
Section 204 Beneficial Use of Dredged Material from
Federal Navigation Project Maintenance
Detailed Project Report and
Environmental Assessment

DRAFT

Newburyport Harbor and North Point, Plum Island Newburyport, Massachusetts



US ARMY CORPS
OF ENGINEERS
New England District

January 2021

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**NEWBURYPORT HARBOR
PLUM ISLAND NORTH POINT
NEWBURYPORT, MASSACHUSETTS**

BENEFICIAL USE OF DREDGED MATERIALS

**DETAILED PROJECT REPORT
AND
ENVIRONMENTAL ASSESSMENT**



JANUARY 2021

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EXECUTIVE SUMMARY

This Study investigated the beneficial use of dredged material from maintenance of the Federal Navigation Project (FNP) for Newburyport Harbor as beach nourishment placed directly on the North Point of Plum Island in the City of Newburyport. This study was authorized by Section 204 of the Water Resources Development Act (WRDA) of 1992 (33 USC Sec. 2326), as amended. The study was conducted in partnership with the City of Newburyport and the Massachusetts Department of Conservation and Recreation (DCR). The remaining areas of beach and dunes at North Point are within the DCR's North Point State Reservation on the south shore of the Merrimack River inlet and are administered by the Salisbury Beach State Reservation located on the north side of the inlet. The city of Newburyport operates the North Point Reservation under agreement with the State.

Plum Island is a barrier island with the Atlantic Ocean to the east and extensive salt marsh to the west between the island and the mainland. Plum Island is located about 32 miles north of Boston. The northern end of the Island is primarily a residential area split between the town of Newbury and the city of Newburyport. The southern areas of the Island in the towns of Newbury, Rowley and Ipswich are part of the Parker River National Wildlife Refuge, with a State Park located at the south end of the island. Plum Island is separated from Salisbury Beach to the North by the Merrimack River inlet including the Federal Navigation Channel for Newburyport Harbor. Newburyport Harbor has been maintained by the Federal government for navigation purposes since the early 1800s. Federal maintenance of the navigation channels is carried out periodically with the dredged sand placed by hopper dredge, nearshore of the beaches in Plum Island and Salisbury on either side of the inlet. Plum Island located south of the mouth of the Merrimack River, the entrance to Newburyport Harbor, has sustained coastal storm damages and has experienced localized, acute, erosion rates along the beach face on the southern shore within the inlet. The annual coastal erosion rate at the site has been estimated at about 53 feet per year at Newburyport, far in excess of the long-term average for this region.

The town of Newbury, city of Newburyport, and town of Salisbury have all expressed their concern and interest to develop long term solutions to their erosion problems. The maintenance of the Newburyport entrance and inner channels provides an opportunity for near-term relief to the current most critically at-risk properties, which are located at North Point in Newburyport. The study area and recommended plan are shown in Figure ES-1.

Historically, the Federal Base Plan for maintenance dredging of Newburyport Harbor FNP, as followed for the past several maintenance cycles, has involved maintenance by a mid-size hopper dredge with placement of the material in designated nearshore bars (15 to 30 foot-water depth) adjacent to the beaches in Salisbury and Newburyport. Placement of the material in the nearshore site has enabled the material to remain in the littoral system of the beaches and be available for natural re-building of the beaches.



The upcoming maintenance dredging planned for the 2021-2022 construction season entails about 220,000 cubic yards (CY) of material to be removed from the 15-foot channel including required material and a 2-foot overdepth allowance, and from the 9-foot inner harbor channel, with a 1-foot allowable overdepth. Unlike previous dredging events, a portion of the material will be used as beach placement at North Point, while the remainder will go to the previously used nearshore placement sites. Recent severe erosion at North Point also extended easterly towards the shore arm of the south jetty, a feature of the FNP. A short stone spur on the upstream side of the south jetty which was constructed in 1970 to prevent flanking of the jetty, has itself been flanked by the erosion. As part of the Federal Base Plan the maintenance operation includes using about 57,000 cubic yards of the dredged material to fill-in the eroded area behind the spur jetty to address the issues with long-term stability of the south jetty. That remainder of the dredged material, about 163,000 CY, would go to the previously used nearshore placement sites as beneficial use.

Under the Section 204 project all of the dredged maintenance material, 220,000 cy, would be placed as beachfill on North Point, including the area west of the spur jetty placement site. The additional sand would increase the elevation and width of the beach berm and extend it to the west in front of the threatened homes along Reservation Terrace. The section of the fill would vary along the beachfill area, with a greater volume placed to the south end of the area where erosion has been most severe. The beachfill area is about 900 feet long by 350 feet wide and is located west of the South Jetty and would receive all 220,000 CY of the sandy dredge material. This area includes about 68 shorefront lots that

could experience damage or loss during the 2022-2032 period. Detail on the placement areas on North Point is shown in Figure ES-2.



Figure ES-2 – Beachfill Placement for the Spur Jetty Protection Base Plan and the Section 204 Expanded Beachfill Placement

Dredging would be accomplished by either a hopper dredge with direct pump-off capability that would discharge into a line moored offshore of the beaches to be filled, or by a hydraulic pipeline dredge that would pump the material from the channel through a discharge pipe.

An Environmental Assessment, Finding of No Significant Impact, and Clean Water Act Section 404(b)(1) Evaluation were prepared for the Section 204 beneficial use features and is included with this Detailed Project Report. Construction windows have been established in coordination with Federal and State agencies for protection of aquatic resources (channel dredging) and nesting shorebirds (on-beach placement). The project construction would be conducted within the following timeframes:

- Dredging Activities (by location):
 - 15-Foot Entrance Channel: All year (no timeframe restriction).
 - 9-Foot Inner Harbor Channel: 1 July to 14 February (no dredging from 15 February to 30 June).

- Placement Activities (by location):
 - Nearshore Placement: All year (no timeframe restriction)
 - On-Beach Placement at North Point: 1 September to 31 March (no on-beach placement from 1 April to 31 August)

The constructed on-beach berm at North Point will not exceed a slope of 1V:10H to ensure the shoreline functions as habitat for foraging shorebirds after project completion. With the implementation of the proposed construction windows and regulating the slope of the on-beach berm design, no unavoidable or significant environmental impacts are anticipated for this project.

Costs for the Section 204 beneficial use project are measured as the increase in cost for direct placement of all of the dredged sand on the North Point Beaches above the cost of the Federal Base Plan for placement of most of the material in the nearshore bars off the beaches and only some of the material on North Point behind the spur jetty. The increased cost for construction of the beach nourishment plan is estimated at \$497,600. The 35 percent non-Federal share of the §204 project is estimated at \$173,950. The 65 percent Federal share would be \$323,050.

The purpose of the Section 204 project, and the benefits produced are solely for storm damage reduction. Benefits for the increased beachfill include delaying the loss and damage of the protected properties for the lifespan of the beachfill. The lifespan of the beachfill is estimated at 3-4 years for Plum Island. All the properties to be protected are private parcels currently developed for residential use. The estimated benefits of the project include delays in damages to structures, value of land lost, and repairs and replacement of damaged utilities that serve the properties subject to damage. Incidental recreation benefits would also be realized. The incremental construction cost of beach nourishment is \$497,000 or \$57,600 when annualized over the 10-year period of analysis used for North Point (Table ES-1). Net annual benefits amount to \$1,455,900 yielding a Benefit to Cost Ratio of 26.3 to one. These benefits indicate a positive National Economic Development plan for beneficial use of dredged material to provide coastal storm damage risk reduction in the city of Newburyport, Massachusetts.

The analysis indicates that nourishment North Point Beach is feasible, environmentally acceptable, and economically justified. This report concludes that there is Federal interest in proceeding with implementation of a project for the beneficial use of dredged material from Newburyport Harbor under the authority of Section 204 of the Water Resources Development Act of 1992 (33 USC Sec. 2326), as amended, in accordance with the Recommended Plan identified in this Detailed Project Report, with such further modifications thereto as in the discretion of the Chief of Engineers may be advisable.

