduce or eliminate risk to human health and the environment related to the Diamond Alkali Superfund Site discussed further in Section 2.16 and Appendix A6. While these tables present the general sediment sampling results throughout the study area waterways and Newark Bay, it should be noted that sampling locations were specific to the remedial investigation of Diamond Alkali. Material generated from the existing navigation channels during the Harbor Deepening Project was tested and found at concentrations suitable for placement at Historic Area Remediation Site (HARS) or beneficial use placement as grading/closure materials, for marsh restorations, and artificial reef development (NBSA 2019).

2.5.3: Water Quality

New Jersey Department of Environmental Protection (NJDEP) and New York State Department of Environmental Conservation (NYSDEC) have established classification systems for the best intended uses of surface waters in the project area (Surface Water Quality Standards, New Jersey Administrative Code 7:9B; Water Quality Regulations, 6 NYCRR parts 700-705). These classifications are based on the extent to which these surface waters will attain the Clean Water Act goals of aquatic life support and swimmability, and the designated uses outlined by the state. Designated uses are generally based on a set of numeric and narrative water quality criteria. The swimmability goal means having all possible surface waters of sufficient quality to allow for primary-contact recreation. The aquatic life support goal means having all possible waters of sufficient quality to support healthy and reproducing aquatic biota.

For Upper New York Bay, the NJDEP and NYSDEC classifications are SE-2 (saline, estuarine waters) and SE-I (fishing), respectively. These waters are suitable for fishing and secondary contact recreation. The Kill Van Kull is classified as SE-3 (NJDEP) and SD (NYSDEC). SE-3 waters are suitable for maintenance and migration of fish populations and secondary contact recreation. Class SD waters are suitable for fish survival. Class SD waters are characterized as waters not primarily used for recreational purposes, shellfish culture, or the development of fish life, and, due to natural or manmade conditions, cannot meet the requirements of these uses. Newark Bay, under jurisdiction of NJDEP, is also classified as SE-3. The New York waters of Lower New York Bay are classified as I around Gravesend Anchorage and as SB further offshore in the vicinity of Ambrose Channel. SB marine waters are suitable for primary contact recreation (e.g., swimming).

2.6: Vegetation, Wetlands, and Submerged Aquatic Vegetation

2.6.1: Aquatic Habitat

Aquatic habitats within the project area, which include both marine and estuarine habitats, vary in depth from shallow subtidal shoals to deeper channel habitats. Estuarine systems consist of tidal and subtidal habitats and adjacent tidal wetlands that are generally surrounded by land but that have open, partially obstructed, or sporadic access to the open ocean. Ocean and freshwater flows mix in estuarine habitats. Estuarine habitat extends upstream and landward to where ocean-derived salts measure less than 0.5 ppt. Estuarine habitat traditionally comprises four salinity categories: oligohaline (<8 ppt), mesohaline (8-18 ppt), and polyhaline (18-30 ppt), with some eurohaline water (>30 ppt) from open ocean embayments where high evaporation rates lead to elevated salinity levels. The estuarine environment affected by marine waters has tidally influenced boundaries. These boundaries are generally maintained by seawater that is transported through inlets mixing with freshwater supplied by land runoff. Estuarine habitats in the project area include the open-water and shoreline areas of Upper New York Bay, the Kill Van Kull, and Newark Bay.

Marine habitat consists of open ocean overlying the continental shelf and its associated coastline (Cowardin et al. 1979, Tiner 1985). Parts of the project area that are considered marine include the open-ocean waters of the New York Bight Apex as well as the open-water areas of Lower New York Bay. Marine habitats are exposed to the waves and currents of the open ocean, while water regimes are determined primarily by the ebb and flow of oceanic tides. Salinity generally exceeds 30 ppt with little or no dilution except at the boundaries of estuarine waters. Marine systems extend from the outer edge of the continental shelf shoreward to the seaward limit of the estuarine system.

Habitats within the estuarine and marine portions of the project area vary from shallow subtidal mudflats to deep channels. Deep channels within the project area include maintained navigation channels, interpier berthing areas, and naturally occurring deep-water areas. Although natural

water depths in the harbor are for the most part less than -20 feet MLLW, depths in some areas exceed -90 feet MLLW (e.g., the Narrows).

Subtidal deep habitats also include submerged structures (e.g., pile fields, wrecks), and some underpier and interpier areas, which provide habitat for most fish species, including juvenile striped bass (*Morone saxatilis*) and recently settled winter flounder (Able et al. 1995). These pile fields and interpier habitats are found throughout the project area but are most extensive along the developed shorelines of the Kill Van Kull and Newark Bay.

The littoral zone (-0 to -6 feet MLLW) are important transitional areas between tidally exposed wetlands and deepwater or pelagic systems. The littoral zone is a recipient, producer, and converter of nutrients in the aquatic ecosystem. The littoral zone receives nutrients, typically in the form of plant debris and organic sediments. The nutrients are flushed from the intertidal wetlands daily, and in seasonal pulses when the plant material breaks down at the end of the growing season. Nutrients can also be exported to the littoral zone by forage fish and invertebrates that feed on plant matter; nutrients exported by silversides (*Menidia menidia*), mummichogs (*Fundulus heteroclitus*), and crustaceans are then immediately available for transfer to higher trophic levels, such as predatory fish and birds.

Some predators, such as bluefish (*Pomatomus saltatrix*), Atlantic needlefish (*Strongylura marina*), and cormorants (*Phalacrocorax sp.*) actively feed in the littoral zone. Nutrients can also be exported to the littoral zone from sewage treatment plant discharges and stormwater outfalls. Non-point discharges, such as runoff from impervious surfaces, can also contribute nutrients as well as contaminants to the littoral zone.

2.6.2: Vegetation

The dominant wetland vegetation in the project area is reflective of the wetland type and degree of human disturbance and invasion by common reed (Phragmites australis). Observations on wetland vegetation and wildlife were made as part of the Harbor Deepening Project Baseline Biological Reconnaissance Survey in September 1998. The wetlands in the tidally influenced creeks are characterized by an unvegetated mud flat grading to a monoculture of saltmarsh cordgrass (Spartina alterniflora), then to a monoculture of common reed. The saltmarsh cordgrass is typically found in the frequently inundated ("IM" wetlands on the NYSDEC maps and "E2EM" wetlands on the National Wetland Inventory maps) portions of the intertidal marsh; common reed is found in the upper portions of the intertidal marsh and in the high marsh. Less commonly observed plants were salt meadow cordgrass (S. patens), groundsel bush (Baccharis halimifolia), both of which occur in the high marsh, and water hemp (Amaranthus cannabinus), which is found in the intertidal marsh. Common reed is an invasive species that often outcompetes cordgrass in the upper intertidal area. While common reed has little food value for wildlife, it functions as cover, traps sediments, and absorbs waterborne nutrients. Common reed spreads by seed and rhizomes (specially adapted roots), rapidly colonizing disturbed or cleared areas. The saline waters carried by mosquito control ditches in portions of the intertidal wetlands may prevent or slow the spread of common reed. In the case of common reed, ditching can serve either to facilitate or prevent its spread. When ditching serves to reduce the tidal influence and period of (saline) inundation, common reed may gain a competitive edge over saltmarsh cordgrass. However, tidal ditches of sufficient width and depth will prevent the spread (by

rhizomes) of common reed. Ditching facilitates the invasion of common reed from the upland edge of the wetland but can prevent invasion in isolated portions of the wetland.

2.6.3: Submerged Aquatic Vegetation

There is no documented submerged aquatic vegetation within the project area.

2.6.4: Intertidal Wetlands

The intertidal system is defined as the area between MLLW and mean higher high water (MHHW). Saltwater marshes, mudflats, gravel/sand beaches, and rock or riprap shorelines subject to periodic tidal inundation are all examples of intertidal habitats. Although there are intertidal wetlands in areas adjacent to the project area, there are no intertidal wetlands within the project area.

2.7: Essential Fish Habitat

An essential fish habitat is defined under the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Sustainable Fisheries Act requires that essential fish habitat be identified for those species actively managed under federal fishery management plans. This includes species managed by the eight regional Fishery Management Councils, established under the Magnuson-Stevens Fishery Conservation and Management Act, as well as those managed by the National Marine Fisheries Service (NMFS) under fishery management plans developed by the Secretary of Commerce.

Essential fish habitat designations emphasize the importance of habitat protection to healthy fisheries and serve to protect and conserve the habitat of marine, estuarine, and anadromous finfish; mollusks; and crustaceans. Essential fish habitat embodies both the water column (including its physical, chemical, and biological growth properties) and its underlying substrate (including sediment, hard bottom, and other submerged structures). Under the essential fish habitat definition, necessary habitat is that which is required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. Essential fish habitat is designated for a species' complete life cycle, including spawning, feeding, and growth to maturity, and may be specific to each life stage (e.g., eggs, larvae).

Species for which essential fish habitats have been designated in the New York and New Jersey Harbor are butterfish (*Peprilus tricanthus*), Atlantic herring (*Clupea harengus*), Atlantic mackerel (*Scomber scombrus*), black sea bass (*Centropristus striata*), bluefish, red hake (*Urophycis chuss*), scup (*Stenotomus chrysops*), summer flounder (*Paralichthys dentatus*), windowpane flounder (*Scophthalmus aquosus*), winter flounder (*Pseudopleuronectes americanus*), little skate (*Leucoraja erinacea*), clearnose skate (*Raja eglanteria*), winter skate (*Leucoraja ocellata*), king mackerel (*Scomberomorus cavalla*), Atlantic Spanish mackerel (*Scomberomorus maculatus*), cobia (*Rachycentron canadum*), sand tiger shark (*Carcharias taurus*), dusky shark (*Carcharhinus obscurus*), and sandbar shark (*Carcharhinus plumbeus*). See Appendix A4 for species-specific Essential Fish Habitat assessment.

2.8: Wildlife

The finfish community in the project area, consisting of a variety of estuarine, marine, and anadromous fish species, is typical of large coastal estuaries and inshore waterways along the Mid-Atlantic Bight. Situated in the transition zone between northern cold water (boreal) species and temperate (warm-water) species, New York Bight and the NY/NJ Harbor estuary serve as a spawning ground, migratory pathway, and nursery/foraging area for many fish species.

Many of the species that are seasonally abundant in the project area are transient or migratory, moving through the project area to upstream spawning grounds in the Hudson River or entering the area on a seasonal basis from nearby ocean waters. These species include estuarine migratory species that use the estuary primarily as a nursery, or as a forage area for juveniles or adults.

Species that migrate from marine waters to spawn in the freshwater reaches of the Hudson River, in freshwater tributaries, or in the upper reaches of the estuary are considered anadromous. This includes several common species of herring (*Clupeidae*) such as blueback herring (*Alosa aestivalis*), alewife (*A. pseudoharengus*), and American shad (*A. sapidissima*), as well as the relatively less common hickory shad (A. *mediocris*) and gizzard shad (*Dorosoma cepedianum*) (U.S. Fish and Wildlife Service, 1997). These species occur in the project area primarily as adults, migrating to spawning areas, and heavily influence the seasonal composition and abundance of the fish community. Other anadromous species occurring in the project area include Atlantic tomcod (*Microgadus tomcod*), Atlantic sturgeon (*Acipenser oxyrhyncus*), rainbow smelt (*Osmerus mordax*), and striped bass.

Deeper, open-water habitats in this region support over 60 migratory and resident fish species including species of commercial or recreational importance such as winter flounder and black sea bass (RPA, 2003; USACE, 2004a). Northwest Staten Island and the islands along the Kill Van Kull were designated as a Special Natural Waterfront Area by New York City due to the diverse landscape of habitats (NYCDCP, 2011). Arlington Marsh and Graniteville Swamp are examples of important habitats within this region.

Large breeding populations of herons, egrets, and ibises have used uninhabited islands in the region as nesting sites, and the nearby marshlands and mudflats as foraging areas. From the late 1970s through the early 1990s, the islands supported the largest heron rookery in New York State. It was estimated that the entire rookery in the study area accounted for almost 25 percent of the wading birds that nested in coastal waters within New York, New Jersey, and Connecticut (U.S. Fish and Wildlife Service, 1997). The three islands near this project are Shooters Island, Hoffman Island, and Swineburne Island. Of these, only Hoffman Island was shown to support active wading bird rookeries during the most recent survey (NYC Audubon, 2019), however all three provide habitat for other bird species and may be recolonized by wading birds in the future. The water of the Upper Bay also supports migratory marine mammals, such as humpback whales (*Megaptera noveangliae*) (NYSDEC, 2019).

Three endangered marine mammals have been identified by NMFS as occurring within the project area. These include the northern right whale (*Eubalaena glacialis*), the humpback whale, and the finback whale (*Balaenoptera physalus*) (NMFS, 1999). These species are migratory, using the harbor in transit to other habitat areas, or have been recorded in the Lower New York Bay area, although some individuals have been documented as far up the Hudson River as the

Troy Dam.

2.9: Benthic Fauna

Benthic communities have varied roles in the estuarine ecosystem. New York Harbor once had a vibrant benthic community, but major environmental degradation due to the development of New York City, heavy industry, and all of the associated pollution from both as well as overfishing of local stocks of shellfish affected benthic populations. Supporting evidence is provided by historical accounts of New York's oyster industry. Before 1900, oysters were found throughout much of the lower estuary and north to Ossining, New York, including Newark Bay, Arthur Kill, Kill Van Kull, Jamaica Bay, Raritan Bay, and the New Jersey shore of the Hudson. By the turn of the century, the shellfish industry was limited to waters south of the Narrows; by 1920 it largely had disappeared from harbor waters (Kirby, 2004; Franz 1982). Filter feeders such as clams, oysters, and sponges clarify and clean the waters of the bay through their biological processes, removing particulate matter and potentially toxic materials, providing for a healthy marine environment. Today's remnant population located primarily on sub-tidal rip-rap and other hard structure rather than natural oyster reefs, which have been eliminated from the region, provides few such ecological services. However, there is an active and growing oyster restoration program to return oysters to New York Bay by constructing new reefs and stocking live oysters (Billion Oyster Project, 2019). Several small restoration reefs are present in the greater region (though none in the project area) at this time, along with remnant oyster populations attached to hard structures, such as rip-rap and concrete pilings.

Benthic primary and secondary consumers, as well as detritivores, pass the energy of primary producers (phytoplankton) to higher levels of the food web. Many benthic species are prey for economically important species such as the blue crab (*Callinectes sapidus*), striped bass, winter flounder, bluefish, and summer flounder (Limburg et al., 2006).

The benthic communities of the lower New York Harbor include an array of fauna that play important roles in the food web (USACE, 2006; Cerrato et al. 1989). The lower New York Bay benthic community includes epifauna (organisms that live attached to surfaces on the river bottom) such as oysters (*Crassostrea virginica*) and barnacles, which need hard structure. These benthic communities live along with organisms that can be found on sand bottom such as blue mussels (*Mytilus edulis*), sponges (phylum *Porifera*), sea squirts (class *Ascidiacea*), and sea stars (class *Asteroidea*).

Also, these benthic communities include infauna that burrow into bottom sediments and are characterized by worms (primarily polychaetes [typically the most numerous organism in the region (USACE, 2006, 1999b)] and nemotodes), clams (the most numerous in the project region is the dwarf surf clam, [*Mulinia lateralis*]), and other tunneling organisms such as tube worms. The USACE 1989-1999 survey indicated few organisms in the project region besides polychates, but the more recent surveys (USACE 1999, 2006, 2011, 2013, 2017) indicated that significant ecological recovery has taken place since the 1980s, with a much wider variety of species being found today compared to earlier decades. The benthic community in the project region is, in some areas low in biomass and diversity due to sediment contamination and sediment composition (less sand and more clay and/or silt, with no reef or hard bottom habitat), with areas

dominated by higher percentage sand sediments holding much greater species numbers, biomass and diversity (USACE, 2006). Due to the nature of this substrate, the biologically active zone (BAZ), where living organisms can be found, is deeper than silt and mud sediment types.

2.10: Special Status Species

The Action Area includes the range of noise impacts as they pertain to special status species.

This section provides a summary of the special status species that are known or have the potential to occur in the Action Area. The following references were consulted for compilation of the special status species that have the potential to occur in the Action Area that is provided in Table 4:

- Information, Planning and Consultation System search conducted within the Action Area (USFWS, 2020);
- National Oceanographic and Atmospheric Administration, National Marine Fisheries Service (NMFS, 2020) Section 7 Mapper, url: https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=1bc332edc5204e03b2 50ac11f9914a27
- Large Whale Strike Database (Jensen and Silber, 2003).

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS	NEW YORK STATE STATUS	NEW JERSEY STATE STATUS	CRITICAL HABITAT IN ACTION AREA (Y/N)
Atlantic Sturgeon	Acipenser oxyrhynchus	E	HPS	E	Ν
Shortnose Sturgeon	Acipenser brevirostrum	Е	Е	E	Ν
Leatherback Sea Turtle	Dermochelys coriacea	Е	E	E	Ν
Loggerhead Sea Turtle	Caretta caretta	E	т	E	Ν
Kemp's Ridley Sea Turtle	Lepidochelys kempii	E	E	E	Ν
Green Sea Turtle	Chelonia mydas	E	Т	Т	Ν
North Atlantic Right Whale	Eubalaena glacialis	Е	E	E	Ν
Fin Whale	Balaenoptera physalus	E	E	E	Ν

Table 4: Special Status species that have potential to occur in Action Area

E = Endangered; *T* = Threatened; HPS = High Priority Species of Greatest Conservation Need (Not Currently Endangered, Threatened, or Special Concern)

2.10.1: Federally Threatened and Endangered Species and Designated Critical Habitat

Animals and plants listed as endangered or threatened are protected under the Endangered Species Act of 1973. According to the Endangered Species Act of 1973, an "endangered species"

is defined as any plant or animal species in danger of extinction throughout all or a substantial portion of its range. A "threatened species" is any species likely to become an endangered species in the foreseeable future throughout all or a substantial part of its range. "Proposed Species" are animal or plant species proposed in the Federal Register to be listed under Section 4 of the Endangered Species Act of 1973. "Candidate species" are species for which the USFWS and NMFS have sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act of 1973. Critical habitat is designated per 50 Code of Federal Regulations parts 17 or 226 and defines those habitats that are essential for the conservation of a species classified by the federal government as threatened or endangered and that may require special management and protection.

A Biological Assessment (BA) for those species under the jurisdiction of NMFS is available in Appendix A1. Coordination is ongoing. There are no candidate species known or with the potential to occur in the project Action Area. The closest critical habitat is for the Atlantic sturgeon, the local distinct population segment, which is a relatively isolated sub-population (New York Bight Distinct Population Segment) (Figure 5), whose critical habitat includes the Hudson River. The critical habitat begins approximately 3 miles upriver of the project Action Area.

Both the Atlantic and shortnose sturgeon (*Acipenser brevirostrum*) migrate through waters of the Hudson River and New York Bay to reach spawning waters in freshwater reaches of the Hudson River. The Hudson River population of shortnose sturgeon is one of the healthiest remaining populations of this species (Woodland and Secor, 2007). Shortnose sturgeon are, however, transient in upper New York Harbor waters and likely only to be found there during their migrations to spawning grounds and are not known to occur in lower New York Harbor. Atlantic sturgeon do migrate through waters of Lower New York Bay, and adjacent channels and waters. The local juvenile population aggregates in the spring and fall near Breezy Point, known as the Rockaway Aggregation. This population experiences the highest by-catch rate during otter trawling fishery seasons (Dunton, 2014).

Based on review of the survey and National Oceanic and Atmospheric Administration stranding data (Jensen and Silber, 2003), there are two records of finback (fin) whale strikes with mortality in New York Harbor and one from Manhattan.

Green sea turtles feed primarily on sea grass and can be found foraging in sea grass beds on the eastern side of Long Island as well as in open pelagic waters and are highly unlikely to be found in the local project area. Therefore, there would be "no effect" to the green sea turtle and this species is dismissed from further analysis. Leatherback, Kemp's Ridely, and loggerhead sea turtles could potentially be found transiting waters of the Action Area and adjacent waters transited by dredging vessels. A Biological Opinion was issued on sea turtles and sturgeon by NMFS in 2012 relative to the New York Harbor Deepening Project. The Biological Opinion did not include detailed analysis on the shortnose sturgeon or Hawksbill sea turtle due to NMFS's determination of "Not Likely to Adversely Affect," due to the extremely low probability of these two species being found in the area and impacted by the proposed dredging. Only the Ambrose Channel was considered suitable sea turtle habitat.



Figure 5: New York Bight Atlantic Sturgeon Distinct Population Segment

2.10.2: Marine Mammals

The Marine Mammal Protection Act of 1972, as amended, prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. In reference to the Marine Mammal Protection Act, a marine mammal is a species found in the U.S. that is classified into one of the following four distinct groups: cetaceans (whales, dolphins, and porpoises), pinnipeds (seals, sea lions, and walruses), sirenians (manatees and dugongs), and marine fissipeds (polar bears and sea otters). Only cetaceans, pinnipeds, and sirenians (a single migratory manatee, named "Ilya" has been spotted several times in recent years) have the potential to occur in the Action Area. All marine mammals in the U.S. are protected under the Marine Mammal Protection Act.

The Marine Mammal Protection Act prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. The term "take" per the Marine Mammal Protection Act is defined as harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal. For most activities, "harassment" refers to the act of pursuit, torment, or annoyance which:

- Can injure a marine mammal or a marine mammal stock in the wild which is referred to as Level A Harassment; or
- Has the potential to disturb a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns that include but are not limited to the following: migration, breathing, nursing, breeding, feeding, or sheltering which is referred to as Level B Harassment.

Table 5 provides a comprehensive listing of marine mammals documented to occur throughout the coastal waters of New York and New Jersey. The humpback whale, West Indies Distinct Population Segment, the only humpback whale population segment that occurs in New York, is no longer federally listed, but is still protected under the Marine Mammal Protection Act and has been recently returning in numbers to New York Harbor waters.

TAXONOMIC CATEGORY/ COMMON NAME	SCIENTIFIC NAMES		
Baleen Whales			
Blue whale	Balaenoptera musculus		
Fin whale	Balaenoptera physalus		
Humpback whale	Megaptera novaeangliae		
Minke whale	Balaenoptera acutorostrata		
Northern right whale	Eubalena glacialis		
Sei whale	Balaenoptera borealis		
Delphinids			
Atlantic white-sided dolphin	Lagenorhynchus acutus		
Bottlenose dolphin	Tursiops truncatus		
Common dolphin	Delphinus delphis		
Long-finned pilot whale	Globicephala melas		
Other toothed whales			
Cuvier's beaked whale	Ziphius cavirostris		
Harbor porpoise	Phocoena phocoena		
Sperm whale	Physeter macrocephalus		
Pinnipeds			
Grey seal	Halichoerus grypus		
Harbor seal	Phoca vitulina		

Table 5: Marine mammals documented to occur throughout the coastal waters of New York and NewJersev

New York and New Jersey Harbor Deepening Channel Improvements Final Integrated Feasibility Report and Environmental Assessment

2.10.3: Bald Eagles Protected under the American Bald and Golden Eagle Act of 1972

Previously listed as federally endangered, the bald eagle (*Haliaeetus leucocephalus*) has made a remarkable comeback and is no longer federally listed. The bald eagle is currently protected under the American Bald and Golden Eagle Act, and the Migratory Bird Treaty Act. Bald eagles breed throughout much of Canada and Alaska, in addition to scattered sites across the lower 48 states, from California to the southeastern U.S. coast and Florida. Wintering habitat covers most of the contiguous U.S., with some year-round distribution in the northwest. Northern birds return to breeding grounds as soon as weather and food availability permit, generally between January and March.

The USFWS National Bald Eagle Management Guidelines (2007) are used to assess potential effects to nesting bald eagles and provides management guidelines to avoid impacts to nesting bald eagles (USFWS, 2007). To avoid disturbing bald eagles, a nest buffer is recommended between the human activity and the nest where applicable. Human impacts are considered detrimental to nesting success within the primary buffer and within the secondary buffer, human impacts are thought to impact the quality of the primary nest buffer. The primary buffer is a distance of 330 feet from the nest and the secondary buffer is a distance of 660 feet from the nest. Human activities that are considered detrimental to breeding activities (e.g. development, logging, use of toxic chemicals, etc.) are to be limited within the primary buffer and those that could impact the integrity of the primary buffer are restricted within a secondary buffer (e.g. developments, roadways, etc.). Per the management guidelines, a nest buffer of 2,640 feet is recommended from the nest for loud, disturbing noises such as those caused by blasting and other loud, intermittent noises.

No bald eagle nests currently exist within the Action Area. The Action Area is not located in a Bald Eagle Concentration Area. The closest known nesting location for bald eagles are in Linden and Kearny (NJDEP, 2019), approximately 4 miles from the study area, and recent sightings indicate there is a nest on Staten Island (Trezza, 2016).

2.10.4: Species Protected under the Migratory Bird Treaty Act and Executive Order 13186

The Migratory Bird Treaty Act and Executive Order 13186 requires agencies to protect and conserve migratory birds and their habitats. Any activity that results in the take of migratory birds or eagles is prohibited unless authorized by the USFWS.

Migratory birds nest throughout North America, some as far north as the Arctic. In late summer and fall, they migrate south for the winter. Some winter in the southern United States, Mexico, the Caribbean or Central America while others go as far as South America. Each spring they return north to their breeding grounds. Many migratory songbirds, shorebirds, and raptors rest and refuel in the area during their spring and fall migrations (Table 6). Others winter south and return to the watershed each spring to breed.

Migratory birds are defined as those described by the USFWS in the 50 Code of Federal Regulations 10.13 and consist of species that that belongs to a family or group of species in the United States as well as Canada, Japan, Mexico, or Russia. Most birds native (naturally occurring in the U.S.) to the U.S. belong to a protected family and are protected by the Migratory Bird Treaty Act. A species qualifies for protection under the Migratory Bird Treaty Act if it meets one or more of the following four criteria:

(1) It (a) belongs to a family or group of species named in the Canadian convention of 1916, as amended in 1996; (b) specimens, photographs, videotape recordings, or audiotape recordings provide convincing evidence of natural occurrence in the United States or its territories; and (c) the documentation of such records has been recognized by the American Ornithologists Union or other competent scientific authorities.

(2) It (a) belongs to a family of group of species named in the Mexican convention of 1936, as amended in 1972; (b) specimens, photographs, videotape recordings, or audiotape recordings provide convincing evidence of natural occurrence in the United States or its territories; and (c) the documentation of such records has been recognized by the American Ornithologists' Union or other competent scientific authorities.

(3) It is a species listed in the annex to the Japanese convention of 1972.

(4) It is a species listed in the appendix to the Russian convention of 1976.

COMMONNAME	SCIENTIFICNAME	COMMONNAME	SCIENTIFIC NAME
American Oystercatcher	Haematopus palliates	Lesser Yellowlegs	Tringa flavipes
Bald Eagle	Haliaeetus Ieucocephalus	Long-eared Owl	Asio otus
Black Scoter	Melanitta nigra	Long-tailed Duck	Clangula hyemalis
Black Skimmer	Rynchops niger	Nelson's Sparrow	Ammodramus nelsoni
Black-billed Cuckoo	Coccyzus erythropthalmus	Northern Gannet	Morus bassanus
Black-legged Kittiwake	Rissa tridactyla	Parasitic Jaeger	Stercorarius parasiticus
Bobolink	Dolichonyx oryzivorus	Prairie Warbler	Dendroica discolor
Bonaparte's Gull	onaparte's Gull Chroicocephalus Philadelphia		Protonotaria citrea
Bridled Tern	Onychoprion anaethetus	Purple Sandpiper	Calidris maritima
Brown Pelican	Pelecanus occidentalis	Razorbill	Alca torda
Buff-breasted Sandpiper	Calidris subruficollis	Red Knot	Calidris canutus
Canada Warbler	Cardellina Canadensis	Red Phalarope	Phalaropus fulicarius
Cerulean Warbler Dendroica cerulean		Red-breasted Merganser	Mergus serrator
Clapper Rail Rallus crepitans		Red-headed Woodpecker	Melanerpes erythrocephalus
Common Eider	Somateria mollissima	Red-necked Phalarope	Phalaropus lobatus
Common Loon	gavia immer	Red-throated Loon	Gavia stellata
Common Tern	Sterna hirundo	Ring-billed Gull	Larus delawarensis
Cory's Shearwater	Calonectris diomedea	Roseate Tern	Sterna dougallii
Double-crested Cormorant	orant culonectris donieded phalacrocorax auritus		Thalasseus maximus

Table 6: Avian species that may rest and refuel in the area during spring and fall migrations(Note this table spans two pages)

COMMONNAME	SCIENTIFIC NAME	COMMONNAME	SCIENTIFIC NAME
Dovekie	Alle	Ruddy Turnstone	Arenaria interpres morinella
Dunlin Calidris	alpina arcticola	Rusty Blackbird	Euphagus carolinus
Eastern Whip-poor- will	Antrostomus vociferous	Saltmarsh Sparrow	Ammodramus caudacutus
Evening Grosbeak	Coccothraustes vespertinus	Seaside Sparrow	Ammodramus maritimus
Golden Eagle	Aquila chrysaetos	Semipalmated Sandpiper	Calidris pusilla
Golden-winged Warbler	Vermivora chrysoptera	Short-billed Dowitcher	Limnodromus griseus
Great Black-backed Gull	Larus marinus	Snowy Owl	Bubo scandiacus
Great Shearwater	Puffinus gravis	Surf Scoter	Melanitta perspicillata
Herring Gull	Larus argentatus	Thick-billed Murre	Uria lomvia
Hudsonian Godwit	Limosa haemastica	Whimbrel	Numenius phaeopus
Kentucky Warbler	Oporornis formosus	White-winged Scoter	Melanitta fusca
King Rail	Rallus elegans	Willet	Tringa semipalmata
Leach's Storm-petrel	Oceanodroma leucorhoa	Wilson's Storm-petrel	Oceanites oceanicus
Least Tern	Sterna antillarum	Wood Thrush	Hylocichla mustelina

2.11: Floodplains

Through Executive Order 11988, federal agencies are required to evaluate all proposed actions within the one percent annual exceedance (100-year) floodplain. Actions include any federal activity involving 1) acquiring, managing, and disposing of federal land and facilities, 2) providing federally undertaken, financed, or assisted construction and improvements, and 3) conducting federal activities and programs affecting land use, including, but not limited to, water and related land resources planning, and licensing activities. In addition, the 0.2 percent annual exceedance (500-year) floodplain should be evaluated for critical actions or facilities, such as storage of hazardous materials or construction of a hospital. The Executive Order provides an eight-step process to evaluate activities in the floodplain that generally includes 1) determine if the proposed action is in the floodplain, 2) provide public review, 3) identify and evaluate practicable alternatives to locating in the one percent annual exceedance floodplain, 4) identify the impacts of the proposed action, 5) minimize threats to life and property and to natural and beneficial floodplain values and restore and preserve natural and beneficial floodplain values, 6) reevaluate alternatives, 7) issue findings and a public explanation, and 8) implement the action. Proposed actions may have limited impacts such that the eight-step process may vary or be reduced in application, which is the case for this project.

The proposed action, widening and deepening within and adjacent to the navigation channels of New York and New Jersey Harbor, is not in the floodplain, and should not impact floodplains under the criteria listed under Executive Order 11988. Any dredged material should be placed either in the offshore HARS site or appropriately permitted upland disposal sites able to handle and properly store non-HARS suitable dredged materials, should any be within the dredging

footprint.

2.12: Cultural Resources

As a federal agency, USACE has certain responsibilities for the identification, protection and preservation of cultural resources that may be located within the Area of Potential Effect associated with the proposed project. Present statutes and regulations governing the identification, protection and preservation of these resources include the National Historic Preservation Act of 1966, as amended; the National Environmental Policy Act of 1969; Executive Order 11593; and the regulations implementing Section 106 of the National Historic Preservation Act of 1966 (36 Code of Federal Regulations Part 800, Protection of Historic Properties, August 2004). Significant cultural resources include any material remains of human activity eligible for inclusion on the National Register of Historic Places. This work is done in coordination with the State Historic Preservation Offices of New Jersey and New York, federally recognized Tribes, and interested parties. The district carried out a review of existing surveys and historical documentation to identify previously recorded historic Places and areas of archaeological sensitivity within the Area of Potential Effect.

The Area of Potential Effect represents the physical extent of the undertaking within which direct and/or indirect effects of the construction, operation, and maintenance of the project could be caused to the character or use of a historic property. For this project, the Area of Potential Effect includes the construction limits of all widened or deepened channels, a 500-foot buffer around any blasting that will take place for vibrations (Figure 4), and any additional locations that will be required to be used as environmental mitigation sites (to be identified in the future). No staging areas have been identified, but if used, staging areas would be part of the Area of Potential Effect as well. For this project, the term construction limits refers to the areas that will actually be deepened or widened, whereas Areas of Potential Effect include all of these areas, in addition to mitigation sites, staging areas, and the 500-foot buffer around known bedrock in the construction limits for potential vibration impacts.



Figure 6: Area of Potential Effect for Cultural Resources of the NYNJHDCI Project

There are many cultural resources within one mile of the Area of Potential Effect. In New York there are 52 archaeological sites within one mile of the Area of Potential Effect (this is 1 mile from the 500-foot vibration buffer). Of these, 14 resources are National Register eligible, 27 are not eligible, and 11 are undetermined. There are also 19 New York State Museum sites within one mile of the Area of Potential Effect. Also, in New York, there are 912 building sites within one mile of the Area of Potential Effect. 75 are listed on the National Register, 113 are eligible, 187 are not eligible, and 537 are unevaluated. In New Jersey, there are five archaeological sites within one mile of the Area of Potential Effect. This is according to spatial data the district received from the NJ State Historic Preservation Office in November 2012 for the Hudson Raritan Estuary Project. In New Jersey there are 26 National Register historic resources and districts within one mile of the Area of Potential Effect. Four resources are listed on the National Register, while the other 22 are eligible for the National Register. See Appendix A9 for the complete listing of cultural resources within one mile of the Area of Potential Effect.

2.13: Recreation

Although opportunities for recreation are present within the Action Area, the major use of the navigation channels and associated anchorages within the Action Area is for marine vessel navigation to and from marine terminals and shipyards via the New York and New Jersey Harbor channels.

Recreational boaters as well as charter fishing boats and cruise liners also use the lower New York Bay for access to attractions, which includes non-commercial fishing as well as land-based sites and tourist attractions, depending on the activity, as well as for access from points upstream in the Hudson River to pursue similar activities.

Recreational fishing in the region, the main recreational activity other than passing cruise liners, occurs mostly from boats and includes estuarine and marine fish species (e.g., porgy, weakfish, striped bass, summer flounder, and bluefish) as well as blue crab, the latter of which is also harvested commercially at a limited scale in New York Bay and the Hudson River. The project Action Area is generally closed to shellfish harvest, though areas outside of it along cleaner oceanic waters are, in some cases, open to such harvest

(<u>https://www.dec.ny.gov/outdoor/103483.html</u>). Overall, recreational opportunities are limited to boat-based activity due to the offshore, deep water nature of the navigation channels in the immediate area of proposed construction.

2.14: Aesthetics and Scenic Resources

The Action Area for visual resources are the industrial, commercial, urban, residential, recreational, and tourist sites as well as transportation routes which include bridges and various highways, with views of the New York and New Jersey Harbor. The visual experience is dependent upon the pattern of the land (i.e., the topography), the pattern of water bodies, vegetation, and manmade development at any location. Views along the harbor include a waterfront with a mix of industrial, commercial, naval, marine, and urban shoreline uses. Within the vicinity of the proposed project, the topography is relatively flat.

Because much of the Action Area is low elevation with very slight relief, viewers can generally see long distances from locations that are only slightly higher than the surrounding area. From the ground level, these locations are only near the river bank. Due to the highly urbanized nature of the Greater New York City Metropolitan Area, with numerous tall buildings throughout the Area, the view of the water is quickly lost as you move inland. However, both multi-story commercial and residential buildings can provide attractive waterfront views. Depending on the height of the individual building, these views can be had from significant distance inland from the harbor. There are four bridges from which the Action Area can be viewed:

- The Verrazzano-Narrows Bridge between Brooklyn, NY and Staten Island, NY;
- The Bayonne Bridge between Staten Island, NY and Bayonne, NJ;
- The Goethals Bridge between Staten Island, NY and Elizabeth, NJ; and
- The Newark Bay Bridge (officially the Vincent R. Casciano Memorial Bridge) between Bayonne, NJ and Newark, NJ.

Two golf clubs with extensive recreational acreage, the Liberty National and Bayonne, lie immediately north and south, respectively, of the Military Ocean Terminal at Bayonne (MOTBY) on the Port Jersey Peninsula. Throughout the industrial portion of the Action Area viewshed, there are numerous towering cranes and related land-side infrastructure used for loading and unloading ships along the waterfront. Navigation within the Action Area includes large commercial deep draft navigation vessels, smaller tugs and service vessels, as well as large and small recreational vessels. Large recreational vessels include national and international passenger ships (cruise liners), which can dock at Brooklyn Cruise Terminal, Cape Liberty Cruise Port, and Manhattan Cruise Terminal.