Table ES-1 Newburyport Harbor and North Point, Plum Island, Massachusetts Section 204 Beneficial Use of Dredged Materials Project Projected Costs and Cost-Sharing		
Dredging and Placement - Cubic Yards	Base Plan	CY with §204
Total Maintenance Dredging	220,000	220,000
Behind Spur Jetty - South Jetty Flank Protection	57,000	57,000
Nearshore Feeder Bars – Salisbury and Plum Island	163,000	- - -
Expanded North Point Beneficial Use Placement	- - -	163,000
Project First Costs (FY 2021 Price Levels)	Base Plan	Cost with §204
Project First Costs for Design & Construction	\$6,137,000	\$6,619,000
Total Investment Cost (with IDC)	\$6,149,800	\$6,653,500
Cost Difference – Cost of Section 204 Project	\$503,700	
§204 Project Cost-Benefit Analysis (FY 2021 Price Levels)		
Capital Recovery Factor – 2.5% at 10 Years	0.114259	
2021 Annual Costs for 10-Year Period of Analysis	\$57,600	
Annual Benefits for 10-Year Period of Analysis	\$1,513,500	
Net Annual Benefits	\$1,455,900	
Benefit Cost Ratio	26.3	
Cost-Sharing – Design & Implementation (FY22)	Base Plan	Cost with §204
Fully Funded Project Cost (December 2021)	\$6,312,000	\$6,809,000
Cost Difference	\$497,000	
Federal Cost – 65%	\$323,050	
Non-Federal Cost – 35%	\$173,950	

Implementation of the Section 204 project requires approval of this report and the project, securing all required Federal, State and local regulatory approvals for the modified disposal plan, commitment of funds by the Federal Government and the non-Federal Sponsor, the Massachusetts Department of Conservation and Recreation, execution of a Project Partnership Agreement between the USACE and the non-Federal Sponsor, provision of all required easements by the non-Federal Sponsor for construction and maintenance of the beachfill and public use and access to the beaches receiving the fill, preparation of plans and specifications, solicitation of bids, award of a contract, and completion of construction.

The recommendations contained in this report reflect the information available at this time and current USACE 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 higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are authorized for implementation funding.

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1 Study Information

1.1 Introduction

This Detailed Project Report and Environmental Assessment (DPR/EA) presents the results of studies to formulate and evaluate alternatives to beneficially use dredged material from the maintenance of the Federal Navigation Project (FNP) for Newburyport Harbor at North Point, Plum Island, Massachusetts. The study was requested by the city of Newburyport and the Massachusetts Department of Conservation and Recreation (DCR). Two alternatives were evaluated: the Federal Base Plan consisting of the least costly means of project maintenance, and beneficial use for coastal storm risk management through onshore placement on the beach at North Point.

Plum Island is located about 32 miles north of Boston in northern Essex County along the State's easterly Atlantic coast. Plum Island is a barrier island with the Atlantic Ocean to the east and extensive salt marsh to the west between the island and the mainland. The 8.3-mile long island lies between the Merrimack River inlet at its northern end and Ipswich Bay at its southern end. The southern 6.3 miles of the island are within the Parker River National Wildlife Refuge (PRNWR). The northern two miles of the Island is primarily a residential area split between the town of Newbury to the south (1.4 miles) and the city of Newburyport at its northern end (0.6 miles).

The project area is located along the south shore within the inlet between the inlet's south jetty and the shoal upstream at the old U.S. Coast Guard Station (Figure 1) within the city of Newburyport. The study area has beachfront homes, businesses, the state park, and the old U.S. Coast Guard station ranging from 150 – 615 feet from the water (average 355 feet). The developed portion of the Island is bound by the Merrimack River and tidal inlet to the west and north, Atlantic Ocean on the east, and the PRNWR to the south (Figure 1). The study area is state land administered by the DCR and is managed by the city of Newburyport under agreement with the Commonwealth of Massachusetts.

Plum Island is separated from Salisbury Beach to the North by the Merrimack River inlet including the Federal Navigation Channel for Newburyport Harbor. Newburyport Harbor has been maintained by the Federal government for navigation purposes since the early 1800s. Federal maintenance dredging of the navigation channels is carried out periodically with the sandy dredge material placed by hopper dredge to nearshore placement sites off the beaches in Plum Island and Salisbury (Figure 1).

This DPR/EA examines the potential for beneficially using a portion of the sand dredged for maintenance of the entrance and inner harbor channels at Newburyport Harbor. The most recent condition survey results show that the channels have shoaled to depths impeding safe navigation with an accumulated 220,000 CY of shoal material, including allowable overdepth. The 220,000 cubic yards of

material is clean sand and suitable for onshore placement for coastal erosion prevention. A hopper dredge or a hydraulic pipeline dredge will perform the work and sand will be disposed of at either of the three disposal sites: Plum Island nearshore placement site, Salisbury nearshore placement site, or directly on the beach at Plum Island, North Point. The project sites are shown in Figure 1. The beach placement site is a candidate for beach nourishment under the Corps of Engineers beneficial use of dredge material program (§204) and is the proposed alternative discussed in this report. The New England District of the Corps of Engineers (NAE) has examined environmental resources as part of the planning and development of the proposed work in compliance with the National Environmental Policy Act of 1969 and appropriate Federal laws, Executive Orders and regulations. This report and accompanying Environmental Assessment provide document investigations and evaluate environmental impacts and alternatives considered for the proposed upcoming maintenance dredging action.

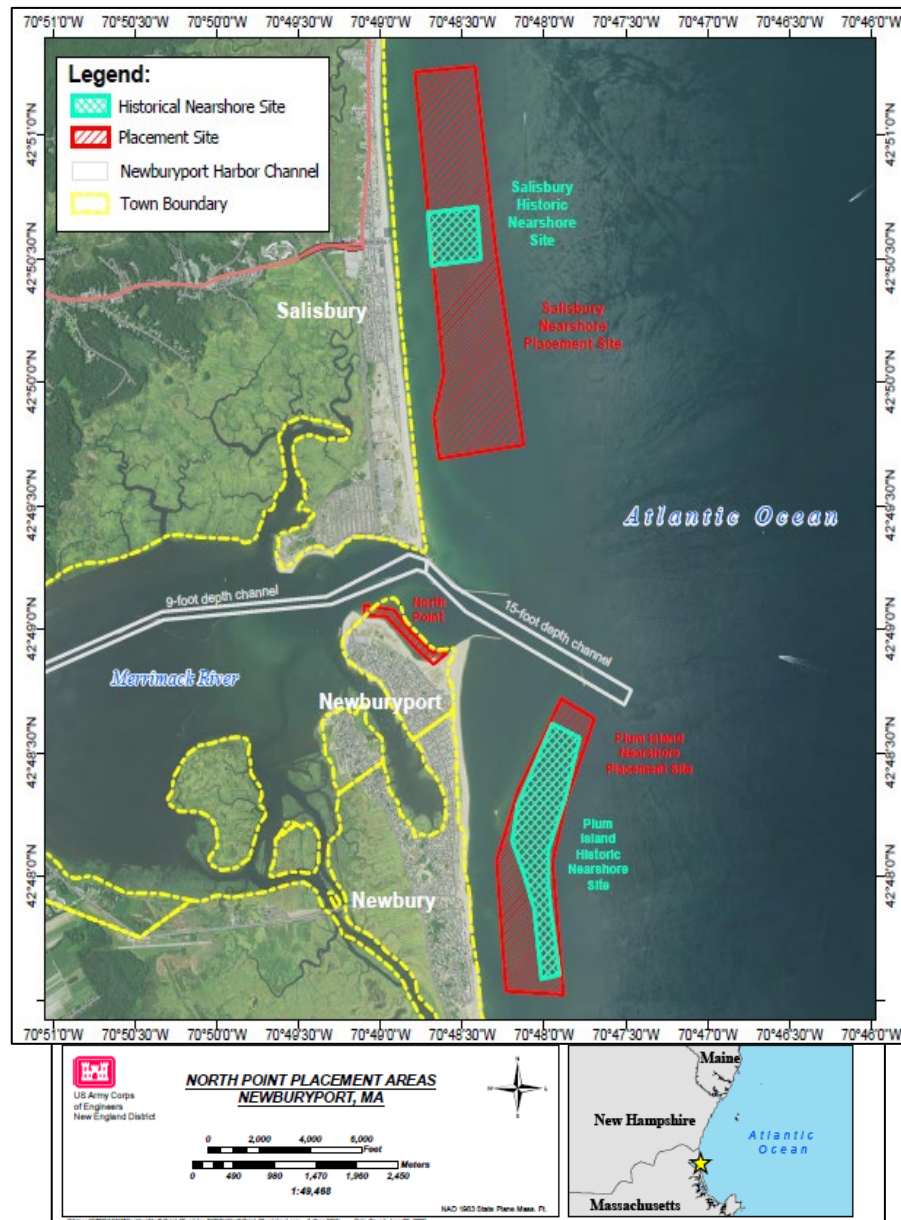


Figure 1. North Point Placement Area and Study Location

1.2 Study Purpose and Authority

The NAE received a request from the city of Newburyport, Massachusetts seeking Federal assistance under Section 204 of the Water Resources Development Act (WRDA) of 1992. Section 204 provides authority for USACE to plan, design, and build projects to protect, restore and create aquatic and ecologically related habitats in connection with dredging of authorized Federal navigation projects. Typically, Section 204 projects involve the beneficial use of dredged material from navigation channels to improve or create wetlands or waterbird nesting habitats, nourish beaches, or otherwise provide flood risk mitigation or coastal storm damage reduction benefits. The local non-Federal Sponsor, the city of Newburyport, understands and agrees with the study/project requirements, including typical costs and cost-sharing.

Initial analysis during the Federal Interest Determination (FID) phase showed federal interest for a beneficial use project at Plum Island for placement of material on a beach site at North Point, Plum Island, Newburyport, Massachusetts.