2.15: Coastal Zone Management

Aquatic habitats within the project area often overlap with wetland habitat types, particularly in shallow-water and intertidal areas. These shallow habitats and their locations are often defined by state and federal agencies as part of the coastal zone and are managed under the states' Coastal Zone Management Act and wetland protection programs. Coastal and aquatic habitats in New Jersey are defined under the Coastal Zone Management Location, Use and Resource Rules (New Jersey Administrative Code 7:7E). New Jersey's location rules classify all coastal land and water locations into general areas or one or more special areas. Special areas (including water areas, water's edge areas, land areas, and coast-wide areas) are those considered naturally valuable or sensitive to impact and require focused attention during project planning. Special water areas in estuarine and marine environments extend landward to the spring high water line. New Jersey special water areas occurring in the project area include shellfish habitat, prime fishing areas, finfish migratory pathways, navigation channels, ports, submerged infrastructure routes, and intertidal and subtidal shallows.

Coastal and aquatic habitats in New York State are defined in regulations promulgated under the Tidal Wetlands Act (Land Use Regulations, NYCRR 661) and delineated as tidal wetlands on state inventory maps. These aquatic/wetland habitats are classified as: coastal fresh marsh; intertidal marsh; coastal shoals, bars, and mud flats; littoral zone; high marsh or salt meadow; and formerly connected tidal wetlands.

2.16: Hazardous, Toxic, and Radioactive Wastes

Hazardous, toxic and radioactive waste is defined by Engineer Regulation 1165-2-132 as:

"Except for dredged material and sediments beneath navigable waters proposed for dredging... hazardous, toxic and radioactive waste includes any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA)... Dredged material and sediments beneath navigable waters proposed for dredging qualify as hazardous, toxic and radioactive waste only if they are within the boundaries of a site designated by the USEPA or a state for a response action (either a removal action or a remedial action) under CERCLA, or if they are part of a National Priority List site under CERCLA."

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980 and provides the U.S. Environmental Protection Agency the funds and authority to remediate contaminated sites where there is no identifiable responsible party. CERCLA was enacted to provide the necessary funds to protect human health and the environment, identify responsible parties to pay for remediation of sites, involve communities in the process, and return contaminated sites to

productive uses (USEPA 2020a).

The National Priorities List is the list of sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. There are six federally listed National Priority List Superfund sites located upgradient of the project and several New York State and New Jersey State listed known contaminated sites within the vicinity of the project, including sites located adjacent to the Kill Van Kull channel on the south shore of Bayonne, New Jersey and north shore of Staten Island, New York (Appendix A6). The majority of these sites are located on land, outside of the NYNJHDCI project area except for a portion of a National Priority List Superfund/State Listed (New Jersey) site, identified as an operable unit of the Diamond Alkali Superfund Site (Diamond Alkali).

The main plant of Diamond Alkali was added to the National Priority List in 1984 and was located at 80 Lister Avenue in Newark, New Jersey approximately five miles upgradient from Newark Bay along the western shore of the Passaic River (refer to Figure 4, Appendix A6). The Diamond Alkali plant is historically known for the manufacturing of agricultural chemicals and herbicides used in the production of "Agent Orange". Agent Orange was primarily used in the 1950s and 1960s during the Vietnam War. Bi-products of Agent Orange manufacturing polluted the surface and subsurface of the plant grounds in addition to the Passaic River which drains south into Newark Bay. Although production of Agent Orange ceased in the 1970s, adverse effects of manufacturing processes are still present to this day. Due to the known pollution concerns, the New Jersey Department of Environmental Protection (NJDEP) prohibits the consumption of fish or shellfish from the Lower Passaic River and Newark Bay (USEPA 2020b).

The Newark Bay Study Area was added as an Operable Unit of the Diamond Alkali in 2004, including Newark Bay, Arthur Kill and Kill Van Kull channels and portions of the Hackensack River. In 2007, a remedial investigation work plan for the Newark Bay Study Area was prepared and included investigation goals to determine the horizontal and vertical extent of Diamond Alkali contamination by sampling for several contaminants including, but not limited to, polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, pesticides and metals. Currently, remedial investigation of the Newark Bay Operable Unit is still in progress under the oversight of the USEPA. Additional Diamond Alkali study information and plans are located on the Newark Bay Study website: www.ournewarkbay.org.

Following the previous 50-foot Harbor Deepening Project, studied under an Environmental Impact Statement and subsequent Environmental Assessment, the project documentation was contested in 2005 to further assess the actions of the 50-foot Harbor Deepening Project (United States District Court, 2005). In June 2007, the district prepared an additional Environmental Assessment to assess the effects of the Harbor Deepening Project on the Newark Bay Study Area, which resulted in a finding of no significant impact (USACE, 2007). In October 2007, the lawsuit was settled by the parties with an agreement stipulating that USACE will work closely with the USEPA and NJDEP on the advancement of the 50-foot Harbor Deepening Project with the ongoing investigation efforts of the Diamond Alkali site planned in the Newark Bay and to perform construction under best management practices, so as not to interfere with ongoing investigation and remediation efforts occurring in the Newark Bay (United States District Court, 2007). The Newark Bay Operable Unit is co-located within the NYNJHDCI project area. No other federal or state listed contaminated sites were identified within the project area (Appendix A6).

In 2007, Tierra Solutions, Inc. prepared a Phase II Remedial Investigation Work Plan for the Newark Bay Study Area, which detailed sampling goals to determine the horizontal and vertical extent and concentration levels of Diamond Alkali contaminants of concern, including, but not limited to, polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, polychlorinated biphenyls, polyaromatic hydrocarbons, pesticides and metals (Tierra 2007). In 2017 a Phase III Sediment Investigation Field Report was prepared to document the sediment sampling activities performed at 231 sampling locations in Newark Bay. Phase III data will be forthcoming in a Remedial Investigation Report, however Phase III data has been incorporated into the Newark Bay Study Area Conceptual Site Model revised in January 2019 (NBSA 2019). Additional Diamond Alkali study information and plans are located on the Newark Bay Study website: www.ournewarkbay.org (NBSW 2020).

In January 2020 the Final Natural Resource Damage Assessment Plan for the Diamond Alkali was released by the USFWS and the National Oceanic and Atmospheric Administration (NOAA), detailing the assessment of accumulated damages caused by the Diamond Alkali on the natural resources located within the Passaic River and Newark Bay, including the Arthur Kill, Kill Van Kull, and portions of the Hackensack River. The purpose of the Natural Resource Damage Assessment Plan is to document the exposure of natural resources to hazardous substance releases and identifies the anticipated procedures for evaluating the injuries caused by exposure. This report details the hazardous substance exposure to natural resources (i.e. fish, shellfish, birds) and outlines recommendations and a proposed pathway forward (USFWS et al 2020).

The District and the USEPA have been meeting on a bimonthly basis to coordinate the NYNJHDCI study and the ongoing remedial investigation and remedial action efforts within the Newark Bay Study Area. In April 2022, the USEPA provided the District with the following updated estimated schedule for the Diamond Alkali, Newark Bay OU (Table 7). Schedule dates have been updated since the release of the Draft Integrated Feasibility Report and Environmental Assessment, which originally presented a Record of Decision anticipated for this study by November 2022. In Spring 2022, the USEPA completed modeling baseline future projection scenarios incorporating the NYNJHDCI Recommended Plan projections. Note schedules are subject to change and the following estimated schedule has been provided for general informational purposes at this present time.

ТАЅК	ESTIMATED COMPLETION SCHEDULE				
Diamond Alkali, Newark Bay Operable Unit					
Modeling baseline scenarios to include the NYNJHDCI Recommended Plan projections	Spring 2022				
Final Remedial Investigation Report	Spring 2022				
Final Feasibility Study Report	End of 2023				
Record of Decision	End of 2024				

Table 7: Diamond Alkali Estimated Schedule

New York and New Jersey Harbor Deepening Channel Improvements Final Integrated Feasibility Report and Environmental Assessment The District will continue to coordinate with the USEPA and NJDEP as necessary in order to not interfere with ongoing investigation and remediation efforts occurring in the Newark Bay Study Area. It is not anticipated that any other federal or state listed contaminated site will affect or be affected by the project.

The schedule for the NYNJHDCI project estimates a signed Chief's Report by May 2022, following State and Agency review. The Preconstruction Engineering and Design phase is not anticipated to begin until after the signing of the Chief's Report with construction estimated to begin in approximately 2025. The Final Remedial Investigation Report for the Diamond Alkali, Newark Bay Operable Unit is currently estimated to be completed in early 2022, with a record of decision estimated by the end of 2024. Schedules are subject to change based on a variety of field and project advancement conditions and therefore, information regarding any future remedial action plans for the responsible parties to remediate the Diamond Alkali Newark Bay Operable Unit will be coordinated with the USEPA and NJDEP as necessary, as well as further future coordination with the USEPA and NJDEP as necessary to ensure complimentary actions commence with the improvement of the Port navigation channels without interfering with remedial action activities.

A Confined Disposal Facility is located in Newark Bay between Port Elizabeth channel and Port Newark channel. Now closed and capped, the Confined Disposal Facility was designed to store contaminated dredge materials and to prevent pollution of the estuary. The Confined Disposal Facility is located outside the proposed dredging areas of the existing navigation channels and will be avoided to ensure no impact to the Confined Disposal Facility.

In accordance with Engineer Regulation 1165-2-132, dredged materials will be tested under dredged material placement criteria for their suitability for beneficial use in accordance with the appropriate guidelines and criteria including, but not limited to, Section 404 of the Clean Water Act and/or Section 103 of the Marine Protection Research and Sanctuaries Act and supplemented by the Corps of Engineers Management Strategy for Disposal of Dredge Material: Containment Testing and Controls, as well as the protocols listed in Section 6.5.

2.17: Air Quality

The project area is located in the New York and New Jersey Harbor System, encompassing parts of the New Jersey counties of Essex, Hudson Middlesex, Monmouth, and Union, and the New York counties of Kings, New York, and Richmond. These counties are part of the New York, Northern New Jersey, Long Island, and Connecticut ozone nonattainment areas. These counties have been designated with the following attainment statuses with respect to the National Ambient Air Quality Standards for criteria pollutants: 'serious' nonattainment area for the 2008 8-hour ozone standard, 'moderate' nonattainment for the 2015 8-hour ozone standard, and 'maintenance' for the 2006 particulate matter less than 2.5 microns standard. Essex, Hudson, and Union Counties, all in New Jersey, are part of a 'maintenance' area for the 1971 carbon monoxide standard (40 Code of Federal Regulations Section 81.331). The ozone nonattainment counties are part of a larger Ozone Transport Region. Ozone is controlled through the regulation of its precursor emissions, which include oxides of nitrogen and volatile organic compounds. Sulfur dioxide is a precursor for particulate matter less than 2.5 microns. The counties in which the project will take place are in attainment of the National Ambient Air Quality Standards for all

other criteria pollutants.

Emissions from the project will be associated with non-road mobile equipment and marine vessels operating in the New York and New Jersey Harbor System. Emissions will primarily be generated from the diesel engines on board the vessels, and will include oxides of nitrogen, volatile organic compounds, sulfur dioxide, carbon monoxide, and particulate matter less than 2.5 microns. Emissions from federal actions, such as the proposed project, are regulated under 40 Code of Federal Regulations Section 93 Subpart B General Conformity, which aims to ensure that emissions from federal actions to not impede a state's progress toward achieving or maintaining compliance with National Ambient Air Quality Standards under their applicable State Implementation Plan.

2.18: Noise and Vibration

Noise and vibration are often defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or diminishes the quality of the environment. Response to noise varies by the type and characteristics of the noise source; distance from the source; receptor sensitivity; and time of day. Noise can be intermittent or continuous, steady or impulsive, and it may be generated by either mobile or stationary sources, and changes in noise are typically measured and reported using a weighted sound intensity (or level), which represents sound heard by the human ear and is measured in units called decibels (dBA). The Action Area includes the navigation channels dredged, the improvement measures, dredged material placement/disposal areas, and the transit of dredging vessels through the project area. The geographic extent of noise impacts is dependent upon factors such as the type of dredging equipment, length of time spent dredging, and environmental conditions such as wind speed and direction. Noise can carry for considerable distance underwater and overland. Underwater noise from blasting as well as other dredged related noise as part of the New York Harbor Channel Deepening and Kill Van Kull were examined in detail (USACE, 2004b, 2012) and impacts to underwater life were determined to be minor from blasting as well as various dredging equipment types, relative to the background noise already present in lower New York Harbor.

The dredges used in the New York and New Jersey Harbor for dredging are mechanical or hydraulic dredges. Sound production is largely influenced by sediment properties – to excavate hard, cohesive and consolidated soils, the dredger must apply greater force to dislodge the material (Robinson et al., 2011). Sound from dredges can be variable, depending on the phase of operation, and the type of dredge used, but typically occur at low frequencies (<500) (Reine et al., 2014).

USACE conducted a study on the impacts of blasting on fish during the 50-foot Harbor Deepening Project. Predictions based on the data collected from this study indicated that impacts on the aquatic community may be reduced using arrays configured with maximum charge weights located in the middle of lesser charge weights. The data also implied that the confined charges used in the Kill Van Kull Blasting Program (as part of original Harbor Deepening Project construction) appeared to have less of an impact on aquatic biota than would equivalent open water charges. Specifically, concerns were related to the swim bladders of fish being impacted by the pressure of blasting. Drilling of the blasting holes, along with mechanical dredging, is more likely than blasting to generate discernible noise. During the initial construction, the north of Staten Island community was concerned about blasting and harbor dredging impacts within the Kill van Kull portion of the project on their community. For the Recommend Plan, it is anticipated that the construction phase within the Kill Van Kull will be seven years in duration (note, the drilling and blasting will not be occurring 24/7). As was undertaken during the initial Harbor Deepening Project's construction, extensive monitoring and protection measures will be required from the dredging companies contracted to implement this work. Also, following the protocol established during the initial construction, coordination will occur with the public and stakeholder groups during the Preconstruction Engineering and Design phase, when more details about the project become available, to further discuss appropriate measures. If unforeseen impacts related to the construction emerge to the North Shore community of Staten Island and/or across the Kill van Kull on the shoreline community of Bayonne, , the appropriate remediation measures will be coordinated with the affected stakeholders and implemented.

2.18.1: Ambient Noise in New York and New Jersey Harbor Action Area

Ambient noise is the all-encompassing sound associated with a given environment at a specified time. Humans hear sound from 0-140 dB, and sound above this threshold is associated with pain. There are several sources of ambient noise within the Action Area which can be attributed to both natural (wind waves, fish, tidal currents, mammals) and anthropogenic (general city noise, commercial and recreational ships/vessels, dredging, pile driving, etc.) inputs. While some anthropogenic underwater noise is produced intentionally (e.g., naval sonar, echosounders), most noise sources are an incidental by-product of human activity (e.g., shipping, construction) (Farcas et al. 2016). For underwater environments, ambient noise includes tides, currents, and waves, as well as noise produced by marine mammals, fish, invertebrates, and by humans. Low frequency noise levels such as these, as well as noise produced by human activities, tend to carry long distances in the water but are attenuated the farther away one is from the source.

The Action Area is a working waterway with adjacent land use characterized largely by industrial, commercial, and residential uses along with significant roadways and associated truck and car noise. In 2017, 2,011 container vessels carrying 3,396,469 TEU utilized the port, following a decreasing trend in number of calls/year while at the same time the volume has been increasing (3,214,338 TEU and 2,251 vessel calls at the port in 2015). Fewer, larger ships call at the port, a common trend world-wide as container vessels increase in size. Noise sources for vessels include cranes, whistles, and various motors for propulsion, while adjacent dockside noise sources include cranes, trucks, cars, and loading and unloading equipment. One unique feature of the port is the express rail network, which was built to support movement of containers via rail, which reduces the need to transport cargo to its destination by truck, though most cargo is still transported by truck. Ship traffic, including ships transiting the study area, can generate sounds ranging from 10 to 1,000 Hz, with most produced at low frequencies (20-500 Hz) with a noise level as high as 188dB at 1 m for a 54,000 gross ton container ship traveling at 21.7 knots. Though the dB decreases rapidly with distance, shipping traffic can elevate noise in a wide area (by 15-20 dB at frequencies below 300 Hz) (McKenna et al., 2013).

Cruise ports in the local area carried 730,617 passengers in 2017. Such vessels typically dock at

the Cape Liberty Cruise Port in Bayonne or the Brooklyn Cruise Terminal, and may also use the New York and New Jersey navigation channels and anchorages as they make their way to and from their docking facilities. A major source of noise in the project Action Area is the network of roads servicing the area, with major highways having noise levels as high as 70-75db within and adjacent to the road during periods of high traffic (Department of Transportation, 2018).

Any increased vessel traffic which is attributable to this project would be nominal and would not result in measurable differences in air quality as compared to the No Action Alternative. Overall growth projections for the Port and the increased containerization of cargo globally are expected to occur independently of the project and therefore are not attributable to it.

In addition to noise and vibrational inputs attributed to this being a bustling commercial, industrial, and military center, the potential areas affected by noise and vibration include expanses of parks, open spaces, and greenways, as well as residential areas. These areas are sensitive noise receptors, or areas where human activity may be adversely affected by excess noise inputs. It it is anticipated that the construction phase within the Kill van Kull will be seven years in duration. These receptors include, but are not limited to schools, churches, cemeteries, homes, golf courses, and parks/playgrounds. Sensitive noise receptors are in areas that generally have lower ambient noise levels, which can range anywhere from 40 dBA (quiet suburban area at night) to 70 dBA (Table 8).

Noise level (dBA)	Extremes	Home Appliances	Speech at 3 ft	Motor Vehicles at 50 ft	Railroad Operations at 100 ft	General Type of Community Environment
120	Jet Aircraft at 500ft.					
110				Sirens	Horns	-
100 —				Diesel Truck (Not Muffled)	Locomotive	
80		Shop Tools	Shout	Diesel Truck (Muffled)	Rail Cars	
70		Blender	Loud Voice	Automobile at 70 mph	at 50 mph Loco Idling	Major Metropolis (Daytime)
60		Dishwasher	Normal Voice	Automobile at 40 mph		Urban (Daytime)
50		Air Conditioner	Normal Voice (Back to Listener)	Automobile at 20 mph		Suburban (Daytime)
40 —		Refrigerator				Rural (Daytime)
30 —						-
20 —						
10 —						
0	Threshold of Hearing					-

Table 8: Common Ambient Noise Levels

Chapter 3: Existing and Future Economic and Navigation Conditions

This chapter describes the existing condition and future without-project condition of the project area. The existing and future conditions will later be compared, as they relate to navigation its influence on the local and national economies. This comparison is integral to the selection of the Recommended Plan.

3.1: Existing Condition

3.1.1: Navigation Features

Authorized in 2000, construction for the existing project commenced in 2004 and was completed in 2016. This project includes a system of channels with a maintained depth of -50 to -53 feet MLLW throughout the Port of New York and New Jersey. The network of federal navigation channels and connected marine terminals are shown in the map in Figure 2.

The New York and New Jersey Harbor is located between the southeastern-most point of New York State and the northeastern part of New Jersey. The existing 50-foot federal navigation channels are adjacent to New York City in New York State and the cities of Bayonne, Elizabeth, and Newark in New Jersey. The network of 50-foot federal navigation channels extends from the Atlantic Ocean into the New York and New Jersey Harbor and the marine terminals of The Port Authority of New York and New Jersey. The harbor's container terminals serve a vast hinterland that can be defined by the 31 immediately surrounding counties within which the most populous metropolitan area in the United States is found (USACE, 2000a; U.S. Census Bureau, 2018).

Ambrose and Anchorage Channels

The Ambrose Channel leads from the Atlantic Ocean and outer harbor into the Port of New York and New Jersey. The Ambrose Channel was authorized by Section 101(a)(2) of the Water Resources Development Act of 2000, in accordance with the Report of the Chief of Engineers dated May 2, 2000, for deepening for its entire length to a depth of -53 feet MLLW. The Anchorage Channel to a depth of -50 feet MLLW (-52 feet MLLW in rock or otherwise hard material) from the Narrows to 1,000 feet passed its juncture with Port Jersey Channel. Construction is complete. The Ambrose Channel is 63,600 feet in length – from the Atlantic Ocean to the Narrows – and is 2,000 feet wide at its base. The Anchorage Channel is 19,000 feet long from the Narrows to the point 1,000 feet north of the junction with the Port Jersey Channel and is also 2,000 feet wide at its base. Evaluating additional anchorages is outside the scope of this study and the anchorages are evaluated in a separate study, the *New York and New Jersey Harbor Anchorages Final General Evaluation Report* (USACE, 2019d). The existing and future fleet will be able to utilize existing anchorages to realize the benefits for a navigation improvement project recommended as part of this study.

Kill Van Kull and Arthur Kill to Gulf Port Reach

The Kill Van Kull and Arthur Kill channels were authorized by Section 101(a)(2) of the Water Resources Development Act of 2000 in accordance with the Report of the Chief of Engineers

dated May 2, 2000, for deepening their entire length to a depth of -50 feet MLLW, and -52 feet MLLW in rock or other hard material. Construction is complete. The Kill Van Kull federal channel begins at its junction with the Anchorage Channel adjacent to Constable Hook, and leads west into the Arthur Kill at Bergen Point. The -50-foot MLLW existing project continues west through the Arthur Kill, wrapping around Staten Island heading south and ending at the Gulf Port Reach. The Kill Van Kull is 31,800 feet long and is 800 feet wide at its base. The Arthur Kill and Kill van Kull vary from 3H:1V to 1H:1V as the channels pass through changing strata.

Newark Bay

Newark Bay, Elizabeth, South Elizabeth, and Elizabeth Pierhead Channels were authorized by Section 101(a)(2) of the Water Resources Development Act of 2000 in accordance with the Report of the Chief of Engineers dated May 2, 2000 to be deepened to a depth of -50 feet MLLW, and -52 feet MLLW in rock or other hard material. Construction is complete. Newark Bay Main Channel as authorized is 14,000 feet in length and extends from its juncture with the Kill Van Kull to a point located 1,500 feet north of the Elizabeth Channel. Newark Bay Channel varies in width from 2,200 feet near Bergen Point to 800 feet at the channel's most northern point. The access channels Elizabeth, South Elizabeth, and Elizabeth Pierhead serve Port Newark/Elizabeth on the west shore of Newark Bay. Elizabeth Channel is 8,800 feet long and varies in width from 500 to 800 feet. South Elizabeth Channel is 2,700 feet long and is 500 feet wide. The slide slopes for these channels also vary from 3H:1V to 1H:1V as the channels pass through changing strata.

Port Jersey Channel

Port Jersey Channel was authorized, by Section 101(a)(2) of the Water Resources Development Act of 2000 in accordance with the Report of the Chief of Engineers dated May 2, 2000 to be deepened to -50 feet MLLW, and -52 feet MLLW in rock or other hard material, for a length of 10,000 feet from its juncture with the Anchorage Channel west through the berthing areas at Global Marine Terminal – New York. Construction is complete. Port Jersey Channel is 500 feet wide at its base and the slide slopes are 3H:1V.

Anchorage Areas

The two main anchorage areas in the Port of New York and New Jersey are Red Hook Flats and Gravesend Bay. The current configuration of the Red Hook Flats and Gravesend Bay anchorages was authorized by the Rivers and Harbors Act of 27 October 1965. The Red Hook Flats contains three separate anchorages, a southern, middle, and north area. The southern area is authorized to a depth of -45 feet MLLW, the middle area is authorized to a depth of -40 feet MLLW, and the northern area is authorized to a depth of -35 feet MLLW. Each of these areas are approximately 3,335 feet in length. Gravesend Bay is authorized to a depth of -47 feet MLLW and is approximately 2,225 feet in length.

3.1.2: Navigation Operational Behaviors

This section focuses on the existing conditions that describe navigation from sea to terminal. Specifically, the focus is on the behavior of the vessel operators as it relates to the channel bottom. By study pathway, this section describes port operations with respect to the current vessel fleet and potential changes that could accommodate the future fleet of container vessels. The study team located and scaled the existing delays, and identified the associated risks experienced by the existing vessel fleet as it relates to the current channel depths and widths. The large vessels calling the port have a greater risk of grounding, collision, or marine casualty, and have therefore resulted in pilot and U.S. Coast Guard imposed restrictions and limitations to operation within the harbor.

The operating restrictions that are described relate to Ultra Large Container Vessels (ULCV) and Super Ultra Large Container Vessels (SULCV)¹. The Vessel Traffic Service New York User's Manual defines ULCVs as container vessels with at least a length overall of 997 feet and a beam of 140 feet. SULCVs are defined as vessels with at least a length overall of 1,160 feet, and a beam of 159 feet. These vessels currently call on the Port of New York and New Jersey. Examples of such vessels include the CMA CGM Marco Polo, which has a nominal TEU capacity of 16,000, length overall of 1,299 feet, and a beam of 176 feet.

Prior to entering the Port of New York and New Jersey, a suitable berth of destination for a ULCV and a SULCV must be confirmed clear and an anchorage spot should be confirmed available for bailout purposes. Suitable berths have sufficient depth and have large enough cranes to unload the vessel. Global Terminal Bayonne (Port Jersey - Port Authority Marine Terminal) has one such berth. ULCVs transiting to Global Terminal Bayonne (Port Jersey - Port Authority Marine Terminal) may draft up to 49 feet. Vessels that draft more than 47 feet must arrive and depart between 1 and 2 hours after high water as measured at the Battery. There cannot be a cruise ship at Bayonne Cruise Terminal and a ULCV at Port Jersey - Port Authority Marine Terminal at the same time. The approach to Port Jersey - Port Authority Marine Terminal must be made as wide as possible, pushing the north-end of the channel limits. The current width of the Port Jersey Channel is a key factor in the difficulty of maneuvering a ULCV in and out of Port Jersey - Port Authority Marine Terminal. The cross-current of the inbound lane results in substantial difficulty in stopping a ULCV. Vessels are not permitted to back into Global Terminal Bayonne, meaning that they must depart by backing out into Anchorage Channel. The current depth of the Anchorage Channel north of the Port Jersey Channel is not deep enough to facilitate backing out a ULCV in an efficient manner. The efficiency constraint is the result of the extra time spent on completing a complicated maneuver.

Generally, ULCVs may not navigate beyond the Narrows when the maximum sustained winds are greater than 20 knots or maximum gusts are 25 knots or greater. This restriction is critical for the safe navigation of tight spaces such as the Kill Van Kull. Vessels must transit the Kill Van Kull to reach either Elizabeth - Port Authority Marine Terminal/Port Newark or Howland Hook. There are several restrictions specific to the Kill Van Kull. ULCVs are required to transit the Kill Van Kull at slow speeds, posing maneuverability challenges with respect to the wind. Vessels should not transit Bergen Point in sustained winds of 30 knots or greater or gusts greater than 34 knots as measured at Mariners Harbor. The vessels are required to transit the Kill Van Kull within 1 hour on either side of high water or low water as measured at the battery, and the maximum draft is 49 feet. Vessels no larger than 500 feet in length overall are permitted to meet or overtake ULCVs in the Kill Van Kull. This restriction imposes extensive delays on the

¹ The study considers a SULCV a subclassification of ULCVs. Reference to ULCVs include SULCV vessels unless otherwise specified.

majority of container, tanker, and other large-vessel traffic transiting to Howland Hook and Elizabeth. ULCV operators would not typically need to wait for the Kill Van Kull to be clear of smaller vessels such as barges. However, no bunker barges are allowed alongside a vessel berthed along the Kill Van Kull while a ULCV passes, and traffic is restricted to one-way from Constable Hook to the Ambrose Channel.

There are additional restrictions on vessels transiting to Global Terminal New York (Howland Hook), and this is largely due to the configuration of the federal channel. A key restriction is the tight turn from the North of Shooter's Island Reach into the Port Elizabeth Reach in the Arthur Kill. The vessels that have a destination of Howland Hook must not have an overall length greater than 1,100 feet, a draft greater than 47 feet (high water or low water). The wind restrictions applied to ULCVs navigating beyond the narrows apply to all large container vessels transiting to Howland Hook. The tight turn, the width of the channel, the length of the vessel, and the wind conditions result in difficult and perilous navigation conditions. Additionally, the largest beam a vessel may have and be safely berthed at Howland Hook is 150 feet. Vessels with beams any larger will violate the channel limits, threatening the safety of passing traffic. Vessels departing Howland Hook must back up out of the terminal and the full length of North of Shooters Island Reach, then execute a k-turn between the South Reach of Newark Bay and Bergen Point. During this operation, traffic is stopped until the k-turn is complete, imposing significant delays to other vessels in the Harbor.

ULCVs are restricted to a maximum of two channel transits per tide window, which generally means a maximum of four transits per day. Many ULCV calls are located at Elizabeth - Port Authority Marine Terminal, which has several berths and cranes that are suited to accommodate a ULCV. ULCVs have berthed on the face of Elizabeth - Port Authority Marine Terminal and are now more commonly berthed on the Elizabeth Channel side. The width of the South Elizabeth channel is not sufficient to accommodate a ULCV. The maximum draft a vessel may have and transit to Elizabeth - Port Authority Marine Terminal is 49 feet. ULCVs are currently transiting the federal channel light-loaded and still reach the 49-foot draft restriction. Transit to and from Elizabeth - Port Authority Marine Terminal through the Newark Bay Channel is restricted to one-way, imposing significant delay on the interacting traffic. ULCVs enter Elizabeth Channel bow-in, which means that the vessels must back out into the Newark Bay Channel in the direction of the Middle Reach (North). This maneuver has been the cause of difficulties and near-misses, especially in cases where pilots are facing wind out of the northwest.

3.1.3: Terminal Facilities

The Port Authority of New York and New Jersey marine facilities consist of six container terminals. The terminals are the first port of call for approximately 72 percent of vessels. They have processed up to 7.2 million TEUs per year and over \$200 billion worth of cargo. The terminals serve 23 ocean carriers including all the major global alliances as well as 11 independent carriers. Figure 7 shows a map of the port with the container terminals highlighted in yellow. The container terminals include Red Hook Container Terminal, Global Container Terminal, Maher Terminal, and Port Newark Container Terminal. The containerized cargo is handled at marine



facilities leased by the Port Authority to individual terminal operators.

APM Terminals: AP Moller-Maersk GCT: Global Container Terminal

Port Newark Container Terminal

Port Newark Container Terminal is a 272-acre facility at Port Newark in New Jersey. Port Newark Container Terminal has 13 Post-Panamax Class ship-to-shore cranes of which seven accommodate the Super Post-Panamax vessels with an outreach of up to 225 feet, and six accommodate the Post-Panamax vessels with an outreach of up to 200 feet. Port Newark Container Terminal has a total berthing area of 4,400 linear feet.

At its current configuration, Port Newark Container Terminal has a throughput capacity of 1.3 million TEUs. Port Newark Container Terminal leads the Port of New York and New Jersey by moving 25% of its vessel container volume via rail. Additional improvements are planned for the terminal, including opening a new gate complex, increasing the terminal capacity, and increasing the peak crane handling. Moreover, Port Newark Container Terminal plans to expand by developing 50 additional acres, deepening the berthing area, and upgrading the container handling equipment, including the addition of super Post-Panamax ship-to-shore cranes. Port Newark Container Terminal has a long-term lease agreement with The Port Authority of New York and New Jersey through the year 2050.

Maher Container Terminal

Maher Container Terminal is a 450-acre facility located at Elizabeth – Port Authority Marine Terminal in Elizabeth, New Jersey. Maher Container Terminal has 24 ship-to-shore Post-Panamax cranes, including 8 Super Post-Panamax cranes with an outreach of up to 225 feet and 16 Post-Panamax cranes with an outreach of up to 200 feet. In addition, the terminal has a total berthing length of 10,128 feet. Maher Container Terminal is immediately adjacent to the ExpressRail Elizabeth, which has 18 working tracks totaling 43,000 linear feet.
A.P. Moller Terminals

A.P. Moller Terminal is a 350-acre facility located at the Elizabeth – Port Authority Marine Terminal in Elizabeth, New Jersey. A.P. Moller Terminal has 15 ship-to-shore Post-Panamax cranes, four of which are Super Post-Panamax cranes with an outreach of 206 feet, and 11 of which are Post-Panamax cranes with an outreach of up to 140 feet. The terminal has a berthing length of 6,001 feet. Like the Maher Terminal, A.P. Moller Terminal is also adjacent to the ExpressRail Elizabeth.

Global Container Terminal New York

Global Container Terminal New York is a 187-acre facility located at Howland Hook Marine Terminal, near Goethals Bridge, in Staten Island, New York. Global Container Terminal New York has 6 ship-to-shore Post-Panamax cranes, with an outreach of up to 135 feet. Global Container Terminal New York has a berthing length of 3,012 feet. This terminal is uniquely equipped with an expanded on-dock rail transfer service, by ExpressRail Staten Island, which has 5 tracks totaling 6,000 linear feet.

Red Hook Container Terminal

Red Hook Container Terminal is a 65.6-acre facility located in Brooklyn, New York. This terminal has five cranes with an outreach of up to 150 feet. The length of the ship berth is 2,080 feet at -42 feet MLLW. Red Hook Terminal connects to Express Rail Elizabeth via barge service. The channel segment leading to Red Hook Container Terminal was not included in the 50-foot deepening project. This terminal was screened from further consideration and analysis because the scope of this study is limited to the currently constructed 50-foot channel.

3.1.4: Port Operations and Economic Considerations

The existing port operations consist of container storage capacity, cargo composition, fleet composition, container services, and route groups.

Distribution Centers

Approximately 1 billion square feet of warehousing and distribution space is located within 50 miles of the port.

Cargo Profile

The Port of New York and New Jersey handled approximately 7.2 million TEUs in 2018 and ranks second in the United States in terms of total containerized volume exported and imported, counting LA/Long Beach as a one port. The TEUs traded at the port over 2011 - 2018 have been plotted in Figure 8. The largest containerized import volumes are for furniture followed by machinery and appliances, plastic and beverages. The largest containerized export volumes are wood pulp followed by vehicle parts, plastic and wood. The lead trading partner is China followed by India for both imports and exports. Germany is third in terms of volume traded for imports and Spain for exports.



Figure 8: TEUs – Port of New York and New Jersey

Historical Commerce

The Port of New York and New Jersey captures 53.5 percent of the North Atlantic market share, 32.8 percent of the East Coast market share and 15.9 percent of the U.S. market share. The Port imports more cargo than it exports based on metric tons. The Port is the first port of call for approximately 75% of all carrier services on the East Coast (Port Authority of New York and New Jersey, 2020). The Port is located in the heart of the New York metropolitan region and provides access to 27 million local consumers. In addition, the Port's rail connections allow shippers to reach another 98 million consumers in destinations as far away as the Ohio Valley, Midwest and Canada.

Historical containerized metric tonnage moving through the Port of New York and New Jersey has been plotted in Figure 9. Based on data for years 2009 to 2017, foreign shipments averaged approximately 37 million metric tons. Of this total, imports accounted for approximately 27 million metric tons, or 72 percent, while exports accounted for 10.3 million tons or 28 percent.



Figure 9: Containerized Tonnage – Port of New York and New Jersey

Fleet Composition

Data for the container fleet was obtained from Waterborne Commerce Statistics Center, the National Navigation Operation & Management Performance Evaluation Assessment System and The Port Authority of New York and New Jersey to determine vessel characteristics of the fleet calling the port. The ships are classified as sub-Panamax (SPX), Panamax (PX), Post-Panamax Generation I (PPX1), Post-Panamax Generation II (PPX 2), Post-Panamax Generation III (PPX 3) and Post-Panamax Generation IV (PPX 4). The vessels are distinguished based on physical and operation characteristics, including lengths overall, design draft, beam, speed and TEU capacity. Containership classes overlap in all facets of dimensions, such as length, beam, depth and TEU capacity. For purposes of this document, Table 9 shows the breakdown of the containership classes. For the purposes of this analysis, beam width was the characteristic that separated the classes. Industry tends to use the terms "very large container vessel (VLCV)" to describe vessels with capacity above 11,000 TEU and "ultra large container vessel (ULCV)" to describe vessels with capacity above 18,000 TEU. These industry classes roughly correspond with PPX3 and PPX4 vessel class, respectively.

	DEADWEIGHT TONNAGE	BEAM	DESIGN					
CLASS	(METRIC TONS)	(FEET)	(FEET)	DRAFT (FEET)				
Subpanamax (SPX)	6,500-40,000	390 - 730	65 - 103	20 - 40				
Panamax (PX)	24,000 - 69,000	558 - 930	105 - 107	27 - 45				
Post-Panamax Generation 1 (PPX1)	71,200 - 80,900	930 - 1,000	108 - 133	45 - 47				
Post-Panamax Generation 2 (PPX2)	80,901 - 110,000	1,026-1,100	134 - 145	46 - 48				
Post-Panamax Generation 3 (PPX3)	117,500 - 144,500	1,100-1,200	149 - 177	49 - 51				
Post-Panamax Generation 4 (PPX4)	150,000 - 194,600	1,201 - 1,308	178 - 194	51 – 52.5				

Figure 10 shows historical trends in containership vessel sizes and fleet composition for the Port of New York and New Jersey. As shown, total calls from 2009 to 2018 remained relatively constant (averaging approximately 2,100 calls per year); however, average vessel size increased dramatically with the average vessel increasing from a Panamax-size vessel to a Post-Panamax Generation 2 vessel. The number of Panamax calls has dropped dramatically as larger Post-Panamax vessels transition to services calling The Port of New York and New Jersey.