1.3 Congressional Districts

The city of Newburyport is in Massachusetts U.S. District 6.

1.4 Non-Federal Sponsorship

The DCR is the non-Federal Sponsor.

1.5 Purpose and Need for the Project

The coasts of Plum Island and Salisbury Beach are experiencing severe coastal erosion. This erosion has generated a local interest in the placement of clean, sandy dredge material on the beaches. Suitable dredge material for this placement will be available during the next maintenance dredging event for the Newburyport Harbor navigation channels for Newburyport Harbor are next maintained (estimated 2020-2021). The erosion area at North Point is approximately 2,300 feet long to the west of the South Jetty. Much of the Reservation's beach and dunelands fronting the inlet have been lost over the past eight years. This leaves only a narrow buffer of remaining dune between the inlet waters and the developed shoreline. Residential and commercial property damage and loss is likely with the next severe winter storm or major rainfall event in the Merrimack River Basin. Plum Island and other local beaches surrounding Newburyport Harbor have sustained coastal storm damages and have experienced localized, acute, erosion rates along the beach face exposed to the Atlantic Ocean. Several structures, including residences and one commercial building, have potential for severe damages in the immediate future. Other areas of Plum Island's Atlantic facing shore have lost homes in the past five years.

1.6 Feasibility Study and Environmental Assessment Purpose

This integrated document serves as the USACE decision document supporting the recommended project and as the EA to meet National Environmental Policy Act (NEPA) requirements for the proposed action.

The analysis conducted during the Feasibility Study determines if the project is warranted and necessary and if necessary, recommend actions.

The NEPA Council on Environmental Quality (CEQ) Regulation, Section 1502.13, provides the fundamental legal guidance on Purpose and Need statements for an EA. The Purpose and Need statement, “shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action.” This step in the NEPA process mirrors a similar step in the USACE 6-step planning process, development of problems and opportunities statements. Once the problems and opportunities are properly defined, the next step is to define the study planning objectives and the constraints that will guide efforts to solve these problems and achieve these opportunities. In developing a feasibility report with integrated NEPA components, the problem and opportunities can be used synonymously with “need” and objective and constraints can be used synonymously with “purpose”.

1.7 Study Location

The study area is within the city of Newburyport portion of Plum Island at its northern end. Plum Island is a barrier island with the Atlantic Ocean to the east and extensive salt marsh to the west between the island and the mainland. Plum Island is located about 32 miles north of Boston. The northern end of the Island is primarily a residential area split between the town of Newbury and the city of Newburyport. The southern areas of the Island are included in a State Park and the PRNWR located in the towns of Newbury, Rowley and Ipswich. Plum Island is separated from Salisbury Beach to the North by the Merrimack River inlet including the Federal Navigation Channel for Newburyport Harbor and the inner channel. Newburyport Harbor has been maintained by the Federal government for navigation purposes since the early 1800s. Federal maintenance of the navigation channels is carried out periodically with the dredged sand placed by hopper dredge, nearshore of the beaches in Plum Island and Salisbury on either side of the inlet.

The project’s non-Federal Sponsor, the DCR and the city of Newburyport requested that the USACE investigate beneficial use of sand as beachfill at North Point due to the severity of the recent erosion in that area. The project area is located between the inlet’s south jetty (to the east) and the point and shoal at the old Coast Guard Station (Figure 1) upstream within the city of Newburyport. The study area has beachfront homes, businesses, the state park, and the old U.S. Coast Guard station ranging from 150 – 615 feet from the water (average 355 feet).

1.8 Federal Navigation Project and Prior Reports

1.8.1 Existing Navigation Projects

The Merrimack River entrance channel to Newburyport Harbor was authorized by Congress as a FNP in 1828. Initial efforts to improve navigability in the first part of the 1800’s included small stone jetties within the inlet, a stone filled timber crib dike was constructed westerly from Plum Island 1,680 linear feet to Woodbridge Island and across the flats to the west to constrain the river flow to increase inlet velocities to effect reduced shoaling of the inlet bars. From 1881 the construction of North Jetty started and was completed in 1906; and

construction of the South Jetty in from 1883 to 1906. The jetties lined both sides of the inlet with the intention of scouring the channel to 17 feet below Mean Low Water (MLW). Construction of the jetties, as well as sand-catch weirs and dikes landward of the southern jetty, acted to stabilize the location of the inlet which had historically migrated south for about a mile before reversing over a long term cycle. Following construction, repairs, extensions, and maintenance of both jetties were completed as needed.

Newburyport Harbor FNP was last maintained in the 2010-2011 dredging season when approximately 165,500 cubic yards (CY pay volume) were removed from the entrance channel by hydraulic pipeline dredge and placed as nourishment on Salisbury Beach (43,000 CY) and Plum Island Center Beach in Newbury (more than 123,500 CY) as a §204 Project. Prior to this, the channel was maintained in 1999, when approximately 145,000 cubic yards were removed and placed at the Plum Island nearshore placement site. Typically, this maintenance dredge material is placed nearshore as the least cost alternative, alternating between the Plum Island and Salisbury Beach nearshore placement sites.

The existing 15-foot Federal channel is typically dredged with a 2-foot allowable overdepth to a pay elevation of -17 feet at mean lower low water (MLLW). The inner harbor channel from the inlet to downtown Newburyport ending at U.S. Route 1 has an authorized depth of -9 feet MLLW and is dredged with a one-foot allowable overdepth to a pay elevation of -10 feet MLLW. The most recent conditions survey results show that the entrance inner harbor channels have shoaled to depths impeding safe navigation with an accumulated 220,000 CY of material, including allowable overdepth. The 220,000 cubic yards of material are clean sand and suitable for onshore placement for coastal erosion prevention.

The jetties were rehabilitated with the intention of reducing porosity and thus inhibiting the flow of water and sediment through the jetties. Maintenance dredging of the federal channel was completed in 1937-1941, 1957-1958, 1961, 1964, 1966, 1968, 1970, 1973, 1981, 1983, 1996, 1999, and 2010. In addition, construction of revetment and sand dike near the U.S. Coast Guard Station along the south bank of the inlet in the river's mouth occurred in 1970. Material from past maintenance dredging cycles has been placed nearshore or directly on the eastern shores of Plum Island and Salisbury Beach.

The existing Federal projects in Newburyport Harbor, consists of:

- Two jetties, one projecting 4,118 feet from the north shore, the other projecting 2,445 feet from the south shore, converging until 1,000 feet apart.
- Entrance Channel
- Inner Harbor Channel
- Dikes in Inlet and Harbor
- Removal of ledges and large boulders in harbor

The maintenance dredging history of the 15-foot and 9-foot Federal channels at Newburyport Harbor is summarized in Table 1. Disposal options have included offshore open water disposal by hopper dredge, nearshore disposal by hopper dredge, or disposal adjacent to the

channel by sidecasting dredge. Section 3, Alternatives, discusses the various nearshore and beach disposal sites for this project.

Table 1: Maintenance Dredging History of Entrance Channel

Dredge Type/Contractor	Work Dates	Quantity in Cubic Yards (CY)
Government Hopper Dredge HYDE	26 July - 12 August 1961	250,000
Government Hopper Dredge HYDE	18 - 25 May 1964	131,000
Government Hopper Dredge LYMAN	3 - 16 May 1966	50,000
Government Hopper Dredge HYDE	2 - 13 July 1968	86,000
Contractor	20 August - 16 Oct 1970	106,190
Government Hopper Dredge HYDE	15 August - 3 September 1973	93,650
Government Hopper Dredge DAVISON	16 June - 3 July 1977	54,000
Contractor Hopper Dredge ATCHAFALAYA	19 June - 1 July 1981	102,600
Contractor Hopper Dredge MERMENTAU	9 - 26 August 1983	123,500
Contractor Hopper Dredge	July – September 1987	156,265
Government Hopper Dredge CURRITUCK	June – July 1990	62,460
Contractor Hopper Dredge GULF COAST TRAILING	August - September 1991	135,290
Contractor Hopper Dredge NORTHERLY ISLAND	26 - April - 10 May 1993	125,040
Contractor Hopper Dredge	8 – 26 September 1996	125,386
Contractor Hopper dredge ATCHAFALAYA	28 July – 16 August 1999	145,017
Contractor Hydraulic cutter-head pipeline dredge Great Lakes D&D - ILLINOIS	16 September- 14 October 2010	143,500

1.8.2 Prior Studies and Reports

A 2018 study analyzing shoreline change on northern Plum Island was performed by USACE's Engineering Research and Development Center (ERDC), Coastal & Hydraulics Laboratory at the request of NAE under the Dredging Operations Technical Support (DOTS) program. The study examined shoreline position using historical and modern aerial and satellite images from 1960 to 2016; aerial LIDAR flown in 2014 and 2015; and a 2016 beach profile survey by NAE. The study concluded the northeast facing beach (North Point) along Reservation Terrace is highly variable with regard to shoreline position and has experienced a cyclical erosion and accretion pattern over time (Figure 2). From 1960 to 1975 the shoreline is substantially erosional, having lost approximately 700 feet of dry beach in 15 years, with substantial erosion occurring between 1965 and 1975. From 1975 to 1995 the shoreline is in some level of stability, or dynamic equilibrium, with short periods of accretion and erosion of approximately less than 200 feet of change. From 1995 to 2008, the shoreline is accretionary having recovered some 700 feet of shoreline that was lost in the 1960s and 1970s. Sometime between 2008 and 2012, the trend reverses and becomes erosional. Although there is

insufficient temporal resolution to discern the beginning of erosion and accretion periods, the study estimates the northeast-facing shoreline began eroding again in 2009 or 2010. If the shoreline follows the historical, cyclical pattern observed, the northeast-facing shore can expect erosion for at least 10 years after the rehabilitation of the jetties.

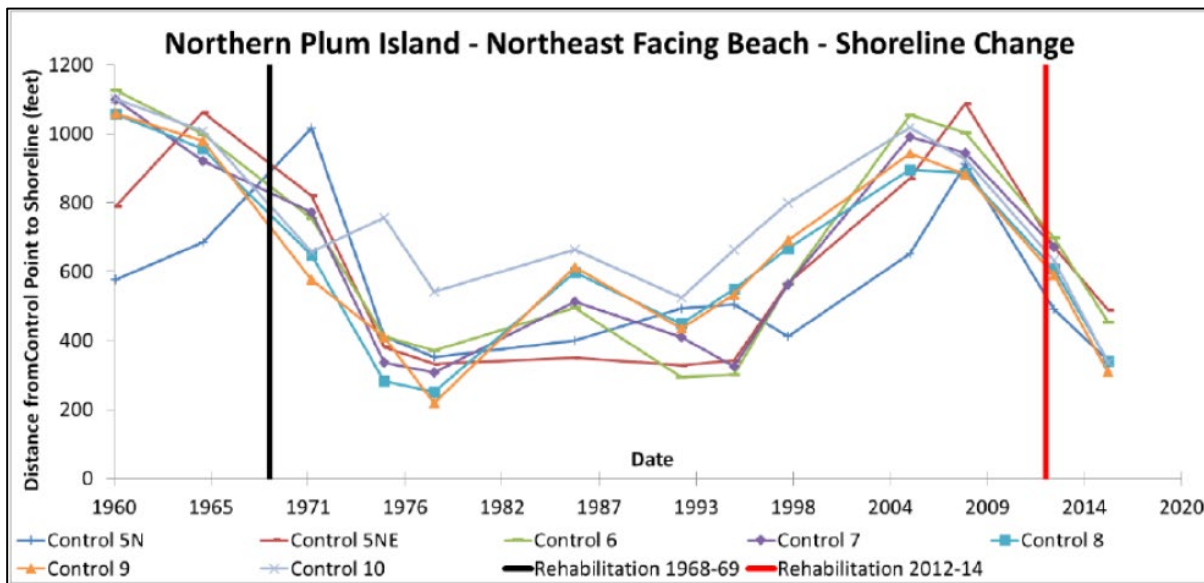


Figure 2. Cyclical Beach Erosion and Accretion Pattern at Plum Island North Point - From 1960-2016 (Taylor, 2018)

In the study area, Massachusetts Coastal Zone Management (CZM) has historic high-water shorelines and shoreline change transects for 1909-1938, 1943-1969, 1970-1982, 1994, 2000, and 2007-2009. Figure 3 illustrates the variability in shoreline location. Long-term change is based on all available shorelines, whereas short-term change is based on shorelines between 1970 and 2009. Accretion and erosion are indicated by positive and negative values, respectively. Due to the cyclical erosion and accretion pattern described in the 2018 DOTS study and the age of the most recent shoreline position, these shoreline change rates were not considered to be reflective of the current and future short-term erosion conditions.

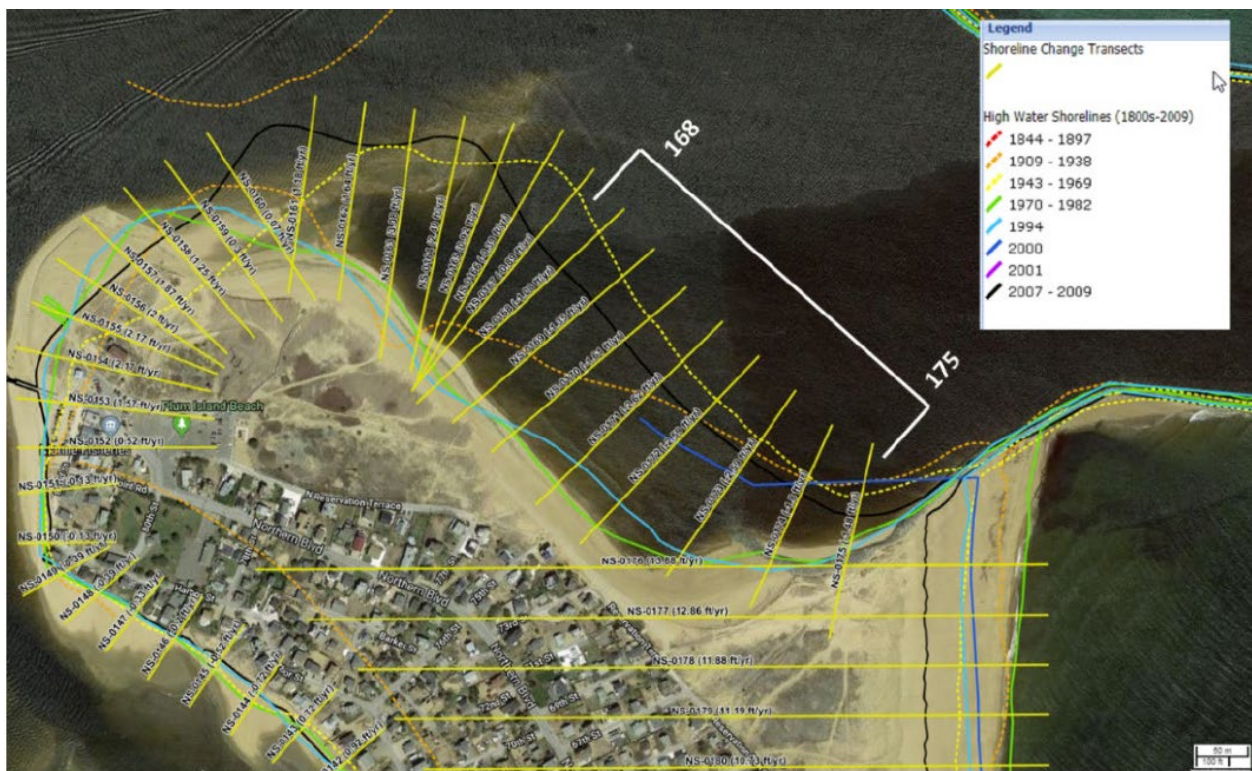


Figure 3. Massachusetts CZM Historic Shorelines and Shoreline Change Transects.

Kraus (2008) conducted a short-term study of possible factors contributing to beach erosion on Plum Island by the Newburyport Harbor FNP. As part of this study, Kraus reviewed the historical impact of jetty rehabilitation and concluded that substantial erosion of the interior beach had occurred in the 1970s immediately following the initial rehabilitation effort. In 1970, in an effort to mitigate against shore erosion at the U.S. Coast Guard Station and the NAE undertook a contract to construct a sand dike and riprap shore protection along the northern Plum Island beach. This sand dike was constructed to an elevation of +22.5 feet MLW, well in excess of the tide range and wave run-up. While there have been a few local attempts by the Commonwealth of Massachusetts and private entities at nourishment in small quantities, USACE has not nourished the northern Plum Island beach since.

2 Plan Formulation

2.1 Navigation Inefficiencies and Need for Project Maintenance

Hydrographic surveys of the entrance channel are performed periodically to identify shoals in the FNP. The shoals present a hazard to navigation and under certain tidal conditions, seas become violent in the entrance channel. Under these conditions, vessels using the harbor are subject to unsafe conditions which may result in hazardous situations and damages. Dredging will restore navigability to the channel and alleviate these potentially hazardous conditions.

2.2 Planning Goals & Objectives

The placement of Newburyport Harbor dredged material alternative was developed based on meeting the following goals and objectives:

- Prevent or delay coastal erosion damages and risks to life and property at North Point Plum Island, including homes, commercial structures, and public infrastructure.
- Provide an economically efficient solution. The additional cost of on direct onshore placement of the material must be outweighed by the benefits of that placement.
- Provide a constructible solution. On shore placement of dredged material has many construction related challenges due to equipment availability and wave and tide activity.
- Provide an environmentally acceptable solution with minimized impacts to shoreline as regulated by Massachusetts Coastal Zone Management.