Container Services

The Port of New York and New Jersey has 40 weekly port of call ocean carrier services and 54 total services. Table 10 shows the service division by region as of 2018.

Table 10: Container Services

WORLD REGION	SERVICES
Asia	11
Indian Subcontinent & Southeast Asia	10
Europe and Mediterranean Region	16
South America and Caribbean	17

Route Groups

Numerous container services call on the Port of New York and New Jersey which are operated by many carriers and have trade routes that originate in various parts of the world. Therefore, carrier services were grouped by the world region they serve. For example, there are a number of carrier services that call on various ports in the Far East, transit the Panama Canal, proceed to ports along the east coast United States, and then return to the Far East. As of 2019, 54 unique ocean carrier services used the terminals at the Port of New York and New Jersey. Container cargo were aggregated into route groups for forecasting, modeling and presentation purposes based on world regions and vessel composition. Vessel service information was provided by the Port Authority. That data along with National Navigation Operation & Management Performance Evaluation Assessment System data was used to determine route groups. Table 11 shows the regions, route groups and the distance of each route.

Each route group has unique characteristics such as cargo volume, cargo weight, ports of call, vessel types, mix of vessels, etc. and therefore are evaluated separately before being combined as part of the National Economic Development (NED) analysis.

Tuble 11. Notice Group Injointation								
	DISTANCE DISTRIBUTION							
ROUTE GROUP REGIONS	MINIMUM	MOST LIKELY	MAXIMUM					
Africa – South America – Caribbean – Gulf of Mexico - East Coast United States	1,450	7,300	16,100					
Europe – Mediterranean – East Coast United States	6,300	7,500	11,500					
Far East – Panama Canal – East Coast United States, including pendulum routes	19,400	29,800	31,900					
Far East – Indian Subcontinent – Southeast Asia – Suez Canal – East Coast United States	16,900	25,300	31,400					

Table 11: Route Group Information

3.2: Future Without-Project Conditions

3.2.1: Navigation Features

The Port of New York and New Jersey federal channels are deepened periodically to maintain the authorized channel dimensions. Under without-project conditions, maintenance dredging is projected to continue on a regularly scheduled basis to maintain the existing condition dimensions presented in Table 1.

Anchorage Areas

The future without-project conditions include the recommended plan of the New York and New Jersey Harbor Anchorages Final General Reevaluation Report (USACE, 2019d). The future-without-project conditions therefore revise the existing conditions with respect to the anchorages such that Gravesend Bay Anchorage will be maintained at -50 feet MLLW, 3,000 feet wide with a maximum swing area of 3,600 feet. The future without-project conditions of the Red Hook Flats are unchanged from the existing condition. The existing and future fleet will be able to utilize existing and proposed anchorages to realize the benefits for a navigation improvement project recommended as part of this study.

3.2.2: Navigation Operational Behaviors

This section focuses on the future without-project conditions that describe navigation from sea to terminal; specifically on the behavior of the vessel operators as it relates to the channel bottom. In what follows, by study pathway, we describe what port operations looks like in the future without-project condition with respect to the future expected vessel fleet. We have characterized the kind of maneuvering tactics that will be required if no project is built in Section 3.1.2. The resulting scale of the expected delays and associated risks are exacerbated by the changing vessel fleet as it they relate to the current channel depths and widths.

Generally, it is expected that the fleet of vessels that call on the Port of New York and New Jersey will continue to include larger and larger vessels. In the future without-project condition, this future fleet is expected to contain ships such as the *Maersk Triple E Ultra Large Container Vessel Class (Triple E)*. The historical record is clear: vessel size has grown extensively, persistently redefining the limits of engineering feasibility and further exploiting economies of scale. There is no reason to believe that this trend will not continue. Indeed, a contract has been

awarded by DNV GL to Hudong Zhonghua Shipbuilding (group) Co. Ltd. for the design of 25-26,000 TEU vessel powered by liquefied natural gas¹. In a separate study, the New York Harbor and Tributaries Focus Area Feasibility Study, it was found that ULCVs at the 21,000 TEU class are among the largest size vessel to be calling on the Port of New York and New Jersey in the near to mid-term. However, the current channel configuration in the future without-project condition inhibits the ability to realize all potential economies of scale. A Triple E vessel would have to transit the channel in the future without-project condition light-loaded so as to not exceed the 49-foot draft limit. Further, such a vessel will be pushed to the horizontal limits of the channel in difficult maneuvers, risking allisions. For example, as discussed in Section 3.1.2, ULCVs enter Elizabeth Channel bow-in and back out into the Newark Bay Channel in the direction of the Middle Reach (North). A Maritime Institute of Technology and Graduate Studies simulation of a Maersk Triple E vessel backing out of Elizabeth Channel in the current channel configurations found that the vessel is likely to allide with the channel bottom to the north and west of Elizabeth Channel limits, experiencing rudder damage. Reduction in transaction cost globally in the use of a vessel the size of a Triple E vessel to transport commerce to the Port of New York and New Jersey may out-weigh the relatively higher risk in transiting the channel. However, this future without-project condition dynamic presents an opportunity to reduce navigation hazards and enable relatively more reliable, safer, and more economically efficient waterborne transportation systems for the movement of commerce throughout the Port of New York and New Jersey.

3.2.3: Port Master Plan

The Port Authority of New York and New Jersey's *Port Master Plan 2050* outlines "options for maximizing [existing] investments and identifies the next generation of potential planning studies, land use, and infrastructure development projects." The *Port Master Plan 2050* is an independent, tangential effort, that is happening regardless of recommendations from this study. The Port Master Plan is a flexible, holistic framework for the near and long term, but is not definitive nor final. Implementation will require design, permits, outreach, and authorization. The plan consists of two phases. Phase I entails a plan for maximizing recent investments over the next 10 to 15 years. Phase II consists of a longer-term plans for future growth over the next 10 to 15 to 30 years. Additionally, The Port Authority of New York and New Jersey has a Wharf Replacement program where they are reconstructing wharves with greater structural strength at the time of replacement.

Phase I: Years 0 to 10/15

The priority of Phase I is expanding container capacity west of the Kill Van Kull through road and rail improvements. Phase I also includes a strategic expansion at Port Jersey - Port Authority Marine Terminal and hardening marine infrastructure through the Berth and Wharf Replacement Program. The Port Authority of New York and New Jersey is also implementing technology to minimize the port facilities' impact on the environment.

At Port Newark and Elizabeth - Port Authority Marine Terminal, The Port Authority of New

New York and New Jersey Harbor Deepening Channel Improvements Final Integrated Feasibility Report and Environmental Assessment

¹ Source: <u>https://www.maritimebulletin.net/2020/01/15/is-the-26000-teu-container-vessel-coming-now/?fbclid=lwAR2ejVNpPeBwzH2MsCNPF3HpePV88sZ-dyUcZQYQo7OUx_bYgfJ7X_Zn0j8</u>

York and New Jersey plans to continue implementing roadside improvement projects. These plans include the Port Street realignment project, data capture using E-ZPass or GPS reader technology, and chassis and empty container storage depot location study, while progressively implementing projects to improve connectivity with I-95 and I-78. The Howland Hook Marine Terminal will be progressively built out to support enhanced container-handling capability. Improvements to road-side connectivity and land-side traffic movements around the Port Jersey – Port Authority Marine Terminal are the focus of Phase I at this site. This work includes building on the recent completion of the New Jersey Turnpike's Interchange 14A and promoting enhanced separation of port and public vehicles.

Phase II: Years 10/15 – 30

Phase II involves accommodating increased volumes of containerized cargo, a principal occupant of The Port Authority of New York and New Jersey's land assets. Phase II also involves streamlining operations and enhancing collaboration within each cargo sector as the other cargo sectors expand. There are plans to incrementally enhance intermodal rail operations, and potentially expand the footprint of the terminal facilities at Port Newark, Brooklyn, and Port Jersey – Port Authority Marine Terminal. Adoption of new technologies are also part of the Phase II plans, including using semi-automated guided vehicles, data-driven operations, and electric vehicles.

Together, the Phase I and Phase II plans support the conclusion that future with- and withoutproject condition landside facilities are sufficient to accommodate the volume of forecast commerce growth over the period of analysis¹.

3.2.4: Port Operations and Economic Considerations

The future without-project port operations consist of container storage capacity, cargo composition, fleet composition, container services, and route groups.

Commodity Forecast

Estimates of the future commerce directly connected to the Port of New York and New Jersey over the period of analysis are linked to the port's hinterland and the extent to which the port shares commodity flows with other ports. Cargo projections ultimately drive vessel fleet projections in terms of the quantities and sizes of vessels in the with- and without-project conditions.

The top import commodities for the Port of New York and New Jersey are furniture, machinery and appliances, plastic and beverages. Top export commodities in terms of volume are wood pulp, vehicle parts, plastic, and wood and articles of wood. As of 2018, the major import growth commodities are apparel, iron and steel, and vehicle parts. The major export growth commodities are food waste, oil seeds and miscellaneous grains, and iron and steel.

The method used to determine the forecast of import and export tonnage consists of three steps. First, the baseline of import and export tonnage was established using an average of historical

¹ Details regarding terminal operators' plans for the future without-project condition were provided to USACE to inform the plan formulation and economic analysis of this study. These details are confidential and therefore are not reported here.

data. Second, the import and export growth rates for each route group were established. Third, the forecast growth rates were applied to the baseline to determine the total import and export trade volumes for the Port of New York and New Jersey.

To minimize the impact of potential variances in the trade volumes on the long-term forecast, five years of data were used to establish the baseline for the commodity forecast. Empirical data from 2013 to 2017 was used to develop a baseline, allowing the forecast to capture the full range of economic growth that occurred during that timeframe. Three years were used to estimate the percent tonnage by trade route. The baseline tonnage represents the starting point from which commerce was forecast. The historical containerized imports that moved through the port from 2013 to 2017 have been organized in Table 12.

During this time period, imports mostly increased with a slight decrease in 2016, but recovered in 2017. Trade with Asia leads the Port of New York and New Jersey market for the Pathway to Elizabeth – Port Authority Marine Terminal accounting for nearly 58% of import tonnage.

					WICTIC TON	5			
CARGO	2013	2014	2015	2016	2017	BASELINE TONNAGE	ROUTE GROUP	ROUTE GROUP PERCENT	BASELINE TONNAGE BY ROUTE GROUP
FAINERIZED	16,987,000	18,311,000	18,431,000	18,025,000	21,404,000	18,631,600	Africa/South & Central America/US East Coast	6%	1,060,000
No			Rate of Ch	ange by Year			EU-MED-ECUS	37%	6,894,000
MPORT C		8%	1%	-2%	19%		East Asia to US East Coast (via Panama Canal)	17%	3,167,000
							East Asia to US East Coast (via Suez)	41%	7,639,000
CARGO	2013	2014	2015	2016	2017	BASELINE TONNAGE	ROUTE GROUP	ROUTE GROUP PERCENT	BASELINE TONNAGE BY ROUTE GROUP
AINERIZED C	9,801,600	9,434,700	9,197,200	9,736,300	9,826,200	9,599,200	9,599,200 Africa/South & Central America/US East Coast		513,000
TNC	Rate of Change by Year		EU-MED-ECUS	26%	2,516,300				
(PORT CO		-4%	-3%	6%	1%		East Asia to US East Coast (via Panama Canal)	20%	1,965,000
ΞÛ							East Asia to US East Coast (via Suez)	48%	4,605,000

Table 12: Pathway to Elizabeth – Port Authority Marine Terminal Historical Containerized BaselineMetric Tons

The Pathway to Port Jersey – Port Authority Marine Terminal includes the channel segments to Global Container Terminal Bayonne which include the Ambrose and the Anchorage Channel. GCT Bayonne handles approximately 10 percent of the port's container volumes. The historical volumes of metric tonnage moving through the terminal have been organized in Table 13.

						10			
CARGO	2013	2014	2015	2016	2017	BASELINE TONNAGE	ROUTE GROUP	ROUTE GROUP PERCENT	BASELINE TONNAGE BY ROUTE GROUP
NERIZED	2,989,900	3,670,100	3,816,900	4,014,300	3,694,100	3,637,000	Africa/South & Central America/US East Coast	7%	272,000
ONTAI	Rate of Change by Year				Europe to US East Coast	10%	346,000		
MPORT C		23%	4%	5% -8% East Asia to US East Coast (via Panama Canal)		40%	1,451,000		
VI							East Asia to US East Coast (via Suez)	43%	1,569,000
O CARGO	2013	2014	2015	2016	2017	BASELINE TONNAGE	ROUTE GROUP	ROUTE GROUP PERCENT	BASELINE TONNAGE BY ROUTE GROUP
INERIZED	1,238,000	1,494,000	1,311,000	1,333,000	1,349,000	1,345,000	Africa/South & Central America/US East Coast	4%	47,500
NTA			Rate of Ch	ange by Yea	r		EU-MED-ECUS	5%	67,200
PORT CON		21%	-12%	2%	1%		East Asia to US East Coast (via Panama Canal)	47%	632,300
EX							East Asia to US East Coast (via Suez)	44%	598,100

Table 13: Pathway to Port Jersey – Port Authority Marine Terminal Historical Containerized BaselineMetric Tons

Data was combined from three sources to develop the long-term trade forecast for the Port of New York and New Jersey. The three sources include The Port Authority of New York and New Jersey, previous USACE East Coast analyses and a national forecast obtained by the Institute for Water Resources that was developed by IHS Global Insight. The task of estimating commodity growth rates has been completed for several USACE deep draft navigation studies along the East Coast in the past decade. Those analyses along with information from the National IHS forecast were used to develop growth rates for application to this study.

IHS is a research firm that develops trade forecasts and provides economic and financial coverage of countries, regions and industries. The company provides data collection of regional, national, and global economic statistics; financial markets and securities; and international trade. When making global trade forecasts, IHS employs sophisticated macroeconomic models that contain all commodities which have physical volume. The trade forecasts are produced using a system of linked world trade commodity models that are collectively called the World Trade Model. The commodities forecasted are grouped into IHS' own categories derived from the International Standard Classification and covers 156 International Standard Classification categories. For all trade partners in the world, the WTM has 103 major countries and regions according to their geographic location.

The most recent containerized tonnage forecast was obtained from the Institute for Water

Resources in 2017. The information from this forecast provided tonnage through year 2025. Since this was the most recent forecast acquired, forecasting using IHS sources end at year 2025. From 2025 through 2040, port information was used for forecasting. The Port Authority of New York and New Jersey staff provided their growth rates for containerized imports and exports through 2037. The Port Authority of New York and New Jersey staff developed a long-range port master plan that includes a market analysis to determine the market potential for the maritime industry. To complete the market analysis, the maritime industry trends were analyzed, the market area was identified and a comparison of port facilities with competing ports was completed. Based on this assessment, projected regional growth in cargo was estimated. These growth rates were used for years 2026 through 2040.

Using the sources described above, growth rates were estimated from the baseline year (2018) to 2050 where the forecast was held constant through the end of the period of analysis (2089)¹. The average growth rates for imports and exports for each period have been organized in Table 14.

IMPORT CONTAINER ANNUAL GROWTH RATES								
	2019-2025	2026-2030	2031-2035	2036-2040				
East Asia to US East Coast (via Suez)	4.9%	2.8%	2.5%	2.5%				
East Asia to US East Coast (via Panama Canal)	5.1%	2.8%	2.5%	2.5%				
Europe to US East Coast	3.1%	2.8%	2.5%	2.5%				
Africa to South & Central America to US East Coast	3.8%	2.8%	2.5%	2.5%				
EXPORT CO	NTAINER ANNU	AL GROWTH RA	TES					
	2019-2025	2026-2030	2031-2035	2036-2040				
East Asia to US East Coast (via Suez)	5.2%	2.8%	2.5%	2.5%				
East Asia to US East Coast (via Panama Canal)	5.7%	2.8%	2.5%	2.5%				
Europe to US East Coast	4.2%	2.8%	2.5%	2.5%				
Africa to South & Central America to US East Coast	4.2%	2.8%	2.5%	2.5%				

Table 14: Containerized Carao Growth Rates

Using the baseline estimated commerce volumes, the estimated growth rates were applied to the forecast import and export tonnage for the Port of New York and New Jersey by route group over the period of analysis. For purposes of this analysis, the forecast is assumed constant after 2050.

Since the pathways are being analyzed separately, individual commodity forecasts were conducted. Although the tonnage is different based on route group volumes, the growth rates remain the same. The import and export commodity forecast tonnage for the Pathway to Elizabeth - Port Authority Marine Terminal has been organized in Table 15 and Table 16. The import and export commodity forecast tonnage for the Pathway to Port Jersey - Port Authority

¹ Period of Analysis is from Base Year 2040 through 2089

Marine Terminal has been organized in Table 17 and Table 18. Commodity throughput for Base Year 2040 was interpolated based on growth rate between 2030 and 2040 for modeling purposes.

IMPORT FORECAST	2018 - BASELINE	2030	2040	2055-2088
East Asia to US East Coast (via Suez)	7,639,000	12,242,000	15,702,000	19,164,000
East Asia to US East Coast (via Panama Canal)	3,110,000	5,053,000	6,481,000	12,272,000
Europe to US East Coast	6,823,000	9,685,000	12,422,000	19,164,000
Africa to South & Central America to US East Coast	1,060,000	1,576,000	2,022,000	2,019,000

Table 15: Pathway to Elizabeth – Port Authority Marine Terminal Import Containerized Metric Tons

Table 16: Pathway to Elizabeth – Port Authority Marine Terminal Export Containerized Metric Tons

EXPORT FORECAST	2018 - BASELINE	2030	2040	2055-2088
East Asia to US East Coast (via Suez)	4,605,000	6,924,000	8,881,000	10,505,000
East Asia to US East Coast (via Panama Canal)	1,965,000	3,271,000	4,196,000	5,468,000
Europe to US East Coast	2,516,000	3,743,000	4,801,000	7,541,000
Africa to South & Central America to US East Coast	513,000	771,000	989,000	1,518,000

Table 17: Pathway to Port Jersey - Port Authority Marine Terminal Import Containerized Metric Tons

IMPORT FORECAST	2018 - BASELINE	2030	2040	2055-2088
East Asia to US East Coast (via Suez)	2,115,000	3,389,000	4,347,000	5,530,000
East Asia to US East Coast (via Panama Canal)	1,497,000	2,432,000	3,120,000	3,969,000
Europe to US East Coast	135,000	192,000	246,000	313,000
Africa to South & Central America to US East Coast	96,000	143,000	183,000	233,000

EXPORT FORECAST	2018 - BASELINE	2030	2040	2055-2088
East Asia to US East Coast (via Suez)	801,000	1,312,000	1,683,000	2,141,000
East Asia to US East Coast (via Panama Canal)	493,000	821,000	1,053,000	1,339,000
Europe to US East Coast	22,000	33,000	42,000	53,000
Africa to South & Central America to US East Coast	16,000	24,000	31,000	39,000

Table 18: Pathway to Port Jersey - Port Authority Marine Terminal Export Containerized Metric Tons

Fleet Forecast

In addition to a commodity forecast, a forecast of the future vessel fleet is required when evaluating navigation projects. To develop the future fleet at The Port of New York and New Jersey, the study simulates loading of the forecasted throughput tonnage distribution by vessel class (Appendix C, Section 4.3). The economics analysis classifies vessels into six vessel classes based on vessel specification: Sub-Panamax (SPX), Panamax (PX), Post-Panamax Generation 1 (PPX1), Post-Panamax Generation 2 (PPX2), Post-Panamax Generation 3 (PPX3), and Post-Panamax Generation 4 (PPX4)¹.

The forecast fleet distribution at the Port of New York and Jersey relies on assumptions of worldwide fleet transition. Currently, most PPX3 and PPX4 vessels operate on the longest, most efficient trade lanes (i.e., Asia-Europe services). However, as shipbuilders put new PPX3 and PPX4 vessels into service, carriers transition older PPX3 and PPXP4 vessels to slightly less efficient routes (e.g. Transpacific then Transatlantic services). PPX1 and PPX2 vessels already on services calling The Port of New York and New Jersey will likely transition to shorter, less efficient routes as newer PPX3 and PPX4 vessels are deployed on The Port of New York and New Jersey services. This process tends to accelerate as carriers face excess vessel capacity on Asia-Europe services, which puts downward pressure on freight rates.

This study assumes that between 2020 and base year 2040, the world fleet of PPX3 and PPX4 vessel will nearly double. This will add significant capacity to Asia-Europe services, and pressure carriers to transition a portion of the PPX3 and PPX4 fleet to slightly less efficient routes (e.g. Transpacific then Transatlantic routes). It is estimated that The Port of New York and New Jersey's share of PPX3 and PPX4 vessels calling weekly by base year 2040 will represent approximately 14 percent and 1 percent of the world fleet of PPX3 and PPX4 vessels, respectively.

Over the study period, it is anticipated that vessels with 10,000 to 14,000 TEU will become the most used vessel class on Transatlantic routes calling at The Port of New York and New Jersey. presents the initial forecast of containerized vessel calls through 2050². The analysis holds the fleet distribution constant after 2035. Changes in overall vessel calls is based on the increasing

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¹ For detailed vessel specification by vessel class, see Appendix C, Table 8. For reference, ULCVs and SULCVs loosely correspond to a PPX3 and PPX4 vessel, respectively.

² Interpolation was used to estimate commodity and fleet for Base Year 2040 during modeling.

commodity forecast. The study uses the fleet forecast as an input to the USACE-certified planning model, HarborSym to estimate benefits for each alternative. Appendix C, Section 4 describes the fleet forecast methodology and future fleet forecast.

Vessel Class	FWOP	52FT	54FT	55FT	57FT
2030					
Panamax Containership	155	155	155	155	155
PPX Gen1 Containership	361	246	166	163	163
PPX Gen2 Containership	713	708	697	697	697
PPX Gen3 Containership	765	765	765	765	765
PPX Gen4 Containership	52	52	52	52	52
Total	2,046	1,926	1,835	1,832	1,832
2040					
Panamax Containership	130	130	130	130	130
PPX Gen1 Containership	353	242	159	153	153
PPX Gen2 Containership	755	700	657	655	655
PPX Gen3 Containership	1,132	1,132	1,132	1,132	1,132
PPX Gen4 Containership	104	104	104	104	104
Total	2,474	2,308	2,182	2,174	2,174
2050					
Panamax Containership	95	95	95	95	95
PPX Gen1 Containership	417	284	182	180	180
PPX Gen2 Containership	909	860	799	792	792
PPX Gen3 Containership	1,464	1,464	1,464	1,464	1,464
PPX Gen4 Containership	156	156	156	156	156
Total	3,041	2,859	2,696	2,687	2,687

Table 19: Vessel Forecast: Calls by Class

Chapter 4: Plan Formulation*

Plan formulation for the NYNJHDCI study was conducted in accordance with the six-step planning process described in *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (U.S. Water Resources Council, 1983) and the *Planning Guidance Notebook* (USACE, 2000b).

To formulate alternative plans, the project delivery team identifies problems and opportunities (Section 4.2), establishes the planning goals and objectives (Section 4.3), identifies the planning constraints and key uncertainties (Section 4.4), and then identifies measures which are developed into an array of alternatives that can be evaluated and compared. This evaluation and comparison ultimately leads to a tentative selection of an alternative, which is reviewed by the public, resource agencies, stakeholders, and agency technical reviewers. Once input obtained through review is addressed and incorporated, the Recommended Plan can be finalized.

The NYNJHDCI study is a result of the approved Initial Appraisal Report. Section 216 of the Rivers and Harbors Act of 1970 limits the analysis of the NYNJHDCI study to the constructed 50-foot Harbor Deepening Project, which included deepening the channels to the Port's container terminals. Accordingly, for the NYNJHDCI analysis, the harbor was organized into three pathways (Figure 11):

- Pathway from sea to Port Jersey Port Authority Marine Terminal. This includes the Ambrose Channel, Anchorage Channel, and Port Jersey Channel. This pathway reaches Global Container Terminal Bayonne.
- Pathway from sea to Elizabeth Port Authority Marine Terminal. This includes the Ambrose Channel, part of Anchorage Channel, Kill Van Kull, Newark Bay Channel, South Elizabeth Channel, and Elizabeth Channel. This pathway reaches Maher, A.P. Moller, and Port Newark.
- Pathway from sea to Howland Hook Marine Terminal. This includes the Ambrose Channel, part of Anchorage Channel, Kill Van Kull, and part of Arthur Kill Channel. This pathway reaches Global Container Terminal New York.



Figure 11: Pathways Used for Analysis

A synopsis of the strategy that the project delivery team used to develop the array of alternatives and the rationale behind this strategy is presented below.

- 1. Identify and screen management measures for addressing the planning goals and objectives
- 2. Screen pathways based on existing problems and projected future conditions
- 3. Incrementally evaluate each navigation pathway for deepening
 - Phase I: Calculate the costs and benefits for dredging from the sea to each destination within the harbor (container terminals), foot by foot of depth dredged. The pathway from the sea to container terminal with the highest net benefits will be selected as the first increment of construction.
 - Phase II: Assuming the pathway selected in Phase I is constructed, calculate the incremental net benefits for deepening, foot by foot, to the remaining container terminal(s). Select the pathway with the highest net benefits as the second added increment.
 - Phase III: Assuming the pathways selected in Phases I and II are constructed, incrementally evaluate additional navigability efficiency components (e.g. bend easing).
- 4. Compare alternatives, identify the national economic development plan, and select Tentatively Selected Plan.

Per the 1983 Principles and Guidelines by the U.S. Water Resources Council, the federal objective of water and related land resources project planning is to "contribute to national economic development consistent with protecting the Nations' environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements" (U.S. Water Resources Council, 1983). The 1983 Principles and Guidelines recommends that

plans are formulated in consideration of four criteria and four accounts.

The 1983 Principles and Guidelines' four criteria:

- Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.
- Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.
- Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.
- Acceptability is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations, and public policies.

The 1983 Principles and Guidelines' four accounts:

- National Economic Development: changes in the economic value of the National output of goods and services.
- Regional Economic Development: the impact of project spending, either directly or indirectly, on the local economy.
- Environmental Quality: the non-monetary beneficial effects on significant natural and cultural resources.
- Other Social Effects: include the effects that are not covered in the other three accounts, such as community impacts, health and safety, and displacement.

The four criteria and four accounts are used iteratively in the plan formulation process as the alternatives are developed, and as they are evaluated and screened, to assist in the selection of an alternative for recommendation.

The period of analysis for this study is 50 years, from 2040 – the estimated end of a project's construction – to 2089. The characteristics of the design vessel are used to inform the channel dimensions and alignment needs for the study's period of analysis. Further refinement of the dimensions and alignment of the channels is expected through application of ship simulations during the Preconstruction Engineering and Design Phase. The Deep Draft Navigation Planning Center of Expertise identified the *Maersk Triple E ULCV Class (Triple E* or design vessel) as the design vessel. This vessel is consistent with a vessel used for the Maritime Institute of Technology and Graduate Studies simulations (Maritime Institute of Technology and graduate Studies, 2016). The design of each navigation pathway will be based off the design vessel's length and beam dimensions for the design vessel to navigate the pathways. The specifications of the design vessel are:

- 1,308.0 feet in length overall
- 193.5-foot beam
- 52.5-foot design draft
- 18,000 TEU capacity

The identification and evaluation of measures and components, further described below, were informed by discussions with the Sandy Hook pilots, Maritime Association, U.S. Coast Guard, and National Oceanic and Atmospheric Administration at a Steering Committee meeting and throughout the process.

4.1: Problem Identification and Opportunities

The existing federal navigation channel was designed for the *Regina Maersk*; this vessel is 1,044 feet long, 140 feet wide, has a static draft of 46 feet, and a capacity to carry 6,400 TEUs. The vessels routinely calling on the harbor today are over 160 feet longer, 17 feet wider, and up to 4 feet deeper (when fully loaded) with twice as much sail area/freeboard than the design vessel. These larger vessels have a greater risk of grounding, collision, or marine casualty, and have resulted in operation limitations within the harbor. Inefficiencies of non-containerized vessels were not identified as a problem, as these vessels are generally not depth constrained in the existing channels. Overall, the problems experienced in the New York and New Jersey Harbor are:

- Inefficiencies of containerships due to depth limitations
- Inefficiencies of containerships due to width limitations

Discussions with the vessel pilots revealed the following problems specific to certain areas (Figure 12):

- 1. Ultra Large Container Vessels are required to back out of Elizabeth Port Authority Marine Terminal. The narrow width of the Newark Bay Channel makes this maneuver difficult for such a large vessel, increasing the risk of grounding in Newark Bay thereby increasing the transportation cost in risk.
- 2. The current width of the Newark Bay Channel restricts traffic to one-way. This restriction increases the transportation cost in time for all interacting agents in the harbor and at the port.
- 3. The South Elizabeth and Newark Bay Channels are too narrow to facilitate backing an Ultra Large Container Vessel out into the Newark Bay Channel. The width of the channels increases the risk of grounding in the South Elizabeth Flats.
- 4. The bend at Bergen Point into Newark Bay Channel is very narrow and the turn very tight. The difficulty of this maneuver requires restrictive speed heightening the transportation cost in time for all interacting agents in the harbor and at the port.
- 5. The width of the channel from Constable Hook to Ambrose Channel restricts traffic to one-way, increasing the transportation cost in time for all interacting agents in the harbor and at the port.
- 6. The bend at the entrance of the Constable Hook Reach is very narrow. The width of this bend imposes restrictive speeds for two-way traffic and incurs higher risk of collisions and allisions. Transportation costs are higher due to the cost of the risk of accidents and due to the cost in time, for all interacting agents in the harbor and at the port.
- 7. There is no space in Newark Bay or in Constable Hook to allow for convoy assembly and maximize throughput of one-way traffic on the Kill Van Kull. The lack of this space in the federal channel increases the transportation cost in time for all interacting agents in the harbor and at the port.

- 8. The entrance into Port Jersey Channel is too narrow and the depth of the Anchorage channel beyond the Port Jersey Channel is too shallow to facilitate backing out an Ultra Large Container Vessel. This will increase transportation costs and the costs associated with the risk of ships grounding.
- 9. There is no place in the Kill Van Kull to allow an Ultra Large Container Vessel to bunker or pull over and facilitate meeting or passing. Should an Ultra Large Container Vessel need to shut down in an emergency situation within the Kill Van Kull, traffic through the Kill Van Kull would be halted. These two factors impose additional transportation costs in time for all interacting agents in the harbor and at the port.



Figure 12: Current and future-anticipated areas of concern for full fleet

Additionally, the restrictions listed above relating to the Kill Van Kill have been described in The Port Authority of New York and New Jersey Port Master Plan:

"In response to navigational and safety challenges faced by today's largest container vessels, the Port's Harbor Safety, Operations, and Navigation Committee published a Deep Draft Advisory in May 2017. That bulletin restricts large vessels transiting the Kill Van Kull to favorable sailing conditions; the largest vessels are restricted from passing and meeting in the Kill Van Kull, and may only transit the Kill Van Kull during slack water" (Port Authority of New York and New Jersey, 2019).

There are opportunities to improve navigational efficiencies related to the depth and width limitations of the existing federal navigation channel. There is also an opportunity to beneficially use the dredged material and improve safety for all harbor users.

4.2: Planning Goal and Objectives

The team developed a planning goal based on problems and opportunities to help create and evaluate alternative plans. It is the overarching intent of the project to improve navigation in the New York and New Jersey Harbor. Plans are formulated to achieve planning objectives during the 50-year period of analysis from 2040 – the estimated end of a project's construction – to 2089. A planning objective states the intended purposes of the planning process and is what solutions should try to achieve. Objectives provide a clear statement of the study purpose.

In support of the goal, the planning objectives are to:

1. Improve the efficiency of operations of containerships in the New York and New Jersey Harbor

Measurement: decreased transportation costs from in-harbor time savings

 Allow more efficient use of containerships transiting the New York and New Jersey Harbor
Measurement: decreased transportation costs by loading existing vessels heavier or

<u>Measurement</u>: decreased transportation costs by loading existing vessels heavier or switching to larger vessels

4.3: Planning Constraints

Constraints are restrictions that limit the extent of the planning process. They can be divided into universal constraints and study-specific constraints. For brevity, only project-specific constraints are included here. The study's constraint is that we cannot impact or modify the piers of the Bayonne Bridge. The bridge was raised in 2019 and the study does not consider further modifying the bridge; this limits the alternatives that can be considered in the Kill Van Kull.

• Impacts to the piers of the Bayonne Bridge

Considerations are issues or matters that should be taken into account during the planning process, but do not necessarily limit the extent of the process as do constraints. Planning took the following considerations into account:

- Impacts to structures/ bulkheading/ on-land facilities
- Impacts to environmental and cultural/historic resources
- Impacts to existing utilities
- Impacts to the other navigation traffic in the harbor

4.4: Key Uncertainties and Planning Decisions

During the formulation process, there are planning decisions and uncertainties that must be considered and documented.

4.4.1: Design

The New York and New Jersey Harbor has been studied extensively. This study uses many sources of existing data for the analyses presented in this report. Should a navigation improvement project recommended in this report move forward to Preconstruction Engineering and Design, additionally analyses and investigations will be conducted to increase fidelity on

project design and project costs. These analyses and investigations include, but are not limited to, ship navigation modeling; topographic and bathymetric surveys; geotechnical investigations; Hazardous, Toxic, and Radioactive Waste investigations; hydrodynamic data collection; hydrodynamic sediment and salinity modeling and analysis; supplemental Dredged Material Management Plan development; utility identification and coordination; mitigation plan refinements; sea level change analysis; and inland hydrology analysis. The estimated cost and length of the Preconstruction Engineering and Design phase for the alternatives considered these efforts.

The characteristics of the design vessel were used to inform the channel dimensions and alignment needs for the study's period of analysis. Further refinement of the dimensions and alignment of the channels is expected through application of ship simulations during the Preconstruction Engineering and Design phase. The ship simulations are not anticipated to significantly alter the footprints of the improvements considered as this study is focusing on the depth constraints of the existing channels.

The study team assumed existing bathymetric and geotechnical data are sufficient to distinguish between the alternatives considered. Collecting new data was deferred to the next phase, Preconstruction Engineering and Design. The availability of existing data enables the study team to work more efficiently however, existing data may not be tailored exactly to the study team's needs, and assumptions or interpolations may be made to cover any gaps in existing data. The decision to use existing bathymetric and geotechnical data from maintenance dredging data and previous studies may result in less accurate dredging quantity and cost estimates, nevertheless this was determined to be an acceptable risk.

The study team made assumptions on the type of material that would be required to be removed during the implementation of a navigation improvement project. Depending on the extent of existing fractured rock due to the previous 50-foot Harbor Deepening Project, blasting may be required. This study is assuming blasting will be required in some locations, and its extent will be confirmed during Preconstruction Engineering and Design through geotechnical investigations. Additional assumptions as to whether material would be HARS-suitable or in need of upland disposal were based on data collected from the prior deepening project. It was assumed that any sediment on the eastern half of the Kill Van Kull was considered to be HARS-suitable; any sediment on the western half was considered to be non-HARS suitable. Additional data collection will be needed to verify these assumptions during Preconstruction Engineering and Design.

USACE is committed to beneficially placing the dredged material that would be generated as a result of implementing any project recommended in this study (see 33 U.S.C. §2326). The analysis of all dredged material placement opportunities is conducted with reference to the Federal Standard, which is defined at 33 C.F.R. §335.7. Accordingly, the alternatives evaluated in this report assume material will be placed at the least cost environmentally acceptable location. This includes beneficially using dredged material by placing it, for example, upland, at the HARS, or on a reef consistent with the current 2008 Dredged Material Management Plan. These assumptions do not dictate the actual final placement of these materials, but rather provide a set of common assumptions for evaluating alternatives. The array of opportunities for beneficial placement changes over time; see Appendix A13 for some potential

opportunities. Should the project move forward, USACE will develop a supplemental projectspecific Dredged Material Management Plan during Preconstruction Engineering and Design. The development of this supplemental project-specific Dredged Material Management Plan will ensure USACE is aware of the full array of opportunities that coincide with the production of the dredged material. Between the current 2008 Dredged Material Management Plan Update and a supplemental project-specific Dredged Material Management Plan. The study team determined that there is sufficient capacity in the harbor and surrounding areas to handle the placement of the volumes and types of material that is anticipated to be produced as part of a navigation improvement project.

Existing utilities are another source of uncertainty for the study. Utilities within the footprint of a navigation improvement project may have to be removed or relocated. The study team used existing information from the previous 50-foot Harbor Deepening Project and contacted utility providers to identify infrastructure of interest and approximate removal and relocation costs. During Preconstruction Engineering and Design, additional analyses and information will be gathered to properly identify all impacted utilities and increase fidelity on removal and relocation costs. 50-ft deepening effort, and from reaching out to several of the utility owners

Hydrologic, salinity, and ecological modeling was also deferred to the Preconstruction Engineering and Design phase because the study team was able to evaluate potential impacts and estimate mitigation costs using existing information and local proxies. The decision to use existing information may result in inaccurate environmental impacts and mitigation costs which would later be revised based on new information; this was determined to be an acceptable risk.