2.3 Future Without-Project Conditions

Future without-project conditions forecast the conditions expected during the period of analysis if no beneficial use beachfill project is constructed. The future without project condition also provides the basis from which alternative plans are formulated and damages are assessed. This study will forecast the conditions expected at Plum Island Beach in Newburyport over the next ten years if no material is placed directly onshore following maintenance dredging expected in the 2021-2022 dredging season. Specifically the analysis will evaluate what structures and/or other infrastructure will be affected by coastal erosion damages and when, over the ten year period, assuming the erosion rate will not change over that time. Historic shoreline erosion rates were used to project the future condition of the beach.

Without this project, the beach area will not be restored to contribute to the functioning, health, and resiliency of the Plum Island community. This alternative would take no further action. Without dredging, this would allow the shoaling to remain, along with extremely hazardous conditions. Without the beneficial use of the North Point beach site, homes, businesses, and critical infrastructure are at risk for total loss or increase in damage potential. The severe erosion experienced along Reservation Terrace, North Point beaches, was estimated at an annual rate of 53 feet per year verified against the latest survey. Plum Island were surveyed by USACE in 2019, providing a detailed and accurate topographic map of the dry beach and dunes. Details of these surveys and the resulting retreat calculations are provided in Appendix B - Coastal Engineering.

2.3.1 Utility and Transportation Infrastructure

Northern Boulevard provides access to the Plum Island Turnpike, which is the only access for vehicles traveling to and from Plum Island. Flooding and associated damage to Northern Boulevard could isolate a portion of the population living in the northern part of Plum Island in the Newbury and Newburyport sections. In addition, although outside of the study area, damage to Plum Island Turnpike, or the bridge and causeway, could have direct effects on the study area with isolation of portions of the island not evacuated prior to a storm event.

Utilities would also be in jeopardy from severe over wash events or a collapse of the road. If long term erosion is left to continue, it could eventually undermine Northern Boulevard and expose water and sewer lines causing damage to those systems requiring their shutdown for an extended period for repair, cleaning and rehabilitation to remove infiltrated seawater and return the system to service. At an extreme, infiltration of seawater into the Newburyport sewer system as far as the treatment plant could have substantial impact on City service beyond Plum Island. Even undamaged properties may need to be temporarily abandoned until service could be restored. It is likely that the town of Newbury and the city of Newburyport will expend funds to prevent damage from occurring to major island roads. Placement of dredge material at North Point will delay the future expenditure of these funds by protecting the major roadways and utilities.

2.3.2 Protection of Shorefront Property

Shorefront properties, mainly private residences, occupy the frontal dunes in the areas exposed to severe erosion alongside Reservation Terrace, North Point Plum Island. In the without project condition these properties would continue to be at severe risk as the beach retreats shoreward. These losses will continue without measures to restore and maintain the beach system in North Point Beach area.

2.4 With Project Condition (Future Beach Conditions with Federal Action)

Future with project conditions forecasts the most likely conditions expected during the period of analysis if the selected beneficial-use project, direct placement of sand at North Point is constructed. The future with project condition provides the basis from which benefits resulting from the construction project are calculated. The primary account used to calculate benefits from a storm damage reduction project is national economic development (NED). This study forecasts the conditions expected on Plum Island North Point over the next 10 years if the 220,000 cubic yards of available material is placed directly onshore, rather than in the nearshore bar system, during the upcoming maintenance dredging of Newburyport Harbor, expected to occur in 2021-2022. Specifically, the analysis will evaluate how the project will either prevent or delay coastal erosion damages to structures and infrastructure over the ten-year (2022-2032) period of analysis, assuming the erosion rate will not change over that time.

2.5 Public Involvement

The project area falls within the geographical area that is the focus of the Merrimack River Beach Alliance (MRBA). The MRBA is a group of elected officials, organizations, agencies, municipalities, and the public, that began meeting in 2000 to discuss ways of building a relationship with partners and the community while addressing the erosion issues within the municipalities Newburyport, Newbury, and Salisbury. The Alliance's efforts for stewardship includes ways to develop and implement increases in public awareness of this unique habitat and expand the number of citizens, businesses, educators, local officials, politicians, and others who will support the environmental stewardship initiative for making the Merrimack River area beaches sustainable.

A Merrimack River maintenance dredging meeting was held in August 2016 followed by the USACE §204 town meeting in July 2016 then a field reconnaissance and site visit on August 2018.

2.6 Formulating Alternatives

The alternatives were developed based on meeting the goals and objectives, as analyzed for the ten-year period of analysis (2022-2032).

The NAE is proposing to dredge approximately 220,000 cubic yards (CY) of sandy material from shoaled areas within the Newburyport Harbor FNP. A hydraulic dredge or hopper dredge, potentially with pump-off capability will be used. This entrance and harbor channels will be dredged to the authorized project depth plus a possible 1 foot of allowable overdepth. The Federal Navigation Channel was last maintained in the 2010-2011 dredging season when approximately 165,500 cubic yards (CY) were removed from the channel by hydraulic pipeline dredge and placed as nourishment on Salisbury Beach (43,000 CY) and Plum Island Center Beach in Newbury (more than 123,500 CY) as a §204 Project. The beach areas nourished in the 2010-2011 project are located about one mile south and north of the beach areas currently being considered and in different municipalities.

Three alternatives have been developed:

- No Action
- Federal Base Plan – direct beach placement to protect the spur jetty (57,000 CY) in addition to nearshore disposal at both Salisbury and Plum Island nearshore sites (163,000 CY)
- Direct Beach Placement of all 220,000 CY at North Point, Plum Island, of which 163,000 CY would be placed under Section 204 authority.

2.7 Disposal Options

Offshore Placement - Historically, dredged material from Newburyport Harbor was disposed of at an offshore placement site (USACE, 1973). The 1973 Environmental Assessment describes the location of this site as: "An area one-half nautical mile square, the sides of which run true north and south and true east and west. The center is at a point with Black Rock Light bearing true 289°, a distance of 3,700 yards; and Newburyport Light bearing true 272°, a distance of 3,200 yards.

Currently, it is the Corps policy to place sandy dredged material at a nearshore site in order for the material to remain within the littoral system of the project area. Offshore placement was therefore not considered as a preferred alternative for the dredge material from Newburyport Harbor.

Nearshore Placement - Two nearshore placement sites were considered for this project. One area is located adjacent to Plum Island Beach and the second adjacent to Salisbury Beach. Both sites has been successfully used in the past for placement of sandy dredged material. Investigation of sediment transport patterns along the Plum Island - Salisbury Beach system

and coordination with the applicable resource agencies indicates that the placement of the sandy dredged material in the nearshore areas would keep the material within the littoral drift system. Nearshore placement will make material available for movement onto the adjacent beaches.

Upland Disposal - The material to be dredged is clean sand that is an important component of the Plum Island-Salisbury Beach system and considered a valuable resource, therefore the removal of this material from the system is deemed unacceptable. Upland disposal was not considered as a preferred alternative for the disposal of material from Newburyport Harbor.

Beach Renourishment – North Point, Newburyport, beach site was evaluated for sand placement. The area was identified and selected sites for sand placement based on the need to alleviate severe beach erosion. The placement of the sandy dredge material on adjacent beaches is considered a practice of beneficial use. The placement of the material on the selected beach sites is considered practical and therefore retained as a possible beneficial re-use alternative.

Beach Renourishment to Protect the Spur Jetty – The landside area behind the spur jetty located adjacent to the North Jetty on North Point, Newburyport, was evaluated for sand placement. Protecting this USACE structure is crucial to the overall system. The area was identified and selected for sand placement based on the need to alleviate severe beach erosion that could compromise the spur jetty structure. The placement of the sandy dredge material is considered a practice of beneficial use. The placement of the material on the selected area of the beach is considered practical and therefore retained as a possible disposal beneficial re-use alternative.

2.8 Dredging Methods

There are a number of dredging methods that could be employed at Newburyport Harbor. Below are the dredge options that could work at Newburyport Harbor:

- **Large Hydraulic Pipeline Dredge:** A hydraulic pipeline dredge remains stationary while it pumps the material through a pipeline to the disposal area. These dredges typically have pump and pipeline diameters of 20 to 30 inches or more and have a much larger dredge hull and much more robust anchoring systems that could be operated stably in the sea conditions of the Newburyport entrance. A pipeline would extend from the working dredge into the inlet to the shore end of the jetties, where it would cross the jetty and transition to a land line extending along the beaches to the discharge area. An A-frame barge would be used to position the floating pipe in the inlet. Heavy equipment such as a small dozer would be used to lay and extend the pipe on the beach, form toe dikes along the discharge area to minimize loss of beach-fill material to the surf, and to spread and grade the material to the finished elevations and slopes.
- **Mechanical Bucket Dredge:** A mechanical dredge operates from a stationary position while removing the material with a clamshell bucket and loading it into scows which transport it to the disposal site. A mechanical dredge utilizing scows to transport and dispose of material for use in nearshore disposal would be able to effectively dredge

the project area. However, such a dredge plant could not directly place the material on the beaches and would only be used if the nearshore disposal sites were the preferred plan.