Hydrodynamic modeling of proposed improvements was also deferred until the Preconstruction Engineering and Design phase. USACE Engineer Research and Development Center's Coastal Hydraulics Laboratory conducted a comprehensive hydrodynamic modeling study of the 50-foot Harbor Deepening Project (USACE ERDC-CHL, November 2020) that was used to make assumptions about the current study until new modeling can be conducted. Hydrodynamic and wave modeling will also be conducted in Preconstruction Engineering and Design to fully understand the impacts of the proposed widening and deepening actions on wave-surge, storm surge, and erosion within the project area and adjacent areas. Additionally, further deepening could potentially alter the hydrodynamics and salinity within the deepened channels, which may affect how the design ship and other ships respond, as well as how aquatic organisms may respond. The model will also be used to explore the impact of climate change on the future with project condition as changes to inland hydrology (increases in flow) and precipitation may have adverse impacts in terms of sedimentation, salinity, and scour at critical areas. This study assumes channel improvements would not result in an increased risk of storm surge or flooding, consistent with previous deepening studies' findings. Additional analyses will be conducted during Preconstruction Engineering and Design to ensure proper mitigation measures, if any, are properly implemented as a project cost.

4.4.2: Sea Level Change

Another uncertainty is sea level rise. The design and implementation of navigation projects requires consideration of the effects of climate change, including global sea level rise. The foundation for coordinated action on climate change preparedness and resilience across the

Federal government was established by Executive Order 13514 of October 5, 2009, and the Interagency Climate Change Adaptation Task Force led by the Council on Environmental Quality (CEQ). In October 2011, the Task Force developed a National Action Plan that provided an overview of the challenges a changing climate presents for the management of the nation's freshwater resources. Climate preparedness and resilience actions have also been established by USACE, as demonstrated by the annual release of the Climate Change Adaptation Plan, prepared under the direction of the USACE Committee on Climate Preparedness and Resilience (CCPR) (USACE, 2015a). USACE established an overarching USACE Climate Change Adaptation Policy Statement and a governance structure to support mainstreaming adaptation in 2011, following the release of the Executive Order (USACE, 2015a). Per Engineer Regulation 1100-2-8162, Incorporating Sea Level Change in Civil Works Program, released in December 2013, followed by Engineer Pamphlet 1100-2-1 (USACE, 2019a), Procedures to Evaluate Sea Level Change: Impacts, Responses and Adaptation in July 2014, USACE plans and incorporates climate change into Civil Works projects.

Climate change and global warming have been observed during the 20th and 21st centuries and have resulted in changes in localized sea levels. The 2014 Intergovernmental Panel on Climate Change (IPCC) report states that over the period of 1901 to 2010, the global mean sea level rose by 0.62 feet (IPCC 2014). The U.S. National Climate Assessment (2012) has established a range of global sea level rise predictions for the year 2100 that all predict sea level rise and range in the predicted value from 0.7 feet on the low end to 6.6 feet as a high prediction with intermediate values between the extremes (U.S. National Climate Assessment 2012).

The IPCC also predicts local sea level rise, addressing the localized factors of subsidence and oceanic currents at any location. Changes to relative sea level can result from a number of factors including isostatic rebound (a process by which the earth's crust, having been compressed beneath the weight of glaciers, bounces back), faulting and consolidation of sediments in fill structures, and sediment compression caused by groundwater withdrawals (Boon 2010).

Oceanic currents influence local sea level rise on the Atlantic Coast due to temperature and salinity changes in the Atlantic Ocean, which cause pressure gradients between the Gulf Stream and coastal waters to decrease, which then cause coastal waters to rise (Sallenger et al. 2012). As a result of these factors, local, relative sea level rise on the mid-Atlantic Coast of the United States from North Carolina northward is occurring at approximately twice the global mean rate, and the rate of sea level rise is accelerating both globally and locally. USACE engineering documents require that planning studies and engineering designs evaluate the entire range of possible future rates of sea-level change, represented by three scenarios of "low", "intermediate", and "high" sea-level change (USACE 2013; USACE 2014).

The use of sea level change scenarios as opposed to individual scenario probabilities underscores the uncertainty in how local relative sea levels will play out into the future. At any location, changes in local relative sea level reflect the integrated effects of global mean sea level change plus local or regional changes in geologic, oceanographic, or atmospheric origin.

The Sea Level Change Curve Calculator is designed to help with the application of the guidance found in Engineer Regulation 1100-2-8162 and EP 1100-2-1. The tools use equations in the regulation to produce tables and graphs for the following three sea level rise scenarios:

- Baseline (or "low") estimate, which is based on historic sea level rise and represents the minimum expected sea level change
- Intermediate estimate
- High estimate, representing the maximum expected sea level rise

The calculator accepts user input – including project start date, selection of an appropriate NOAA long-term tide gauge, and project life span – to calculate projected sea level change for the respective project. The start date used by the calculator is 1992, which corresponds to the midpoint of the current National Tidal Datum Epoch of 1983-2001.

The Newark Bay Main, Port Elizabeth, South Elizabeth, Kill Van Kull, Arthur Kill, Port Jersey, and Anchorage channels were analyzed using data from NOAA station The Battery, NY (#8518750) tide gauge. The Ambrose channel was analyzed using data from the NOAA Station Sandy Hook, NJ (#8531680) tide gauge. Estimated relative sea level change projections from 2020 to 2127 for each gauge were used in this study, calculated with the USACE Sea Level Change Curve Calculator are illustrated on Figure 13 and Figure 14. Each figure notes the projected construction start dates for each site and the period of analysis (2040-2089). There were no relevant sea level change thresholds identified for the NYNJHDCI study. Regardless of the sea level change scenario, the Port of New York and New Jersey has plans to implement resilience measures to be operable in the future. This is consistent with The Port Authority of New York and New Jersey's Port Master Plan.



Figure 13: NOAA Gauge: The Battery, NY (#8518750) Relative Sea Level Change Projections, 1992-2138



Figure 14: NOAA Gauge: Sandy Hook, NJ (#8531680) Relative Sea Level Change Projections, 1992-2138

The sea level change curve calculator data tables, with annual intervals, for each of these gauges are provided in Appendix B1, Attachment 6. It is anticipated that sea level change will yield an incremental decrease in operation and maintenance dredging requirements given the fact that all authorized depths are referenced to MLLW. MLLW will increase with rising sea levels yielding a theoretical decrease in operation and maintenance dredging requirements that is proportional to the volume of water added within the project channel area. The actual realized decrease is expected to be less, however, due to the complex shoaling patterns observed in maintenance surveys. Projected decreases in operation and maintenance dredging requirements were not calculated due to this fact as well the wide possible range of sea level change seen in the three curves.

Sea level change could theoretically impact the depth of the selected plan as the cumulative increases in channel depths brought about by sea level change may negate the need for additional deepening, particularly in the latter years of the project's adaptation horizon. Such gains would not be realized though as the proposed project and all channel depths are referenced to MLLW, which will rise along with rising seas. The impact of sea level change, which increases channel depth, and sedimentation, which decreases channel depth, were also compared for selected channels. When sedimentation is considered, it is concluded that sedimentation outpaces sea level change, in all channels, for the low and intermediate curve and outpaces the high curve for all channels within the inner harbor. The rate of sea level change for the high curve outpaces sedimentation only in Anchorage and Ambrose channels. Sea level change, therefore, does not serve to provide additional clearance in almost all instances. Finally, the impacts of sea level change on bridge trafficability and dockside infrastructure were also considered. It was concluded that sea level change will have no impact on bridge trafficability for both the period of analysis and the adaptation horizon. It is also concluded that sea level change will have no impact on dockside infrastructure for both the low and intermediate curves. If the high curve of sea level change were realized, there would be no impacts during the period of analysis. There

would however be impacts during the latter years of the adaptation horizon on the two wharves with the lowest elevation. If the projected high curve is realized, MSL will intersect the base elevation of Port Jersey South in 2119 and Port Newark South in 2131. These years are within the 100-year adaptation horizon which extends to 2137. Possible adaptations that can be developed to counteract these impacts are discussed below. A fuller discussion on the analysis of the impacts of sea level change on recommended plan depth selection, operation and maintenance requirements, bridge trafficability and dockside infrastructure can be found in Appendix B1.

The impacts of sea level change on shore side infrastructure are explicitly considered in The Port Authority of New York and New Jersey's Sustainability Policy which directs the Authority to "develop strategies that reduce the risk posed by climate change to its facilities and operations and, in collaboration with other regional stakeholders, develop strategies that mitigate the risk to the region posed by climate change in a manner that will promote a sustainable environment." The Port Authority of New York and New Jersey has also issued climate resilience design guidelines and sustainable infrastructure guidelines in their effort to extend project life-cycles, reduce future operational costs and develop resiliency strategies. One resilience strategy to be implemented by The Port Authority of New York and New Jersey is to reconstruct wharves with greater structural strength at the time of replacement, thereby imbuing the structure with capacity to adapt to sea level change in the future. Should the high rate of sea level change be realized, possible mitigation strategies at Port Jersey South and Port Newark South include elevating the deck and/or constructing a perimeter floodwall, which would be supported by the previously reinforced wharf structure. Additional measures include backflow preventers on drainage outfalls and stormwater pumps. The Port Authority of New York and New Jersey will also protect continuity of terminal operations by mitigating flood risk from sea level change-intensified storm surge events by elevating or floodproofing critical electrical and mechanical equipment throughout the sites.

4.4.3: Economics

The commodity and fleet forecast developed for the study is an additional source of uncertainty. The long-term trade forecast assumes compound average annual growth of 3.5 percent through 2050. While the study assumes that long-term positive economic growth will drive continued increases in containerized trade, future trade volumes are difficult to predict with certainty. Commodity flows are subject to the ups and downs of the business cycle, individual commodity markets, and political influence.

The fleet forecast assumes that Post Panamax Generation 3 vessels (nominal capacity of 10,000 – 14,000 TEUs) will comprise a larger percentage of calls and carry a larger share of total cargo over the study period. This assumption is based on analysis of containerized vessel order books and firms' preference for the economies of scale and lower unit transportation costs realized by larger, more efficient vessels. However, vessel scrap rates and deployment are firm-level decisions based on operating costs, fleet availability, trade volume, landside infrastructure constraints, scheduling, and other exogenous factors. As a result, forecasting the fleet distribution over the study period involves significant uncertainty. More importantly, the share of cargo carried on Post Panamax Generation 3 and Post Panamax Generation 4 vessels (nominal capacity

of 14,000+ TEUs), the benefitting classes of containerships for this project, is subject to change.

There is also uncertainty with the model used to calculate benefits, HarborSym. Port and individual operations are subject to change based on various conditions including weather, congestion, labor availability, schedule, pilot practices, and other factors leading to variability. The HarborSym model included variations or ranges for many of the variables involved in the vessel costs, loading, distances, speeds, etc. For this study, in-port transportation costs account for only approximately 7 percent of total transportation costs. As a result, assumptions based on the commodity forecast, fleet forecast, and vessel loading assumptions have greater impact on total transportation costs and the difference between plans.

Despite these uncertainties regarding the economic analysis, there is a low risk of changes of low commodity growth and fleet transition to project justification or plan selection.

4.5: Management Measures and Components

Measures are the building blocks of alternative plans. A variety of structural/ physical modification and nonstructural/ operational measures were considered to satisfy the study objectives and constraints in consultation with The Port Authority of New York and New Jersey staff. Consideration of the various measures was conducted consistent with federal water resources policies and practices. Measures were evaluated for compatibility with local conditions and relative effectiveness in meeting planning objectives. They are presented below by category.

Nonstructural/Operational Measures: The implementation of nonstructural/ operational measures have the potential to improve navigation within the New York and New Jersey Harbor without the physical modification of the channels. The nonstructural measures considered are listed below. Several measures that allow for greater vessel loading economies are currently in use in the Port and are discussed in the "Port Operations" section. Since many of these nonstructural measures are already being implemented within the harbor, only limited further benefits could be realized. These measures were therefore not carried forward.

- Alternative sites for, or means of, commerce delivery: This non-structural measure generally refers to an alternative site either within or outside the port. Existing sites within the port are usually being used for other types of cargo transportation (e.g., bulk cargo). Sites outside the port would require transportation back to the region by other means. The scope of this study considers all container terminal sites in the port, including existing, expanded, and planned terminals. Moreover, the non-federal partners have not identified any other alternative terminal sites. Therefore, no additional port terminal sites have been identified or proposed for cargo routing or handling. The delivery of goods to an alternative site outside the port (i.e., another East Coast port) with cargo transported back to the region via road or rail is inherently more costly to the carrier. Accordingly, this measure has not been included for further analysis.
- Reduce vessel speed in the channel: Reducing vessel speed while transiting the channel will reduce the amount of squat affecting the vessel. Reducing vessel squat would allow the vessel to ride higher in the water, thereby reducing the vessel's draft while transiting the channel. Implementation of vessel speed reduction is constrained by the need to maintain sufficient speed for maneuverability and the need to reduce crab angle when

transiting the channel under windy conditions. The amount of squat reduction potentially gained by slowing to a minimum safe speed would be inconsequential because vessels typically operate at or very near this speed under existing conditions. Therefore, reducing vessel speed in the channel does not meet the planning objectives, and is not carried forward.

- Increase tugboat assistance: Tugboats are used to improve the maneuverability of vessels that have slowed during channel transits, to turn vessels, and to dock vessels. The standard operating practices for tug assistance are sufficient for vessels currently using the channel. Additional tug assistance would not improve the efficiency of vessels transiting the channel because additional use of tugs would not improve vessel loading, increase the size of vessels using the channel, or appreciably increase vessel speed. Additional use of tugs is not carried forward.
- Improve vessel scheduling and timing of transits: Improving the vessel scheduling and timing of transits could potentially reduce the need for restrictions on vessels meeting in the channel. The most effective system currently in use for optimizing vessel scheduling and timing of transits is the Vessel Traffic System, which is under the direction of the Coast Guard. The Vessel Traffic System is currently in use in the New York Harbor. Therefore, significant improvements in the restrictions on vessels meeting in the channel are unlikely to take place by pursuing further improvements in vessel scheduling and timing of transits. Therefore, this measure does not meet the planning objectives and is not carried forward.
- Relocate aids to navigation: There are some spots adjacent to Ambrose Channel that are naturally deeper than federally maintained channel depths. However, there are not sufficient areas of existing deep water where simply moving the aids to navigation would meet the planning objectives. Therefore, this measure is not carried forward. However, existing deep-water areas may be incorporated into channel widening in some areas.
- Use lightering: During a lightering operation, a vessel is loaded or unloaded to an operable draft in order to transit the channel. Container ships are not capable of lightering. The scope of this study is constrained to container vessel traffic; therefore, this measure is not carried forward.
- Tidal advantage: Tidal advantage is the use of high tide to provide additional underkeel clearance, which allows vessels with deep drafts to transit the channel. This is already a common practice within the study area that is projected to continue. Therefore, this measure was not carried forward.

Structural Measures: Structural measures are those measures that modify the physical attributes of the navigation channels. Since the vessels currently calling at the port are constrained by the dimensions of the channel, a few of these structural measures were carried forward.

- Channel deepening: Deepening the existing channel could potentially allow for deeper and more efficient loading of the existing fleet and allow for the efficient use of larger vessels. This measure was carried forward.
- Stepped channel: In a stepped channel configuration, the inbound lane would be dredged more deeply than the outbound lane. The inbound lane would be designed to accommodate deeply laden inbound traffic. The outbound lane would be shallower than the inbound lane under the presumption that outbound traffic would have less cargo and thus be operating at shallower drafts. This configuration has not been used in New York

Harbor. The stepped channel configuration would be insufficient for existing and projected future conditions in New York Harbor because outbound container traffic currently is loaded nearly as deeply as inbound traffic. Outbound container traffic can be expected to be loaded even more deeply as deepening projects at other U.S. east coast container ports completed and considering New York Harbor is often the first port of call for the largest container vessels. Therefore, a stepped channel configuration was not carried forward.

Channel widening: Channel widening consists of bend easing and widening channels for improved navigation when turning. Widening the navigation channel would allow for more efficient operation of the vessels within the harbor. Increasing the area in the federal channel available for the largest container vessels to complete turns in and out of the harbor would allow for safer, faster transit. Information collected from the harbor and docking pilots identified several areas where the area available for completing a turn is perilous. The information collected from the pilots is consistent with the Maritime Institute of Technology and Graduate Studies simulations. During the simulations, incidents or near incidents occurred while completing turns. Channel widening would be needed to meet USACE's design specifications for the design vessel and to improve efficiency and safety. Channel widening was considered independently and as a necessary addition to deepening for slope stability and design criteria purposes. This measure was carried forward. However, widening specific areas was removed from further consideration. Widening the Kill Van Kull for two-way traffic was considered but eliminated from further consideration because the space between the piers of the Bayonne Bridge does not allow for two-way traffic. Widening the channel and impacting Combined Disposal Facility outside of the Port Jersey Channel was also eliminated from further consideration due to environmental considerations and the anticipated costs as compared to benefits.

In summary, measures removed from further consideration include:

- Nonstructural/operational changes
 - Improve vessel scheduling and timing of transits (Vessel Traffic System)
 - Relocate aids to navigation to take advantage of naturally deep areas
 - Use lightering
 - Reduce vessel speed in the channel
 - Increase the use of tugboat assistance to improve vessel maneuverability
 - o Alternative sites of commerce delivery
- Stepped channel

Measures kept for further consideration include:

- Channel deepening
- Improve existing turning areas and/or create new turning areas
- Channel widening

4.6: Screen Pathways

The USACE met with the operators of the major marine terminals in the Port of New York and New Jersey and the pilot associations responsible for navigating deep draft container vessel

traffic into the harbor.

USACE met with the following marine terminal operators:

- A.P. Moller (Elizabeth Port Authority Marine Terminal) on March 23, 2020
- Global Container Terminals of Bayonne (Port Jersey Port Authority Marine Terminal) and New York (Howland Hook) on March 31, 2020
- Port Newark Container Terminal (Elizabeth Port Authority Marine Terminal) on April 2, 2020
- Maher (Elizabeth Port Authority Marine Terminal) on April 16, 2020

USACE met with the Sandy Hook Pilots Association, Metro Pilots Association, and Moran Towing Corporation:

- August 7, 2019
- February 4, 2020

USACE collected data during these meetings that informed the future without-project conditions. Based on this information, USACE carried out a preliminary evaluation of the implementation of several different measures in the Arthur Kill channel/pathway to Howland Hook Marine Terminal. USACE determined that the existing configuration of the Arthur Kill channel/pathway sufficiently accommodates Howland Hook Marine Terminal's anticipated future fleet, which includes vessels with a capacity of up to 10,000 TEUs, to navigate to the terminal without channel modification. USACE made this determination by comparing the existing channel depth to the drafts of the existing fleet as well as the largest vessels within Howland Hook Marine Terminal's anticipated future fleet. As a result, while efficiency deepening was considered, it is not recommended for further consideration because the existing channel depth is not being used to its fullest potential and can accommodate deeper drafting vessels, including the 10,000 TEU vessel.

Efficiency widening of the Arthur Kill channel/pathway to Howland Hook Marine Terminal was also preliminarily evaluated. Benefits were calculated based on the transportation cost savings that would be possible were the channel wider. For example, a wider channel would mean that the largest vessels would not have to wait for slack water to enter/exit the channel, reducing the transportation cost in time. The benefits were compared to a preliminary cost estimate for widening the channel. The costs were calculated based on a cost of dredging per cubic yard. The preliminary evaluation demonstrated that efficiency widening would result in low quantifiable benefits but high quantifiable costs. The Arthur Kill channel/pathway is therefore not being considered for efficiency widening because a preliminary evaluation indicates low quantifiable benefits and high costs. As neither efficiency widening nor efficiency deepening can be demonstrated to have higher benefits than costs, the Arthur Kill channel/pathway has been screened from further analysis. This decision had been fully coordinated with The Port Authority of New York and New Jersey staff.

During public review of the draft integrated report, the team received a comment from New York City Economic Development Cooperation that expressed concern that the pathway to Howland Hook Marine Terminal had been removed from consideration. While the U.S. Coast Guard Vessel Traffic Service guidelines restrict vessels with a length overall of 1,100 feet or draft greater than 47 feet from calling at Howland Hook, pent up market demand during the coronavirus (COVID-19) global pandemic led the Coast Guard and Harbor Pilots to allow larger vessels on a case-by-case basis. This development potentially changes the use of the facility in the future, as the Pilots and the Coast Guard now know they can navigate larger vessels into Howland Hook. As a result, The Port Authority of New York and New Jersey independently pursued ship simulation of a 14,000 TEU vessel and a 18,000 TEU vessel transiting to Howland Hook Marine Terminal with the Maritime Institute of Technology and Graduate Studies. Results from the simulations showed that, with some channel modifications, 14,000 TEU and 18,000 TEU vessels can transit to Howland Hook. Based on the results of the simulations changed economic conditions, channel improvements to the pathway to Howland Hook Marine Terminal may be economically justified given further analysis.

The study team identified that a specific feasibility study would be warranted to analyze the navigation pathway to Howland Hook Marine Terminal. Under the same study authority, Section 216 of the Rivers and Harbors Act of 1970, it is recommended that a feasibility study be initiated to determine whether there are additional federal investments warranted for channel improvements.



Figure 15: Pathways Moving Forward

4.7: Alternative Plan Formulation

The plan formulation strategy for this study is conducted in three phases, as described below. The formulation cost assumptions made during the analysis include the following (please see Appendix B4: Cost Engineering for more information):

- 1. The alternatives evaluated in this report assume material will be placed at the least cost environmentally acceptable location. This includes beneficially using dredged material by placing it, for example, upland, at the HARS, or on a reef consistent with the current 2008 Dredged Material Management Plan.
- 2. The anticipated volume of maintenance dredging for each channel is calculated based on the estimated rate of sedimentation observed from past operation and maintenance of the harbor applied to any portions of the channel to be widened as part of this project. Consistent with current New York District practice, the Port Jersey channel is anticipated to be maintained by dredging every 10 years, the Anchorage channel reaches to be maintained every seven years and all other channels are assumed to be maintained together in a single contract every three years.
- 3. The total template area that can be cleared without the need for blasting changes based on the depth of the alternatives. Those reaches with multiple categories of rock hardness are assumed to be blasted at production rates with the hardest applicable category.
- 4. Cultural mitigation, environmental mitigation, structural demolitions, and utility relocations are not incorporated into the cost estimates. These items, while having the potential to be costly, are assumed not to significantly differ between alternatives. Therefore, their inclusion would not assist in the selection of the Recommended Plan.
- 5. Where production blasting is assumed, drilling and blasting lateral spacing is assumed to be 12 feet for moderately hard tock, 10 feet for hard rock, and 8 feet for hardest rock.
- 6. The current list of structures exposed to blasting vibrations and deepening/widening is assumed to be correct.
- 7. The quantities requiring pre-treatment increase with depth according to the geometry of the cone-shaped influence of blasting. It is assumed approximately 30-40% of bedrock areas to be deepened, in particular the Kill Van Kull Channel, may be removed to the design grade by use of backhoe and cutter dredge types without pre-treatments such as drilling and blasting.
- 8. On average, between 2 and 3 dredge plants are assumed to be working at any given time over the duration of the deepening.

The benefits for each pathway were also calculated at the same depths as costs. Under future with- and without-project conditions, the volume of cargo moving through the Port of New York and New Jersey is assumed to be the same. The share of the commodity projections also remains the same as existing condition. However, channel deepening will allow shippers to load vessels more efficiently and take advantage of larger vessels. This efficiency translates to transportation cost savings and is the main driver of the national economic development benefits. Specific benefit assumptions made during the analysis include the following:

- 1. Vessels continue to load up to a 49-foot sailing draft with a -50-foot MLLW channel; sailing draft becomes 0.7 feet deeper with each additional foot of available channel depth.
- 2. The future vessel fleet will include Post-Panamax Generation III and Post-Panamax Generation IV vessels with maximum sailing drafts up to the maximum design standards within these classes.
- 3. Vessel utilization for the Post-Panamax Generation III and Post-Panamax Generation IV vessels reflect the utilization rates of the Post-Panamax Generation II and Post-Panamax Generation I-sized vessels.
- 4. Vessels can transit the channel in the HarborSym model if they do not violate the underkeel clearance requirements (~+3 feet inner channel).

For more information see Appendix B4: Cost Engineering, and Appendix C: Economics.

4.7.1: Phase I: Determine First Added Increment

Phase I of the plan formulation strategy is to calculate the costs and benefits for deepening each pathway from sea to container terminal, foot by foot, and select the pathway with the highest net benefits as the first increment.

The team calculated the costs for deepening each pathway – the pathway from sea to Port Jersey – Port Authority Marine Terminal and the pathway from sea to Elizabeth – Port Authority Marine Terminal – by 2 to 7 feet to a maintained depth¹ between -52 feet MLLW and -57 feet MLLW, respectively.

Table 20 contains the inputs and results of the benefit-cost analysis conducted in Phase I. The total formulation costs for deepening in Phase I range from \$406.3 million, for deepening the pathways from sea to Port Jersey - Port Authority Marine Terminal by 2 feet, to \$5,660.4 million (\$5.6 billion) for deepening the pathway from sea to Elizabeth - Port Authority Marine Terminal by 7 feet, or \$15.1 million to \$36.9 million annually, respectively. Of the alternatives considered in Phase I, deepening the pathway from sea to Elizabeth - Port Authority Marine Terminal by 4 feet reasonably maximizes net benefits. With an average annual equivalent cost of \$159.6 million and an average annual equivalent benefit of \$237.6 million, deepening the pathway from sea to Elizabeth - Port Authority Marine Terminal by 4 feet is estimated to yield net benefits of \$78.0 million and have a benefit-to-cost ratio of 1.5. Therefore, deepening the pathway from sea to Elizabeth - Port Authority Marine Terminal by 4 feet to a maintained depth of -54 feet MLLW is selected as the first added increment.

¹ The maintained depth, authorized channel level, and total (dredged) depth of the various channelsmay differ. The authorized channel level is used herein as it is defined in Engineer Regulation 1110-2-1613, and reflects the loaded summer saltwater draft of the design vessel together with gross underkeel clearance (including allowances for squat, salinity, wave motion, and safety clearance). Maintained depth is understood in relation to the authorized channel level. The maintained depth only differs from the authorized channel level in areas in which the channel bottom is composed of rock or otherwise hard material. In rock-bottomed or hard-bottomed areas, an additional 2 feet of safety clearance is required. The total (dredged) depth of the channel is the sum of the authorized channel level and the dredging tolerance (paid overdepth).

Table 20: Phase I Alternative Costs and Benefits							
ALTERNATIVE		FORMULAT	ON COST	BENEFITS		BENEFIT-	
		TOTAL INVESTMENT ¹	ANNUALIZED ²	ANNUALIZED	NET	COST RATIO	
PATHWAY FROM SEA TO PORT JERSEY-PORT AUTHORITY MARINE TERMINAL							
Alt 1a	No Action						
Alt 1b	Deepen by 2 feet	\$406.3 million	\$15.1 million	\$34.2 million	\$19.0 million	2.3	
Alt 1c	Deepen by 3 feet	\$485.5 million	\$18.0 million	\$49.6 million	\$31.5 million	2.8	
Alt 1d	Deepen by 4 feet	\$571.6 million	\$21.2 million	\$65.1 million	\$43.8 million	3.1	
Alt 1e	Deepen by 5 feet	\$657.0 million	\$24.3 million	\$66.9 million	\$42.4 million	2.7	
Alt 1f	Deepen by 6 feet	\$819.2 million	\$30.3 million	\$66.9 million	\$36.4 million	2.2	
Alt 1g	Deepen by 7 feet	\$997.3 million	\$36.9 million	\$66.9 million	\$29.8 million	1.8	
PATHWAY FROM SEA TO ELIZABETH-PORT AUTHORITY MARINE TERMINAL							
Alt 2a	No Action						
Alt 2b	Deepen by 2 feet	\$3,351.5 million	\$128.3 million	\$130.5 million	\$2.2 million	1.0	
Alt 2c	Deepen by 3 feet	\$3,749.9 million	\$143.0 million	\$184.0 million	\$41.0 million	1.3	
Alt 2d	Deepen by 4 feet	\$4,195.8 million	\$159.6 million	\$237.6 million	\$78.0 million	1.5	
Alt 2e	Deepen by 5 feet	\$4,656.9 million	\$176.6 million	\$243.9 million	\$67.3 million	1.4	
Alt 2f	Deepen by 6 feet	\$5,206.6 million	\$197.0 million	\$243.9 million	\$46.9 million	1.2	
Alt 2g	Deepen by 7 feet	\$5,660.4 million	\$213.8 million	\$243.9 million	\$30.1 million	1.1	

Fiscal Year 2020 price level and 2.75% discount rate

¹ Total investment costs include the cost of mobilization, demobilization, the berth deepening associated cost, and the first cost contingency.

² The annualized costs includes the annual cost of operation and maintenance (\$136 thousand for the Pathway to Port Jersey alternatives; \$4.1 million for Pathway to Port Elizabeth alternatives)

4.7.2: Phase II: Determine Second Added Increment

Phase II of the plan formulation strategy is to assume the pathway selected in Phase I – sea to Elizabeth - Port Authority Marine Terminal – is constructed and to calculate the incremental costs and benefits for deepening the remaining pathway – sea to Port Jersey - Port Authority Marine Terminal – foot by foot. The team selects the depth that results in the highest net benefits as the second added increment.

The difference between Phase I and Phase II is that Phase II assumes that the pathway from sea to Elizabeth – Port Authority Marine Terminal has already been deepened by 4 feet to maintained depth of -54 feet MLLW. Therefore, when calculating the costs to deepen the pathway from sea to Port Jersey – Port Authority Marine Terminal by 2 to 4 feet in Phase II, the costs only include the cost to deepen from mid-Anchorage Channel to Port Jersey - Port Authority Marine Terminal. It is assumed the costs to deepen the pathway from sea to Elizabeth – Port Authority Marine Terminal, which includes Ambrose Channel, part of Anchorage Channel, the Kill Van Kull, and Newark Bay Channel, by 4 feet are sunk as this pathway was already constructed. The Phase II alternatives that involve deepening from sea to Port Jersey – Port Authority Marine Terminal beyond 4 feet therefore include the costs to deepen from sea to mid-Anchorage Channel by the incremental depth; for example, the Phase II alternative pathway from sea to Port Jersey – Port Authority Marine Terminal being deepened by 6 feet includes the cost of deepening the from sea to mid-Anchorage Channel by 2 feet and deepening from mid-Anchorage Channel to Port Jersey – Port Authority Marine Terminal by 6 feet.

Table 21 contains the inputs and results of the benefit cost analysis conducted in Phase II. The incremental total formulation costs for deepening the pathway from sea to Elizabeth – Port Authority Marine Terminal range from \$245.6 million for deepening by 2 feet to \$558.8 million for deepening by 7 feet, or \$9.2 million to \$20.8 million annually, respectively.

Of the alternatives considered in Phase II, deepening the pathway from sea to Port Jersey – Port Authority Marine Terminal by 4 feet reasonably maximizes incremental net benefits. With an annual cost of \$10.7 million and an annual benefit of \$65.1 million, deepening the pathway from sea to Port Jersey - Port Authority Marine Terminal by 4 feet is estimated to yield net benefits of \$54.4 million and have a benefit-to-cost ratio of 6.1. Therefore, deepening the pathway from sea to Port Jersey - Port Authority Marine Terminal by 4 feet is selected as the second added increment.

ALTERNATIVE		FORMULATION COST		BENEFITS		BENEFIT-	
		TOTAL INVESTMENT ¹	ANNUALIZED ²	ANNUALIZED	NET	COST RATIO	
PATHWAY FROM SEA TO PORT JERSEY-PORT AUTHORITY MARINE TERMINAL							
Alt 2a	No Action						
Alt 2b	Deepen by 2 feet	\$245.6 million	\$9.2 million	\$34.2 million	\$24.9 million	3.7	
Alt 2c	Deepen by 3 feet	\$265.7 million	\$10.0 million	\$49.6 million	\$39.7 million	5.0	
Alt 2d	Deepen by 4 feet	\$286.3 million	\$10.7 million	\$65.1 million	\$54.4 million	6.1	
Alt 2e	Deepen by 5 feet	\$342.3 million	\$12.8 million	\$66.9 million	\$54.0 million	5.2	
Alt 2f	Deepen by 6 feet	\$436.5 million	\$16.3 million	\$66.9 million	\$50.5 million	4.1	
Alt 2g	Deepen by 7 feet	\$558.8 million	\$20.8 million	\$66.9 million	\$46.0 million	3.2	

Table 21: Phase II Incremental Alternative Costs and Benefits

Fiscal Year 2020 price level and 2.75% discount rate

¹ Total investment costs include the cost of mobilization, demobilization, the berth deepening associated cost, and the first cost contingency.

² The annualized costs includes the annual cost of operation and maintenance (\$136 thousand for the Pathway to Port Jersey alternatives; \$4.1 million for Pathway to Port Elizabeth alternatives)

4.7.3: Phase III: Add Additional Efficiency Components

One efficiency component was evaluated at the eastern entrance of the Kill Van Kull. This component is a widening that would allow vessels to meet and pass other vessels and would allow for vessels to be closer to the Kill Van Kull as they wait for other vessels to transit the channel. This component is indicated by a green polygon in Figure 16.



Figure 16: Considered Efficiency Component at Eastern End of Kill Van Kull

Table 22 contains the inputs and results of the benefit-cost analysis conducted in Phase III. The efficiency component is not economically justified with a cost a benefit-to-cost ratio of 0.3.

Table 22: Phase III Costs and Benefits								
	FORMULATION COST		BEN	BENEFIT-				
ALTERNATIVE	TOTAL*	ANNUALIZED	ANNUALIZED	NET	COST RATIO			
Kill Van Kull Meeting and Passing Zone	\$28.9 million	\$1.1 million	\$367.0 thous and	-\$707.0 thousand	0.3			

The final step of the plan formulation process is determining the most economically efficient alternative combination with most net benefits (the national economic development plan) and selecting the plan for recommendation (Tentatively Selected Plan). Evaluating the focused array of alternatives and determining the Tentatively Selected Plan is described in the following section.

4.8: Evaluation of the Focused Array of Alternative Plans

The focused array of alternatives was developed with economically justified components that are estimated to provide the most net benefits from the incremental analysis presented above. The components that are shown to be producing the most net benefits are deepening the pathway to Elizabeth – Port Authority Marine Terminal by 4 feet, deepening the pathway to Elizabeth – Port Authority Marine Terminal by 5 feet, deepening the pathway to Port Jersey – Port Authority Marine Terminal by 4 feet, and deepening the pathway to Port Jersey – Port Authority Marine Terminal by 5 feet. Various combinations of these components make up the focused array of alternatives (Table 23).



Per the 1983 Principles and Guidelines by the U. S. Water Resources Council, the federal objective of water and related land resources project planning is to "contribute to national economic development consistent with protecting the Nations' environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements" (U.S. Water Resources Council, 1983).

4.8.1: Meets Planning Objectives and Avoids Constraints

Alternatives B, C, D, E, and F all meet the objectives of the study, improve the efficiency of operations of containerships in the New York and New Jersey Harbor and allow more efficient use of containerships transiting the New York and New Jersey Harbor. This is shown by the estimation of producing positive net benefits. However, Alternatives D, E, and F better meet these objectives by improving efficiencies of vessels transiting to both Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal, while Alternatives B and C only improve efficiency to one containership terminal. Additionally, all of the alternatives were formulated to avoid the study constraint of avoiding impacts to the piers of the Bayonne Bridge.

4.8.2: The Principles and Guidelines Criteria

The 1983 Principles and Guidelines require that plans are formulated in consideration of four criteria: completeness, effectiveness, efficiency, and acceptability. The study team carefully analyzed and compared all of the alternatives for completeness, their effectiveness at alleviating navigation inefficiencies, their benefits and costs, and their legality (Table 24).

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective. All the alternatives in the focused array were evaluated with consideration of necessary investments and other actions. The plans were looked at for environmental, vessel traffic, and cultural resource impacts, as well as the costs associated with mitigating those impacts and acquiring the required real estate for implementation. Therefore, all actionable alternatives considered as part of the focused array are complete.
Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities. All the actionable alternatives in the final array alleviate the problem of inefficiencies due to depth and width limitations and achieve the study objectives to improve navigational efficiencies related to depth and width limitations in the existing federal navigation channel. Therefore, all actionable alternatives considered as part of the focused array are effective.

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment. Efficiency was measured through a comparison of benefit cost ratios, improved navigation efficiencies, and benefits from the project. This preliminary analysis indicated that all alternatives in the focused array are economically justified and efficient.

Acceptability is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations, and public policies. The study team formulated the alternatives in accordance with applicable laws and regulations. All alternatives considered as part of the focused array are acceptable.