- **Small Split-Hull Hopper Dredge:** A hopper dredge moves through the dredging area, removing the material from the bottom and pumping it into the hopper. When the hopper is full the dredge proceeds to the disposal site and empties the material through bottom opening doors. A hopper dredge would be an effective dredging method in the Merrimack River. Historically, maintenance dredging of the entrance channel has been performed by small class, self-propelled hopper dredges. Hopper dredges are less subject to damage from wave action and have little impact on vessel traffic because they dredge while underway, and do not employ anchoring devices while working in the channel. A small hopper dredge using split hull discharge could be used if the preferred disposal plan involved use of the nearshore sites offshore of the beaches.
- **Large Pump-Off Hopper Dredge:** For hopper dredging with direct placement on the beaches a large-class hopper dredge with onboard pump-off capability would be required. A pump-off configured hopper dredge removes the material in the manner of a typical hopper dredge, but has the ability to pump the material ashore by connecting to a pipeline anchored off the receiving beach. These vessels are larger than those typically used to working in New England waters. Using this method, a pipeline would be placed along the beach through the beach-fill areas with a branch leading offshore to a moored or barge-mounted connection in a water depth sufficient for the loaded hopper dredge to tie-up and connect to the discharge line.

If nearshore placement is used for disposal, the use of either a small hopper dredge or a mechanical dredge is the preferred dredging method for this project. If direct beach placement is performed as a beneficial use, then either a large pump-off hopper or a large hydraulic pipeline dredge would be preferred.

Dredging will occur during a single three to four month period depending on the availability of funds. This assessment shall be reviewed periodically to determine its continuing applicability.

3 Alternatives

3.1 Federal Base Plans

3.1.1 No Action

The only alternative to maintenance dredging of the Newburyport Harbor entrance channel and the inner channel is the No Action alternative (not maintaining the channel). This would allow the shoaling to remain, along with extremely hazardous conditions. The fishing fleet will suffer long term increased economic costs from delays. The businesses of party/tour boat operators may be damaged by cancellations due to rough seas at the entrance channel, resulting in long-term financial losses. Hazardous sea conditions near the shoaled areas will

continue to cause unsafe conditions and endanger small craft. Dredging will restore navigability to the channel and alleviate these potentially hazardous conditions.

Should the maintenance dredging proceed without the beneficial use beach placement sites, it would need to rely on the nearshore placement sites. Without the beneficial use of the North Point beach site, homes, businesses, and critical infrastructure are at risk for total loss or increase in damage potential.

3.1.2 Federal Base Plan – Nearshore Disposal

The Federal Base Plan for maintenance dredging of Newburyport Harbor, as practiced for the past several decades, is dredging by either a medium-sized (~2,800 CY capacity) hopper dredge or a mechanical bucket dredge, with disposal at the Plum Island and Salisbury nearshore sites to keep the sand in the littoral system. The hopper dredge or dredge scows discharge their load by opening the doors in the hopper floor or scow bins at a location estimated to be approximately 2,500 feet from shore in 18 to 30 feet of water. Possible consequences of the Federal Base Plan (no-action alternative) would include continued erosion and retreat of the beaches, without a natural source of material to renourish the adjacent beaches, resulting in greater damages to structures sooner, than if the dredged sand were placed directly on the beach.

Two nearshore disposal sites were considered for this project. One area is located to the south of the project adjacent to Plum Island Beach and the second being adjacent to Salisbury Beach (Figure 1). Investigation of sediment transport patterns along the Plum Island - Salisbury Beach system and coordination with the applicable resource agencies indicates that the placement of the sandy dredged material in the nearshore areas would keep the material within the littoral drift system. Nearshore placement will make material available for movement onto the adjacent beaches. In addition to the nearshore placement sites, 57,000 CY of dredge material will be placed along the south jetty spur to protect the structure from additional erosion that could compromise the system.

- Adjacent to Plum Island: The Plum Island nearshore disposal site is 1.5 nautical miles long and is east of Plum Island Beach. This site has been successfully used in the past for disposal of dredged material. This site is located directly offshore of a severely eroding beach area.
- Adjacent to Salisbury Beach: This disposal area is located to the north of the dredge project, adjacent to Salisbury Beach and has been used historically for disposal of the sandy dredge material. While Salisbury Beach is showing signs of eroding, the erosion rate is more significant at the Plum Island Beach site.

This alternative also combines the protection of the USACE owned spur jetty that is currently at risk due to erosion. In order to determine the effect of a beach placement of dredged material, a cross sectional beach fill construction design must be determined appropriate for the topography, local coastal processes, amount of material available for placement, and the length of beach to be protected. USACE LIDAR and survey data was used to develop cross sections of the beaches at various locations along the study area. Details on these cross sections can be found in Appendix B.

Approximately 57,000 CY of material is needed to protect the spur jetty and the remaining 163,000 CY of the available 220,000 CY yards will be placed at North Point, Plum Island beach.

- **USACE Jetty Spur Protection:** This alternative proposes construction of a 500-foot long by 350-foot wide (includes taper) by beach fill project using about 57,000 CY cubic yards of material to be dredged for maintenance of Merrimack River (Figure 4). Construction would involve direct placement by either a self-propelled hopper dredge with pump off capabilities or by a large hydraulic pipeline dredge. At the predicted rates of erosion, this volume of fill would delay the structure being compromised by approximately 2 years. Analysis of the beach fill longevity and future shoreline position assumed the beach fill project would be constructed in 2022. Future year conditions were projected assuming the recent average annual erosion rate of about 53 feet/year continued.



Figure 4. Beachfill Placement for the Spur Jetty Protection Base Plan and the Section 204 Project Expanded Beachfill Placement.

3.2 Beneficial Use §204

3.2.1 Direct Beach Placement at North Point, Plum Island – Sand Material

The State and municipality have requested that the dredged sand be placed directly on the beaches, rather than in the nearshore bar system (Federal Base Plan). This would ensure that the material would provide immediate protection to the most critical at-risk sections of Plum Island beaches, North Point in Newburyport. In order to determine the effect of a beach

placement of dredged material, a cross sectional beach fill construction design must be determined appropriate for the topography, local coastal processes, amount of material available for placement, and the length of beach to be protected. USACE LIDAR and survey data was used to develop cross sections of the beaches at various locations along the study area. Details on these cross sections can be found in Appendix B. Approximately 220,000 CY of material is available and North Point, Plum Island beach replenishment alternative would require all 220,000 cubic yards.

This alternative proposes construction of a 900-foot long by 350-foot wide (includes the tapering) beach fill project using 220,000 cubic yards of material to be dredged for maintenance of Merrimack River. Construction would involve direct placement by either a self-propelled hopper dredge or by a large hydraulic pipeline dredge. At the predicted rates of erosion, this volume of fill would delay further losses of beach by about 3 - 4 years. Analysis of the beach fill longevity and future shoreline position assumed the beach fill project would be constructed in 2022. Future year conditions were projected assuming the recent average annual erosion rate of about 53 feet/year continued.

4 Existing Conditions

4.1 Project Area – Merrimack River Dredge

4.1.1 General

The Atlantic Ocean entrance to Newburyport Harbor was authorized by Congress as a FNP in 1828. Initial efforts to improve navigability in 1828, a stone filled timber crib dike was constructed westerly from Plum Island 1,680 linear feet to Woodbridge Island to constrain the river flow to increase inlet velocities to effect removal of the bars. From 1881 the construction of North Jetty started followed by the construction of the South Jetty in 1883 and continued until 1906. The jetties lined both sides of the inlet with the intention of scouring the channel to 17 feet below MLW. Construction of the jetties, as well as sand-catch weirs and dikes landward of the southern jetty, acted to stabilize the location of the inlet which had historically migrated south. The jetties were rehabilitated with the intention of reducing porosity and thus inhibiting the flow of water and sediment through the jetties.

Newburyport Harbor is located in the lower 3.5 miles of the estuary of the Merrimack River in Essex County, Massachusetts, 54 miles north of Boston and 20 miles southwest of Portsmouth, New Hampshire. The FNP is abutted by the city of Newburyport on the south shore and the town of Salisbury on the north shore. The southern areas of the Island are included in a State Park and the PRNWR located in the towns of Newbury, Rowley and Ipswich.

The city of Newburyport is comprised of approximately nine square miles. Approximately 40 percent of the available land is intensively developed, and 40 percent is open space including cleared lands and farmlands. The remaining areas include woodland, and freshwater or tidal marsh. Public land use areas include such areas as city forest, parks and playgrounds. The most prominent water uses of the estuary in Newburyport Harbor are recreational boating, and commercial and recreational fishing. As Newburyport Harbor is at the mouth of the

Merrimack River, many mariners from upstream cities and towns depend on the harbor for access to the ocean.