	ALTERNATIVE	COMPLETE	EFFECTIVE	EFFICIENT	ACCEPTABLE
A	No Action	N	N	Ν	Y
В	Deepen Pathway to Elizabeth – Port Authority Marine Terminal by 4'	Y	Y	Y	Y
С	Deepen Pathway to Port Jersey – Port Authority Marine Terminal by 4'	Y	Y	Y	Y
D	Deepen Pathway to Elizabeth – Port Authority Marine Terminal by 4' and Port Jersey – Port Authority Marine Terminal by 4'	Y	Y	Y	Y
E	Deepen Pathway to Elizabeth – Port Authority Marine Terminal by 4' and Port Jersey – Port Authority Marine Terminal by 5'	Y	Y	Y	Y
F	Deepen Pathway to Elizabeth – Port Authority Marine Terminal by 5' and Port Jersey – Port Authority Marine Terminal by 5'	Y	Y	Y	Y

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4.8.3: The Principles and Guidelines Accounts

The 1983 Principles and Guidelines also requires that study alternatives be evaluated under the following accounts:

National Economic Development (NED): National economic development effects are changes in the economic value of the National output of goods and services. Benefits and net benefits of the alternatives are presented in Table 25. Alternative A, No Action does not contribute to national economic development. All of the other alternatives contribute to national economic development in various amounts, with Alternative D marginally contributing the most.

	ALTERNATIVE	TOTAL INVESTMENT COST ¹	TOTAL ANNUALIZED COST ²	ANNUAL BENEFITS	NET BENEFITS	BENEFIT- COST RATIO
A	No Action	\$0	\$0	\$0	\$0	
В	Deepen Pathwayto EPAMT 4'	\$4.2 billion	\$159.6 million	\$237.6 million	\$78.0 million	1.5
С	Deepen Pathwayto PJPAMT by 4'	\$571.6 million	\$21.2 million	\$65.1 million	\$43.8 million	3.1
D	Deepen Pathwayto EPAMT by 4' and PJPAMT by 4'	\$4.48 billion	\$170.3 million	\$302.7 million	\$132.4 million	1.8
E	Deepen Pathwayto EPAMT by 4' and PJPAMT by 5'	\$4.54 billion	\$172.4 million	\$304.4 million	\$132.1 million	2.2
F	Deepen Pathwayto EPAMT by 5' and PJPAMT by 5'	\$5.0 billion	\$189.3 million	\$310.8 million	\$121.5 million	1.6

Table 25: Summary Economics of Focused Array of Alternatives

Fiscal Year 2020 price level and 2.75% discount rate

EPAMT = Elizabeth Port Authority Marine Terminal, PJPAMT = Port Jersey - Port Authority Marine Terminal ¹Total investment costs include the cost of mobilization, demobilization, the berth deepening associated cost, and the first cost contingency.

²The annualized costs includes the annual cost of operation and maintenance (\$136 thousand for the Pathway to Port Jersey alternatives; \$4.1 million for Pathway to Port Elizabeth alternatives)

Regional Economic Development (RED): Regional economic development effects are the impacts of project spending, either directly or indirectly, on the local economy. Besides Alternative A, implementation of the any of these alternatives could induce regional economic development benefits in the area. The primary regional economic development benefit as explained in the economic appendix is a result of the construction of the deepened pathways which lead to the primary commercial ports. Construction requires several years of employment for every role involved in a channel deepening - employment that would not be required and thus would likely not exist in the without-project condition. The additional employment has knock-on effects such as increased spending by those employed and additional taxes collected by regional governments. Relatedly, the Port of New York and New Jersey is a crucial driver for the availability of jobs in the region and a high standard of living afforded by these jobs. The competitiveness of the Port of New York and New Jersey, driven by transportation cost, would be threatened were no action taken as in the without-project condition. Thus, there are important indirect economic impacts afforded to the region that would not occur in the without-project condition. Alternatives B through F support the continued regional economic growth in the availability of jobs and the high standard of living that is derived from this robust facet of industry. However, Alternatives D, E, and F support the continued regional economic growth more than the others because more terminals are benefiting from the plans. However, Alternative F would contribute the most since it deepens the two navigation pathways the most.

Environmental Quality (EQ): Environmental quality is the non-monetary beneficial effects on

significant natural and cultural resources. The categories that make up environmental quality are considered for each alternative in Table 27 and Table 28 using the definitions in Table 26.

IMPACT SCALE	CRITERIA
No Effect	The resource area would not be affected and there would be no impact.
Negligible	Changes would either be non-detectable or, if detected, would have effects that would be slight and local. Impacts would be well below regulatory standards, as applicable.
Minor	Changes to the resource would be measurable, but the changes would be small and localized. Impacts would be within or below regulatory standards, as applicable. Mitigation measures would reduce any potential adverse effects.
Moderate	Changes to the resource would be measurable and could have either localized or regional scale impacts. Impacts would be within or below regulatory standards, but historical conditions would be altered on a short-term basis. Mitigation measures would be necessary, and the measures would reduce any potential adverse effects.
Major	Changes to the resource would be readily measurable and would have substantial consequences on regional levels. Impacts would exceed regulatory standards. Mitigation measures to offset the adverse effects would be required to reduce impacts, though long-term changes to the resource would be expected.

Table 26: Defining Criteria for Scale of Impacts

Table 27: So	ale of Final Array's Impacts to Environmental Quality/Resource.
	(Note this table spans two pages)

		ALTERNATIVES									
	A- No Action	B- Deepen Pathway to EPAMT by 4'	C- Deepen Pathway to PJPAMT by 4'	D- Deepen Pathway to EPAMT by 4' and PJPAMT by 4'	E- Deepen Pathway to EPAMT by 4' and PJPAMT by 5'	F- Deepen Pathway to EPAMT by 5' and PJPAMT by 5'					
Water resources & quality	Temporary, Negligible to Minor	Temporary, Minor	Temporary, Minor	Temporary, Minor	Temporary, Minor	Temporary, Minor					
Vegetation	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect					
Essential Fish Habitat	Temporary, Negligible to Minor	Permanent, Minor	Permanent, Minor	Permanent, Minor	Permanent, Minor	Permanent, Minor					
Wildlife	Temporary, Negligible to Minor	Temporary to Permanent, Minor	Temporary to Permanent, Minor	Temporary to Permanent, Minor	Temporary to Permanent, Minor	Temporary to Permanent, Minor					
Cultural resources	No Effect	Permanent, Minor	Permanent, Minor	Permanent, Minor	Permanent, Minor	Permanent, Minor					

	ALTERNATIVES									
	A- No Action	B- Deepen Pathway to EPAMT by 4'	C- Deepen Pathway to PJPAMT by 4'	D- Deepen Pathway to EPAMT by 4' and PJPAMT by 4'	E- Deepen Pathway to EPAMT by 4' and PJPAMT by 5'	F- Deepen Pathway to EPAMT by 5' and PJPAMT by 5'				
Air quality	No Effect	Temporary, Minor	Temporary, Minor	Temporary, Minor	Temporary, Minor	Temporary, Minor				
Topography / Bathymetry	Permanent, Negligible to Minor	Permanent, Minor	Permanent, Minor	Permanent, Minor	Permanent, Minor	Permanent, Minor				
Hazardous, Toxic, and Radioactive Wastes	No Effect	Temporary, Negligible	Temporary, Negligible	Temporary, Negligible	Temporary, Negligible	Temporary, Negligible				

EPAMT = Elizabeth – Port Authority Marine Terminal

PJPAMT= Port Jersey – Port Authority Marine Terminal

		,	, ,							
	ALTERNATIVES									
				D- Deepen	E- Deepen	F- Deepen				
				Pathway to	Pathway to	Pathway to				
		B- Deepen	C- Deepen	EPAMT by 4'	EPAMT by 4'	EPAMT by 5'				
		Pathway to	Pathway to	and PJPAMT	and PJPAMT	and PJPAMT				
	A- No Action	EPAMT by 4'	PJPAMT by 4'	by 4'	by 5'	by 5'				
	Temporary	Temporary,	Temporary,	Temporary,	Temporary,	Temporary,				
Recreation	Negligible	Negligible to								
	Negligible	Minor	Minor	Minor	Minor	Minor				
	Permanent	Permanent,	Permanent,	Permanent,	Permanent,	Permanent,				
Aesthetics	Negligible	Negligible to								
	Negligible	Minor	Minor	Minor	Minor	Minor				
Environmental		Temporary	Temporary,	Temporary	Temporary	Temporary				
lustice	No Effect	Minor	Negligible to	Minor	Minor	Minor				
Justice		IVIIIOI	Minor	WIIIO	WIIIO	WIIIO				
Noise and	No Effect	Temporary,	Temporary,	Temporary,	Temporary,	Temporary,				
Vibration	NULHELL	Minor	Minor	Minor	Minor	Minor				

Table 28: Scale of Final Array's Impacts to Socioeconomic Resources

EPAMT = Elizabeth – Port Authority Marine Terminal

PJPAMT= Port Jersey – Port Authority Marine Terminal

Other Social Effects (OSE): Other social effects include the effects that are not covered in the NED, RED, and EQ. This account includes things such as community impacts, health and safety, and displacement. In the future with-project condition, the Port of New York – New Jersey maintains its place amongst the lower cost and highest volume routes. The least cost access for import and export activities is a decision factor for businesses currently residing in the port's hinterlands and for businesses considering relocation to the port's hinterlands. For firms operating on thin margins such as light industry, transportation (transaction) cost plays an important role in the long-term decisions of a firm. Survey evidence suggests that stability of transportation costs and shipping time/customer proximity are two important factors in the

decisions of firms considering relocating to the United States (Tate, Ellram, Schoenherr, & Petersen, 2014). Should relative per-unit transportation costs of goods arriving to or being shipped from the Port of New York and New Jersey become sufficiently larger than other large ports, businesses considering relocation to the United States would thus be more likely to choose to relocate in the catchment area of other large ports, all else equal. Alternatives B through E support the region's ability to retain and attract business as it relates to transportation cost; however, Alternatives D, E, and F provide better support than the others because more terminals would benefit from the plans.

4.9: Comparison and Trade-off Analysis of the Focused Array of Alternative Plans

The study team considered how well each alternative performed relative to others as related to planning objectives, planning constraints, the Principles and Guidelines accounts, and the Principles and Guidelines criteria. Table 29 summarizes the relative performance relative to these selection criteria on a subjective scale of Low-Medium-High as they compare to each other.

Of the focused array of alternatives, Alternatives D, E, F meet the objectives of improving navigation efficiencies the most because they improve efficiencies to two different terminals. Alternative F would result in more navigation efficiencies because it deepens the two pathways the most. All the alternatives are successful at avoiding the study constraints.

Alternatives D, E, and F all contribute to the Principles and Guidelines Criteria and Accounts a high amount. They each contribute a high amount national economic development benefits, contribute to regional economic development, and will have benefits to other social effects and environmental quality. In the long term, deeper channels (i.e., Alternative F) will allow for vessels to load more efficiently and may result in a decrease in vessel calls, reducing airpollutant emissions.

		ALTERNATIVES									
	A- No Action	B- Deepen Pathway to EPAMT by 4'	C- Deepen Pathway to PJPAMT by 4'	D- Deepen Pathway to EPAMT by 4' and PJPAMT by 4'	E- Deepen Pathway to EPAMT by 4' and PJPAMT by 5'	F- Deepen Pathway to EPAMT by 5' and PJPAMT by 5'					
Objectives	Low	Medium	Medium	High	High	High					
Constraints	High	High	High	High	High	High					
Principles and Guidelines Accounts	Low	Medium	Medium	High	High	High					
Principles and Guidelines Criteria	Low	Medium	Medium	High	High	High					

Table 29: Ranking of Final Array of Alternatives in Relation to Each Other

The study team considered the costs, benefits, and trade-offs related to each alternative. In coordination with the non-federal sponsor, The Port Authority of New York and New Jersey, the study team agreed that the alternatives improving channels to two terminals (Alternatives D, E, and F) provide the most economic and social benefits, acceptably avoid significant impact to the environment and communities, and contribute the greatest to the Principles and Guidelines criteria and accounts. Therefore, Alternatives B and C were removed from further consideration.

While the previous analyses identified Alternative D – deepening the pathways to Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal by 4 feet (to a maintained depth of -54 feet MLLW¹³) as the national economic development plan because it reasonably maximizes net benefits, Alternative E – deepening the pathways to Elizabeth – Port Authority Marine Terminal by 4 feet (to a maintained depth of -54 feet MLLW) and Port Jersey – Port Authority Marine Terminal by 5 feet (to a maintained depth of -55 feet MLLW), and Alternative F – deepening the pathways to Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal by 5 feet (to a maintained depth of -55 feet MLLW), and Alternative F – deepening the pathways to Elizabeth – Port Authority Marine Terminal by 5 feet (to a maintained depth of -55 feet MLLW) also have considerable net benefits that are close to the net benefits provided by Alternative D. Due to this closeness, further refinement of quantities, cost calculation assumptions, and benefit calculation assumptions may affect the alternative that produces the most net benefits.

Therefore, the draft integrated report released in December 2020 presented the Tentatively Selected Plan as deepening the pathways to Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal by *up to* 5 feet (up to -55 feet MLLW), noting economic refinements would be made to confirm the national economic development plan.

4.10: Economic Optimization

Between the release of the draft integrated report and this final integrated report, the Deep Draft Navigation Planning Center of Expertise updated the economic analysis for the -54 feet MLLW plan and the -55 feet MLLW plan based on fleet trends at the Port of New York and New Jersey from 2019 through 2020 and additional input from The Port Authority of New York and New Jersey. A summary of these updates is presented below; additional detail can be found in Appendix C: Economics. Updates included:

- Refining the Post-Panamax Generation 3 Representative Fleet.
- Refining the Post-Panamax Generation 3 Sailing Draft Distribution.
- Refining the Post-Panamax Generation 4 Cargo Distribution.

Generally, the update leads to minor changes in total vessel calls. However, vessel call reductions increase for the -55 feet MLLW alternative by more than the -54 feet MLLW alternative. This results in a benefit increase across alternatives, and a higher benefit increase for the -55 feet MLLW alternative than the -54 feet MLLW alternative.

Table 30 presents the previous and updated benefit-cost summary for the NYNJHDCI feasibility study's -54 feet MLLW and -55 feet MLLW alternatives. As a result of the update, national

¹³ In the future with- and without-project conditions, Ambrose Channel is consistently maintained 3 feet deeper reflecting underkeel clearance allowances for wave action.

economic development benefits of the -54 feet MLLW alternative increased approximately 20 percent, and national economic development benefits of the -55 feet MLLW alternative increased 26 percent. Based on the update, the -55 feet MLLW alternative has 10 percent more net national economic development benefits than the -54 feet MLLW alternative. Therefore, deepening the pathways to Elizabeth - Port Authority Marine Terminal and Port Jersey - Port Authority Marine Terminal by 5 feet (to a maintained depth of -55 feet MLLW) is the national economic development plan. Appendix C includes sensitivity analysis testing the effects of alternative commodity and fleet growth scenarios. The analysis includes a no-growth scenario, low-growth scenario, and a breakeven analysis. In both the no-growth and low-growth scenarios, all alternatives remain economically justified and the -55-feet MLLW alternative maximizes net benefits. The breakeven analysis indicates relatively low risk of low commodity growth and fleet transition to project justification or plan selection. The 5-foot deepening plan is also the comprehensive benefits plan, in accordance with the Assistant Secretary of the Army for Civil Works policy directive dated 5 January 2021, because it contributes the most to the Principles and Guidelines accounts. Considering these factors, deepening the pathways to Elizabeth - Port Authority Marine Terminal and Port Jersey - Port Authority Marine Terminal by 5 feet (to a maintained depth of -55 feet MLLW) was selected as the Recommended Plan.

DEEPEN PATHWAYS TO ELIZABETH-POR									
	TERMINAL AND PORT								
	Y MARINE TERMINAL BY								
	4 FEET TO -54 FEET 5 FEET TO -55 FE								
	MLLW	MLLW							
Total AAEQ Costs	\$168,730,000	\$180,740,000							
Total AAEQ Benefits	\$394,690,000	\$429,360,000							
Total Net Benefits	\$225,960,000	\$248,620,000							

Table 30:	National	Economic Deve	elopment	Updates

Fiscal Year 2021 Price Level and Discount Rate of 2.5% AAEQ: Average Annual Equivalent

Chapter 5: Recommended Plan*

The Recommended Plan would deepen the pathways to Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal by 5 feet to a maintained depth of -55 feet MLLW. The Recommended Plan involves deepening Ambrose Channel, Anchorage Channel, the Kill Van Kull, Newark Bay Channel, South Elizabeth Channel, Elizabeth Channel, and Port Jersey Channel (Figure 18 and Figure 17). This Recommended Plan includes the additional width required for structural stability and for the navigation of the design vessel – with a length of 1,308.0 feet and beam of 193.5 feet – to transit from sea to Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal. Channel configurations were designed to avoid and minimize environmental and cultural resource impacts while still meeting navigation safety requirements. The Recommended Plan reflects the least cost dredged material placement plan, which includes beneficially using dredged material by placing it either upland, at the HARS, or on a reef.

The dimensions, characteristics, and dredged material composition for the Recommended Plan are displayed in Table 31 and Table 32. A discussion of the dredged material composition volume estimating methods used in this study can be found in Section 6.3 of the Channel Design Appendix (Appendix B1). Please note that the maintained depth, authorized channel level, and total (dredged) depth of the various channels may differ. The authorized channel level is used as it is defined in Engineer Regulation 1110-2-1613, and reflects the loaded summer saltwater draft of the design vessel together with gross underkeel clearance (including allowances for squat, salinity, wave motion, and safety clearance). Maintained depth is understood in relation to the authorized channel level. The maintained depth only differs from the authorized channel level in areas in which the channel bottom is composed of rock or otherwise hard material. In rockbottomed or hard-bottomed areas, an additional 2 feet of safety clearance is required. The total (dredged) depth of the channel is the sum of the authorized channel level and the dredging tolerance (paid overdepth). See Appendix B1 – Channel Design for more details on the design.

USACE is committed to beneficially using the dredged material that would be generated as a result of implementing the Recommended Plan. While this report assumes the least cost placement option for study purposes, the final placement decisions would be made during the Preconstruction Engineering and Design phase. The beneficial use placement locations will be determined based on the type of material (e.g. sand, silt, rock), volume needed at a particular project location, suitability of the material as established through testing and consistent with the Dredged Material Management Plan for the Port of New York and New Jersey Update, and in coordination with federal, state, and local stakeholders. All viable beneficial use placement location Engineering and Design. Additionally, USACE will develop a supplemental project-specific Dredged Material Management Plan during Preconstruction Engineering and Design to identify the full array of opportunities that coincide with the production of the dredged material. Additional information can be found in Appendix A13.



Figure 17: Recommended Plan – Inner Harbor



Figure 18: Recommended Plan – From Sea to Ports

Table 31: Recommended Plan – Dimensions and Characteristics										
	Proposed Maintained Channel Level ^a [ft MLLW]	Proposed Authorized Channel Level ^b [ft MLLW]	Total Depth ^c [ft MLLW]	Length of Improve- ment [ft]	Quantity to be Dredged (cy)	Channel Bottom Width	Predominant Side Slope	Predominant Channel Bottom Material Type		
Ambrose Channel	-58	-58	-59	90,000	6,389,000	2,000	3:1	Sand		
Anchorage Channel	-55	-55	-56.5	31,000	3,800,000	2,000	3:1	Sand		
Port Jersey Channel	-55	-57	-58.5	6,000	3,003,000	450 to 2,313	3:1/1:1 against berths	Sand/silt/silty clay		
Kill Van Kull	-55	-57	-58.5	28,000	4,451,000	800 to 2,313	3:1/1:1 through rock	HARS suitable material & moderately hard rock and till		
Newark Bay	-55	-57	-58.5	13,000	14,148,000	1,740 to 2,008	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately hard rock and till		
South Elizabeth Channel	-55	-57	-58.5	2,000	423,000	500 to 640	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately hard rock and till		
Port Elizabeth Channel	-55	-57	-58.5	8,000	1,024,000	500 to 750	3:1/1:1 through rock & against berths	Non-HARS suitable material & moderately hard rock and till		

^a Maintained channel level includes the summer salt water draft, squat, salinity, wave motion, and safety clearance. The channels will be maintained at this depth.

^b The authorized channel level includes additional safety clearance needed for hard bottom.

^c The total depth includes an additional dredging tolerance (paid over depth). This is the sum of the depths and specific to each plan.

Table 32: Recommended Plan – Quantities (Cubic Yards)

	Ambrose Channel	Anchorage Channel	Port Jersey Channel	Kill Van Kull	Newark Bay	S. Elizabeth Channel	Elizabeth Channel	TOTAL (cubic yards)
HARS suitable sand (HARS placement)	6,389,000	3,155,000	1,635,000	596,000	1,065,000			12,840,000
Non-HARS suitable sand/ sediment (upland placement)		645,000	1,368,000	87,000	5,215,000	169,000	842,000	8,326,000
Moderately Hard Rock/Till ^a (HARS placement)				2,402,000	5,614,000	176,000	138,000	8,330,000
"Harder" Rock ^b (HARS or reefplacement ^d)				819,000	11,000			830,000
"Hardest" Rock ^c (reef placement ^d)				547,000	2,242,000	78,000	43,000	2,910,000
Total Quantity to be Dredged	6,389,000	3,800,000	3,003,000	4,451,000	14,148,000	423,000	1,024,000	33,238,000

Values may appear off due to rounding.

^a Pleistocene silt, clay, sand, and gravel; ^b Schist, serpentenite; ^c Diabase, sandstone, and other rock; ^d material must meet reef manager and regulatory requirements

Dredging will be carried out by multiple kinds of water-based dredges and limited blasting. There is not expected to be considerable noise generated by the blasting itself, as the overlying water column deadens the sound. During the previous -50-foot Harbor Deepening Project, onland vibrations from blasting did not exceed background vibration levels. Drilling of the blasting holes, along with mechanical dredging, is more likely to generate discernible noise. For the Recommend Plan, it is anticipated that the construction phase within the Kill Van Kull will be seven years in duration which could temporally affect the overall quality of life to nearby affected communities. Extensive monitoring and protection measures will be required from the dredging companies contracted to implement this work. For example, multiple measures and best management practices were implemented during construction of the -50-foot Harbor Deepening Project. In addition to the measures taken on the -50-foot Harbor Deepening Project, the following measures, at a minimum, will be implemented. Specific measures to be implemented will be determined during Preconstruction Engineering and Design with continued coordination with local communities and stakeholder groups.

Further coordination will occur with the public and stakeholder groups during the Preconstruction Engineering and Design phase, when more details about the project become available, to further discuss appropriate measures and construction management measures to remediate unforeseen adverse impacts.

- Surveying structures, with owners' permission, before and after blasting to document damage or lack thereof
- Based on pre-construction surveys, vibration and noise limits will be set in the specifications and will address a variety of receptors including residential, historical, commercial, and industrial structures.
- Vibration monitoring performed by a blasting vibration specialist, to ensure levels are kept within regulatory and permit requirements
- Conducting a test blast program to start off each construction contract to demonstrate compliance, monitored for noise and vibration
- Developing an agreed-upon plan to either stabilize structures or develop relocation agreements for the properties affected during the blasting process
- Working with communities to ensure that structures do not suffer any negative consequences due to blasting
- Remediating any negative consequences to structures or property
- Having a community liaison in the area available during construction and work with residents and communities in close proximity to the construction zone to minimize any potential adverse effects and remediate the adverse effects that cannot be minimized

5.1: Refined Costs

The project first cost is used as the basis for providing the cost of the project for which authorization is sought. The project first cost includes the Preconstruction Engineering and Design costs; construction costs, including mitigation costs; lands, easements, rights-of-way, and relocations; and contingencies. A discussion of needed Preconstruction Engineering and Design tasks can be found in Section 9 of Appendix B, Channel Design Appendix. These tasks include the development of a supplemental project-specific Dredged Material Management Plan to identify the full array of opportunities that coincide with the production of the dredged material.

The associated costs represent the costs that are responsible to be borne by another federal agency and the costs that are not part of the federal project but are a necessary to realize benefits. For the Recommended Plan, the associated costs are estimated to be \$85.3 million, representing the cost for The Port Authority of New York and New Jersey to deepen the berths to realize the benefits of deeper channels. Aids to navigation are not anticipated to be significant; further coordination with the U.S. Coast Guard will occur during the Preconstruction Engineering and Design phase to determine the cost for aids to navigation. See Appendix B4 – Cost Engineering for more information on the analyses and assumptions.

The anticipated volume of maintenance dredging for each channel is calculated based on the estimated rate of sedimentation observed from past operation and maintenance of the harbor applied to any portions of the channel to be widened as part of this project. Consistent with current New York District practice, the Port Jersey channel is anticipated to be maintained by dredging every 10 years, the Anchorage Channel to be maintained every seven years, and all other channels are assumed to be maintained together in a single contract every three years. The anticipated incremental operation and maintenance costs are estimated to be \$3.5 million annually for the Recommended Plan.

The costs for the value of lands, easements, rights-of-way, and relocations are estimated to be \$1,315.1 million. In accordance with 33 U.S. Code § 2211, the relocations are cost shared with the utility owners. Accordingly, an estimated \$662.9 million of lands, easements, rights-of-way, and relocations is to be borne by the non-federal sponsor and an estimated \$652.1 million is to be borne by the utility owners. The lands, easements, rights-of-way, and relocation costs includes acquiring 0.17 acres in fee, 1.00 acre for temporary work easements, and 0.25 acres for a temporary road easement. It also includes the relocation of 12 utility lines (see section 8.2 and Appendix D – Real Estate Plan for additional information).

Total costs and average annual equivalent costs are presented in Table 33 and Table 34, respectively.

Table 33: Recommended Plan Total Costs					
	ACCOUNT				
01	LANDS AND DAMAGES	\$10.98 million			
02	RELOCATIONS ¹	\$1,304.1 million			
06	FISH & WILDLIFE FACILITIES	\$13.86 million			
12	NAVIGATION PORTS & HARBORS	\$3,489.68 million			
19	BUILDINGS, GROUNDS & UTILITIES	\$31.50 million			
30	PLANNING, ENGINEERING & DESIGN	\$532.31 million			
31	CONSTRUCTION MANAGEMENT	\$181.47 million			
Tot	al Project First Costs	\$5,563.90 million			
12	Navigation Aids ²	\$0.00 million			
12	Local Service Facilities ³	\$85.27 million			
	Interest During Construction ⁴	\$1,549.41 million			
Total Economic Cost \$7,198.58 million					
Fiscal Year 2022 Price Level and discount rate of 2.25%					
¹ In accordance with 33 U.S. Code § 2211, the relocations are cost shared with the					

¹ In accordance with 33 U.S. Code § 2211, the relocations are cost shared with the utility owners.

² Responsibility of another Federal Agency (i.e. U.S. Coast Guard)

³ Associated financial costs not part of the recommended Federal project but are necessary non-Federal responsibility

⁴ Represents the opportunity cost of capital incurred during the construction period. Calculated using the construction duration with contingency (24 years)

Note: Totals may appear off due to rounding

	RECOMMENDED PLAN		
AAEQ Investment Cost	\$241.28 million		
AAEQ Operation and Maintenance Cost	\$3.52 million		
Total AAEQ Costs	\$244.81 million		

Table 34: Average Annual Equivalent (AAEQ) Costs

Fiscal Year 2022 Price Level and discount rate of 2.25%

5.2: National Economic Development Benefits

The Recommended Plan of deepening the pathways to Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal 5 feet to a maintained depth of -55 feet MLLW would allow for currently-calling vessels to increase their loads and allow larger vessels to call at the Port of New York and New Jersey. The increase in cargo per vessel call yields economic benefits by allowing for more efficient use of containerships. Overall, the project will result in a decrease in the number of vessels calling on Port because the larger vessels can transport the cargo normally transported in numerous small vessels. Some ships will need fewer tugs because the widenings will increase maneuverability and make turns easier. Studies have shown that erosion is related more to speed than to the size of a vessel. There is a program in the harbor to reduce vessel speed, and so long as the vessels are complying with that program, there should be no increase in erosion.

The average annual equivalent benefits and the benefit-to-cost ratio for the Recommended Plan are presented in Table 35.

	RECOMMENDED PLAN
AAEQ Benefits	\$433.47 million
Total AAEQ Costs	\$244.81 million
AAEQ Net Benefits	\$188.67 million
Benefit Cost Ratio	1.8
Economically Justified?	Yes

Table 35: Average Annual Equivalent (AAEQ) Benefits

Fiscal Year 2022 Price Level and discount rate of 2.25%

Appendix C includes sensitivity analysis testing the effects of alternative commodity and fleet growth scenarios. The analysis includes a no-growth scenario, low-growth scenario, and a breakeven analysis. In both the no-growth and low-growth scenarios, the Recommended Plan remains economically justified and the -55-feet MLLW alternative maximizes net benefits. The breakeven analysis indicates relatively low risk of low commodity growth and fleet transition to project justification or plan selection.

5.3: Regional Economic Development Benefits

The expenditures associated with the proposed project are estimated to be \$5,563.9 million. Of this total expenditure, \$3,812.2 million will be captured within the local impact area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in the following tables. The regional economic effects are shown for the local, state, and national impact areas. In summary, the Civil Works expenditures \$5,563.9 million support a total of 51,589.0 full-time equivalent jobs, \$4,277.3 million in labor income, \$5,118.7 million in the gross regional product, and \$7,316.8 million in economic output in the local impact area. More broadly, these expenditures support 88,093.3 full-time equivalent jobs, \$6,313.8 million in labor income, \$8,488.63 million in the gross regional product, and \$14,409.8 million in economic output in the nation. Detailed analysis is included in Appendix C, Section 8.

5.4: Other Social Effects

5.4.1: Urban and Community Impacts

The Recommended Plan will have no substantial adverse impact on the real income, employment distribution, or population distribution and composition of the surrounding community. The Recommended Plan would help maintain the positive effect that port activity has on the metropolitan, State, and national economies by reducing transportation costs from inefficient delivery, delays, and congestion. The Recommended Plan would not be expected to have a deleterious effect on the fiscal condition of the Port. The Recommended Plan would not be expected to significantly impact any educational, cultural, or recreational opportunities as

discussed in Section 6.13. The Recommended Plan would not likely have any impacts on community cohesion factors such as diversity, ties, integrity of neighborhoods etc. Similarly, it would have no impact housing supply, community services etc. The nature of the Recommended Plan improvements is underwater modifications that will not affect any community aesthetics.

5.4.2: Economic Vitality

Economic vitality is another social effect that is influenced by the dynamics of the maritime industry. The investment in the New York and New Jersey Harbor supports the economic vitality of the region through the continued economic development and investment that has occurred in the communities that are economically tied to the harbor. Economic vitality relates to the ability of a community to retain and attract businesses, the availability to provide employment opportunities for residents, a person or group's standard of living, and the local tax base and coinciding ability to provide municipal services. Each of these components of economic vitality are supported through the New York – New Jersey Harbor Deepening Channel Improvements Recommended Plan. The Port of New York and New Jersey is expected to remain among the busiest ports in the nation and the first port of call for the largest vessels calling the East Coast.

In the future with-project condition, the Port of New York – New Jersey maintains its place amongst the lower cost and highest volume routes. The least cost access for import and export activities is a decision factor for businesses currently residing in the port's hinterlands and for businesses considering relocation to the port's hinterlands. For firms operating on thin margins such as light industry, transportation (transaction) cost plays an important role in the long-term decisions of a firm. Survey evidence suggests that stability of transportation costs and shipping time/customer proximity are two important factors in the decisions of firms considering relocating to the United States (Tate, Ellram, Schoenherr, & Petersen, 2014). Should relative perunit transportation costs of goods arriving to or being shipped from the Port of New York and New Jersey become sufficiently larger than other large ports, businesses considering relocation to the United States would thus be more likely to choose to relocate in the catchment area of other large ports, all else equal. The Recommended Plan therefore supports the region's ability to retain and attract business.

The Port of New York and New Jersey is a crucial driver for the availability of jobs in the region and a high standard of living afforded by these jobs. A study by the North Jersey Transportation Planning Authority reported that the Port of New York and New Jersey directly supports 229,000 workers and indirectly supports 171,000 jobs associated with the port (Cushman & Wakefield Research, 2018). The port is responsible for \$25.7 billion in personal income and \$64.8 billion in business income in the region. The Recommended Plan promotes the continued economic vitality in the availability of jobs and the high standard of living that is derived from this robust facet of industry. In the near-to-mid-term, the deepening of the federal navigation channels also supports jobs and regional economic development which in turn supports the economic vitality of the region. The Recommended Plan consists of a multibillion-dollar dredging project with a construction duration of several years. The resulting job security and secondary economic impacts also support the economic vitality of the region.

5.4.3: Life, Health, and Safety

The Recommended Plan will not likely affect risk of flood and other disaster risks, or efforts to reduce disease-carrying vectors and insects in the study area. It is unlikely to have impacts on safety risks to community populations and property on land. Previous deepening studies were not found to increase the risk of storm surge. Additional analyses will be conducted during the Preconstruction Engineering and Design phase. It will have no impacts on emergency services or medical treatment facilities. As discussed in Section 6.5: Water Resources and Water Quality and 6.16: Air Quality, the Recommended Plan is not likely to have significant long-term adverse effects on water or air quality.

5.4.4: Displacements or Long-Term Productivity

The Recommended Plan would not displace any people, businesses, or farms. The Recommended Plan would have no impacts to the productivity of landside resources such as agricultural land. However, the Recommended Plan would reduce transportation costs for shipping goods from the Port, which would enhance the productivity of industry users of the channel. This in turn could have positive indirect effects on the cost of consumer goods that pass through the Port.

Energy requirements and energy conservation. The Recommended Plan would have no adverse effect on broader energy consumption, conservation, or access to resources. These plans would have the positive effect of reducing transportation delays and ship calls, which would save vessel fuel consumption that would have otherwise occurred.

Emergency preparedness. The Recommended Plan would have a positive effect on protecting a major component of the National water transportation system: The Port of New York and New Jersey. The Recommended Plan would improve navigability in the Port. The risk reduction is difficult to quantify, but the improved navigability would be expected to reduce the risks where width constraints and turning geometries are contributing factors. The Recommended Plan has no effects on other emergency preparedness considerations such as water supplies, critical power supplies, reserve food production potential, conservation of scarce fuels, or dispersal of population and industry.

5.5: Environmental Operating Procedures

The Environmental Operating Principles are an essential component of USACE's risk management approach in decision making, allowing the organization to offset uncertainty by building flexibility into the management and construction of infrastructure. The Environmental Operating Principles are:

- Foster sustainability as a way of life throughout the organization
- Proactively consider environmental consequences of all USACE activities and act accordingly
- Create mutually supporting economic and environmentally sustainable solutions
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE, which may impact human and natural environments

- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs
- Leverage scientific, economic and social knowledge to understand the environmental context and effects of USACE's actions in a collaborative manner
- Employ an open, transparent process that respects views of individuals and groups interested in USACE activities

Plan selection considered these principles to ensure the sustainability and resiliency of the NED plan while considering the environmental consequences of implementation. In addition to construction best management practices to maintain water quality standards, other opportunities to implement sustainable measures that are cost effective and comply with USACE construction standards will be further evaluated during the Preconstruction Engineering and Design phase. If out-of-kind mitigation (e.g. vegetated wetlands) is warranted, planting plans will utilize native vegetation that support pollinator species, have a lower susceptibility to disease or pests, and are more adaptable to climate change. The study team considered avoiding and minimizing adverse impacts to existing environmental resources and cultural resources within the project area to the extent practicable during the plan formulation process. Where impacts to these resources are unavoidable, compensatory mitigation will be performed.

Continuous coordination with The Port Authority of New York and New Jersey, the states of New York and New Jersey, federal resource agencies, and the public occurred throughout the study to ensure an open and transparent process that respects views of individuals and groups. The project will be constructed in compliance with all applicable environmental laws and regulations.

Chapter 6: Environmental Consequences*

This chapter describes the existing and projected future conditions for each of the resources that reasonably could be expected to be impacted by the project and its Area of Potential Effect. Existing and projected future condition descriptions include physical, chemical, biological, and sociological conditions. These conditions are described without implementation of the alternative actions and with implementation of the alternative actions, including implementing best management practices. The comparison of without-project (which assumes no dredging activity and continued navigation use as at present) and with-project conditions defines the impacts of the alternatives. Table 36 provides a summary of the impacts for the resources that could be potentially affected by implementation of the Recommended Plan and the No Action alternative, which serves as a baseline for assessing the impacts of the Recommended Plan.

PESOLIPCE	NO ACTION ALTERNATIVE/FUTURE	ACTION PROJECT	
RESOURCE	WITHOUT-PROJECT ALTERNATIVE	ALTERNATIVE	
Topography and Bathymetry	Permanent, Negligible to Minor	Permanent, Minor	
Environmental Justice	No Effect	Temporary, Minor	
Geology and Soils	No Effect	No Effect	
Water Resources and Water Quality	Temporary, Negligible to Minor	Temporary, Minor	
Vegetation, Wetlands, and Submerged Aquatic Vegetation and unvegetated littoral habitat	Temporary, Negligible to Minor	Permanent, Minor	
Essential Fish Habitat	Temporary, Negligible to Minor	Permanent, Minor	
Wildlife	Temporary, Negligible to Minor	Temporary to Permanent, Minor	
Benthic Fauna	Temporary, Minor	Temporary, Minor	
Special Status Species	Temporary, No Effect to Minor	Pending	
Floodplains Cultural Resources	No Effect No Effect	No Effect Permanent, Minor	
Recreation	Temporary, Negligible	Temporary, Negligible to Minor	
Aesthetics and Scenic Resources	Permanent, Negligible	Permanent, Negligible to Minor	
Hazardous, Toxic, and Radioactive Wastes	No Effect	Temporary, Negligible	
Air Quality	No Effect	No Effect	
Noise and Vibration	No Effect	Temporary, Minor	

Table 36: Summary of Impacts

6.1: Topography and Bathymetry

6.1.1: No Action/Future Without-Project Alternative

Existing maintenance dredging operations, dredged material placement/disposal, and navigation

within the Action Area would continue. The existing sediment within the dredging footprint in the channel would continue to be removed as needed. Continued maintenance of the channel system should have no effect on seismicity because the Action Area is not within a seismically-active geologic setting.

New York and New Jersey Port growth is anticipated to increase throughout the next 50 years, with increasing TEUs over time, though fewer vessels may call due to increasing average container vessel size. Also, additional development may occur in the future, though the New York City Greater Metropolitan Area is almost entirely built out and redevelopment is more likely. None of these activities are expected to significantly alter the topography in the project Action Area, and therefore would have no effect.

Climatic changes, such as sea level rise, and are predicted to continue in the future, and have the potential to cause changes in the nature and character of the estuarine ecosystem in the Action Area (NYSDEC, 2017). Erosion and loss of estuarine and ocean beaches is anticipated to occur with sea level rise. Over the course of time, more landforms may become submerged, and other areas may become lower-lying and flood more frequently, particularly within the coastal physiographic province in which this project is located. This could alter local topography and bathymetry significantly unless actions are taken to prevent alterations to current elevations and landforms. Effects to the bathymetry and topography from implementation of the No Action/Future Without-Project Alternative are predicted to be negligible to minor and permanent. The proposed action will not influence the chance of flooding in the local floodplain. No effect on local floodplains due to project implementation is expected, and impacts to floodplains, as defined in Executive Order 11988, are dismissed from further consideration.

6.1.2: Action Project Alternative

The proposed dredging will alter the bathymetry within and adjacent to the navigation channels resulting in deeper and wider channels. Potential impacts related to channel side-slope failure include damage to structures located near the top of the slope and more frequent maintenance dredging if shoaling is produced by failure of side-slopes. A channel side-slope stability analysis will need to be performed to identify structures which may be impacted by extending the channel side-slopes laterally.

It is not anticipated that the future with-project condition would increase erosion. Studies have shown that erosion is primarily caused by the wake of a vessel. Specifically, wake related to a vessel's speed than its size. Larger ships tend to move slower and create less wake than the smaller, faster moving vessels. Ultra large container vessels have restrictions on speed to limit the wake they produce. Additionally, a deeper channel is likely to result in a decrease in the number of vessels calling at the port as compared to the future without-project condition since the larger vessels can transport the cargo normally transported in numerous small vessels. Additional analyses will be conducted during Preconstruction Engineering and Design to ensure proper mitigation measures, if any, are properly implemented as a project cost.

The Action Project Alternative is anticipated to have minor permanent effects to topography and bathymetry.

6.2: Socioeconomics

6.2.1: No Action/Future Without-Project Alternative

Under the No Action/Future Without-Project Alternative, socioeconomic conditions are expected to continue to follow local and national trends. No effect is expected to socioeconomic conditions.

6.2.2: Action Project Alternative

The proposed action is not expected to adversely impact the socioeconomic environment. Regional economic development analysis was performed by USACE (see Section 8.2 of Appendix C – Economics) for the proposed project. This analysis found that the proposed project would support approximately 88,000 jobs over the construction period, 6,313.8 million in labor income, and 14,409.8 in economic output in the nation.

6.3: Environmental Justice

6.3.1: No Action/Future Without-Project Alternative

Executive Order 12898 directs Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. Under the No Action/Future Without-Project Alternative, maintenance dredging will continue. No effect is expected to environmental justice communities.

6.3.2: Action Project Alternative

Consistent with Executive Order 12898, an evaluation of the population in the vicinity of the New York and New Jersey Harbor was conducted to determine the potential for the project to adversely affect minority and low-income populations. This analysis followed the guidance and methodologies recommended in the Council on Environmental Quality (CEQ)'s *Environmental Justice Guidance under the National Environmental Policy Act* (CEQ, 1997), and involved the following five steps:

- 1. Identify the area (i.e. Study Area) where adverse effects may be caused;
- 2. Compile population and economic data for the Study Area and identify potential environmental justice areas (i.e. minority or low-income communities);
- 3. Identify potential adverse effects of the Recommended Plan on environmental justice areas;
- 4. Evaluate the potential adverse effects of the Recommended Plan on environmental justice areas relative to their overall effects, in order to determine if the effects on environmental justice areas would be disproportionate;
- 5. If environmental justice communities are found to be disproportionately highly and adversely affected, develops steps to avoid, minimize or offset those impacts.

Since all dredging activities will take place in or adjacent to existing navigation channels, no primary direct impacts related to environmental justice issues will occur in landside residential

areas. In order to identify landside areas that may experience secondary direct project impacts, such as odor or noise, a one mile "buffer area" was delineated around all deepening and/or widening areas with the use of Geographic Information System (GIS) software. The one-mile buffer area was selected for this study for consistency with the original Harbor Deepening Project environmental justice analysis. Census tracts with any portion of their area falling within this buffer were then evaluated for minority and low-income populations. The buffer area consists of sections of Union, Essex, and Hudson Counties in New Jersey, and sections of Richmond and Kings Counties in New York, and includes residences, businesses, and other resources that have the potential to be impacted by this project.

Census block groups are adjudicated based on criteria defined by the New York State Department of Environmental Conservation, in the Commissioner Policy 29 (NYSDEC, 2003). A census block group is considered to be an environmental justice community if it meets the NYSDEC threshold for a low-income community and/or a minority population. Specifically, for the purposes of this analysis, a low-income community is defined as "a census block group, or contiguous area with multiple census block groups, having a low-income population equal to or greater than 23.59% of the total population." A minority population is defined as "a census block group, or contiguous area with multiple census block groups, having a minority population equal to or greater than 51.1%...."

Based on the 2016 American Community Survey (US Census Bureau, 2016a and 2016b), within the one mile buffer of all measures there are 190 census block groups. Of these 190 census block groups, 87 census block groups (or 45.7% of the total census block groups) meet the NYSDEC criteria outlined above to be considered an environmental justice community (Figure 19). See Table 37 for a breakdown of census block groups by county. This includes two environmental justice communities along the Kill van Kull, with especially close proximity to the project: the North Shore of the borough of Staten Island (identified as one of ten Environmental Justice Showcase Communities by USEPA) New York City and the city of Bayonne in New Jersey. (The North Shore of Staten Island is a showcase environmental justice community because of the increased number of children with elevated lead levels in their blood due to residual contamination from the area's former industrial uses. The Recommended Plan will not construct or implement any feature containing lead-based paint and excavated lead contaminated soil.)

Based on a review of the likely potential impacts of the project, the analysis concludes that minority and low-income populations would not bear a disproportionately high and significant adverse share of operation or construction impacts as a result of the project. While some localized adverse effects would occur in the study area during the construction phase of the project, these effects would be temporary and would end once construction is complete. The environmental categories of concern that could potentially result in an adverse effect were considered for additional analysis, in order to determine if these categories had the potential to affect environmental justice communities, and to what degree (i.e. to a disproportionately high and significantly adverse level). Furthermore, based on comments received during the public comment period, particular care was given to topics of community concern, which included potential blasting, noise, vibration, flooding, and erosion.

This analysis found that the category of noise and vibration, due to dredging within the Kill Van Kull and limited drilling and blasting (not 24/7) (estimated to be approximately seven years in

duration), may result in temporary localized adverse effects, and may also disproportionately affect the adjacent environmental justice communities. There is not expected to be considerable noise generated by the blasting itself, as the overlying water column deadens the sound. During the previous 50-foot Harbor Deepening Project, on-land vibrations from blasting did not exceed background vibration levels. Drilling of the blasting holes, along with mechanical dredging, is more likely to generate discernible noise. During the initial construction, the North Shore Community of Staten Island was concerned about blasting and harbor dredging impacts within the Kill Van Kull portion of the project on their community's quality of life. As was undertaken during the initial Harbor Deepening Project's construction, extensive monitoring and protection measures will be required from the dredging companies contracted to implement this work. Also, following the protocol established during the initial construction, coordination will occur with the public and stakeholder groups during the Preconstruction Engineering and Design phase, when more details about the project become available, to further discuss appropriate measures. In order to avoid and minimize these potentially disproportionate adverse effects, a number of best management practices (successfully implemented during the construction of the original Harbor Deepening Project) will be employed, to include at a minimum:

- Surveying structures, with owners' permission, before and after blasting to document damage or lack thereof
- Setting noise and vibration limits in the specifications based on pre-construction surveys, taking into consideration multiple structure types including, but not limited to, residential, commercial, industrial, and historical
- Vibration monitoring, performed by a blasting vibration specialist, to ensure levels are kept within regulatory and permit requirements
- Conducting a test blast program to start off each construction contract to demonstrate compliance, monitored for noise and vibration
- Blasting will occur between the hours of 0700 (7 a.m) and 1900 (7 p.m), and not occur on Sundays
- Developing an agreed-upon plan to either stabilize structures or develop relocation agreements for the properties affected during the blasting process
- Working with communities to ensure that structures do not suffer any negative consequences due to blasting
- Remediating any negative consequences to structures or property
- Having a community liaison in the area available during construction and work with residents and communities in close proximity to the construction zone to minimize any potential adverse effects and remediate the adverse effects that cannot be minimized

If unforeseen impacts to the north shore community of Staten Island and/or across the Kill van Kull on the shoreline community of Bayonne, related to the construction emerge, the appropriate adaptive measures will be coordinated with the affected stakeholders and implemented.



Figure 19: Environmental Justice Analysis

Action Alternative in dark blue, 1-mile buffer in light blue. Environmental Justice community Census Block Groups in red, non-Environmental Justice community census block groups in yellow.

Table 57. Dreakdown of census block Groups by county								
COUNTY	UNION	ESSEX	HUDSON	RICHMOND	KINGS	TOTAL		
Environmental Justice census block groups	2	1	19	58	7	87		
Total census block groups	3	2	44	86	55	190		

Table 37: Breakdown of Census Block Groups by County

6.4: Geology and Soils

6.4.1: No Action/Future Without-Project Alternative

Existing maintenance dredging operations, dredged material placement/disposal, and navigation within the Action Area would continue. The existing sediment within the dredging footprint in the channel would continue to be removed as needed.

New York and New Jersey Port growth is anticipated to increase throughout the next 50 years, with increasing TEUs over time, though fewer vessels may call due to increasing average container vessel size. Also, additional development may occur in the future, though the New York City Greater Metropolitan Area is almost entirely built out and redevelopment is more likely. None of these activities are expected to significantly alter the geology in the project Action Area. No effect.

6.4.2: Action Project Alternative

No adverse impacts on the geology of the project area are expected. Although deepening of the channels may affect the rate of sediment accumulation and scour, none of this is expected to affect existing geology. No economically important or significant mineral deposits have been mapped in the area to be deepened. In addition, no effects are expected on existing faults or shear zones.

6.5: Water Resources and Water Quality

6.5.1: No Action/Future Without-Project Alternative

Temporary and negligible to minor adverse impacts to water quality that result from current maintenance operations that include increased Total Suspended Solids, turbidity, and nutrient levels would continue at dredging sites. Overall impacts to water quality with current operations are temporary, adverse and negligible to minor.

All maintenance dredging activity within the boundaries of present navigation channels would comply with current Water Quality Permits for the New York and New Jersey Harbor system of connected channels. Sediments will be tested in accordance with the Evaluation of Dredged Material for Discharge in Waters of the U.S.-Testing Manual (USEPA, 1998) and the USACE Manual, Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing Manual (USACE, 2003) as well as State sampling requirements of the NJDEP, Appendix G of the Coastal Zone Management Regulations, N.J.A.C. 7:7, Department's Dredging Technical Manual and additionally, the NJDEP and NYDEC coordinated sediment sampling and analysis plan protocols for dredging and dredge material placement in New York and New Jersey, as previously utilized for sampling of USACE maintenance dredging projects and the Harbor Deepening Project, prior to commencement of dredging to ensure appropriate placement/disposal of dredged material. The dredging operations would result in temporary, adverse impacts to water quality that are negligible to minor.

Continued development, shipping and other navigation operations, and stormwater discharges will continue to negatively impact water quality within the Action Area and adjacent areas. The Port of New York and New Jersey's growth is anticipated to increase throughout the next 50 years, which may increase the number of vessels transiting New York Harbor. However, the trend towards vessels with increasing TEU capacity is likely to continue, which would mean fewer, but larger vessels calling at the port with an overall increase in TEUs over time.

Climatic changes, such as ocean acidification, are predicted to continue, and have the potential to cause changes in the nature and character of the estuarine ecosystem in the Action Area

(NYSDEC, 2017). The pH within surface waters will likely drop as ocean acidification occurs. Higher temperatures, lower dissolved oxygen levels, and increased phytoplankton productivity may result in alterations to the local ecosystem. Rising seas, due to climate change, may increase salinity as the amount of saltwater relative to freshwater input is altered.

6.5.2: Action Project Alternative

Implementation of the Action Alternative may result in a temporary increase in Total Suspended Solids and turbidity in the dredging footprint and adjacent areas. There may be a slight, temporary increase in the level of dissolved nutrients (N and P) in the water column as well following dredging activities as nutrients in sediment are released by dredging. These adverse water quality impacts would be temporary in nature and are anticipated to result in minor levels of impact, primarily in the sediment plume, which should quickly settle due to the predominant sand sediments to be dredged.

Increased depths from dredging in estuarine environments also has the potential to alter salinity levels within the dredging footprint and can also potentially result in changes in Dissolved Oxygen levels. These changes in salinity and decreases in dissolved oxygen, and flushing rates are anticipated to cause permanent, minor impacts to water quality that are, based on prior water quality modeling for the original Harbor Deepening Project, negligible and not significant in nature. The proposed dredging will alter the bathymetry in and adjacent to the navigation channels and may also potentially increase the tidal prism in the area of the channel. No significant adverse impacts to water quality were found for the 50-foot channel deepening, and similarly, none are expected for the channel improvements. However, further hydrodynamic modelling, including water quality parameters, will be required.

Groundwater flow through bedrock is also unlikely to be affected. Blasting will likely widen fractures in exposed bedrock, but this widening will be limited to the navigation channel and will not produce significant effects on groundwater.

Possible effects of removal of the sediment blanket over potential artesian aquifers should be investigated, as geologic data become available from USACE. No continuous water-bearing, unconsolidated formations are expected to be disturbed or exposed as a result of channel deepening. Although the Magothy and Raritan Formations are important aquifers in the project area, preliminary information indicates that they are overlain by a considerable thickness of Pleistocene and Recent sediments. This finding should be confirmed when preliminary project plans and geologic maps (based on sediment borings) are finalized. Anticipated depths of current mining of sand from the Ambrose Channel should be considered when evaluating the depth of cover over the Magothy Formation.

6.6: Vegetation, Wetlands, and Submerged Aquatic Vegetation

6.6.1: No Action/Future Without-Project Alternative

Existing maintenance dredging operations and navigation within the Action Area would continue. These operations can cause minor turbidity, siltation, and boat wakes within the Action Area. However, there is no submerged aquatic vegetation in the Action Area.

Climatic changes, such as sea level rise and increasing temperatures, are predicted to continue in the future, potential to cause changes in the nature and character of the estuarine ecosystem in the Action Area (NYSDEC, 2017). In general, wetlands both inside and outside of Action Area as well as submerged aquatic vegetation are at increased risk of damage and loss from potential increases in sea level rise and salinity shifts. The locations of these resources may shift in response to climate change and the ensuing sea level rise. Wetlands may erode further or be at increased risk of becoming too inundated to support vegetation. As a result, they may transition into mudflats and/or subaqueous bottom. Alternatively, sea level rise may cause estuarine wetlands to retreat inland, by converting existing uplands to wetlands. In addition, higher salinity levels in waterways in combination with increased sea level may result in inundation of freshwater wetlands further upstream in the Hudson River and other waterways connecting to New York Harbor, or conversion to estuarine wetlands due to salinity shifts.

The Action Area itself is already a highly developed city and port with substantial navigation and shipping operations, with few wetland areas and modest vegetative cover. Therefore, continuing maintenance dredging operations would not likely cause substantial shifts to these community types in future conditions.

6.6.2: Action Project Alternative

The study area encompasses subtidal habitats of varying depths, ranging from shallow subtidal shoals to deeper channel habitats. The navigation channel provides deeper open-water and deepwater benthic habitats. Similar to the No Action/Future Without Project Alternative, there would be no impacts to submerged aquatic vegetation with implementation of the Action Alternative. Within New York State the regulated habitat includes the littoral zone (defined as extending seaward from shore to a depth of six feet at mean low water), which has no impacts. In New Jersey, the regulated habitat includes intertidal and subtidal shallows (defined as extending seaward to a depth of four feet below mean low water). The proposed project will convert approximately 0.53 acres of subtidal shallows, regulated by the State of New Jersey, to deep water habitat. Compensatory mitigation is planned for these impacts.



Figure 20: Regulated Habitat Impacts

Channel bottom to be deepened in blue, side slopes in light blue, and widenings in grey. Littoral habitat (6 feet MLLW or shallower) shown in tan. New Jersey-regulated subtidal shallows (4 feet MLLW or shallower) potentially impacted (approximately 0.53 acres) in red. There are no potential impacts to New York-regulated littoral habitat (defined as 6 feet MLLW or shallower).

6.7: Essential Fish Habitat

6.7.1: No Action/Future Without-Project Alternative

Existing maintenance dredging operations and navigation within the Action Area would continue. Current dredging and navigation operations that may affect egg, larval, juvenile, and adult life stages of fishes within the Action Area include direct removal or burial, turbidity/siltation effects, temporary shifts in dissolved oxygen during dredging operations, entrainment, visual and noise disturbances, and alteration of habitat. The impacts to essential fish habitat would be negligible to minor and temporary.

As a result of climate change, global temperatures and sea level are expected to rise in the foreseeable future. Predicted climate change impacts such as increased ocean temperatures, ocean acidification, sea level rise, and changes in currents, upwelling, and weather patterns all

have the potential to affect the nature and character of the estuarine and coastal ecosystem in the Action Area.

Sea level rise may result in an increase in salinity in upstream areas that could affect breeding sites and survival of early life stages (eggs, larvae, and young of the year). There could be shifts in breeding habitat availability and timing, and the effects of this change on fish populations could be detrimental although relatively uncertain at this time. The shifts in salinity, temperature, and sea level rise all have the potential to result in shifts in prey species availability, which could also cause detrimental effects to fish resources and habitats. These impacts related to climate change, mainly warming waters, are being observed about species range and distribution (Nye et al., 2009; Rose, 2005).

6.7.2: Action Project Alternative

Based on the 2017 and previous contract-specific Harbor Deepening Project Conservation Recommendations, potential impacts from the proposed Federal action of deepening and widening existing deep-water channels currently comprising the NYNJHDCI could include:

- Physical disturbance and re-suspended sediments/re-deposition of suspended sediments (short-term direct and indirect impacts including potential burial and/or release of contaminants)
- Entrainment of early life stages (eggs and larvae) as a form of short-term direct impact due primarily due to hydraulic dredging and capture of eggs and possibly larvae in the dredge
- Loss of essential fish habitat function as a long-term indirect impact due to increased sedimentation and/or changes in depths, currents, substrate types, and/or in-water structures that reduce or eliminate the suitability of habitat for essential fish habitat-managed species.

For specific species assessments, please see Appendix A4 – Essential Fish Habitat.

6.8: Wildlife

6.8.1: No Action/Future Without-Project Alternative

Fish

Existing maintenance dredging operations and navigation within the Action Area would continue. Current dredging and navigation operations that may affect egg, larval, juvenile, and adult life stages of fishes within the Action Area include direct removal or burial, turbidity/siltation effects, temporary shifts in dissolved oxygen during dredging operations, entrainment, visual and noise disturbances, and alteration of habitat. The impacts to fish resources would be negligible to minor and temporary.

As a result of climate change, global temperatures and sea level are expected to rise in the foreseeable future. Predicted climate change impacts such as increased ocean temperatures, ocean acidification, sea level rise, and changes in currents, upwelling, and weather patterns all

have the potential to affect the nature and character of the estuarine and coastal ecosystem in the Action Area.

Sea level rise may result in an increase in salinity in upstream areas that could affect breeding sites and survival of early life stages (eggs, larvae, and young of the year). There could be shifts in breeding habitat availability and timing, and the effects of this change on fish populations could be detrimental although relatively uncertain at this time. The shifts in salinity, temperature, and sea level rise all have the potential to result in shifts in prey species availability, which could also cause detrimental effects to fish resources and habitats. These impacts related to climate change, mainly warming waters, are being observed about species range and distribution (Nye et al., 2009; Rose, 2005).

Birds

Existing maintenance dredging operations, and navigation within the Action Area would continue. Operation of vessels and dredging equipment may flush wildlife, such as waterfowl or other birds foraging or resting in the open waters of the project Action Area out of the area. The increased Total Suspended Solids and turbidity resulting from dredging operations may temporarily disrupt foraging abilities for some wildlife. This results in temporary, negligible to minor, adverse impacts to wildlife.

6.8.2: Action Project Alternative

Fish

Potential impacts to fish and fish habitat from the Action Alternative, the Gravesend Hybrid Plan, result from dredging vessels transiting to dredging locations, and dredging. Offshore disposal of dredged material at HARS and any impact it may have has already been addressed in prior NEPA documents (USEPA, 1997). Decreases in light penetration in the water column can result in behavioral responses from fishes due to the disturbance effect and also potentially limit visibility. Increased depths from dredging in estuarine environments also has the potential to alter salinity levels within the dredging footprint and can also potentially result in changes in Dissolved Oxygen levels.

Prior water quality modeling, as noted in the water quality section of this NEPA document, indicated no significant changes to salinity or dissolved oxygen from the 50-foot deepening of the harbor, and, therefore, we expect no significant impacts to fish due to changes in salinity or dissolved oxygen due to the dredging, either during or post-dredging. Dredging has the potential to release nutrients and/or contaminants from sediments, which can impact fishes, prey, and habitat. Based on observation, there are impacts to individual fish in the vicinity of the blast, which are brought up to the surface/stunned and often eaten by opportunistic birds overhead. Impacts are not significant to the larger fish community, however, and instead they are temporary, spatially limited, and focused on the individuals in the vicinity of the blast at the time that it occurs.

Historical investigations have been conducted between at least 1990 and 2016 to assess concentrations of contaminants in the Lower Passaic River into Newark Bay (U.S. Fish and Wildlife Service et al 2020). Sampling analysis included several contaminants of concern, including dioxins, PCBs, pesticides, polycyclic aromatic hydrocarbons and mercury. A Damages Report prepared by the U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration and published in January 2020 reviews the ecological impact to the estuary and aquatic species. While the Damages Report specifically discusses the damages associated with the Diamond Alkali Superfund Site, the report found that these contaminants of concern are present in the sediments of the Lower Passaic River and Newark Bay and additionally, are also present within many species of fish and bird tissues tested (USFWS and NOAA, 2020). Currently Newark Bay is undergoing remedial investigation under the oversight of the USEPA to further assess the extent and presence of contaminants of concern and it is likely that remedial actions will occur sometime in the future. Dredging actions occur within the existing navigation channels and are expected to continue for the next 50 years. While current dredging operations, as well as the proposed deepening dredge operations, temporarily resuspend sediments, the material is tested under dredged material placement criteria, removing associated sediment from Newark Bay to an appropriate placement facility. Placement criteria sampling analysis for the proposed deepening will take place during the Preconstruction Engineering and Design phase.

Fishes can also be impacted by potential strikes from dredging vessels/equipment. Fish may be impacted by noise disturbances which may cause species to flee the area of impact or potentially alter other behaviors, including foraging success. Fishes and their habitat could potentially be impacted by releases of munitions, explosives of concern or unexploded ordnance during construction operations. There has been concern in the past regarding the occurrence of munitions, explosives of concern or unexploded ordnance in that, historically, chances for an encounter increases as the further south towards Raritan Bay and southward along the New Jersey coastline dredging occurs. Due to its location in a heavily urban area and based on current dredging operations, we do not expect any munitions, explosives of concern or unexploded ordnance in the dredging footprint.

The temporary increase in Total Suspended Solids and turbidity in the water column at the dredging site has the potential to directly impact fishes and fish habitat. The impacts to fish species from Total Suspended Solids and turbidity are directly related to: the species tolerance, exposure rate, duration of the exposure, and life stage. Deposition of suspended sediments may induce impacts to fish eggs and larvae through deposition, abrasion, and or smothering, especially in the dredging and disposal areas (Wilbur and Clarke, 2001). However, in species, such as the white perch, the deposition of particulate matter on eggs does not demonstrate any adverse effects. White perch eggs can tolerate concentrations of 500 mg/L of particulate matter without any adverse effects. Winter flounder, a local species which lays demersal eggs, as well as Atlantic sturgeon, are essential fish habitat species and will be addressed in detail within the essential fish habitat assessment attached to this document.

Increases in Total Suspended Solids and turbidity can impact prey species' predator avoidance response due to visual impairments caused by decreased water clarity (Gregory and Northcote, 1993; Wilbur and Clarke, 2001). Turbid waters can also visually impair predator species that rely on sight to forage. Increased Total Suspended Solids and turbidity alters the ability for light to penetrate the water column; this impairs both physical and biological processes in the affected area (Johnston, 1981; Wilbur and Clarke, 2001). Increased turbidity can impact primary productivity and respiration of organisms within the project area.

The behavioral response of estuarine fish species to Total Suspended Solids and turbidity has

been documented in a number of studies; it has been found that the suspension of fine particles hinders gas exchange with the water by coating the respiratory epithelia of juvenile and adult fish (Wilbur and Clarke, 2000). The larger suspended particles can be trapped in the gill filaments and fill the opercular cavity, which may lead to asphyxiation by prohibiting the passage of water through the gills (Johnston 1981; Wilbur and Clarke, 2000). Even so, increased sediment loading in the water column is predicted to be temporary and small in scale relative to the surface acreage and volume of local Action Area waters, with the effects subsiding within hours of ceasing operations with a return to normal within a day or two at most, as the majority of the material to be dredged settles quickly. Another behavioral response may be for fish and/or prey species to move away from the disturbance and visual effects. It is anticipated that demersal species, especially those that could be foraging in the project area, such as flounder, red and silver hake, and other demersal fish will be most affected and leave the immediate dredging footprint.

While dredging operations could temporarily increase Total Suspended Solids and turbidity, these impacts will be minor when compared to background levels. The flushing rate (due to the water exchange and tidal fluctuations) within the Action Area will minimize potential Total Suspended Solids/turbidity plumes and cause them to disperse quickly, minimizing long term impacts to water quality. The extent and duration of turbidity plumes is dependent on factors such as dredge type, sediment composition, and hydrologic and environmental conditions in the Action Area. The Action Area is largely composed of coarse to silty sand, with some rock. Sediments with larger grain sizes tend to settle out of the water column at a faster rate than fine sediments, so it is predicted that turbidity plumes predominately composed of sands will settle faster than those with fine grained, muddy benthic sediments. The faster settling rate of suspended sands in the water column generally results in turbidity plumes of lesser extents than plumes composed of fine grained sediments; the water column also returns to pre-dredging conditions faster, thus minimizing adverse impacts to sensitive egg and larval life stages, although this is dependent on the hydrological and environmental conditions at the time of dredging and/or placement activities.

Direct removal of benthic substrate by dredging may impact fish habitat by removing important prey species (i.e. benthic organisms), food species (i.e. macroalgae), or by alteration of nursery and/or spawning areas. Recolonization of the newly exposed substrate after dredging is not only a function of site-specific characteristics (i.e. bathymetry, tidal energy), but also of substrate requirements of the larvae of re-colonizing species (Rhoads and Germano, 1982). Any deviation from the existing benthic floor changes the habitat complexion for smaller species that utilize the area for foraging and living space. Additionally, some demersal species require specific substrates for foraging and spawning. Therefore, dredging and dredged material placement/disposal will likely result in the temporary loss of some fish habitat, including foraging grounds.

Entrainment is defined as the direct uptake of aquatic organisms by the suction field generated at the suction intake of a hopper dredge or capture by a mechanical dredge. The entrainment of fishes during dredging operations can lead to direct injury and/or death to the entrained fishes. During dredging, a possible impact to fish species is the entrainment of eggs, larvae, juveniles, and adult life stages. Life stages with limited or no swimming ability, especially eggs and larvae,

have a higher potential to be entrained.

Egg, larvae, and juvenile entrainment is possible depending on the location and time or year that dredging occurs. Typically, major concerns of juvenile entrainment relate to fish below 200 mm (Hoover et al., 2005; Boysen and Hoover, 2009). Burton et al. (1992) used modeling software to predict the rate of entrainment of striped bass (*Morone saxatilis*), herring (*Alosa* spp.), and white perch (*Morone americana*) larvae. This simulation involved the continuous use of four hydraulic dredges to determine a conservative estimate of mortality and entrainment. Despite the large amount of material being dredged in this simulation, the authors concluded that less than one percent of the total larval fish population would be lost. Therefore, we expect the impacts to fish to be minor, adverse but not significant.

Juveniles and adults can also be entrained by dredge operations. One factor influencing potential entrainment for larger fish is based on the swimming stamina and size of the individual fish at risk (Boysen and Hoover, 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger finfish is unlikely due to the increased swimming performance. In a separate study on juveniles and adults involving 15 species of commercial and sport fish, entrainment rates varied from 0.001 to 0.135 fish per cubic yard for both cutterhead and hopper dredging operations. Out of the entrained fish, approximately 37.6 percent of the fish were mortally entrained. Over a four-year period, Larson and Moehl (1990) observed entrainment rates ranging from less than 0.001 to 0.341 fish entrained per cubic yard of material dredged, distributed among fourteen species of fish. As expected, the majority of the fish entrained during this study were demersal species. Entrainment and mortality rates are anticipated to range from negligible to minor for all fish species, especially when fish mortality is compared to the amount of material dredged and duration anticipated.

Due to the open-water environment of the New York and New Jersey Harbor and the vast width of the Federal channels, the likelihood of vessel strikes to managed fish species and their prey is possible, but is not likely as it is not anticipated to be a substantial threat due to the limited amount of time the dredging vessels/equipment will be operating and the ability of motile fishes to move away from potential dredging impacts. Eggs, larvae, and species with limited swimming ability would be at highest risk of strike impacts. Effects to managed fish species and their prey from dredging vessel equipment/strikes is anticipated to range from negligible to minor and be temporary in duration and not significant. Minor impacts due to noise on local fish populations are expected from dredging (USACE, 2012b) and blasting (USACE, 2004b).

Underwater blasting may result in temporary displacement, injury, or mortality of fish. Blast induced injuries include rupture of swim bladders and hemorrhaging. The extent of damage to fish populations depends on the presence or absence of a swim bladder. Fish with swim bladders (e.g., Atlantic herring) will be unable to adjust to the abrupt change in pressure propagated by the blast. These fish may be killed or injured. Fish without swim bladders (e.g., winter flounder) are less likely to be injured and would in fact sustain injuries only if they are in the immediate vicinity of the blast. Blasting may displace resident fishes, although this impact is expected to be only temporary. The implementation of best management practices to reduce noise and vibration to the extent practicable and seasonal restrictions designed to be protective of migratory finfish will avoid and mitigate the adverse effects to fish from blasting activities. See Appendix A1 – Endangered Species Act for detailed analysis.

Once dredging is complete, impacted benthic areas will likely begin to re-colonize with organisms similar to those from adjacent non-impacted areas. However, benthic organisms and habitats are expected to recover to near pre-construction conditions following a dredging or dredged material placement/disposal event. Overall, the adverse effects fish and fish habitats are expected to be minor and range from temporary to permanent impacts, but not significant.

To avoid and minimize these impacts, the District will implement time-of-year restrictions for dredging activities. Currently within the Newark Bay-Kill Van Kull Complex no dredging or blasting will occur between March 1 and June 30 of each year. Additionally, a no dredging window of January 15 – May 31 will be placed in the Port Jersey Channel. Ongoing consultation with NMFS throughout the life of the project will result in project-specific Conservation Recommendation under the Essential Fish Habitat Amendment and under the Endangered Species Act.

Bird

Compared to current operations, operation of vessels and dredging equipment could temporarily flush additional wildlife out of the area. The increased Total Suspended Solids and turbidity resulting from additional dredging operations with implementation of the Action Project Alternative may disrupt foraging abilities for some wildlife. This would result in temporary, negligible to minor, adverse impacts to wildlife.

The dredging is also anticipated to have a temporary, negligible to minor, adverse impact to benthic invertebrates and fish. This potentially impacts some of the prey species of birds. However, because of the already disturbed nature of the majority of the Action Area and the amount of other available habitat for prey species, current additional dredging and dredged material placement is not anticipated to have any substantial impact on any prey invertebrate or fish populations.

6.9: Benthic Fauna

6.9.1: No Action/Future Without-Project Alternative

Monitoring in the general project area (USACE, 2011) indicated that within the Ambrose Channel, which consists primarily of sand sediments, blue mussels predominate in biomass and number, accounting for 86% of the total organisms found, followed by amphipods and polychaetes, with an average density of 3,696 animals/meters². Further upriver, the Anchorage channel consisted of mostly polychaetes, with arthropods and mollusks following in abundance with few blue mussels found as would be expected in a more silt-dominated bottom habitat. Various annelid species (*Spio setosa*) were the most numerous, followed by amphipods and a small clam, the northern dwarf tellin (*Tellina agilis*) with an average density of 2,580 animals/meters².

Existing maintenance dredging operations and navigation within the Action Area would continue, which, while infrequent, is likely to cause removal or entrainment of benthic organisms, strikes and crushing of benthic organisms. Additionally, benthic organisms outside the dredging footprint could be impacted temporarily by increased levels of Total Suspended Solids and turbidity from some maintenance dredging. The siltation of benthic organisms may

prevent or reduce respiration and/or foraging for filter-feeding organisms. However, the sediment plume during dredging operations will likely not be significant enough to result in more than minor mortality of benthic life outside the channel, as quantities of Total Suspended Solids released should not result in burial of the benthos deep enough such that they will be unable to survive.

Dredging activities often generate no more increased suspended sediments than commercial shipping operations, bottom fishing or than those generated during severe storms (Parr et al. 1998). Furthermore, natural events such as storms, floods and large tides can increase suspended sediments over much larger areas and for longer periods than dredging operations (International Association of Dredging Companies, 2015). It is therefore often very difficult to distinguish the environmental effects of dredging from those resulting from natural processes or normal navigation activities (Pennekamp et al., 1996).

Maintenance dredging will cause minor, adverse impacts to the benthic community resulting from direct removal or entrainment of benthic organisms, strikes and crushing of benthic organisms, and turbidity/siltation effects that could include burial and potentially impact respiration of benthic organisms. The existing and projected future adverse impacts to the benthic community are temporary, minor and adverse.

6.9.2: Action Project Alternative

It is anticipated that impacts to benthic habitats will involve the potential loss and displacement of non-motile benthic organisms at the dredging site. McCauley et al. (1977) documented that the total abundance of benthic organisms at a dredging site returned to pre-dredging levels seven to 28 days after dredging was completed. In a similar study conducted on the nearby James River, Diaz (1994) revealed that almost all species of benthic organisms had recolonized the disturbed areas within three weeks after the dredging was completed. Diaz (1994) also demonstrated that benthic organisms continued to sustain pre-disturbance population densities three months after a dredging event.

6.10: Special Status Species

6.10.1: No Action/Future Without-Project Alternative

Federally Endangered and Threatened Species

Existing dredging operations and navigation within the Action Area would continue and are anticipated to continue for the next 50 years. There is no history of takes of sturgeon, whales or sea turtles due to navigational dredging in the New York Harbor. Adverse impacts to Federally listed species that range from no impact to minor, adverse impacts resulting from existing, though infrequent, dredging operations will continue. Adverse impacts to Federally listed species that occur with the No Action/Future Without-Project Alternative would be similar and at the same impact threshold to those that would occur with implementation of the Action Alternative, but most impacts would be relatively less due to the temporary increase in dredging activity to construct the channel improvements. Impacts to state listed species, which do not include any additional species not already protected under the Federal Endangered Species Act of 1973,

would be at the same impact threshold as those described in the Action Alternative Section but would be relatively less.