The Merrimack River is the fourth largest river in New England with a 5,010 square mile basin area. The river descends from the White Mountains in New Hampshire southward 115.3 miles to the south to the Atlantic Ocean in Newburyport, Massachusetts. Out of the basin's 5,010 square miles, 76 percent (3,810 square miles) lie in New Hampshire, and 24 percent (1,200 square miles) lie in Massachusetts. The Merrimack River Basin covers parts of the Massachusetts counties of Essex, Middlesex and Worcester.

5 Plan Evaluation

5.1 Cost Estimates for Alternative Plans

Cost estimates have been developed for both the Federal Base Plan and the beneficial use alternative evaluated in this study. The estimates were developed using the Corps of Engineers Dredge Estimating Program with inputs based on recent construction bids for work of this type in New England. Costs include construction contract costs and non-contract costs, and use current price levels as of FY21. Construction contract estimates include costs for mobilization and demobilization of the construction plant, unit costs for dredging and disposal of the dredged material, and costs for planting and fencing. The contract unit costs for dredging and disposal include removal of the material from the channel, transport and placement of the material on the beach, contractor profit, overhead and bonds, and spreading and grading of the material on the beach. A 21% contingency was applied to the contract costs according to the risk associated with each construction method.

For the Federal Base Plan, a medium sized hopper dredge with pump-off capabilities using nearshore bar system disposal was estimated, the same construction method used for the past several decades. Non-contract costs include Corps of Engineers costs for project design, engineering and supervision, administration of the contract, and any included post-construction monitoring. Design costs include preparation of Plans and Specifications, final regulatory approvals, execution of the PPA, contracting and project management costs during design. Supervision and Administration costs include costs for pre- and post-construction surveys, contract administration, supervision and inspection of construction activities, contracting and project management during construction, and close-out of the contract and project accounts.

Under Section 204 authority Feasibility costs are 100 percent Federal. Design and construction phase costs are cost-shared with the sponsor at rates based on the purpose of the beneficial use (in this case coastal storm risk management) and the benefits derived. Base plan costs were subtracted from the beneficial use alternatives costs to determine Section 204 project costs. As all protected properties and all identified benefits are to private lots developed for residential and small business use, Federal and non-Federal costs were apportioned at a 35/65 rate. The full project cost assigned to the beneficial use project, including proportional design costs, was used for computing the Section 204 project costs, annual costs, and for benefit-cost analysis. The project cost estimate summaries are provided in Appendix D.

5.2 Annual Costs

In order to compare project costs with project benefits, both must be placed on an equal basis. Costs are annualized by amortizing the Section 204 project first costs over the project life, 10 years, and annualizing any operations and maintenance costs for the beachfill project. Cost amortization used a ten-year period of analysis, with a 2-1/2% interest rate, yielding a capital recovery factor of 0.11426 applied to the first cost. Annual maintenance costs include management and redistribution of the beachfill. Management of the Section 204 project beachfill would increase this annual maintenance effort as more sand has been added to the beaches. Maintenance costs for both plans were computed as a function of the beachfill volume and beachfill length, using the section 204 project construction unit cost, minus the amount spent currently without the project for this effort. The annual costs are shown in Table 2 and the cost sharing responsibilities in Table 3.

Table 2: Project Cost Estimates for the Base Plan and Section 204 Alternative with Benefit-Cost Comparison in Fiscal Year 2021 Dollars.

Beneficial Use of Dredge Material §204 Project	Base Plan: Place Material at North Point and Nearshore Sites with Hopper Dredge	Alternative: Place Material at North Point Beach with Pipeline Dredge
2021 Total First Cost	\$6,137,000	\$6,619,000
IDC - @ 2.5%	\$12,800	\$34,500
2020 Total Investment	\$6,149,800	\$6,653,500
Incremental Cost of Beach Placement		\$503,700
Capital Recovery Factor-10 years		0.114259
2021 Annual Costs for 10-Year Period of Analysis		\$57,600
Annual Benefits for 10-Year Period of Analysis		\$1,513,500
Net Annual Benefits		\$1,455,900
Benefit-Cost Ratio		26.3

Table 3: Project First Costs Deltas and Cost Sharing

	Federal Base Plan for O&M Dredging	Project with §204 Alternative	Difference
Project First Costs	\$6,137,000	\$6,619,000	\$482,000
Fully Funded Costs	\$6,312,000	\$6,809,000	\$497,000
Cost Sharing 65% Federal/35% Non-Federal of the Fully Funded Costs		Federal Share Non-Federal Share	\$323,050 \$173,950

6 Economic Analysis

Under Section 204, USACE has the authority to construct projects to reduce storm damage and risk to property, restore, enhance or create habitat, or for other limited purposes, in connection with the dredging of an authorized navigation project. Economic justification is a requirement for Federal participation in such projects. The cost of the §204 project is measured as the difference between the cost of Federal Base Plan for placement of the dredged materials versus the cost of the project including beneficial use of the dredged materials. For storm damage reduction projects such as at Newburyport Harbor, that is the difference between nearshore placement and direct placement of the material on the beaches. The difference in cost must be justified by the damages and cost that will likely be prevented by the project's construction.

North Point Beach on Plum Island is undergoing long term erosion at a rate of about 53 feet per year, even with the nearshore placement of dredged materials off the beaches over the last several decades and more recent state and municipal efforts to place sand on the beaches after storm events. If more effective protective measures are not implemented, it is anticipated that long term erosion will continue at the current rate and continue to threaten the shorefront structures along Northern Boulevard and the sewer and water system under the road.

Although the period of analysis for this study is ten years, direct placement of the dredged material on the beach as recommended by the alternatives, prevents or delays coastal erosion damages for approximately three to four years at North Point, based on the estimate retreat rates. The anticipated maintenance cycle for the harbor's entrance and inner channel is about five to ten years.

Benefits are calculated by comparing the without-project and with-project conditions. The without project condition is the continued placement of the dredged material in the nearshore bar system in addition to direct material placement to protect the USACE south Jetty spur. The with-project condition is the delay in further loss and damage during the period the dredged material is expected to remain on the beach. This delay in loss and damage has been evaluated for the structures in Newburyport that will be impacted over the 10-year period of analysis from 2022, when construction is expected to be completed. Benefits calculated included the value of the structures lost or damaged, the value of the land lost, the cost to the State or municipality to acquire the lost property, relocation assistance costs for property owners, costs for demolition and disposal of damaged structures, and reduced State and municipal emergency response costs. The cost of repair and rehabilitation of the municipal water and sewer system that runs beneath Northern Boulevard is also included. Each of these is described briefly below. The detailed economic analysis is provided in Appendix E.

6.1 Structural Damages and Losses Avoided

Assessor's records for the municipality were used to estimate the depreciated replacement value of the structures that would be lost or damaged during the period of analysis. The method for estimating damages based on long term erosion is the timing of when the erosion reaches the seaward edge of the structure. When this occurs, the structure is considered a total loss and is not rebuilt. Appendix E shows the detailed calculations for each of the

structures. An average annual benefit for the Section 204 beachfill project for land and structures combined was calculated at about \$1,471,100.

6.2 Land loss Avoided

Land losses would occur at the beach. Under the with-project condition these losses would be delayed by the beachfill. The value of the loss was estimated from average values obtained from the municipal assessor. An average annual benefit for the Section 204 beachfill project is about \$1,342,000 was calculated.

6.3 Structure Damage Avoided

Structures destroyed or severely damaged and condemned must be demolished to the extent not already accomplished by the storm and the debris removed and disposed. This includes the buildings, outbuildings, supports and foundations, paved surfaces, fuel tanks, and utility connections. An average annual benefit calculated for the Section 204 beachfill project was \$129,100.

6.4 Utility Damage Avoided

Utility damage losses would occur at the Reservation Terrace. Under the with-project condition these losses would be delayed by the beachfill. An average annual benefit calculated for the Section 204 beachfill project is about \$34,400.

6.5 Recreation Losses Avoided

The average annual benefit for recreation losses avoided was calculated to be approximately \$8,000 for the Section 204 beachfill project. Realization of these benefits will require the non-Federal Sponsor to continue to provide public parking at North point for access to the beach, also a requirement for all USACE projects involving beach fill.

6.6 Economic Benefit Summary

Total economic benefits were calculated for the beneficial use alternative, which consists of placing all 220,000 CY of dredged sand on Plum Island Beach at Newburyport, North Point. The annual benefits are shown in Table 4. Annual benefits are described in detail in the Economics Analysis – Appendix E.

Table 4: Economic Analysis – Fiscal Year 2021 Dollars

Benefit Categories	Benefit
Annual Structure Damage Avoided	\$ 129,100
Annual Land Loss Avoided	\$ 1,342,000
Annuals Recreation Benefit	\$ 8,000
Annual Avoided Utility Cost	\$ 34,400
TOTAL ANNUAL PROJECT BENEFITS	\$ 1,513,500

6.7 Benefit-Cost Analysis

Economic justification is determined by comparing benefits with costs. To be eligible for Federal participation in project implementation under Section 204, annual project benefits must be equal to or greater than annualized project costs, as indicated by a benefit to cost ratio of 1:1 or greater. As shown in Table 2, the beneficial use alternative meets this test.