Marine Mammals

According to Todd et al. (2014), there are few studies on the effects of dredging on marine mammals due to dredging activities in isolation. In terms of direct effects, vessel collisions are possible, but improbable because dredges operate either in a stationary position or at low speeds. The risk of injury to marine mammals from collisions with dredge-related vessels is considered discountable considering the species mobility and slow speed of the dredge vessels (10 knots or less) and associated barges and scow. Also, trained personnel that know how to recognize the presence of threatened and endangered whale and sea turtle species are always onboard to help ensure that vessel interactions are avoided. No marine mammal strikes with dredge-related vessels has ever been reported to occur in the Action Area.

Within a noisy harbor area such as New York Harbor, ongoing exposure to underwater noise may cause a masking effect such that the noise of an oncoming vessel may not be detected. Marine mammals may habituate to the noisy harbor and simply not respond to an oncoming vessel as they are so adapted to the sound of vessels. In addition, the noise of the dredging vessel/equipment, and also the vessels in the harbor itself, has an adverse effect to listed whales in the Action Area and may interfere with their ability to communicate and forage for prey in addition to the vessel strike risks. Todd et al. (2014) noted that while dredging noise levels vary greatly and depend partly on the method and the material being dredged, limited data seem to indicate that dredging is unlikely to cause physiological damage to marine mammal auditory systems.

Effects of turbidity are often localized with minimal direct impact on marine mammals (Todd et al., 2014). No Level A or B harassment to marine mammals occurs with existing dredging and dredged material placement/disposal operations. Todd et al. (2014) note that the indirect effects of dredging are more complex, and less understood. In general, literature has suggested that dredging can cause reductions in biomass and varying levels of prey availability, depending on the surrounding conditions. However, it is also noted that marine mammals can likely compensate for small-scale changes in prey by switching prey species or moving to other foraging areas (Todd et al., 2014).

Marine mammals that may occur in the Action Area are accustomed to the busy harbor of which the Action Area is a portion. They are also highly mobile, and it is expected that they would move away from disturbance such as noise or equipment operations. The Action Area is also limited relative to the surrounding area available for use. Therefore, the species are likely to move and forage elsewhere during the operation. Noise generated by dredge activities would not be expected to affect migration, nursing, breeding, feeding, or sheltering.

Overall, no Level A or Level B harassment to marine mammals from implementation of the Action Alternative is anticipated. Overall, no substantive disruption of behavioral patterns to migration, breathing, nursing, breeding, feeding or sheltering would be anticipated.
Species Protected under the Migratory Bird Treaty Act of 1918 and Executive Order 13186 and Other State Listed Bird Species

Migratory birds have the potential to forage, rest, and/or migrate through the Action Area. The noise and temporary turbidity plume caused by dredging actions may cause migratory birds to move away from the disturbance; however, this is a negligible to minor, and temporary impact that does not substantially impact their long-term foraging or breeding success. Dredging operations have a temporary, negligible to minor adverse impact to benthic invertebrates and fish. This dredging may impact some of the prey species of migratory birds. Future shifts in salinity, temperature, and sea level rise all have the potential to result in shifts in prey species availability which could also cause detrimental effects to migratory birds. However, because of the already disturbed nature of the majority of the Action Area and the amount of other available habitat for prey species, current dredging operations, which are infrequent in the New York Harbor area, should not have any substantial impact on any prey invertebrate or fish populations.

6.10.2: Action Project Alternative

An assessment by the USACE of the potential impacts of implementation of the Action Project Alternative on Federally listed species is provided in the Biological Assessment (Appendix A1 – Endangered Species Act). The results of the impacts assessment are summarized there. Please note that best management practices/mitigation measures for Federally listed species are described in the BA found in Appendix A1 as well. Effect determination will remain pending until receipt of the NMFS Biological Opinion.

Atlantic Sturgeon

From reviewing the best available information on Atlantic sturgeon life history, and their behavior in and around the study area or Action Area, it appears that Atlantic sturgeon are present in the vicinity of the area primarily while migrating between spawning grounds in the Hudson River and their offshore oceanic environments, via the Ambrose and Anchorage channels. Several generic threats to Atlantic sturgeon from dredging and blasting activities have been identified. However, as summarized below, those most closely associated with and given the physical nature and actions associated with the area are not deemed to impact the continued existence and recovery of the species.

Proposed construction for the NYNJHDCI will occur in the Ambrose, Anchorage- Port Jersey, Kill Van Kull and Newark Bay main channels, as well as into South Elizabeth and Elizabeth Channels. The potential impacts of dredging and blasting on benthic resources (e.g., Atlantic sturgeon prey) within the Kill Van Kull-Newark Bay complex indicate a temporary and shortterm loss and/or shift in benthic community within those localized contract areas. Given the nature of the impact, the availability of resources available to Atlantic sturgeon in those areas of the project where they are documented as primarily occurring and are ubiquitous, such as the Lower Bay and entire Raritan Bay, and that Atlantic sturgeon are indiscriminate feeders, the impacts associated with dredging on benthic resources is unlikely to have an adverse impact on the species.

Given the information described in this section, the greatest potential risk for indirect or direct impacts to Atlantic sturgeon from the NYNJHDCI is therefore limited to the Ambrose and

possibly the Anchorage channel areas since these channels not only are situated as the major migratory spawning pathway for the New York Bight Distinct Population Segment, but are also the only channels at which large hopper dredges could be deployed. The District is committed to minimizing impacts of hopper dredging activities on Atlantic sturgeon. To reiterate, because the area of impact from the contract areas in Ambrose and Anchorage channels are so small relative to the surrounding Upper, Lower and Raritan Bays, there are many opportunities available for Atlantic sturgeon to avoid active dredges. Additionally, as part of the conditions outlined in the NMFS 2012 Biological Opinion, the District currently equips hopper dredges in the Ambrose channel with sea turtle deflectors (and unexploded ordnance screens, as applicable) on the draghead. This measure is meant to reduce the risk of interaction with protected species that may be present in the dredge area.

As part of the Terms and Conditions of the 2012 Biological Opinion, USACE has been required to use NMFS-approved protected species observers to monitor for takes onboard hopper dredges on deep draft navigation projects, as appropriate.

Additionally, a number of best management practices (in addition to observers) were reviewed and agreement between NMFS and the District was reached regarding the conduct of a pilot study, as an element of mitigation, to explore the feasibility of designing and deploying a tickler chain apparatus to attach to the draghead, which would serve to move bottom-dwelling individuals (turtles or Atlantic sturgeon) out ahead of and away from the area of effect of the draghead intake. This study has been deployed on one of the Districts' Coastal Storm Reduction projects (Fire Island to Moriches Inlet) and was concluded 2020. The technical team comprised of USACE's Engineer Research and Development Center's subject matter experts (mechanical engineer and endangered species specialists) and District biologists have the report under preparation, currently, and the report has been coordinated with the NMFS team. The study is intended to identify the feasibility of deploying new best management practices, as well as identify any other best management practices for future feasibility investigations that could reduce the risk to protected species with the Districts' area of responsibility.

Based on this BA, potential impacts to Atlantic sturgeon as part of the proposed improvements to the NYNJHDCI appears to be limited to a temporary and short-term loss and/or shift in benthic community and potential risk of entrainment by hopper dredges in the Ambrose and Anchorage channels, as well as possible adverse effects due to blasting activities in the Newark Bay-Kill Van Kull Complex. These potential impacts are not likely to jeopardize the continued existence of Atlantic sturgeon due to the use of best management practices during blasting activities that significantly reduce the adverse effects to finfish, and the implementation of seasonal restrictions (i.e. no dredging or blasting from March 1 to June 30) protective of anadromous fish throughout the Newark Bay-Kill Van Kull Complex. Construction activities at the Ambrose and Anchorage Channels are unlikely to increase risk to sturgeon due to the expansiveness of the two Bays permitting ease of passage of sturgeon to and from their upriver spawning grounds, and to/from feeding, overwintering and offshore migratory pathways. The District will continue to actively work with NMFS to ensure that any potential impacts of the planned activities are minimized.

Sea Turtles

Sea turtles are not expected to occur in the Upper Bay-Port Jersey or Newark Bay-Kill Van Kull

complex areas of the project because it is a highly congested and trafficked area, and the physical habitat characteristics in the area do not suggest that it would represent a concentration area for sea turtles.

If present at all in the New York Bight, sea turtles are more likely to be present as transients in the Lower Bay, well outside of the Ambrose Channel contracts footprint.

In the 2012 Biological Opinion, hopper dredging, particularly utilizing large hopper dredges, was identified as a dredging type of concern for entraining sea turtles. Although a hopper dredge will be used to remove material from the Ambrose and Anchorage contract areas, the likelihood of adversely affecting a sea turtle will be rare.

Based on the many years of documented sea turtle observer data (1993-2010), there was only one observed Loggerhead turtle take out of 13 projects in New York, New Jersey and New England; the total dredged quantity during the turtle season was approximately 18.7 million cubic yards of material. The take was considered a freak incidence and occurred during a beach re-nourishment project along the Sandy Hook to Barnegat Inlet in 1997 (Long Branch borrow area), which is along the New Jersey shore and well away from the contract areas in the Ambrose Channel. Also, when compared to other dredging projects along the East Coast (see Sea Turtle Warehouse at: http://el.erdc.usace.army.mil/seaturtles), the overwhelming majority of turtle takes has been in the Gulf (200 takes) and South Atlantic Regions (446 takes) where sea turtles cluster to over winter, not in the North Atlantic (67) or New York District (1) where juveniles migrate to feed. Based on this information, observed take appears to be a rare occurrence within the District and should be an indication that sea turtle occurrence is rare in the contract areas for the NYNJHDCI, and new methods to monitor such an unlikely event are not warranted. Therefore, turtle deflectors will continue to be used, as appropriate, as well as an onboard lookout to determine the deflectors are deployed properly and to identify presence of turtles to vessel operators so they can be avoided.

Based on this BA, impacts to the leatherback, green, Kemp's Ridley and Northwest Atlantic Ocean distinct population segment of loggerhead sea turtles as part of the proposed construction of the NYNJHDCI appears to be limited to a temporary and short-term loss and/or shift in benthic community and potential and low risk of entrainment by hopper dredges in the Ambrose and Anchorage channels. These impacts are not likely to jeopardize the continued existence of these sea turtle species. The District will continue to actively work with NMFS to ensure that any potential impacts of the planned activities are minimized, such as the continued use of sea turtle deflectors or, as applicable and permitted by NMFS, the use of the tickler chain apparatus on the dragheads of hopper dredges.

Whales

Endangered Species Act of 1973 listed species of whales will not occur in or utilize the Upper Bay or NB complex areas of the project. The Ambrose Channel element of the HDCI is the only area where whales would likely be found. Because whales forage upon pelagic prey items (e.g., krill, copepods), dredging and its impacts on the benthic environment will not have any direct effects on whale prey/foraging items. Additionally, as dredging operations will not be undertaken within the vicinity of Endangered Species Act listed species of whales, migratory behaviors of Endangered Species Act listed whales will also not be affected. Impacts to listed species of whales during deepening of the Ambrose Channel are unlikely because the hopper dredge would move very slowly at \leq 2.6 knots, a speed at which whales can easily avoid contact with the dredge. Collisions with a transiting hopper dredge between the dredge site and the placement site could occur at offshore placement sites, such as the HARS. An analysis by Vanderlaan and Taggart (2006, as referenced in Harbor Deepening Project Biological Opinion) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death of a whale increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. The speed of the dredge in the proposed project is not expected to exceed 2.6 knots while dredging and 9.4 knots while transiting to/from the deepening/placement sites, thereby reducing the likelihood of vessel collision impacts.

Large whales, particularly right whales, are vulnerable to injury and mortality from ship strikes. Ship strike injuries to whales take two forms: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist et al.2001). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. Laist et al. (2001) reports that of 41 ship strike accounts that reported vessel speed, no lethal or severe injuries occurred at speeds below ten knots, and no collisions have been reported for vessels traveling less than six knots. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist et al. 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%.

Collisions with a slowly transiting hopper might occur, but the suggested reduced speed (10 knots) during transit lessens the probability of a ship strike resulting in death. Although vessel strikes are acknowledged as being one of the primary known sources of whale mortality in the northeast, ship strikes remain relatively rare events and a small increase in vessel traffic within the project area does not necessarily translate into an increase in ship strike events (2012 BA). Onboard lookouts would also reduce the risk of vessel-whale collisions. If the lookout on board the hopper dredge observes a whale in the vicinity of the vessel during transit throughout the project area, maximum vessel speeds would be limited to 10 knots. If a Right Whale is observed, the vessel would maintain a 500-yard buffer from the whale. For all other whale species, a 100-yard buffer would be maintained. The District concludes that the potential impacts to whales is negligible (discountable or insignificant).

6.11: Floodplains

6.11.1: No Action/Future Without-Project Alternative

The No Action/Future Without-Project Alternative would have No Effect on floodplains. This was dismissed from detailed analysis due to lack of any impacts.

6.11.2: Action Project Alternative

The Action Project Alternative would have No Effect on floodplains. Previous studies for the harbor found that deepening the channels is not likely to increase the risk of storm surge. Additional analyses will be conducted during the Preconstruction Engineering and Design phase. If it is found that floodplains change as a result of the project during the Preconstruction Engineering and Design phase, measures would be implemented to offset any effects.

6.12: Cultural Resources

6.12.1: No Action/Future Without-Project Alternative

Existing maintenance dredging operations and navigation within the project area would continue under the no action alternative. Presently, maintenance dredging and navigation is causing no effect to cultural resources. When the 50-foot navigation channel was being designed, cultural resource surveys were conducted to identify any National Register Eligible resources within the area of potential effect. Six national register eligible shipwrecks were recorded by these efforts, and the New York District mitigated for impacts to these shipwrecks with recordation and salvaging important elements from the shipwrecks to be curated in a museum. Continuing maintenance dredging does not affect any additional cultural resources and neither does the navigation of ships through the project area.

6.12.2: Action Project Alternative

Under the action alternative, there are potential adverse impacts to National Register Eligible cultural resources. There is one National Register Eligible shipwreck within the project's construction limits. This is one of the shipwrecks that the New York District already mitigated for during the previous 50-foot harbor deepening project. Since the action alternative includes widening the existing federal navigation channels (hence, a larger Area of Potential Effect than the previous 50-foot harbor deepening project) additional cultural resources surveys will be required to complete the identification of cultural resources in the area of potential effect. Both remote sensing surveys for shipwrecks and geomorphic surveys for submerged Native American sites will be carried out. Based on the high number of cultural resources around the Area of Potential Effect (see chapter 2, Existing Conditions), it is highly likely that additional survey work will identify additional National Register Eligible resources within the Area of Potential Effect. Based on this likelihood, the New York District expects this project to have adverse impacts to National Register Eligible cultural resources. To guide the identification and evaluation of historic properties in the Area of Potential Effect a Programmatic Agreement was coordinated between the New York District, New York and New Jersey State Historic Preservation Offices, New York City Landmarks Preservation Commission, Federally Recognized Tribes, and Interested parties and executed on January 21, 2022. Appendix A9 presents the details of this coordination. The PA outlines that any properties requiring mitigation will be addressed with a treatment plan. Potential mitigation measures include recordation following State Historic Preservation Office or Historic American Building Survey/Historic American Engineering Record guidelines, salvage and donation of significant structural elements to museums, or data recovery for archaeological sites eligible for the National Register of

Historic Places under criterion D.

Part of the action alternative will cause the blasting of bedrock. Since bedrock blasting creates vibrations, historic structures within 500-feet of the blasting will need to be monitored for vibration levels to ensure that no damage is done to them during bedrock blasting. It is the New York District's goal to have no effect to historic properties during bedrock blasting, so blasting intensity will be lowered in areas near historic structures to avoid impacting them. During the Preconstruction Engineering and Design phase, blasting plans will be developed with the respective New York and New Jersey State Historic Preservation Offices. The guidelines for this coordination are laid out in the draft Programmatic Agreement in Appendix A9.

6.13: Recreation

6.13.1: No Action/Future Without-Project Alternative

Existing maintenance dredging operations, dredged material placement/disposal, and navigation within the Action Area would continue. These operations can cause minor turbidity, siltation, and boat wakes within the Action Area. None of these temporary and minor impacts would have any effect on recreational resources in the project Action Area.

Climatic changes, such as sea level rise, are predicted to continue in the future, and have the potential to cause changes in the nature and character of the estuarine ecosystem in the Action Area (NYSDEC, 2017). In general, as sea level rises, shoreline recreational sites, including parks and beaches, may become inundated unless preventative actions are taken to maintain elevation over time. Alternatively, sea level rise may cause estuarine wetlands to retreat inland, by converting existing uplands to wetlands, altering the use of shoreline parks that are currently upland vegetation.

The Action Area itself is already a highly developed city and port with substantial navigation and shipping operations, with few nearshore parks and a beach on the western shore of lower New York Bay. Continuing maintenance dredging operations would not cause any significant impacts to these recreational resources. Adverse impacts to recreational resources with implementation of the No Action/Future Without-Project Alternative are likely to be temporary and negligible.

6.13.2: Action Project Alternative

Similar to the No Action/Future Without-Project Alternative, there would be no significant impacts to local recreational resources with implementation of the Action Alternative. There may be minor, temporary and negligible impacts to recreational resources in the project Action Area during construction, due to the presence of dredging vessels and any support vessels during construction. Recreational fishermen may need to move their vessels from the immediate vicinity of dredging vessels due to vessel noise and localized turbidity, which will temporarily disturb fish in the local area as described in the noise and fishery sections of this EA. While parks provide views of the project Action Area, the majority of parks are some distance from the navigation channel and proposed improvements, which have frequent commercial vessel traffic. The exceptions to this are several parks along the Kill Van Kull, which range from 50-500 feet from proposed work. Minor, temporary adverse impacts to recreational resources as a result of

project implementation are expected.

6.14: Aesthetics and Scenic Resources

6.14.1: No Action/Future Without-Project Alternative

Under the No Action/Future Without-Project alternative, existing navigational uses within the project area (industry, commerce, military, and recreation) would continue and the view sheds and vistas would reflect the continued industrial land use within the area. Over time, deep draft navigation would likely increase slightly with the predicted growth in commodity movement assumed to occur over the 50-year period of analysis.

6.14.2: Action Project Alternative

Initial construction of the Recommended Plan would require deepening and widening of the navigation channels and adjacent areas. Once construction is completed, the channels and improvements would need routine maintenance. Construction and maintenance would be consistent with the aesthetic character of the working harbor.

Implementing the Action Alternative would result in temporary negligible effects on the visual resources within the Action Area over the period of construction. There would be a permanent, negligible to minor change to the aesthetic environment of the Action Area as it would continue to be that of a working waterfront with a mix of industrial, commercial, highway transport, naval, marine, and urban shoreline uses, but would allow for a larger class of vessel to transit the area. This may alter the viewshed of the Action Area, though not significantly.

6.15: Hazardous, Toxic, and Radioactive Wastes

6.15.1: No Action/Future Without-Project Alternative

Under the No Action/Future Without-Project Alternative, dredging operations in the existing navigation channels would continue to occur and are anticipated to continue to occur for the next 50 years, therefore it is not anticipated that any federal or state listed hazardous, toxic and radioactive waste site would affect or be affected by the No Action/Future Without-Project Alternative.

6.15.2: Action Project Alternative

The Action Area is heavily urban and, as discussed in Appendix A6, has many known contaminated sites located in the vicinity, both in New Jersey and New York, including sites along the south shore of Bayonne, New Jersey and north shore of Staten Island, New York. These sites are primarily located on land and outside of the NYNJHDCI project boundary except for a portion of one Federal and State (New Jersey) listed Superfund site identified as the Diamond Alkali, Newark Bay Operable Unit located in New Jersey. The Diamond Alkali, Newark Bay Operable Unit located in New Jersey. The Diamond Alkali, Newark Bay Operable Unit located in New Jersey. The Diamond Alkali, operable Unit includes Newark Bay, Arthur Kill and Kill van Kull channels and portions of the Hackensack River, bound by the Lower Passaic River Restoration Project downstream boundary, the Contrail Bridge at the Hackensack River, the Bayonne Bridge, and

the Goethals Bridge. The Final Remedial Investigation Report for the Diamond Alkali, Newark Bay Operable Unit is currently estimated to be completed in early 2022 with a record of decision by end of 2024 according to USEPA. The proposed deepening will occur in the existing navigation channels, where dredging operations are currently performed and are anticipated to continue for the next 50 years. The Action Project Alternative is not anticipated to have an adverse impact on the nearby CERCLA sites (Diamond Alkali and the Newark Bay Operable Unit) as the District intends to continue coordination with USEPA and NJDEP as necessary. It is not anticipated that any other federal or state listed contaminated site will affect or be affected by the Action Project Alternative as they are located outside of the project boundaries.

A Confined Disposal Facility is in Newark Bay between Port Elizabeth channel and Port Newark channel. Now closed and capped, the Confined Disposal Facility was designed to store contaminated dredge materials and to prevent pollution of the estuary. The Confined Disposal Facility is located outside the proposed dredging areas of the existing navigation channels and will be avoided to ensure no impact to the Confined Disposal Facility.

In accordance with Engineer Regulation 1165-2-132, dredged materials will be tested under dredged material placement criteria for their suitability for beneficial use in accordance with the appropriate guidelines and criteria including, but not limited to, Section 404 of the Clean Water Act and/or Section 103 of the Marine Protection Research and Sanctuaries Act and supplemented by the Corps of Engineers Management Strategy for Disposal of Dredge Material: Containment Testing and Controls, as well as the protocols listed in Section 6.5.

6.16: Air Quality

6.16.1: No Action/Future Without-Project Alternative

The No-Action Alternative would result in periodic maintenance dredging that would not be subject to General Conformity Rule review and compliance since maintenance dredging is statutorily exempt from the Rule. While regulated emissions from the maintenance dredging may be lower overall than the temporary (construction) emissions from implementing the Recommended Plan, none of the benefits, such as full mitigation of construction-related emissions and greater navigational efficiency resulting from the channel improvements which would lead to a reduction in vessel emissions accessing the terminals, of the Recommended Plan would be realized. The No-Action Alternative would permit the continued unmitigated release of regulated emissions related to maintenance construction operations as well as prevent newer, cleaner, larger and fewer vessels faster and safer access to the terminals.

6.16.2: Action Project Alternative

The project will produce temporary localized emissions from the diesel-powered dredging equipment and marine vessels working on the project. These emissions will be fully offset by reductions occurring in the same airshed and during the same time period as the work, as specified by the General Conformity regulations and by procedures established by the Regional Air Team. Therefore, there will be no anticipated net increase of emissions and no significant impacts from the project. As stated in the Air Quality Section (Section 2.22), the counties in which the project will be performed (New Jersey counties of Essex, Hudson, and Union, and

New York counties of Kings and Richmond) have been designated with the following attainment status with respect to the National Ambient Air Quality Standards for criteria pollutants: 'serious' nonattainment area for the 2008 8-hour ozone standard, 'moderate' nonattainment for the 2015 8-hour ozone standard, and 'maintenance' for the 2006 particulate matter less than 2.5 microns standard. In addition, Essex, Hudson, and Union Counties, all in New Jersey, are part of a 'maintenance' area for the 1971 carbon monoxide standard (40 Code of Federal Regulations Section 81.331). The ozone nonattainment counties are part of a larger Ozone Transport Region. Ozone is controlled through the regulation of its precursor emissions, which include oxides of nitrogen and volatile organic compounds. Volatile organic compounds are emitted at a fractional rate compared to oxides of nitrogen emissions. In addition, sulfur dioxide is a precursor for particulate matter less than 2.5 microns. Because of these designations and since the project is a Federal Action taken by the USACE, this project triggers a General Conformity Review under 40 Code of Federal Regulations Section 93.154. General Conformity ensures that Federal Actions do not have a negative impact on State Implementation Plans. For the pollutants that will be emitted as part of the project, the annual de minimis levels are: 50 tons of oxides of nitrogen or volatile organic compounds, 100 tons of CO, 100 tons of particulate matter less than 2.5 microns, and 100 tons of sulfur dioxide. Projects that don't have any annual emissions exceeding these threshold levels are presumed to be in conformity with the State Implementation Plan.

The emissions associated with the project are estimated as part of the General Conformity Review and are summarized below, by calendar year.

Estimated Emissions, tons per year															
Pollutant	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
NO _x	428	497	497	497	433	436	436	436	436	436	358	279	279	279	105
VOC	14	17	17	17	15	15	15	15	15	15	13	10	10	10	4
PM _{2.5}	20	24	24	24	21	21	21	21	21	21	18	14	14	14	5
SO ₂	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
0	56	64	64	64	55	55	55	55	55	55	44	32	32	32	12

Table 38: Estimated Emissions

The emission levels of oxides of nitrogen will exceed the ozone 'de minimis' level for General Conformity; therefore, applicable oxides of nitrogen emissions will need to be fully offset as part of the project. Because oxides of nitrogen will be fully offset, by rule, the net oxides of nitrogen emissions increase will be zero and therefore will produce no significant impacts.

A Statement of Conformity has been prepared and will be signed to document that the proposed project has met the General Conformity requirements. The associated mitigation and tracking over the life of the project will be coordinated through the Regional Air Team that consists of: USEPA Region 2, NYSDEC, NJDEP, USACE New York District, The Port Authority of New York and New Jersey, New York City Department of Transportation and other agencies associated with the ongoing mitigation efforts associated with the Harbor Deepening Project, the Hurricane Sandy-related restoration projects, and the current proposed Project. This approach has been successfully used to fully offset emissions from the Harbor Deepening Project and the Hurricane Sandy-related restoration projects, which covered lengthy construction periods

between 2005 and 2020. See https://www.epa.gov/newsreleases/epa-releases-case-study-air-pollution-reductions-new-yorknew-jersey-harbor-deepening.

The mitigation options for oxides of nitrogen include the use of available Surplus Oxides of Nitrogen Emission Offsets generated by the Harbor Deepening Project and/or subsequent Marine Vessel Engine Replacement Programs, establishment of a new Marine Vessel Engine Replacement Program, the purchase of USEPA Cross-State Air Pollution Rule ozone season oxides of nitrogen allowances, Clean Vessel Incentive voluntary speed reduction program offsets, statutory exemption, and/or State Implementation Plan accommodation. The final combination of the above options will be coordinated and tracked through the Regional Air Team. The draft Statement of Conformity is provided as Appendix A5. In meeting the General Conformity requirements, the project will not incur significant impacts.

6.17: Noise and Vibration

6.17.1: No Action/Future Without-Project Alternative

Existing dredging operations, dredged material placement, and navigation would continue in the Action Area. Current maintenance operations would continue to generate construction related noise from vessels and equipment (e.g., dredge operation, pumps, transportation, and final dredged material placement/disposal). Recreational use of local Action Area waters is also expected to continue, such as recreational fishing and cruise liners calling at local port facilities. The lower New York Harbor is a region of major shipping and recreational boat traffic and background noises, both in air and underwater, reflect this and current background noise from these activities are expected to continue.

Industries located along the shoreline are expected to continue to contribute to noise in the Action Area. These levels will vary depending on time of day and machinery used. Air traffic to and from Newark International Airport is also expected to continue. Noise from traffic along major roadways (e.g., New Jersey Turnpike and Interstate 278), bridges (e.g., Goethels, Bayonne, Verrazzano), and railroads contribute to regional ambient noise. Population growth and increased use of railways and roadways may cause regional noise levels to rise in the future.

6.17.2: Action Project Alternative

Local noise in the immediate construction area within the project Action Area would increase with implementation of the Action Project Alternative, as compared to the No Action/Future Without-Project Alternative because of the increased duration of construction and maintenance operations required to do the proposed dredging. Additionally, it is conservatively estimated that 17% of the project will require blasting (see Section 6.18), which will cause a temporary, minor increase in noise. At a range of 1-meter, confined blasting has a peak level of 220dB, compared to a peak range of 175-190dB for dredging, depending on the type of dredge (see Table 39) (Suedel et al., 2019). Noise impacts from the action project alternative are expected to be minor and temporary.

	SOURCE LEVEL			
SOUND SOURCE	dB re 1µPa at 1m,			
	(unless otherwise noted)			
Natural				
Biological				
Sperm whale click	236 (RMS)			
Snapping shrimp	183 - 189 (peak)			
Harbor porpoise click	205 (peak)			
Physical				
Waves	~40 - 80			
Weather (rain, thunder)	~80			
Ambient Harbor ^a	60 - 73.2			
Anthropogenic				
Offshore Construction				
Explosives	272-287 (peak)			
Confined Blasting	220 (peak)			
Pile Driving	243-257 (peak)			
Seismic surveys				
Airgun array	260-262 (peak)			
Sonar				
Echosounders	235 (peak)			
Military sonar (low-frequency)	215 (peak)			
Military sonar (mid-frequency)	223-235 (peak)			
Offshore industrial activities				
Wind turbine	142 (RMS)			
Drilling	145-190 (RMS)			
Shipping				
Small boats and ships	160-180 (RMS)			
Large vessels	189-190 (RMS)			
New York and New Jersey Harbor				
(ambient) ^b	75-125			
Dredging				
Cutter suction dredge	168-175			
Trailing suction hopper dredge	172-190			
Grabdredge	107-124 ^c			
Backhoe dredge	163-179			

Table 39: Sound levels of Natural and Anthropogenic Sources

^aAmbient sound measured at Cook Inlet, Alaska (absent of shipping noise)

 $^{\mathrm{b}}\mathsf{A}\mathsf{m}\mathsf{b}\mathsf{i}\mathsf{e}\mathsf{n}\mathsf{t}\mathsf{h}\mathsf{a}\mathsf{r}\mathsf{b}\mathsf{o}\mathsf{r}\mathsf{s}\mathsf{o}\mathsf{u}\mathsf{n}\mathsf{d}\mathsf{s}$ (with shipping) measured at 3 m depth

°124 dB was measured at 158 m from sound source

Peak = maximum pressure, RMS = root mean square

6.18: Confined Underwater Blasting

Blasting is proposed to occur in areas where there is competent bedrock that will not be removable by mechanical methods such as a cutterhead or a rock bucket. Competent bedrock includes unweathered serpentinite and schist, and diabase. Confined underwater blasting is performed from the surface on barges equipped with specialized equipment, which are held in place by either spuds or an anchoring system. All vessels and personnel are required to follow EM-385-1-1, Occupational Safety and Health Administration (OSHA) safety, and all Coast Guard regulations. It is expected that there will only be one barge for blasting operating at a given time.

Once a blast barges is in place, steel casing is driven into the sediment in the locations above the blast holes and the blast holes are drilled. Each drill hole may range from 2 inches to 5 inches, or more, in diameter, depending on a number of factors including the selected blast pattern, drill pattern, the borehole length and subdrill length, the drilling equipment and barge, and vibration limits and proximity of structures.

When blasting underwater, there are a number of considerations that affect the location of blast holes and the weight explosives in each blast hole. These factors include expansion of gasses, shock waves, temperature, pressure/depth, salinity, and ice. An additional factor, beyond physical factors, is that the number and spacing of blast holes are dependent upon the type of rock and degree of weathering. These limitations and effects of each factor are described in Blasting for Rock Excavations (USACE, 2018). Where blasting is required, drilling and blasting spacing between boreholes and between ranges is assumed to be 12 feet for moderately hard rock, 10 feet for hard rock, and 8 feet for hardest rock.

Prior to any drilling or blasting, a variety of site-specific studies and surveys must take place, pre-blast tests must be conducted, and multiple plans must be in place, including, but not limited to, a blasting safety plan, a test blasting plan, an operational blasting plan and a blasting monitoring plan.

Drilling of the blasting holes, along with mechanical dredging, is more likely to generate discernible noise than the confined underwater blasting itself. This is because the blasting noise is confined within rock beneath the water column. Extensive monitoring and protection measures will be required from the dredging companies contracted to implement this work.

There are several best management practices implemented in order to minimize safety risk and disturbance to nearby residents. Through all stages of blasting, a community liaison will be available to address concerns and work with residents and communities in close proximity to the construction zone to minimize any potential adverse effects and remediate the adverse effects that cannot be minimized.

Dredging will be a 24-hour a day, 6-days per week operation when there is no seasonal restriction to protect natural resources preventing work. The District is committed to only perform blasting and drilling during daylight hours. Though blasting will not be performed at night, there may be other activities related to the work such as surveying, dredging or removing blasted materials, that may be performed at night, and these activities will require onboard lighting.

Prior to blasting or drilling activities, the District, or contractor, will conduct pre-blasting surveys for nearby structures where access is allowed. These surveys will, at a minimum, contain photo or video documentation of the structure prior to any work. If any damage is reported, the District and Contracting Officer's Representative will rely on the pre- and post-blasting reports to determine the extent of damage and required repairs as a result.

The construction specifications will require on-land vibration and noise monitoring to be conducted by a blasting vibration specialist, provided by the construction contractor. Additional vibration and noise monitoring will be performed independently by the New York District as quality assurance. Multiple vibration and noise monitors will be deployed and will document the initial Test Blast program and the entirety of production blasting. The vibration and noise monitors will document background levels prior to the start of the initial Test Blast program. The blasting vibration specialist will use the vibration and noise data to develop site-specific equations to predict levels at various distances. Initial predictions will be based on the generic scaled-distance equations presented in Blasting for Rock Excavations (USACE, 2018).

Vibration and noise limits will be set in the specifications and will address a variety of receptors including residential, historical, commercial, and industrial structures. During the previous NY/NJ Harbor deepening project, on-land vibrations were well controlled and did not cause damage. We do not anticipate significant on-land noise, in excess of background noise levels, from the confined underwater blasts. Drilling of the blasting holes, along with mechanical dredging, is more likely to generate discernible noise.

6.19: Summary of Mitigation

The various mitigation measures being considered to avoid, minimize, reduce or compensate for the adverse environmental impacts expected from implementation of the proposed action are summarized in Table 40.

Table 40: Summary of Mitigation Measures

SUBTIDAL SHALLOWS HABITAT

Compensatory mitigation for approximately 0.53 acres of regulated subtidal shallows habitat impacted through the restoration and/or enhancement of habitat, purchasing credits from a mitigation bank, and/or an in-lieu fee program. The current plan for meeting the project's compensatory mitigation is restoring approximately 1.59 acres (a 3-to-1 ratio¹) of out-of-kind habitat in the Sea Bright Offshore Borrow Area (SBOBA) to pre-dredge conditions by placing suitable grain size sediment within an area that was previously excavated for beach nourishment projects. To facilitate beneficial use, additional suitable dredge material will also be placed at SBOBA to satisfy Essential Fish Habitat consultation recommendations. Further refinements to the mitigation plan will occur in Preconstruction Engineering and Design.

CULTURAL RESOURCES

The project has the potential to have an adverse impact on historic properties, however, additional investigation is required to determine what sites will be impacted. A Programmatic Agreement (see Appendix A9) between the New York District, New York and New Jersey State Historic Preservation Offices, New York City Landmarks Preservation Commission, Federally Recognized Tribes, and Interested parties was coordinated to guide identification and evaluation of historic properties. Both remote sensing surveys for shipwrecks and geomorphic surveys for submerged Native American sites will be carried out.

AIR QUALITY

The mitigation options for oxides of nitrogen include the use of available Surplus Oxides of Nitrogen Emission Offsets generated by the Harbor Deepening Project and The Port Authority of New York and New Jersey Clean Vessel Incentive offsets, establishment of new Marine Vessel Engine Replacement Programs, the purchase of USEPA Cross-State Air Pollution Rule ozone season oxides of nitrogen allowances, statutory exemption, and/or State Implementation Plan accommodation. The final combination of the above options will be coordinated and tracked through the Regional Air Team. The Statement of Conformity is provided in Appendix A5.

6.20: Compensatory Mitigation

As described in section 6.6.2, the Recommended Plan includes approximately 0.53 acres of impact to regulated subtidal shallows habitat. These impacts will be mitigated, either through the restoration and/or enhancement of habitat (see Appendix A11), purchasing of credits from a mitigation bank, or an in-lieu fee program. The current plan for meeting the project's compensatory mitigation is restoring approximately 1.59 acres (a 3-to-1 ratio²) of out-of-kind habitat in the Sea Bright Offshore Borrow Area to pre-dredge conditions by placing suitable grain size sediment within an area that was previously excavated for beach nourishment projects. To facilitate beneficial use, additional suitable dredge material will also be placed at SBOBA to satisfy Essential Fish Habitat consultation recommendations. Further refinements to the mitigation plan will occur in Preconstruction Engineering and Design. Other potential mitigation sites may be identified through the Comprehensive Restoration Plan for the Hudson Raritan Estuary (USACE, 2016), among other sources, as necessary. In this case, in-kind, in-place

¹ A 3-to-1 ratio was used solely for planning purposes to develop cost estimates.

² A 3-to-1 ratio was used solely for planning purposes to develop cost estimates.

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mitigation is preferable. If none such sites exist, out-of-kind and/or out-of-place sites would be used.

Chapter 7: Coordination and Compliance with Environmental Requirements*

7.1: Table of Environmental Compliance, Executive Orders, and Permitting Requirements

Compliance with the following environmental laws (and implementing regulations) and Executive Orders is required for the project alternatives under consideration (Table 41). Note this is not necessarily an exhaustive list of all applicable environmental requirements.

TITLE OF LAW	U.S. CODE	COMPLIANCE STATUS
Abandoned Shipwreck Act of 1987	43 United States Code (U.S.C.) 2101	In Compliance
American Bald and Golden Eagle Protection Act of 1962, as amended	16 U.S.C. 668	N/A
American Indian Religious Freedom Act of 1978	Public Law No. 95-341, 42 U.S.C. 1996	N/A
Anadromous Fish Conservation Act of 1965	16 U.S.C. 757 a et seq.	In Compliance
Archaeological and Historic Preservation Act of 1974	Public Law 93-291 and 16 U.S.C.469-469c	In Compliance
Archaeological Resources Protection Act of 1979	16 U.S.C. 470aa–470mm	N/A
Clean Air Act of 1972, as amended	42 U.S.C. 7401 et seq.	In Compliance
Clean Water Act of 1972, as amended	33 U.S.C. 1251 et seq.	In Compliance
Coastal Barrier Resources Act of 1982	Public Law 114-314	N/A
Coastal Zone Management Act of 1972, as amended	16 U.S.C. 1451 et seq.	In Compliance
Comprehensive Environmental Responses, Compensation and Liability Act of 1980	42 U.S.C. 9601	N/A
Deepwater Port Act of 1974, as amended	33 U.S.C. 1501	N/A
Emergency Wetlands Resources Act	16 U.S.C. 3901-3932	N/A
Endangered Species Act of 1973	16 U.S.C. 1531	In Compliance
Estuary Protection Act of 1968	16 U.S.C. 1221 et seq.	N/A

Table 41: Environmental Compliance(Note this table spans two pages)

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TITLE OF LAW	U.S. CODE	COMPLIANCE STATUS
Fish and Wildlife Coordination Act of 1958, as amended	16 U.S.C. 661	In Compliance
Flood Control Act of 1970	33 U.S.C. 549	In Compliance
Land and Water Conservation Act	16 U.S.C. 460	N/A
Magnuson-Stevens Fishery Conservation and Management Act – Essential Fish Habitat Amendment	16 U.S.C. 1801	In Compliance
Marine Mammal Protection Act of 1972, as amended	16 U.S.C. 1361	N/A
Marine Protection, Research, and Sanctuaries Act of 1972	33 U.S.C. 1401	In Compliance
Migratory Bird Conservation Act of 1928, as amended	16 U.S.C. 715	N/A
Migratory Bird Treaty Act of 1918, as amended	16 U.S.C. 703	N/A
National Environmental Policy Act of 1969, as amended	42 U.S.C. 4321 et seq.	In Compliance
National Historic Preservation Act of 1966, as amended	54 U.S.C. Section 300101	In Compliance
Native American Graves Protection and Repatriation Act of 1990	25 U.S.C. 3001	In Compliance
Noise Control Act of 1972, as amended	42 U.S.C. 4901	N/A
Resource Conservation and Recovery Act of 1976	42 U.S.C. 6901 et seq.	N/A
Rivers and Harbors Act of 1888, Section 11	33 U.S.C. 608	N/A
Rivers and Harbors Act of 1899	33 U.S.C. 401 et seq.	N/A
Safe Drinking Water Act of 1974, as amended	42 U.S.C. 300	N/A
Submerged Lands Act of 1953	43 U.S.C. 1301 et seq.	N/A
Toxic Substances Control Act of 1976	15 U.S.C. 2601	N/A

TITLE OF EXECUTIVE ORDER	EXECUTIVE ORDER NUMBER	COMPLIANCE STATUS
Protection and Enhancement of Environmental Quality	11514/11991	In Compliance
Protection and Enhancement of the Cultural Environment	11593	N/A
Floodplain Management	11988	N/A
Protection of Wetlands	11990	N/A
Federal Compliance with Pollution Control Standards	12088	N/A
Offshore Oil Spill Pollution	12123	N/A
Federal Compliance with Right-to-Know Laws and Pollution Prevention	12856	N/A
Federal Actions to Address Environmental Justice and	12898	
Minority and Low-income Populations		In Compliance
Protection of Children from Environmental Health Risks and Safety Risks	13045	N/A
Invasive Species	13112	N/A
Marine Protected Areas	13158	N/A
Consultation and Coordination with Indian Tribal Governments	13175	In Compliance
Responsibilities of Federal Agencies to Protect Migratory Birds	13186	N/A
Facilitation of Cooperative Conservation	13352	N/A
Planning for Federal Sustainability in the Next Decade (2015)	13693	N/A

Table 42: Executive Orders

	r ernntting keyan ennemts				
LAW	AGENCY RESPONSIBLE	PERMIT, AGREEMENT, AUTHORIZATION, OR NOTIFICATION REQUIRED			
Comprehensive Environmental Responses, Compensation and Liability Act of 1980, as amended	U.S. Environmental Protection Agency (USEPA)	N/A			
Clean Water Act, Section 401	NYSDEC	Concurrence received; Water Quality Certification will be applied for during Preconstruction Engineering and Design			
Coastal Zone Management Act (CZMA)	NYDOS, NJDEP	Concurrence received			
Endangered Species Act of 1973	NMFS	Biological Opinion			
Endangered Species Act of 1973	USFWS	Biological Opinion			
Fish and Wildlife Coordination Act (FWCA)	USFWS	Planning Aid Letter			
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	EFH Conservation Recommendations			
Marine Mammal Protection Act of 1972, as amended	NMFS	N/A			
Marine Protection, Research, and Sanctuaries Act of 1972*	USEPA	N/A			
Migratory Bird Treaty Act of 1918, as amended	USFWS	N/A			
National Historic Preservation Act of 1966, as amended	NYSDPRHP	Programmatic Agreement			
Noise Control Act of 1972	USEPA	N/A			
Resource Conservation and Recovery Act of 1976	USEPA, NYSDEC	Testing, quantification, and notification for any hazardous materials.			

Table 43: Permitting Requirements

N/A = Not Applicable; NYSDEC = New York State Department of Environmental Conservation; NMFS = National Marine Fisheries Service; NYSDPRHP = New York State Department of Parks, Recreation and Historic Preservation; USEPA = U.S. Environmental Protection Agency; USFWS = U.S. Fish and Wildlife Service

7.2: National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 *et seq.*

The NEPA requires that all Federal agencies use a systematic, interdisciplinary approach to protect the human environment. This approach promotes the integrated use of natural and social sciences in planning and decision-making that could have an impact on the environment. This document follows the Update to the Regulations Implementing the Procedural Provisions of the

National Environmental Policy Act, published in the Federal Register on July 16, 2020, and affects all documents, including this one, published on or after September 14, 2020 (85 FR 43304).

NEPA requires the preparation of an Environmental Impact Statement for any major Federal action that could have a significant impact on quality of the human environment and the preparation of an Environmental Assessment (EA) for those Federal actions that do not cause a significant impact but do not qualify for a categorical exclusion. The NEPA regulations issued by Council on Environmental Quality provide for a scoping process to identify and the scope and significance of environmental issues associated with a project. The process identifies and eliminates from further detailed study issues that are not significant. USACE used this process to comply with NEPA, and an Environmental Impact Statement was initially identified as the appropriate NEPA document. However, after gathering data, performing preliminary impact analysis, and conducting initial scoping (including a November 2019 Interagency Meeting), it was determined that an Environmental Assessment was the appropriate NEPA document to prepare for this project. This choice was especially prudent given the Environmental Impact Statement, and four supplemental Environmental Assessments prepared for original review of the original 50-foot Harbor Deepening Project. The study was focused on an Integrated Feasibility Report and Environmental Assessment on those issues most relevant to the environment and the decision-making process. An agency, tribal, and public review of the Draft Integrated Feasibility Report and Environmental Assessment was extended from 30 to 75 days, and conclude on January 19, 2021. Comments received have informed the revisions to this Final Integrated Feasibility Report and Environmental Assessment, and are available, along with their responses, in Appendix A14. The Final Integrated Feasibility Report and Environmental Assessment, including all appendices, the Finding of No Significant Impact (FONSI) and supporting documentation fulfills the requirements of the NEPA for the New York and New Jersey Harbor Deepening Channel Improvements Feasibility Report. Upon the signing of the Finding of No Significant Impact, the project will be in full compliance with the NEPA. A draft Finding of No Significant Impact is provided in Appendix A10.

7.3: Clean Water Act

The USACE will obtain Water Quality Certifications from the States of New York and New Jersey pursuant to the Clean Water Act during Preconstruction Engineering and Design. This Final Integrated Feasibility Report and Environmental Assessment contains sufficient information to demonstrate that the Recommended Plan is in compliance with the Clean Water Act. All dredged material placement actions will comply with water quality standards as regulated by the States of New York and New Jersey. Prior to commencement of construction, dredged material will undergo evaluation procedures including chemical and biological testing in accordance with Federal guidance and regulations to provide information to reach a factual determination concerning Clean Water Act, Section 404 requirements (40 Code of Federal Regulations 230.11) and applicable state water quality standards. A water quality certification support letter from each affected state will be requested finalization of this integrated report.

7.4: Wetlands

Section 404 of the Clean Water Act and 33 Code of Federal Regulations 36(c)(4) and 33 Code of Federal Regulations 320.4(b) require the USACE to avoid, minimize, and mitigate impacts to wetlands. No direct or indirect impacts to intertidal or freshwater wetlands are anticipated with implementation of this project. All impacts to state regulated subtidal shallows habitat anticipated with implementation of this project will be mitigated.

7.5: Federal Coastal Zone Management Act, 16 U.S.C. 1451 et seq.

The Federal Coastal Zone Management Act requires each Federal agency activity performed within or outside the coastal zone (including development projects) that affects land or water use, or natural resources of the coastal zone to be carried out in a manner which is consistent to the maximum extent practicable, i.e. fully consistent, with the enforceable policies of approved state management programs unless full consistency is prohibited by existing law applicable to the Federal agency.

To implement the Coastal Zone Management Act and to establish procedures for compliance with its Federal consistency provisions, the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, promulgated regulations which are contained in 15 Code of Federal Regulations. Part 930. As per 15 Code of Federal Regulations 930.37, a Federal agency may use its NEPA documents as a vehicle for its consistency determination.

The State of New York's Coastal Management Program was established under the guidelines of the National Coastal Zone Management Act (1972) as a state-Federal partnership to comprehensively manage coastal resources. The New York State Department of State is the designated state coastal management agency and is responsible for the implementation of the state's Coastal Management Program. Implementation includes the direct regulation of impacts to coastal resources within the critical areas of the state including coastal waters, tidelands, beaches and beach dune systems; and indirect certification authority over Federal actions and state permit decisions within the eight coastal counties. In addition, the City of New York has established a coastal zone under the Local Waterfront Revitalization Program. The Local Waterfront Revitalization Program includes 10 policy statements applicable to the City's Coastal Zone (see Appendix A3).

The State of New Jersey administers its coastal zone program through the NJDEP Land Use Regulation Program. The Coastal Zone Management Rules (N.J.A.C. 7:7 as amended through 10/5/2021) regulate the use and development of coastal resources, and are used by NJDEP in reviewing permit applications under the Waterfront Development Law, Coastal Area Facility Review Act (CAFRA) (N.J.S.A. 13:19-1 et seq. [as amended to July 19, 1993]), Federal Consistency Determinations (307 of the Federal Coastal Zone Management Act) among others.

In accordance with the Coastal Zone Management Act, it has been determined that the proposed channel improvements would be carried out in a manner that is fully consistent with the enforceable policies of the New York Coastal Management Program, the New Jersey Coastal Management Program, and the NYC Local Waterfront Revitalization Program (The Federal Consistency Determination with the Coastal Zone Management Act is provided in Appendix

A3).

7.6: Clean Air Act, as amended, 42U.S.C. 7401 et seq.

A Statement of Conformity, including regulated emission estimates and mitigation measures to be implemented, is included in Appendix A5 as required under 40 CFR Section 93.154.

7.7: U.S. Fish and Wildlife Coordination Act, 16 U.S.C.661-666(c)

Coordination with the U.S. Fish and Wildlife Service is complete and available in Appendix A8.

7.8: Magnuson-Stevens Fishery Conservation and Management Act – Essential Fish Habitat

Coordination with the National Marine Fisheries Service is complete and available in Appendix A8.

7.9: Endangered Species Act

Coordination with the NMFS, pursuant to Section 7 of the Endangered Species Act of 1973, is complete. Compliance documentation is provided in Appendix A1.

7.10: Marine Mammal Protection Act, 16 U.S.C. 1631 et seq.

The Marine Mammal Protection Act prohibits the take of marine mammals including the West Indian manatee, and all cetaceans found in the Action Area. Through coordination with NMFS for ESA Section 7 it has been determined that compliance has been met, and no separate coordination is required. No Incidental Take Authorization is required with implementation of the Preferred Alternative.

7.11: Section 106 and 110(f) of the National Historic Preservation Act, 16 U.S.C. 470 *et seq*.

The National Historic Preservation Act applies to properties listed in or eligible for listing in the National Register of Historic Places; these are referred to as "historic properties." Historic properties eligible for listing in the National Register of Historic Places include prehistoric and historic sites, structures, buildings, objects, and collections of these in districts. Section 106 of the National Historic Preservation Act and its implementing regulations at 36 Code of Federal Regulations Part 800, require the lead Federal agency to assess the potential effects of an undertaking on historic properties that are within the proposed project's Area of Potential Effect, which is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist" (36 Code of Federal Regulations Section 800.16[d]).

An initial coordination letter was sent out in October 2019 to the New York State Historic Preservation Office, New Jersey State Historic Preservation Office, New York City Landmarks Preservation Commission, Delaware Nation, Delaware Tribe, Shawnee Tribe, Shinnecock Indian Nation, Stockbridge Munsee Community, and the Unkechaug. In November 2019 thirty-one potential interested parties were contacted to participate in the consultation process. Responses were received from the New York and New Jersey State Historic Preservation Offices, Stockbridge Munsee, and two interested parties (South Street Sea Port Museum and Intrepid Sea, Air, & Space Museum) that they wished to be included in the consultation process. On September 1, 2020 the District sent a draft Programmatic Agreement and Historic Properties Summary document to the following parties, henceforth referred to as the Consulting Parties, New York and New Jersey State Historic Preservation Offices, New York City Landmarks Preservation Commission (NYCLPC), Delaware Nation, Delaware Tribe, Shawnee Tribe, Shinnecock Indian Nation, Stockbridge Munsee Community, Unkechaug, South Street Seaport Museum, and the Intrepid Sea, Air, & Space Museum.

Once comments on the draft Programmatic Agreement were received, the District compiled all comments into a comprehensive matrix to streamline the iterative editorial process. The District addressed the draft comments and submitted an interim draft version of the Programmatic Agreement to the Consulting Parties on June 25, 2021. This interim draft included concurrence and participation by the NY and NJ SHPOs, the NYCLPC as well as an updated Programmatic Agreement duration of ten years instead of twenty. The ACHP declined to participate at that time. The Districted updated and legally certified the final draft of the Programmatic Agreement following the receipt of subsequent comments from the Consulting Parties regarding the interim draft. The final draft of the Programmatic Agreement was released to the Consulting Parties on August 21, 2021. The final draft was once again updated in October 2021 and submitted to the District Commander for Signature on October 18, 2021 and was subsequently routed to the New York and New Jersey State Historic Preservation Offices, and the New York City Landmarks Preservation Commission (NYCLPC) for concurrent signature. The final signature was received on January 21, 2022 resulting in a fully executed Programmatic Agreement.

The recommended plan for the HDCI project required the Programmatic Agreement to be signed and executed before the Final Feasibility Report and Environmental Assessment are released for public review. Future survey work to identify and evaluate cultural resources in the area of potential effect will be carried out after the Programmatic Agreement is executed following the stipulations laid out in the agreement.

7.12: Resource Conservation and Recovery Act, as amended, 42 U.S.C. 6901 *et seq*.

The Resource Conservation and Recovery Act controls the management and disposal of hazardous waste. "Hazardous and/or toxic wastes", classified by the Resource Conservation and Recovery Act, are materials that may pose a potential hazard to human health or the environment due to quantity, concentration, chemical characteristics, or physical characteristics. This applies to discarded or spent materials that are listed in 40 Code of Federal Regulations 261.31-.34 and/or that exhibit one of the following characteristics: ignitable, corrosive, reactive, or toxic. Radioactive wastes are materials contaminated with radioactive isotopes from anthropogenic

sources (e.g., generated by fission reactions) or naturally occurring radioactive materials (e.g., radon gas, uranium ore). No radioactive waste is expected to be encountered during the proposed dredging.

Dredging within the Action Area of the proposed project is not anticipated to generate material with hazardous levels of contamination based on current dredging operations and historical testing data from the proposed dredged areas.

7.13: Comprehensive Environmental Response, Compensation and Liability Act 42 U.S.C. 9601 *et seq*.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) governs the liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous substance disposal sites.

There are several federal and state listed contaminated sites within the nearby vicinity, however, the majority of these sites are located on land and outside of the Action Area. Contaminants of concern originating from these sites may be present within the dredging limits of the Action Area, including but not limited to, volatile organic compounds, dioxins, polychlorinated biphenyls PCBs, pesticides, and metals. Dredged material will be handled as described in the Hazardous, Toxic, and Radioactive Waste Appendix A6, which recommends dredged material be tested for placement criteria for beneficial use at an appropriate placement site able to store such material, such as the offshore HARS site. Another placement site would only be used if the analytical results exceed the limits for placement at the offshore HARS site.

7.14: Marine Protection, Research and Sanctuaries Act

The Act has two essential aims: to regulate intentional ocean disposal of materials, and to authorize any related research. While the Marine Protection Research and Sanctuaries Act of 1972 regulates the ocean dumping of waste and provides for a research program on ocean dumping, it also provides for the designation and regulation of marine sanctuaries.

Ocean dredged material placement is regulated under Section 103 of the Marine Protection Resources and Sanctuaries Act of 1972, Public Law 92-532 (Marine Protection Research and Sanctuaries Act of 1972). The law states that any proposed placement of dredged material into ocean waters must be evaluated through the use of criteria published by the USEPA in Title 40 of the Code of Federal Regulations, Parts 220228 (40 Code of Federal Regulations 220-228). The primary purpose of Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 is to limit and regulate adverse environmental impacts of ocean placement of dredged material. Dredged material proposed for ocean placement must comply with 40 Code of Federal Regulations 220-228 (Ocean Dumping Regulations) and 33 Code of Federal Regulations 320-330 and 335-338 (USACE Regulations for discharge of dredged materials into waters of the U.S.) prior to being issued an ocean placement permit. The technical evaluation of potential contaminant-related impacts that may be associated with ocean placement of dredged material is conducted in accordance with 40 Code of Federal Regulations 220-228, the Ocean Testing Manual, and the Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities.

All dredged material will be tested as established by the Marine Protection Research and Sanctuaries Act of 1972. Materials from dredge activities from the proposed dredging are expected to be placed at HARS offshore dredged material disposal site. All required testing for placement at HARS, which has its own management plan (USACE and USEPA, 2010) will be followed and confirmed during the Preconstruction Engineering and Design phase.

7.15: Executive Order 11988, Floodplain Management

This Executive Order states that Federal agencies shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out agency responsibilities. The proposed project has no effect on floodplains.

7.16: Executive Order 11990, Protection of Wetlands

This Executive Order directs all federal agencies to minimize the destruction, loss, or degradation of wetlands; and preserve and enhance the natural beneficial values of wetlands in the conduct of the agency's responsibilities. No direct or indirect impacts to jurisdictional wetlands are anticipated with implementation of this project.

7.17: Executive Order 13112, Invasive Species

Under this Executive Order, the introduction of invasive species has been evaluated in Section 6.22. The project would not induce the introduction or spread of invasive species to the project area.

7.18: Executive Order 12898, Federal Actions to Address Environmental Justice

In accordance with this Executive Order, the USACE performed an environmental justice analysis and has determined that minority and low-income populations would not bear a disproportionately high and significantly adverse share of operation or construction impacts as a result of the project. While some localized adverse effects would occur in the study area during the construction phase of the project, these effects would be temporary and would end once construction is complete. The analysis found that the category of noise and vibration, due to activities within the Kill Van Kull, may result in temporary localized adverse effects, and may also disproportionately affect the immediate environmental justice community of North Shore Community of Staten Island and Bayonne. There is not expected to be considerable noise generated by the blasting itself, as the overlying water column deadens the sound. Best management practices and if needed, local construction management measures will be employed to avoid, minimize and/or remediate these impacts (see Section 6.3.2).

7.19: Executive Order 13045, Protection of Children from Environmental and Safety Risks

This Executive Order ensures that all Federal actions address the unique vulnerabilities of children. In accordance with this Executive Order, the USACE has determined that no children would bear a disproportionately high share of adverse environmental consequences resulting from the proposed work and there should be no effect on children. As noted above, the North Shore of Staten Island is a showcase environmental justice community because of the increased number of children with elevated lead levels in their blood due to residual contamination from the area's former industrial uses. As discussed in Section 6.3.2, the Recommended Plan will not increase the existing elevated levels within community children.

7.20: Migratory Bird Treaty Act, 16 U.S.C. 703 *et seq*.; Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds

This Act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations. Negligible to a minor level of impact are expected on local migratory birds, no significant impacts to migratory birds is expected as a result of project implementation.

7.21: List of Preparers

The project delivery team for the study was extensive. It comprised team members from Districts in the USACE North Atlantic and South Atlantic Division (Norfolk, New York, and Mobile Districts) (Table 44). The team members listed below provided substantial text to the Final Integrated Feasibility Report and Environmental Assessment.

NAME	CONTRIBUTION/EDUCATION	AFFILIATION
Jesse Miller	Environmental Analyst/BS, Ecology	USACE
Jenine Gallo	Regional Technical Specialist, Environmental	USACE
Ryan Clark	Archaeologist / MA Applied Archaeology	USACE
Cheryl Alkemeyer	Hazardous, Toxic and Radioactive Waste Specialist/BS, Environmental and Occupational Health	USACE
Karen Baumert	Plan Formulator/ Study Manager	USACE
Walker Messer	Deep Draft Navigation Planning Center of Expertise Economist	USACE
Julie McGuire	Deep Draft Navigation Planning Center of Expertise Economist	USACE
Michael Morgan	Civil Engineer	USACE
Gail Woolley	Civil Engineer	USACE
Christopher Dols	Cost Engineer	USACE
Christopher Hagerman	Structural Engineer	USACE
Jong Hee Kim	Geotechnical Engineer	USACE
Paul Fitzpatrick	Real Estate Specialist	USACE
John Butler	Structural Engineer	USACE

Chapter 8: Plan Implementation

8.1: Institutional Requirements

The implementation of the Recommended Plan is subject to cost sharing and other applicable requirements of federal laws, regulations, and policies. Federal implementation of the project for commercial navigation includes, but is not limited to, the following items of local cooperation to be undertaken by the non-Federal sponsor in accordance with applicable federal laws, regulations, and policies:

a. Provide the non-Federal share of construction costs, as further specified below:

1) Provide, during design, 50 percent of the costs of design for the general navigation features of the project in accordance with the terms of the design agreement for the project;

2) Provide, during construction, 50 percent of the costs of the general navigation facilities allocated to that portion of the project with a channel depth in excess of 50 feet;

b. Provide all real property interests, including those required for relocations and dredged material placement facilities, acquire or compel the removal of obstructions, and perform or ensure the performance of all relocations, including utility relocations, as determined by the Federal government to be necessary for the construction, operation, and maintenance of the general navigation features;

c. For each relocation of a utility, or portion thereof, located in or under navigable waters of the United States that is required to accommodate a channel depth over 45 feet, pay to the owner of the utility at least one half of the owner's relocation costs, unless the owner voluntarily agrees to waive all or a portion of the non-Federal sponsor's contribution;

d. Pay, with interest over a period not to exceed 30 years following completion of construction of the general navigation features, an additional amount equal to 10 percent of the construction costs of the general navigation features less the amount of credit afforded by the Federal government for the value of the real property interests and relocations, including utility relocations, provided by the non-Federal sponsor for the general navigation features, except for the value of the real property interests and relocations provided for mitigation, which is included in the construction costs of the general navigation features;

e. For general navigation features in excess of 50 feet (MLLW), pay 50 percent of the excess cost of operation and maintenance of the project, which includes operation and maintenance of dredged material placement facilities, over that cost which the Federal government would have incurred for operation and maintenance of the project if the channel had a depth of 50 feet;

f. Ensure that the local service facilities are constructed, operated, and maintained at no cost to the Federal government, and that all applicable licenses and permits necessary for construction, operation, and maintenance of such work are obtained;

g. Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon the real property interests that the non-Federal sponsor owns or controls for the purpose of operating and maintaining the project;

h. Hold and save the Federal government free from all damages arising from design, construction, operation and maintenance of the project, except for damages due to the fault or negligence of the Federal government or its contractors;

i. Perform, or ensure performance of, any investigations for hazardous, toxic, and radioactive wastes (HTRW) that are determined necessary to identify the existence and extent of any HTRW regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, and any other applicable law, that may exist in, on, or under real property interests that the Federal government determines to be necessary for construction, operation and maintenance of the general navigation features;

j. Agree, as between the Federal government and the non-Federal sponsor, to be solely responsible for the performance and costs of cleanup and response of any HTRW regulated under applicable law that are located in, on, or under real property interests required for construction, operation, and maintenance of the project, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination, without reimbursement or credit by the Federal government;

k. Perform the non-Federal sponsor's responsibilities in a manner that will not cause HTRW liability to arise under applicable law to the maximum extent practicable; and

1. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4630 and 4655) and the Uniform Regulations contained in 49 C.F.R Part 24, in acquiring real property interests necessary for construction, operation, and maintenance of the project including those necessary for relocations, and placement area improvements; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

8.2: Real Estate Requirements

USACE projects require the non-federal sponsor provide lands, easements, rights-of-way, and relocations for a project. The Recommended Plan will require the non-federal sponsor to acquire temporary and permanent easements for construction. Since the project is currently at a feasibility-level design, the size of the real estate interests required are preliminary estimates based on available GIS data. The precise size and location of the required real estate interests will be identified during the Preconstruction Engineering and Design phase when Plans and Specifications and detailed drawings are prepared. As a result, the number of required acreage is subject to change with project refinements. The costs for the value of lands, easements, rights-of-way, and relocations are estimated to be \$1,315.1 million. In accordance with 33 U.S. Code § 2211, the relocations are cost shared with the utility owners. Accordingly, an estimated \$662.9 million of lands, easements, rights-of-way, and relocations is to be borne by the non-federal

sponsor and an estimated \$652.1 million is to be borne by the utility owners. The lands, easements, rights-of-way, and relocations include acquiring 0.17 acres in fee, 1.00 acre for temporary work easements, and 0.25 acres for a temporary road easement (Table 45). It also includes the relocation of 12 utility lines (Table 46).

	REQUIRED	NUMBER O	F PARCELS	NUMBER OF OWNERS		
REQUIRED INTEREST	ACRES	PRIVATE	PUBLIC	PRIVATE	PUBLIC	
Fee	0.169	0	2	0	1	
Temporary Work Area Easement	1.00	1	0	1	0	
Temporary Road Easement	0.25	1	1	1	1	

Table 45: Required Lands, Easements, and Rights of Way Summary

LITH ITY NAME /DESCRIPTION	LENGTH TO BE	PROPOSED				
	REMOVED (LF)	TREATMENT				
Utility 2 - (1) Gas Pipeline in Atlantic Ocean	12,000	Relocation				
Utility 2 - (1) Gas Pipeline in Verrazano Narrows	6,000	Relocation				
Utility 3 - (2) Gas 24" (2) Oil 20"	8,304	Relocation				
Utility 4 - (2) 8.75" Steel Pipes encasing six Electric Cables	4,060	Relocation				
Utility 5 - (3) Electric Power lines, about 33,000'-long each	99,000	Relocation				
Utility 6 - (1) Conduit incasing two 10" petroleum Pipelines	6,000	Relocation				

Any conclusion or categorization that an item is a utility or facility relocation to be performed by the non-federal sponsor as part of its lands, easements, rights-of-way, and relocations responsibilities is preliminary only. USACE will make a final determination of the relocations necessary for the construction, operation or maintenance of the project after further analysis and completion and approval of a Final Attorney's Opinion of Compensability for each of the impacted utilities and facilities. Details on cost sharing are provided in Section 8.4: Cost Sharing and Non-Federal Partner Responsibilities, and details on lands, easements, rights-of-way, and relocations are provided in Appendix D – Real Estate Plan.

8.3: Implementation Schedule

For Preconstruction Engineering and Design and construction to be initiated, the USACE must sign a Design Agreement with a non-federal sponsor to cost share Preconstruction Engineering and Design and must sign a Project Partnership Agreement for construction. This project would require congressional authorization for Preconstruction Engineering and Design and construction. The Preconstruction Engineering and Design and construction phases would be cost shared 50 percent federal and 50 percent non-federal. Implementation would then occur, provided that sufficient funds are appropriated to design and construct the project.

The Port Authority of New York and New Jersey and USACE have coordinated with the publics and key stakeholder groups throughout the feasibility phase. Coordination will continue during the Preconstruction Engineering and Design phase as USACE and The Port Authority of New York and New Jersey work with communities to make sure there is transparency and community involvement as the design progresses. There will be quarterly stakeholder meetings throughout the design process to ensure communities are appropriately informed and involved throughout the process.

The draft schedule for plan implementation was developed for planning and cost estimating purpose (Table 47). This schedule is dependent on congressional authorization, federal and non-federal budgeted funding, real estate acquisition, and agreement executions.

TASK	DATE					
Chief of Engineering Report Approval	May 2022					
Design Agreement	July 2022					
Preconstruction Engineering and Design	July 2022 – September 2024					
Project Partnership Agreement Execution	October 2024					
Construction	October 2024 – June 2040					

Table 47: Approximate Recommended Plan Implementation Schedule

8.4: Cost Sharing and Non-Federal Partner Responsibilities

Cost sharing for the Recommended Plan will be done in accordance with Section 101 of the Water Resources Development Act of 1986, as amended, and cost shared as a general navigation feature. The cost share is based on all recommended channel depths being greater than -50 feet. Channel depths greater than -50 feet are cost shared 50 percent non-federal and 50 percent federal. The Port Authority of New York and New Jersey will provide all lands, easements, rights-of-way, and relocations. Disposal necessary for the project is cost-shared as a general navigation feature. Aids to navigation are not anticipated to be significant; further coordination with the U.S. Coast Guard will occur during the Preconstruction Engineering and Design phase to determine the cost for aids to navigation. An additional 10 percent of the total costs of general navigation features will be repaid by the non-federal sponsor over a period not to exceed 30years. The sponsor's costs for lands, easements, rights-of-way, and relocations¹, are credited against the additional cash contribution. The Port Authority of New York and New Jersey shall also pay 50% of the excess cost of operation and maintenance of the project over that cost which the Secretary determines would be incurred for operation and maintenance if the project had a depth of 50 feet. Consistent with current New York District practice, the Port Jersey channel is anticipated to be maintained by dredging every 10 years (about 7,400 cubic yards), the

¹ Any conclusion or categorization that an item is a utility or facility relocation to be performed by the non-federal sponsor as part of its lands, easements, rights-of-way, and relocations responsibilities is preliminary only. USACE will make a final determination of the relocations necessary for the construction, operation or maintenance of the project after further analysis and completion and approval of a Final Attorney's Opinion of Compensability for each of the impacted utilities and facilities.

Anchorage Channel to be maintained every seven years (about 5,300 cubic yards), and all other channels are assumed to be maintained together in a single contract every three years (about 91,000 cubic yards).

The federal share of the Recommended Plan costs is estimated to be \$2,124.6 million and the non-federal share of the Recommended Plan costs is estimated to be \$3,439.3 million, not including \$85.3 million estimated for local service facilities (Table 48).

Recommended Plan	Total Cost	Federal Share	Non-Federal Share
General Navigation Features – Dredging ¹	\$4,248,800	\$2,124,400	\$2,124,400
Lands, Easements, Rights-of-Way, and Relocations (LERRs)	\$1,315,100	\$156 ²	\$1,314,900 ³
Project First Costs, Recommended (rounded)	\$5,563,900	\$2,124,600	\$3,439,300 ³
Additional 10% of NED Plan GNF over 30 Years Less LERR ⁴	\$-	\$-	\$-
Project First Costs including 10% of NED Plan GNF Adjustment over 30 Years	\$5,563,900	\$2,124,600	\$3,439,300 ³
Non-Federal Local Service Facilities (LSF)	\$85,300	\$-	\$85,300
USCG Aids to Navigation (100% USCG Federal Cost)	\$-	\$-	\$-
Total Project Costs – Recommended Plan including 10% of NED Plan GNF Adjustment over 30 Years (rounded)	\$5,649,200	\$2,124,600	\$3,524,600 ³
Annual Incremental OMRR&R over 50 years (GNF) ⁵	\$3,500	\$1,800	\$1,800

Table 48: Recommended Plan, Approximate Federal and Non-Federal Sponsor Costs(\$1,000s, October 2021 Price Level)

¹ Includes Preconstruction, Engineering, and Design, and Construction Management

 $^{\rm 2}$ Federal LERR costs represent administrative costs, only.

³ In accordance with 33 U.S. Code § 2211, the relocations are cost shared with the utility owners. This cost reflects \$652.1 million to be borne by the utility owners. Creditable LERR is limited to 10% of GNF.

 4 The estimated cost of Non-Federal LERR exceeds 10% of GNF costs.

⁵ Annualized at the 2.25% discount rate

Rows and columns may not add up due to rounding

8.5: Views of the Non-Federal Sponsor and Other Agencies

New York District has coordinated with the Port of New York and New Jersey continuously throughout the study. Coordination with the public and resource agencies is ongoing. A public meeting will be held during the comment period of this draft integrated report. New York District has also coordinated with pilots that use the harbor throughout the formulation process. The pilots' input was considered and incorporated into the measures and alternatives considered during plan formulation. The feedback received from the pilots was positive.

The Port Authority of New York and New Jersey and USACE have coordinated with the publics and key stakeholder groups during this feasibility phase. Two virtual public meetings were held on December 4, 2021, during the public review period of the Draft Integrated Feasibility Report and Environmental Assessment. The public meetings consisted of a presentation and a questionand-answer session. Additionally, the study team reached out to key stakeholder groups listed below.

- Baykeeper
- Citizens Advisory Committee

- Natural Resources Protective Association
- The North Shore Waterfront Conservancy of Staten Island
- Staten Island Community Board 1
- NYC Environmental Justice Alliance (NYC-EJA)
- New Jersey Environmental Justice Alliance (NJEJA)
- Urban Waters Federal Partnership
- NJ congressional district representatives
- NY congressional district representatives

Coordination will continue during the Preconstruction Engineering and Design phase as USACE and The Port Authority of New York and New Jersey work with communities to make sure there is transparency and community engagement as the design progresses.

The Port Authority of New York and New Jersey staff have indicated their support for the Recommended Plan, deepening the pathways to Elizabeth – Port Authority Marine Terminal and Port Jersey – Port Authority Marine Terminal by 5 feet to a maintained depth of -55 feet MLLW. A support letter from The Port Authority of New York and New Jersey is included in Appendix E.

Chapter 9: Recommendation

In making the following recommendations, I have given consideration to all significant aspects in the overall public interest, including environmental, social and economic effects, engineering feasibility and compatibility of the project with the policies, desires and capabilities of The Port Authority of New York and New Jersey, the State of New Jersey, the State of New York, and other non-federal interests.

I recommend that the selected plan for navigation improvements in the New York and New Jersey Harbor be authorized for construction as a Federal project, subject to such modifications as may be prescribed by the Chief of Engineers. The Recommended Plan is fully detailed in this Final Integrated Feasibility Report and Environmental Assessment. The Recommended Plan consists of deepening the channels from sea to Port Jersey – Port Authority Marine Terminal and Elizabeth – Port Authority Marine Terminal to a maintained depth of -55 feet mean lower low water.

The Recommended Plan is estimated to provide \$433.5 million in annualized benefits and have a Project First Cost of \$5,563.9 million. The plan has a benefit cost ratio of 1.8. In accordance with 33 U.S. Code § 2211, the non-federal sponsor would be responsible for funding \$662.9 million of lands, easements, rights-of-way, and relocation costs, with utility owners funding an additional \$652.1 million. The non-federal sponsor would also be responsible for 50% of the excess cost of operation and maintenance of the project over that cost which the Secretary determines would be incurred for operation and maintenance if the project had a depth of 50 feet.

The New York and New Jersey Harbor Deepening Channel Improvements study identified that a specific feasibility study would be warranted for the pathway to Howland Hook Marine Terminal. Under the same study authority, Section 216 of the Rivers and Harbors Act of 1970, I recommend that a feasibility study be initiated to determine whether there are additional federal investments warranted for channel improvements for the pathway to Howland Hook Marine Terminal.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of highest review levels within the Executive Branch. Consequently, the recommendations may be modified (by the Chief of Engineers) before they are transmitted to the Congress as proposals for authorization and implementing funding. However, prior to transmittal to Congress, the partner, the State, interested federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Matthew W. Luzzatto Colonel, U.S. Army District Engineer

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