7 Environmental Impacts

An Environmental Assessment, Finding of No Significant Impact, and Clean Water Act Section 404(b)(1) Evaluation were prepared for the Section 204 beneficial use features and is included with this Detailed Project Report. Construction windows have been established in coordination with Federal and State agencies for protection of aquatic resources (channel dredging) and nesting shorebirds (on-beach placement). The project construction would be conducted within the following timeframes:

- Dredging Activities (by location):
 - 15-Foot Entrance Channel: All year (no timeframe restriction).
 - 9-Foot Inner Harbor Channel: 1 July to 14 February (no dredging from 15 February to 30 June).
- Placement Activities (by location):
 - Nearshore Placement: All year (no timeframe restriction)
 - On-Beach Placement at North Point: 1 September to 31 March (no on-beach placement from 1 April to 31 August)

The constructed on-beach berm at North Point will not exceed a slope of 1V:10H to ensure the shoreline functions as habitat for foraging shorebirds after project completion. With the implementation of the proposed construction windows and regulating the slope of the on-beach berm design, no unavoidable or significant environmental impacts are anticipated for this project. Analysis of the environmental impacts of this project, are detailed within the EA section of this report.

8 Real Estate Requirements

A Real Estate Planning Report is included as Appendix H. The report describes the interests required for project implementation and identifies the properties involved, their value, and ownership. A Temporary Work Area Easement must be secured for all areas needed for access and staging for construction equipment and operations. At Newburyport, these areas consist of the public parking area.

9 Cultural Resources Impacts

No impacts to cultural resources are expected with the project, either under the Federal Base Plan or with the Section 204 beneficial use alternative for beachfill at Plum Island. The project has been coordinated with the State Historic Preservation Office and the Massachusetts Bureau of Underwater Archaeological Resources. The Federal Base Plan includes use of the Plum Island nearshore placement and direct placement of sand to protect the spur jetty for the upcoming maintenance dredging project. This plan would be followed should the beneficial use alternative not be pursued.

Maintenance dredging of the Newburyport Harbor channel with disposal of dredged material at the previously used Plum Island nearshore disposal sites, or as beachfill material on the beach, is unlikely to have an effect upon any structure or site of historic, architectural or archaeological significance as defined by the National Historic Preservation Act of 1966, as amended.

10 Selection of a Plan

10.1 The Selected Plan

The Selected Plan is based on consideration of economic efficiency, minimization of environmental impacts, navigational safety and the needs of state government and local stakeholders. The benefits to beach placement are determined by estimating the value of the erosion losses and damages that would occur without beneficial placement and comparing them to the erosion losses and damages that would occur with beneficial placement. The benefits equal the degree to which erosion losses and damages are reduced. A total of 68 residential structures are expected to be damaged due to coastal erosion from 2022 to 2032 if risk reduction measures are not implemented. That number would decrease to 37 structures in the with-project condition, yielding annual benefits of \$129,100. The 204 Beneficial Use of Dredge Material plan results in the greatest net benefits and is the preferred NED plan. This plan provides the most favorable improvement method for meeting the project objectives.

10.2 Implementation Responsibilities

10.2.1 Cost Apportionment

For projects implemented under Section 204 authority for beneficial use of dredge material for coastal storm risk management purposes, the non-Federal Sponsor is required to provide cost-sharing of 35 percent of the cost of design and construction up-front upon execution of a PPA. The remaining 65 percent of the first cost of design and construction is the Federal contribution. The non-Federal Sponsor also must provide all lands, easements, rights of way, and relocations required for implementation and operations and maintenance of the project. The non-Federal Sponsor may receive a credit for its real estate costs applicable towards its 35 percent cost share.

10.3 Federal Responsibilities

The Federal government will be responsible for preparation of plans and specifications and contract advertisement, award and supervision and inspection of the work. The Federal government will be responsible for project compliance with Federal environmental laws and regulations, including the National Environmental Compliance Act, Endangered Species Act, consistency with the Coastal Zone Management Act, and the Clean Water Act.

10.4 Non-Federal Responsibilities

Formal assurance of local cooperation must be furnished by a local sponsoring agency. The local non-Federal Sponsor must be a public agency or a non-profit environmental organization. Private interests may also qualify if there is no requirement for future operation and maintenance of the project modification. The non-Federal Sponsor must provide assurance that they intend to meet these items prior to project authorization. The PPA will detail these and other requirements of the Government and the non-Federal Sponsor for implementation and future maintenance of the project. The sponsoring agency must normally agree to:

- Provide without cost to the United States, all necessary lands, easements, rights-of-way, access routes and relocation of utilities necessary for project construction and subsequent operation and maintenance of the project.
- Provide 35% of the Design and Implementation Phase costs.
- Maintain and operate the project after completion without cost to the United States.
- Continue to provide public parking for beach access at North Point.

11 Conclusion

NAE has evaluated the data for the proposed Federal plan for beneficial use of dredge material at North Point, Plum Island Massachusetts. NAE will review, evaluate, and consider the comments and views of interested agencies, stakeholders, and the concerned public regarding the alternative plans. The potential consequences of each alternative was evaluated on the basis of engineering feasibility, environmental impact and economic efficiency.

The NAE recommends proceeding with implementation of a Section 204 project for the beneficial use of dredged material from Newburyport Harbor in accordance with the Recommended Plan identified in this Detailed Project Report, with such further modifications thereto as in the discretion of the Chief of Engineers may be advisable. The analysis indicates that nourishment of Plum Island Beach at North Point Beach is feasible, environmentally acceptable, and economically justified.

The Corps of Engineers, pursuant to the Section 204 authority, may study, design and implement projects to reduce storm damage to property in connection with the dredging of an authorized navigation project. Coastal storm risk management was added as a Section 204 project purpose by Section 2037 of the Water Resources Act of 2007. The Corps of Engineers may share in the costs of

design and construction in excess of the most cost-effective means of carrying out dredging of the FNP (the Federal Base Plan – in this case nearshore bar placement).

The non-Federal Sponsor, the DCR, is currently capable and willing to enter into a PPA to share in the cost of construction and provide all real estate interests. For this project, the sole project purpose and all evaluated project benefits are for storm damage reduction to private properties and the utilities that service those properties. Cost sharing for project implementation, exclusive of any real estate costs, where the project purpose and benefits are for coastal storm damage reduction, is 65 percent Federal and 35 percent non-Federal, as specified in Section 103(c) of the Water Resources Development Act of 1986. Costs and cost-sharing would depend on the construction method bid.

This report also concludes that the Section 204 beachfill will only provide temporary protection for the beach area nourished. Benefits for the beachfill include delaying the loss and damage of the protected properties for the lifespan of the beachfill. The lifespan of the beachfill is estimated at 3-4 years for North Point, Plum Island. It is unlikely that similar use of dredged material from future maintenance cycles for nourishment of these areas would supply enough sand to provide a long-term solution for the erosion problems being experienced on Plum Island.

Accordingly, additional studies are recommended under more encompassing State or Federal authorities to address long term needs for shore protection for these and neighboring communities for a more permanent and sustainable solution to coastal erosion in the region. The NAE and the Commonwealth of Massachusetts have suggested an even broader Regional Sediment Management Study for northern Essex County that would likely cover the entire littoral cell north of Cape Ann to Hampton, New Hampshire.

12 Recommendation

The recommendation of this feasibility level investigation is that placement of dredged material from maintenance dredging of the existing FNP for Newburyport Harbor, Newburyport, Massachusetts, be beneficially used under the Continuing Authority of Section 204 of the WRDA of 1992, as amended by Section 2037 of WRDA 2007, as beachfill at North Point Plum Island in Newburyport. The beachfill would be used to widen and increase the elevation of the beach to provide a period of protection to shorefront properties. The DCR has agreed to execute a PPA with the Government for construction and future maintenance of the project as the non-Federal Sponsor. The non-Federal Sponsor would ensure management of the beaches consistent with public use and access and in accordance with measures to protect shorebirds.

It is also recommended, that should the Commonwealth and the three municipalities (Newbury, Newburyport and Salisbury) agree, a more comprehensive study be conducted for northern Essex County and its associated littoral system to determine if a wider-range and longer-term solution exists to address the beach erosion and storm protection needs of this section of the Massachusetts coast, including Salisbury, Newburyport, Newbury and perhaps communities further south along Ipswich Bay to Cape Ann.

The recommendations contained herein reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect program and budgeting priorities inherent in local and state programs, or the formulation of a national Civil Works water resources program. Consequently, the recommendations may be modified at higher levels within the Executive Branch before they are used to support funding. However, prior to executing a PPA, the non-Federal Sponsor will be advised of any modifications and will be afforded an opportunity to comment further.

Date

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Colonel, Corps of Engineers
District Engineer

13 References

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